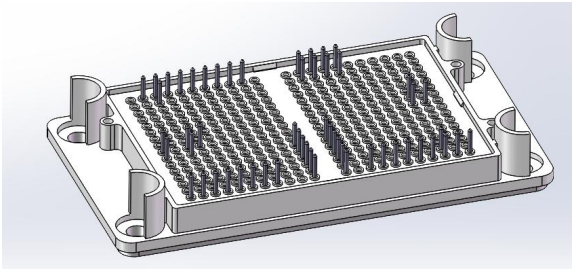
JL3I600V65RE3F7SN

The JL3I600V65RE3F7SN is a power module containing a I−type neutral point clamped three−level inverter. The integrated field stop trench IGBTs and FRDs provide lower conduction losses and switching losses, enabling designers to achieve high efficiency and superior reliability.

RoHS

Features



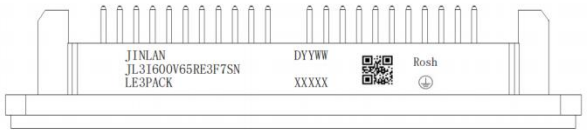
• Electrical features

- Neutral Point Clamped Three−level Inverter Module
- 650 V Field Stop IGBTs
- Low Inductive layout
- Solderable Pins/Press−fit Pins
-Thermistor
- Pb−Free, Halogen Free/BFR Free and RoHS Compliant

Typical Applications

- Solar Inverters
- Uninterruptable Power Supplies Systems
- Energy Storage System

MARKING DIAGRAM

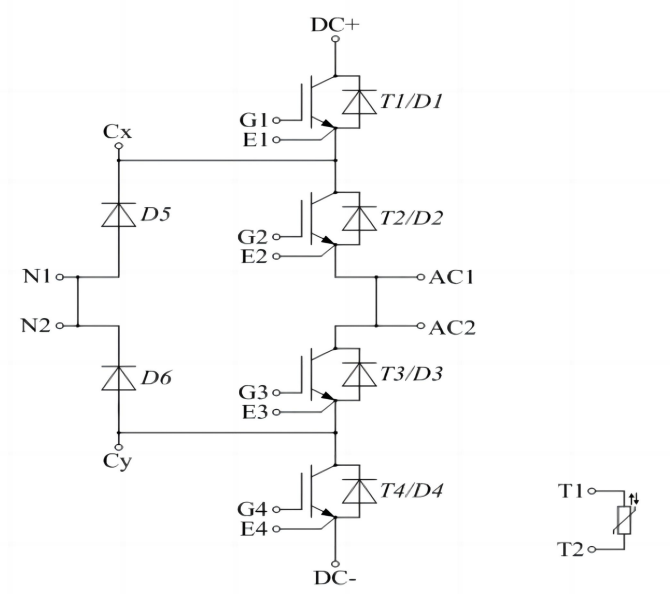


JINLAN	= Company Name
JL3I600V65RE3F7SN	= Specific Device Code
YYWW	= Year and Work Week Code
XXXXX	=Serial Number
QR code	= Custom Assembly Information

Product validation

• Qualified for industrial applications according to the relevant tests of IEC 60747, 60749 and 60068

Description



Package Insulation coordination

Parameter	Symbol	Note or test condition	Values	Unit
Isolation test voltage	V_{ISOL}	RMS,f=50Hz,t=60s	3.2	kV
Material of module baseplate			Cu	
Internal isolation		basic insulation(class 1,IEC 61140)	Al_2O_3	
Creepage distance	d_{creep}	terminal to heatsink	14.2	mm
Creepage distance	d_{creep}	terminal to terminal	6.8	mm
Clearance	d_{clear}	terminal to heatsink	12.4	mm
Clearance	d_{clear}	terminal to terminal	5.5	mm
Comparative tracking index (electrical)	*CTI*		>400	

Package Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Mounting torque for module mounting	*M*	-Mounting according to valid application note	M5, Screw	3		5	Nm
Weight	*G*				TBD		g

MAXIMUM RATINGS (Note 1)

Symbol	Rating	Value	Unit
OUTER IGBT (T1,T4)			
V_{CES}	Collector−Emitter Voltage	650	V
V_{GE}	Gate− Emitter Voltage	±20	V
	Positive Transient Gate−Emitter Voltage (t_{pulse} = 5 s, D < 0.10)	30	
I_{CN}	Implemented collector current	800	A
I_{CDC}	Continuous Collector Current @ T_c = 80°C (T_{JMAX} = 175°C)	520	A
I_{CRM}	Repetitive peak collector current (t_p = 1ms)	1600	A
P_{tot}	Maximum Power Dissipation @ T_c = 80°C (T_{JMAX} = 175°C)	871	W
T_{JMAX}	Maximum Operating Junction Temperature	175	°C
INNER IGBT (T2, T3)			
V_{CES}	Collector−Emitter Voltage	650	V
V_{GE}	Gate− Emitter Voltage	±20	V
	Positive Transient Gate−Emitter Voltage (t_{pulse} = 5 s, D < 0.10)	30	
I_{CN}	Implemented collector current	600	A
I_{CDC}	Continuous Collector Current @ T_c = 80°C (T_{JMAX} = 175°C)	510	A
I_{CRM}	Repetitive peak collector current (t_p = 1ms)	1200	A
P_{tot}	Maximum Power Dissipation @ T_c = 80°C (T_{JMAX} = 175°C)	659	W
T_{JMAX}	Maximum Operating Junction Temperature	175	°C
NEUTRAL POINT DIODE (D5, D6)			
V_{RRM}	Peak Repetitive Reverse Voltage	650	V
I_F	Continuous Forward Current @ T_c = 80°C (T_{JMAX} = 175°C)	300	A
I_{FRM}	Repetitive Peak Forward Current (T_{JMAX} = 175°C)	600	A
P_{tot}	Maximum Power Dissipation @ T_c = 80°C (T_{JMAX} = 175°C)	608	W
T_{JMAX}	Maximum Operating Junction Temperature	175	°C
INVERSE DIODES (D1, D2, D3, D4)			
V_{RRM}	Peak Repetitive Reverse Voltage	650	V
I_F	Continuous Forward Current @ T_c = 80°C (T_J = 175°C)	225	A
I_{FRM}	Repetitive Peak Forward Current (t_p = 1 ms)	450	A
P_{tot}	Maximum Power Dissipation @ T_c = 80°C (T_{JMAX} = 175°C)	387	W
T_{JMAX}	Maximum Operating Junction Temperature	175	°C
THERMAL PROPERTIES			
T_{stg}	Storage Temperature Range	−40 to 125	°C
$T_{vj\,op}$	Temperature under switching condition	−40 to 150	°C

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Refer to ELECTRICAL CHARACTERISTICS, RECOMMENDED OPERATING RANGES and/ or APPLICATION INFORMATION for Safe Operating parameters.

RECOMMENDED OPERATING RANGES

Symbol	Rating	Min	Max	Unit
T_J	Module Operating Junction Temperature	-40	175	°C

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise noted)(AC test is three-level test mode)

