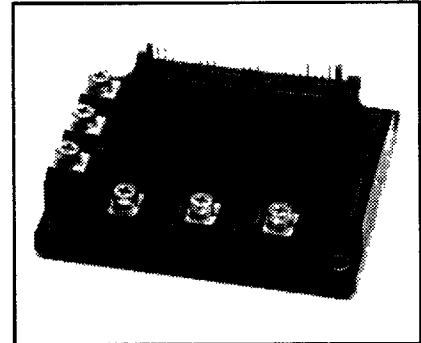
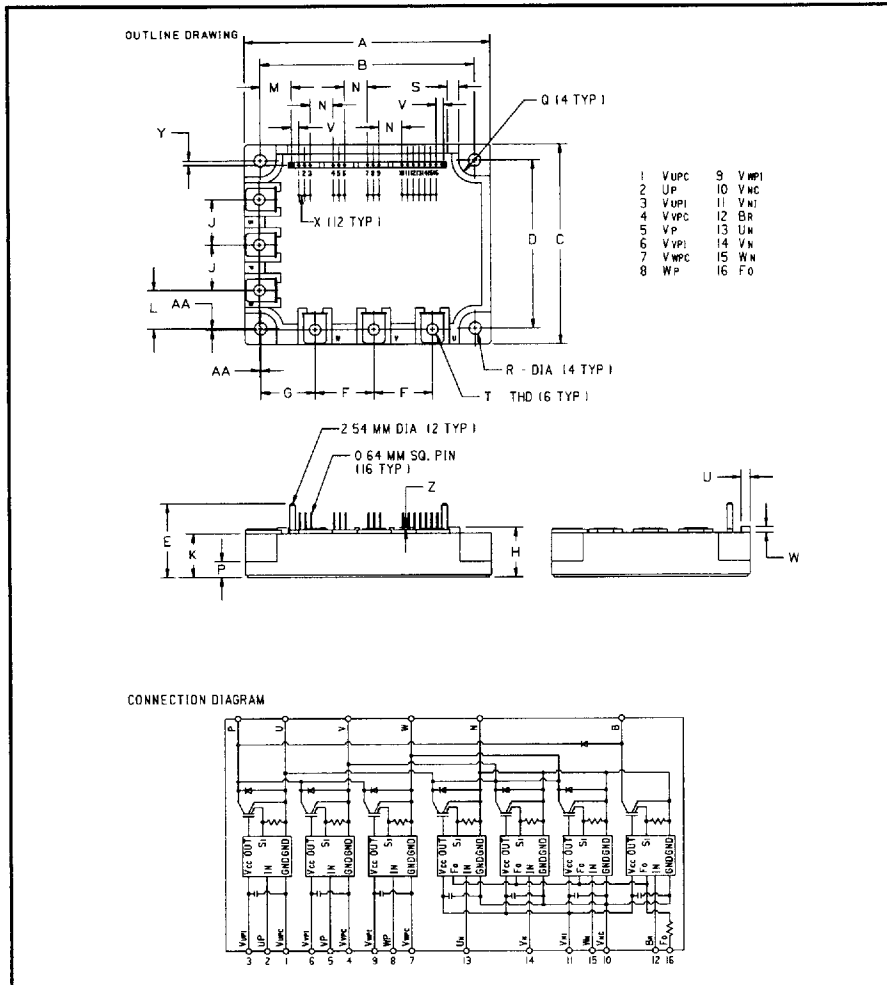


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**Intellimod™-3 Modules**  
 Three Phase + Brake  
 IGBT Inverter Output  
 50 Amperes/110-230 Volt Line



### Description

Powerex Intellimod-3 Modules are designed for applications requiring a high frequency (20kHz) output switching inverter. The modules are isolated from the baseplate, consisting of complete drive, control and protection circuitry for the IGBT inverter.

### Features:

- ☐ Complete Output Power Circuit
- ☐ Gate Drive Circuit
- ☐ Protection Logic
  - Short Circuit
  - Over-Current
  - Over Temperature
  - Under Voltage

### Applications:

- ☐ Inverters
- ☐ Small UPS
- ☐ Motion/Servo Control
- ☐ AC Motor Control

**Ordering Information**  
 PM50RHA060

110-230 Volt Line, PM50RHA060 Outline Drawing

| Dimensions | Inches    | Millimeters |
|------------|-----------|-------------|
| A          | 4.29±0.04 | 109.0±1.0   |
| B          | 3.74±0.02 | 95.0±0.5    |
| C          | 3.46±0.04 | 88.0±1.0    |
| D          | 2.91±0.02 | 74.0±0.5    |
| E          | 1.28      | 32.6        |
| F          | 1.02      | 26.0        |
| G          | 0.94      | 24.0        |
| H          | 0.87      | 22.0        |
| J          | 0.79      | 20.0        |
| K          | 0.76      | 19.4        |
| L          | 0.67      | 17.0        |
| M          | 0.54      | 13.8        |
| N          | 0.4       | 10.16       |

| Dimensions | Inches    | Millimeters |
|------------|-----------|-------------|
| P          | 0.28      | 7.0         |
| Q          | 0.38 R    | 7.0 R       |
| R          | 0.22 Dia. | 5.5 Dia.    |
| S          | 0.2       | 5.0         |
| T          | M5 Metric | M5          |
| U          | 0.16      | 4.0         |
| V          | 0.127     | 3.22        |
| W          | 0.1       | 2.6         |
| X          | 0.1       | 2.54        |
| Y          | 0.08      | 2.0         |
| Z          | 0.04      | 1.0         |
| AA         | 0.02      | 0.5         |



