

April 1995

Features

- Logic Level Gate Drive
- Internal Voltage Clamp
- ESD Gate Protection
- $T_J = +150^{\circ}\text{C}$
- Ignition Energy Capable

Applications

- Automotive Ignition
- Small Engine Ignition
- Fuel Ignitor

Description

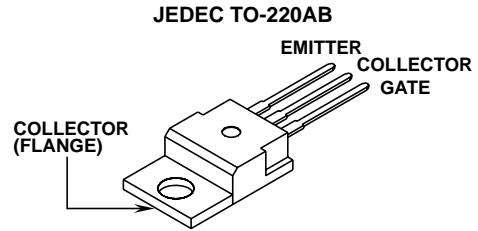
This N-Channel IGBT is a MOS gated, logic level device which is intended to be used as an ignition coil driver in automotive ignition circuits. Unique features include an active voltage clamp between the drain and the gate and ESD protection for the logic level gate. Some specifications are unique to this automotive application and are intended to assure device survival in this harsh environment. The development type number for this device is TA49023.

PACKAGING AVAILABILITY

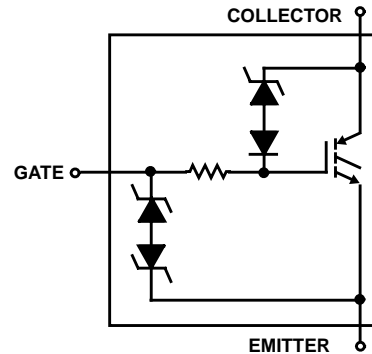
| PART NUMBER | PACKAGE | BRAND |
|---------------|----------|----------|
| HGTP14N40F3VL | TO-220AB | 14N40FVL |

NOTE: When ordering, use the entire part number.

Package



Symbol



Absolute Maximum Ratings $T_C = +25^{\circ}\text{C}$, Unless Otherwise Specified

| | HGTP14N40F3VL | UNITS |
|--|---------------|-----------------------|
| Collector-Emitter Breakdown Voltage at 10mA | 420 | V |
| Collector-Gate Breakdown Voltage $R_{GE} = 10\text{k}\Omega$ | 420 | V |
| Collector Current Continuous | | |
| $V_{GE} = 4.5\text{V}$ at $T_C = +25^{\circ}\text{C}$ | 19 | A |
| $V_{GE} = 4.5\text{V}$ at $T_C = +90^{\circ}\text{C}$ | 14 | A |
| Gate-Emitter Voltage Continuous | ± 10 | V |
| Gate-Emitter Voltage Pulsed or | ± 12 | V |
| Gate-Emitter Current Pulsed | ± 10 | mA |
| Open Secondary Turn-Off Current | | |
| $L = 2.3\text{mH}$ at $+25^{\circ}\text{C}$ | 17 | A |
| $L = 2.3\text{mH}$ at $+150^{\circ}\text{C}$ | 12 | A |
| Drain to Source Avalanche Energy at $L = 2.3\text{mH}$, $T_C = +25^{\circ}\text{C}$ | 330 | mJ |
| Power Dissipation Total at $T_C = +25^{\circ}\text{C}$ | 83 | W |
| Power Dissipation Derating $T_C > +25^{\circ}\text{C}$ | 0.67 | W/ $^{\circ}\text{C}$ |
| Operating and Storage Junction Temperature Range | -40 to +150 | $^{\circ}\text{C}$ |
| Maximum Lead Temperature for Soldering | 260 | $^{\circ}\text{C}$ |
| Electrostatic Voltage at 100pF, 1500 Ω | 6 | KV |

