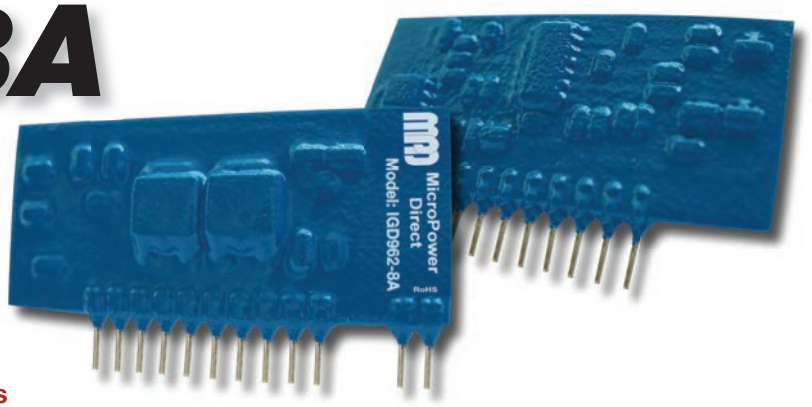
IGD962-8A

Hybrid Integrated Isolated N-Channel IGBT Driver



Key Features:

- Shielded OptoCoupler
- 30 kV/μS CMR
- VISO = 3,750 VAC
- ± 8A Output
- Two Supply Drive Topology
- TTL Compatible Input
- Short Circuit Protected
- Fault Signal Output
- Switching Freq. to 40 kHz
- Compatible With M57962AL

RoHS

Recommended For:

- 600V Series IGBT (up to 600A)
- 1200V Series IGBT (up to 400A)
- 1700V Series IGBT (up to 200A)

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Electrical Specifications

Absolute Maximum Ratings, T_A = 25 °C unless otherwise noted.

Parameter		Conditions	Min.	Typ.	Max.	Units
Supply Voltage	V_{CC}				18	VDC
	V_{EE}				-15	
Input Voltage	V_{IN}	Pin 1			50	VDC
Input Current	I_{IN}	Between Pin 13 & Pin 14			25	mA
Output Voltage	V_O	When Output is "H"			V_{CC}	VDC
		When Output is "L"			V_{EE}	
Output Current	I_{GON}	Pulse Width 2 μS, Frequency ≦ 20 kHz			+8.0	A
	I_{GOFF}				-8.0	
Isolation Voltage	V_{ISO}	Sine Wave Voltage 50 Hz/ 60 Hz , 1 Min			3,750	VAC
Operating Temperature	T_{OP}		-40		+70	°C
Storage Temperature	T_{ST}		-50		+125	°C
Fault Output Current	I_{FO}	Pin 8 Input Current			20	mA

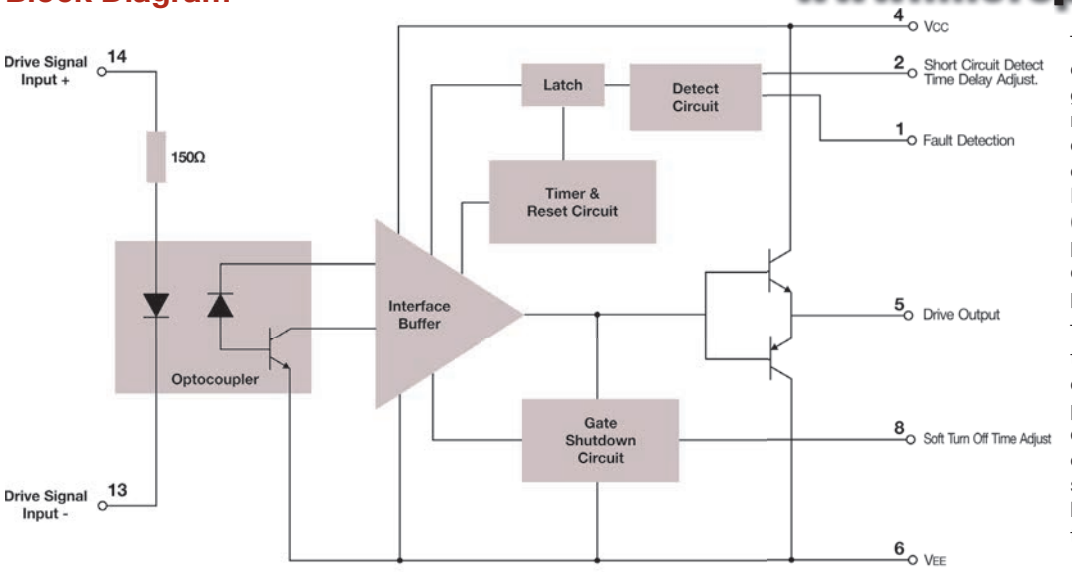
Electrical Characteristics, T_A = 25 °C, V_{CC} = 15 VDC, V_{EE} = -10 VDC unless otherwise noted.

