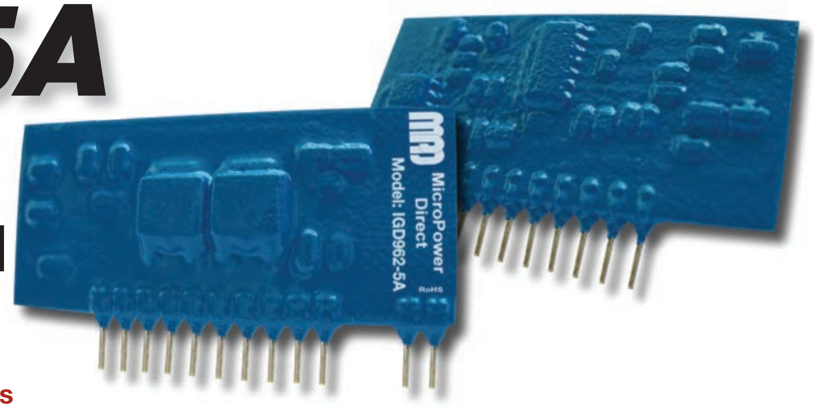
# IGD962-5A

## Hybrid Integrated Isolated N-Channel IGBT Driver




### Key Features:

- Shielded OptoCoupler
- 30 kV/μS CMR
- $V_{ISO}$ = 3,750 VAC
- ±5A Output
- Two Supply Drive Topology
- TTL Compatible Input
- Short Circuit Protected
- Fault Signal Output
- Switching Freq. to 20 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.

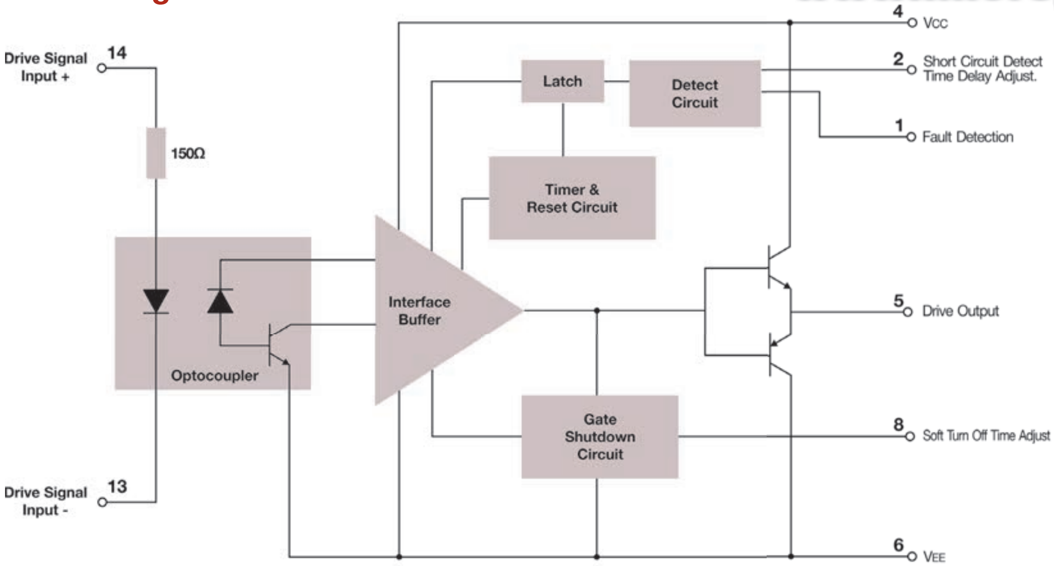
| Parameter | | Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| Supply Voltage | $V_{CC}$ | | | | 18 | VDC |
| | $V_{EE}$ | | | | -15 | |
| Input Voltage | $V_{IN}$ | Pin 1 | | | 50 | VDC |
| Input Current | $I_{IN}$ | Between Pin 13 & Pin 14 | | | 25 | mA |
| Output Voltage | $V_O$ | When Output is "H" | | | $V_{CC}$ | VDC |
| | | When Output is "L" | | | $V_{EE}$ | |
| Output Current | $I_{GON}$ | Pulse Width 2 μS, Frequency ≦ 20 kHz | | | +5.0 | A |
| | $I_{GOFF}$ | | | | -5.0 | |
| Isolation Voltage | $V_{ISO}$ | Sine Wave Voltage 50 Hz/ 60 Hz , 1 Min | | | 3,750 | VAC |
| Junction Temperature | $T_J$ | | | | 150 | °C |
| Operating Temperature | $T_{OP}$ | | -20 | | +70 | °C |
| Storage Temperature | $T_{ST}$ | | -40 | | +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 | -8.5 | -10 | |
| Switching Frequency | $f$ | Recommended Range | 0 | | 20 | 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 | | 0.5 | 1.0 | μS |
| "L-H" Rise Time | $T_R$ | $I_{IH}$ = 16 mA | | 0.6 | 1.0 | μS |
| "H-L" Propagation | $T_{PHL}$ | $I_{IH}$ = 16 mA | | 1.0 | 1.3 | μS |
| "H-L" Fall Time | $T_F$ | $I_{IH}$ = 16 mA | | 0.4 | 1.0 | μS |
| Protection Threshold Voltage | $V_{OCP}$ | $V_{CC}$ = 15V, $V_{EE}$ = -10V | | 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 | $T_{TRIP}$ | $C_{TRIP}$ not Installed | | 2.6 | | μS |
| | $T_{TRIP}$ | $C_{TRIP}$ = 1,000 pF | | 3.0 | | μS |
| Soft Turn-Off Time | $T_{OFF}$ | | | 5.0 | | μS |
| SC Detect Voltage | $V_{SC}$ | Collector Voltage of Module | 15 | | | VDC |

