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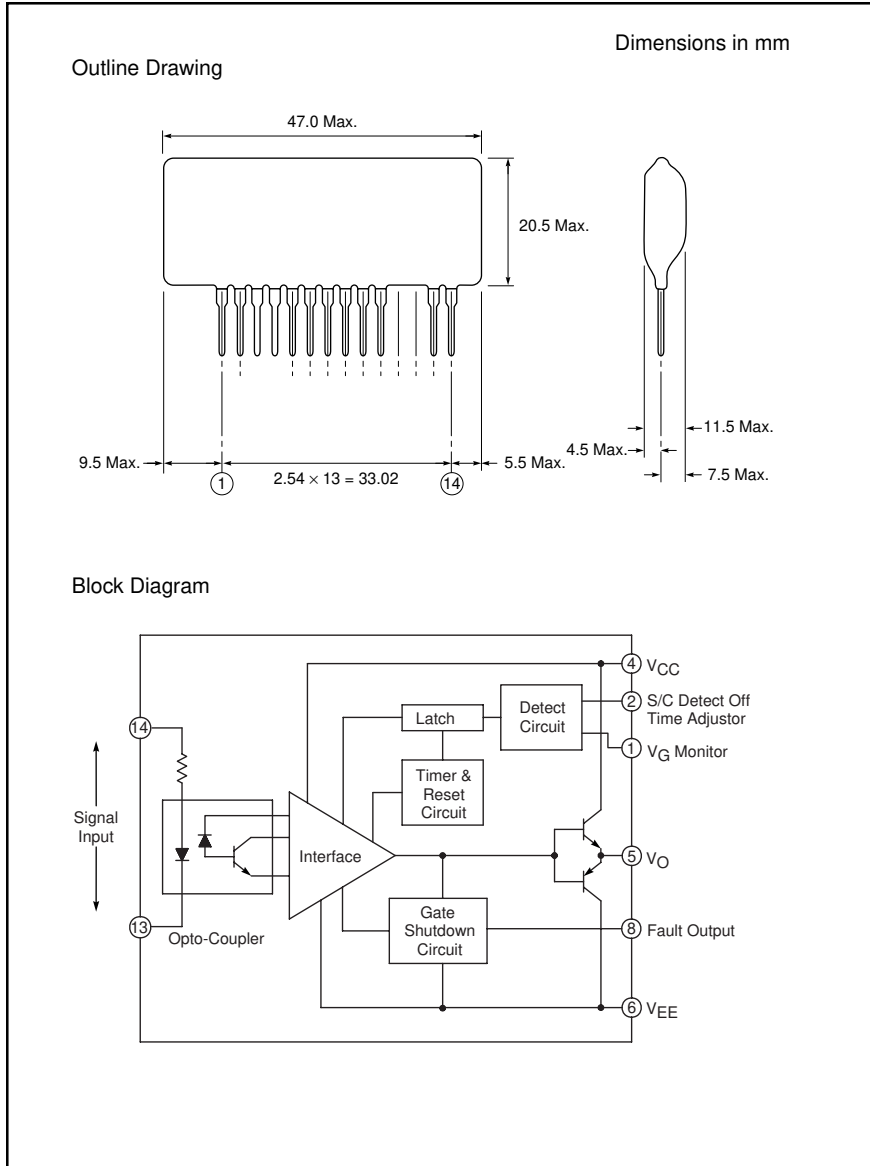
Contact us

Tel: +86-755-8981 8866 Fax: +86-755-8427 6832

Email & Skype: info@chipsmall.com Web: www.chipsmall.com

Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China





Hybrid Integrated Circuit For Driving IGBT Modules

Description:

M57160AL-01 is a hybrid integrated circuit designed for driving Powerex 600V and 1200V F-Series IGBT Modules. This device operates as an isolation amplifier for these modules and provides the required electrical isolation between the input and output with an opto-coupler. Short circuit protection is provided by a built-in gate voltage detector that monitors the F-Series IGBT's internal RTC circuit. A fault signal is provided if the short circuit protection is activated.

Features:

- Built-in Short Circuit Protection with Timer and Reset Functions
- Adjustable Blanking Time
- Low Voltage of V_{EE} (-3V)
- Electrical Isolation Between Input and Output with Opto-couplers
($V_{iso} = 2500V_{RMS}$ for 1 min.)

Application:

To drive IGBT modules for inverter, AC Servo systems, etc.