INTERSIL CORPORATION IGBT PRODUCT IS COVERED BY ONE OR MORE OF THE FOLLOWING U.S. PATENTS:

| | | | | | | | |
|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| 4,364,073 | 4,417,385 | 4,430,792 | 4,443,931 | 4,466,176 | 4,516,143 | 4,532,534 | 4,567,641 |
| 4,587,713 | 4,598,461 | 4,605,948 | 4,618,872 | 4,620,211 | 4,631,564 | 4,639,754 | 4,639,762 |
| 4,641,162 | 4,644,637 | 4,682,195 | 4,684,413 | 4,694,313 | 4,717,679 | 4,743,952 | 4,783,690 |
| 4,794,432 | 4,801,986 | 4,803,533 | 4,809,045 | 4,809,047 | 4,810,665 | 4,823,176 | 4,837,606 |
| 4,860,080 | 4,883,767 | 4,888,627 | 4,890,143 | 4,901,127 | 4,904,609 | 4,933,740 | 4,963,951 |
| 4,969,027 | | | | | | | |

Specifications HGTP14N40F3VL

Electrical Specifications $T_C = +25^\circ\text{C}$, Unless Otherwise Specified

| PARAMETERS | SYMBOL | TEST CONDITIONS | | LIMITS | | | UNITS |
|---------------------------------------|-----------------------------|--|----------------------------|----------|-----|----------|--------------------|
| | | | | MIN | TYP | MAX | |
| Collector-Emitter Breakdown Voltage | BV_{CES} | $I_C = 10\text{mA}$, $V_{GE} = 0\text{V}$ | $T_C = +150^\circ\text{C}$ | 345 | 370 | 415 | V |
| | | | $T_C = +25^\circ\text{C}$ | 350 | 375 | 420 | V |
| | | | $T_C = -40^\circ\text{C}$ | 355 | 380 | 425 | V |
| Collector-Emitter Clamp Bkdn. Voltage | $BV_{CE(CL)}$ | $I_C = 10\text{A}$ | $T_C = +150^\circ\text{C}$ | 350 | 385 | 430 | V |
| Emitter-Collector Breakdown Voltage | BV_{ECS} | $I_C = 1.0\text{mA}$ | $T_C = +25^\circ\text{C}$ | 24 | - | - | V |
| Collector-Emitter Leakage Current | I_{CES} | $V_{CE} = 250\text{V}$ | $T_C = +25^\circ\text{C}$ | - | - | 50 | μA |
| | | $V_{CE} = 250\text{V}$ | $T_C = +150^\circ\text{C}$ | - | - | 250 | μA |
| Collector-Emitter Saturation Voltage | $V_{CE(SAT)}$ | $I_C = 10\text{A}$ $V_{GE} = 4.5\text{V}$ | $T_C = +25^\circ\text{C}$ | - | - | 2.0 | V |
| | | | $T_C = +150^\circ\text{C}$ | - | - | 2.3 | V |
| Gate-Emitter Threshold Voltage | $V_{GE(TH)}$ | $I_C = 1.0\text{mA}$ $V_{CE} = V_{GE}$ | $T_C = +25^\circ\text{C}$ | 1.0 | 1.5 | 2.0 | V |
| Gate-Emitter Leakage Current | I_{GES} | $V_{GE} = \pm 10\text{V}$ | | - | - | ± 10 | μA |
| Gate-Emitter Breakdown Voltage | BV_{GES} | $I_{GES} = \pm 1.0\text{mA}$ | | ± 12 | - | - | V |
| Current Turn-off Time-Inductive Load | $t_{D(OFF)I} + t_{F(OFF)I}$ | $R_L = 32\Omega$, $I_C = 10\text{A}$, $R_G = 25\Omega$, $L = 550\mu\text{H}$, $V_{CL} = 320\text{V}$, $V_{GE} = 5\text{V}$, $T_C = +125^\circ\text{C}$ | | - | 12 | 16 | μs |
| Inductive Use Test | UIS | $L = 2.3\text{mH}$, $V_G = 5\text{V}$, Figure 13 | $T_C = +150^\circ\text{C}$ | 12 | - | - | A |
| | | | $T_C = +25^\circ\text{C}$ | 17 | - | - | A |
| Thermal Resistance | $R_{\theta JC}$ | | | - | 1.5 | - | $^\circ\text{C/W}$ |

