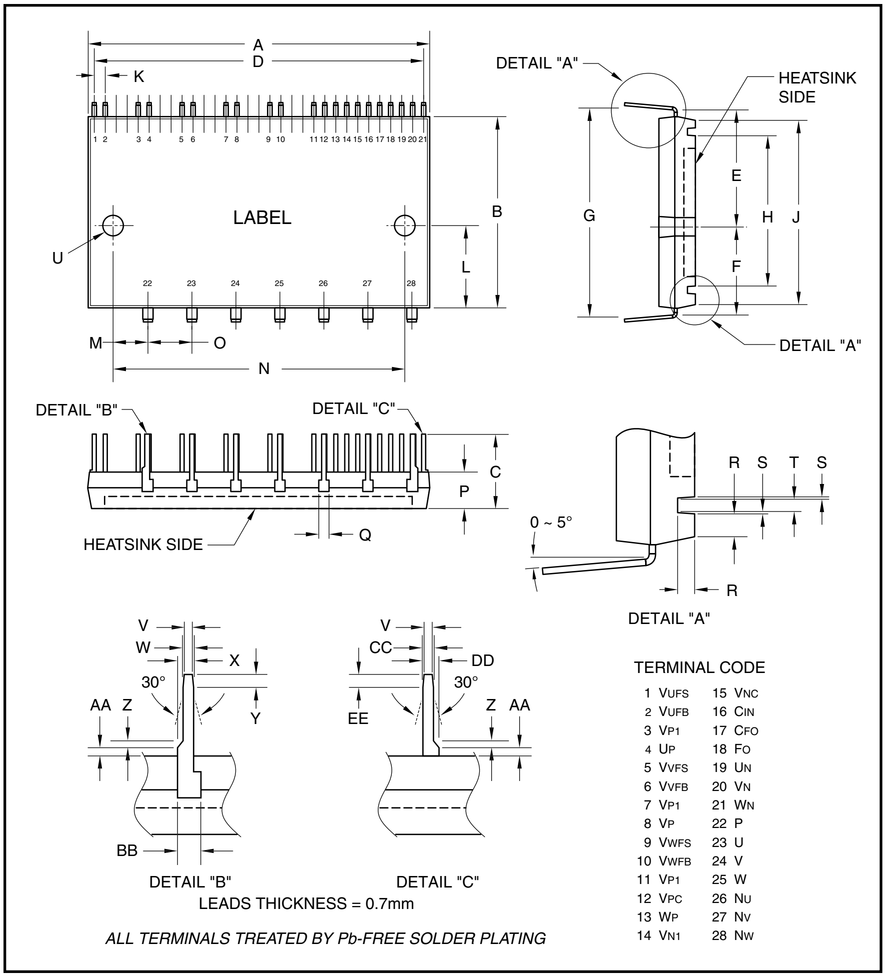
Powerex, Inc., 200 E. Hillis Street, Youngwood, Pennsylvania 15697-1800 (724) 925-7272

PS22053

Intellimod™ Module

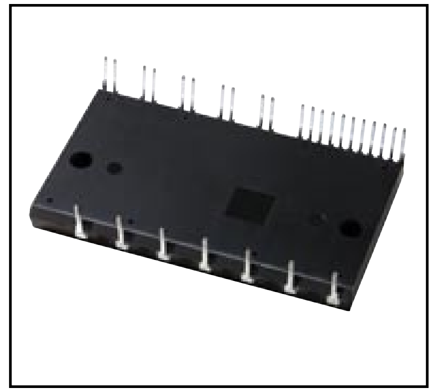
Dual-In-Line Intelligent Power Module
10 Amperes/1200 Volts



Outline Drawing and Circuit Diagram

Dimensions	Inches	Millimeters
A	3.11±0.02	79.0±0.5
B	1.73±0.02	44.0±0.5
C	0.63±0.01	16.1±0.3
D	3.0	76.2
E	1.08±0.02	27.4±0.5
F	0.80±0.02	20.4±0.5
G	1.91±0.02	48.6±0.5
H	1.34±0.02	34.0±0.5
J	1.67±0.02	42.5±0.5
K	0.10±0.01	2.54±0.3
L	0.73±0.02	18.5±0.5
M	0.31±0.01	8.0±0.3
N	2.64±0.01	67.0±0.3
O	0.40±0.01	10.16±0.3
P	0.32±0.02	8.2±0.5

Dimensions	Inches	Millimeters
Q	0.09	2.5
R	0.08	2.0
S	0.01	0.3
T	0.07	1.7
U	0.18±0.008 Dia.	4.5±0.2 Dia.
V	0.024	0.6
W	0.039±0.008	1.0±0.2
X	0.06±0.008	1.5±0.2
Y	0.05	1.2
Z	0.02	0.5
AA	0.024±0.02	0.6±0.5
BB	0.098	2.5
CC	0.031±0.008	0.8±0.2
DD	0.051±0.008	1.3±0.2
EE	0.04	1.0



Description:
DIP-IPMs are intelligent power modules that integrate power devices, drivers, and protection circuitry in an ultra compact dual-in-line transfer-mold package for use in driving small three phase motors. Use of 4th generation IGBTs, DIP packaging, and application specific HVICs allow the designer to reduce inverter size and overall design time.

Features:
- ☐ Compact Packages
- ☐ Single Power Supply
- ☐ Integrated HVICs
- ☐ Direct Connection to CPU

Applications:
- ☐ Washing Machines
- ☐ Refrigerators
- ☐ Air Conditioners
- ☐ Small Servo Motors
- ☐ Small Motor Control

Ordering Information:
PS22053 is a 1200V, 10 Ampere DIP Intelligent Power Module.

