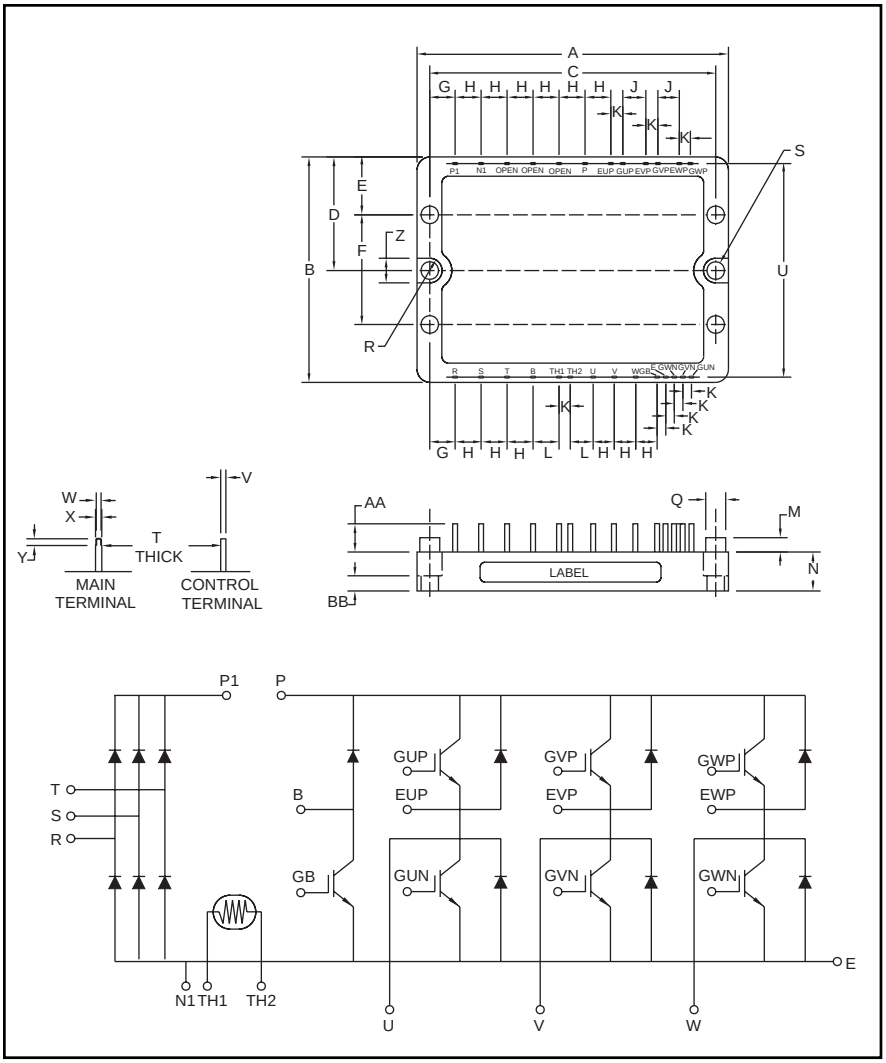
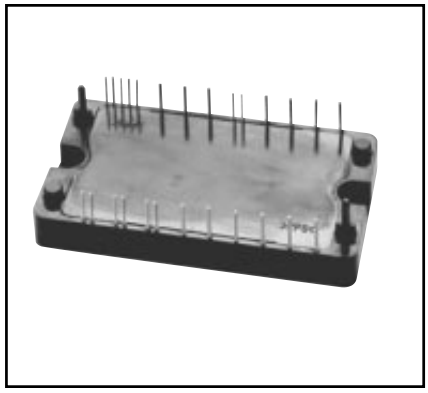
Powerex, Inc., 200 Hillis Street, Youngwood, Pennsylvania 15697-1800 (724) 925-7272

# Flexpak CIB Module

***Three Phase Converter +***
***Three Phase Inverter +***
***Brake + Thermistor***
***50 Amperes/600 Volts***




**Outline Drawing and Circuit Diagram**



**Description:**
Powerex Flexpak CIB Modules are designed for use in switching applications. Each module consists of a three phase diode converter section, a three phase IGBT inverter section, a brake and a thermistor. All components and interconnects are isolated from the heat sinking baseplate, offering simplified system assembly and thermal management.

