TOSHIBA INTELLIGENT POWER MODULE

MIG30J106L

HIGH POWER SWITCHING APPLICATIONS

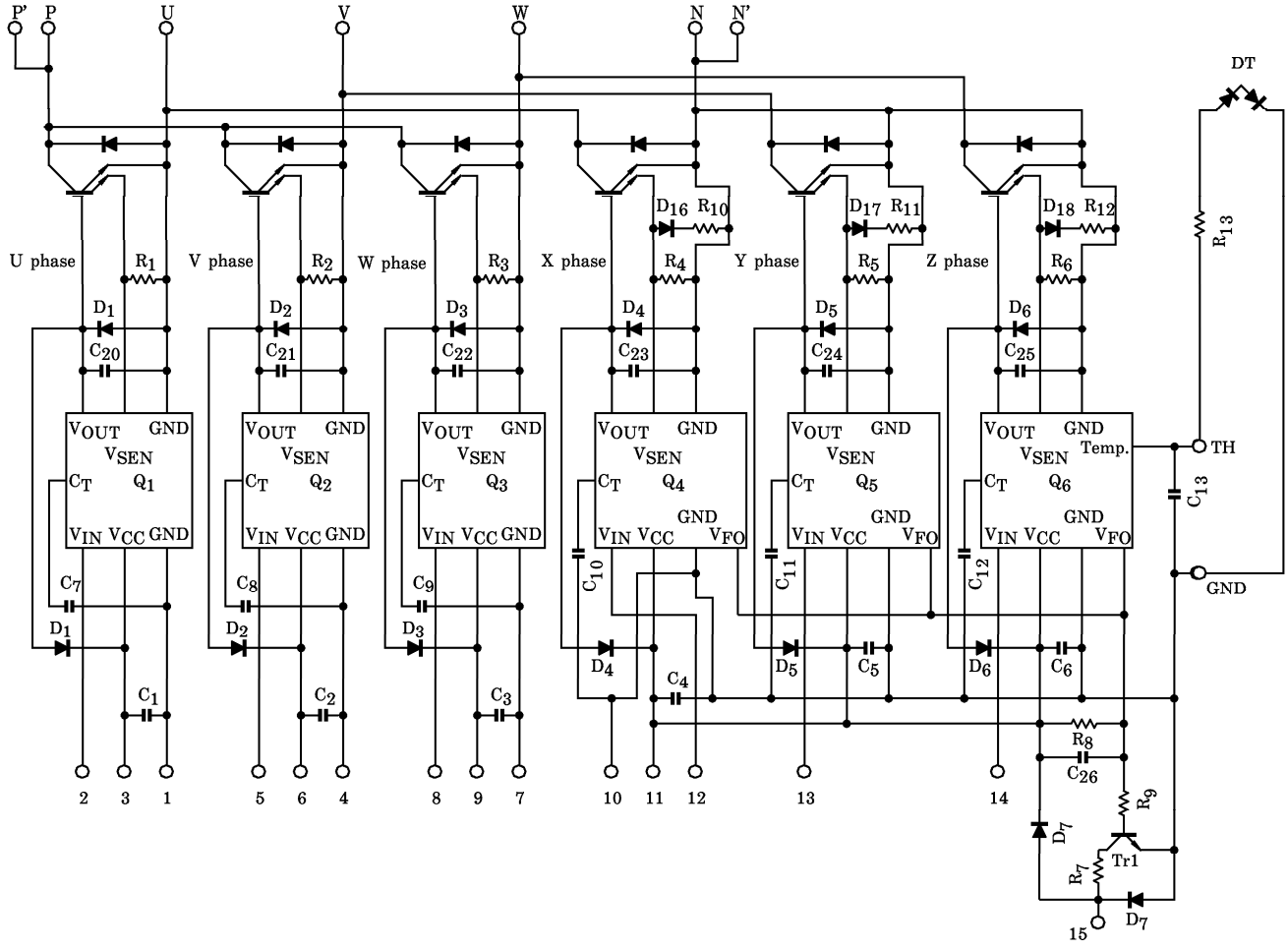
MOTOR CONTROL APPLICATIONS

The Electrodes are Isolated from Case

- Three Phase IGBT Inverter Output
- Gate Drive Circuit
- Protection Logic

  Over Current
  Over Temperature
  Under Voltage

EQUIVALENT CIRCUIT



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MAXIMUM RATINGS (T_j = 25°C)

	ITEM	SYMBOL	CONDITION	RATING	UNIT
Inverter Part	Supply Voltage	V_{CC}	P-N	450	V
	Collector Emitter Voltage	V_{CES}	—	600	V
	Collector Current (DC)	$\pm I_C$	Tc = 25°C	30	A
	Collector Current (Peak)	$\pm I_{CP}$	Tc = 25°C	60	A
	Collector Power Dissipation	P_C	Tc = 25°C	50	W
	Junction Temperature	T_j	—	150	°C
Control Part	Supply Voltage	V_D	—	20	V
	Input Current	I_{IN}	—	30	mA
	Fault Output Voltage	V_{FO}	—	20	V
	Fault Output Current	I_{FO}	—	10	mA
All System	Operating Temperature	Tc	—	−20~+90	°C
	Storage Temperature Range	T_{stg}	—	−40~+125	°C
	Isolation Voltage	V_{ISO}	(*)	2500	V_{rms}

(*) AC 1 minute, Defect Current 1mA.

