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**FLAT-BASE TYPE
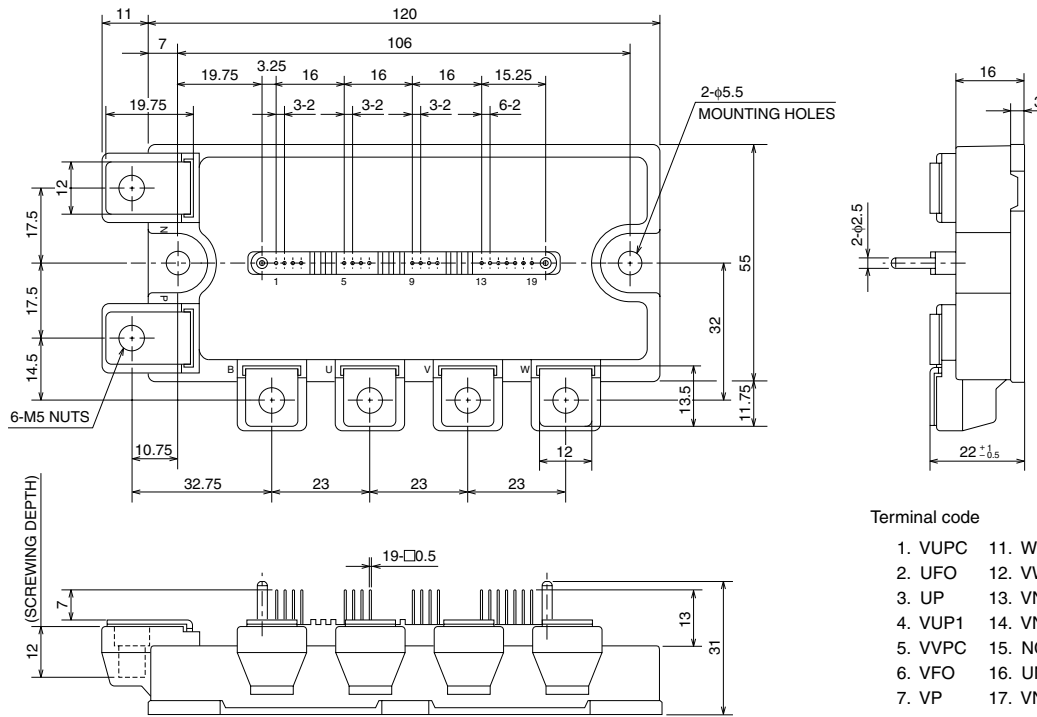INSULATED PACKAGE**

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FEATURE

a) Adopting new 5th generation IGBT (CSTBT) chip, which performance is improved by 1μm fine rule process.
For example, typical V_{ce}(sat)=1.9V @Tj=125°C

b) I adopt the over-temperature conservation by Tj detection of CSTBT chip, and error output is possible from all each conservation upper and lower arm of IPM.

c) New small package
Reduce the package size by 10%, thickness by 22% from S-DASH series.

• 3ϕ 75A, 1200V Current-sense IGBT type inverter

• Monolithic gate drive & protection logic

• Detection, protection & status indication circuits for, short-circuit, over-temperature & under-voltage (P-Fo available from upper arm devices)

• Acoustic noise-less 11kW/15kW class inverter application

• UL Recognized   Yellow Card No.E80276(N)
                            File No.E80271