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

Characteristics	Symbol	PS22053	Units
Power Device Junction Temperature*	T_j	-20 to 125	°C
Module Case Operation Temperature (See Note 1)	T_C	-20 to 100	°C
Storage Temperature	T_{stg}	-40 to 125	°C
Mounting Torque, M4 Mounting Screws	—	13	in-lb
Module Weight (Typical)	—	77	Grams
Self-protection Supply Voltage Limit (Short Circuit Protection Capability)**	$V_{CC(prot.)}$	800	Volts
Heatsink Flatness (See Note 2)		-50 to 100	µm
Isolation Voltage, AC 1 minute, 60Hz Sinusoidal, Connection Pins to Heatsink Plate	V_{ISO}	2500	Volts

*The maximum junction temperature rating of the power chips integrated within the DIP-IPM is 150°C (@$T_C \le$ 100°C). However, to ensure safe operation of the DIP-IPM, the average junction temperature should be limited to $T_{j(avg)} \le$ 125°C (@$T_C \le$ 100°C).
**V_D = 13.5 ~ 16.5V, Inverter Part, T_j = 125°C, Non-repetitive, Less than 2µs

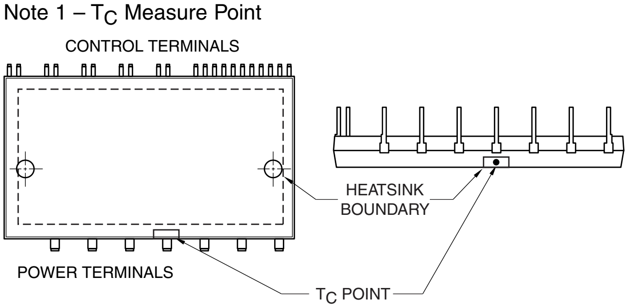
IGBT Inverter Sector

Characteristics	Symbol	PS22053	Units
Collector-Emitter Voltage	V_{CES}	1200	Volts
Collector Current (T_C = 25°C)	$\pm I_C$	10	Amperes
Peak Collector Current (T_C = 25°C, <1ms)	$\pm I_{CP}$	20	Amperes
Supply Voltage (Applied between P-NU, NV, NW)	V_{CC}	900	Volts
Supply Voltage, Surge (Applied between P-NU, NV, NW)	$V_{CC(surge)}$	1000	Volts
Collector Dissipation (T_C = 25°C, per 1 Chip)	P_C	40	Watts

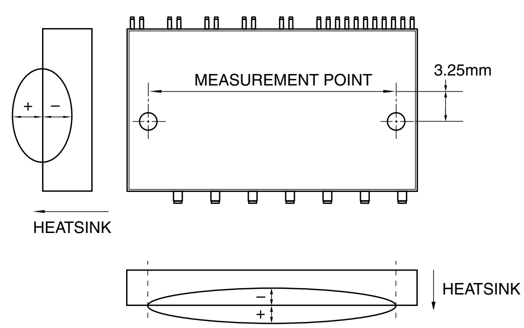
Control Sector

Characteristics	Symbol	PS22053	Units
Supply Voltage (Applied between V_{P1}-V_{PC}, V_{N1}-V_{NC})	V_D	20	Volts
Supply Voltage (Applied between V_{UFB}-V_{UFS}, V_{VFB}-V_{VFS}, V_{WFB}-V_{WFS})	V_{DB}	20	Volts
Input Voltage (Applied between U_P, V_P, W_P-V_{PC}, U_N, V_N, W_N-V_{NC})	V_{IN}	-0.5 ~ V_D+0.5	Volts
Fault Output Supply Voltage (Applied between F_O-V_{NC})	V_{FO}	-0.5 ~ V_D+0.5	Volts
Fault Output Current (Sink Current at F_O Terminal)	I_{FO}	1	mA
Current Sensing Input Voltage (Applied between C_{IN}-V_{NC})	V_{SC}	-0.5 ~ V_D+0.5	Volts

Note 1 – T_C Measure Point



Note 2 – Flatness Measurement Position



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

Characteristics	Symbol	Test Conditions	Min.	Typ.	Max.	Units
IGBT Inverter Sector						
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	I_C = 10A, T_j = 25°C, V_D = V_{DB} = 15V, V_{IN} = 5V	—	2.7	3.4	Volts
		I_C = 10A, T_j = 125°C, V_D = V_{DB} = 15V, V_{IN} = 5V	—	2.5	3.2	Volts
Diode Forward Voltage	V_{EC}	$-I_C$ = 10A, V_{IN} = 0V	—	2.5	3.0	Volts
Inductive Load Switching Times	t_{on}	V_{CC} = 600V, V_D = V_{DB} = 15V, I_C = 10A, T_j = 125°C, V_{IN} = 0 ⇔ 5V, Inductive Load (Upper-Lower Arm)	0.8	1.5	2.2	μs
	t_{rr}		—	0.2	—	μs
	$t_{C(on)}$		—	0.4	0.7	μs
	t_{off}		—	2.8	3.8	μs
	$t_{C(off)}$		—	0.4	0.7	μs
Collector-Emitter Cutoff Current	I_{CES}	V_{CE} = V_{CES}, T_j = 25°C	—	—	1.0	mA
		V_{CE} = V_{CES}, T_j = 125°C	—	—	10	mA
Control Sector						
Circuit Current I_D	V_{IN} = 5V	Total of V_{P1}-V_{PC}, V_{N1}-V_{NC}	—	—	3.70	mA
V_D = V_{DB} = 15V		V_{UFB}-V_{UFS}, V_{VFB}-V_{VFS}, V_{WFB}-V_{WFS}	—	—	1.30	mA
	V_{IN} = 0V	Total of V_{P1}-V_{PC}, V_{N1}-V_{NC}	—	—	3.50	mA
		V_{UFB}-V_{UFS}, V_{VFB}-V_{VFS}, V_{WFB}-V_{WFS}	—	—	1.30	mA
Fault Output Voltage	V_{FOH}	V_{SC} = 0V, F_O Terminal Pull-up to 5V by 10kΩ	4.9	—	—	Volts
	V_{FOL}	V_{SC} = 1V, I_{FO} = 1mA	—	—	1.10	Volts
Input Current	I_{IN}	V_{IN} = 5V	0.70	1.5	2.00	mA
Short Circuit Trip Level*	$V_{SC(ref)}$	V_D = 15V	0.43	0.48	0.53	Volts
Supply Circuit Under-voltage	UV_{DBt}	Trip Level, T_j ≤ 125°C	10.0	—	12.0	Volts
	UV_{DBr}	Reset Level, T_j ≤ 125°C	10.5	—	12.5	Volts
	UV_{Dt}	Trip Level, T_j ≤ 125°C	10.3	—	12.5	Volts
	UV_{Dr}	Reset Level, T_j ≤ 125°C	10.8	—	13.0	Volts
Fault Output Pulse Width**	t_{FO}	C_{FO} = 22nF	1.6	2.4	—	ms
ON Threshold Voltage	$V_{th(on)}$	Applied between U_P, V_P, W_P-V_{PC}, U_N, V_N, W_N-V_{NC}	2.5	3.0	4.2	Volts
OFF Threshold Voltage	$V_{th(off)}$		0.8	1.4	2.0	Volts

