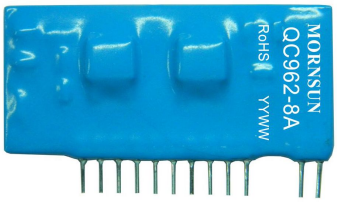
DC-DC Converter for IGBT Driver
QC962-8A

MORNSUN®

Hybrid integrated IGBT driver



Patent protection RoHS

Recommended modules

- 600V series IGBT (current ⩽600A)
- 1,200V series IGBT (current ⩽400A)
- 1,700V series IGBT (current ⩽200A)

Applications

- General inverter
- AC servo drive system
- Uninterruptible power supply (UPS)
- Electric welding machine

FEATURES

- Built-in high CMRR opto-coupler (CMR: Typ.: 30kV/μs, Min.: 15kV/μs)
- Built in positive-negative power supply
- Input signal compatible with CMOS & TTL level
- High-isolated voltage optocoupler (3750Vrms/min)
- Short-circuit protection and fault output function
- Soft shut-down and reset timer can be achieved during over-current fault
- Adjustable controlled time of detect short circuit
- Switching frequency up to 40kHz
- Drop-in replacement to M57962AL (See the notes for compatibility)

QC962-8A is a hybrid integrated IGBT driver. Its main function is to receive the square wave signal from the controller, and after isolation and amplification, apply to the gate of the IGBT to control the turn-on and turn off of IGBT. It is a square wave signal through the optocoupler that provides reliable electrical isolation, the common mode interference caused by IGBT cannot affect the control system. In addition, QC962-8A can also be used to detect the under-saturated voltage-drop of the collector of IGBT to quickly identify the overcurrent or short circuit state of IGBT, and trigger the protection function, so as to avoid IGBT being burned in the fault conditions, afterwards the controller will issue a warning signal .

Maximum ratings

Item	Symbol	Testing Conditions	Value	Unit
Power Supply Input Voltage	V_{CC}	DC	18	V
	V_{EE}		-15	
Current input during high level signals status	I_{IH}	Between terminal 13 and 14	25	mA
Voltage input during high level signals status	V_{IH}	No limiting current resistance	5.25	V
Drive Output Voltage	V_o+	Input signal is high	V_{CC}	V
	V_o-	Input signal is low	V_{EE}	
Output Current	$I_{g\,on}$	Pulse width: 2μs Frequency f=20kHz	+8	A
	$I_{g\,off}$		-8	
Input & Output Isolation Voltage	V_{ISO}	Sine 50Hz/60 Hz, 1min, leak current lower than 1mA	3750	V
Fault Output Current	I_{FO}	PIN8 input current	20	mA
Max. Input Voltage to Fault Detect Pin	V_{R1}	PIN1 input voltage	50	V
Operating Temperature	T_{OP}		-40℃ to +70℃	--
Storage Temperature	T_{ST}		-50 ℃ to +125℃	

Note: 1. Unless otherwise specified, the ambient temperature is Ta=25℃;
2. 20V<V_{CC}-V_{EE}<28V.

Input Specifications

Item	Symbol	Testing Conditions	Min.	Typ.	Max.	Unit
Power Supply Input Voltage	V_{CC}	DC input	14	15	--	V
	V_{EE}	DC input	-7	-10	--	
Current input during high level signals status	I_{IH}	Between terminal 13 and terminal 14	10	16	20	mA

Output Specifications

Item	Symbol	Testing Conditions	Min.	Typ.	Max.	Unit
Voltage output during high level signals status	V_{OH}		13	14	--	V
Voltage output during low level signals status	V_{OL}		-6	-9	--	

General Specifications

Item	Symbol	Testing Conditions	Min.	Typ.	Max.	Unit
Switching Frequency	f		0	20	40	kHz
Gate Resistance	R_g		2	--	--	Ω
Turn-on Delay Time	T_{PLH}	I_{IH} =16mA VCC=15V VEE=-10V Rg =2Ω	--	0.4	1	μs
Turn-on Rise Time	T_R		--	0.6	0.8	
Turn-off Delay Time	T_{PHL}		--	0.6	1.3	
Turn-off Fall Time	T_F		--	0.4	0.8	
Threshold voltage protection	V_{OCP}	VCC=15V VEE=-10V	--	9.2	--	V
Protective Reset time	T_{timer}	Duration from the start to the end of protective signal	1	1.3	2	ms
Fault Output Current	I_{FO}	PIN8 input current, R=4.7k	--	5	--	mA
Short circuit detecting time (Blind zone time)	T_{trip}	Pin1: ⩾15V,Pin2:open	--	2.6	--	μs
Protective Soft Turn-off Time	T_{CF}	Pin1: ⩾15V	--	5	--	
Output of quantity of electric charge	Q_g	Rg=2Ω, Cg=160nF, Vcc=15V, Vee=-10V	--	3.4	4.0	μC
Rated power of the module	P_{in}	Rg=2Ω, Cg=160nF, Vcc=15V, Vee=-10V, f=25kHz	--	3.4	--	W

Note: Unless otherwise specified, Ta=25℃, Vcc=15V, V_{EE}=-10V.

