Anexo1: Antropometría y ergonomía

Evidentemente, el diseño del sistema mecatrónico de asistencia técnica debe tener en cuenta la antropometría del usuario final, así como la ergonomía durante su uso; por ello, se utilizaron las dimensiones descritas en [7] en el Manual antropométrico del hombre peruano para el diseño industrial realizado por el Instituto de Investigación Tecnológica Industrial y de Normas Técnicas (Perú). Dicho estudio logra realizar una caracterización antropométrica fundamental de la población de las personas de edad avanzada.

Se considera ancianos a las personas mayores de 60 años en los países en vías de desarrollo y 65 años para los países desarrollados. Los cambios fisiológicos principales que se presentan con el envejecimiento son los siguientes:

- Disminución de la estatura.
- Disminución en el peso corporal.
- Aumento de la grasa corporal.
- Disminución de la masa muscular.
- Disminución de la fuerza muscular.
- Disminución del funcionamiento de los órganos y sistemas corporales como el músculo-esquelético, cardiovascular y respiratorio.

Específicamente, en lo que refiere a la motricidad, se observa lo siguiente:

- Disminución de la fuerza y coordinación muscular.
- Disminución progresiva del tiempo de reacción.
- Cambio en la marcha, menor balanceo y pasos más cortos, dificultad para mantener el equilibrio o sostenerse en pie.
- Disminución del tacto superficial y reflejos posturales.

Para apoyar a las personas con estos problemas se suele utilizar las ayudas técnicas, más conocido como andaderas. Esta herramienta permitirá dar soporte adicional para mantener el balance o la estabilidad al caminar. El criterio de indicación médica para el uso de la andadera es la alteración de la funcionalidad de la marcha.

La alteración de la funcionalidad de la marcha puede deberse a los siguientes factores:

1. Inestabilidad Articular

   Una articulación se vuelve inestable cuando no es capaz de mantener su posición fisiológica durante la descarga del peso corporal o durante la ejecución de la marcha. Se relaciona con la deformación articular, historia de traumatismos, caídas a repetición, debilidad muscular, problemas del aparato ligamentario o tendinoso que acompaña a la osteoartrosis (degeneración e inflamación por uso y desgaste) alteraciones congénitas y/o alteración de la propiocepción. El uso de ayuda técnica proporciona mayor estabilidad a la extremidad lesionada.

2. Riesgo de Caídas

   Esto ocurre debido a la pérdida del equilibrio. También se presenta en pacientes portadores de osteoartrosis, asociado a patologías crónicas concomitantes y a la edad.

3. Amputación

   La amputación es el corte y separación de una extremidad del cuerpo mediante traumatismo (avulsión) o cirugía. Como medida quirúrgica se utiliza para controlar el dolor o un proceso causado por una enfermedad en la extremidad afectada, por ejemplo un tumor maligno o una gangrena.

4. Síndrome post caída (Fear of Falling)

   Trastorno que limita la movilidad, la actividad física y la calidad de vida, el cual se basa en el temor a sufrir nuevas caídas. Se presenta, con mayor frecuencia, en personas que han sufrido fracturas, personas mayores de 65 años de edad y personas que sufren retraso mental.

5. Enfermedad de Parkinson

   Enfermedad crónica degenerativa que afecta a las neuronas cerebrales. Produce temblores, dificultad para coordinar los movimientos y rigidez.

Luego de conocer las características fisiológicas del usuario del sistema mecatrónico, procedemos a describir su antropometría. En la figura A.1.1 y en la A.1.2 se observa tanto al usuario como sus medidas antropométricas. De estas medidas, se usó el 95 percentil de la altura de la cadera para diseñar la altura del andador.

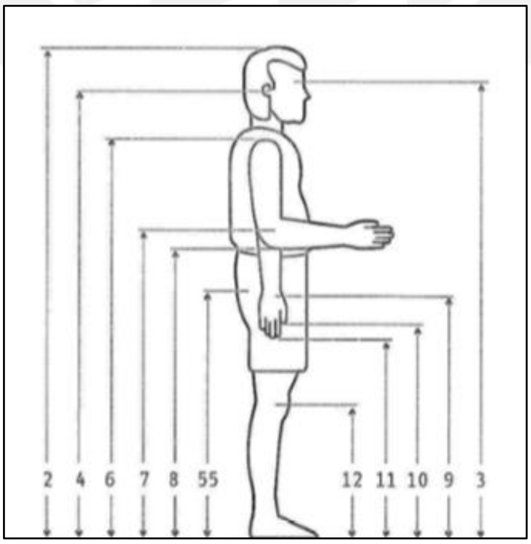


Figura A.1.1 Vista frontal del usuario

Fuente: [7]

Dimensiones		60 - 90 años (n=40)				
				Percentiles		
		x̄	D.E.	5	50	95
1	Peso (Kg)	70.2	13.3	46.2	68.0	95.2
2	Estatura	1632	68.6	1519	1635	1746
3	Altura ojos	1514	65.9	1405	1508	1623
4	Altura oído	1500	63.6	1395	1500	1605
6	Altura hombro	1346	65.9	1238	1340	1455
7	Altura codo	1041	53.9	952	1031	1130
8	Altura codo flexionado	1007	50.9	923	1000	1091
9	Altura muñeca	806	40.5	739	801	872
10	Altura nudillo	721	41.7	652	716	790
11	Altura dedo medio	614	37.4	552	610	675
12	Altura rodilla	456	30.4	406	458	506
55	Altura cadera	973	54.2	884	974	1062

Figura A.1.2 Medidas antropométricas de una persona de edad avanzada

Fuente: [8]

En la figura A.1.3 y A.1.4 se observa las dimensiones de la persona tanto con los brazos extendidos como juntos. Se utilizó el 95 percentil en las medidas del ancho máximo del cuerpo y el alcance del brazo lateral.

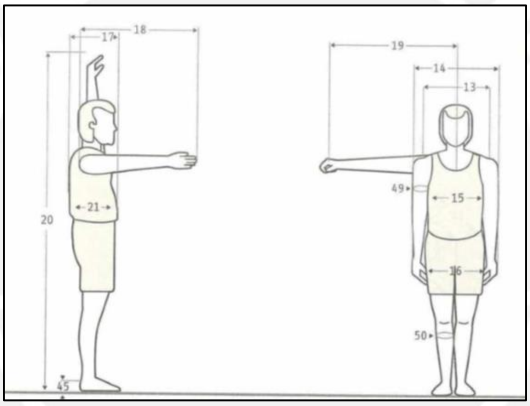


Figura A.1.3 Vista lateral del usuario

Fuente: [8]

Dimensiones		60 - 90 años (n=40)				
				Percentiles		
		x̄	D.E.	5	50	95
13	Diámetro máx. bideltoideo	454	29.3	406	452	503
14	Anchura máx. cuerpo	513	44.8	439	506	586
15	Diámetro transversal tórax	315	25.7	269	314	366
16	Diámetro bitrocantérico	348	26.3	309	348	401
17	Profundidad máx. cuerpo	348	26.5	226	292	369
18	Alcance brazo frontal	618	42.0	549	620	687
19	Alcance brazo lateral	608	40.6	541	612	675
20	Alcance máx. vertical	1980	99.0	1816	1896	2143
21	Profundidad tórax	269	28.9	221	268	317
45	Altura tobillo	83	9.2	68	82	98
49	Perímetro brazo	274	30.7	223	272	324
50	Perímetro pantorrilla	347	30.4	298	342	397

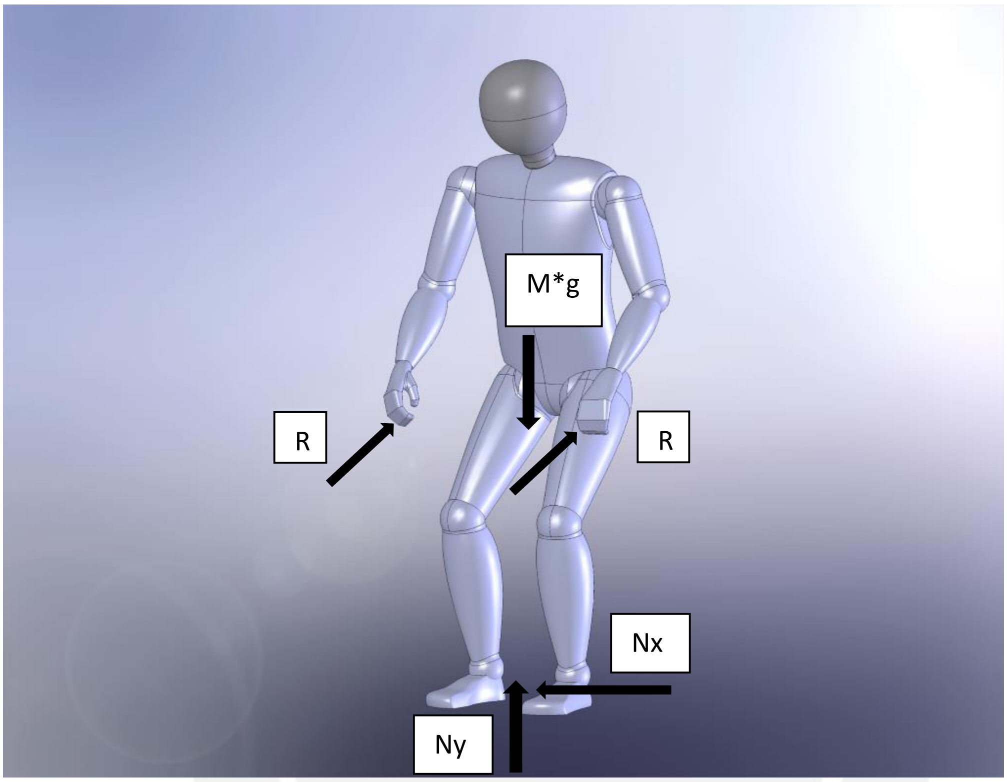
Figura A.1.4 Medidas antropométricas de una persona de edad avanzada

Fuente: [8]

Anexo2: Cálculo de la fuerza sobre la andadera

Cálculos de la fuerza sobre la andadera

El DCL de la persona al momento de sujetar la andadera se muestra en la figura1.



Las ecuaciones de equilibrio son las siguientes:

$\sum \mathbf{Fx} = \mathbf{0} \quad \ldots(1)$

$\sum \mathbf{Fy} = \mathbf{0} \quad \ldots(2)$

$\sum \mathbf{Mo} = \mathbf{0} \quad \ldots(3)$

Las variables a utilizar en las ecuaciones son las siguientes:

M*g ------> Esta variable representa el peso de la persona.

D -----> Esta variable representa el desplazamiento del centro de gravedad de la persona.

R---------> Representa la reacción entre la persona y la andadera.

Nx y Ny -----> Representan las componentes de la reacción entre la persona y el asfalto.

Rx -----> Representa la componente horizontal de la reacción R.

Ry -----> Representa la componente vertical de la reacción R.

31.5 -----> Representa la longitud del brazo según un estudio de las medidas antropomórficas del hombre peruano.

101.3 -----> Representa la distancia entre los pies y la cadera según un estudio de las medidas antropométricas del hombre peruano

De la ecuación (1) se obtiene la siguiente expresión:

Nx = 2*Rx… (4)

De la ecuación (2) se obtiene la siguiente expresión:

Ny + 2*Ry = M*g… (5)

De la ecuación (3) se obtiene la siguiente expresión:

M*g*d = 2*Ry*31.5 + 2*Rx*101.3… (6)

Además Rx y Ry se relacionan por medio de las siguientes expresiones:

Rx = R*sin (θ)…7

Ry = R*cos (θ)…8

Reemplazando 7 y 8 en 6 se obtiene lo siguiente:

R = M*g*d/ (63* cos (θ) + 202.6* sin (θ))…9

Reemplazando los valores para una persona de 80 kg y con la coordenada X del centro de gravedad al límite del área de sustentación (área en la cual la coordenada del centro de gravedad debe permanecer dentro, en caso no sucediese, la persona perdería el equilibrio y muy probablemente se caiga.

Luego de haber reemplazado los valores correspondientes en la ecuación (9) se observa que la reacción depende de 3 variables, estas son el peso de la persona, la coordenada x del centro de gravedad y el ángulo con el cual la persona sujeta el sistema mecatrónico.

La tabla 1 representa las componentes de las reacciones entre la persona y la andadera para distintos ángulos de sujeción.

Cálculo de la reacciones entre la persona y la andadera							
distancia máxima d	Peso de la persona(kg)	Peso de la persona(N)	Ángulo	Radianes	R	R1	R2
12,45	80	784,8	0	0	155,0914286	155,0914286	0
12,45	80	784,8	10	0,174532925	100,4973985	98,9706172	17,45119011
12,45	80	784,8	20	0,34906585	76,04064296	71,45483107	26,0074316
12,45	80	784,8	30	0,523598776	62,68949729	54,29069721	31,34474865
12,45	80	784,8	40	0,698131701	54,74134998	41,93430696	35,18706151
12,45	80	784,8	50	0,872664626	49,92819903	32,09322771	38,24721942
12,45	80	784,8	60	1,047197551	47,21160412	23,60580206	40,88644852
12,45	80	784,8	70	1,221730476	46,10393234	15,76847355	43,32352501
12,45	80	784,8	80	1,396263402	46,42531808	8,061671883	45,72001319
12,45	80	784,8	90	1,570796327	48,22685094	2,95425E-15	48,22685094

Tabla 2.1 Cálculo de la fuerza de la persona sobre el sistema mecatrónico

En la figura 2.1 se muestra la distribución de las reacciones variando el peso de la persona y la posición de su centro de gravedad cuando el ángulo de incidencia es cero. Se puede apreciar que para una persona de 102 kg con 13 cm de coordenada y de centro de gravedad nos produce una fuerza de 206,5 N.

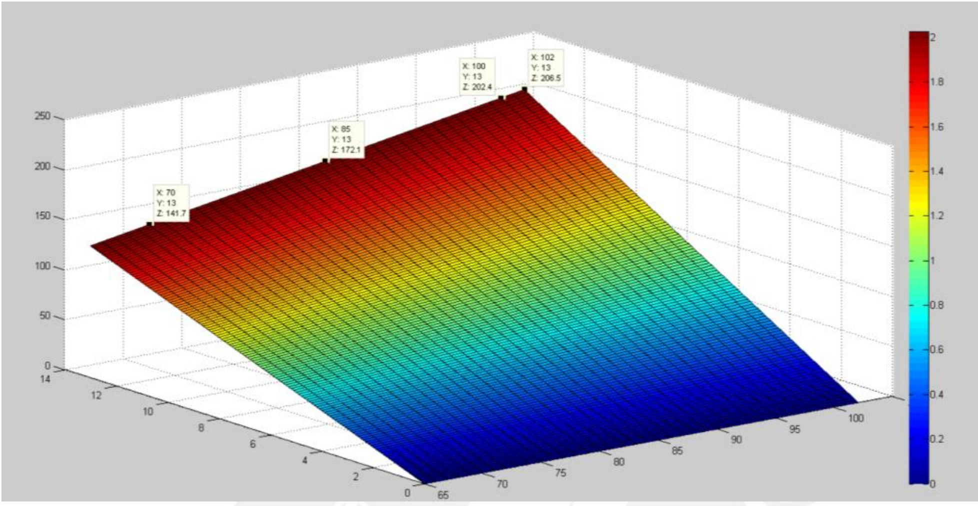


Figura 2.1 Distribución de la reacción variando el peso y la coordenada y del centro de gravedad.

Anexo3: Cálculos para el dimensionamiento del sistema Tri-star

Se estableció según normativa que las huellas y contrahuellas de las gradas y escalinatas deberán tener dimensiones uniformes: huella de 30 cm y contrahuella de 15 cm a 17,5 cm (anexo4). La gran mayoría de escaleras en el Perú no cumplen con esta normativa. Por este motivo, para obtener las dimensiones del Tri-star, aplicaremos un factor de seguridad de 1.2 a una contrahuella de 16,25 cm (valor obtenido de la media entre el valor mínimo (15 cm) y máximo (17,5 cm) según normativa.

En la figura 3.1 se observa que el sistema Tri-star debe cumplir una longitud mínima "a" para que se pueda subir exitosamente el desnivel, así como un radio medio de la rueda "b" para complementar "a" y no tener problemas al momento de subir cualquier dimensionado de contrahuella que contemplen los cálculos a realizar.

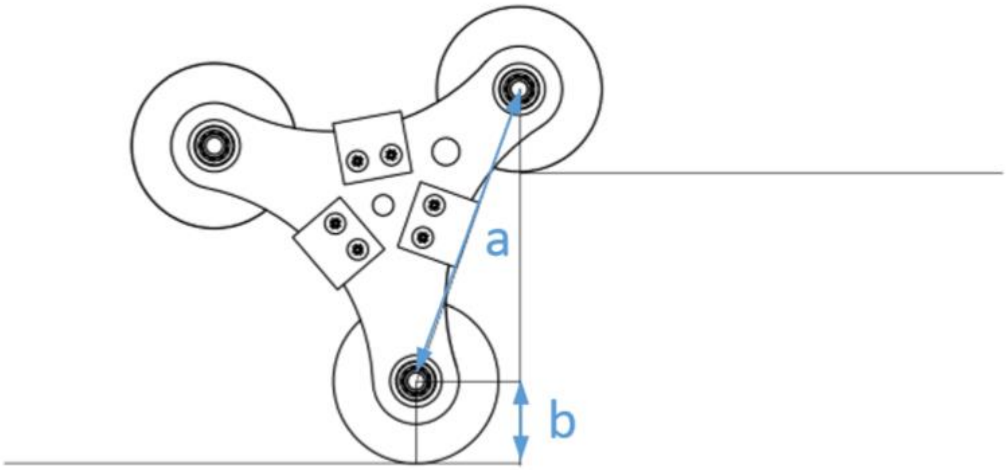


Fig. 3.1: Sistema Tri-star al momento de subir un desnivel

El valor de contrahuella máximo será de 19.5 cm. Para que el sistema pueda subir satisfactoriamente las gradas de la escalera con el valor hallado se debe cumplir la siguiente ecuación:

- $b + a \cdot \sin(60°) >= 19,5$ …(1)

Siendo "b" el radio medio de la rueda y "a" la longitud del triángulo equilátero en cual se basó el dibujo del Soporte Tri-star.

El valor del diámetro medio de la rueda (2b) es de 3,25 inch que equivalen a 8,266 cm.

Reemplazando este valor en la ecuación (1) se obtiene la siguiente expresión:

- 4,133 cm + a*Sin(60°) >= 19,5 …(2)

Evaluando la expresión (2) se obtiene lo siguiente:

- a >= 17,74 cm

Tomaremos el valor entero superior más cercano al valor mínimo. En este caso el valor seleccionado es de 18 cm.

Anexo4: Cálculo de selección de los motores del sistema Tri-star

Una vez hallada la fuerza que ejerce el usuario sobre la andadera al momento de apoyarse sobre ella, se procederá a calcular el torque necesario del motor que pueda hacer girar el sistema Tri-star.

En la figura 1 se muestra la vista superior del sistema mecatrónico. El punto "O" pertenece al plano de simetría.

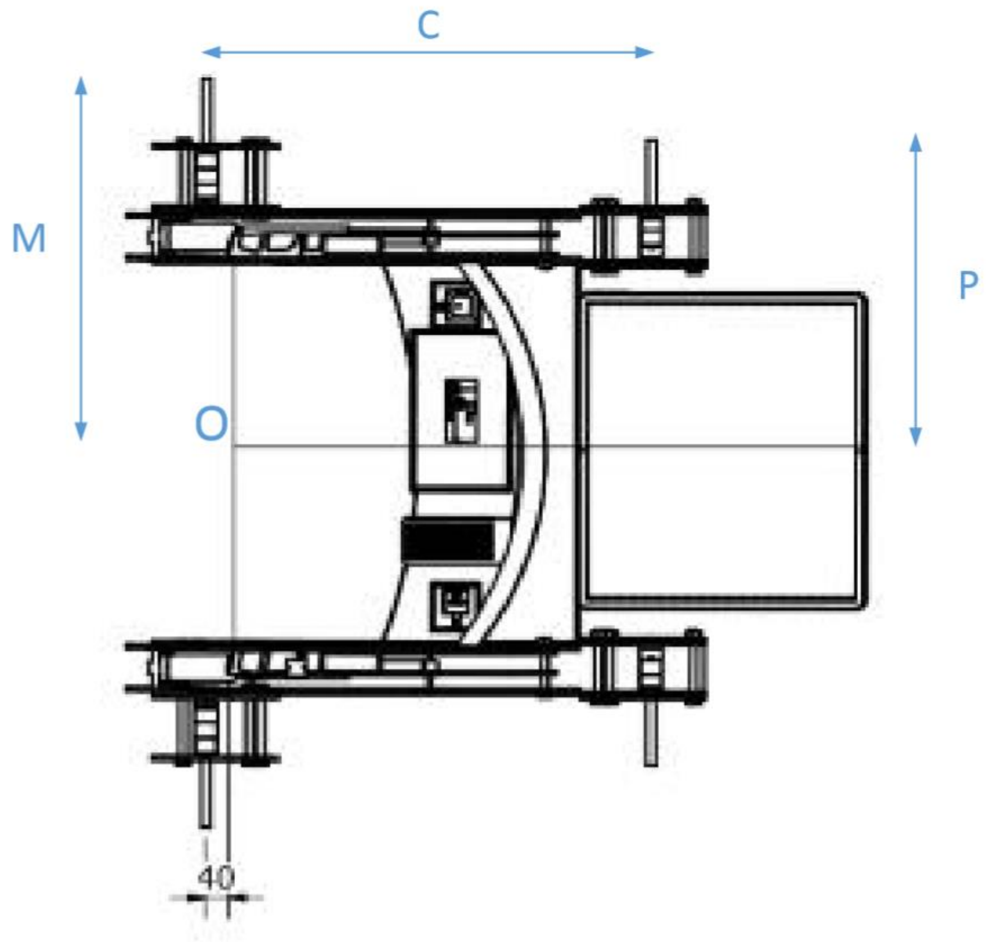


Figura 1: Vista superior del sistema mecatrónico

Fuente: Elaboración propia

Las ecuaciones de equilibrio son las siguientes:

$$\sum \mathbf{Fx} = \mathbf{0} \quad \ldots(1)$$

$$\sum \mathbf{Fy} = \mathbf{0} \quad \ldots(2)$$

$$\sum \mathbf{Mo} = \mathbf{0} \quad \ldots(3)$$

En la figura 2 se observan las distribuciones de las reacciones en cada punto de apoyo del sistema Tri-star. Por lo que las ecuaciones de equilibrio desarrolladas son las siguientes:

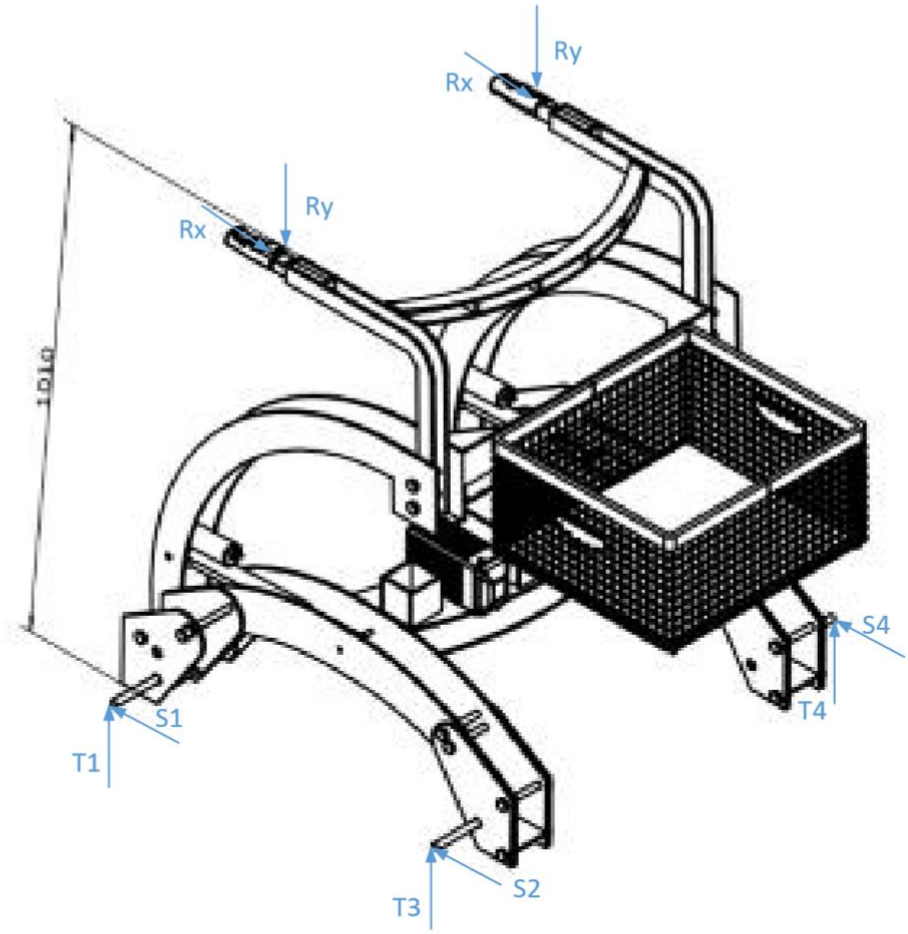


Fig. 2: Vista isométrica del sistema mecatrónico

Fuente: Elaboración propia

De la ecuación (1) se obtiene la siguiente expresión:

S1 + S2 +S3 + S4 = Rx + Rx… (4)

De la ecuación (2) se obtiene la siguiente expresión:

T1 + T2 +T3 + T4 = Ry + Ry + W… (5)

De la ecuación (3) se obtiene las siguientes expresiones:

C*(T3 + T4) = 8*Ry + 202*Rx + C*0, 5*W... (6)

S1 = S2 ^ S3 = S4… (7)

T1 = T2 ^ T3 = T4… (8)

La fuerza que realiza la persona sobre la andadera no es constante, por lo que al peso de una persona de edad avanzada de 70 Kg se le multiplicará un factor de seguridad de 1.5, es decir la andadera estaría siendo diseñada para una persona de 105 Kg.

En la figura 3 se observa que la reacción máxima(R) entre el usuario y el sistema mecatrónico es de 203,5575 N, esta ocurre cuando el ángulo entre la componente vertical y horizontal es cero, es decir, no hay componente horizontal.

R=d*W/(63*cosθ + 202.6*senθ)

Cálculo de la reacciones entre la persona y la andadera							
distancia máxima d	Peso de la persona(kg)	Peso de la persona(N)	Ángulo	Radianes	R	R1	R3
12,45	105	1030,05	0	0	203,5575	203,5575	0
12,45	105	1030,05	10	0,174532925	131,9028355	129,8989351	22,90468702
12,45	105	1030,05	20	0,34906585	99,80334388	93,78446578	34,13475398
12,45	105	1030,05	30	0,523598776	82,2799652	71,25654008	41,1399826
12,45	105	1030,05	40	0,698131701	71,84802185	55,03877789	46,18301823
12,45	105	1030,05	50	0,872664626	65,53076122	42,12236137	50,19947549
12,45	105	1030,05	60	1,047197551	61,96523041	30,9826152	53,66346368
12,45	105	1030,05	70	1,221730476	60,51141119	20,69612153	56,86212657
12,45	105	1030,05	80	1,396263402	60,93322999	10,58094435	60,00751731
12,45	105	1030,05	90	1,570796327	63,29774186	3,87746E-15	63,29774186
12,45	105	1030,05					
12,45	105	1030,05					
12,45	105	1030,05					
12,45	105	1030,05					

Fig. 3: Tabla de reacciones 105 Kg

Fuente: Elaboración propia

En la figura 4 se observa que para un peso de 25 kg de la andadera, las componentes verticales de las reacciones sobre los ejes del Tri-star varían respecto al ángulo de sujeción de la persona. La reacción más crítica se obtiene cuando T1 = T2 = 250,782 N y T3 = T4 = 75,399 N. Este resultado es coherente con el sentido común, debido a que los 2 Tri-star traseros, aquellos que se encuentran debajo del actuador lineal, son los que soportarán mayor carga en comparación con los otros dos que se encuentran en la parte delantera.

Cálculo de las reacciones en los ejes del Tri-star						
Peso de la andadera(kg)	Distancia entre ejes de Tri-star	Peso de la andadera(N)	T3+T4	T1+T2	T1=T2	T3=T4
25	57,8	245,25	150,7990484	501,5659516	250,782976	75,3995242
25	57,8	245,25	220,6516135	284,3962567	142,198128	110,325807
25	57,8	245,25	254,9000178	177,9189137	88,9594569	127,450009
25	57,8	245,25	276,2639067	111,4991735	55,7495867	138,131953
25	57,8	245,25	291,6436835	63,6838723	31,8419361	145,821842
25	57,8	245,25	303,8926979	25,60202482	12,8010124	151,946349
25	57,8	245,25	314,456844	-7,241613636	-3,6208068	157,228422
25	57,8	245,25	324,211826	-37,56958289	-18,784791	162,105913
25	57,8	245,25	333,8043434	-67,39245474	-33,696227	166,902172
25	57,8	245,25	343,8385615	-98,5885615	-49,294281	171,919281

Fig. 4: Reacciones en los ejes del Tri-star

Fuente: Elaboración propia

En la figura 5 se muestra el diagrama de cuerpo libre del sistema Tri-star al momento de rotar. Para calcular el torque necesario se deben cumplir las siguientes expresiones:

$$\sum \mathbf{Fx} = \mathbf{0} \quad \textbf{...(9)}$$

$$\sum \mathbf{Fy} = \mathbf{0} \quad \textbf{...(10)}$$

$$\sum \mathbf{Mo} = \mathbf{0} \quad \textbf{...(11)}$$

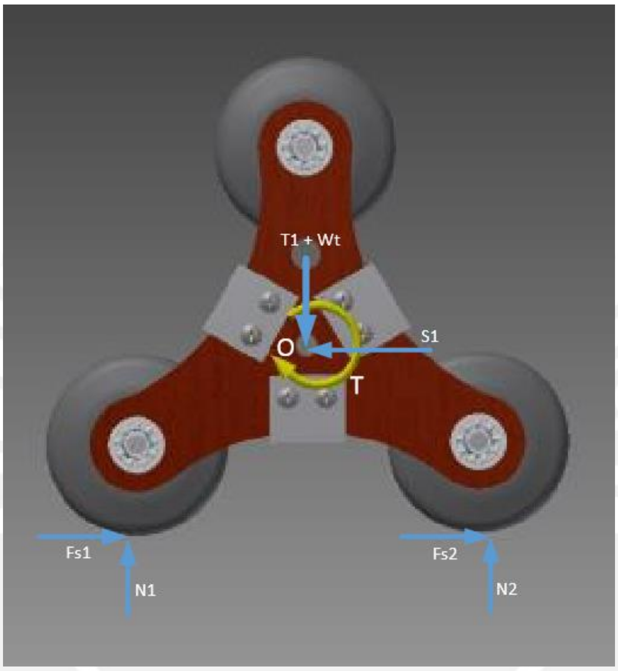


Fig. 5: D.C.L Tri-star

Fuente: Elaboración propia

De la ecuación (9) se obtiene la siguiente expresión:

Fs1 + Fs2 = S1… (12)

De la ecuación (10) se obtiene la siguiente expresión:

N1 + N2 = T1 + Wt… (13)

De la ecuación (11) se obtiene las siguientes expresiones:

Tcarga = 2*Fs1*d... (14)

d: representa la distancia vertical entre O y el punto de contacto entre las ruedas y el asfalto.

En la figura 6 se observa que el torque necesario para los Tri-star traseros según las consideraciones expuestas anteriormente es de 16,2241 N.m.

Cálculo del torque del motor Tri-star 1					
Peso tristar(kg)	Peso tristar(N)	eficiente de fricción del asfa	Normal sobre el tristar	Distancia del eje a la Fr	Torque necesario
2	19,62	0,6	270,4029758	0,1	16,22417855
2	19,62	0,6	161,8181283	0,1	9,709087701
2	19,62	0,6	108,5794569	0,1	6,514767412
2	19,62	0,6	75,36958675	0,1	4,522175205
2	19,62	0,6	51,46193615	0,1	3,087716169
2	19,62	0,6	32,42101241	0,1	1,945260745
2	19,62	0,6	15,99919318	0,1	0,959951591
2	19,62	0,6	0,835208554	0,1	0,050112513
2	19,62	0,6	-14,07622737	0,1	-0,844573642
2	19,62	0,6	-29,67428075	0,1	-1,780456845

Fig. 6: Tabla acerca del torque necesario Tri-star1

Fuente: Elaboración propia

En la figura 7 se observa que el torque necesario para los Tri-star delanteros según las consideraciones expuestas es de 11, 42 N.m como máximo.

Cálculo del torque del motor Tri-star 2					
Peso tristar(kg)	Peso tristar(N)	eficiente de fricción del asfa	Normal sobre el tristar	Distancia del eje a la Fr	Torque necesario
2	19,62	0,6	95,01952422	0,1	5,701171453
2	19,62	0,6	129,9458067	0,1	7,796748404
2	19,62	0,6	147,0700089	0,1	8,824200535
2	19,62	0,6	157,7519533	0,1	9,4651172
2	19,62	0,6	165,4418417	0,1	9,926510504
2	19,62	0,6	171,566349	0,1	10,29398094
2	19,62	0,6	176,848422	0,1	10,61090532
2	19,62	0,6	181,725913	0,1	10,90355478
2	19,62	0,6	186,5221717	0,1	11,1913303
2	19,62	0,6	191,5392808	0,1	11,49235685

Fig. 7: Tabla acerca torque necesario Tri-star2

Fuente: Elaboración propia

Se requiere que el sistema Tri-star gire por lo menos en 4 s. Una vez determinado el tiempo de giro, se procederá a calcular la velocidad angular que está determinada por la siguiente expresión:

$w = 2 * \pi * f$… (15)

$f = 1/T = ¼$ Hz… (16)

Por lo tanto, la potencia necesaria es representada por la siguiente expresión:

$P = w * T$… (17)

Reemplazando (16) en (15):

$w = 1{,}57$ rad/s... (18)

Reemplazando (18) en (17):

$P = 1{,}57 * 16{,}2241 = 25{,}47$ W

Una vez calculado la potencia y el torque necesario procedemos a evaluar los motores que existen en el mercado con estas características. El motor seleccionado cumple las características expuestas y además viene con su encoder acoplado. Esto nos servirá de gran ayuda al momento de controlar el giro del Tri-star. El motor seleccionado es el 3274E_0 24V/173.3Kg-cm/15RPM 168:1 DC Gear Motor w/Encoder.

En la figura 8 se muestra una tabla con información acerca de las propiedades del motor.

Motor Type	DC Motor with Encoder
Output Power (Mechanical)	30 W
Maximum Speed at Rated Voltage	15 RPM
Rated Torque	173 kg·cm
Stall Torque	1.2 Mg·cm

Fig. 8: Propiedades del motor

En la figura 9 se observa las propiedades eléctricas del motor. Entre ellas tenemos al voltaje de alimentación, corriente nominal y la corriente de arranque.

Rated Voltage	24 V DC
Rated Current	2.2 A
Stall Current	10.8 A

Fig. 9: Propiedades eléctricas

En la figura 10 se observa las propiedades físicas del motor. Entre ellas tenemos al diámetro del eje.

Shaft Diameter	12 mm

Fig. 10: Propiedades físicas

En la figura 11 se observa las especificaciones de la caja reductora del motor. Entre las más resaltantes tenemos a la máxima carga axial y radial en el eje.

Gearbox Type	Planetary
Gear Ratio	$167\ {}^{601}/_{625}$: 1
Number of Gear Trains	4
Maximum Strength of Gears	460 kg·cm
Shaft Maximum Axial Load	200 N
Shaft Maximum Radial Load	100 N

Fig. 11: Especificaciones de la caja reductora

Anexo5: Cálculo del motor para el frenado

El resorte está sometido a cargas de tracción en el análisis estático. Las ecuaciones que se establecen son las siguientes:

$\sum \mathbf{Fx} = \mathbf{0}$ **…(1)**

$\sum \mathbf{Fy} = \mathbf{0}$ **…(2)**

$\sum \mathbf{Mo} = \mathbf{0}$ **…(3)**

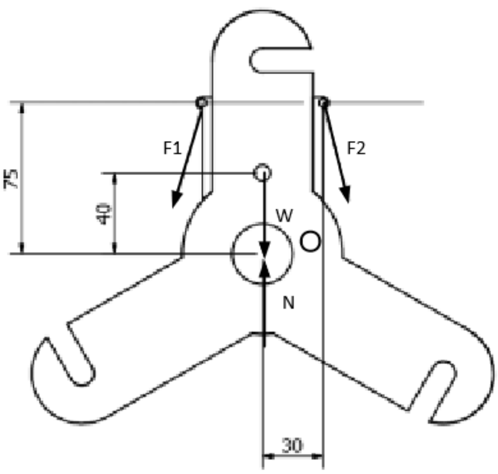


Fig. 1: D.C.L placa de frenado

Fuente: Elaboración propia

El ángulo entre F1 y el eje Y es de 75°

De la ecuación (1) se obtiene la siguiente expresión:

F1*Sin (θ) = F2*Sin (θ)… (4)

De la ecuación (2) se obtiene la siguiente expresión:

F1*Cos (θ) + F2*Cos (θ) + W = N… (5)

De la ecuación (3) se obtiene las siguientes expresiones:

+F1*d – F2*d = 0... (6)

En el instante en el cual el eje del motor empieza a girar F1 es asociada a la tracción del resorte y F2 es asociada a la compresión.

Para que el sistema pueda rotar, el torque del motor tiene que ser mayor que el de la carga, para que la aceleración angular sea positiva.

La ecuación que se establece en este instante es la siguiente:

Tm > $\sum \mathbf{Mo}$ **… (7)**

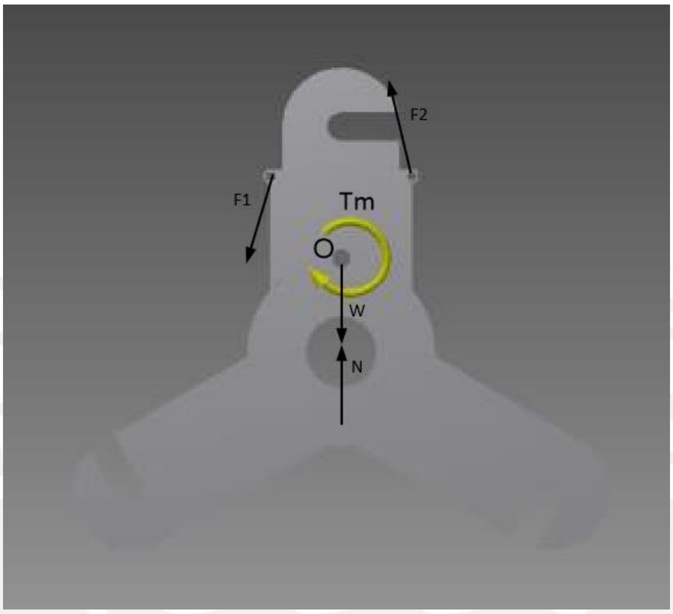


Fig. 2: D.C.L placa de frenado en rotación inminente

Fuente: Elaboración propia

De la ecuación (7) se obtiene las siguientes expresiones:

F1 = 9,68 + c*x

x: elongación máxima de 1 cm

c: constante de elasticidad del resorte (0,61 N/mm)

Tm > 0,70 N.m

Con el torque del motor necesario para mover el sistema de frenado. Se seleccionó el motor 75:1 Metal Gear motor 25Dx54L mm HP with 48 CPR Encoder. Además entre sus especificaciones están una velocidad de rotación de 130 RPM, 9.4 kg-cm de torque y finalmente, una corriente de arranque de 6 A.

Anexo 6: Selección del actuador lineal

El actuador tiene que ser capaz de vencer la fuerza que ejerce la persona sobre el sistema mecatrónico al momento de subir los peldaños de una escalera o desniveles.

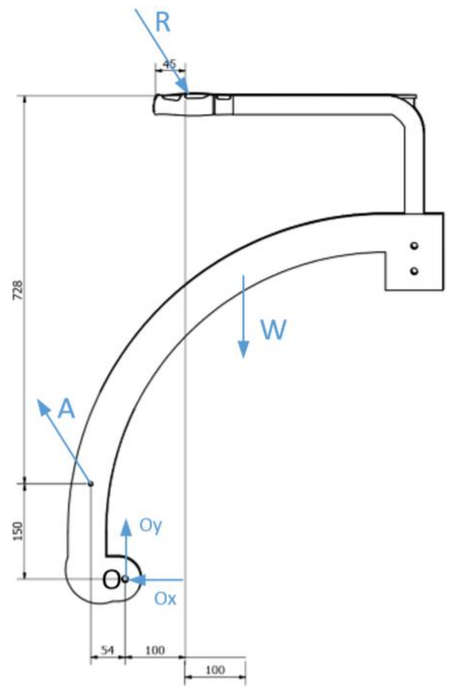


Figura A.6.1 D.C.L del sistema mecatrónico

Fuente: Elaboración propia

Para seleccionar el actuador primero se procede a hallar la fuerza a vencer. Las ecuaciones de equilibrio son las siguientes:

$\sum \mathbf{Fx} = \mathbf{0}$ **…(1)**

$\sum \mathbf{Fy} = \mathbf{0}$ **…(2)**

$\sum \mathbf{Mo} = \mathbf{0}$ **…(3)**

Las componentes de la fuerza R son Rx y Ry, el subíndice hace alusión a la dirección.

Los componentes de A son los siguientes:

En la dirección x → A*Cos (θ)

En la dirección y → A*Sin (θ)

Además el peso de esa estructura es de 5,25 kg.

De la ecuación (1) se obtiene la siguiente expresión:

A*Cos (θ)+ Ox = Rx… (4)

De la ecuación (2) se obtiene la siguiente expresión:

A*Sin (θ)+ Oy = Ry + W… (5)

De la ecuación (3) se obtiene las siguientes expresiones:

Ry*100 + Rx*880 + A*54*Sen (θ) + W*d = A*150*Cos (θ)... (6)

El ángulo θ máximo ocurrirá cuando se esté subiendo las gradas de la escalera tanto en subida como en bajada. El ángulo máximo según medidas normalizadas de los peldaños es de 33,63 °. Este ángulo también corresponde a la inclinación detectada por el acelerómetro. Una vez hallado el ángulo, se procede a reemplazarlo en la ecuación 6. La máxima fuerza ejercida por una persona de 70 kg es de 135,705 N. Esta máxima fuerza se caracteriza por poseer solamente la componente vertical (Ry).

Reemplazando θ y Ry en la ecuación (6) se obtiene la siguiente expresión:

A = 251,8 N

Utilizando como factor de seguridad al valor de 1,5 obtenemos 377,7. El actuador seleccionado debe ser capaz de superar ese valor. Se escoge el actuador de capacidad de carga dinámica de 50 kg.

Una vez calculado la fuerza necesaria, se procede a comprobar si una carrera de 8” cumple con los requisitos del sistema.

El actuador lineal con 8” de carrera posee las siguientes características:

Longitud retraída → 12,3”

Longitud extendida → 20,1”

En la figura A.6.2 se observa que la medida de la distancia entre los 2 apoyos del actuador lineal es de 353 mm. A este valor le restamos la longitud retraída y obtenemos que el vástago del actuador lineal se desplazó 40,58 mm. Como este valor es menor que 8” se concluye que la disposición geométrica del actuador lineal en el sistema mecatrónico no genera ningún inconveniente a la estructura.

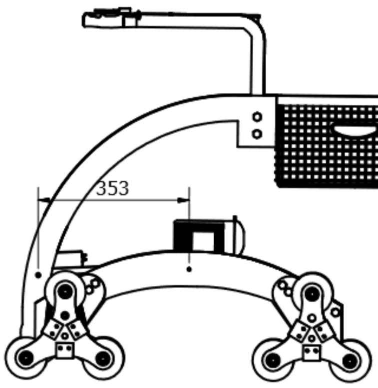


Figura A.6.2 Vista frontal del sistema mecatrónico

Fuente: Elaboración propia

En la figura A.6.3 se observa que la medida de la distancia entre los 2 apoyos del actuador lineal al momento de bajar los peldaños de la escalera es de 432 mm. A este valor le restamos la longitud retraída y obtenemos que el vástago del actuador lineal se desplazó 119,58 mm. Este valor equivale a 4,7”, como este valor es menor que 8” se concluye que el actuador lineal es capaz de generar los desplazamientos necesarios del vástago para que la altura con la cual se sujeta el sistema mecatrónico al momento de bajar sea la misma que en las condiciones de traslado en superficies planas. Esto permitirá que el usuario siempre se apoye en el andador aproximadamente a la altura de la cadera.

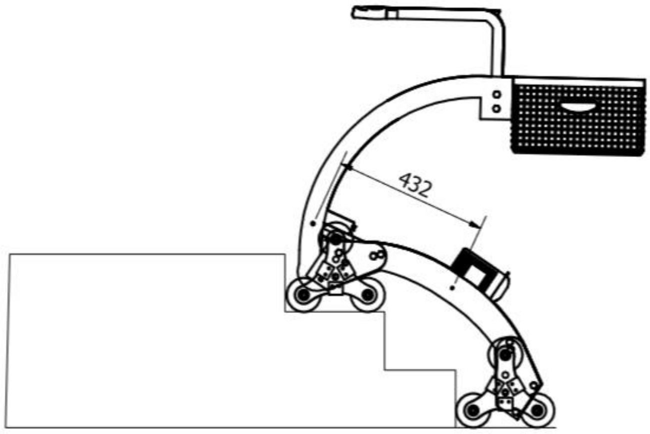


Figura A.6.3 Vista frontal del sistema mecatrónico cuando baja la escalera

Fuente: Elaboración propia

En la figura A.6.4 se observa que la medida de la distancia entre los 2 apoyos del actuador lineal al momento de subir los peldaños de la escalera es de 266 mm. A la longitud retraída le restamos este valor y obtenemos que el vástago del actuador lineal se retrajo 46,42 mm. Este valor equivale a 1,82”, como este valor es menor que 8” se concluye que el actuador lineal es capaz de generar los desplazamientos necesarios del vástago para que la altura con la cual se sujeta el sistema mecatrónico al momento de subir sea la misma que en las condiciones de traslado en superficies planas de la cadera.

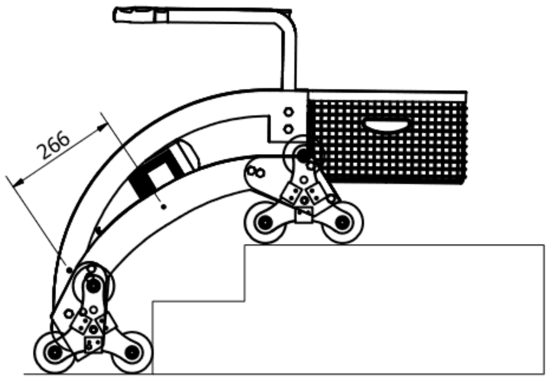


Figura A.6.4 Vista frontal del sistema mecatrónico cuando sube los peldaños de la escalera.

Fuente: Elaboración propia

Finalmente, teniendo en consideración los cálculos realizados, el actuador lineal eléctrico seleccionado es el **Concentric LACT8P-12V-20.**

Las características más resaltantes se encuentran en figura A.6.5.

Gear ratio:	20:1
Free-run current @ 12V:	500 mA
Stall current @ 12V:	10 A
Linear speed @ 12V:	0.5 in/s
Linear force @ 12V:	110 lb[1]
Maximum duty cycle:	25%
Feedback potentiometer included?:	Y

Figura A.6.4 Especificaciones del actuador seleccionado

Fuente: [26]

Anexo 7: Selección de los componentes electrónicos

A.7.1 Selección de los microcontroladores

Para seleccionar el microcontrolador se debe de tomar en cuenta los siguientes requerimientos:

1. Líneas de transmisión y recepción para comunicación con el módulo GPS y GSM.
2. Disponibilidad de modo de trabajo SLEEP, para limitar el consumo de energía cuando está inactivo.
3. Manejo de interrupciones externas para el accionamiento de subsistemas
4. Capacidad de generar múltiples señales PWM a alta frecuencia y resolución.
5. Posibilidad de implementar variadas tareas en un mismo elemento, tareas de control, comunicaciones, etc.
6. Gran capacidad de almacenamiento no volátil (EEPROM).

A partir de las características mencionadas, el modelo de microcontrolador seleccionado es **ATmega2560** de la marca **Atmel**, puesto que cumple con los requerimientos.

Sus características más importantes son las siguientes:

1. En cuanto al almacenamiento, en la figura A.5.1.1 se observa las capacidades de memoria EEPROM según modelo de Arduino. El modelo de Arduino utilizado (Arduino Mega) tiene mayor memoria EEPROM disponible. Esto permitirá que el historial de la evolución de la frecuencia cardiaca de la persona tenga más muestras guardadas.

Modelo	EEROM disponible
Arduino UNO	1 KB
Arduino Leonardo	1 KB
Arduino Due	No tiene
Arduino Yun	1 KB
Arduino MEGA	4 KB
Arduino Micro	1 KB
Arduino Lilypad	1 KB
Arduino Nano	512 Bytes
Arduino Pro mini	512 Bytes
Arduino Pro	512 Bytes
Arduino Mini	1 KB
Arduino Fio	1 KB

Figura A.7.1.1 Capacidades de memoria EEPROM según modelo de Arduino

Fuente: [20]

2. En cuanto a las interrupciones externas disponibles, en la figura A.5.1.2 se observa los pines disponibles de interrupción según los distintos modelos de Arduino. En el sistema se usarán los siguientes:

- 1 pulsador con enclavamiento conectado al pin int.0 (2)
- 1 pulsador con enclavamiento conectado al pin int.1 (3)
- 1 pulsador con enclavamiento conectado al pin int.2 (21)
- 1 pulsador con enclavamiento conectado al pin int.3 (20)
- Pin int.1 del acelerómetro conectado al pin int.4 (19)

Board	int.0	int.1	int.2	int.3	int.4	int.5
Uno, Ethernet	2	3				
Mega2560	2	3	21	20	19	18
Leonardo	3	2	0	1	7	

Figura A.7.1.2 Pines disponibles de interrupción según modelo de Arduino

Fuente: [21]

A.7.2 Selección del sensor de pulso

Para seleccionar el sensor de pulso, se debe de tener en cuenta los siguientes requerimientos:

1. Incluya un circuito de amplificación, señal muestreada, y de cancelación de ruido.
2. Rapidez al momento de obtener las lecturas.
3. Rango de voltaje de entrada entre 3.3 V y 5 V.
4. Bajo consumo de corriente.
5. Comodidad al momento de usarlo.
6. Capacidad de trabajar con Arduino Mega2560

A partir de las características mencionadas, el sensor de pulso utilizado es el **Pulse Sensor Amped** puesto que cumple con los requerimientos mencionados.

Las características eléctricas más resaltantes se muestran en la tabla A.5.2.1

Pulse Sensor	
Voltaje de entrada	3V - 5V
Corriente de consumo	4mA a 5V
Diámetro	16mm

Tabla A.7.2.1: Tabla de especificaciones del sensor de pulso

Fuente: Elaboración propia

En cuanto al uso del sensor, este se coloca sobre la yema del dedo y utiliza la cantidad de luz infrarroja reflejada por la sangre, que circula por el interior, como parámetro a medir.

El sensor utilizado consiste en un emisor infrarrojo y un detector montado a un lado y debe estar presionado contra la piel. Cuando el corazón bombea, la presión arterial se eleva considerablemente y lo mismo ocurre con la cantidad de luz infrarroja procedente del emisor que se refleja en el detector. Parte de la luz roja e infrarroja atraviesa el tejido, pero con cada pulsación el paso de la sangre reduce ligeramente la cantidad de luz que es capaz de traspasarlo. Esta variación se detecta con otro sensor, un fotodiodo cuyas propiedades varían según la luz, generando una corriente eléctrica dependiendo de la cantidad de luz que recibe. El detector deja pasar más corriente cuando recibe más luz, que a su vez provoca una caída de tensión para entrar al circuito amplificador.

A.7.3 Selección del acelerómetro

Para seleccionar el acelerómetro se debe de tener en cuenta los siguientes requerimientos:

1. Capaz de medir aceleración, inclinación, vibración y caída libre con alta precisión.
2. Tamaño reducido.
3. Bajo consumo de corriente.
4. Capacidad de medición de los 3 ejes con alta resolución.
5. Capacidad de trabajar con Arduino Mega 2560.
6. Rango de voltaje de entrada entre 3 V y 5 V.
7. Incluya pines de interrupción.

A partir de las características mencionadas, el acelerómetro utilizado es el **Acelerómetro Digital 3 Ejes – ADXL 345.**

El sensor será utilizado para medir inclinaciones, que ocurrirán cuando el usuario suba o baje los peldaños de una escalera. En la figura A.7.3.1 se observa que la aceleración medida es la proyección de la aceleración de la gravedad sobre el eje sensado (Ecuación 1). El ángulo de inclinación está representado por la Ecuación 2.

Ecuación 1:

$$A = g \times \sin(\alpha)$$

Ecuación 2:

$$\alpha = \arcsin\left(\frac{A}{g}\right)$$

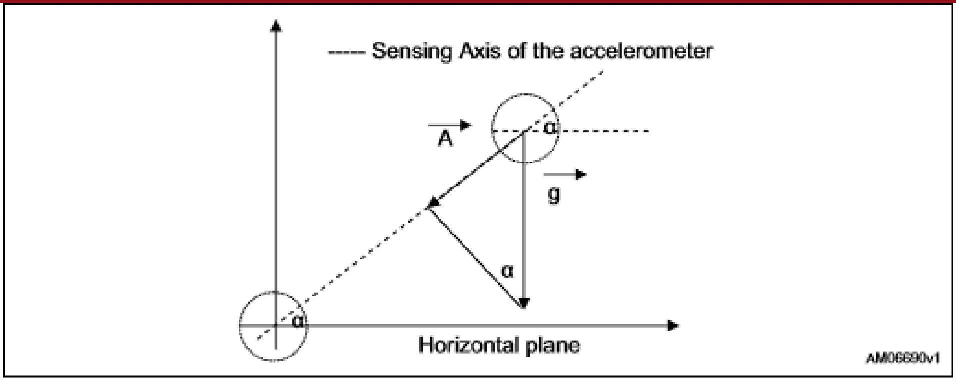


Figura A.7.3.1 Medición del ángulo de inclinación usando 1 eje del acelerómetro

Fuente: [22]

A.7.4 Selección del módulo GPS

Para seleccionar módulo GPS se debe de tener en cuenta los siguientes requerimientos:

1. Ultra sensibilidad.
2. Tamaño reducido.
3. Regular precisión
4. Tiempo de lectura corto
5. Bajo consumo de corriente
6. Límite de operación como máximo de 18 km.

A partir de las características mencionadas, el módulo GPS seleccionado es el **SkyLabs SKM53.** Este módulo trabaja con el chip MediaTek3329 y viene con una antena integrada. Se comunica a través del puerto serial UART. Con este módulo se medirá la longitud y latitud de la ubicación del usuario.

En la figura A.7.4.1 se observan las características del módulo GPS utilizado en el sistema mecatrónico. Entre las más importantes tenemos a la altitud límite de operación representada por el valor de 18 km y al tiempo de lectura en caliente, sucede cuando se usa previamente, de 1 s.

Tipo de receptor	L1 frecuency band, C/A code	
	22 Tracking / 66 Canales de lectura	
Sensibilidad	Tracking	165dBm
	Adquisition	148dBm
Precisión	Posición	3mts. 3D RMS sin SA
	Velocidad	0.1m/s sin SA
	Timing (PPS)	60ns RMS
Tiempo de lectura	Cold start	36 s
	Warm Start	33 s
	Hot start	1 s
	Re-Adquisition	<1s
Consumo de energía	Tracking	<30mA @ 3V Vcc
	Acquisition	40mA
	Sleep/Standby	TBD
Frecuencia de actualización de datos de navegación	1Hz	
Límites de operación	Altitude	Max 18,000m
	Velocity	Max 515m/s
	Aceleración	Menor a 4g
Especificaciones de la antena	OutlineDimension	18.2 x 18.2 x 4.0 mm
	Center Frequency	1575 ± 3 MHz
	Bandwidth	10 MHz min
	Impedance	50 Ω
	Axial Ratio	3 dB max
	Polarization	RHCP
Dimensiones y peso	Dimensiones	30mm x20mm x 11.4mm
	Peso	9g
Fuente de poder	VCC	5V ±5%
	Corriente	55mA(typical)
Entorno	Temperatura de operación	40 ˜ +85 (sin batería de respaldo)
	Temperature de almacenamiento	0 ˜ +125

Figura A.7.4.1 Características del módulo GPS

Fuente: [23]

A.7.5 Selección del módulo GSM

Al momento de seleccionar el módulo GSM se tuvieron en cuenta las siguientes consideraciones:

1. Controlable vía comandos AT estándar.
2. Bajo consumo de corriente (modo sleep).
3. Incorpore un Real Time Clock.
4. Capacidad de trabajar con Arduino Mega 2560.

A partir de las características mencionadas anteriormente, el módulo GSM seleccionado es el **Shield GPRS/GSM SIM900.**

Las especificaciones [44] del módulo usado son las siguientes:

- Quad-Band 850 / 900/ 1800 / 1900 MHz - funciona en todas las redes celulares del planeta.
- GPRS multi-slot class 10/8
- Estación móvil GPRS clase B
- Cumple con GSM phase 2/2+
- Clase 4 (2 W @ 850 / 900 MHz)
- Clase 1 (1 W @ 1800 / 1900MHz)
- Controlable vía comandos AT estándar: GSM 07.07 & 07.05 | Comandos mejorados: SIMCOM AT Commands.
- Servicio Short Message Service (SMS) - para poder enviar pequeños paquetes de datos a través de la red celular.
- Pila TCP/UDP incorporada - permite enviar datos a un servidor web. Ejem: Pachube, Fusion Tables
- Incorpora un Real Time Clock - RTC. (Requiere pila)
- Puerto serial configurable para comunicación con el shield.
- Soporte para comunicación por softwareSerial (pines 6 y 7).
- Jack para audífonos y micrófono (handsfree)
- Bajo consumo (en modo sleep) - 1.5mA
- Jack para alimentación externa.
- Soporta rangos temperatura - -40°C to +85 °C

Finalmente, para enviar información se usará clases “call.h” y “sms.h” ubicadas dentro de la librería “call” del Arduino.

A.7.6 Selección del controlador del motor del sistema Tri-star y del sistema de frenado

Para seleccionar el controlador del motor se debe de tener en cuenta los siguientes requerimientos:

1. Voltaje de entrada que comprenda la tensión de alimentación del motor.
2. Corriente máxima de salida que contemple la corriente de arranque del motor.
3. Corriente pico.
4. Capacidad PWM.
5. Sistema de protección contra cortocircuito, sobrecalentamiento y sobrevoltaje.
6. Interfaz fácil de operar.

A partir de las características mencionadas, el controlador utilizado es el **Driver BTS7960.**

Algunas de las especificaciones más importantes son las siguientes:

- Voltaje de entrada:4.8-35V
- Corriente máxima de salida:15A@13.8V por canal
- Corriente pico:20A a 13.8V por canal
- Capacidad PWM: hasta 25 kHz
- Interfaces:4 digital (incluye 2 salidas PWM)
- Modo de operación: Puente H de alta potencia
- Protección contra cortocircuito, sobrecalentamiento y sobrevoltaje
- Dimensiones:73x68x14mm

El controlador seleccionado es de configuración puente H con transistores MOSFET para el control de dos motores. En cuanto al sistema Tri-star, comprende la tensión de alimentación del motor (24VDC). El motor tiene una corriente de arranque de 10.8 A y una corriente nominal de 2.2 A. El driver es capaz de mover a los motores debido a que su corriente de salida máxima es de 15 A. Por otro lado, en cuanto al subsistema de frenado, el driver comprende en su voltaje de entrada a la tensión de alimentación del motor (6VDC). Además, el driver es capaz de accionar los motores debido a que la corriente de arranque del motor es de 6 A y el controlador es capaz de proporcionarlos.

En base a lo anterior, el driver seleccionado cumple todas las exigencias del motor del sistema Tri-star y de frenado.

A.7.7 Selección del controlador del actuador lineal eléctrico

Para seleccionar el driver del actuador lineal se debe de tomar en cuenta los siguientes requerimientos:

1. Voltaje de entrada que comprenda la tensión de alimentación del motor.
2. Corriente máxima de salida que contemple la corriente de trabajo del motor del actuador lineal.
3. Capacidad PWM.
4. Capacidad de realimentación y minimización del error.

A partir de las características descritas, el controlador seleccionado es el **Jrk 21v3 USB Motor Controller with Feedback.**

En la figura A.7.7.1 se observan las especificaciones del driver seleccionado. Entre ellas tenemos el rango de voltaje de alimentación que comprende todos los valores entre 5v y 28v.

Motor driver:	MC33926
Motor channels:	1
Control interface:	USB; non-inverted TTL serial; RC servo pulses; analog voltage[2]
Minimum operating voltage:	5 V
Maximum operating voltage:	28 V
Continuous output current per channel:	3 A
Peak output current per channel:	5 A
Current sense:	0.5 V/A[3]
Maximum PWM frequency:	20 kHz
Minimum logic voltage:	4 V[4]
Maximum logic voltage:	5 V
Reverse voltage protection?:	Y

Figura A.6.7.1 Características del driver del actuador lineal

A.7.8 Selección de la batería de control

La capacidad de la batería se seleccionará en base al consumo de corriente de todos los dispositivos electrónicos. Para la selección se considerará que todos los equipos electrónicos están ejecutando tareas a la vez, esto nos proporcionará un umbral que nos indicará que el consumo no excederá el valor límite.

El consumo energético para cada componente es el siguiente:

Acelerómetro en modo de adquisición de datos → 40 uA.

Sensor de pulso → 4 mA.

Módulo GSM → 1,5 mA.

Módulo GPS en modo de adquisición de datos → 40 mA.

Driver → 3 mA.

Teniendo en cuanta que se tiene 4 drivers, el consumo total de todos los componentes es 57,5 mA. Utilizando un factor de seguridad de 1,5, para establecer un límite en cuanto al consumo, obtenemos un valor final de 86,25 mA. Para la alimentación del Arduino se utilizará 9 V, se elige este valor de tensión debido a que disipa menos calor, en el regulador de voltaje interno del microcontrolador, en comparación con mayores tensiones. La batería de 9 V recargable tiene una capacidad de 250 mA. Utilizando solo esta batería, nuestro sistema mecatrónico tendría una independencia de 2 h 54 min. Si bien es cierto las personas de la tercera edad no están mucho tiempo caminando, tenemos que asegurar que el sistema mecatrónico dure 12 h como máximo. Para obtener este tiempo, se procede a configurar 5 baterías de 9 v de 250 mA. De esta manera se obtiene 1000 mA que dividido entre el consumo máximo, 86,25 mA, se obtiene 11 h 35 min. Tiempo suficiente de independencia para que el usuario pueda desplazarse con el sistema mecatrónico sin tener ningún inconveniente en cuanto a la duración de uso.

Finalmente, se la batería recargable seleccionada es **Camelion 9V 250 mAh**. Se utilizarán 5 de estas con configuración en paralelo para la alimentación del sistema de control.

A.7.9 Selección de la batería de los motores del sistema Tri-star

El sistema Tri-star solo se utilizará para subir las gradas de las escaleras. La capacidad de la batería se seleccionará de manera semejante al calculado para el sistema de control. Para la selección se considerará que todos los equipos eléctricos están ejecutando tareas a la vez, esto nos proporcionará un umbral que nos indicará que el consumo no excederá el valor límite.

El consumo energético de cada componente es el siguiente:

Motor Tri-star → 2,2 A.

Motor Frenado → 450 mA.

Actuador lineal → 500 mA.

Los eventos son mutuamente excluyentes, es decir se ejecutará solo uno de los procesos, luego de terminar uno de ellos se procederá con la siguiente secuencia. A partir de esto, se utilizarán los máximos valores de consumo que corresponden al motor del sistema Tri-star. Como se mencionó, un pulsador permitirá accionar los dos Tri-star delanteros. En ese instante, dos motores estarán ejecutando instrucciones, por lo que el consumo de corriente será 4,4 A. El tiempo necesario, para subir peldaños o cambios de nivel contemplados en el dimensionamiento del sistema Tri-star, será como máximo de 2 h 30 min. A partir de este tiempo, obtenemos 10,12 A de capacidad de la batería. Por otro lado, la tensión con la que la batería alimentará a los componentes será de 24V, debido a que necesita ser capaz de suministrar el voltaje de alimentación de los motores, que corresponde al valor de tensión nominal de la batería.

Finalmente, la batería recargable seleccionada es **NiMH 24V 10 Ah**.

Anexo8: Análisis de esfuerzos

Para los análisis y simulaciones mostrados a continuación, se utilizaron los valores calculados en los anexos del cálculo de la fuerza sobre la andadera y el anexo acerca del torque del motor.

Para las simulaciones se asumió el caso de un extremo fijo, mientras que en el otro se aplicaron las solicitaciones mecánicas, de este modo, se simuló el comportamiento del sistema de asistencia técnica para las personas de edad avanzada.

A.8.1. Análisis del brazo superior

En el análisis se considera la fuerza máxima que ejerce una persona de 70 kg al momento de sujetar el sistema mecatrónico. Según cálculos anteriores, la máxima fuerza ejercida por la persona tiene solo componente vertical y un valor de 135,725 N

En la figura A.8.1.1 se observan las características físicas del elemento simulado.

Material	Aluminum 6061
Density	2,7 g/cm^3
Mass	0,220783 kg
Area	73440,2 mm^2
Volume	81771,6 mm^3
Center of Gravity	x=204,99 mm y=-56,6174 mm z=-12,3202 mm

Figura A.8.1.1 Características físicas del brazo superior

Fuente: [31]

En la figura A.8.1.2 se observan las características físicas del material utilizado.

Name	Aluminum 6061	
General	Mass Density	2,7 g/cm^3
	Yield Strength	275 MPa
	Ultimate Tensile Strength	310 MPa
Stress	Young's Modulus	68,9 GPa
	Poisson's Ratio	0,33 ul
	Shear Modulus	25,9023 GPa
Part Name(s)	brazo_superior_simu	

Figura A.8.1.2 Características físicas del aluminio utilizado

Fuente: [31]

Las condiciones de operación se muestran en la figura A.8.1.3

Load Type	Force
Magnitude	135.705 N
Vector X	0.000 N
Vector Y	-135.705 N
Vector Z	0.000 N

Figura A.8.1.3 Condiciones de operación

Fuente: [31]

Resultados de la simulación:

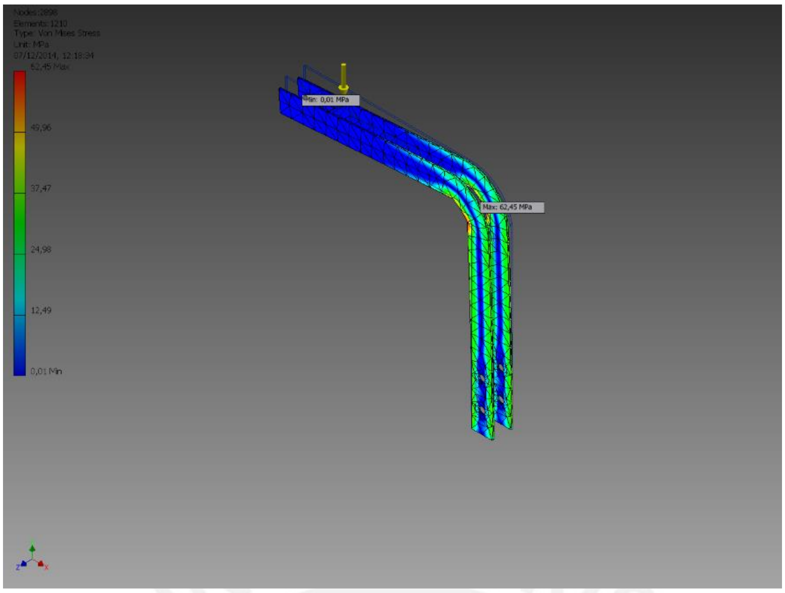


Figura A.8.1.4 Evaluación de esfuerzos por von Mises

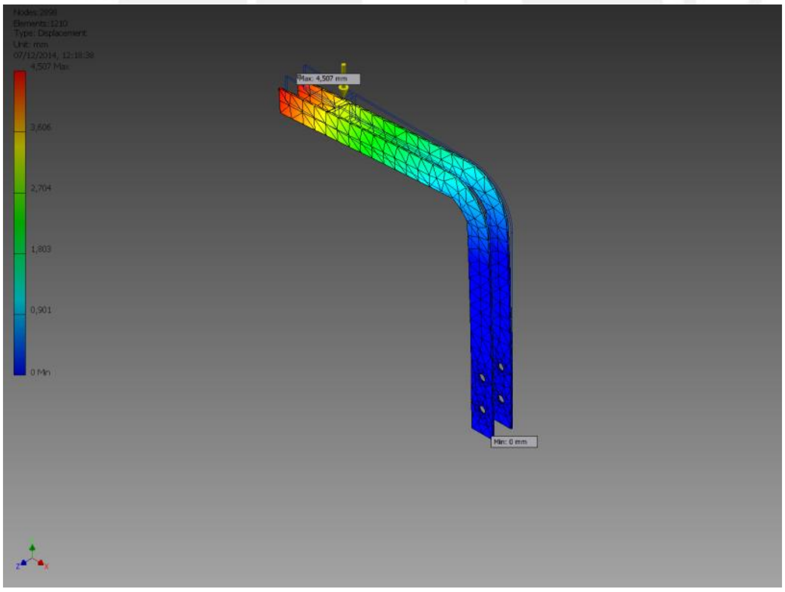


Figura A.8.1.5 Evaluación de deformaciones

Como se observa, para esta pieza se cuenta con un FS = 4 y una deformación máxima de 4,507 mm.

Considerando un ángulo de sujeción 40°, condición en la que normalmente se sostiene este tipo de aparatos. Se obtienen los siguientes resultados:

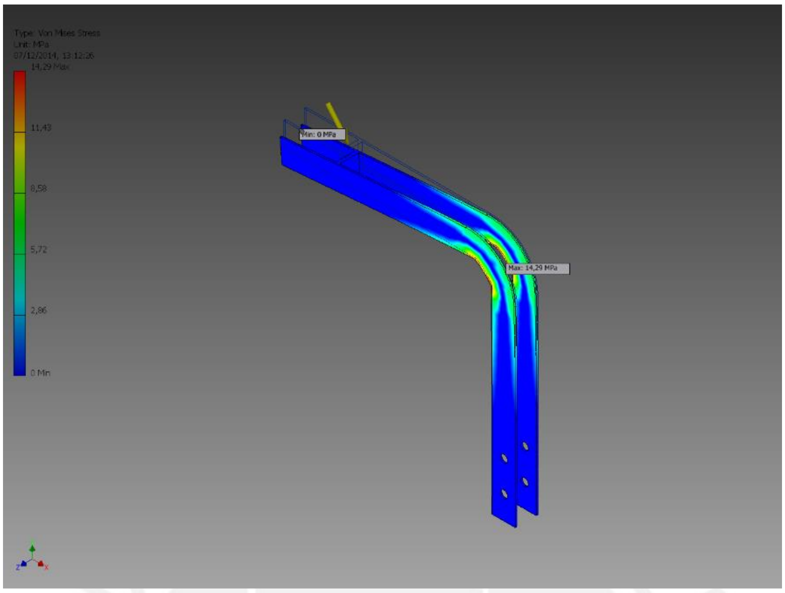


Figura A.8.1.6 Evaluación de esfuerzos por von Mises

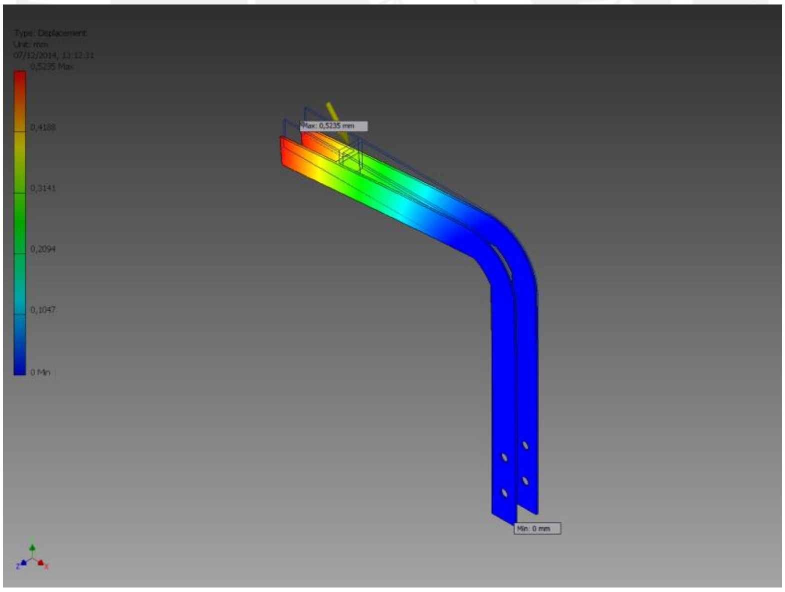


Figura A.8.1.7 Evaluación de deformaciones

En la figura A.8.1.6 y A.8.1.7 se observa que el esfuerzo máximo y la deformación son 4 veces menor que el valor que se muestra en la figura A.8.1.4 y A.1.5 respectivamente. Finalmente, se concluye que este elemento de 3 mm de espesor no fallará.

A.8.2. Análisis del brazo curvo medio

En este análisis se considera la fuerza máxima que ejerce una persona de 70 kg al momento de sujetar el sistema mecatrónico. Según cálculos anteriores, la máxima fuerza ejercida por la persona tiene solo componente vertical y un valor de 135,725 N. Además, el ángulo entre el eje comprendido entre esta fuerza y el eje –y es de 72°. Por otro lado, la máxima fuerza que ejerce el actuador fue hallada en el anexo 6 y tiene como módulo 251,8 N.

Las características físicas del elemento se describen en la figura A.8.2.1.

Material	Aluminum 6061
Density	2,7 g/cm^3
Mass	0,447322 kg
Area	135188 mm^2
Volume	165675 mm^3
Center of Gravity	x=-264,635 mm y=269,319 mm z=1,28 mm

Figura A.8.2.1 Características físicas del brazo curvo

Fuente: [31]

La fuerza que ejerce la persona al momento de sujetar y la ocasionada por el actuador se describen en las figuras A.8.2.2 y A.8.2.3 respectivamente.

Load Type	Force
Magnitude	135,705 N
Vector X	0,000 N
Vector Y	-135,705 N
Vector Z	0,000 N

Figura A.8.2.2 Fuerza ocasionada por la sujeción del sistema mecatrónico

Fuente: [31]

Load Type	Force
Magnitude	251,798 N
Vector X	-209,510 N
Vector Y	139,670 N
Vector Z	0,000 N

Figura A.8.2.3 Fuerza ocasionada por el actuador.

Fuente: [31]

Los resultados de la simulación tanto de la evaluación de esfuerzos y de deformaciones se visualizan en las figuras A.8.2.4 y A.8.2.5 respectivamente.

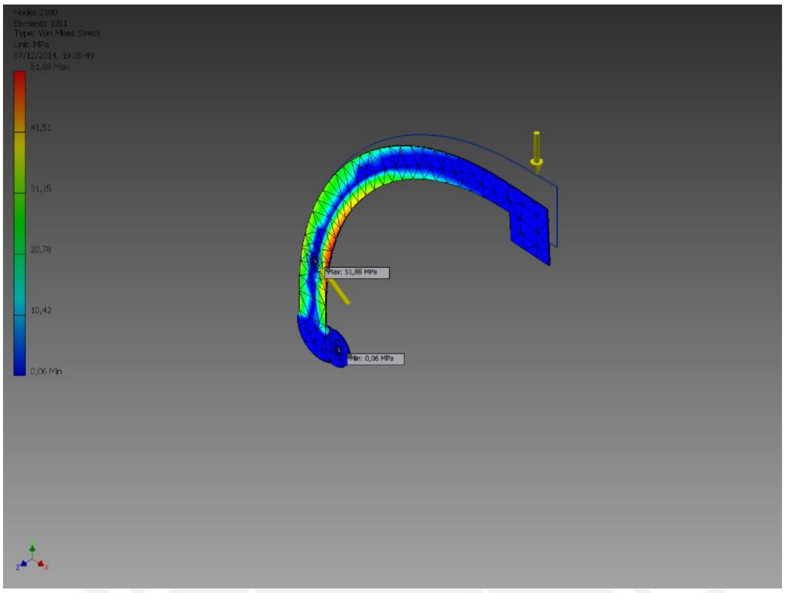


Figura A.8.2.4 Evaluación de esfuerzos por von Mises

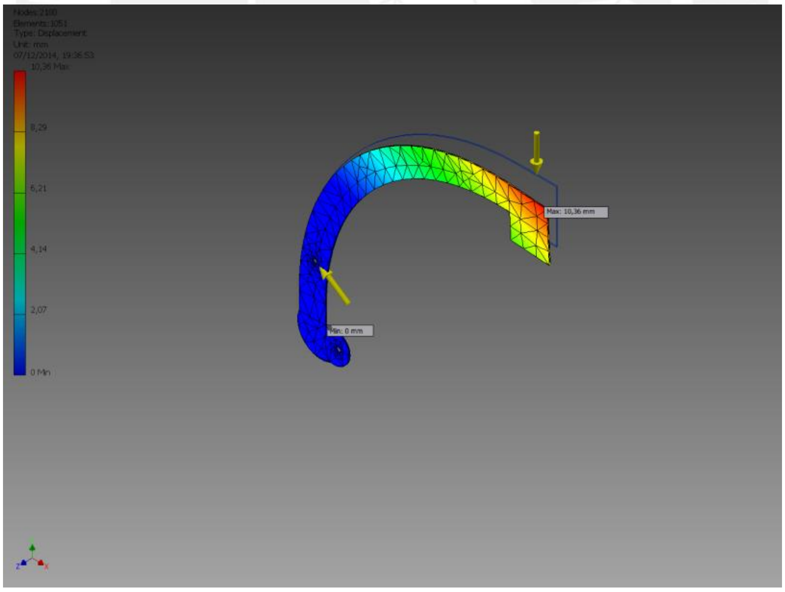


Figura A.8.2.5 Evaluación de deformaciones

Como se observa, para esta pieza se cuenta con un FS = 5,3 y una deformación máxima de 10,36 mm. A partir de esto, se concluye que la pieza de 3 mm de espesor resistirá las cargas que se le apliquen.

A.8.3. Análisis del brazo curvo inferior

En el análisis se considera la fuerza máxima que ejerce el actuador a este elemento. Según cálculos anteriores, la máxima fuerza que ejerce el actuador fue hallada en el anexo 6 y tiene como módulo 251,8 N. Se puede apreciar que el esfuerzo máximo es de 34,5 MPa y una deformación de 12,52 mm. Finalmente, se concluye que el elemento no fallará debido a que el máximo esfuerzo ocasionado en este es mucho menor que el límite elástico.

