Anexos

Anexo A: Análisis y Cálculos del Sistema Mecatrónico

A.1 ESPECIFICACIONES DE NORMAS:

Según la norma EN 81-2, relacionada a la iluminación, se especifica que los ascensores pueden ser considerados como pequeñas oficinas y, por lo tanto, se debe tener un mínimo de 50 lux. En el caso de la ventilación, según DIN 1946 se especifica que, en la cabina de los ascensores se debe tener un flujo de aire de $20m^3/\mathrm{h}$ por persona.

A.2 VENTILACIÓN:

$$Caudal\ requerido/persona = 20\ m^3/h\ = 0.333\ m^3/min.$$

Suponiendo que en promedio se encuentran 8 personas usando el ascensor:

$$Caudal\ requerido = 2.664\ m^3/min.$$

Se realizará un ejemplo de cálculo para conocer la potencia total de un ventilador:

- $\mathrm{Caudal\ requerido\ por\ ventilador} = 2.664\ m^3/\mathrm{min}\ \div \mathrm{cantidad\ de\ ventiladores}$

  Suponiendo que se trabajará con 2 ventiladores, entonces:

  $$Caudal\ requerido\ por\ ventilador = 1.332\ m^3/min.$$

- A partir de este caudal hallado, se puede seleccionar el ventilador. Sin embargo este no sería el único criterio para seleccionar los ventiladores, ya que adicionalmente se tienen datos de voltaje, corriente, ruido y la potencia.

- Para hallar la potencia total se realiza una simple operación:

  $$Potencia\ TOTAL = Potencia\ \times número\ dispositivos.$$

A.3 ILUMINACIÓN:

- Las unidades de lux se obtienen de la relación entre la cantidad de lúmenes y área. La magnitud de lúmenes es un dato del producto y como área de cabina se tiene un 2.7 m^2, entonces se requieren de 135 lúmenes para cumplir con suministrar los 50 lux.
- La potencia total se halla de la misma forma que en la parte de ventilación.

Tabla 10 Características de ventiladores

Cant.	Caudal requerido por unidad [m^3/min]	Código de ventilador	Vcc (V)	Potencia (W)	Potencia TOTAL (W)
2	1.332	381-1074-ND	24	2.6	5.2
		381-1073-ND	12	2.4	4.8
4	0.666	259-1619-ND	12	0.8	3.2
		P9763-ND	24	7.08	28.32
6	0.444	603-1278-ND	12	1.2	7.2
		603-1279-ND	12	1.2	7.2
8	0.333	381-2481-ND	24	1	8
		381-2682-ND	12	1	8
		259-1578-ND	12	1.32	10.56

Fuente: *http://www.digikey.com/product-search/es?pv14=126&pv14=127&FV=fff40012%2Cfff80052&k=ventiladores&mnonly=0&newproducts=0&ColumnSort=0&page=1&quantity=0&ptm=0&fid=0&pageSize=25*

Tabla 11 Características de dispositivos de iluminación

Producto	Corriente(mA)	Voltaje(V)	POTENCIA(W)	Lúmenes	Cantidad	POTENCIA TOTAL (W)
289-1185-ND	27	24	0.648	8.3	17	11.016
LE-0603-04W-ND	9	24	0.216	10	14	3.024
LE-0509-01W-ND	15	24	0.36	2	68	24.48
289-1183-ND	14	24	0.336	3.5	39	13.104
LE-0509-02W-ND	20	24	0.48	2.5	54	25.92
289-1181-ND	15	24	0.36	3.5	39	14.04

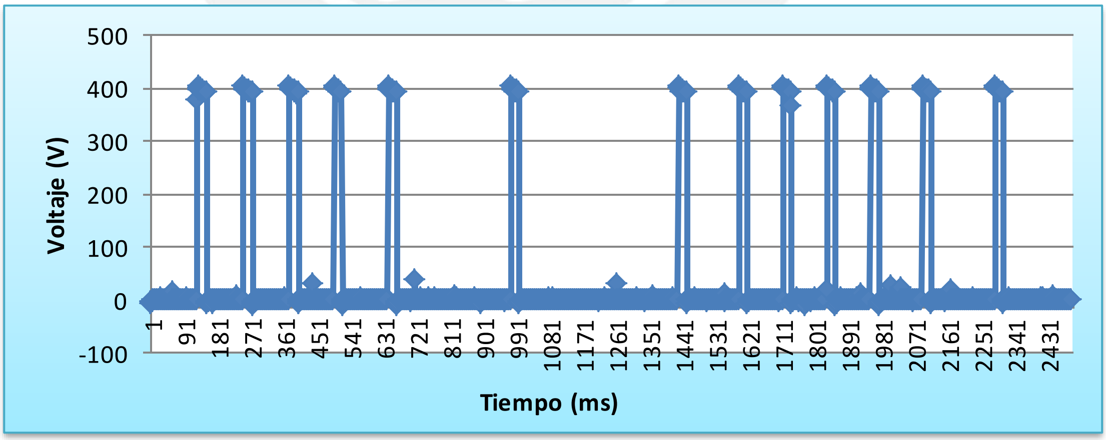
Fuente: *http://www.digikey.com/product-search/es?v=289&FV=fff40008%2Cfff8028b%2C940008%2C4fc0036&k=LED&mnonly=0&newproducts=0&ColumnSort=0&page=1&quantity=0&ptm=0&fid=0&pageSize=25*

A.4 CÁLCULO DE DISPOSITIVOS DE ALMACENAMIENTO EN 1° ETAPA

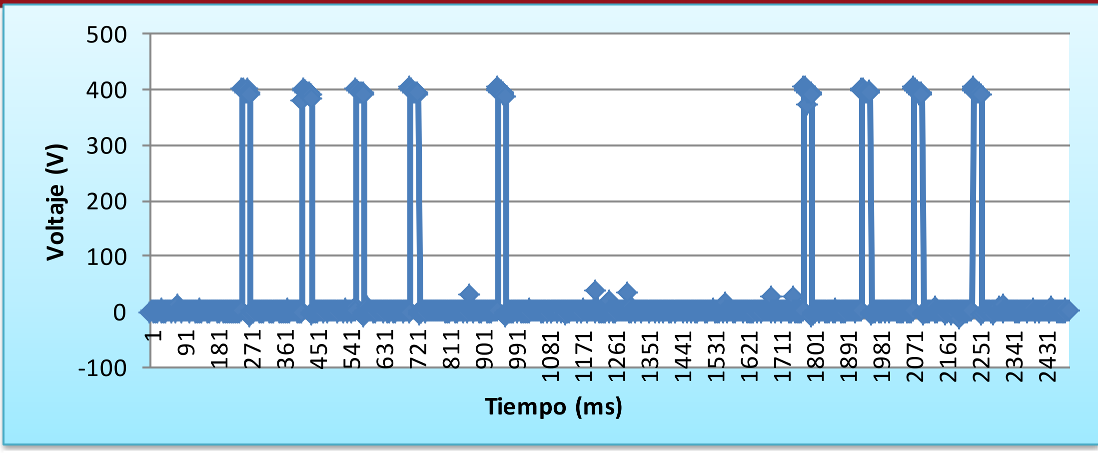
Para este segmento se tuvieron en cuenta la adquisición de datos en un estudio previo a un ascensor. Los gráficos presentados líneas abajo son datos adquiridos durante el frenado del ascensor en su funcionamiento normal. Se presentan los datos adquiridos en la Tabla 2 y las gráficas relacionadas:

Tabla 12 Datos de consumo de energía de ascensor en funcionamiento

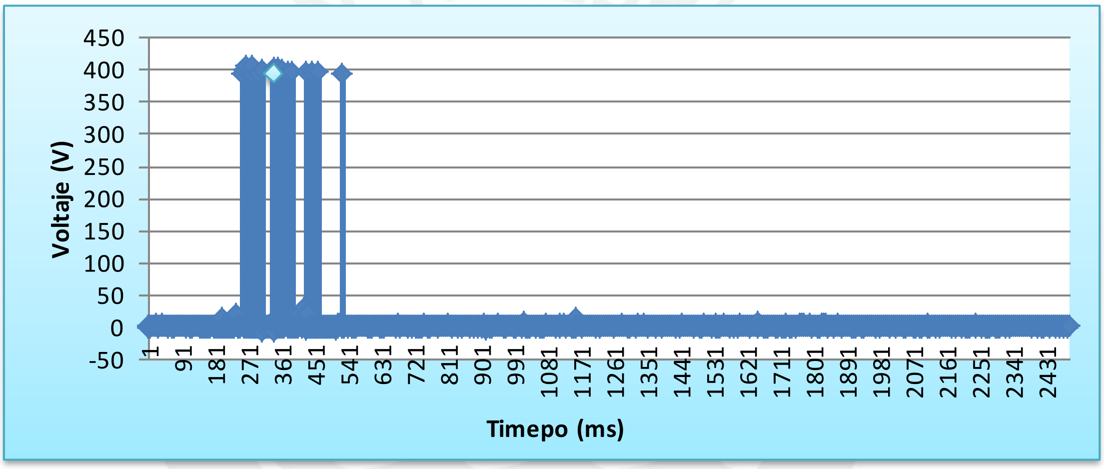
Gráfica	Voltaje máximo (V)	Energía (W-s)	Energía (kW-h)	Potencia promedio (W)	Cantidad de pulsos significativos
1	404	238.24	6.62×10^{-5}	440.1	12
2	404	160.34	4.45×10^{-5}	321.8	9
3	404	282	7.84×10^{-5}	205.6	18
4	402	1588.25	4.41×10^{-4}	562.6	91
5	404	3330	8.69×10^{-4}	365.5	201



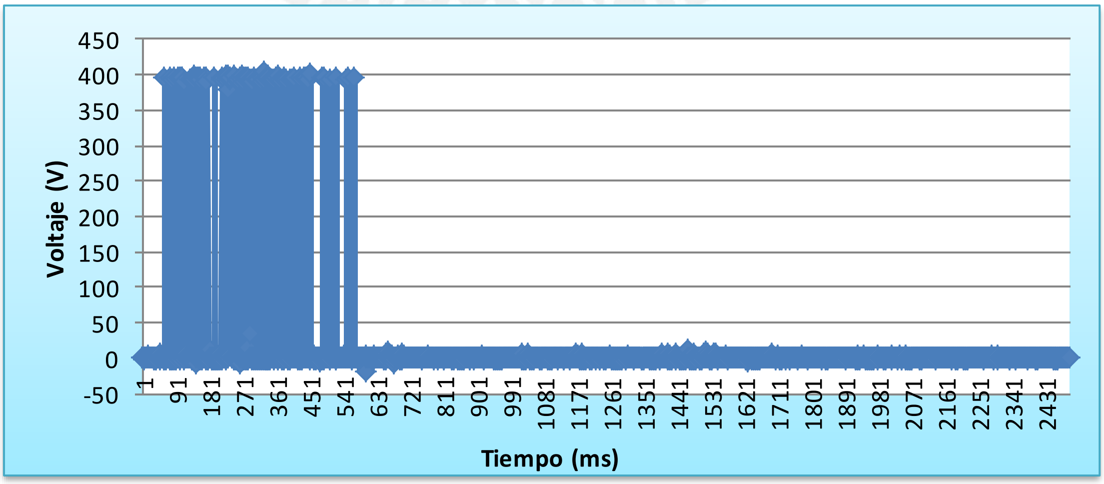
Gráfica 1 Primera adquisición de datos de un ascensor



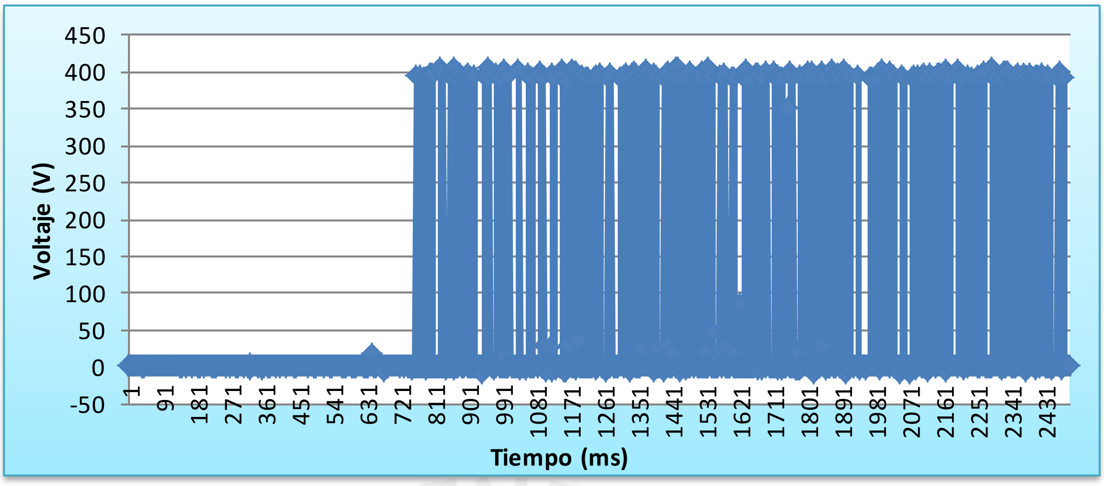
Gráfica 1 Segunda adquisición de datos de un ascensor



Gráfica 2 Tercera adquisición de datos de un ascensor



Gráfica 3 Cuarta adquisición de datos de un ascensor



Gráfica 4 Quinta adquisición de datos de un ascensor

Se obtuvieron datos críticos en la Gráfica 5:

- Máximo voltaje: 404 V
- Número de pulsos significativos (voltaje mayor a 300V): 201
- Duración del tren de impulsos: 3.44 segundos
- **Energía: 3330 Joules**

