



1. Description

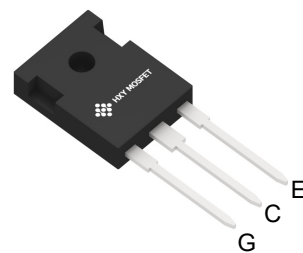
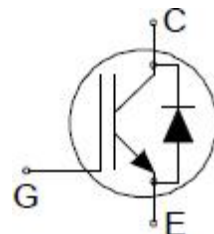
DGTD65T50S1PT is obtained by advanced Trench and Field Stop (T-FS) technology which reduces the conduction loss, improves switching performance and enhances the avalanche energy.

Device Per Unit

Package Type	Unit	Quantity
TO-247	Tube	30

Key Characteristics

Parameter	Value	Unit
V_{CES}	650	V
I_C	50	A
$V_{CE(sat).typ}$	1.65	V



TO-247

Features

- Positive temperature coefficient
- Fast Switching
- Low $V_{CE(sat)}$
- Reliable and Rugged
- Halogen Free and Green Devices Available
- (RoHS Compliant)

Applications

- UPS
- Motor drives
- Boost
- Portable power station



2. Absolute ratings

Symbol	Parameter	Values	Units
V_{CES}	Collector-Emitter Voltage	650	V
I_C	Collector Current @ $T_C=25^{\circ}\text{C}$	100	A
	Collector Current @ $T_C=100^{\circ}\text{C}$	50	A
I_{CM}	Pulsed Collector Current, tp limited by T_{Jmax}	200	A
I_F	Diode Continuous Forward Current @ $T_C=25^{\circ}\text{C}$	100	A
	Diode Continuous Forward Current @ $T_C=100^{\circ}\text{C}$	50	A
I_{FM}	Diode Maximum Forward Current, limited by T_{Jmax}	200	A
V_{GES}	Gate-Emitter Voltage	± 30	V
t_{SC}	Short circuit withstand time $V_{GE}=15\text{V}$, $V_{CC}\leq 400\text{V}$, allowed number of short circuits<1000, times between short circuits $\geq 1.0\text{s}$, $T_J\leq 175^{\circ}\text{C}$	4	μs
P_D	Power Dissipation @ $T_C=25^{\circ}\text{C}$	300	W
T_{Jmax} , T_{stg}	Operating Junction and Storage Temperature Range	-55 to 175	$^{\circ}\text{C}$
T_L	Maximum Temperature for Soldering	260	$^{\circ}\text{C}$

3. Thermal characteristics

Symbol	Parameter	Values	Units
$R_{\theta JC}$	Junction-to-Case (IGBT)	0.50	$^{\circ}\text{C/W}$
$R_{\theta JC}$	Junction-to-Case (Diode)	0.65	$^{\circ}\text{C/W}$
$R_{\theta JA}$	Junction-to-Ambient	40	$^{\circ}\text{C/W}$

4. Electrical Characteristics (at $T_C = 25^{\circ}\text{C}$, unless otherwise specified)

Static Characteristics

Symbol	Parameter	Test Conditions	Values			Units
			Min.	Typ.	Max.	
V_{CES}	Collector-Emitter Breakdown Voltage	$V_{GE}=0\text{V}$ $I_C=1\text{mA}$	650	--	--	V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$V_{GE}=15\text{V}$ $I_C=50\text{A}$ $T_J=25^{\circ}\text{C}$	--	1.65	1.95	V
		$T_J=125^{\circ}\text{C}$	--	1.80		
		$T_J=175^{\circ}\text{C}$	--	2.00		



$V_{GE(TH)}$	Gate Threshold Voltage	$V_{CE}=V_{GE}, I_C=1mA$	4.5	5.3	6.5	V
V_F	Diode Forward Voltage	$I_F=50A$ $T_J=25^{\circ}C$ $T_J=125^{\circ}C$ $T_J=175^{\circ}C$	-- -- --	1.45 1.26 1.23	1.85 -- --	V
I_{CES}	Collector-Emitter Leakage Current	$V_{CE}=650V$ $V_{GE}=0V$	--	--	10	μA
$I_{GES(F)}$	Gate-Emitter Forward Leakage Current	$V_{GE}=+20V$	--	--	100	nA
$I_{GES(R)}$	Gate-Emitter Reverse Leakage Current	$V_{GE}=-20V$	--	--	-100	nA
Pulse width $tp \leq 300\mu s$, $\delta \leq 2\%$						

Dynamic Characteristics

Symbol	Parameter	Test Conditions	Values			Units
			Min.	Typ.	Max.	
C_{ies}	Input Capacitance	$V_{GE}=0V$ $V_{CE}=25V$ $f=1.0MHz$	--	3363	--	pF
C_{oes}	Output Capacitance		--	206	--	
C_{res}	Reverse Transfer Capacitance		--	92	--	
Q_g	Gate charge	$V_{CC}=520V$ $I_{CE}=50A$ $V_{GE}=15V$	--	179	--	nC
Q_{ge}	Gate-emitter charge		--	31	--	
Q_{gc}	Gate-collector charge		--	87	--	
$I_{C(SC)}$	Short circuit collector current Max.1000 short circuits, times between short circuits $\geq 1.0s$	$V_{GE}=15V, V_{CC} \leq 400V$ $t_{sc} \leq 4\mu s, T_J \leq 175^{\circ}C$		469		A

IGBT Switching Characteristics, at $T_J=25^{\circ}C$

Symbol	Parameter	Test Conditions	Values			Units
			Min.	Typ.	Max.	
$t_{d(on)}$	Turn-on Delay Time	$I_C=50A$ $V_{CC}=400V$ $V_{GE}=15V$ $R_g=5\Omega$ Inductive Load	--	24	--	ns
t_r	Rise Time		--	86	--	
$t_{d(off)}$	Turn-Off Delay Time		--	122	--	
t_f	Fall Time		--	74	--	
E_{on}	Turn-On Switching Loss		--	1.38	--	mJ
E_{off}	Turn-Off Switching Loss		--	1.14	--	
E_{ts}	Total Switching Loss		--	2.52	--	