Recommended Modules:

Powerex 600V and 1200V
F-Series IGBT Modules



Powerex, Inc., 200 Hillis Street, Youngwood, Pennsylvania 15697-1800 (724) 925-7272

M57160AL-01
Hybrid IC for IGBT Gate Driver

Absolute Maximum Ratings, $T_a = 25^\circ\text{C}$ unless otherwise specified

Item	Symbol	Test Conditions	Limit	Units
Supply Voltage	V_{CC}	DC	18	Volts
	V_{EE}	DC	-15	Volts
Input Voltage	V_I	Applied between: (13) – (14)	-1 ~ 7	Volts
Output Voltage	V_O	Applied at the Output Voltage "H"	V_{CC}	Volts
Output Current	I_{OHP}	Pulse Width 2 μs , $f \leq 20\text{kHz}$	-5	Amperes
	I_{OLP}	Pulse Width 2 μs , $f \leq 20\text{kHz}$	5	Amperes
Isolation Voltage	V_{RMS}	Sinewave Voltage 60Hz, 1 min.	2500	Volts
Case Temperature	T_c		85	$^\circ\text{C}$
Operating Temperature	T_{opg}	No Condensation Permitted	-20 ~ 60	$^\circ\text{C}$
Storage Temperature	t_{stg}		* -25 ~ 100	$^\circ\text{C}$
Fault Output Current	I_{FO}	Applied (8) pin	20	mA
Input Voltage	V_{R1}	Applied (1) pin	V_{CC}	Volts

* Differs from H/C conditions

Electrical Characteristics, $T_a = 25^\circ\text{C}$, $V_{CC} = 15\text{V}$, $V_{EE} = -5\text{V}$, $R_G = 2\Omega$ unless otherwise specified

Characteristics	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Supply Voltage	V_{CC}		14	15	—	Volts
	V_{EE}	Recommended Range	-3.0	-5.0	-10	Volts
Pull-up Voltage on Input Side	V_{IN}		4.75	5.00	5.25	Volts
"H" Input Current	I_{IH}	Recommended Range	15.2	16	19	mA
Switching Frequency	f	Recommended Range**	—	—	20	kHz
Gate Resistor	R_G	Recommended Range	2.0	—	—	Ω
"H" Input Current	I_{IH}	$V_{IN} = 5\text{V}$	—	16	—	mA
"H" Output Voltage	V_{OH}		13	14	—	Volts
"L" Output Voltage	V_{OL}		-3.0	-4.0	—	Volts
"L-H" Propagation Time	t_{PLH}		—	0.4	1.0	μs
"L-H" Rise Time	t_r	$I_{IH} = 16\text{mA}$	—	0.5	1.0	μs
"H-L" Propagation Time	t_{PHL}		—	0.8	1.3	μs
"H-L" Fall Time	t_f		—	0.4	1.0	μs
Timer	t_{timer}	Between Start and Cancel (Under Input Sign "L")	1.0	—	2.0	ms
Fault Output Current	I_{FO}	Applied (8) pin, $R = 3.9\text{k}\Omega$	—	5.0	—	mA
Controlled Time Detect Short Circuit 1	t_{trip1}	Pin (1) : 11.5V, Pin (2) : Open	—	4.0	—	μs
Controlled Time Detect Short Circuit 2***	t_{trip2}	Pin (1) : 11.5V, Pin (2) – (4) : 22pF (Connective Capacitance)	—	6.2	—	μs
Over-current Detect Voltage	V_{SC}	Difference Between V_{CC} and Gate Voltage of IGBT	—	3.0	—	Volts

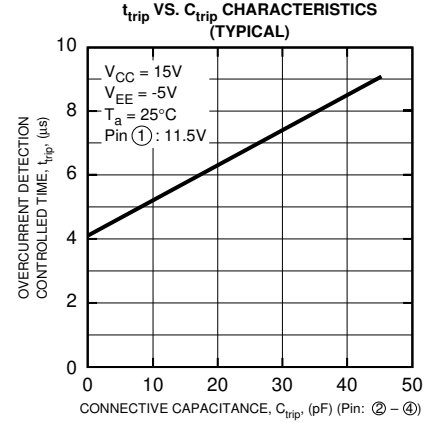
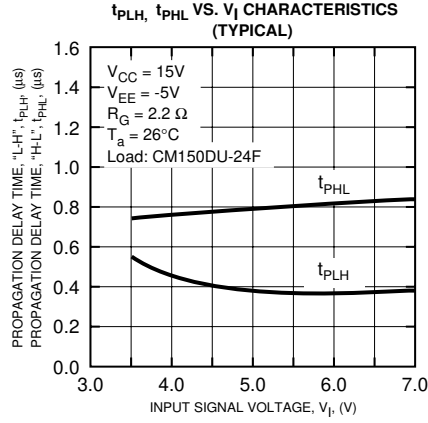
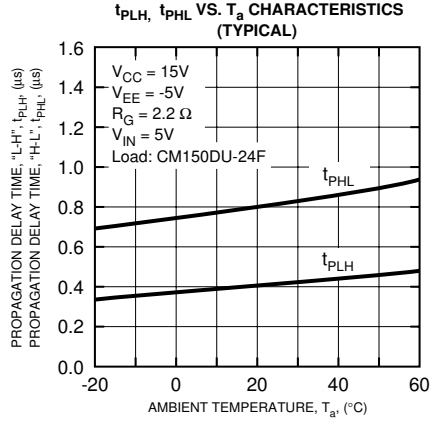
**Please refer to the Maximum Limit of Switching Frequency curves