A partir de estos datos de energía y voltaje que ingresaría a nuestro sistema se puede calcular y seleccionar la capacitancia para la primera etapa:

$$\boldsymbol{C = 3330 * \frac{2}{404^2} = 0.04080\ F.}$$

$$\boldsymbol{C = 40800\ \mu F.}$$

Para poder escalar esta magnitud y adaptarla a nuestro prototipo y simular el funcionamiento a 48V se debe a aplicar el siguiente factor:

$$\boldsymbol{Factor = \frac{48V}{404V} = 0.12.}$$

Para el cálculo de la capacitancia en la simulación (48V) se tendría:

$$C = 0.12 * 40800\ \mu F.$$

$$C = 4896\ \mu F.$$

Entonces se tendría una capacidad de energía de:

$$C = 0.5 * 4896 * 10^{-6} * 48^2 = 5.64\ J.$$

A.5 CÁLCULO DE RESISTENCIA DE POTENCIA (DISIPACIÓN DE CALOR)

Teniendo en cuenta que el tren de impulsos en la simulación tiene una duración aproximada a los 3.44 segundos y que el MOSFET dirigido a la resistencia de disipación se encuentra en estado de conducción, se procede a calcular la potencia que se tendría que disipar:

$$Potencia = 5.64\ J * 3.44\ s = 19.4\ W.$$

A.6 CÁLCULO DE DISPOSITIVOS DE ALMACENAMIENTO EN 2° ETAPA

La segunda etapa de almacenamiento se encarga de alimentar a los dispositivos de alimentación y ventilación. El parámetro a tomar en cuenta es la potencia que requieren estos dispositivos en total. Los siguientes dispositivos son aquellos que serían tomados en cuenta en una **situación real**:

- 2 ventiladores 381-1074-ND, la potencia total necesaria sería 5.2W
- 14 dispositivos de iluminación LED de código LE-0603-04W-ND, con una potencia total de 3.024 W.

Para calcular el total de kilowatts-hora:

$$kilowatts - hora\ al\ día = (5.2 + 3.024) * \frac{24}{1000} = 0.197\ kW - h.$$

Como los dispositivos trabajan con 24V es posible obtener la magnitud de amperios-hora y así poder seleccionar la batería más adecuada:

$$amperios - hora = 0.197 * \frac{1000}{24} = 8.224Ah.$$

En el caso de la **experimentación** se seleccionaron los dispositivos con menor potencia de consumo, 24V de alimentación, sólo un ventilador y sólo un dispositivo de iluminación. Entonces de las tablas de dispositivos se seleccionan:

- El ventilador 381-2481-ND de 1W
- El dispositivo de iluminación LE-0603-04W-ND de 0.216W

Los kilowatts-hora al día se calculan de la misma manera, y se obtienen:

$$\boldsymbol{kilowatts - hora\ al\ día = 0.029kW - h.}$$

De la misma manera también se obtienen los amperios-hora:

$$\boldsymbol{amperios - hora = 0.029 * \frac{1000}{24} = 1.216Ah.}$$

Para la parte de simulación, los dispositivos de ventilación e iluminación que se señalan son solo para tener una referencia de cuánto debería ser el MÍNIMO de amperios-hora que deben ser capaces de brindar las baterías.

Anexo B: Sistemas Electrónicos

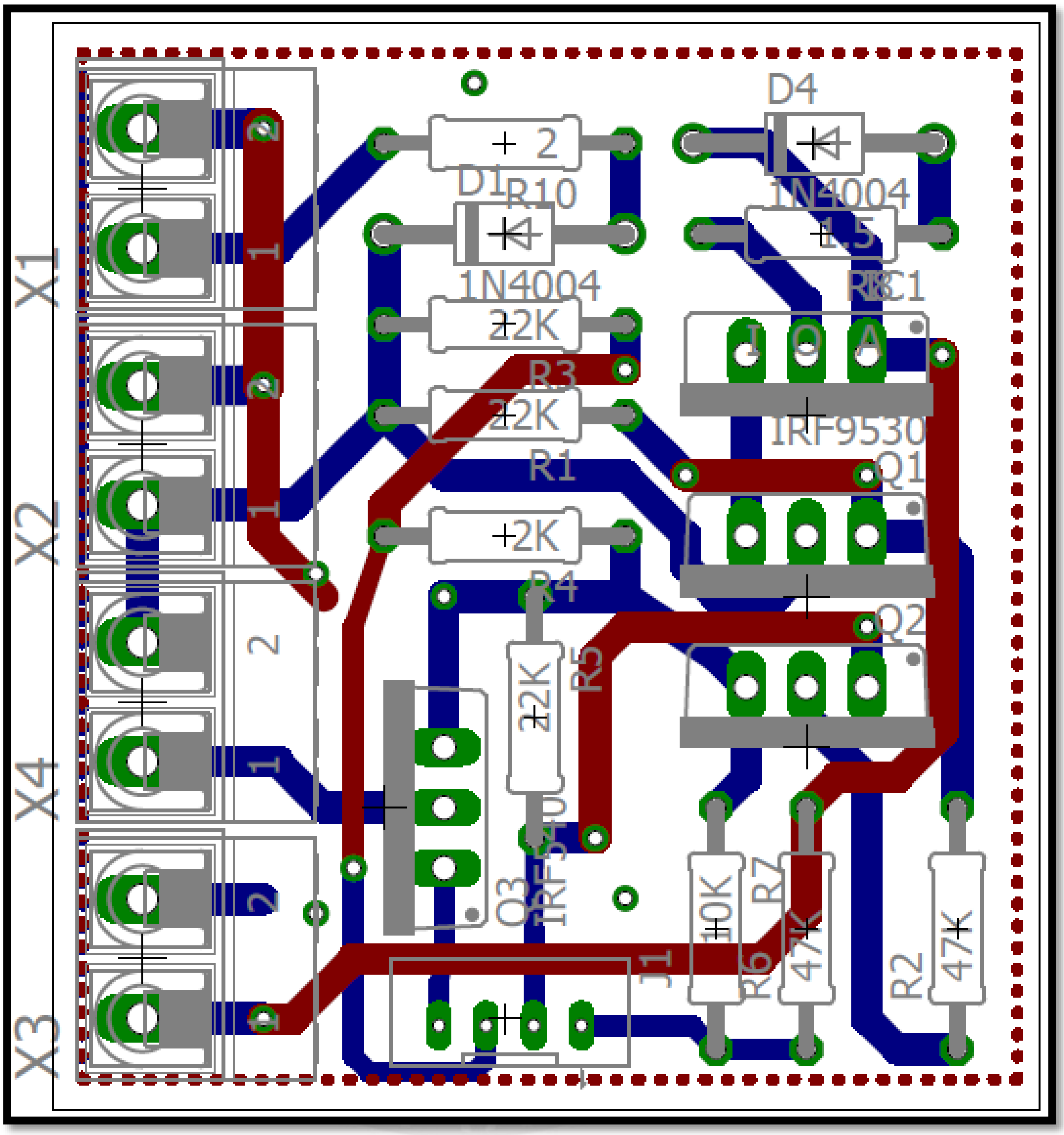


Figura 21 Tarjeta empleada en simulación de sistema

International IOR Rectifier

PD - 94758

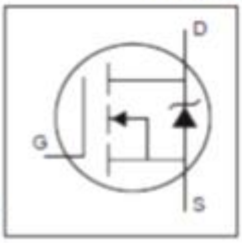
AUTOMOTIVE MOSFET

IRF540Z
IRF540ZS
IRF540ZL

HEXFET® Power MOSFET

Features

- Advanced Process Technology
- Ultra Low On-Resistance
- 175°C Operating Temperature
- Fast Switching
- Repetitive Avalanche Allowed up to Tjmax



V_{DSS} = 100V

$R_{DS(on)}$ = 26.5mΩ

I_D = 36A

Description

Specifically designed for Automotive applications, this HEXFET® Power MOSFET utilizes the latest processing techniques to achieve extremely low on-resistance per silicon area. Additional features of this design are a 175°C junction operating temperature, fast switching speed and improved repetitive avalanche rating . These features combine to make this design an extremely efficient and reliable device for use in Automotive applications and a wide variety of other applications.