Parameter		Conditions	Min.	Typ.	Max.	Units
Supply Voltage	V_{CC}	Recommended Range	14	15		VDC
	V_{EE}		-7	-10		
Switching Frequency	f	Recommended Range	0	20	40	kHz
Gate Resistor	R_G		2			Ω
Input CMR			15	30		kV/μS
"H" Input Current	I_{IH}	Recommended Range	10	16	20	mA
"H" Output Voltage	V_{OH}		13	14		VDC
"L" Output Voltage	V_{OL}		-6	-9		VDC
"L-H" Propagation	T_{PLH}	I_{IH} = 16 mA, R_G = 2Ω		0.4	1.0	μS
"L-H" Rise Time	T_R	I_{IH} = 16 mA, R_G = 2Ω		0.6	0.8	μS
"H-L" Propagation	T_{PHL}	I_{IH} = 16 mA, R_G = 2Ω		0.6	1.3	μS
"H-L" Fall Time	T_F	I_{IH} = 16 mA, R_G = 2Ω		0.4	0.8	μS
Protection Threshold Voltage	V_{OCP}			9.4		VDC
Protection Reset Time	T_{TIMER}		1.0	1.3	2.0	mS
Fault Output Current	I_{FO}			5.0		mA
Controlled Time Detect	T_{TRIP}	C_{TRIP}, R_{TRIP} not Installed		2.32		μS
Soft Turn-Off Time	T_{OFF}			5.0		μS
SC Detect Voltage	V_{SC}	Collector Voltage of Module	15			VDC
Charge Quantity	Q_G	C_G = 160 nF, R_G = 2Ω		3.4	4.0	μC
Total Power	P_{IN}	C_G = 160 nF, R_G = 2Ω, f = 25k		3.4		W

Notes:
1. Exceeding Absolute Maximum Ratings may damage the module. These are not continuous operating ratings.
2. A user manual is available for this driver. For a copy, go to our website or call the factory.

www.micropowerdirect.com

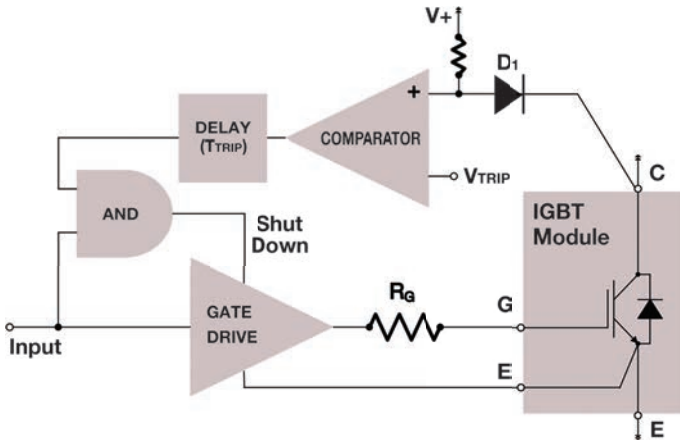
Block Diagram



The **IGD962-8A** is a hybrid integrated circuit designed to provide the isolated gate drive required for high power IGBT modules. It features an internal high speed optocoupler, high transient immunity, short circuit protection and a fault signal output. It is packaged in a compact single-in-line (SIP) package that minimizes the required printed circuit board space. The block diagram at left illustrates its' main components and features.