***Length of wiring of capacitor controlled time detect short circuit is within 5cm from (2) and (4) pin coming and going.

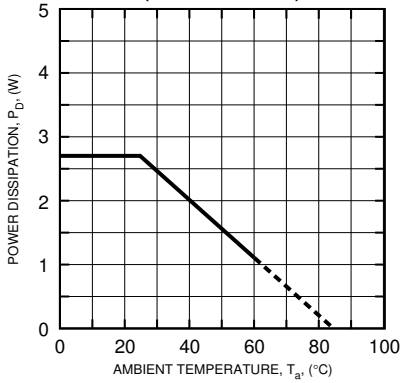


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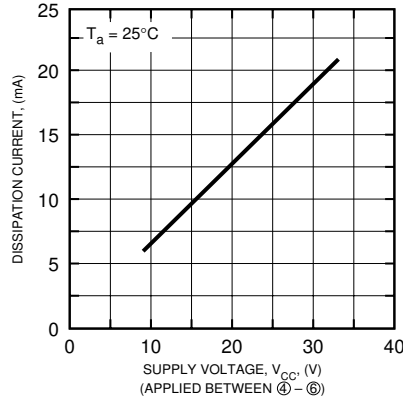
M57160AL-01
Hybrid IC for IGBT Gate Driver



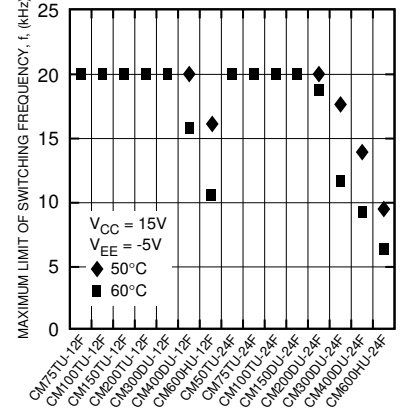
POWER DISSIPATION VS. AMBIENT TEMPERATURE (MAXIMUM RATING)



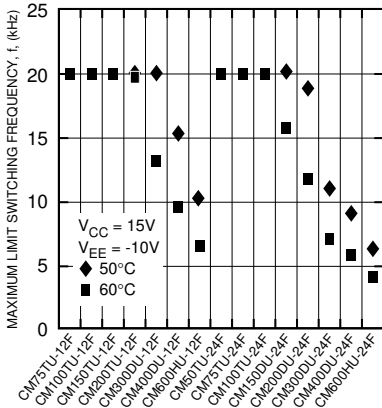
DISSIPATION CURRENT VS. SUPPLY VOLTAGE (APPLIED BETWEEN: ④ - ⑥) INPUT SIGNAL "L" (TYPICAL)