IGBT Switching Characteristics, at $T_J=175^{\circ}\text{C}$

Symbol	Parameter	Test Conditions	Values			Units
			Min.	Typ.	Max.	
$t_{d(on)}$	Turn-on Delay Time	$I_C=50\text{A}$ $V_{CC}=400\text{V}$ $V_{GE}=15\text{V}$ $R_g=5\Omega$ Inductive Load	--	33	--	ns
t_r	Rise Time		--	97	--	
$t_{d(off)}$	Turn-Off Delay Time		--	146	--	
t_f	Fall Time		--	84	--	
E_{on}	Turn-On Switching Loss		--	1.65	--	mJ
E_{off}	Turn-Off Switching Loss		--	1.32	--	
E_{ts}	Total Switching Loss		--	2.97	--	

Diode Characteristics, at $T_J=25^{\circ}\text{C}$

Symbol	Parameter	Test Conditions	Values			Units
			Min.	Typ.	Max.	
T_{rr}	Reverse Recovery Time	$I_F=50\text{A}$ $V_{CC}=400\text{V}$ $di/dt=200\text{A}/\mu\text{s}$	--	98	--	ns
Q_{rr}	Reverse Recovery Charge		--	1580	--	μC
I_{rrm}	Reverse Recovery Current		--	26	--	A

Diode Characteristics, at $T_J=175^{\circ}\text{C}$

Symbol	Parameter	Test Conditions	Values			Units
			Min.	Typ.	Max.	
T_{rr}	Reverse Recovery Time	$I_F=50\text{A}$ $V_{CC}=400\text{V}$ $di/dt=200\text{A}/\mu\text{s}$	--	104	--	ns
Q_{rr}	Reverse Recovery Charge		--	1640	--	μC
I_{rrm}	Reverse Recovery Current		--	27	--	A