Symbol	Parameter	Test Condition		Min	Typ	Max	Unit
OUTER IGBT (T1,T4)							
I_{CES}	Collector−Emitter Cutoff Current	V_{GE} = 0 V, V_{CE} = 650 V		--	--	100	μA
$V_{CE(sat)}$	Collector−Emitter Saturation Voltage	V_{GE} = 15 V, I_C =200 A	T_J = 25°C	--	1.25	1.45	V
			T_J = 150°C	--	1.43	--	
		V_{GE} = 15 V, I_C =800 A	T_J = 25°C	--	1.45	1.70	
			T_J = 150°C	--	1.66	--	
$V_{GE(TH)}$	Gate−Emitter Threshold Voltage	V_{GE} = V_{CE} , I_C = 2 mA		5.1	5.8	6.5	V
I_{GES}	Gate Leakage Current	V_{GE} = 20 V, V_{CE} = 0 V		--	--	400	nA
$t_{d(on)}$	Turn−On Delay Time	T_J = 25°C V_{CE} =400 V, I_C =200A V_{GE} = 0 V to +15 V, R_G = 15Ω		--	88	--	ns
t_r	Rise Time			--	28	--	
$t_{d(off)}$	Turn−off Delay Time			--	304	--	
t_f	Fall Time			--	54	--	
E_{on}	Turn−On Switching Loss per Pulse			--	4.4	--	mJ
E_{off}	Turn Off Switching Loss per Pulse			--	3.0	--	
$t_{d(on)}$	Turn−On Delay Time	T_J =125°C V_{CE} =400 V, I_C =200A V_{GE} = 0 V to +15 V, R_G = 15Ω		--	84	--	ns
t_r	Rise Time			--	26	--	
$t_{d(off)}$	Turn−off Delay Time			--	322	--	
t_f	Fall Time			--	56	--	
E_{on}	Turn−on Switching Loss per Pulse			--	5.59	--	mJ
E_{off}	Turn Off Switching Loss per Pulse			--	4.23	--	
C_{ies}	Input Capacitance	V_{CE} = 20 V, V_{GE} = 0 V, f = 10 kHz		--	34.287	--	nF
C_{oes}	Output Capacitance			--	0.142	--	
C_{res}	Reverse Transfer Capacitance			--	0.116	--	
Q_g	Total Gate Charge	V_{CE} = 600 V, V_{GE} = ± 15 V		--	1617.6	--	nC
R_{thJH}	Thermal Resistance − Chip−to−Heatsink	Thermal grease, Thickness = 2 Mil ±2%, A = 2.87 W/mK		--	0.188	--	°C/W
R_{thJC}	Thermal Resistance − Chip−to−Case			--	0.109	--	°C/W
NEUTRAL POINT DIODE (D5, D6)							
V_F	Diode Forward Voltage	I_F = 100 A, V_{GE} = 0 V	T_J = 25°C	--	1.45	--	V
			T_J = 150°C	--	1.25	--	
		I_F = 300 A, V_{GE} = 0 V	T_J = 25°C	--	1.75	1.95	
			T_J = 150°C	--	1.60	--	
t_{rr}	Reverse Recovery Time	T_J = 25°C V_{CE} =400 V, I_C =200A V_{GE} = 0 V to +15 V, R_G = 15Ω		--	98	--	ns
Q_{rr}	Reverse Recovery Charge			--	42.34	--	μC
I_{RRM}	Peak Reverse Recovery Current			--	215	--	A
t_{rr}	Reverse Recovery Time	T_J = 125°C V_{CE} =400 V, I_C =200A V_{GE} = 0 V to +15 V, R_G = 15Ω		--	126	--	ns
Q_{rr}	Reverse Recovery Charge			--	26.31	--	μC
I_{RRM}	Peak Reverse Recovery Current			--	181	--	A
R_{thJH}	Thermal Resistance − Chip−to−Heatsink	Thermal grease, Thickness = 2 Mil ±2%, A = 2.87 W/mK		--	0.230	--	°C/W
R_{thJC}	Thermal Resistance − Chip−to−Case			--	0.156	--	°C/W
INNER IGBT (T2, T3)							
I_{CES}	Collector−Emitter Cutoff Current	V_{GE} = 0 V, V_{CE} = 650 V		--	--	100	μA
$V_{CE(sat)}$	Collector−Emitter Saturation Voltage	V_{GE} = 15 V, I_C = 200 A	T_J = 25°C	--	1.32	1.55	V
			T_J = 150°C	--	1.51	--	
		V_{GE} = 15 V, I_C = 600 A	T_J = 25°C	--	1.45	1.70	
			T_J = 150°C	--	1.66	--	
$V_{GE(TH)}$	Gate−Emitter Threshold Voltage	V_{GE} = V_{CE} , I_C =1.5 mA		5.1	5.8	6.5	V
I_{GES}	Gate Leakage Current	V_{GE} = 30 V, V_{CE} = 0 V		--	--	400	nA

ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise noted) (AC test is three-level test mode)

Symbol	Parameter	Test Condition		Min	Typ	Max	Unit
INNER IGBT (T2, T3)							
$t_{d(on)}$	Turn−On Delay Time	T_J = 25°C V_{CE} =400 V, I_C =200A V_{GE} = 0 V to +15 V, R_G = 15Ω		--	114	--	ns
t_r	Rise Time			--	31	--	
$t_{d(off)}$	Turn−Off Delay Time			--	345	--	
t_f	Fall Time			--	56	--	
E_{on}	Turn−On Switching Loss per Pulse			--	5.63	--	mJ
E_{off}	Turn Off Switching Loss per Pulse			--	4.34	--	
$t_{d(on)}$	Turn−On Delay Time	T_J =125°C V_{CE} =400 V, I_C =200A V_{GE} = 0 V to +15 V, R_G = 15Ω		--	105	--	ns
t_r	Rise Time			--	39	--	
$t_{d(off)}$	Turn−Off Delay Time			--	372	--	
t_f	Fall Time			--	40	--	
E_{on}	Turn−On Switching Loss per Pulse			--	6.74	--	mJ
E_{off}	Turn Off Switching Loss per Pulse			--	5.12	--	
C_{ies}	Input Capacitance	V_{CE} = 20 V, V_{GE} = 0 V, f = 10 kHz		--	28.573	--	nF
C_{oes}	Output Capacitance			--	1.185	--	
C_{res}	Reverse Transfer Capacitance			--	0.967	--	
Q_g	Total Gate Charge	V_{CE} = 480 V, I_C = 375 A, V_{GE} = ± 15 V		--	1213.2	--	μC
R_{thJH}	Thermal Resistance − Chip−to−Heatsink	Thermal grease, Thickness = 2 Mil ±2%, A = 2.87 W/mK		--	0.219	--	°C/W
R_{thJC}	Thermal Resistance − Chip−to−Case			--	0.144	--	°C/W
INVERSE DIODES (D1, D2, D3, D4)							
V_F	Diode Forward Voltage	I_F = 100 A, V_{GE} = 0 V	T_J = 25°C	--	1.35	--	V
			T_J = 150°C	--	1.22	--	
		I_F = 225A, V_{GE} = 0 V	T_J = 25°C	--	1.61	1.90	
			T_J = 150°C	--	1.45	--	
t_{rr}	Reverse Recovery Time	T_J = 25°C V_{CE} =400 V, I_C =200A V_{GE} = 0 V to +15 V, R_G = 15Ω		--	110	--	ns
Q_{rr}	Reverse Recovery Charge			--	31.76	--	μC
I_{RRM}	Peak Reverse Recovery Current			--	206	--	A
t_{rr}	Reverse Recovery Time	T_J =125°C V_{CE} =400 V, I_C =200A V_{GE} = 0 V to +15 V, R_G = 15Ω		--	141	--	ns
Q_{rr}	Reverse Recovery Charge			--	20.31	--	μC
I_{RRM}	Peak Reverse Recovery Current			--	173	--	A
R_{thJH}	Thermal Resistance − Chip−to−Heatsink	Thermal grease, Thickness = 2 Mil ±2%, A = 2.87 W/mK		--	0.323	--	°C/W
R_{thJC}	Thermal Resistance − Chip−to−Case			--	0.245	--	°C/W
THERMISTOR PROPERTIES							
R_{25}	Rated Resistance	T_C = 25°C		--	5	--	kQ
ΔR/R	Deviation of R100	T_C=100 ℃,R_{100}=493Ω		-5	--	5	%
P_{25}	Power Dissipation	T_C = 25°C		--	--	20	mW
$B_{25/50}$	B-value	$R_2=R_{25}\exp[B_{25/50}(1/T_2- 1/(298.15K))]$		--	3375	--	K
$B_{25/80}$	B-value	$R_2=R_{25}\exp[B_{25/80}(1/T_2- 1/(298.15K))]$		--	3411	--	K
$B_{25/100}$	B-value	$R_2=R_{25}\exp[B_{25/100}(1/T_2- 1/(298.15K))]$		--	3433	--	K