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IntelliMod-3 Modules

Three Phase + Brake IGBT Inverter Output

50 Amperes/110-230 Volt Line

T-57-29

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

| Characteristics                                                                      | Symbol          | PM50RHA060  | Units            |
|--------------------------------------------------------------------------------------|-----------------|-------------|------------------|
| Power Device Junction Temperature                                                    | $T_J$           | -20 to +150 | $^\circ\text{C}$ |
| Storage Temperature                                                                  | $T_{STG}$       | -40 to +125 | $^\circ\text{C}$ |
| Case Operating Temperature                                                           | $T_C$           | -20 to +100 | $^\circ\text{C}$ |
| Mounting Torque, M5 Mounting Screws                                                  | —               | 17          | Kg-cm            |
| Mounting Torque, M5 Main Terminal Screws                                             | —               | 17          | Kg-cm            |
| Module Weight (Typical)                                                              | —               | 550         | Grams            |
| Supply Voltage Protected by OC and SC ( $V_D = 13.5 - 16.5\text{V}$ , Inverter Part) | $V_{CC(prot.)}$ | 400         | Volts            |
| Isolation Voltage AC 1 minute, 60Hz                                                  | $V_{RMS}$       | 2500        | Volts            |

**Control Sector**

|                                                                                                                        |           |    |       |
|------------------------------------------------------------------------------------------------------------------------|-----------|----|-------|
| Supply Voltage Applied between ( $V_{UP1} - V_{UPC}$ , $V_{VP1} - V_{VPC}$ , $V_{WP1} - V_{WPC}$ , $V_{N1} - V_{NC}$ ) | $V_D$     | 20 | Volts |
| Input Voltage Applied between ( $U_P$ , $V_P$ , $U_N$ , $V_N$ , $W_N$ , $B_r$ )                                        | $V_{CIN}$ | 20 | Volts |
| Fault Output Supply Voltage                                                                                            | $V_{FO}$  | 20 | Volts |
| Fault Output Current                                                                                                   | $I_{FO}$  | 20 | mA    |

**IGBT Inverter Sector**

|                                              |                 |     |         |
|----------------------------------------------|-----------------|-----|---------|
| Collector-Emitter Voltage Fig. 1             | $V_{CES}$       | 600 | Volts   |
| Collector Current $\pm$                      | $I_C$           | 50  | Amperes |
| Peak Collector Current $\pm$                 | $I_{CP}$        | 100 | Amperes |
| Supply Voltage (Applied between P - N)       | $V_{CC}$        | 450 | Volts   |
| Supply Voltage (Surge) Applied between P - N | $V_{CC(surge)}$ | 500 | Volts   |
| Collector Dissipation                        | $P_C$           | 138 | Watts   |

**Brake Sector**

|                                              |                 |     |         |
|----------------------------------------------|-----------------|-----|---------|
| Collector-Emitter Voltage Fig. 1             | $V_{CES}$       | 600 | Volts   |
| Collector Current $\pm$                      | $I_C$           | 15  | Amperes |
| Peak Collector Current $\pm$                 | $I_{CP}$        | 30  | Amperes |
| Supply Voltage (Applied between P - N)       | $V_{CC}$        | 450 | Volts   |
| Supply Voltage (Surge) Applied between P - N | $V_{CC(surge)}$ | 500 | Volts   |
| Collector Dissipation                        | $P_C$           | 52  | Watts   |
| Diode Forward Current                        | $I_F$           | 15  | Amperes |
| Diode DC Reverse Voltage                     | $V_{R(DC)}$     | 600 | Volts   |