5. Characteristics Curves

Figure 1: Power Dissipation

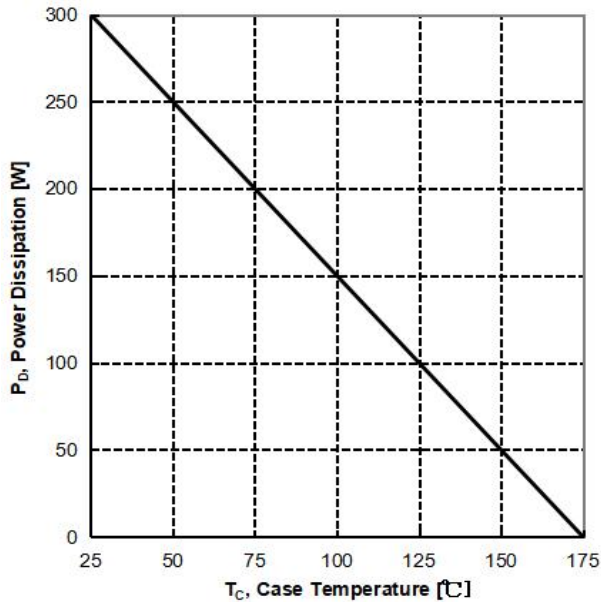


Figure 2: Collector Current vs. Case Temperature

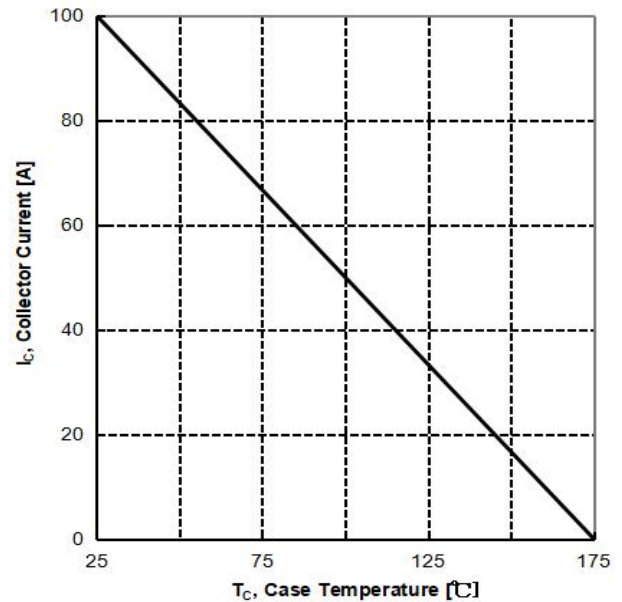


Figure 3: Safe Operation Area

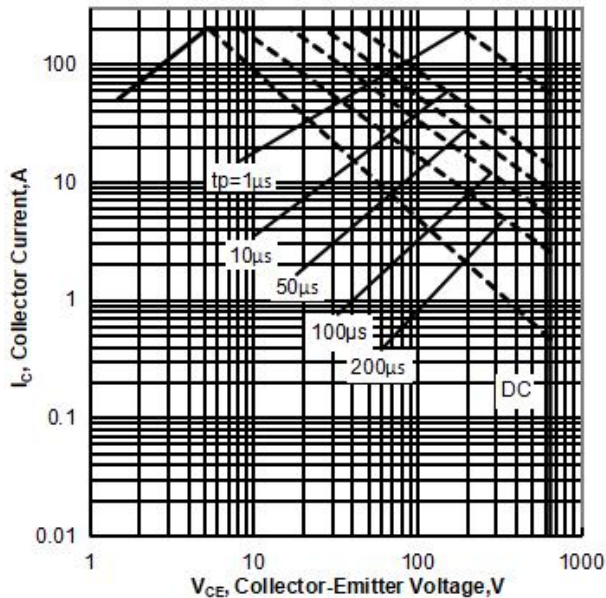


Figure 4: Typical Transfer Characteristics

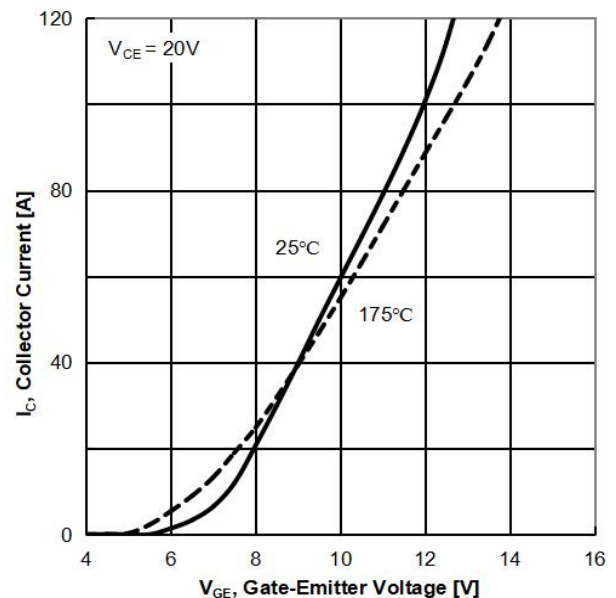




Figure 5: Typical Output Characteristics

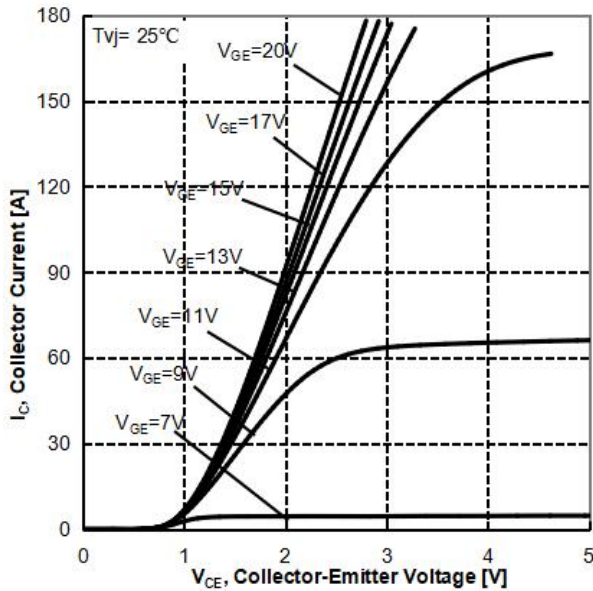


Figure 6: Typical Output Characteristics

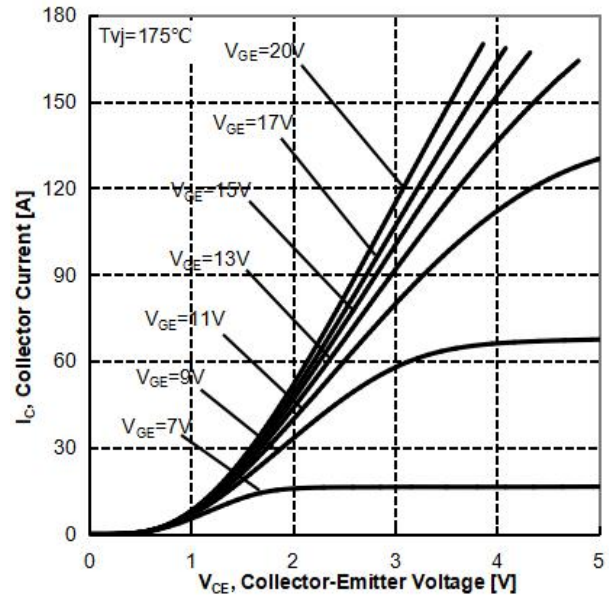


Figure 7: Typical Collector-Emitter Saturation Voltage vs. Junction Temperature

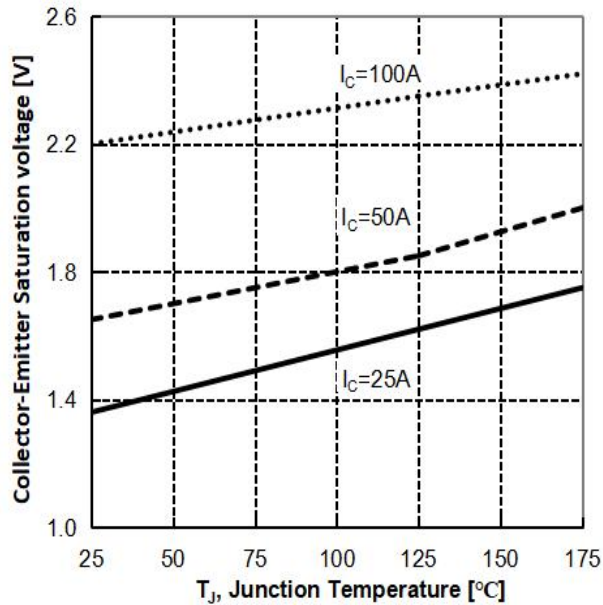


Figure 8: Typical Gate-Emitter Threshold Voltage vs. Junction Temperature

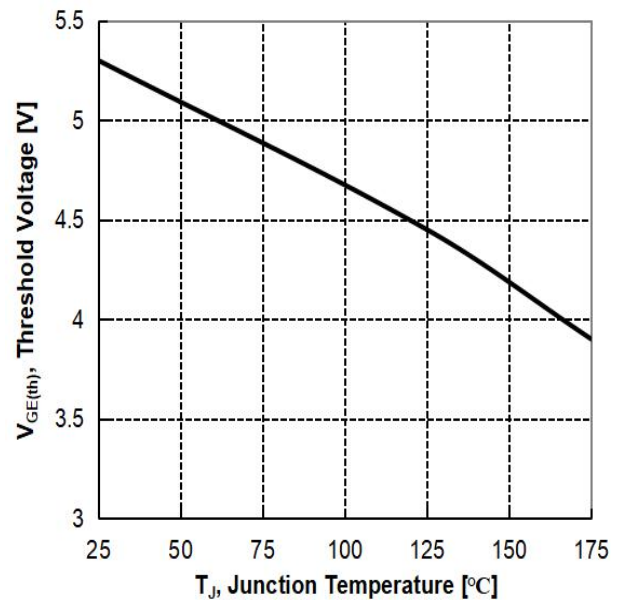




Figure 9: Typical Switching Times vs.
Gate Resistor ($T_J=25^{\circ}\text{C}$, $V_{CE}=400\text{V}$,
 $V_{GE}=15\text{V}$, $I_C=50\text{A}$)

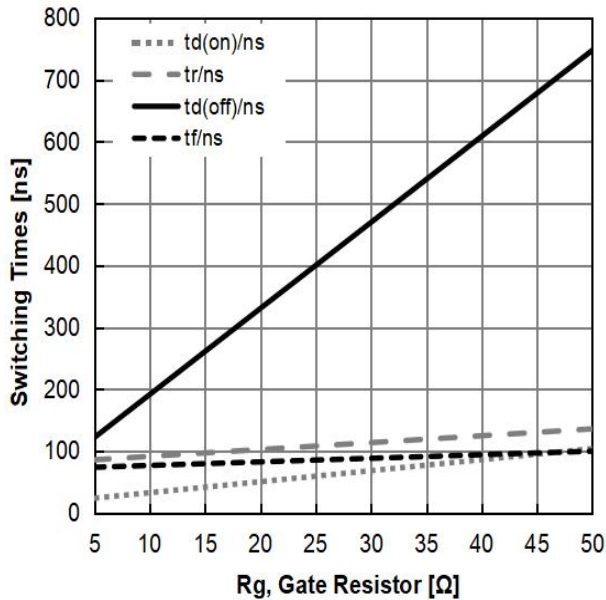


Figure 10: Typical Switching Energy vs.
Gate Resistor ($T_J=25^{\circ}\text{C}$, $V_{CE}=400\text{V}$,
 $V_{GE}=15\text{V}$, $I_C=50\text{A}$)