APPLICATION

General purpose inverter, servo drives and other motor controls

PACKAGE OUTLINES

Dimensions in mm
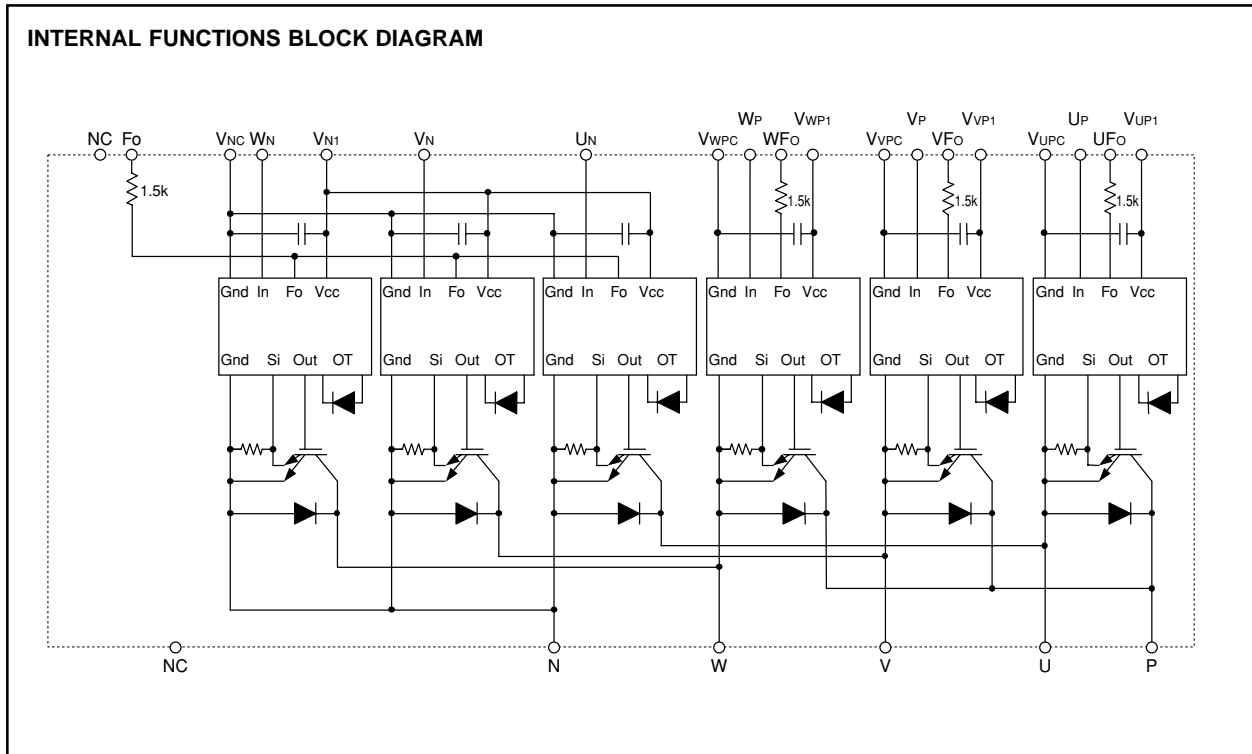

Terminal code

1. VUPC	11. WP
2. UFO	12. VWP1
3. UP	13. VNC
4. VUP1	14. VN1
5. VVPC	15. NC
6. VFO	16. UN
7. VP	17. VN
8. VVP1	18. WN
9. VWPC	19. Fo
10. WFO	

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INTERNAL FUNCTIONS BLOCK DIAGRAM

MAXIMUM RATINGS (Tj = 25°C, unless otherwise noted)
INVERTER PART

Symbol	Parameter	Condition		Ratings	Unit
V_{CES}	Collector-Emitter Voltage	V_D = 15V, V_{CIN} = 15V		1200	V
±I_C	Collector Current	T_C = 25°C		75	A
±I_{CP}	Collector Current (Peak)	T_C = 25°C		150	A
P_C	Collector Dissipation	T_C = 25°C	(Note-1)	595	W
T_j	Junction Temperature			−20 ~ +150	°C