ELECTRICAL CHARACTERISTICS (T_j = 25°C)

Inverter part

ITEM	SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{CC}	—	P-N		—	300	—	V
Collector-Emitter Saturation Voltage	$V_{CE\ (sat)}$	Fig.1	V_D = 15V, I_{IN} = 10mA	I_C = 30A	—	1.8	2.3	V
				I_C = 30A, T_j = 125°C	—	—	3.0	
Forward Voltage	V_F	Fig.2	I_F = 30A		—	2.2	2.9	V
Switching Time	t_{on}	Fig.3	V_{CC} = 300V, I_C = 30A, V_D = 15V, I_{IN} = 10mA, L-Load		—	1.3	2.5	μs
	t_{rr}				—	0.1	0.2	
	$t_{c\ (on)}$				—	0.8	1.6	
	t_{off}				—	1.3	2.8	
	$t_{c\ (off)}$				—	0.7	1.0	
Collector Cut-off Current	I_{CEX}	Fig.5	V_{CE} = 600V	—	—	—	1.0	mA
				T_j = 125°C	—	—	20	

CONTROL PART (T_j = 25°C)

ITEM		SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Circuit Current		I_D	—	V_D = 15V	High Side	—	7	—	mA
			—	I_{IN} = 10mA	Low Side	—	21	—	
Input On Current		$I_{IN\,(ON)}$	—	V_D = 15V		—	5.0	—	mA
Input Off Current		$I_{IN\,(OFF)}$				—	4.0	—	
Fault Output Current (Normal Operation)		I_{FO}	—	V_D = 15V, V_{FO} = 15V		—	10	—	mA
Over Current Trip Level		OC	Fig.6	V_D = 15V (Low Side)		28.5	36	—	A
				V_D = 15V (High Side)		48	56	—	
Over Current Cut Off Time		$t_{off\,(OC)}$	—	V_D = 15V		—	13	—	μs
Over Temperature Protection	Trip Level	OT	—	—		100	110	—	°C
	Reset Level					—	15	—	
Under Voltage Protection	Trip Level	UV	—	—		—	12.0	—	V
	Reset Level	UVr				—	12.5	—	
Fault Output Pulse Width		t_{FO}	—	V_D = 15V		8	13	—	ms

THERMAL RESISTANCE

ITEM	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Junction to Case Thermal Resistance	$R_{th\,(j-c)}$	—	INV, IGBT	—	1.8	2.5	°C / W
	$R_{th\,(j-c)}$	—	INV, FWD	—	3.2	4.5	
Capacitance (Electrodes-Case)		—	—	—	450	900	pF