MAXIMUM LIMIT OF SWITCHING FREQUENCY



MAXIMUM LIMIT OF SWITCHING FREQUENCY

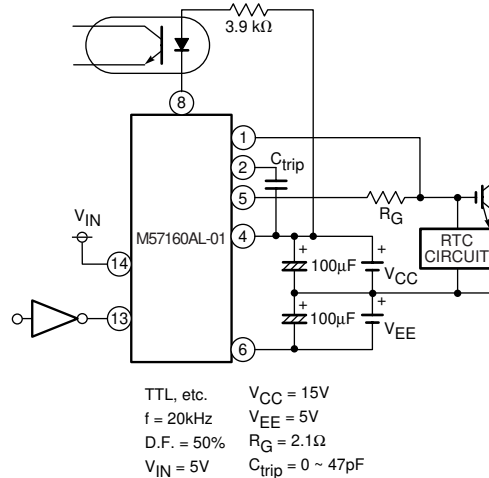


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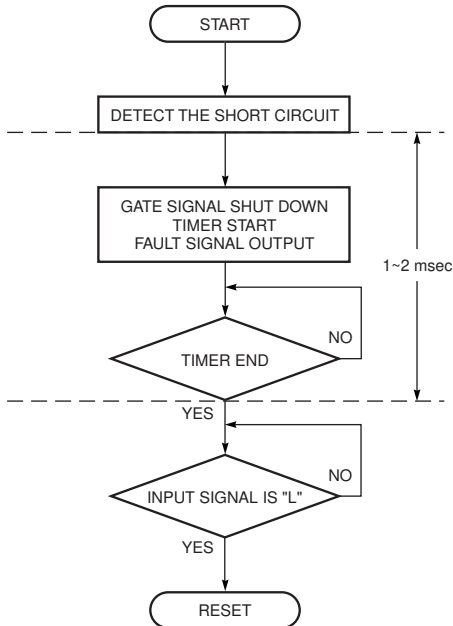
Operation of Protection Circuit

1. During a short circuit, high current causes the F-Series IGBT module's built in RTC to activate and pull the gate voltage down. This reduction of gate voltage is detected by pin ① of the M57160AL-01. If the gate voltage remains more than 3 volts below V_{CC} for more than t_{trip} , then a soft shutdown and fault output signal are initiated by the M57160AL-01.
2. When a short circuit is detected the M57160AL-01 output will remain latched in the low (off) state for t_{timer} , which is typically 1.5ms. After t_{timer} has expired an off state input command of at least $5\mu s$ will unlatch the output and normal operation will resume.
3. The t_{trip} time can be extended by connecting external capacitance between pin ② and pin ④.

Application Circuit Example



Operation Flow on Detecting Short Circuit



Note: When the protection circuit is activated the output voltage becomes $-|V_{EE}| + 2$ Volts.

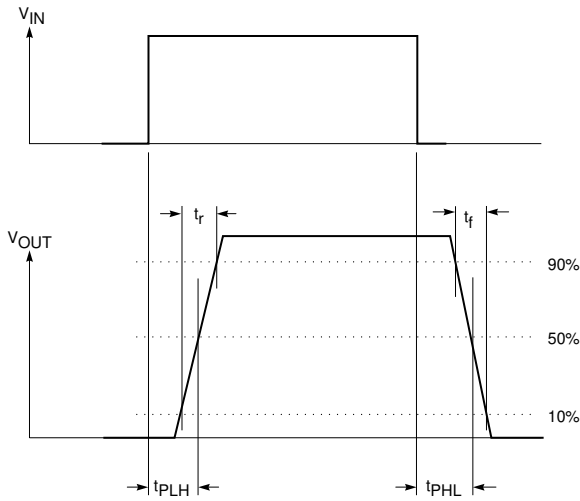
Precaution

1. The ③, ⑦, and ⑩ pins are for production test purposes only. Do not use these pins for any connections.
2. The $100\mu F$ capacitors for power supply decoupling must be located as close as possible to the M57160AL-01.
3. If C_{trip} is used it must be connected as close as possible to pins ② and ④.
4. To avoid possible misoperation, the input signal should be maintained in the off state during power up/down.
5. If it is necessary or desirable to disable the short circuit protection function this can be accomplished by leaving pin ① not connected.

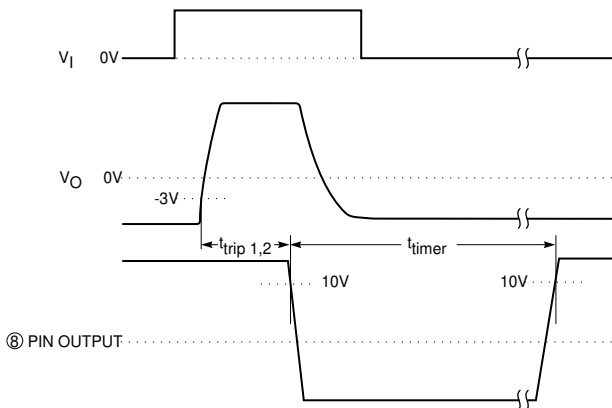
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Definition of Characteristics

