

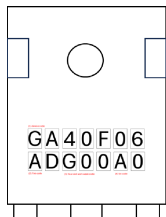
Product Summary

VCE	VGE	VCE(sat) TYP/MAX		IC at Tc=100°C
650V	± 20V	1.5V/1.88V	IC=40A, VGE=15V	40A

Package: TO-247-3L

Marking Symbol Code

- ❖ Laser Marking Device Code: GA40F06



G : Gostone (fixed)
A : Discrete
40 : Current rating at 100°C
F : Structure: Field stop
06 : Voltage rating: 650V
AD : Fab Code
G00 : Year and Work week Code
A0 : LOT Code

Form

- ❖ Tube: 50pcs / tube

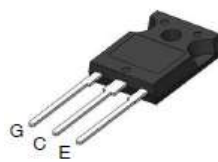
Features

- ❖ Low Conduction Loss and Optimized Switching
- ❖ Maximum Junction Temperature Tj = 175°C
- ❖ Short Circuit Rated
- ❖ Easy Parallel Operation
- ❖ Halogen-Free / RoHS Compliant

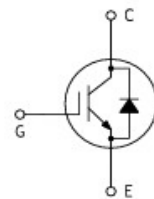
Application

- ❖ Motor Control, UPS, Solar inverters
General Application Requiring High Power Switch

PIN Connections



G: Gate
C: Collector
E: Emitter



Built-in FRD

Absolute Maximum Rating Ta=25°C

Parameter	Symbol	Rating	Unit
Collector to Emitter Voltage	Tj> 25°C VCES	650	V
Gate to Emitter Voltage	VGES	±20	V
Collector Current	DC Tc=25°C	78	A
	DC Tc=100°C	48	A
	Pulse	ICP*1	A
Diode forward current	DC Tc=25°C	75	A
	DC Tc=100°C	40	A
	Pulse	IFP*1	A
Short circuit withstand time	VCC<400V, Tj=150°C	tsc	5 us
Power Dissipation	Tc=25°C	PD	230 W
	Tc=100°C		115 W
Operating junction Temperature	Tj	-40 to +175	°C
Storage Temperature	Tstg	-55 to +150	°C

Note *1 Pulse time limited by Tjmax

Thermal Characteristics Ta = 25°C

Parameter	Symbol	Rating	Unit
Thermal Resistance			
Junction to Ambient	Rth(j-a)	40	°C/W
Junction to Case-IGBT	Rth(j-c)	0.63	°C/W
Junction to Case-Diode	Rth(j-c)	1.2	°C/W

ORDERING INFORMATION

VCE	IC at Tc=100°C	Device Marking	Ordering Codes	Package	Packing
650V	40A	GA40F06	GA40F06K1BW	TO-247-3L	Tube

Electrical Characteristics of IGBT (Ta=25degC +/- 3degC)

Static Characteristics

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Collector-Emitter Breakdown Voltage	VCES	IC=250uA, VGE=0V	650			V
Zero Gate Voltage Collector Current	ICES	VCE=650V, VGE=0V			20	uA
Gate-Emitter Leakage Current, forward	IGES(F)	VGE=+20V, VCE=0V			100	nA
Gate-Emitter Leakage Current, reverse	IGES(R)	VGE=-20V, VCE=0V			-100	nA
Gate-Emitter Threshold Voltage	VGE(th)	VCE=VGE, IC=1mA	4.3	5	5.7	V
Collector-Emitter threshold voltage	VCE(sat)	IC=40A, VGE=15V Tj=25°C Tj=125°C Tj=175°C		1.5	1.88	V
				1.75		
				1.85		
Transconductance	gFS	IC=40A, VCE=20V		20		S

Dynamic Characteristics *1

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Input Capacitance	Cies	VCE=25V, VGE=0V, f=1000kHz		2110		pF
Output Capacitance	Coes			110		
Reverse Transfer Capacitance	Cres			36		
Total Gate Charge	Qg	VCC=520V, VGE=15V, IC=40A		190		nC
Short-Circuit Collector Current	Isc	VCC<=400V, VGE=15V, tsc<=3us, Tj=150°C		170		A