TEST CIRCUIT

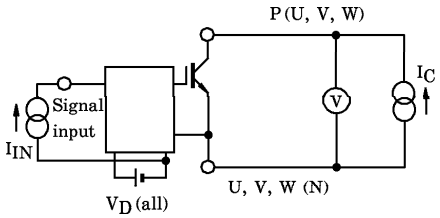


Fig.1 $V_{CE\,(sat)}$

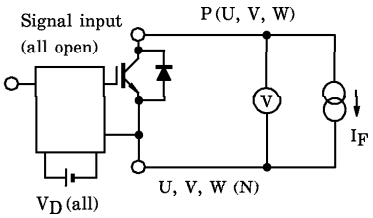


Fig.2 V_F

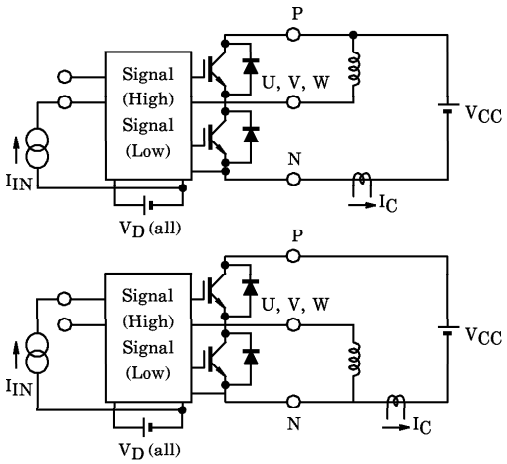


Fig.3 Switching Time Test

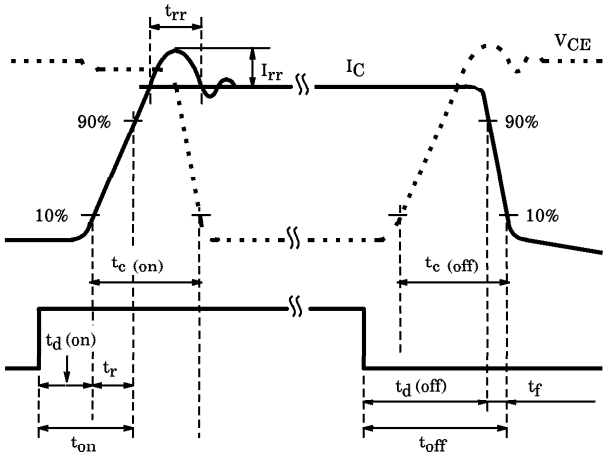


Fig.4 Switching Test Waveforms

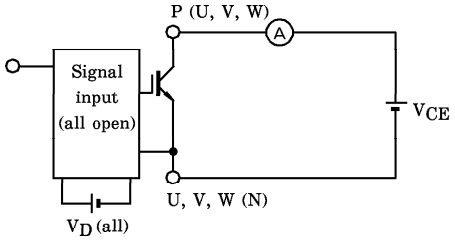


Fig.5 I_{CEX}

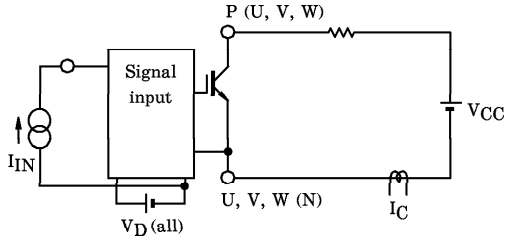
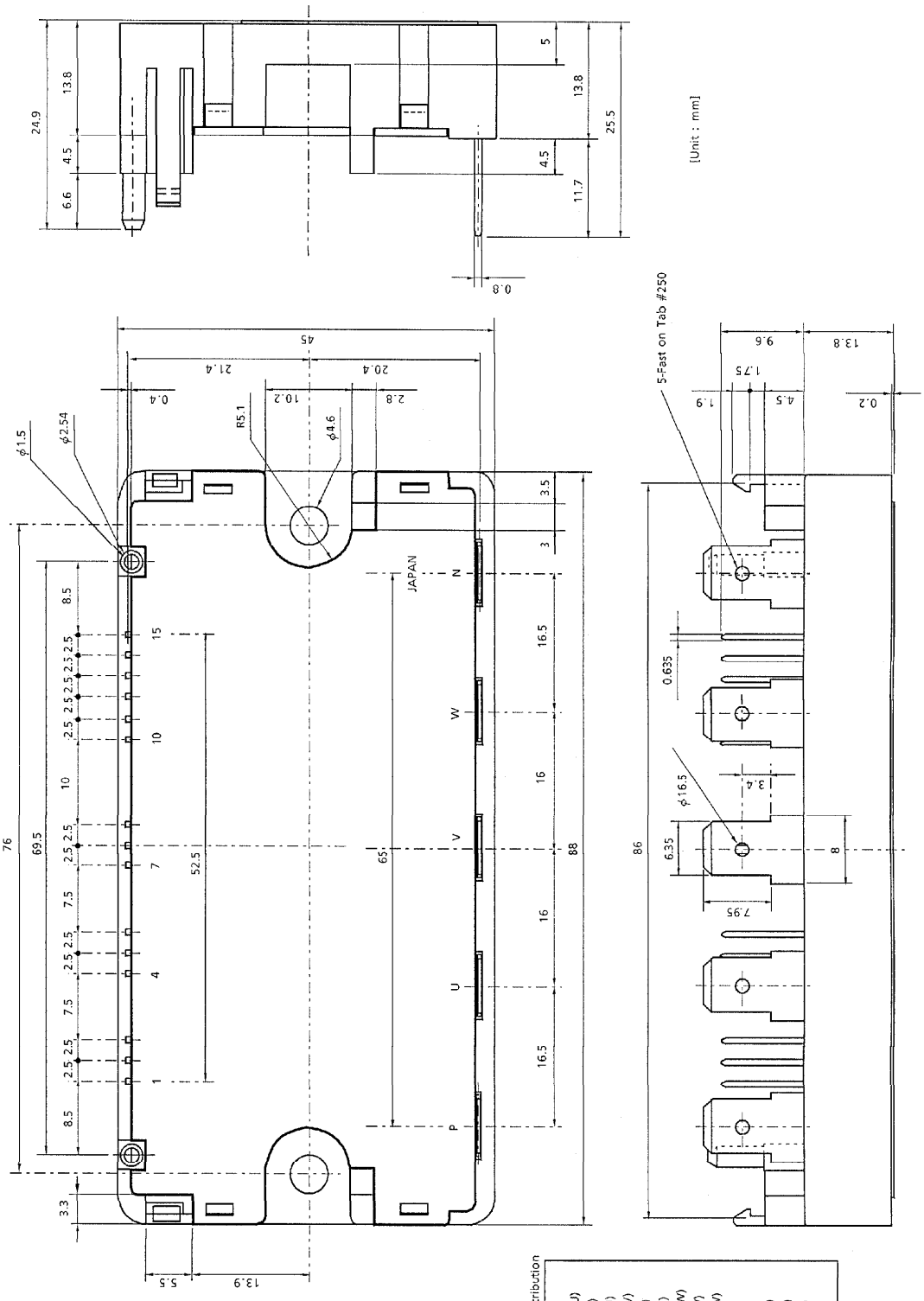