* Short Circuit protection is functioning only for N-side IGBTs. Please select the value of the external shunt resistance such that the SC trip level is less than 1.7 times the current rating.
**Fault output is asserted when the lower arms short circuit or control supply under-voltage protection function operates. The fault output pulse-width t_{FO} depends on the capacitance value of C_{FO} according to the following approximate equation: $C_{FO} = (9.3 \times 10^{-6}) \times t_{FO}$ {F} .

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Thermal Characteristics

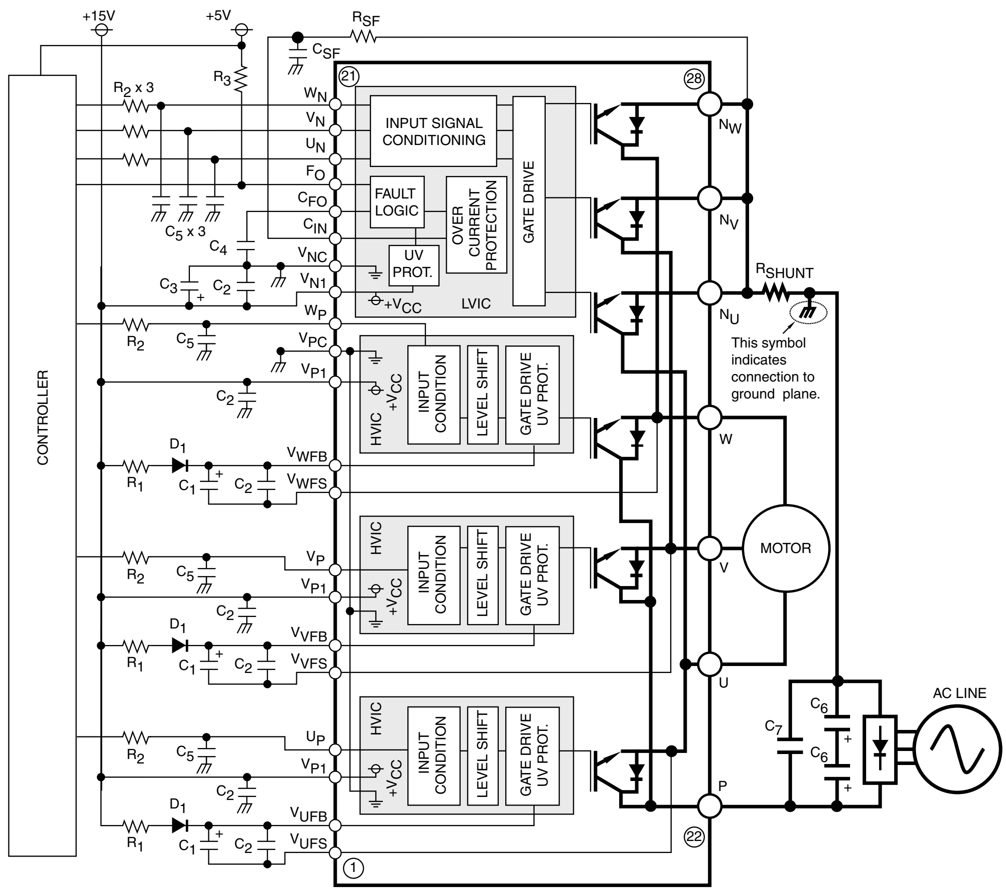
Characteristic	Symbol	Condition	Min.	Typ.	Max.	Units
Junction to Case	$R_{th(j-c)Q}$	IGBT Part (Per 1/6 Module)	—	—	2.00	°C/Watt
Thermal Resistance	$R_{th(j-c)D}$	FWDi Part (Per 1/6 Module)	—	—	2.67	°C/Watt
Contact Thermal resistance	$R_{th(c-f)}$	Per 1 Module	—	—	0.047	°C/Watt

Recommended Conditions for Use

Characteristic	Symbol	Condition	Min.	Typ.	Value	Units
Supply Voltage	V_{CC}	Applied between P-NU, NV, NW	350	600	800	Volts
Control Supply Voltage	V_D	Applied between V_{P1}-V_{PC}, V_{N1}-V_{NC}	13.5	15.0	16.5	Volts
	V_{DB}	Applied between V_{UFB}-V_{UFS}, V_{VFB}-V_{VFS}, V_{WFB}-V_{WFS}	13.5	15.0	16.5	Volts
Control Supply Variation	dV_D, dV_{DB}	—	-1	—	1	V/µs
Arm Shoot-through Blocking Time	t_{DEAD}	For Each Input Signal, $T_C \leq 100°C$	3.3	—	—	µs
PWM Input Frequency	f_{PWM}	$T_j \leq 125°C$, $T_C \leq 100°C$	—	—	15	kHz
Output r.m.s. Current*	I_O	V_{CC} = 600V, $V_D = V_{DB}$ = 15V, f_C = 5kHz P.F. = 0.8, Sinusoidal PWM, $T_j \leq 125°C$, $T_f \leq 100°C$	—	—	7.6	A_{rms}
		V_{CC} = 600V, $V_D = V_{DB}$ = 15V, f_C = 15kHz P.F. = 0.8, Sinusoidal PWM, $T_j \leq 125°C$, $T_f \leq 100°C$	—	—	4.2	A_{rms}
Allowable Minimum Input Pulse Width	$P_{WIN(on)}$**	—	1.5	—	—	µs
	$P_{WIN(off)}$*** $I_C \leq 10A$	$350 \leq V_{CC} \leq 800V$, $13.5 \leq V_D \leq 16.5V$, $13.5 \leq V_{DB} \leq 16.5V$, $-20 \leq T_C \leq 100°C$ N Line Wiring Inductance Less than 10nH	2.5	—	—	µs
	$10 < I_C \leq 17A$		2.7	—	—	µs
V_{NC} Voltage Variation	V_{NC}	Between V_{NC}-NU, NV, NW (Including Surge)	-5.0	—	5.0	Volts