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

TYPICAL CHARACTERISTICS - IGBT T1,T4 AND DIODE D1,D4

Figure 1.Typical Output Characteristics

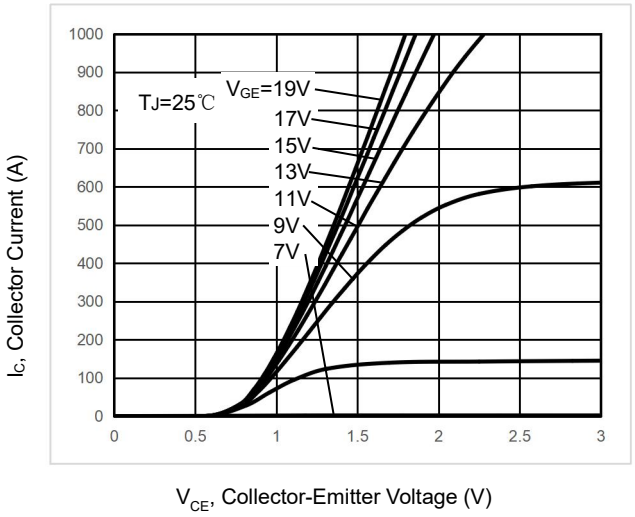


Figure 2.Typical Output Characteristics

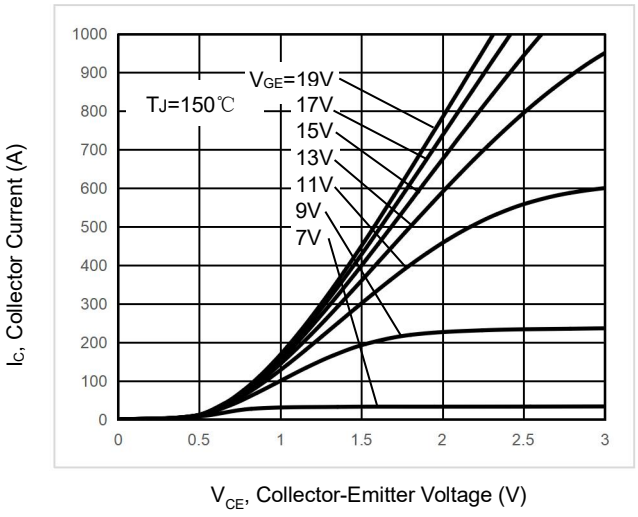


Figure 3.Typical Transfer Characteristics

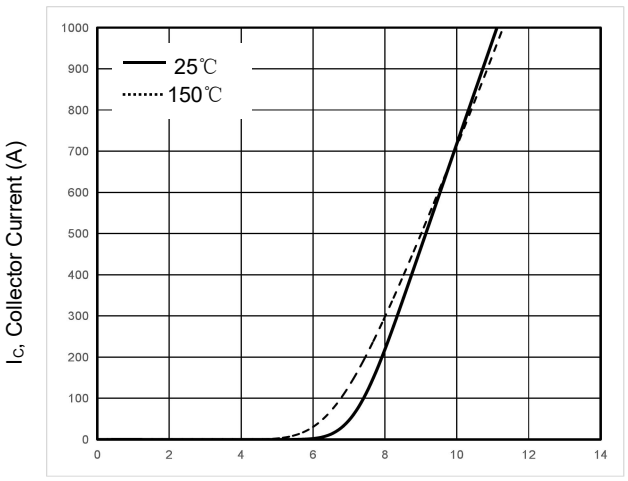
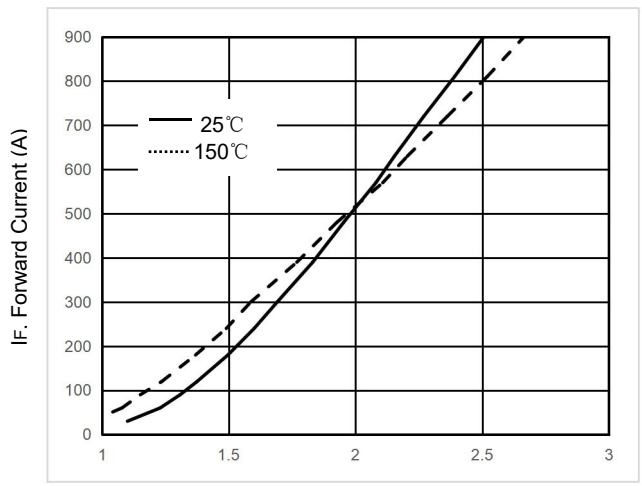


Figure 4.Typical Transfer Characteristics



TYPICAL CHARACTERISTICS - IGBT T1,T4 AND DIODE D1,D4

Figure 5.Transient Thermal Impedance(T1,T4)

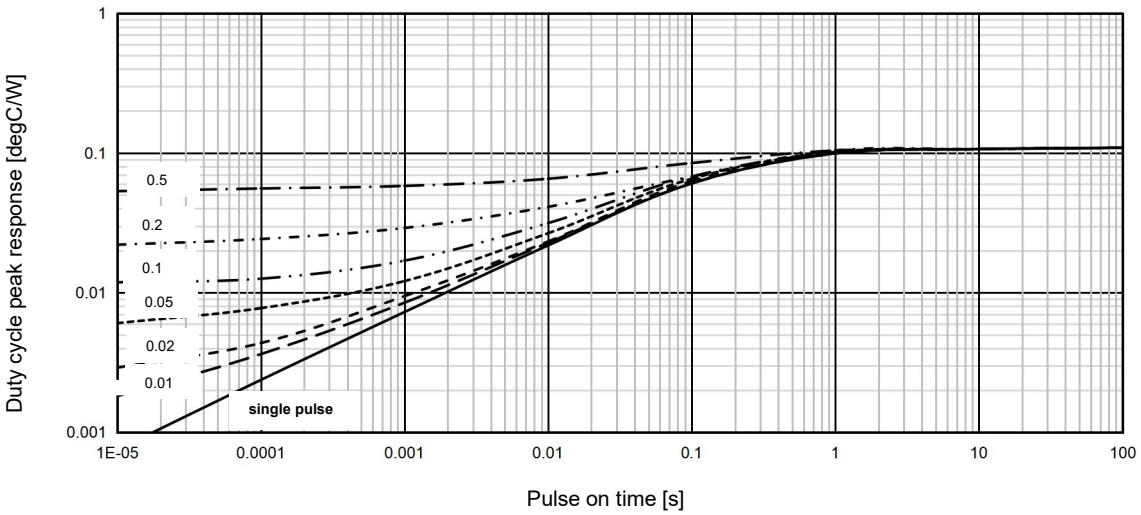
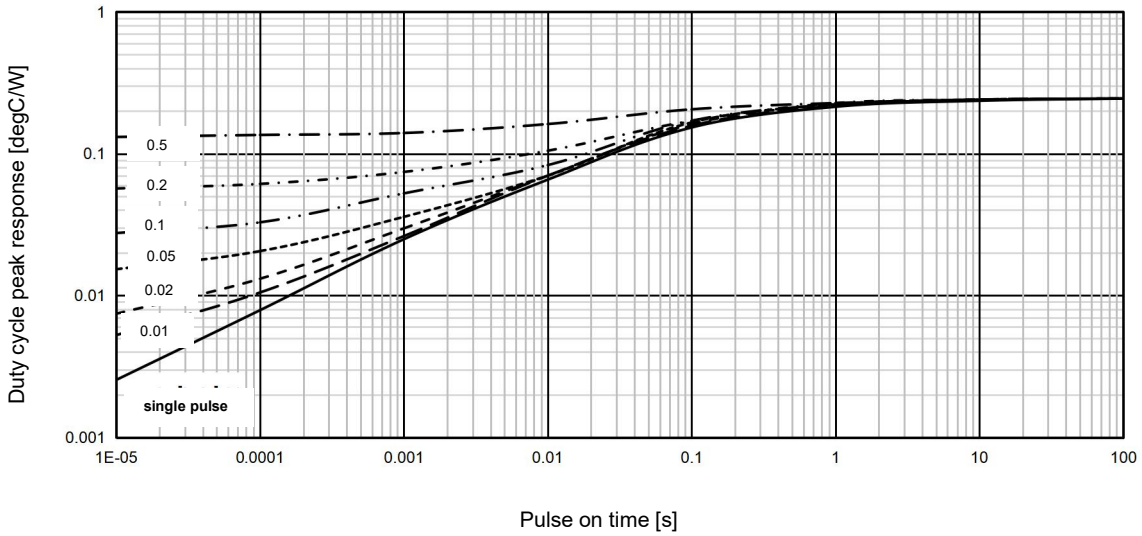


Figure 6.Transient Thermal Impedance(D1,D4)



TYPICAL CHARACTERISTICS - IGBT T1,T4 AND DIODE D1,D4

Figure 7.RBSOA(T1,T4)

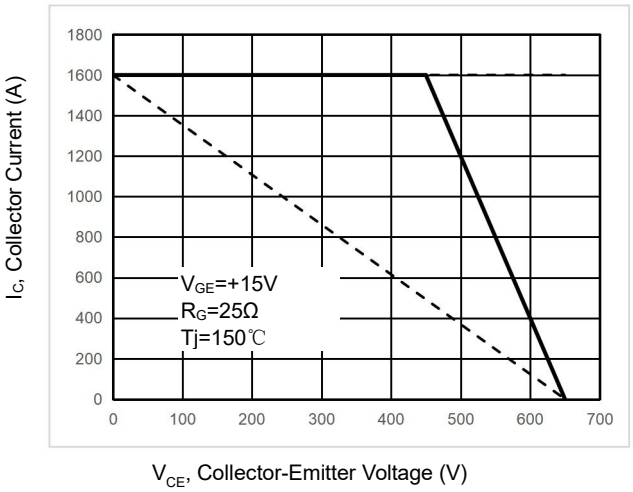


Figure 8.Capacitance(T1,T4)

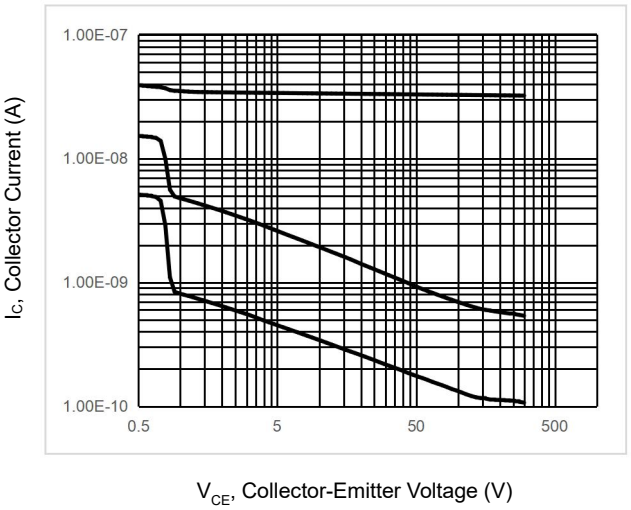
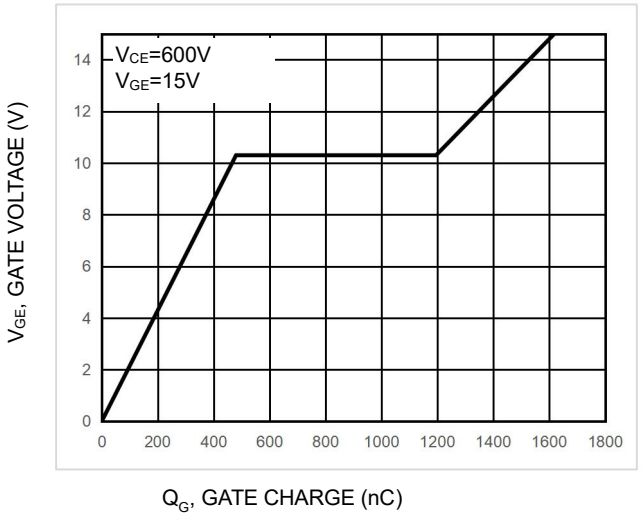