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T-57-29

PM50RHA060

Intellimod-3 Modules

Three Phase + Brake IGBT Inverter Output

50 Amperes/110-230 Volt Line

## Electrical Characteristics, $T_j = 25^\circ\text{C}$ unless otherwise specified

| Characteristics                         | Symbol                | Test Conditions                                                                                                                                                                      | Min. | Typ. | Max. | Units              |
|-----------------------------------------|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|--------------------|
| <b>Control Sector</b>                   |                       |                                                                                                                                                                                      |      |      |      |                    |
| Overcurrent Trip Level Inverter Part    | OC                    | $-20^{\circ}\text{C} \leq T \leq 125^{\circ}\text{C}$ , $V_D = 15\text{V}$                                                                                                           | 65   | 88   | —    | Amperes            |
| Overcurrent Trip Level Brake Part       |                       |                                                                                                                                                                                      | 18   | 26   | —    | Amperes            |
| Short Circuit Trip Level Inverter Part  | SC                    | $-20^{\circ}\text{C} \leq T \leq 125^{\circ}\text{C}$ , $V_D = 15\text{V}$                                                                                                           | —    | 132  | —    | Amperes            |
| Short Circuit Trip Level Brake Part     |                       |                                                                                                                                                                                      | —    | 39   | —    | Amperes            |
| Over Current Delay Time                 | $t_{\text{off(OC)}}$  | $V_D = 15\text{V}$ , Fig. 7                                                                                                                                                          | —    | 10   | —    | $\mu\text{S}$      |
| Over Temperature Protection             | OT                    | Trip Level                                                                                                                                                                           | 111  | 118  | 125  | $^{\circ}\text{C}$ |
| Over Temperature Protection             | $\text{OT}_R$         | Reset Level                                                                                                                                                                          | —    | 100  | —    | $^{\circ}\text{C}$ |
| Supply Circuit Under Voltage Protection | UV                    | Trip Level                                                                                                                                                                           | 11.5 | 12.0 | 12.5 | Volts              |
| Supply Circuit Under Voltage Protection | $\text{UV}_R$         | Reset Level                                                                                                                                                                          | —    | 12.5 | —    | Volts              |
| Supply Voltage                          | $V_D$                 | Applied between $V_{\text{UP1}} - V_{\text{UPC}}$ ,<br>$V_{\text{VP1}} - V_{\text{VPC}}$ , $V_{\text{WP1}} - V_{\text{WPC}}$ , $V_{\text{N1}} - V_{\text{NC}}$                       | 13.5 | 15   | 16.5 | Volts              |
| Circuit Current                         | $I_D$                 | $V_D = 15\text{V}$ , $V_{\text{CIN}} = 15\text{V}$ , $V_{\text{N1}} - V_{\text{NC}}$                                                                                                 | —    | 80   | 120  | mA                 |
|                                         | $I_D$                 | $V_D = 15\text{V}$ , $V_{\text{CIN}} = 15\text{V}$ , $V_{\text{XP1}} - V_{\text{XPC}}$                                                                                               | —    | 25   | 35   | mA                 |
| Input Bias On Voltage                   | $V_{\text{CIN(on)}}$  | Applied between $V_{\text{UP1}} - V_{\text{UPC}}$ , $B_r - V_{\text{NC}}$<br>$V_{\text{VP1}} - V_{\text{VPC}}$ , $V_{\text{WP1}} - V_{\text{WPC}}$ , $V_{\text{N1}} - V_{\text{NC}}$ | 1.2  | 1.5  | 1.8  | Volts              |
| Input Bias Off Voltage                  | $V_{\text{CIN(off)}}$ | Applied between $V_{\text{UP1}} - V_{\text{UPC}}$ , $B_r - V_{\text{NC}}$<br>$V_{\text{VP1}} - V_{\text{VPC}}$ , $V_{\text{WP1}} - V_{\text{WPC}}$ , $V_{\text{N1}} - V_{\text{NC}}$ | 1.7  | 2.0  | 2.3  | Volts              |
| PWM Input Frequency                     | $f_{\text{PWM}}$      | 3- $\phi$ Sinusoidal                                                                                                                                                                 | —    | 15   | 20   | kHz                |
| Dead Time                               | $t_{\text{DEAD}}$     | For each Input Pulse                                                                                                                                                                 | 3.0  | —    | —    | $\mu\text{S}$      |
|                                         |                       | Using example Interface Circuit*                                                                                                                                                     | 5.0  | —    | —    | $\mu\text{S}$      |
| Fault Output Current                    | $I_{\text{FO(H)}}$    | $V_D = 15\text{V}$ , $V_{\text{FO}} = 15\text{V}$                                                                                                                                    | —    | —    | 0.01 | mA                 |
|                                         | $I_{\text{FO(L)}}$    | $V_D = 15\text{V}$ , $V_{\text{FO}} = 15\text{V}$                                                                                                                                    | —    | 10   | 15   | mA                 |
| Minimum Fault Output Pulse Width        | $t_{\text{FO}}$       | $V_D = 15\text{V}$                                                                                                                                                                   | 1.0  | 2.0  | —    | mS                 |
|                                         |                       | Using example Interface Circuit*<br>$V_D = 15\text{V}$                                                                                                                               | 1.0  | 2.0  | —    | mS                 |
| <b>Brake Sector</b>                     |                       |                                                                                                                                                                                      |      |      |      |                    |
| Collector Emitter Saturation Voltage    | $V_{\text{CE(sat)}}$  | $V_D = 15\text{V}$ , $I_C = 15\text{A}$ ,<br>$T_J = 25^{\circ}\text{C}$ , Fig. 2                                                                                                     | —    | 2.6  | 3.5  | Volts              |
|                                         |                       | $V_D = 15\text{V}$ , $I_C = 15\text{A}$ ,<br>$T_J = 125^{\circ}\text{C}$ , Fig. 2                                                                                                    | —    | 3.0  | 4.0  | Volts              |
| Diode Forward Voltage                   | $V_{\text{FM}}$       | $I_C = 15\text{A}$ , $V_D = 15\text{V}$ , $V_{\text{CIN}} = 15\text{V}$ , Fig. 3                                                                                                     | —    | 1.7  | 2.2  | Volts              |
| Collector Cutoff Current                | $I_{\text{CEX}}$      | $V_{\text{CE}} = V_{\text{CES}}$ , $T_J = 25^{\circ}\text{C}$ , Fig. 6                                                                                                               | —    | —    | 1    | mA                 |
|                                         |                       | $V_{\text{CE}} = V_{\text{CES}}$ , $T_J = 125^{\circ}\text{C}$ , Fig. 6                                                                                                              | —    | —    | 10   | mA                 |

\*See Intellimod-3 Applications Data Section 4.3.