Design Reference

1. Typical application circui

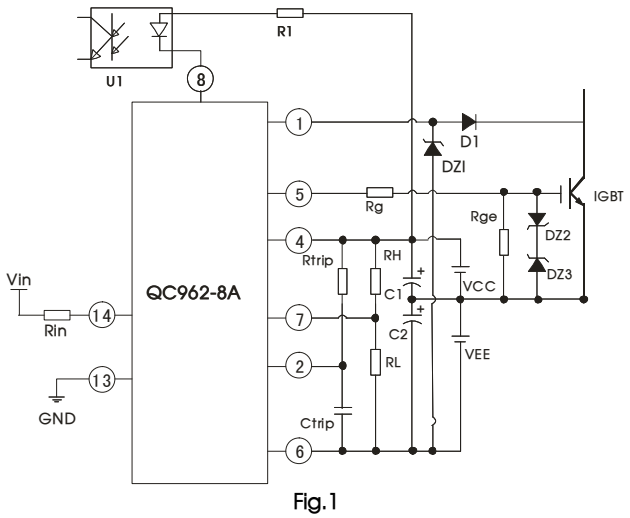


Fig.1

TTL&COMS compatible
f=20kHz
Vin=3.3-5V
V_{CC} =15V
V_{EE} = -10V
R_G=2Ω
D_1 : fast recovery diode (trr⩽0.2μs)
DZ1 : 30V TVS
DZ2, DZ3: 18V
R1=4.7kΩ
Rge=10kΩ
C1, C2: 100uF (low ESR)

Note: Connect a capacitance value during 1uF-10uF in parallel with both ends of the capacitor C1 and C2, to reduce ripple & noise

2. Definition of Characteristic

1)Specifications of short circuit protection

QC962-8A Detecting a short circuit condition can be divided into the following three cases:

A.When the short-circuit protection signal time is less than the Short circuit protection suppression time, The driver is a normal state that the fault output is forbidden;

B.When the short-circuit protection signal time is longer than the suppression time, The short circuit signal disappears At the course of the drive control signal falls, The driver triggers the Short circuit protection and resume normal work after short circuit signal disappears

C.When the short-circuit signal time is longer than the self-recovery time, The driver triggers the Short circuit protection and restores the periodic detection signal issued from the circuit to resume normal work after short signal disappears.

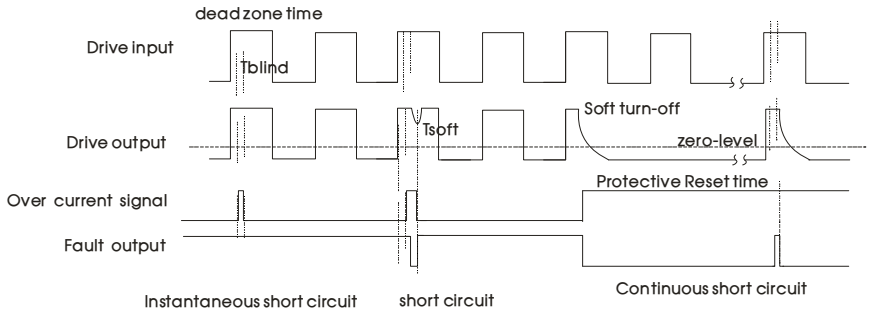


Fig.2 schematic diagram of protection

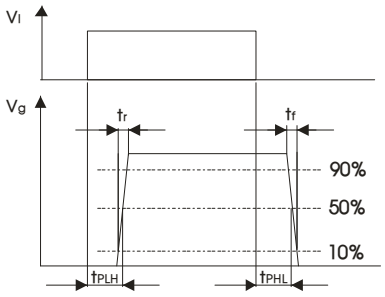


Fig.3 Schematic diagram of signal delay test

2)Input and Output delay time, rise time, fall time characteristics defined (see Fig.2)

3)Product operating temperature and operating frequency derate

It is suggested that the IGBT driver ambient temperature is decided for environment temperature and signal frequency.