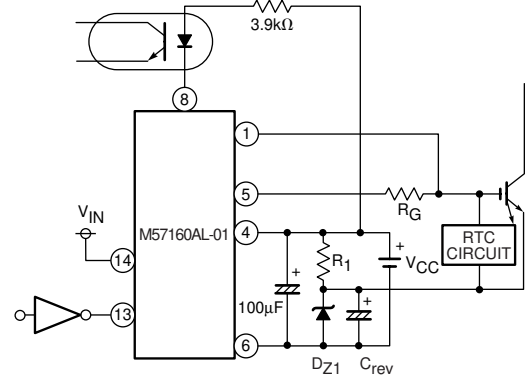
1. Switching Operation



2. The Timing When the Over Current or Short Circuit Protection Operates

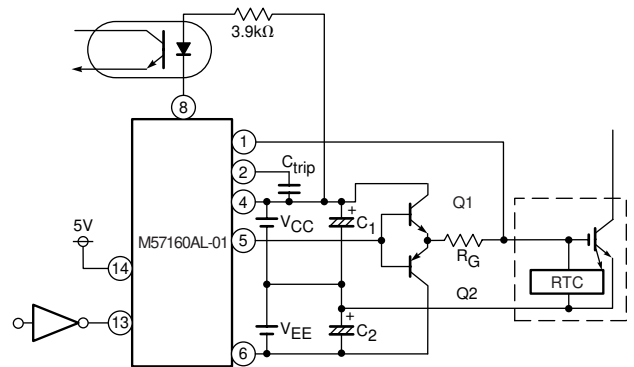


Application Example for Single Power Supply



$V_{CC} = 20V$
 $R_1 = 3.3k\Omega$
 $V_Z (D_{Z1}) = 5.1V$
 $C_{rev} = 47\mu F$ min.
 Note: Input signals must be delayed until C_{rev} is fully charged.

Application Example for High Power Module



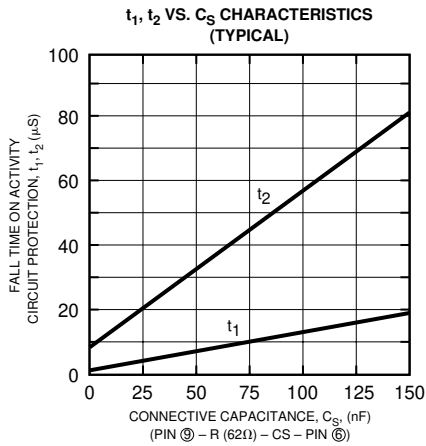
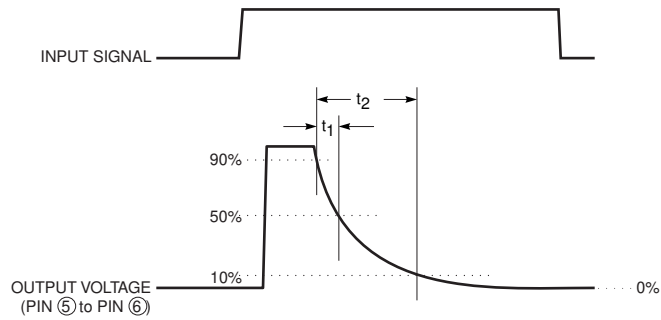
$V_{CC} = 15V$
 $V_{EE} = 5V$
 $C_{trip} = 0 \sim 47pF$
 $C_1 \cdot C_2 \geq 100\mu F$ (low impedance type)

Manufacturer	Q1 (NPN)	Q2 (PNP)
Motorola	D44VH10	D45VH10
Shindengen	2SC4151	2SA1601
Zetex	ZTX851	ZTX951

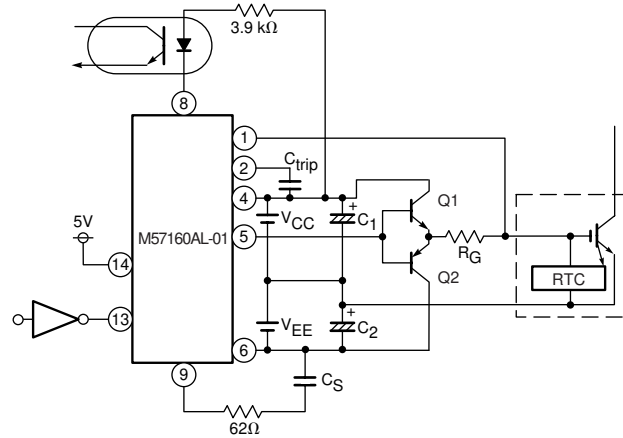
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Adjustment of Soft Shutdown

If it is necessary to make the soft shutdown slower in order to control transient voltages, an external capacitor (C_S) and 62Ω resistor can be connected between pin (6) and pin (9).



Application Example for Softer Shutdown



$V_{CC} = 15V$
 $V_{EE} = 5V$
 $C_{trip} = 22pF$
 $C_1 \cdot C_2 \geq 100\mu F$ (low impedance)

Manufacturer	Q1 (NPN)	Q2 (PNP)
Motorola	D44VH10	D45VH10
Shindengen	2SC4151	2SA1601
Zetex	ZTX851	ZTX951