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PM50RHA060

Intellimod-3 Modules

Three Phase + Brake IGBT Inverter Output

50 Amperes/110-230 Volt Line

T-57-29

**Electrical Characteristics,  $T_J = 25^\circ\text{C}$  unless otherwise specified**

| Characteristics                      | Symbol        | Test Conditions                                                                                      | Min. | Typ. | Max. | Units         |
|--------------------------------------|---------------|------------------------------------------------------------------------------------------------------|------|------|------|---------------|
| <b>IGBT Inverter Sector</b>          |               |                                                                                                      |      |      |      |               |
| Collector Cutoff Current             | $I_{CEX}$     | $V_{CE} = V_{CES}$ , $T_J = 25^\circ\text{C}$ , Fig. 6                                               | —    | —    | 1    | mA            |
| Collector Cutoff Current             | $I_{CEX}$     | $V_{CE} = V_{CES}$ , $T_J = 125^\circ\text{C}$ , Fig. 6                                              | —    | —    | 10   | mA            |
| Diode Forward Voltage                | $V_{FM}$      | $-I_C = 50\text{A}$ , $V_D = 15\text{V}$ , $V_{CIN} = 15\text{V}$ , Fig. 3                           | —    | 1.7  | 2.5  | Volts         |
| Collector Emitter Saturation Voltage | $V_{CE(sat)}$ | $V_D = 15\text{V}$ , $I_{CIN} = 0\text{mA}$ , $I_C = 50\text{A}$ , Fig. 2                            | —    | 2.7  | 3.5  | Volts         |
| Collector Emitter Saturation Voltage | $V_{CE(sat)}$ | $V_D = 15\text{V}$ , $V_{CIN} = 0\text{V}$ , $I_C = 50\text{A}$ , $T_J = 125^\circ\text{C}$ , Fig. 2 | —    | 2.5  | 3.4  | Volts         |
| Inductive Load Switching Times       | $t_{on}$      | $V_D = 15\text{V}$ , $V_{CIN} = 0\text{V}$ ,                                                         | 0.3  | 0.6  | 1.5  | $\mu\text{S}$ |
|                                      | $t_{rr}$      | $V_{CC} = 300\text{V}$ , $I_C = 50\text{A}$ ,                                                        | —    | 0.25 | 0.4  | $\mu\text{S}$ |
|                                      | $t_{C(on)}$   | $T_J = 125^\circ\text{C}$                                                                            | —    | 0.4  | 1.2  | $\mu\text{S}$ |
|                                      | $t_{off}$     | Fig. 4, 5                                                                                            | —    | 2.0  | 3.3  | $\mu\text{S}$ |
|                                      | $t_{C(off)}$  |                                                                                                      | —    | 0.6  | 1.2  | $\mu\text{S}$ |

**Thermal Characteristics**

| Characteristics                      | Symbol         | Test Conditions                     | Min. | Typ. | Max. | Units              |
|--------------------------------------|----------------|-------------------------------------|------|------|------|--------------------|
| Thermal Resistances Junction to Case | $R_{th(j-c)Q}$ | Inverter IGBT                       | —    | —    | 0.9  | $^\circ\text{C/W}$ |
|                                      | $R_{th(j-c)F}$ | Inverter FWD                        | —    | —    | 2.5  | $^\circ\text{C/W}$ |
|                                      | $R_{th(j-c)Q}$ | Brake IGBT                          | —    | —    | 2.4  | $^\circ\text{C/W}$ |
|                                      | $R_{th(j-c)F}$ | Brake FWD                           | —    | —    | 4.5  | $^\circ\text{C/W}$ |
| Contact Thermal Resistance           | $R_{th(c-f)}$  | Case to Fin, Thermal Grease Applied | —    | —    | 0.19 | $^\circ\text{C/W}$ |

**Recommended Operating Conditions**

| Characteristics     | Symbol         | Test Conditions                                                                                        | Value   | Units         |
|---------------------|----------------|--------------------------------------------------------------------------------------------------------|---------|---------------|
| Supply Voltage      | $V_{CC}$       | Applied across P - N Terminals                                                                         | 0 ~ 400 | Volts         |
|                     | $V_D$          | Applied between $V_{UP1} - V_{UPC}$ ,<br>$V_{N1} - V_{NC}$ , $V_{VP1} - V_{VPC}$ , $V_{WP1} - V_{WPC}$ | 15±1.5  | Volts         |
| Input On Voltage    | $V_{CIN(on)}$  | Applied between<br>$U_P$ , $V_P$ , $W_P$ , $U_N$ , $V_N$ , $W_N$ , $B_r$                               | 0 ~ 0.8 | Volts         |
| Input Off Voltage   | $V_{CIN(off)}$ |                                                                                                        | 4 ~ 15  | Volts         |
| PWM Input Frequency | $f_{PWM}$      | Using example Interface Circuit *                                                                      | 5 ~ 20  | kHz           |
| Minimum Dead Time   | $t_{DEAD}$     | Using example Interface Circuit *                                                                      | 5.0     | $\mu\text{S}$ |

\*See Intellimod-3 Applications Data Section 4.3.