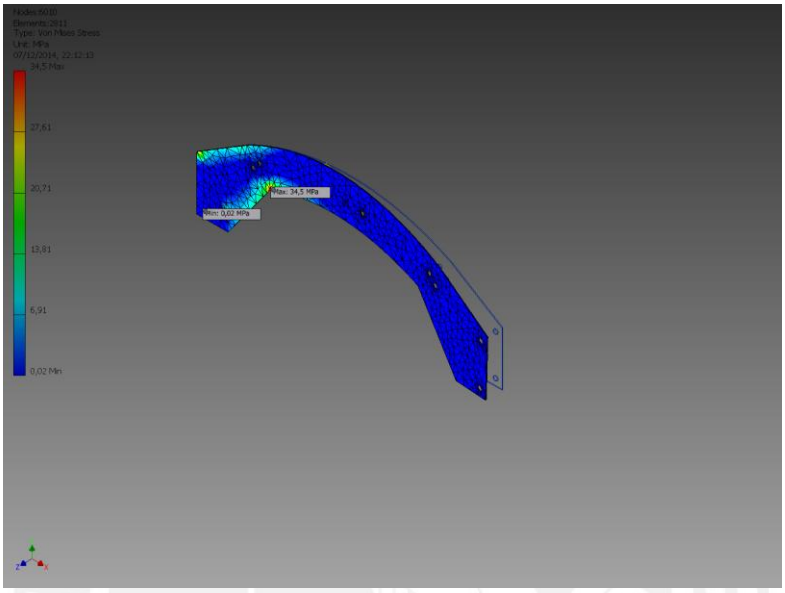


Figura A.8.3.1 Evaluación de esfuerzos por von Mises

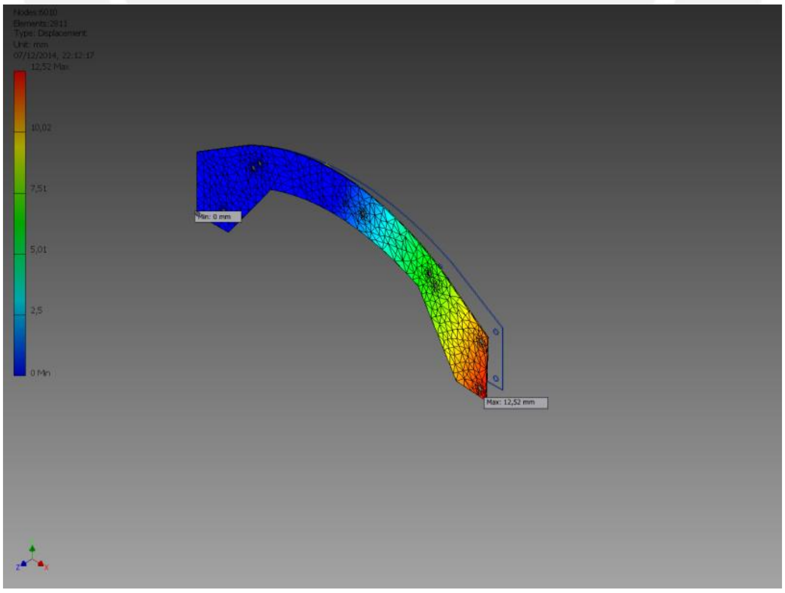


Figura A.8.3.2 Evaluación de deformaciones

A.8.4. Análisis del soporte del sistema Tri-star

En el análisis se considera la fuerza máxima que ejerce el eje del motor al soporte. Según cálculos anteriores, el módulo de esta fuerza es de 228,28 N. Además, el ángulo entre el eje comprendido entre esta fuerza y el eje –y es de 72°. Por otro lado, la simulación de esfuerzos considera también el momento torsor ocasionado por el motor seleccionado. El valor de este es de 16,97 N.m en sentido horario.

En la figura A.8.4.1 se observan las características físicas del elemento simulado.

Material	Aluminum 6061
Density	2,7 g/cm^3
Mass	0,210489 kg
Area	38636,2 mm^2
Volume	77958,9 mm^3
Center of Gravity	x=90 mm y=51,3744 mm z=2,375 mm

Figura A.8.4.1 Características físicas del soporte del Tri-star.

Fuente: [31]

Resultados de la simulación:

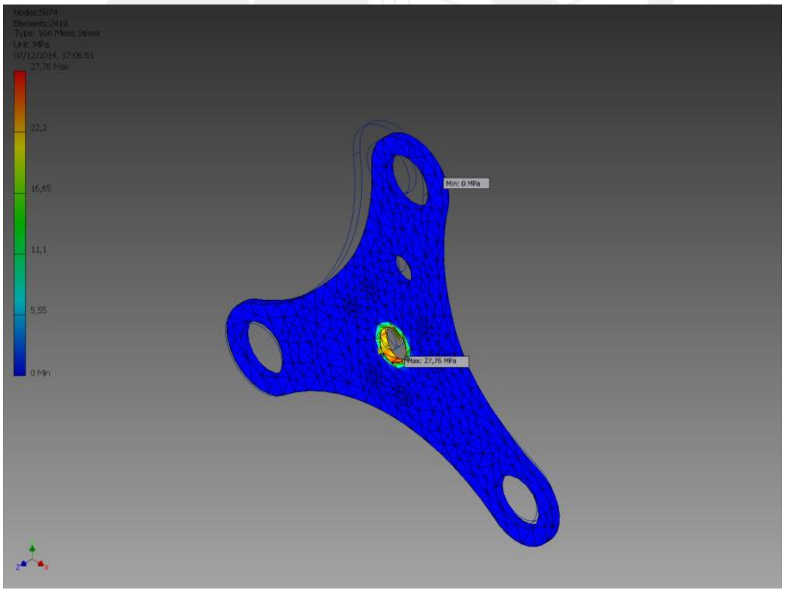


Figura A.8.4.2 Evaluación de esfuerzos por von Mises

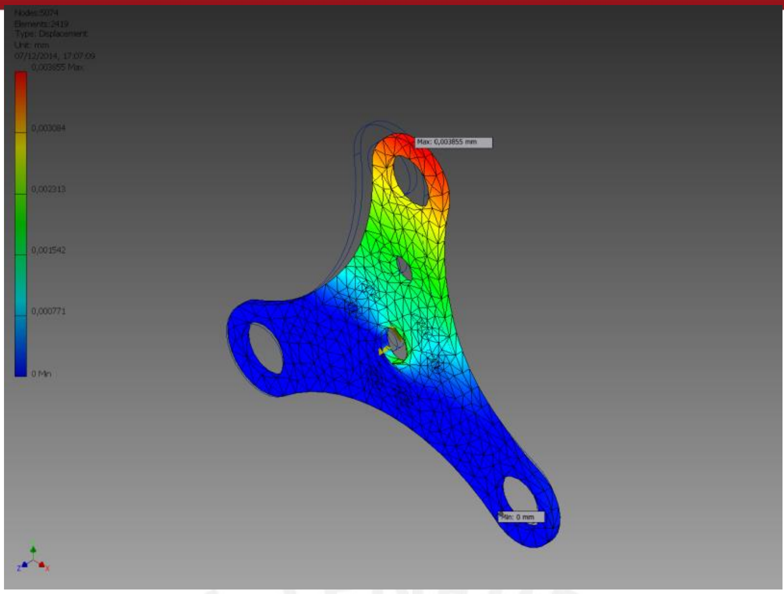


Figura A.8.4.3 Evaluación de esfuerzos por von Mises

Como se observa, para esta pieza se cuenta con un FS = 9 y una deformación máxima de 0,003855 mm.

Ahora, se simulará el sistema cuando una persona de 100 kg usa el dispositivo. En la figura A.8.4.4 y A.8.4.5 se detalla el momento y la fuerza respectiva que se aplicarán sobre el soporte.

Load Type	Moment
Magnitude	16971,000 N mm
Vector X	0,000 N mm
Vector Y	0,000 N mm
Vector Z	-16971,000 N mm

Figura A.8.4.4 Evaluación de esfuerzos por von Mises

Load Type	Bearing Load
Magnitude	281,298 N
Vector X	74,729 N
Vector Y	-271,191 N
Vector Z	0,000 N

Figura A.8.4.5 Evaluación de esfuerzos por von Mises

Finalmente, como se visualiza en la figura A.8.4.6, el esfuerzo máximo es de 28,1 MPa. Se concluye que el soporte del sistema de 5 mm de espesor no fallará al momento de ser sometido a los esfuerzos que actúen en este.

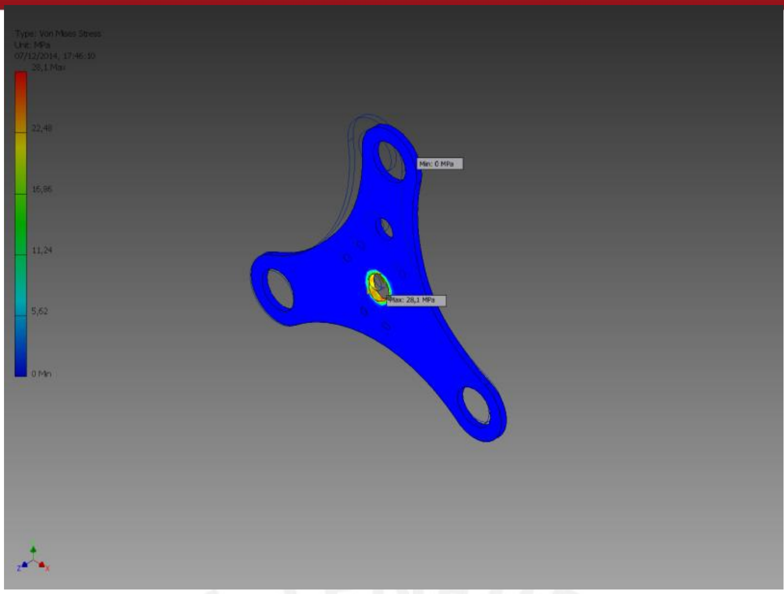
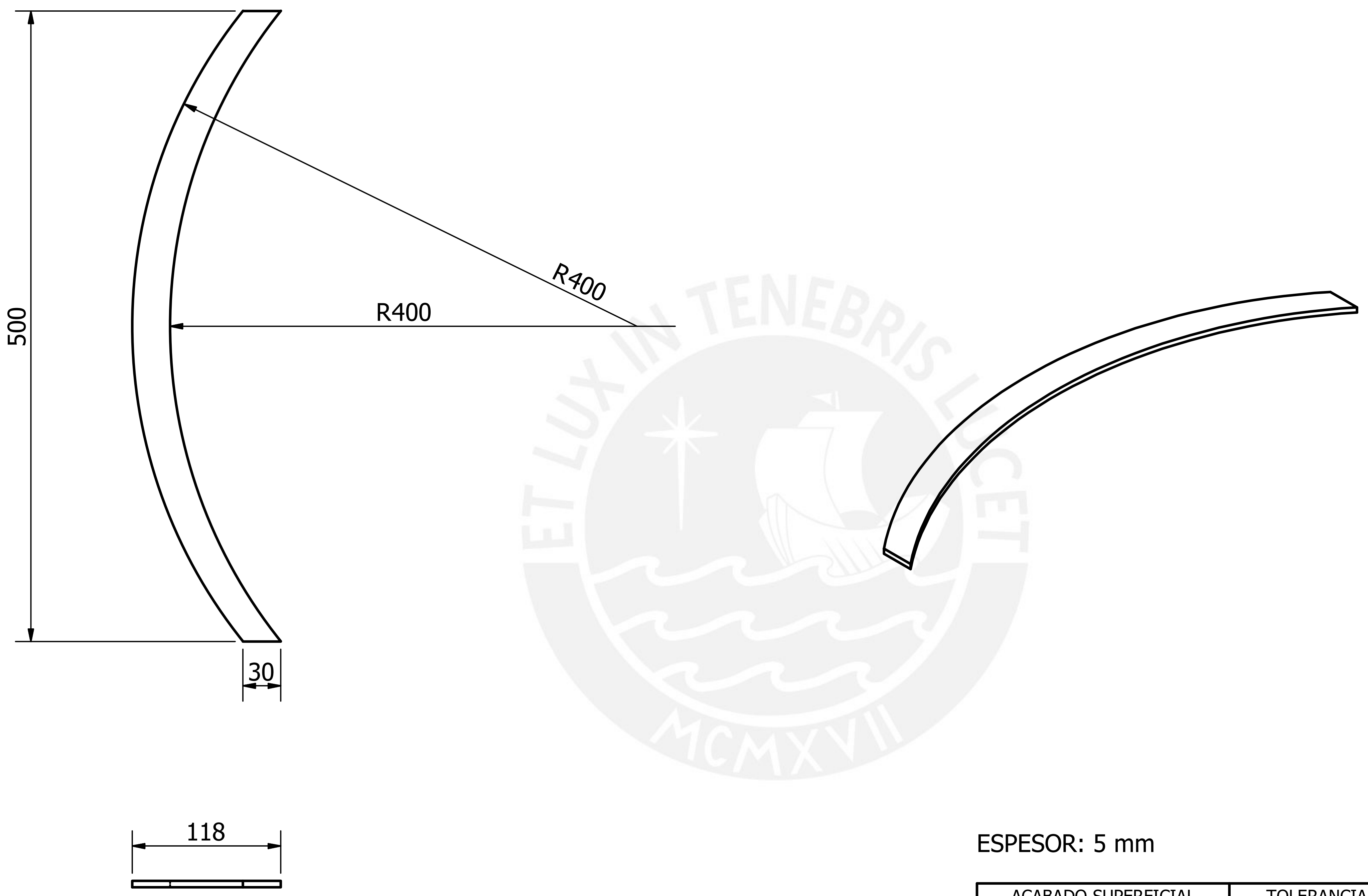


Figura A.8.4.6 Evaluación de esfuerzos por von Mises



ESPESOR: 5 mm

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	MEDIA SEGÚN DIN 7168	ALUMINIO 6061

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METODO DE PROYECCION	TRABAJO DE FIN DE CARRERA 2014-2 DESPIECE ARCO A0	ESCALA 1:4
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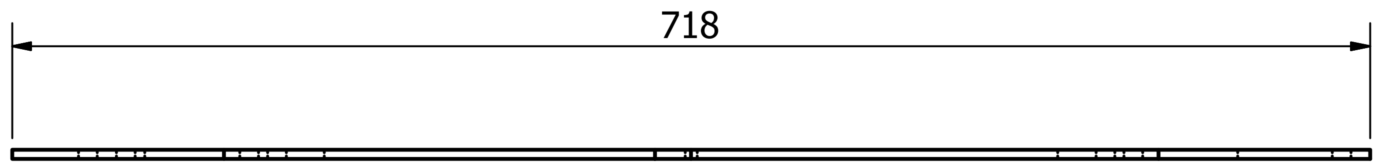
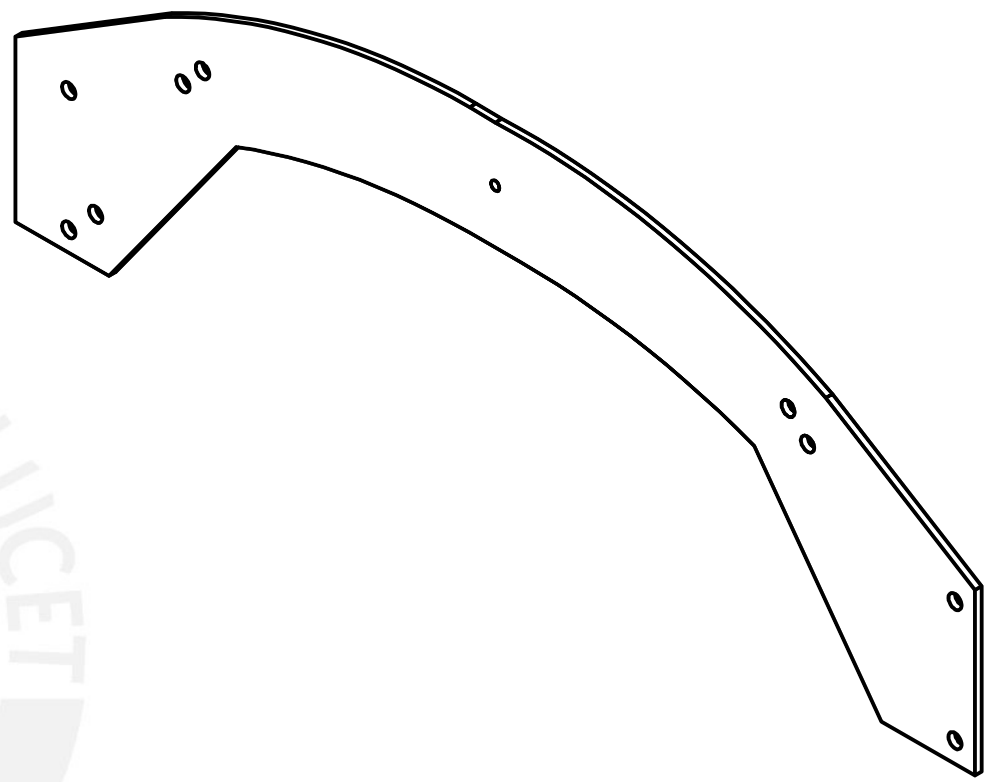
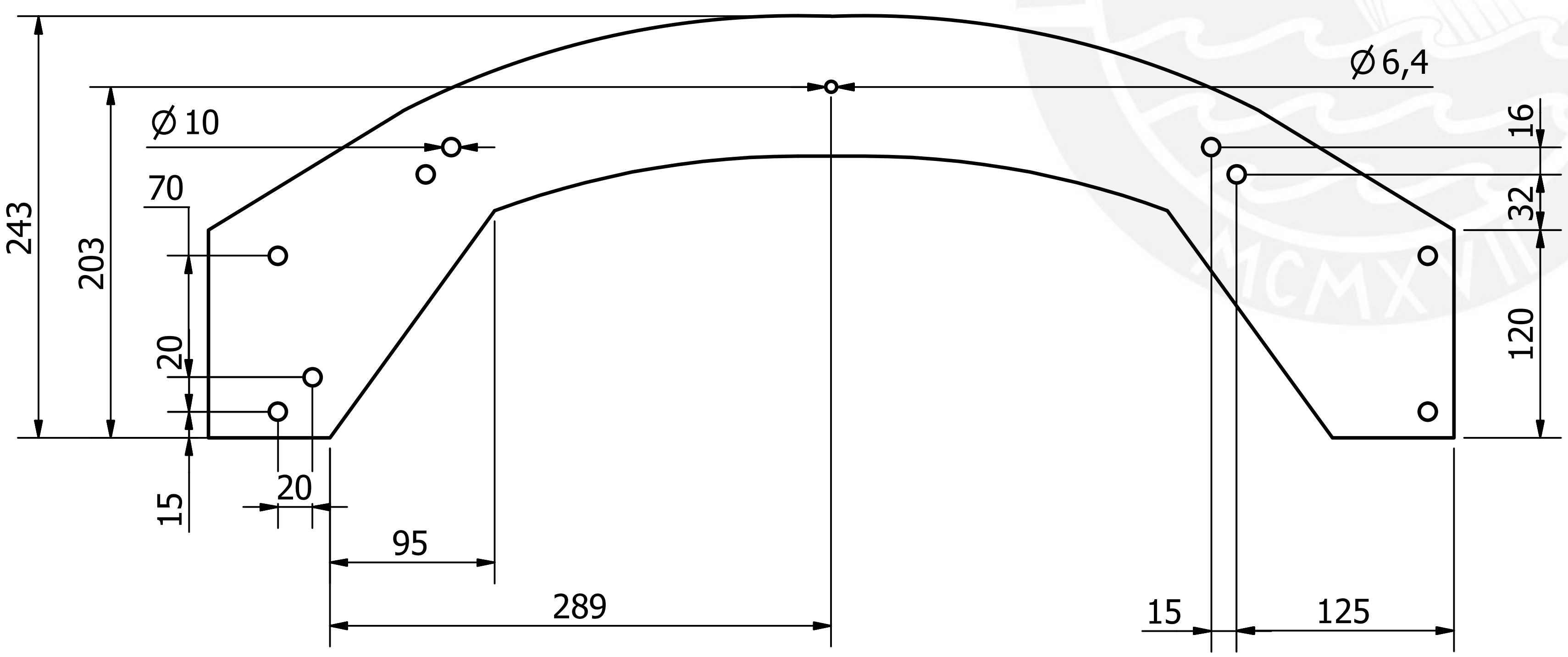
		LAMINA: A4

TOLERANCIAS DIMENSIONALES SEGUN DIN 7168					
GRADO DE EXACTITUD	Más de 0,5 hasta 3	Más de 3 hasta 6	Más de 6 hasta 30	Más de 30 hasta 120	Más de 120 hasta 400
MEDIO	±0,1	±0,1	±0,2	±0,3	±0,5

COTA NOMINAL	COTA MAXIMA	COTA MINIMA







ESPESOR: 3 mm

ACABADO SUPERFICIAL	TOLERANCIA GENERAL	MATERIAL
	MEDIA SEGÚN DIN 7168	ALUMINIO 6061

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METODO DE PROYECCION

TRABAJO DE FIN DE CARRERA

2014-2

DESPIECE

SOPORTE C0

ESCALA 1:4

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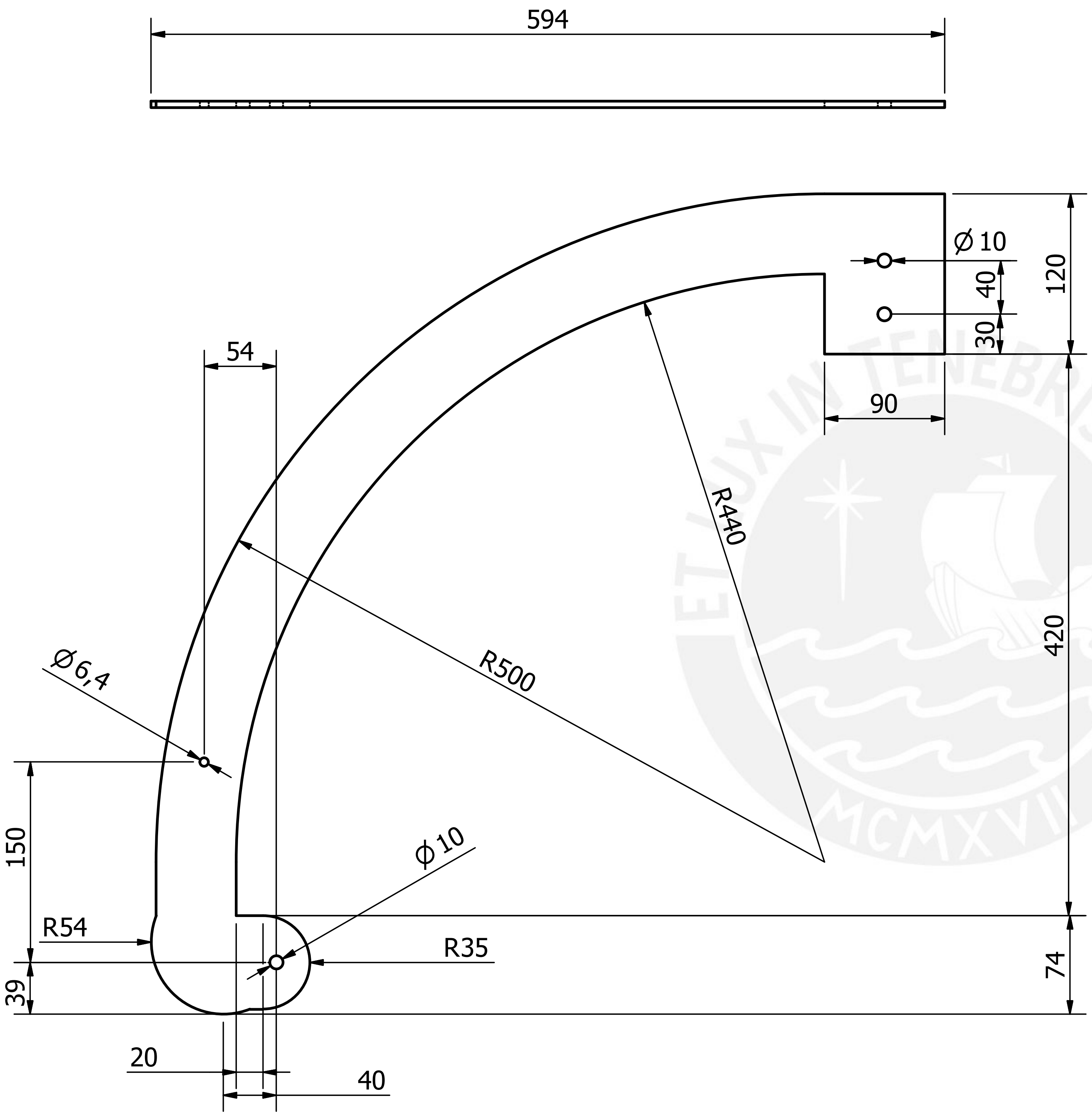
LAMINA: A4

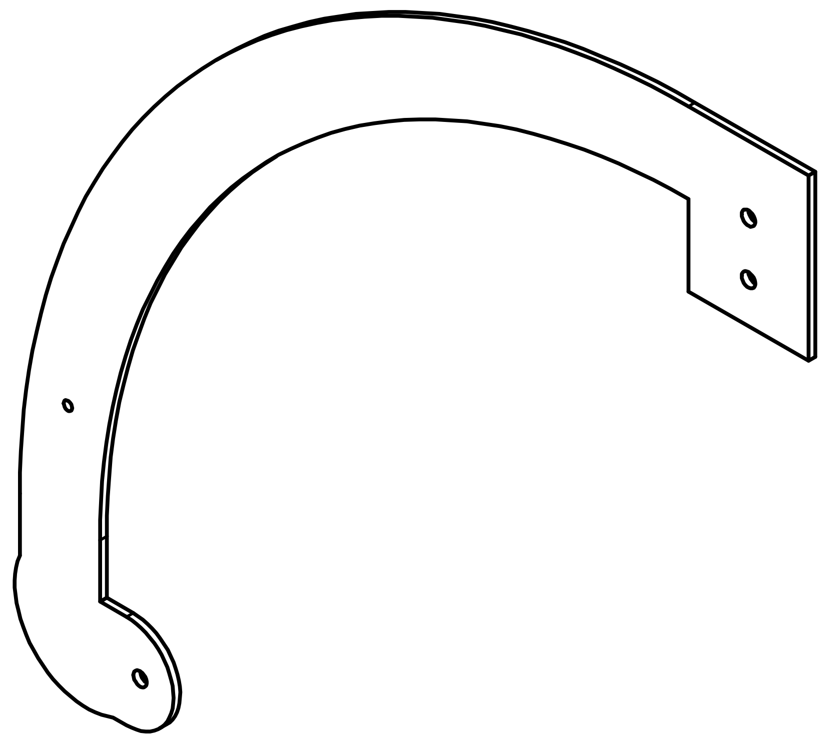
TOLERANCIAS DIMENSIONALES

SEGUN DIN 7168

GRADO DE EXACTITUD	Más de 0,5 hasta 3	Más de 3 hasta 6	Más de 6 hasta 30	Más de 30 hasta 120	Más de 120 hasta 400
MEDIO	±0,1	±0,1	±0,2	±0,3	±0,5

COTA NOMINAL	COTA MAXIMA	COTA MINIMA





ESPESOR: 3 mm

ACABADO SUPERFICIAL	TOLERANCIA GENERAL	MATERIAL
	MEDIA SEGÚN DIN 7168	ALUMINIO 6061

PONTIFICIA UNIVERSIDAD CATOLICA DEL PERU
FACULTAD DE CIENCIAS E INGENIERÍA - SECCIÓN DE ING. MECATRÓNICA

METODO DE PROYECCION	TRABAJO DE FIN DE CARRERA 2014-2 DESPIECE SOPORTE B0	ESCALA 1:4
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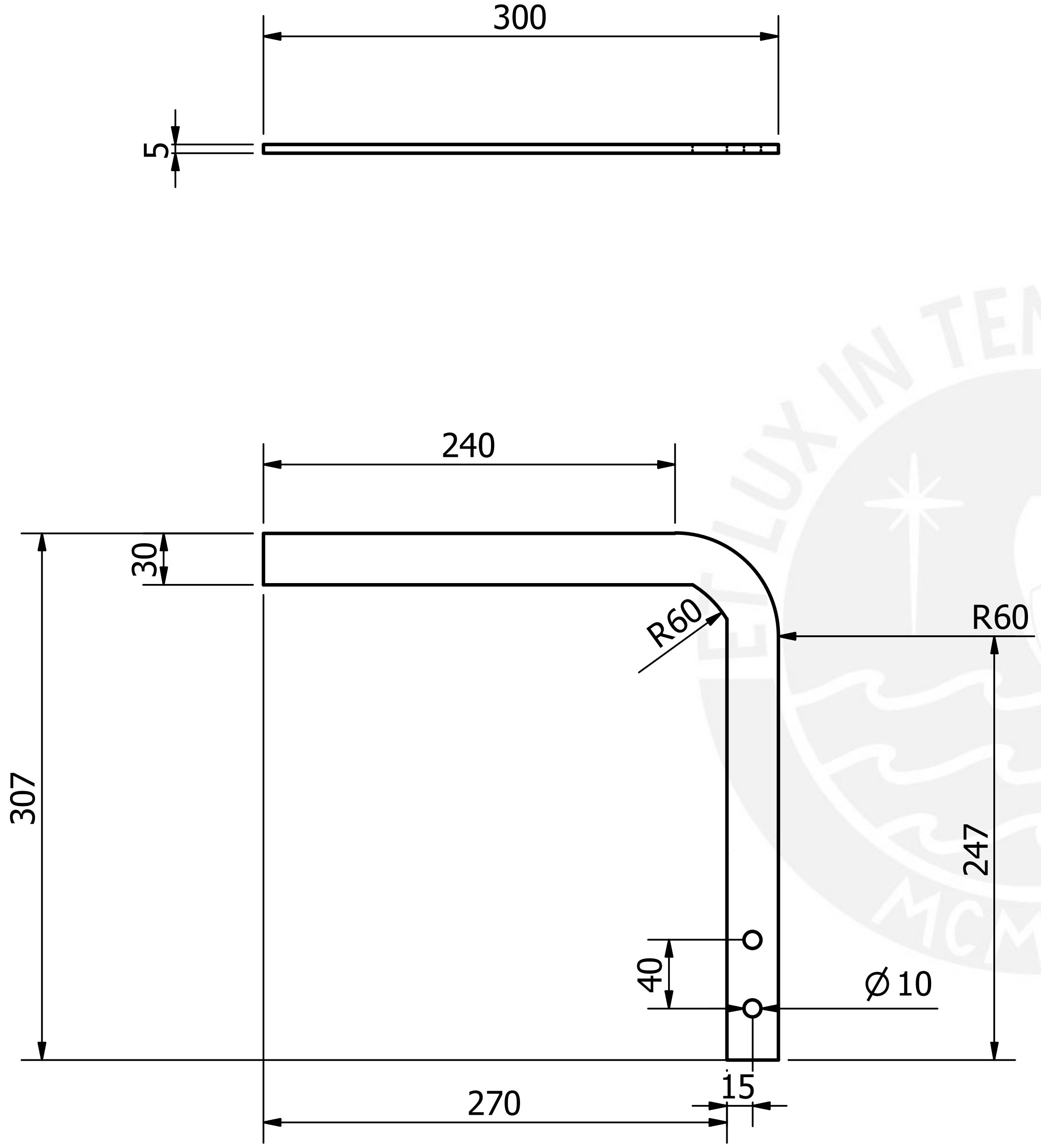
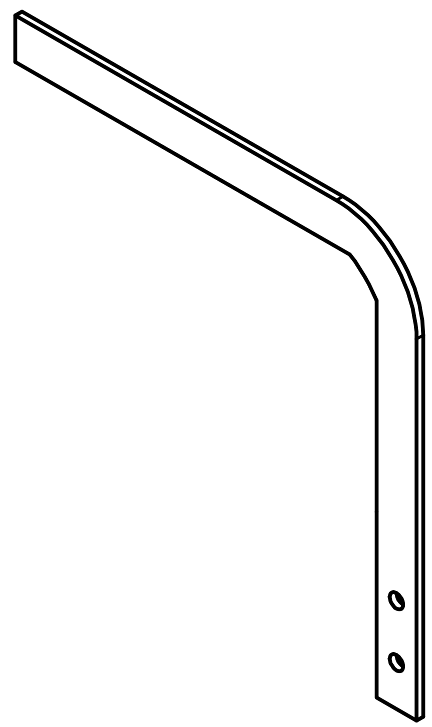
		LAMINA: A4

TOLERANCIAS DIMENSIONALES
SEGUN DIN 7168

GRADO DE EXACTITUD	Más de 0,5 hasta 3	Más de 3 hasta 6	Más de 6 hasta 30	Más de 30 hasta 120	Más de 120 hasta 400
MEDIO	±0,1	±0,1	±0,2	±0,3	±0,5

COTA NOMINAL	COTA MAXIMA	COTA MINIMA





ESPESOR: 3 mm

ACABADO SUPERFICIAL	TOLERANCIA GENERAL	MATERIAL
	MEDIA SEGÚN DIN 7168	ALUMINIO 6061

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METODO DE PROYECCION	TRABAJO DE FIN DE CARRERA 2014-2 DESPIECE SOPORTE A0	ESCALA 1:4
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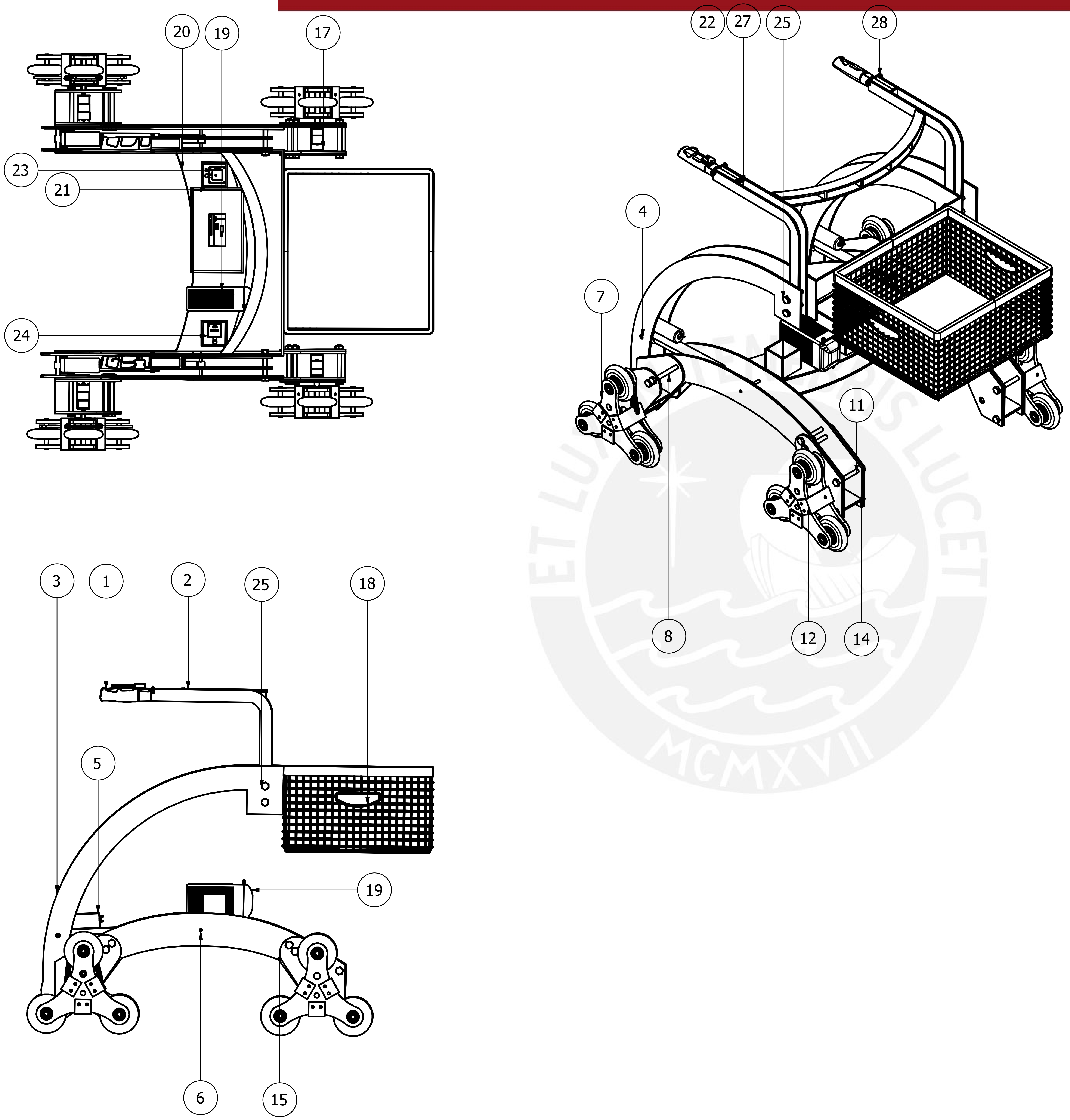
		LAMINA: A4

TOLERANCIAS DIMENSIONALES

SEGUN DIN 7168

GRADO DE EXACTITUD	Más de 0,5 hasta 3	Más de 3 hasta 6	Más de 6 hasta 30	Más de 30 hasta 120	Más de 120 hasta 400
MEDIO	±0,1	±0,1	±0,2	±0,3	±0,5

COTA NOMINAL	COTA MAXIMA	COTA MINIMA



28	4	pulsador		Generic	
27	1	switch			
26	4	DIN 988 - S10 x 16	DIN 988	Steel, Mild	
25	4	DIN 933 - M10 x 70	DIN 933	Steel, Mild	
24	1	GPS_tesis			
23	1	GSM_tesis			
22	1	pulse sensor		Generic	
21	1	electrónica_module			
20	1	soporte_final_electro			
19	1	battery_2			
18	1	canasta		Aluminum 6061	
17	1	unión_planchas_motor_2		Brass, Soft Yellow, Welded	
16	1	unión_planchas_motor		Brass, Soft Yellow, Welded	
15	1	SOPORTE MOTOR			
14	2	BASE MOTOR		Brass, Soft Yellow, Welded	
13	2	RUEDAS			
12	2	UNIÓN TRI-STAR			
11	8	DIN 933 - M10 x 90	DIN 933	Steel, Mild	
10	12	EJE RUEDA		Generic	
9	17	DIN 934 - M10	DIN 934	Steel, Mild	
8	6	DIN 933 - M10 x 95	DIN 933	Steel, Mild	
7	1	SOPORTE TRI-STAR			
6	1	EJE ACTUADOR 2		Generic	
5	2	ACTUADOR			
4	1	EJE ACTUADOR 1		Generic	
3	4	SOPORTE B0		Generic	
2	4	SOPORTE A0			
1	2	MANGO		Generic	
POS.	CANT.	DESCRIPCION	NORMA	MATERIAL	OBSERVACIONES

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SISTEMA DE ASISTENCIA TÉCNICA

ESCALA

1:2

20101384

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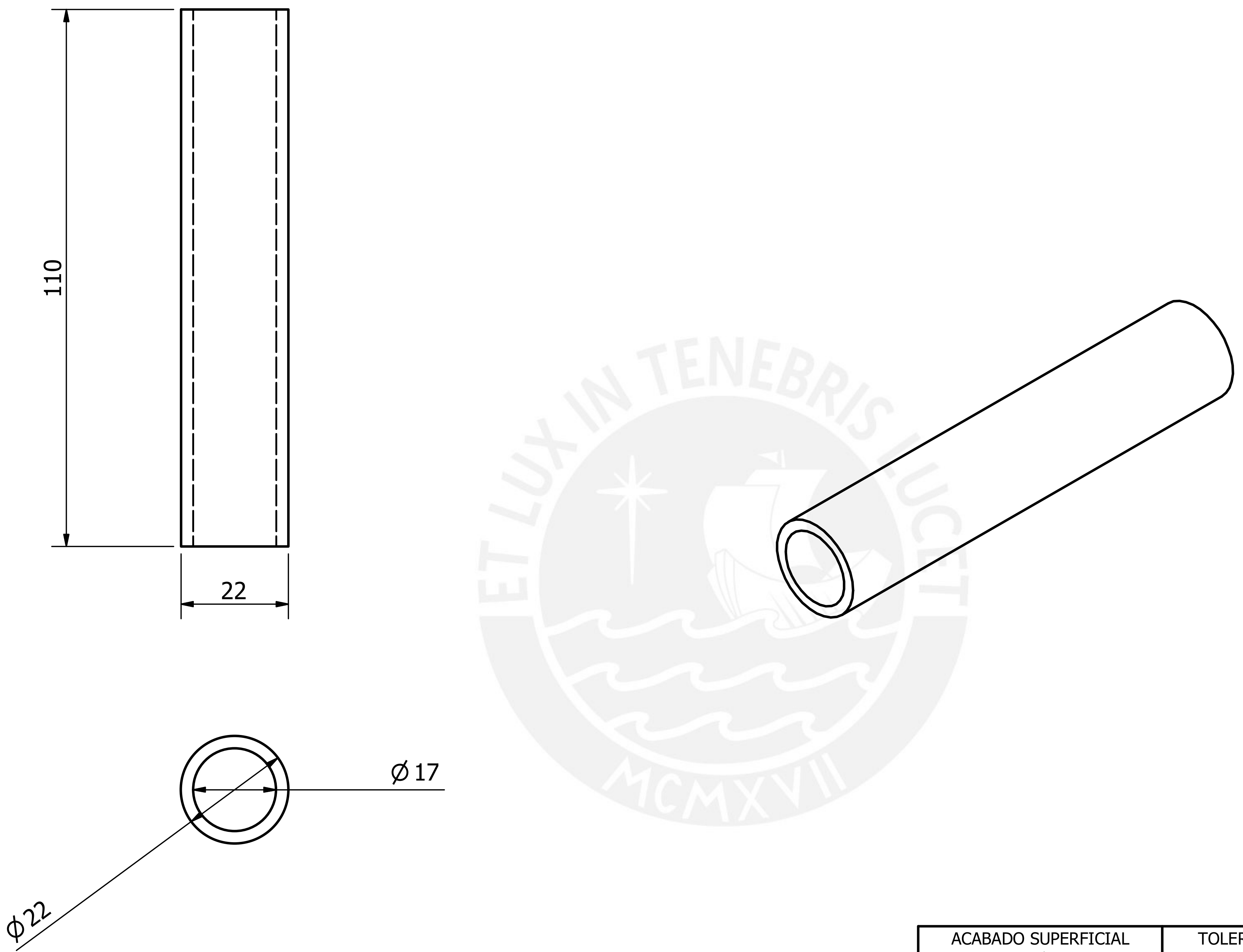
LAMINA: A2



ACABADO SUPERFICIAL	TOLERANCIA GENERAL	MATERIAL
	MEDIA SEGÚN DIN 7168	ALUMINIO 6061

PONTIFICIA UNIVERSIDAD CATOLICA DEL PERU

FACULTAD DE CIENCIAS E INGENIERÍA - SECCIÓN DE ING. MECATRÓNICA

METODO DE PROYECCION

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2014-2

DESPIECE

PASADOR MANGO

ESCALA 1:1

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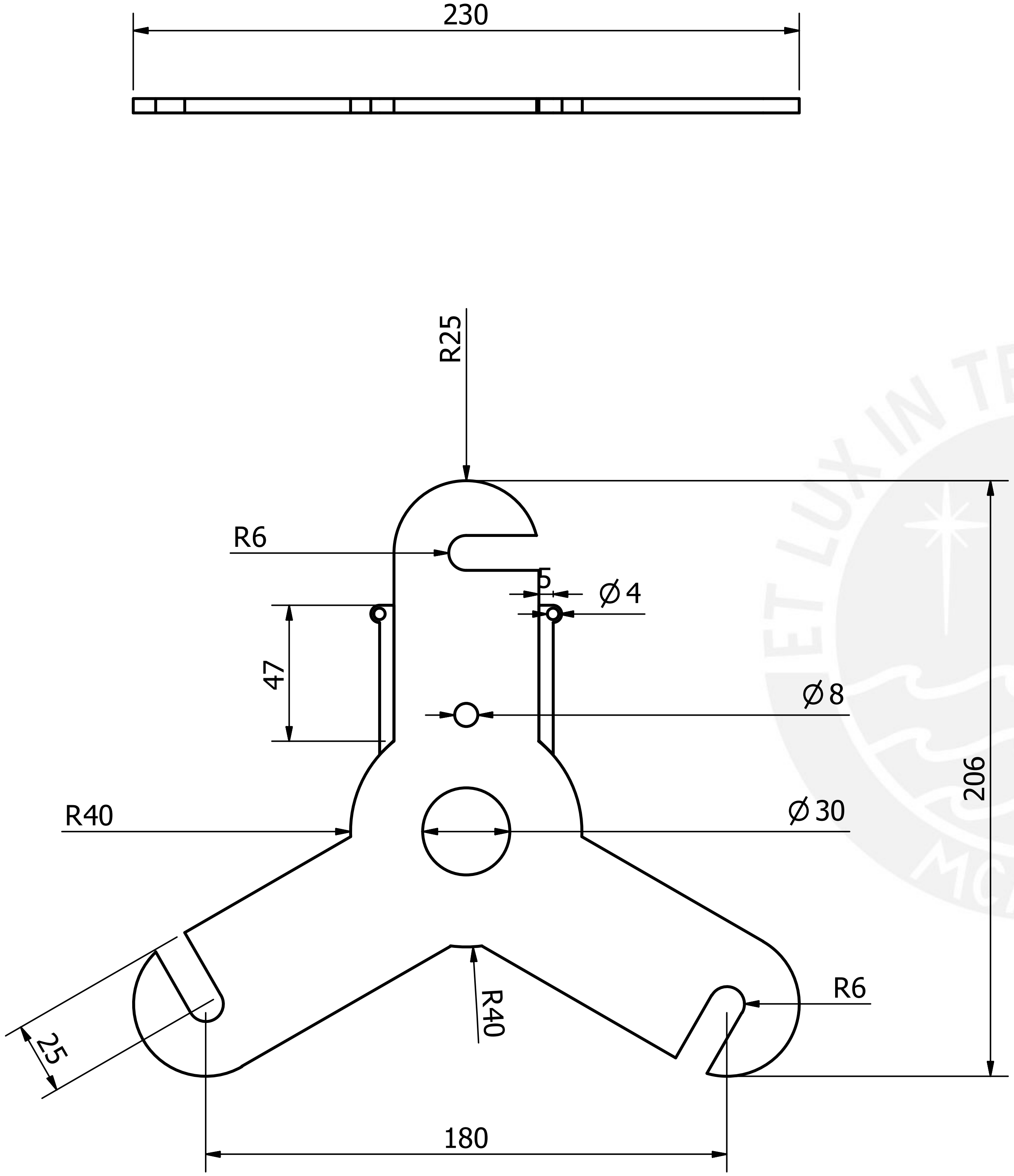
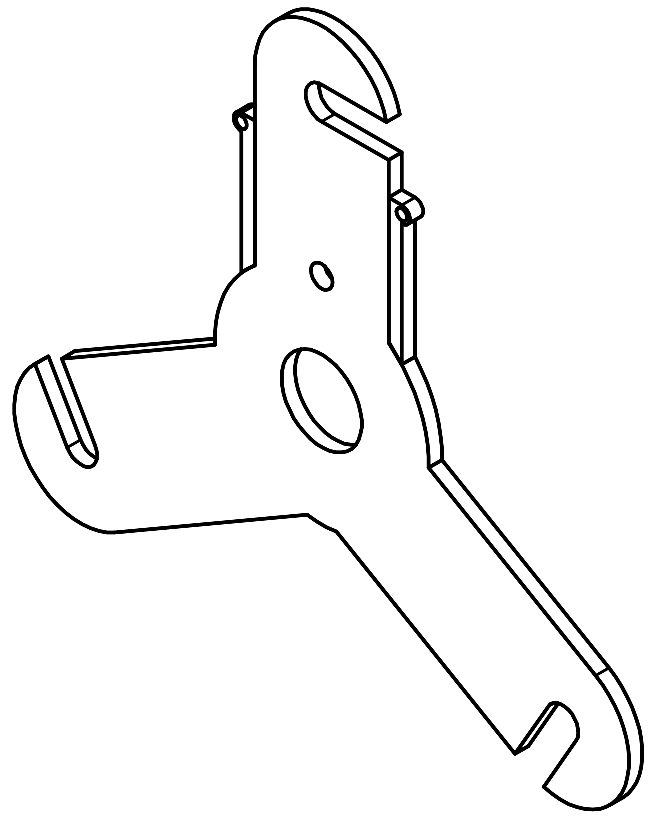
TOLERANCIAS DIMENSIONALES

SEGUN DIN 7168

GRADO DE EXACTITUD	Más de 0,5 hasta 3	Más de 3 hasta 6	Más de 6 hasta 30	Más de 30 hasta 120	Más de 120 hasta 400
MEDIO	±0,1	±0,1	±0,2	±0,3	±0,5

COTA NOMINAL	COTA MAXIMA	COTA MINIMA





ESPESOR: 3 mm

ACABADO SUPERFICIAL	TOLERANCIA GENERAL	MATERIAL
	MEDIA SEGÚN DIN 7168	ALUMINIO 6061

PONTIFICIA UNIVERSIDAD CATOLICA DEL PERU

FACULTAD DE CIENCIAS E INGENIERÍA - SECCIÓN DE ING. MECATRÓNICA

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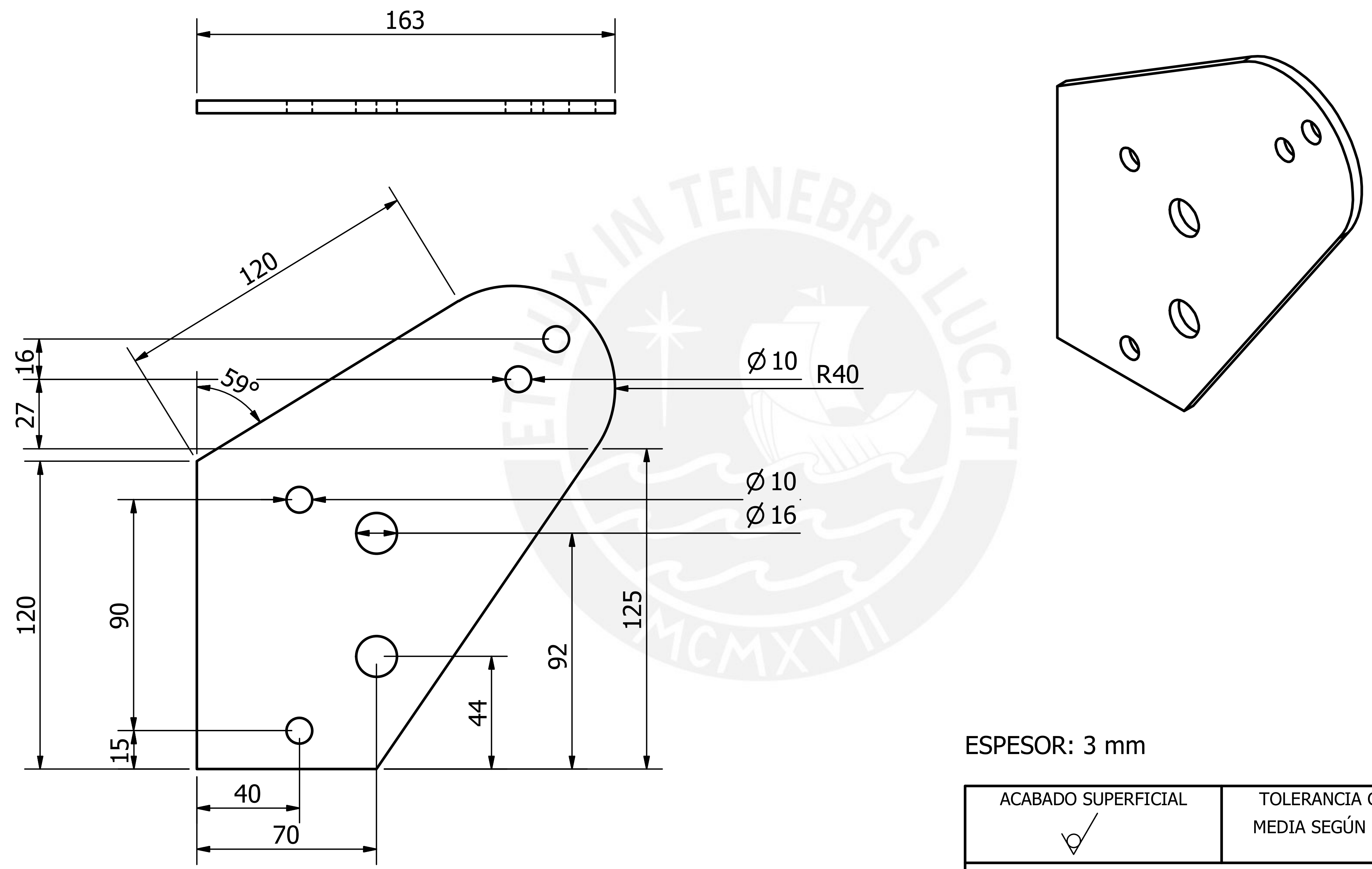
		LAMINA: A4

TOLERANCIAS DIMENSIONALES

SEGUN DIN 7168

GRADO DE EXACTITUD	Más de 0,5 hasta 3	Más de 3 hasta 6	Más de 6 hasta 30	Más de 30 hasta 120	Más de 120 hasta 400
MEDIO	±0,1	±0,1	±0,2	±0,3	±0,5

COTA NOMINAL	COTA MAXIMA	COTA MINIMA



ESPESOR: 3 mm

ACABADO SUPERFICIAL	TOLERANCIA GENERAL MEDIA SEGÚN DIN 7168	MATERIAL ALUMINIO 6061

PONTIFICIA UNIVERSIDAD CATOLICA DEL PERU
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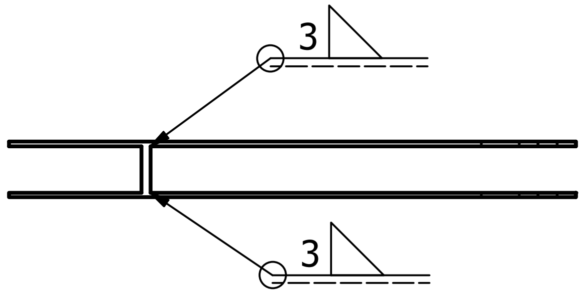
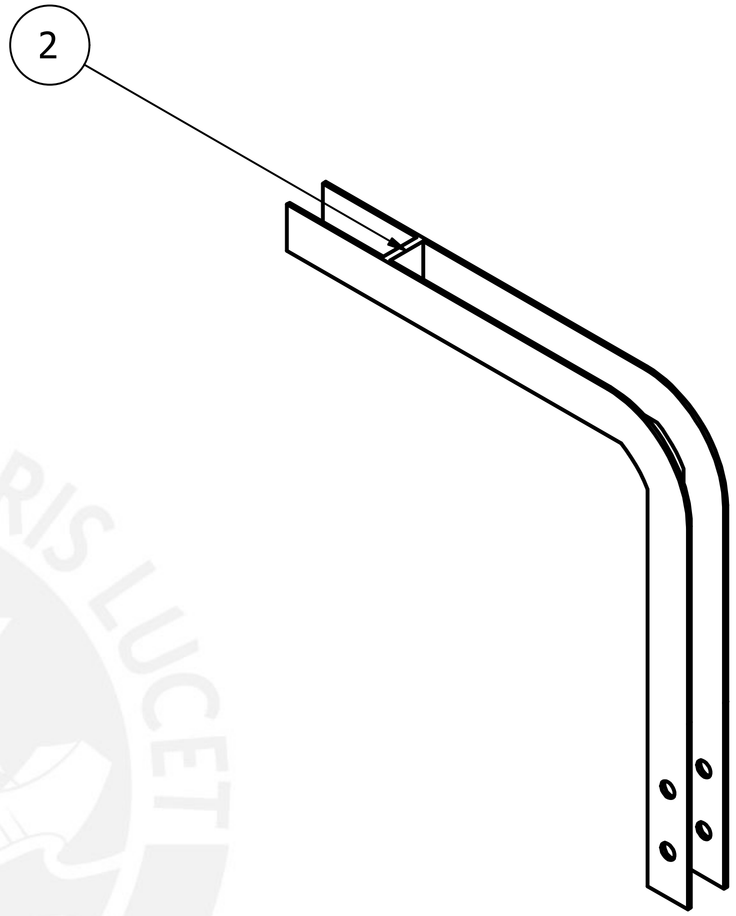
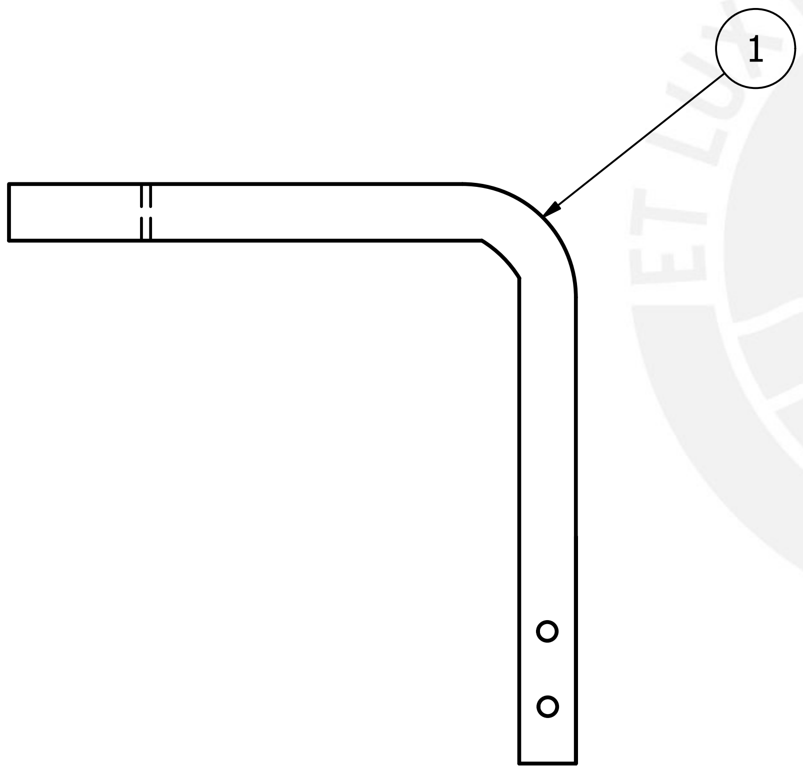
METODO DE PROYECCION	TRABAJO DE FIN DE CARRERA 2014-2 DESPIECE SOPORTE D0	ESCALA 1:2
20101384	PALACIOS LAVADO, JUAN JOSÉ JUNIOR	FECHA: 10/10/2014
		LAMINA: A4

TOLERANCIAS DIMENSIONALES SEGUN DIN 7168					
GRADO DE EXACTITUD	Más de 0,5 hasta 3	Más de 3 hasta 6	Más de 6 hasta 30	Más de 30 hasta 120	Más de 120 hasta 400
MEDIO	±0,1	±0,1	±0,2	±0,3	±0,5

COTA NOMINAL	COTA MAXIMA	COTA MINIMA



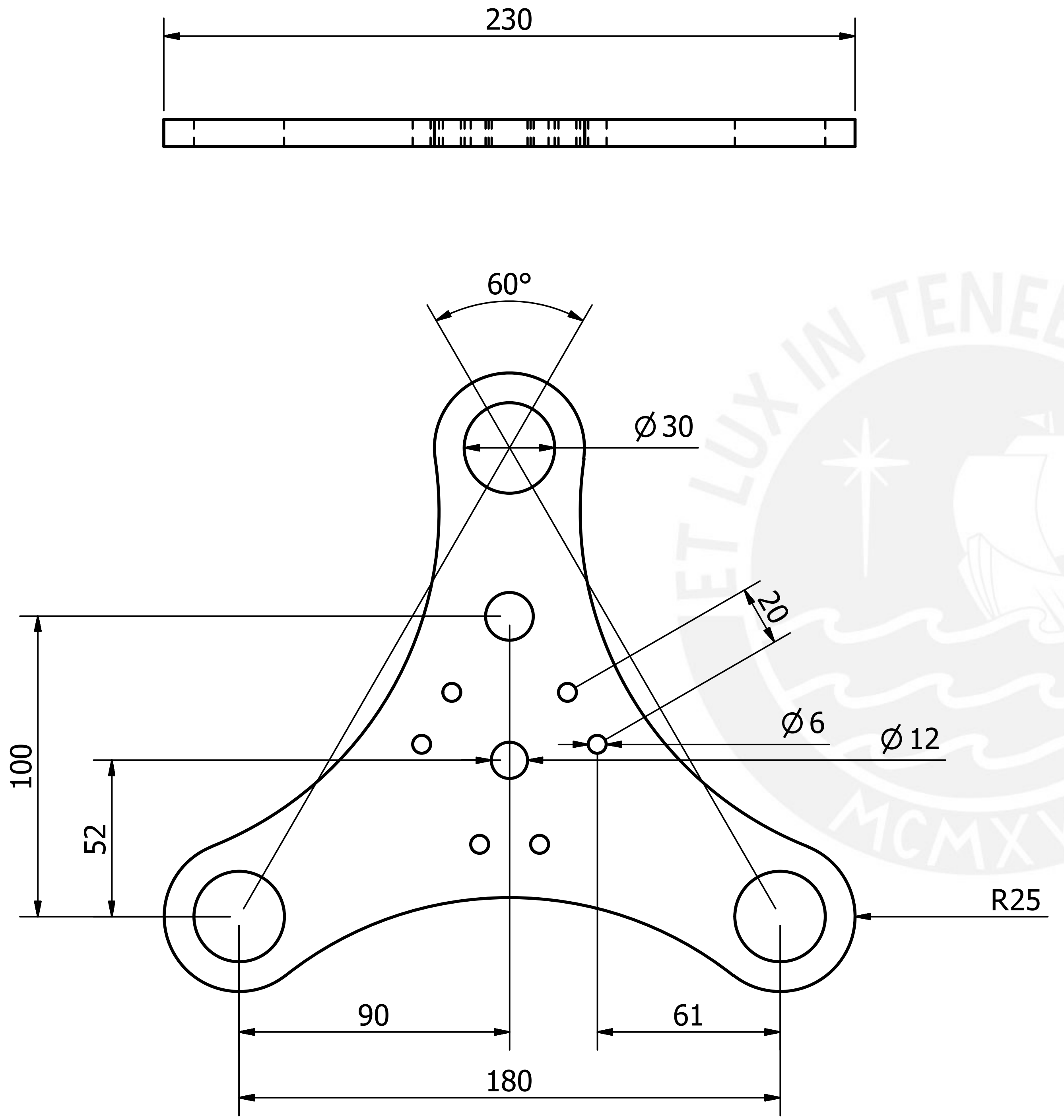


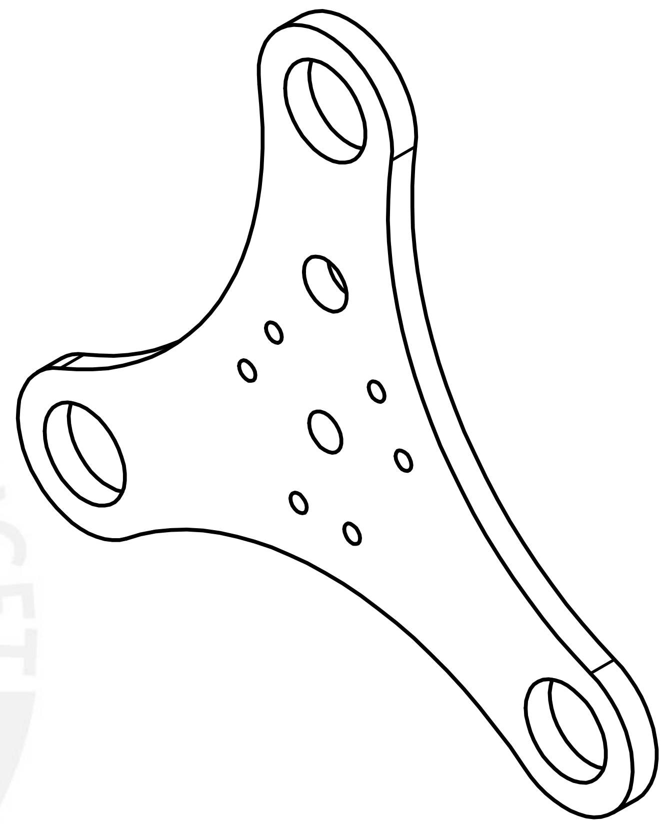


2	1	UNIÓN SOPORTE A0		Aluminum 6061	
1	1	SOPORTE A0		Aluminum 6061	
POS.	CANT.	DESCRIPCION	NORMA	MATERIAL	OBSERVACIONES

PONTIFICIA UNIVERSIDAD CATOLICA DEL PERU
FACULTAD DE CIENCIAS E INGENIRÍA - SECCIÓN DE ING. MECATRÓNICA

METODO DE PROYECCION	TRABAJO DE FIN DE CARRERA 2014-2 ENSAMBLE SOPORTE SUPERIOR	ESCALA 1:4
20101384	PALACIOS LAVADO, JUAN JOSÉ JUNIOR	FECHA: 15/10/2014
		LAMINA: A3





ESPESOR: 5 mm

ACABADO SUPERFICIAL	TOLERANCIA GENERAL	MATERIAL
	MEDIA SEGÚN DIN 7168	ALUMINIO 6061

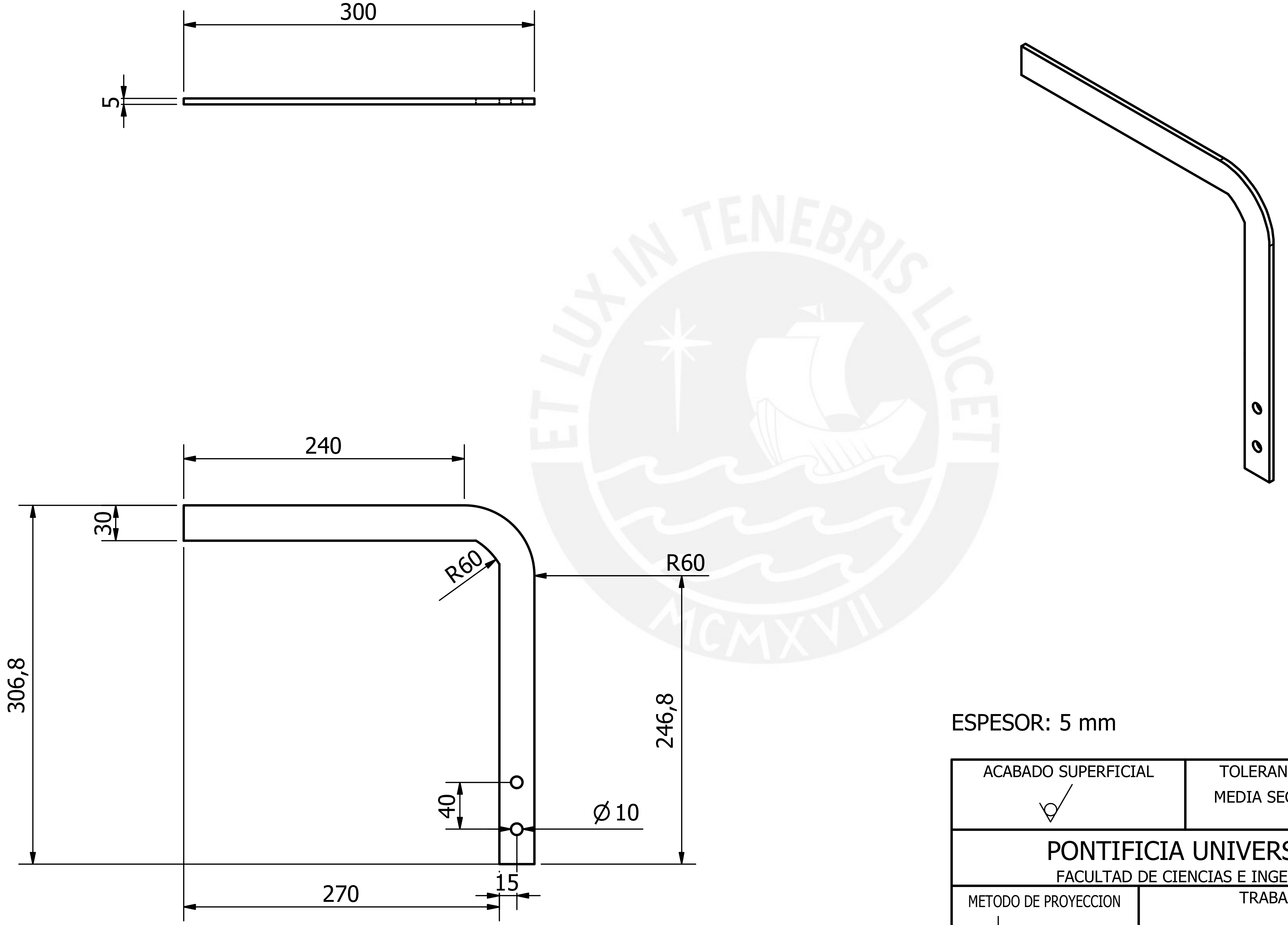
PONTIFICIA UNIVERSIDAD CATOLICA DEL PERU

FACULTAD DE CIENCIAS E INGENIERÍA - SECCIÓN DE ING. MECATRÓNICA

METODO DE PROYECCION	TRABAJO DE FIN DE CARRERA 2014-2 DESPIECE SOPORTE TRISTAR	ESCALA 1:2
20101384	PALACIOS LAVADO, JUAN JOSÉ JUNIOR	FECHA: 10/10/2014
		LAMINA: A4

TOLERANCIAS DIMENSIONALES SEGUN DIN 7168					
GRADO DE EXACTITUD	Más de 0,5 hasta 3	Más de 3 hasta 6	Más de 6 hasta 30	Más de 30 hasta 120	Más de 120 hasta 400
MEDIO	±0,1	±0,1	±0,2	±0,3	±0,5

COTA NOMINAL	COTA MAXIMA	COTA MINIMA



ESPESOR: 5 mm

ACABADO SUPERFICIAL	TOLERANCIA GENERAL	MATERIAL
	MEDIA SEGÚN DIN 7168	ALUMINIO 6061

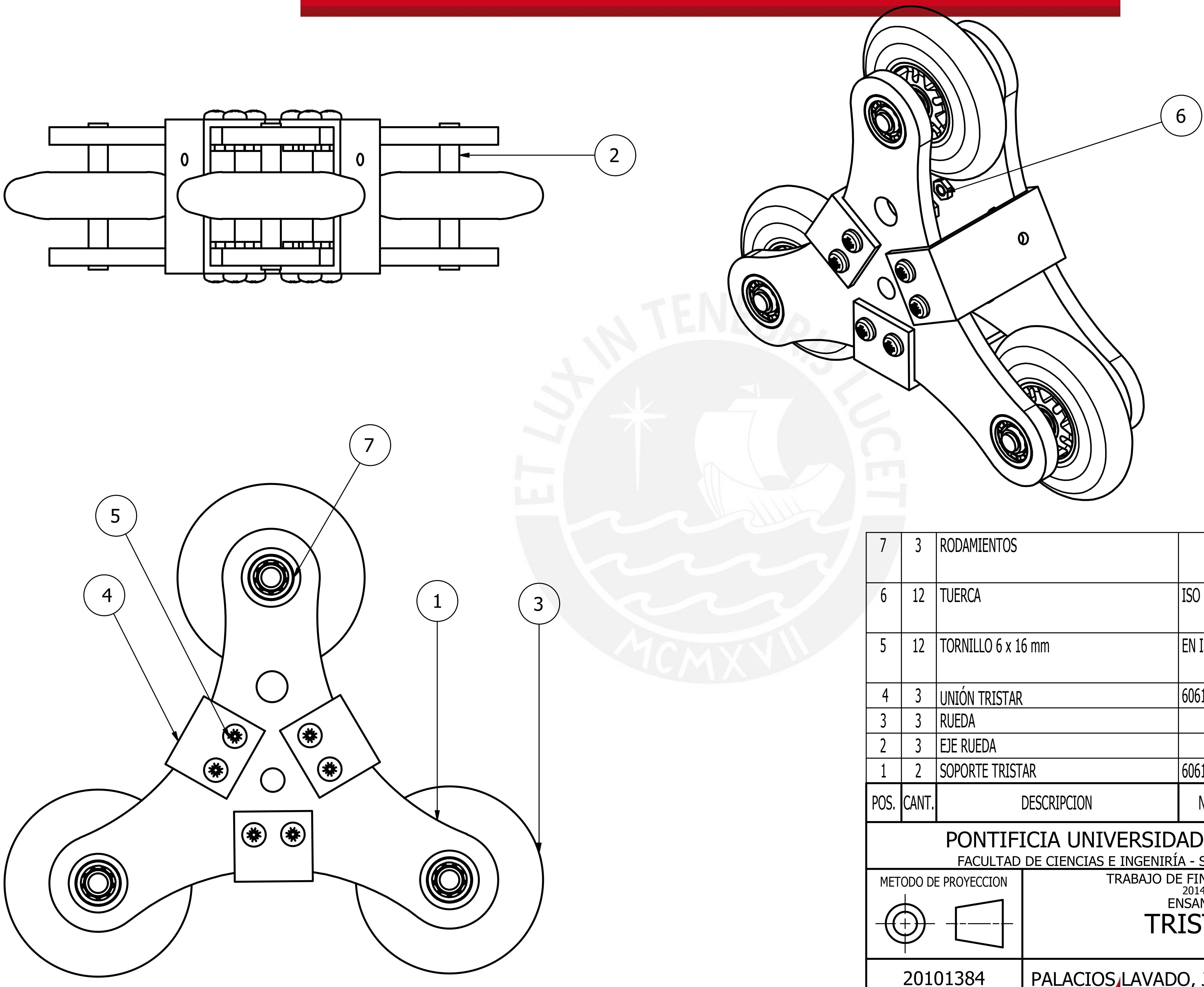
PONTIFICIA UNIVERSIDAD CATOLICA DEL PERU

FACULTAD DE CIENCIAS E INGENIERÍA - SECCIÓN DE ING. MECATRÓNICA

METODO DE PROYECCION	TRABAJO DE FIN DE CARRERA 2014-2 DESPIECE **SOPORTE A0**	ESCALA 1:4
20101384	PALACIOS LAVADO, JUAN JOSÉ JUNIOR	FECHA: 10/10/2014
		LAMINA: A4

TOLERANCIAS DIMENSIONALES SEGUN DIN 7168					
GRADO DE EXACTITUD	Más de 0,5 hasta 3	Más de 3 hasta 6	Más de 6 hasta 30	Más de 30 hasta 120	Más de 120 hasta 400
MEDIO	±0,1	±0,1	±0,2	±0,3	±0,5

COTA NOMINAL	COTA MAXIMA	COTA MINIMA



POS.	CANT.	DESCRIPCION	NORMA	MATERIAL	OBSERVACIONES
7	3	RODAMIENTOS		ACERO INÓXIDABLE	
6	12	TUERCA	ISO 4036	ACERO INÓXIDABLE	
5	12	TORNILLO 6 x 16 mm	EN ISO 7045	ACERO INÓXIDABLE	
4	3	UNIÓN TRISTAR	6061	ALUMINIO	
3	3	RUEDA		CAUCHO	
2	3	EJE RUEDA		ACERO	
1	2	SOPORTE TRISTAR	6061	ALUMINIO	

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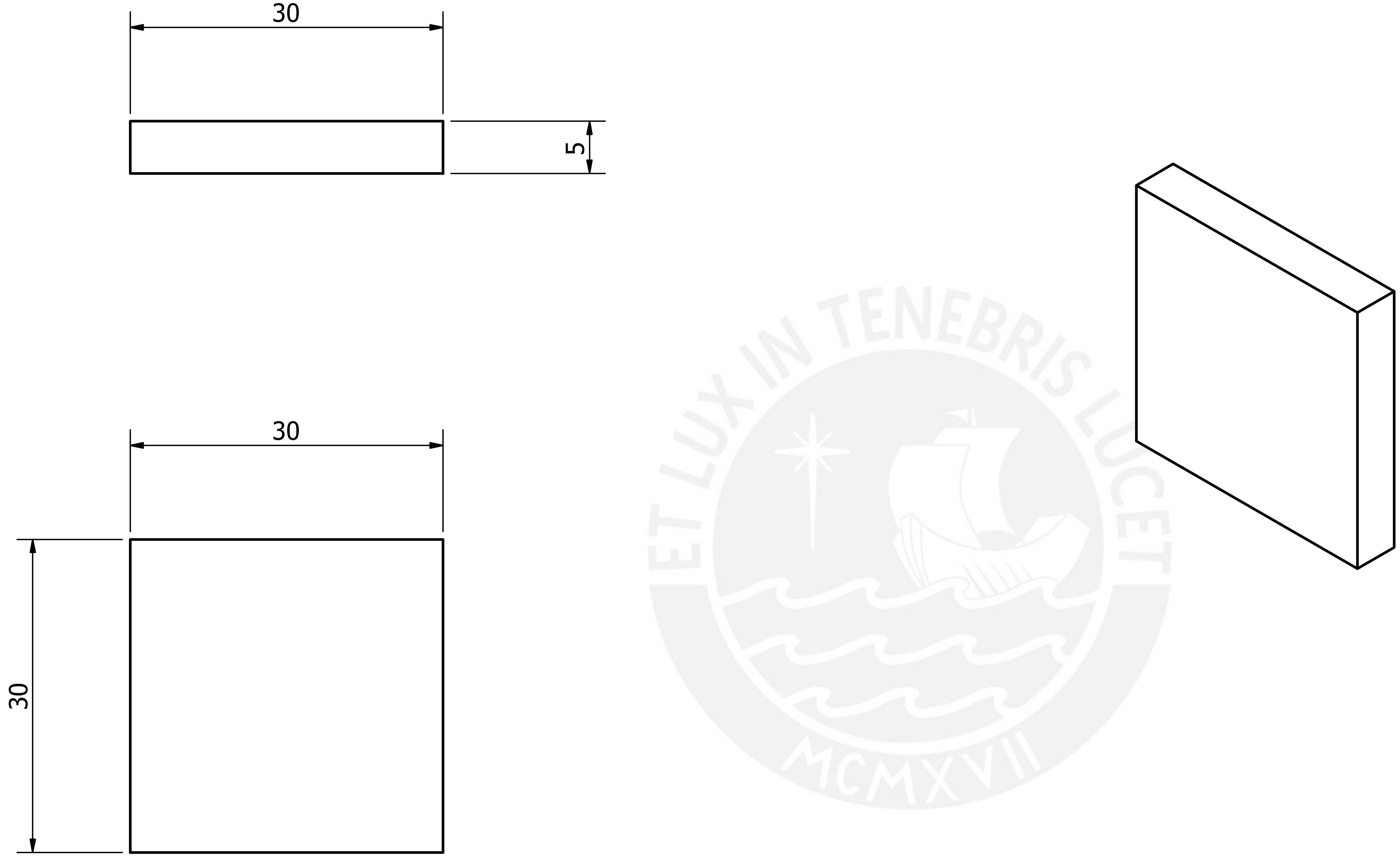
FACULTAD DE CIENCIAS E INGENIRÍA - SECCIÓN DE ING. MECATRÓNICA

METODO DE PROYECCION	TRABAJO DE FIN DE CARRERA 2014-2 ENSAMBLE **TRISTAR**	ESCALA 1:2
20101384	PALACIOS LAVADO, JUAN JOSÉ JUNIOR	FECHA: 15/10/2014
		LAMINA: A3



ESPESOR: 5 mm

ACABADO SUPERFICIAL	TOLERANCIA GENERAL MEDIA SEGÚN DIN 7168	MATERIAL ALUMINIO 6061

PONTIFICIA UNIVERSIDAD CATOLICA DEL PERU

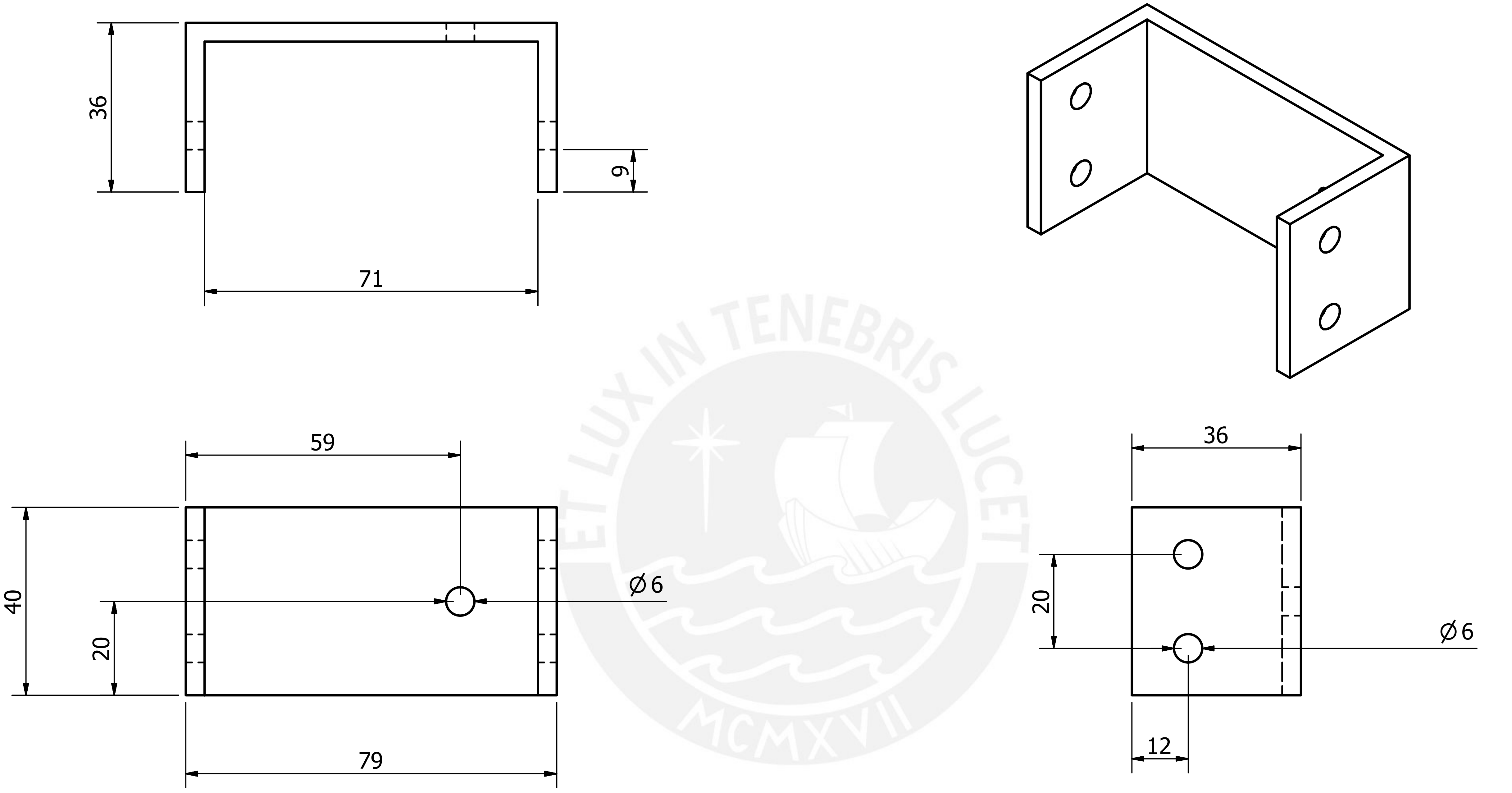
FACULTAD DE CIENCIAS E INGENIERÍA - SECCIÓN DE ING. MECATRÓNICA

METODO DE PROYECCION	TRABAJO DE FIN DE CARRERA 2014-2 DESPIECE UNIÓN ARCO A0	ESCALA 2:1
20101384	PALACIOS LAVADO, JUAN JOSÉ JUNIOR	FECHA: 10/10/2014
		LAMINA: A4

TOLERANCIAS DIMENSIONALES SEGUN DIN 7168

GRADO DE EXACTITUD	Más de 0,5 hasta 3	Más de 3 hasta 6	Más de 6 hasta 30	Más de 30 hasta 120	Más de 120 hasta 400
MEDIO	±0,1	±0,1	±0,2	±0,3	±0,5

COTA NOMINAL	COTA MAXIMA	COTA MINIMA



ESPESOR: 2 mm

ACABADO SUPERFICIAL	TOLERANCIA GENERAL MEDIA SEGÚN DIN 7168	MATERIAL ALUMINIO 6061

PONTIFICIA UNIVERSIDAD CATOLICA DEL PERU
FACULTAD DE CIENCIAS E INGENIERÍA - SECCIÓN DE ING. MECATRÓNICA

METODO DE PROYECCION	TRABAJO DE FIN DE CARRERA 2014-2 DESPIECE **UNIÓN TRISTAR**	ESCALA 1:1
20101384	PALACIOS LAVADO, JUAN JOSÉ JUNIOR	FECHA: 10/10/2014
		LAMINA: A4

TOLERANCIAS DIMENSIONALES
SEGUN DIN 7168

GRADO DE EXACTITUD	Más de 0,5 hasta 3	Más de 3 hasta 6	Más de 6 hasta 30	Más de 30 hasta 120	Más de 120 hasta 400
MEDIO	±0,1	±0,1	±0,2	±0,3	±0,5

COTA NOMINAL	COTA MAXIMA	COTA MINIMA

ANALOG DEVICES

3-Axis, ±2 *g*/±4 *g*/±8 *g*/±16 *g* Digital Accelerometer

ADXL345

FEATURES

Ultralow power: as low as 40 µA in measurement mode and 0.1 µA in standby mode at V_S = 2.5 V (typical)
Power consumption scales automatically with bandwidth
User-selectable resolution
- **Fixed 10-bit resolution**
- **Full resolution, where resolution increases with *g* range, up to 13-bit resolution at ±16 *g* (maintaining 4 m*g*/LSB scale factor in all *g* ranges)**

Embedded, patent pending FIFO technology minimizes host processor load
Tap/double tap detection
Activity/inactivity monitoring
Free-fall detection
Supply voltage range: 2.0 V to 3.6 V
I/O voltage range: 1.7 V to V_S
SPI (3- and 4-wire) and I²C digital interfaces
Flexible interrupt modes mappable to either interrupt pin
Measurement ranges selectable via serial command
Bandwidth selectable via serial command
Wide temperature range (−40°C to +85°C)
10,000 *g* shock survival
Pb free/RoHS compliant
Small and thin: 3 mm × 5 mm × 1 mm LGA package

APPLICATIONS

Handsets
Medical instrumentation
Gaming and pointing devices
Industrial instrumentation
Personal navigation devices
Hard disk drive (HDD) protection
Fitness equipment

GENERAL DESCRIPTION

The ADXL345 is a small, thin, low power, 3-axis accelerometer with high resolution (13-bit) measurement at up to ±16 *g*. Digital output data is formatted as 16-bit twos complement and is accessible through either a SPI (3- or 4-wire) or I²C digital interface.