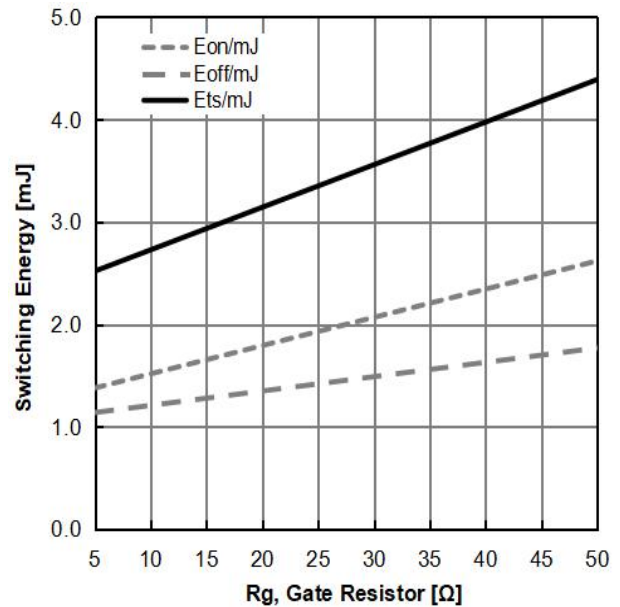


Figure 11: Typical Switching Times vs.
Junction Temperature ($V_{CE}=400\text{V}$,
 $V_{GE}=15\text{V}$, $I_C=50\text{A}$, $R_g=5\Omega$)

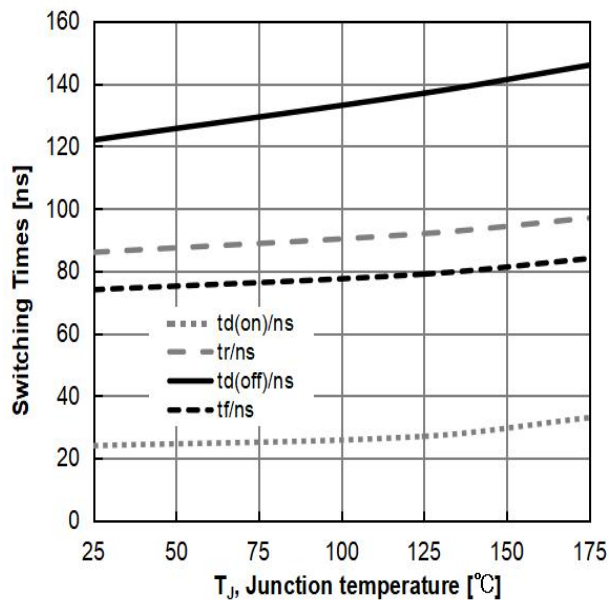


Figure 12: Typical Switching Energy vs.
Junction Temperature ($V_{CE}=400\text{V}$,
 $V_{GE}=15\text{V}$, $I_C=50\text{A}$, $R_g=5\Omega$)

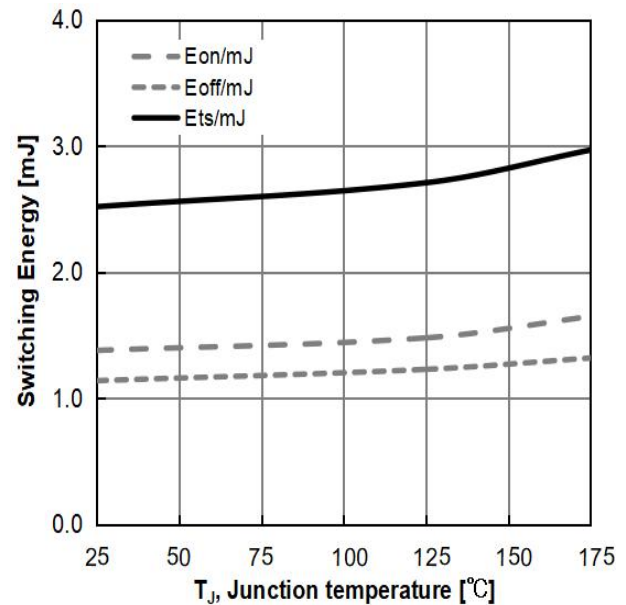




Figure 13: Typical Switching Times vs.
Collector Current ($T_J=25^{\circ}\text{C}$, $V_{CE}=400\text{V}$,
 $V_{GE}=15\text{V}$, $R_g=5\Omega$)

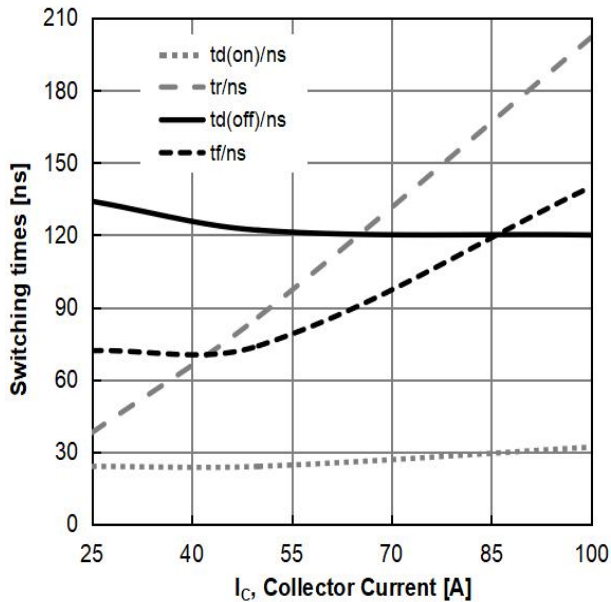


Figure 14: Typical Switching Energy vs.
Collector Current ($T_J=25^{\circ}\text{C}$, $V_{CE}=400\text{V}$,
 $V_{GE}=15\text{V}$, $R_g=5\Omega$)