Figure 9.Gate Voltage vs. Gate Charge



TYPICAL CHARACTERISTICS - IGBT T2,T3 AND DIODE D2,D3

Figure 10.Typical Output Characteristics

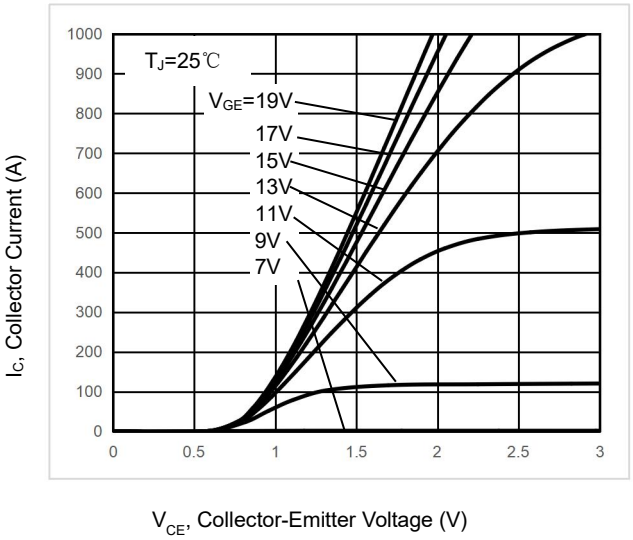


Figure 11.Typical Output Characteristics

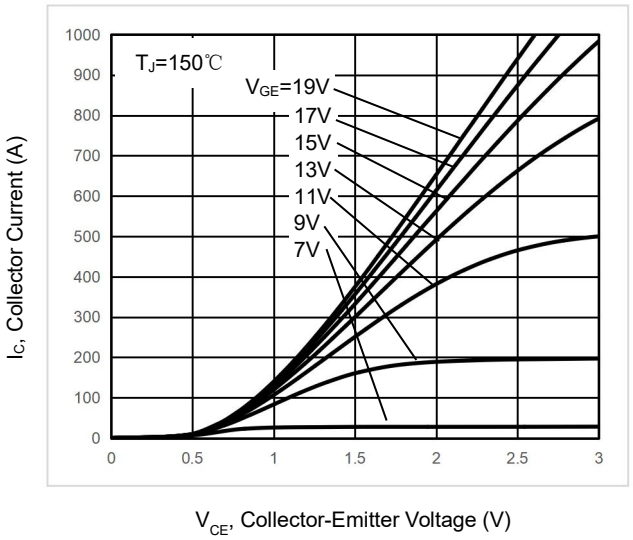


Figure 12.Typical Transfer Characteristics

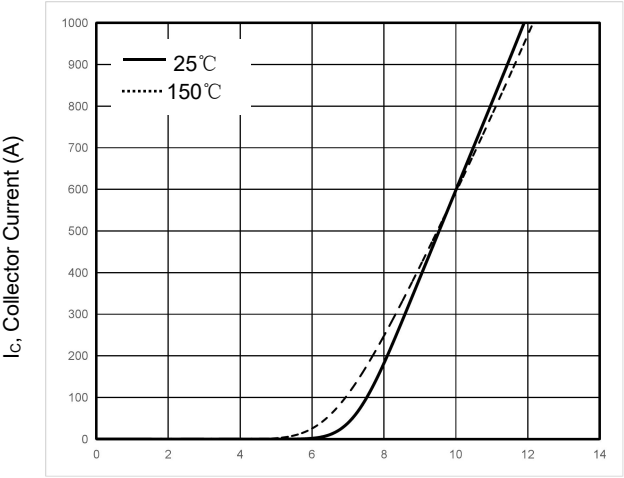
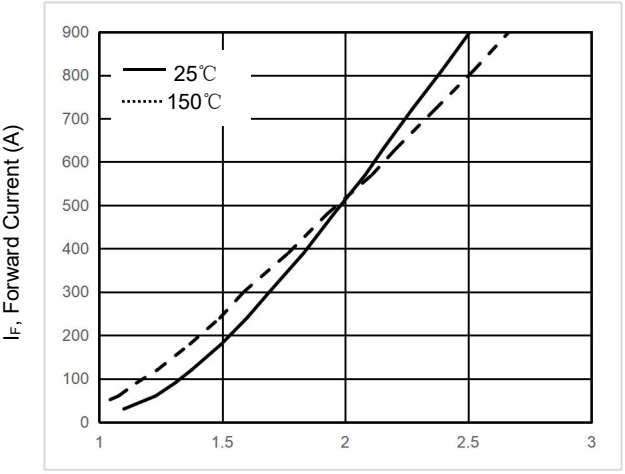


Figure 13.Typical Transfer Characteristics



TYPICAL CHARACTERISTICS - IGBT T2,T3 AND DIODE D2,D3

Figure 14.Transient Thermal Impedance(T2,T3)

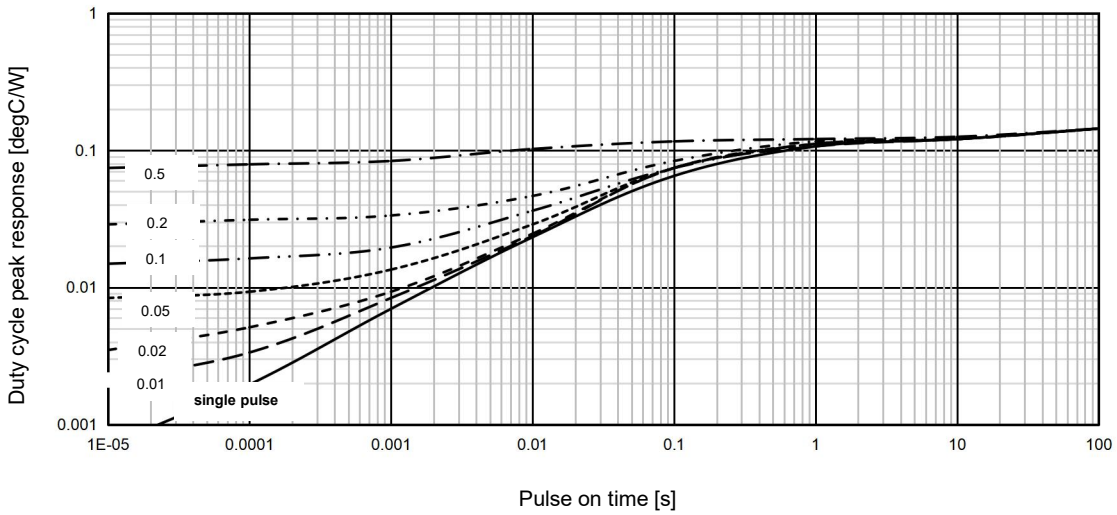
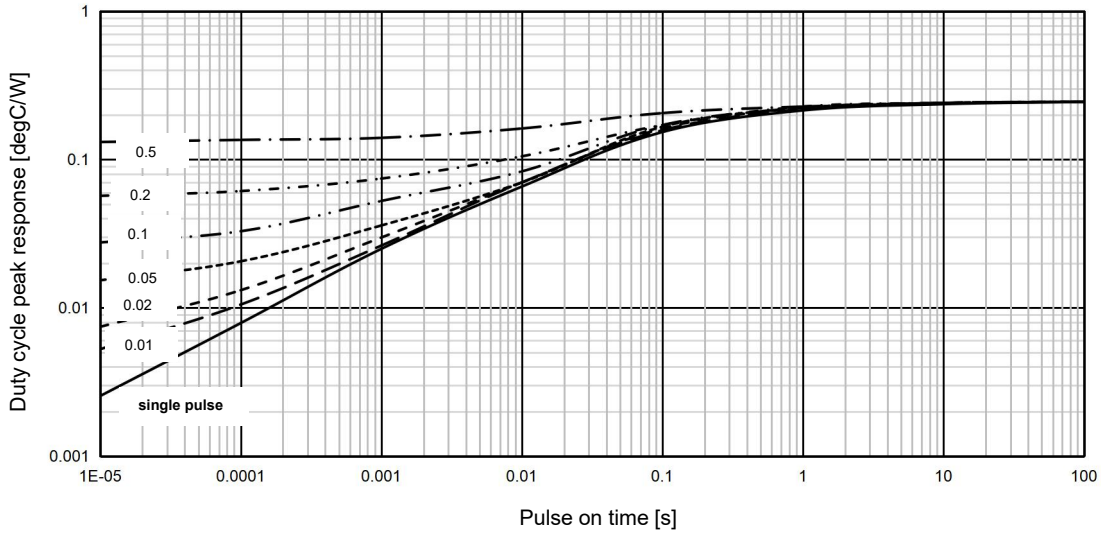