The ADXL345 is well suited for mobile device applications. It measures the static acceleration of gravity in tilt-sensing applications, as well as dynamic acceleration resulting from motion or shock. Its high resolution (4 m*g*/LSB) enables measurement of inclination changes less than 1.0°.

Several special sensing functions are provided. Activity and inactivity sensing detect the presence or lack of motion and if the acceleration on any axis exceeds a user-set level. Tap sensing detects single and double taps. Free-fall sensing detects if the device is falling. These functions can be mapped to one of two interrupt output pins. An integrated, patent pending 32-level first in, first out (FIFO) buffer can be used to store data to minimize host processor intervention.

Low power modes enable intelligent motion-based power management with threshold sensing and active acceleration measurement at extremely low power dissipation.

The ADXL345 is supplied in a small, thin, 3 mm × 5 mm × 1 mm, 14-lead, plastic package.

FUNCTIONAL BLOCK DIAGRAM

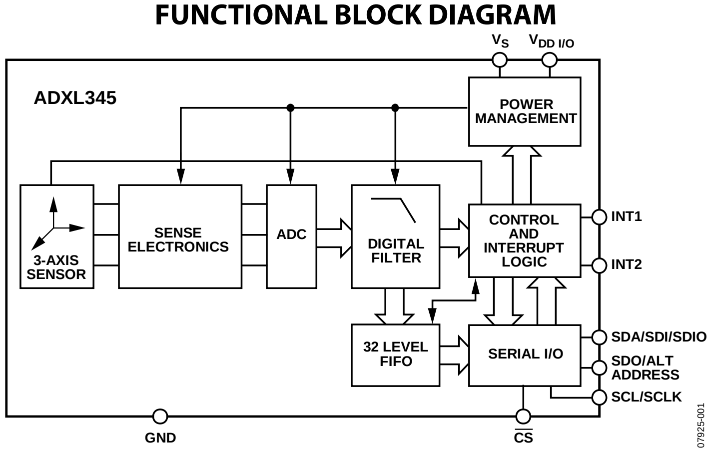


Figure 1.

One Technology Way, P.O. Box 9106, Norwood, MA 02062-9106, U.S.A.
Tel: 781.329.4700 www.analog.com
Fax: 781.461.3113

TABLE OF CONTENTS

REVISION HISTORY

5/09—Revision 0: Initial Version

SPECIFICATIONS

T_A = 25°C, V_S = 2.5 V, $V_{DD\ I/O}$ = 1.8 V, acceleration = 0 *g*, C_S = 1 µF tantalum, C_{IO} = 0.1 µF, unless otherwise noted.

Table 1. Specifications[1]

Parameter	Test Conditions	Min	Typ	Max	Unit
SENSOR INPUT	Each axis				
Measurement Range	User selectable		±2, ±4, ±8, ±16		*g*
Nonlinearity	Percentage of full scale		±0.5		%
Inter-Axis Alignment Error			±0.1		Degrees
Cross-Axis Sensitivity[2]			±1		%
OUTPUT RESOLUTION	Each axis				
All *g* Ranges	10-bit resolution		10		Bits
±2 *g* Range	Full resolution		10		Bits
±4 *g* Range	Full resolution		11		Bits
±8 *g* Range	Full resolution		12		Bits
±16 *g* Range	Full resolution		13		Bits
SENSITIVITY	Each axis				
Sensitivity at X_{OUT}, Y_{OUT}, Z_{OUT}	±2 *g*, 10-bit or full resolution	232	256	286	LSB/*g*
Scale Factor at X_{OUT}, Y_{OUT}, Z_{OUT}	±2 *g*, 10-bit or full resolution	3.5	3.9	4.3	m*g*/LSB
Sensitivity at X_{OUT}, Y_{OUT}, Z_{OUT}	±4 *g*, 10-bit resolution	116	128	143	LSB/*g*
Scale Factor at X_{OUT}, Y_{OUT}, Z_{OUT}	±4 *g*, 10-bit resolution	7.0	7.8	8.6	m*g*/LSB
Sensitivity at X_{OUT}, Y_{OUT}, Z_{OUT}	±8 *g*, 10-bit resolution	58	64	71	LSB/*g*
Scale Factor at X_{OUT}, Y_{OUT}, Z_{OUT}	±8 *g*, 10-bit resolution	14.0	15.6	17.2	m*g*/LSB
Sensitivity at X_{OUT}, Y_{OUT}, Z_{OUT}	±16 *g*, 10-bit resolution	29	32	36	LSB/*g*
Scale Factor at X_{OUT}, Y_{OUT}, Z_{OUT}	±16 *g*, 10-bit resolution	28.1	31.2	34.3	m*g*/LSB
Sensitivity Change Due to Temperature			±0.01		%/°C
0 *g* BIAS LEVEL	Each axis				
0 *g* Output for X_{OUT}, Y_{OUT}		−150	±40	+150	m*g*
0 *g* Output for Z_{OUT}		−250	±80	+250	m*g*
0 *g* Offset vs. Temperature for x-, y-Axes			±0.8		m*g*/°C
0 *g* Offset vs. Temperature for z-Axis			±4.5		m*g*/°C
NOISE PERFORMANCE					
Noise (x-, y-Axes)	Data rate = 100 Hz for ±2 *g*, 10-bit or full resolution		<1.0		LSB rms
Noise (z-Axis)	Data rate = 100 Hz for ±2 *g*, 10-bit or full resolution		<1.5		LSB rms
OUTPUT DATA RATE AND BANDWIDTH	User selectable				
Measurement Rate[3]		6.25		3200	Hz
SELF-TEST[4]	Data rate ≥ 100 Hz, 2.0 V ≤ V_S ≤ 3.6 V				
Output Change in x-Axis		0.20		2.10	*g*
Output Change in y-Axis		−2.10		−0.20	*g*
Output Change in z-Axis		0.30		3.40	*g*
POWER SUPPLY					
Operating Voltage Range (V_S)		2.0	2.5	3.6	V
Interface Voltage Range ($V_{DD\ I/O}$)	V_S ≤ 2.5 V	1.7	1.8	V_S	V
	V_S ≥ 2.5 V	2.0	2.5	V_S	V
Supply Current	Data rate > 100 Hz		145		µA
	Data rate < 10 Hz		40		µA
Standby Mode Leakage Current			0.1	2	µA
Turn-On Time[5]	Data rate = 3200 Hz		1.4		ms
TEMPERATURE					
Operating Temperature Range		−40		+85	°C
WEIGHT					
Device Weight			20		mg

[1] All minimum and maximum specifications are guaranteed. Typical specifications are not guaranteed.
[2] Cross-axis sensitivity is defined as coupling between any two axes.
[3] Bandwidth is half the output data rate.
[4] Self-test change is defined as the output (*g*) when the SELF_TEST bit = 1 (in the DATA_FORMAT register) minus the output (*g*) when the SELF_TEST bit = 0 (in the DATA_FORMAT register). Due to device filtering, the output reaches its final value after 4 × τ when enabling or disabling self-test, where τ = 1/(data rate).
[5] Turn-on and wake-up times are determined by the user-defined bandwidth. At a 100 Hz data rate, the turn-on and wake-up times are each approximately 11.1 ms. For other data rates, the turn-on and wake-up times are each approximately τ + 1.1 in milliseconds, where τ = 1/(data rate).

ABSOLUTE MAXIMUM RATINGS

Table 2.

Parameter	Rating
Acceleration	
Any Axis, Unpowered	10,000 *g*
Any Axis, Powered	10,000 *g*
V_S	−0.3 V to +3.6 V
$V_{DD\ I/O}$	−0.3 V to +3.6 V
Digital Pins	−0.3 V to $V_{DD\ I/O}$ + 0.3 V or 3.6 V, whichever is less
All Other Pins	−0.3 V to +3.6 V
Output Short-Circuit Duration (Any Pin to Ground)	Indefinite
Temperature Range	
Powered	−40°C to +105°C
Storage	−40°C to +105°C

Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only; functional operation of the device at these or any other conditions above those indicated in the operational section of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

THERMAL RESISTANCE

Table 3. Package Characteristics

Package Type	θ_{JA}	θ_{JC}	Device Weight
14-Terminal LGA	150°C/W	85°C/W	20 mg

ESD CAUTION

ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

PIN CONFIGURATION AND FUNCTION DESCRIPTIONS

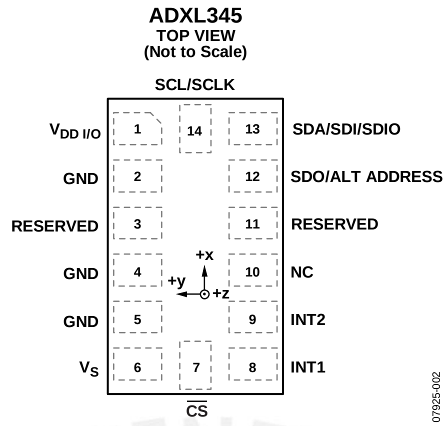


Figure 2. Pin Configuration

Table 4. Pin Function Descriptions

Pin No.	Mnemonic	Description
1	$V_{DD\ I/O}$	Digital Interface Supply Voltage.
2	GND	Must be connected to ground.
3	Reserved	Reserved. This pin must be connected to V_S or left open.
4	GND	Must be connected to ground.
5	GND	Must be connected to ground.
6	V_S	Supply Voltage.
7	$\overline{CS}$	Chip Select.
8	INT1	Interrupt 1 Output.
9	INT2	Interrupt 2 Output.
10	NC	Not Internally Connected.
11	Reserved	Reserved. This pin must be connected to ground or left open.
12	SDO/ALT ADDRESS	Serial Data Output/Alternate I^2C Address Select.
13	SDA/SDI/SDIO	Serial Data (I^2C)/Serial Data Input (SPI 4-Wire)/Serial Data Input and Output (SPI 3-Wire).
14	SCL/SCLK	Serial Communications Clock.

THEORY OF OPERATION

The ADXL345 is a complete 3-axis acceleration measurement system with a selectable measurement range of ±2 *g*, ±4 *g*, ±8 *g*, or ±16 *g*. It measures both dynamic acceleration resulting from motion or shock and static acceleration, such as gravity, which allows the device to be used as a tilt sensor.

The sensor is a polysilicon surface-micromachined structure built on top of a silicon wafer. Polysilicon springs suspend the structure over the surface of the wafer and provide a resistance against acceleration forces.

Deflection of the structure is measured using differential capacitors that consist of independent fixed plates and plates attached to the moving mass. Acceleration deflects the beam and unbalances the differential capacitor, resulting in a sensor output whose amplitude is proportional to acceleration. Phase-sensitive demodulation is used to determine the magnitude and polarity of the acceleration.

POWER SEQUENCING

Power can be applied to V_S or $V_{DD\,I/O}$ in any sequence without damaging the ADXL345. All possible power-on modes are summarized in Table 5. The interface voltage level is set with the interface supply voltage, $V_{DD\,I/O}$, which must be present to ensure that the ADXL345 does not create a conflict on the communication bus. For single-supply operation, $V_{DD\,I/O}$ can be the same as the main supply, V_S. In a dual-supply application, however, $V_{DD\,I/O}$ can differ from V_S to accommodate the desired interface voltage, as long as V_S is greater than $V_{DD\,I/O}$.

After V_S is applied, the device enters standby mode, where power consumption is minimized and the device waits for $V_{DD\,I/O}$ to be applied and for the command to enter measurement mode to be received. (This command can be initiated by setting the measure bit in the POWER_CTL register (Address 0x2D).) In addition, any register can be written to or read from to configure the part while the device is in standby mode. It is recommended to configure the device in standby mode and then to enable measurement mode. Clearing the measure bit returns the device to the standby mode.

Table 5. Power Sequencing

Condition	V_S	$V_{DD\,I/O}$	Description
Power Off	Off	Off	The device is completely off, but there is a potential for a communication bus conflict.
Bus Disabled	On	Off	The device is on in standby mode, but communication is unavailable and will create a conflict on the communication bus. The duration of this state should be minimized during power-up to prevent a conflict.
Bus Enabled	Off	On	No functions are available, but the device will not create a conflict on the communication bus.
Standby or Measurement	On	On	At power-up, the device is in standby mode, awaiting a command to enter measurement mode, and all sensor functions are off. After the device is instructed to enter measurement mode, all sensor functions are available.

POWER SAVINGS

Power Modes

The ADXL345 automatically modulates its power consumption in proportion to its output data rate, as outlined in Table 6. If additional power savings is desired, a lower power mode is available. In this mode, the internal sampling rate is reduced, allowing for power savings in the 12.5 Hz to 400 Hz data rate range but at the expense of slightly greater noise. To enter lower power mode, set the LOW_POWER bit (Bit 4) in the BW_RATE register (Address 0x2C). The current consumption in low power mode is shown in Table 7 for cases where there is an advantage for using low power mode. The current consumption values shown in Table 6 and Table 7 are for a V_S of 2.5 V. Current scales linearly with V_S.

Table 6. Current Consumption vs. Data Rate (T_A = 25°C, V_S = 2.5 V, $V_{DD\,I/O}$ = 1.8 V)

Output Data Rate (Hz)	Bandwidth (Hz)	Rate Code	I_{DD} (µA)
3200	1600	1111	145
1600	800	1110	100
800	400	1101	145
400	200	1100	145
200	100	1011	145
100	50	1010	145
50	25	1001	100
25	12.5	1000	65
12.5	6.25	0111	55
6.25	3.125	0110	40

Table 7. Current Consumption vs. Data Rate, Low Power Mode (T_A = 25°C, V_S = 2.5 V, $V_{DD\,I/O}$ = 1.8 V)

Output Data Rate (Hz)	Bandwidth (Hz)	Rate Code	I_{DD} (µA)
400	200	1100	100
200	100	1011	65
100	50	1010	55
50	25	1001	50
25	12.5	1000	40
12.5	6.25	0111	40

Auto Sleep Mode

Additional power can be saved if the ADXL345 automatically switches to sleep mode during periods of inactivity. To enable this feature, set the THRESH_INACT register (Address 0x25) and the TIME_INACT register (Address 0x26) each to a value that signifies inactivity (the appropriate value depends on the application), and then set the AUTO_SLEEP bit and the link bit in the POWER_CTL register (Address 0x2D). Current consumption at the sub-8 Hz data rates used in this mode is typically 40 µA for a V_S of 2.5 V.

Standby Mode

For even lower power operation, standby mode can be used. In standby mode, current consumption is reduced to 0.1 µA (typical). In this mode, no measurements are made. Standby mode is entered by clearing the measure bit (Bit 3) in the POWER_CTL register (Address 0x2D). Placing the device into standby mode preserves the contents of FIFO.

SERIAL COMMUNICATIONS

I²C and SPI digital communications are available. In both cases, the ADXL345 operates as a slave. I²C mode is enabled if the $\overline{CS}$ pin is tied high to $V_{DD\ I/O}$. The $\overline{CS}$ pin should always be tied high to $V_{DD\ I/O}$ or be driven by an external controller because there is no default mode if the $\overline{CS}$ pin is left unconnected. Therefore, not taking these precautions may result in an inability to communicate with the part. In SPI mode, the $\overline{CS}$ pin is controlled by the bus master. In both SPI and I²C modes of operation, data transmitted from the ADXL345 to the master device should be ignored during writes to the ADXL345.

SPI

For SPI, either 3- or 4-wire configuration is possible, as shown in the connection diagrams in Figure 3 and Figure 4. Clearing the SPI bit in the DATA_FORMAT register (Address 0x31) selects 4-wire mode, whereas setting the SPI bit selects 3-wire mode. The maximum SPI clock speed is 5 MHz with 100 pF maximum loading, and the timing scheme follows clock polarity (CPOL) = 1 and clock phase (CPHA) = 1.

$\overline{CS}$ is the serial port enable line and is controlled by the SPI master. This line must go low at the start of a transmission and high at the end of a transmission, as shown in Figure 5. SCLK is the serial port clock and is supplied by the SPI master. It is stopped high when $\overline{CS}$ is high during a period of no transmission. SDI and SDO are the serial data input and output, respectively. Data should be sampled at the rising edge of SCLK.

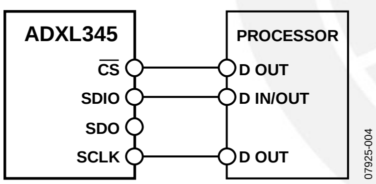


Figure 3. 3-Wire SPI Connection Diagram

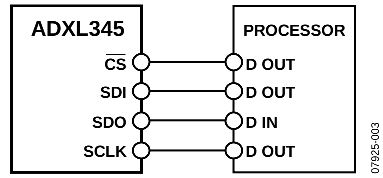


Figure 4. 4-Wire SPI Connection Diagram

To read or write multiple bytes in a single transmission, the multiple-byte bit, located after the R/$\overline{W}$ bit in the first byte transfer (MB in Figure 5 to Figure 7), must be set. After the register addressing and the first byte of data, each subsequent set of clock pulses (eight clock pulses) causes the ADXL345 to point to the next register for a read or write. This shifting continues until the clock pulses cease and $\overline{CS}$ is deasserted. To perform reads or writes on different, nonsequential registers, $\overline{CS}$ must be deasserted between transmissions and the new register must be addressed separately.

The timing diagram for 3-wire SPI reads or writes is shown in Figure 7. The 4-wire equivalents for SPI writes and reads are shown in Figure 5 and Figure 6, respectively.

Table 8. SPI Digital Input/Output Voltage

Parameter	Limit[1]	Unit
Digital Input Voltage		
Low Level Input Voltage (V_{IL})	$0.2 \times V_{DD\ I/O}$	V max
High Level Input Voltage (V_{IH})	$0.8 \times V_{DD\ I/O}$	V min
Digital Output Voltage		
Low Level Output Voltage (V_{OL})	$0.15 \times V_{DD\ I/O}$	V max
High Level Output Voltage (V_{OH})	$0.85 \times V_{DD\ I/O}$	V min

[1] Limits based on characterization results, not production tested.

Table 9. SPI Timing (T_A = 25°C, V_S = 2.5 V, $V_{DD\ I/O}$ = 1.8 V)[1]

	Limit[2, 3]			
Parameter	Min	Max	Unit	Description
f_{SCLK}		5	MHz	SPI clock frequency
t_{SCLK}	200		ns	1/(SPI clock frequency) mark-space ratio for the SCLK input is 40/60 to 60/40
t_{DELAY}	10		ns	$\overline{CS}$ falling edge to SCLK falling edge
t_{QUIET}	10		ns	SCLK rising edge to $\overline{CS}$ rising edge
t_{DIS}		100	ns	$\overline{CS}$ rising edge to SDO disabled
$t_{CS,DIS}$	250		ns	$\overline{CS}$ deassertion between SPI communications
t_S	$0.4 \times t_{SCLK}$		ns	SCLK low pulse width (space)
t_M	$0.4 \times t_{SCLK}$		ns	SCLK high pulse width (mark)
t_{SDO}		95	ns	SCLK falling edge to SDO transition
t_{SETUP}	10		ns	SDI valid before SCLK rising edge
t_{HOLD}	10		ns	SDI valid after SCLK rising edge

[1] The $\overline{CS}$, SCLK, SDI, and SDO pins are not internally pulled up or down; they must be driven for proper operation.
[2] Limits based on characterization results, characterized with f_{SCLK} = 5 MHz and bus load capacitance of 100 pF; not production tested.
[3] The timing values are measured corresponding to the input thresholds (V_{IL} and V_{IH}) given in Table 8.

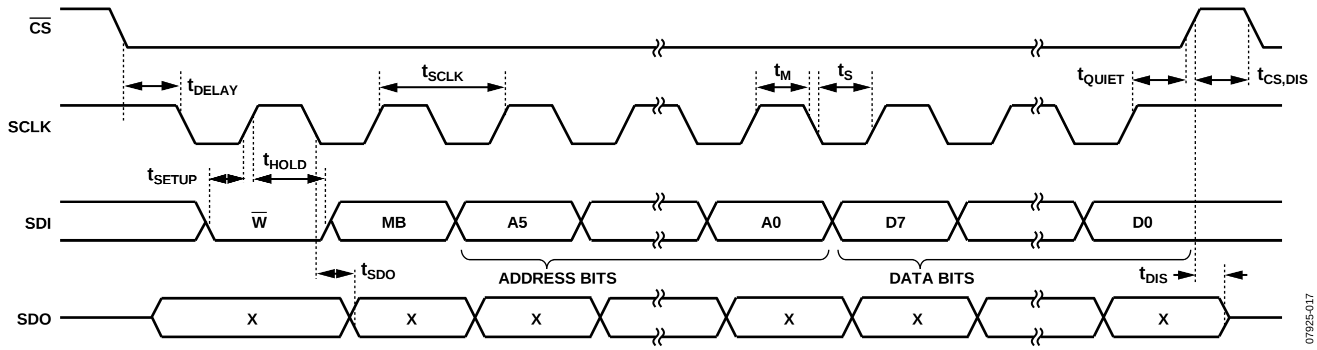


Figure 5. SPI 4-Wire Write

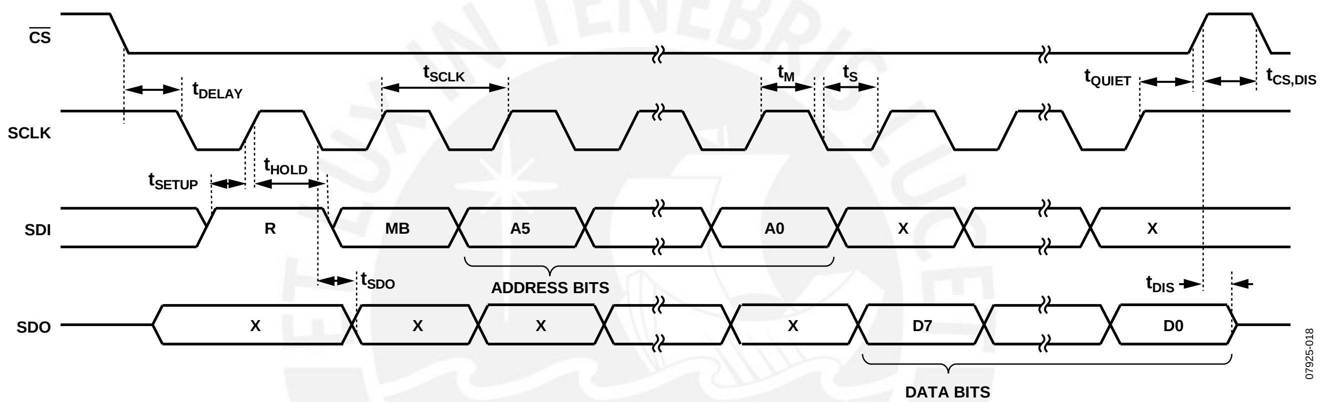


Figure 6. SPI 4-Wire Read

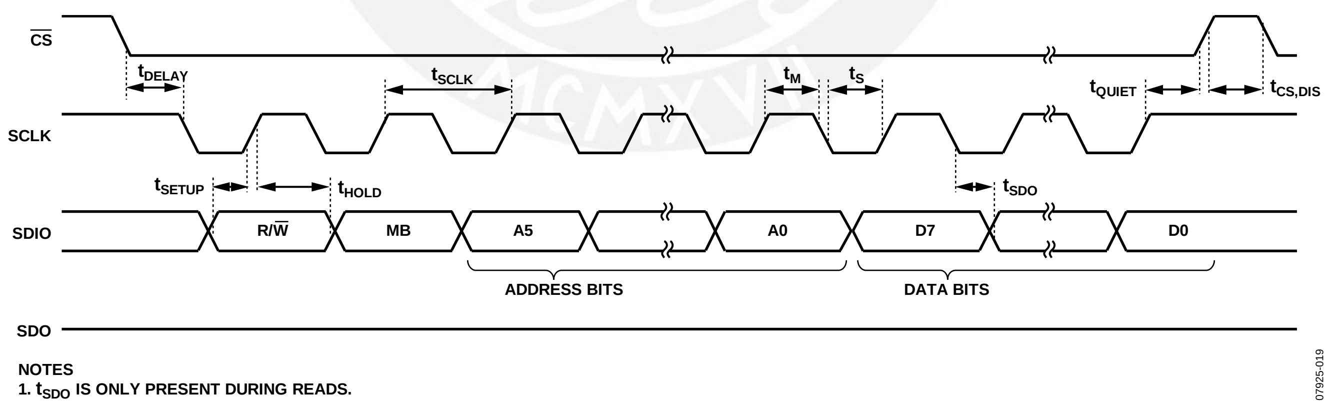


Figure 7. SPI 3-Wire Read/Write

I²C

With $\overline{CS}$ tied high to $V_{DD\ I/O}$, the ADXL345 is in I²C mode, requiring a simple 2-wire connection as shown in Figure 8. The ADXL345 conforms to the *UM10204 I²C-Bus Specification and User Manual*, Rev. 03—19 June 2007, available from NXP Semiconductor. It supports standard (100 kHz) and fast (400 kHz) data transfer modes if the timing parameters given in Table 11 and Figure 10 are met. Single- or multiple-byte reads/writes are supported, as shown in Figure 9. With the SDO/ALT ADDRESS pin high, the 7-bit I²C address for the device is 0x1D, followed by the R/$\overline{W}$ bit. This translates to 0x3A for a write and 0x3B for a read. An alternate I²C address of 0x53 (followed by the R/$\overline{W}$ bit) can be chosen by grounding the SDO/ALT ADDRESS pin (Pin 12). This translates to 0xA6 for a write and 0xA7 for a read.

If other devices are connected to the same I²C bus, the nominal operating voltage level of these other devices cannot exceed $V_{DD\ I/O}$ by more than 0.3 V. External pull-up resistors, R_P, are necessary for proper I²C operation. Refer to the *UM10204 I²C-Bus Specification and User Manual*, Rev. 03—19 June 2007, when selecting pull-up resistor values to ensure proper operation.

Table 10. I²C Digital Input/Output Voltage

Parameter	Limit[1]	Unit
Digital Input Voltage		
Low Level Input Voltage (V_{IL})	$0.25 \times V_{DD\ I/O}$	V max
High Level Input Voltage (V_{IH})	$0.75 \times V_{DD\ I/O}$	V min
Digital Output Voltage		
Low Level Output Voltage (V_{OL})[2]	$0.2 \times V_{DD\ I/O}$	V max

[1] Limits based on characterization results; not production tested.
[2] The limit given is only for $V_{DD\ I/O} < 2$ V. When $V_{DD\ I/O} > 2$ V, the limit is 0.4 V max.

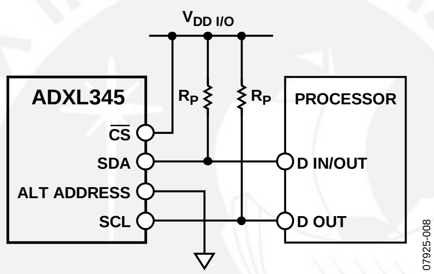


Figure 8. I²C Connection Diagram (Address 0x53)

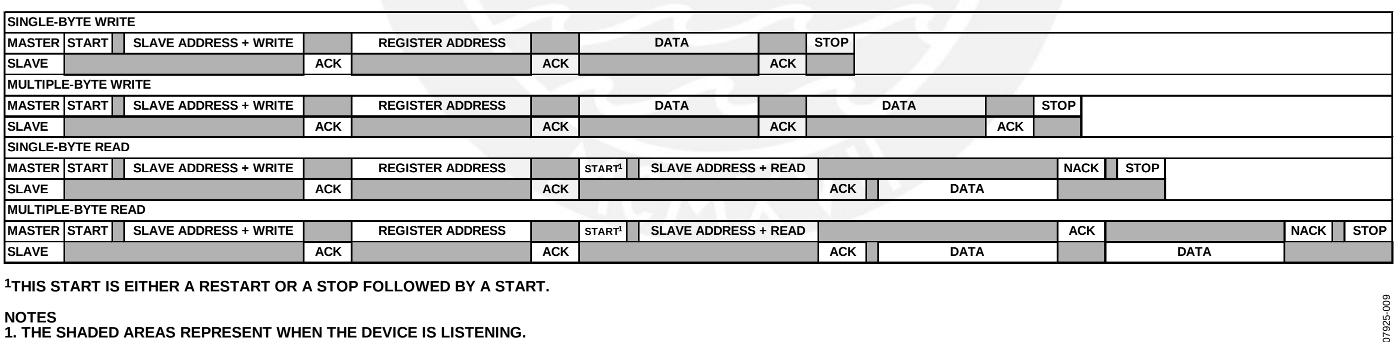


Figure 9. I²C Device Addressing

Table 11. I²C Timing (T_A = 25°C, V_S = 2.5 V, $V_{DD\ I/O}$ = 1.8 V)

Parameter	Limit[1, 2] Min	Max	Unit	Description
f_{SCL}		400	kHz	SCL clock frequency
t_1	2.5		μs	SCL cycle time
t_2	0.6		μs	t_{HIGH}, SCL high time
t_3	1.3		μs	t_{LOW}, SCL low time
t_4	0.6		μs	$t_{HD,\ STA}$, start/repeated start condition hold time
t_5	350		ns	$t_{SU,\ DAT}$, data setup time
t_6[3, 4, 5, 6]	0	0.65	μs	$t_{HD,\ DAT}$, data hold time
t_7	0.6		μs	$t_{SU,\ STA}$, setup time for repeated start
t_8	0.6		μs	$t_{SU,\ STO}$, stop condition setup time
t_9	1.3		μs	t_{BUF}, bus-free time between a stop condition and a start condition
t_{10}		300	ns	t_R, rise time of both SCL and SDA when receiving
	0		ns	t_R, rise time of both SCL and SDA when receiving or transmitting
t_{11}		250	ns	t_F, fall time of SDA when receiving
		300	ns	t_F, fall time of both SCL and SDA when transmitting
	20 + 0.1 C_b[7]		ns	t_F, fall time of both SCL and SDA when transmitting or receiveing
C_b		400	pF	Capacitive load for each bus line

[1] Limits based on characterization results, with f_{SCL} = 400 kHz and a 3 mA sink current; not production tested.
[2] All values referred to the V_{IH} and the V_{IL} levels given in Table 10.
[3] t_6 is the data hold time that is measured from the falling edge of SCL. It applies to data in transmission and acknowledge times.
[4] A transmitting device must internally provide an output hold time of at least 300 ns for the SDA signal (with respect to $V_{IH(min)}$ of the SCL signal) to bridge the undefined region of the falling edge of SCL.
[5] The maximum t_6 value must be met only if the device does not stretch the low period (t_3) of the SCL signal.
[6] The maximum value for t_6 is a function of the clock low time (t_3), the clock rise time (t_{10}), and the minimum data setup time ($t_{5(min)}$). This value is calculated as $t_{6(max)} = t_3 - t_{10} - t_{5(min)}$.
[7] C_b is the total capacitance of one bus line in picofarads.

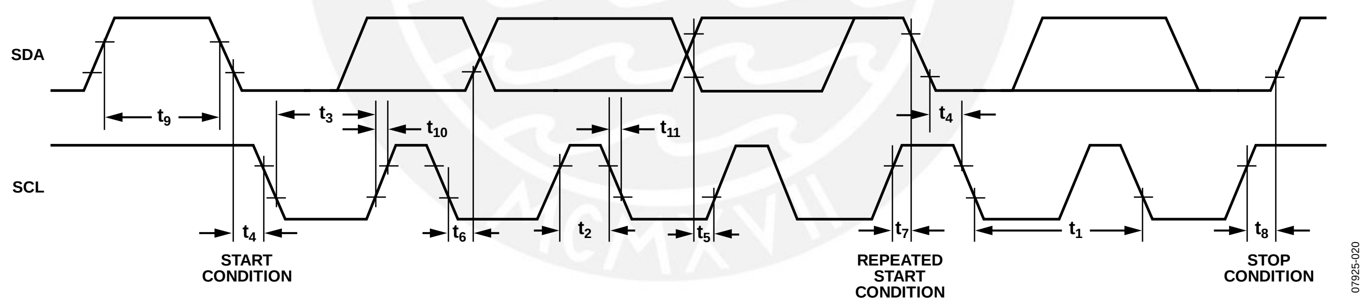


Figure 10. I²C Timing Diagram

INTERRUPTS

The ADXL345 provides two output pins for driving interrupts: INT1 and INT2. Each interrupt function is described in detail in this section. All functions can be used simultaneously, with the only limiting feature being that some functions may need to share interrupt pins. Interrupts are enabled by setting the appropriate bit in the INT_ENABLE register (Address 0x2E) and are mapped to either the INT1 or INT2 pin based on the contents of the INT_MAP register (Address 0x2F). It is recommended that interrupt bits be configured with the interrupts disabled, preventing interrupts from being accidentally triggered during configuration. This can be done by writing a value of 0x00 to the INT_ENABLE register. Clearing interrupts is performed either by reading the data registers (Address 0x32 to Address 0x37) until the interrupt condition is no longer valid for the data-related interrupts or by reading the INT_SOURCE register (Address 0x30) for the remaining interrupts. This section describes the interrupts that can be set in the INT_ENABLE register and monitored in the INT_SOURCE register.

DATA_READY

The DATA_READY bit is set when new data is available and is cleared when no new data is available.

SINGLE_TAP

The SINGLE_TAP bit is set when a single acceleration event that is greater than the value in the THRESH_TAP register (Address 0x1D) occurs for less time than is specified in the DUR register (Address 0x21).

DOUBLE_TAP

The DOUBLE_TAP bit is set when two acceleration events that are greater than the value in the THRESH_TAP register (Address 0x1D) occur for less time than is specified in the DUR register (Address 0x21), with the second tap starting after the time specified by the latent register (Address 0x22) but within the time specified in the window register (Address 0x23). See the Tap Detection section for more details.

Activity

The activity bit is set when acceleration greater than the value stored in the THRESH_ACT register (Address 0x24) is experienced.

Inactivity

The inactivity bit is set when acceleration of less than the value stored in the THRESH_INACT register (Address 0x25) is experienced for more time than is specified in the TIME_INACT register (Address 0x26). The maximum value for TIME_INACT is 255 sec.

FREE_FALL

The FREE_FALL bit is set when acceleration of less than the value stored in the THRESH_FF register (Address 0x28) is experienced for more time than is specified in the TIME_FF register (Address 0x29). The FREE_FALL interrupt differs from the inactivity interrupt as follows: all axes always participate, the timer period is much smaller (1.28 sec maximum), and the mode of operation is always dc-coupled.

Watermark

The watermark bit is set when the number of samples in FIFO equals the value stored in the samples bits (Register FIFO_CTL, Address 0x38). The watermark bit is cleared automatically when FIFO is read, and the content returns to a value below the value stored in the samples bits.

Overrun

The overrun bit is set when new data replaces unread data. The precise operation of the overrun function depends on the FIFO mode. In bypass mode, the overrun bit is set when new data replaces unread data in the DATAX, DATAY, and DATAZ registers (Address 0x32 to Address 0x37). In all other modes, the overrun bit is set when FIFO is filled. The overrun bit is automatically cleared when the contents of FIFO are read.

FIFO

The ADXL345 contains patent pending technology for an embedded 32-level FIFO that can be used to minimize host processor burden. This buffer has four modes: bypass, FIFO, stream, and trigger (see Table 19). Each mode is selected by the settings of the FIFO_MODE bits in the FIFO_CTL register (Address 0x38).

Bypass Mode

In bypass mode, FIFO is not operational and, therefore, remains empty.

FIFO Mode

In FIFO mode, data from measurements of the x-, y-, and z-axes are stored in FIFO. When the number of samples in FIFO equals the level specified in the samples bits of the FIFO_CTL register (Address 0x38), the watermark interrupt is set. FIFO continues accumulating samples until it is full (32 samples from measurements of the x-, y-, and z-axes) and then stops collecting data. After FIFO stops collecting data, the device continues to operate; therefore, features such as tap detection can be used after FIFO is full. The watermark interrupt continues to occur until the number of samples in FIFO is less than the value stored in the samples bits of the FIFO_CTL register.

Stream Mode

In stream mode, data from measurements of the x-, y-, and z-axes are stored in FIFO. When the number of samples in FIFO equals the level specified in the samples bits of the FIFO_CTL register (Address 0x38), the watermark interrupt is set. FIFO continues accumulating samples and holds the latest 32 samples from measurements of the x-, y-, and z-axes, discarding older data as new data arrives. The watermark interrupt continues occurring until the number of samples in FIFO is less than the value stored in the samples bits of the FIFO_CTL register.

Trigger Mode

In trigger mode, FIFO accumulates samples, holding the latest 32 samples from measurements of the x-, y-, and z-axes. After a trigger event occurs and an interrupt is sent to the INT1 or INT2 pin (determined by the trigger bit in the FIFO_CTL register), FIFO keeps the last n samples (where n is the value specified by the samples bits in the FIFO_CTL register) and then operates in FIFO mode, collecting new samples only when FIFO is not full. A delay of at least 5 μs should be present between the trigger event occurring and the start of reading data from the FIFO to allow the FIFO to discard and retain the necessary samples. Additional trigger events cannot be recognized until the trigger mode is reset. To reset the trigger mode, set the device to bypass mode and then set the device back to trigger mode. Note that the FIFO data should be read first because placing the device into bypass mode clears FIFO.

Retrieving Data from FIFO

The FIFO data is read through the DATAX, DATAY, and DATAZ registers (Address 0x32 to Address 0x37). When the FIFO is in FIFO, stream, or trigger mode, reads to the DATAX, DATAY, and DATAZ registers read data stored in the FIFO. Each time data is read from the FIFO, the oldest x-, y-, and z-axes data are placed into the DATAX, DATAY and DATAZ registers.

If a single-byte read operation is performed, the remaining bytes of data for the current FIFO sample are lost. Therefore, all axes of interest should be read in a burst (or multiple-byte) read operation. To ensure that the FIFO has completely popped (that is, that new data has completely moved into the DATAX, DATAY, and DATAZ registers), there must be at least 5 μs between the end of reading the data registers and the start of a new read of the FIFO or a read of the FIFO_STATUS register (Address 0x39). The end of reading a data register is signified by the transition from Register 0x37 to Register 0x38 or by the $\overline{\text{CS}}$ pin going high.

For SPI operation at 1.6 MHz or less, the register addressing portion of the transmission is a sufficient delay to ensure that the FIFO has completely popped. For SPI operation greater than 1.6 MHz, it is necessary to deassert the $\overline{\text{CS}}$ pin to ensure a total delay of 5 μs; otherwise, the delay will not be sufficient. The total delay necessary for 5 MHz operation is at most 3.4 μs. This is not a concern when using I^2C mode because the communication rate is low enough to ensure a sufficient delay between FIFO reads.

SELF-TEST

The ADXL345 incorporates a self-test feature that effectively tests its mechanical and electronic systems simultaneously. When the self-test function is enabled (via the SELF_TEST bit in the DATA_FORMAT register, Address 0x31), an electrostatic force is exerted on the mechanical sensor. This electrostatic force moves the mechanical sensing element in the same manner as acceleration, and it is additive to the acceleration experienced by the device. This added electrostatic force results in an output change in the x-, y-, and z-axes. Because the electrostatic force is proportional to V_S^2, the output change varies with V_S. The self-test feature of the ADXL345 also exhibits a bimodal behavior that depends on which phase of the clock self-test is enabled. However, the limits shown in Table 1 and Table 12 to Table 15 are valid for all potential self-test values across the entire allowable voltage range. Use of the self-test feature at data rates less than 100 Hz may yield values outside these limits. Therefore, the part should be placed into a data rate of 100 Hz or greater when using self-test.

Table 12. Self-Test Output in LSB for ±2 *g*, Full Resolution

Axis	Min	Max	Unit
X	50	540	LSB
Y	−540	−50	LSB
Z	75	875	LSB

Table 13. Self-Test Output in LSB for ±4 *g*, 10-Bit Resolution

Axis	Min	Max	Unit
X	25	270	LSB
Y	−270	−25	LSB
Z	38	438	LSB

Table 14. Self-Test Output in LSB for ±8 *g*, 10-Bit Resolution

Axis	Min	Max	Unit
X	12	135	LSB
Y	−135	−12	LSB
Z	19	219	LSB

Table 15. Self-Test Output in LSB for ±16 *g*, 10-Bit Resolution

Axis	Min	Max	Unit
X	6	67	LSB
Y	−67	−6	LSB
Z	10	110	LSB

REGISTER MAP

Table 16. Register Map

Address					
Hex	Dec	Name	Type	Reset Value	Description
0x00	0	DEVID	R	11100101	Device ID.
0x01 to 0x01C	1 to 28	Reserved			Reserved. Do not access.
0x1D	29	THRESH_TAP	R/$\overline{W}$	00000000	Tap threshold.
0x1E	30	OFSX	R/$\overline{W}$	00000000	X-axis offset.
0x1F	31	OFSY	R/$\overline{W}$	00000000	Y-axis offset.
0x20	32	OFSZ	R/$\overline{W}$	00000000	Z-axis offset.
0x21	33	DUR	R/$\overline{W}$	00000000	Tap duration.
0x22	34	Latent	R/$\overline{W}$	00000000	Tap latency.
0x23	35	Window	R/$\overline{W}$	00000000	Tap window.
0x24	36	THRESH_ACT	R/$\overline{W}$	00000000	Activity threshold.
0x25	37	THRESH_INACT	R/$\overline{W}$	00000000	Inactivity threshold.
0x26	38	TIME_INACT	R/$\overline{W}$	00000000	Inactivity time.
0x27	39	ACT_INACT_CTL	R/$\overline{W}$	00000000	Axis enable control for activity and inactivity detection.
0x28	40	THRESH_FF	R/$\overline{W}$	00000000	Free-fall threshold.
0x29	41	TIME_FF	R/$\overline{W}$	00000000	Free-fall time.
0x2A	42	TAP_AXES	R/$\overline{W}$	00000000	Axis control for tap/double tap.
0x2B	43	ACT_TAP_STATUS	R	00000000	Source of tap/double tap.
0x2C	44	BW_RATE	R/$\overline{W}$	00001010	Data rate and power mode control.
0x2D	45	POWER_CTL	R/$\overline{W}$	00000000	Power-saving features control.
0x2E	46	INT_ENABLE	R/$\overline{W}$	00000000	Interrupt enable control.
0x2F	47	INT_MAP	R/$\overline{W}$	00000000	Interrupt mapping control.
0x30	48	INT_SOURCE	R	00000010	Source of interrupts.
0x31	49	DATA_FORMAT	R/$\overline{W}$	00000000	Data format control.
0x32	50	DATAX0	R	00000000	X-Axis Data 0.
0x33	51	DATAX1	R	00000000	X-Axis Data 1.
0x34	52	DATAY0	R	00000000	Y-Axis Data 0.
0x35	53	DATAY1	R	00000000	Y-Axis Data 1.
0x36	54	DATAZ0	R	00000000	Z-Axis Data 0.
0x37	55	DATAZ1	R	00000000	Z-Axis Data 1.
0x38	56	FIFO_CTL	R/$\overline{W}$	00000000	FIFO control.
0x39	57	FIFO_STATUS	R	00000000	FIFO status.

REGISTER DEFINITIONS

Register 0x00—DEVID (Read Only)

D7	D6	D5	D4	D3	D2	D1	D0
1	1	1	0	0	1	0	1

The DEVID register holds a fixed device ID code of 0xE5 (345 octal).

Register 0x1D—THRESH_TAP (Read/Write)

The THRESH_TAP register is eight bits and holds the threshold value for tap interrupts. The data format is unsigned, so the magnitude of the tap event is compared with the value in THRESH_TAP. The scale factor is 62.5 m*g*/LSB (that is, 0xFF = +16 *g*). A value of 0 may result in undesirable behavior if tap/double tap interrupts are enabled.

Register 0x1E, Register 0x1F, Register 0x20—OFSX, OFSY, OFSZ (Read/Write)

The OFSX, OFSY, and OFSZ registers are each eight bits and offer user-set offset adjustments in twos complement format with a scale factor of 15.6 m*g*/LSB (that is, 0x7F = +2 *g*).

Register 0x21—DUR (Read/Write)

The DUR register is eight bits and contains an unsigned time value representing the maximum time that an event must be above the THRESH_TAP threshold to qualify as a tap event. The scale factor is 625 µs/LSB. A value of 0 disables the tap/double tap functions.

Register 0x22—Latent (Read/Write)

The latent register is eight bits and contains an unsigned time value representing the wait time from the detection of a tap event to the start of the time window (defined by the window register) during which a possible second tap event can be detected. The scale factor is 1.25 ms/LSB. A value of 0 disables the double tap function.

Register 0x23—Window (Read/Write)

The window register is eight bits and contains an unsigned time value representing the amount of time after the expiration of the latency time (determined by the latent register) during which a second valid tap can begin. The scale factor is 1.25 ms/LSB. A value of 0 disables the double tap function.

Register 0x24—THRESH_ACT (Read/Write)

The THRESH_ACT register is eight bits and holds the threshold value for detecting activity. The data format is unsigned, so the magnitude of the activity event is compared with the value in the THRESH_ACT register. The scale factor is 62.5 m*g*/LSB. A value of 0 may result in undesirable behavior if the activity interrupt is enabled.

Register 0x25—THRESH_INACT (Read/Write)

The THRESH_INACT register is eight bits and holds the threshold value for detecting inactivity. The data format is unsigned, so the magnitude of the inactivity event is compared with the value in the THRESH_INACT register. The scale factor is 62.5 m*g*/LSB. A value of 0 m*g* may result in undesirable behavior if the inactivity interrupt is enabled.

Register 0x26—TIME_INACT (Read/Write)

The TIME_INACT register is eight bits and contains an unsigned time value representing the amount of time that acceleration must be less than the value in the THRESH_INACT register for inactivity to be declared. The scale factor is 1 sec/LSB. Unlike the other interrupt functions, which use unfiltered data (see the Threshold section), the inactivity function uses filtered output data. At least one output sample must be generated for the inactivity interrupt to be triggered. This results in the function appearing unresponsive if the TIME_INACT register is set to a value less than the time constant of the output data rate. A value of 0 results in an interrupt when the output data is less than the value in the THRESH_INACT register.

Register 0x27—ACT_INACT_CTL (Read/Write)

D7	D6	D5	D4
ACT ac/dc	ACT_X enable	ACT_Y enable	ACT_Z enable
D3	**D2**	**D1**	**D0**
INACT ac/dc	INACT_X enable	INACT_Y enable	INACT_Z enable

ACT AC/DC and INACT AC/DC Bits

A setting of 0 selects dc-coupled operation, and a setting of 1 enables ac-coupled operation. In dc-coupled operation, the current acceleration magnitude is compared directly with THRESH_ACT and THRESH_INACT to determine whether activity or inactivity is detected.

In ac-coupled operation for activity detection, the acceleration value at the start of activity detection is taken as a reference value. New samples of acceleration are then compared to this reference value, and if the magnitude of the difference exceeds the THRESH_ACT value, the device triggers an activity interrupt.

Similarly, in ac-coupled operation for inactivity detection, a reference value is used for comparison and is updated whenever the device exceeds the inactivity threshold. After the reference value is selected, the device compares the magnitude of the difference between the reference value and the current acceleration with THRESH_INACT. If the difference is less than the value in THRESH_INACT for the time in TIME_INACT, the device is considered inactive and the inactivity interrupt is triggered.

ACT_x Enable Bits and INACT_x Enable Bits

A setting of 1 enables x-, y-, or z-axis participation in detecting activity or inactivity. A setting of 0 excludes the selected axis from participation. If all axes are excluded, the function is disabled.

Register 0x28—THRESH_FF (Read/Write)

The THRESH_FF register is eight bits and holds the threshold value, in unsigned format, for free-fall detection. The root-sum-square (RSS) value of all axes is calculated and compared with the value in THRESH_FF to determine if a free-fall event occurred. The scale factor is 62.5 m*g*/LSB. Note that a value of 0 m*g* may result in undesirable behavior if the free-fall interrupt is enabled. Values between 300 m*g* and 600 m*g* (0x05 to 0x09) are recommended.

Register 0x29—TIME_FF (Read/Write)

The TIME_FF register is eight bits and stores an unsigned time value representing the minimum time that the RSS value of all axes must be less than THRESH_FF to generate a free-fall interrupt. The scale factor is 5 ms/LSB. A value of 0 may result in undesirable behavior if the free-fall interrupt is enabled. Values between 100 ms and 350 ms (0x14 to 0x46) are recommended.

Register 0x2A—TAP_AXES (Read/Write)

D7	D6	D5	D4	D3	D2	D1	D0
0	0	0	0	Suppress	TAP_X enable	TAP_Y enable	TAP_Z enable

Suppress Bit

Setting the suppress bit suppresses double tap detection if acceleration greater than the value in THRESH_TAP is present between taps. See the Tap Detection section for more details.

TAP_x Enable Bits

A setting of 1 in the TAP_X enable, TAP_Y enable, or TAP_Z enable bit enables x-, y-, or z-axis participation in tap detection. A setting of 0 excludes the selected axis from participation in tap detection.

Register 0x2B—ACT_TAP_STATUS (Read Only)

D7	D6	D5	D4	D3	D2	D1	D0
0	ACT_X source	ACT_Y source	ACT_Z source	Asleep	TAP_X source	TAP_Y source	TAP_Z source

ACT_x Source and TAP_x Source Bits

These bits indicate the first axis involved in a tap or activity event. A setting of 1 corresponds to involvement in the event, and a setting of 0 corresponds to no involvement. When new data is available, these bits are not cleared but are overwritten by the new data. The ACT_TAP_STATUS register should be read before clearing the interrupt. Disabling an axis from participation clears the corresponding source bit when the next activity or tap/double tap event occurs.

Asleep Bit

A setting of 1 in the asleep bit indicates that the part is asleep, and a setting of 0 indicates that the part is not asleep. See the Register 0x2D—POWER_CTL (Read/Write) section for more information on autosleep mode.

Register 0x2C—BW_RATE (Read/Write)

D7	D6	D5	D4	D3	D2	D1	D0
0	0	0	LOW_POWER	Rate			

LOW_POWER Bit

A setting of 0 in the LOW_POWER bit selects normal operation, and a setting of 1 selects reduced power operation, which has somewhat higher noise (see the Power Modes section for details).

Rate Bits

These bits select the device bandwidth and output data rate (see Table 6 and Table 7 for details). The default value is 0x0A, which translates to a 100 Hz output data rate. An output data rate should be selected that is appropriate for the communication protocol and frequency selected. Selecting too high of an output data rate with a low communication speed results in samples being discarded.

Register 0x2D—POWER_CTL (Read/Write)

D7	D6	D5	D4	D3	D2	D1	D0
0	0	Link	AUTO_SLEEP	Measure	Sleep	Wakeup	

Link Bit

A setting of 1 in the link bit with both the activity and inactivity functions enabled delays the start of the activity function until inactivity is detected. After activity is detected, inactivity detection begins, preventing the detection of activity. This bit serially links the activity and inactivity functions. When this bit is set to 0, the inactivity and activity functions are concurrent. Additional information can be found in the Link Mode section.

When clearing the link bit, it is recommended that the part be placed into standby mode and then set back to measurement mode with a subsequent write. This is done to ensure that the device is properly biased if sleep mode is manually disabled; otherwise, the first few samples of data after the link bit is cleared may have additional noise, especially if the device was asleep when the bit was cleared.

AUTO_SLEEP Bit

If the link bit is set, a setting of 1 in the AUTO_SLEEP bit sets the ADXL345 to switch to sleep mode when inactivity is detected (that is, when acceleration has been below the THRESH_INACT value for at least the time indicated by TIME_INACT). A setting of 0 disables automatic switching to sleep mode. See the description of the sleep bit in this section for more information.

When clearing the AUTO_SLEEP bit, it is recommended that the part be placed into standby mode and then set back to measurement mode with a subsequent write. This is done to ensure that the device is properly biased if sleep mode is manually disabled; otherwise, the first few samples of data after the AUTO_SLEEP bit is cleared may have additional noise, especially if the device was asleep when the bit was cleared.

Measure Bit

A setting of 0 in the measure bit places the part into standby mode, and a setting of 1 places the part into measurement mode. The ADXL345 powers up in standby mode with minimum power consumption.

Sleep Bit

A setting of 0 in the sleep bit puts the part into the normal mode of operation, and a setting of 1 places the part into sleep mode. Sleep mode suppresses DATA_READY, stops transmission of data to FIFO, and switches the sampling rate to one specified by the wakeup bits. In sleep mode, only the activity function can be used.

When clearing the sleep bit, it is recommended that the part be placed into standby mode and then set back to measurement mode with a subsequent write. This is done to ensure that the device is properly biased if sleep mode is manually disabled; otherwise, the first few samples of data after the sleep bit is cleared may have additional noise, especially if the device was asleep when the bit was cleared.

Wakeup Bits

These bits control the frequency of readings in sleep mode as described in Table 17.

Table 17. Frequency of Readings in Sleep Mode

Setting		
D1	D0	Frequency (Hz)
0	0	8
0	1	4
1	0	2
1	1	1

Register 0x2E—INT_ENABLE (Read/Write)

D7	D6	D5	D4
DATA_READY	SINGLE_TAP	DOUBLE_TAP	Activity
D3	**D2**	**D1**	**D0**
Inactivity	FREE_FALL	Watermark	Overrun

Setting bits in this register to a value of 1 enables their respective functions to generate interrupts, whereas a value of 0 prevents the functions from generating interrupts. The DATA_READY, watermark, and overrun bits enable only the interrupt output; the functions are always enabled. It is recommended that interrupts be configured before enabling their outputs.

Register 0x2F—INT_MAP (Read/Write)

D7	D6	D5	D4
DATA_READY	SINGLE_TAP	DOUBLE_TAP	Activity
D3	**D2**	**D1**	**D0**
Inactivity	FREE_FALL	Watermark	Overrun

Any bits set to 0 in this register send their respective interrupts to the INT1 pin, whereas bits set to 1 send their respective interrupts to the INT2 pin. All selected interrupts for a given pin are OR'ed.

Register 0x30—INT_SOURCE (Read Only)

D7	D6	D5	D4
DATA_READY	SINGLE_TAP	DOUBLE_TAP	Activity
D3	**D2**	**D1**	**D0**
Inactivity	FREE_FALL	Watermark	Overrun

Bits set to 1 in this register indicate that their respective functions have triggered an event, whereas a value of 0 indicates that the corresponding event has not occurred. The DATA_READY, watermark, and overrun bits are always set if the corresponding events occur, regardless of the INT_ENABLE register settings, and are cleared by reading data from the DATAX, DATAY, and DATAZ registers. The DATA_READY and watermark bits may require multiple reads, as indicated in the FIFO mode descriptions in the FIFO section. Other bits, and the corresponding interrupts, are cleared by reading the INT_SOURCE register.

Register 0x31—DATA_FORMAT (Read/Write)

D7	D6	D5	D4	D3	D2	D1	D0
SELF_TEST	SPI	INT_INVERT	0	FULL_RES	Justify	Range	

The DATA_FORMAT register controls the presentation of data to Register 0x32 through Register 0x37. All data, except that for the ±16 *g* range, must be clipped to avoid rollover.

SELF_TEST Bit

A setting of 1 in the SELF_TEST bit applies a self-test force to the sensor, causing a shift in the output data. A value of 0 disables the self-test force.

SPI Bit

A value of 1 in the SPI bit sets the device to 3-wire SPI mode, and a value of 0 sets the device to 4-wire SPI mode.

INT_INVERT Bit

A value of 0 in the INT_INVERT bit sets the interrupts to active high, and a value of 1 sets the interrupts to active low.

FULL_RES Bit

When this bit is set to a value of 1, the device is in full resolution mode, where the output resolution increases with the *g* range set by the range bits to maintain a 4 m*g*/LSB scale factor. When the FULL_RES bit is set to 0, the device is in 10-bit mode, and the range bits determine the maximum *g* range and scale factor.

Justify Bit

A setting of 1 in the justify bit selects left (MSB) justified mode, and a setting of 0 selects right justified mode with sign extension.

Range Bits

These bits set the *g* range as described in Table 18.

Table 18. *g* Range Setting

Setting		
D1	D0	*g* Range
0	0	±2 *g*
0	1	±4 *g*
1	0	±8 *g*
1	1	±16 *g*

Register 0x32 to Register 0x37—DATAX0, DATAX1, DATAY0, DATAY1, DATAZ0, DATAZ1 (Read Only)

These six bytes (Register 0x32 to Register 0x37) are eight bits each and hold the output data for each axis. Register 0x32 and Register 0x33 hold the output data for the x-axis, Register 0x34 and Register 0x35 hold the output data for the y-axis, and Register 0x36 and Register 0x37 hold the output data for the z-axis. The output data is twos complement, with DATAx0 as the least significant byte and DATAx1 as the most significant byte, where x represent X, Y, or Z. The DATA_FORMAT register (Address 0x31) controls the format of the data. It is recommended that a multiple-byte read of all registers be performed to prevent a change in data between reads of sequential registers.

Register 0x38—FIFO_CTL (Read/Write)

D7	D6	D5	D4	D3	D2	D1	D0
FIFO_MODE		Trigger	Samples				

FIFO_MODE Bits

These bits set the FIFO mode, as described in Table 19.

Table 19. FIFO Modes

Setting			
D7	D6	Mode	Function
0	0	Bypass	FIFO is bypassed.
0	1	FIFO	FIFO collects up to 32 values and then stops collecting data, collecting new data only when FIFO is not full.
1	0	Stream	FIFO holds the last 32 data values. When FIFO is full, the oldest data is overwritten with newer data.
1	1	Trigger	When triggered by the trigger bit, FIFO holds the last data samples before the trigger event and then continues to collect data until full. New data is collected only when FIFO is not full.

Trigger Bit

A value of 0 in the trigger bit links the trigger event of trigger mode to INT1, and a value of 1 links the trigger event to INT2.

Samples Bits

The function of these bits depends on the FIFO mode selected (see Table 20). Entering a value of 0 in the samples bits immediately sets the watermark status bit in the INT_SOURCE register, regardless of which FIFO mode is selected. Undesirable operation may occur if a value of 0 is used for the samples bits when trigger mode is used.

Table 20. Samples Bits Functions

FIFO Mode	Samples Bits Function
Bypass	None.
FIFO	Specifies how many FIFO entries are needed to trigger a watermark interrupt.
Stream	Specifies how many FIFO entries are needed to trigger a watermark interrupt.
Trigger	Specifies how many FIFO samples are retained in the FIFO buffer before a trigger event.

0x39—FIFO_STATUS (Read Only)

D7	D6	D5	D4	D3	D2	D1	D0
FIFO_TRIG	0	Entries					

FIFO_TRIG Bit

A 1 in the FIFO_TRIG bit corresponds to a trigger event occurring, and a 0 means that a FIFO trigger event has not occurred.

Entries Bits

These bits report how many data values are stored in FIFO. Access to collect the data from FIFO is provided through the DATAX, DATAY, and DATAZ registers. FIFO reads must be done in burst or multiple-byte mode because each FIFO level is cleared after any read (single- or multiple-byte) of FIFO. FIFO stores a maximum of 32 entries, which equates to a maximum of 33 entries available at any given time because an additional entry is available at the output filter of the device.

APPLICATIONS INFORMATION

POWER SUPPLY DECOUPLING

A 1 μF tantalum capacitor (C_S) at V_S and a 0.1 μF ceramic capacitor (C_{IO}) at $V_{DD\ I/O}$ placed close to the ADXL345 supply pins is used for testing and is recommended to adequately decouple the accelerometer from noise on the power supply. If additional decoupling is necessary, a resistor or ferrite bead, no larger than 100 Ω, in series with V_S may be helpful. Additionally, increasing the bypass capacitance on V_S to a 10 μF tantalum capacitor in parallel with a 0.1 μF ceramic capacitor may also improve noise.

Care should be taken to ensure that the connection from the ADXL345 ground to the power supply ground has low impedance because noise transmitted through ground has an effect similar to noise transmitted through V_S. It is recommended that V_S and $V_{DD\ I/O}$ be separate supplies to minimize digital clocking noise on the V_S supply. If this is not possible, additional filtering of the supplies as previously mentioned may be necessary.

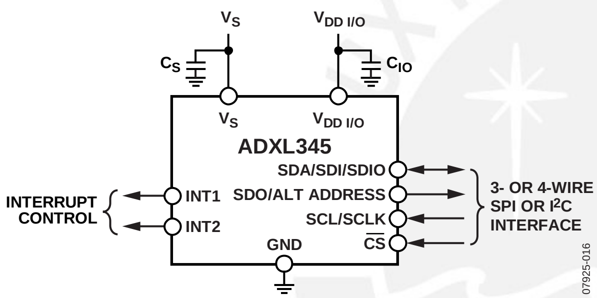


Figure 11. Application Diagram

MECHANICAL CONSIDERATIONS FOR MOUNTING

The ADXL345 should be mounted on the PCB in a location close to a hard mounting point of the PCB to the case. Mounting the ADXL345 at an unsupported PCB location, as shown in Figure 12, may result in large, apparent measurement errors due to undampened PCB vibration. Locating the accelerometer near a hard mounting point ensures that any PCB vibration at the accelerometer is above the accelerometer's mechanical sensor resonant frequency and, therefore, effectively invisible to the accelerometer.

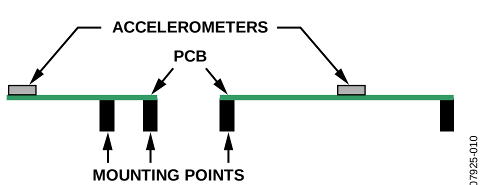


Figure 12. Incorrectly Placed Accelerometers

TAP DETECTION

The tap interrupt function is capable of detecting either single or double taps. The following parameters are shown in Figure 13 for a valid single and valid double tap event:

- The tap detection threshold is defined by the THRESH_TAP register (Address 0x1D).
- The maximum tap duration time is defined by the DUR register (Address 0x21).
- The tap latency time is defined by the latent register (Address 0x22) and is the waiting period from the end of the first tap until the start of the time window, when a second tap can be detected, which is determined by the value in the window register (Address 0x23).
- The interval after the latency time (set by the latent register) is defined by the window register. Although a second tap must begin after the latency time has expired, it need not finish before the end of the time defined by the window register.

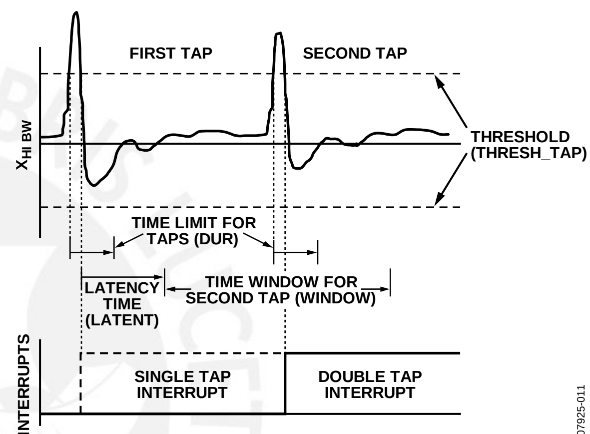


Figure 13. Tap Interrupt Function with Valid Single and Double Taps

If only the single tap function is in use, the single tap interrupt is triggered when the acceleration goes below the threshold, as long as DUR has not been exceeded. If both single and double tap functions are in use, the single tap interrupt is triggered when the double tap event has been either validated or invalidated.

Several events can occur to invalidate the second tap of a double tap event. First, if the suppress bit in the TAP_AXES register (Address 0x2A) is set, any acceleration spike above the threshold during the latency time (set by the latent register) invalidates the double tap detection, as shown in Figure 14.

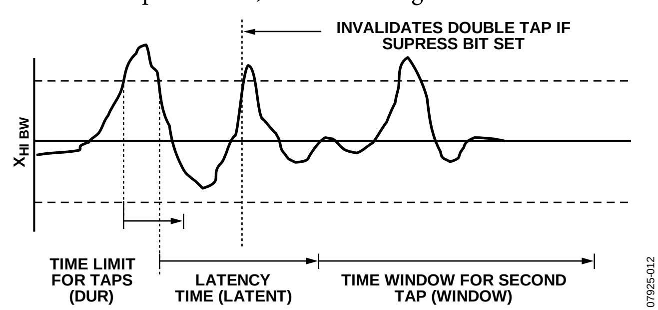


Figure 14. Double Tap Event Invalid Due to High g Event When the Suppress Bit Is Set

A double tap event can also be invalidated if acceleration above the threshold is detected at the start of the time window for the second tap (set by the window register). This results in an invalid double tap at the start of this window, as shown in Figure 15. Additionally, a double tap event can be invalidated if an acceleration exceeds the time limit for taps (set by the DUR register), resulting in an invalid double tap at the end of the DUR time limit for the second tap event, also shown in Figure 15.

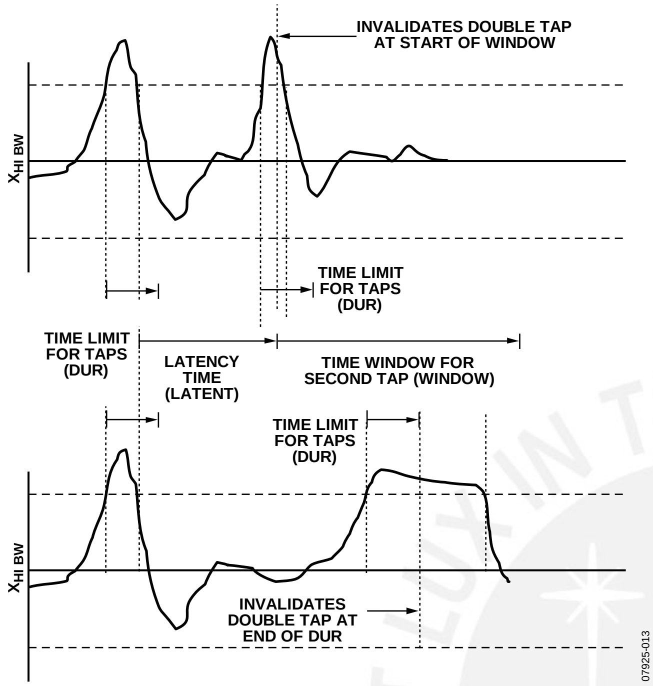


Figure 15. Tap Interrupt Function with Invalid Double Taps

Single taps, double taps, or both can be detected by setting the respective bits in the INT_ENABLE register (Address 0x2E). Control over participation of each of the three axes in single tap/double tap detection is exerted by setting the appropriate bits in the TAP_AXES register (Address 0x2A). For the double tap function to operate, both the latent and window registers must be set to a nonzero value.

Every mechanical system has somewhat different single tap/double tap responses based on the mechanical characteristics of the system. Therefore, some experimentation with values for the latent, window, and THRESH_TAP registers is required. In general, a good starting point is to set the latent register to a value greater than 0x10, to set the window register to a value greater than 0x10, and to set the THRESH_TAP register to be greater than 3 *g*. Setting a very low value in the latent, window, or THRESH_TAP register may result in an unpredictable response due to the accelerometer picking up echoes of the tap inputs.

After a tap interrupt has been received, the first axis to exceed the THRESH_TAP level is reported in the ACT_TAP_STATUS register (Address 0x2B). This register is never cleared, but is overwritten with new data.

THRESHOLD

The lower output data rates are achieved by decimating a common sampling frequency inside the device. The activity, free-fall, and single tap/double tap detection functions are performed using unfiltered data. Since the output data is filtered, the high frequency and high *g* data that is used to determine activity, free-fall, and single tap/double tap events may not be present if the output of the accelerometer is examined. This may result in trigger events being detected when acceleration does not appear to trigger an event because the unfiltered data may have exceeded a threshold or remained below a threshold for a certain period of time while the filtered output data has not exceeded such a threshold.

LINK MODE

The function of the link bit is to reduce the number of activity interrupts that the processor must service by setting the device to look for activity only after inactivity. For proper operation of this feature, the processor must still respond to the activity and inactivity interrupts by reading the INT_SOURCE register (Address 0x30) and, therefore, clearing the interrupts. If an activity interrupt is not cleared, the part cannot go into autosleep mode. The asleep bit in the ACT_TAP_STATUS register (Address 0x2B) indicates if the part is asleep.

SLEEP MODE VS. LOW POWER MODE

In applications where a low data rate is sufficient and low power consumption is desired, it is recommended that the low power mode be used in conjunction with the FIFO. The sleep mode, while offering a low data rate and low average current consumption, suppresses the DATA_READY interrupt, preventing the accelerometer from sending an interrupt signal to the host processor when data is ready to be collected. In this application, setting the part into low power mode (by setting the LOW_POWER bit in the BW_RATE register) and enabling the FIFO in FIFO mode to collect a large value of samples reduces the power consumption of the ADXL345 and allows the host processor to go to sleep while the FIFO is filling up.

USING SELF-TEST

The self-test change is defined as the difference between the acceleration output of an axis with self-test enabled and the acceleration output of the same axis with self-test disabled (see Endnote 4 of Table 1). This definition assumes that the sensor does not move between these two measurements, because if the sensor moves, a non–self-test related shift corrupts the test.

Proper configuration of the ADXL345 is also necessary for an accurate self-test measurement. The part should be set with a data rate greater than or equal to 100 Hz. This is done by ensuring that a value greater than or equal to 0x0A is written into the rate bits (Bit D3 through Bit D0) in the BW_RATE register (Address 0x2C). It is also recommended that the part be set to full-resolution, 16 *g* mode to ensure that there is sufficient dynamic range for the entire self-test shift. This is done by setting Bit D3 of the DATA_FORMAT register (Address 0x31) and writing a value of 0x03 to the range bits (Bit D1 and Bit D0) of the DATA_FORMAT register (Address 0x31). This results in a high dynamic range for measurement and a 3.9 m*g*/LSB scale factor.

After the part is configured for accurate self-test measurement, several samples of x-, y-, and z-axis acceleration data should be retrieved from the sensor and averaged together. The number of samples averaged is a choice of the system designer, but a recommended starting point is 0.1 sec worth of data, which corresponds to 10 samples at 100 Hz data rate. The averaged values should be stored and labeled appropriately as the self-test disabled data, that is, X_{ST_OFF}, Y_{ST_OFF}, and Z_{ST_OFF}.

Next, self-test should be enabled by setting Bit D7 of the DATA_FORMAT register (Address 0x31). The output needs some time (about four samples) to settle after enabling self-test. After allowing the output to settle, several samples of the x-, y-, and z-axis acceleration data should be taken again and averaged. It is recommended that the same number of samples be taken for this average as was previously taken. These averaged values should again be stored and labeled appropriately as the value with self-test enabled, that is, X_{ST_ON}, Y_{ST_ON}, and Z_{ST_ON}. Self-test can then be disabled by clearing Bit D7 of the DATA_FORMAT register (Address 0x31).

With the stored values for self-test enabled and disabled, the self-test change is as follows:

$$X_{ST} = X_{ST\_ON} - X_{ST\_OFF}$$

$$Y_{ST} = Y_{ST\_ON} - Y_{ST\_OFF}$$

$$Z_{ST} = Z_{ST\_ON} - Z_{ST\_OFF}$$

Because the measured output for each axis is expressed in LSBs, X_{ST}, Y_{ST}, and Z_{ST} are also expressed in LSBs. These values can be converted to *g*'s of acceleration by multiplying each value by the 3.9 m*g*/LSB scale factor, if configured for full-resolution, 16 *g* mode. Additionally, Table 12 through Table 15 correspond to the self-test range converted to LSBs and can be compared with the measured self-test change. If the part was placed into full-resolution, 16 *g* mode, the values listed in Table 12 should be used. Although the fixed 10-bit mode or a range other than 16 *g* can be used, a different set of values, as indicated in Table 13 through Table 15, would need to be used. Using a range below 8 *g* may result in insufficient dynamic range and should be considered when selecting the range of operation for measuring self-test. In addition, note that the range in Table 1 and the values in Table 12 through Table 15 take into account all possible supply voltages, V_S, and no additional conversion due to V_S is necessary.

If the self-test change is within the valid range, the test is considered successful. Generally, a part is considered to pass if the minimum magnitude of change is achieved. However, a part that changes by more than the maximum magnitude is not necessarily a failure.

AXES OF ACCELERATION SENSITIVITY

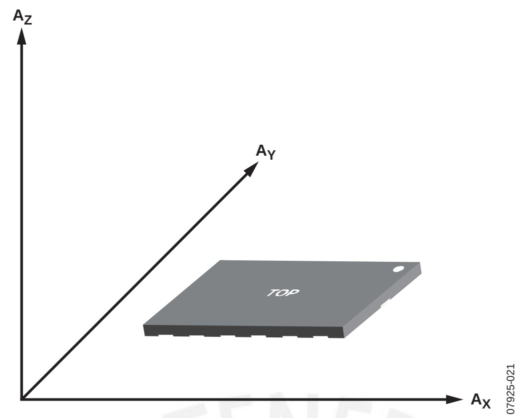


Figure 16. Axes of Acceleration Sensitivity (Corresponding Output Voltage Increases When Accelerated Along the Sensitive Axis)

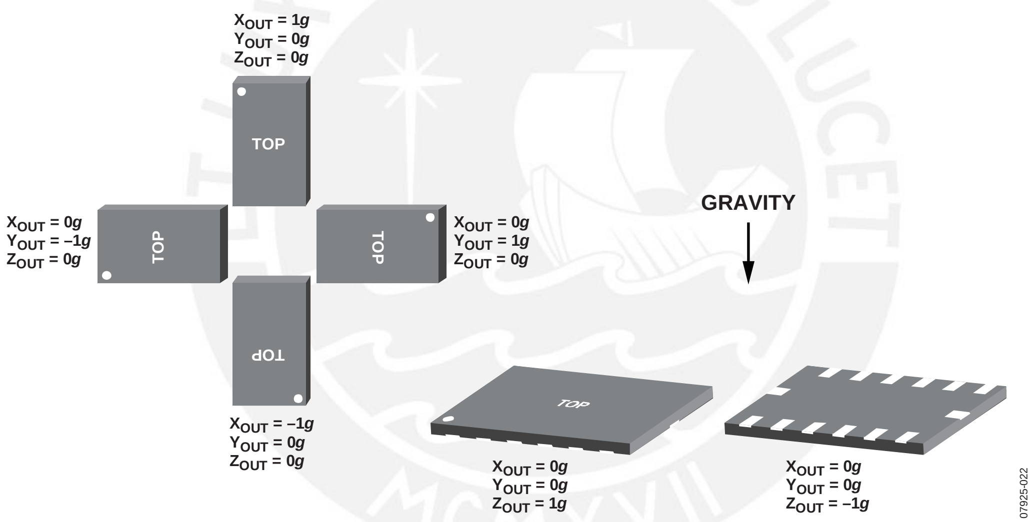


Figure 17. Output Response vs. Orientation to Gravity

LAYOUT AND DESIGN RECOMMENDATIONS

Figure 18 shows the recommended printed wiring board land pattern. Figure 19 and Table 21 provide details about the recommended soldering profile.