TO-220AB IRF540Z | D²Pak IRF540ZS | TO-262 IRF540ZL

Absolute Maximum Ratings

	Parameter	Max.	Units
I_D @ T_C = 25°C	Continuous Drain Current, V_{GS} @ 10V (Silicon Limited)	36	A
I_D @ T_C = 100°C	Continuous Drain Current, V_{GS} @ 10V	25	
I_{DM}	Pulsed Drain Current	140	
P_D @T_C = 25°C	Power Dissipation	92	W
	Linear Derating Factor	0.61	W/°C
V_{GS}	Gate-to-Source Voltage	± 20	V
E_{AS} (Thermally limited)	Single Pulse Avalanche Energy	83	mJ
E_{AS} (Tested)	Single Pulse Avalanche Energy Tested Value	120	
I_{AR}	Avalanche Current	See Fig.12a, 12b, 15, 16	A
E_{AR}	Repetitive Avalanche Energy		mJ
T_J T_{STG}	Operating Junction and Storage Temperature Range	-55 to + 175	°C
	Soldering Temperature, for 10 seconds	300 (1.6mm from case)	
	Mounting Torque, 6-32 or M3 screw	10 lbf•in (1.1N•m)	

Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{θJC}$	Junction-to-Case	—	1.64	°C/W
$R_{θCS}$	Case-to-Sink, Flat Greased Surface	0.50	—	
$R_{θJA}$	Junction-to-Ambient	—	62	
$R_{θJA}$	Junction-to-Ambient (PCB Mount)	—	40	

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IRF540Z/S/L

International IOR Rectifier

Electrical Characteristics @ T_J = 25°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	100	—	—	V	V_{GS} = 0V, I_D = 250μA
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.093	—	V/°C	Reference to 25°C, I_D = 1mA
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	21	26.5	mΩ	V_{GS} = 10V, I_D = 22A
$V_{GS(th)}$	Gate Threshold Voltage	2.0	—	4.0	V	V_{DS} = V_{GS}, I_D = 250μA
gfs	Forward Transconductance	36	—	—	V	V_{DS} = 25V, I_D = 22A
I_{DSS}	Drain-to-Source Leakage Current	—	—	20	μA	V_{DS} = 100V, V_{GS} = 0V
		—	—	250		V_{DS} = 100V, V_{GS} = 0V, T_J = 125°C
I_{GSS}	Gate-to-Source Forward Leakage	—	—	200	nA	V_{GS} = 20V
	Gate-to-Source Reverse Leakage	—	—	-200		V_{GS} = -20V
Q_g	Total Gate Charge	—	42	63	nC	I_D = 22A
Q_{gs}	Gate-to-Source Charge	—	9.7	—		V_{DS} = 80V
Q_{gd}	Gate-to-Drain ("Miller") Charge	—	15	—		V_{GS} = 10V
$t_{d(on)}$	Turn-On Delay Time	—	15	—	ns	V_{DD} = 50V
t_r	Rise Time	—	51	—		I_D = 22A
$t_{d(off)}$	Turn-Off Delay Time	—	43	—		R_G = 12 Ω
t_f	Fall Time	—	39	—		V_{GS} = 10V
L_D	Internal Drain Inductance	—	4.5	—	nH	Between lead, 6mm (0.25in.)
L_S	Internal Source Inductance	—	7.5	—		from package and center of die contact
C_{iss}	Input Capacitance	—	1770	—	pF	V_{GS} = 0V
C_{oss}	Output Capacitance	—	180	—		V_{DS} = 25V
C_{rss}	Reverse Transfer Capacitance	—	100	—		ƒ = 1.0MHz
C_{oss}	Output Capacitance	—	730	—		V_{GS} = 0V, V_{DS} = 1.0V, ƒ = 1.0MHz
C_{oss}	Output Capacitance	—	110	—		V_{GS} = 0V, V_{DS} = 80V, ƒ = 1.0MHz
C_{oss} eff.	Effective Output Capacitance	—	170	—		V_{GS} = 0V, V_{DS} = 0V to 80V

Source-Drain Ratings and Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	—	—	36	A	MOSFET symbol showing the
I_{SM}	Pulsed Source Current (Body Diode)	—	—	140		integral reverse p-n junction diode.
V_{SD}	Diode Forward Voltage	—	—	1.3	V	T_J = 25°C, I_S = 22A, V_{GS} = 0V
t_{rr}	Reverse Recovery Time	—	33	50	ns	T_J = 25°C, I_F = 22A, V_{DD} = 50V
Q_{rr}	Reverse Recovery Charge	—	41	62	nC	di/dt = 100A/μs
t_{on}	Forward Turn-On Time	Intrinsic turn-on time is negligible (turn-on is dominated by LS+LD)				