Fig.6 OC

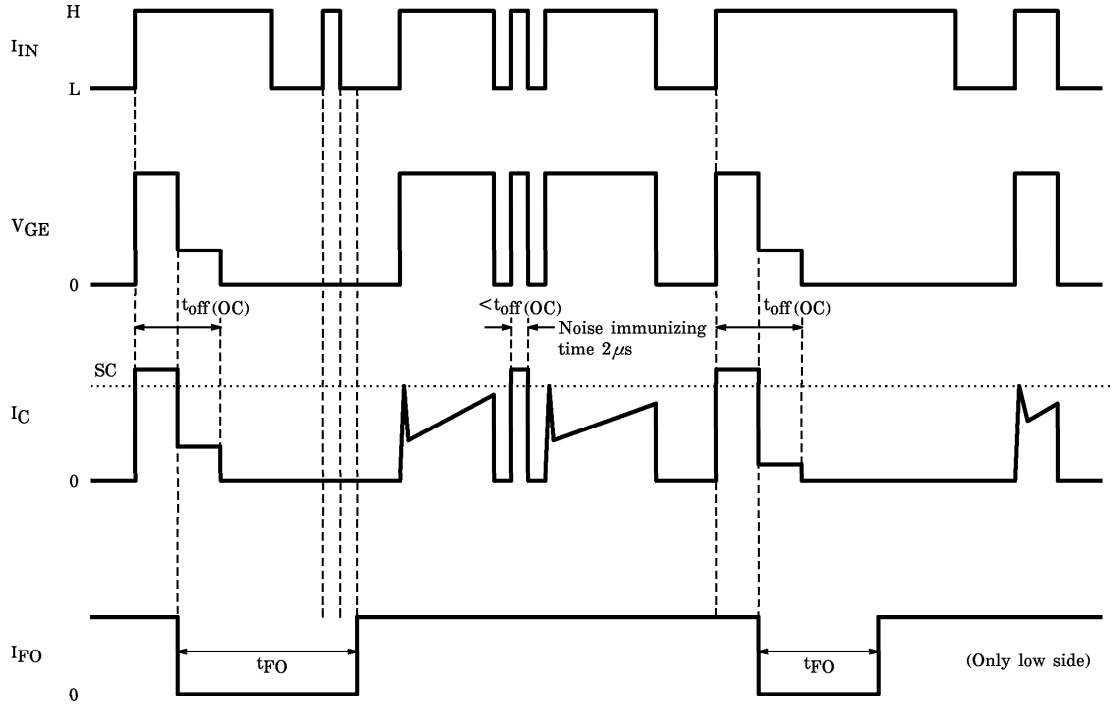


OUTLINE

MIG20J106LA – 5

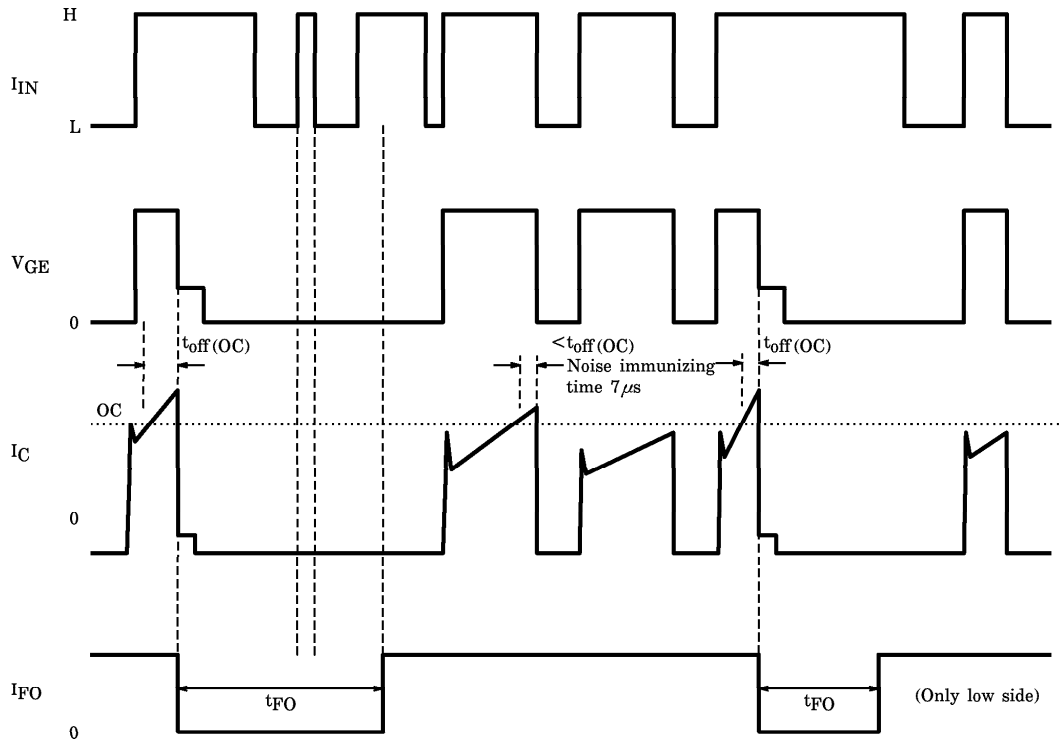
TIMING CHART FOR SHORT CURRENT PROTECTION SEQUENCE

1. Upon occasion of short current condition, at first step, V_{GE} is step-down to one-half of nominal value in order to reduce IGBT saturation current and finally. V_{GE} is completely interrupted after some certain time, t_{off} (OC).
2. An error signal output (V_{FO}) goes into 'H' level when the lower arm IGBT is subjected to over current condition. The timing of V_{FO} output ('H' level) is provided at complete interruption of V_{GE} and the 'H' level is maintained during some certain time duration (t_{FO}).
3. The reset operation is provided on condition that error signal output return to 'L' level after certain time duration and over current or short current condition is removed, and next input signal turns from operation "off" to "on".