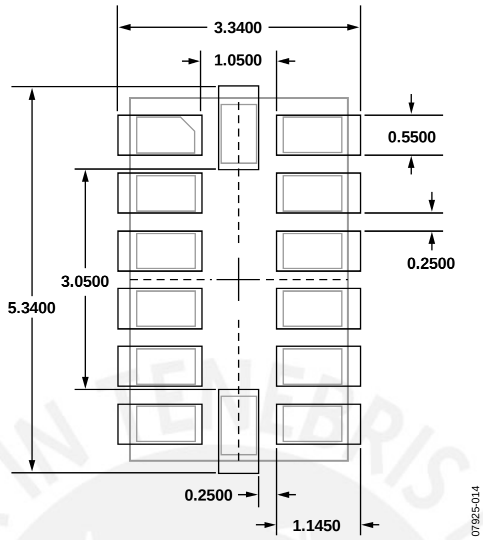


Figure 18. Recommended Printed Wiring Board Land Pattern (Dimensions shown in millimeters)

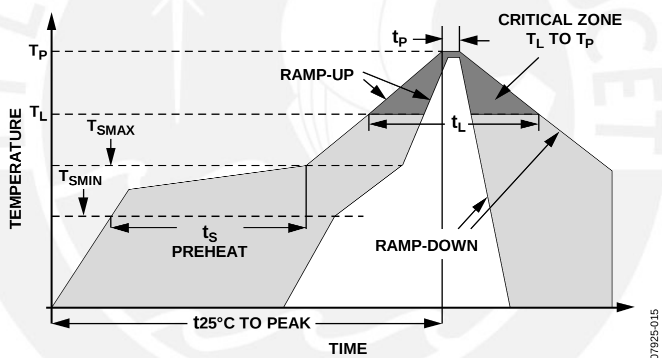


Figure 19. Recommended Soldering Profile

Table 21. Recommended Soldering Profile[1, 2]

	Condition	
Profile Feature	**Sn63/Pb37**	**Pb-Free**
Average Ramp Rate from Liquid Temperature (T_L) to Peak Temperature (T_P)	3°C/sec max	3°C/sec max
Preheat		
Minimum Temperature (T_{SMIN})	100°C	150°C
Maximum Temperature (T_{SMAX})	150°C	200°C
Time from T_{SMIN} to T_{SMAX} (t_S)	60 sec to 120 sec	60 sec to 180 sec
T_{SMAX} to T_L Ramp-Up Rate	3°C/sec max	3°C/sec max
Liquid Temperature (T_L)	183°C	217°C
Time Maintained Above T_L (t_L)	60 sec to 150 sec	60 sec to 150 sec
Peak Temperature (T_P)	240 + 0/−5°C	260 + 0/−5°C
Time of Actual T_P − 5°C (t_P)	10 sec to 30 sec	20 sec to 40 sec
Ramp-Down Rate	6°C/sec max	6°C/sec max
Time 25°C to Peak Temperature	6 minutes max	8 minutes max

[1] Based on JEDEC Standard J-STD-020D.1.
[2] For best results, the soldering profile should be in accordance with the recommendations of the manufacturer of the solder paste used.

OUTLINE DIMENSIONS

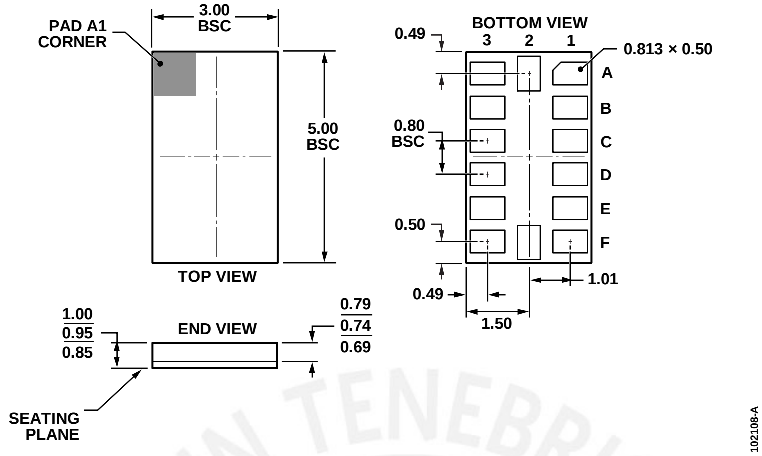


Figure 20. 14-Terminal Land Grid Array [LGA]
(CC-14-1)
Solder Terminations Finish Is Au over Ni
(Dimensions shown in millimeters)

ORDERING GUIDE

Model	Measurement Range (*g*)	Specified Voltage (V)	Temperature Range	Package Description	Package Option
ADXL345BCCZ[1]	±2, ±4, ±8, ±16	2.5	−40°C to +85°C	14-Terminal Land Grid Array [LGA]	CC-14-1
ADXL345BCCZ-RL[1]	±2, ±4, ±8, ±16	2.5	−40°C to +85°C	14-Terminal Land Grid Array [LGA]	CC-14-1
ADXL345BCCZ-RL7[1]	±2, ±4, ±8, ±16	2.5	−40°C to +85°C	14- Terminal Land Grid Array [LGA]	CC-14-1
EVAL-ADXL345Z[1]				Evaluation Board	
EVAL-ADXL345Z-M[1]				Analog Devices Inertial Sensor Evaluation System, Includes ADXL345 Satellite	
EVAL-ADXL345Z-S[1]				ADXL345 Satellite, Standalone	

[1] Z = RoHS Compliant Part.

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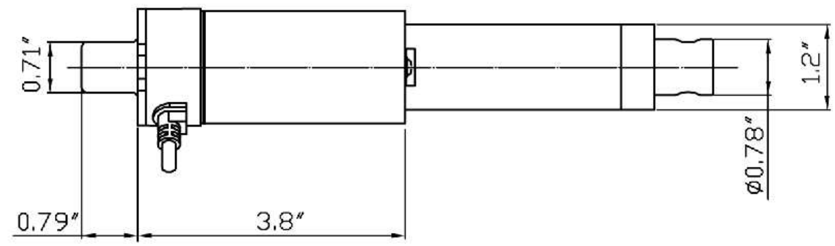
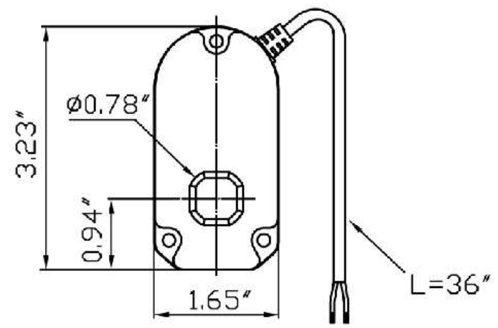
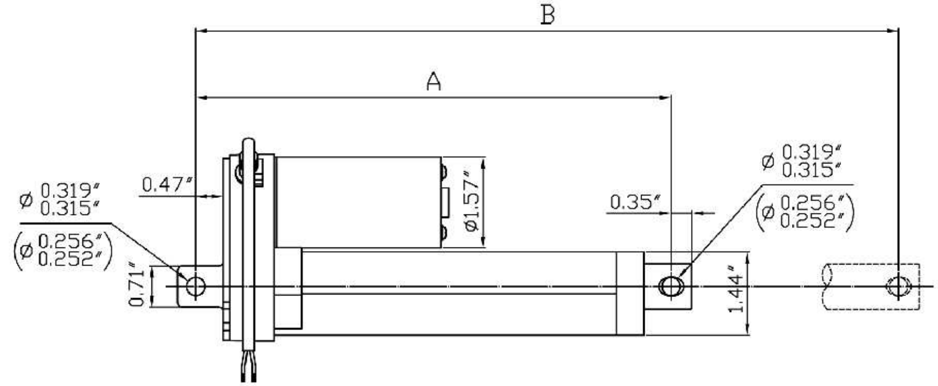
D07925-0-5/09(0)

Gear Ratio	No Load speed(in/s)	Max. Load(lbs)
5:1	1.8″	34
10:1	1.1″	56
20:1	0.6″	112
30:1	0.4″	167
40:1	0.28″	222
Motor Speed	6000rpm	
Input	12V / 24V(DC)	







WIRE COLOR	COMMENT
RED	MOTOR(+)
BLACK	MOTOR(-)

Stroke	2″	4″	6″	8″	10″	12″
Retracted Length (A±0.12″)	6.2″	8.2″	10.2″	12.3″	14.3″	16.3″
Extended Length (B±0.12″)	8.2″	12.2″	16.2″	20.1″	24.1″	28.1″

Global Solutions
IOWA Export-Import
512 Tuttle Street
Des Moines, Iowa 50309-4618

Revision	Date	Drawn By	Description
A	5/25/2010	KO	LD Series Actuator
B			
C			
D			

Units	Inches
Tolerances	
Materials	
Finish	
Scale	None
Revision	A
Comments:	

Part Name

LD3 Standard

Part No.

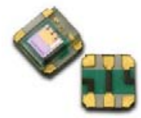
LACT2 - LACT12

5 4 3 2 1

APDS-9008

Miniature Surface-Mount Ambient Light Photo Sensor

Data Sheet



Description

The APDS-9008 is a low cost analog-output ambient light photo sensor in miniature chipLED lead-free surface mount package. It consists of a spectrally suited photo sensor, which provides excellent responsivity that is close to the response of the human eyes, as show in figure 2. The APDS-9008 is ideal for applications in which the measurement of ambient light is used to control display backlighting. Mobile appliances such as the mobile phones and PDAs that draw heavy current from display backlighting will benefit from incorporating these photo sensor products in their designs by reducing power consumption significantly.

Application Support Information

The Application Engineering Group is available to assist you with the application design associated with APDS-9008 ambient light photo sensor module. You can contact them through your local sales representatives for additional details.

Features

- Excellent responsivity
  - Close responsivity to the human eye
- Miniature ChipLED Leadfree surface-mount package
  Height – 0.55 mm
  Width – 1.60 mm
  Depth – 1.50 mm
- Low sensitivity variation across various light sources
- Operating temperature : -40°C to 85°C
- Vcc supply 1.6 to 5.5V
- Lead-free package, RoHS compliance
- Output linearity across wide illumination range
- High output saturation voltage

Applications

- Detection of ambient light to control display backlighting
  Mobile devices – Mobile phones, PDAs
  Computing devices – Notebooks, Webpads
  Consumer devices – TVs, Video Cameras, Digital Still Camera
- Automatic Residential and Commercial Lighting Management
- Electronic Signs and Signals

Ordering Information

Part Number	Packaging Type	Package	Quantity
APDS-9008-020	Tape and Reel	6-pins Chipled package	2500

Typical Application Circuit

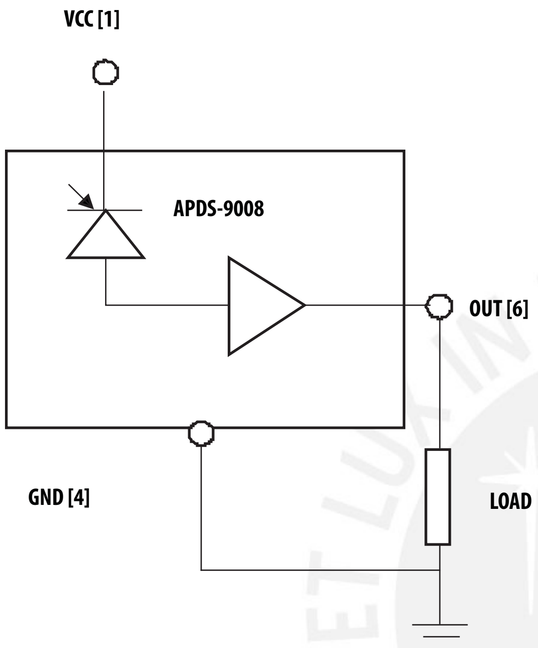


Figure 1. Typical application circuit for APDS-9008

I/O Pins Configuration Table

Pin	Symbol	Description
1	VCC	VCC
2	NC	No Connect
3	NC	No Connect
4	GND	Ground
5	NC	No Connect
6	Iout	Out

Absolute Maximum Ratings

For implementations where case to ambient thermal resistance is ≤ 50 °C /W

Parameter	Symbol	Min.	Max.	Units
Storage Temperature	T_S	-40	85	°C
Supply Voltage	V_{CC}	0	6	V

Recommended Operating Conditions

Parameter	Symbol	Min.	Max.	Units	Conditions
Operating Temperature	T_A	-40	85	°C	
Supply Voltage	V_{CC}	1.6	5.5	V	

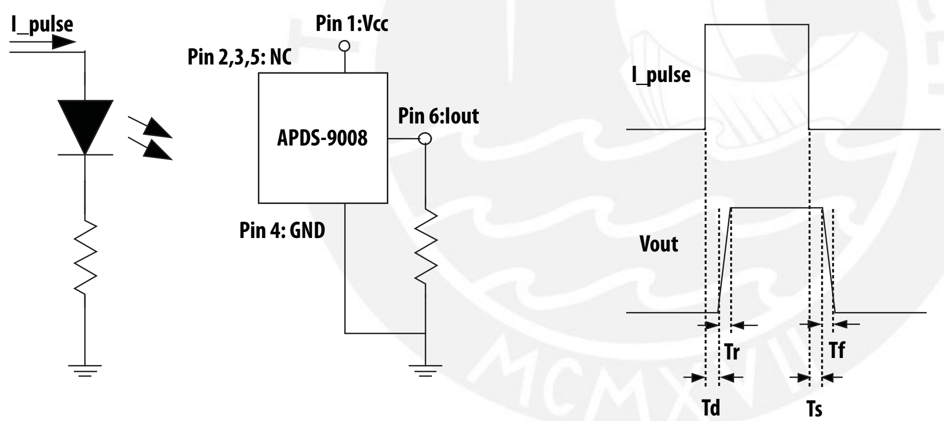
CAUTION: *It is advised that normal static precautions be taken in handling and assembly of this component to prevent damage and/or degradation which may be induced by ESD.*

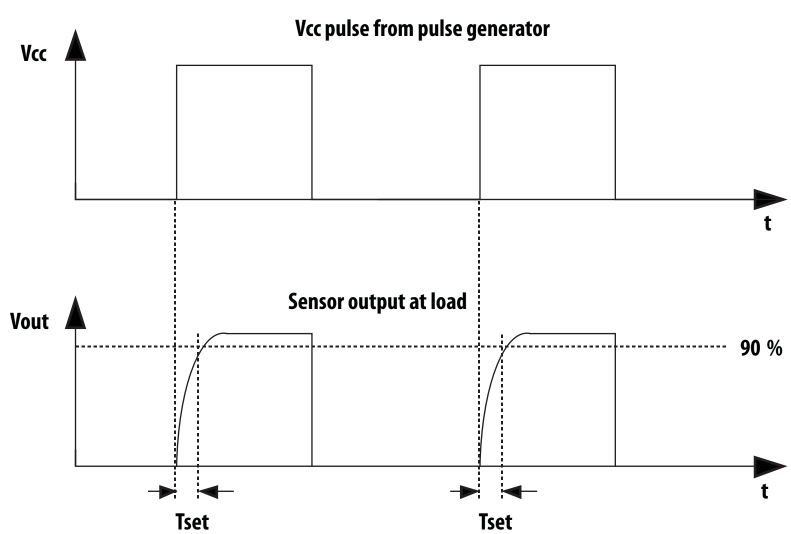
Electrical & Optical Specifications (Ta=25°C)

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Supply Current	ICC		42		μA	Vcc =1.8V, Lux = 100 (2)
Photo Current (I)	$I_{\_PH1}$	28	40	52	μA	Vcc =1.8V, Lux = 100 (2)
Photo Current (II)	$I_{\_PH2}$		44		μA	Vcc =1.8V, Lux = 100 (1)
Dark Current	$I_{\_DARK}$		300		nA	Vcc =1.8V, Lux = 0
Light Current Ratio	$I_{\_PH2}/I_{\_PH1}$		1.1			Incandescent light / Fluorescent light
Rise Time	Tr		5		ms	Rl = 1Kohm, Lux = 100
Fall Time	Tf		5		ms	R1 = 1Kohm, Lux=100
Settling Time	T_{set}		10		ms	R1=2.4Kohm,Lux=100
Peak sensitivity wavelength	λ		565		nm	
Propagation delay	Td		5		ms	Rl = 1Kohm, Lux = 100
Storage delay	Ts		5		ms	R1 = 1Kohm, Lux=100
Saturation voltage	Vsat	1.5			V	R1 = 100Kohm, Lux = 100, Vcc=1.8V

Notes :
1. Illuminance by CIE standard light source (Incandescent lamp)
2. Fluorescence light is used as light source, however, white LED is substituted in a mass production process.

Light Measurement Circuit and Waveforms





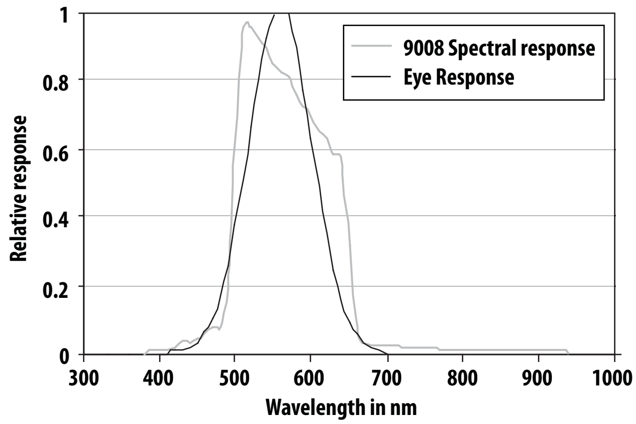


Figure 2. Relative Spectral Response Vs Wavelength

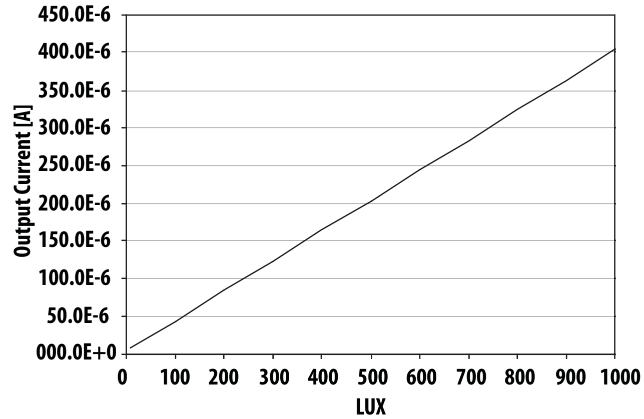


Figure 3. Average Iout Vs Lux (Vcc=1.8v, T=25°C, White LED source)

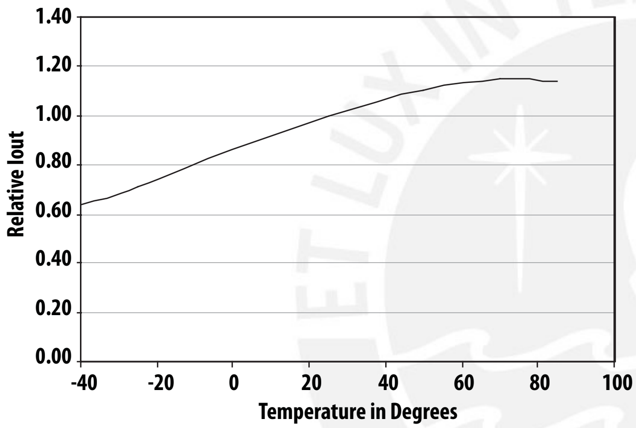


Figure 4. Relative Iout Vs Temp (Vcc=1.8v, 100 Lux)

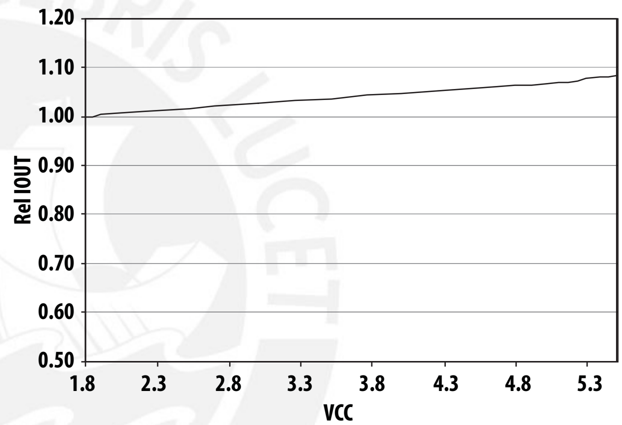


Figure 5. Relative Iout Vs Vcc (T=25°C, 100 Lux)

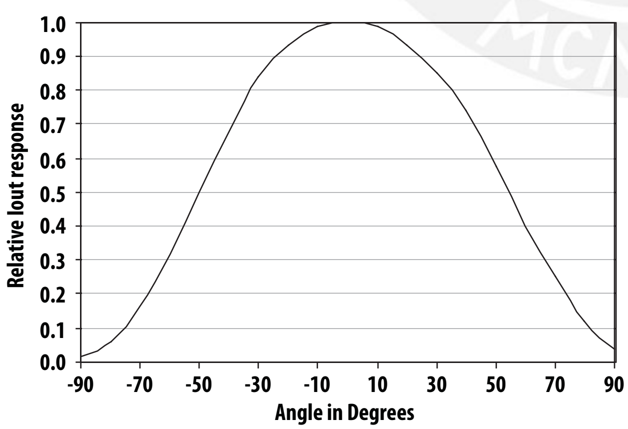


Figure 6. Relative Iout Vs Angle (Vcc=1.8V, T=25°C)

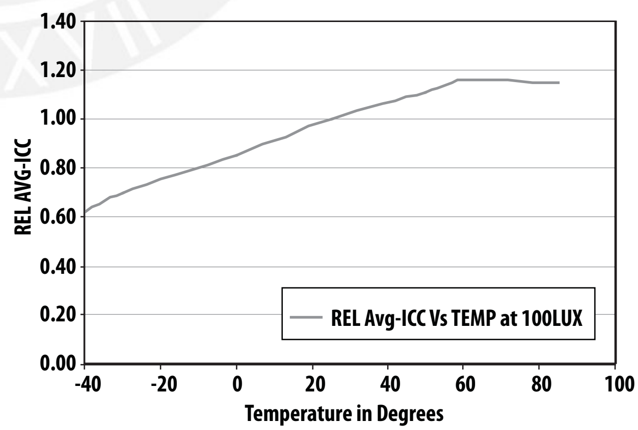


Figure 7. Relative Average Icc Vs Temp (Vcc=1.8V, T=25°C, 100 Lux)

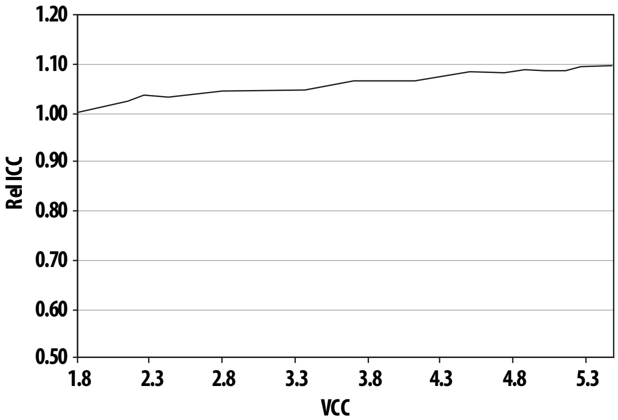


Figure 8. Relative average Icc Vs Vcc (T=25°C, 100 Lux)

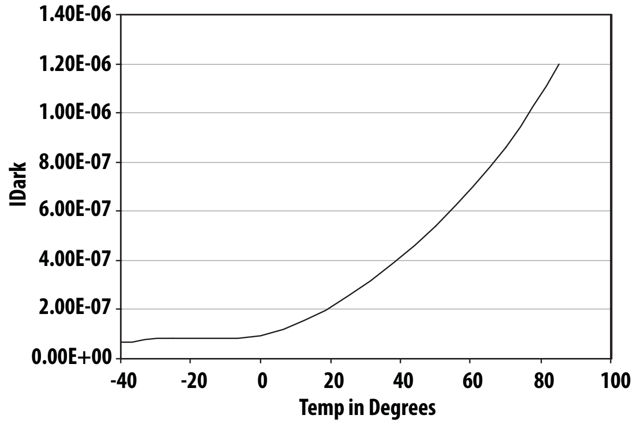


Figure 9. Dark Current Vs Temp (Vcc=1.8V)

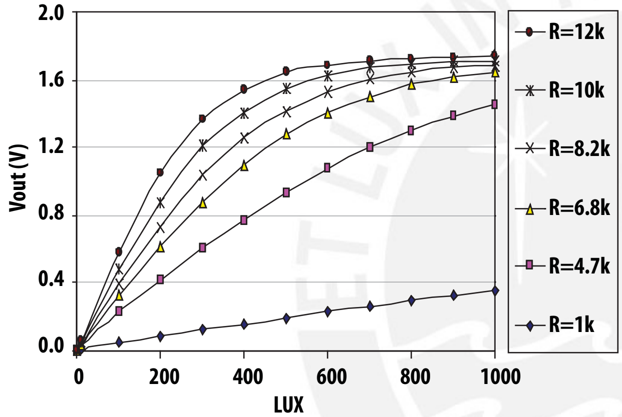
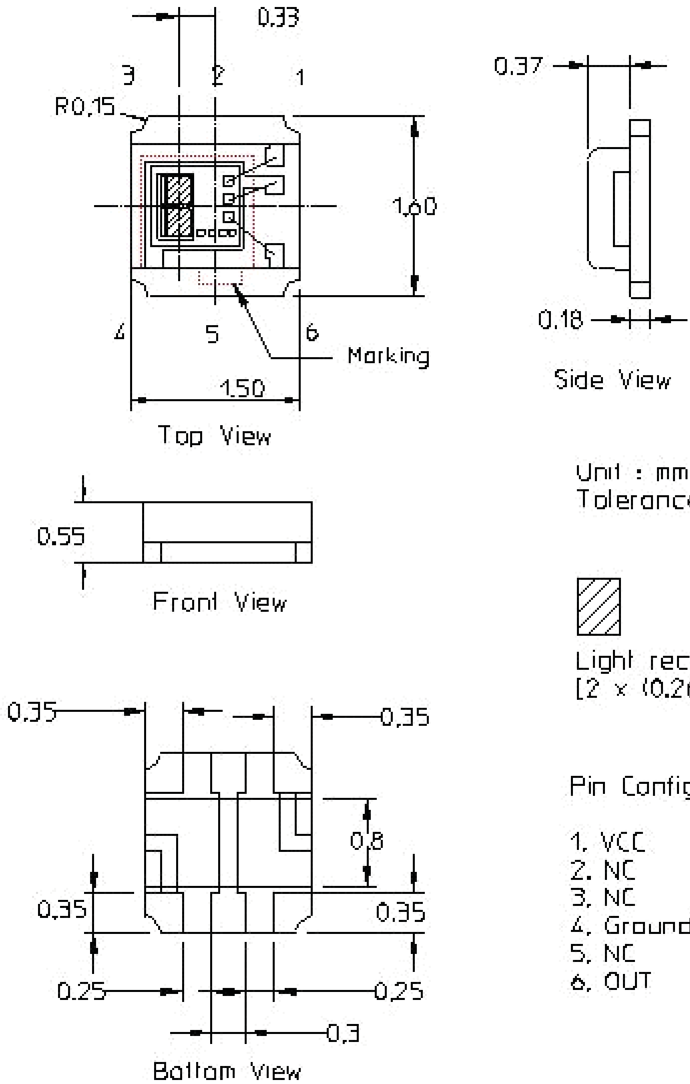


Figure 10. General Luminance Vs Typical Output Voltage
(Vcc=1.8V, T=25°C, Light Source = White LED)

APDS-9008 Package Outline



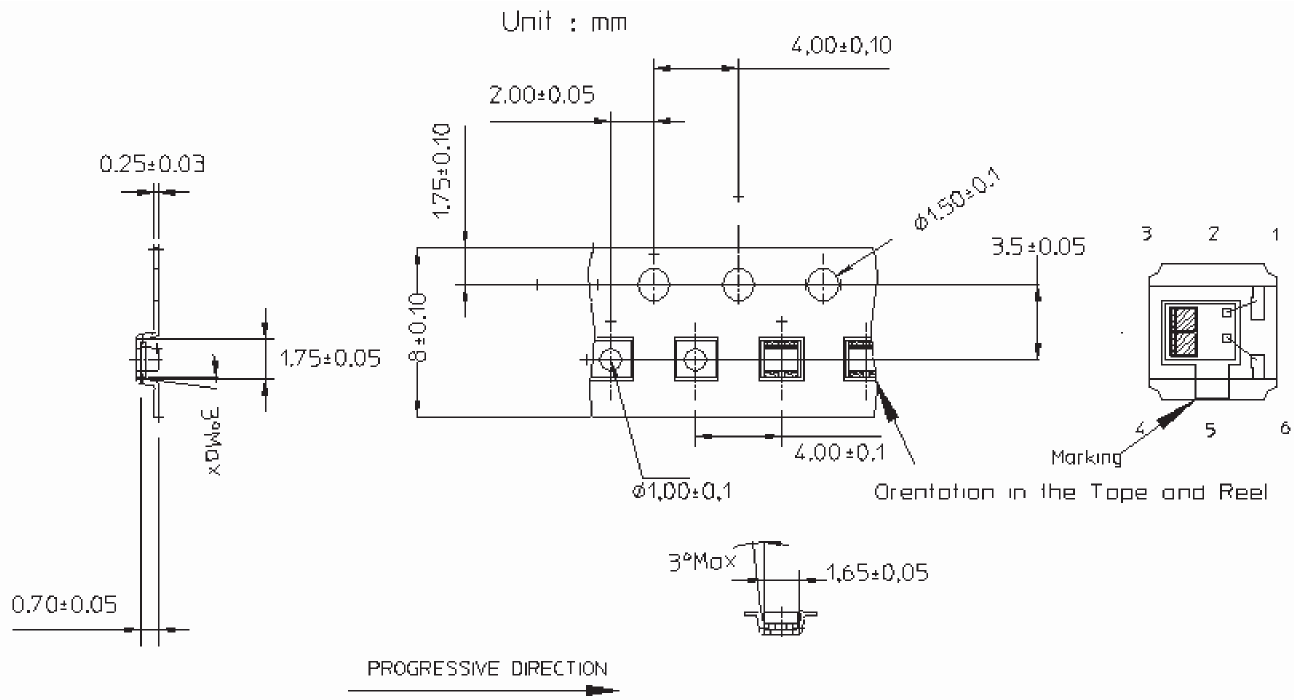
Unit : mm
Tolerance : ±0.1

Light receiving area
[2 × (0.2616 × 0.2166)]mm

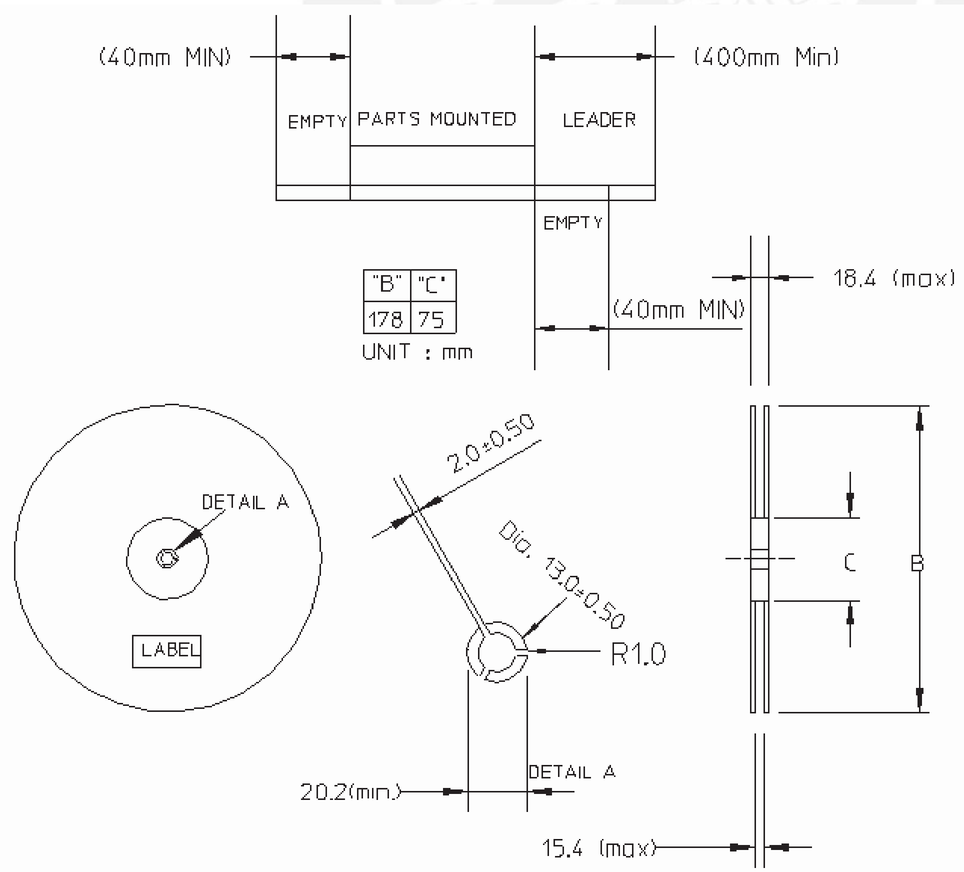
Pin Configuration

1. VCC
2. NC
3. NC
4. Ground
5. NC
6. OUT

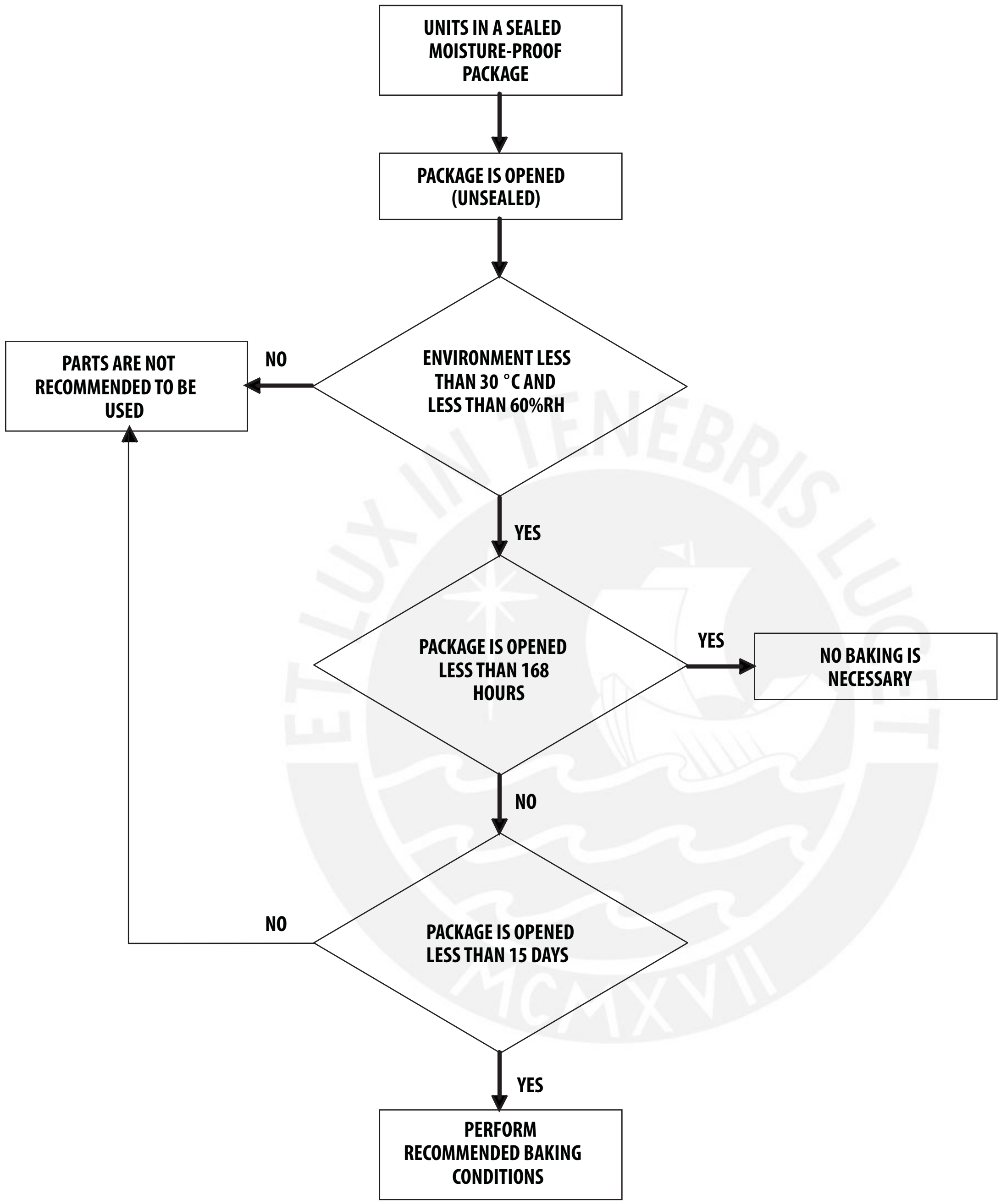
APDS-9008 Tape and Reel Dimension



Material of Carrier Tape : Conductive Polystrene
Material of Cover Tape : PVC
Method of Cover : Heat Sensitive Adhesive



Moisture Proof Packaging



All APDS-9008 options are shipped in moisture proof package. Once opened, moisture absorption begins. This part is compliant to JEDEC Level 3.

Baking Conditions:

Package	Temperature	Time
In Reel	60°C	48 hours
In Bulk	100°C	6 hours

* Baking should only be done once.

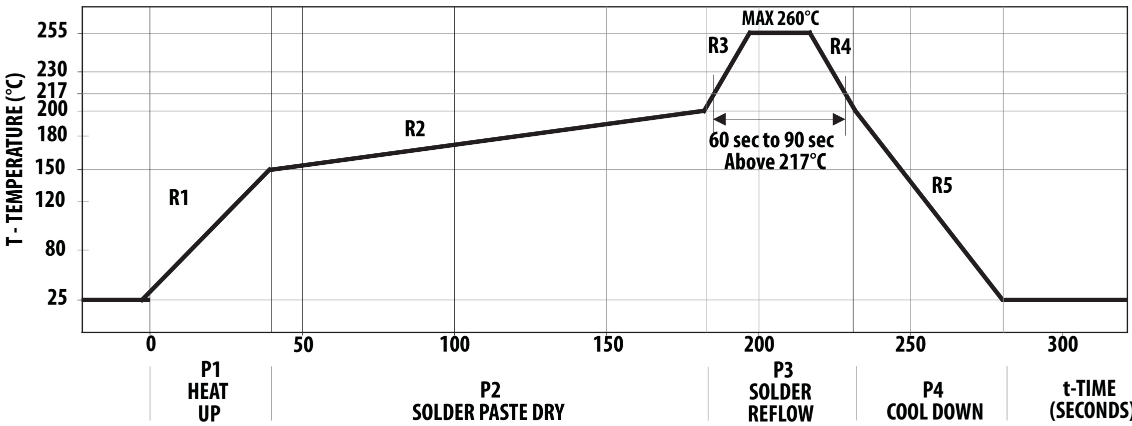
Recommended Storage Conditions:

Storage Temperature	100°C to 300°C
Relative Humidity	below 60% RH

Time from unsealing to soldering:

After removal from the bag, the parts should be soldered within 168 hours if stored at the recommended storage conditions. If times longer than 168 hours are needed, the parts must be stored in a dry box.

Recommended Reflow Profile



Process Zone	Symbol	ΔT	Maximum ΔT/Δtime or Duration
Heat Up	P1, R1	25°C to 150°C	3°C/s
Solder Paste Dry	P2, R2	150°C to 200°C	100s to 180s
Solder Reflow	P3, R3 P3, R4	200°C to 260°C 260°C to 200°C	3°C/s -6°C/s
Cool Down	P4, R5	200°C to 25°C	-6°C/s
Time maintained above liquidus point , 217°C		> 217°C	60s to 120s
Peak Temperature		260°C	-
Time within 5°C of actual Peak Temperature		>255°C	20s to 40s
Time 25°C to Peak Temperature		25°C to 260°C	8mins

The reflow profile is a straight-line representation of a nominal temperature profile for a convective reflow solder process. The temperature profile is divided into four process zones, each with different ΔT/Δtime temperature change rates or duration. The ΔT/Δtime rates or duration are detailed in the above table. The temperatures are measured at the component to printed circuit board connections.

Process zone P1, the PC board and component pins are heated to a temperature of 150°C to activate the flux in the solder paste. The temperature ramp up rate, R1, is limited to 3°C per second to allow for even heating of both the PC board and component pins.

Process zone P2 should be of sufficient time duration (100 to 180 seconds) to dry the solder paste. The temperature is raised to a level just below the liquidus point of the solder.

Process zone P3 is the solder reflow zone. In zone P3, the temperature is quickly raised above the liquidus point of solder to 260°C (500°F) for optimum results. The dwell time above the liquidus point of solder should be between 60 and 120 seconds. This is to assure proper coalescing of the solder paste into liquid solder and the formation of good solder connections. Beyond the recommended dwell time the intermetallic growth within the solder connections becomes excessive, resulting in the formation of weak and unreliable connections. The temperature is then rapidly reduced to a point below the solidus temperature of the solder to allow the solder within the connections to freeze solid.

Process zone P4 is the cool down after solder freeze. The cool down rate, R5, from the liquidus point of the solder to 25°C (77°F) should not exceed 6°C per second maximum. This limitation is necessary to allow the PC board and component pins to change dimensions evenly, putting minimal stresses on the component.

It is recommended to perform reflow soldering no more than twice.

Appendix A. SMT Assembly Application Note

1.0 Solder Pad, Mask and Metal Stencil Aperture

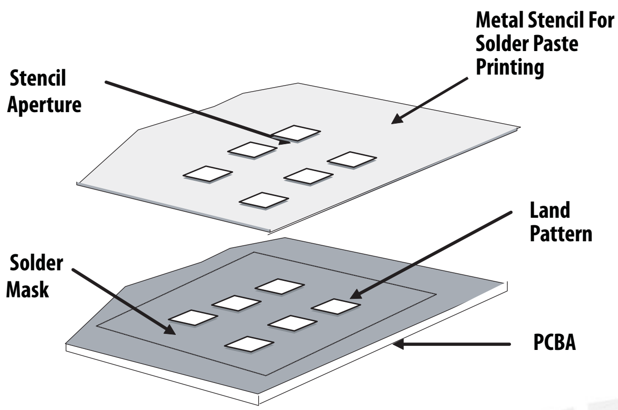


Figure A1. Stencil and PCBA

1.1 Recommended Land Pattern

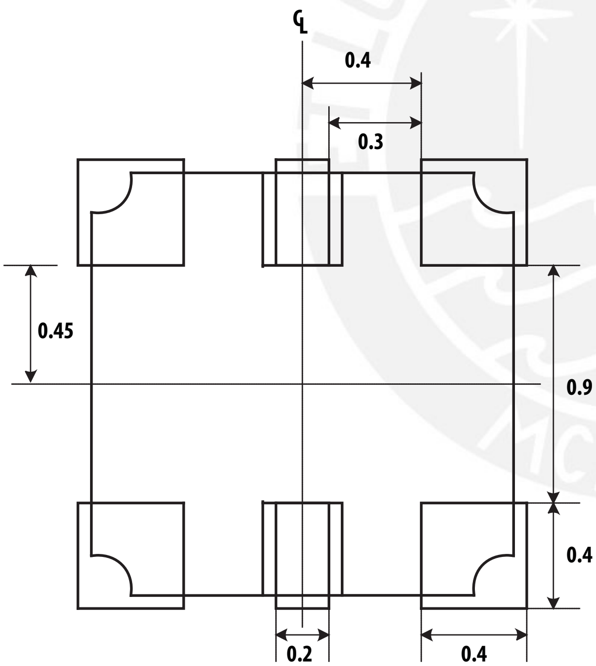


Figure A2. Recommended Land Pattern

1.2 Recommended Metal Solder Stencil Aperture

It is recommended that a 0.11 mm (0.004 inches) thick stencil be used for solder paste printing. Aperture opening for shield pad is 0.4mm x 0.4mm and 0.2mm x 0.4mm (as per land pattern). This is to ensure adequate printed solder paste volume and no shorting.

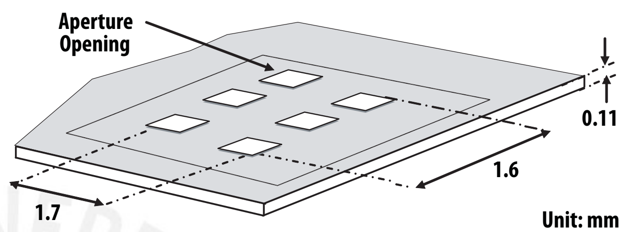


Figure A3. Solder Stencil Aperture

1.3 Adjacent Land Keepout and Solder Mask Areas

Adjacent land keep-out is the maximum space occupied by the unit relative to the land pattern. There should be no other SMD components within this area.

The minimum solder resist strip width required to avoid solder bridging adjacent pads is 0.2 mm.

Note: Wet/Liquid Photo-Imageable solder resist/mask is recommended.

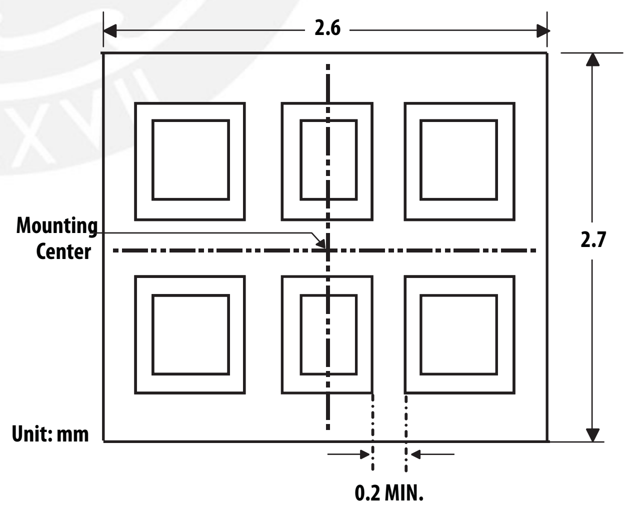


Figure A4. Adjacent Land Keepout and Solder Mask Areas

Appendix B. Optical Window Design for APDS-9008

1.0 Optical Window Dimensions

To ensure that the performance of the APDS-9008 will not be affected by improper window design, there are some constraints on the dimensions and design of the window. There is a constraint on the minimum size of the window, which is placed in front of the photo light sensor, so that it will not affect the angular response of the APDS-9008. This minimum dimension that is recommended will ensure at least a ±35° light reception cone.

If a smaller window is required, a light pipe or light guide can be used. A light pipe or light guide is a cylindrical piece of transparent plastic, which makes use of total internal reflection to focus the light.

The thickness of the window should be kept as minimum as possible because there is a loss of power in every optical window of about 8% due to reflection (4% on each side) and an additional loss of energy in the plastic material.

Figure B1 and B2 illustrate the two types of window that we have recommended which could either be a flat window or a flat window with light pipe.

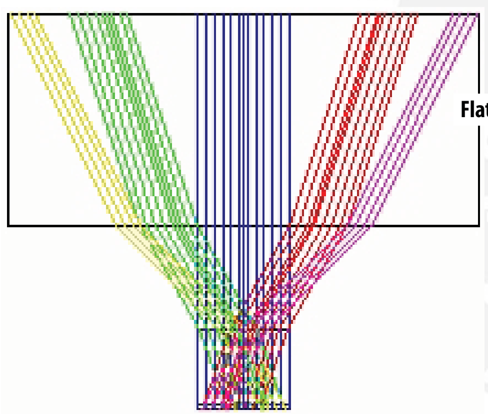


Figure B1. Window Size Determination for Flat Window

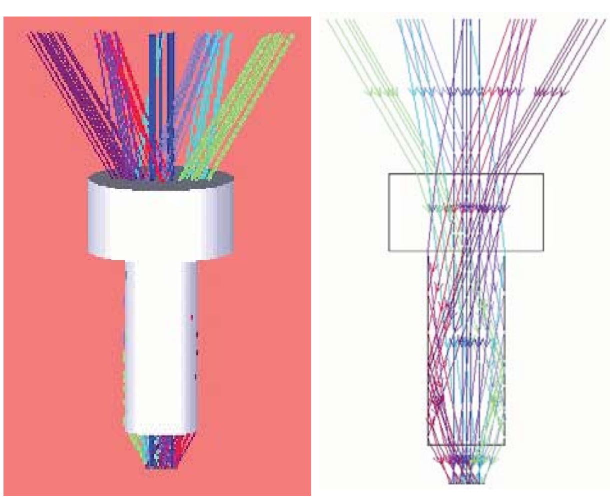


Figure B2. Window Design of Flat Window with Light Guide

Table 1 and Figure B3 below show the recommended dimensions of the window. These dimension values are based on a window thickness of 1.0mm with a refractive index 1.585.

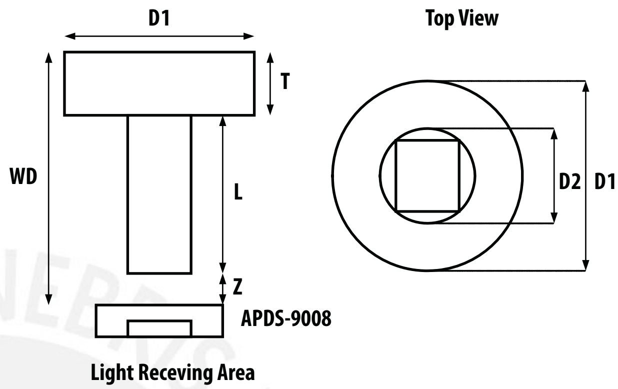


Figure B3. Recommended Window Dimensions

WD: Working Distance between window front panel & APDS-9008

D1: Window Diameter

T: Thickness

L: Length of Light Pipe

D2: Light Pipe Diameter

Z: Distance between window rear panel and APDS-9008

Table 1. Recommended dimension for optical window

All dimensions are in mm

WD (T+L+Z)	Flat Window (L=0.0)		Flat window with Light Pipe (D2=1.5; Z =0.5)	
	Z	D1	D1	L
1.5	0.5	2.25	-	-
2.0	1.0	3.25	-	-
2.5	1.5	4.25	-	-
3.0	2.0	5.00	2.5	1.5

The window should be placed directly on top of the photo sensor to achieve better performance and if a flat window with a light pipe is used, dimension D2 should be 1.5mm to optimize the performance of APDS-9008.

2.1 Optical Window Material

The material of the window is recommended to be polycarbonate. The surface finish of the plastic should be smooth, without any texture.

The recommended plastic material for use as a window is available from Bayer AG and Bayer Antwerp N. V. (Europe), Bayer Corp.(USA) and Bayer Polymers Co., Ltd. (Thailand), as shown in Table 2.

Table 2. Recommended Plastic Materials

Material number	Visible light transmission	Refractive index
Makrolon LQ2647	87%	1.587
Makrolon LQ3147	87%	1.587
Makrolon LQ3187	85%	1.587

Appendix C . General Application Guide for APDS-9008

The APDS-9008 is a low cost analog-output ambient light photo sensor whose spectral response closely emulates the human eyes. APDS-9008 consists of a photo sensor that is able to produce a high gain photo current to a sufficient level that can be converted to voltage with a standard value of external resistor. APDS-9008 can easily be integrated into systems that use ADC input which is available for sampling of the external source, as shown in figure C1 below.

The amount of converted voltage, Vout, is mainly dependant proportionally on the photo current which generated by the brightness of the light shone on the photo sensor and the load resistor used, RL. Increasing the brightness of the light or/and the load resistor will increase the output voltage.

Brightness is measured as "LUX" unit, which describes how intense a light source that our eyes perceive. LUX meter is the equipment for "LUX" measurement. Light sources with the same LUX level appear at the same brightness to the human eyes.

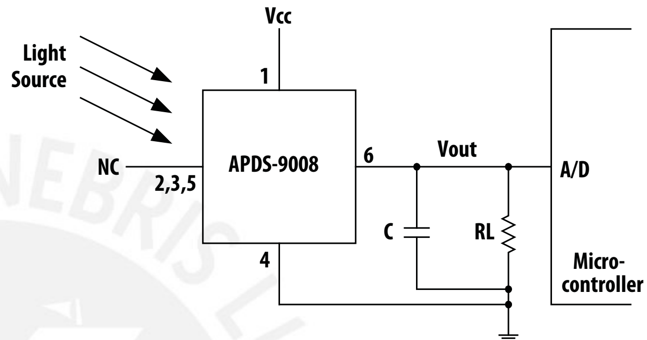


Figure C1. Configuration of APDS-9008

Selection of the load resistor RL will determine the amount of current-to-voltage conversion in the circuit.

Light source e.g. fluorescent light consists of ac noise frequency of about 100Hz. A capacitor of 10uF, which act as a low-pass filter, is recommended to add in parallel with the load resistor to reduce the ripples.

SKYLAB
Simplify Your System

GPS Module DataSheet

Name: Ultra High Sensitivity and The Smart Antenna GPS Module

Model NO.: SKM53

Revision: 001

Revision History:

Revision	Description	Approved	Date
001	Initial Release to 001	Neil	20100310

Skylab M&C Technology Co., Ltd.
Address: Room.801, Bldg.211, Terra Industrial Park, Futian District, Shenzhen
Phone: 86-755 8340 8210（Sales Support）
Phone: 86-755 8340 8130（Technical Support）
Fax: 86-755-8340 8560
E-Mail: sales@skylab.com.cn

SkyNav SKM53 Series
Ultra High Sensitivity and Low Power
The Smart Antenna GPS Module

Simplify your systems

General Description

The SkyNav SKM53 Series with embedded GPS antenna enables high performance navigation in the most stringent applications and solid fix even in harsh GPS visibility environments.

It is based on the high performance features of the MediaTek 3329 single-chip architecture, Its –165dBm tracking sensitivity extends positioning coverage into place like urban canyons and dense foliage environment where the GPS was not possible before. The 6-pin UART connector design is the easiest and convenient solution to be embedded in a portable device and receiver like PND, GPS mouse, car holder, personal locator, speed camera detector and vehicle locator.

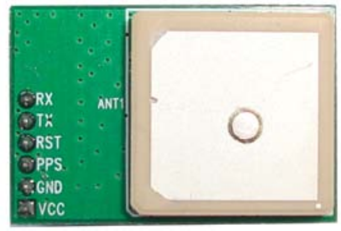


Figure 1: SKM53 Top View

Applications

- LBS (Location Based Service)
- Vehicle navigation system
- PND (Portable Navigation Device)
- GPS mouse and Bluetooth GPS receiver
- Timing application

Features

- Ultra high sensitivity: -165dBm
- 22 tracking/66 acquisition-channel receiver
- WAAS/EGNOS/MSAS/GAGAN support
- NMEA protocols (default speed: 9600bps)
- Internal back-up battery
- One serial port
- Embedded patch antenna 18.2 x 18.2 x 4.0 mm
- Operating temperature range: -40 to 85℃
- RoHS compliant (Lead-free)
- Tiny form factor ： 30mm x20mm x 8.5mm

Pin Assignment

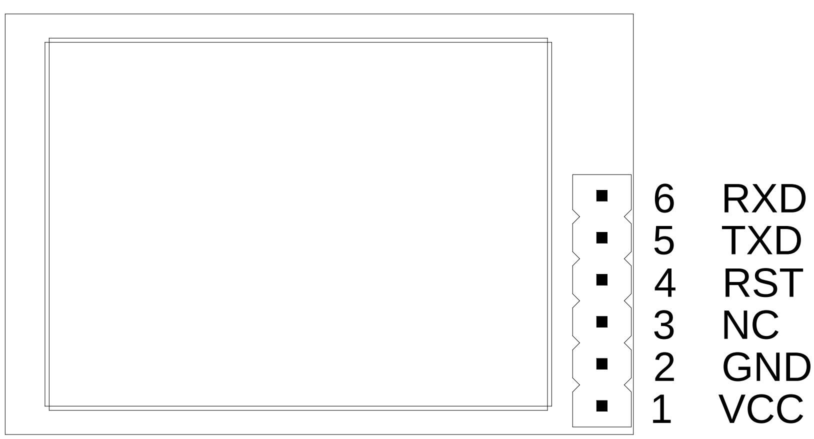


Figure 2: SKM53 Pin Package

Performance Specification

Parameter	Specification	
GPS receiver		
Receiver Type	L1 frequency band, C/A code, 22 Tracking / 66 Acquisition-Channel	
Sensitivity	Tracking Acquisition	-165dBm -148dBm
Accuracy	Position Velocity Timing (PPS)	3.0m CEP without SA 0.1m/s without SA 60ns RMS
Acquisition Time	Cold Start Warm Start Hot Start Re-Acquisition	36s 33s 1s <1s
Power Consumption	Tracking Acquisition Sleep/Standby	<35mA @3.3V 45mA @3.3V TBD
Navigation Data Update Rate	1Hz	
Operational Limits	Altitude Velocity Acceleration	Max 18,000m Max 515m/s Less than 4g
Antenna Specifications		
Outline Dimension	18.2 x 18.2 x 4.0 mm	
Center Frequency	1575 ± 3 MHz	
Bandwidth	10 MHz min	
Impedance	50 Ω	
Axial Ratio	3 dB max	
Polarization	RHCP	
Mechanical requirements		
Dimension	30mm x20mm x 8.5mm	
Weight	15g	
Power consumption		
VCC	5V ±5%	
Current	50mA(typical)	
Environment		
Operating temperature	40~+85℃(w/o backup battery)	
Storage temperature	40 ~ +125 ℃	
Humidity	≦95%	

Hardware Interfaces Configuration

Power Supply: Regulated power for the SKM53 series is required. The input voltage Vcc should be 5V, current is no less than 150mA. Suitable decoupling must be provided by external decoupling circuitry(10uF and 1uF). It can reduce the Noise from power supply and increase power stability.

UART Ports: The module supports one full duplex serial channels UART. The serial connections are at 2.85V LVTTL logic levels, if need different voltage levels, use appropriate level shifters. the data format is however fixed: X, N, 8, 1, i.e. X baud rate, no parity, eight data bits and one stop bit, no other data formats are supported, LSB is sent first. The modules default baud rate is set up 9600bps. The RXD0 & TXD0 recommended to pull up (10KΩ). It can increase the stability of serial data.

Pin Description

Pin No.	Pin name	I/O	Description	Remark
UART Port				
1	VCC	P	Module Power Supply	VCC: 5V ±5%
2	GND	G	Module Power Ground	Reference Ground
3	NC	O	Not Open	Leave Open
4	RST	I	Module Reset (Active Low Status)	
5	TXD	I	TTL:VOH≥0.75 *VCC VOL≤0.25VCC	Leave Open in not used
6	RXD	O	TTL:VIH ≥0.7 *VCC VIL ≤0.3 *VCC	Leave Open in not used

Mechanical Specification

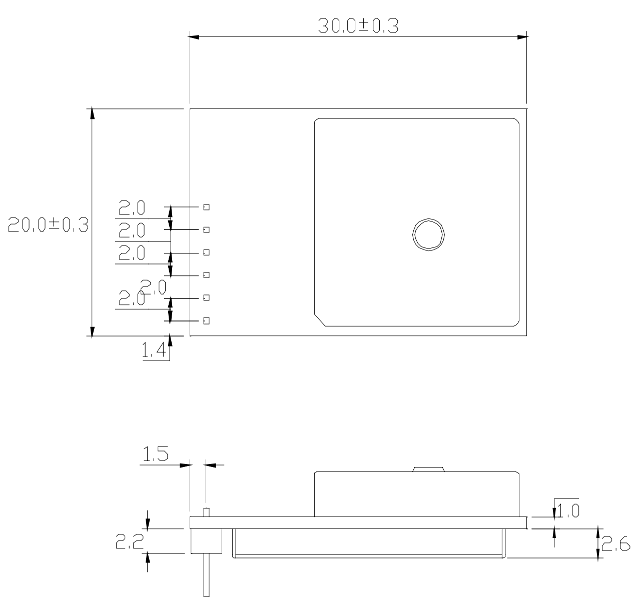


Figure 3: SKM53 Series Dimensions

Packaging Specification

SKM53 modules are shipped in tray and with 24 units per tray. Each tray is ‘dry’ package.

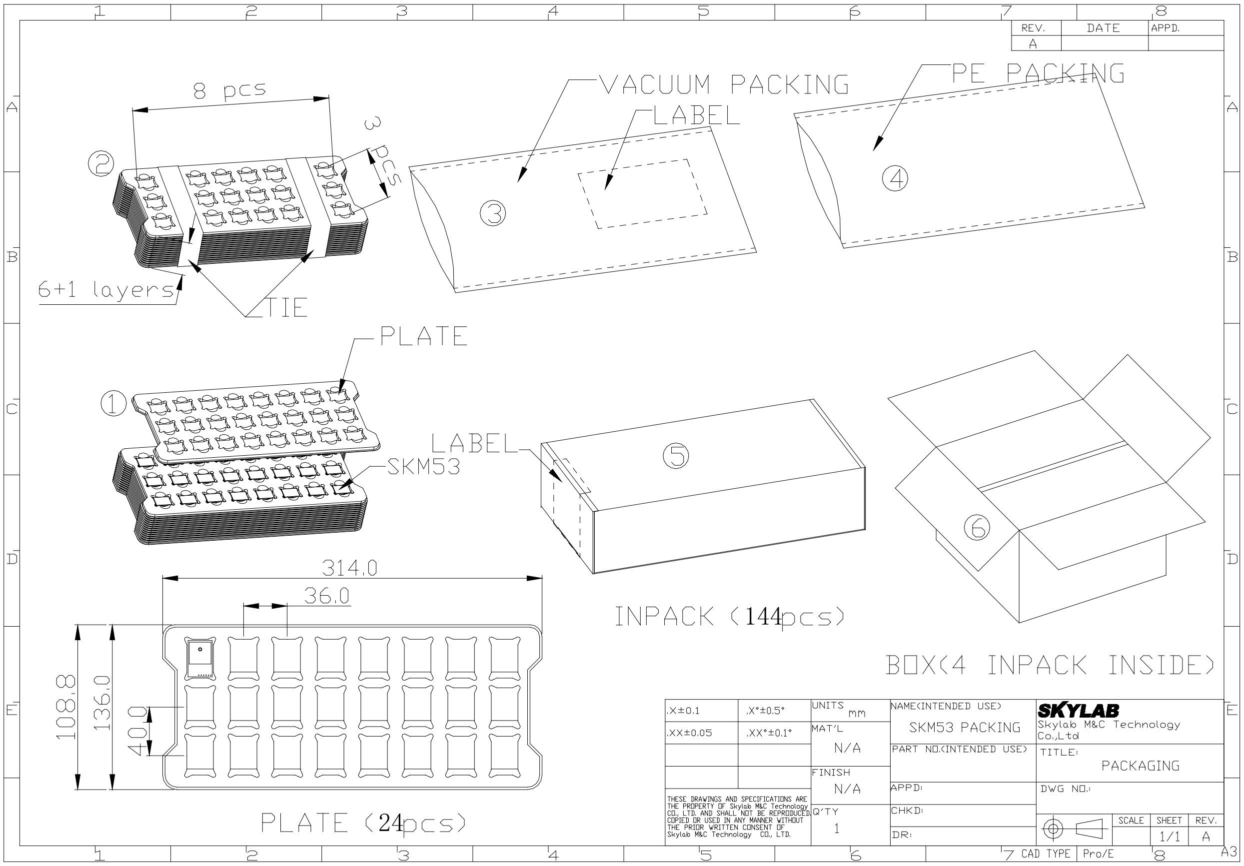


Figure 2: SKM56 Dimensions

Software Protocol

NMEA 0183 Protocol

The NMEA protocol is an ASCII-based protocol, Records start with a $ and with carriage return/line feed. GPS specific messages all start with $GPxxx where xxx is a three-letter identifier of the message data that follows. NMEA messages have a checksum, which allows detection of corrupted data transfers.

The SkyNav SKM53 module supports the following NMEA-0183 messages: GGA, GLL, GSA, GSV, RMC VTG, ZDA and DTM. The module default NMEA-0183 output is set up GGA, GSA ,GSV, RMC and default baud rate is set up 9600bps.

Table 1: NMEA-0183 Output Messages

NMEA Record	Description	Default
GGA	Global positioning system fixed data	Y
GLL	Geographic position—latitude/longitude	N
GSA	GNSS DOP and active satellites	Y

GSV	GNSS satellites in view	Y
RMC	Recommended minimum specific GNSS data	Y
VTG	Course over ground and ground speed	N
ZDA	Date and Time	N
DTM	Datum reference	N

GGA-Global Positioning System Fixed Data

This sentence contains the position, time and quality of the navigation fix.
See RMC for Fix Status, Fix Mode, Fix Date, Speed, and True Course.
See GSA for Fix Type, PDOP, and VDOP.
$GPGGA,033410.000,2232.1745,N,11401.1920,E,1,07,1.1,107.14,M,0.00,M,,*64
Table 2: GGA Data Format

Name	Example	Units	Description
Message ID	$GPGGA		GGA protocol header
UTC Position	033410.000		hhmmss.sss
Latitude	2232.1745		ddmm.mmmm
N/S indicator	N		N=north or S=south
Longitude	11401.1920		dddmm.mmmm
E/W Indicator	E		E=east or W=west
Position Fix Indicator	1		See Table 2-1
Satellites Used	07		Range 0 to 12
HDOP	1.1		Horizontal Dilution of Precision
MSL Altitude	107.14	meters	Altitude (referenced to the Ellipsoid)
AltUnit	M	meters	Altitude Unit
GeoSep	0.00	meters	Geoidal Separation
GeoSepUnit	M	meters	Geoidal Separation Unit
Age of Diff.Corr.	<Null>	second	Null fields when it is not Used
Diff.Ref.Station ID	<Null>		Null fields when it is not Used
Checksum	*64		
EOL	<CR> <LF>		End of message termination

Table 2-1: Position Fix Indicators

Value	Description
0	Fix not available or invalid
1	GPS SPS Mode, fix valid
2	Differential GPS, SPS Mode, fix valid
3	GPS PPS Mode, fix valid

GLL-Geographic Position – Latitude/Longitude

This sentence contains the fix latitude and longitude.
$GPGLL,2232.1843,N,11401.1905,E,035059.000,A,A*54

Table 3: GLL Data Format

Name	Example	Units	Description
Message ID	$GPGLL		GLL protocol header
Latitude	2232.1843		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	11401.1905		dddmm.mmmm
E/W Indicator	E		E=east or W=west
UTC Position	035059.000		hhmmss.sss
Fix Status	A		A=data valid or V=data not valid
Fix Mode	A		A=autonomous, N = No fix, D=DGPS, E=DR
Checksum	*54		
EOL	<CR> <LF>		End of message temination

GSA-GNSS DOP and Active Satellites

This sentence contains the mode of operation, type of fix, PRNs of the satellites used in the solution as well as PDOP, HDOP and VDOP.

$GPGSA,A,3,02,09,10,15,18,24,27,29,,,,,1.8,0.9,1.5*39

Table 4: GSA Data Format

Name	Example	Units	Description
Message	$GPGSA		GSA protocol header
Mode 1	A		See Table 4-2
Mode 2	3		See Table 4-1
ID of satellite used	02		Sv on Channel 1
ID of satellite used	09		Sv on Channel 2
…	…		…
ID of satellite used	<Null>		Sv on Channel 12 (Null fields when it is not Used)
PDOP	1.8		Position Dilution of Precision
HDOP	0.9		Horizontal Dilution of Precision
VDOP	1.5		Vertical Dilution of Precision
Checksum	*39		
EOL	<CR> <LF>		End of message termination

Table 4-1: Mode 1

Value	Description
1	Fix not available
2	2D Fix
3	3D Fix

Table 4-2: Mode 2

Value	Description
M	Manual-forced to operate in 2D or 3D mode
A	Automatic-allowed to automatically switch 2D/3D

GSV-GNSS Satellites in View

This sentence contains the PRNs, azimuth, elevation, and signal strength of all satellites in view.

$GPGSV,3,1,12,02,35,123,25,24,22,321,48,15,78,335,53,29,45,261,45*77

$GPGSV,3,2,12,26,22,223,28,05,34,046,30,10,16,064,39,18,14,284,48*75

$GPGSV,3,3,12,27,32,161,31,33,,,30,09,25,170,34,21,15,318,*4B

Table 5: GGA Data Format

Name	Example	Units	Description
Message ID	$GPGSV		GSV protocol header
Number of Message	3		Total number of GSV sentences (Range 1 to 3)
Message Number	1		Sentence number of the total (Range 1 to 3)
Satellites in View	12		Number of satellites in view
Satellite ID	02		Channel 1(Range 01 to 32)
Elevation	35	degrees	Channel 1(Range 00 to 90)
Azinmuth	123	degrees	Channel 1(Range 000 to 359)
SNR(C/NO)	25	dB-Hz	Channel 1(Range 00 to 99, null when not tracking)
…			…
Satellite ID	29		Channel 4(Range 01 to 32)
Elevation	45	degrees	Channel 4(Range 00 to 90)
Azimuth	261	degrees	Channel 4(Range 000 to 359)
SNR(C/NO)	45	dB-Hz	Channel 4(Range 00 to 99, null when not tracking)
Checksum	*77		
EOL	<CR> <LF>		End of message termination

Depending on the number of satellites tracked multiple messages of GSV data may be required.

RMC-Recommended Minimum Specific GNSS Data

This sentence contains the recommended minimum fix information.

See GGA for Fix Quality, Sats Used, HDOP, Altitude, Geoidal Separation, and DGPS data.

See GSA for Fix Type, PDOP and VDOP.

$GPRMC,075747.000,A,2232.8990,N,11405.3368,E,3.9,357.8,260210,,,A*6A

Table 6: RMC Data Format

Name	Example	Units	Description
Message ID	$GPRMC		RMC protocol header
UTS Position	075747.000		hhmmss.sss
Status	A		A=data valid or V=data not valid
Latitude	2232.8990		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	11405.3368		dddmm.mmmm
E/W Indicator	E		E=east or W=west
Speed Over Ground	3.9	Knots	
Course Over Ground	357.8	Degrees	True Course

Date(UTC)	260210		ddmmyy
Magnetic variation	<Null>	Degrees	Null fields when it is not Used
Magnetic Variation Direction	<Null>		E=east or W=west (Null fields when it is not Used)
Fix Mode	A		A=autonomous, N = No fix, D=DGPS, E=DR
Checksum	*6A		
EOL	<CR> <LF>		End of message termination

VTG-Course Over Ground and Ground Speed

This sentence contains the course and speed of the navigation solution.

$GPVTG,303.8,T,,,0.0,N,0.0,K,A*48

Table 7: VTG Data Format

Name	Example	Units	Description
Message ID	$GPVTG		VTG protocol header
Tcourse	303.8	Degrees	True Course
Reference	T		T = True
Mcourse	<Null>	Degrees	Magnetic Course (Null fields when it is not Used)
Reference	<Null>		M = Magnetic (Null fields when it is not Used)
Speed over ground	0.0	Knots	Nautical Miles per Hour
Units	N		Knots
Speed over ground	0.0	Km/hr	in Kilometers per Hour
Units	K		Kilometer per hour
Mode	A		A=Autonomous, N=No fix, D=DGPS, E=DR
Checksum	*48		
EOL	<CR> <LF>		End of message termination

ZDA-Date and Time

This sentence contains UTC date & time, and local time zone offset information.

$GPZDA,060819.000,22,03,2010,,*50

Table 8: ZDA Data Format

Name	Example	Units	Description
Message ID	$GPZDA		ZDA protocol header
UTC Time	060819.000		hhmmss.sss
Day	22		UTC time: day (01 ... 31) dd
Month	03		UTC time: month (01 ... 12) mm
Year	2010		UTC time: year (4 digit year) yyyy
local zone hours	<null>		Local Time Zone Offset Hours (Null fields when it is not Used)
local zone minutes	<null>		Local Time Zone Offset Minutes (Null fields when it is not Used)
Checksum	*50		

EOL	<CR> <LF>		End of message termination

DTM - Datum reference

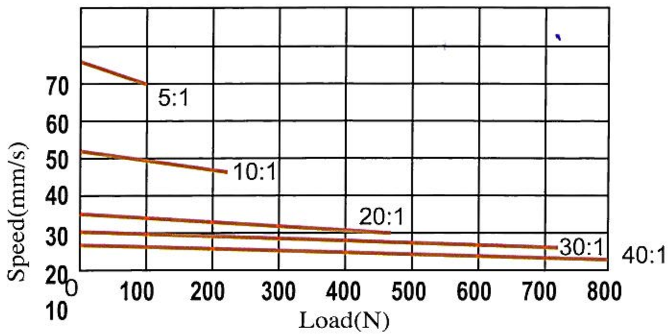
This sentence contains the ID of the datum selected, along with configured offsets.

$GPDTM,W84,,0.000000,S,0.000000,W,0.00,W84*50

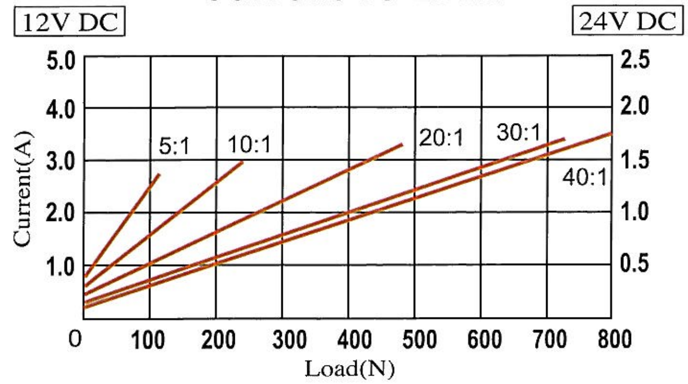
Table 9: DTM Data Format

Name	Example	Units	Description
Message ID	$GPDTM		DTM protocol header
DatumID	W84		Local Datum ID
DatumSubD	<null>		Datum Subdivision Code (Null fields when it is not Used)
LatOfs	0.000000		Latitude Offset (in minutes)
LatDirection	S		N = North S = South
LonOfs	0.000000		Longitude Offset (in minutes)
LonDirection	W		E = East W = West
AltOfs	0.00		Altitude Offset (in meters)
RefDatum	W84		Reference Datum ID
Checksum	*50		
EOL	<CR> <LF>		End of message termination

Speed vs Load



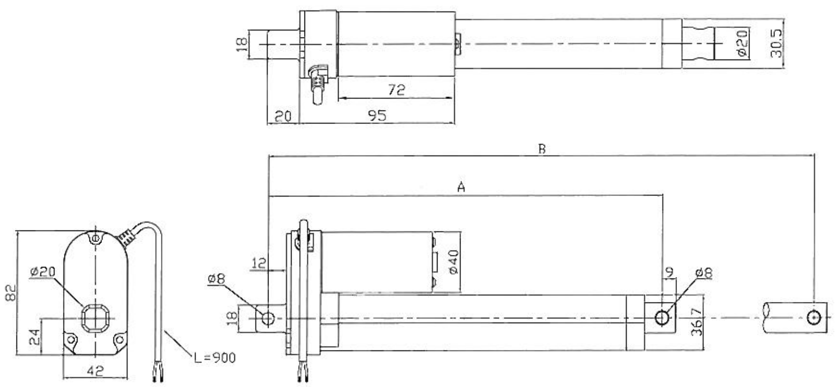
Current vs Load



Standard	Stroke	50	100	150	200	250	300
	A	158	209	260	311	362	413
	B	208	309	410	511	612	713

(mm)

A: Retracted Length
B: Extended Length
Stroke = B - A

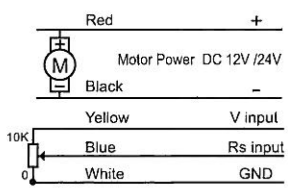


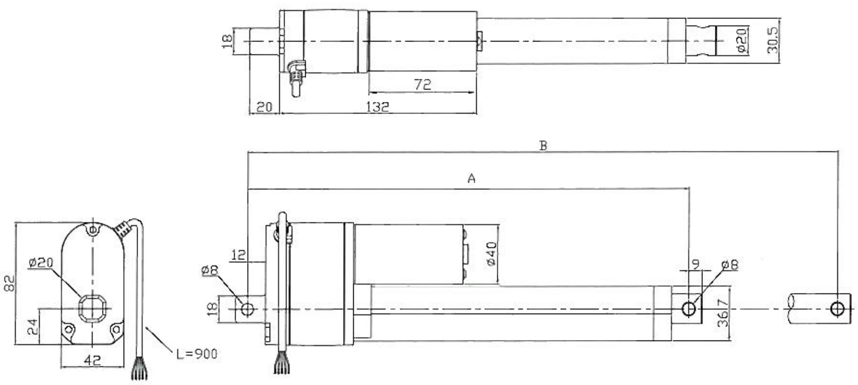
Potentiometer	Stroke	50	100	150	200	250	300
	A	195	246	297	348	399	450
	B	245	346	447	548	649	750

(mm)

A: Retracted Length
B: Extended Length
Stroke = B - A

Value of POT	
Stroke(mm)	Resistance(Ω)
50	0.3-9.3K
100	0.3-9.7K
150	0.3-8.6K
200	0.3-9.6K
250	0.3-9.3K
300	0.3-9.3K
Remark:tolerance:±0.3K	



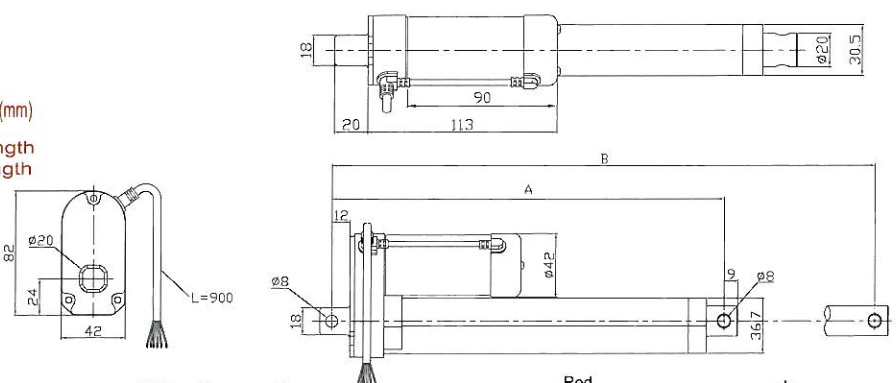


Hall Effect	Stroke	50	100	150	200	250	300
	A	158	209	260	311	362	413
	B	208	309	410	511	612	713

(mm)

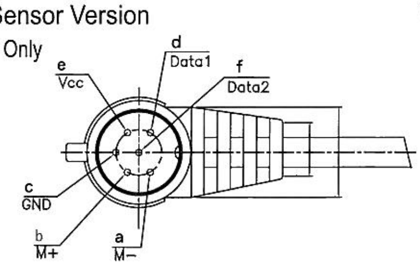
A: Retracted Length
B: Extended Length
Stroke = B - A

Hall Sensor	
Gear Ratio	Resolution(Pulses/mm)
5:1	2.3
10:1	3.6
20:1	6.9
30:1	10.6
40:1	14.3

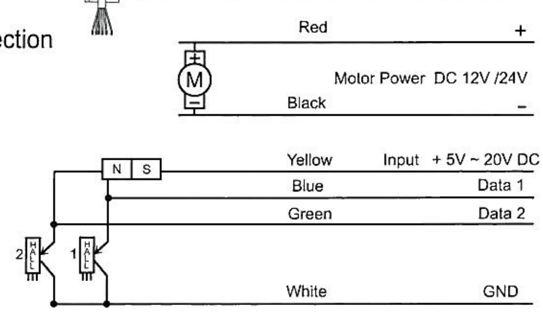


Standard Plug for Hall Sensor Version

∗Pin Data2 for 2 Hall Sensor Only



Wire Connection



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Light Duty Linear Actuators

Standard Features

- 12/24 DC Motor
- Compact Design
- Standard Preset Limit Switches
- All Aluminum Frame and Extension Tube
- Nominal Stroke Lengths: 2” [50mm], 4” [100mm], 6” [150mm], 8” [200mm], 10” [300mm]12” [300mm]
- Duty Cycle: 25%
- Gear Ratio: 20:1 [STD]
- Working Temperature: -13F [-25C] +149F [+65C]
- Protection: IP65

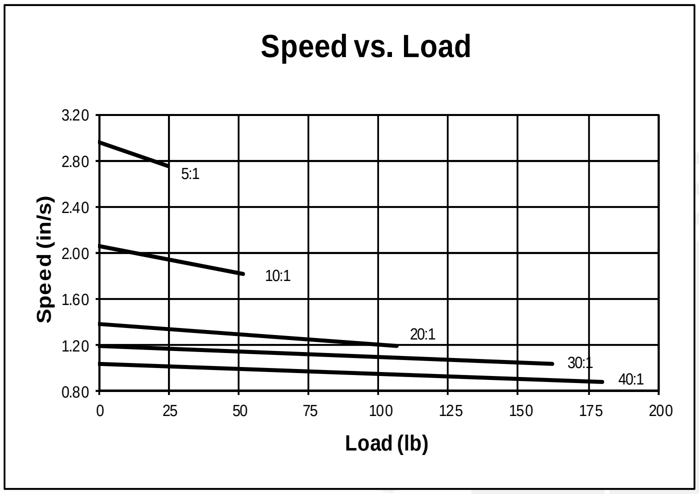
Options

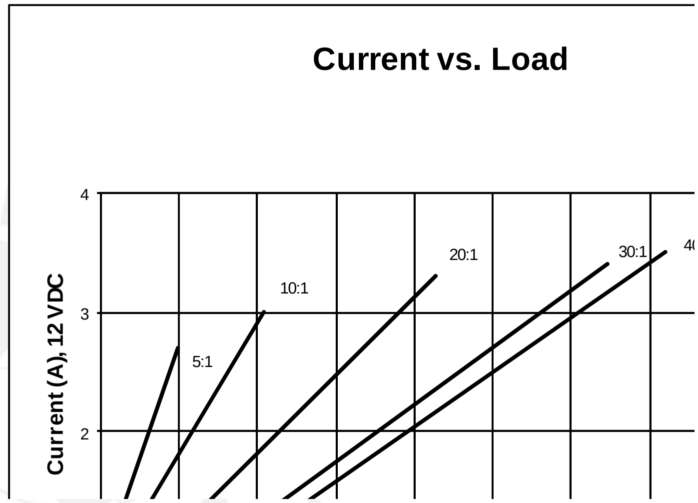
- Gear Ratios: 5:1,10:1, 30:1, 40:1
- Potentiometer
- Hall Effect Sensor

Accessories

Performance Data

Gear Ratio	Max Load / Dynamic		Speed / No Load		Speed / Max Load	
	Newtons	Lbs [US]	mm / Sec	Inches / Sec	mm / Sec	Inches / Sec
5:1	110	25	56	2.20	50	1.96
10:1	230	52	31	1.20	25	0.98
20:1	475	107	15	0.59	10	0.39
30:1	720	162	10	0.39	5	0.19
40:1	800	180	8	0.31	3	0.12



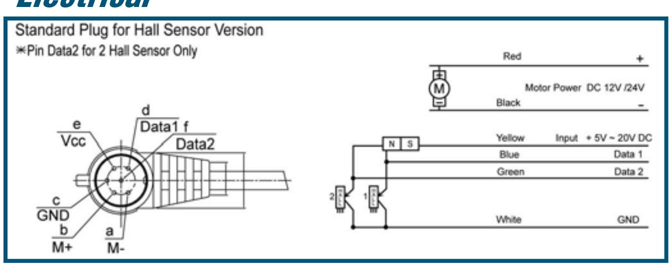


Dimensions

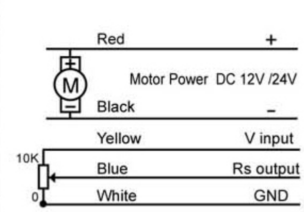
Nominal Stroke	2"		4"		6"		8"		10"		12"	
	Metric	Inch	Metric	Inch	Metric	Inch	Metric	Inch	Metric	Inch	Metric	Inch
Standard Actuator												
Actual Stroke	50	1.969	100	3.937	150	5.906	200	7.874	250	9.843	300	11.811
Retracted Length	158	6.220	209	8.228	260	10.236	311	12.244	362	14.252	413	16.260
Actuator With Potentiometer												
Actual Stroke	50	1.969	100	3.937	150	5.906	200	7.874	250	9.843	300	11.811
Retracted Length	195	7.677	246	9.685	297	11.693	348	13.701	399	15.709	450	17.717

Electrical

Mechanical Connections: .25"



Value of POT	
Stroke(mm)	Resistance(Ω)
50	0.3-9.3K
100	0.3-9.7K
150	0.3-8.6K
200	0.3-9.6K
250	0.3-9.3K
300	0.3-9.3K
Remark:tolerance:±0.3K	



AN3182
Application note

Tilt measurement using a low-g 3-axis accelerometer

Introduction

This application note describes the methods and techniques for measuring tilt angles from a low-*g* 3-axis accelerometer. The LIS331DLH 3-axis digital accelerometer is used as an example in this document. Other 3-axis analog or digital accelerometers may also be applied to the tilt angle measurement procedures described here, depending on their respective specifications.