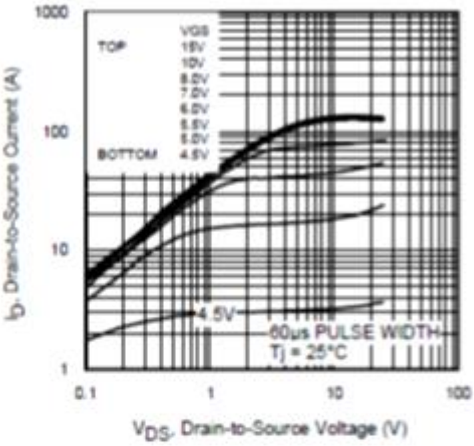


Fig 1. Typical Output Characteristics

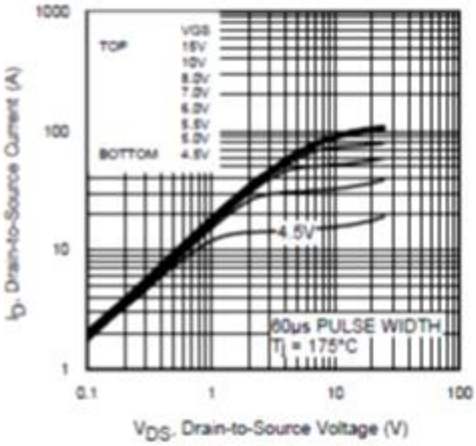


Fig 2. Typical Output Characteristics

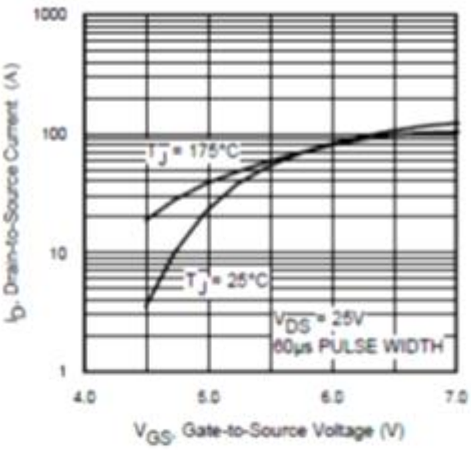


Fig 3. Typical Transfer Characteristics

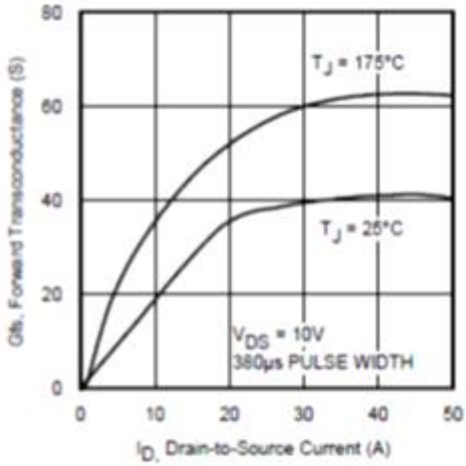


Fig 4. Typical Forward Transconductance Vs. Drain Current

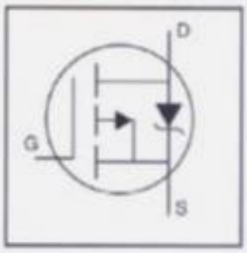
International
IOR Rectifier

PD - 94790A

IRF9540NPbF

HEXFET® Power MOSFET

- Lead-Free
- Advanced Process Technology
- Dynamic dv/dt Rating
- 175°C Operating Temperature
- Fast Switching
- P-Channel
- Fully Avalanche Rated



V_{DSS} = -100V

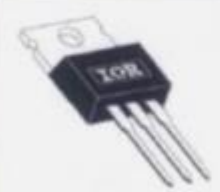
$R_{DS(on)}$ = 0.117Ω

I_D = -23A

Description

Fifth Generation HEXFETs from International Rectifier utilize advanced processing techniques to achieve extremely low on-resistance per silicon area. This benefit, combined with the fast switching speed and ruggedized device design that HEXFET Power MOSFETs are well known for, provides the designer with an extremely efficient and reliable device for use in a wide variety of applications.

The TO-220 package is universally preferred for all commercial-industrial applications at power dissipation levels to approximately 50 watts. The low thermal resistance and low package cost of the TO-220 contribute to its wide acceptance throughout the industry.



TO-220AB

Absolute Maximum Ratings

	Parameter	Max.	Units
I_D @ T_C = 25°C	Continuous Drain Current, V_{GS} @ -10V	-23	A
I_D @ T_C = 100°C	Continuous Drain Current, V_{GS} @ -10V	-16	
I_{DM}	Pulsed Drain Current ①	-76	
P_D @ T_C = 25°C	Power Dissipation	140	W
	Linear Derating Factor	0.91	W/°C
V_{GS}	Gate-to-Source Voltage	± 20	V
E_{AS}	Single Pulse Avalanche Energy②	430	mJ
I_{AR}	Avalanche Current①	-11	A
E_{AR}	Repetitive Avalanche Energy①	14	mJ
dv/dt	Peak Diode Recovery dv/dt ③	-5.0	V/ns
T_J T_{STG}	Operating Junction and Storage Temperature Range	-55 to + 175	°C
	Soldering Temperature, for 10 seconds	300 (1.6mm from case)	
	Mounting torque, 6-32 or M3 srew	10 lbf•in (1.1N•m)	

Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{θJC}$	Junction-to-Case	——	1.1	°C/W
$R_{θCS}$	Case-to-Sink, Flat, Greased Surface	0.50	——	
$R_{θJA}$	Junction-to-Ambient	——	62	

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IRF9540NPbF

International IOR Rectifier

Electrical Characteristics @ $T_J = 25°C$ (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	-100	—	—	V	$V_{GS} = 0V$, $I_D = -250\mu A$
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	-0.11	—	V/°C	Reference to 25°C, $I_D = -1mA$
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	—	0.117	Ω	$V_{GS} = -10V$, $I_D = -11A$ ④
$V_{GS(th)}$	Gate Threshold Voltage	-2.0	—	-4.0	V	$V_{DS} = V_{GS}$, $I_D = -250\mu A$
g_{fs}	Forward Transconductance	5.3	—	—	S	$V_{DS} = -50V$, $I_D = -11A$
I_{DSS}	Drain-to-Source Leakage Current	—	—	-25	μA	$V_{DS} = -100V$, $V_{GS} = 0V$
		—	—	-250		$V_{DS} = -80V$, $V_{GS} = 0V$, $T_J = 150°C$
I_{GSS}	Gate-to-Source Forward Leakage	—	—	100	nA	$V_{GS} = 20V$
	Gate-to-Source Reverse Leakage	—	—	-100		$V_{GS} = -20V$
Q_g	Total Gate Charge	—	—	97	nC	$I_D = -11A$
Q_{gs}	Gate-to-Source Charge	—	—	15		$V_{DS} = -80V$
Q_{gd}	Gate-to-Drain ("Miller") Charge	—	—	51		$V_{GS} = -10V$, See Fig. 6 and 13 ④
$t_{d(on)}$	Turn-On Delay Time	—	15	—	ns	$V_{DD} = -50V$
t_r	Rise Time	—	67	—		$I_D = -11A$
$t_{d(off)}$	Turn-Off Delay Time	—	51	—		$R_G = 5.1\Omega$
t_f	Fall Time	—	51	—		$R_D = 4.2\Omega$, See Fig. 10 ④
L_D	Internal Drain Inductance	—	4.5	—	nH	Between lead, 6mm (0.25in.)
L_S	Internal Source Inductance	—	7.5	—		from package and center of die contact
C_{iss}	Input Capacitance	—	1300	—	pF	$V_{GS} = 0V$
C_{oss}	Output Capacitance	—	400	—		$V_{DS} = -25V$
C_{rss}	Reverse Transfer Capacitance	—	240	—		$f = 1.0MHz$, See Fig. 5

Source-Drain Ratings and Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	—	—	-23	A	MOSFET symbol showing the
I_{SM}	Pulsed Source Current (Body Diode) ①	—	—	-76		integral reverse p-n junction diode.
V_{SD}	Diode Forward Voltage	—	—	-1.6	V	$T_J = 25°C$, $I_S = -11A$, $V_{GS} = 0V$ ④
t_{rr}	Reverse Recovery Time	—	150	220	ns	$T_J = 25°C$, $I_F = -11A$
Q_{rr}	Reverse Recovery Charge	—	830	1200	nC	$di/dt = -100A/\mu s$ ④
t_{on}	Forward Turn-On Time	Intrinsic turn-on time is negligible (turn-on is dominated by L_S+L_D)				

Notes:

① Repetitive rating; pulse width limited by max. junction temperature. (See fig. 11)

② Starting $T_J = 25°C$, $L = 7.1mH$, $R_G = 25\Omega$, $I_{AS} = -11A$. (See Figure 12)

③ $I_{SD} \leq -11A$, $di/dt \leq -470A/\mu s$, $V_{DD} \leq V_{(BR)DSS}$, $T_J \leq 175°C$

④ Pulse width ≤ 300μs; duty cycle ≤ 2%.