The **IGD962-8A** converts logic level control signals into a fully isolated gate drive of +15V/-10.0V. Gate drive current is ±8A peak. Gate drive power isolation is provided by an external DC/DC converter (see connection diagram on page 3). Control signal isolation is provided by an internal high speed optocoupler. Desaturation detection is used for short circuit protection.

Fault Detection Circuit

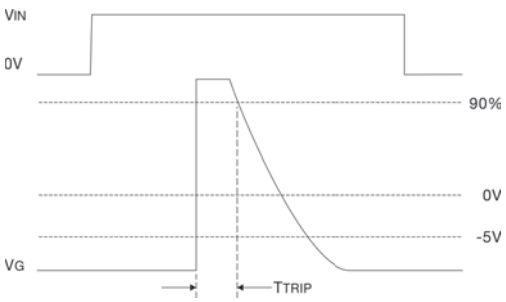


The **IGD962-8A** provides short circuit protection by means of an on-state collector-emitter voltage sensing circuit. This type of protection is often called "Desaturation Detection". A block diagram of a typical desaturation detector is illustrated at left.

During a normal on-state condition, the comparator output will be low. During a normal off-state condition the comparator output will be high. If the IGBT turns on into a short circuit, the high current will cause it's collector-emitter voltage to rise above the level of VTRIP, even though the gate of the IGBT is being driven on.

This condition (a high VCE when the IGBT is supposed to be on) is often called desaturation. Desaturation can be detected by a logical AND of the driver input signal and the comparator output. When the output of the AND goes high a short circuit is indicated. The output of the AND is then used to command the IGBT to shut down.

TTRIP Delay

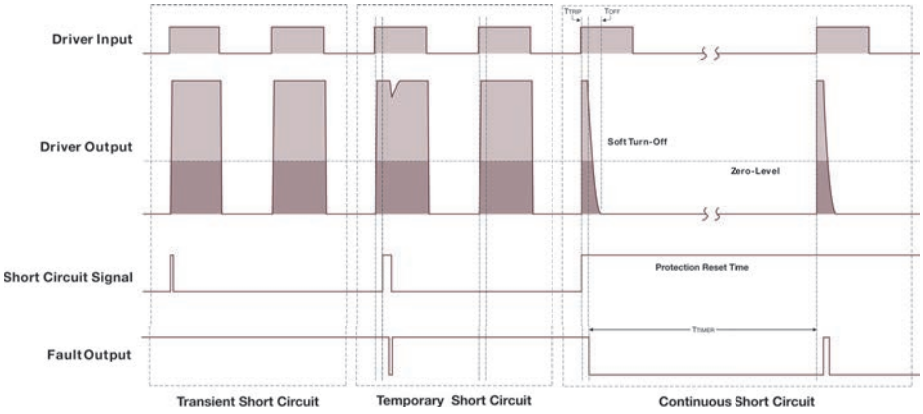


The TTRIP and fault detection waveforms above illustrate the response of the **IGD962-8A** to typical fault conditions. In the first block, an instantaneous or transient short circuit occurs.

To prevent false triggering of the fault detection circuit, there is a built in delay (TTRIP) during which it ignores the fault signal. This delay is provided after the comparator output (see desaturation block diagram above) to allow for the normal turn-on time of the IGBT.

The default delay is 2.32 μs, which will be sufficient for most applications. This can be increased by adding a capacitor (CTRIP) between pin 2 and pin 6 or a resistor (RTRIP) between pin 2 and pin 4. See page 4 for more information. The maximum allowable delay is limited by the IGBT's short circuit withstanding capability. The recommended limit for a typical application is 3.5 μs.