Figure 15.Transient Thermal Impedance(D2,D3)



TYPICAL CHARACTERISTICS - IGBT T2,T3 AND DIODE D2,D3

Figure 16.RBSOA (T2,T3)

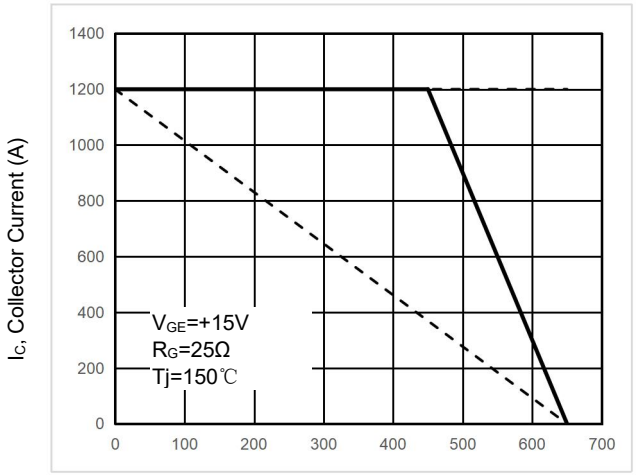


Figure 17.Capacitance (T2,T3)

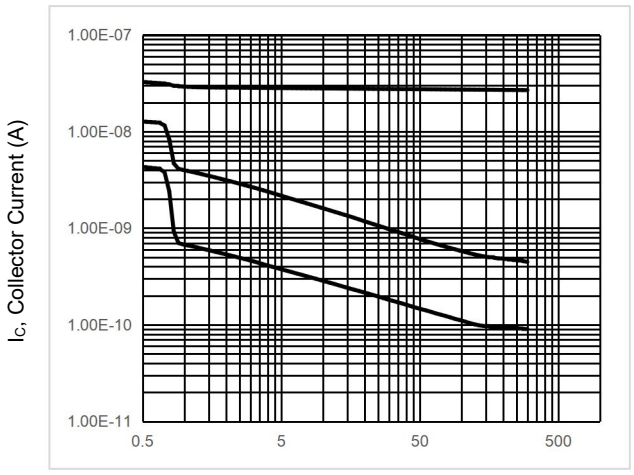
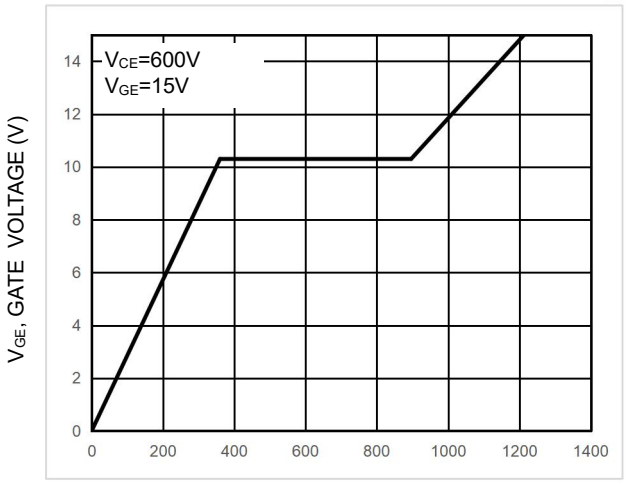


Figure 18.Gate Voltage vs. Gate Charge



TYPICAL CHARACTERISTICS - DIODE D5,D6

Figure 19.Diode Forward Characteristics

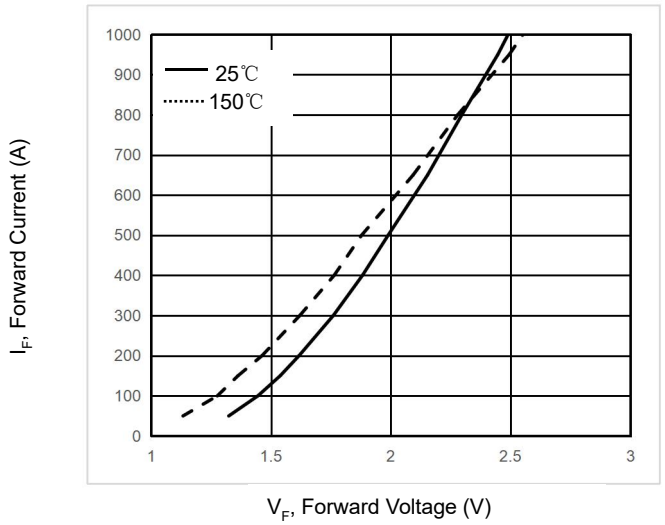
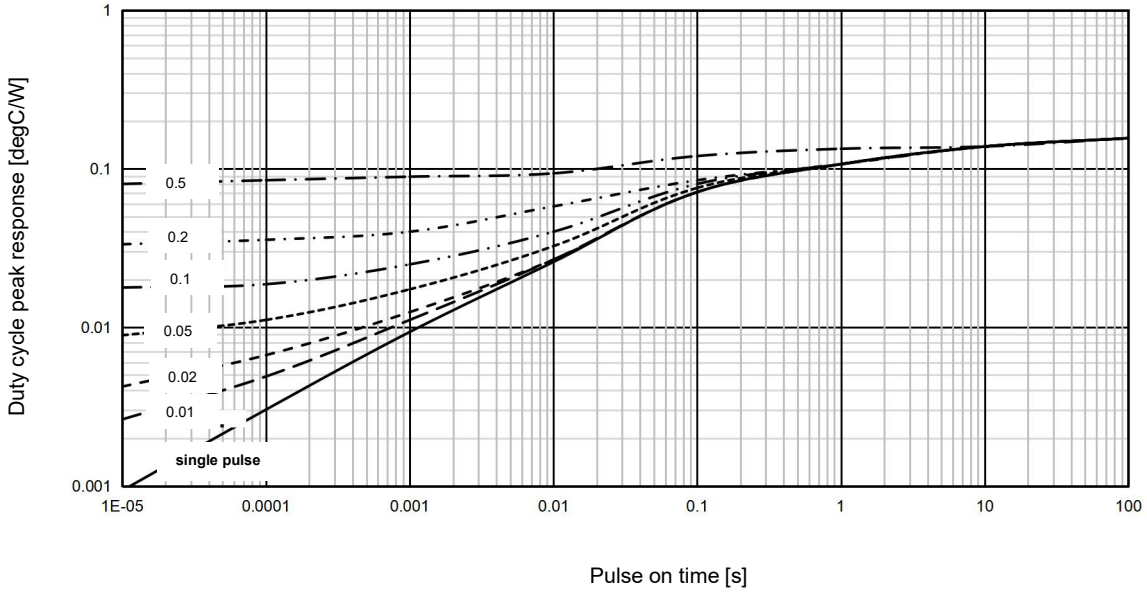


Figure 20.Transient Thermal Impedance(D5,D6)