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PM50RHA060

Intellimod-3 Modules

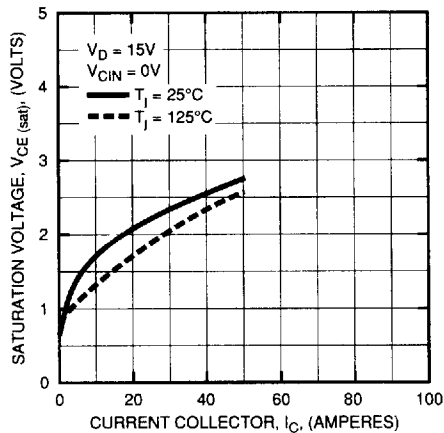
Three Phase + Brake IGBT Inverter Output

50 Amperes/110-230 Volt Line

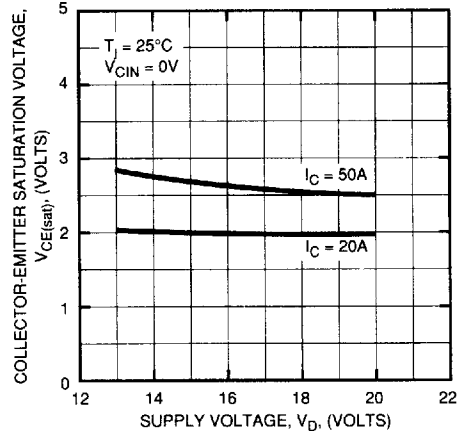
Inverter Part

T-57-29

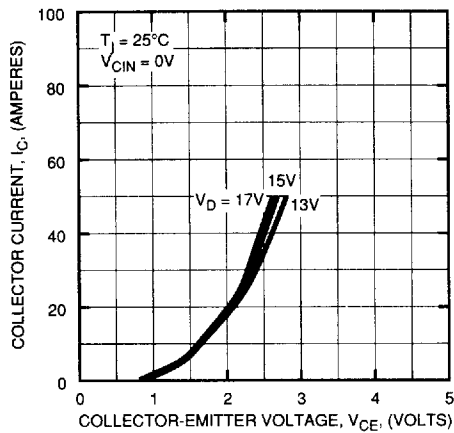
SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)



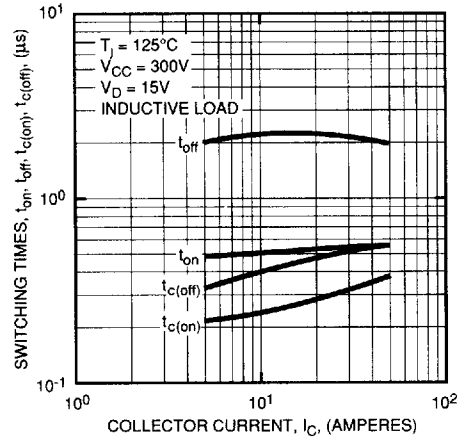
COLLECTOR-EMITTER SATURATION VOLTAGE (TYPICAL)



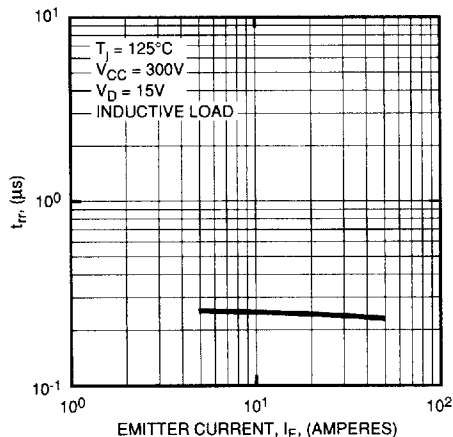
OUTPUT CHARACTERISTICS (TYPICAL)



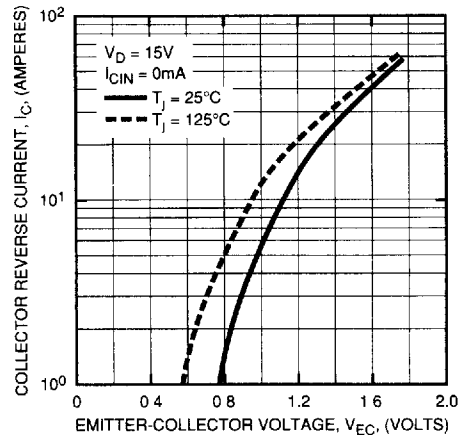
SWITCHING TIME VS. COLLECTOR CURRENT (TYPICAL)



REVERSE RECOVERY CHARACTERISTICS OF FREE-WHEEL DIODE (TYPICAL)



REVERSE COLLECTOR CURRENT VS. EMITTER-COLLECTOR VOLTAGE (DIODE FORWARD CHARACTERISTICS) (TYPICAL)





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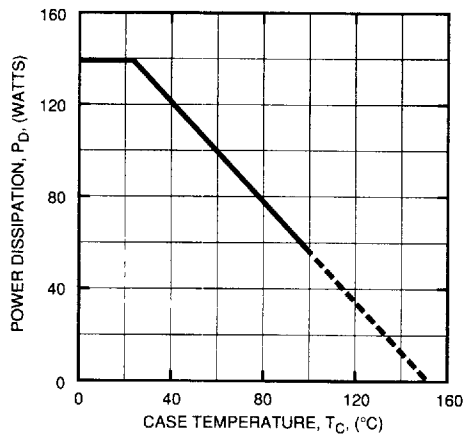
Intellimod-3 Modules