HGTP14N40F3VL

Typical Performance Curves

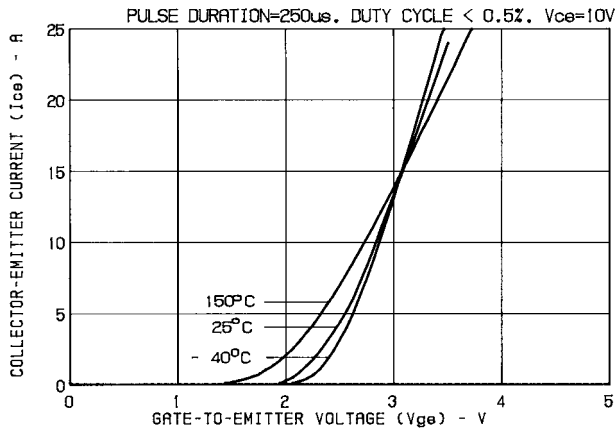


FIGURE 1. TRANSFER CHARACTERISTICS (TYP.)

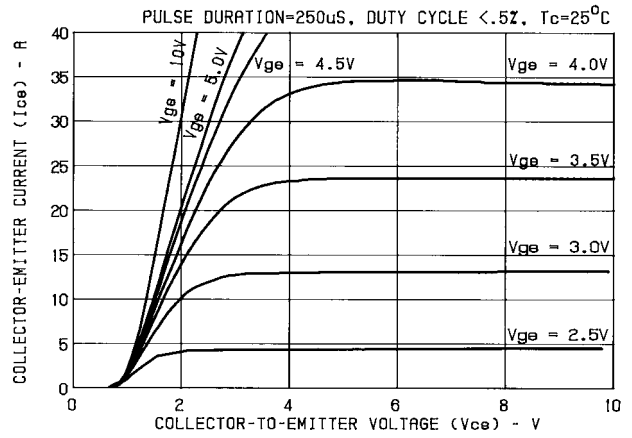


FIGURE 2. SATURATION CHARACTERISTIC (TYP.)

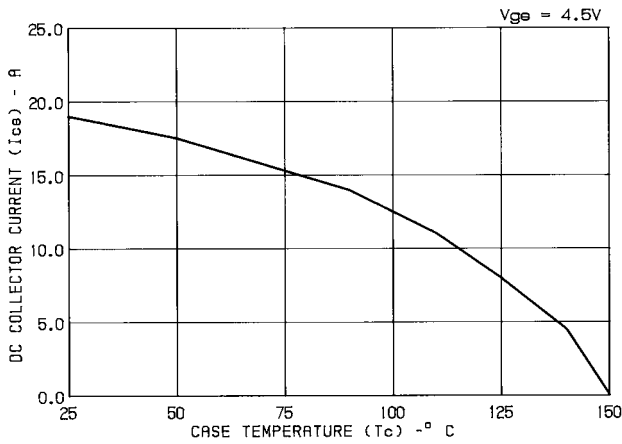


FIGURE 3. MAXIMUM DC COLLECTOR CURRENT AS A FUNCTION OF CASE TEMPERATURE

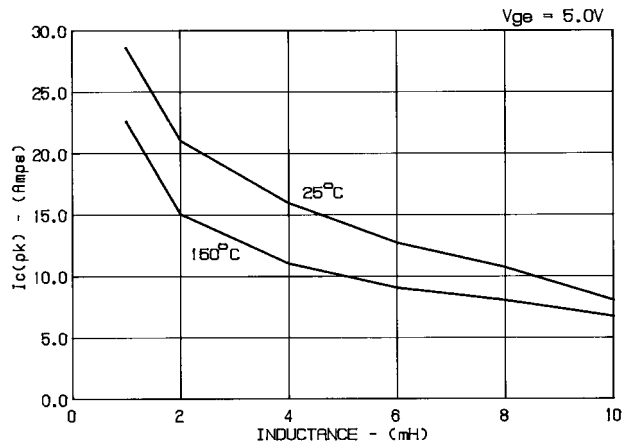


FIGURE 4. OPEN SECONDARY CURRENT AS A FUNCTION OF INDUCTANCE (TYP.)