**Features:**
- ☐ Low Drive Power
- ☐ Low $V_{CE(sat)}$
- ☐ Discrete Super-Fast Recovery (70ns) Free-Wheel Diodes
- ☐ High Frequency Operation (20-25 kHz)
- ☐ Isolated Baseplate for Easy Heat Sinking

**Applications:**
- ☐ AC & DC Motor Control
- ☐ Motion/Servo Control
- ☐ General Purpose Inverters
- ☐ Robotics

**Ordering Information:**
Example: Select the complete module part number you desire from the table below - i.e. CM50AD05-12H is a 600V ($V_{CES}$), 50 Ampere Flexpak CIB Power Module.

| Type | Current Rating Amperes | $V_{CES}$ Volts (x 50) |
|---|---|---|
| CM | 50 | 12 |

| Dimensions | Inches | Millimeters |
|---|---|---|
| A | 4.72 | 120.0 |
| B | 2.48 | 63.0 |
| C | 4.33 | 110.0 |
| D | 1.24 | 31.5 |
| E | 0.37 | 9.5 |
| F | 1.73 | 44.0 |
| G | 0.24 | 6.0 |
| H | 0.43 | 11.0 |
| J | 0.30 | 7.62 |
| K | 0.10 | 2.54 |
| L | 0.39 | 10.0 |
| M | 0.16 | 4.0 |
| N | 0.51 | 13.0 |

| Dimensions | Inches | Millimeters |
|---|---|---|
| Q | 0.24 | 6.0 |
| R | 0.20 | 5.0 |
| S | 0.18 | 4.5 |
| T | 0.02 | 0.6 |
| U | 2.36 | 60.0 |
| V | 0.02 | 0.6 |
| W | 0.06 | 1.5 |
| X | 0.10 | 2.5 |
| Y | 0.10 | 2.5 |
| Z | 0.39 | 10.0 |
| AA | 0.47 | 12.0 |
| BB | 0.25 | 6.4 |

***CM50AD05-12H***
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*50 Amperes/600 Volts*

## Absolute Maximum Ratings, $T_j$ = 25°C unless otherwise specified

| Characteristics | Symbol | CM50AD05-12H | Units |
|---|---|---|---|
| Power Device Junction Temperature | $T_j$ | -40 to 150 | °C |
| Storage Temperature | $T_{stg}$ | -40 to 125 | °C |
| Mounting Torque, M4 Mounting Screws | — | 13 | in-lb |
| Module Weight (Typical) | — | 140 | Grams |
| Isolation Voltage, AC 1 minute, 60Hz | $V_{iso}$ | 2500 | Volts |

## Converter Sector

| | | | |
|---|---|---|---|
| Repetitive Peak Reverse Voltage | $V_{RRM}$ | 800 | Volts |
| Recommended AC Input Voltage | $E_a$ | 220 | Volts |
| DC Output Current (3 Phase Rectifying Circuit) | $I_O$ | 50 | Amperes |
| Surge (Non-repetitive) Forward Current (1/2 Cycle at 60Hz, Peak Value) | $I_{FSM}$ | 500 | Amperes |
| $I^2t$ for Fusing (1 Cycle of Surge Current) | $I^2t$ | $1.0 \times 10^3$ | $A^2s$ |

## IGBT Inverter and Brake Sector

| | | | |
|---|---|---|---|
| Collector-Emitter Voltage (G-E Short) | $V_{CES}$ | 600 | Volts |
| Gate-Emitter Voltage (C-E Short) | $V_{GES}$ | ±20 | Volts |
| Collector Current ($T_C$ = 25°C) | $I_C$ | 50 | Amperes |
| Collector Current (Pulse)** | $I_{CM}$ | 100 | Amperes |
| Emitter Current* ($T_C$ = 25°C) | $I_E$ | 50 | Amperes |
| Emitter Current* (Pulse)** | $I_{EM}$ | 100 | Amperes |
| Maximum Collector Dissipation ($T_C$ = 25°C, $T_j$ <150°C) | $P_C$ | — | Watts |
| Repetitive Peak Reverse Voltage (Brake Sector) | $V_{RRM}$ | 600 | Volts |
| Forward Current (Brake Sector) | $I_{FM}$ | 50 | Amperes |

* Characteristics of the anti-parallel emitter-collector free-wheel diode.
** Pulse width and repetition rate should be such that device junction temperature ($T_j$) does not exceed maximum rating.