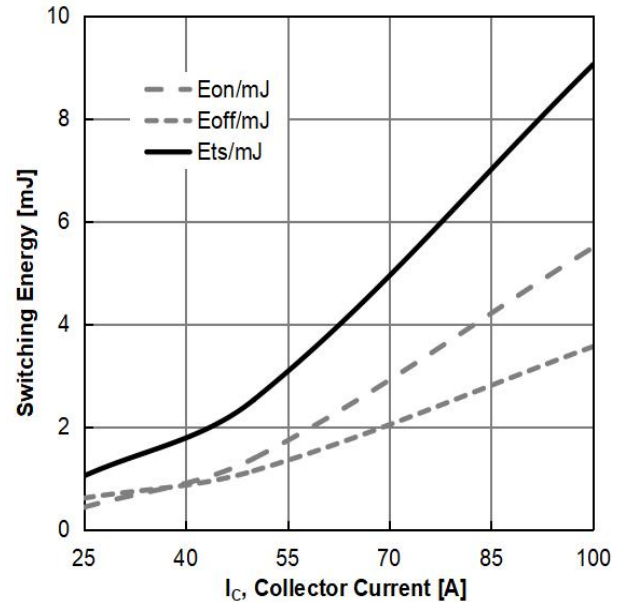


Figure 15: Typical Switching Times vs.
 V_{CE} ($T_J=25^{\circ}\text{C}$, $V_{GE}=15\text{V}$, $I_C=50\text{A}$, $R_g=5\Omega$)

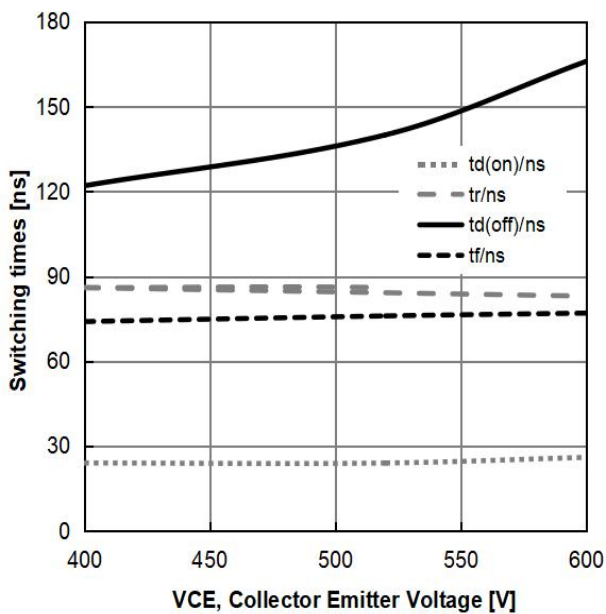


Figure 16: Typical Switching Energy vs.
 V_{CE} ($T_J=25^{\circ}\text{C}$, $V_{GE}=15\text{V}$, $I_C=50\text{A}$, $R_g=5\Omega$)