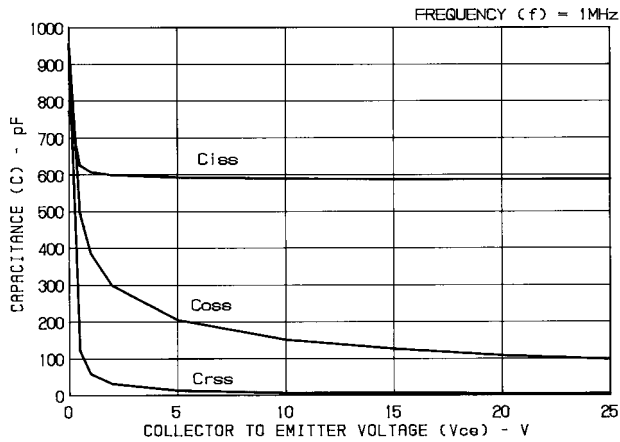


FIGURE 5. CAPACITANCE AS A FUNCTION OF COLLECTOR-EMITTER VOLTAGE (TYP.)

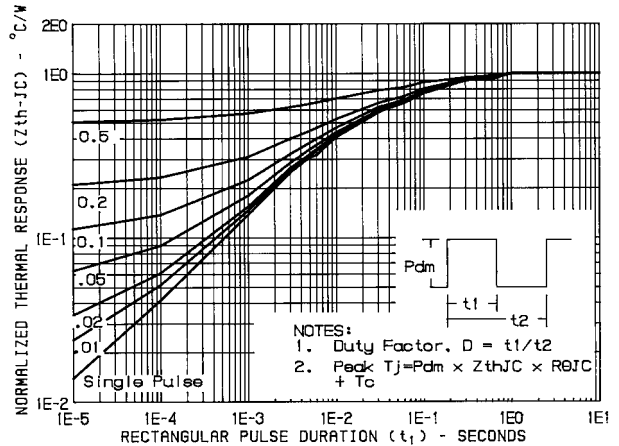


FIGURE 6. MAXIMUM EFFECTIVE TRANSIENT THERMAL IMPEDANCE, JUNCTION-TO-CASE, vs PULSE DURATION

Typical Performance Curves (Continued)

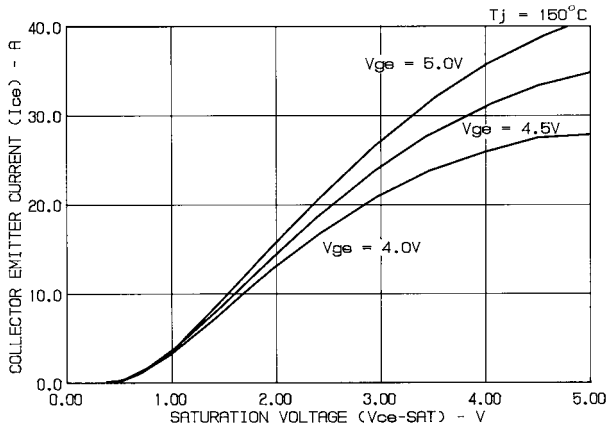


FIGURE 7. COLLECTOR-EMITTER CURRENT AS A FUNCTION OF SATURATION VOLTAGE; $T_j = +150^\circ\text{C}$ (TYP.)