**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.

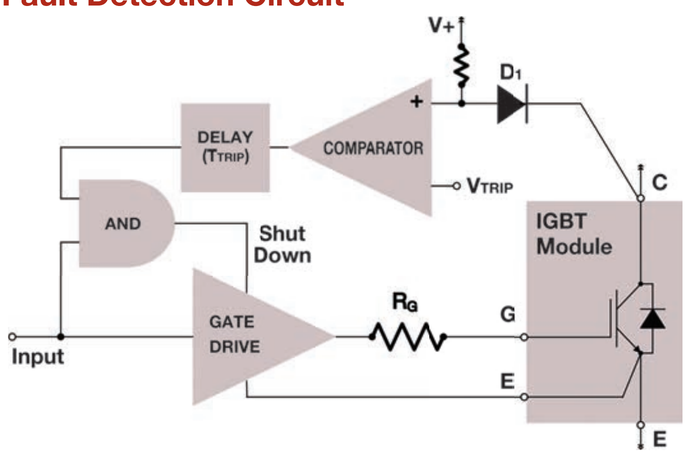
## Block Diagram




The **IGD962-5A** 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 **IGD962-5A** converts logic level control signals into a fully isolated gate drive of +15V/-8.5V. Gate drive current is 5A 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

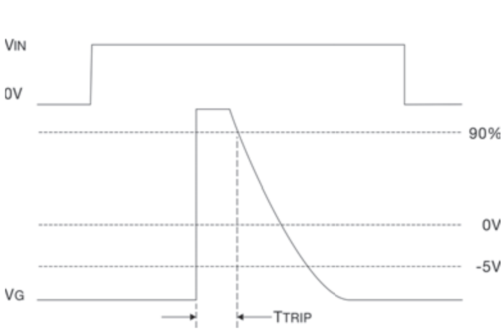



The **IGD962-5A** provides short circuit protection by means of an on-state collector-emitter voltage sensing circuit. This type of protection is often called "Desaturation Detection". A block diagram of a typical desaturation detector is illustrated at left.