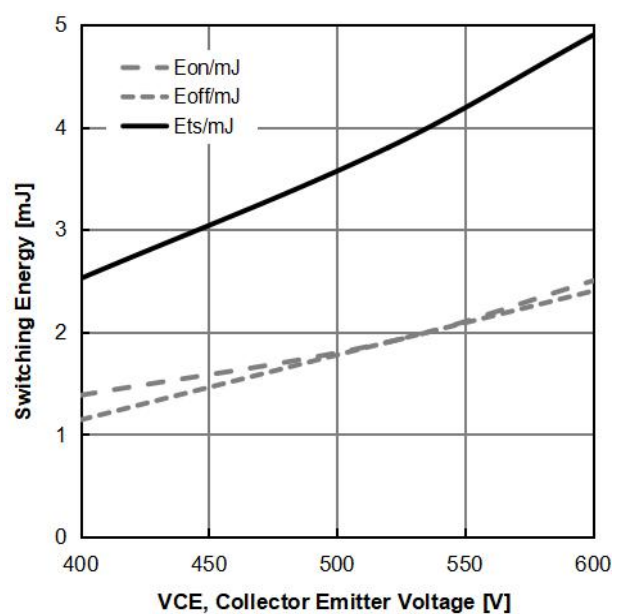




Figure 17: Typical Capacitance vs.
Collector- Emitter Voltage

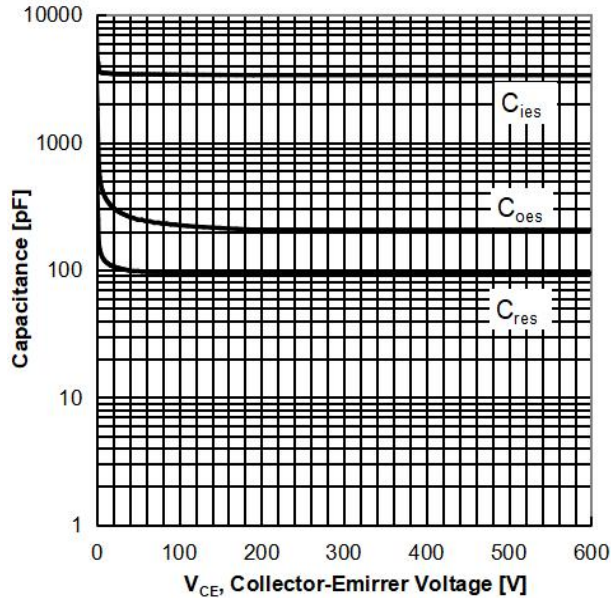


Figure 18: Typical Gate Charge

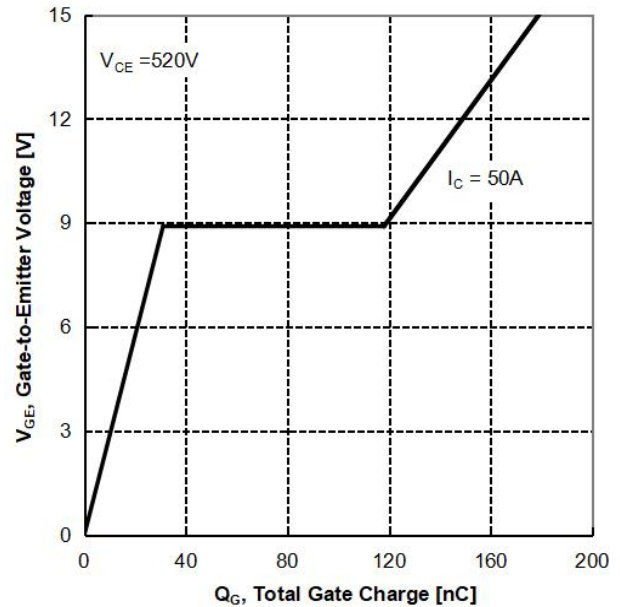


Figure 19: IGBT Transient Thermal
Impedance vs. Pulse Width

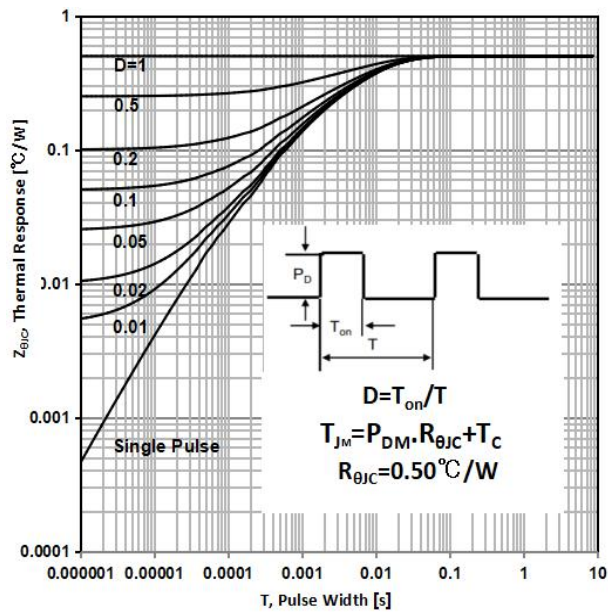


Figure 20: Diode Transient Thermal
Impedance vs. Pulse Width

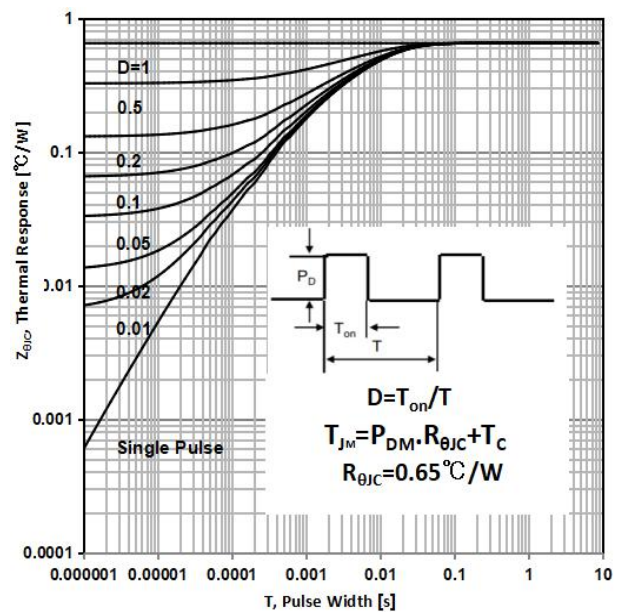
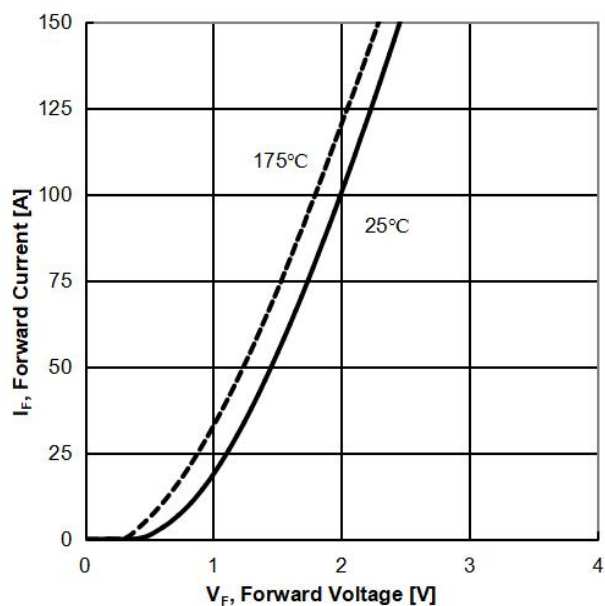