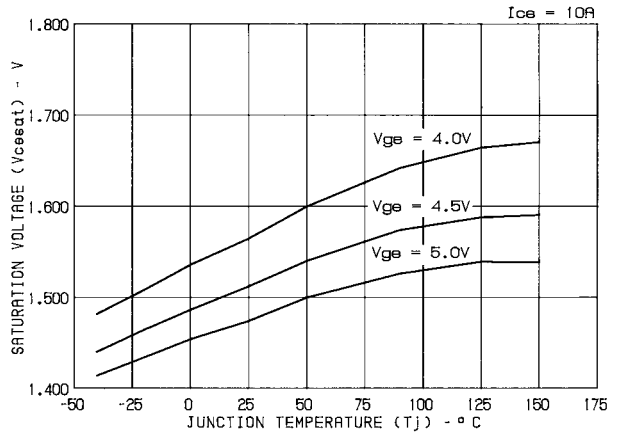


FIGURE 8. SATURATION VOLTAGE AS A FUNCTION OF JUNCTION TEMPERATURE (TYP.)

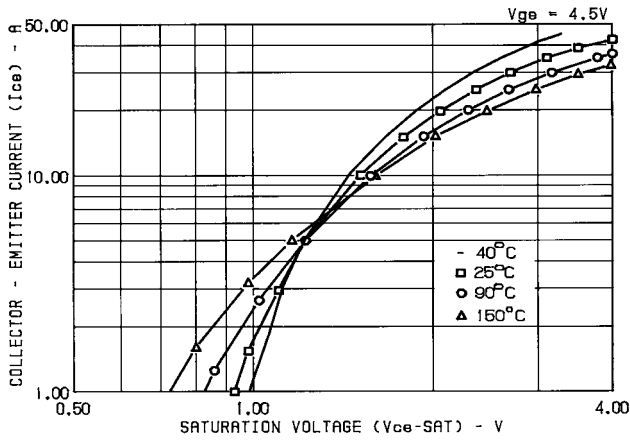


FIGURE 9. COLLECTOR-EMITTER CURRENT AS A FUNCTION OF SATURATION VOLTAGE (TYP.)

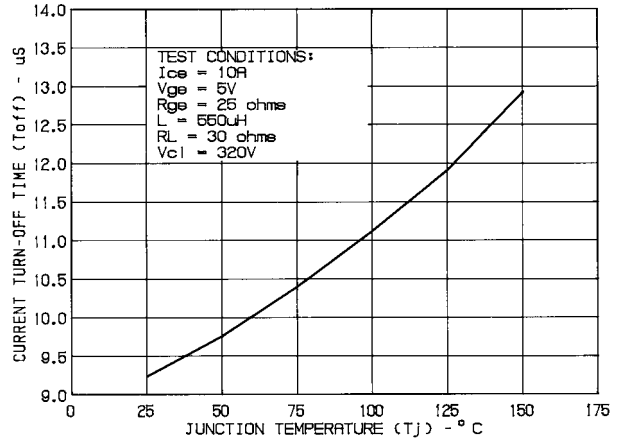


FIGURE 10. INDUCTIVE CURRENT TURN-OFF TIME AS A FUNCTION OF JUNCTION TEMPERATURE (TYP.)

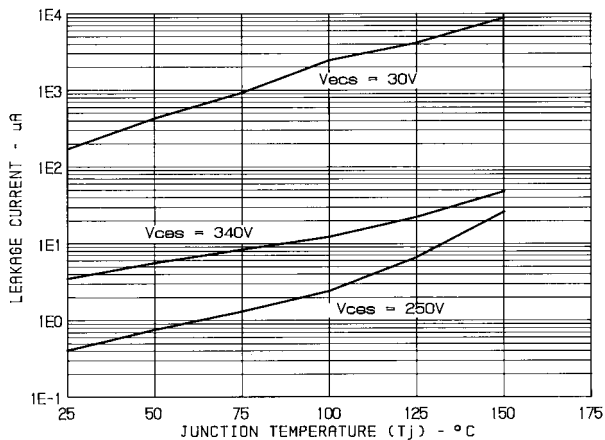


FIGURE 11. LEAKAGE CURRENTS AS A FUNCTION OF JUNCTION TEMPERATURE (TYP.)