Fault Detection Waveforms



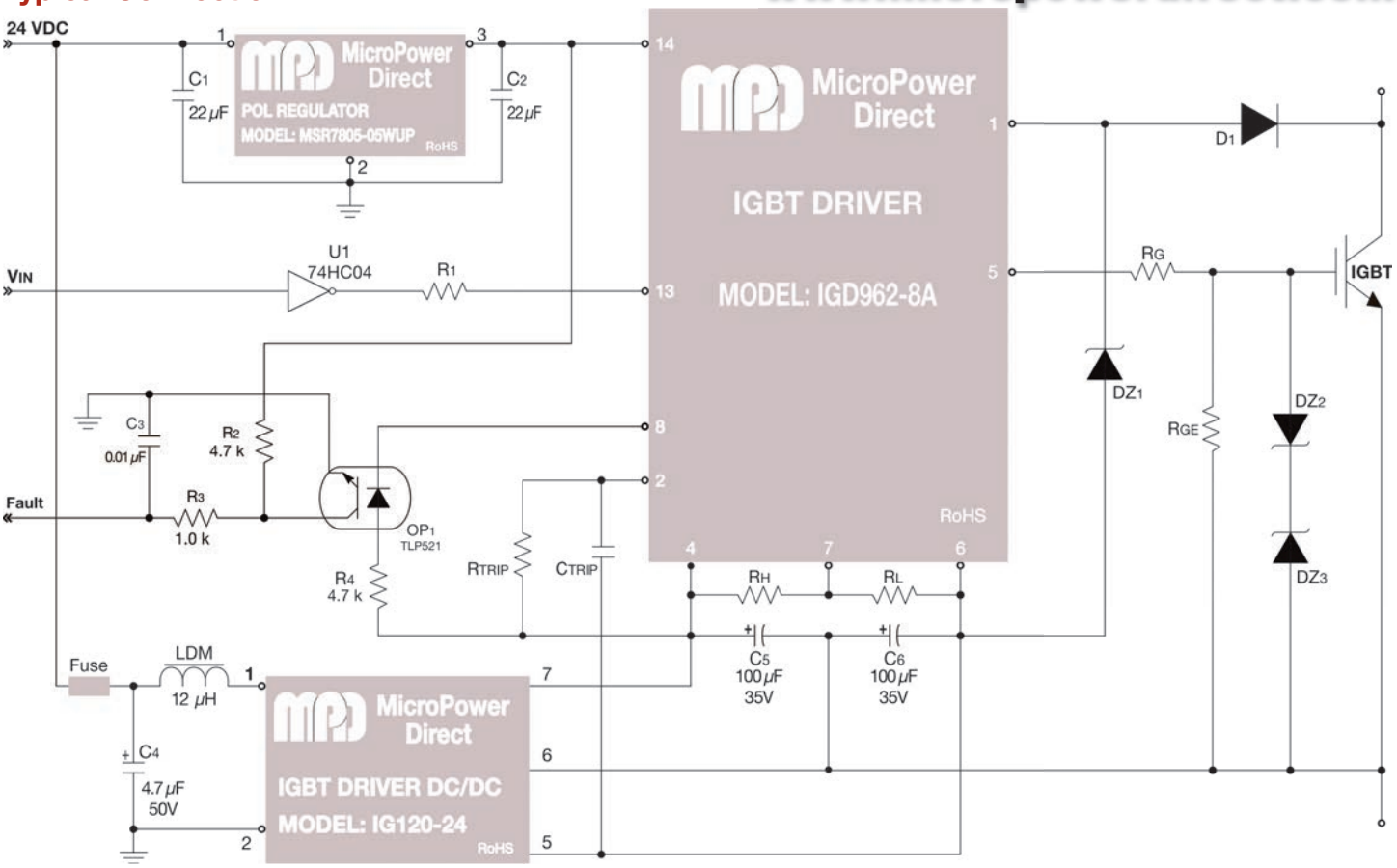
In block two, a temporary short circuit condition extends past the TTRIP limit (>2.32 μs) and triggers a shutdown. When an actual short circuit is detected (at the end of TTRIP), the driver provides a soft shut down. This will limit the transient voltage surge that occurs when large short circuit currents are interrupted. The default soft shutdown time is 5.0 μs, which should work for most applications.

When the short circuit signal extends past TTRIP, a fault signal is generated (from pin 8 & OP1). At this time, the driver output will start to decay. In our example, the short circuit is only temporary. When the IGBT VCE returns to a normal level, the over current signal will go low. This causes the fault signal to return high and the driver output will start to recover.

In block three, the driver turns on into a continuous short circuit condition. As soon as TTRIP ends, the fault signal goes low (from pin 8 & OP1), and the IGBT is shutdown. The driver will try to turn the IGBT on again after 1.3 mS.