Three Phase + Brake IGBT Inverter Output

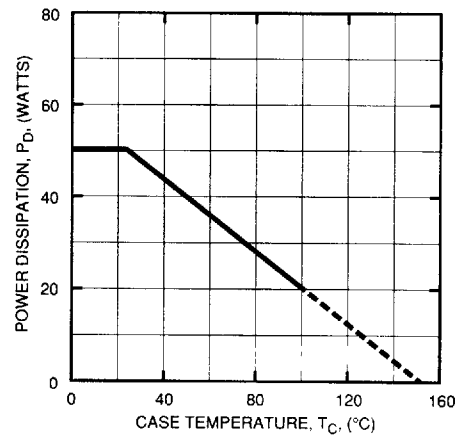
50 Amperes/110-230 Volt Line

Inverter Part

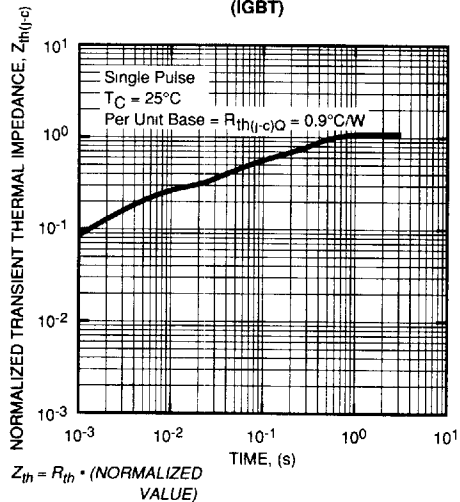
POWER DISSIPATION DERATING CURVE  
(PER IGBT ELEMENT)



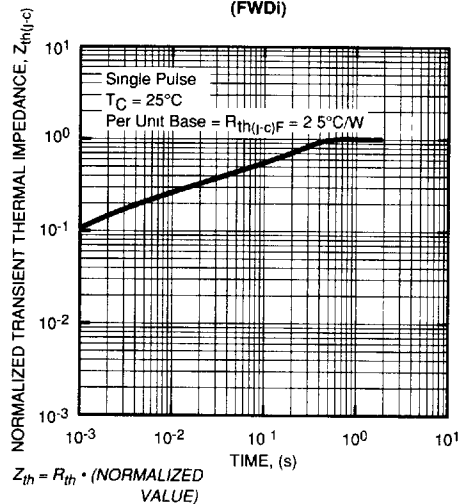
POWER DISSIPATION DERATING CURVE  
(PER FWDI ELEMENT)



TRANSIENT THERMAL  
IMPEDANCE CHARACTERISTICS  
(IGBT)



TRANSIENT THERMAL  
IMPEDANCE CHARACTERISTICS  
(FWDI)





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Intellimod-3 Modules

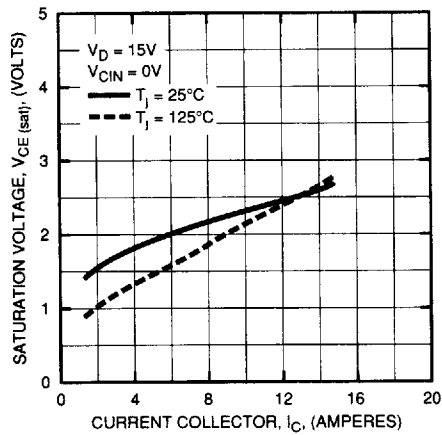
Three Phase + Brake IGBT Inverter Output

50 Amperes/110-230 Volt Line

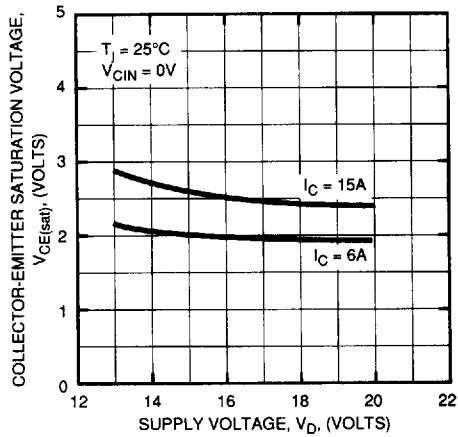
Brake Part

T-57-29

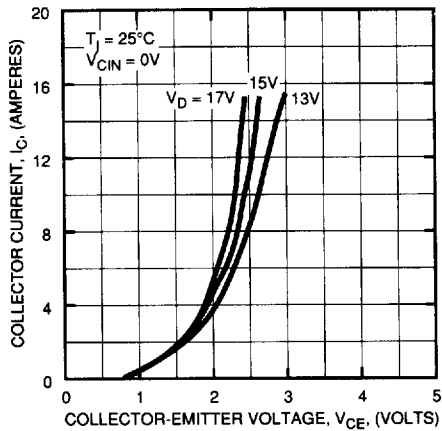
SATURATION VOLTAGE  
CHARACTERISTICS (TYPICAL)



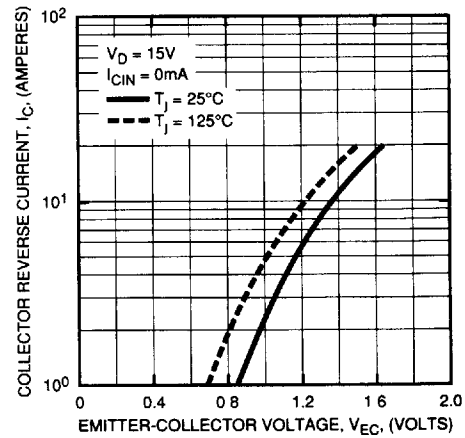
COLLECTOR-EMITTER SATURATION  
VOLTAGE (TYPICAL)