*The allowable r.m.s. current also depends on the user application conditions.
**DIP-IPM might make no response to the input ON signal with pulse width less than $P_{WIN(on)}$.
***DIP-IPM might make no response or not work properly if the input OFF signal pulse width is less than $P_{WIN(off)}$.

Application Circuit



Component Selection:

Dsgn.	Typ. Value	Description
D_1	1A, 1200V	Boot strap supply diode – Ultra fast recovery
C_1	10-100uF, 50V	Boot strap supply reservoir – Electrolytic, long life, low impedance, 105°C (Note 5)
C_2	0.22-2.0uF, 50V	Local decoupling/High frequency noise filters – Multilayer ceramic (Note 8)
C_3	10-100uF, 50V	Control power supply filter – Electrolytic, long life, low Impedance, 105°C
C_4	22nF, 50V	Fault lock-out timing capacitor – Multilayer ceramic (Note 4)
C_5	100pF, 50V	Optional input signal noise filter – Multilayer ceramic (Note 1)
C_6	200-2000uF, 450V	Main DC bus filter capacitor – Electrolytic, long life, high ripple current, 105°C
C_7	0.1-0.22uF, 1000V	Surge voltage suppression capacitor – Polyester/polypropylene film (Note 9)
C_{SF}	1000pF, 50V	Short circuit detection filter capacitor – Multilayer ceramic (Note 6, Note 7)
R_{SF}	1.8k ohm	Short circuit detection filter resistor (Note 6, Note 7)
R_{SHUNT}	5-100 mohm	Current sensing resistor – Non-inductive, temperature stable, tight tolerance (Note 10)
R_1	10 ohm	Boot strap supply inrush limiting resistor (Note 5)
R_2	330 ohm	Optional control input noise filter (Note 1, Note 2)
R_3	10k ohm	Fault output signal pull-up resistor (Note 3)

Notes:

1) To prevent input signal oscillations minimize wiring length to controller (~2cm). Additional RC filtering (C5 etc.) may be required. If filtering is added be careful to maintain proper dead time and voltage levels. See application notes for details.
2) Internal HVIC provides high voltage level shifting allowing direct connection of all six driving signals to the controller.
3) F_O output is an open collector type. Pull up resistor (R3) should be adjusted to current sink capability of the controller.
4) C4 sets the fault output duration and lock-out time. $C4 \approx 9.3E^{-6} \times t_{FO}$, 22nF gives ~2.4ms.
5) Boot strap supply component values must be adjusted depending on the PWM frequency and technique.
6) Wiring length associated with R_{SHUNT}, R_{SF}, C_{SF} must be minimized to avoid improper operation of the OC function.
7) R_{SF}, C_{SF} set over circuit protection trip time. Recommend time constant is 1.5us-2.0us. See application notes.
8) Local decoupling/high frequency filter capacitors must be connected as close as possible to the modules pins.
9) The length of the DC link wiring between C6, C7, the DIP's P terminal and the shunt must be minimized to prevent excessive transient voltages. In particular, C7 should be mounted as close to the DIP as possible.
10) Use a high quality, tight tolorance current sensing resistor. Connect resistor as close as possible to the DIP's N terminal. Be careful to check for proper power rating. See application notes for calculation of resistance value.

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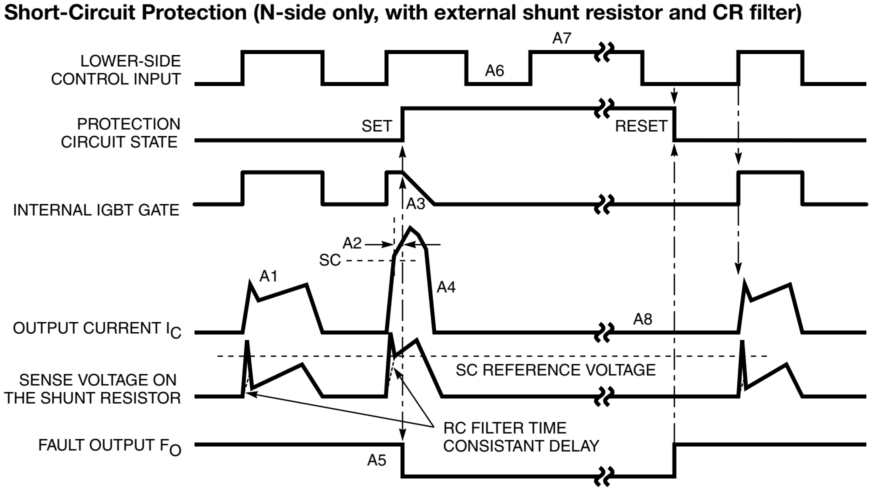
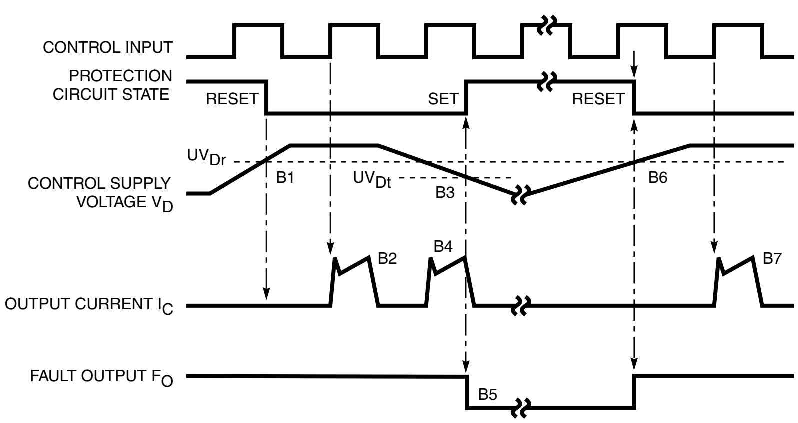
Protection Function Timing Diagrams