The ultra-low power LIS331DLH digital accelerometer is housed in a 3 x 3 x 1 mm LGA-16 package. It has an I^2C / SPI digital serial interface for 3-axis acceleration outputs, so no external ADC chip is required. It also features a dynamically user-selectable full-scale measurement range of ±2 *g* / ±4 *g* / ±8 *g*, with output data rates from 0.5 Hz to 1 kHz.

Section 1 of this application note introduces the terminology and parameters related to the accelerometer, while *Section 2* presents the accelerometer calibration techniques. *Section 3* describes the tilt sensing theory and the methods of determining tilt angle measurement.

Contents

List of figures

1 Terminology

Low-*g* MEMS accelerometers are widely used for tilt sensing in consumer electronics and industrial applications, such as screen rotation and automobile security alert systems. Another popular application for low-*g* accelerometers is tilt compensated electronic compasses for map rotation and personal navigation devices. This application note describes how to obtain accurate tilt measurements with respect to local Earth horizontal plane, by compensating for a few non idealities that may cause angular tilt calculation error. In this document, the 3-axis digital accelerometer LIS331DLH is used as an example. For detailed information and device specifications, refer to the LIS331DLH datasheet available at http://www.st.com. Other 3-axis analog or digital accelerometers may also be used, in accordance with their respective specifications.

1.1 Accelerometer datasheet

When designing a tilt sensing system, the first step is to examine the accelerometer specifications and understand the meaning of each parameter that affects tilt sensing accuracy. *Table 1* shows the main parameters of the LIS331DLH 3-axis digital accelerometer when a full-scale of ±2 *g* is selected, which is optimum for tilt sensing applications. Note that higher full-scale ranges can also be selected for tilt sensing, but accuracy is affected by the resulting lower sensitivity.

Table 1. Main parameters for the LIS331DLH @ Vdd = 2.5 V, T = 25 °C

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
Vdd	Power supply		2.16	2.5	3.6	V
Idd	Current consumption in normal mode			250		µA
ODR	Output data rate in normal mode	Selectable by DR bits in CTRL_REG1		50/100/400/ 1000		Hz
BW	System bandwidth			ODR/2		Hz
Ton	Turn-on time	ODR = 100 Hz		1/ODR + 1		ms
Top	Operating temperature range		-40		+85	°C
FS	Full-scale measurement rage	FS bit set to 00		±2.0		g
So	Sensitivity	FS bit set to 00 12-bit representation	0.9	1	1.1	m*g*/LSB
TCSo	Sensitivity change vs. temperature	FS bit set to 00		±0.01		%/°C
TyOff	Typical zero-*g* level offset accuracy	FS bit set to 00		±20		m*g*
TCOff	Zero-*g* level change vs. temperature	Max delta from 25 °C		±0.1		m*g*/°C
An	Acceleration noise density	FS bit set to 00		218		$(\mu g)/(\sqrt{Hz})$

1.2 Understanding the parameters

- Vdd - Power supply: This parameter defines the accelerometer operating DC power supply range between +2.16 V and +3.6 V (typical +2.5 V). Correct operation of the accelerometer using a power supply voltage outside of this range is not guaranteed. The parameters in *Table 1* are provided by the accelerometer manufacturer under Vdd = +2.5 V at a room temperature of T = 25 °C. It is recommended to keep the Vdd clean, with minimum ripple. One possible way to do this is to use an ultra low-noise low-dropout regulator to power the accelerometer.
- Idd - Current consumption in normal mode: In the case of the LIS331DLH, lower ODR corresponds to lower current consumption.
- ODR - Output data rate in normal mode: This parameter shows the possible output data rates in normal mode. The user can select different ODR by setting the DR bits in the CTRL_REG1 register.
- BW - System bandwidth: This parameter defines the bandwidth of the system. When ODR = 100 Hz, BW is typically 50 Hz with built-in low pass filter. The system recognizes any motion below 50 Hz. If the system has dynamic motion higher than 50 Hz, then ODR needs to be increased to a higher setting in order to cover all useful system signals.
- Ton - Turn-on time: This parameter defines the time required before the accelerometer is ready to output measured acceleration data after exiting power-down mode. For example, at ODR = 100 Hz, the user should wait for a minimum of 1/100 + 1 = 11 ms after exiting from power-down mode before sampling the accelerometer data.
- Top - operating temperature range: This parameter defines the operating temperature range. When the device is operated inside the specified range, proper behavior of the sensor is guaranteed.
- FS - Full-scale measurement range: For tilt sensing applications, a ±2.0 *g* range is sufficient because the Earth's gravity is ±1 *g* only. If the application requires measurement of higher *g* acceleration, the user can set the LIS331DLH to a higher full-scale range of ±4.0 *g* or ±8.0 *g*, which results in lower sensitivity.
- So - Sensitivity: This parameter defines the value of 1LSB with respect to m*g* in the digital representation. For example, at ±2.0 *g* full-scale range, the sensitivity is typically about 1 m*g*/LSB at 12-bit representation. Therefore, when the sensor is stable on a horizontal surface, the Z axis output is around 1000LSB.
- TCSo - Sensitivity change vs. temperature: This parameter defines how sensitivity changes with temperature. For example, at a ±2.0 *g* full-scale range, the sensitivity changes within ±0.01%/°C. Therefore, if the environmental temperature changes 40 °C, from 25 °C to 65 °C, then the sensitivity changes within the range of ±0.01% * 40 = ±0.4%, which means the sensitivity change over 40 °C is within 0.996 m*g*/LSB and 1.004 m*g*/LSB, which shows that the sensitivity is very stable versus temperature change. Thus, temperature compensation for sensitivity can be ignored.
- TyOff - Typical zero-*g* level offset accuracy: This parameter defines the zero-*g* accuracy at a room temperature of 25 °C. For example, at a ±2.0 *g* full-scale range, the zero-*g* accuracy of ±20 m*g* means that the zero-*g* output varies typically in the range of ±20 m*g* around the expected ideal value.
- TCOff - Zero-*g* level change vs. temperature: This parameter defines how much the zero-*g* level is affected by temperature variations. For example, at ±2.0 *g* full-scale range, the zero-*g* level changes typically within ±0.1 mg/°C. This means that if the environmental temperature changes 40 °C, from 25 °C to 65 °C, then the zero-*g* level changes within the range of ±0.1 mg * 40 = ±4 m*g*, which shows that the zero-*g* level is

very stable versus temperature change. So temperature compensation for the zero-*g* level can be ignored.

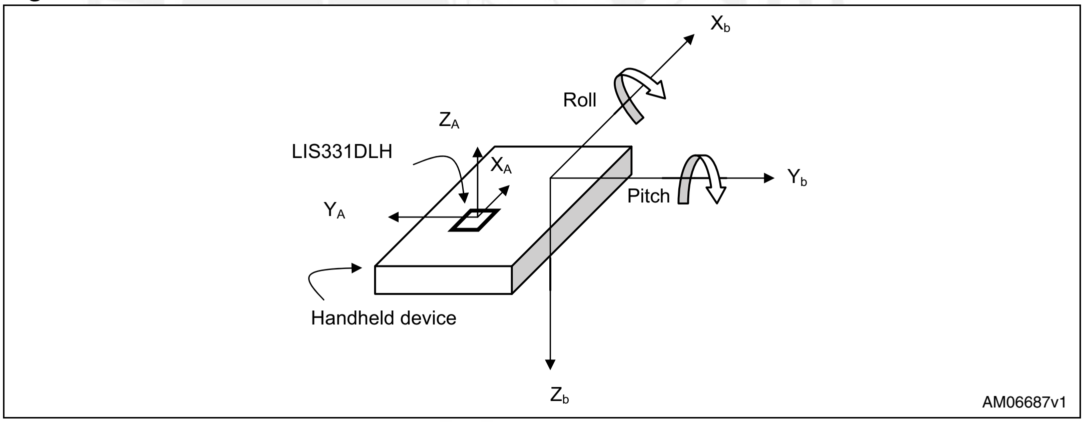
- An - Acceleration noise density: This parameter defines the standard resolution the user can obtain from the accelerometer (once the desired BW is selected).

  $1\ \sigma$ resolution = $A_n(\mu g/\sqrt{Hz}) \cdot \sqrt{BW(Hz)}$. The higher BW leads to lower resolution.
- NL - Non linearity: This parameter defines the maximum error between the outputs and the best fit straight line. For example, at ±2.0 *g* full-scale range, the non linearity of 0.5% of FS means the largest error is 0.5% * 4000 m*g* = 2 m*g*, which corresponds to 0.1°. When the application requires measurements of around the 0 *g* condition (as with tilt measurement), the non-linearity effect is negligible and can be ignored.
- CrossAx - Cross-axis sensitivity: The cross-axis effect arises due to natural misalignment of die positioning on the package substrate. Even if negligible in most applications, for very accurate tilt measurement the cross-axis sensitivity effect can be easily compensated for by following the procedure in *Section 2: Calibrating the accelerometer*. Moreover, when the device is placed on the final application board, the accelerometer calibration compensates both the device cross-axis sensitivity, and the misalignment between the accelerometer sensing axes and the board axes.

1.3 Definitions

Assume that the LIS331DLH accelerometer is installed in a handheld device, such as a cell phone, a PDA or simply on a PCB board as shown in *Figure 1*.

Figure 1. Accelerometer inside a handheld device



X_b, Y_b and Z_b are the handheld device body axes with a forward-right-down configuration.

X_A, Y_A and Z_A are the accelerometer sensing axes, respectively. Note that the sign of Y_A and Z_A from the sensor measurements need to be reversed to have the sensing axes in the same direction as the device body axes.

Pitch and roll angles are referenced to the local horizontal plane, which is perpendicular to the Earth's gravity.

- Pitch (α) is defined as the angle between the X_b axis and the horizontal plane. Assume that the pitch angle resolution is 0.1°, then it goes from 0° to +179.9° when rotating around the Y_b axis with the X_b axis moving upwards from a flat level, and then keeps moving from a vertical position (+90°) back to a flat level again. The pitch angle goes from 0° to -180° when the X_b axis is moving downwards from a flat level, and then keeps moving from a vertical position (-90°) back to a flat level again. For example, in *Figure 2*, Y_b is fixed, X_b is rotating from Pitch = 0° to +30°, +90°, +150° and +179.9° for a positive direction.

- Roll (β) is defined as the angle between the Y_b axis and the horizontal plane. Assume that the roll angle resolution is 0.1°, then it goes from 0° to +179.9° when rotating around the Xb axis with the Y_b axis moving downwards from a flat level, and then keeps moving from a vertical position (+90°) back to a flat level again. The roll angle goes from 0° to -180° when the Y_b axis is moving upwards from a flat level, and then keeps moving from a vertical position (-90°) back to a flat level again. For example, in *Figure 3*, X_b is fixed, Y_b is rotating from roll = 0° to +30°, +90°, +150° and +179.9° for a positive direction.

Figure 2. Pitch definition

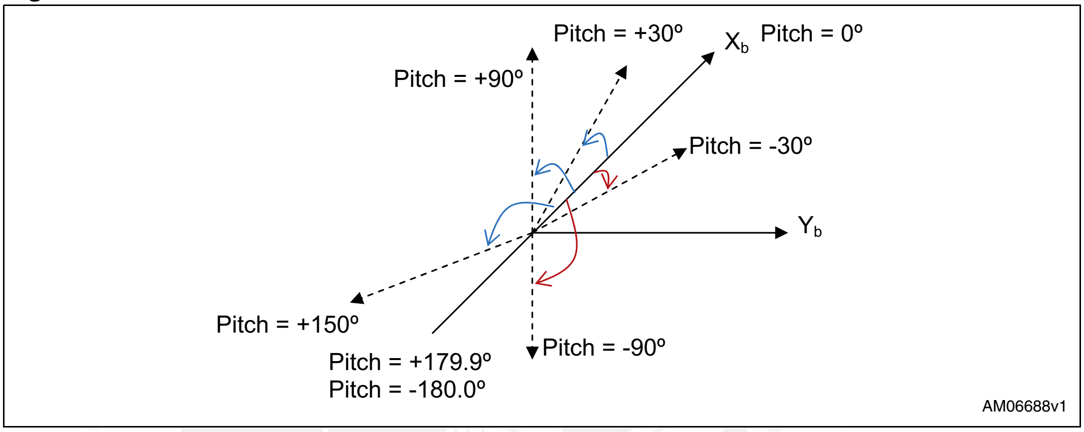
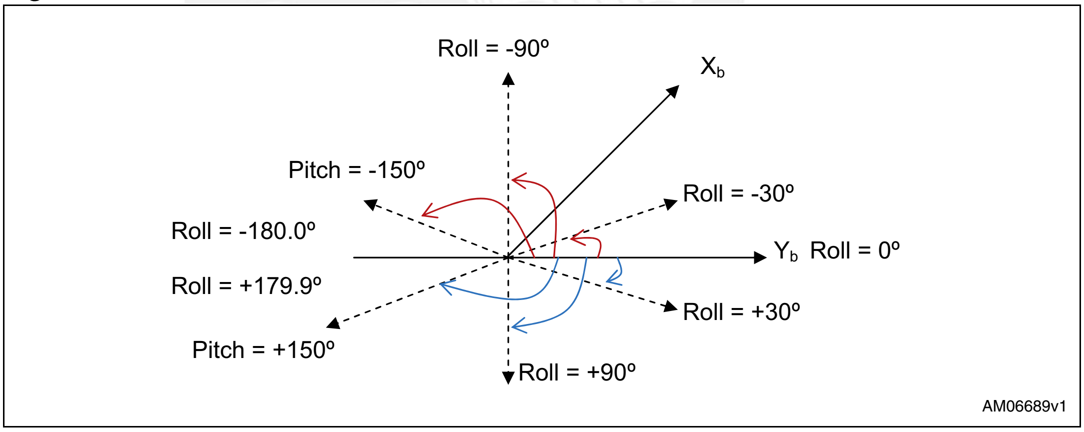


Figure 3. Roll definition



Assume A_x, A_y, A_z is the accelerometer raw measurement in the format of LSBs. *Table 2* shows the sign definition of the raw sensor data at 6 stationary positions with respect to the known Earth gravity vector. For example, in *Figure 1*, X_b and Y_b are level and Z_b is pointing down. Therefore, $A_x = A_y = 0$, $A_z = +1$ *g*.

Table 2. Sign definition of LIS331DLH sensor raw measurements

Stationary position	Accelerometer (signed integer)		
	A_x	A_y	A_z
Z_b down	0	0	+1 *g*
Z_b up	0	0	-1 *g*
Y_b down	0	+1 *g*	0
Y_b up	0	-1 *g*	0
X_b down	+1 *g*	0	0
X_b up	-1 *g*	0	0

2 Calibrating the accelerometer

Section 1 describes the accelerometer parameters and the definition of the pitch and roll tilt angles. The next step is to calibrate the accelerometer before tilt calculation can take place.

Please note that all accelerometers from ST, including the LIS331DLH, have been factory-calibrated. For most applications, such as screen portrait/landscape rotation and laptop lid open/close detection, accelerometer calibration is not necessary. This means that users can use the zero-*g* level and sensitivity parameters from the datasheet directly to convert raw measurements A_x, A_y and A_z to normalized measurements A_{x1}, A_{y1} and A_{z1}. For applications that require better than 1° tilt-measurement accuracy, such as automobile alert systems, tilt-compensated electronic compasses and level monitoring systems, accelerometer calibration is suggested.

The relationship between the normalized A_{x1}, A_{y1} and A_{z1} and the accelerometer raw measurements A_x, A_y and A_z can be expressed as,

Equation 1

$$\begin{bmatrix} A_{x1} \\ A_{y1} \\ A_{z1} \end{bmatrix} = [A\_m]_{3x3} \begin{bmatrix} 1/A\_SC_x & 0 & 0 \\ 0 & 1/A\_SC_y & 0 \\ 0 & 0 & 1/A\_SC_z \end{bmatrix} \cdot \begin{bmatrix} A_x - A\_OS_x \\ A_y - A\_OS_y \\ A_z - A\_OS_z \end{bmatrix}$$
$$= \begin{bmatrix} ACC_{11} & ACC_{12} & ACC_{13} \\ ACC_{21} & ACC_{22} & ACC_{23} \\ ACC_{31} & ACC_{32} & ACC_{33} \end{bmatrix} \cdot \begin{bmatrix} A_x \\ A_y \\ A_z \end{bmatrix} + \begin{bmatrix} ACC_{10} \\ ACC_{20} \\ ACC_{30} \end{bmatrix}$$

where [A_m] is the 3 x 3 misalignment matrix between the accelerometer sensing axes and the device body axes, A_SC_i (i = x, y, z) is the sensitivity (or scale factor) and A_OS_i is the zero-*g* level (or offset).

The goal of accelerometer calibration is to determine 12 parameters from ACC10 to ACC33, so that with any given raw measurements at arbitrary positions, the normalized values A_{x1}, A_{y1} and A_{z1} can be obtained, resulting in:

Equation 2

$$|A| = \sqrt{A_{x1}^2 + A_{y1}^2 + A_{z1}^2} = 1$$

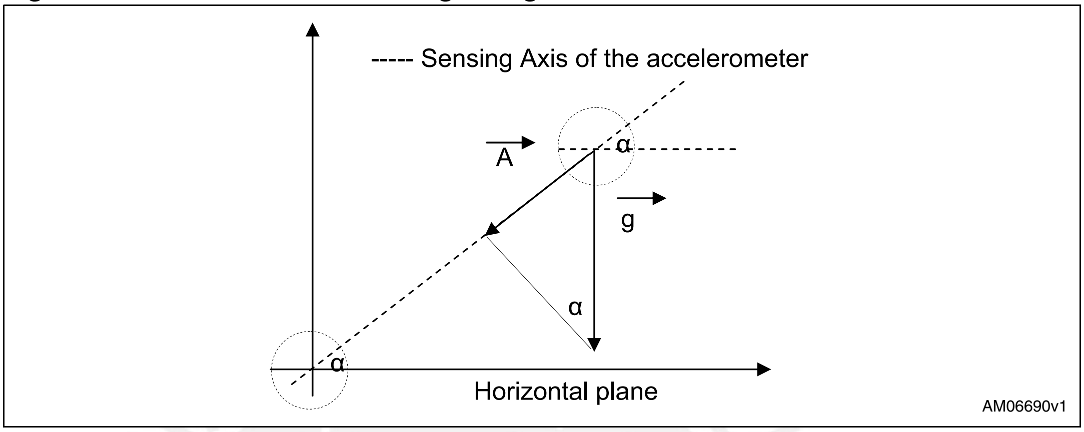
Calibration can be performed at 6 stationary positions as shown in Table 2. Collect 5 to 10 seconds of accelerometer raw data with ODR = 100 Hz at each position with known A_{x1}, Ay1 and Az1. Then apply the least square method to obtain the 12 accelerometer calibration parameters. Refer to Appendix A for additional details.

3 Calculating tilt angles

3.1 Theory of operation

Figure 4 shows the single sensing axis of the accelerometer for tilt measurement.

Figure 4. Tilt measurement using a single axis of the accelerometer



The accelerometer measures the projection of the gravity vector on the sensing axis. The amplitude of the sensed acceleration changes as the sin of the angle α between the sensitive axis and the horizontal plane.

Equation 3

$$A = g \times \sin(\alpha)$$

Using *Equation 3*, it is possible to estimate the tilt angle,

Equation 4

$$\alpha = \arcsin\left(\frac{A}{g}\right)$$

where:

- A = acceleration measured
- g = Earth gravity vector

A single axis of the accelerometer with 360° rotation is shown in *Figure 5* and *6*.

Figure 5. 360° rotation of a single axis of the accelerometer

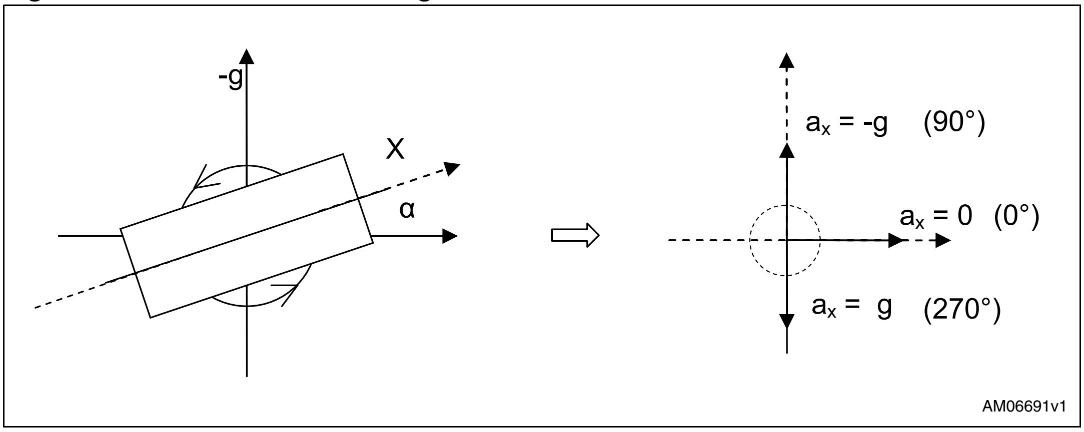
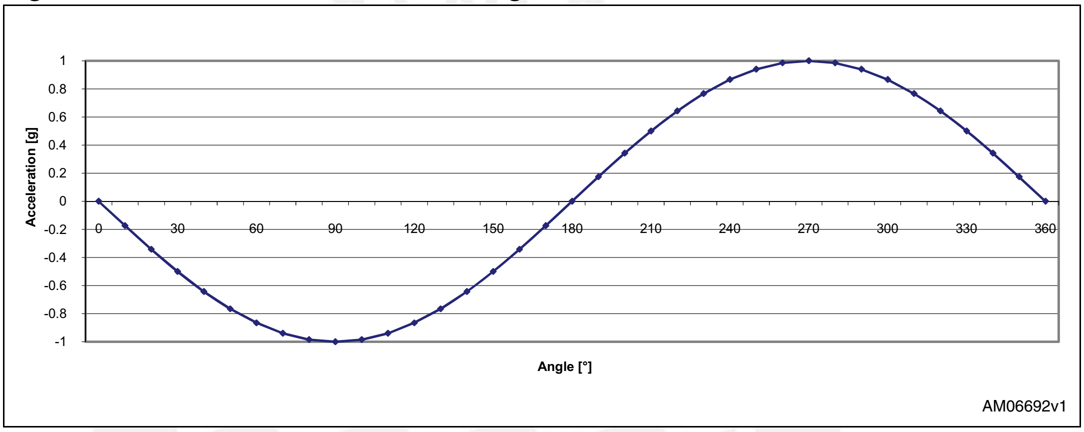


Figure 6. Plot of 360° rotation of a single axis of the accelerometer



3.2 Tilt sensing

3.2.1 Single-axis tilt sensing

From *Figure 5* and *6*, it can be observed that the sensor is most responsive to changes in tilt angle when the sensing axis is perpendicular to the force of gravity. In this case, the sensitivity is approximately 17.45 m*g*/° [= sin(1°) - sin(0°)]. Due to the derivate function of the sin function, the sensor has lower sensitivity (less responsive to tilt angle changes) when the sensing axis is close to its +1 *g* or -1 *g* position. In this case, sensitivity is only 0.15 mg/° [= sin(90°) - sin(89°)]. *Table 3* shows the sensitivity at different tilt angles. In other words, the sin function has good linearity at [0° 45°], [135° 225°] and [315° 36°] as shown in *Figure 6*.

Table 3. Tilt sensitivity of single axis accelerometer

Tilt [°]	Acceleration [*g*]	Δ*g* /° [m*g*/°]
0	0.000	17.452
15	0.259	16.818
30	0.500	15.038
45	0.707	12.233

Table 3. **Tilt sensitivity of single axis accelerometer (continued)**

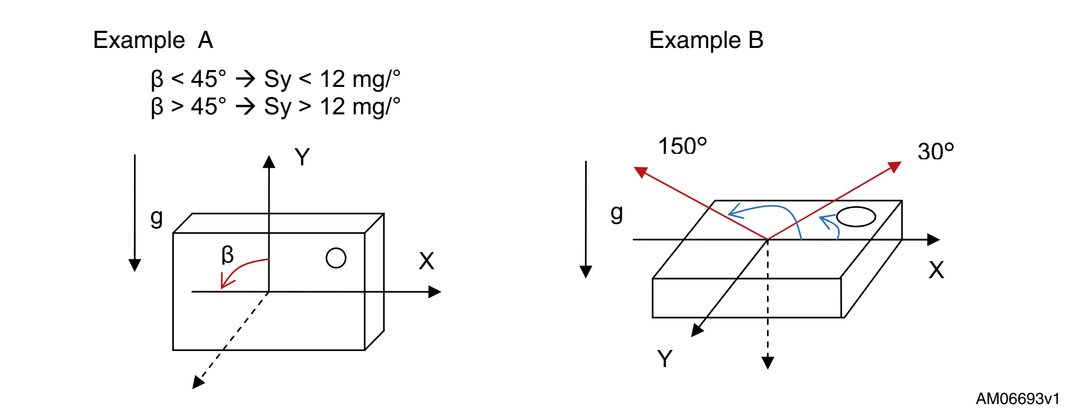
Tilt [°]	Acceleration [*g*]	Δ*g* /° [m*g*/°]
60	0.866	8.594
75	0.966	4.37
90	1.000	0.152

3.2.2 Dual-axis tilt sensing

When a dual-axis tilt sensing approach is used, the user should be aware of two different situations in which this approach could limit overall accuracy or even inhibit tilt calculation.

- *Figure 7*, Example A: Rotate the accelerometer counter-clockwise around the dotted arrow with β angle. When β is less than 45°, the X axis has higher sensitivity, while the Y axis has lower sensitivity. And when β is greater than 45°, the X axis has lower sensitivity while the Y axis has higher sensitivity. Therefore, when the two-axis approach is used, it is always recommended to calculate the angle based on the orthogonal axis to a ±1 *g* condition.
- *Figure 7*, Example B: At this position, both the X and Y axes have high sensitivity. However, without the help of a third axis (for example the Z axis), it is impossible to distinguish a tilt angle of 30° from one of 150° because the X axis has the same outputs at these two tilt angles.

Figure 7. **Tilt sensitivity of a dual-axis accelerometer**



3.2.3 Tri-axis tilt sensing

With a 3-axis accelerometer, the user can use the Z axis to combine with the X and Y axes for tilt sensing, to improve tilt sensitivity and accuracy (see *Figure 8*).

There are two ways to calculate 3 tilt angles in *Figure 8*. The first is use basic trigonometric *Equation 5*, *6* and *7*, where A_{x1}, A_{y1} and A_{z1} are the values obtained after applying accelerometer calibration on raw measurement data (A_x, A_y, A_z), as described in *Section 2*.

Equation 5

$$\alpha = \arcsin\left(\frac{A_{x1}}{g}\right)$$

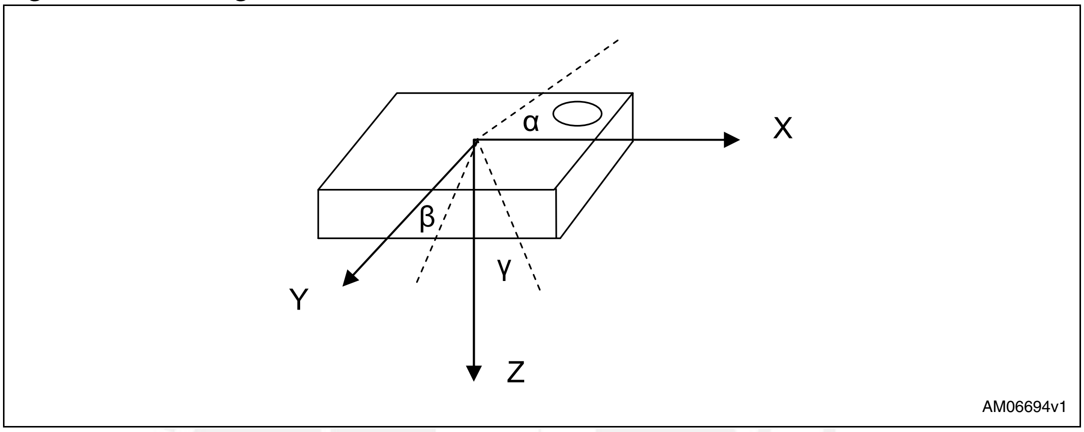
Equation 6

$$\beta = \arcsin\left(\frac{A_{y1}}{g}\right)$$

Equation 7

$$\gamma = \arccos\left(\frac{A_{z1}}{g}\right)$$

Figure 8. Tilt angles from a tri-axis accelerometer



The second way is to use trigonometric *Equation 8* and *9* to calculate pitch and roll tilt angle, which produces constant sensitivity over 360° of rotation, as shown in *Figure 9*.

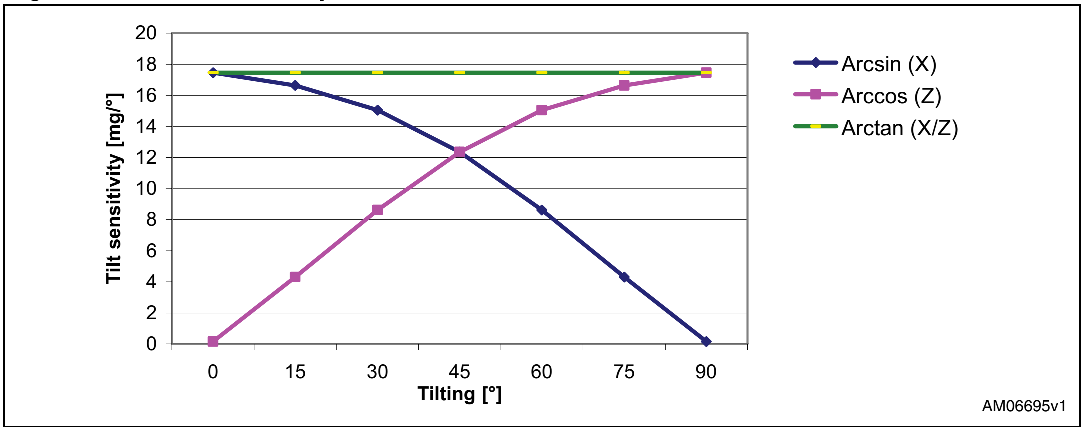
Equation 8

$$\text{Pitch} = \alpha = \arctan\left(\frac{A_{x1}}{\sqrt{(A_{y1})^2 + (A_{z1})^2}}\right)$$

Equation 9

$$\text{Roll} = \beta = \arctan\left(\frac{A_{y1}}{\sqrt{(A_{x1})^2 + (A_{z1})^2}}\right)$$

Figure 9. Tilt sensitivity of a tri-axis accelerometer



Appendix A Least square method

Let's consider accelerometer calibration at the 6 stationary positions shown in *Table 2*. *Equation 1* can be rewritten as:

Equation 10

$$\begin{bmatrix} A_{x1} & A_{y1} & A_{z1} \end{bmatrix} = \begin{bmatrix} A_x & A_y & A_z & 1 \end{bmatrix} \cdot \begin{bmatrix} ACC_{11} & ACC_{21} & ACC_{31} \\ ACC_{12} & ACC_{22} & ACC_{32} \\ ACC_{13} & ACC_{23} & ACC_{33} \\ ACC_{10} & ACC_{20} & ACC_{30} \end{bmatrix}$$

Or

Equation 11

$$Y = w \cdot X$$

where:

- Matrix X is the 12 calibration parameters that need to be determined
- Matrix w is sensor raw data LSBs collected at 6 stationary positions
- Matrix Y is the known normalized Earth gravity vector

For example,

- At Z_b down position (P1 position), $\begin{bmatrix} A_{x1} & A_{y1} & A_{z1} \end{bmatrix} = \begin{bmatrix} 0 & 0 & 1 \end{bmatrix}$, and assume that at Z_b down position, n1 sets of accelerometer raw data A_x, A_y and A_z have been collected. Then,

Equation 12

$$Y_1 = \begin{bmatrix} 0 & 0 & 1 \end{bmatrix}_{n1x3}$$
$$w_1 = \begin{bmatrix} A_{xP1} & A_{yP1} & A_{zP1} & 1 \end{bmatrix}_{n1x4}$$

where:

Matrix Y_1 has the same row of [0 0 1].

Matrix w_1 contains raw data in the format of LSBs.

- At Z_b up position (P2 position), $\begin{bmatrix} A_{x1} & A_{y1} & A_{z1} \end{bmatrix} = \begin{bmatrix} 0 & 0 & -1 \end{bmatrix}$, and assume that at Z_b up position, n2 sets of accelerometer raw data A_x, A_y and A_z have been collected. Then,

Equation 13

$$Y_2 = \begin{bmatrix} 0 & 0 & -1 \end{bmatrix}_{n2x3}$$
$$w_2 = \begin{bmatrix} A_{xP2} & A_{yP2} & A_{zP2} & 1 \end{bmatrix}_{n2x4}$$

- At Y_b down position (P3 position), $\begin{bmatrix} A_{x1} & A_{y1} & A_{z1} \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \end{bmatrix}$, and assume that at Y_b down position, n3 sets of accelerometer raw data A_x, A_y and A_z have been collected. Then,

Equation 14

$$Y_3 = \begin{bmatrix} 0 & 1 & 0 \end{bmatrix}_{n3x3}$$
$$w_3 = \begin{bmatrix} A_{xP3} & A_{yP3} & A_{zP3} & 1 \end{bmatrix}_{n3x4}$$

- At Y_b up position (P4 position), $\begin{bmatrix} A_{x1} & A_{y1} & A_{z1} \end{bmatrix} = \begin{bmatrix} 0 & -1 & 0 \end{bmatrix}$, and assume that at Y_b up position, n4 sets of accelerometer raw data A_x, A_y and A_z have been collected. Then,

Equation 15

$$Y_4 = \begin{bmatrix} 0 & -1 & 0 \end{bmatrix}_{n4x3}$$
$$w_4 = \begin{bmatrix} A_{xP4} & A_{yP4} & A_{zP4} & 1 \end{bmatrix}_{n4x4}$$

- At X_b down position (P5 position), $\begin{bmatrix} A_{x1} & A_{y1} & A_{z1} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix}$, and assume that at Xb down position, n5 sets of accelerometer raw data A_x, A_y and A_z have been collected. Then,

Equation 16

$$Y_5 = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix}_{n5x3}$$
$$w_5 = \begin{bmatrix} A_{xP5} & A_{yP5} & A_{zP5} & 1 \end{bmatrix}_{n5x4}$$

- At X_b up position (P6 position), $\begin{bmatrix} A_{x1} & A_{y1} & A_{z1} \end{bmatrix} = \begin{bmatrix} -1 & 0 & 0 \end{bmatrix}$, and assume that at X_b up position, n6 sets of accelerometer raw data A_x, A_y and A_z have been collected. Then,

Equation 17

$$Y_6 = \begin{bmatrix} -1 & 0 & 0 \end{bmatrix}_{n6x3}$$
$$w_6 = \begin{bmatrix} A_{xP6} & A_{yP6} & A_{zP6} & 1 \end{bmatrix}_{n6x4}$$

Combine *Equation 12* to *17* and let n = n1 + n2 + n3 + n4 + n5 + n6, then *Equation 11* becomes:

Equation 18

$$Y_{nx3} = w_{nx4} \cdot X_{4x3}$$

where:

Equation 19

$$Y = \begin{bmatrix} Y_1 \\ Y_2 \\ Y_3 \\ Y_4 \\ Y_5 \\ Y_6 \end{bmatrix}_{nx3}$$

$$w = \begin{bmatrix} w_1 \\ w_2 \\ w_3 \\ w_4 \\ w_5 \\ w_6 \end{bmatrix}_{nx4}$$

Therefore, the calibration parameter matrix X can be determined by the least square method as:

Equation 20

$$X = \left[w^T \cdot w\right]^{-1} \cdot w^T \cdot Y$$

where:

Equation 21

$$w^T \quad \text{means matrix transpose}$$

$$\left[w^T \cdot w\right]^{-1} \quad \text{means matrix inverse}$$

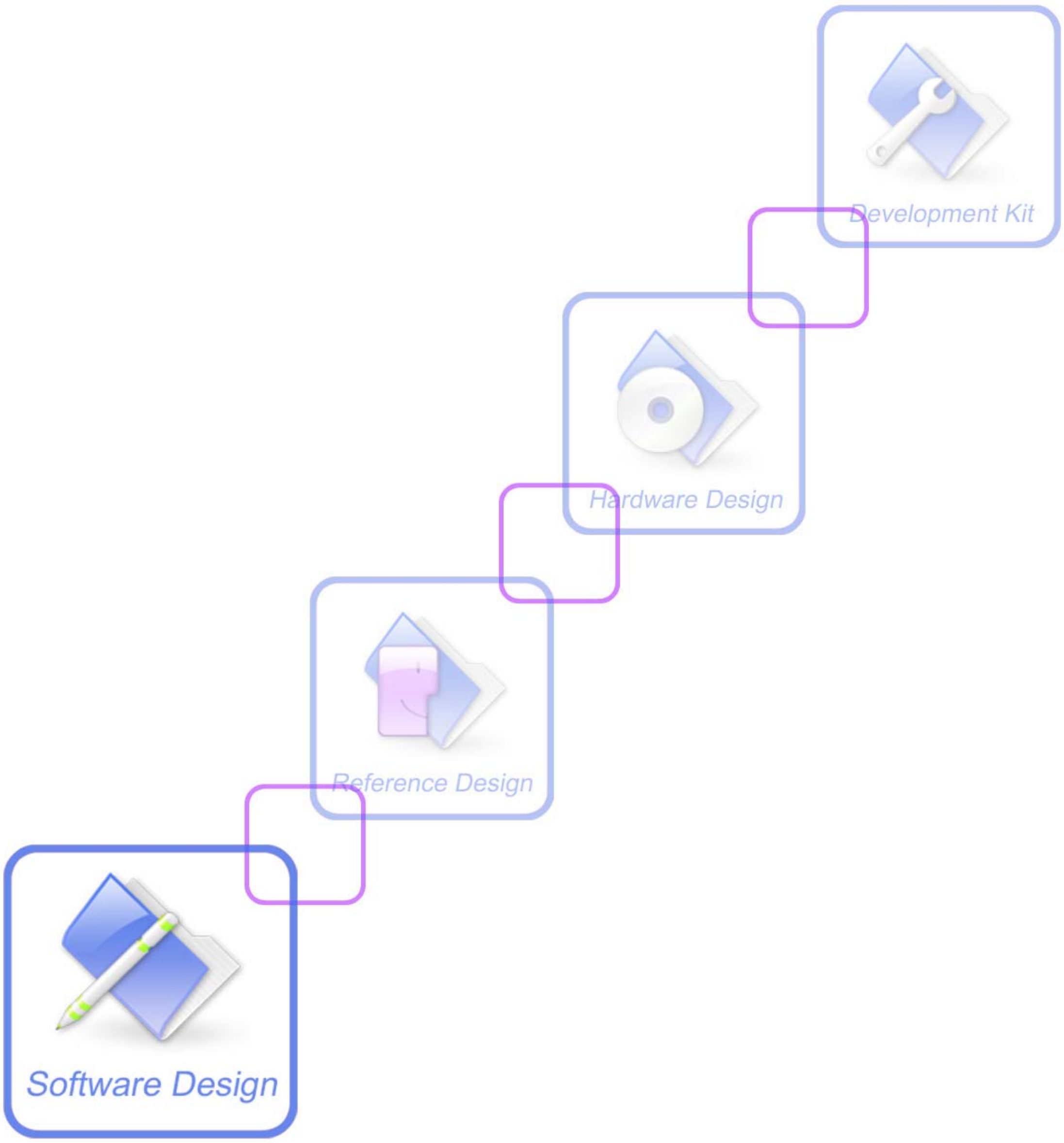
Revision history

Table 4. Document revision history

Date	Revision	Changes
21-Apr-2010	1	Initial release.

A company of SIM Tech

SIM900_AT Command Manual_ V1.03



Document Title:	SIM900 AT Command Manual
Version:	1.03
Date:	2010-12-24
Status:	Release
Document Control ID:	SIM900_AT Command Manual_V1.03

General Notes

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Version History

Version	Chapter	What is new
V1.00	New version	Created on the basis of SIM900 AT Test Result
V1.01	3.2.50 AT+CALS 6.2.27 AT+CBTE 6.2.30 AT+STTONE 8.2.21 AT+CIPDPDP 8.2.25AT+CIPUDPMODE 6.2.45 AT+SGPIO 6.2.46 AT+SPWM 6.2.47 AT+ECHO	Add new command Add new command Add new command Add new command Add new command Add new command Add new command Add new command
V1.02	3.2.16 AT+CLCC 3.2.30 AT+CR	Add write command Add parameter GPRS
V1.03	6.2.47 AT+SPWM 6.2.48 AT+ECHO 6.2.50 AT+GSMBUSY 8.2.26 AT+CIPRXGET 8.2.27 AT+CIPQRCLOSE 8.2.28 AT+CIPSCONT 9.2.1 AT+SAPBR 10.2.x HTTP commands 11.2.x FTP commands	Modified the command Modified the parameter scope Add new command Add new command Add new command Add new command Add new command Add new commands Add new commands

Contents

1 Introduction

1.1 Scope of the document

This document presents the AT Command Set for SIMCOM SIM900 series cellular engine.

1.2 Related documents

You can visit the SIMCom Website using the following link:
http://www.sim.com

1.3 Conventions and abbreviations

In this document, the GSM engines are referred to as following term:

1) ME (Mobile Equipment);
2) MS (Mobile Station);
3) TA (Terminal Adapter);
4) DCE (Data Communication Equipment) or facsimile DCE (FAX modem, FAX board);

In application, controlling device controls the GSM engine by sending AT Command via its serial interface. The controlling device at the other end of the serial line is referred to as following term:

1) TE (Terminal Equipment);
2) DTE (Data Terminal Equipment) or plainly "the application" which is running on an embedded system;

1.4 AT Command syntax

The "AT" or "at" prefix must be set at the beginning of each Command line. To terminate a Command line enter <CR>.
Commands are usually followed by a response that includes. "<CR><LF><response><CR><LF>"
Throughout this document, only the responses are presented, <CR><LF> are omitted intentionally.

The AT Command set implemented by SIM900 is a combination of GSM07.05, GSM07.07 and ITU-T recommendation V.25ter and the AT commands developed by SIMCom.
Note: A HEX string such as "00 49 49 49 49 FF FF FF FF" will be sent out through serial port at the baud rate of 115200 immediately after SIM900 is powered on. The string shall be ignored since it is used for synchronization with PC tool. Only enter AT Command through serial port after SIM900 is powered on and Unsolicited Result Code "RDY" is received from serial port. If auto-bauding is enabled, the Unsolicited Result Codes "RDY" and so on are not indicated when you start up the ME, and the "AT" prefix, not "at" prefix must be set at the beginning of each command line.

All these AT commands can be split into three categories syntactically: "**basic**", "**S parameter**", and "**extended**". These are as follows:

1.4.1 Basic syntax

These AT commands have the format of "**AT<*x*><*n*>**", or "**AT&<x><n>**", where "**<*x*>**"is the Command, and "**<*n*>**"is/are the argument(s) for that Command. An example of this is "**ATE<*n*>**", which tells the DCE whether received characters should be echoed back to the DTE according to the value of "**<*n*>**". "**<*n*>**" is optional and a default will be used if missing.

1.4.2 S Parameter syntax

These AT commands have the format of "**ATS<*n*>=<*m*>**", where "**<*n*>**" is the index of the **S** register to set, and "**<*m*>**"is the value to assign to it. "**<*m*>**" is optional; if it is missing, then a default value is assigned.

1.4.3 Extended Syntax

These commands can operate in several modes, as in the following table:

Table 1: Types of AT commands and responses

Test Command	AT+<*x*>=?	The mobile equipment returns the list of parameters and value ranges set with the corresponding Write Command or by internal processes.
Read Command	AT+<*x*>?	This command returns the currently set value of the parameter or parameters.
Write Command	AT+<x>=<…>	This command sets the user-definable parameter values.
Execution Command	AT+<x>	The execution command reads non-variable parameters affected by internal processes in the GSM engine.

1.4.4 Combining AT commands on the same Command line

You can enter several AT commands on the same line. In this case, you do not need to type the "**AT**" or "**at**" prefix before every command. Instead, you only need type "**AT**" or "**at**" the beginning of the command line. Please note to use a semicolon as the command delimiter after an extended command, for example: ATE1&W&F+ICF?; +CFUN?; &W.

The Command line buffer can accept a maximum of 556 characters. If the characters entered exceeded this number then none of the Command will executed and TA will return "**ERROR**".

1.4.5 Entering successive AT commands on separate lines

When you need to enter a series of AT commands on separate lines, please Note that you need to wait the final response (for example OK, CME error, CMS error) of last AT Command you entered before you enter the next AT Command.

1.5 Supported character sets

The SIM900 AT Command interface defaults to the **IRA** character set. The SIM900 supports the following character sets:

- GSM format
- UCS2

- HEX
- IRA
- PCCP
- PCDN
- 8859-1

The character set can be set and interrogated using the "**AT+CSCS**" Command (GSM 07.07). The character set is defined in GSM specification 07.05.

The character set affects transmission and reception of SMS and SMS Cell Broadcast messages, the entry and display of phone book entries text field and SIM Application Toolkit alpha strings.

1.6 Flow control

Flow control is very important for correct communication between the GSM engine and DTE. For in the case such as a data or fax call, the sending device is transferring data faster than the receiving side is ready to accept. When the receiving buffer reaches its capacity, the receiving device should be capable to cause the sending device to pause until it catches up.

There are basically two approaches to achieve data flow control: software flow control and hardware flow control. SIM900 support both two kinds of flow control.
In Multiplex mode, it is recommended to use the hardware flow control.

1.6.1 Software flow control (XON/XOFF flow control)

Software flow control sends different characters to stop (XOFF, decimal 19) and resume (XON, decimal 17) data flow. It is quite useful in some applications that only use three wires on the serial interface.
The default flow control approach of SIM900 is hardware flow control (RTS/CTS flow control), to enable software flow control in the DTE interface and within GSM engine, type the following AT Command:

AT+IFC=1, 1

This setting is stored volatile, for use after restart, **AT+IFC=1, 1** should be stored to the user profile with **AT&W**.

NOTE:

The AT commands listed in the table of **AT&W** chapter should be stored to user profile with **AT&W** for use after restart. Most other AT commands in V.25, 07.05, 07.07, GPRS will store parameters automatically and can be used after module restart.

Ensure that any communications software package (e.g. Hyper terminal) uses software flow control.

NOTE:

Software Flow control should not be used for data calls where binary data will be transmitted or received (e.g. TCP/IP) as the DTE interface may interpret binary data as flow control characters.

1.6.2 Hardware flow control (RTS/CTS flow control)

Hardware flow control achieves the data flow control by controlling the RTS/CTS line. When the data transfer should be suspended, the CTS line is set inactive until the transfer from the receiving buffer has completed. When the receiving buffer is ok to receive more data, CTS goes active once again.
To achieve hardware flow control, ensure that the RTS/CTS lines are present on your application platform.

2 AT Commands According to V.25TER

These AT Commands are designed according to the ITU-T (International Telecommunication Union, Telecommunication sector) V.25ter document.

2.1 Overview of AT Commands According to V.25TER

Command	Description
A/	RE-ISSUES THE LAST COMMAND GIVEN
ATA	ANSWER AN INCOMING CALL
ATD	MOBILE ORIGINATED CALL TO DIAL A NUMBER
ATD><N>	ORIGINATE CALL TO PHONE NUMBER IN CURRENT MEMORY
ATD><STR>	ORIGINATE CALL TO PHONE NUMBER IN MEMORY WHICH CORRESPONDS TO FIELD <STR>
ATDL	REDIAL LAST TELEPHONE NUMBER USED
ATE	SET COMMAND ECHO MODE
ATH	DISCONNECT EXISTING CONNECTION
ATI	DISPLAY PRODUCT IDENTIFICATION INFORMATION
ATL	SET MONITOR SPEAKER LOUDNESS
ATM	SET MONITOR SPEAKER MODE
+++	SWITCH FROM DATA MODE OR PPP ONLINE MODE TO COMMAND MODE
ATO	SWITCH FROM COMMAND MODE TO DATA MODE
ATP	SELECT PULSE DIALLING
ATQ	SET RESULT CODE PRESENTATION MODE
ATS0	SET NUMBER OF RINGS BEFORE AUTOMATICALLY ANSWERING THE CALL
ATS3	SET COMMAND LINE TERMINATION CHARACTER
ATS4	SET RESPONSE FORMATTING CHARACTER
ATS5	SET COMMAND LINE EDITING CHARACTER
ATS6	PAUSE BEFORE BLIND DIALLING
ATS7	SET NUMBER OF SECONDS TO WAIT FOR CONNECTION COMPLETION
ATS8	SET NUMBER OF SECONDS TO WAIT FOR COMMA DIAL MODIFIER ENCOUNTERED IN DIAL STRING OF D COMMAND
ATS10	SET DISCONNECT DELAY AFTER INDICATING THE ABSENCE OF DATA CARRIER
ATT	SELECT TONE DIALING
ATV	TA RESPONSE FORMAT
ATX	SET CONNECT RESULT CODE FORMAT AND MONITOR CALL

	PROGRESS
ATZ	RESET DEFAULT CONFIGURATION
AT&C	SET DCD FUNCTION MODE
AT&D	SET DTR FUNCTION MODE
AT&F	FACTORY DEFINED CONFIGURATION
AT&V	DISPLAY CURRENT CONFIGURATION
AT&W	STORE ACTIVE PROFILE
AT+GCAP	REQUEST COMPLETE TA CAPABILITIES LIST
AT+GMI	REQUEST MANUFACTURER IDENTIFICATION
AT+GMM	REQUEST TA MODEL IDENTIFICATION
AT+GMR	REQUEST TA REVISION IDENTIFICATION OF SOFTWARE RELEASE
AT+GOI	REQUEST GLOBAL OBJECT IDENTIFICATION
AT+GSN	REQUEST TA SERIAL NUMBER IDENTIFICATION (IMEI)
AT+ICF	SET TE-TA CONTROL CHARACTER FRAMING
AT+IFC	SET TE-TA LOCAL DATA FLOW CONTROL
AT+IPR	SET TE-TA FIXED LOCAL RATE
AT+HVOIC	DISCONNECT VOICE CALL ONLY

2.2 Detailed Description of AT Commands According to V.25TER

2.2.1 A/ Re-issues the Last Command Given

A/ Re-issues the Last Command Given	
Execution Command **A/**	Response Re-issues the previous Command
Reference V.25ter	Note

2.2.2 ATA ANSWER AN INCOMING CALL

ATA ANSWER AN INCOMING CALL

Execution Command **ATA**	Response TA sends off-hook to the remote station. Note1: Any additional commands on the same Command line are ignored. Note2: This Command may be aborted generally by receiving a character during execution. The aborting is not possible during some states of connection establishment such as handshaking. Response in case of data call, if successfully connected **CONNECT<text>** TA switches to data mode. Note: **<text>** output only if **ATX<value>** parameter setting with the **<value>**>0 When TA returns to Command mode after call release **OK** Response in case of voice call, if successfully connected **OK** Response if no connection **NO CARRIER**
Reference V.25ter	Note See also **ATX**

2.2.3 ATD Mobile Originated Call to Dial A Number

ATD Mobile Originated Call to Dial A Number	
Execution Command **ATD<n>[<mgsm][;]**	Response This Command can be used to set up outgoing *voice, data or fax calls*. It also serves to control *supplementary services.* Note: This Command may be aborted generally by receiving an **ATH** Command or a character during execution. The aborting is not possible during some states of connection establishment such as handshaking. If no dial tone and (parameter setting **ATX2** or **ATX4**) **NO DIALTONE** If busy and (parameter setting **ATX3** or **ATX4**) **BUSY** If a connection cannot be established **NO CARRIER** If the remote station does not answer **NO ANSWER**

	If connection successful and non-voice call. **CONNECT<text>** TA switches to data mode. Note: **<text>** output only if **ATX<value>** parameter setting with the **<value>** >0 When TA returns to Command mode after call release **OK** If connection successful and voice call **OK**
	Parameters **<n>** String of dialing digits and optionally V.25ter modifiers dialing digits: **0-9, * , #, +, A, B, C** Following V.25ter modifiers are ignored: **,(comma), T, P, !, W, @** **Emergency call:** **<n>** Standardized emergency number 112 (no SIM needed) **<mgsm>** String of **GSM** modifiers: **I** Actives **CLIR** (Disables presentation of own number to called party) **i** Deactivates **CLIR** (Enable presentation of own number to called party) **G** Activates Closed User Group invocation for this call only **g** Deactivates Closed User Group invocation for this call only **<;>** Only required to set up voice call , return to Command state
Reference V.25ter	Note ● Parameter "I" and "i" only if no *# code is within the dial string ● **<n>** is default for last number that can be dialed by **ATDL** ● *# codes sent with **ATD** are treated as voice calls. Therefore, the Command must be terminated with a semicolon ";" ● See **ATX** Command for setting result code and call monitoring parameters. Responses returned after dialing with **ATD** ● For voice call two different responses mode can be determined. **TA** returns "**OK**" immediately either after dialing was completed or after the call is established. The setting is controlled by **AT+COLP**. Factory default is **AT+COLP=0**, this cause the **TA** returns "**OK**" immediately

	after dialing was completed, otherwise **TA** will returns "**OK**", "**BUSY**", "**NO DIAL TONE**", "**NO CARRIER**". Using **ATD** during an active voice call: ● When a user originates a second voice call while there is already an active voice call, the first call will be automatically put on hold. ● The current states of all calls can be easily checked at any time by using the **AT+CLCC** Command.

2.2.4 ATD><n> Originate Call to Phone Number in Current Memory

ATD><n> Originate Call to Phone Number in Current Memory	
Execution Command **ATD><n>[<clir>][<cug>][;]**	Response This Command can be used to dial a phone number from current phonebook memory. Note: This Command may be aborted generally by receiving an **ATH** Command or a character during execution. The aborting is not possible during some states of connection establishment such as handshaking. If error is related to ME functionality **+CME ERROR: <err>** If no dial tone and (parameter setting **ATX2** or **ATX4**) **NO DIALTONE** If busy and (parameter setting **ATX3** or **ATX4**) **BUSY** If a connection cannot be established **NO CARRIER** If the remote station does not answer **NO ANSWER** If connection successful and non-voice call. **CONNECT<text> TA** switches to data mode. Note: **<text>** output only if **ATX<value>** parameter setting with the **<value>** >0 When **TA** returns to Command mode after call release **OK** If successfully connected and voice call

	OK
	Parameters **<n>** Integer type memory location should be in the range of locations available in the memory used **<mgsm>** String of **GSM** modifiers: **<clir>** **I** Override the CLIR supplementary service subscription default value for this call Invocation (restrict CLI presentation) **i** Override the CLIR supplementary service subscription default value for this call Suppression (allow CLI presentation) **<cug>** **G** Control the CUG supplementary service information for this call CUG Not supported **g** Control the CUG supplementary service information for this call CUG Not supported **<;>** Only required to set up voice call , return to Command state
Reference V.25ter	Note ● Parameter "I" and "i" only if no *# code is within the dial string ● *# codes sent with **ATD** are treated as voice calls. Therefore, the Command must be terminated with a semicolon ";" ● See **ATX** Command for setting result code and call monitoring parameters.

2.2.5 ATD><str> Originate Call to Phone Number in Memory Which Corresponds to Field <str>

ATD><str> Originate Call to Phone Number in Memory Which Corresponds to Field <str>	
Execution Command **ATD><str>[<clir>][<cug>][;]**	Response This Command make the **TA** attempts to set up an outgoing call to stored number. All available memories are searched for the entry **<str>**. Note: This Command may be aborted generally by receiving an **ATH** Command or a character during execution. The aborting is not possible during some states of connection establishment such as handshaking. If error is related to ME functionality **+CME ERROR: <err>** If no dial tone and (parameter setting **ATX2** or **ATX4**)

	NO DIALTONE If busy and (parameter setting **ATX3** or **ATX4**) **BUSY** If a connection cannot be established **NO CARRIER** If the remote station does not answer **NO ANSWER** If connection successful and non-voice call. **CONNECT<text> TA** switches to data mode. Note: **<text>** output only if **ATX<value>** parameter setting with the **<value>** >0 When **TA** returns to Command mode after call release **OK** If successfully connected and voice call **OK**
	Parameters **<str>** String type (string should be included in quotation marks) value ("**x**"), which should equal to an alphanumeric field in at least one phone book entry in the searched memories. **str** formatted as current **TE** character set specified by **+CSCS**. **<mgsm>** String of **GSM** modifiers: **I** Actives **CLIR** (Disables presentation of own number to called party) **i** Deactivates **CLIR** (Enable presentation of own number to called party) **G** Activates Closed User Group invocation for this call only **g** Deactivates Closed User Group invocation for this call only <;> only required to set up voice call , return to Command state
Reference V.25ter	Note ● Parameter "I" and "i" only if no *# code is within the dial string ● *# codes sent with **ATD** are treated as voice calls. Therefore, the Command must be terminated with a semicolon ";" ● See **ATX** Command for setting result code and call monitoring parameters.

2.2.6 ATDL Redial Last Telephone Number Used

ATDL Redial Last Telephone Number Used	
Execution Command **ATDL**	Response This Command redials the last voice and data call number used. Note: This Command may be aborted generally by receiving an **ATH** Command or a character during execution. The aborting is not possible during some states of connection establishment such as handshaking. If error is related to ME functionality **+CME ERROR: <err>** If no dial tone and (parameter setting **ATX2** or **ATX4**) **NO DIALTONE** If busy and (parameter setting **ATX3** or **ATX4**) **BUSY** If a connection cannot be established **NO CARRIER** If the remote station does not answer **NO ANSWER** If connection successful and non-voice call. **CONNECT<text> TA** switches to data mode. Note: **<text>** output only if **ATX<value>** parameter setting with the **<value>** >0 When **TA** returns to Command mode after call release **OK** If successfully connected and voice call **OK**
Reference V.25ter	Note ● See **ATX** Command for setting result code and call monitoring parameters. ● Return the numbers and symbols which **ATD** supports if there is no last dialing context.

2.2.7 ATE Set Command Echo Mode

ATE Set Command Echo Mode	
Execution	Response

Command **ATE<value>**	This setting determines whether or not the TA echoes characters received from TE during Command state. **OK**
	Parameter **<value>** 0 Echo mode off 1 Echo mode on
Reference V.25ter	Note

2.2.8 ATH Disconnect Existing Connection

ATH Disconnect Existing Connection	
Execution Command **ATH[n]**	Response Disconnect existing call by local TE from Command line and terminate call **OK** Note: OK is issued after circuit 109(DCD) is turned off, if it was previously on.
	Parameter **<n>** 0 Disconnect ALL calls on the channel the command is requested. All active or waiting calls, CS data calls, GPRS call of the channel will be disconnected. 1 Disconnect all calls on ALL connected channels. All active or waiting calls, CSD calls, GPRS call will be disconnected. (clean up of all calls of the ME) 2 Disconnect all connected CS data call only on the channel the command is requested. (speech calls (active or waiting) or GPRS calls are not disconnected) 3 Disconnect all connected GPRS calls only on the channel the command is requested (speech calls (active or waiting) or CS data calls are not disconnected. 4 Disconnect all CS calls (either speech or data) but does not disconnect waiting call (either speech or data) on the channel the command is requested. 5 Disconnect waiting call (either speech or data) but does not disconnect other active calls (either CS speech, CS data or GPRS) on the channel the command is requested. (rejection of incoming call)
Reference V.25ter	Note

2.2.9 ATI Display Product Identification Information

ATI Display Product Identification Information	
Execution Command **ATI**	Response TA issues product information text Example: **SIM900 R11.0** **OK**
Reference V.25ter	Note

2.2.10 ATL Set Monitor speaker loudness

ATL Set Monitor speaker loudness	
Execution Command **ATL<value>**	Response **OK**
	Parameter **<value>** 0..9 volume
Reference V.25ter	Note No effect in GSM

2.2.11 ATM Set Monitor Speaker Mode

ATM Set Monitor Speaker Mode	
Execution Command **ATM<value>**	Response **OK**
	Parameter **<value>** 0..9 mode
Reference V.25ter	Note No effect in GSM

2.2.12 +++ Switch from Data Mode or PPP Online Mode to Command Mode

+++ Switch from Data Mode or PPP Online Mode to Command Mode	
Execution Command +++	Response The +++ character sequence causes the TA to cancel the data flow over the AT interface and switch to Command mode. This allows you to enter AT Command while maintaining the data connection to the remote server. **OK** To prevent the +++ escape sequence from being misinterpreted as data, it should comply to following sequence:

	1. No characters entered for T1 time (1 second) 2. "+++" characters entered with no characters in between (0.5 second) 3. No characters entered for T1 timer (0.5 second) 4. Switch to Command mode, otherwise go to step 1.
	Parameter
Reference V.25ter	Note To return from Command mode back to data mode: Enter **ATO**.

2.2.13 ATO Switch from Command Mode to Data Mode

ATO Switch from Command Mode to Data Mode	
Execution Command **ATO[n]**	Response TA resumes the connection and switches back from Command mode to data mode. **CONNECT** If connection is not successfully resumed **NO CARRIER** else TA returns to data mode from Command mode **CONNECT** <text> Note: <text> only if parameter setting ATX>0
	Parameter **<n>** 0 Switch from Command mode to data mode.
Reference V.25ter	Note

2.2.14 ATP Select Pulse Dialling

ATP Select Pulse Dialling	
Execution Command **ATP**	Response **OK**
Reference V.25ter	Note No effect in GSM

2.2.15 ATQ Set Result Code Presentation Mode

ATQ Set Result Code Presentation Mode	
Execution Command **ATQ<n>**	Response This parameter setting determines whether or not the TA transmits any result code to the TE. Information text transmitted in response is not affected by this setting.

	If <n>=0: **OK** If <n>=1: (none)
	Parameter **<n>** 0 TA transmits result code 1 Result codes are suppressed and not transmitted
Reference V.25ter	Note

2.2.16 ATS0 Set Number of Rings before Automatically Answering the Call

ATS0 Set Number of Rings before Automatically Answering the Call	
Read Command **ATS0?**	Response **<n>** **OK**
	Parameter See Write Command
Write Command **ATS0=<n>**	Response This parameter setting determines the number of rings before auto-answer. **OK** **ERROR**
	Parameter **<n>** 0 Automatic answering is disable. 1-255 Number of rings the modem will wait for before answering the phone if a ring is detected.
Reference V.25ter	Note If <n> is set too high, the calling party may hang up before the call can be answered automatically.

2.2.17 ATS3 Set Command Line Termination Character

ATS3 Set Command Line Termination Character	
Read Command **ATS3?**	Response **<n>** **OK**
	Parameter See Write Command
Write Command **ATS3=<n>**	Response This parameter setting determines the character recognized by TA to

	terminate an incoming Command line. The TA also returns this character in output. **OK** **ERROR**
	Parameter **<n>** 13 Command line termination character
Reference V.25ter	Note Default 13 = CR. It only supports default value.

2.2.18 ATS4 Set Response Formatting Character

ATS4 Set Response Formatting Character	
Read Command **ATS4?**	Response **<n>** **OK**
	Parameter See Write Command
Write Command **ATS4=<n>**	Response This parameter setting determines the character generated by the TA for result code and information text. **OK** **ERROR**
	Parameter **<n>** 10 Response formatting character
Reference V.25ter	Note Default 10 = LF. It only supports default value.

2.2.19 ATS5 Set Command Line Editing Character

ATS5 Set Command Line Editing Character	
Read Command **ATS5?**	Response **<n>** **OK**
	Parameter See Write Command
Write Command **ATS5=<n>**	Response This parameter setting determines the character recognized by TA as a request to delete from the Command line the immediately preceding

	character. **OK** **ERROR**
	Parameter **<n>** 0-8-127 Response formatting character
Reference V.25ter	Note Default 8 = Backspace.

2.2.20 ATS6 Pause Before Blind Dialling

ATS6 Pause Before Blind Dialling	
Read Command **ATS6?**	Response **ERROR**
Write Command **ATS6=<n>**	Response **OK** **ERROR**
	Parameter **<n>** 0..999 Time
Reference V.25ter	Note No effect in GSM

2.2.21 ATS7 Set Number of Seconds to Wait for Connection Completion

ATS7 Set Number of Seconds to Wait for Connection Completion	
Read Command **ATS7?**	Response **<n>** **OK**
	Parameter See Write Command
Write Command **ATS7=<n>**	Response This parameter setting determines the amount of time to wait for the connection completion in case of answering or originating a call. **OK** **ERROR**
	Parameter **<n>** 1-60-255 Number of seconds to wait for connection completion
Reference	Note

V.25ter	● If called party has specified a high value for ATS0=<n>, call setup may fail. ● The correlation between ATS7 and ATS0 is important ● Example: Call may fail if ATS7=30 and ATS0=20. ● ATS7 is only applicable to data call.

2.2.22 ATS8 Set Number of Seconds to Wait for Comma Dial Modifier Encountered in Dial String of D Command

ATS8 Set Number of Seconds to Wait for Comma Dial Modifier Encountered in Dial String of D Command	
Read Command **ATS8?**	Response **<n>** **OK**
	Parameter See Write Command
Write Command **ATS8=<n>**	Response **OK** **ERROR**
	Parameter **<n>** 0-255 The value of this register determines how long the modem should pause when it sees a comma in the dialing string.
Reference V.25ter	Note No effect in GSM

2.2.23 ATS10 Set Disconnect Delay after Indicating the Absence of Data Carrier

ATS10 Set Disconnect Delay after Indicating the Absence of Data Carrier	
Read Command **ATS10?**	Response **<n>** **OK**
	Parameter See Write Command
Write Command **ATS10=<n>**	Response This parameter setting determines the amount of time that the TA will remain connected in absence of data carrier. If the data carrier is once more detected before disconnecting, the TA remains connected. **OK** **ERROR**
	Parameter

	<n> 1-15-254 Number of tenths seconds of delay
Reference V.25ter	Note

2.2.24 ATT Select Tone Dialing

ATT Select Tone Dialing	
Execution Command **ATT**	Response **OK**
Reference V.25ter	Note No effect in GSM

2.2.25 ATV TA Response Format

ATV TA Response Format	
Execution Command **ATV<value>**	Response This parameter setting determines the contents of the header and trailer transmitted with result codes and information responses. When <value>=0 **0** When <value>=1 **OK**
	Parameter **<value>** 0 Information response: <text><CR><LF> Short result code format: <numeric code><CR> 1 Information response: <CR><LF><text><CR><LF> Long result code format: <CR><LF><verbose code> <CR><LF> The result codes, their numeric equivalents and brief descriptions of the use of each are listed in the following table.
Reference V.25ter	Note

ATV1	**ATV0**	**Description**
OK	0	Acknowledges execution of a Command
CONNECT	1	A connection has been established; the DCE is moving from Command state to online data state
RING	2	The DCE has detected an incoming call signal from network
NO CARRIER	3	The connection has been terminated or the attempt to establish a connection failed
ERROR	4	Command not recognized, Command line maximum

		length exceeded, parameter value invalid, or other problem with processing the Command line
NO DIALTONE	6	No dial tone detected
BUSY	7	Engaged (busy) signal detected
NO ANSWER	8	"@" (Wait for Quiet Answer) dial modifier was used, but remote ringing followed by five seconds of silence was not detected before expiration of the connection timer (S7)
PROCEEDING	9	An AT command is being processed
CONNECT <text>	Manufacturer-specific	Same as CONNECT, but includes manufacturer-specific text that may specify DTE speed, line speed, error control, data compression, or other status

2.2.26 ATX Set CONNECT Result Code Format and Monitor Call Progress

ATX Set CONNECT Result Code Format and Monitor Call Progress	
Execution Command **ATX<value>**	Response This parameter setting determines whether or not the TA detected the presence of dial tone and busy signal and whether or not TA transmits particular result codes. **OK** **ERROR**
	Parameter **<value>** 0 **CONNECT** result code only returned, dial tone and busy detection are both disabled. 1 **CONNECT<text>** result code only returned, dial tone and busy detection are both disabled. 2 **CONNECT<text>** result code returned, dial tone detection is enabled, busy detection is disabled. 3 **CONNECT<text>** result code returned, dial tone detection is disabled, busy detection is enabled. 4 **CONNECT<text>** result code returned, dial tone and busy detection are both enabled.
Reference V.25ter	Note

2.2.27 ATZ Reset Default Configuration

ATZ Reset Default Configuration	
Execution Command **ATZ[<value>]**	Response TA sets all current parameters to the user defined profile. **OK**

	ERROR
	Parameter **<value>** 0 Restore profile 0 1 Restore profile 1
Reference V.25ter	Note

Parameter impacted by Z command:

Command	Parameter name	Default value
ATE	<echo>	0x01
ATQ	<result>	0x00
ATV	<format>	0x01
ATX	<result>	0x04
AT&C	<behavior>	0x01
AT&D	<behavior>	0x01
AT+IFC	<TA_by_TE>	0x00
AT+IFC	<TE_by_TA>	0x00
AT+FCLASS	<class>	0x00
ATS0	<num>	0x00
ATS3	<char>	0x00
ATS4	<char>	0x0D
ATS5	<char>	0x0A
ATS7	<time>	0x08
ATS8	<time>	0x32
ATS10	<time>	0x0E

2.2.28 AT&C Set DCD Function Mode

AT&C Set DCD Function Mode	
Execution Command **AT&C[<value>]**	Response This parameter determines how the state of circuit 109 **(DCD)** relates to the detection of received line signal from the distant end. **OK** **ERROR**
	Parameter **<value>** 0 **DCD** line is always ON 1 **DCD** line is ON only in the presence of data carrier
Reference V.25ter	Note

2.2.29 AT&D Set DTR Function Mode

AT&D Set DTR Function Mode	
Execution Command **AT&D[<value>]**	Response This parameter determines how the TA responds when circuit 108/2 (DTR) is changed from the ON to the OFF condition during data mode. **OK** **ERROR**
	Parameter **<value>** 0 TA ignores status on DTR. 1 ON->OFF on DTR: Change to Command mode with remaining the connected call. 2 ON->OFF on DTR: Disconnect call, change to Command mode. During state DTR = OFF is auto-answer off.
Reference V.25ter	Note

2.2.30 AT&F Factory Defined Configuration

AT&F Factory Defined Configuration	
Execution Command **AT&F[<value>]**	Response TA sets all current parameters to the manufacturer defined profile. **OK**
	Parameter **<value>** 0 Set all TA parameters to manufacturer defaults.
Reference V.25ter	Note

Parameter impacted by &F command:

Command	Parameter name	Default value
ATE	<echo>	0x01
ATQ	<result>	0x00
ATV	<format>	0x01
ATX	<result>	0x04
AT+IFC	<TA_by_TE>	0x00
AT+IFC	<TE_by_TA>	0x00
ATS0	<num>	0x00
ATS3	<char>	0x0D
ATS4	<char>	0x0A
ATS5	<char>	0x08

ATS7	<time>	0x64
ATS8	<time>	0x02
ATS10	<time>	0x0E
AT+CRLP	<ver>	0x00
AT+CRLP	<T4>	0x07
AT+CRLP	<iws>	0x61
AT+CRLP	<mws>	0x61
AT+CRLP	<T1>	0x48
AT+CRLP	<N2>	0x06
AT+CPBS	<storage>	0x53 0x4D 0x00
AT+CSMP	<fo>	0x11
AT+CSMP	<vp>	0x00
AT+CSMP	<vp>	0x18
AT+CSMP	<vp>	0x00
AT+CSMP	<vp>	0x00
AT+CSMP	<fo>	0x11
AT+CSMP	<vp>	0x00
AT+CSMP	<vp>	0x18
AT+CSMP	<vp>	0x00
AT+CSMP	<vp>	0x00
AT+CSMP	<fo>	0x11
AT+CSMP	<vp>	0x00
AT+CSMP	<vp>	0x18
AT+CSMP	<vp>	0x00
AT+CSMP	<vp>	0x00
AT+CSMP	<vp>	0x00..0x00
AT+CSMP	<pid>	0x00
AT+CSMP	<dcs>	0x00
AT+CR	<mode>	0x00
AT+CSTA	<type>	0x81
AT+CBST	<speed>	0x05 0x02 0x00
AT+CBST	<name>	0x01 0x00
AT+CBST	<ce>	0x01
AT+CRC	<mode>	0x00
AT+CMOD	<mode>	0x00
AT+CMEE	<n>	0x00
AT+CREG	<n>	0x00
AT+CGREG	<n>	0x00

AT+CSMS	<service>	0x00
AT+CMGF	<mode>	0x00
AT+CSDH	<show>	0x00
AT+CSCS	<chset>	0x00
AT+CLIR	<n>	0x00
AT+CLIP	<n>	0x00
AT+COLP	<n>	0x00

2.2.31 AT&V Display Current Configuration

AT&V Display Current Configuration	
Execution Command **AT&V[<n>]**	Response TA returns the current parameter setting. <current configurations text> **OK** **ERROR**
	Parameter **<n>** 0 Responses in numeric format
Reference V.25ter	Note

2.2.32 AT&W Store Active Profile

AT&W Store Active Profile	
Execution Command **AT&W[<n>]**	Response TA stores the current parameter setting in the user defined profile. **OK** **ERROR**
	Parameter **<n>** 0 Store the current configuration in profile 0 1 Store the current configuration in profile 1
Reference V.25ter	Note The user defined profile is stored in non volatile memory.

Parameter stored by &W

Command	**Parameter name**	**Displayedby &V**
ATE	<echo>	Y
ATQ	<result>	Y
ATV	<format>	Y
ATX	<result>	Y

AT&C	<behavior>	Y
AT&D	<behavior>	Y
AT+IFC	<TA_by_TE>	Y
AT+IFC	<TE_by_TA>	Y
AT+FCLASS	<class>	Y
ATS0	<num>	Y
ATS3	<char>	Y
ATS4	<char>	Y
ATS5	<char>	Y
ATS7	<time>	Y
ATS8	<time>	Y
ATS10	<time>	Y

2.2.33 AT+GCAP Request Complete TA Capabilities List

AT+GCAP Request Complete TA Capabilities List	
Execution Command **AT+GCAP**	Response TA reports a list of additional capabilities. **+GCAP:** list of supported **<name>**s **OK**
	Parameter **<name>** +CGSM GSM function is supported +FCLASS FAX function is supported
Reference V.25ter	Note The command can be executed only when the SIM card is present.

2.2.34 AT+GMI Request Manufacturer Identification

AT+GMI Request Manufacturer Identification	
Test Command **AT+GMI=?**	Response **OK**
	Parameter
Execution Command **AT+GMI**	TA reports one or more lines of information text which permit the user to identify the manufacturer. **SIMCOM_Ltd** **OK**
Reference V.25ter	Note

2.2.35 AT+GMM Request TA Model Identification

AT+GMM Request TA Model Identification	
Test Command **AT+GMM=?**	Response **OK**
Execution Command **AT+GMM**	TA reports one or more lines of information text which permit the user to identify the specific model of device. **<model>** **OK**
	Parameter **<model>** product model identification text
Reference V.25ter	Note

2.2.36 AT+GMR Request TA Revision Identification of Software Release

AT+GMR Request TA Revision Identification of Software Release	
Test Command **AT+GMR=?**	Response **OK**
Execution Command **AT+GMR**	TA reports one or more lines of information text which permit the user to identify the revision of software release. **Revision: <revision>** **OK**
	Parameter **<revision>** Revision of software release
Reference V.25ter	Note

2.2.37 AT+GOI Request Global Object Identification

AT+GOI Request Global Object Identification	
Test Command **AT+GOI=?**	Response **OK**
Execution Command **AT+GOI**	Response TA reports one or more lines of information text which permit the user to identify the device, based on the ISO system for registering unique object identifiers. **<Object Id>**

	OK
	Parameter **<Object Id>** identifier of device type see X.208, 209 for the format of <Object Id>
Reference V.25ter	Note

2.2.38 AT+GSN Request TA Serial Number Identification (IMEI)

AT+GSN Request TA Serial Number Identification(IMEI)	
Test Command **AT+GSN=?**	Response **OK**
Execution Command **AT+GSN**	Response TA reports the IMEI (international mobile equipment identifier) number in information text which permit the user to identify the individual ME device. **<sn>** **OK**
	Parameter **<sn>** IMEI of the telephone(International Mobile station Equipment Identity)
Reference V.25ter	Note The serial number (IMEI) is varied by individual ME device.

2.2.39 AT+ICF Set TE-TA Control Character Framing

AT+ICF Set TE-TA Control Character Framing	
Test Command **AT+ICF=?**	Response **+ICF: (**list of supported **<format>**s**),(**list of supported **<parity>**s**)** **OK**
	Parameters See Write Command
Read Command **AT+ICF?**	Response **+ICF: <format>,<parity>** **OK**
	Parameters See Write Command
Write Command **AT+ICF=<format>,[<parity>]**	Response This parameter setting determines the serial interface character framing format and parity received by TA from TE.