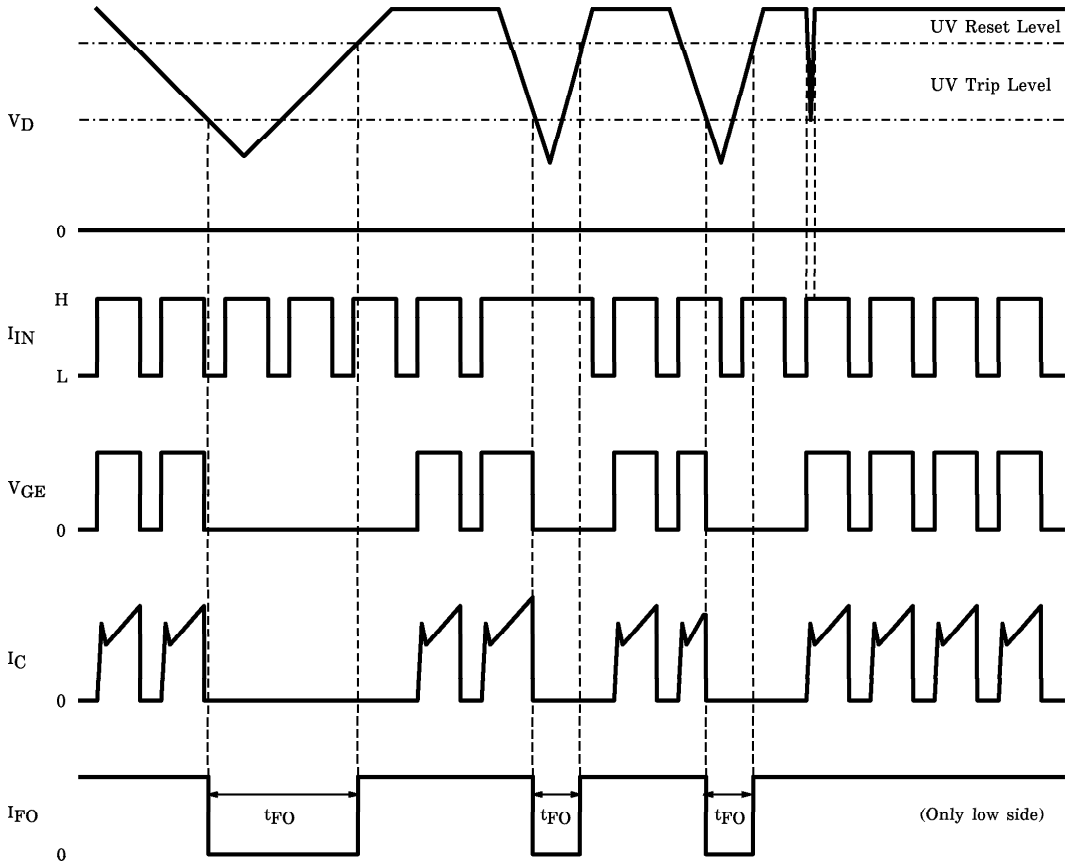
TIMING CHART FOR OVER CURRENT PROTECTION SEQUENCE

1. Upon occasion of over current condition, at first step, V_{GE} is step-down to one-half of nominal value in order to reduce IGBT saturation current and finally. V_{GE} is completely interrupted after some certain time, t_{off} (OC).
2. An error signal output (V_{FO}) goes into 'H' level when the lower arm IGBT is subjected to over current condition. The timing of V_{FO} output ('H' level) is provided at complete interruption of V_{GE} and the 'H' level is maintained during some certain time duration (t_{FO}).
3. The reset operation is provided on condition that error signal output return to 'L' level after certain time duration and over current condition is removed and input signal turns from operation "off" to "on".



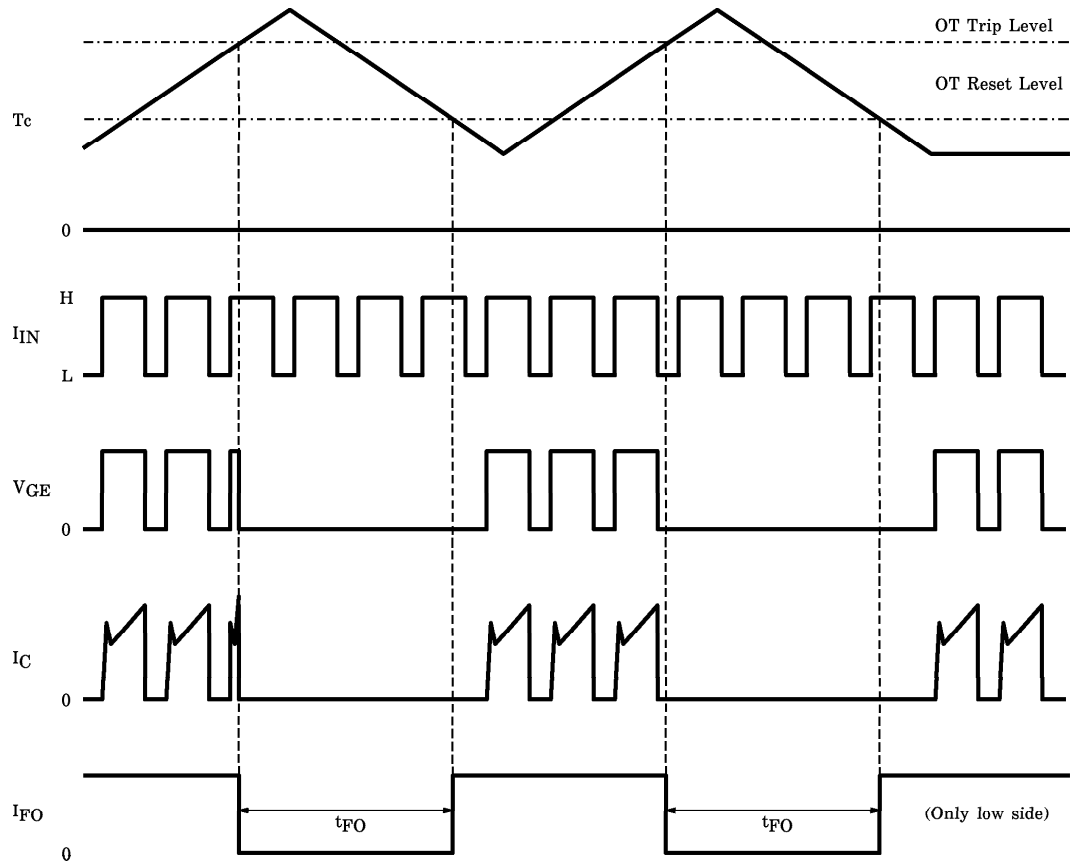
TIMING CHART FOR CONTROL POWER SUPPLY UNDER VOLTAGE PROTECTION SEQUENCE

1. Upon occasion of control power supply under voltage, gate voltage (V_{GE}) is interrupted and IGBT moves into 'off-stage'.
   (This condition continues between UV Trip Level and UV Reset Level as shown in the chart)
2. An error signal output (V_{FO}) stays in 'H' level until the power supply voltage returns to the reset level after the voltage reaches to the trip level.
3. The reset operation is provided on condition that power supply voltage returns to the UV reset level and input signal turns from operation "off" to "on".