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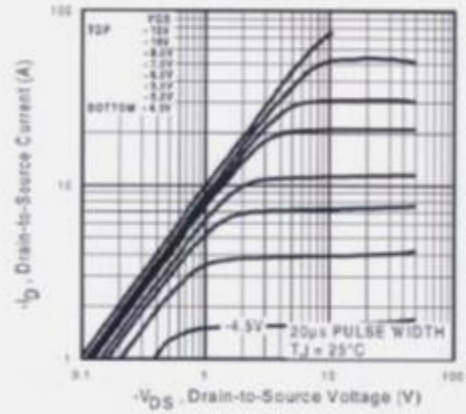


Fig 1. Typical Output Characteristics

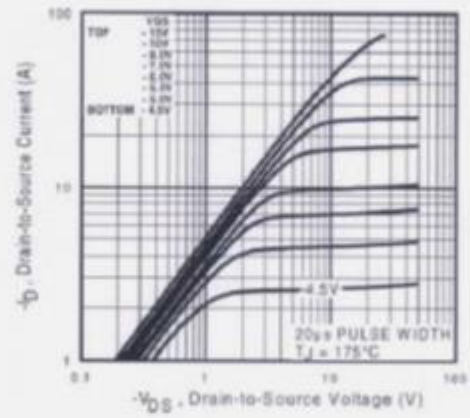


Fig 2. Typical Output Characteristics

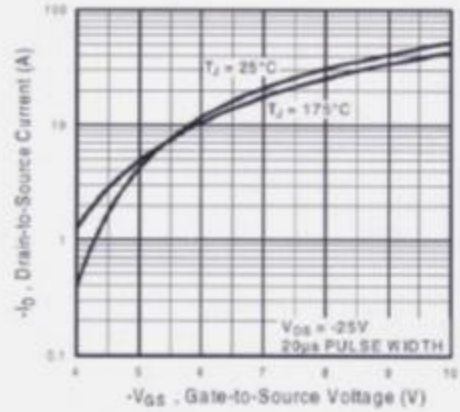


Fig 3. Typical Transfer Characteristics

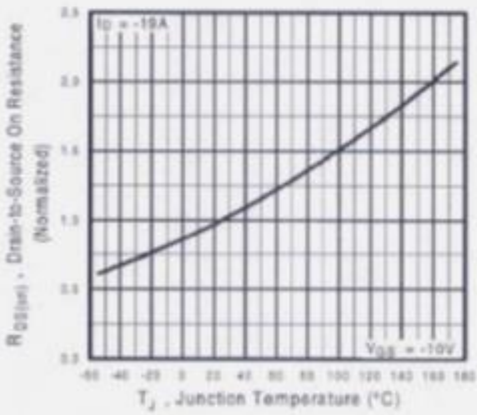


Fig 4. Normalized On-Resistance Vs. Temperature

LM117HV/LM317HV 3-Terminal Adjustable Regulator

Check for Samples: LM117HV, LM317HV

FEATURES

- Adjustable Output Down to 1.2V
- Specified 1.5A Output Current
- Line Regulation Typically 0.01%/V
- Load Regulation Typically 0.1%
- Current Limit Constant with Temperature
- 100% Electrical Burn-in
- Eliminates the Need to Stock Many Voltages
- Standard 3-lead Transistor Package
- 80 dB Ripple Rejection
- Output is Short-circuit Protected
- P⁺ Product Enhancement Tested

DESCRIPTION

The LM117HV/LM317HV are adjustable 3-terminal positive voltage regulators capable of supplying in excess of 1.5A over a 1.2V to 57V output range. They are exceptionally easy to use and require only two external resistors to set the output voltage. Further, both line and load regulation are better than standard fixed regulators. Also, the LM117HV is packaged in standard transistor packages which are easily mounted and handled.

In addition to higher performance than fixed regulators, the LM117HV series offers full overload protection available only in IC's. Included on the chip are current limit, thermal overload protection and safe area protection. All overload protection circuitry remains fully functional even if the adjustment terminal is disconnected.

Normally, no capacitors are needed unless the device is situated more than 6 inches from the input filter capacitors in which case an input bypass is needed. An optional output capacitor can be added to improve transient response. The adjustment terminal can be bypassed to achieve very high ripple rejections ratios which are difficult to achieve with standard 3-terminal regulators.

Besides replacing fixed regulators, the LM117HV is useful in a wide variety of other applications. Since the regulator is "floating" and sees only the input-to-output differential voltage, supplies of several hundred volts can be regulated as long as the maximum input to output differential is not exceeded, i.e. do not short the output to ground.

Also, it makes an especially simple adjustable switching regulator, a programmable output regulator, or by connecting a fixed resistor between the adjustment and output, the LM117HV can be used as a precision current regulator. Supplies with electronic shutdown can be achieved by clamping the adjustment terminal to ground which programs the output to 1.2V where most loads draw little current.

The LM117HVK STEEL and LM317HVK STEEL are packaged in standard TO-3 transistor packages, while the LM117HVH and LM317HVH are packaged in a solid Kovar base TO transistor package. The LM317HVT uses a TO-220 plastic package. The LM117HV is rated for operation from −55°C to +150°C, and the LM317HV from 0°C to +125°C.

Connection Diagrams

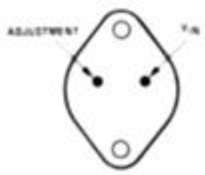


Figure 1. (TO-3)
Metal Can Package
Case is Output
Bottom View
See Package Number NDS0002A

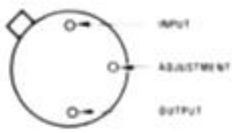


Figure 2. (TO)
Metal Can Package
Case is Output
Bottom View
See Package Number NDT0003A

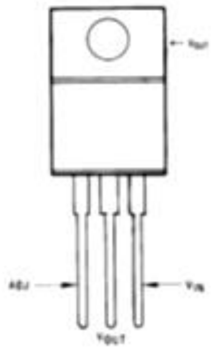
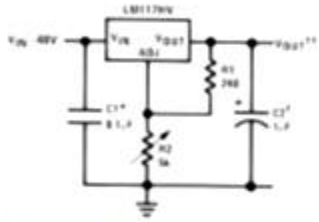


Figure 3. (TO-220)
Plastic Package
Front View
See Package Number NDE0003B

Typical Applications



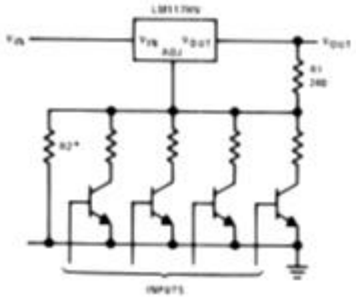
Full output current not available at high input-output voltages

†Optional—improves transient response. Output capacitors in the range of 1 μF to 1000 μF of aluminum or tantalum electrolytic are commonly used to provide improved output impedance and rejection of transients.