If the fault condition causing the short circuit is removed during the period of TTIMER, the unit will recover at that point and operate normally.

Typical Connection



Notes:

To minimize the potential for problems (and/or failures) caused by induced noise or EMI interference; the connection of the gate driver must be done with great care. Some recommendations would include:

1 The **IGD962-8A** requires an external supply to power its internal circuits and set up V_{CC} and V_{EE}. Our typical connection uses an **IG120-24**, a DC/DC converter that has an input-output isolation level of 3,000 VAC.It is a good choice for powering IGBT modules with a μC of 2 or less. For IGBT modules with a μC greater than 2, we recommend our **IG480** series.

The **IG120-24** converts a 24V input bus voltage into gate driver voltage levels consisting of +15V (V_{CC}) at pin 4 and -8.7V (V_{EE}) at pin 6. This allows the driver to provide a floating gate drive suitable for high or low side switching.

To minimize the length of connecting board traces or wires, the **IG120-24** should be mounted as close to the **IGD962-8A** as possible. It is recommended that an external fuse be used on the input of the DC/DC. A 200 mA slow blow, fuse should be sufficient.

Low impedance electrolytic capacitors (C_5 and C_6) are used to decouple the supply outputs. The recommended values for C_5 and C_6 is 100 μF/35V. These capacitors should be mounted as close to the **IGD962-8A** driver as possible. To ensure peak gate current, these capacitors should have a low ESR rating. It is important that these components be selected for low impedance and a maximum allowable ripple current that is sufficient for the application.

The addition of the input filter components (C_4 and LDM) will typically bring the DC/DC circuit within the limits of EN 55022 Class B. The recommended values for these components are 4.7 μF/50V and 12 μH as shown in the connection diagram. If conforming to EN 55022 class B is not a concern; the inductor (LDM) can be eliminated. In this case, the recommended value for C_4 is 100 μF/35V.

2. Our circuit uses a low cost POL switching regulator (the **MSR7805-05WUP**) to provide a stable 5V input signal voltage to the input (pin 14) of the **IGD962-8A**. The input signal voltage cannot exceed 5.25V. The internal dissipation caused by the resultant increase in input current could damage the input optocoupler. A current limiting resistor (R_1) is used to help prevent this. The resistor value is calculated by the formula:

$$R_{IN} = \frac{V_{IN} - 1.7}{I_{IH}} - 150\Omega$$

If we were using a 15V input for our circuit, the current limiting resistor would be equal to:

$$R_{IN} = \frac{15 - 1.7}{16\ mA} - 150\Omega = 681\Omega$$

3 The gate wiring of the IGBT gate-emitter drive loop must be shorter than 1 meter.

4 Twisted pair wiring is recommended for the gate-emitter drive loop to minimize mutual induction.

5 If a large voltage spike is generated at the IGBT collector, the value of the gate resistor (R_G) should be increased. The range of acceptable values for R_G is 2Ω to 5Ω.

6 The peak reverse voltage rating of D_1 must be higher than the peak value of the IGBT collector voltage.

7 The voltage level at pin 1 could go "High" depending on the reverse recovery characteristics of D_1. A 30V zener diode DZ_1 is connected between pin 1 and pin 6 to prevent any problems caused by this.

8 The **IGD962-8A** has a short circuit detection time delay of 2.32 μS, sufficient for most applications. If required, this can be extended to 3.5 μS by connecting a capacitor (C_{TRIP}) or a resistor (R_{TRIP}). If used, these trim components should be mounted as close to the driver as possible (no more than 5 cm). See page 2 & 4 or contact the factory for details.

9 To help limit transient voltage surges that could occur if a short circuit is interrupted, a soft shutdown is provided by the driver. The default time (T_{OFF}) is 5 μS.

10 If the **IGD962-8A** short circuit protection is activated, it will immediately shut down the gate drive and pull pin 8 low to indicate a fault (via OP_1). During normal operation, the collector of OP_1 is pulled high by R_2. In the event of a fault, the driver output is disabled and a fault signal is produced that lasts a minimum of 1 mS (T_{TIMER}). The RC filter (C_3 and R_3) help provide noise immunity. If the short circuit protection circuit is not used, these components can be eliminated and pin 8 should be left open.