OUTPUT CHARACTERISTICS  
(TYPICAL)



REVERSE COLLECTOR CURRENT VS.  
EMITTER-COLLECTOR VOLTAGE  
(DIODE FORWARD CHARACTERISTICS)  
(TYPICAL)





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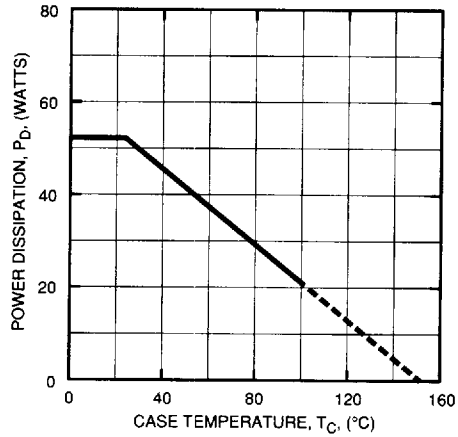
Intellimod-3 Modules

Three Phase + Brake IGBT Inverter Output

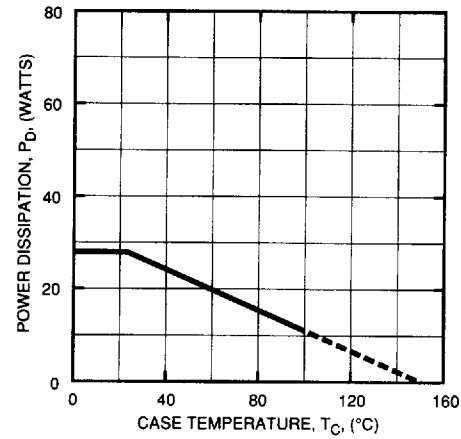
50 Amperes/110-230 Volt Line

Brake Part

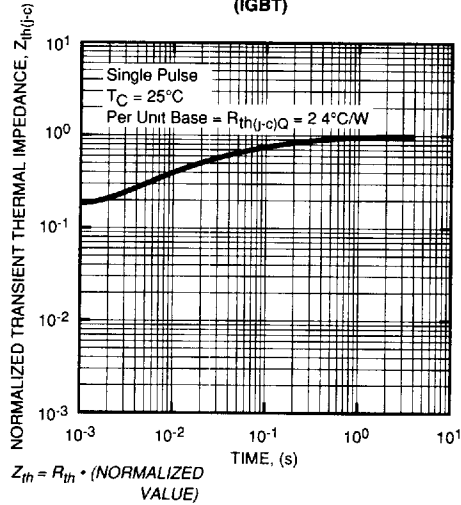
POWER DISSIPATION DERATING CURVE  
(PER IGBT ELEMENT)



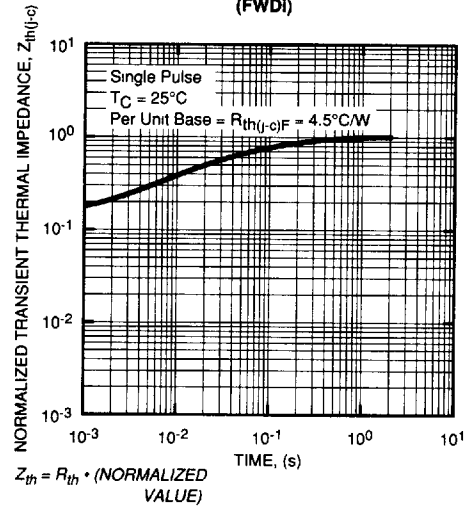
POWER DISSIPATION DERATING CURVE  
(PER FWDI ELEMENT)



TRANSIENT THERMAL  
IMPEDANCE CHARACTERISTICS  
(IGBT)



TRANSIENT THERMAL  
IMPEDANCE CHARACTERISTICS  
(FWDI)