Short-Circuit Protection (N-side only, with external shunt resistor and CR filter)



A1: Normal operation – IGBT turn on and conducting current.
A2: Short-circuit current detected (SC trigger).
A3: IGBT gate hard interrupted.
A4: IGBT turn off.
A5: F_O output with a fixed pulse width (determined by the external capacitance C_{FO}).
A6: Input "L" – IGBT off.
A7: Input "H" – IGBT on is blocked during the F_O output period.
A8: IGBT stays in off state.

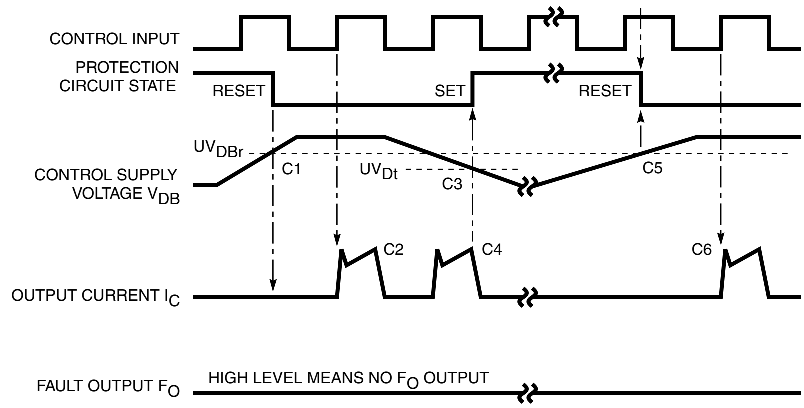
Under-Voltage Protection (N-side, UV_D)



B1: Control supply voltage rise – After the voltage level reaches UV_{Dr}, the drive circuit begins to work at the rising edge of the next input signal.
B2 : Normal operation – IGBT turn on and conducting current.
B3: Under-voltage trip (UV_{Dt}).
B4: IGBT turn off regardless of the control input level.
B5: F_O asserted during the period from minimum pulse width or until control supply recover to UV_{Dr}.
B6: Under-voltage reset (UV_{Dr}).
B7: Normal operation – IGBT turn on and conducting current.

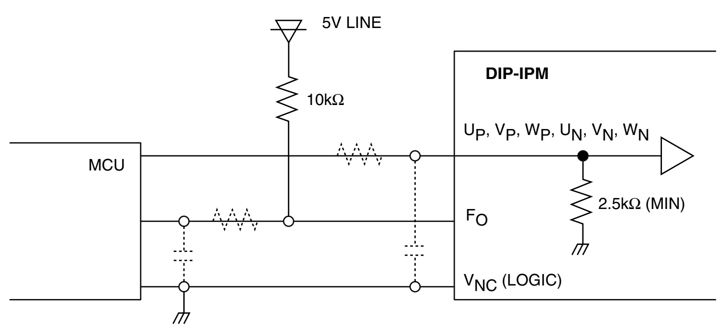
Protection Function Timing Diagrams

Under-Voltage Protection (P-side, UV_{DB})



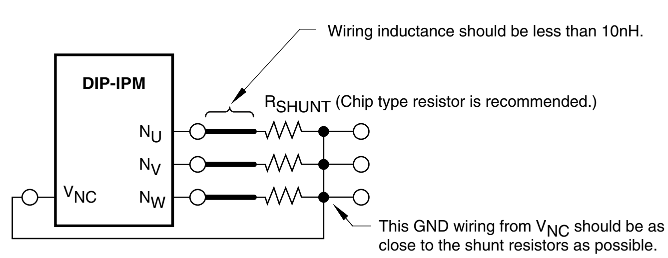
C1: Control supply voltage rises – After the voltage level reaches UV_{DBr}, the drive circuit begins to work at the rising edge of the next input signal.
C2: Normal operation – IGBT turn on and conducting current.
C3: Under-voltage trip (UV_{DBt}).
C4: IGBT stays off regardless of the control input level, but there is no F_O signal output.
C5: Under-voltage reset (UV_{Dr}).
C6: Normal operation – IGBT turn on and conducting current.

Typical Interface Circuit



NOTE: RC coupling at each input (parts shown dotted) may change depending on the PWM control scheme used in the application and the wiring impedance of the printed circuit board. The DIP-IPM input signal section integrates a 2.5kΩ (min) pull-down resistor. Therefore, when using an external filtering resistor, care must be taken to satisfy the turn-on threshold voltage requirement.