11 If the short circuit protection circuit is not used, a 4.7 kΩ should be connected between pin 1 and pin 6 (D_1 and DZ_1 are not required with this configuration).

Short Circuit Detection Time Trims

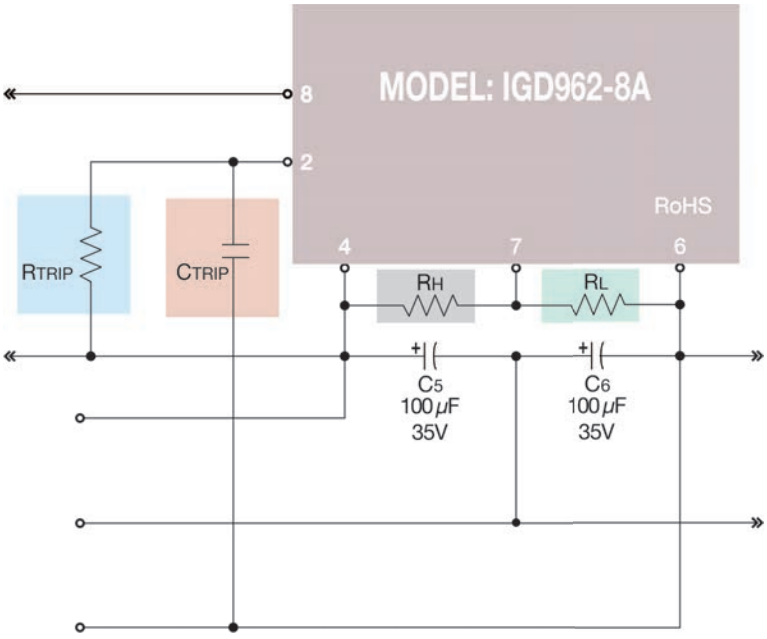


Table 1
SC Detection Time
Vs CTRIP & RTRIP

CTRIP	RTRIP	TTRIP
---	20 kΩ	1.80 µS
---	51 kΩ	2.06 µS
---	---	2.32 µS
4.7 nF	20 kΩ	2.34 µS
4.7 nF	51 kΩ	2.74 µS
10 nF	20 kΩ	3.14 µS
4.7 nF	---	3.16 µS