## PM50RHA060

### Intellimod-3 Modules

#### Three Phase + Brake IGBT Inverter Output

50 Amperes/110-230 Volt Line

T-57-29

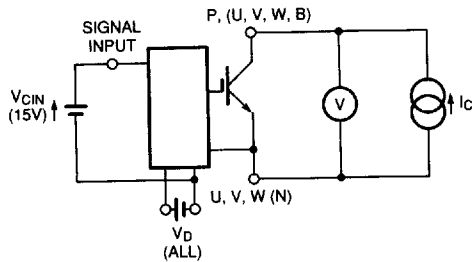


Figure 1  $V_{CES}$  Test

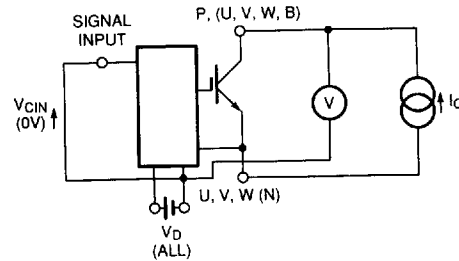


Figure 2  $V_{CE(SAT)}$  Test

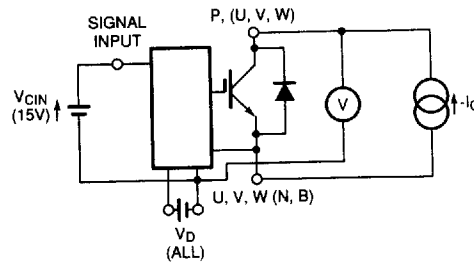
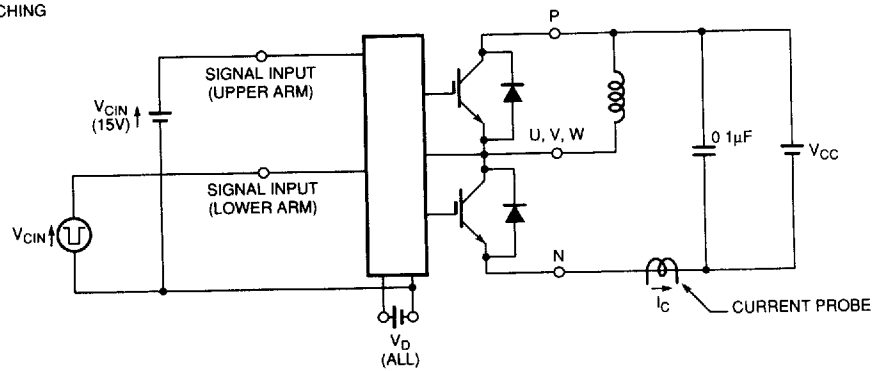


Figure 3  $V_{EC}$  Test

#### A) LOWER ARM SWITCHING



#### B) UPPER ARM SWITCHING

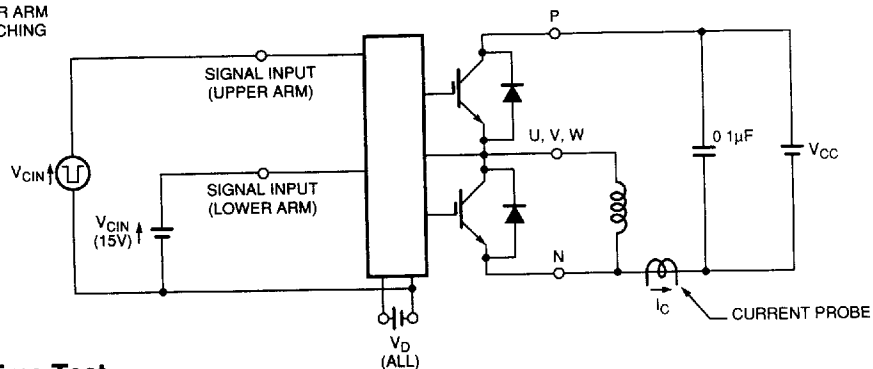


Figure 4 Switching Time Test

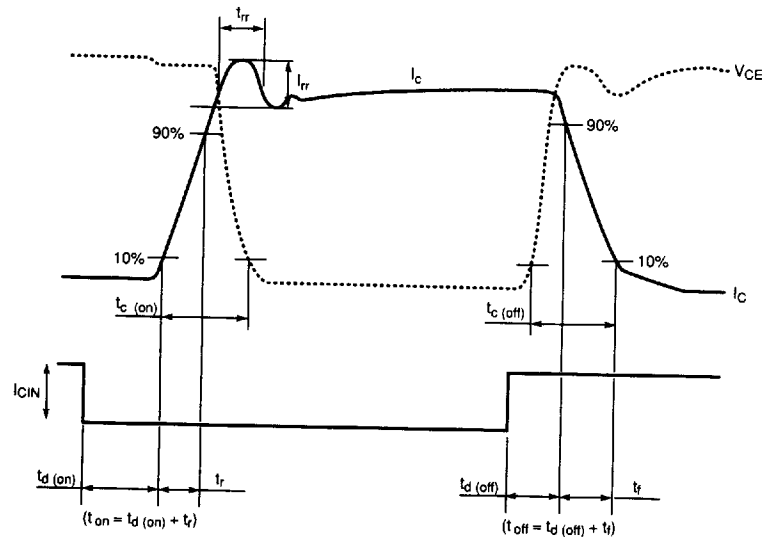


Figure 5 Switching Test Waveform

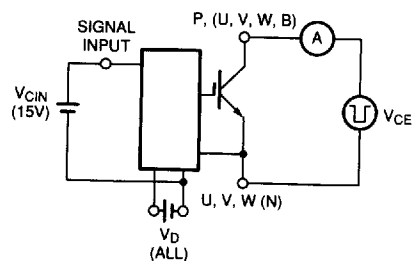


Figure 6  $I_{CES}$  Test

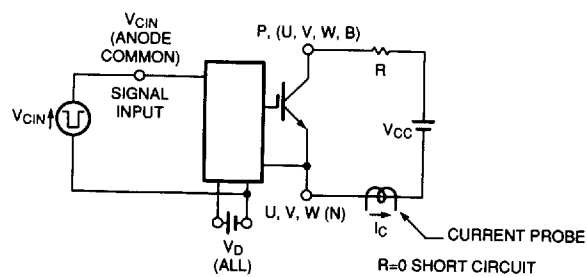


Figure 7 Over Current and Short Circuit Test