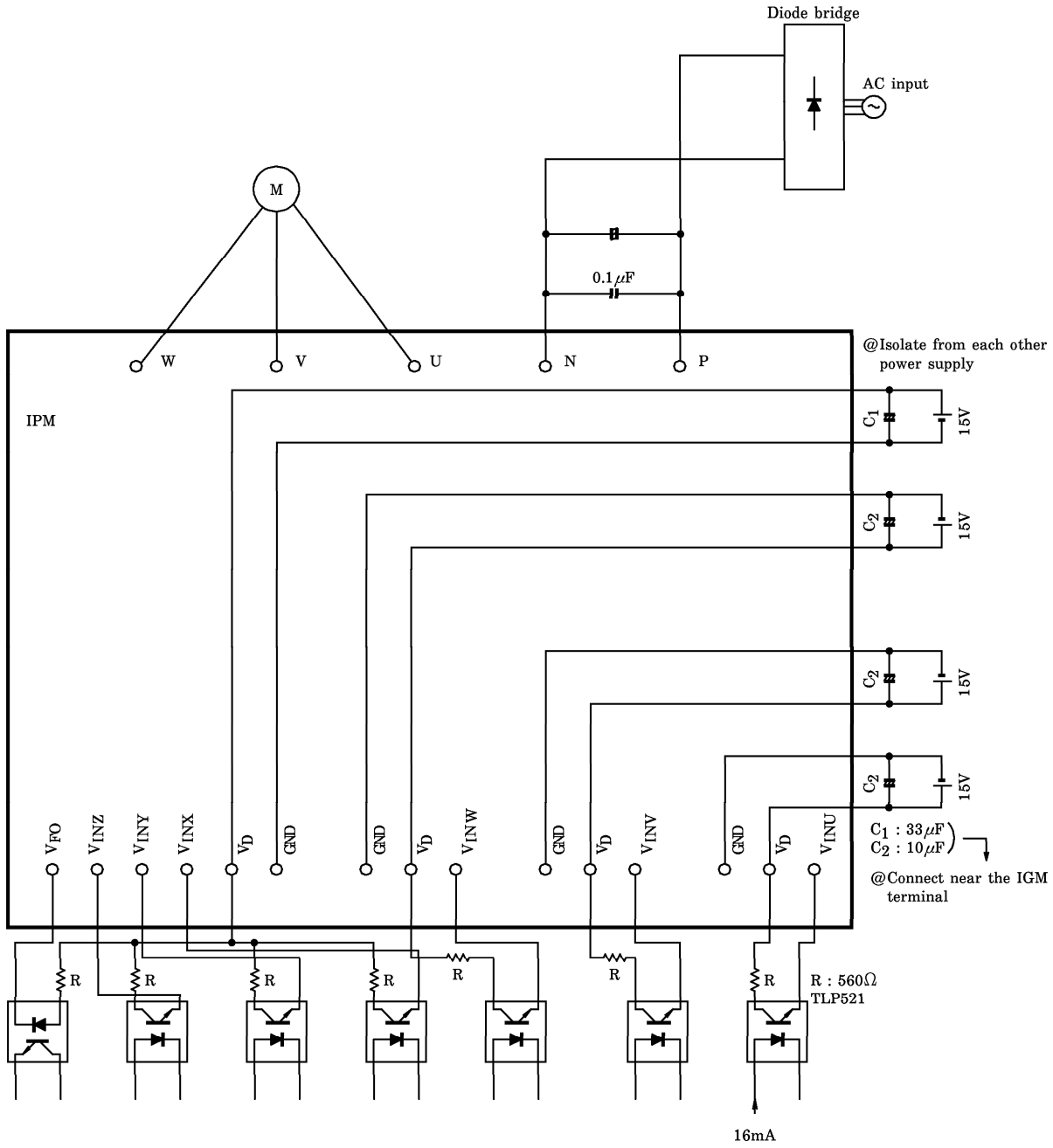


TIMING CHART FOR OVER TEMPERATURE PROTECTION SEQUENCE

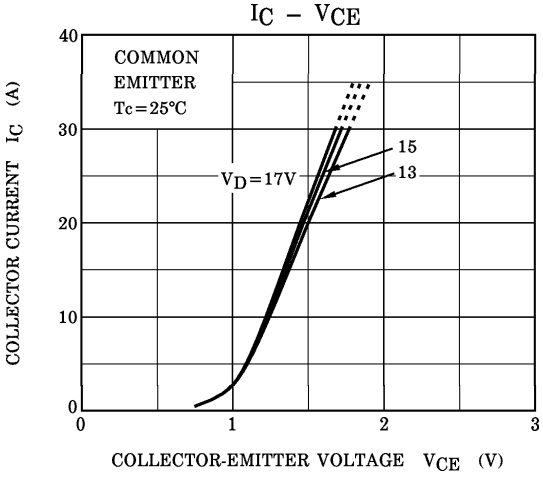
1. Using temperature dependent characteristics of diode on IMS substrate, the case temperature (Tc) is detected. Upon occasion of over temperature condition, V_{GE} of the lower arm IGBT is interrupted. (This condition continues between OT Trip Level and OT Reset Level as shown in the chart)
2. An error signal output (V_{FO}) stays in 'H' level until the case temperature goes below the reset level after the temperature reaches to the trip level.
3. The reset operation is provided on condition that case temperature goes below the OT reset level and input signal turns from operation "off" to "on".