CONTROL PART

Symbol	Parameter	Condition	Ratings	Unit
V_D	Supply Voltage	Applied between : V_{UP1}-V_{UPC} V_{VP1}-V_{VPC}, V_{WP1}-V_{WPC}, V_{N1}-V_{NC}	20	V
V_{CIN}	Input Voltage	Applied between : U_P-V_{UPC}, V_P-V_{VPC} W_P-V_{WPC}, U_N • V_N • W_N-V_{NC}	20	V
V_{FO}	Fault Output Supply Voltage	Applied between : U_{FO}-V_{UPC}, V_{FO}-V_{VPC}, W_{FO}-V_{WPC} F_O-V_{NC}	20	V
I_{FO}	Fault Output Current	Sink current at U_{FO}, V_{FO}, W_{FO}, F_O terminals	20	mA

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TOTAL SYSTEM

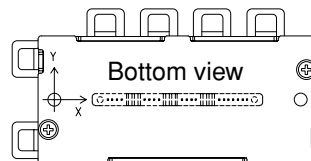| Symbol	Parameter	Condition	Ratings	Unit
$V_{CC(PROT)}$	Supply Voltage Protected by SC	V_D = 13.5 ~ 16.5V, Inverter Part, T_j = +125°C Start	800	V
$V_{CC(surge)}$	Supply Voltage (Surge)	Applied between : P-N, Surge value	1000	V
T_{stg}	Storage Temperature		−40 ~ +125	°C
V_{iso}	Isolation Voltage	60Hz, Sinusoidal, Charged part to Base, AC 1 min.	2500	V_{rms}

THERMAL RESISTANCES

Symbol	Parameter	Condition		Min.	Typ.	Max.	Unit
$R_{th(j-c)Q}$	Junction to case Thermal Resistances	Inverter IGBT (per 1 element)	(Note-1)	—	—	0.21*	
$R_{th(j-c)F}$		Inverter FWDi (per 1 element)	(Note-1)	—	—	0.30*	°C/W
$R_{th(c-f)}$	Contact Thermal Resistance	Case to fin, (per 1 module) Thermal grease applied	(Note-1)	—	—	0.038	

* If you use this value, $R_{th(f-a)}$ should be measured just under the chips.

(Note-1) T_C (under the chip) measurement point is below.   (Unit : mm)

arm / axis	UP		VP		WP		UN		VN		WN	
	IGBT	FWDi	IGBT	FWDi	IGBT	FWDi	IGBT	FWDi	IGBT	FWDi	IGBT	FWDi
X	28.3	28.3	65.0	65.0	87.0	87.0	39.3	39.3	54.0	54.0	76.0	76.0
Y	−8.2	2.0	−8.2	2.0	−8.2	2.0	6.2	−4.0	6.2	−4.0	6.2	−4.0

Bottom view

ELECTRICAL CHARACTERISTICS (T_j = 25°C, unless otherwise noted)
INVERTER PART

Symbol	Parameter	Condition		Min.	Typ.	Max.	Unit
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	V_D = 15V, I_C = 75A V_{CIN} = 0V (Fig. 1)	T_j = 25°C	—	1.8	2.3	V
			T_j = 125°C	—	1.9	2.4	
V_{EC}	FWDi Forward Voltage	−I_C = 75A, V_D = 15V, V_{CIN} = 15V (Fig. 2)		—	2.5	3.5	V
t_{on}	Switching Time	V_D = 15V, V_{CIN} = 0V↔15V V_{CC} = 600V, I_C = 75A T_j = 125°C Inductive Load (Fig. 3,4)		0.5	1.0	2.5	μs
t_{rr}				—	0.5	0.8	
$t_{c(on)}$				—	0.4	1.0	
t_{off}				—	2.0	3.0	
$t_{c(off)}$				—	0.7	1.2	
I_{CES}	Collector-Emitter Cutoff Current	V_{CE} = V_{CES}, V_{CIN} = 15V (Fig. 5)	T_j = 25°C	—	—	1	mA
			T_j = 125°C	—	—	10	