TYPICAL CHARACTERISTICS - T1/T4 IGBT COMUTATES D5,D6 DIODE

Figure 21.Typical Switching Loss Eon vs. IC

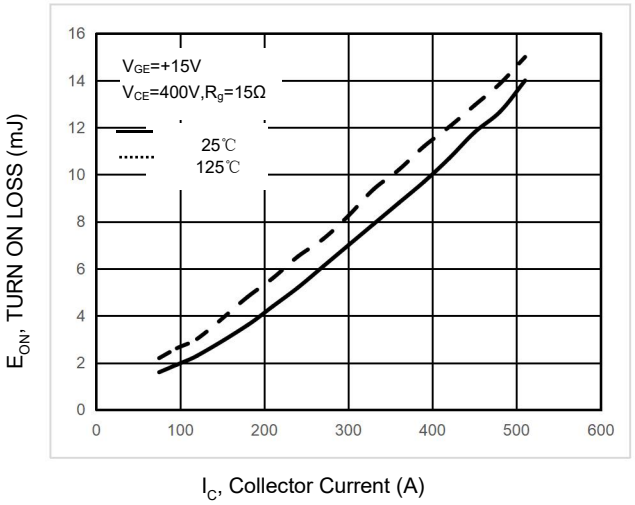


Figure22.Typical Switching Loss Eoff vs. IC

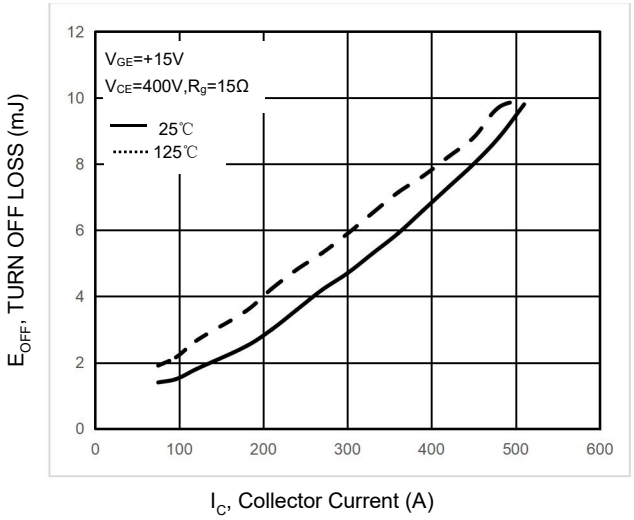


Figure 23.Typical Switching Loss Eon vs. R_G

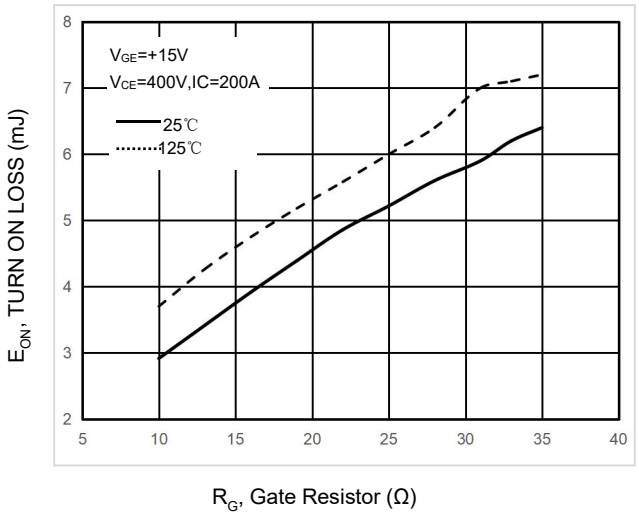


Figure 24.Typical Switching Loss Eoff vs. R_G

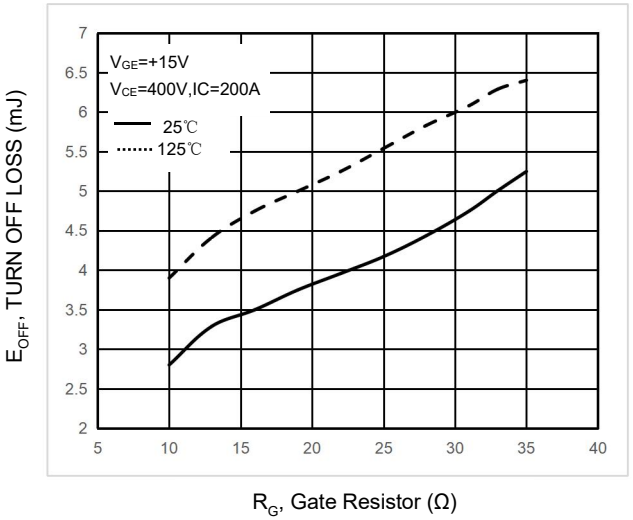


Figure 25.Typical Switching Time Tdon vs. IC

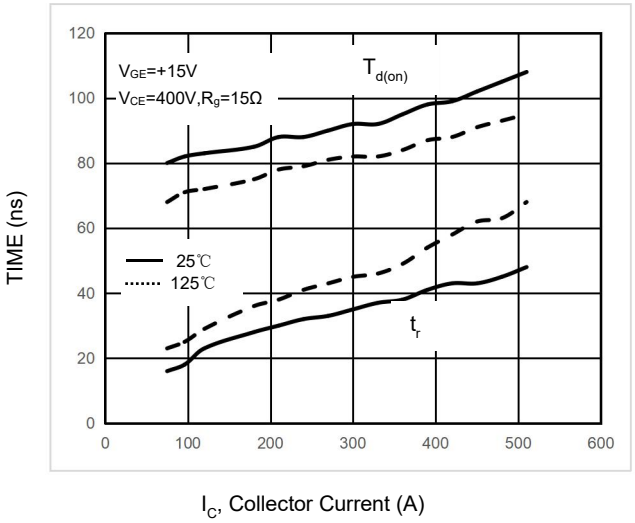
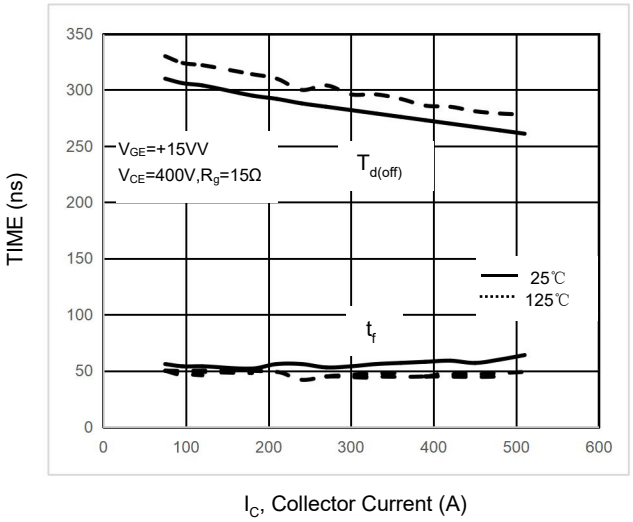


Figure 26.Typical Switching Time Tdoff vs. IC



TYPICAL CHARACTERISTICS - T1/T4 COMUTATES D5,D6 DIODE

Figure 27.Typical Switching Time Tdon vs. R_G

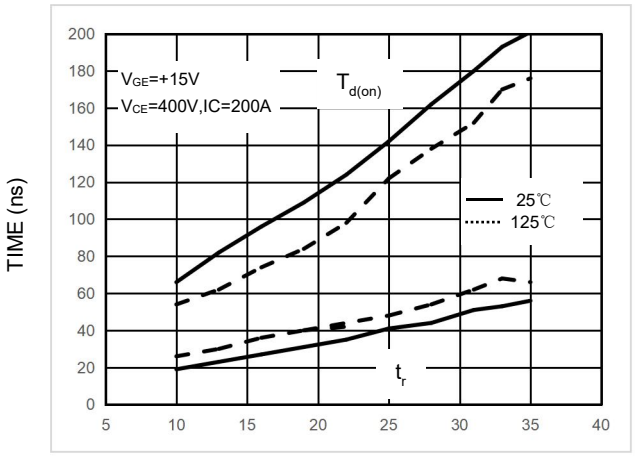


Figure28.Typical Switching Time Tdoff vs. R_G

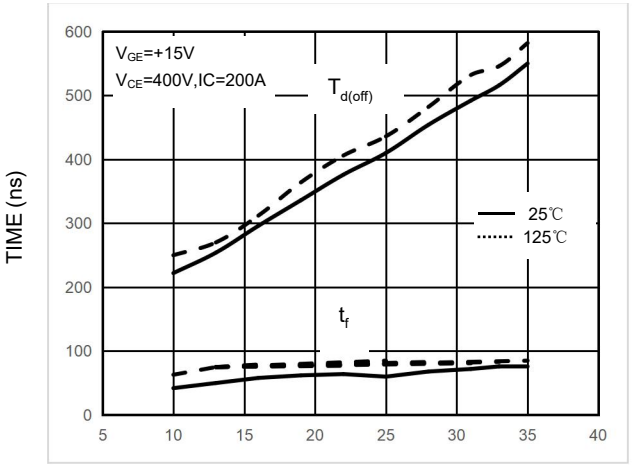


Figure 29.Typical Reverse Recovery Time vs. IC

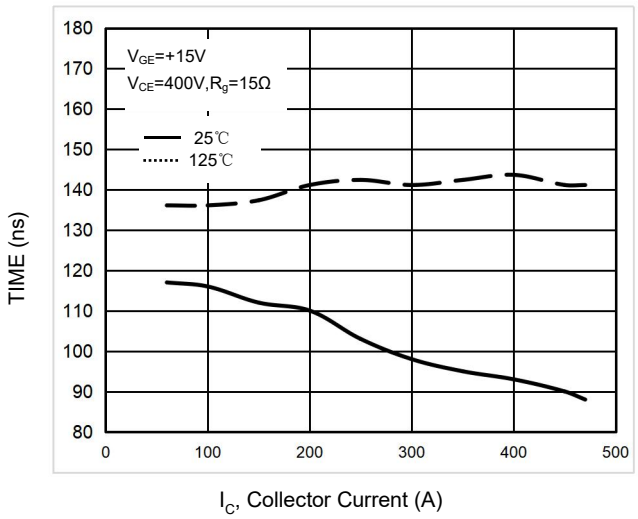
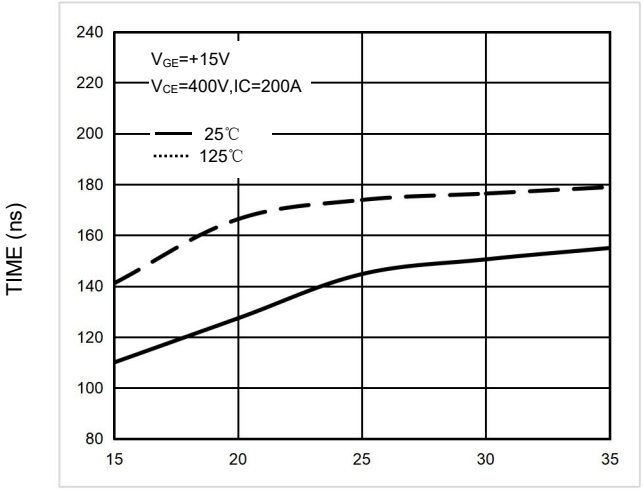