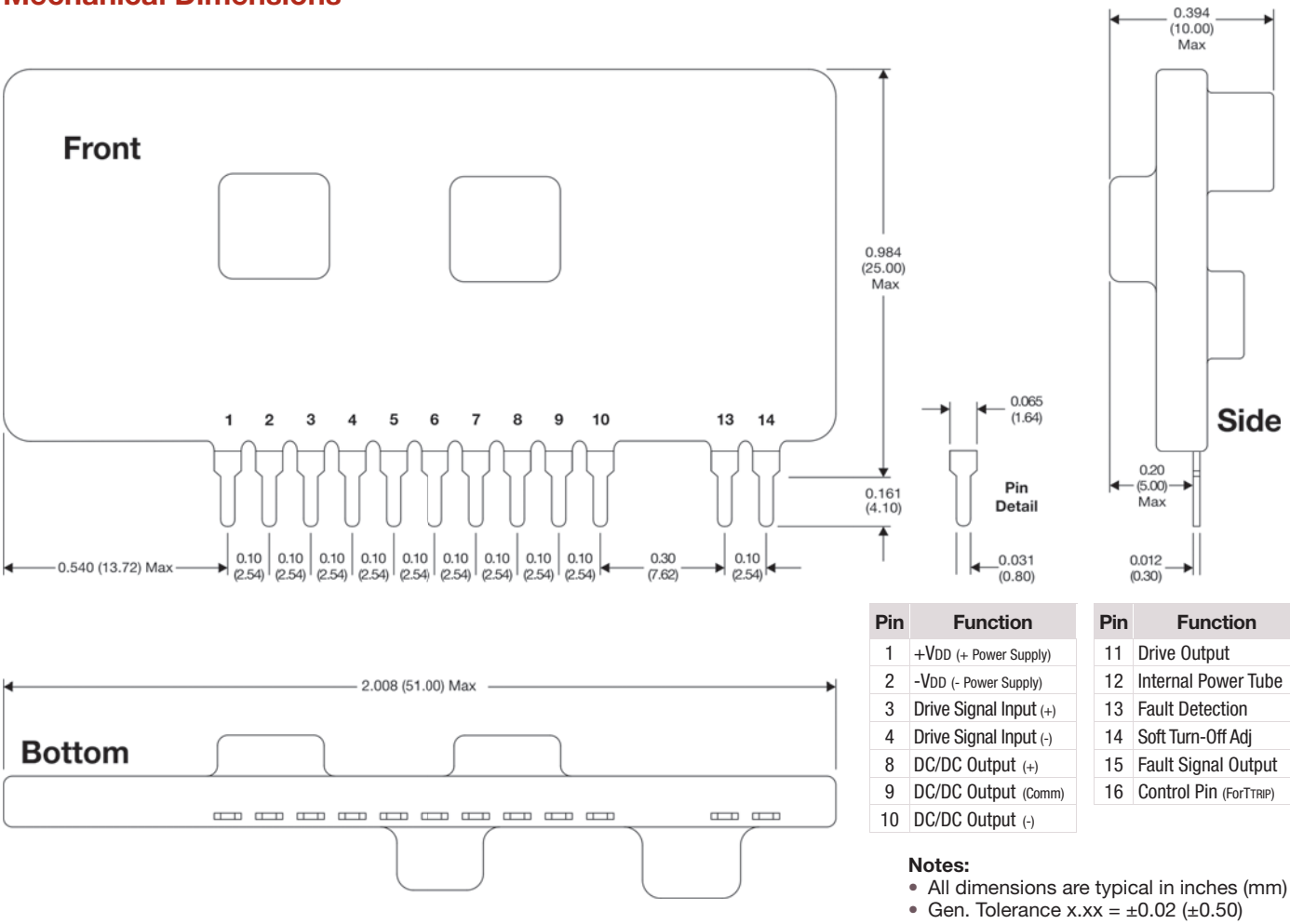
Table 2
Over Current Threshold Voltage
And TTRIP Vs RL & RH

RL	RH	VOCP	TTRIP
51 kΩ	---	8.0V	1.90 µS
100 kΩ	---	8.5V	2.18 µS
150 kΩ	---	8.8V	2.22 µS
---	---	9.4V	2.32 µS
	24 kΩ	10.0V	2.42 µS
---	12 kΩ	10.5V	2.52 µS

The **IDG962-8A** provides trims to adjust the timing of the short circuit detection circuit (TTRIP). The trims RTRIP and CTRIP adjust the time span of TTRIP. The short circuit detection time delay can be adjusted down to 1.80 µS, it should not be adjusted over 3.5 µS. The circuit conditions for Table 1 are VCC = 15V, VEE = -10V, switching frequency = 25 kHz and RG = 2Ω.

The trims RL and RH adjust the level of the over current protection threshold voltage VOCP (VTRIP in the desaturation detection block diagram on page 2). This is done by adjusting VCC or VEE with the trims RH and RL. Increasing VCC raises VOCP. Decreasing VEE lowers VOCP. The range of the adjustment should be within 8.0V to 10.5V. The circuit conditions for Table 2 are VCC = 15V, VEE = -10V and switching frequency = 25 kHz.

Mechanical Dimensions



Pin	Function
1	+VDD (+ Power Supply)
2	-VDD (- Power Supply)
3	Drive Signal Input (+)
4	Drive Signal Input (-)
8	DC/DC Output (+)
9	DC/DC Output (Comm)
10	DC/DC Output (-)

Pin	Function
11	Drive Output
12	Internal Power Tube
13	Fault Detection
14	Soft Turn-Off Adj
15	Fault Signal Output
16	Control Pin (For TTRIP)

Notes:
- All dimensions are typical in inches (mm)
- Gen. Tolerance x.xx = ±0.02 (±0.50)
- Pin Tolerance x.xx = ±0.004 (±0.10)
- Pins 3, 9 and 10 have no external function. They may be used by the factory for production testing. They should be left floating.

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