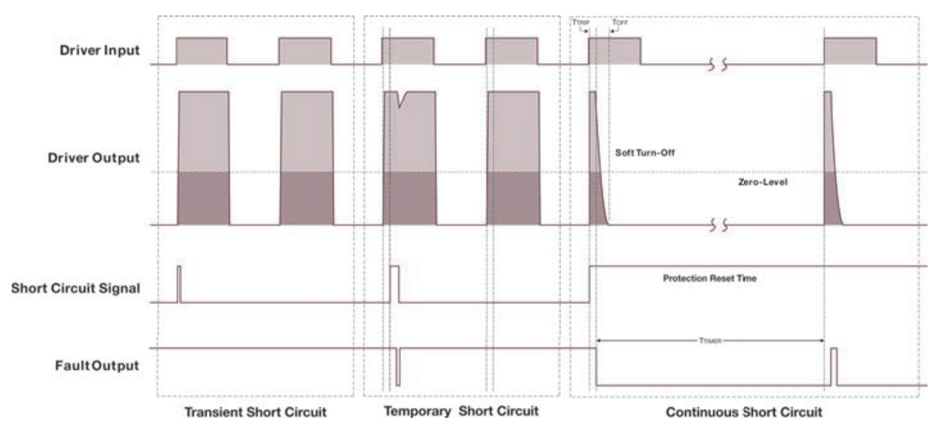
During a normal on-state condition, the comparator output will be low. During a normal off-state condition the comparator output will be high. If the IGBT turns on into a short circuit, the high current will cause it's collector-emitter voltage to rise above the level of $V_{TRIP}$, even though the gate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

This condition (a high $V_{CE}$ 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




## Fault Detection Waveforms




The $T_{TRIP}$ and fault detection waveforms above illustrate the response of the **IGD962-5A** 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 ($T_{TRIP}$) 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 2.6 µs, which will be sufficient for most applications. This can be increased by adding a capacitor ($C_{TRIP}$) between pin 2 and pin 4 (a 1,000 PF capacitor will increase $T_{TRIP}$ to 3.0 µs. 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.

In block two, a temporary short circuit condition extends past the $T_{TRIP}$ limit (>2.6 µs) and triggers a shutdown. When an actual short circuit is detected (at the end of $T_{TRIP}$), 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.