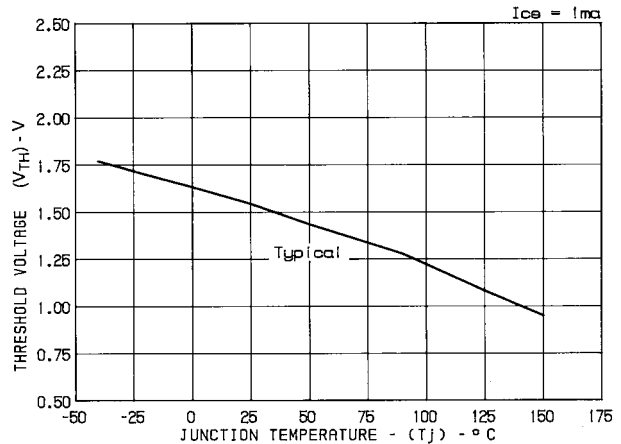


FIGURE 12. THRESHOLD VOLTAGE AS A FUNCTION OF JUNCTION TEMPERATURE (TYP.)

Test Circuits

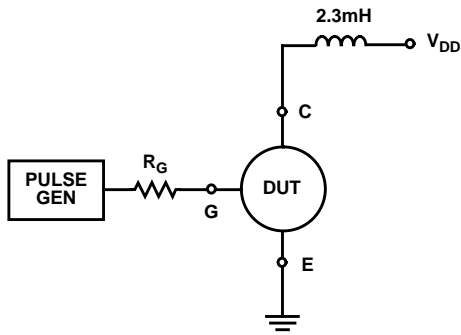


FIGURE 13. USE TEST CIRCUIT

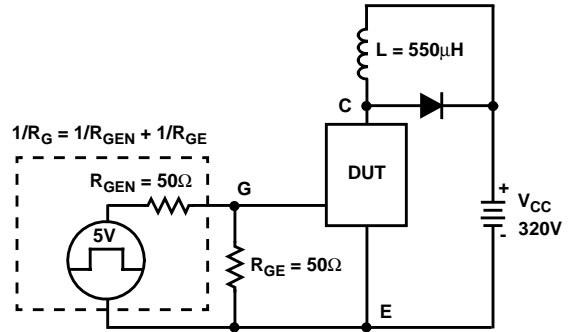


FIGURE 14. INDUCTIVE SWITCHING TEST CIRCUIT

Handling Precautions for IGBT's

Insulated Gate Bipolar Transistors are susceptible to gate-insulation damage by the electrostatic discharge of energy through the devices. When handling these devices, care should be exercised to assure that the static charge built in the handler's body capacitance is not discharged through the device. With proper handling and application procedures, however, IGBT's are currently being extensively used in production by numerous equipment manufacturers in military, industrial and consumer applications, with virtually no damage problems due to electrostatic discharge. IGBT's can be handled safely if the following basic precautions are taken:

1. Prior to assembly into a circuit, all leads should be kept shorted together either by the use of metal shorting springs or by the insertion into conductive material such as "†ECCOSORB LD26" or equivalent.

2. When devices are removed by hand from their carriers, the hand being used should be grounded by any suitable means - for example, with a metallic wristband.
3. Tips of soldering irons should be grounded.
4. Devices should never be inserted into or removed from circuits with power on.
5. **Gate Voltage Rating** - Never exceed the gate-voltage rating of V_{GEM} . Exceeding the rated V_{GE} can result in permanent damage to the oxide layer in the gate region.
6. **Gate Termination** - The gates of these devices are essentially capacitors. Circuits that leave the gate open-circuited or floating should be avoided. These conditions can result in turn-on of the device due to voltage buildup on the input capacitor due to leakage currents or pickup.

† Trademark Emerson and Cumming, Inc.