Figure 21: Typical Capacitance vs.
Collector- Emitter Voltage





6. Test Circuit and Waveform

Figure 22. Inductive Switching Test Circuit

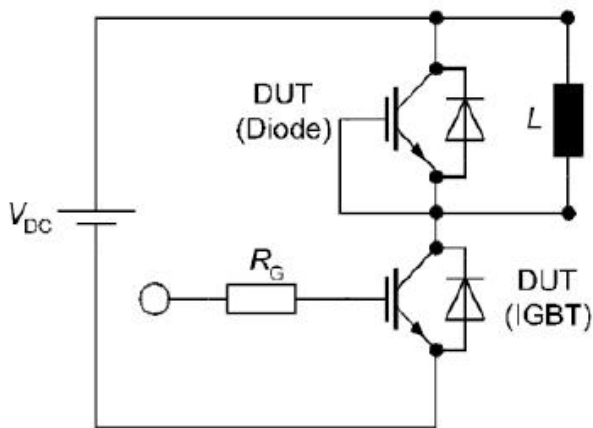


Figure 23. Definition of switching times

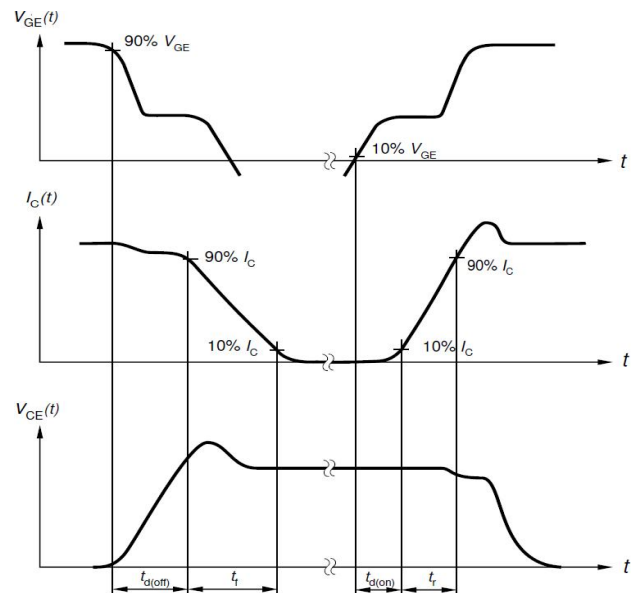


Figure 24. Definition of switching losses

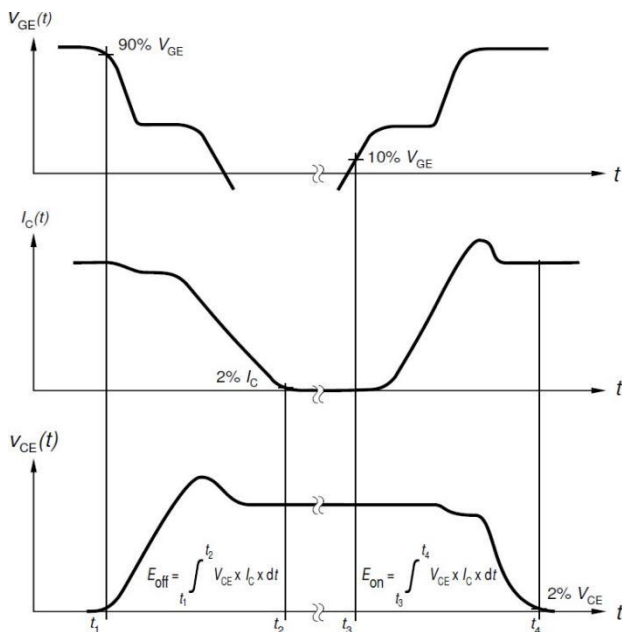
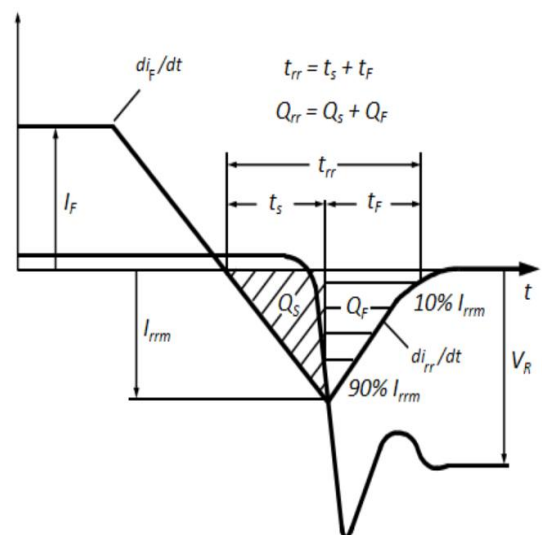


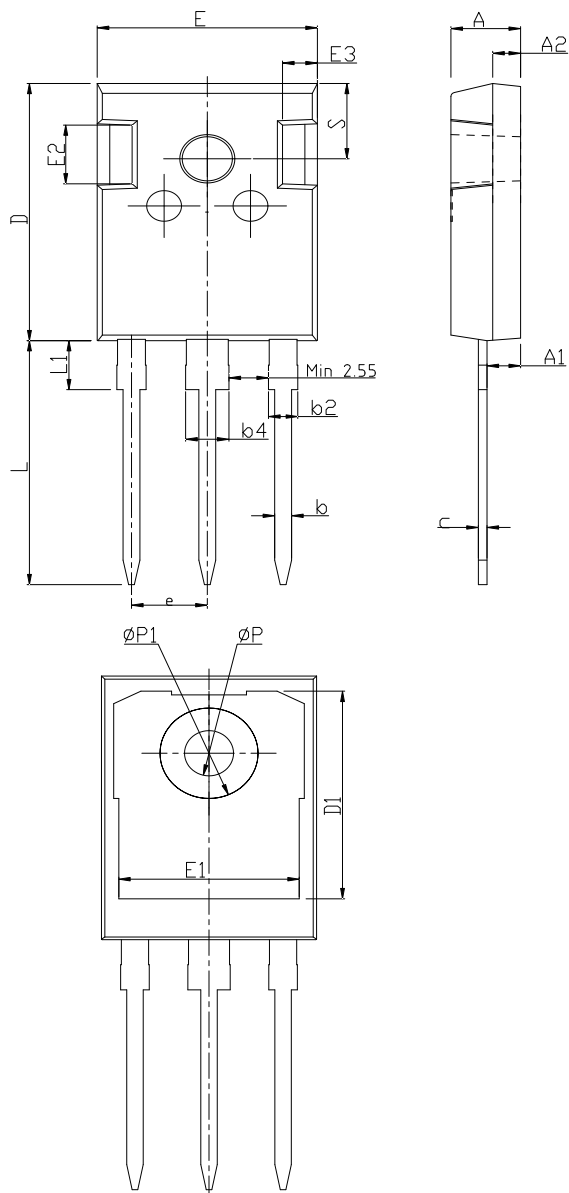
Figure 25. Definition of diode switching characteristics