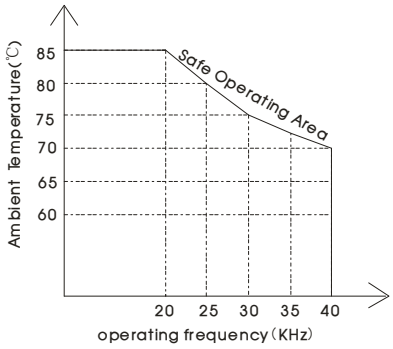


Fig.4 QC962-8A safe operating area

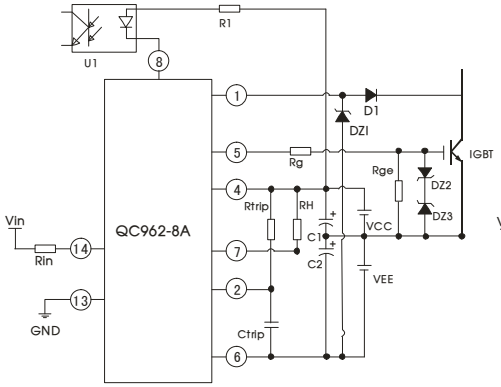


Fig.5 Reduce the protection of threshold voltage

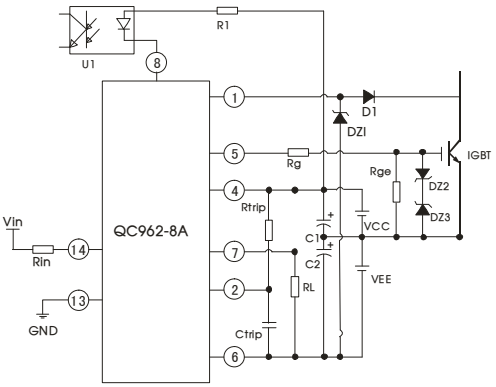


Fig.6 Increase the protection of threshold voltage

3. Parameter adjustment

1)Over current protection threshold voltage regulation characteristics

Over current protection threshold voltage is the threshold level of start protection when IGBT drive detecting IGBT over current. QC962-8A product has the function of regulating protection threshold voltage, the user can through the external resistors Rh and Rl to regulate the over current protection threshold voltage value, proposed to adjust the voltage value can not be less than 8V, shall not be higher than 10V, the specific adjustment can refer to the following table. (the data in table is for reference only, the actual application should be measured)

RH(kΩ)	RL(kΩ)	Vocp(V)	Ttrip(uS)	Note
12	---	10.5	2.52	Test conditions Vcc=15V Vee=-10V f=25kHz
24	---	10.0	2.42	
---	---	9.4	2.32	
---	150	8.8	2.22	
---	100	8.5	2.18	
---	51	8.0	1.90	

Over current protection threshold voltage is affected by power supply voltage, the higher the Vcc, the higher over-current protection threshold voltage; the lower the Vee, the higher over-current protection threshold voltage. and vice versa, at the same time over current protection threshold voltage size also affects the short circuit protection suppression time size, threshold voltage the higher the inhibition time shorter, short circuit protection, in order to obtain the short circuit protection and reasonable inhibition time, users can refer to short circuit protection inhibition time regulation characteristics adjusting short protection time.

2) Adjustment of short-circuit detection time delay

The short-circuit detection time delay is defined between the time in which a desaturation is detected and the time in which the gate voltage fall down to 90% of extent. This diver have a minimum short-circuit detection time delay, and you can adjust the short-circuit detection time delay by connecting the capacitor (Ctrip). But the short-circuit detection time delay must be set less than 3.5μS. Please refer to below table.(the data only for refer).