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## Electrical and Mechanical Characteristics, $T_j$ = 25°C unless otherwise specified

| Characteristics | | Symbol | Test Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|---|
| **Converter Sector** | | | | | | | |
| Repetitive Reverse Current | | $I_{RRM}$ | $V_R = V_{RRM}$, $T_j$ = 150°C | — | — | 8 | mA |
| Forward Voltage Drop | | $V_{FM}$ | $I_F$ = 50A | — | — | 1.5 | Volts |
| Thermal Resistance (Junction-to-Case) | | $R_{th(j-c)}$ | Per Diode | — | — | 1.7 | °C/W |
| **IGBT Inverter and Brake Sector** | | | | | | | |
| Collector Cutoff Current | | $I_{CES}$ | $V_{CE} = V_{CES}$, $V_{GE}$ = 0V | — | — | 1.0 | mA |
| Gate-Emitter Threshold Voltage | | $V_{GE(th)}$ | $V_{CE}$ = 10V, $I_C$ = 5.0mA | 4.5 | 6.0 | 7.5 | Volts |
| Gate-Emitter Cutoff Current | | $I_{GES}$ | $V_{GE} = V_{GES}$, $V_{CE}$ = 0V | — | — | 0.5 | µA |
| Collector-Emitter Saturation Voltage** | | $V_{CE(sat)}$ | $V_{GE}$ = 15V, $I_C$ = 50A, $T_j$ = 25°C | — | 2.2 | 2.8 | Volts |
| | | | $V_{GE}$ = 15V, $I_C$ = 50A, $T_j$ = 150°C | — | — | — | Volts |
| Input Capacitance | | $C_{ies}$ | $V_{GE}$ = 0V, $V_{CE}$ = 10V | — | — | 5.0 | nF |
| Output Capacitance | | $C_{oes}$ | | — | — | 3.8 | nF |
| Reverse Transfer Capacitance | | $C_{res}$ | | — | — | 1.0 | nF |
| Total Gate Charge | | $Q_G$ | $V_{CC}$ = 300V, $I_C$ = 50A, $V_{GE}$ = 15V | — | 150 | — | nC |
| Resistive Load | Turn-on Delay Time | $t_{d(on)}$ | $V_{GE1} = V_{GE2}$ = 15V, | — | — | 120 | nS |
| Switching | Rise Time | $t_r$ | $V_{CC}$ = 300V, $I_C$ = 50A, | — | — | 300 | nS |
| Times | Turn-off Delay Time | $t_{d(off)}$ | $R_g$ = 13Ω, | — | — | 200 | nS |
| (Inverter Sector) | Fall Time | $t_f$ | Resistive Load | — | — | 300 | nS |
| Emitter-Collector Voltage* (Inverter Sector) | | $V_{EC}$ | $I_E$ = 50A, $V_{GE}$ = 0V | — | — | 2.8 | Volts |
| Reverse Recovery Time* (Inverter Sector) | | $t_{rr}$ | $I_E$ = 50A, $V_{GE}$ = 0V, | — | — | 110 | nS |
| Reverse Recovery Charge* (Inverter Sector) | | $Q_{rr}$ | $di_E/dt$ = -100A/µs | — | 0.14 | — | µC |
| Thermal Resistance, Junction to Case | | $R_{th(j-c)}Q$ | Per IGBT | — | — | 1.2 | °C/W |
| | | $R_{th(j-c)}D$ | Per FWDi | — | — | 2.2 | °C/W |
| | | $R_{th(j-c)}D$ | Clamp Diode Part | — | — | 2.4 | °C/W |
| Forward Voltage Drop (Brake Sector) | | $V_{FM}$ | $I_F$ = 50A, Clamp Diode Part | — | — | 1.5 | Volts |
| **Thermistor Sector** | | | | | | | |
| Thermistor Resistance | | $R_{TO}$ | $T_O$ = 25°C (298K) | — | 100 | — | kΩ |
| Material Constant*** | | β | $T_1$ = 25°C, $T_2$ = 50°C | — | 4000 | — | K |
| **Thermal Characteristics** | | | | | | | |
| Contact Thermal Resistance | | $R_{th(c-f)}$ | Case to Fin Per Module | — | 0.035 | — | °C/W |
| | | | Thermal Grease Applied | | | | |

*Characteristics of the anti-parallel emitter-collector free-wheel diode.