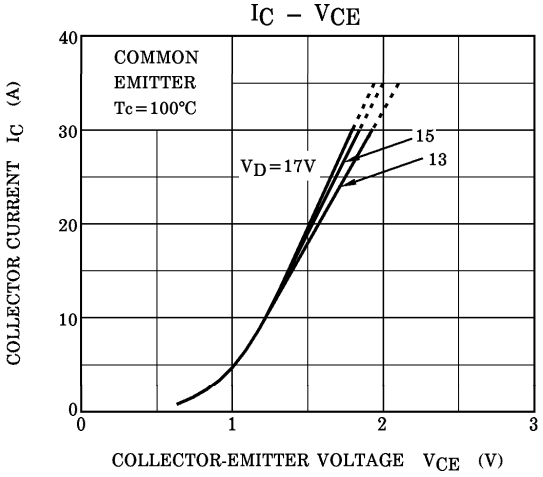
APPLICATION



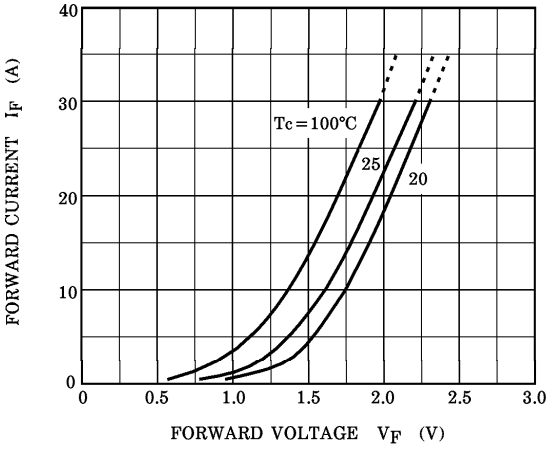
I_C – V_{CE}



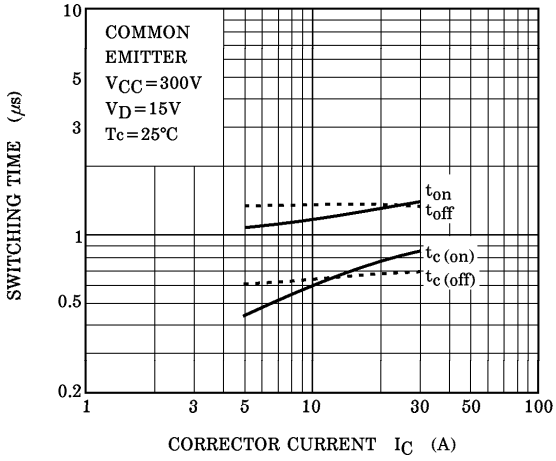
I_C – V_{CE}



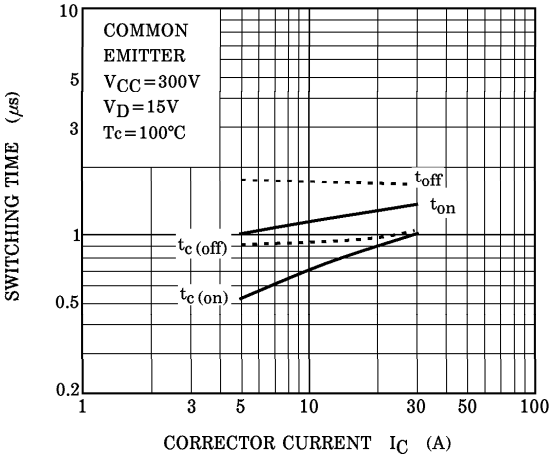
I_F – V_F



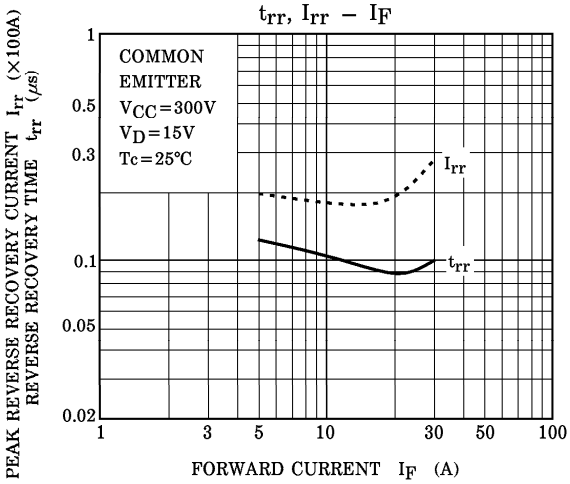
SWITCHING TIME – I_C

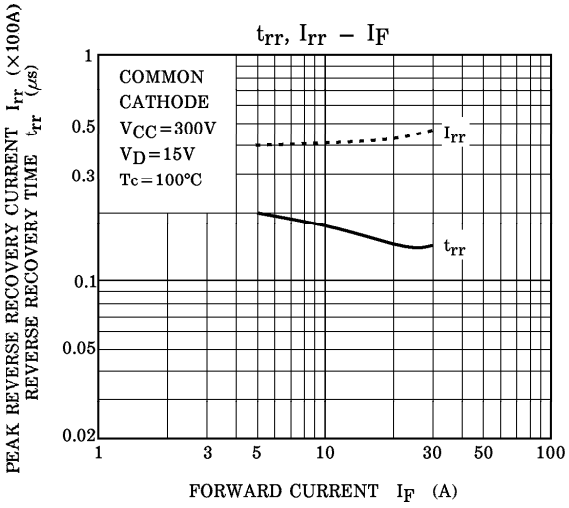


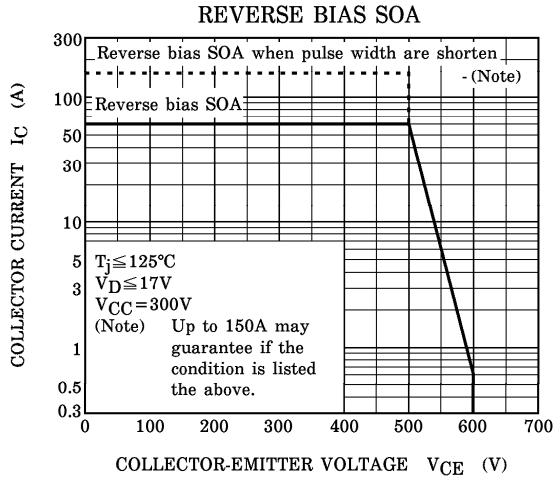
SWITCHING TIME – I_C

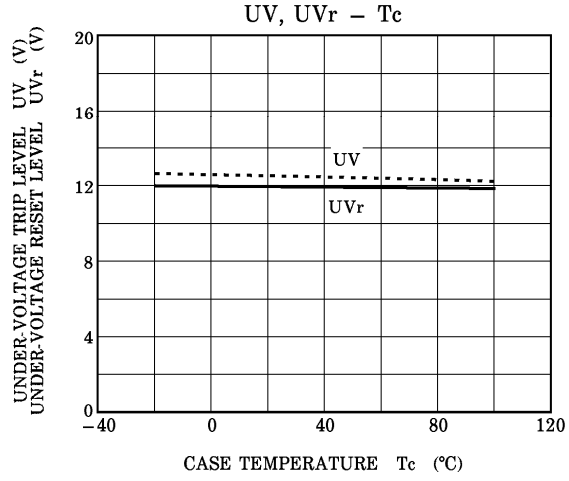


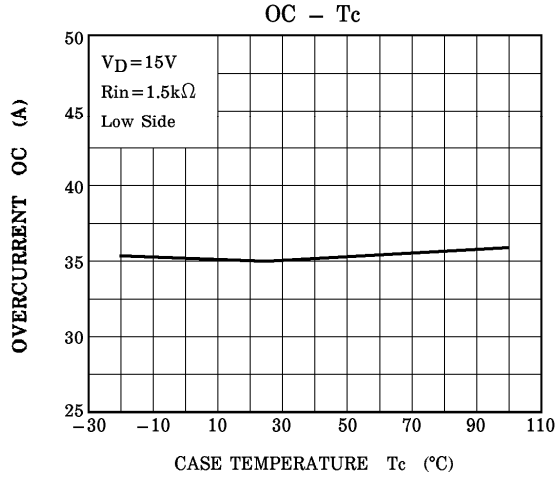
t_{rr}, I_{rr} – I_F

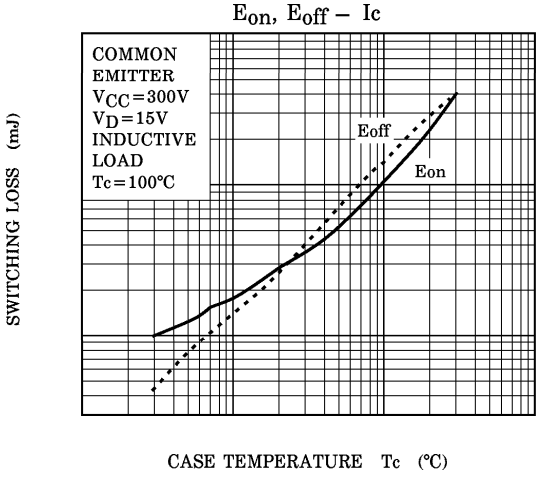


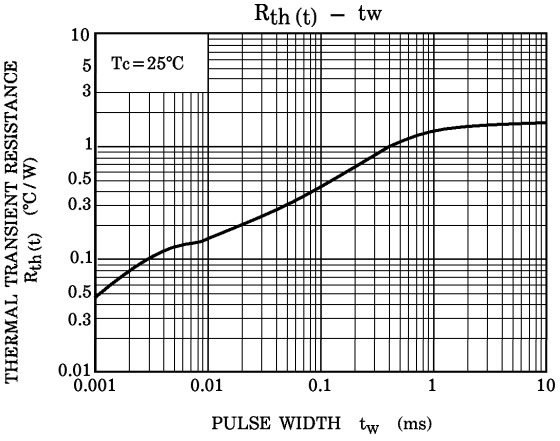

t_{rr}, I_{rr} – I_F
COMMON CATHODE
V_{CC}=300V
V_D=15V
Tc=100°C
I_{rr}
t_{rr}
PEAK REVERSE RECOVERY CURRENT I_{rr} (×100A)
REVERSE RECOVERY TIME t_{rr} (μs)
FORWARD CURRENT I_F (A)

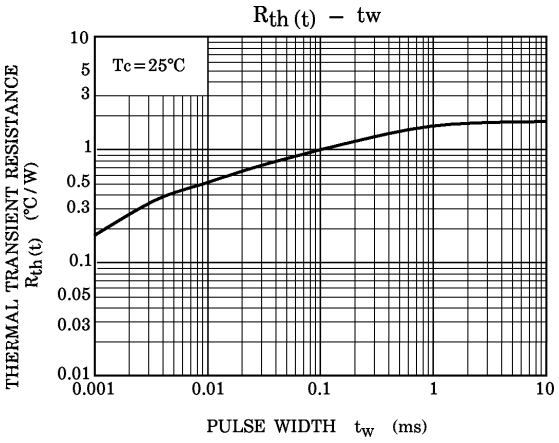

REVERSE BIAS SOA