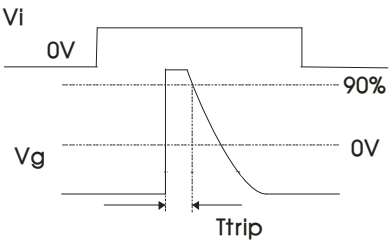


Fig.6 Protective inhibition test

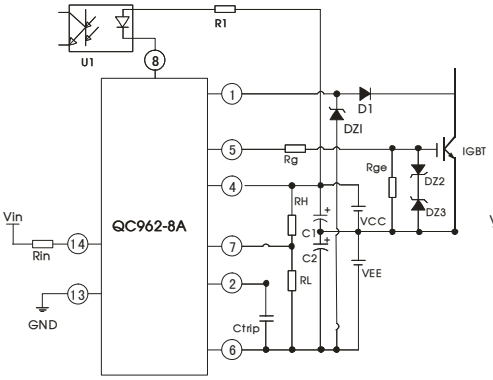


Fig.7 Increase the protective inhibition time

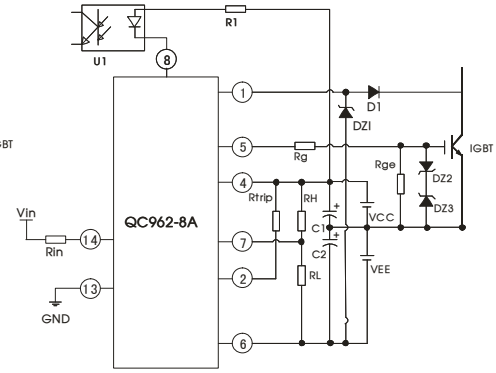


Fig.8 Reduce the protective inhibition time

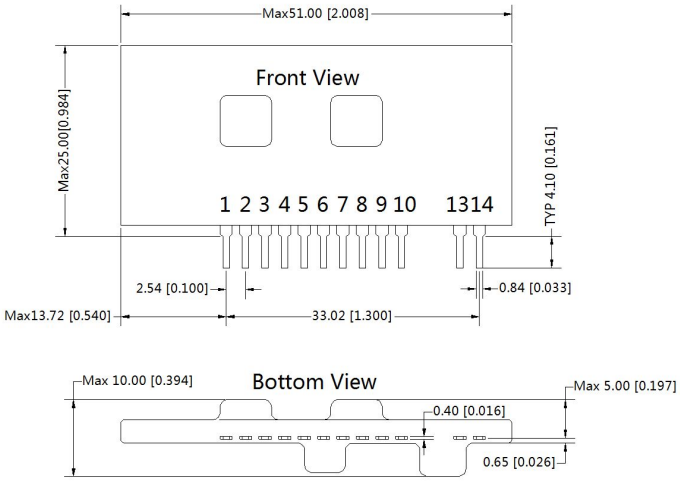
Ctrip(nF)	Rtrip(kΩ)	Ttrip(uS)	Note
---	---	2.34	Test conditions Vcc=15V Vee=-10V f=25kHz Rg=2Ω
---	51	2.06	
---	20	1.80	
4.7	---	3.16	
4.7	51	2.74	
4.7	20	2.34	
10	---	4.30	
10	51	3.70	
10	20	3.14	

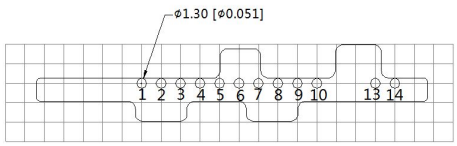
4. Other features

1) This product is relative to the M57962AL product to increase the threshold of protection regulation function and pin 7, if users need to use this function can refer to the over current threshold adjusted properly adjusting characteristics, if users need not the adjustment function, please send this pin feet up processing
2) This product is relative to the M57962AL product to increase the short-circuit protection inhibition time adjusting function and pin 2, if users need to use this function can refer to the short circuit protection inhibition time properly adjusting characteristics, if users need not this adjustment function, please send this pin feet up processing;
3) This product pin 3, 9, 10 for undefined function feet, to be used in production testing process, please 3, 9, 10 pin is left floating in the application;
4) The largest peak output current of 8A, relative to the peak output current of M57962AL products has increased, the users can adjusted according to the actual need of appropriate gate limit circuit resistance Rg

5. For more information Please find the application note on www.mornsun-power.com

Dimensions and Recommended Layout





Note:Grid 2.54*2.54mm

Note:
Unit :mm[inch]
Pin section tolerances :±0.10[±0.004]
General tolerances:±0.50[±0.020]

Pin-Out	
Pin	Description
1	Fault detect
2	Reaction time
4	Power supply(+)
5	Drive output
6	Power supply(-)
7	Adjust protection hreshold voltage
8	Fault signal output
13	Drive signal input(-)
14	Drive signal input(+)
3,9,10	Not connected

Note:

1. Packing information please refer to Product Packing Information which can be downloaded from www.mornsun-power.com. Packing bag number: 58230001;
2. The IGBT gate-emitter drive loop wiring must be shorter than one meter.
3. The IGBT gate-emitter drive loop wiring should be twisted.
4. If large voltage spike is generated at the collector of the IGBT, increase the IGBT gate resistor;
5. Pin3,9,10 are used only for the test circuit and not be connected with the application circuit;
6. The external blocking capacitors must be connected as close as possible to the driver's pin;
7. The peak reverse voltage of the diode D1(to connect PIN13) must be higher than the peak value of the IGBT collector voltage;
8. The distance between the capacitor Ctrip and pin2-4 should be as short as possible(Max.5cm);
9. Pin1 voltage could be high due to the reverse recovery characteristic of the diode D1 and the 30V zener diode DZ1 is connected between pin1 and pin6 for protecting the driver;
10. The higher input signal voltage, the higher input signal current. It will result in more dissipation. The input port is a circuit composed of a high-speed optocoupler series with a 150ohm resistor. Practically, a current-limiting resistor is inserted, which value can be obtained according to the following equation: $R = \frac{Vin - 1.7V}{16mA} - 150\Omega$
11. Products are related to laws and regulations: see "Features" and "EMC";
12. Our products shall be classified according to ISO14001 and related environmental laws and regulations, and shall be handled by qualified units.

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