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CONTROL PART

Symbol	Parameter	Condition		Limits			Unit
				Min.	Typ.	Max.	
ID	Circuit Current	VD = 15V, VCIN = 15V	VN1-VNC	—	15	25	mA
			V*P1-V*PC	—	5	10	
Vth(ON)	Input ON Threshold Voltage	Applied between : UP-VUPC, VP-VVPC, WP-VWPC	1.2	1.5	1.8	V
Vth(OFF)	Input OFF Threshold Voltage	UN • VN • WN-VNC	1.7	2.0	2.3	
SC	Short Circuit Trip Level	−20 ≤ Tj ≤ 125°C, VD = 15V	(Fig. 3,6)	150	—	—	A
toff(SC)	Short Circuit Current Delay Time	VD = 15V	(Fig. 3,6)	—	0.2	—	µs
OT	Over Temperature Protection	VD = 15V	Trip level	135	145	—	°C
OTr		Detect Tj of IGBT chip	Reset level	—	125	—	
UV	Supply Circuit Under-Voltage Protection	−20 ≤ Tj ≤ 125°C	Trip level	11.5	12.0	12.5	V
UVr			Reset level	—	12.5	—	
IFO(H)	Fault Output Current	VD = 15V, VFO = 15V	(Note-2)	—	—	0.01	mA
IFO(L)				—	10	15	
tFO	Minimum Fault Output Pulse Width	VD = 15V	(Note-2)	1.0	1.8	—	ms

(Note-2) Fault output is given only when the internal SC, OT & UV protections schemes of either upper or lower arm device operate to protect it.

MECHANICAL RATINGS AND CHARACTERISTICS

Symbol	Parameter	Condition		Limits			Unit
				Min.	Typ.	Max.	
—	Mounting torque	Main terminal	screw : M5	2.5	3.0	3.5	N • m
—	Mounting torque	Mounting part	screw : M5	2.5	3.0	3.5	N • m
—	Weight	—		—	380	—	g

RECOMMENDED CONDITIONS FOR USE

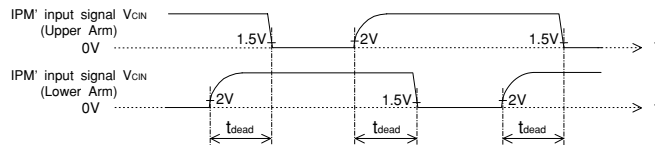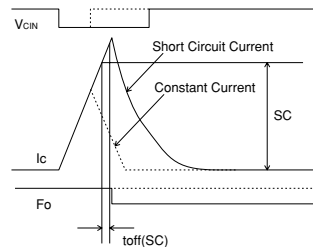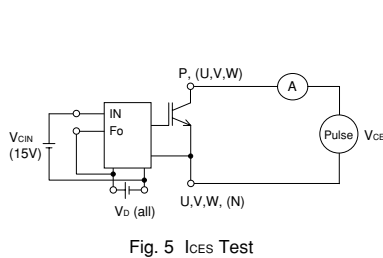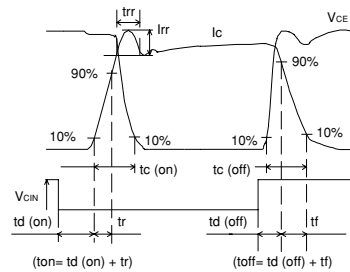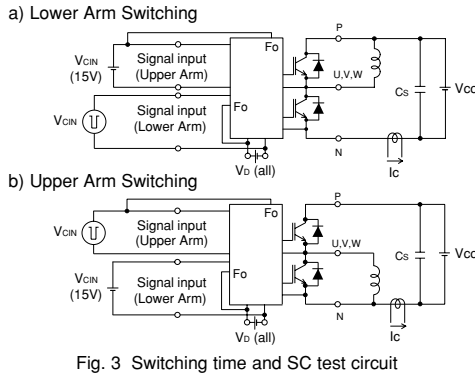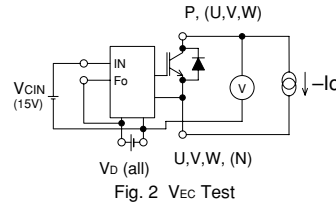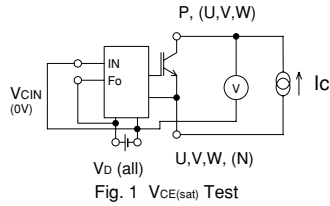| Symbol	Parameter	Condition	Recommended value	Unit
VCC	Supply Voltage	Applied across P-N terminals	≤ 800	V
VD	Control Supply Voltage	Applied between : VUP1-VUPC, VVP1-VVPC VWP1-VWPC, VN1-VNC (Note-3)	15.0 ± 1.5	V
VCIN(ON)	Input ON Voltage	Applied between : UP-VUPC, VP-VVPC, WP-VWPC	≤ 0.8	V
VCIN(OFF)	Input OFF Voltage	UN • VN • WN-VNC	≥ 9.0	
fPWM	PWM Input Frequency	Using Application Circuit of Fig. 8	≤ 20	kHz
tdead	Arm Shoot-through Blocking Time	For IPM's each input signals (Fig. 7)	≥ 2.5	µs