IGBT Switching Characteristics *1 *2

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Turn-On Delay Time	td(on)	VCC=400V, VGE=0 to 15V, RG=10Ω, IC=40A, Inductive Load, Tj=25°C		40		ns
Rise Time	tr			80		
Turn-Off Delay Time	td(off)			280		ns
Fall Time	tf			43		
Turn-On Energy	Eon	VCC=400V, VGE=0 to 15V, RG=10Ω, IC=40A, Inductive Load, Tj=25°C		1.75		mJ
Turn-Off Energy	Eoff			1.05		
Turn-On Delay Time	td(on)	VCC=400V, VGE=0 to 15V, RG=10Ω, IC=40A, Inductive Load, Tj=175°C		40		ns
Rise Time	tr			80		
Turn-Off Delay Time	td(off)			322		ns
Fall Time	tf			43		
Turn-On Energy	Eon	VCC=400V, VGE=0 to 15V, RG=10Ω, IC=40A, Inductive Load, Tj=175°C		1.87		mJ
Turn-Off Energy	Eoff			1.30		

Electrical Characteristics of Diode (Ta=25degC +/- 3degC)

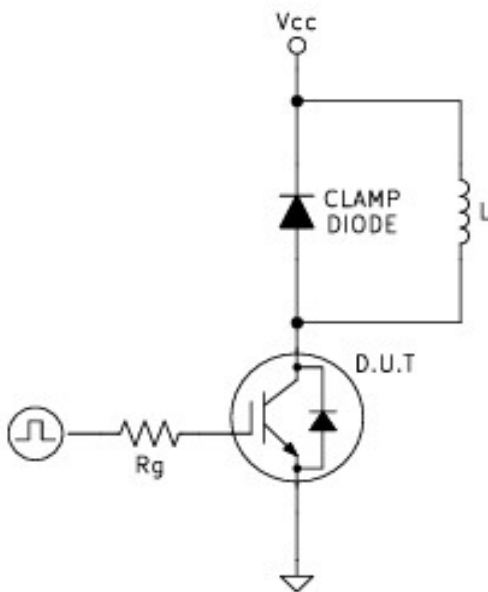
Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Diode Forward Voltage	VF	IF=40A		1.75	2.2	V
Diode Reverse Recovery Time *1*2	trr	VCC=400V, IF=40A, diF/dt=-500A/us, Tj=25°C		66		ns
Diode Peak reverse Recovery Current *1*2	Irrm			14		A
Diode Reverse Recovery Charge *1*2	Qrr			0.50		uC
Diode Reverse Recovery Time *1*2	trr	VCC=400V, IF=40A, diF/dt=-500A/us, Tj=175°C		150		ns
Diode Peak reverse Recovery Current *1*2	Irrm			24		A
Diode Reverse Recovery Charge *1*2	Qrr			2.14		uC

Note *1 Guaranteed by Design

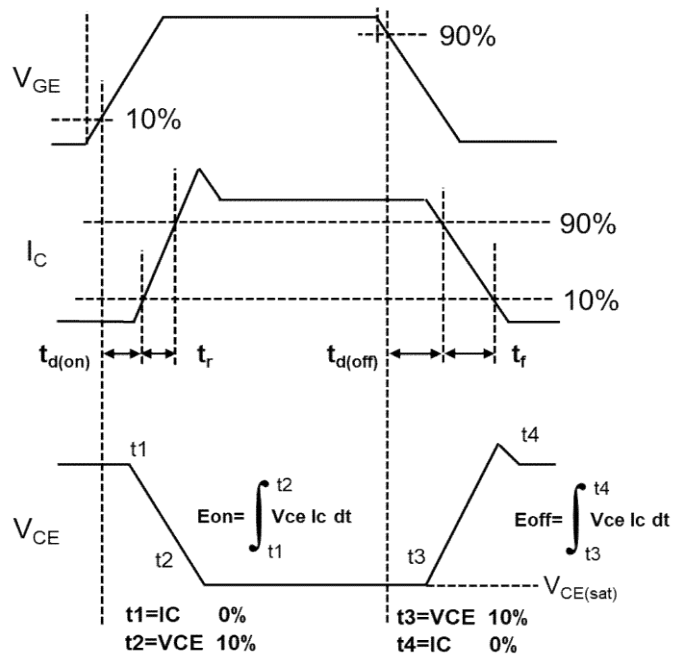
Note *2 Measurement Circuit for Switching Characteristics