Wiring Method Around Shunt Resistor



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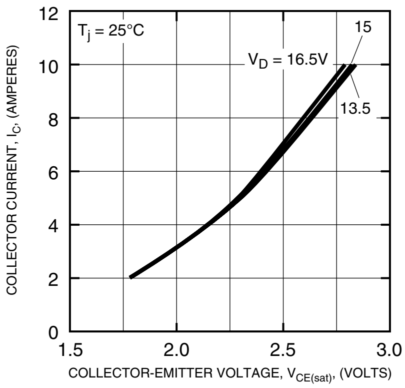
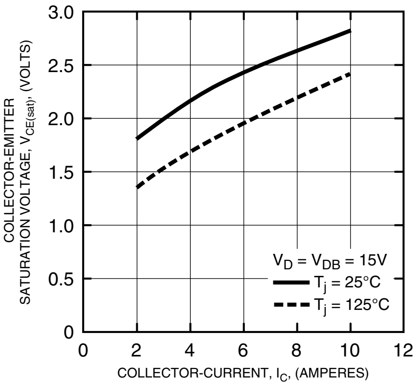
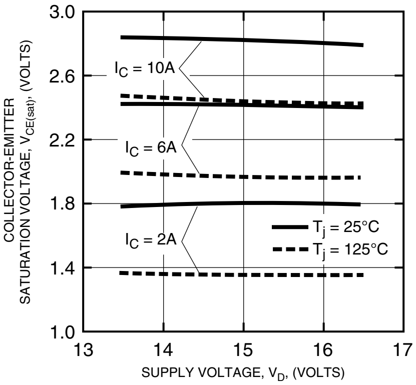


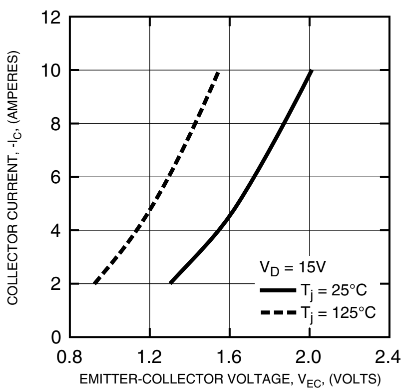
OUTPUT CHARACTERISTICS
(TYPICAL - INVERTER PART)



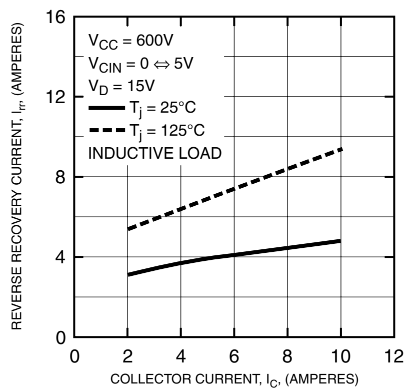
COLLECTOR-EMITTER
SATURATION VOLTAGE CHARACTERISTICS
(TYPICAL - INVERTER PART)



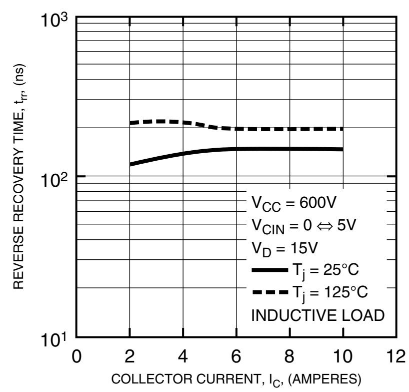
COLLECTOR-EMITTER SATURATION VOLTAGE
VS. SUPPLY VOLTAGE CHARACTERISTICS
(TYPICAL - INVERTER PART)



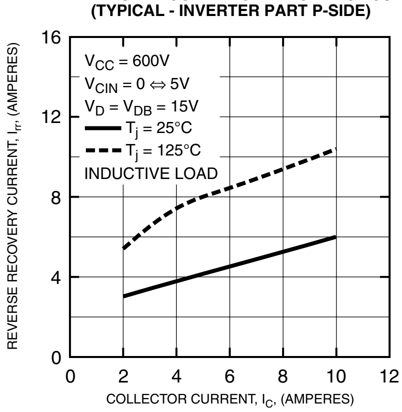
FREE-WHEEL DIODE
FORWARD CHARACTERISTICS
(TYPICAL - INVERTER PART)



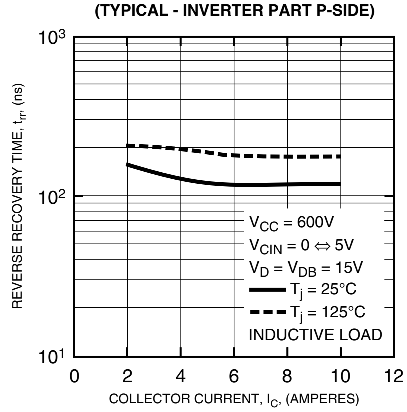
REVERSE RECOVERY CHARACTERISTICS
(TYPICAL - INVERTER PART N-SIDE)



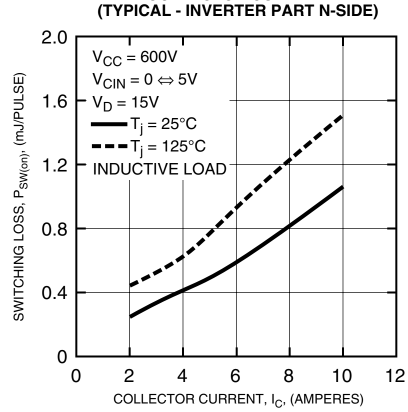
REVERSE RECOVERY CHARACTERISTICS
(TYPICAL - INVERTER PART N-SIDE)



REVERSE RECOVERY CHARACTERISTICS
(TYPICAL - INVERTER PART P-SIDE)



REVERSE RECOVERY CHARACTERISTICS
(TYPICAL - INVERTER PART P-SIDE)



SWITCHING LOSS (ON) VS.
COLLECTOR CURRENT
(TYPICAL - INVERTER PART N-SIDE)