(Note-3) With ripple satisfying the following conditions: dv/dt swing ≤ ±5V/µs, Variation ≤ 2V peak to peak

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PRECAUTIONS FOR TESTING

1. Before appling any control supply voltage (VD), the input terminals should be pulled up by resistores, etc. to their corresponding supply voltage and each input signal should be kept off state.
   After this, the specified ON and OFF level setting for each input signal should be done.

2. When performing "SC" tests, the turn-off surge voltage spike at the corresponding protection operation should not be allowed to rise above VCES rating of the device.
   (These test should not be done by using a curve tracer or its equivalent.)

Fig. 1 $V_{CE(sat)}$ Test

Fig. 2 V_{EC} Test

a) Lower Arm Switching

b) Upper Arm Switching

Fig. 3 Switching time and SC test circuit

Fig. 4 Switching time test waveform

$(ton= td (on) + tr)$ $(toff= td (off) + tf)$

Fig. 5 I_{CES} Test

Fig. 6 SC test waveform

1.5V: Input on threshold voltage Vth(on) typical value, 2V: Input off threshold voltage Vth(off) typical value

Fig. 7 Dead time measurement point example

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Fig. 8 Application Example Circuit

□ : Interface which is the same as the U-phase
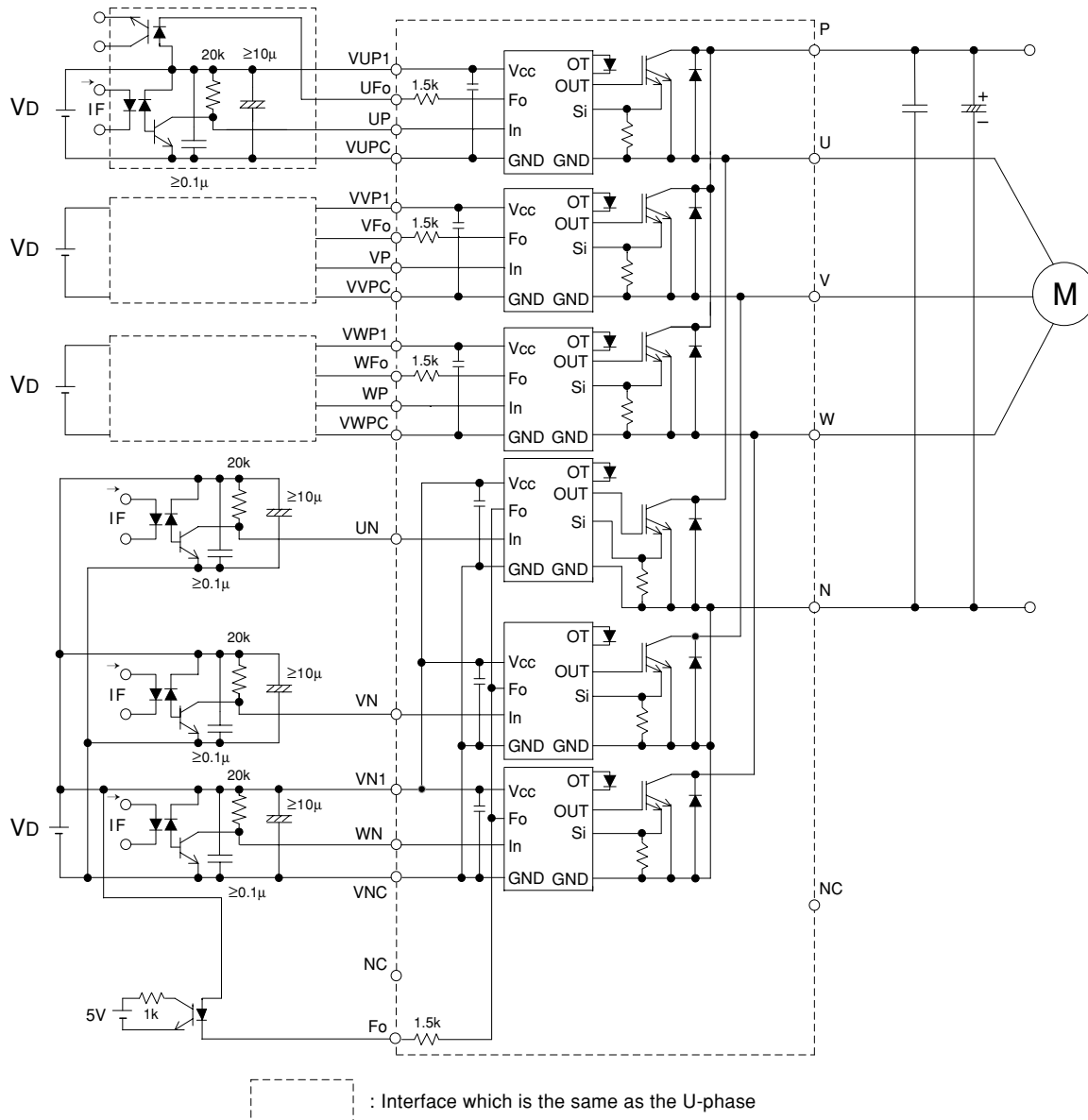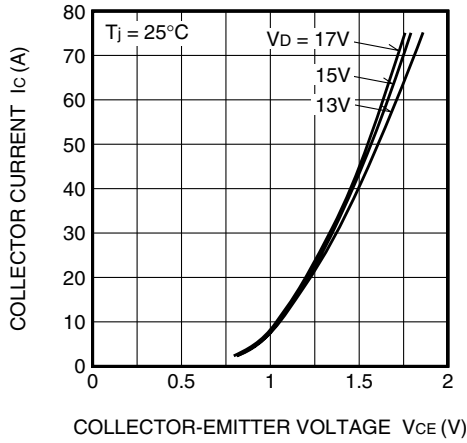
NOTES FOR STABLE AND SAFE OPERATION ;