Measurement Circuit for Switching Characteristics

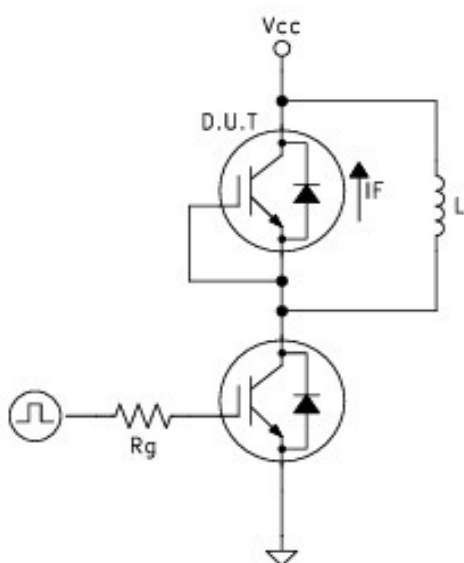
Switching Test Circuit



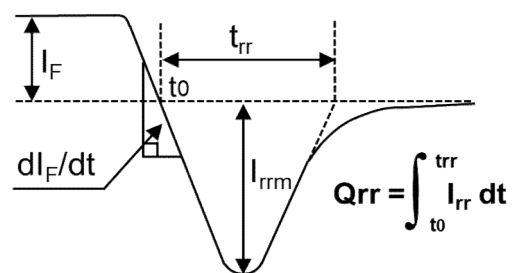
Definition of IGBT Switching Characteristics

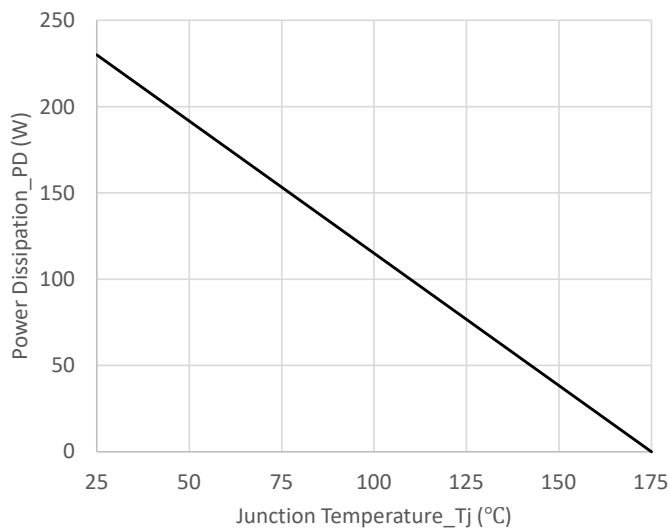