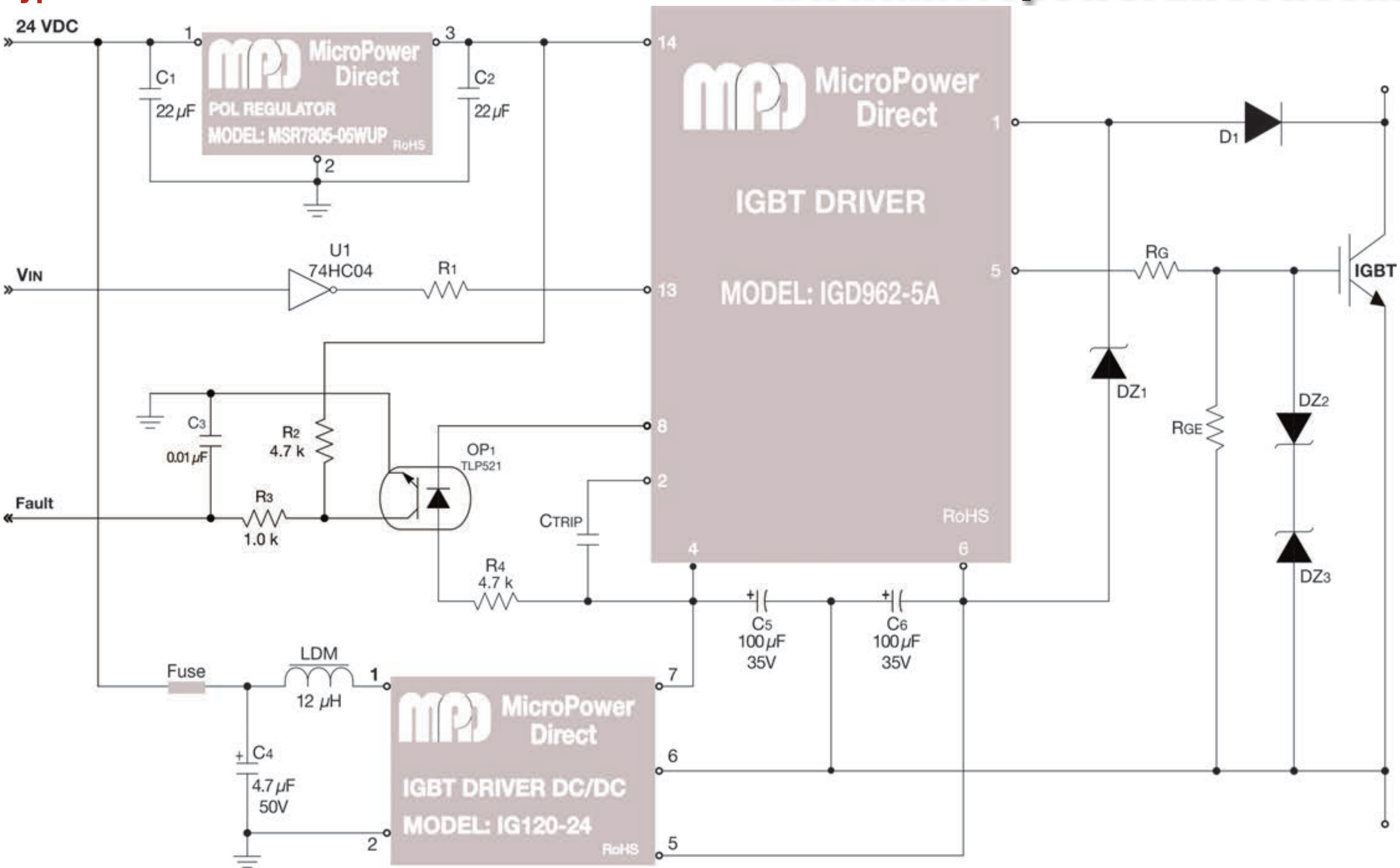
When the short circuit signal extends past $T_{TRIP}$, a fault signal is generated (from pin 8 & $OP_1$). At this time, the driver output will start to decay. In our example, the short circuit is only temporary. When the IGBT $V_{CE}$ returns to a normal level, the over current signal will go low. This 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 $T_{TRIP}$ ends, the fault signal goes low (from pin 8 & $OP_1$), 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 $T_{TIMER}$, 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 **IGD962-5A** 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 **IGD962-5A** 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 **IGD962-5A** 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 **IGD962-5A**. 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 typical 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 **IGD962-5A** has a short circuit detection time delay of 2.6 µS, sufficient for most applications. If required, this can be extended to 3.0 µS by connecting a capacitor ($C_{TRIP}$) between pin 2 and pin 4. If used, $C_{TRIP}$ should be mounted as close to the driver pins as possible (no more than 5 cm). See page 2 or contact the factory for details..