	OK
	Parameters **<format>** 1 8 data 0 parity 2 stop 2 8 data 1 parity 1 stop 3 8 data 0 parity 1 stop 4 7 data 0 parity 2 stop 5 7 data 1 parity 1 stop 6 7 data 0 parity 1 stop **<parity>** 0 odd 1 even 3 space (0)
Reference V.25ter	Note ● The Command is applied for Command state; ● In **<format>** parameter, "0 parity" means no parity; ● The **<parity>** field is ignored if the **<format>** field specifies no parity and string "**+ICF: <format>,255**" will be response to **AT+ICF**? Command.

2.2.40 AT+IFC Set TE-TA Local Data Flow Control

AT+IFC Set TE-TA Local Data Flow Control	
Test Command **AT+IFC=?**	Response **+IFC: (**list of supported **<dce_by_dte>**s**),(**list of supported **<dte_by_dce>**s**)** **OK**
	Parameters See Write Command
Read Command **AT+IFC?**	Response **+IFC: <dce_by_dte>,<dte_by_dce>** **OK**
	Parameters See Write Command
Write Command **AT+IFC=<dce_by_dte>[,<dte_by_dce>]**	Response This parameter setting determines the data flow control on the serial interface for data mode. **OK**
	Parameters **<dce_by_dte>** Specifies the method will be used by TE at receive of data from TA 0 No flow control

	1 Software flow control 2 Hardware flow control **<dte_by_dce>** Specifies the method will be used by TA at receive of data from TE 0 No flow control 1 Software flow control 2 Hardware flow control
Reference V.25ter	Note

2.2.41 AT+IPR Set TE-TA Fixed Local Rate

AT+IPR Set TE-TA Fixed Local Rate	
Test Command **AT+IPR=?**	Response **+IPR: (),(**list of supported **<rate>**s**)** **OK**
	Parameter See Write Command
Read Command **AT+IPR?**	Response **+IPR: <rate>** **OK**
	Parameter See Write Command
Write Command **AT+IPR=<rate>**	Response This parameter setting determines the data rate of the TA on the serial interface. The rate of Command takes effect following the issuance of any result code associated with the current Command line. **OK**
	Parameter **<rate>** Baud rate per second 0 (Auto-bauding) 1200 2400 4800 9600 19200 38400 57600 115200

Reference V.25ter	Note Factory setting is AT+IPR=0（auto-bauding）.

2.2.41.1 Auto-bauding

Synchronization between DTE and DCE ensure that DTE and DCE are correctly synchronized and the baud rate used by the DTE is detected by the DCE (= ME). To allow the baud rate to be synchronized, simply issue an "AT" string. This is necessary when you start up the module while auto-bauding is enabled. It is recommended to wait 3 to 5 seconds before sending the first AT character. Otherwise undefined characters might be returned.

If you want to use auto-bauding and auto-answer at the same time, you can easily enable the DTE-DCE synchronization, when you activate auto-bauding first and then configure the auto-answer mode.

Restrictions on auto-bauding operation

- The serial interface has to be operated at 8 data bits, no parity and 1 stop bit (factory setting).
- Only the strings "AT" or "At" (not "aT" or "at") can be detected when auto-bauding is enabled.
- AT+IPR=0 setting to auto-bauding will take effect after module resets. If user wants to change DTE baud rate during module is running, i.e. from 57600 to 4800, DTR shall be used to urge auto-bauding progress. DTR shall be pulled up to invalid state at least 2 seconds by DTE and then pulled down to valid state. The step will urge auto-bauding progress and DCE will synchronize its baud rate after it receives data from the serial port.
- Unsolicited Result Codes that may be issued before the ME detects the new baud rate (by receiving the first AT Command string) will be sent at the previously detected baud rate.
- The Unsolicited Result Codes "RDY" and so on are not indicated when you start up the ME while auto-bauding is enabled.
- It is not recommended to switch to auto-bauding from a baud rate that cannot be detected by the auto-bauding mechanism (e.g. 300 baud). Responses to +IPR=0 and any commands on the same line might be corrupted.

Auto-bauding and baud rate after restart

The most recently detected baud rate can not be stored when module is powered down.

2.2.42 AT+HVOIC Disconnect Voice Call Only

AT+HVOIC Disconnect Voice Call Only	
Execution Command **AT+HVOIC**	Response Disconnect existing voice call by local TE from Command line and terminate call with existing PPP or CSD connection on. **OK**
Reference V.25ter	Note

3 AT Commands According to GSM07.07

3.1 Overview of AT Command According to GSM07.07

Command	Description
AT+CACM	ACCUMULATED CALL METER(ACM) RESET OR QUERY
AT+CAMM	ACCUMULATED CALL METER MAXIMUM(ACM MAX) SET OR QUERY
AT+CAOC	ADVICE OF CHARGE
AT+CBST	SELECT BEARER SERVICE TYPE
AT+CCFC	CALL FORWARDING NUMBER AND CONDITIONS CONTROL
AT+CCWA	CALL WAITING CONTROL
AT+CEER	EXTENDED ERROR REPORT
AT+CGMI	REQUEST MANUFACTURER IDENTIFICATION
AT+CGMM	REQUEST MODEL IDENTIFICATION
AT+CGMR	REQUEST TA REVISION IDENTIFICATION OF SOFTWARE RELEASE
AT+CGSN	REQUEST PRODUCT SERIAL NUMBER IDENTIFICATION (IDENTICAL WITH +GSN)
AT+CSCS	SELECT TE CHARACTER SET
AT+CSTA	SELECT TYPE OF ADDRESS
AT+CHLD	CALL HOLD AND MULTIPARTY
AT+CIMI	REQUEST INTERNATIONAL MOBILE SUBSCRIBER IDENTITY
AT+CLCC	LIST CURRENT CALLS OF ME
AT+CLCK	FACILITY LOCK
AT+CLIP	CALLING LINE IDENTIFICATION PRESENTATION
AT+CLIR	CALLING LINE IDENTIFICATION RESTRICTION
AT+CMEE	REPORT MOBILE EQUIPMENT ERROR
AT+COLP	CONNECTED LINE IDENTIFICATION PRESENTATION
AT+COPS	OPERATOR SELECTION
AT+CPAS	PHONE ACTIVITY STATUS
AT+CPBF	FIND PHONEBOOK ENTRIES
AT+CPBR	READ CURRENT PHONEBOOK ENTRIES
AT+CPBS	SELECT PHONEBOOK MEMORY STORAGE
AT+CPBW	WRITE PHONEBOOK ENTRY
AT+CPIN	ENTER PIN
AT+CPWD	CHANGE PASSWORD
AT+CR	SERVICE REPORTING CONTROL
AT+CRC	SET CELLULAR RESULT CODES FOR INCOMING CALL

	INDICATION
AT+CREG	NETWORK REGISTRATION
AT+CRLP	SELECT RADIO LINK PROTOCOL PARAMETERS
AT+CRSM	RESTRICTED SIM ACCESS
AT+CSQ	SIGNAL QUALITY REPORT
AT+FCLASS	FAX: SELECT, READ OR TEST SERVICE CLASS
AT+FMI	FAX: REPORT MANUFACTURED ID
AT+FMM	FAX: REPORT MODEL ID
AT+FMR	FAX: REPORT REVISION ID
AT+VTD	TONE DURATION
AT+VTS	DTMF AND TONE GENERATION
AT+CMUX	MULTIPLEXER CONTROL
AT+CNUM	SUBSCRIBER NUMBER
AT+CPOL	PREFERRED OPERATOR LIST
AT+COPN	READ OPERATOR NAMES
AT+CFUN	SET PHONE FUNCTIONALITY
AT+CCLK	CLOCK
AT+CSIM	GENERIC SIM ACCESS
AT+CALM	ALERT SOUND MODE
AT+CALS	ALERT SOUND SELECT
AT+CRSL	RINGER SOUND LEVEL
AT+CLVL	LOUD SPEAKER VOLUME LEVEL
AT+CMUT	MUTE CONTROL
AT+CPUC	PRICE PER UNIT AND CURRENCY TABLE
AT+CCWE	CALL METER MAXIMUM EVENT
AT+CBC	BATTERY CHARGE
AT+CUSD	UNSTRUCTURED SUPPLEMENTARY SERVICE DATA
AT+CSSN	SUPPLEMENTARY SERVICES NOTIFICATION

3.2 Detailed Descriptions of AT Command According to GSM07.07

3.2.1 AT+CACM Accumulated Call Meter (ACM) Reset or Query

AT+CACM Accumulated Call Meter(ACM) Reset or Query	
Test Command **AT+CACM=?**	Response **OK**
Read Command **AT+CACM?**	Response TA returns the current value of ACM.

	+CACM: <acm> **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameter **<acm>** string type (string should be included in quotation marks); three bytes of the current ACM value in hexa-decimal format (e.g. "00001E" indicates decimal value 30) 000000 – FFFFFF
Write Command **AT+CACM=<passwd>**	Response TA resets the Advice of Charge related accumulated call meter (ACM) value in SIM file EF (ACM). ACM contains the total number of home units for both the current and preceding calls. **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameter **<passwd>** string type (string should be included in quotation marks): SIM PIN2
Reference GSM 07.07 [13]	Note

3.2.2 AT+CAMM Accumulated Call Meter Maximum (ACM max) Set or Query

AT+CAMM Accumulated Call Meter Maximum(ACM max) Set or Query	
Test Command **AT+CAMM=?**	Response **OK**
Read Command **AT+CAMM?**	Response TA returns the current value of ACM max. **+CAMM: <acmmax>** **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters See Write Command
Write Command **AT+CAMM=<acmmax>[,<passwd**	Response TA sets the Advice of Charge related accumulated call meter maximum value in SIM file EF (ACM max). ACM max contains the maximum

>]	number of home units allowed to be consumed by the subscriber. **OK** **ERROR** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters **<acmmax>** string type (string should be included in quotation marks); three bytes of the max. ACM value in hex-decimal format (e.g. "00001E" indicates decimal value 30) 000000 disable ACMmax feature 000001-FFFFFF **<passwd>** string type (string should be included in quotation marks) SIM PIN2
Reference GSM 07.07 [13]	Note

3.2.3 AT+CAOC Advice of Charge

AT+CAOC Advice of Charge	
Test Command **AT+CAOC=?**	Response **+CAOC: (**list of supported **<mode>**s**)** **OK**
	Parameters See Write Command
Read Command **AT+CAOC?**	Response **+CAOC: <mode>** **OK**
	Parameters See Write Command
Write Command **AT+CAOC=<mode>**	Response TA sets the Advice of Charge supplementary service function mode. If <mode>=0, TA returns the current call meter value **+CAOC: <ccm>** **OK** If <mode>=1, TA deactivates the unsolicited reporting of CCM value **OK** If <mode>=2, TA activates the unsolicited reporting of CCM value

	OK **ERROR** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters **<mode>** 0 Query CCM value 1 Deactivate the unsolicited reporting of CCM value 2 Activate the unsolicited reporting of CCM value **<ccm>** String type (string should be included in quotation marks); three bytes of the current CCM value in hex-decimal format (e.g. "00001E" indicates decimal value 30); bytes are similarly coded as ACMmax value in the SIM 000000-FFFFFF
Reference GSM 07.07 [13]	Note

3.2.4 AT+CBST Select Bearer Service Type

AT+CBST Select Bearer Service Type	
Test Command **AT+CBST=?**	Response **+CBST: (**list of supported **<speed>**s**),(**list of supported **<name>**s**),(**list of supported **<ce>**s**)** **OK**
	Parameters See Write Command
Read Command **AT+CBST?**	Response **+CBST: <speed>,<name>,<ce>** **OK**
	Parameters See Write Command
Write Command **AT+CBST=<speed>[,<name>[,<ce>]]**	Response TA selects the bearer service **<name>** with data rate **<speed>**, and the connection element **<ce>** to be used when data calls are originated. **OK** **ERROR**
	Parameters **<speed>** 0 Auto-bauding (automatic selection of the speed; this

	setting is possible in case of 3.1kHz modern and non-transparent service) 7 9600 bps (V.32) 71 9600 bps (V.110 or X.31 flag stuffing) Supported if UMTS_FTR is activated **<name>** 0 Data circuit asynchronous (UDI or 3.1 kHz modem) **<ce>** 1 Non-transparent
Reference GSM 07.07 [14]	Note ● GSM 02.02[1]: lists the allowed combinations of the sub parameters ● It only supports the speed of 9600bps when in non-transparent mode.

3.2.5 AT+CCFC Call Forwarding Number and Conditions Control

AT+CCFC Call Forwarding Number and Conditions Control	
Test Command **AT+CCFC=?**	Response **+CCFC: (**list of supported **<reason>**s**)** **OK**
	Parameter See Write Command
Write Command **AT+CCFC = <reason>, <mode> [, <number> [, <type> [,<class> [, <subaddr> [,<satype> [,time]]]]]]**	Response TA controls the call forwarding supplementary service. Registration, erasure, activation, deactivation, and status query are supported. Only ,<reads> and <mode> should be entered with mode (0-2,4) If <mode>≠2 and Command successful **OK** If <mode>=2 and Command successful (only in connection with <reads> 0 –3) For registered call forwarding numbers: when <mode>=2 and command successful: **+CCFC: <status>,<class1> [,<number>,<type>[,<subaddr>,<satype>[,<time>]]] [<CR><LF>+CCFC: <status>,<class2> [,<number>,<type>[,<subaddr>,<satype>[,<time>]]][…]** **OK** If no call forwarding numbers are registered (and therefore all classes are inactive): **+CCFC: <status>, <class>** **OK** where <status>=0 and <class>=7 If error is related to ME functionality: **+CME ERROR: <err>**

	Parameters **<reason>** 0 Unconditional 1 Mobile busy 2 No reply 3 Not reachable 4 All call forwarding 5 All conditional call forwarding **<mode>** 0 Disable 1 Enable 2 Query status 3 Registration 4 Erasure **<number>** string type (Phone number of forwarding address in format specified by <type>) **<type>** type of address **<subaddr>** string type (subaddress of format specified by <satype>) **<satype>** type of sub-address in integer **<class>** 1 Voice (telephony) 2 Data (refers to all bearer services; with <mode>=2 this may refer only to some bearer service if TA does not support values 16, 32, 64 and 128) 4 Fax (facsimile services) 7 All classes **<time>** 1..30 When "no reply" is enabled or queried, this gives the time in seconds to wait before call is forwarded, default value is 20.Supported only if it is multiples of 5. **<status>** 0 Not active 1 Active
Reference GSM07.07	Note

3.2.6 AT+CCWA Call Waiting Control

AT+CCWA Call Waiting Control	
Test Command **AT+CCWA=?**	Response **+CCWA: (**list of supported **<n**>s**)** **OK**
	Parameter See Write Command
Read Command	Response

AT+CCWA?	**+CCWA: <n>** **OK**
	Parameter See Write Command
Write Command **AT+CCWA=<n>[,<mode>[,<class>]]**	Response TA controls the Call Waiting supplementary service. Activation, deactivation and status query are supported. If <mode>≠2 and Command successful **OK** If <mode>=2 and Command successful **+CCWA:<status>,<class1>[<CR><LF>+CCWA:<status>,<class2>[...]]** **OK** **ERROR** If error is related to ME functionality: **+CME ERROR: <err>** Note: <status>=0 should be returned only if service is not active for any <class> i.e. +CCWA: 0, 7 will be returned in this case. When mode=2, all active call waiting classes will be reported. In this mode the Command is abortable by pressing any key.
	Parameters **<n>** 0 Disable presentation of an unsolicited result code 1 Enable presentation of an unsolicited result code **<mode>** When <mode> parameter not given, network is not interrogated 0 Disable 1 Enable 2 Query status **<class>** is a sum of integers each representing a class of information 1 voice (telephony) 2 data (refers to all bearer services; with <mode>=2 this may refer only to some bearer service if TA does not support values 16, 32, 64 and 128) 4 fax (facsimile services) 7 default(1+2+4) **<status>** 0 not active 1 enable
	Unsolicited result code **RING** **+CCWA: <number>,<type>,<class>[,<alpha>]**

	Parameters **<number>** String type (string should be included in quotation marks) phone number of calling address in format specified by <type> **<type>** Type of address octet in integer format; 129 Unknown type (IDSN format number) 161 National number type (IDSN format) 145 International number type (ISDN format) 177 Network specific number (ISDN format) **<alpha>** optional string type(string should be included in quotation marks) alphanumeric representation of <number> corresponding to the entry found in phone book.
Reference GSM07.07	Note

3.2.7AT+CEER Extended Error Report

AT+CEER Extended Error Report	
Test Command **AT+CEER=?**	Response **+CEER: (**list of supported **<n>**s**)** **OK**
	Parameter See Write Command
Read Command **AT+CEER?**	Response **+CEER: <n>** **OK**
	Parameter See Write Command
Write Command **AT+CEER=<n>**	Response **OK**
	Parameter **<n>** 0 The reason for last call release as text code 1 The reason for last call release as number code
Execution Command **AT+CEER**	Response TA returns an extended report of the reason for the last call release. **+CEER: <report>** **OK**

Parameter

<report> If AT+CEER=0, return <c>

<c> a string that represents the Cause

If AT+CEER=1, return

CauseSelect: <cs> Cause:<c>

<cs> number representing the CauseSelect

<c> number representing the Cause

Parameters

CauseSelect <cs>	**Cause <c>(number)**	**<c>(string)**
0 (No cause)	0	(No cause)
16 (Service provider)	0	(Unknown)
	1	(Not Allowed)
	2	(No cause)
	6	(Wrong parameter)
	9	(Network access not allowed)
	20	(all call instances are used)
	21	(ACM over ACM Max)
	22	(invalid AOC element)
	23	(SIM increase not allowed)
	24	(switch off)
	25	(Unknown call id)
	28	(barred)
65 (Local cause)	1	(state error)
	2	(no call entity)
	3	(wrong TI)
	6	(DTMF buffer overflow)
	7	(call disconnected)
	17	(No cell available)
	32	(Local rejection)
	33	(PLMN not allowed)
	34	(emergency call not possible)
	35	(authentication rejected)
	36	(network rejection)
	37	(LA not allowed)
	38	(Local timeout)

		39	(server congestion)
		40	(local data rejection)
		48	(failed replace PDP context)
	66 (MM network cause)	See [24.008]	
	67 (CC network cause)	See [24.008]	
	69 (RP cause)	See [24.008]	
	71 (SIM cause)	0	(Unknown problem)
		1	(Memory problem)
		2	(File Id not found)
		6	(Increase problem)
		7	(Technical problem)
		11	(Command not allowed)
		15	(SIM card out)
	73 (SM cause)	See [24.008]	
Reference GSM 07.07 [13]	Note		

3.2.8 AT+CGMI   Request Manufacturer Identification

AT+CGMI Request Manufacturer Identification	
Test Command **AT+CGMI=?**	Response **OK**
Execution Command **AT+CGMI**	Response TA returns manufacturer identification text. **<manufacturer>** **OK**
	Parameter **<manufacturer>** the ID of manufacturer
Reference GSM 07.07 [13]	Note

3.2.9 AT+CGMM   Request Model Identification

AT+CGMM Request Model Identification	
Test Command	Response

AT+CGMM=?	**OK**
Execution Command **AT+CGMM**	Response TA returns product model identification text. **<model>** **OK**
	Parameter **<model>** product model identification text
Reference GSM 07.07 [13]	Note

3.2.10 AT+CGMR Request TA Revision Identification of Software Release

AT+CGMR Request TA Revision Identification of Software Release	
Test Command **AT+CGMR=?**	Response **OK**
Execution Command **AT+CGMR**	Response TA returns product software version identification text. **Revision: <revision>** **OK**
	Parameter **<revision>** product software version identification text
Reference GSM 07.07 [13]	Note

3.2.11 AT+CGSN Request Product Serial Number Identification (Identical with +GSN)

AT+CGSN Request Product Serial Number Identification (Identical with +GSN)	
Test Command **AT+CGSN=?**	Response **OK**
Execution Command **AT+CGSN**	Response see +GSN **<sn>** **OK**
	Parameter **<sn>** International mobile equipment identity (IMEI)
Reference GSM 07.07 [13]	Note

3.2.12 AT+CSCS   Select TE Character Set

AT+CSCS Select TE Character Set	
Test Command **AT+CSCS=?**	Response **+CSCS: (**list of supported **<chset>**s**)** **OK**
	Parameter **<chset>** "GSM" GSM 7 bit default alphabet (3GPP TS 23.038); "UCS2" 16-bit universal multiple-octet coded character set (ISO/IEC10646); UCS2 character strings are converted to hexadecimal numbers from 0000 to FFFF; e.g. "004100620063" equals three 16-bit characters with decimal values 65, 98 and 99 "IRA" International reference alphabet (ITU-T T.50) "HEX" Character strings consist only of hexadecimal numbers from 00 to FF; "PCCP" PC character set Code "PCDN" PC Danish/Norwegian character set "8859-1" ISO 8859 Latin 1 character set
Read Command **AT+CSCS?**	Response **+CSCS: <chset>** **OK**
	Parameter See Test Command
Write Command **AT+CSCS=<chset>**	Response Sets which character set **<chset>** are used by the TE. The TA can then convert character strings correctly between the TE and ME character sets. **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameter See Test Command
Reference GSM 07.07 [13]	Note

3.2.13 AT+CSTA Select Type of Address

AT+CSTA Select Type of Address	
Test Command **AT+CSTA=?**	Response **+CSTA: (**list of supported **<type>**s**)** **OK**
	Parameter See Write Command
Read Command **AT+CSTA?**	Response **+CSTA: <type>** **OK**
	Parameter **<type>** Current address type setting.
Write Command **AT+CSTA=<type>**	Response **OK** If <type> is not in the parameter range: **ERROR**
	Parameter **<type>** Type of address octet in integer format; 129 Unknown type (IDSN format number) 161 National number type (IDSN format) 145 International number type (ISDN format) 177 Network specific number (ISDN format)
Reference GSM 07.07 [13]	Note The ATD Command overrides this setting when a number is dialed.

3.2.14 AT+CHLD Call Hold and Multiparty

AT+CHLD Call Hold and Multiparty	
Test Command **AT+CHLD=?**	Response **+CHLD: (**list of supported **<n>**s**)** **OK**
	Parameter See Write Command
Write Command **AT+CHLD=<n>**	Response TA controls the supplementary services Call Hold, Multiparty and Explicit

	Call Transfer. Calls can be put on hold, recovered, released, added to conversation, and transferred. Note These supplementary services are only applicable to tele service 11 (Speech: Telephony). **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameter **<n>** 0 Releases all held calls or sets User Determined User Busy (UDUB) for a waiting call 1 Releases all active calls (if any exist) and accepts the other (held or waiting) call. 1x Releases a specific active call x 2 Place all active calls on hold (if any) and accept the other (held or waiting) call. 2x Places all active calls on hold except call X with which communication shall be supported. 3 Adds a held call to the conversation. 4 Connects the two calls and disconnects the subscriber from both calls(ECT) 6 Swap operation(retrieves the held call and holds the active call). Not applicable for calls engaged in a multiparty operation(+CME ERROR returned) 6x Retrieves the specified held call x. Not applicable for calls engaged in a multiparty operation (+CME ERROR returned) 7x Holds the specified active call x. Not applicable for calls engaged in a multiparty operation (+CME ERROR returned) 8x Releases the specified call x (whatever its state). 9x Aborts MO speech call x setup without releasing other calls. Possible if OK result code is sent before call is connected: allowed if *PSCSSC mode = enabled and +COLP = disabled.
Reference	Note

3.2.15 AT+CIMI Request International Mobile Subscriber Identity

AT+CIMI Request International Mobile Subscriber Identity	
Test Command **AT+CIMI=?**	Response **OK**

Execution Command **AT+CIMI**	Response TA returns <IMSI>for identifying the individual SIM which is attached to ME. **<IMSI>** **OK** If error is related to ME functionality: **+CME ERROR: <err>**	
	Parameter **<IMSI>** International Mobile Subscriber Identity (string without double quotes)	
Reference GSM 07.07 [13]	Note	

3.2.16 AT+CLCC List Current Calls of ME

AT+CLCC List Current Calls of ME	
Test Command **AT+CLCC=?**	Response **+CLCC: (0,1)** **OK**
	Parameters See Write Command
Read Command **AT+CLCC?**	Response **+CLCC: <n>** **OK**
	Parameters See Write Command
Write Command **AT+CLCC=<n>**	Response **OK**
	Parameter **<n>** 0 Don't report a list of current calls of ME automatically when the current call status changes. 1 Report a list of current calls of ME automatically when the current call status changes.

Execution Command **AT+CLCC**	Response TA returns a list of current calls of ME. Note: If Command succeeds but no calls are available, no information response is sent to TE. **[+CLCC: <id1>,<dir>,<stat>,<mode>,<mpty>[,<number>,<type>,<alphaID>][<CR><LF>+CLCC: <id2>,<dir>,<stat>,<mode>,<mpty> [,<number>,<type>,<alphaID>][...]]]** **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters **<id*x*>** 1..7 Call identification number This number can be used in +CHLD command operations **<dir>** 0 Mobile originated (MO) call 1 Mobile terminated (MT) call **<stat>** State of the call: 0 active 1 held 2 dialing (MO call) 3 alerting (MO call) 4 incoming (MT call) 5 waiting (MT call) 6 disconnect **<mode>** Bearer/tele service: 0 voice 1 data 2 fax **<mpty>** 0 Call is not one of multiparty (conference) call parties 1 Call is one of multiparty (conference) call parties **<number>** String type(string should be included in quotation marks) phone number in format specified by <type>. **<type>** Type of address **<alphaId>** String type(string should be included in quotation marks) alphanumeric representation of <number> corresponding to the entry found in phone book.
Reference GSM 07.07 [13][14]	Note

3.2.17 AT+CLCK Facility Lock

AT+CLCK Facility Lock	
Test Command **AT+CLCK=?**	Response **+CLCK: (**list of supported **<fac>**s**)** **OK**
	Parameter See Write Command
Write Command **AT+CLCK=** **<fac>,<mode>** **[,<passwd>** **[,<class>]]**	Response This Command is used to lock, unlock or interrogate a ME or a network facility <fac>. Password is normally needed to do such actions. When querying the status of a network service (<mode>=2) the response line for 'not active' case (<status>=0) should be returned only if service is not active for any <class>. If <mode>≠2 and Command is successful **OK** If <mode>=2 and Command is successful **+CLCK: <status>[,<class1>[<CR><LF>+CLCK: <status>,<class2>[…]]** **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters **<fac>** "AO" BAOC (Barr All Outgoing Calls) "OI" BOIC (Barr Outgoing International Calls) "OX" BOIC-exHC (Barr Outgoing International Calls except to Home Country) "AI" BAIC (Barr All Incoming Calls) "IR" BIC-Roam (Barr Incoming Calls when Roaming outside the home country) "AB" All Barring services "AG" All out oing barring services "AC" All in Coming barring services "FD" SIM card or active application in the UICC (GSM or USIM) fixed dialling memory feature (if PIN2 authentication has not been done during the current session, PIN2 is required as <passwd>) "SC" SIM (lock SIM/UICC card) (SIM/UICC asks password in MT power-up and when this lock command issued) Correspond to PIN1 code.

	"PN" Network Personalization, Correspond to NCK code "PU" Network subset Personalization Correspond to NSCK code "PP" Service Provider Personalization Correspond to SPCK code **<mode>** 0 unlock 1 lock 2 query status **<passwd>** String type (Shall be the same as password specified for the facility from the MT user interface or with command Change Password +CPWD) **<class>** 1 voice (telephony) 2 data refers to all bearer services; with <mode>=2 this may refer only to some bearer service if TA does not support values 16, 32, 64 and 128) 4 fax (facsimile services) 7 all classes **<status>** 0 Not active 1 Active
Reference GSM 07.07 [14]	Note CME errors if SIM not inserted or PIN is not entered.

3.2.18 AT+CLIP Calling Line Identification Presentation

AT+CLIP Calling Line Identification Presentation	
Test Command **AT+CLIP=?**	Response **+CLIP: (**list of supported **<n>**s**)** **OK**
	Parameter See Write Command
Read Command **AT+CLIP?**	Response **+CLIP: <n>, <m>** **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters See Write Command
Write Command **AT+CLIP=<n>**	Response TA enables or disables the presentation of the CLI at the TE. It has no effect on the execution of the supplementary service CLIP in the network. **OK**

	If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters **<n>** 0 Disable +CLIP notification. 1 Enable +CLIP notification. **<m>** 0 CLIP not provisioned 1 CLIP provisioned 2 unknown (e.g. no network, etc.)
	Unsolicited Result Code When the presentation of the CLI at the TE is enabled (and calling subscriber allows), an unsolicited result code is returned after every RING (or +CRING: <type>) at a mobile terminating call. **+CLIP: <number>,<type> [,<subaddr>,<satype>,<alphaId>,<CLI validity>]** Parameters **<number>** String type (string should be included in quotation marks) phone number of calling address in format specified by <type> **<type>** Type of address octet in integer format; 129 Unknown type(IDSN format number) 161 National number type(IDSN format) 145 International number type(ISDN format) 177 Network specific number(ISDN format) **<subaddr>** string type (subaddress of format specified by <satype>) **<satype>** Integer type(type of subaddress) **<alphaId>** string type (string should be included in quotation marks) alphanumeric representation of <number> corresponding to the entry found in phone book **<CLI validity>** 0 CLI valid 1 CLI has been withheld by the originator 2 CLI is not available due to interworking problems or limitations of originating network
Reference	Note

3.2.19 AT+CLIR Calling Line Identification Restriction

AT+CLIR Calling Line Identification Restriction	
Test Command **AT+CLIR=?**	Response **+CLIR: (**list of supported **<n>**s**)** **OK**

	Parameter See Write Command
Read Command **AT+CLIR?**	Response **+CLIR: <n>, <m>** **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters See Write Command
Write Command **AT+CLIR=<n>**	Response TA restricts or enables the presentation of the CLI to the called party when originating a call. The Command overrides the CLIR subscription (default is restricted or allowed) when temporary mode is provisioned as a default adjustment for all following outgoing calls. This adjustment can be revoked by using the opposite Command. **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters **<n>** (parameter sets the adjustment for outgoing calls): 0 presentation indicator is used according to the subscription of the CLIR service. 1 CLIR invocation 2 CLIR suppression **<m>** (parameter shows the subscriber CLIR service status in the network): 0 CLIR not provisioned 1 CLIR provisioned in permanent mode 2 unknown (e.g. no network, etc.) 3 CLIR temporary mode presentation restricted 4 CLIR temporary mode presentation allowed
Reference	Note

3.2.20 AT+CMEE Report Mobile Equipment Error

AT+CMEE Report Mobile Equipment Error	
Test Command **AT+CMEE=?**	Response **+CMEE: (**list of supported **<n>**s**)**

	OK
	Parameter See Write Command
Read Command **AT+CMEE?**	Response **+CMEE: <n>** **OK**
	Parameter See Write Command
Write Command **AT+CMEE=<n>**	Response TA disables or enables the use of result code +CME ERROR: <err> as an indication of an error relating to the functionality of the ME. **OK** If error is related to ME functionality: **+CME ERROR:<err>**
	Parameter **<n>** 0 Disable +CME ERROR: <err> result code and use ERROR instead. 1 Enable +CME ERROR: <err> result code and use numeric <err> 2 Enable +CME ERROR: <err> result code and use verbose <err> values
Reference GSM 07.07 [13]	Note

3.2.21 AT+COLP Connected Line Identification Presentation

AT+COLP Connected Line Identification Presentation	
Test Command **AT+COLP=?**	Response **+COLP: (**list of supported **<n>**s**)** **OK**
	Parameter See Write Command
Read Command **AT+COLP?**	Response **+COLP: <n>,<m>** **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters See Write Command

Write Command **AT+COLP=<n>**	Response TA enables or disables the presentation of the COL (Connected Line) at the TE for a mobile originated call. It has no effect on the execution of the supplementary service COLR in the network. Intermediate result code is returned from TA to TE before any +CR or V.25ter responses. **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters **<n>** (parameter sets/shows the result code presentation status in the TA): 0 Disable +COLP notification 1 Enable +COLP notification **<m>** (parameter shows the subscriber COLP service status in the network): 0 COLP not provisioned 1 COLP provisioned 2 Unknown (e.g. no network, etc.)
	Intermediate result code When enabled (and called subscriber allows), an intermediate result code is returned before any +CR or V.25ter responses: **+COLP: <number>,<type>[,<subaddr>,<satype> ,<alphaId>]**
	Parameters **<number>** string type (string should be included in quotation marks) phone number of format specified by <type> **<type>** Type of address octet in integer format; 129 Unknown type(IDSN format number) 161 National number type(IDSN format) 145 International number type(ISDN format) 177 Network specific number(ISDN format) **<subaddr>** string type (string should be included in quotation marks) sub address of format specified by <satype> **<satype>** Type of sub address octet in integer format (refer GSM 04.08 [8] sub clause 10.5.4.8) **<alphaId>** string type (string should be included in quotation marks) alphanumeric representation of <number> corresponding to the entry found in phone book.
Reference	Note

3.2.22 AT+COPS Operator Selection

AT+COPS Operator Selection	
Test Command **AT+COPS=?**	Response TA returns a list of quadruplets, each representing an operator present in the network. Any of the formats may be unavailable and should then be an empty field. The list of operators shall be in order: home network, networks referenced in SIM, and other networks. **+COPS: (**list of supported**<stat>**, long alphanumeric **<oper>**, short alphanumeric **<oper>**, numeric **<oper>)**s **[,,(**list of supported **<mode>**s**),(**list of supported **<format>**s**)]** **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters See Write Command
Read Command **AT+COPS?**	Response TA returns the current mode and the currently selected operator. If no operator is selected, <format> and <oper> are omitted. **+COPS: <mode>[,<format>, <oper>]** **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters See Write Command
Write Command **AT+COPS = <mode>, [<format>[,<oper >]]**	Response TA forces an attempt to select and register the GSM network operator. If the selected operator is not available, no other operator shall be selected (except <mode>=4). The selected operator name format shall apply to further read commands (+COPS?). **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters **<stat>** 0 unknown 1 operator available 2 operator current 3 operator forbidden **<oper>** Refer to [27.007] operator in format as per <format>

	<mode> 0 automatic mode; <oper> field is ignored 1 manual (<oper> field shall be present, and <AcT> optionally) 4 manual/automatic (<oper> field shall be present); if manual selection fails, automatic mode (<mode>=0) is entered **<format>** 0 long format alphanumeric <oper> 1 short format alphanumeric <oper> 2 numeric <oper>; GSM Location Area Identification number
Reference GSM 07.07 [14]	Note

3.2.23 AT+CPAS Phone Activity Status

AT+CPAS Phone Activity Status	
Test Command **AT+CPAS=?**	Response **+CPAS: (**list of supported **<pas>**s**)** **OK**
	Parameter See Execution Command
Execution Command **AT+CPAS**	Response TA returns the activity status of ME. **+CPAS: <pas>** **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameter **<pas>** 0 Ready (MT allows commands from TA/TE) 2 Unknown (MT is not guaranteed to respond to instructions) 3 Ringing (MT is ready for commands from TA/TE, but the ringer is active) 4 Call in progress (MT is ready for commands from TA/TE, but a call is in progress)
Reference GSM 07.07 [13]	Note

3.2.24 AT+CPBF Find Phonebook Entries

AT+CPBF Find Phonebook Entries	
Test Command	Response

AT+CPBF=?	**+CPBF:** maximum length of field **<nlength>,**maximum length of field **<tlength>** **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters See Write Command
Write Command **AT+CPBF=[<find text>]**	Response TA returns phone book entries (from the current phone book memory storage selected with +CPBS) which contains alphanumeric string <findtext>. **[+CPBF:<index1>,<number>,<type>,<text>][----]** **<CR><LF>[+CBPF:<index2>,<number>,<type>,<text>]** **OK**
	Parameters **<findtext>** string type(string should be included in quotation marks) field of maximum length <tlength> in current TE character set specified by +CSCS. **<index1>** integer type values in the range of location numbers of phone book memory **<index2>** integer type values in the range of location numbers of phone book memory **<number>** string type(string should be included in quotation marks) phone number of format <type> **<type>** type of address octet in integer format ; 129 Unknown type (IDSN format number) 161 National number type (IDSN format) 145 International number type (ISDN format) 177 Network specific number (ISDN format) **<text>** string type (string should be included in quotation marks) field of maximum length <tlength> in current TE character set specified by +CSCS. **<nlength>** integer type value indicating the maximum length of field <number> **<tlength>** integer type value indicating the maximum length of field <text>
Reference GSM 07.07 [13]	Note

3.2.25 AT+CPBR Read Current Phonebook Entries

AT+CPBR Read Current Phonebook Entries	
Test Command **AT+CPBR=?**	Response TA returns location range supported by the current storage as a compound value and the maximum lengths of <number> and <text> fields. **+CPBR: (**list of supported **<index>**s)**, <nlength>, <tlength>** **OK**
	Parameters **<index>** location number **<nlength>** max. length of phone number **<tlength>** max. length of text for number
Write Command **AT+CPBR=** **<index1>** **[, <index2>]**	Response TA returns phone book entries in location number range <index1>... <index2> from the current phone book memory storage selected with +CPBS. If <index2> is left out, only location <index1> is returned. **+CPBR:<index1>,<number>,<type>,<text>[<CR><LF>+CPBR: ..... <CR><LF>+CPBR: <index2>, <number>, <type>, <text>]** **OK**
	Parameters **<index1>** read as of this location number **<index2>** read to this location number **<number>** phone number **<type>** type of number **<text>** text for phone number in current TE character set specified by +CSCS.
Reference GSM 07.07 [13]	Note

3.2.26 AT+CPBS Select Phonebook Memory Storage

AT+CPBS Select Phonebook Memory Storage	
Test Command **AT+CPBS=?**	Response **+CPBS: (**list of supported **<storage>**s**)** **OK**
	Parameter See Write Command
Read Command **AT+CPBS?**	Response **+CPBS: <storage>[,<used>,<total>]**

	OK	
	Parameters See Write Command	
Write Command **AT+CPBS=<storage>**	Response TA selects current phone book memory storage, which is used by other phone book commands. **OK**	
	Parameters **<storage>** "DC" ME dialed calls list(+CPBW may not be applicable for this storage)(same as LD) "EN" SIM (or MT) emergency number (+CPBW is not be applicable for this storage) "FD" SIM fix dialing-phone book. If a SIM card is present or if a UICC with an active GSM application is present, the information in EFFDN under DFTelecom is selected "MC" MT missed (unanswered received) calls list (+CPBW may not be applicable for this storage) "ON" SIM (or MT) own numbers (MSISDNs) list (reading of this storage may be available through +CNUM also). When storing information in the SIM/UICC, if a SIM card is present or if a UICC with an active GSM application is present, the information in EFMSISDN under DFTelecom is selected. "RC" MT received calls list (+CPBW may not be applicable for this storage) "SM" SIM/UICC phonebook. If a SIM card is present or if a UICC with an active GSM application is present, the EFADN under DFTelecom is selected. "LA" Last Number All list (LND/LNM/LNR) "ME" ME phonebook "BN" SIM barred dialed number "SD" SIM service dial number "VM" SIM voice mailbox "LD" SIM last-dialing-phone book **<used>** integer type value indicating the total number of used locations in selected memory **<total>** integer type value indicating the total number of locations in selected memory	
Reference GSM 07.07 [13]	Note	

3.2.27 AT+CPBW Write Phonebook Entry

AT+CPBW Write Phonebook Entry	
Test Command **AT+CPBW=?**	Response TA returns location range supported by the current storage, the maximum length of <number> field, supported number formats of the storage, and the maximum length of <text> field. **+CPBW: (**list of supported **<index>**s**), <nlength>, (**list of supported **<type>**s**), <tlength>** **OK**
	Parameters See Write Command
Write Command **AT+CPBW=** **<index>** **[, <number>,** **[<type>, [<text>]]]**	Response TA writes phone book entry in location number <index> in the current phone book memory storage selected with +CPBS. Entry fields written are phone number <number> (in the format <type>) and text <text> associated with the number. If those fields are omitted, phone book entry is deleted. If <index> is left out, but <number> is given, entry is written to the first free location in the phone book. **OK**
	Parameters **<nlength>** Max length of phone number **<tlength>** Max length of text for number **<index>** Location number **<number>** Phone number **<type>** Type of number; 129 National number type (IDSN format 161 National number type (IDSN format) 145 International number type (ISDN format) 177 Network specific number (ISDN format) **<text>** String type(string should be included in quotation marks): text for phone number in current TE character set specified by +CSCS. Note: The following characters in <text> must be entered via the escape sequence: GSM char. Seq. Seq.(hex) Note \ \5C 5C 35 43 (backslash) " \22 5C 32 32 (string delimiter) BSP \08 5C 30 38 (backspace) NULL \00 5C 30 30 (GSM null) ‘0’ (GSM null) may cause problems for application layer

	software when reading string lengths.
Reference GSM 07.07 [13]	Note

3.2.28 AT+CPIN Enter PIN

AT+CPIN Enter PIN	
Test Command **AT+CPIN=?**	Response **OK**
Read Command **AT+CPIN?**	Response TA returns an alphanumeric string indicating whether some password is required or not. **+CPIN: <code>** **OK**
	Parameter **<code>** READY MT is not pending for any password SIM PIN MT is waiting SIM PIN to be given SIM PUK MT is waiting for SIM PUK to be given PH_SIM PIN ME is waiting for phone to SIM card (antitheft) PH_SIM PUK ME is waiting for SIM PUK (antitheft) SIM PIN2 PIN2, e.g. for editing the FDN book possible only if preceding Command was acknowledged with +CME ERROR:17 SIM PUK2 possible only if preceding Command was acknowledged with error +CME ERROR: 18.
Write Command **AT+CPIN=<pin>** **[, <new pin>]**	Response TA stores a password which is necessary before it can be operated (SIM PIN, SIM PUK, PH-SIM PIN, etc.). If the PIN required is SIM PUK or SIM PUK2, the second pin is required. This second pin, <new pin>, is used to replace the old pin in the SIM. **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters **<pin>** string type; password **<new pin>** string type; If the PIN required is SIM PUK or SIMPUK2: new password
Reference	Note

GSM 07.07 [13]	

3.2.29 AT+CPWD Change Password

AT+CPWD Change Password	
Test Command **AT+CPWD=?**	Response TA returns a list of pairs which present the available facilities and the maximum length of their password. **+CPWD: (**list of supported **<fac>**s, list of supported **<pwdlength>**s**)** **OK**
	Parameters **<fac>** see Write Command **<pwdlength>** integer max. length of password
Write Command **AT+CPWD = <fac>, <oldpwd>, <newpwd>**	Response TA sets a new password for the facility lock function. **OK**
	Parameters **<fac>** "AO" BAOC (Barr All Outgoing Calls) "OI" BOIC (Barr Outgoing International Calls) "OX" BOIC-exHC (Barr Outgoing International Calls except to Home Country) "AI" BAIC (Barr All Incoming Calls) "IR" BIC-Roam (Barr Incoming Calls when Roaming outside the home country) "AB" all Barring services "P2" SIM PIN2 "SC" SIM (lock SIM/UICC card) (SIM/UICC asks password in MT power-up and when this lock command issued) Correspond to PIN1 code. **<oldpwd>** string type (string should be included in quotation marks): password specified for the facility from the user interface or with Command. If an old password has not yet been set, <oldpwd> is not to enter. **<newpwd>** string type (string should be included in quotation marks): new password
Reference GSM 07.07 [13]	Note

3.2.30 AT+CR Service Reporting Control

AT+CR Service Reporting Control	
Test Command **AT+CR=?**	Response **+CR: (**list of supported **<mode>**s) **OK**
	Parameter See Write Command
Read Command **AT+CR?**	Response **+CR: <mode>** **OK**
	Parameter See Write Command
Write Command **AT+CR=<mode>**	Response TA controls whether or not intermediate result code +CR: <serv> is returned from the TA to the TE at a call set up. **OK**
	Parameter **<mode>** <u>0</u> Disable 1 Enable
	Intermediate result code If enabled, an intermediate result code is transmitted at the point during connect negotiation at which the TA has determined which speed and quality of service will be used, before any error control or data compression reports are transmitted, and before any final result code (e.g. CONNECT) is transmitted. **+CR:<serv>**
	Parameters **<serv>** ASYNC asynchronous transparent SYNC synchronous transparent REL ASYNC asynchronous non-transparent REL SYNC synchronous non-transparent GPRS for GPRS
Reference GSM 07.07 [13]	Note

3.2.31 AT+CRC Set Cellular Result Codes for Incoming Call Indication

AT+CRC Set Cellular Result Codes for Incoming Call Indication	
Test Command	Response

AT+CRC=?	**+CRC: (**list of supported **<mode**>s**)** **OK**	
	Parameter See Write Command	
Read Command **AT+CRC?**	Response **+CRC: <mode>** **OK**	
	Parameter See Write Command	
Write Command **AT+CRC=<mode** **>**	Response TA controls whether or not the extended format of incoming call indication is used. **OK**	
	Parameter **<mode>** 0 Disable extended format 1 Enable extended format	
	Unsolicited Result Code When enabled, an incoming call is indicated to the TE with unsolicited result code **+CRING: <type>** instead of the normal **RING**.	
	Parameter **<type>** ASYNC asynchronous transparent SYNC synchronous transparent REL ASYNC asynchronous non-transparent REL SYNC synchronous non-transparent FAX facsimile VOICE voice	
Reference GSM 07.07 [13]	Note	

3.2.32 AT+CREG Network Registration

AT+CREG Network Registration	
Test Command **AT+CREG=?**	Response **+CREG: (**list of supported **<n**>s**)** **OK**
	Parameter See Write Command

Read Command **AT+CREG?**	Response TA returns the status of result code presentation and an integer <stat> which shows whether the network has currently indicated the registration of the ME. Location information elements <lac> and <ci> are returned only when <n>=2 and ME is registered in the network. **+CREG: <n>,<stat>[,<lac>,<ci>]** **OK** If error is related to ME functionality: **+CME ERROR: <err>**
Write Command **AT+CREG=[<n>]**	Response TA controls the presentation of an unsolicited result code +CREG: <stat> when <n>=1 and there is a change in the ME network registration status. **OK**
	Parameters **<n>** 0 Disable network registration unsolicited result code 1 Enable network registration unsolicited result code +CREG: <stat> 2 Enable network registration unsolicited result code with location information +CREG: <stat>[,<lac>,<ci>] **<stat>** 0 Not registered, MT is not currently searching a new operator to register to 1 Registered, home network 2 Not registered, but MT is currently searching a new operator to register to 3 Registration denied 4 Unknown 5 Registered, roaming **<lac>** String type (string should be included in quotation marks); two byte location area code in hexadecimal format **<ci>** String type (string should be included in quotation marks); two byte cell ID in hexadecimal format
	Unsolicited Result Code If <n>=1 and there is a change in the MT network registration status **+CREG: <stat>** If <n>=2 and there is a change in the MT network registration status or a change of the network cell: **+CREG: <stat>[,<lac>,<ci>]**
	Parameters See Write Command
Reference GSM 07.07 [13]	Note

3.2.33 AT+CRLP Select Radio Link Protocol Parameters

AT+CRLP Select Radio Link Protocol Parameters	
Test Command **AT+CRLP=?**	Response TA returns values supported. RLP versions 0 and 1 share the same parameter set. TA returns only one line for this set (where <ver*x*> is not present). **+CRLP: (**list of supported **<iws>**s**),(**list of supported **<mws>**s**),(**list of supported **<T1>**s**),(**list of supported **<N2>**s**),(**list of supported **<ver1>**s**),(**list of supported **<T4>**s**)** **OK**
	Parameters See Write Command
Read Command **AT+CRLP?**	Response TA returns current settings for RLP version. RLP versions 0 and 1 share the same parameter set. TA returns only one line for this set (where <verx> is not present). **+CRLP: <iws>,<mws>,<T1>,<N2>,<ver1>,<T4>** **OK**
	Parameters See Write Command
Write Command **AT+CRLP=<iws>[,<mws>[,<T1>[,<N2>[,<ver>[,<T4>]]]]]**	Response TA sets radio link protocol (RLP) parameters used when non-transparent data calls are setup. **OK**
	Parameters **<iws>** 0-61 Interworking window size (IWF to MS) **<mws>** 0-61 Mobile window size(MS to IWF) **<T1>** 44-255 Acknowledgment timer T1 in 10 ms units **<N2>** 1-255 Retransmission attempts N2 **<verx>** 0 RLP version number **<T4>** 7 Re-sequencing period in integer format, in units of 10 ms.
Reference GSM 07.07 [13]	Note

3.2.34 AT+CRSM Restricted SIM Access

AT+CRSM Restricted SIM Access	
Test Command **AT+CRSM=?**	Response **OK**

Write Command **AT+CRSM=<Command>[,<fileId>[,<P1>,<P2>,<P3>[,<data>]]]**	Response **+CRSM: <sw1>, <sw2> [,<response>]** **OK** **ERROR** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters **<Command>** 176 READ BINARY 178 READ RECORD 192 GET RESPONSE 214 UPDATE BINARY 220 UPDATE RECORD 242 STATUS All other values are reserved; refer GSM 11.11. **<fileId>** integer type; this is the identifier for an elementary data file on SIM. Mandatory for every Command except STATUS **<P1>,<P2>,<P3>** integer type, range 0 – 255 Parameters to be passed on by the ME to the SIM; refer GSM 11.11. **<data>** information which shall be written to the SIM (hex-decimal character format) **<sw1>, <sw2>** integer type, range 0 - 255 Status information from the SIM about the execution of the actual Command. These parameters are delivered to the TE in both cases, on successful or failed execution of the Command; refer GSM 11.11. **<response>** response of a successful completion of the Command previously issued (hexadecimal character format)
Reference GSM 07.07 GSM 11.11	Note

3.2.35 AT+CSQ Signal Quality Report

AT+CSQ Signal Quality Report	
Test Command **AT+CSQ=?**	Response **+CSQ: (**list of supported **<rssi>**s**),(**list of supported **<ber>**s**)** **OK**
Execution Command **AT+CSQ**	Response **+CSQ: <rssi>,<ber>**

	OK If error is related to ME functionality: **+CME ERROR: <err>** Execution Command returns received signal strength indication <rssi> and channel bit error rate <ber> from the ME. Test Command returns values supported by the TA.
	Parameters **<rssi>** 0 -115 dBm or less 1 -111 dBm 2...30 -110... -54 dBm 31 -52 dBm or greater 99 not known or not detectable **<ber>** (in percent): 0...7 As RXQUAL values in the table in GSM 05.08 [20] subclause 7.2.4 99 Not known or not detectable
Reference GSM 07.07 [13]	Note

3.2.36 AT+FCLASS FAX: Select, Read or Test Service Class

AT+FCLASS FAX: Select, Read or Test Service Class	
Test Command **AT+FCLASS=?**	Response **+FCLASS: (**list of supported **<class>**s**)** **OK**
	Parameter See Write Command
Read Command **AT+FCLASS?**	Response **+FCLASS: <class>** **OK**
	Parameter See Write Command
Write Command **AT+FCLASS=** **<class>**	Response TA sets a particular mode of operation (data fax). This causes the TA to process information in a manner suitable for that type of information **OK**
	Parameter **<n>** <u>0</u> data

	1 fax class 1 (TIA-578-A)
Reference GSM 07.07 [13]	Note

3.2.37 AT+FMI FAX: Report Manufactured ID

AT+FMI FAX: Report Manufactured ID	
Test Command **AT+FMI =?**	Response **OK**
Execution Command **AT+FMI**	Response TA reports one or more lines of information text which permit the user to identify the manufacturer. **<manufacturer Id>** **OK**
	Parameter **<manufacturer Id>** the ID of manufacturer
Reference EIA/TIA-578-D	Note

3.2.38 AT+FMM FAX: Report Model ID

AT+FMM FAX: Report Model ID	
Test Command **AT+FMM =?**	Response **OK**
Execution Command **AT+FMM**	Response TA reports one or more lines of information text which permit the user to identify the specific model of device. **<model Id>** **OK**
	Parameter **<model Id>** the ID of model
Reference EIA/TIA-578-D	Note

3.2.39 AT+FMR FAX: Report Revision ID

AT+FMR FAX: Report Revision ID	
Test Command **AT+FMR =?**	Response **OK**

Execution Command **AT+FMR**	Response TA reports one or more lines of information text which permit the user to identify the version, revision level or data or other information of the device. **Revision:<Revision Id>** **OK**
	Parameter **<Revision Id>** the version, revision level or data or other information of the device.
Reference EIA/TIA-578-D	Note

3.2.40 AT+VTD Tone Duration

AT+VTD Tone Duration	
Test Command **AT+VTD=?**	Response **+VTD: (**list of supported **<n>**s**)** **OK**
	Parameter See Write Command
Read Command **AT+VTD?**	Response **+VTD: <n>** **OK**
	Parameter See Write Command
Write Command **AT+VTD = <n>**	Response This Command refers to an integer <n> that defines the length of tones emitted as a result of the +VTS Command. This does not affect the D Command. **OK**
	Parameter **<n>** 1-255 duration of the tone in 1/10 seconds
Reference GSM 07.07 [13]	Note

3.2.41 AT+VTS DTMF and Tone Generation

AT+VTS DTMF and Tone Generation	
Test Command **AT+VTS=?**	Response **+VTS: (**list of supported **<dtmf>**s**), ,(**list of supported **<duration>**s)

	OK
	Parameters See Write Command
Write Command Generate tone Duration is set by +VTD **AT+VTS=<dtmf-string>**	Response This Command allows the transmission of DTMF tones and arbitrary tones in voice mode. These tones may be used (for example) when announcing the start of a recording period. Note: D is used only for dialing. **OK** If error is related to ME functionality: **+CME ERROR: <err>** Note: The Command is writing only. Parameters **<dtmf-string>** which has a max length of 20 characters, must be entered between double quotes ("") and consists of combinations of the following separated by commas. But a single character does not require quotes. 1) **<dtmf>** A single ASCII characters in the set 0-9, #,*, A-D. This is interpreted as a sequence of DTMF tones whose duration is set by the +VTD Command. 2) {**<dtmf>**, **<duration>**} This is interpreted as a DTMF tone whose duration is determined by **<duration>**. **<duration>** duration of the tone in 1/10 seconds range :1-255
Reference GSM 07.07 [13]	Note

3.2.42 AT+CMUX Multiplexer Control

AT+CMUX Multiplexer Control	
Test Command **AT+CMUX=?**	Response **+CMUX:** list of supported **(<mode>**s**),(<subset>**s**),(<port_speed>**s**),(<N1>**s**),(<T1>**s**),(<N2>**s**),(<T2>**s**),(<T3>**s**),(<k>**s) **OK**
	Parameters See Write Command
Read Command **AT+CMUX ?**	Response: **+CMUX:[<mode>[,<subset>[,<port_speed>[,<N1>[,<T1>[,<N2>[,<T2>[,<T3>[,<k>]]]]]]]]]**

	OK **ERROR**
	Parameters See Write Command
Write Command **AT+CMUX=<mode>[,<subset>[,<port_speed>[,<N1>[,<T1>[,<N2>[,<T2>[,<T3>[,<k>]]]]]]]]**	Response If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters **<mode>** multiplexer transparency mechanism 0 Basic option **<subset>** the way in which the multiplexer control channel is set up 0 UIH frames used only **<port_speed>** transmission rate 1 9 600 bits/t 2 19 200 bits/t 3 38 400 bits/t 4 57 600 bits/t 5 115 200bit/s 6 230 400 bits/t 7 460 800 bits/t proprietary values, available if MUX NEW PORT SPEED FTR is activated 8 921 600 bits/t Proprietary values, available if MUX NEW PORT SPEED FTR is activated **<N1>** maximum frame size 1-32768 Default: 127 **<T1>** acknowledgement timer in units of ten milliseconds 1-255 Default:10 (100 ms) **<N2>** maximum number of re-transmissions 0-100 Default:3 **<T2>** response timer for the multiplexer control channel in units of ten milliseconds 2-255 Default:30 **<T3>** wake up response timers in seconds 1-255 Default:10 **<k>** window size, for Advanced operation with Error Recovery options 1-7 Default:2
Reference GSM 07.07 [13]	Note The multiplexing transmission rate is according to the current serial baud rate. It is recommended to enable multiplexing protocol under 115200

	bit/s baud rate Multiplexer control channels are listed as follows: **Channel Number** **Type** **DLCI** None Multiplexer Control 0 1 07.07 and 07.05 1 2 07.07 and 07.05 2 3 07.07 and 07.05 3 4 07.07 and 07.05 4

3.2.43 AT+CNUM Subscriber Number

AT+CNUM Subscriber Number	
Test Command **AT+CNUM=?**	Response **OK**
Execution Command **AT+CNUM**	Response **+CNUM: [<alpha1>],<number1>,<type1>[,<speed>,<service>]** **[<CR><LF>+CNUM:[<alpha2>],<number2>,<type2>[,<speed>,<serv ice>]** **[...]]** **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters <**alpha*x***> optional alphanumeric string associated with <*numberx*>; used character set should be the one selected with Command Select TE Character Set +CSCS <**number*x***> string type (string should be included in quotation marks) phone number of format specified by <type*x*> <**type*x***> type of address octet in integer format (refer GSM04.08[8] subclause 10.5.4.7) <**speed**> as defined by the +CBST Command **<service>** (service related to the phone number:) 0 asynchronous modem 1 synchronous modem 2 PAD Access (asynchronous) 3 Packet Access (synchronous) 4 Voice 5 Fax
Reference GSM 07.07 [13]	Note

3.2.44 AT+CPOL Preferred Operator List

AT+CPOL Preferred Operator List	
Test Command **AT+CPOL=?**	Response **+CPOL: (**list of supported **<index>**s)**,(**list of supported **<format>**s**)** **OK**
	Parameters See Write Command
Read Command **AT+CPOL?**	Response **+CPOL: <index1>,<format>,<oper1>** **[<CR><LF>+CPOL: <index2>,<format>,<oper2>[…]]** **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters See Write Command
Write Command **AT+CPOL=<index>[,<format>,<oper>]**	Response **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters **<index>** integer type: order number of operator in SIM preferred operator list **<format>** indicates whether alphanumeric or numeric format used (see +COPS Command) 0 long format alphanumeric <oper> 1 short format alphanumeric <oper> 2 numeric <oper> **<oper>** string type(string should be included in quotation marks)
Reference GSM 07.07 [13]	Note

3.2.45 AT+COPN Read Operator Names

AT+COPN Read Operator Names	
Test Command **AT+COPN=?**	Response **OK**
Execution Command **AT+COPN**	Response **+COPN: <numeric1>,<alpha1>** **[<CR><LF>+COPN: <numeric2>,<alpha2>** **[…]]**

	OK If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters **<numeric*n*>** string type (string should be included in quotation marks): operator in numeric format (see +COPS) **<alpha*n*>** string type (string should be included in quotation marks): operator in long alphanumeric format (see +COPS)
Reference GSM 07.07 [13]	Note

3.2.46 AT+CFUN Set Phone Functionality

AT+CFUN Set Phone Functionality	
Test Command **AT+CFUN=?**	Response **+CFUN: (**list of supported **<fun>**s**),(**list of supported **<rst>**s**)** **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters See Write Command
Read Command **AT+CFUN?**	Response **+CFUN: <fun>** **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters See Write Command
Write Command **AT+CFUN=<fun>,[<rst>]**	Response **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters **<fun>** 0 minimum functionality 1 full functionality (Default) 4 disable phone both transmit and receive RF circuits **<rst>** <u>0</u> Do not reset the MT before setting it to <fun> power level 1 Reset the MT before setting it to <fun> power level

Reference GSM 07.07 [13]	Note ● Minimum functionality mode(AT+CFUN=0)and RF disabled functionality mode (AT+CFUN=4) cannot be switched to each other. ● The <fun> power level will be written to flash except minimum functionality. ● AT+CFUN=1,1 can be used to reset module purposely. Response string "OK" will be returned after module resets if baud rate is set to fixed baud rate.

3.2.47 AT+CCLK Clock

AT+CCLK Clock	
Test Command **AT+CCLK=?**	Response **OK**
Read Command **AT+CCLK?**	Response **+CCLK: <time>** **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameter See Write Command
Write Command **AT+CCLK=<time>**	Response **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameter **<time>** string type(string should be included in quotation marks) value; format is "yy/MM/dd,hh:mm:ss±zz", where characters indicate year (two last digits),month, day, hour, minutes, seconds and time zone (indicates the difference, expressed in quarters of an hour, between the local time and GMT; range -47...+48). E.g. 6th of May 1994, 22:10:00 GMT+2 hours equals to "94/05/06,22:10:00+08"
Reference GSM 07.07 [13]	Note

3.2.48 AT+CSIM Generic SIM Access

AT+CSIM Generic SIM Access

Test Command **AT+CSIM=?**	Response **OK**	
Write Command **AT+CSIM=<length>,<Command>**	Response **+CSIM: <length>,<response>** **OK** If error is related to ME functionality: **+CME ERROR: <err>**	
	Parameters **<length>** integer type: length of characters sent to the TE in <Command> or <response> (i.e. twice the number of octets in the raw data) **<Command>** string type(string should be included in quotation marks): hex format: GSM 11.11 SIM Command sent from the ME to the SIM **<response>** string type(string should be included in quotation marks): hex format: GSM 11.11 response from SIM to <Command>	
Reference GSM 07.07 [13]	Note	

3.2.49 AT+CALM Alert Sound Mode

AT+CALM Alert Sound Mode	
Test Command **AT+CALM=?**	Response **+CALM: (**list of supported **<mode>**s**)** **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameter See Write Command
Read Command **AT+CALM?**	Response **+CALM: <mode>** **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameter See Write Command
Write Command	Response

AT+CALM=<mode>	**OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameter **<mode>** 0 normal mode 1 silent mode (all sounds from ME are prevented)
Reference GSM 07.07 [13]	Note If CALM is set to silent mode before, when user sets CALM to normal mode during an incoming call, the module maintains silent this time. But next time the normal mode works.

3.2.50 AT+CALS Alert Sound Select

AT+CALS Alert Sound Select	
Test Command **AT+CALS=?**	Response **+CALS: (**list of supported **<n>**s**)** **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameter See Write Command
Read Command **AT+CALS?**	Response **+CALS: <n>** **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameter See Write Command
Write Command **AT+CALS=<n>**	Response **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameter **<n>** 0-19 alert sound type
Reference	Note

3.2.51 AT+CRSL Ringer Sound Level

AT+CRSL Ringer Sound Level	
Test Command	Response

AT+CRSL=?	**+CRSL: (**list of supported **<level>**s**)** **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameter See Write Command
Read Command **AT+CRSL?**	Response **+CRSL: <level>** **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameter See Write Command
Write Command **AT+CRSL=<level>**	Response **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameter **<level>** integer type value (0-4) with manufacturer specific range (smallest value represents the lowest sound level) 0 LEVEL OFF 1 LEVEL LOW 2 LEVEL MEDIUM 3 LEVEL HIGH 4 LEVEL CRESCENDO
Reference GSM 07.07 [13]	Note It is related to the command AT+CLVL.

3.2.52 AT+CLVL Loud Speaker Volume Level

AT+CLVL Loud Speaker Volume Level	
Test Command **AT+CLVL=?**	Response **+CLVL: (**list of supported **<level>**s**)** **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameter See Write Command
Read Command	Response

AT+CLVL?	**+CLVL: <level>** **OK** If error is related to ME functionality: **+CME ERROR: <err>**	
	Parameter See Write Command	
Write Command **AT+CLVL=<level>**	Response **OK** If error is related to ME functionality: **+CME ERROR: <err>**	
	Parameter **<level>** 0-100 integer type value with manufacturer specific range (smallest value represents the lowest sound level)	
Reference GSM 07.07 [13]	Note	

3.2.53 AT+CMUT Mute Control

AT+CMUT Mute Control	
Test Command **AT+CMUT=?**	Response **+CMUT: (**list of supported **<n>**s**)** **OK**
	Parameter See Write Command
Read Command **AT+CMUT?**	Response **+CMUT: <n>** **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameter See Write Command
Write Command **AT+CMUT=<n>**	Response **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameter **<n>** <u>0</u> mute off 1 mute on

Reference GSM 07.07 [13]	Note Only during a call this command can be set successfully.

3.2.54 AT+CPUC Price Per Unit and Currency Table

AT+CPUC Price Per Unit and Currency Table	
Test Command **AT+CPUC=?**	Response **OK**
Read Command **AT+CPUC?**	Response **+CPUC: <currency>,<ppu>** **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters See Write Command
Write Command **AT+CPUC=<currency>,<ppu>[,<passwd>]**	Response **OK** **+CME ERROR: <err>**
	Parameters **<currency>** string type (string should be included in quotation marks); three-character currency code (e.g. "GBP", "DEM"); character set as specified by Command Select TE Character Set+CSCS **<ppu>** string type (string should be included in quotation marks); price per unit; dot is used as a decimal separator(e.g. "2.66") **<passwd>** string type (string should be included in quotation marks); SIM PIN2
Reference GSM 07.07 [13]	Note

3.2.55 AT+CCWE Call Meter Maximum Event

AT+CCWE Call Meter Maximum Event	
Test Command AT+CCWE=?	Response **+CCWE: (**list of supported **<mode>**s**)** **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameter

	See Write Command
Read Command **AT+CCWE?**	Response **+CCWE: <mode>** **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameter See Write Command
Write Command **AT+CCWE=<mode>**	Response **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameter **<mode>** <u>0</u> Disable call meter warning event 1 Enable call meter warning event
	Unsolicited result codes supported: **+CCWV** Shortly before the ACM (Accumulated Call Meter) maximum value is reached, an unsolicited result code +CCWV will be sent, if enabled by this command. The warning is issued approximately when 5 seconds call time remains. It is also issued when starting a call if less than 5 s call time remains.
Reference GSM 07.07 [13]	Note GSM 07.07 specifies 30 seconds, so SIMCom deviates from the specification.

3.2.56 AT+CBC Battery Charge

AT+CBC Battery Charge	
Test Command **AT+CBC=?**	Response **+CBC: (**list of supported **<bcs>**s**),(**list of supported **<bcl>**s**),(<voltage>)** **OK**
	Parameters See Execution Command
Execution Command **AT+CBC**	Response **+CBC: <bcs>, <bcl>,<voltage>**

	OK If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters **<bcs>** charge status 0 ME is not charging 1 ME is charging 2 Charging has finished **<bcl>** battery connection level 1...100 battery has 1-100 percent of capacity remaining vent **<voltage>** battery voltage(mV)
Reference GSM 07.07 [13]	Note This command depends on hardware and only be used when battery is charging.

3.2.57 AT+CUSD Unstructured Supplementary Service Data

AT+CUSD Unstructured Supplementary Service Data	
Test Command **AT+CUSD=?**	Response **+CUSD: (**list of supported **<n>**s**)** **OK**
	Parameter See Write Command
Read Command **AT+CUSD?**	Response **+CUSD: <n>** **OK**
	Parameter See Write Command
Write Command **AT+CUSD=<n>[,<str>[,<dcs>]]**	Response **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters **<n>** a numeric parameter which indicates control of the unstructured supplementary service data 0 disable the result code presentation in the TE 1 enable the result code presentation in the TE

	2 cancel session (not applicable to read Command response) **<str>** string type(string should be included in quotation marks) USSD-string **<dcs>** Cell Broadcast Data Coding Scheme in integer format (default 0)
Reference GSM 03.38 [25]	Note

3.2.58 AT+CSSN Supplementary Services Notification

AT+CSSN Supplementary Services Notification	
Test Command **AT+CSSN=?**	Response **+CSSN: (**list of supported **<n>**s**),(**list of supported **<m>**s**)** **OK**
	Parameters See Write Command
Read Command **AT+CSSN?**	Response **+CSSN: <n>,<m>** **OK**
	Parameters See Write Command
Write Command **AT+CSSN=<n>[,<m>]**	Response **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters **<n>** a numeric parameter which indicates whether to show the +CSSI:<code1>[,<index>] result code presentation status after a mobile originated call setup 0 disable 1 enable **<m>** a numeric parameter which indicates whether to show the +CSSU:<code2> result code presentation status during a mobile terminated call setup or during a call, or when a forward check supplementary service notification is received. <u>0</u> disable 1 enable **<code1>** 0 unconditional call forwarding is active 1 some of the conditional call forwarding are active 2 call has been forwarded 3 call is waiting

	4 this is a CUG call (also <index> present) 5 outgoing calls are barred 6 incoming calls are barred 7 CLIR suppression rejected **<index>** closed user group index **<code2>** 0 this is a forwarded call 1 this is a CUG call (also <index> present) (MT call setup) 2 call has been put on hold (during a voice call) 3 call has been retrieved (during a voice call) 4 multiparty call entered (during a voice call) 5 call on hold has been released (this is not a SS notification) (during a voice call) 6 forward check SS message received (can be received whenever) 7 call is being connected (alerting) with the remote party in alerting state in explicit call transfer operation (during a voice call) 8 call has been connected with the other remote party in explicit call transfer operation (also number and subaddress parameters may be present) (during a voice call or MT call setup) 9 this is a deflected call (MT call setup)
Reference	Note

4 AT Commands According to GSM07.05

The GSM 07.05 commands are for performing SMS and CBS related operations. SIM900 supports both Text and PDU modes.

4.1 Overview of AT Commands According to GSM07.05

Command	Description
AT+CMGD	DELETE SMS MESSAGE
AT+CMGF	SELECT SMS MESSAGE FORMAT
AT+CMGL	LIST SMS MESSAGES FROM PREFERRED STORE
AT+CMGR	READ SMS MESSAGE
AT+CMGS	SEND SMS MESSAGE
AT+CMGW	WRITE SMS MESSAGE TO MEMORY
AT+CMSS	SEND SMS MESSAGE FROM STORAGE
AT+CNMI	NEW SMS MESSAGE INDICATIONS
AT+CPMS	PREFERRED SMS MESSAGE STORAGE
AT+CRES	RESTORE SMS SETTINGS
AT+CSAS	SAVE SMS SETTINGS
AT+CSCA	SMS SERVICE CENTER ADDRESS
AT+CSCB	SELECT CELL BROADCAST SMS MESSAGES
AT+CSDH	SHOW SMS TEXT MODE PARAMETERS
AT+CSMP	SET SMS TEXT MODE PARAMETERS
AT+CSMS	SELECT MESSAGE SERVICE

4.2 Detailed Descriptions of AT Commands According to GSM07.05

4.2.1 AT+CMGD Delete SMS Message

AT+CMGD Delete SMS Message	
Test Command **AT+CMGD=?**	Response **+CMGD: (**list of supported **<index>**s**),(**list of supported **<delflag>**s**)** **OK**
	Parameters See Write Command
Write Command **AT+CMGD=<index>[,<delflag>]**	Response TA deletes message from preferred message storage <**mem1**> location <**index**>. **OK** **ERROR**

	If error is related to ME functionality: **+CMS ERROR:<err>**
	Parameters **<index>** integer type; value in the range of location numbers supported by the associated memory **<delflag>** 0 Delete the message specified in <index> 1 Delete all read messages from preferred message storage, leaving unread messages and stored mobile originated messages (whether sent or not) untouched 2 Delete all read messages from preferred message storage and sent mobile originated messages, leaving unread messages and unsent mobile originated messages untouched 3 Delete all read messages from preferred message storage, sent and unsent mobile originated messages leaving unread messages untouched 4 Delete all messages from preferred message storage including unread messages
Reference GSM 07.05	Note

4.2.2 AT+CMGF Select SMS Message Format

AT+CMGF Select SMS Message Format	
Test Command **AT+CMGF=?**	Response **+CMGF: (**list of supported **<mode>**s**)** **OK**
	Parameter See Write Command
Read Command **AT+CMGF?**	Response **+CMGF: <mode>** **OK**
	Parameter See Write Command
Write Command **AT+CMGF=<mode>**	Response TA sets parameter to deNote which input and output format of messages to use. **OK**
	Parameter **<mode>** 0 PDU mode 1 text mode

Reference GSM 07.05	Note

4.2.3 AT+CMGL List SMS Messages from Preferred Store

AT+CMGL List SMS Messages from Preferred Store	
Test Command **AT+CMGL=?**	Response **+CMGL: (**list of supported **<stat>**s**)** **OK**
	Parameter See Write Command
Write Command **AT+CMGL=<stat>[,<mode>]**	Parameters 1) If text mode: **<stat>** "REC UNREAD" Received unread messages "REC READ" Received read messages "STO UNSENT" Stored unsent messages "STO SENT" Stored sent messages "ALL" All messages **<mode>** 0 normal 1 not change status of the specified SMS record 2) If PDU mode: **<stat>** 0 Received unread messages 1 Received read messages 2 Stored unsent messages 3 Stored sent messages 4 All messages **<mode>** 0 normal 1 not change status of the specified SMS record
	Response TA returns messages with status value <stat> from message storage <mem1> to the TE. If status of the message is 'received unread', status in the storage changes to 'received read'. 1) If text mode (+CMGF=1) and Command successful: for SMS-SUBMITs and/or SMS-DELIVERs: **+CMGL: <index>,<stat>,<oa/da>,[<alpha>],[<scts>][,<tooa/toda>,<length>]<CR><LF><data>[<CR><LF>** **+CMGL: <index>,<stat>,<da/oa>,[<alpha>],[<scts>][,<tooa/toda>,<length>]<CR><LF><data>[...]]** for SMS-STATUS-REPORTs: **+CMGL:**

<index>,<stat>,<fo>,<mr>,[<ra>],[<tora>],<scts>,<dt>,<st>[<CR><LF>
+CMGL: <index>,<stat>,<fo>,<mr>,[<ra>],[<tora>],<scts>,<dt>,<st>[...]]
for SMS-COMMANDs:
+CMGL: <index>,<stat>,<fo>,<ct>[<CR><LF>
+CMGL: <index>,<stat>,<fo>,<ct>[...]]
for CBM storage:
+CMGL:<index>,<stat>,<sn>,<mid>,<page>,<pages><CR><LF><data><CR><LF>
+CMGL: <index>,<stat>,<sn>,<mid>,<page>,<pages><CR><LF><data>[...]]
OK

2) If PDU mode (+CMGF=0) and Command successful:
+CMGL:<index>,<stat>,[<alpha>],<length><CR><LF><pdu><CR><LF>
+CMGL: <index>,<stat>,[alpha],<length><CR><LF><pdu>[...]]
OK

3)If error is related to ME functionality:
+CMS ERROR: <err>

Parameters

<alpha> string type(string should be included in quotation marks) alphanumeric representation of <da> or <oa> corresponding to the entry found in MT phonebook; implementation of this feature is manufacturer specific; used character set should be the one selected with Command Select TE Character Set +CSCS (see definition of this Command in TS 07.07)

<da> GSM 03.40 TP-Destination-Address Address-Value field in string format; BCD numbers (or GSM default alphabet characters) are converted to characters of the currently selected TE character set (refer Command+CSCS in TS 07.07); type of address given by <toda>

<data> In the case of SMS: GSM 03.40 TP-User-Data in text mode responses; format:
- if <dcs> indicates that GSM 03.38 default alphabet is used and <fo> indicates that GSM 03.40 TPUser-Data-Header-Indication is not set:
- if TE character set other than "HEX" (refer Command Select TE Character Set +CSCS in TS 07.07):ME/TA converts GSM alphabet into current TE character set

	according to rules of Annex A - if TE character set is "HEX": ME/TA converts each 7-bit character of GSM alphabet into two IRA character long hexadecimal number (e.g. character P (GSM 23) is presented as 17 (IRA 49 and 55)) - if <dcs> indicates that 8-bit or UCS2 data coding scheme is used, or <fo> indicates that GSM 03.40 TP-User-Data-Header-Indication is set: ME/TA converts each 8-bit octet into two IRA character long hexadecimal number (e.g. octet with integer value 42 is presented to TE as two characters 2A (IRA 50 and 65)) In the case of CBS: GSM 03.41 CBM Content of Message in text mode responses; format: - if <dcs> indicates that GSM 03.38 default alphabet is used: - if TE character set other than "HEX" (refer Command +CSCS in GSM 07.07): ME/TA converts GSM alphabet into current TE character set according to rules of Annex A - if TE character set is "HEX": ME/TA converts each 7-bit character of GSM alphabet into two IRA character long hexadecimal number - if <dcs> indicates that 8-bit or UCS2 data coding scheme is used: ME/TA converts each 8-bit octet into two IRA character long hexadecimal number **<length>** integer type value indicating in the text mode (+CMGF=1) the length of the message body <data> (or <cdata>) in characters; or in PDU mode (+CMGF=0), the length of the actual TP data unit in octets (i.e. the RP layer SMSC address octets are not counted in the length) **<index>** integer type; value in the range of location numbers supported by the associated memory **<oa>** GSM 03.40 TP-Originating-Address Address-Value field in string format; BCD numbers (or GSM default alphabet characters) are converted to characters of the currently selected TE character set (refer Command +CSCS in TS 07.07); type of address given by <tooa> **<pdu>** In the case of SMS: GSM 04.11 SC address followed by GSM 03.40 TPDU in hexadecimal format: ME/TA converts each octet of TP data unit into two IRA character long hexadecimal number (e.g. octet with integer value 42 is presented to TE as two characters 2A (IRA 50 and 65)). In the case of CBS: GSM 03.41 TPDU in hexadecimal format. **<scts>** GSM 03.40 TP-Service-Center-Time-Stamp in time-string format (refer <dt>) **<toda>** GSM 04.11 TP-Destination-Address Type-of-Address octet

	in integer format (when first character of <da> is + (IRA 43) default is 145, otherwise default is 129) **<tooa>** GSM 04.11 TP-Originating-Address Type-of-Address octet in integer format (default refer<toda>)
Execution Command **AT+CMGL**	1) If text mode: the same as AT+CMGL="REC UNREAD", received unread messages 2) If PDU mode: the same as AT+CMGL=0, received unread messages See more messages please refer to Write Command.
	Parameters See Write Command
Reference GSM 07.05	Note

4.2.4 AT+CMGR Read SMS Message

AT+CMGR Read SMS Message	
Test Command **AT+CMGR=?**	Response **OK**
Write Command **AT+CMGR=<index>[,<mode>]**	Parameters **<index>** integer type; value in the range of location numbers supported by the associated memory **<mode>** 0 normal 1 not change status of the specified SMS record
	Response TA returns SMS message with location value <index> from message storage <mem1> to the TE. If status of the message is 'received unread', status in the storage changes to 'received read'. 1) If text mode (+CMGF=1) and Command successful: for SMS-DELIVER: **+CMGR:** **<stat>,<oa>,[<alpha>],<scts>[,<tooa>,<fo>,<pid>,<dcs>,<sca>,<tosca>,<length>]<CR><LF><data>** for SMS-SUBMIT: **+CMGR:** **<stat>,<da>,[<alpha>][,<toda>,<fo>,<pid>,<dcs>,[<vp>],<sca>,<tosca>,<length>]<CR><LF><data>** for SMS-STATUS-REPORTs: **+CMGR: <stat>,<fo>,<mr>,[<ra>],[<tora>],<scts>,<dt>,<st>** for SMS-COMMANDs: **+CMGR:**

	<stat>,<fo>,<ct>[,<pid>,[<mn>],[<da>],[<toda>],<length><CR><LF><cdata>] for CBM storage: **+CMGR: <stat>,<sn>,<mid>,<dcs>,<page>,<pages><CR><LF><data>** 2) If PDU mode (+CMGF=0) and Command successful: **+CMGR: <stat>,[<alpha>],<length><CR><LF><pdu>** **OK** 3) If error is related to ME functionality: **+CMS ERROR: <err>**
	Parameters **<alpha>** string type (string should be included in quotation marks) alphanumeric representation of <da> or <oa> corresponding to the entry found in MT phonebook; implementation of this feature is manufacturer specific **<da>** GSM 03.40 TP-Destination-Address Address-Value field in string format; BCD numbers (or GSM default alphabet characters) are converted to characters of the currently selected TE character set (specified by +CSCS in TS 07.07); type of address given by <toda> **<data>** In the case of SMS: GSM 03.40 TP-User-Data in text mode responses; format: - if <dcs> indicates that GSM 03.38 default alphabet is used and <fo> indicates that GSM 03.40 TPUser-Data-Header-Indication is not set: - if TE character set other than "HEX" (refer Command Select TE Character Set +CSCS in TS 07.07):ME/TA converts GSM alphabet into current TE character set according to rules of Annex A - if TE character set is "HEX": ME/TA converts each 7-bit character of GSM alphabet into two IRA character long hexadecimal number (e.g. character P (GSM 23) is presented as 17 (IRA 49 and 55)) - if <dcs> indicates that 8-bit or UCS2 data coding scheme is used, or <fo> indicates that GSM 03.40 TP-User-Data-Header-Indication is set: ME/TA converts each 8-bit octet into two IRA character long hexadecimal number (e.g. octet with integer value 42 is presented to TE as two characters 2A (IRA 50 and 65)) In the case of CBS: GSM 03.41 CBM Content of Message in text mode responses; format: - if <dcs> indicates that GSM 03.38 default alphabet is used:

- if TE character set other than "HEX" (refer Command +CSCS in GSM 07.07): ME/TA converts GSM alphabet into current TE character set according to rules of Annex A
- if TE character set is "HEX": ME/TA converts each 7-bit character of GSM alphabet into two IRA character long hexadecimal number
- if <dcs> indicates that 8-bit or UCS2 data coding scheme is used: ME/TA converts each 8-bit octet into two IRA character long hexadecimal number

<dcs> depending on the Command or result code: GSM 03.38 SMS Data Coding Scheme (default 0), or Cell Broadcast Data Coding Scheme in integer format

<fo> depending on the Command or result code: first octet of GSM 03.40 SMS-DELIVER, SMS-SUBMIT (default 17), SMS-STATUS-REPORT, or SMS-COMMAND (default 2) in integer format

<length> integer type value indicating in the text mode (+CMGF=1) the length of the message body <data> (or <cdata>) in characters; or in PDU mode (+CMGF=0), the length of the actual TP data unit in octets (i.e. the RP layer SMSC address octets are not counted in the length)

<mid> GSM 03.41 CBM Message Identifier in integer format

<oa> GSM 03.40 TP-Originating-Address Address-Value field in string format; BCD numbers (or GSM default alphabet characters) are converted characters of the currently selected TE character set (specified by +CSCS in TS 07.07); type of address given by <tooa>

<pdu> In the case of SMS: GSM 04.11 SC address followed by GSM 03.40 TPDU in hexadecimal format: ME/TA converts each octet of TP data unit into two IRA character long hexadecimal number (e.g. octet with integer value 42 is presented to TE as two characters 2A (IRA 50 and 65)). In the case of CBS: GSM 03.41 TPDU in hexadecimal format.