Reverse bias SOA when pulse width are shorten
- (Note)
Reverse bias SOA
T_j≦125°C
V_D≦17V
V_{CC}=300V
(Note) Up to 150A may guarantee if the condition is listed the above.
COLLECTOR CURRENT I_C (A)
COLLECTOR-EMITTER VOLTAGE V_{CE} (V)


UV, UVr – Tc
UV
UVr
UNDER-VOLTAGE TRIP LEVEL UV (V)
UNDER-VOLTAGE RESET LEVEL UVr (V)
CASE TEMPERATURE Tc (°C)


OC – Tc
V_D=15V
Rin=1.5kΩ
Low Side
OVERCURRENT OC (A)
CASE TEMPERATURE Tc (°C)


E_{on}, E_{off} – Ic
COMMON EMITTER
V_{CC}=300V
V_D=15V
INDUCTIVE LOAD
Tc=100°C
Eoff
Eon
SWITCHING LOSS (mJ)
CASE TEMPERATURE Tc (°C)


R_{th} (t) – tw
Tc=25°C
THERMAL TRANSIENT RESISTANCE R_{th} (t) (°C/W)
PULSE WIDTH t_w (ms)


R_{th} (t) – tw
Tc = 25°C
THERMAL TRANSIENT RESISTANCE
R_{th} (t) (°C / W)
10
5
3
1
0.5
0.3
0.1
0.05
0.03
0.01
0.001
0.01
0.1
1
10
PULSE WIDTH t_W (ms)