**Pulse width and repetition rate should be such as to cause negligible temperature rise.

***$T = \dfrac{1}{\frac{1}{\beta} \bullet \ln\left[\frac{R_T}{R_{TO}}\right] + \frac{1}{T_O}}$

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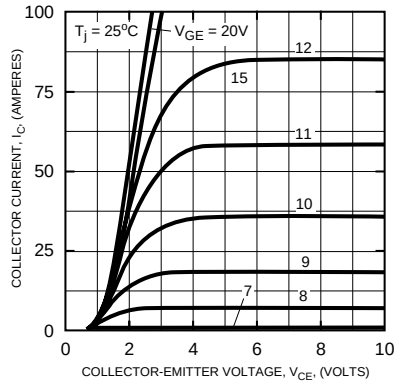
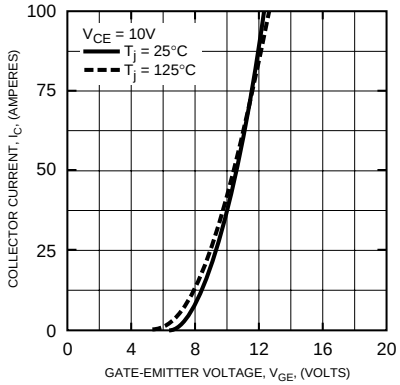
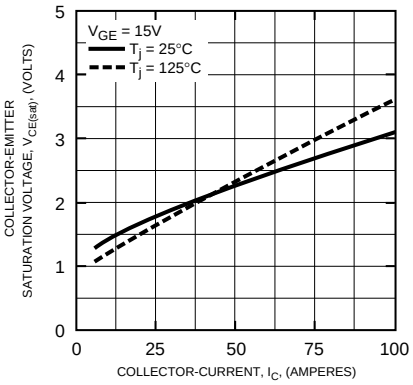
**OUTPUT CHARACTERISTICS (TYPICAL)**



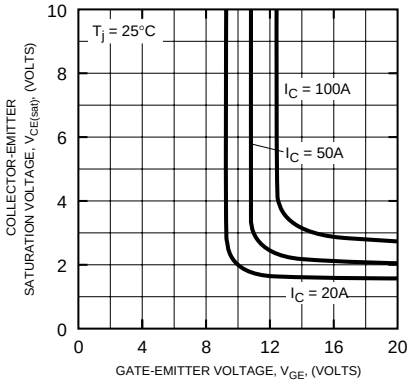

**TRANSFER CHARACTERISTICS (TYPICAL)**



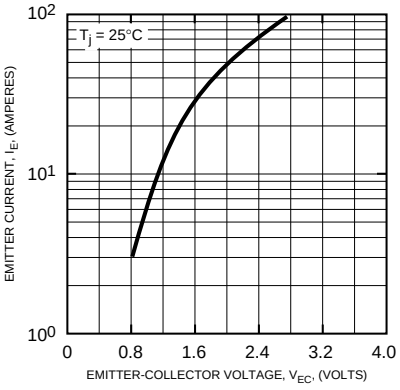

**COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)**



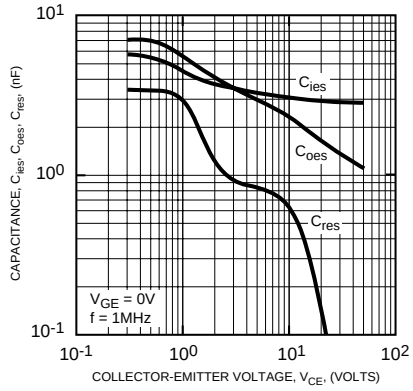

**COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)**



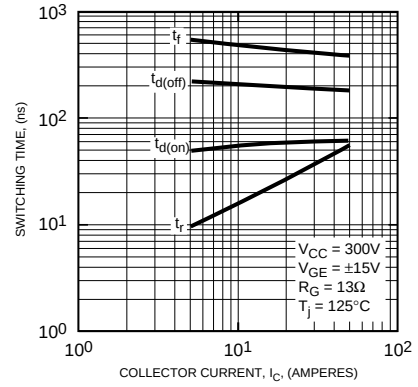

**FREE-WHEEL DIODE FORWARD CHARACTERISTICS (TYPICAL)**



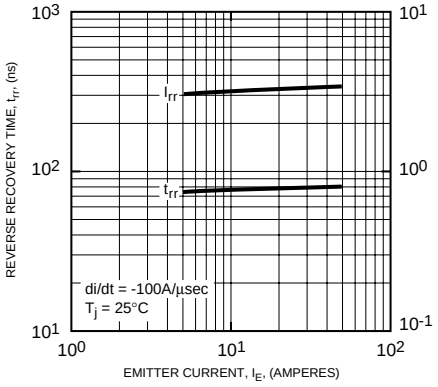

**CAPACITANCE VS. $V_{CE}$ (TYPICAL)**




**HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)**




**REVERSE RECOVERY CHARACTERISTICS (TYPICAL)**




**GATE CHARGE, $V_{GE}$**