<pid> GSM 03.40 TP-Protocol-Identifier in integer format (default 0)

<sca> GSM 04.11 RP SC address Address-Value field in string format; BCD numbers (or GSM default alphabet characters) are converted to characters of the currently selected TE character set (specified by +CSCS in TS 07.07); type of address given by <tosca>

<scts> GSM 03.40 TP-Service-Centre-Time-Stamp in time-string format (refer <dt>)

<stat> 0 "REC UNREAD" Received unread messages
1 "REC READ" Received read messages

	2 "STO UNSENT" Stored unsent messages 3 "STO SENT" Stored sent messages **<toda>** GSM 04.11 TP-Destination-Address Type-of-Address octet in integer format (when first character of <da> is + (IRA 43) default is 145, otherwise default is 129) **<tooa>** GSM 04.11 TP-Originating-Address Type-of-Address octet in integer format (default refer<toda>) **<tosca>** GSM 04.11 RP SC address Type-of-Address octet in integer format (default refer <toda>) **<vp>** depending on SMS-SUBMIT <fo> setting: GSM 03.40 TP-Validity-Period either in integer format (default 167) or in time-string format (refer <dt>)
Reference GSM 07.05	Note

4.2.5 AT+CMGS Send SMS Message

AT+CMGS Send SMS Message	
Test Command **AT+CMGS=?**	Response **OK**
Write Command 1) If text mode (+CMGF=1): **+CMGS=<da>[,<toda>]<CR>** **text is entered** **<ctrl-Z/ESC>** ESC quits without sending 2) If PDU mode (+CMGF=0): **+CMGS=<length><CR>** **PDU is given** **<ctrl-Z/ESC>**	Parameters **<da>** GSM 03.40 TP-Destination-Address Address-Value field in string format(string should be included in quotation marks); BCD numbers (or GSM default alphabet characters) are converted to characters of the currently selected TE character set (specified by +CSCS in TS 07.07); type of address given by <toda> **<toda>** GSM 04.11 TP-Destination-Address Type-of-Address octet in integer format (when first character of <da> is + (IRA 43) default is 145, otherwise default is 129) **<length>** integer type value (not exceed 160 bytes) indicating in the text mode (+CMGF=1) the length of the message body <data> (or <cdata>) in characters; or in PDU mode (+CMGF=0), the length of the actual TP data unit in octets (i.e. the RP layer SMSC address octets are not counted in the length) Response TA sends message from a TE to the network (SMS-SUBMIT). Message reference value <mr> is returned to the TE on successful message delivery. Optionally (when +CSMS <service> value is 1 and network supports) <scts> is returned. Values can be used to identify message upon unsolicited delivery status report result code. 1) If text mode(+CMGF=1) and sending successful: **+CMGS: <mr>**

	OK 2) If PDU mode(+CMGF=0) and sending successful: **+CMGS: <mr>** **OK** 3)If error is related to ME functionality: **+CMS ERROR: <err>**
	Parameter **<mr>** GSM 03.40 TP-Message-Reference in integer format
Reference GSM 07.05	Note If TE Character Set is GSM, it supports 160-byte maximum; If TE Character Set is UCS2, it supports 70-word maximum.

4.2.6 AT+CMGW Write SMS Message to Memory

AT+CMGW Write SMS Message to Memory	
Test Command **AT+CMGW=?**	Response **OK**
Write Command 1) If text mode (+CMGF=1): **AT+CMGW=<oa/da>[,<tooa/toda>]** <CR> **text is entered** **<ctrl-Z/ESC>** <ESC> quits without sending 2) If PDU mode (+CMGF=0): **AT+CMGW=<length><CR>** **PDU is given** **<ctrl-Z/ESC>**	Response TA transmits SMS message (either SMS-DELIVER or SMS-SUBMIT) from TE to memory storage <mem2>. Memory location <index> of the stored message is returned. By default message status will be set to 'stored unsent', but parameter <stat> allows also other status values to be given. If writing is successful: **+CMGW: <index>** **OK** If error is related to ME functionality: **+CMS ERROR: <err>** Parameters **<oa>** GSM 03.40 TP-Originating-Address Address-Value field in string format(string should be included in quotation marks); BCD numbers (or GSM default alphabet characters) are converted to characters of the currently selected TE character set (specified by +CSCS in TS 07.07);type of address given by <tooa> **<da>** GSM 03.40 TP-Destination-Address Address-Value field in string format(string should be included in quotation marks);

	BCD numbers (or GSM default alphabet characters) are converted to characters of the currently selected TE character set (specified by +CSCS in TS 07.07); type of address given by <toda> **<tooa>** GSM 04.11 TP-Originating-Address Type-of-Address octet in integer format (default refer <toda>) **<toda>** GSM 04.11 TP-Destination-Address Type-of-Address octet in integer format (when first character of <da> is + (IRA 43) default is 145, otherwise default is 129) 129 Unknown type(IDSN format number) 161 National number type(IDSN format) 145 International number type(ISDN format) 177 Network specific number(ISDN format) **<length>** integer type value (not exceed 160 bytes) indicating in the text mode (+CMGF=1) the length of the message body <data> (or <cdata>) in characters; or in PDU mode (+CMGF=0), the length of the actual TP data unit in octets (i.e. the RP layer SMSC address octets are not counted in the length) **<pdu>** In the case of SMS: GSM 04.11 SC address followed by GSM 03.40 TPDU in hexadecimal format: ME/TA converts each octet of TP data unit into two IRA character long hexadecimal number (e.g. octet with integer value 42 is presented to TE as two characters 2A (IRA 50 and 65)). In the case of CBS: GSM 03.41 TPDU in hexadecimal format. **<index>** Index of message in selected storage <mem2>
Execution Command **AT+CMGW**	Response TA transmits SMS message (either SMS-DELIVER or SMS-SUBMIT) from TE to memory storage <mem2>. Memory location <index> of the stored message is returned. By default message status will be set to 'stored unsent', but parameter <stat> allows also other status values to be given. If writing is successful: **+CMGW: <index>** **OK** If error is related to ME functionality: **+CMS ERROR: <err>**
Reference GSM 07.05	Note

4.2.7 AT+CMSS Send SMS Message from Storage

AT+CMSS Send SMS Message from Storage	
Test Command **AT+CMSS=?**	Response **OK**
Write Command **AT+CMSS=<index>,<da>[,<toda>]**	Response TA sends message with location value <index> from message storage <mem2> to the network (SMS-SUBMIT). If new recipient address <da> is given, it shall be used instead of the one stored with the message. Reference value <mr> is returned to the TE on successful message delivery. Values can be used to identify message upon unsolicited delivery status report result code. 1) If text mode(+CMGF=1) and sending successful: **+CMSS: <mr>** **OK** 2) If PDU mode(+CMGF=0) and sending successful: **+CMSS: <mr>** **OK** 3)If error is related to ME functionality: **+CMS ERROR: <err>**
	Parameters **<index>** integer type; value in the range of location numbers supported by the associated memory **<da>** GSM 03.40 TP-Destination-Address Address-Value field in string format(string should be included in quotation marks); BCD numbers (or GSM default alphabet characters) are converted to characters of the currently selected TE character set (specified by +CSCS in TS 07.07); type of address given by <toda> **<toda>** GSM 04.11 TP-Destination-Address Type-of-Address octet in integer format (when first character of <da> is + (IRA 43) default is 145, otherwise default is 129) **<mr>** GSM 03.40 TP-Message-Reference in integer format
Reference GSM 07.05	Note

4.2.8 AT+CNMI New SMS Message Indications

AT+CNMI New SMS Message Indications	
Test Command **AT+CNMI=?**	Response **+CNMI: (**list of supported **<mode>**s**),(**list of supported **<mt>**s**),(**list of

	supported **<bm>**s)**,(**list of supported **<ds>**s)**,(**list of supported **<bfr>**s) **OK**
	Parameters See Write Command
Read Command **AT+CNMI?**	Response **+CNMI: <mode>,<mt>,<bm>,<ds>,<bfr>** **OK**
	Parameters See Write Command
Write Command **AT+CNMI=<mode>[,<mt>[,<bm>[,<ds>[,<bfr>]]]]**	Response TA selects the procedure for how the receiving of new messages from the network is indicated to the TE when TE is active, e.g. DTR signal is ON. If TE is inactive (e.g. DTR signal is OFF), message receiving should be done as specified in GSM 03.38. **OK** **ERROR**
	Parameters **<mode>** 0 Buffer unsolicited result codes in the TA. If TA result code buffer is full, indications can be buffered in some other place or the oldest indications may be discarded and replaced with the new received indications. 1 Discard indication and reject new received message unsolicited result codes when TA-TE link is reserved (e.g. in on-line data mode). Otherwise forward them directly to the TE. 2 Buffer unsolicited result codes in the TA when TA-TE link is reserved (e.g. in on-line data mode) and flush them to the TE after reservation. Otherwise forward them directly to the TE. 3 Forward unsolicited result codes directly to the TE. TA-TE link specific inband technique used to embed result codes and data when TA is in on-line data mode. **<mt>** (the rules for storing received SMs depend on its data coding scheme (refer GSM 03.38 [2]), preferred memory storage (+CPMS) setting and this value): 0 No SMS-DELIVER indications are routed to the TE. 1 If SMS-DELIVER is stored into ME/TA, indication of the memory location is routed to the TE using unsolicited result code: +CMTI: <mem>,<index> 2 SMS-DELIVERs (except class 2) are routed directly to

	the TE using unsolicited result code: +CMT: [<alpha>],<length><CR><LF><pdu> (PDU mode enabled) or +CMT: <oa>, [<alpha>],<scts> *[,<tooa>,<fo>,<pid>,<dcs>,<sca>,<tosca>,<length>]*<CR><LF><data> (text mode enabled; about parameters in italics, refer Command Show Text Mode Parameters +CSDH). Class 2 messages result in indication as defined in <mt>=1. 3 Class 3 SMS-DELIVERs are routed directly to TE using unsolicited result codes defined in <mt>=2. Messages of other classes result in indication as defined in <mt>=1. **<bm>** (the rules for storing received CBMs depend on its data coding scheme (refer GSM 03.38 [2]), the setting of Select CBM Types (+CSCB) and this value): 0 No CBM indications are routed to the TE. 2 New CBMs are routed directly to the TE using unsolicited result code: +CBM: <length><CR><LF><pdu> (PDU mode enabled) or +CBM: <sn>,<mid>,<dcs>,<page>,<pages><CR><LF><data> (text mode enabled). **<ds>** 0 No SMS-STATUS-REPORTs are routed to the TE. 1 SMS-STATUS-REPORTs are routed to the TE using unsolicited result code: +CDS: <length><CR><LF><pdu> (PDU mode enabled) or +CDS: <fo>,<mr>,[<ra>],[<tora>],<scts>,<dt>,<st> (text mode enabled) **<bfr>** 0 TA buffer of unsolicited result codes defined within this Command is flushed to the TE when <mode> 1...3 is entered (OK response shall be given before flushing the codes). 1 TA buffer of unsolicited result codes defined within this command is cleared when <mode> 1…3 is entered
	Unsolicited result code 1.Indication that new message has been received **+CMTI: <mem>,<index>** 2.Short message is output directly **+CMT: [<alpha>],<length><CR><LF><pdu>** 3.Cell broadcast message is output directly **+CBM: <length><CR><LF><pdu>**
Reference GSM 07.05	Note

4.2.9 AT+CPMS Preferred SMS Message Storage

AT+CPMS Preferred SMS Message Storage	
Test Command **AT+CPMS=?**	Response **+CPMS: (**list of supported **<mem1>**s**),(**list of supported **<mem2>**s**),(**list of supported **<mem3>**s**)** **OK**
	Parameters See Write Command
Read Command **AT+CPMS?**	Response **+CPMS: <mem1>,<used1>,<total1>,<mem2>,<used2>,<total2>, <mem3>,<used3>,<total3>** **OK** **ERROR**
	Parameters See Write Command
Write Command **AT+CPMS= <mem1> [,<mem2> [,<mem3>]]**	Response TA selects memory storages <mem1>, <mem2> and <mem3> to be used for reading, writing, etc. **+CPMS: <used1>,<total1>,<used2>,<total2>,<used3>,<total3>** **OK** **ERROR**
	Parameters **<mem1>** Messages to be read and deleted from this memory storage "SM" SIM message storage **<mem2>** Messages will be written and sent to this memory storage "SM" SIM message storage **<mem3>** Received messages will be placed in this memory storage if routing to PC is not set ("+CNMI") "SM" SIM message storage **<usedx>** integer type; Number of messages currently in <memx> **<totalx>** integer type; Number of messages storable in <memx>
Reference GSM 07.05	Note

4.2.10 AT+CRES Restore SMS Settings

AT+CRES Restore SMS Settings

Test Command **AT+CRES=?**	Response **+CRES: (**list of supported **<profile**>s**)** **OK**	Parameter See Write Command
Write Command **AT+CRES=<profile>**	Response TA restores SMS settings for +CSCA, +CSMP from non-volatile memory to active memory. **OK** **ERROR**	Parameter **<profile>** 0 Restore SM service settings from profile 0 1 Restore SM service settings from profile 1
Execution Command **AT+CRES**	Response Same as AT+CRES=0. **OK** If error is related to ME functionality: **+CMS ERROR <err>**	
Reference GSM 07.05	Note	

4.2.11 AT+CSAS Save SMS Settings

AT+CSAS Save SMS Settings		
Test Command **AT+CSAS=?**	Response **+CSAS: (**list of supported **<profile**>s**)** **OK**	Parameter See Write Command
Write Command **AT+CSAS=<profile>**	Response TA saves SMS settings for +CSCA, +CSMP from non-volatile memory to active memory. **OK** **ERROR**	Parameter **<profile>** 0 Save SM service setting in profile 0 1 Save SM service setting in profile 1
Execution Command **AT+CSAS**	Response Same as AT+CSAS=0 **OK**	

	If error is related to ME functionality: **+CMS ERROR <err>**
Reference GSM 07.05	Note

4.2.12 AT+CSCA SMS Service Center Address

AT+CSCA SMS Service Center Address	
Test Command **AT+CSCA=?**	Response **OK**
Read Command **AT+CSCA?**	Response **+CSCA: <sca>,<tosca>[,<scaAlpha>]** **OK**
	Parameters See Write Command
Write Command **AT+CSCA=<sca>[,<tosca>]**	Response TA updates the SMSC address, through which mobile originated SMS are transmitted. In text mode, setting is used by send and writes commands. In PDU mode, setting is used by the same commands, but only when the length of the SMSC address coded into <pdu> parameter equals zero. Note: The Command writes the parameters in NON-VOLATILE memory. **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters **<sca>** GSM 04.11 RP SC address Address-Value field in string format(string should be included in quotation marks); BCD numbers (or GSM default alphabet characters) are converted to characters of the currently selected TE character set (specified by +CSCS in TS 07.07); type of address given by <tosca> **<tosca>** Service center address format GSM 04.11 RP SC address Type-of-Address octet in integer format (default refer <toda>) **<scaAlpha>** string type(string should be included in quotation marks) Service center address alpha data
Reference GSM 07.05	Note

4.2.13 AT+CSCB Select Cell Broadcast SMS Messages

AT+CSCB Select Cell Broadcast SMS Messages	
Test Command **AT+CSCB=?**	Response **+CSCB: (**list of supported **<mode>**s**)** **OK**
	Parameter See Write Command
Read Command **AT+CSCB?**	Response **+CSCB: <mode>,<mids>,<dcss>** **OK**
	Parameters See Write Command
Write Command **AT+CSCB=<mode>[,mids>[,<dcss>]]**	Response TA selects which types of CBMs are to be received by the ME. Note: The Command writes the parameters in NON-VOLATILE memory. **OK** If error is related to ME functionality: **+CMS ERROR: <err>**
	Parameters **<mode>** 0 message types specified in <mids> and <dcss> are accepted 1 message types specified in <mids> and <dcss> are not accepted. **<mids>** string type (string should be included in quotation marks); all different possible combinations of CBM message identifiers (refer <mid>) (default is empty string); e.g. "0,1,5,320,922". Total 15 different **<mids>** values can be supported. **<mids>** values cannot be written consecutively, such as "100-200" **<dcss>** string type(string should be included in quotation marks); all different possible combinations of CBM data coding schemes (refer <dcs>) (default is empty string); e.g. "0,5". Total 5 different **<dcss>** values can be supported. **<dcss>** values cannot be written consecutively, such as "0-5"
Reference GSM 07.05	Note ● AT+CSCB=0 will reset <mids> and <dcss> and select no <mids> and no <dcss>. ● AT+CSCB=1 means all <dcss> are accepted but this command has no effect on the list of the <mids> accepted. "0-255" means all <dcss> are

	accepted. ● AT+CSCB=0, <mids> will add the <mids> values in the <mids> current list handled by module. ● AT+CSCB=0, <dcss> will add the <dcss> values in the <dcss> current list handled by module. ● If AT+CSCB=0, <mids> is received while the list of <mids> is full, OK is returned and new value is not added.

4.2.14 AT+CSDH Show SMS Text Mode Parameters

AT+CSDH Show SMS Text Mode Parameters	
Test Command **AT+CSDH=?**	Response **+CSDH: (**list of supported **<show>**s**)** **OK**
	Parameter See Write Command
Read Command **AT+CSDH?**	Response **+CSDH: <show>** **OK**
	Parameter See Write Command
Write Command **AT+CSDH=<show>**	Response TA determines whether detailed header information is shown in text mode result codes. **OK**
	Parameter **<show>** <u>0</u> do not show header values defined in commands +CSCA and +CSMP (<sca>, <tosca>, <fo>, <vp>, <pid> and <dcs>) nor <length>, <toda> or <tooa> in +CMT, +CMGL, +CMGR result codes for SMS-DELIVERs and SMS-SUBMITs in text mode 1 show the values in result codes
Reference GSM 07.05	Note

4.2.15 AT+CSMP Set SMS Text Mode Parameters

AT+CSMP Set SMS Text Mode Parameters	
Test Command	Response

AT+CSMP=?	**+CSMP: (**list of supported **<fo>**s)**,(**list of supported **<vp>**s)**,(**list of supported **<pid>**s)**,(**list of supported **<dcs>**s**)** **OK**
	Parameters See Write Command
Read Command **AT+CSMP?**	Response **+CSMP: <fo>,<vp>,<pid>,<dcs>** **OK**
	Parameters See Write Command
Write Command **AT+CSMP=[<fo>[,<vp>,<pid>,<dcs>]]**	Response TA selects values for additional parameters needed when SM is sent to the network or placed in a storage when text mode is selected (+CMGF=1). It is possible to set the validity period starting from when the SM is received by the SMSC (<vp> is in range 0... 255) or define the absolute time of the validity period termination (<vp> is a string). Note: The Command writes the parameters in NON-VOLATILE memory. **OK**
	Parameters **<fo>** depending on the Command or result code: first octet of GSM 03.40 SMS-DELIVER, SMS-SUBMIT (default 17), SMS-STATUS-REPORT, or SMS-COMMAND (default 2) in integer format. SMS status report is supported under text mode if <fo> is set to 49. **<vp>** depending on SMS-SUBMIT <fo> setting: GSM 03.40 TP-Validity-Period either in integer format (default 167) or in time-string format (refer <dt>) **<pid>** GSM 03.40 TP-Protocol-Identifier in integer format (default 0). **<dcs>** GSM 03.38 SMS Data Coding Scheme in Integer format.
Reference GSM 07.05	Note

4.2.16 AT+CSMS Select Message Service

AT+CSMS Select Message Service	
Test Command **AT+CSMS=?**	Response **+CSMS: (**list of supported **<service>**s**)** **OK**

	Parameter See Write Command
Read Command **AT+CSMS?**	Response **+CSMS: <service>,<mt>,<mo>,<bm>** **OK**
	Parameters See Write Command
Write Command **AT+CSMS=** **<service>**	Response **+CSMS: <mt>,<mo>,<bm>** **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters **<service>** 0 GSM 03.40 and 03.41 (the syntax of SMS AT commands is compatible with GSM 07.05 Phase 2 version 4.7.0; Phase 2+ features which do not require new Command syntax may be supported (e.g. correct routing of messages with new Phase 2+ data coding schemes)) 1 GSM 03.40 and 03.41 (the syntax of SMS AT commands is compatible with GSM 07.05 Phase 2+ version; the requirement of <service> setting 1 is mentioned under corresponding command descriptions) **<mt>** Mobile Terminated Messages: 0 Type not supported 1 Type supported **<mo>** Mobile Originated Messages: 0 Type not supported 1 Type supported **<bm>** Broadcast Type Messages: 0 Type not supported 1 Type supported
Reference GSM 07.05	Note

5 AT Commands for SIM Application Toolkit

5.1 STK AT Command

*PSSTK command is defined to support SIM toolkit by AT commands. Only part of SIM toolkit commands that interact with user or MMI can be controlled. All other SIM toolkit mechanism such as terminal profile, SMS or CBM data download, call control or MO SMS control by SIM, event download and all command that does not require interaction with the user (or screen) are internally managed by the ME.

AT*PSSTKI SIM Toolkit interface configuration	
Test Command **AT*PSSTKI=?**	Response ***PSSTKI: (**list of supported <**mode**>s**)** **OK**
	Parameter See Write Command
Read Command **AT*PSSTKI?**	Response ***PSSTKI: <mode>** **OK** **ERROR**
	Parameter See Write Command
Write Command **AT*PSSTKI =<mode>**	Response **OK** **ERROR**
	Parameter <**mode**> integer type 0 SIM toolkit notification is disabled 1 SIM toolkit notification is enabled
Reference	Note If AT*PSSTKI=1 is set, *PSSTK: "SETUP MENU" string will be sent out after power on.

AT*PSSTK SIM toolkit control	
Test Command **AT*PSSTK=?**	Response ***PSSTK: (**list of supported <**response type**>s) Parameter

	See Write Command
Read Command **AT*PSSTK?**	Response **ERROR**
Write Command **AT*PSSTK =<response type>,[<parameter1>,…,<parametern]**	Response **OK** **ERROR**
	Parameters **<response type>** string type that represents the type of response to be sent to SIM "COMMAND REJECTED" "NOTIFICATION" "SETUP CALL" "DISPLAY TEXT" "GET INKEY" "GET INPUT" "PLAY TONE" "SELECT ITEM" "SETUP MENU" "REMOVE MENU" "MENU SELECTION" "ALL CALLS DISCONNECTED" "USER ACTIVITY" "IDLE SCREEN AVAILABLE" "SETUP CALL TERMINATED" "GET ITEM LIST" "LANGUAGE NOTIFICATION" "SETUP IDLE MODE TEXT" **<parameteri>** integer or string type which number of parameters depends on response type.
Reference	Note

6 AT Commands Special for SIMCOM

6.1 Overview

Command	Description
AT+SIDET	CHANGE THE SIDE TONE GAIN LEVEL
AT+CPOWD	POWER OFF
AT+SPIC	TIMES REMAINED TO INPUT SIM PIN/PUK
AT+CMIC	CHANGE THE MICROPHONE GAIN LEVEL
AT+CALA	SET ALARM TIME
AT+CALD	DELETE ALARM
AT+CADC	READ ADC
AT+CSNS	SINGLE NUMBERING SCHEME
AT+CDSCB	RESET CELL BROADCAST
AT+CMOD	CONFIGURE ALTERNATING MODE CALLS
AT+CFGRI	INDICATE RI WHEN USING URC
AT+CLTS	GET LOCAL TIMESTAMP
AT+CEXTHS	EXTERNAL HEADSET JACK CONTROL
AT+CEXTBUT	HEADSET BUTTON STATUS REPORTING
AT+CSMINS	SIM INSERTED STATUS REPORTING
AT+CLDTMF	LOCAL DTMF TONE GENERATION
AT+CDRIND	CS VOICE/DATA CALL TERMINATION INDICATION
AT+CSPN	GET SERVICE PROVIDER NAME FROM SIM
AT+CCVM	GET AND SET THE VOICE MAIL NUMBER ON THE SIM
AT+CBAND	GET AND SET MOBILE OPERATION BAND
AT+CHF	CONFIGURE HANDS FREE OPERATION
AT+CHFA	SWAP THE AUDIO CHANNELS
AT+CSCLK	CONFIGURE SLOW CLOCK
AT+CENG	SWITCH ON OR OFF ENGINEERING MODE
AT+SCLASS0	STORE CLASS 0 SMS TO SIM WHEN RECEIVED CLASS 0 SMS
AT+CCID	SHOW ICCID
AT+CMTE	SET CRITICAL TEMPERATURE OPERATING MODE OR QUERY TEMPERATURE
AT+CBTE	BATTERY TEMPERATURE QUERY
AT+CSDT	SWITCH ON OR OFF DETECTING SIM CARD
AT+CMGDA	DELETE ALL SMS
AT+STTONE	PLAY SIM TOOLKIT TONE
AT+SIMTONE	GENERATE SPECIFIC TONE

AT+CCPD	ENABLE OR DISABLE ALPHA STRING
AT+CGID	GET SIM CARD GROUP IDENTIFIER
AT+MORING	SHOW STATE OF MOBILE ORIGINATED CALL
AT+CMGHEX	ENABLE OR DISABLE SENDING NON-ASCII CHARACTER SMS
AT+AUTEST	AUDIO CHANNEL LOOPBACK TEST
AT+CCODE	CONFIGURE SMS CODE MODE
AT+CIURC	ENABLE OR DISABLE INITIAL URC PRESENTATION
AT+CPSPWD	CHANGE PS SUPER PASSWORD
AT+EXUNSOL	ENABLE OR DISABLE PROPRIETARY UNSOLICITED INDICATIONS
AT+CGMSCLASS	CHANGE GPRS MULTISLOT CLASS
AT+CDEVICE	VIEW CURRENT FLASH DEVICE TYPE
AT+CCALR	CALL READY QUERY
AT+GSV	DISPLAY PRODUCT IDENTIFICATION INFORMATION
AT+SGPIO	CONTROL THE GPIO
AT+SPWM	GENERATE THE PULSE-WIDTH-MODULATION
AT+ECHO	ECHO CANCELLATION CONTROL
AT+CAAS	CONTROL AUTO AUDIO SWITCH
AT+SVR	CONFIGURE VOICE CODING TYPE FOR VOICE CALLS
AT+GSMBUSY	REJECT INCOMING CALL

6.2 Detailed Descriptions of Commands

6.2.1 AT+SIDET Change the Side Tone Gain Level

AT+SIDET Change the Side Tone Gain Level	
Test Command **AT+SIDET=?**	Response **+SIDET: (**list of supported **<channel>**s**),(**list of supported **<gainlevel>**s**)** **OK**
	Parameters See Write Command
Read Command **AT+SIDET?**	Response: **+SIDET: <gainlevel>**,**<gainlevel>** **OK**
	Parameters See Write Command

Write Command **AT+SIDET=<channel>,<gainlevel>**	Response **OK** **ERROR**	
	Parameters **<channel>** 0 main audio handset channel 1 aux audio headset channel 2 main audio handfree channel 3 aux audio handfree channel **<gainlevel>** int: 0 – 16	
Reference	Note <gainlevel> value is related to channel specific.	

6.2.2 AT+CPOWD Power Off

AT+CPOWD Power Off	
Write Command **AT+CPOWD=<n>**	Response **[NORMAL POWER DOWN]**
	Parameter **<n>** 0 Power off urgently (Will not send out NORMAL POWER DOWN) 1 Normal power off (Will send out NORMAL POWER DOWN)
Reference	Note

6.2.3 AT+SPIC Times Remained to Input SIM PIN/PUK

AT+SPIC Times Remained to Input SIM PIN/PUK	
Execution Command **AT+SPIC**	Response Times remained to input SIM PIN **+SPIC: <pin1>,<pin2>,<puk1>,<puk2>** **OK**
	Parameters **<pin1>** Times remained to input chv1 **<pin2>** Times remained to input chv2 **<puk1>** Times remained to input puk1 **<puk2>** Times remained to input puk2
Reference	Note

6.2.4 AT+CMIC Change the Microphone Gain Level

AT+CMIC Change the Microphone Gain Level	
Test Command **AT+CMIC=?**	Response **+CMIC: (**list of supported **<channel>**s**),(**list of supported **<gainlevel>**s) **OK**
	Parameters See Write Command
Read Command **AT+CMIC?**	Response **+CMIC: (0,<gainlevel>),(1,<gainlevel>),(2,<gainlevel>),(3,<gainlevel>)** **OK**
	Parameters See Write Command
Write Command **AT+CMIC=<channel>,<gainlevel>**	Response **OK** **ERROR**
	Parameters **<channel>** 0 main audio handset channel 1 aux audio headset channel 2 main audio handfree channel 3 aux audio handfree channel **<gainlevel>** int: 0 – 15 0 0dB 1 +1.5dB 2 +3.0 dB 3 +4.5 dB 4 +6.0 dB 5 +7.5 dB 6 +9.0 dB 7 +10.5 dB 8 +12.0 dB 9 +13.5 dB 10 +15.0 dB 11 +16.5 dB 12 +18.0 dB 13 +19.5 dB 14 +21.0 dB 15 +22.5 dB
Reference	Note Please refer to actual model for channel number.

6.2.5 AT+CALA Set Alarm Time

AT+CALA Set Alarm Time	
Test Command **AT+CALA=?**	Response: **+CALA: ("yy/mm/dd,hh:mm:ss","hh:mm:ss"),(1-5),(0-7)** **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters See Write Command
Read Command **AT+CALA?**	Response: **+CALA: <time>,<n1>,[<recurr>]** **(<CR><LF> +CALA: <time>,<n2>,[<recurr>] …)** **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters See Write Command
Write Command **AT+CALA=<time>,<n>,[<recurr>]**	Response **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters **<time>** a string parameter(string should be included in quotation marks) which indicates the time when alarm arrives. The format is "yy/MM/dd,hh:mm:ss" where characters indicate the last two digits of year, month, day, hour, minute, second and time zone. The time zone is expressed in quarters of an hour between the local time and GMT, ranging from -48 to +48. **<n>** index of the alarm (range 1 to 5 for now). **<recurr>** "0", "1"---"7" string type value indicating day of week for the alarm in one of the following formats: "<1..7>[,<1..7>[…]]" – Set a recurrent alarm for one or more days in the week. The digits 1 to 7 correspond to the days in the week, Monday (1), …, Sunday (7). Example: The string "1,2,3,4,5" may be used to set an alarm for all weekdays. "0" – Set a recurrent alarm for all days in the week
Reference	Note

6.2.6 AT+CALD Delete Alarm

AT+CALD Delete Alarm	
Test Command **AT+CALD=?**	Response: **+CALD:** (list of supported <**n**>s) **OK**
	Parameter See Write Command
Write Command **AT+CALD=<n>**	Response **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameter **<n>** integer type value indicating the index of the alarm; default is manufacturer specific (range 1 to 5 now).
Reference	Note

6.2.7 AT+CADC Read ADC

AT+CADC Read ADC	
Test Command **AT+CADC=?**	Response: **+CADC: (**list of supported **<status**>s**),(**list of supported **<value**>s**)** **OK**
	Parameters **<status>** 1 success 0 fail **<value>** integer 0-2800
Read Command **AT+CADC?**	Response: **+CADC: <status>,<value>** **OK**
	Parameters See Test Command
Reference	Note

6.2.8 AT+CSNS Single Numbering Scheme

AT+CSNS Single Numbering Scheme	
Test Command **AT+CSNS =?**	Response **+CSNS: (**list of supported **<mode**>s**)**

	OK
	Parameter See Write Command
Read Command **AT+CSNS?**	Response **+CSNS: <mode>** **OK**
	Parameter See Write Command
Write Command **AT+CSNS=<mode>**	Response **OK** **ERROR**
	Parameter **<mode>** 0 voice 2 fax 4 data
Reference	Note

6.2.9 AT+CDSCB Reset Cell Broadcast

AT+CDSCB Reset Cell Broadcast	
Execution Command **AT+CDSCB**	Response **OK**
Reference	Note Please also refer to AT+CSCB.

6.2.10 AT+CMOD Configure Alternating Mode Calls

AT+CMOD Configure Alternating Mode Calls	
Test Command **AT+CMOD =?**	Response **+CMOD: (0)** **OK**
	Parameter See Write Command
Read Command **AT+CMOD?**	Response **+CMOD: <mode>**

	OK
	Parameter See Write Command
Write Command **AT+CMOD=[<mode>]**	Response **OK** **ERROR**
	Parameter **<mode>** 0 Only single mode is supported
Reference	Note

6.2.11 AT+CFGRI Indicate RI When Using URC

AT+CFGRI Indicate RI When Using URC	
Read Command **AT+CFGRI?**	Response **+CFGRI: <status>** **OK**
	Parameter See Write Command
Write Command **AT+CFGRI=<status>**	Response **OK** **ERROR**
	Parameter **<status>** 1 on 0 off
Reference	Note

6.2.12 AT+CLTS Get Local Timestamp

AT+CLTS Get Local Timestamp	
Test Command **AT+CLTS=?**	Response **+CLTS: "yy/MM/dd,hh:mm:ss+/-zz"** **OK**
Write Command **AT+CLTS=<mode>**	Response **OK** **ERROR**
	Parameter **<mode>**

	0 disable 1 enable
	Unsolicited Result Code When "get local timestamp" function is enabled, the following URC may be reported if network sends the message to the MS to provide the MS with subscriber specific information. 1. Refresh network name by network: ***PSNWID: "<mcc>", "<mnc>", "<full network name>", <full network name CI>, "<short network name>",<short network name CI>** 2. Refresh time and time zone by network: This is UTC time, the time queried by AT+CCLK command is local time. ***PSUTTZ: <year>, <month>, <day>, <hour>, <min>, <sec>, "<time zone>", <dst>** 3. Refresh network time zone by network: **+CTZV: "<time zone>"** 4. Refresh Network Daylight Saving Time by network: **DST: <dst>**
	Parameters **<mcc>** string type; mobile country code **<mnc>** string type; mobile network code **<full network name>** string type; name of the network in full length. **<full network name CI>** integer type; indicates whether to add CI. 0 The MS will not add the initial letters of the Country's Name to the text string. 1 The MS will add the initial letters of the Country's Name and a separator (e.g. a space) to the text string. **<short network name>** string type; abbreviated name of the network **<short network name CI>** integer type; indicates whether to add CI. 0 The MS will not add the initial letters of the Country's Name to the text string. 1 The MS will add the initial letters of the Country's Name and a separator (e.g. a space) to the text string. **<year>** 4 digits of year (from network) **<month>** month (from network) **<day>** day (from network) **<hour>** hour (from network) **<min>** minute (from network)

	<sec> second (from network) **<time zone>** string type; network time zone. If the network time zone has been adjusted for Daylight Saving Time, the network shall indicate this by including the <dst> (Network Daylight Saving Time) **<dst>** Network Daylight Saving Time; the content of this indicates the value that used to adjust the network time zone 0 No adjustment for Daylight Saving Time 1 +1 hour adjustment for Daylight Saving 2 +2 hours adjustment for Daylight Saving Time 3 Reserved
Reference	Note ● Support for this Command will be network dependent. ● Set AT+CLTS=1, it means user can receive network time updating and use AT+CCLK to show current time.

6.2.13 AT+CEXTHS External Headset Jack Control

AT+CEXTHS External Headset Jack Control	
Test Command **AT+CEXTHS=?**	Response **+CEXTHS: (<mode>s)** **OK**
	Parameter See Write Command
Read Command **AT+CEXTHS?**	Response **+CEXTHS: <mode>,<headset attach>** **OK**
	Parameters See Write Command
Write Command **AT+CEXTHS=<mode>**	Response **OK** **ERROR** If error is related to ME functionality: **+CME ERROR: <err>**
	Unsolicited result code: **+CEXTHS: <mode>,<headset attach>**
	Parameters **<mode>** a numeric parameter which indicates whether an unsolicited event code (indicating whether the headset has been

	attached/detached) should be sent to the terminal. 0 not send unsolicited event code 1 send unsolicited event code **<headset attach>** a numeric parameter which indicates whether a headset has been attached or not 0 not attached 1 attached
Reference	Note This command is related to the actual module.

6.2.14 AT+CEXTBUT Headset Button Status Reporting

AT+CEXTBUT Headset Button Status Reporting	
Test Command **AT+CEXTBUT=?**	Response **+CEXTBUT: (**list of supported **<mode>**s**)** **OK**
	Parameter See Write Command
Read Command **AT+CEXTBUT?**	Response **+CEXTBUT: <mode>,<headset button press>** **OK**
	Parameters See Write Command
Write Command **AT+CEXTBUT=<mode>**	Response **OK** **ERROR** If error is related to ME functionality: **+CME ERROR: <err>**
	Unsolicited result code **+CEXTBUT: <mode>,<headset button press>**
	Parameters **<mode>** a numeric parameter which indicates whether an unsolicited event code (indicating whether the headset button has been pressed) should be sent to the terminal. 0 not send unsolicited event code 1 send unsolicited event code **<headset button press>** a numeric parameter which indicates whether a headset button has been pressed or not 0 not pressed 1 pressed

Reference	Note This command is related to the actual module.

6.2.15 AT+CSMINS SIM Inserted Status Reporting

AT+CSMINS SIM Inserted Status Reporting	
Test Command **AT+CSMINS=?**	Response **+CSMINS: (**list of supported **<n>**s**)** **OK**
	Parameter See Write Command
Read Command **AT+CSMINS?**	Response **+CSMINS: <n>,<SIM inserted>** **OK**
	Parameters See Write Command
Write Command **AT+CSMINS=<n>**	Response **OK** **ERROR** If error is related to ME functionality: **+CME ERROR: <err>**
	Unsolicited result code: **+CSMINS:<n>,<SIM inserted>**
	Parameters **<n>** a numeric parameter to show an unsolicited event code indicating whether the SIM has been inserted or removed. 0 disable 1 enable **<SIM inserted>** a numeric parameter which indicates whether SIM card has been inserted. 0 not inserted 1 inserted
Reference	Note

6.2.16 AT+CLDTMF Local DTMF Tone Generation

AT+CLDTMF Local DTMF Tone Generation	
Test Command **AT+CLDTMF=?**	Response **+CLDTMF: (1-100),(0-9,A,B,C,D,*,#)**

	OK
Write Command **AT+CLDTMF=<n>[,<DTMF string>]**	Response **OK** **ERROR**
	Parameters **<n>** a numeric parameter(1-100) which indicates the duration of all DTMF tones in <DTMF -string> in 1/10 secs **<DTMF -string>** a string parameter (string should be included in quotation marks) which has a max length of 20 chars of form <DTMF>, separated by commas. **<DTMF>** A single ASCII chars in the set 0-9,#,*,A-D.
Execution Command **AT+CLDTMF**	Response **OK** Abort any DTMF tone currently being generated and any DTMF tone sequence.
Reference	Note

6.2.17 AT+CDRIND CS Voice/Data Call Termination Indication

AT+CDRIND CS Voice/Data Call Termination Indication	
Test Command **AT+CDRIND=?**	Response **+CDRIND: (**list of supported **<n>**s**)** **OK**
	Parameter See Write Command
Read Command **AT+CDRIND?**	Response **+CDRIND: <n>** **OK**
	Parameter See Write Command
Write Command **AT+CDRIND=<n>**	Response **OK** **ERROR**
	Parameter **<n>** a numeric parameter to enable an unsolicited event code indicating whether a CS voice call, CS data has been terminated. 0 disable 1 enable
	Unsolicited result code

	When enabled, an unsolicited result code is returned after the connection has been terminated **+CDRIND: <type>**
	Parameter **<type>** connection type 0 CSV connection 1 CSD connection 2 PPP connection
Reference	Note

6.2.18 AT+CSPN Get Service Provider Name from SIM

AT+CSPN Get Service Provider Name from SIM	
Read Command **AT+CSPN?**	Response: **+CSPN: <spn>,<display mode>** **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters **<spn>** string type(string should be included in quotation marks); service provider name on SIM **<display mode>** 0 not display PLMN. Already registered on PLMN 1 display PLMN
Reference	Note CME errors occur if SIM is not inserted.

6.2.19 AT+CCVM Get and Set the Voice Mail Number on the SIM

AT+CCVM Get and Set the Voice Mail Number on the SIM	
Test Command **AT+CCVM=?**	Response **+CCVM:** maximum length of field **<vm number>[,** maximum length of field **<alpha string>]** **OK**
	Parameters See Write Command
Read Command **AT+CCVM?**	Response If voice mail number is not set: **OK** If voice mail number is set: **+CCVM: <vm number>[,<alpha string>]**

	OK
	Parameters See Write Command
Write Command **AT+CCVM=<vm number>[,<alpha string>]**	Response **OK** **ERROR** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters **<vm number>** string type (string should be included in quotation marks) -The voice mail number to write to the SIM **<alpha string>** string type (string should be included in quotation marks) -The alpha-string to write to the SIM
Reference	Note

6.2.20 AT+CBAND Get and Set Mobile Operation Band

AT+CBAND Get and Set Mobile Operation Band	
Test Command **AT+CBAND=?**	Response **+CBAND: (**list of supported **<op_band**>s**)** **OK**
	Parameter See Write Command
Read Command **AT+CBAND?**	Response **+CBAND: <op_band>[,<ALL_BAND>]** **OK**
	Parameter See Write Command
Write Command **AT+CBAND=<op_band>**	Response **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameter **<op_band>** A string parameter which indicate the operation band. And the following strings should be included in quotation marks. PGSM_MODE

	DCS_MODE PCS_MODE EGSM_DCS_MODE GSM850_PCS_MODE ALL_BAND
Reference	Note Radio settings are stored in non-volatile memory.

6.2.21 AT+CHF Configure Hands Free Operation

AT+CHF Configure Hands Free Operation	
Test Command **AT+CHF=?**	Response **+CHF: (**list of supported **<ind>**s**),(** list of supported **<state>**s**)** **OK**
	Parameters See Write Command
Read Command **AT+CHF?**	Response **+CHF: <ind>,<state>** **OK**
	Parameters See Write Command
Write Command **AT+CHF=<ind>[,<state>]**	Response **OK** **ERROR** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters **<ind>** 0 Unsolicited result code disabled 1 Unsolicited result code enabled (non-volatile) **<state>** 0 main audio handset channel 1 aux audio headset channel 2 main audio handfree channel 3 aux audio handfree channel (volatile)
Reference	Note This command is related to the actual module.

6.2.22 AT+CHFA Swap the Audio Channels

AT+CHFA Swap the Audio Channels

Test Command **AT+CHFA=?**	Response **+CHFA: (0 = NORMAL_AUDIO, 1 = HEADSET_AUDIO, 2 = HANDFREE_AUDIO, 3 = HEADSET_HANDFREE_AUDIO)** **OK**	
Read Command **AT+CHFA?**	Response **+CHFA: <n>** **OK**	
	Parameter See Write Command	
Write Command **AT+CHFA=<n>**	Response **OK** If error is related to ME functionality: **+CME ERROR: <err>**	
	Parameter **<n>** 0 main audio handset channel 1 aux audio headset channel 2 main audio handfree channel 3 aux audio handfree channel	
Reference	Note ● This Command swaps the audio channels among different channels. ● This command is related to the actual module.	

6.2.23 AT+CSCLK Configure Slow Clock

AT+CSCLK Configure Slow Clock	
Test Command **AT+CSCLK=?**	Response **+CSCLK: (**list of supported **<n>**s**)** **OK**
	Parameter See Write Command
Read Command **AT+CSCLK?**	Response **+CSCLK: <n>** **OK**
	Parameter See Write Command
Write Command **AT+CSCLK**	Response **OK**

=<n>	**ERROR**
	Parameter **<n>** 0 disable slow clock, module will not enter sleep mode. 1 enable slow clock, it is controlled by DTR. When DTR is high, module can enter sleep mode. When DTR changes to low level, module can quit sleep mode. 2 The module decides by itself when it enters sleep mode. When there is no data on serial port, module can enter sleep mode. Otherwise, it will quit sleep mode.
Reference	Note

6.2.24 AT+CENG Switch On or Off Engineering Mode

AT+CENG Switch On or Off Engineering Mode	
Test Command **AT+CENG=?**	Response TA returns the list of supported modes. **+CENG: (**list of supported **<mode>**s**),(**list of supported **<Ncell>**s**)** **OK**
	Parameters See Write Command
Read Command **AT+CENG?**	Response Engineering Mode is designed to allow a field engineer to view and test the network information received by a handset, when the handset is either in idle mode or dedicated mode (that is: with a call active). In each mode, the engineer is able to view network interaction for the "serving cell" (the cell the handset is currently registered with) or for the neighboring cells. TA returns the current engineering mode. The network information including serving cell and neighboring cells are returned only when <mode>=1 or <mode> = 2. <cell> carry with them corresponding network interaction. **+CENG: <mode>,<Ncell>** **[+CENG: <cell>,"<arfcn>,<rxl>,<rxq>,<mcc>,<mnc>,<bsic>,<cellid>,<rla>,<txp>,<lac>,<TA>"** **<CR><LF>+CENG: <cell>,"<arfcn>,<rxl>,<bsic>,[<cellid>,]<mcc>,<mnc>,<lac>"…]**

	OK if <mode>=3 **+CENG: <mode>,<Ncell>** **[+CENG: <cell>,<mcc>,<mnc>,<lac>,<cellid>,<bsic>,<rxl> <CR><LF>+CENG: <cell>,<mcc>,<mnc>,<lac>,<cellid>, <bsic>,<rxl>…]** **OK**
	Parameters See Write Command
Write Command **AT+CENG =<mode>[,<Ncell >]**	Response Switch on or off engineering mode. It will report +CENG: (network information) automatically if <mode>=2. **OK** **ERROR**
	Parameters **<mode>** 0 switch off engineering mode 1 switch on engineering mode 2 switch on engineering mode, and activate the URC report of network information 3 switch on engineering mode, with limited URC report **<Ncell>** 0 un-display neighbor cell ID 1 display neighbor cell ID If <mode> =3, ignore this parameter. **<cell>** 0 the serving cell 1-6 the index of the neighboring cell **<arfcn>** absolute radio frequency channel number **<rxl>** receive level **<rxq>** receive quality **<mcc>** mobile country code **<mnc>** mobile network code **<bsic>** base station identity code **<cellid>** cell id **<lac>** location area code **<rla>** receive level access minimum **<txp>** transmit power maximum CCCH **<TA>** Timing Advance
Reference	Note

6.2.25 AT+SCLASS0 Store Class 0 SMS to SIM When Received Class 0 SMS

AT+SCLASS0 Store Class 0 SMS to SIM When Module Received Class 0 SMS	
Test Command **AT+SCLASS0=?**	Response **+SCLASS0: (0, 1)** **OK**
	Parameter See Write Command
Read Command **AT+SCLASS0?**	Response **+SCLASS0: <mode>** **OK**
	Parameter See Write Command
Write Command **AT+SCLASS0=<mode>**	Response **OK** **ERROR**
	Parameter **<mode>** 0 disable to store Class 0 SMS to SIM when module receives Class 0 SMS 1 enable to store Class 0 SMS to SIM when module receives Class 0 SMS
Reference	Note

6.2.26 AT+CCID Show ICCID

AT+CCID Show ICCID	
Test Command **AT+CCID =?**	Response: **OK**
Execution Command **AT+CCID**	Response: **Ccid data** [ex. 898600810906F8048812] **OK**
Reference	Note

6.2.27 AT+CMTE Set Critical Temperature Operating Mode or Query Temperature

AT+CMTE Set Critical Temperature Operating Mode or Query Temperature	
Read Command	Response

AT+CMTE?	**+CMTE: <mode><Temperature>** **OK**
	Parameters See Write Command
Write Command **AT+CMTE= <mode>**	Response **OK** **ERROR**
	Parameters **<mode>** 0 disable temperature detection 1 enable temperature detection **<Temperature>** range of -40 to 90
Reference	Note ● When temperature is extremely high or low, product will power off. ● URCs indicating the alert level "1" or "-1" are intended to enable the user to take appropriate precautions, such as protecting the module from exposure to extreme conditions, or saving or backing up data etc. ● Level "2" or "-2" URCs are followed by immediate shutdown.

6.2.28 AT+CBTE Battery Temperature Query

AT+CBTE Battery Temperature Query	
Read Command **AT+CBTE ?**	Response: **+CBTE: <voltage>** **OK**
	Parameter **<voltage>** battery voltage(mV)
Reference	Note ● Only supported in SIM900D ● The temperature can be calculated according to the resistance of NTC and the voltage supported by this command.

6.2.29 AT+CSDT Switch On or Off Detecting SIM Card

AT+CSDT Switch On or Off Detecting SIM Card	
Test Command **AT+CSDT =?**	Response **+CSDT: (0-1)** **OK**
	Parameter

	See Write Command
Read Command **AT+CSDT?**	Response **+CSDT: <mode>** **OK**
	Parameter See Write Command
Write Command **AT+CSDT=<mode>**	Response **OK** **ERROR**
	Parameter **<mode>** 0 switch off detecting SIM card 1 switch on detecting SIM card
Reference	Note It is not supported temporarily.

6.2.30 AT+CMGDA Delete All SMS

AT+CMGDA Delete All SMS	
Test Command **AT+CMGDA=?**	Response: **+CMGDA: (**list of supported **<type>**s**)** **OK** **+CMS ERROR: <err>**
	Parameter See Write Command
Write Command **AT+CMGDA=<type>**	Response: **OK** **ERROR** **+CMS ERROR: <err>**
	Parameter **<type>** 1) If text mode: "DEL READ" delete all read messages "DEL UNREAD" delete all unread messages "DEL SENT" delete all sent SMS "DEL UNSENT" delete all unsent SMS "DEL INBOX" delete all received SMS "DEL ALL" delete all SMS 2) If PDU mode: 1 delete all read messages

	2 delete all unread messages 3 delete all sent SMS 4 delete all unsent SMS 5 delete all received SMS 6 delete all SMS
Reference	Note

6.2.31 AT+STTONE Play SIM Toolkit Tone

AT+STTONE Play SIM Toolkit Tone	
Test Command **AT+STTONE=?**	Response **+STTONE: (**list of supported <**mode**>s**),(**list of supported <**tone**>s**),(**list of supported <**duration**>s**)** **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters See Write Command
Write Command **AT+STTONE=<mode>,<tone>,<duration>**	Response **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters **<mode>** 0 Stop playing tone 1 Start playing tone **<tone>** numeric type 1 Dial Tone 2 Called Subscriber Busy 3 Congestion 4 Radio Path Acknowledge 5 Radio Path Not Available / Call Dropped 6 Error / Special information 7 Call Waiting Tone 8 Ringing Tone 16 General Beep 17 Positive Acknowledgement Tone 18 Negative Acknowledgement or Error Tone 19 Indian Dial Tone 20 American Dial Tone **<duration>** numeric type, in milliseconds. Max requested value = 255*60*1000 = 15300000ms

	(supported range = 3- 15300000)
Reference	Note ● The default <tone>, if none is entered, it should be General Beep. ● The default <duration>, if none is entered, it should be 500ms.

6.2.32 AT+SIMTONE Generate Specifically Tone

AT+SIMTONE Generate Specifically Tone	
Test Command **AT+SIMTONE=?**	Response **+SIMTONE: (0,1),(20-20000),(200-25500),(0,100-25500),(0-500000)** **OK**
	Parameters See Write Command
Write Command **AT+SIMTONE=<mode>,<frequency>,<periodOn>,<periodOff>[,<duration>]**	Response **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters **<mode>** 0 Stop playing tone 1 Start playing tone **<frequency>** the frequency of tone to be generated **<periodOn>** the period of generating tone, must be multiple of 100 **<periodOff>** the period of stopping tone, must be multiple of 100 **<duration>** duration of tones in milliseconds
Reference	Note

6.2.33 AT+CCPD Enable or Disable Alpha String

AT+CCPD Enable or Disable Alpha String	
Test Command **AT+CCPD=?**	Response **+CCPD: (0,1)** **OK**
	Parameter See Write Command
Read Command **AT+CCPD?**	Response **+CCPD: <mode>** **OK**
	Parameter See Write Command

Write Command **AT+CCPD=<mode>**	Response **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameter **<mode>** 0 disable to present alpha string 1 enable to present alpha string
Reference	Note

6.2.34 AT+CGID Get SIM Card Group Identifier

AT+CGID Get SIM Card Group Identifier	
Execution Command **AT+CGID**	Response **+GID: <gid1> <gid2>** **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters **<gid1>** integer type of SIM card group identifier 1 **<gid2>** integer type of SIM card group identifier 2
Reference	Note If the SIM supports GID files, the GID values will be retuned. Otherwise 0xff is retuned.

6.2.35 AT+MORING Show State of Mobile Originated Call

AT+MORING Show State of Mobile Originated Call	
Test Command **AT+MORING=?**	Response **+MORING: (0,1)** **OK**
	Parameter See Write Command
Read Command **AT+MORING?**	Response **+MORING: <mode>** **OK**
	Parameter See Write Command
Write Command	Response

AT+MORING =<mode>	**OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameter **<mode>** 0 not show call state of mobile originated call 1 show call state of mobile originated call. After the call number is dialed, the URC strings of MO RING will be sent if another call is alerted and the URC strings of MO CONNECTED will be sent if the call is established.
	Unsolicited Result Code **MO RING** the call is alerted. **MO CONNECTED** the call is established.
Reference	Note

6.2.36 AT+CMGHEX Enable or Disable Sending Non-ASCII Character SMS

AT+CMGHEX Enable or Disable Sending Non-ASCII Character SMS	
Test Command **AT+CMGHEX =?**	Response **+CMGHEX: (**list of supported **<mode>**s**)** **OK**
	Parameter See Write Command
Read Command **AT+CMGHEX?**	Response **+CMGHEX: <mode>** **OK**
	Parameter See Write Command
Write Command **AT+CMGHEX =<mode>**	Response **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameter **<mode>** 0 Send SMS in ordinary way 1 Enable to send SMS varying from 0x00 to 0x7f except 0x1a and 0x1b under text mode and GSM character set

Reference	Note Only be available in TEXT mode and AT+CSCS="GSM".

6.2.37AT+AUTEST Audio Channel Loopback Test

AT+AUTEST Audio Channel Loopback Test	
Test Command **AT+AUTEST=?**	Response **+AUTEST: (0-1),(0-1)** **OK**
	Parameter See Write Command
Write Command **AT+AUTEST=** **<state>,<type>**	Response **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters **<state>** 0 test is off 1 test is on **<type>** 0 Normal audio channel 1 AUX audio channel
Reference	Note

6.2.38AT+CCODE Configure SMS Code Mode

AT+CCODE Configure SMS Code Mode	
Test Command **AT+CCODE=?**	Response **+CCODE: (0,1)** **OK**
	Parameter See Write Command
Read Command **AT+CCODE?**	Response **+CCODE:<mode>** **OK**
	Parameter See Write Command
Write Command **AT+CCODE=** **<mode>**	Response **OK** If error is related to ME functionality: **+CME ERROR: <err>**

	Parameter **<mode>** 0 code mode compatible with NOKIA 1 code mode compatible with SIEMENS
Reference	Note

6.2.39 AT+CIURC Enable or Disable Initial URC Presentation

AT+CIURC Enable or Disable Initial URC Presentation	
Test Command **AT+CIURC=?**	Response **+CIURC: (0,1)** **OK**
	Parameter See Write Command
Read Command **AT+CIURC?**	Response **+CIURC:<mode>** **OK**
	Parameter See Write Command
Write Command **AT+CIURC=<mode>**	Response **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameter **<mode>** 0 disable URC presentation. 1 enable URC presentation
Reference	Note When module is powered on and initialization procedure is over. URC "Call Ready" will be presented if <mode> is 1.

6.2.40 AT+CPSPWD Change PS Super Password

AT+CPSPWD Change PS Super Password	
Write Command **AT+CPSPWD=<oldpwd>,<newpwd>**	Response **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters **<oldpwd>** string type(string should be included in quotation marks).

	Old password and length should be 8. **<newpwd>** string type(string should be included in quotation marks). New password and length should be 8.
Reference	Note Default value of <oldpwd> is "12345678". If module is locked to a specific SIM card through AT+CLCK and password lost or SIM state is PH-SIM PUK, user can use the super password to unlock it. It is not supported temporarily.

6.2.41 AT+EXUNSOL Enable or Disable Proprietary Unsolicited Indications

AT+EXUNSOL Enable or Disable Proprietary Unsolicited Indications	
Test Command **AT+EXUNSOL =?**	Response **+EXUNSOL: (**list of supported **<exunsol>**s**)** **OK**
	Parameters See Write Command
Write Command **AT+EXUNSOL=<exunsol>,<mode>**	Response **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters **<exunsol>** string type(string should be included in quotation marks). values are currently reserved by the present document "SQ" Signal Quality Report Displays signal strength and channel bit error rate (similar To AT+CSQ) in form +CSQN: <rssi>,<ber>when values change. **<mode>** 0 disable 1 enable 2 query
Reference	Note

6.2.42 AT+CGMSCLASS Change GPRS Multislot Class

AT+CGMSCLASS Change GPRS Multislot Class

Test Command **AT+CGMSCLASS=?**	Response **MULTISLOT CLASS: (4,8,9,10)** **OK**
	Parameter See Write Command
Read Command **AT+CGMSCLASS?**	Response **MULTISLOT CLASS: <class>** **OK**
	Parameter See Write Command
Write Command **AT+CGMSCLASS=<class>**	Response **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameter **<class>** GPRS multi-slot class
Reference	Note

6.2.43 AT+CDEVICE View Current Flash Device Type

AT+CDEVICE View Current Flash Device Type	
Read Command **AT+CDEVICE?**	Response **Device Name: (Current flash device type)** **OK**
Reference V.25ter	Note

6.2.44 AT+CCALR Call Ready Query

AT+CCALR Call Ready Query	
Test Command **AT+CCALR=?**	Response **+CCALR: (**list of supported **<mode>**s**)** **OK**
	Parameter **<mode>** a numeric parameter which indicates whether the module is

	ready for phone call. 0 module is not ready for phone call 1 module is ready for phone call
Read Command **AT+CCALR?**	Response ME returns the status of result code presentation and an integer <n> which shows whether the module is currently ready for phone call. **+CCALR: <mode>** **OK**
	Parameter **<mode>** See Test Command
Reference	Note

6.2.45 AT+GSV Display Product Identification Information

AT+GSV Display Product Identification Information	
Execution Command **AT+GSV**	Response TA returns product information text Example: **SIMCOM_Ltd** **SIMCOM_SIM900** **Revision: 1137B01V01SIM900M32_ST** **OK**
Reference	Note

6.2.46 AT+SGPIO Control the GPIO

AT+ SGPIO Control the GPIO	
Test Command **AT+SGPIO=?**	Response **+SGPIO: (0-1),(1-12),(0-2),(0-1)** **OK**
	Parameters See Write Command
Write Command **AT+SGPIO=<operation>,<GPIO>,<function>,<level>**	Response **OK** **ERROR**
	Parameters

	<Operation> 0 set the GPIO function including the GPIO output and GPIO as the Keypad. 1 read the GPIO level. Please note that only when the gpio is set as input, user can use parameter 1 to read the GPIO level, otherwise the module will return "ERROR". **<GPIO>** the GPIO you want to be set. (it has relations with the hardware, Please refer to the hardware manual) **<function>** Only when <Operation> is set to 0, this option takes effect. 0 set the GPIO to input. 1 set the GPIO to output 2 set the GPIO to keypad **<level>** 0 set the GPIO low level 1 set the GPIO high level
Reference	Note Only GPIO1, GPIO2, GPIO3, GPIO4, GPIO6, GPIO7, GPIO8, GPIO9 can be used as Keypad. And if one of them is set to gpio function, others will be set to GPIO output and low level automatically.

6.2.47 AT+SPWM Generate the Pulse-Width-Modulation

AT+SPWM Generate the Pulse-Width-Modulation	
Test Command **AT+SPWM=?**	Response **+SPWM: (**list of supported **<index>s),(** list of supported **<period**>s**),(** list of supported **<level**>s**)** **OK**
	Parameters See Write Command
Write Command **AT+SPWM=<index>,<period>,<level>**	Response **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters **<index>** integer type: the index number of PWM port, which value is 0-2; 0: for buzzer (according to the hardware support or not). 1: corresponding to PWM_OUT0 in the hardware circuit 2: corresponding to PWM_OUT1 in the hardware circuit **<period>** The range of <period> is 0-126 if <index> is set to 1 or 2, the range of <period> is 0-65535 if <index> is set to 0,

	the output frequency equals to (26MHz/8)/(period+1). **<level>** 0-100: tone level, which can be converted to duty ratio.
Reference	Note ● We have a 26MHz crystal oscillator. The MAX frequency of PWM is 26/8=3.25Mhz. ● The equation of final frequency and <period> is this: frequency =3.25/(period+1), for example, if <period> is set to 100, we get a frequency: 3.25/101 = 32.178Khz. ● The equation of <level> and duty factor is: duty factor = (level+1).

6.2.48 AT+ECHO Echo Cancellation Control

AT+ECHO Echo Cancellation Control	
Test Command **AT+ECHO=?**	Response **+ECHO: MIC:(**list of supported **<mic>**s**), ES:(** list of supported **<es>**s**), SES:(**list of supported **<ses>**s**), MODE:(**list of supported **<mode>**s**)** **OK**
	Parameters See Write Command
Read Command **AT+ECHO?**	Response **+ECHO: (0, <es>, <ses>, <mode>),(1, <es>, <ses>, <mode>),(2, <es>, <ses>, <mode>),(3, <es>, <ses>, <mode>)** **OK**
	Parameters See Write Command
Write Command **AT+ECHO=<mic>,<es>[,<ses>[,<mode>]]**	Response **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters **<mic>** audio channel 0 main audio handset channel 1 aux audio headset channel 2 main audio handfree channel 3 aux audio handfree channel **<es>** echo suppression 0-8 (when mic=0or1 default value is 0; when mic=2 or 3 default value is 7) the bigger the value, the stronger the restraint. **<ses>** selective echo suppression

	0-6 (when mic=0 or1 default value is 0; when mic=2 or 3 default value is 5) **<mode>** 0 close echo algorithm 1 open echo algorithm
Reference	Note For this command, please refer to actual model.

6.2.49 AT+CAAS Control Auto Audio Switch

AT+CAAS Control Auto Audio Switch	
Test Command **AT+CAAS=?**	Response **+CAAS**: **(0-2)** **OK**
	Parameter See Write Command
Read Command **AT+CAAS?**	Response **+CAAS: <mode>** **OK**
	Parameter See Write Command
Write Command **AT+CAAS=<mode>**	Response This parameter setting determines whether or not the audio channel will be switched automatically to the corresponding channel in case of headset attaching or detaching. **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameter **<mode>** 0 disable automatic audio channel switch function, the headset HOOK function is disabled; 1 enable automatic audio channel switch function, the headset HOOK function is enabled; 2 disable automatic audio channel switch function, the headset HOOK function is enabled.
Reference	Note ● For this command, please refer to actual model. ● The headset detection is still worked when <mode> is set to 0. In other

	word, if "AT+CEXTHS=1" is set, the unsolicited event code (indicating whether the headset has been attached/detached) will be sent to the terminal.

6.2.50 AT+SVR Configure Voice Coding Type for Voice Calls

AT+SVR Configure Voice Coding Type for Voice Calls	
Test Command **AT+SVR=?**	Response **+SVR: (**list of supported **<voice_rate_coding>**s**)** **OK**
	Parameter See Write Command
Read Command **AT+SVR?**	Response **+SVR: <voice_rate_coding>** **OK**
	Parameter See Write Command
Write Command **AT+SVR=<voice_rate_coding>**	Response **OK** If error is related to ME functionality: **+CME ERROR: <error>**
	Parameter **<voice_rate_coding>** A number parameter which indicate the voice coding type. 0:FR 1:EFR / FR 2.FR / HR 3:FR / HR 4:HR /EFR 5:EFR/ HR 6:AMR-FR/EFR,AMR-HR 7:AMR-FR/EFR,AMR-HR/HR 8:AMR-HR/ HR/AMR-FR/EFR 9:AMR-HR/AMR-FR/EFR 10:AMR-HR/AMR-FR/FR 11:AMR-HR/HR/AMR-FR 12:AMR-FR/AMR-HR 13:AMR-FR/FR/AMR-HR 14:AMR-FR/FR/AMR-HR/HR 15:AMR-FR/EFR/FR/AMR-HR/HR 16:AMR-HR/ AMR-FR /EFR/FR/HR (default value)

Reference	Note The parameter of AT+SVR is stored in non-volatile memory.

6.2.51 AT+GSMBUSY Reject Incoming Call

AT+GSMBUSY Reject Incoming Call	
Test Command **AT+GSMBUSY=?**	Response **+GSMBUSY: (0,1)** **OK**
	Parameter See Write Command
Read Command **AT+GSMBUSY?**	Response **+GSMBUSY: <mode>** **OK**
	Parameter See Write Command
Write Command **AT+GSMBUSY=<mode>**	Response **OK** If error is related to ME functionality: **+CME ERROR: <error>**
	Parameter **<mode>** 0 enable incoming call 1 forbid incoming call
Reference	Note The parameter is not saved if the module power down.

7 AT Commands for GPRS Support

7.1 Overview of AT Commands for GPRS Support

Command	Description
AT+CGATT	ATTACH OR DETACH FROM GPRS SERVICE
AT+CGDCONT	DEFINE PDP CONTEXT
AT+CGQMIN	QUALITY OF SERVICE PROFILE (MINIMUM ACCEPTABLE)
AT+CGQREQ	QUALITY OF SERVICE PROFILE (REQUESTED)
AT+CGACT	PDP CONTEXT ACTIVATE OR DEACTIVATE
AT+CGDATA	ENTER DATA STATE
AT+CGPADDR	SHOW PDP ADDRESS
AT+CGCLASS	GPRS MOBILE STATION CLASS
AT+CGEREP	CONTROL UNSOLICITED GPRS EVENT REPORTING
AT+CGREG	NETWORK REGISTRATION STATUS
AT+CGSMS	SELECT SERVICE FOR MO SMS MESSAGES

7.2 Detailed Descriptions of AT Commands for GPRS Support

7.2.1 AT+CGATT Attach or Detach from GPRS Service

AT+CGATT Attach or Detach from GPRS Service	
Test Command **AT+CGATT=?**	Response **+CGATT: (**list of supported **<state>**s**)** **OK**
	Parameter See Write Command
Read Command **AT+CGATT?**	Response **+CGATT: <state>** **OK**
	Parameter See Write Command
Write Command **AT+CGATT=<state>**	Response **OK** If error is related to ME functionality: **+CME ERROR: <err>**

	Parameter **<state>** indicates the state of GPRS attachment 0 detached 1 attached Other values are reserved and will result in an ERROR response to the Write Command.
Reference	Note

7.2.2 AT+CGDCONT Define PDP Context

AT+CGDCONT	**Define PDP Context**
Test Command **AT+CGDCONT =?**	Response **+CGDCONT: (**range of supported **<cid>**s)**,<PDP_type>,,,(**list of supported**<d_comp>**s)**,(**list of supported**<h_comp>**s) **[<CR><LF>+CGDCONT:** **(**range of supported **<cid>**s)**, <PDP_type>,,,(**list ofsupported **<d_comp>**s)**,(**list of supported **<h_comp>**s) **[...]]** **OK**
	Parameters See Write Command
Read Command **AT+CGDCONT ?**	Response **+CGDCONT:** **<cid>,<PDP_type>,<APN>,<PDP_addr>,<data_comp>,<head_comp>** **[<CR><LF>+CGDCONT:** **<cid>,<PDP_type>,<APN>,<PDP_addr>,<data_comp>,<head_comp>** **[…]]** **OK**
	Parameters See Write Command
Write Command **AT+CGDCONT =<cid>[,<PDP_type>,[APN>[,<PDP_addr>[,<d_comp>[,<h_comp>]]]]]**	Response **OK** **ERROR**
	Parameters **<cid>** (PDP Context Identifier) 1 PDP Context Identifier 1 Definition stored in non-volatile memory 2 PDP Context Identifier 2

	Definition stored in non-volatile memory 3 PDP Context Identifier 3 Default <cid> Locked in non-volatile memory and is always defined, it can not be changed by user. **<PDP_type>** (Packet Data Protocol type) IP Internet Protocol (IETF STD 5) **<APN>** (Access Point Name) a string parameter(string should be included in quotation marks) which is a logical name that is used to select the GGSN or the external packet data network. If the value is null or omitted, then the subscription value will be requested. **<PDP_addr>** a string parameter (IP address). Format: "<n>.<n>.<n>.<n>" where <n>=0..255 If the value is null or equals 0.0.0.0 a dynamic address will be requested. The allocated address may be read using the +CGPADDR command **<d_comp>** a numeric parameter that controls PDP data compression 0 –PDP data compression off (default if value is omitted) **<h_comp>** a numeric parameter that controls PDP data compression 0 –PDP header compression off (default if value is omitted)
Reference	Note

7.2.2.1For <cid> 1,2 and 3 the following parameters are stored in non volatile memory:

Parameter name	**Default value**
<cid>	1,2 or 3
Locked	0xFF..0xFF
Defined	0x00
<precedence>	0x00
<delay>	0x00
<reliability>	0x03
<peak>	0x00
<mean>	0x00
<pdp_type>	0x01 (IP)
<APN>	0xFF..0xFF
<PDP_address>	0x00..0x00
<Guaranteed bitrate DL>	0x00
<Guaranteed bitrate UL>	0x00
<Traffic handling priority>	0x00

<Transfer delay>	0x00
<SDU error ratio>	0x00
<Residual bit error ratio>	0x00
<Maximum bitrate DL>	0x00
<Maximum bitrate UL>	0x00
<Maximum SDUsize>	0x00
<Delivery of erroneous SDUs>	0x00
<Delivery order>	0x00
<Traffic class>	0x00

7.2.3 AT+CGQMIN Quality of Service Profile (Minimum Acceptable)

AT+CGQMIN Quality of Service Profile (Minimum Acceptable)	
Test Command **AT+CGQMIN=?**	Response **+CGQMIN: <PDP_type>,(**list of supported **<precedence**>s**),(**list of supported **<delay**>s**),(**list of supported **<reliability**>s**),(**list of supported **<peak**>s**),(**list of supported **<mean**>s**)** **[<CR><LF>+CGQMIN: <PDP_type>,(**list of supported **<precedence>** s**),(**list of supported **<delay**>s**),(**list of supported **<reliability**>s**),(**list of supported **<peak**>s**),(**list of supported **<mean**>s**)** **[…]]** **OK**
	Parameters See Write Command
Read Command **AT+CGQMIN?**	Response **+CGQMIN: <cid>,<precedence>,<delay>,>reliability>,<peak>,<mean>** **[<CR><LF>+CGQMIN:** **<cid>,<precedence>,<delay>,<reliability>,<peak>,<mean>** **[…]]** **OK**
	Parameters See Write Command
Write Command **AT+CGQMIN=<cid>[,<precedence>[,<delay>[,<reliability>[,<peak>[,<mean>]]]]]**	Response **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters

	<cid> 1..3 PDP Context Identifier Definition stored in non-volatile memory (refer to +CGDCONT). cid 3 is reserved and is always defined, it cannot be changed by user. **<precedence>** 0 QOS precedence class subscribed value 1..3 QOS precedence class **<delay>** 0 QOS delay class subscribed value 1..4 QOS delay class subscribed **<reliability>** 0 QOS reliability class subscribed value 1..5 QOS reliability class. **<peak>** 0 QOS peak throughput class subscribed value 1..9 QOS peak throughput class **<mean>** 0 QOS mean throughput class subscribed value 1..18 QOS mean throughput class 31 QOS mean throughput class best effort
Reference	Note

7.2.4 AT+CGQREQ Quality of Service Profile (Requested)

AT+CGQREQ Quality of Service Profile (Requested)	
Test Command **AT+CGQREQ=?**	Response **+CGQREQ: <PDP_type>,(**list of supported **<precedence>**s**),(**list of supported **<delay>**s**),(**list of supported **<reliability>**s**),<**list of supported **<peak>**s**),(**list of supported **<mean>**s**)** **[<CR><LF>+CGQREQ: <PDP_type>,(**list of supported **<precedence>**s**),(**list of supported **<delay>**s**),(**list of supported **<reliability>**s**),(**list of supported **<peak>**s**),(**list of supported **<mean>**s**)** **[…]]** **OK**
	Parameters See Write Command
Read Command **AT+CGQREQ?**	Response **+CGQREQ: <cid>,<precedence>,<delay>,>reliability>,<peak>,<mean>**

	[<CR><LF>+CGQREQ: <cid>,<precedence>,<delay>,<reliability>,<peak>,<mean> […]] **OK**
	Parameters See Write Command
Write Command **AT+CGQREQ=<cid>[,<precedence>[,<delay>[,<reliability>[,<peak>[,<mean>]]]]]**	Response **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters **<cid>** a numeric parameter which specifies a particular PDP context definition (see +CGDCONT Command) 1..3 Definition stored in non-volatile memory (refer to +CGDCONT) cid 3 is reserved and is always defined, it cannot be changed by user. The following parameter are defined in GSM 03.60 **<precedence>** a numeric parameter which specifies the precedence class 0 QOS precedence class subscribed value 1..3 QOS precedence class **<delay>** a numeric parameter which specifies the delay class 0 QOS delay class subscribed value 1..4 QOS delay class **<reliability>** a numeric parameter which specifies the reliability class 0 QOS reliability class subscribed value 1..5 QOS reliability class; default value: 3 **<peak>** a numeric parameter which specifies the peak throughput class 0 QOS peak throughput class subscribed value 1..9 QOS peak throughput class **<mean>** a numeric parameter which specifies the mean throughput class 0 QOS mean throughput class subscribed value 1..18 QOS mean throughput class 31 QOS mean throughput class best effort
Reference	Note

7.2.5 AT+CGACT PDP Context Activate or Deactivate

AT+CGACT PDP Context Activate or Deactivate	
Test Command **AT+CGACT=?**	Response **+CGACT: (**list of supported **<state>**s**)** **OK**
	Parameters See Write Command
Read Command **AT+CGACT?**	Response **+CGACT: <cid>,<state>[<CR><LF>+CGACT:<cid><state>…]** **OK**
	Parameters See Write Command
Write Command **AT+CGACT=[<state> [,<cid>]]**	Response **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters **<state>** indicates the state of PDP context activation 0 deactivated 1 activated Other values are reserved and will result in an ERROR response to the Write Command. **<cid>** a numeric parameter which specifies a particular PDP context definition (see +CGDCONT Command) 1..3 PDP Context Identifier, cid 3 is reserved and is always defined, it cannot be changed by user.
Reference	Note ● This command is used to test PDPs with network simulators. Successful activation of PDP on real network is not guaranteed. ● Refer to AT+CGDATA clarification for more information.

7.2.6 AT+CGDATA Enter Data State

AT+CGDATA Enter Data State	
Test Command **AT+CGDATA=?**	Response **+CGDATA:** list of supported **<L2P>**s **OK**

	Parameter See Write Command
Write Command **AT+CGDATA=<L2P>,[<cid>]**	Response **CONNECT** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters **<L2P>** a string parameter (string should be included in quotation marks) that indicates the layer 2 protocol to be used between the TE and MT: PPP – Point to Point protocol for a PDP such as IP Other values are not supported and will result in an ERROR response to the execution Command. **<cid>** a numeric parameter which specifies a particular PDP context definition (see +CGDCONT Command) 1..3 PDP Context Identifier. cid 3 is reserved and is always defined, it cannot be changed by user.
Reference	Note

7.2.7 AT+CGPADDR Show PDP Address

AT+CGPADDR Show PDP Address	
Test Command **AT+CGPADDR=?**	Response **+CGPADDR: (**list of defined **<cid**>s**)** **OK**
	Parameters See Write Command
Write Command **AT+CGPADDR=** <cid>	Response **+CGPADDR: <cid>,<PDP_addr>** **[<CR><LF>+CGPADDR: <cid>,<PDP_addr>[…]]** **OK** **ERROR**
	Parameters **<cid>** a numeric parameter which specifies a particular PDP context definition (see +CGDCONT Command) If <cid> is not specified,

	the addresses for all defined contexts will be returned. 1..3 PDP Context Identifier, cid 3 is reserved and is always defined, it cannot be changed by user. **<PDP_addr>** String type IP address Format: "<n>.<n>.<n>.<n>" where <n>=0..255
Reference	Note Write command returns address provided by the network if a connection has been established.

7.2.8 AT+CGCLASS GPRS Mobile Station Class

AT+CGCLASS GPRS Mobile Station Class	
Test Command **AT+CGCLASS=?**	Response **+CGCLASS: (**list of supported **<class>**s**)** **OK**
	Parameter See Write Command
Read Command **AT+CGCLASS?**	Response **+CGCLASS: <class>** **OK**
	Parameter See Write Command
Write Command **AT+CGCLASS=<class>**	Response **OK** **ERROR** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameter **<class>** a string parameter(string should be included in quotation marks) which indicates the GPRS mobile class (in descending order of functionality) B Class-B mode of operation (A/Gb mode), (not applicable in Iu mode) MT would operate PS and CS services but not simultaneously CC Class-C mode of operation in CS only mode

	(A/Gb mode), or CS (Iu mode) (lowest mode of operation). MT would only operate CS services
Reference	Note It only supports Class B and CC.