*Needed if device is more than 6 inches from filter capacitors.

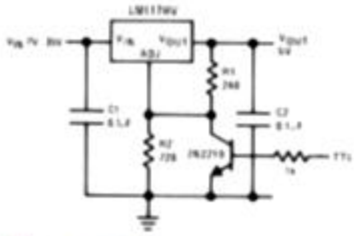
$$††V_{OUT} = 1.25V\left(1 + \frac{R2}{R1}\right) + I_{ADJ} R_2$$

Figure 4. 1.2V-45V Adjustable Regulator



*Sets maximum V_{OUT}

Figure 5. Digitally Selected Outputs



*Min. output ≈ 1.2V

Figure 6. 5V Logic Regulator with Electronic Shutdown*

These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

ABSOLUTE MAXIMUM RATINGS[1][2]

Power Dissipation		Internally limited
Input—Output Voltage Differential		+60V, −0.3V
Operating Junction Temperature Range	LM117HV	−55°C to +150°C
	LM317HV	0°C to +125°C
Storage Temperature		−65°C to +150°C
Lead Temperature (Soldering, 10 sec.)		300°C
ESD Tolerance[3]		2000V

(1) "Absolute Maximum Ratings" indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is functional, but do not ensure specific performance limits.
(2) Refer to RETS117HVH for LM117HVH or RETS117HVK for LM117HVK military specifications.
(3) Human body model, 1.5 kΩ in series with 100 pF.

ELECTRICAL CHARACTERISTICS[1]

Parameter	Conditions	LM117HV			LM317HV			Units
		Min	Typ	Max	Min	Typ	Max	
Line Regulation	$T_J = 25°C$, $3V \le V_{IN} - V_{OUT} \le 60V$ $I_L = 10$ mA[2]		0.01	0.02		0.01	0.04	%/V
Load Regulation	$T_J = 25°C$, $10 mA \le I_{OUT} \le I_{MAX}$		0.1	0.3		0.1	0.5	%
Thermal Regulation	$T_J = 25°C$, 20 ms Pulse		0.03	0.07		0.04	0.07	%/W
Adjustment Pin Current			50	100		50	100	μA
Adjustment Pin Current Change	$10 mA \le I_L \le I_{MAX}$ $3.0 V \le (V_{IN} - V_{OUT}) \le 60V$		0.2	5		0.2	5	μA
Reference Voltage	$3.0 V \le (V_{IN} - V_{OUT}) \le 60V$[3] $10 mA \le I_{OUT} \le I_{MAX}$, $P \le P_{MAX}$	1.20	1.25	1.30	1.20	1.25	1.30	V
Line Regulation	$3.0V \le (V_{IN} - V_{OUT}) \le 60V$, $I_L = 10$ mA,[2]		0.02	0.05		0.02	0.07	%/V
Load Regulation	$10 mA \le I_{OUT} \le I_{MAX}$[2]		0.3	1		0.3	1.5	%
Temperature Stability	$T_{MIN} \le T_J \le T_{MAX}$		1			1		%
Minimum Load Current	$(V_{IN} - V_{OUT}) = 60V$		3.5	7		3.5	12	mA
Current Limit	$(V_{IN} - V_{OUT}) \le 15V$							
	K, NDE Packages	1.5	2.2	3.5	1.5	2.2	3.7	A
	NDT Package	0.5	0.8	1.8	0.5	0.8	1.9	A
	$(V_{IN} - V_{OUT}) \le 60V$							
	K, NDE Packages		0.3			0.3		A
	NDT Package		0.03			0.03		A
RMS Output Noise, % of V_{OUT}	$T_J = 25°C$, $10 Hz \le f \le 10 kHz$		0.003			0.003		%
Ripple Rejection Ratio	$V_{OUT} = 10V$, f = 120 Hz		65			65		dB
	$C_{ADJ} = 10$ μF	66	80		66	80		dB
Long-Term Stability	$T_J = 125°C$		0.3	1		0.3	1	%

(1) Unless otherwise specified, these specifications apply: $-55°C \le T_J \le +150°C$ for the LM117HV, and $0°C \le T_J \le +125°C$ for the LM317HV; $V_{IN} - V_{OUT} = 5V$ and $I_{OUT} = 0.1A$ for the TO package and $I_{OUT} = 0.5A$ for the TO-3 and TO-220 packages. Although power dissipation is internally limited, these specifications are applicable for power dissipations of 2W for the TO and 20W for the TO-3 and TO-220. I_{MAX} is 1.5A for the TO-3 and TO-220 and 0.5A for the TO package.
(2) Regulation is measured at constant junction temperature. Changes in output voltage due to heating effects must be taken into account separately. Pulse testing with low duty cycle is used.
(3) Refer to RETS117HVH for LM117HVH or RETS117HVK for LM117HVK military specifications.

ELECTRICAL CHARACTERISTICS[1] (continued)

Parameter	Conditions	LM117HV			LM317HV			Units
		Min	Typ	Max	Min	Typ	Max	
Thermal Resistance, Junction to Case	NDT Package		12	15		12	15	°C/W
	NDE Package					4	5	°C/W
	NDS Package		2.3	3		2.3	3	°C/W
Thermal Resistance, Junction to Ambient (no heat sink)	NDT Package		140			140		°C/W
	NDE Package					50		°C/W
	NDS Package		35			35		°C/W

TYPICAL PERFORMANCE CHARACTERISTICS

Output capacitor = 0 µF unless otherwise noted.

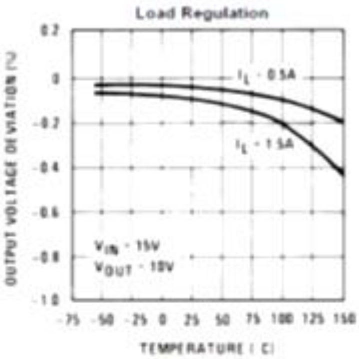


Figure 7.

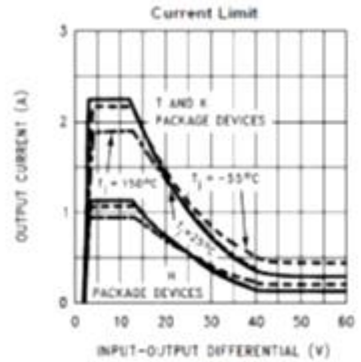


Figure 8.