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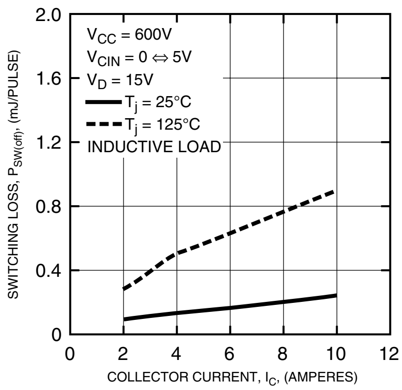
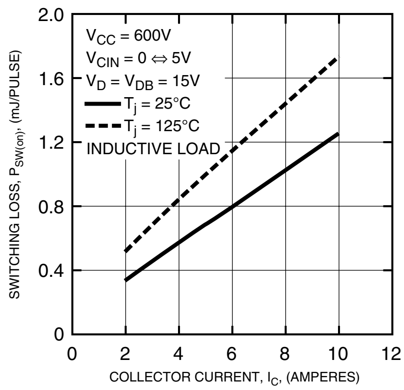
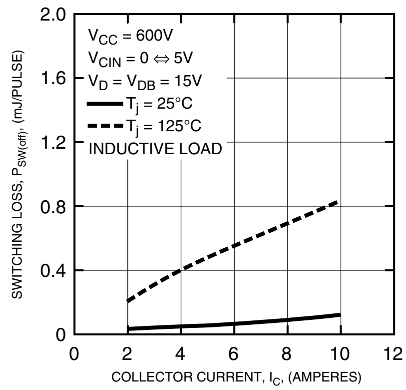
SWITCHING LOSS (OFF) VS. COLLECTOR CURRENT (TYPICAL - INVERTER PART N-SIDE)



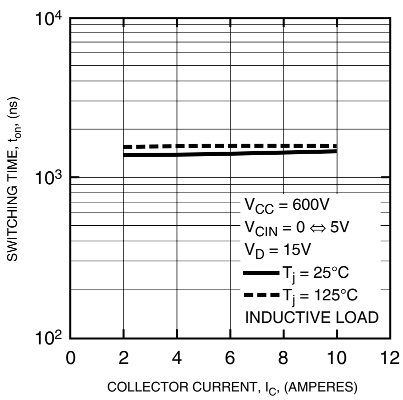
SWITCHING LOSS (ON) VS. COLLECTOR CURRENT (TYPICAL - INVERTER PART P-SIDE)



SWITCHING LOSS (OFF) VS. COLLECTOR CURRENT (TYPICAL - INVERTER PART P-SIDE)



SWITCHING TIME (ON) VS. COLLECTOR CURRENT (TYPICAL - INVERTER PART N-SIDE)



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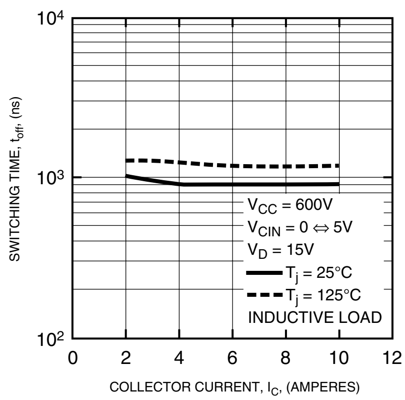

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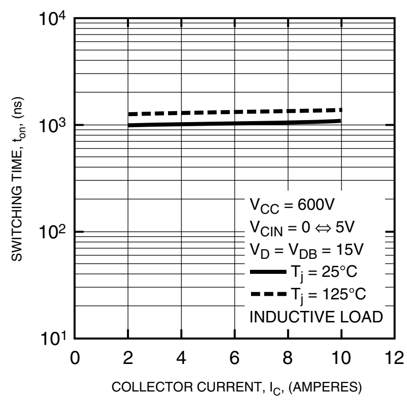

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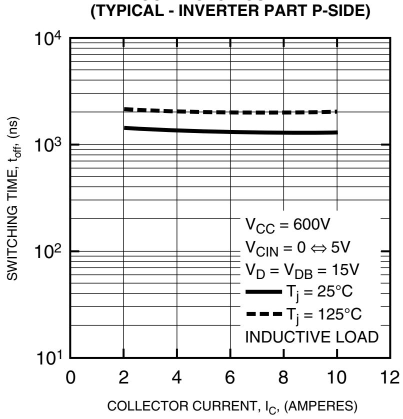

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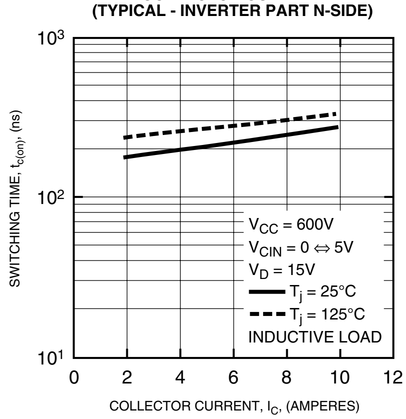
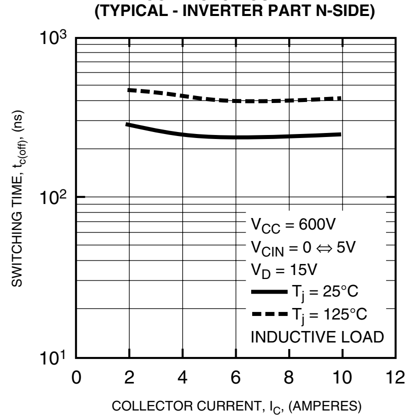


SWITCHING TIME (OFF) VS. COLLECTOR CURRENT (TYPICAL - INVERTER PART N-SIDE)