7.2.9 AT+CGEREP Control Unsolicited GPRS Event Reporting

AT+CGEREP Control Unsolicited GPRS Event Reporting	
Test Command **AT+CGEREP=?**	Response **+CGEREP: (**list of supported **<mode>**s**),(**list of supported **<bfr>**s**)** **OK**
	Parameters See Write Command
Read Command **AT+CGEREP?**	Response **+CGEREP: <mode>,<bfr>** **OK**
	Parameters See Write Command
Write Command **AT+CGEREP=<mode>[,<bfr>]**	Response **OK** **ERROR**
	Parameters **<mode>** 0 Buffer unsolicited result codes in the MT; if MT result code buffer is full, the oldest ones is discarded. 1 Discard unsolicited result codes when MT TE link is reserved (e.g. in on line data mode); otherwise forward them directly to the TE 2 Buffer unsolicited result codes in the MT when MT TE link is reserved (e.g. in on line data mode) and flush them to the TE when MT TE link becomes available; otherwise forward them directly to the TE **<bfr>** 0 MT buffer of unsolicited result codes defined within this command is cleared when <mode> 1 or 2 is entered

	1 MT buffer of unsolicited result codes defined within this command is flushed to the TE when <mode> 1 or 2 is entered
Reference	Note

7.2.10 AT+CGREG Network Registration Status

AT+CGREG Network Registration Status	
Test Command **AT+CGREG=?**	Response **+CGREG: (**list of supported **<n>**s**)** **OK**
	Parameters See Write Command
Read Command **AT+CGREG?**	Response **+CGREG: <n>,<stat>[,<lac>,<ci>]** **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters See Write Command
Write Command **AT+CGREG=** **<n>**	Response **OK** **ERROR**
	Parameters **<n>** 0 disable network registration unsolicited result code 1 enable network registration unsolicited result code +CGREG:<stat> 2 enable network registration and location information unsolicited result code +CGREG: <stat>[,<lac>,<ci>] **<stat>** 0 Not registered, MT is not currently searching an operator to register to The GPRS service is disabled, the UE is allowed to attach for GPRS if requested by the user 1 Registered, home network 2 Not registered, but MT is currently trying to attach or

	searching an operator to register to The GPRS service is enabled, but an allowable PLMN is currently not available. The UE will start a GPRS attach as soon as an allowable PLMN is available. 3 Registration denied The GPRS service is disabled, the UE is not allowed to attach for GPRS if it is requested by the user. 4 Unknown 5 Registered, roaming **<lac>** string type (string should be included in quotation marks); two byte location area code in hexadecimal format (e.g. "00C3" equals 195 in decimal) **<ci>** string type (string should be included in quotation marks); two bytes cell ID in hexadecimal format
Reference	Note

7.2.11 AT+CGSMS Select Service for MO SMS Messages

AT+CGSMS Select Service for MO SMS Messages	
Test Command **AT+CGSMS=?**	Response **+CGSMS: (**list of currently available <**service**>s**)** **OK**
	Parameter See Write Command
Read Command **AT+CGSMS?**	Response **+CGSMS: <service>** **OK**
	Parameter See Write Command
Write Command **AT+CGSMS=<service>**	Response **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameter **<service>** a numeric parameter which indicates the service or service preference to be used 0 Packet Domain

	1 Circuit switched 2 Packet Domain preferred (use circuit switched if GPRS not available) 3 Circuit switched preferred (use Packet Domain if circuit switched not available)
Reference	Note The circuit switched service route is the default method

8 AT Commands for TCPIP Application Toolkit

8.1 Overview

Command	Description
AT+CIPMUX	START UP MULTI-IP CONNECTION
AT+CIPSTART	START UP TCP OR UDP CONNECTION
AT+CIPSEND	SEND DATA THROUGH TCP OR UDP CONNECTION
AT+CIPQSEND	SELECT DATA TRANSMITTING MODE
AT+CIPACK	QUERY PREVIOUS CONNECTION DATA TRANSMITTING STATE
AT+CIPCLOSE	CLOSE TCP OR UDP CONNECTION
AT+CIPSHUT	DEACTIVATE GPRS PDP CONTEXT
AT+CLPORT	SET LOCAL PORT
AT+CSTT	START TASK AND SET APN, USER NAME, PASSWORD
AT+CIICR	BRING UP WIRELESS CONNECTION WITH GPRS OR CSD
AT+CIFSR	GET LOCAL IP ADDRESS
AT+CIPSTATUS	QUERY CURRENT CONNECTION STATUS
AT+CDNSCFG	CONFIGURE DOMAIN NAME SERVER
AT+CDNSGIP	QUERY THE IP ADDRESS OF GIVEN DOMAIN NAME
AT+CIPHEAD	ADD AN IP HEAD AT THE BEGINNING OF A PACKAGE RECEIVED
AT+CIPATS	SET AUTO SENDING TIMER
AT+CIPSPRT	SET PROMPT OF ‘>’ WHEN MODULE SENDS DATA
AT+CIPSERVER	CONFIGURE MODULE AS SERVER
AT+CIPCSGP	SET CSD OR GPRS FOR CONNECTION MODE
AT+CIPSRIP	SHOW REMOTE IP ADDRESS AND PORT WHEN RECEIVED DATA
AT+CIPDPDP	SET WHETHER TO CHECK STATE OF GPRS NETWORK TIMING
AT+CIPMODE	SELECT TCPIP APPLICATION MODE
AT+CIPCCFG	CONFIGURE TRANSPARENT TRANSFER MODE
AT+CIPSHOWTP	DISPLAY TRANSFER PROTOCOL IN IP HEAD WHEN RECEIVED DATA
AT+CIPUDPMODE	UDP EXTENDED MODE
AT+CIPRXGET	GET DATA FROM NETWORK MANUALLY
AT+CIPQRCLOSE	QUICK REMOTE CLOSE
AT+CIPSCONT	SAVE TCPIP APPLICATION CONTEXT

8.2 Detailed Descriptions of Commands

8.2.1 AT+CIPMUX Start Up Multi-IP Connection

AT+CIPMUX Start Up Multi-IP Connection	
Test Command **AT+CIPMUX=?**	Response **+CIPMUX: (0,1)** **OK**
	Parameter See Write Command
Read Command **AT+CIPMUX?**	Response **+CIPMUX: <n>** **OK**
	Parameter See Write Command
Write Command **AT+CIPMUX=<n>**	Response **OK**
	Parameter **<n>** 0 Single IP connection 1 Multi IP connection
Reference	Note ● Only in IP initial state, AT+CIPMUX=1 is effective; ● Only when multi IP connection and GPRS application are both shut down, AT+CIPMUX=0 is effective.

8.2.2 AT+CIPSTART Start Up TCP or UDP Connection

AT+CIPSTART Start Up TCP or UDP Connection	
Test Command **AT+CIPSTART=?**	Response 1) If AT+CIPMUX=0 **+CIPSTART: (**list of supported **<mode>),(<IP address>),(<port>)** **+CIPSTART: (**list of supported **<mode>),(<domain name>),(<port>)** **OK** 2) If AT+CIPMUX=1 **+CIPSTART: (**list of supported **<n>),(**list of supported **<mode>),(<IP address>),(<port>)** **+CIPSTART: (**list of supported **<n>),(**list of supported **<mode>),(<domain name>),(<port>)**

	OK
	Parameters See Write Command
Write Command 1)If single IP connection (+CIPMUX=0) **AT+CIPSTART=<mode>,<IP address>,<port>** Or **AT+CIPSTART=<mode>,<domain name>,<port>** 2)If multi-IP connection (+CIPMUX=1) **AT+CIPSTART=<n>,<mode>,<address>,<port>** **AT+CIPSTART=<n>,<mode>,<domain name>, <port>**	Response 1)If single IP connection (+CIPMUX=0) If format is right response **OK** otherwise response If error is related to ME functionality: **+CME ERROR <err>** Response when connection exists **ALREADY CONNECT** Response when connection is successful **CONNECT OK** Otherwise **STATE**: **<state>** **CONNECT FAIL** 2)If multi-IP connection (+CIPMUX=1) If format is right **OK**, otherwise response If error is related to ME functionality: **+CME ERROR <err>** Response when connection exists **<n>,ALREADY CONNECT** If connection is successful **<n>,CONNECT OK** Otherwise **<n>,CONNECT FAIL**
	Parameters **<n>** 0..7 a numeric parameter which indicates the connection number **<mode>** a string parameter(string should be included in quotation marks) which indicates the connection type "TCP" Establish a TCP connection "UDP" Establish a UDP connection **<IP address>** a string parameter(string should be included in quotation marks) which indicates remote server IP address **<port>** remote server port

	<domain name> a string parameter(string should be included in quotation marks) which indicates remote server domain name **<state>** a string parameter(string should be included in quotation marks) which indicates the progress of connecting 0 IP INITIAL 1 IP START 2 IP CONFIG 3 IP GPRSACT 4 IP STATUS 5 TCP CONNECTING/UDP CONNECTING/ SERVER LISTENING 6 CONNECT OK 7 TCP CLOSING/UDP CLOSING 8 TCP CLOSED/UDP CLOSED 9 PDP DEACT In Multi-IP state: 0 IP INITIAL 1 IP START 2 IP CONFIG 3 IP GPRSACT 4 IP STATUS 5 IP PROCESSING 9 PDP DEACT
Reference	Note ● This command allows establishment of a TCP/UDP connection only when the state is IP INITIAL or IP STATUS when it is in single state. In multi-IP state, the state is in IP STATUS only. So it is necessary to process "AT+CIPSHUT" before user establishes a TCP/UDP connection with this command when the state is not IP INITIAL or IP STATUS. ● When module is in multi-IP state, before this command is executed, it is necessary to process "AT+CSTT, AT+CIICR, AT+CIFSR".

8.2.3 AT+CIPSEND Send Data Through TCP or UDP Connection

AT+CIPSEND	**Send Data Through TCP or UDP Connection**
Test Command **AT+CIPSEND=?**	Response 1) For single IP connection (+CIPMUX=0) **+CIPSEND: <length>** **OK** 2) For multi IP connection (+CIPMUX=1) **+CIPSEND: <0-7>,<length>**

	OK
	Parameters See Write Command
Read Command **AT+CIPSEND?**	Response 1) For single IP connection (+CIPMUX=0) **+CIPSEND:<size>** **OK** 2) For multi IP connection (+CIPMUX=1) **+CIPSEND:<n><size>** **OK**
	Parameters **<n>** a numeric parameter which indicates the connection number **<size>** a numeric parameter which indicates the data length sent at a time
Write Command 1) If single IP connection (+CIPMUX=0) **AT+CIPSEND=<length>** 2) If multi IP connection (+CIPMUX=1) **AT+CIPSEND=<n>[,<length>]**	Response This Command is used to send changeable length data If single IP is connected (+CIPMUX=0) If connection is not established or module is disconnected: If error is related to ME functionality: **+CME ERROR <err>** If sending is successful: When +CIPQSEND=0 **SEND OK** When +CIPQSEND=1 **DATA ACCEPT:<length>** If sending fails: **SEND FAIL** If multi IP connection is established (+CIPMUX=1) If connection is not established or module is disconnected: If error is related to ME functionality: **+CME ERROR <err>** If sending is successful: When +CIPQSEND=0 **<n>,SEND OK** When +CIPQSEND=1 **DATA ACCEPT:<n>,<length>** If sending fails: **<n>,SEND FAIL**

	Parameters **<n>** a numeric parameter which indicates the connection number **<length>** a numeric parameter which indicates the length of sending data, it must be less than <size>
Execution Command **AT+CIPSEND** response">", then type data for send, tap CTRL+Z to send, tap ESC to cancel the operation	Response This Command is used to send changeable length data. If single IP connection is established (+CIPMUX=0) If connection is not established or module is disconnected: If error is related to ME functionality: **+CME ERROR <err>** If sending is successful: When +CIPQSEND=0 **SEND OK** When +CIPQSEND=1 **DATA ACCEPT:<length>** If sending fails: **SEND FAIL** Note This Command can only be used in single IP connection mode (+CIPMUX=0) and to send data on the TCP or UDP connection that has been established already. Ctrl-Z is used as a termination symbol. ESC is used to cancel sending data. There are at most **<size>** bytes which can be sent at a time.
Reference	Note ● The data length which can be sent depends on network status. ● Set the time that send data automatically with the Command of AT+CIPATS. ● Only send data at the status of established connection**.**

8.2.4 AT+CIPQSEND Select Data Transmitting Mode

AT+CIPQSEND	**Select Data Transmitting Mode**
Test Command **AT+CIPQSEND=?**	Response **+CIPQSEND: (0,1)** **OK**
	Parameter See Write Command

Read Command **AT+CIPQSEND?**	Response **+CIPQSEND: <n>** **OK**	
	Parameter See Write Command	
Write Command **AT+CIPQSEND=<n>**	Response **OK**	
	Parameter **<n>** 0 Normal mode – when the server receives TCP data, it will responsd SEND OK. 1 Quick send mode – when the data is sent to module, it will responsd DATA ACCEPT:<n>,<length>, while not responding SEND OK.	
Reference	Note	

8.2.5 AT+CIPACK Query Previous Connection Data Transmitting State

AT+CIPACK Query Previous Connection Data Transmitting State	
Test Command **AT+CIPACK=?**	Response **OK**
Write Command If in multi IP connection (+CIPMUX=1) **AT+CIPACK=<n>**	Response **+CIPACK: <txlen>, <acklen>, <nacklen>** **OK**
	Parameters **<n>** a numeric parameter which indicates the connection number **<txlen>** the data amount which has been sent **<acklen>** the data amount confirmed successfully by the server **<nacklen>** the data amount without confirmation by the server
Execution Command If in single IP connection (+CIPMUX=0) **AT+CIPACK**	Response **+CIPACK: <txlen>, <acklen>, <nacklen>** **OK**
	Parameters See Write Command
Reference	Note

8.2.6 AT+CIPCLOSE   Close TCP or UDP Connection

AT+CIPCLOSE Close TCP or UDP Connection	
Test Command **AT+CIPCLOSE =?**	Response **OK**
Write Command 1) If single IP connection (+CIPMUX=0) **AT+CIPCLOSE =<n>** 2) If multi IP connection (+CIPMUX=1) **AT+CIPCLOSE =<id>, [<n>]**	Response: 1) For single IP connection (+CIPMUX=0) **CLOSE OK** 2) For multi IP connection (+CIPMUX=1) **<n>, CLOSE OK** Parameters **<n>** 0 slow close 1 quick close **<id>** a numeric parameter which indicates the connection number
Execution Command **AT+CIPCLOSE**	Response If close is successfully: **CLOSE OK** If close fails: **ERROR**
Reference	Note AT+CIPCLOSE only closes connection at the status of TCP/UDP which returns CONNECTING or CONNECT OK, otherwise it will return ERROR, after the connection is closed, the status is IP CLOSE in single IP mode

8.2.7 AT+CIPSHUT   Deactivate GPRS PDP Context

AT+CIPSHUT Deactivate GPRS PDP Context	
Test Command **AT+CIPSHUT=?**	Response **OK**
Execution Command **AT+CIPSHUT**	Response If close is successful: **SHUT OK** If close fails: **ERROR**
Reference	Note ● If this command is executed in multi-connection mode, all of the IP

	connection will be shut. ● User can close gprs pdp context by AT+CIPSHUT. After it is closed, the status is IP INITIAL. ● If "+PDP: DEACT" urc is reported which means the gprs is released by the network, then user still needs to execute "AT+CIPSHUT" command to make PDP context come back to original state.

8.2.8 AT+CLPORT Set Local Port

AT+CLPORT Set Local Port	
Test Command **AT+CLPORT=?**	Response **+CLPORT: (**list of supported **<port>**s**)** **OK**
	Parameters See Write Command
Read Command **AT+CLPORT?**	Response **TCP: <port>** **UDP: <port>** **OK**
	Parameters See Write Command
Write Command **AT+CLPORT=<mode>,<port>**	Response **OK** **ERROR**
	Parameters **<mode>** a string parameter(string should be included in quotation marks) which indicates the connection type "TCP" TCP local port "UDP" UDP local port **<port>** 0-65535 a numeric parameter which indicates the local port 0 is default value, a port can be dynamically allocated a port.
Reference	Note This command will be effective only in single connection mode (+CIPMUX=0) and when module is set as a Client

8.2.9 AT+CSTT Start Task and Set APN, USER NAME, PASSWORD

AT+CSTT Start Task and Set APN, USER NAME, PASSWORD	
Test Command	Response

AT+CSTT=?	**+CSTT: "APN","USER","PWD"** **OK**	
	Parameters See Write Command	
Read Command **AT+CSTT?**	Response **+CSTT: <apn>,<user name>,<password>** **OK**	
	Parameters See Write Command	
Write Command **AT+CSTT=<apn>,<user name>,<password>**	Response **OK** **ERROR**	
	Parameters **<apn>** a string parameter (string should be included in quotation marks) which indicates the GPRS access point name **<user name>** a string parameter (string should be included in quotation marks) which indicates the GPRS user name **<password>** a string parameter (string should be included in quotation marks) which indicates the GPRS password	
Execution Command **AT+CSTT**	Response **OK** **ERROR**	
Reference	Note The write command and execution command of this command is valid only at the state of IP INITIAL. After this command is executed, the state will be changed to IP START.	

8.2.10 AT+CIICR Bring Up Wireless Connection with GPRS or CSD

AT+CIICR Bring Up Wireless Connection with GPRS or CSD	
Test Command **AT+CIICR=?**	Response **OK**
Execution Command **AT+CIICR**	Response **OK** **ERROR**
Reference	Note ● AT+CIICR only activates moving scene at the status of IP START,

	after operating this Command is executed, the state will be changed to IP CONFIG. ● After module accepts the activated operation, if it is activated successfully, module state will be changed to IP GPRSACT, and it responds OK, otherwise it will responsd ERROR.

8.2.11 AT+CIFSR Get Local IP Address

AT+CIFSR Get Local IP Address	
Test Command **AT+CIFSR=?**	Response **OK**
Execution Command **AT+CIFSR**	Response **<IP address>** **ERROR**
	Parameter **<IP address>** a string parameter(string should be included in quotation marks) which indicates the IP address assigned from GPRS or CSD
Reference	Note Only after PDP context is activated, local IP Address can be obtained by AT+CIFSR, otherwise it will respond ERROR. The active status are IP GPRSACT, TCP/UDP CONNECTING, CONNECT OK, IP CLOSE.

8.2.12 AT+CIPSTATUS Query Current Connection Status

AT+CIPSTATUS Query Current Connection Status	
Test Command **AT+CIPSTATUS =?**	Response **OK**
Write Command If multi IP connection mode (+CIPMUX=1) **AT+CIPSTATUS=<n>**	Response **+CIPSTATUS: <n>,<bearer>, <TCP/UDP>, <IP address>, <port>, <client state>** **OK**
	Parameters See Execution Command
Execution Command **AT+CIPSTATUS**	Response 1）If in single connection mode (+CIPMUX=0) **OK**

STATE: <state>

2) If in multi-connection mode (+CIPMUX=1)

OK

STATE: <state>

If the module is set as server

S: 0, <bearer>, <port>, <server state>

C: <n>,<bearer>, <TCP/UDP>, <IP address>, <port>, <client state>

Parameters

<n> 0-7 a numeric parameter which indicates the connection number

<bearer> 0-1 GPRS bearer, default is 0

<server state> OPENING
LISTENING
CLOSING

<client state> INITIAL
CONNECTING
CONNECTED
REMOTE CLOSING
CLOSING
CLOSED

<state> a string parameter(string should be included in quotation marks) which indicates the progress of connecting

0 IP INITIAL
1 IP START
2 IP CONFIG
3 IP GPRSACT
4 IP STATUS
5 TCP CONNECTING/UDP CONNECTING /SERVER LISTENING
6 CONNECT OK
7 TCP CLOSING/UDP CLOSING
8 TCP CLOSED/UDP CLOSED
9 PDP DEACT

In Multi-IP state:

0 IP INITIAL
1 IP START
2 IP CONFIG
3 IP GPRSACT
4 IP STATUS
5 IP PROCESSING
9 PDP DEACT

Reference	Note

8.2.13 AT+CDNSCFG Configure Domain Name Server

AT+CDNSCFG Configure Domain Name Server	
Test Command **AT+CDNSCFG=?**	Response **+CDNSCFG: ("Primary DNS"),("Secondary DNS")** **OK**
	Parameter See Write Command
Read Command **AT+CDNSCFG?**	Response **PrimaryDns: <pri_dns>** **SecondaryDns: <sec_dns>** **OK**
	Parameter See Write Command
Write Command **AT+CDNSCFG=<pri_dns>,[<sec_dns>]**	Response **OK** **ERROR**
	Parameters **<pri_dns>** a string parameter(string should be included in quotation marks) which indicates the IP address of the primary domain name server **<sec_dns>** a string parameter (string should be included in quotation marks) which indicates the IP address of the secondary domain name server
Reference	Note

8.2.14 AT+CDNSGIP Query the IP Address of Given Domain Name

AT+CDNSGIP Query the IP Address of Given Domain Name	
Test Command **AT+CDNSGIP=?**	Response **OK**
Write Command **AT+CDNSGIP=<domain name>**	Response **OK** **ERROR**

	If successful, return: **+CDNSGIP: 1, <domain name>,<IP>** If fail, return: **+CDNSGIP:0,<dns error code>**
	Parameters **<domain name>** a string parameter(string should be included in quotation marks) which indicates the domain name **<IP>** a string parameter(string should be included in quotation marks) which indicates the IP address corresponding to the domain name **<dns error code>** a numeric parameter which indicates the error code 10 DNS GENERAL ERROR 11 DNS MAX RETRIES, 12 DNS NO SERVER ADDR, 13 DNS NO MEMORY, 14 DNS INVALID NAME, 15 DNS INVALID RESP, There are some other error code as well.
Reference	Note

8.2.15 AT+CIPHEAD Add an IP Head at the Beginning of a Package Received

AT+CIPHEAD Add an IP Head at the Beginning of a Package Received	
Test Command **AT+CIPHEAD=?**	Response **+CIPHEAD: (**list of supported **<mode>**s**)** **OK**
	Parameter See Write Command
Read Command **AT+CIPHEAD?**	Response **+CIPHEAD: <mode>** **OK**
	Parameter See Write Command
Write Command **AT+CIPHEAD=<mode>**	Response **OK** **ERROR**

	Parameter **<mode>** a numeric parameter which indicates whether an IP header is added to the received data or not. 0 not add IP header 1 add IP header, the format is "+IPD,data length:"
Reference	Note This command will be effective only in single connection mode (+CIPMUX=0) and command mode.

8.2.16 AT+CIPATS Set Auto Sending Timer

AT+CIPATS Set Auto Sending Timer	
Test Command **AT+CIPATS=?**	Response **+CIPATS: (**list of supported **<mode>**s**),(**list of supported **<time>**) **OK**
	Parameters See Write Command
Read Command **AT+CIPATS?**	Response **+CIPATS: <mode>,<time>** **OK**
	Parameters See Write Command
Write Command **AT+CIPATS=<mode>[,<time>]**	Response **OK** **ERROR**
	Parameters **<mode>** a numeric parameter which indicates whether set timer when module is sending data 0 not set timer when module is sending data 1 Set timer when module is sending data **<time>** 1..100 a numeric parameter which indicates the seconds after which the data will be sent
Reference	Note

8.2.17 AT+CIPSPRT Set Prompt of '>' When Module Sends Data

AT+CIPSPRT Set Prompt of '>' When Module Sends Data

Test Command **AT+CIPSPRT=?**	Response **+CIPSPRT: (**list of supported **<send prompt>**s**)** **OK**
	Parameter See Write Command
Read Command **AT+CIPSPRT?**	Response **+CIPSPRT: <send prompt>** **OK**
	Parameter See Write Command
Write Command **AT+CIPSPRT=<send prompt>**	Response **OK** **ERROR**
	Parameter **<send prompt>** a numeric parameter which indicates whether to echo prompt '>' after module issues AT+CIPSEND command 0 it shows "send ok" but does not prompt echo '>' when sending is successful <u>1</u> it prompts echo '>' and shows "send ok" when sending is successful 2 it neither prompts echo '>' nor shows "send ok" when sending is successful
Reference	Note

8.2.18 AT+CIPSERVER Configure Module as Server

AT+CIPSERVER Configure Module as Server	
Test Command **AT+CIPSERVER=?**	Response **+CIPSERVER: (0-CLOSE SERVER, 1-OPEN SERVER),(1,65535)** **OK**
	Parameters See Write Command
Read Command **AT+CIPSERVER?**	Response +**CIPSERVER: <mode>[,<port>,<channel id>,<bearer>]** **OK**

	Parameters See Write Command
Write Command **AT+CIPSERVER=<mode>[,<port>]**	Response **OK** **ERROR**
	Parameters **<mode>** 0 close server 1 open server **<port>** 1..65535 Listening port **<channel id>** channel id **<bearer>** GPRS bearer
Reference	Note This command is allowed to establish a TCP server only when the state is IP INITIAL or IP STATUS when it is in single state. In multi-IP state, the state is in IP STATUS only.

8.2.19 AT+CIPCSGP Set CSD or GPRS for Connection Mode

AT+CIPCSGP Set CSD or GPRS for Connection Mode	
Test Command **AT+CIPCSGP=?**	Response **+CIPCSGP:0-CSD,DIALNUMBER,USER NAME,PASSWORD,RATE(0-3)** **+CIPCSGP: 1-GPRS,APN,USER NAME,PASSWORD** **OK**
	Parameters See Write Command
Read Command **AT+CIPCSGP?**	Response **+CIPCSGP: <mode>, <apn>, <user name>, <password>[,<rate>]** **OK**
	Parameters See Write Command
Write Command **AT+CIPCSGP=<mode>,[(<apn>,<user name>,<password>),(<d**	Response **OK** **ERROR**
	Parameters

ial number>, <user name>, <password>, <rate>)]	**<mode>** a numeric parameter which indicates the wireless connection mode 0 set CSD as wireless connection mode 1 set GPRS as wireless connection mode GPRS parameters: **<apn>** a string parameter(string should be included in quotation marks) which indicates the access point name **<user name>** a string parameter(string should be included in quotation marks) which indicates the user name **<password>** a string parameter(string should be included in quotation marks) which indicates the password CSD parameters: **<dial number>** a string parameter(string should be included in quotation marks) which indicates the CSD dial numbers **<user name>** a string parameter(string should be included in quotation marks) which indicates the CSD user name **<password>** a string parameter(string should be included in quotation marks) which indicates the CSD password **<rate>** a numeric parameter which indicates the CSD connection rate 0 2400 1 4800 2 9600 3 14400
Reference	Note

8.2.20 AT+CIPSRIP Show Remote IP Address and Port When Received Data

AT+CIPSRIP Show Remote IP Address and Port When Received Data	
Test Command **AT+CIPSRIP=?**	Response **+CIPSRIP: (**list of supported **<mode>**s**)** **OK**
	Parameter See Write Command
Read Command **AT+CIPSRIP?**	Response **+CIPSRIP**: **<mode>** **OK**
	Parameter

	See Write Command
Write Command **AT+CIPSRIP=<mode>**	Response **OK** **ERROR**
	Parameter **<mode>** a numeric parameter which shows remote IP address and port. 0 do not show the prompt 1 show the prompt, the format is as follows: RECV FROM:<IP ADDRESS>:<PORT>
Reference	Note This command will be effective only in single connection mode (+CIPMUX=0)

8.2.21 AT+CIPDPDP Set Whether to Check State of GPRS Network Timing

AT+CIPDPDP Set Whether to Check State of GPRS Network Timing	
Test Command **AT+CIPDPDP=?**	Response **+CIPDPDP: (**list of supported**<mode>**s**,** list of supported **<interval>,** list of supported **<timer>)** **OK**
	Parameters See Write Command
Read Command **AT+CIPDPDP?**	Response **+CIPDPDP: <mode>, <interval>, <timer>** **OK**
	Parameters See Write Command
Write Command **AT+CIPDPDP=<mode>[,<interval>,<timer>]**	Response **OK** **ERROR**
	Parameters **<mode>** 0 not set detect PDP 1 set detect PDP **<interval>**

	1<interval<=180(s) **<timer>** 1<timer<=10
Reference	Note If "+PDP: DEACT" urc is reported because of module not attaching to gprs for a certain time or other reasons, user still needs to execute "AT+CIPSHUT" command makes PDP context come back to original state.

8.2.22 AT+CIPMODE Select TCPIP Application Mode

AT+CIPMODE Select TCPIP Application Mode	
Test Command **AT+CIPMODE=?**	Response **+CIPMODE: (0-NORMAL MODE,1-TRANSPARENT MODE)** **OK**
	Parameter See Write Command
Read Command **AT+CIPMODE?**	Response **+CIPMODE: <mode>** **OK**
	Parameter See Write Command
Write Command **AT+CIPMODE=<mode>**	Response **OK** **ERROR**
	Parameter **<mode>** 0 normal mode 1 transparent mode
Reference	Note

8.2.23AT+CIPCCFG Configure Transparent Transfer Mode

AT+CIPCCFG Configure Transparent Transfer Mode	
Test Command **AT+CIPCCFG=?**	Response **+CIPCCFG: (NmRetry:3-8),(WaitTm:2-10),(SendSz:1-1460),(esc:0,1)** **OK**
	Parameters

	See Write Command
Read Command **AT+CIPCCFG?**	Response **+CIPCCFG: <NmRetry>,<WaitTm>,<SendSz>,<esc>** **OK**
	Parameters See Write Command
Write Command **AT+CIPCCFG=<NmRetry>,<WaitTm>,<SendSz>,<esc>**	Response **OK** **ERROR**
	Parameters **<NmRetry>** number of retries to be made for an IP packet. **<WaitTm>** number of 200ms intervals to wait for serial input before sending the packet. **<SendSz>** size in bytes of data block to be received from serial port before sending. **<esc>** whether turn on the escape sequence is turned on, default is TRUE.
Reference	Note This command will be effective only in single connection mode (+CIPMUX=0)

8.2.24 AT+CIPSHOWTP Display Transfer Protocol in IP Head When Received Data

AT+CIPSHOWTP	**Display Transfer Protocol in IP Head When Received Data**
Test Command **AT+CIPSHOWTP=?**	Response **+CIPSHOWTP: (**list of supported **<mode>**s**)** **OK**
	Parameter See Write Command
Read Command **AT+CIPSHOWTP?**	Response **+CIPSHOWTP: <mode>** **OK**
	Parameter See Write Command
Write Command **AT+CIPSHOWTP**	Response **OK**

=<mode>	**ERROR** Parameter **<mode>** a numeric parameter which indicates whether to display transfer protocol in IP header to received data or not 0 not display transfer protocol 1 display transfer protocol, the format is "+IPD, <data size>,<TCP/UDP>:<data>"
Reference	Note ● This command will be effective only in single connection mode (+CIPMUX=0) ● Only when +CIPHEAD is set to 1, the setting of this command will work

8.2.25 AT+CIPUDPMODE UDP Extended Mode

AT+CIPUDPMODE UDP Extended Mode	
Test Command **AT+CIPUDPMODE=?**	Response **+ CIPUDPMODE: (0-2),("(0,255).(0,255).(0,255).(0,255)"),(1,65535)** **OK**
	Parameters See Write Command
Read Command **AT+CIPUDPMODE?**	Response **+CIPUDPMODE: <mode>,[<IP address>,<Port>]** **OK**
	Parameter See Write Command
Write Command **AT+CIPUDPMODE=<mode>,[<IP address>,<Port>]**	Response **OK** **ERROR**
	Parameter **<mode>** 0 UDP Normal Mode 1 UDP Extended Mode 2 Set UDP address to be sent **<IP address>** a string parameter (string should be included in quotation marks) which indicates remote IP address **<port>** remote port

Reference	Note This Command is used to set UDP extended mode, for single IP connection (+CIPMUX=0)

8.2.26 AT+CIPRXGET Get Data from Network Manually

AT+CIPRXGET	**Get Data from Network Manually**
Test Command **AT+CIPRXGET =?**	Response **+CIPRXGET: (**list of supported **<mode>**s**),(**list of supported **<len>)** **OK**
	Parameters See Write Command
Read Command **AT+CIPRXGET ?**	Response **+CIPRXGET: <mode>** **OK**
	Parameters See Write Command
Write Command 1) If single IP connection (+CIPMUX=0) **AT+CIPRXGET =<mode>[,<len>]** 2) If multi IP connection (+CIPMUX=1) **AT+CIPRXGET =<mode>,<id>[,<len>]**	Response **OK** **ERROR**
	Parameters **<mode>** 0 disable getting data from network manually, the module is set to normal mode, data will be pushed to TE directly. 1 enable getting data from network manually. 2 the module can get data, but the length of output data can not exceed 1460 bytes at a time. 3 similar to mode 2, but in HEX mode, which means the module can get 730 bytes maximum at a time. 4 query how many data are not read with a given ID. **<id>** a numeric parameter which indicates the connection number **<len>** 1-1460 (bytes) the supported length of data.
Reference	Note To enable this function, parameter <mode> must be set to 1 before connection.

8.2.27 AT+CIPQRCLOSE Quick Remote Close

AT+CIPQRCLOSE Quick Remote Close	
Test Command **AT+CIPQRCLOSE=?**	Response **+CIPQRCLOSE: (**list of supported **<mode>**s**)** **OK**
	Parameter See Write Command
Read Command **AT+CIPQRCLOSE?**	Response **+CIPQRCLOSE: <mode>** **OK**
	Parameter See Write Command
Write Command **AT+CIPQRCLOSE=<mode>**	Response **OK** **ERROR**
	Parameter **<mode>** 0 module returns FIN frame after module received FIN frame from remote side 1 module returns RST frame after module received FIN frame from remote side
Reference	Note ● If RST frame instead of FIN frame is responded to remote side, disconnection process will speed up. ● To enable this function, parameter <mode> must be set to 1 before connection.

8.2.28 AT+CIPSCONT Save TCPIP Application Context

AT+CIPSCONT Save TCPIP Application Context	
Read Command **AT+CIPSCONT?**	Response TA returns TCPIP Application Context, which consists of the following AT Command parameters. **+CIPSCONT:<mode0>** **+CIPCSGP:<mode>** **Gprs Config APN:<apn>** **Gprs Config UserId:<user name>**

	Gprs Config Password:<password> **+CLPORT:<port>** **+CIPHEAD:<mode>** **+CIPSHOWTP:<mode>** **+CIPSRIP:<mode>** **+CIPATS:<mode>,<time>** **+CIPSPRT:<send prompt>** **+CIPQSEND:<n>** **+CIPMODE:<mode>** **+CIPCCFG:<NmRetry>,<WaitTm>,<SendSz>,<esc>** **+CIPMUX:<n>** **+CIPDPDP:<mode>, <interval>, <timer>** **+CIPRXGET:<mode>** **+CIPQRCLOSE:<mode>** **+CIPUDPMODE:<mode>** **OK**
	Parameters **<mode0>** 0 saved, the value from NVRAM 1 unsaved, the value from RAM For other parameters, see the related command.
Execution Command **AT+CIPSCONT**	Response Module saves current TCPIP Application Contexts to NVRAM. When system is rebooted, the parameters will be loaded automatically. **OK**
Reference	Note

9 AT Commands for IP Application

9.1 Overview

Command	Description
AT+SAPBR	BEARER SETTINGS FOR APPLICATIONS BASED ON IP

9.2 Detailed Descriptions of Commands

9.2.1 AT+SAPBR   Bearer Settings for Applications Based on IP

AT+SAPBR Bearer Settings for Applications Based on IP	
Test Command **AT+SAPBR=?**	Response **+SAPBR: (0-5),(1-3), "ConParamTag","ConParamValue"** **OK**
	Parameters See Write Command
Write Command **AT+SAPBR =<cmd_type>,<cid>,[<ConParamTag>,<ConParamValue>]**	Response **OK** **If<cmd_type> = 2** **+SAPBR: <cid>,<Status>,<IP_Addr>** **OK** **If <cmd_type>=4** **+SAPBR: <ConParamTag>,<ConParamValue>** **OK** Unsolicited Result Code **+SAPBR <cid>: DEACT**
	Parameters **<cmd_type>** 0 close bearer 1 open bearer 2 query bearer 3 set bearer parameters 4 get bearer parameters 5 save the values of parameters to NVRAM

	<cid> bearer profile identifier **<Status>** 0 bearer is connecting 1 bearer is connected 2 bearer is closing 3 bearer is closed **<ConParamTag>** bearer parameter "CONTYPE" Type of Internet connection. Value refer to <ConP"aramValue_ConType> "APN" Access point name string: maximum 50 characters "USER" User name string: maximum 50 characters "PWD" Password string: maximum 50 characters "PHONENUM" Phone number for CSD call "RATE" CSD connection rate. For value refer to <ConParamValue_Rate> **<ConParamValue>** bearer paramer value **<ConParamValue_ConType>** "CSD" Circuit-switched data call. "GPRS" GPRS connection. **<ConParamValue_Rate>** 0 2400 1 4800 2 9600 3 14400 **<IP_Addr>** the IP address of bearer
Reference	Note This command is applied to activate some applications such as HTTP, FTP.

10 AT Commands for HTTP Application

SIM900 has an embedded TCP/IP stack that is driven by AT commands and enables the host application to easily access the Internet HTTP service. This chapter is a reference guide to all the AT commands and responses defined to use with the TCP/IP stack in HTTP Service.

10.1 Overview

Command	Description
AT+HTTPINIT	INITIALIZE HTTP SERVICE
AT+HTTPTERM	TERMINATE HTTP SERVICE
AT+HTTPPARA	SET HTTP PARAMETERS VALUE
AT+HTTPDATA	INPUT HTTP DATA
AT+HTTPACTION	HTTP METHOD ACTION
AT+HTTPREAD	READ THE HTTP SERVER RESPONSE
AT+HTTPSCONT	SAVE HTTP APPLICATION CONTEXT

10.2 Detailed Descriptions of Commands

10.2.1 AT+HTTPINIT Initialize HTTP Service

AT+HTTPINIT Initialize HTTP Service	
Test Command **AT+HTTPINIT=?**	Response **OK**
Execution Command **AT+HTTPINIT**	Response **OK** If error is related to ME functionality: **+CME ERROR: <err>**
Reference	Note HTTPINIT should first be executed to initialize the HTTP service.

10.2.2 AT+HTTPTERM Terminate HTTP Service

AT+HTTPTERM Terminate HTTP Service

Test Command **AT+HTTPTERM=?**	Response **OK**
Execution command **AT+ HTTPTERM**	Response **OK** If error is related to ME functionality: **+CME ERROR: <err>**
Reference	Note

10.2.3 AT+HTTPPARA Set HTTP Parameters Value

AT+HTTPPARA	**Set HTTP Parameters Value**
Test Command **AT+HTTPPARA=?**	Response **+HTTPPARA: "HTTPParamTag","HTTPParmValue"** **OK**
	Parameters See Write Command
Read Command **AT+HTTPPARA?**	Response **+ HTTPPARA: <HTTPParamTag>,<HTTPParamValue>** **OK**
	Parameters See Write Command
Write Command **AT+ HTTPPARA=<HTTPParamTag>,<HTTPParamValue>**	Response **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters **<HTTPParamTag>** HTTP Parameter "CID" (Mandatory Parameter) bearer profile identifier "URL" (Mandatory Parameter) HTTP client URL "http://'server'/'path':'tcpPort' " "server": FQDN or IP-address "path": path of file or directory "tcpPort": default value is 80. Refer to "IETF-RFC 2616".

	"UA" The user agent string which is set by the application to identify the mobile. Usually this parameter is set as operation system and software version information. Default value is SIMCOM_MODULE. "PROIP" The IP address of HTTP proxy server "PROPORT" The port of HTTP proxy server "REDIR" This flag controls the redirection mechanism of the SIM900 when it is acting as HTTP client (numeric). If the server sends a redirect code (range 30x), the client will automatically send a new HTTP request when the flag is set to (1). Default value is 0 (no redirection). "BREAK" Parameter for HTTP method "GET" used for resuming broken transfer. "BREAKEND" Parameter for HTTP method "GET", used for resuming broken transfer. which is used together with "BREAK", If the value of "BREAKEND" is bigger than "BREAK", the transfer scope is from "BREAK" to "BREAKEND". If the value of "BREAKEND" is smaller than "BREAK", the transfer scope is from "BREAK" to the end of the file. If both "BREAKEND" and "BREAK" are 0, the resume broken transfer function is disabled. **<HTTPParamValue>** HTTP Parameter value. Type and supported content depend on related <HTTPParamTag>.
Reference	Note Not all the HTTP Server supports "BREAK" and "BREAKEND" parameters

10.2.4 AT+HTTPDATA Input HTTP Data

AT+HTTPDATA	**Input HTTP Data**
Test Command **AT+HTTPDATA =?**	Response **+HTTPDATA: (1-318976),(1000-120000)** **OK**
	Parameters See Write Command

Write Command **AT+HTTPDATA=<size>,<time>**	Response **DOWNLOAD** **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters **<size>** Size in bytes of the data to POST. **<time>** Maximum time in milliseconds to input data.
Reference	Note It is strongly recommended to set enough time to input all datawith the length of <size>.

10.2.5 AT+HTTPACTION HTTP Method Action

AT+HTTPACTION HTTP Method Action	
Test Command **AT+HTTPACTION=?**	Response **+HTTPACTION: (0-2)** **OK**
	Parameter See Write Command
Write Command **AT+HTTPACTION=<Method>**	Response **OK** If error is related to ME functionality: **+CME ERROR: <err>** Unsolicited Result Code **+HTTPACTION: <Method>,<StatusCode>,<DataLen>**
	Parameter **<Method>** HTTP method specification: 0 GET 1 POST 2 HEAD **<StatusCode>** HTTP Status Code responded by remote server, it identifier refer to HTTP1.1(RFC2616) 100 Continue

	101	Switching Protocols
	200	OK
	201	Created
	202	Accepted
	203	Non-Authoritative Information
	204	No Content
	205	Reset Content
	206	Partial Content
	300	Multiple Choices
	301	Moved Permanently
	302	Found
	303	See Other
	304	Not Modified
	305	Use Proxy
	307	Temporary Redirect
	400	Bad Request
	401	Unauthorized
	402	Payment Required
	403	Forbidden
	404	Not Found
	405	Method Not Allowed
	406	Not Acceptable
	407	Proxy Authentication Required
	408	Request Time-out
	409	Conflict
	410	Gone
	411	Length Required
	412	Precondition Failed
	413	Request Entity Too Large
	414	Request-URI Too Large
	415	Unsupported Media Type
	416	Requested range not satisfiable
	417	Expectation Failed
	500	Internal Server Error
	501	Not Implemented
	502	Bad Gateway
	503	Service Unavailable
	504	Gateway Time-out
	505	HTTP Version not supported
	600	Not HTTP PDU
	601	Network Error
	602	No memory
	603	DNS Error
	604	Stack Busy

	<DataLen> the length of data got
Reference	Note

10.2.6 AT+HTTPREAD Read the HTTP Server Response

AT+HTTPREAD	**Read the HTTP Server Response**
Test Command **AT+HTTPREAD=?**	Response **+HTTPREAD: (1- 318976),(1- 318976)** **OK**
	Parameters See Write Command
Write Command **AT+ HTTPREAD =<start_address><byte_size>**	Response **+HTTPREAD: <date_len>** **<data>** **OK** Read data when AT+HTTPACTION=0 or AT+HTTPDATA is executed. If<byte_size> is bigger than the data size received, module will only return actual data size. If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters **<data>** data from HTTP server or user input **<start_address>** The starting point for data output **<byte_size>** The length for data output **<data_len>** The actual length for data output
Execution Command **AT+HTTPREAD**	Response **+HTTPREAD:<date_len>** **<data>** **OK** Read all data when AT+HTTPACTION=0 or AT+HTTPDATA is executed. If error is related to ME functionality:

	+CME ERROR: <err>
Reference	Note

10.2.7 AT+HTTPSCONT Save HTTP Application Context

AT+HTTPSCONT Save HTTP Application Context	
Read Command **AT+HTTPSCONT?**	Response TA returns HTTP Application Context, which consists of the following AT Command parameters. **+HTTPSCONT:<mode>** **CID:<value>** **URL: <value>** **UA: <value>** **PROIP: <value>** **PROPORT: <value>** **REDIR: <value>** **BREAK: <value>** **BREAKEND: <value>** **OK**
	Parameters **<mode>** 0 saved, the value from NVRAM 1 unsaved, the value from RAM For other parameters, see the related command.
Execution Command **AT+HTTPSCONT**	Response TA saves HTTP Application Context which consists of following AT Command parameters, and when system is rebooted, the parameters will be loaded automatically. **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameter
Reference	Note

11 AT Commands for FTP Application

SIM900 has an embedded TCP/IP stack that is driven by AT commands and enables the host application to easily access the Internet FTP service. This chapter is a reference guide to all the AT commands and responses defined for using with the TCP/IP stack in FTP Service.

11.1 Overview

Command	Description
AT+FTPPORT	SET FTP CONTROL PORT
AT+FTPMODE	SET ACTIVE OR PASSIVE FTP MODE
AT+FTPTYPE	SET THE TYPE OF DATA TO BE TRANSFERRED
AT+FTPPUTOPT	SET FTP PUT TYPE
AT+FTPCID	SET FTP BEARER PROFILE IDENTIFIER
AT+FTPREST	SET RESUME BROKEN DOWNLOAD
AT+FTPSERV	SET FTP SERVER ADDRESS
AT+FTPUN	SET FTP USER NAME
AT+FTPPW	SET FTP PASSWORD
AT+FTPGETNAME	SET DOWNLOAD FILE NAME
AT+FTPGETPATH	SET DOWNLOAD FILE PATH
AT+FTPPUTNAME	SET UPLOAD FILE NAME
AT+FTPPUTPATH	SET UPLOAD FILE PATH
AT+FTPGET	DOWNLOAD FILE
AT+FTPPUT	SET UPLOAD FILE
AT+FTPSCONT	SAVE FTP APPLICATION CONTEXT

11.2 Detailed Descriptions of Commands

11.2.1 AT+FTPPORT Set FTP Control Port

AT+FTPPORT Set FTP Control Port	
Test Command **AT+FTPPORT =?**	Response **OK**

Read Command **AT+ FTPPORT?**	Response **+FTPPORT: <value>** **OK**
	Parameter See Write Command
Write Command **AT+FTPPORT =<value>**	Response **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameter **<value>** The value of FTP Control port, from 1 to 65535. Default value is 21
Reference	Note Numbers above 65535 are illegal as the port identification fields are 16 bits long in the TCP header.

11.2.2 AT+FTPMODE Set Active or Passive FTP Mode

AT+FTPMODE	**Set Active or Passive FTP Mode**
Test Command **AT+FTPMODE =?**	Response **OK**
Read Command **AT+FTPMODE?**	Response **+FTPMODE: <value>** **OK**
	Parameter See Write Command
Write Command **AT+FTPMODE =<value>**	Response **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameter **<value>** 0 Active FTP mode <u>1</u> Passive FTP mode
Reference	Note

11.2.3 AT+FTPTYPE Set the Type of Data to Be Transferred

AT+FTPTYPE Set the Type of Data to Be Transferred	
Test Command **AT+FTPTYPE =?**	Response **OK**
Read Command **AT+FTPTYPE?**	Response **+FTPTYPE: <value>** **OK**
	Parameter See Write Command
Write Command **AT+FTPTYPE =<value>**	Response **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameter **<value>** "A" for FTP ASCII sessions "I" for FTP Binary sessions
Reference	Note When this value is set to A, all the data sent by the stack to the FTP server is made of 7 bits characters (NVT-ASCII: the MSB is set to 0). As a consequence binary data containing 8 bits characters will be corrupted during the transfer if the FTPTYPE is set to A.

11.2.4 AT+FTPPUTOPT Set FTP Put Type

AT+FTPPUTOPT Set FTP Put Type	
Test Command **AT+FTPPUTOPT =?**	Response **OK**
Read Command **AT+FTPPUTOPT?**	Response **+FTPPUTOPT: <value>** **OK**
	Parameter See Write Command
Write Command **AT+FTPPUTOPT =<value>**	Response **OK**

	If error is related to ME functionality: **+CME ERROR: <err>**
	Parameter **<value>** "APPE" for appending file "STOU" for storing unique file "STOR" for storing file
Reference	Note

11.2.5 AT+FTPCID Set FTP Bearer Profile Identifier

AT+FTPCID Set FTP Bearer Profile Identifier	
Test Command **AT+FTPCID=?**	Response **OK**
	Parameter See Write Command
Read Command **AT+FTPCID?**	Response **+ FTPCID: <value>** **OK**
	Parameter See Write Command
Write Command **AT+FTPCID=<value>**	Response **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameter **<value>** bearer profile identifier refer to AT+SAPBR
Reference	Note

11.2.6 AT+FTPREST Set Resume Broken Download

AT+FTPREST Set Resume Broken Download	
Test Command **AT+FTPREST=?**	Response **OK**

Read Command **AT+ FTPREST?**	Response **+ FTPREST: <value>** **OK**
	Parameter See Write Command
Write Command **AT+FTPREST= <value>**	Response **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameter **<value>** broken point to be resumed
Reference	Note

11.2.7 AT+FTPSERV Set FTP Server Address

AT+FTPSERV Set FTP Server Address	
Test Command **AT+FTPSERV =?**	Response **OK**
Read Command **AT+FTPSERV?**	Response **+FTPSERV: <value>** **OK**
	Parameter See Write Command
Write Command **AT+FTPSERV =<value>**	Response **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameter **<value>** 32-bit number in dotted-decimal notation (i.e. xxx.xxx.xxx.xxx) or alphanumeric ASCII text string up to 49 characters if DNS is available
Reference	Note

11.2.8 AT+FTPUN Set FTP User Name

AT+FTPUN Set FTP User Name	
Test Command **AT+FTPUN=?**	Response **OK**
	Parameter See Write Command
Read Command **AT+FTPUN?**	Response **+FTPUN: <value>** **OK**
	Parameter See Write Command
Write Command **AT+FTPUN=<value>**	Response **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameter **<value>** Alphanumeric ASCII text string up to 49 characters.
Reference	Note

11.2.9 AT+FTPPW Set FTP Password

AT+FTPPW Set FTP Password	
Test Command **AT+FTPPW =?**	Response **OK**
	Parameter See Write Command
Read Command **AT+FTPPW?**	Response **+FTPPW: <value>** **OK**

	Parameter See Write Command
Write Command **AT+FTPPW =<value>**	Response **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameter **<value>** Alphanumeric ASCII text string up to 49 characters.
Reference	Note

11.2.10 AT+FTPGETNAME Set Download File Name

AT+FTPGETNAME Set Download File Name	
Test Command **AT+FTPGETNAME =?**	Response **OK**
Read Command **AT+FTPGETNAME?**	Response **+ FTPGETNAME: <value>** **OK**
	Parameter See Write Command
Write Command **AT+FTPGETNAME =<value>**	Response **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameter **<value>** Alphanumeric ASCII text string up to 99 characters
Reference	Note

11.2.11 AT+FTPGETPATH Set Download File Path

AT+FTPGETPATH Set Download File Path	
Test Command **AT+FTPGETPATH =?**	Response **OK**

Read Command **AT+FTPGETPATH?**	Response **+FTPGETPATH: <value>** **OK**	
	Parameter See Write Command	
Write Command **AT+FTPGETPATH =<value>**	Response **OK** If error is related to ME functionality: **+CME ERROR: <err>**	
	Parameter **<value>**	Alphanumeric ASCII text string up to 99 characters
Reference	Note	

11.2.12 AT+FTPPUTNAME Set Upload File Name

AT+FTPPUTNAME Set Upload File Name		
Test Command **AT+FTPPUTNAME=?**	Response **OK**	
Read Command **AT+FTPPUTNAME?**	Response **+FTPPUTNAME: <value>** **OK**	
	Parameter See Write Command	
Write Command **AT+FTPPUTNAME =<value>**	Response **OK** If error is related to ME functionality: **+CME ERROR: <err>**	
	Parameter **<value>**	Alphanumeric ASCII text string up to 99 characters
Reference	Note	

11.2.13 AT+FTPPUTPATH Set Upload File Path

AT+FTPPUTPATH Set Upload File Path	
Test Command **AT+FTPPUTPATH =?**	Response **OK**
Read Command **AT+FTPPUTPATH?**	Response **+FTPPUTPATH: <value>** **OK**
	Parameter See Write Command
Write Command **AT+FTPPUTPATH =<value>**	Response **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameter **<value>** Alphanumeric ASCII text string up to 99 characters
Reference	Note

11.2.14 AT+FTPGET Download File

AT+FTPGET Download File	
Test Command **AT+FTPGET =?**	Response **OK**
Write Command **AT+FTPGET =<mode>,[<reqlength>]**	Response If mode is 1 and it is a successful FTP get session: **OK** **+FTPGET:1,1** If data transfer finished: **+FTPGET:1,0** If mode is 1 and it is a failed FTP get session: **OK** **+FTPGET:1,<error>** If mode is 2: **+FTPGET:2,<cnflength>**

	012345678… **OK** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters **<mode>** 1 for opening FTP get session 2 for reading FTP download data. **<reqlength>** Requested number of data bytes (1-1460)to be read **<cnflength>** Confirmed number of data bytes to be read, which may be less than <length>. 0 indicates that no data can be read. **<error>** 61 Net error 62 DNS error 63 connect error 64 timeout 65 server error 66 operation not allow 70 replay error 71 user error 72 password error 73 type error 74 rest error 75 passive error 76 active error 77 operate error 78 upload error 79 download error
Reference	Note When "+FTPGET:1,1" is shown,then use AT+FTPGET:2,<reqlength> to read data. If the module still has unread data, "+FTPGET:1,1" will be shown again in a certain time.

11.2.15 AT+FTPPUT Set Upload File

AT+FTPPUT Set Upload File	
Test Command **AT+FTPPUT=?**	Response **OK**
Write Command **AT+FTPPUT =<mode>,[<reqlength>]**	Response If mode is 1 and it is a successful FTP get session: **OK** **+FTPPUT:1,1,<maxlength>** If mode is 1 and it is a failed FTP get session:

	OK **+FTPPUT:1,<error>** If mode is 2 and <reqlength> is not 0 **+FTPPUT:2,<cnflength>** **……　　　//Input data** **OK** If mode is 2 and <reqlength> is 0, it will respond OK, and FTP session will be closed **OK** If data transfer finished. **+FTPPUT:1,0** If error is related to ME functionality: **+CME ERROR: <err>**
	Parameters **<mode>** 1 for opening FTP put session 2 for writing FTP upload data. **<reqlength>** Requested number of data bytes(0-<maxlength>) to be transmitted **<cnflength>** Confirmed number of data bytes to be transmitted **<maxlength>** The max. length of data can be sent at a time. It depends on the network status. **<error>** see AT+FTPGET
Reference	Note When "+FTPPUT:1,1,<maxlength>" is shown, then use AT+FTPPUT=2, <reqlength> to write data.

11.2.16 AT+FTPSCONT Save FTP Application Context

AT+FTPSCONT	**Save FTP Application Context**
Read Command **AT+FTPSCONT ?**	Response TA returns FTP Application Context, which consists of the following AT Command parameters. **+FTPSCONT:<mode>** **+FTPSERV: <value>** **+FTPPORT: <value>** **+FTPUN: <value>** **+FTPPW: <value>** **+FTPCID: <value>**

	+FTPMODE: <value> **+FTPTYPE: <value>** **+FTPPUTOPT: <value>** **+FTPREST: <value>** **+FTPGETNAME: <value>** **+FTPGETPATH: <value>** **+FTPPUTNAME: <value>** **+FTPPUTPATH: <value>** **+FTPTIMEOUT: <value>** **OK**
	Parameter **<mode>** 0 saved, the value from NVRAM 1 unsaved, the value from RAM For other parameters, see the related command.
Execution Command **AT+FTPSCONT**	Response TA saves FTP Application Context which consist of following AT Command parameters, and when system is rebooted, the parameters will be loaded automatically. **OK**
Reference	Note

12 Supported Unsolicited Result Codes

12.1 Summary of CME ERROR Codes

Final result code +CME ERROR: <err> indicates an error related to mobile equipment or network. The operation is similar to ERROR result code. None of the following commands in the same Command line is executed. Neither ERROR nor OK result code shall be returned.
<err> values used by common messaging commands:

Code of <err>	Meaning
0	phone failure
1	no connection to phone
2	phone-adaptor link reserved
3	operation not allowed
4	operation not supported
5	PH-SIM PIN required
6	PH-FSIM PIN required
7	PH-FSIM PUK required
10	SIM not inserted
11	SIM PIN required
12	SIM PUK required
13	SIM failure
14	SIM busy
15	SIM wrong
16	incorrect password
17	SIM PIN2 required
18	SIM PUK2 required
20	memory full
21	invalid index
22	not found
23	memory failure
24	text string too long
25	invalid characters in text string
26	dial string too long
27	invalid characters in dial string
30	no network service
31	network timeout
32	network not allowed - emergency calls only

40	network personalization PIN required
41	network personalization PUK required
42	network subset personalization PIN required
43	network subset personalization PUK required
44	service provider personalization PIN required
45	service provider personalization PUK required
46	corporate personalization PIN required
47	corporate personalization PUK required
99	Resource limitation
100	Unknown
103	illegal MS
106	illegal ME
107	GPRS services not allowed
111	PLMN not allowed
112	location area not allowed
113	roaming not allowed in this location area
132	service option not supported
133	requested service option not subscribed
134	service option temporarily out of order
148	unspecified GPRS error
149	PDP authentication failure
150	invalid mobile class

12.2 Summary of CMS ERROR Codes

Final result code +CMS ERROR: <err> indicates an error related to message service or network. The operation is similar to ERROR result code. None of the following commands in the same Command line is executed. Neither ERROR nor OK result code shall be returned.
<err> values used by common messaging commands:

Code of <err>	Meaning
300	ME failure
301	SMS ME reserved
302	Operation not allowed
303	Operation not supported
304	Invalid PDU mode
305	Invalid text mode

310	SIM not inserted
311	SIM pin necessary
312	PH SIM pin necessary
313	SIM failure
314	SIM busy
315	SIM wrong
316	SIM PUK required
317	SIM PIN2 required
318	SIM PUK2 required
320	Memory failure
321	Invalid memory index
322	Memory full
323	Invalid parameter
324	Invalid input format
330	SMSC address unknown
331	No network
332	Network timeout
340	No CNMA ack
500	Unknown
512	SIM not ready
513	Unread records on SIM
514	CB error unknown
515	PS busy
517	SM not ready
528	Invalid (non-hex) chars inPDU
529	Incorrect PDU length
530	Invalid MTI
531	Invalid (non-hex) chars in address
532	Invalid address (no digits read)
533	Incorrect PDU length (UDL)
534	Incorrect SCA length
536	Invalid First Octet (should be 2 or 34)
537	Invalid Command type
538	SRR bit not set
539	SRR bit set
540	Invalid User Data Header IE
753	CRSM missing parameter
754	CRSM invalid command

755	CRSM invalid file ID
756	CRSM missing P parameter
757	CRSM invalid P parameter
758	CRSM missing command data
759	CRSM invalid characters in command data.
765	Invalid input value
766	Unsupported mode
767	Operation failed
768	Mux already running
769	Unable to get control
770	SIM network reject
771	Call setup in progress
772	SIM powered down
773	SIM file not present

13 AT Commands Sample

13.1 Profile Commands

Demonstration	Syntax	Expect Result
The AT Command interpreter actively responds to input.	AT	OK
Display the product name and the product release information.	ATI	SIM900 R11.0
Display product identification information: the manufacturer, the product name and the product revision information.	AT+GSV	SIMCOM_Ltd SIMCOM_SIM900 Revision:1137B01SIM900M32_ST OK
Display current configuration, a list of the current active profile parameters.	AT&V	[A complete listing of the active profile] OK
Reporting of mobile equipment errors. The default CME error reporting setting is disabled. Switch to verbose mode	AT+CMEE=? AT+CMEE? AT+CSCS=? AT+CSCS="TEST"	+CMEE: (0-2) OK +CMEE: 1 OK +CSCS: ("IRA","GSM","UCS2","HEX","PCCP","PCDN","8859-1") OK

Displays a string explaining the error in more details.	AT+CMEE=2 AT+CSCS="TEST"	ERROR OK +CME ERROR: operation not allowed
Store the current configuration in nonvolatile memory. When the board is reset, the configuration changes from the last session are loaded.	ATE0&W AT [Reset the board] AT ATE1&W AT	OK [No echo] OK [No echo] OK [No echo] OK [Echo on] OK
Set the ME to minimum functionality	AT+IPR？ AT+CFUN=0 AT+IPR = 115200 AT+IPR? AT+CFUN=0	+IPR:0 OK OK +CPIN: NOT READY OK +IPR:115200 OK +CPIN: NOT READY

ME has entered full functionality mode.	AT+CFUN?	+CFUN:1 OK

13.2 SIM Commands

Demonstration	Syntax	Expect Result
List available phonebooks, and select the SIM phonebook.	AT+CPBS=?	+CPBS: ("MC","RC","DC","LD","LA","ME","SM","FD", "ON","BN","SD","VM","EN") OK

	AT+CPBS="SM"	OK
Display the ranges of phonebook entries and list the contents of the phonebook.	AT+CPBR=? AT+CPBR=1,10	+CPBR: (1-250),40,14 OK [a listing of phonebook contents] OK
Write an entry to the current phonebook.	AT+CPBW=,"13918 18xxxx",129,"Daniel" AT+CPBR=1,10	 OK [a listing of phonebook contents] OK
Find an entry in the current phonebook using a text search.	AT+CPBF="Daniel"	+CPBF:5, "13918186089",129,"Daniel" OK
Delete an entry from the current phonebook specified by its position index.	AT+CPBW=2 AT+CPBR=1,10	OK [a listing of phonebook contents] OK

13.3 General Commands

Demonstration	Syntax	Expect Result
Display the current network operator that the handset is currently registered with.	AT+COPS?	+COPS: 0,0,"CHINA MOBILE" OK
Display a full list of network operator names.	AT+COPN	+COPN: "20201", "COSMO" [skip a bit] +COPN: "901012","Maritime Comm Partner AS" OK
reduce its functionality. This will deregister the handset from the network.	AT+IPR? AT+CFUN=0 [wait for deregister] ATD6241xxxx; AT+CFUN=1	+IPR: 0 OK OK ERROR OK

Request the IMSI	AT+CIMI	460008184101641 OK

13.4 Call Control Commands

Demonstration	Syntax	Expect Result
Make a voice call	ATD6241xxxx;	OK MS makes a voice call
Hang up a call	ATH	OK Call dropped
Make a voice call using the last number facility. The initial call is established and then cancelled. The second call is made using the previous dial string.	ATD6241xxxx; ATH ATDL	OK OK OK
Example of a MT voice call Make MT voice call to MS.	ATA ATH	RING RING OK[accept call] OK[hang up call]
Call related to supplementary service: AT+CHLD. This Command provides support for call waiting functionality.	AT+CHLD=<N>	Return value:(0,1,1x,2,2x,3,4,6, 6x,7x,8x,9x)
Terminate current call and accept waiting call. Establish a voice call from EVB, receive an incoming call(incoming call accepts waiting status), terminate active call and accept incoming call. Note call waiting must be active for this option – use "AT+CCWA=1,1" before running this demonstration.	AT+CCWA=1,1 ATD6241xxxx; <RX incoming call> AT+CHLD=1	OK OK RING +CCWA: "62418148 ", 129,1,"" OK <waiting call active>
Set current call to busy state and accept waiting call. Establish a voice call from EVB, receive an incoming call(incoming call accepts waiting status), place active call on hold and switch to incoming call. Terminate active call and switch back to original call. Note call waiting must have been previously enabled for this demonstration to work.	ATD6241xxxx; <RX incoming call> AT+CHLD=2 AT+CHLD=1	RING +CCWA: "1391818 6089",129,1,"" OK <waiting call active other call on hold> OK <incoming call terminated, dialed number now active>

Switch between active and held calls. Establish a voice call from EVB, receive an incoming call (incoming call accepts waiting status), place active call on hold and switch to incoming call. Switch between both calls, placing each in the hold state whilst the other is active before terminating each one. This feature relies on knowing each call's ID. This is done using the List Current Calls(AT+CLCC) Command. A call's ID is required to switch between held and active calls. Held calls are not automatically resumed when all other calls are terminated. They need to be made active using the AT+CHLD=2x Command. Note call waiting must have been previously enabled for this demonstration to work.	ATD6241xxxx; <RX incoming call> AT+CHLD=2 AT+CHLD=21 AT+CLCC AT+CHLD=22 AT+CHLD=12 AT+CHLD=11	OK RING +CCWA: "1391818 6089",129,1,"" OK <incoming call activated, original on hold> OK <original call activated, incoming call held> +CLCC:1,0,0,0,0,"62 418148",129,"" +CLCC:2,1,1,0,0, "139 18186089",129, "" OK <Note incoming call held flag set> OK <original call held, incoming call active> OK <terminate incoming call> <terminate original call>
Send busy status to incoming waiting caller. Establish a voice call from EVB, receive an incoming call (incoming call accepts waiting status), send 'busy' status to waiting mobile. Note call waiting must have been previously enabled for this demonstration to work.	ATD6241xxxx; <RX incoming call> AT+CHLD=0	OK RING +CCWA: "1391818 6089",129,1,"" OK OK <incoming call sent busy msg, current call retained>
Drop all calls on hold. Establish a voice call from EVB, receive an incoming call (incoming call accepts waiting status), switch to incoming call and drop all waiting calls. Note call waiting must have been previously enabled for this demonstration to work.	ATD6241xxxx; <RX incoming call> AT+CHLD=2 AT+CHLD=0	OK RING +CCWA: "1391818 6089",129,1,"" OK <incoming call actived, original on hold> OK <incoming call actived, current call

		terminate>

13.5 SIM Toolkit Commands

Demonstration	Syntax	Expect Result
Select the 1st menu item: individual assistance	AT*PSSTK="MENU SELECTION",1	*PSSTK: "SELECT ITEM",0,0,,0,0,1,0,0,5
Go to the menu of individual assistance	AT*PSSTK="GET ITEM LIST",5	*PSSTK: "GET ITEM LIST",1,1,2,5E2E52A9,0,0,0 *PSSTK: "GET ITEM LIST",2,2,2,752862377BA17406,0,0,0 *PSSTK: "GET ITEM LIST",3,3,2,52067EC47BA17406,0,0,0 *PSSTK: "GET ITEM LIST",4,4,2,7FA453D16D88606F,0,0,0 *PSSTK: "GET ITEM LIST",5,5,2,65E57A0B63D09192,0,0,0 OK
Select 1: help	AT*PSSTK="SELECT ITEM",1,1,0,0	*PSSTK: "NOTIFICATION",1,19,1,2,53D190014FE1606F2026,0,0
Go back to main menu	AT*PSSTK="NOTIFICATION",1,0	*PSSTK: "END SESSION"

13.6 Audio Commands

Demonstration	Syntax	Expect Result
DTMF tones	AT+CLDTMF=2, "1,2,3,4,5"	OK

13.7 SMS Commands

Demonstration	Syntax	Expect Result
Set SMS system into text mode, as opposed to PDU mode.	AT+CMGF=1	OK
Send an SMS to myself.	AT+CSCS="GSM"	OK

	AT+CMGS="+861391818xxxx" >This is a test <Ctrl+Z>	+CMGS:34 OK
Unsolicited notification of the SMS arriving		+CMTI: "SM",1
Read SMS message that has just arrived. Note: the number should be the same as that given in the +CMTI notification.	AT+CMGR=1	+CMGR: "REC UNREAD", "+8613918186089", "","02/01/30,20:40:31+00" This is a test OK
Reading the message again and change the status to "READ" from "UNREAD"	AT+CMGR=1	+CMGR: "REC READ", "+8613918186089","", "02/01/30,20:40:31+00" This is a test OK
Send another SMS to myself.	AT+CMGS="+861391818xxxx" >Test again<Ctrl+Z>	+CMGS:35 OK
Unsolicited notification of the SMS arriving		+CMTI: "SM",2
List all SMS messages. Note:"ALL" must be in uppercase.	AT+CMGL="ALL"	+CMGL: 1, "REC READ","+8613918186089", "", "02/01/30,20:40:31+00" This is a test +CMGL: 2, "REC UNREAD"," ", "+8613918186089", "" ,"02/01/30,20:45:12+00" Test again OK
Delete an SMS message.	AT+CMGD=1	OK
List all SMS messages to show message has been deleted.	AT+CMGL="ALL"	+CMGL: 2, "REC READ", "+8613918186089","","02/01/30,20:45:12+00" Test again

		OK
Send SMS using Chinese characters	AT+CSMP=17,167,2,25 AT+CSCS="UCS2" AT+CMGS="00310033003900310038003100380003x003x003x003x" >4E014E50<Ctrl+Z>	OK OK +CMGS:36 OK

13.8 GPRS Commands

Demonstration	Syntax	Expect Result
Establish a GPRS context.	Setup modem driver Setup dial up connection with *99# Run internet explorer	Should be able to surf the web using Internet explorer.
There are two GPRS Service Codes for the ATD Command: Value 88 and 99. Establish a connection by service code 99. Establish a connection by service code 99 and using CID 1	ATD*99# ATD*99***1#	CONNECT CONNECT
Check if the MS is connected to the GPRS network Detach from the GPRS network Check if the MS is connected to the GPRS network	AT+CGATT? AT+CGATT=0 AT+CGATT?	+CGATT:1 OK OK +CGATT: 0 OK
Check the class of the MS	AT+CGCLASS?	+CGCLASS:B OK
Establish a context using the terminal equipment: defines CID 1 and sets the PDP type to IP, access	AT+CGDCONT=1,"IP","CMNET" ATD*99#	OK CONNECT

point name and IP address aren't set.		
Cancel a context using the terminal equipment Pause data transfer and enter Command mode by +++ Stop the GPRS data transfer	AT+CGDCONT=1, "IP","CMNET" ATD*99# +++ ATH	OK CONNECT OK OK
Reconnect a context using the terminal equipment Resume the data transfer	AT+CGDCONT=1, "IP","CMNET" ATD*99# +++ ATO	OK CONNECT OK CONNECT

*Quality of Service (QOS) is a special parameter of a CID which consists of several parameters itself.

The QOS consists of

The precedence class

The delay class

The reliability class

The peak throughput class

The mean throughput class

And is decided in "requested QOS" and "minimum acceptable QOS".

All parameters of the QOS are initiated by default to the "network subscribed value (=0)" but the QOS itself is set to be undefined. To define a QOS use the AT+CGQREQ or AT+CGQMIN Command.

Overwrite the precedence class of QOS of CID 1 and sets the QOS of CID 1 to be present	AT+CGQREQ=1,2	OK
Response: all QOS values of CID 1 are set to network subscribed except precedence class which is set to 2	AT+CGQREQ	+CGQREQ:1,2,,,, +CGQREQ: 3,0,0,3,0,0 OK
Set the QOS of CID 1 to not present. Once defined, the CID can be activated.	AT+CGQREQ=1	OK
Activate CID 1, if the CID is already active, the mobile returns OK at once. If no CID is defined the mobile responds +CME ERROR: invalid index. Note: If the mobile is NOT attached by AT+CGATT=1 before activating, the	AT+CGACT=1,1 AT+CGACT=1,3	OK +CME ERROR: requested service option not subscribed.

attachment is automatically done by the AT+CGACT Command.		
Use the defined and activated CID to get online. The mobile can be connected using the parameters of appointed CID or using default parameter	AT+CGDATA="PPP", 1	CONNECT

The mobile supports Layer 2 Protocol (L2P) PPP only.

Note: If the mobile is NOT attached by AT+CGATT=1 and the CID is NOT activated before connecting, attaching and activating is automatically done by the AT+CGDATA Command.

Some providers require using an APN to establish a GPRS connection. So if user uses the Microsoft Windows Dial-Up Network and ATD*9… to connect to GPRS, user must provide the context definition as part of the modem definition (Modem properties/Connection/Advanced…/Extra settings.) As an alternative, user can define and activate the context in a terminal program (e.g. Microsoft HyperTerminal) and then use the Dial-Up Network to send only the ATD Command.

Contact us:
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URL: www.sim.com/wm

Secure Online Shopping

Welcome to the Bayside Blades SECURE shopping cart, all sensitive information is stored using SSL SECURE PAYMENT.

Product	Quantity	Price	Amount
Razor OEM Scooter wheels and bearing combo, Blue	12	10.00	120.00

	Subtotal	120.00
All prices are in Australian Dollars.	**Shipping**	71.55
	TOTAL	191.55

Your order summary

Descriptions	Amount
3274E_0.24V/173.3Kg-cm/15RPM 168:1 ... Item number: 3274E Item price: £96.59 Quantity: 4	£386.36
Item total	**£386.36**

Total £386.36 GBP

Your order summary

Descriptions	Amount
Pulse Sensor Amped! - Pulse Sensor ... Item description: Pulse Sensor Amped... Item price: $25.00 Quantity: 1	$25.00
Item total	**$25.00**

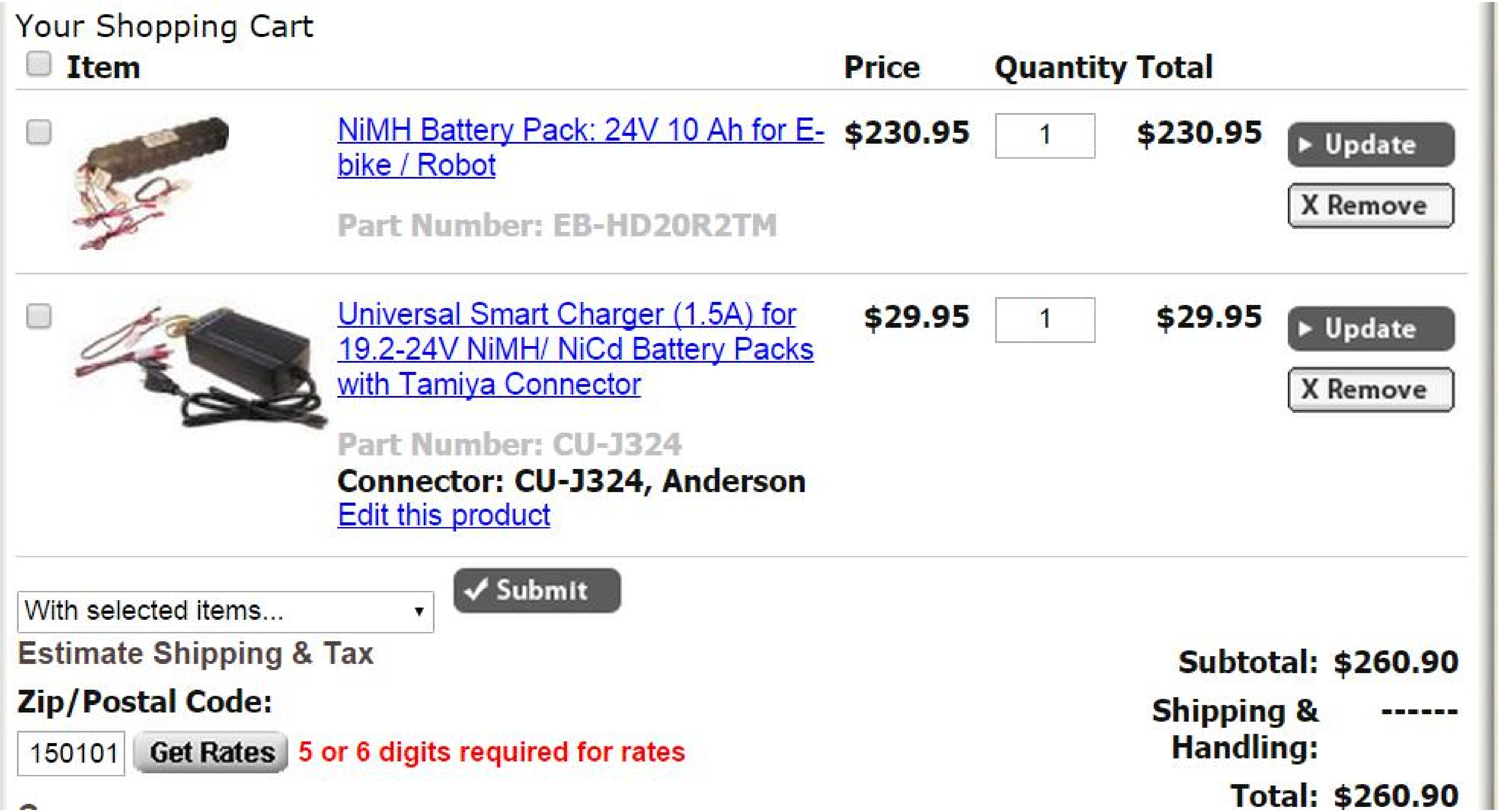
Total $25.00 USD

Product			Quantity	Price	Total Price
x		#2311 Concentric LACT10P-12V-20 Linear Actuator with Feedback: 10" Stroke, 12V, 0.5"/s	2	$109.95	$219.90
		Subtotal			**$219.90**

Shipping Estimate

For shipping the 2 items in your cart to a Peru address, postal code Lima 43:

Shipping service	Price (USD)
USPS Priority Mail International	73.95
USPS Priority Mail Express International	90.95
FedEx International Economy	176.45
FedEx International Priority	181.95


Your Shopping Cart
Item
Price
Quantity
Total
NiMH Battery Pack: 24V 10 Ah for E-bike / Robot
Part Number: EB-HD20R2TM
$230.95
1
$230.95
Update
X Remove
Universal Smart Charger (1.5A) for 19.2-24V NiMH/ NiCd Battery Packs with Tamiya Connector
Part Number: CU-J324
Connector: CU-J324, Anderson
Edit this product
$29.95
1
$29.95
Update
X Remove
With selected items...
Submit
Estimate Shipping & Tax
Zip/Postal Code:
150101
Get Rates
5 or 6 digits required for rates
Subtotal: $260.90
Shipping & Handling: ------
Total: $260.90

	Product Name		Move to Wishlist	Unit Price	Qty	Subtotal
	3274E_0 24V/173.3Kg-cm/15RPM 168:1 DC Gear Motor w/Encoder Product Code: 3274E *Earning 193 Robo Points For This Item*	Edit		£96.59	2	£193.18

Continue Shopping

Clear Shopping Cart

Update Shopping Basket

SPEND YOUR POINTS

You Will Spend: 0 Points

Maximize my discount with points

DISCOUNT CODES

Enter your voucher code if you have one.

Apply Voucher

ESTIMATE DELIVERY

Enter your destination to get a delivery estimate.

Country*

Peru

County

Lima

Postcode/Zip

01

Get a Quote

Royal Mail

International Signed (Up to 250GBP Compensation) £53.19

Update Total

You Will Earn:	193 Robo Points
Subtotal	£193.18
Delivery (Royal Mail - International Signed (Up to 250GBP Compensation))	£53.19
Grand Total Excl. VAT	**£246.37**
VAT	£0.00
Grand Total Incl. VAT	**£246.37**

Check out with PayPal

-OR-

Proceed to Checkout

Product			Quantity	Price	Total Price
x		#2275 75:1 Metal Gearmotor 25Dx54L mm HP with 48 CPR Encoder	2	$36.95	$73.90
		Subtotal			**$73.90**

FERRETERÍA INDUSTRIAL
TORRES

COMPRA Y VENTA DE ACERO INOXIDABLE, BRONCE, ALUMINIO, COBRE EN:
TUBOS - EJES - PLANCHAS - VARILLAS - MALLAS - PLATINAS
ÁNGULOS - DISCOS - BOCINAS - CONEXIONES EN GENERAL
AV. ARGENTINA 725 PUESTOS 166-156 - LIMA CERCADO
NEXTEL: 838*6085 RPC: 965 773 769

PLASTICOS DE INGENIERÍA Y AISLANTES
- FIBRAS DE VIDRIO
- FERROCEL
- ASBESTO - TEFLÓN
- NYLON BLANCO Y NEGRO
- BAQUELITA Y AFINAS

RUC Nº 10438592798

NOTA DE VENTA

Nº 001341

Señor(es): Jose Junior Palacios

Dirección: .... Teléf.: ....

DÍA	MES	AÑO
08	12	14

CANT.	DESCRIPCIÓN	PREC. UNIT.	IMPORTE
	Servicio de Corte x 8 piezas	25.00	200.00
	Servicio Pieza 1	30,00	
	Servicio Pieza 2	50.00	

Importante.-No es comprobante de pago, sírvase canjear por su Boleta o Factura.
-Una vez salida la mercadería, no hay lugar a cambio ni devoluciones.
-El importe total no incluye el impuesto del IGV.

DESPACHADO POR

TOTAL S/. 200.00

TORRES

COMPRA Y VENTA DE ACERO INOXIDABLE, BRONCE, ALUMINIO, COBRE EN:

TUBOS - EJES - PLANCHAS - VARILLAS - MALLAS - PLATINAS
ÁNGULOS - DISCOS - BOCINAS - CONEXIONES EN GENERAL
AV. ARGENTINA 725 PUESTOS 166-156 - LIMA CERCADO
NEXTEL: 838*6085 RPC: 965 773 769

- ...
- FERROCEL
- ASBESTO - TEFLÓN
- NYLON BLANCO Y NEGRO
- BAQUELITA Y AFINAS

RUC N° 10438592...

NOTA DE VENT...

Nº 001340...

...s): Jose Junior Palacio

...: .... Teléf.: ....

DÍA	MES	A...
08	12	1...

DESCRIPCIÓN	PREC. UNIT.	IMPO...
Plancha Alum ~~3/16~~ x 40 x 50 de 5mm		S/. 68...
" " 3mm x 100 x 72cm		S/. 157...
" " 3mm x 100 cm x 90cm		S/. 170...
" " 3mm x 30 x 50cm		S/. 32...
" " 3mm x 40 x 45cm		S/. 3...
Servicio de Cor		
	TOTAL S/.	442...

-No es comprobante de pago, sírvase canjear por su Boleta o Factura.
-Una vez salida la mercadería, no hay lugar a cambio ni devoluciones.
-El importe total no incluye el impuesto del IGV.

DESPACHADO POR

Shipping Estimate

For shipping the 2 items in your cart to a Peru address, postal code Lima 43:

Shipping service	Price (USD)
USPS First-Class International	21.45
FedEx International Economy	34.45
FedEx International Priority	36.45
USPS Priority Mail International	42.95
USPS Priority Mail Express International	56.45