Figure 30.Typical Reverse Recovery Time vs. R_G



TYPICAL CHARACTERISTICS - T2/T3 COMUTATES D1,D4 DIODE

Figure 31.Typical Switching Loss Eon vs. IC

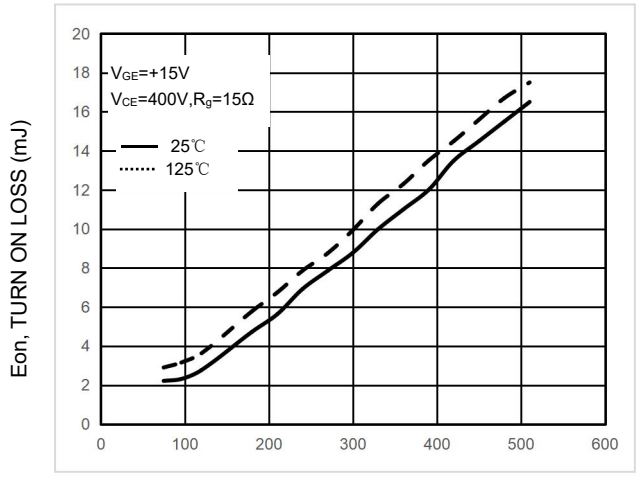


Figure 32.Typical Switching Loss Eoff vs. IC

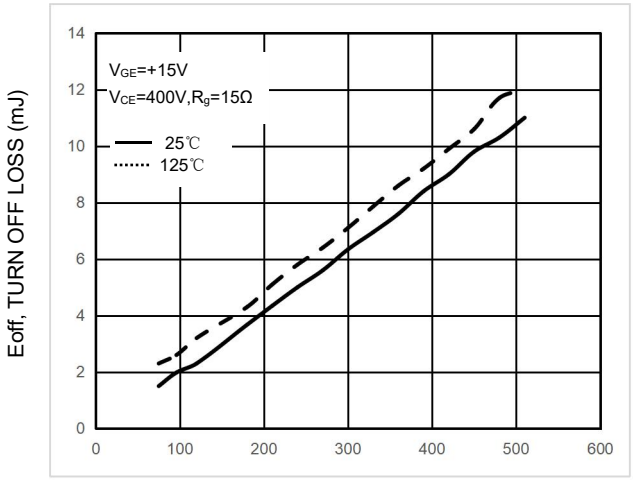


Figure 33.Typical Switching Loss Eon vs. R_G

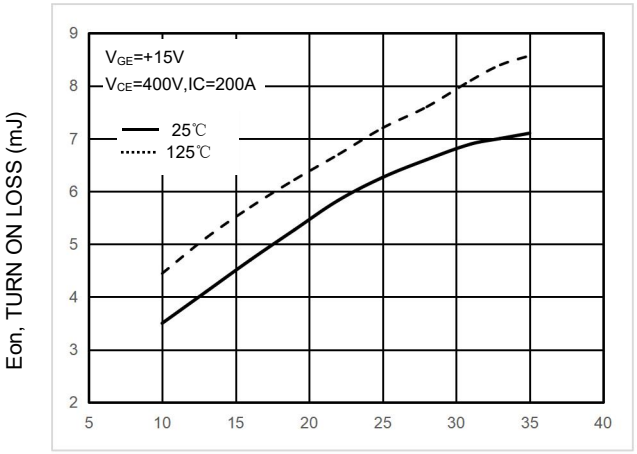


Figure 34.Typical Switching Loss Eoff vs. R_G

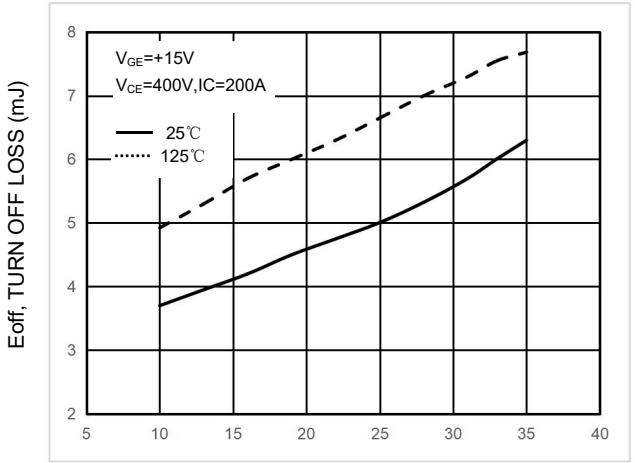


Figure 35.Typical Switching Time Tdon vs. IC

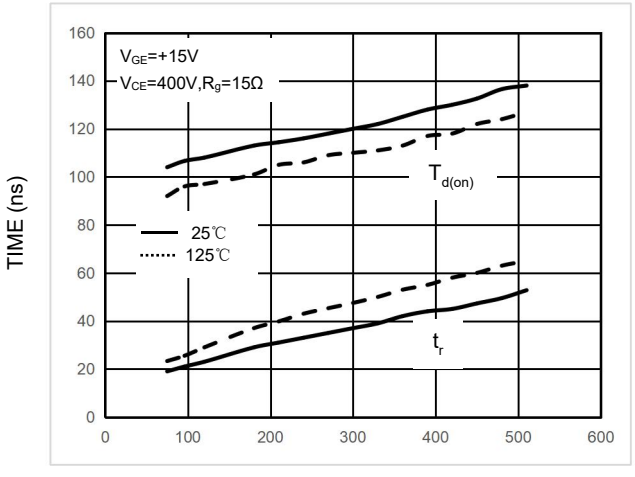
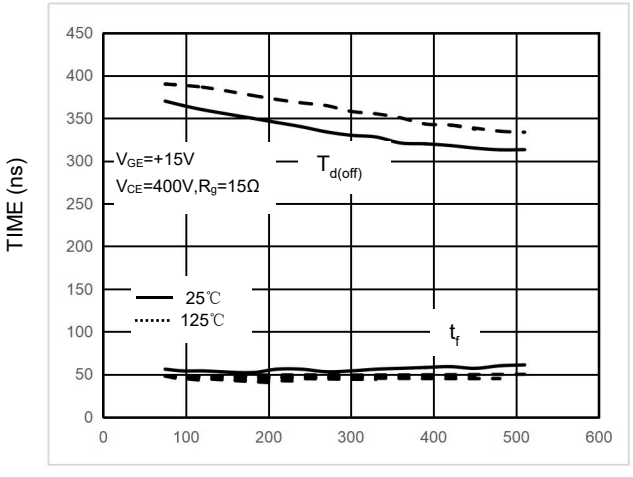