7. Package Information

TO-247

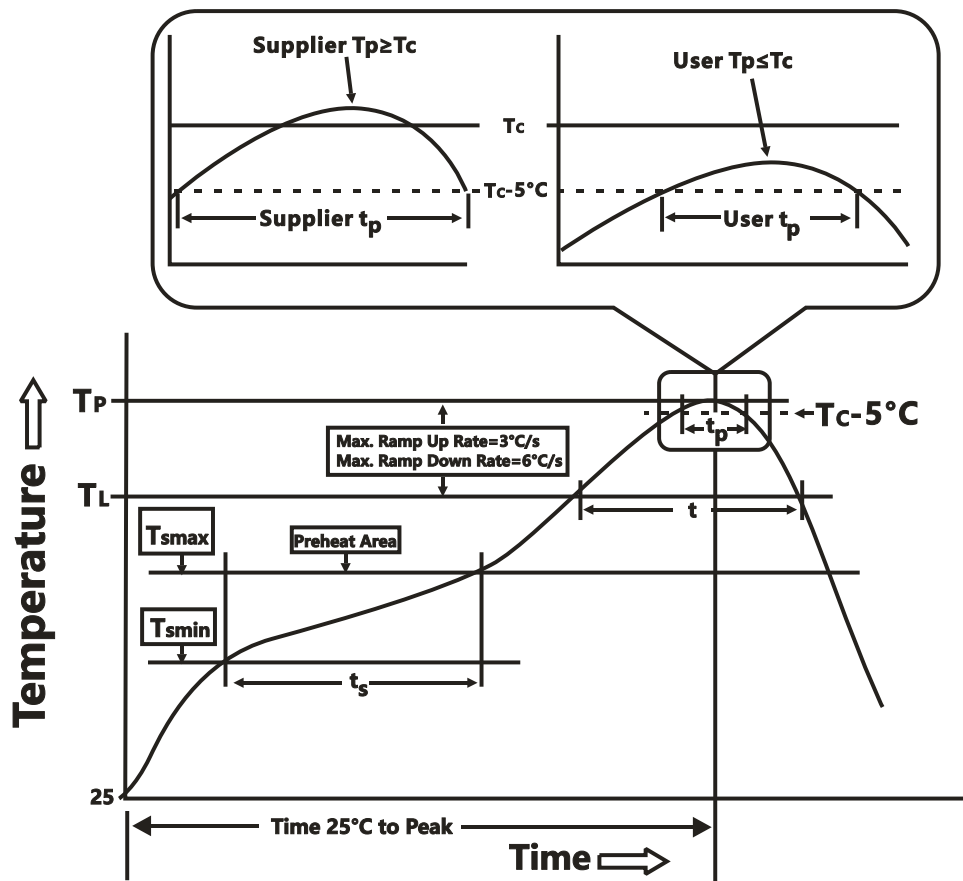


COMMON DIMENSIONS

SYMBOL	mm		
	MIN	NOM	MAX
A	4.80	5.00	5.20
A1	2.21	2.41	2.59
A2	1.85	2.00	2.15
b	1.11	1.21	1.36
b2	1.91	2.01	2.21
b4	2.91	3.01	3.21
c	0.51	0.61	0.75
D	20.70	21.00	21.30
D1	16.25	16.55	16.85
E	15.50	15.80	16.10
E1	13.00	13.30	13.60
E2	4.80	5.00	5.20
E3	2.30	2.50	2.70
e	5.44BSC		
L	19.62	19.92	20.22
L1	-	-	4.30
ØP	3.40	3.60	3.80
ØP1	-	-	7.30
S	6.15BSC		



8. Classification Profile



9. Classification Reflow Profiles

Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
Preheat & Soak		
Temperature min (T_{smin})	100 °C	150 °C
Temperature max (T_{smax})	150 °C	200 °C
Time (T_{smin} to T_{smax}) (T_s)	60-120 seconds	60-120 seconds
Average ramp-up rate (T_{smax} to T_P)	3 °C/second max.	3°C/second max.
Liquidous temperature (T_L)	183 °C	217 °C
Time at liquidous (t_L)	60-150 seconds	60-150 seconds



Peak package body temperature (T_p)*	See Classification Temp in table 1	See Classification Temp in table 2
Time (t_p)** within 5°C of the specified classification temperature (T_c)	20** seconds	30** seconds
Average ramp-down rate (T_p to T_{smax})	6 °C/second max.	6 °C/second max.
Time 25°C to peak temperature	6 minutes max.	8 minutes max.
*Tolerance for peak profile Temperature (T_p) is defined as a supplier minimum and a user maximum.		
** Tolerance for time at peak profile temperature (t_p) is defined as a supplier minimum and a user maximum.		

Table 1.Sn-Pb Eutectic Process – Classification Temperatures (T_c)

Package Thickness	Volume mm ³ <350	Volume mm ³ ≥350
<2.5 mm	235 °C	220 °C
≥2.5 mm	220 °C	220 °C

Table 2.Pb-free Process – Classification Temperatures (T_c)

Package Thickness	Volume mm ³ <350	Volume mm ³ 350-2000	Volume mm ³ ≥2000
<1.6 mm	260 °C	260 °C	260 °C
1.6 mm – 2.5 mm	260 °C	250 °C	245 °C
≥2.5 mm	250 °C	245 °C	245 °C

10. Reliability Test Program

Test item	Method	Description
HTRB	JESD-22, A108	168/500 Hrs, Bias @ 150°C
HTGB	JESD-22, A108	168 /500 Hrs, 100%V _{GE} @ 150°C
PCT	JESD-22, A102	96 Hrs, 100%RH, 2atm, 121°C
TCT	JESD-22, A104	250/500 Cycles, -55°C~150°C



Attention

- Any and all HUA XUAN YANG ELECTRONICS products described or contained herein do not have specifications that can handle applications that require extremely high levels of reliability, such as life-support systems, aircraft's control systems, or other applications whose failure can be reasonably expected to result in serious physical and/or material damage. Consult with your HUA XUAN YANG ELECTRONICS representative nearest you before using any HUA XUAN YANG ELECTRONICS products described or contained herein in such applications.
- HUA XUAN YANG ELECTRONICS assumes no responsibility for equipment failures that result from using products at values that exceed, even momentarily, rated values (such as maximum ratings, operating condition ranges, or other parameters) listed in products specifications of any and all HUA XUAN YANG ELECTRONICS products described or contained herein.
- Specifications of any and all HUA XUAN YANG ELECTRONICS products described or contained herein stipulate the performance, characteristics, and functions of the described products in the independent state, and are not guarantees of the performance, characteristics, and functions of the described products as mounted in the customer's products or equipment. To verify symptoms and states that cannot be evaluated in an independent device, the customer should always evaluate and test devices mounted in the customer's products or equipment.
- HUA XUAN YANG ELECTRONICS CO.,LTD. strives to supply high-quality high-reliability products. However, any and all semiconductor products fail with some probability. It is possible that these probabilistic failures could give rise to accidents or events that could endanger human lives, that could give rise to smoke or fire, or that could cause damage to other property. When designing equipment, adopt safety measures so that these kinds of accidents or events cannot occur. Such measures include but are not limited to protective circuits and error prevention circuits for safe design, redundant design, and structural design.
- In the event that any or all HUA XUAN YANG ELECTRONICS products(including technical data, services) described or contained herein are controlled under any of applicable local export control laws and regulations, such products must not be exported without obtaining the export license from the authorities concerned in accordance with the above law.
- No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying and recording, or any information storage or retrieval system, or otherwise, without the prior written permission of HUA XUAN YANG ELECTRONICS CO.,LTD.
- Information (including circuit diagrams and circuit parameters) herein is for example only ; it is not guaranteed for volume production. HUA XUAN YANG ELECTRONICS believes information herein is accurate and reliable, but no guarantees are made or implied regarding its use or any infringements of intellectual property rights or other rights of third parties.
- Any and all information described or contained herein are subject to change without notice due to product/technology improvement, etc. When designing equipment, refer to the "Delivery Specification" for the HUA XUAN YANG ELECTRONICS product that you intend to use.