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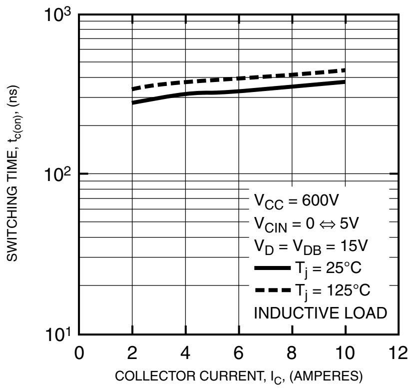
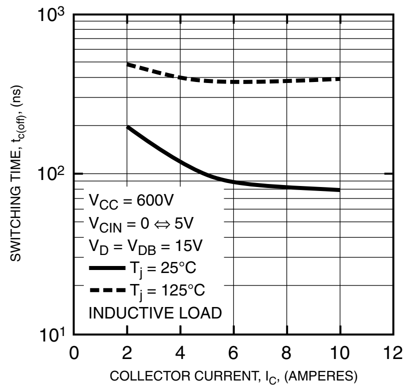
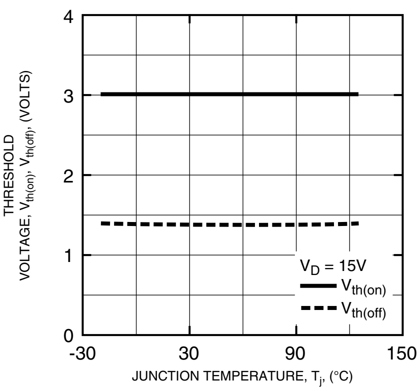
SWITCHING TIME (ON) VS. COLLECTOR CURRENT (TYPICAL - INVERTER PART P-SIDE)



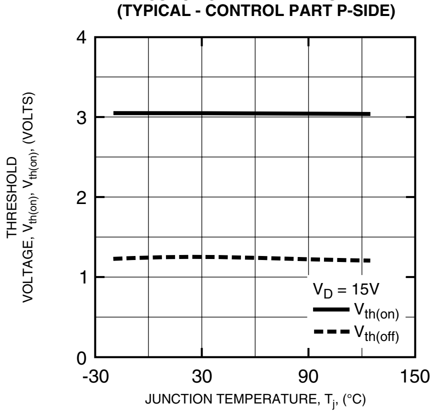
SWITCHING TIME (OFF) VS. COLLECTOR CURRENT (TYPICAL - INVERTER PART P-SIDE)



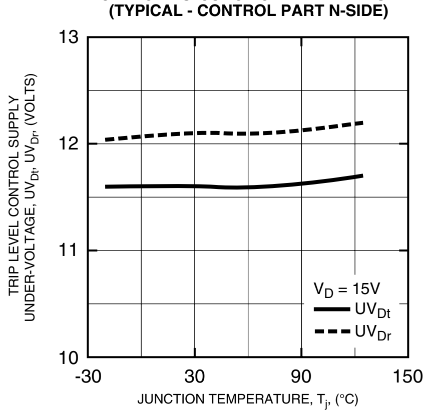
THRESHOLD VOLTAGE VS. JUNCTION TEMPERATURE CHARACTERISTICS (TYPICAL - CONTROL PART N-SIDE)



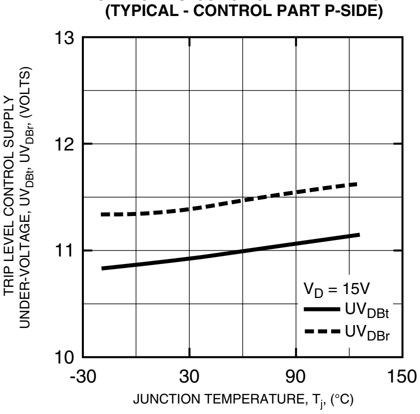
THRESHOLD VOLTAGE VS. JUNCTION TEMPERATURE (TYPICAL - CONTROL PART P-SIDE)



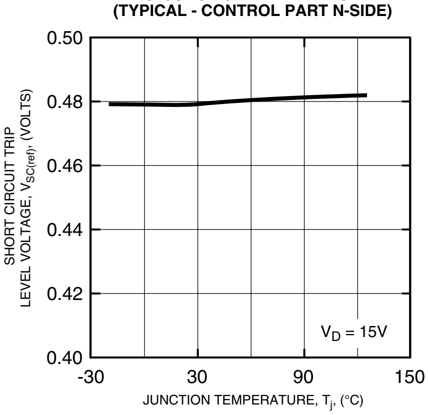
TRIP LEVEL CONTROL SUPPLY UNDER-VOLTAGE VS. JUNCTION TEMPERATURE (TYPICAL - CONTROL PART N-SIDE)



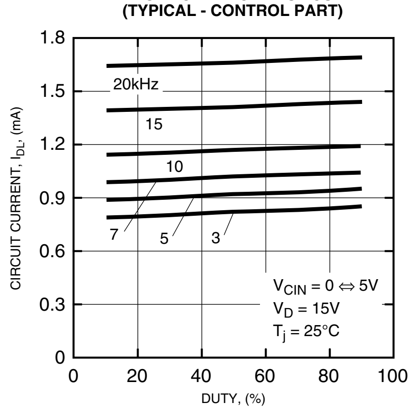
TRIP LEVEL CONTROL SUPPLY UNDER-VOLTAGE VS. JUNCTION TEMPERATURE (TYPICAL - CONTROL PART P-SIDE)



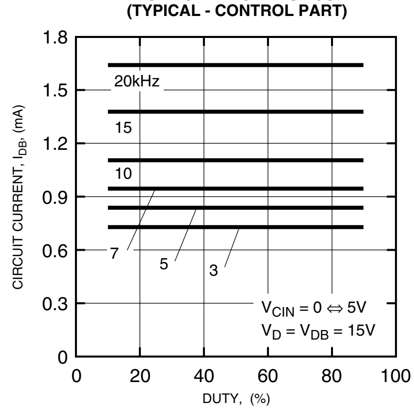
SHORT CIRCUIT TRIP LEVEL VOLTAGE VS. JUNCTION TEMPERATURE (TYPICAL - CONTROL PART N-SIDE)



CIRCUIT CURRENT VS. DUTY CHARACTERISTICS (TYPICAL - CONTROL PART)



CIRCUIT CURRENT VS. DUTY CHARACTERISTICS (TYPICAL - CONTROL PART)



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Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits,General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.

Как с нами связаться

Телефон: 8 (812) 309 58 32 (многоканальный)
Факс: 8 (812) 320-02-42
Электронная почта: org@eplast1.ru
Адрес: 198099, г. Санкт-Петербург, ул. Калинина, дом 2, корпус 4, литера А.