Figure 36.Typical Switching Time Tdoff vs. IC



TYPICAL CHARACTERISTICS - T2/T3 COMUTATES D1,D4 DIODE

Figure 37.Typical Switching Time Tdon vs. R_G

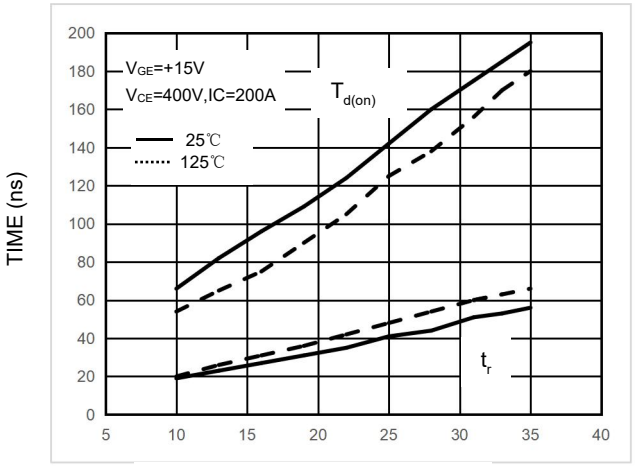


Figure 38.Typical Switching Time Tdoff vs. R_G

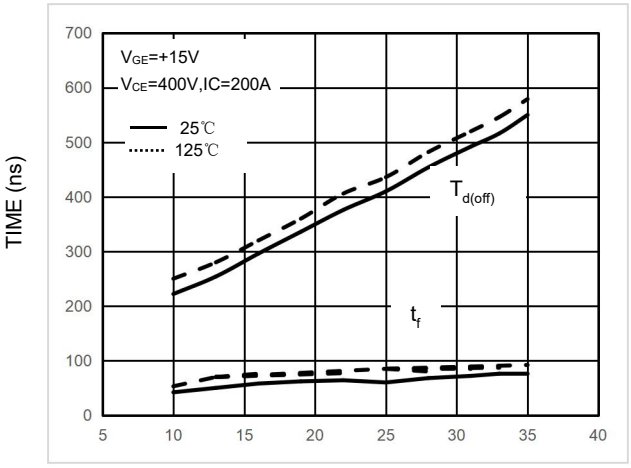


Figure 39.Typical Reverse Recovery Time vs. IC

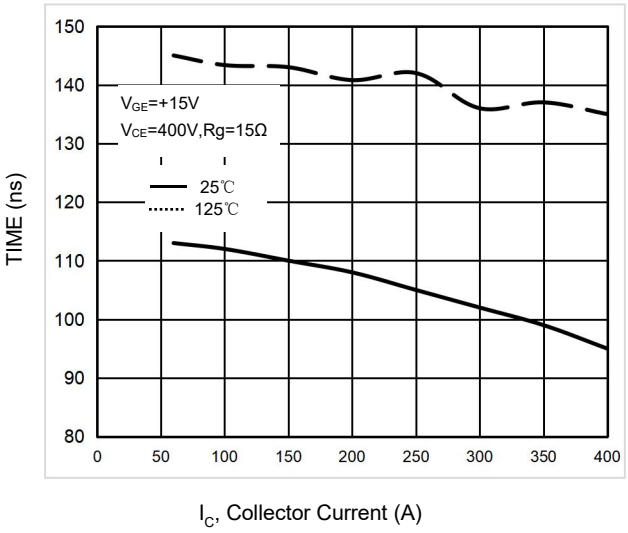
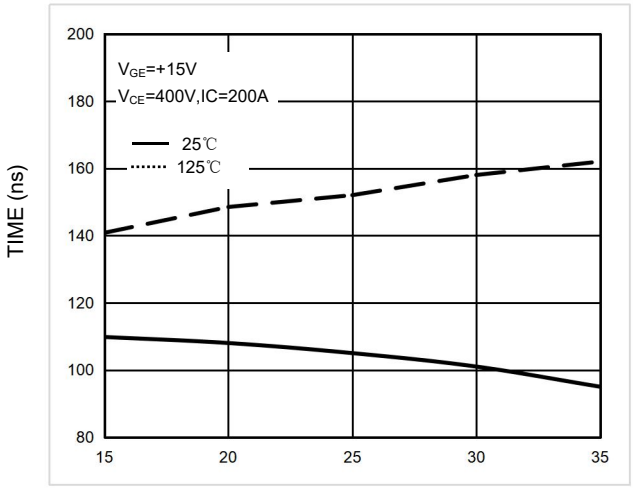
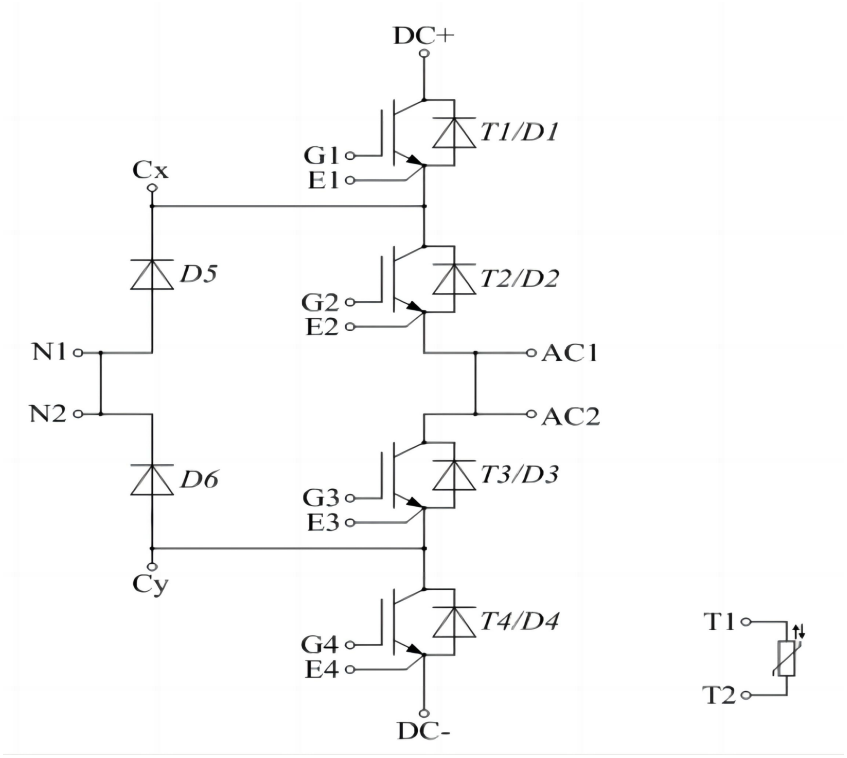


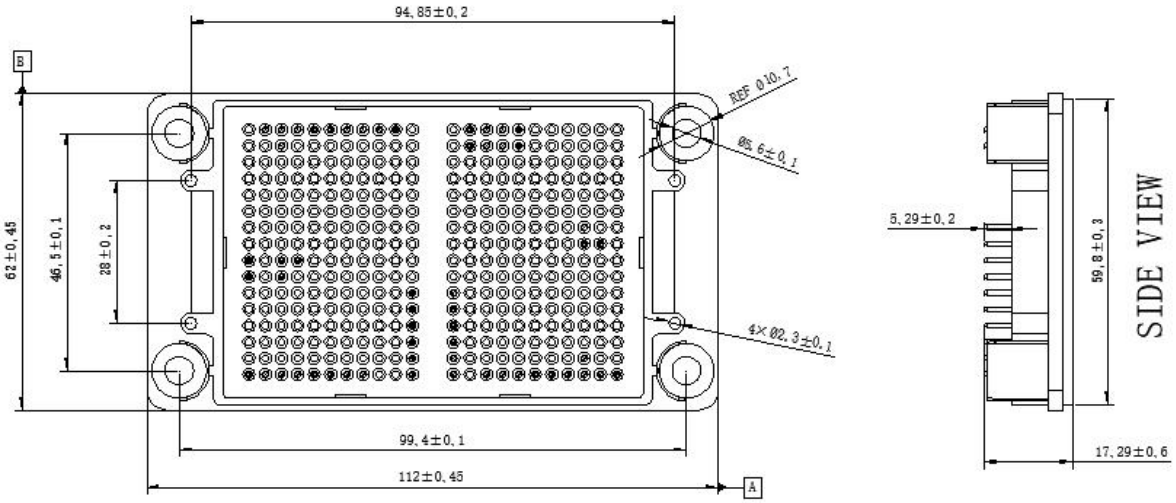
Figure 40.Typical Reverse Recovery Time vs. R_G



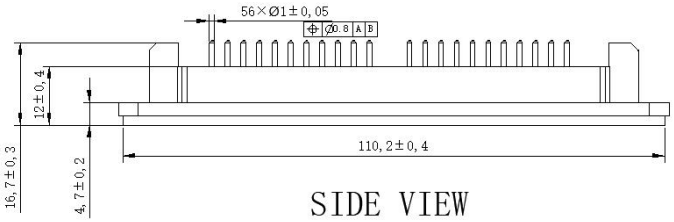
CIRCUIT DIAGRAM



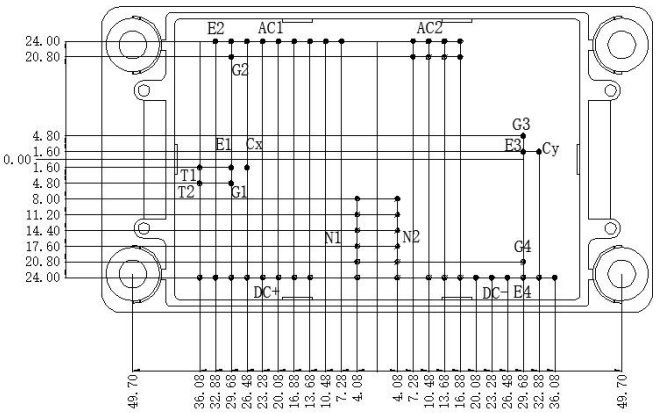
PACKAGE DIMENSIONS



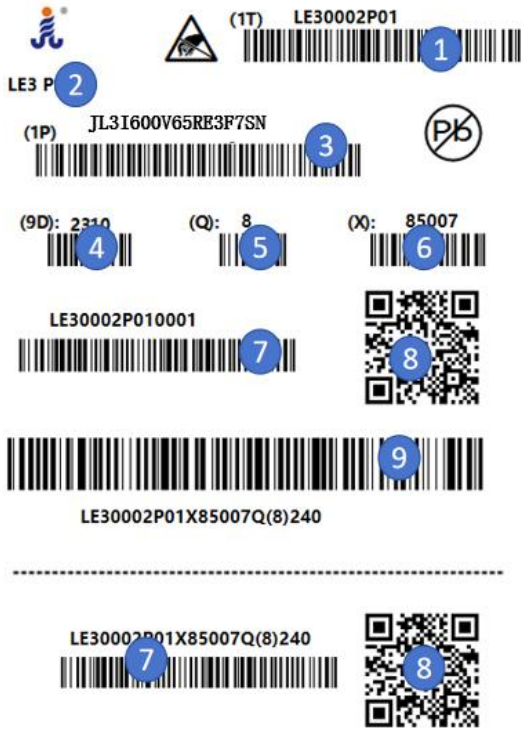
TOP VIEW



SIDE VIEW



MODULE LABEL CODE



1.Lot ID

2.Package

3.Device

4.Date code

5.Quantity per box

6.Product ID

7.Label serial number

8.MES and SAP connection code

9.Lot ID+Product ID+Quantity/box+Total lot Quantity

REVISION HISTORY

Document version	Date of release	Description of changes
Rev.00	2023-12-13	Preview

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