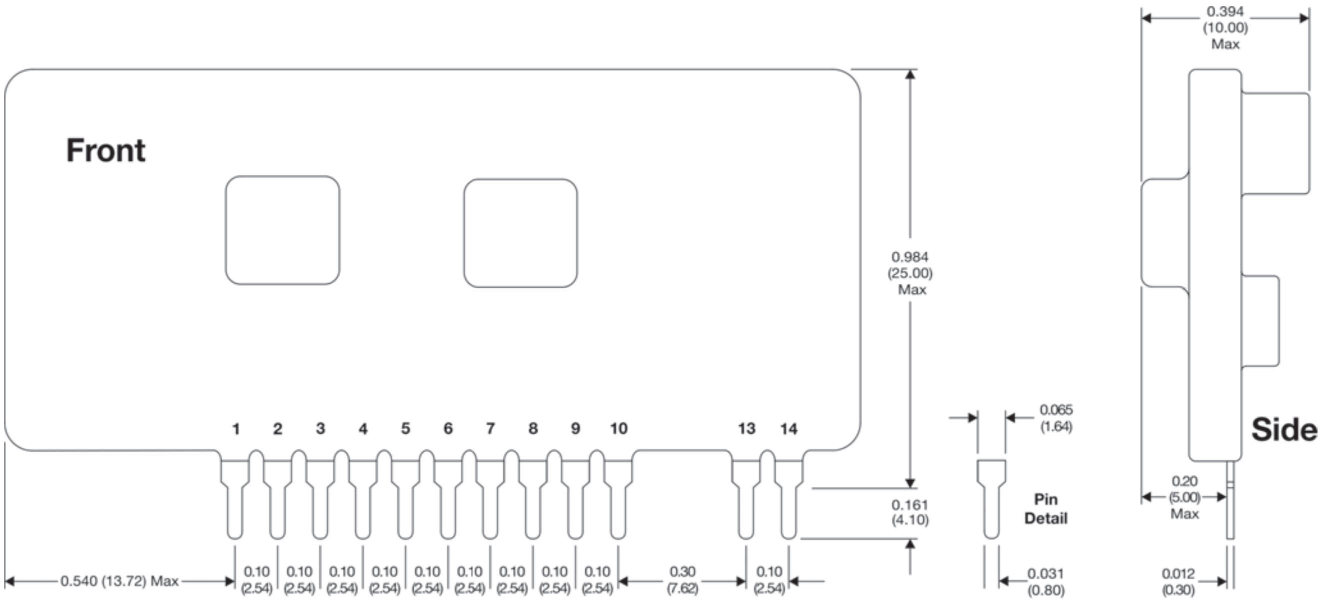
9 To help limit transient voltage surges that could occur if a short circuit is interrupted, a soft shutdown is provided by the driver. The default time ($T_{OFF}$) is 5 µS.

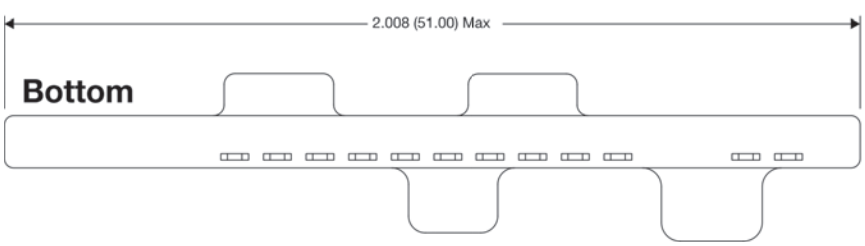
10 If the **IGD962-5A** short circuit protection is activated, it will immediately shut down the gate drive and pull pin 8 low to indicate a fault (via $OP_1$). During normal operation, the collector of $OP_1$ is pulled high by $R_2$. In the event of a fault, the driver output is disabled and a fault 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).

## Mechanical Dimensions






| Pin | Function | Pin | Function |
|---|---|---|---|
| 1 | Fault Detection | 6 | VEE (- Power Supply) |
| 2 | Fault Detection Trim | 8 | Fault Signal Output |
| 4 | Vcc (+ Power Supply) | 13 | Drive Signal Input (+) |
| 5 | Gate Drive Output | 14 | Drive Signal Input (-) |

**Notes:**
- All dimensions are typical in inches (mm)
- Gen. Tolerance x.xx = ±0.012 (±0.30)
- Pin Tolerance x.xx = ±0.004 (±0.10)
- Pins 3, 7, 9 and 10 have no external function. They may be used by the factory for production testing. They should be left floating.

# More Literature:


### Application Note
An in depth look at IGBT's, including their development, advantages & disadvantages, and usage.


### Product Manual
In depth information on the use and performance of the **IGD1205W** IGBT Drivers.


### Product Datasheets
In depth specifications on the connection and performance of a full line of IGBT drivers and isolated DC/DC converters.

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