- Design the PCB pattern to minimize wiring length between opto-coupler and IPM's input terminal, and also to minimize the stray capacity between the input and output wirings of opto-coupler.
- Connect low impedance capacitor between the Vcc and GND terminal of each fast switching opto-coupler.
- Fast switching opto-couplers: t_{PLH}, t_{PHL} ≤ 0.8μs, Use High CMR type.
- Slow switching opto-coupler: CTR > 100%
- Use 4 isolated control power supplies (V_D). Also, care should be taken to minimize the instantaneous voltage charge of the power supply.
- Make inductance of DC bus line as small as possible, and minimize surge voltage using snubber capacitor between P and N terminal.
- Use line noise filter capacitor (ex. 4.7nF) between each input AC line and ground to reject common-mode noise from AC line and improve noise immunity of the system.
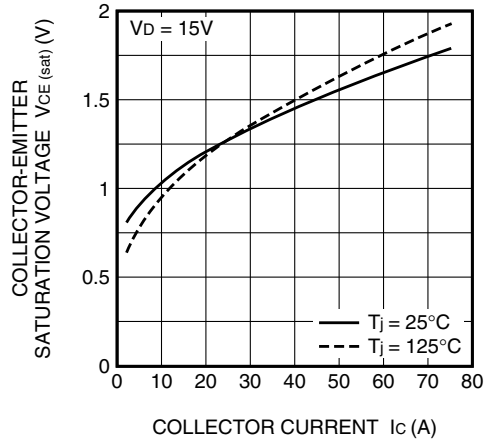
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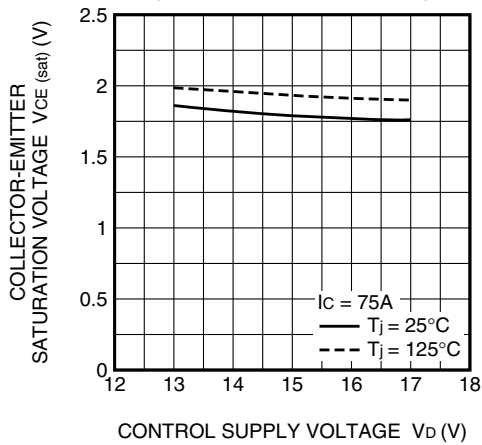
PERFORMANCE CURVES

OUTPUT CHARACTERISTICS (INVERTER PART · TYPICAL)

Tj = 25°C

VD = 17V
15V
13V

COLLECTOR CURRENT Ic (A)
COLLECTOR-EMITTER VOLTAGE VCE (V)

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

VD = 15V

Tj = 25°C
Tj = 125°C

COLLECTOR-EMITTER SATURATION VOLTAGE VCE (sat) (V)
COLLECTOR CURRENT Ic (A)

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

Ic = 75A
Tj = 25°C
Tj = 125°C

COLLECTOR-EMITTER SATURATION VOLTAGE VCE (sat) (V)
CONTROL SUPPLY VOLTAGE VD (V)

SWITCHING TIME CHARACTERISTICS (TYPICAL)

VCC = 600V
VD = 15V
Tj = 25°C
Tj = 125°C
Inductive load

tc(off)
tc(off)
tc(on)
tc(off)

SWITCHING TIME tc(on), tc(off) (μs)
COLLECTOR CURRENT Ic (A)

SWITCHING TIME CHARACTERISTICS (TYPICAL)

toff
toff
ton

VCC = 600V
VD = 15V
Tj = 25°C
Tj = 125°C
Inductive load

SWITCHING TIME ton, toff (μs)
COLLECTOR CURRENT Ic (A)

SWITCHING LOSS CHARACTERISTICS (TYPICAL)

ESW(on)
ESW(off)
ESW(on)
ESW(off)
ESW(on)
ESW(off)

VCC = 600V
VD = 15V
Tj = 25°C
Tj = 125°C
Inductive load

SWITCHING LOSS ESW(on), ESW(off) (mJ/pulse)
COLLECTOR CURRENT Ic (A)

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DIODE FORWARD CHARACTERISTICS
(INVERTER PART · TYPICAL)

DIODE REVERSE RECOVERY CHARACTERISTICS
(INVERTER PART · TYPICAL)

I$_D$ VS. f$_c$ CHARACTERISTICS
(TYPICAL)

TRANSIENT THERMAL
IMPEDANCE CHARACTERISTICS
(INVERTER PART)

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