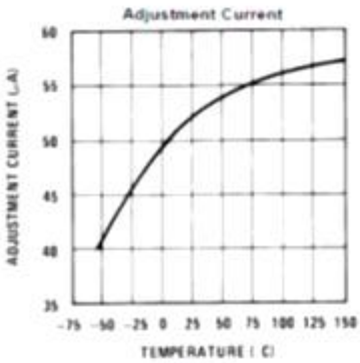


Figure 9.

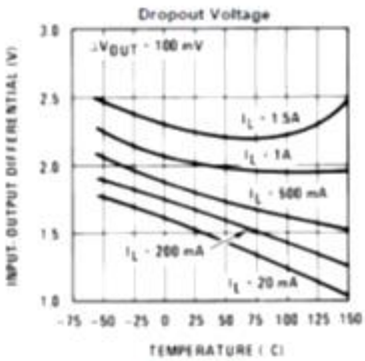


Figure 10.

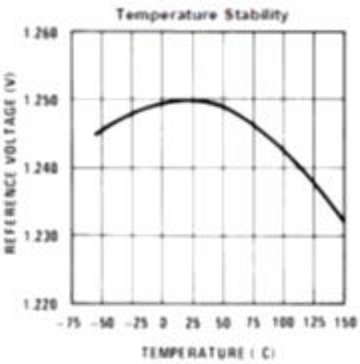


Figure 11.

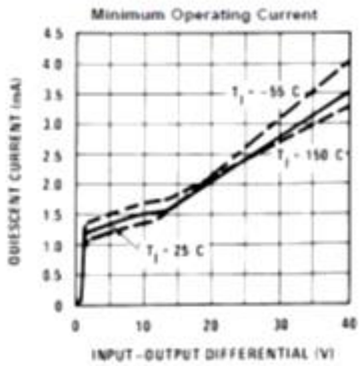


Figure 12.

Anexo C: Programas

PROGRAMA 1: (Funcionamiento normal del sistema)

```
int in_capacitor=A0;   //carga de capacitor
int in_bate=A1;        //carga de baterías
int out_mosfet_resis=4;      //habilita disipación de energía en resistencia
int out_mosfet_317=5;        //habilita flujo de energía en LM317hv
void setup()
{
  // put your setup code here, to run once:
  pinMode(in_capacitor, INPUT);
  pinMode(in_bate, INPUT);
  pinMode(out_mosfet_resis, OUTPUT);
  pinMode(out_mosfet_317, OUTPUT);

  digitalWrite(out_mosfet_resis,LOW);
  digitalWrite(out_mosfet_317,LOW);
}

  void loop()
{
  // put your main code here, to run repeatedly:
  //inicializo mis salidas en cero = mosfets en corte
  // 778 indica la carga completa del condensador
    while (analogRead(2)<=778)
          {
       // se mantiene en este loop hasta que se cargue el condensador en
95%
          digitalWrite(5,LOW);
       Serial.print("condensador cargando ");
       Serial.print(in_bate/800);
       //800 designa el 100% de la carga del condensador
       Serial.print("%");
          }
    Serial.print("condensador cargado ");
    Serial.print("condensador cargado ");
    Serial.print("condensador cargado ");
       //990 indica la carga completa de las baterías
    while (analogRead(3)<=990)
          {
       // se mantiene en este loop hasta que las baterías se llenen
          digitalWrite(5,HIGH);
       Serial.print("batería cargando");
       Serial.print(in_bate/990);
       Serial.print("%");
          }
  Serial.print("batería cargada");Serial.print("batería
cargada");Serial.print("batería cargada");
```

```
  //si tanto baterías como condensadores se encuentran llenos entonces se
  //disipa la energía en forma de calor
  digitalWrite(4,HIGH);
  Serial.print("disipando energía");
  //se cierra el paso de energía a las baterías
  digitalWrite(5,LOW);
  Serial.print("no ingresa energía a baterías");

  delay(2);
}
```

PROGRAMA 2: (Generación de ondas cuadradas que simulan frenado de ascensor.)

```
int outPin = 10;

void setup()
{
  pinMode(outPin, OUTPUT);      // sets se habilita el pin 10 como salida
}

void loop()
{
  unsigned long s=0;
  s=millis();
  while(millis()-s <= 10000)
  {
  digitalWrite(outPin, HIGH);   // pin 10 activado
  delayMicroseconds(900);        // pausa de 900 microsegundos
  digitalWrite(outPin, LOW);    // pin 10 desactivado
  delayMicroseconds(100);
  delay(9);        // pausa de 9 milisegundos
  }
 // esta ráfaga de pulsos se generará durante 10 segundos cada minuto
  s=millis();
  while(millis()-s <= 50000)
  {
    digitalWrite(outPin, LOW);
  }

}
```

PROGRAMA 3: (programa empleado para probar carga directa de baterías mediante tarjeta diseñada, se habilita flujo de energía por LM317hv)

```
int out_mosfet_317=5;
void setup() {
  // put your setup code here, to run once:
pinMode(out_mosfet_317,OUTPUT);
digitalWrite(out_mosfet_317,HIGH);
}

void loop() {
  // put your main code here, to run repeatedly:

}
```

Anexo D: Proformas

Componentes principales que se importarían para sistema real

ARTECH Solutions

ARTECH SOLUTIONS SAC
Calle Cavallini 150, San Borja. Lima - Perú.
Telefonos: 365-0735 99781-0851
email: ventas@artech.com.pe
www.artech.com.pe

Lima, 28 de Mayo de 2015

Atención: PONTIFICA UNIVERSIDAD CATOLICA DEL PERU

Referencia : Componentes Electrónicos

COTIZACION 150529
De acuerdo a su solicitud adjunto la cotización de los siguientes componentes electrónicos:

Ítem	Cantidad	Código	Descripción	Precio Unitario US $	Precio Total US $
1	3	E36D451CSN203MFP0M-ND	Capacitor de aluminio 20000uF 450V	245.8	737.4
2	2	522-1023-ND	Baterías 12V 8Ah	94.0	188.0
			SUB-TOTAL U.S. $		925.4
			IGV		166.57
			TOTAL U.S. $		1091.97

CONSIDERACIONES.

- El plazo de entrega es de 21 días a partir de la orden de compra.
- La presente cotización tiene validez de 30 días.
- Puede realizar el pago a través de transferencia a nuestra cuenta corriente dólares en el BCP : 193-1797084-1-72

Laureano Rodríguez Polo
Gerente General
ARTECH SOLUTIONS SAC

LISTADO DE PRECIOS DE DISPOSITIVOS EMPLEADOS EN EXPERIMENTACIÓN

CANTIDAD	DESCRIPCIÓN	SUBTOTAL	IGV	TOTAL
1	CIRCUITO IMPRESO EN FIBRA DE VIDRIO CON MÁSCARA Y DISTRIBUCIÓN	12	2.16	14.16
2	MOSFET IRF540	4.92	1.08	6
1	MOSFET IRF9540	2.46	0.54	3
2	BATERÍA 12V 4A-h OPALUX	65.6	14.4	80
7	BORNERA DE 2 ENTRADAS	8.89	1.61	10.5
		TOTAL		**113.66**