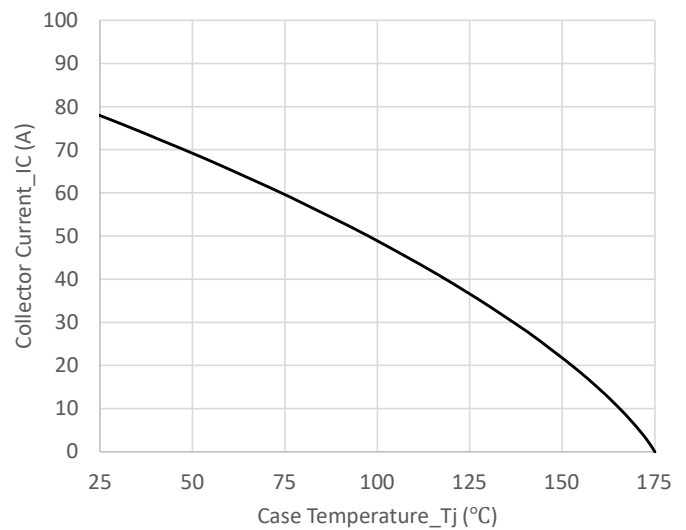
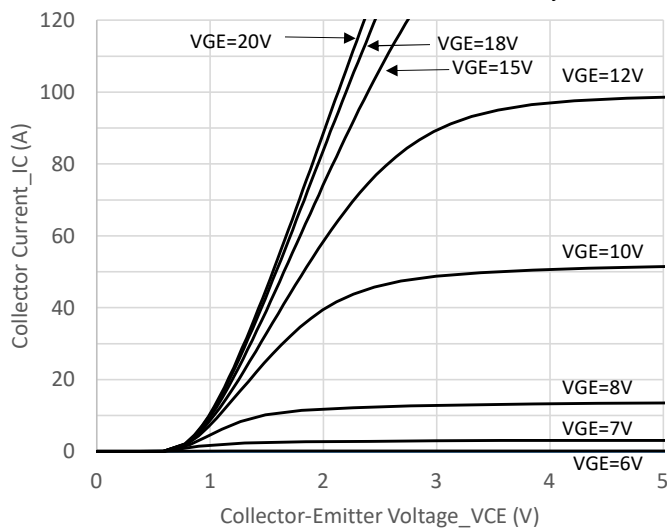
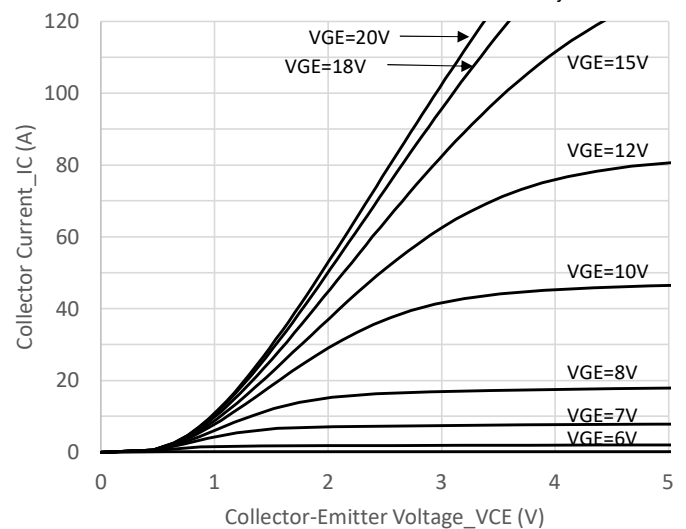
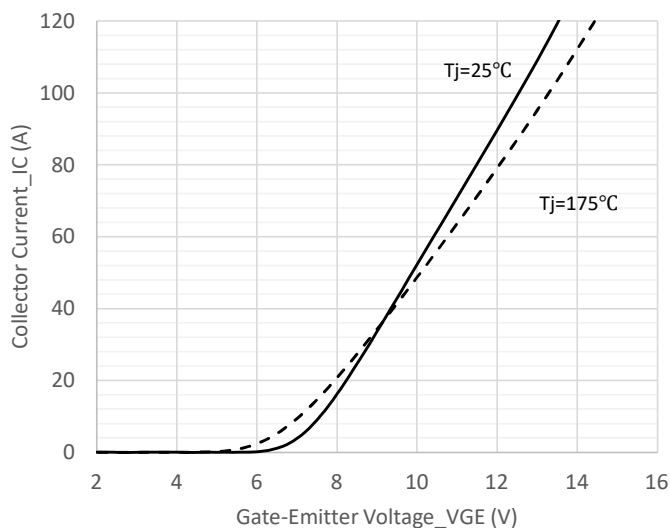
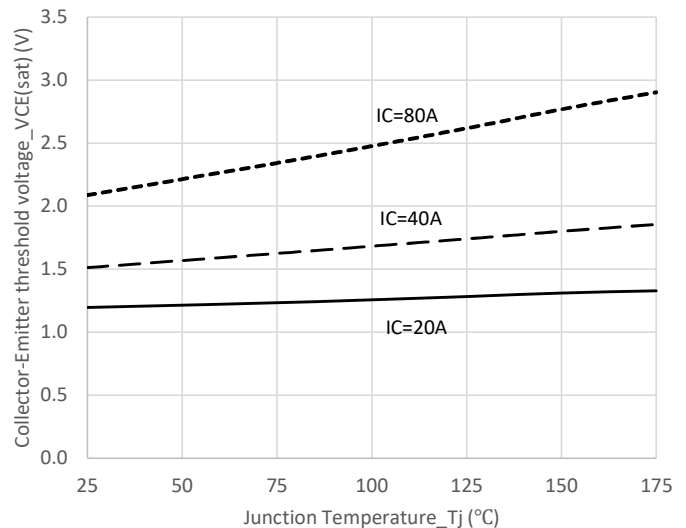


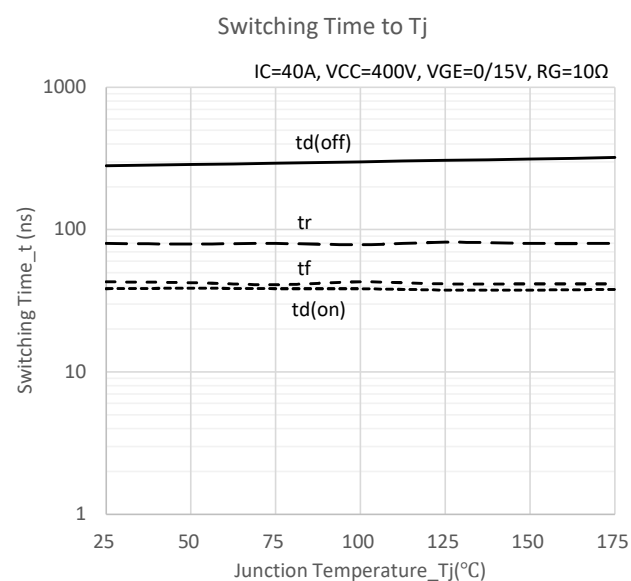
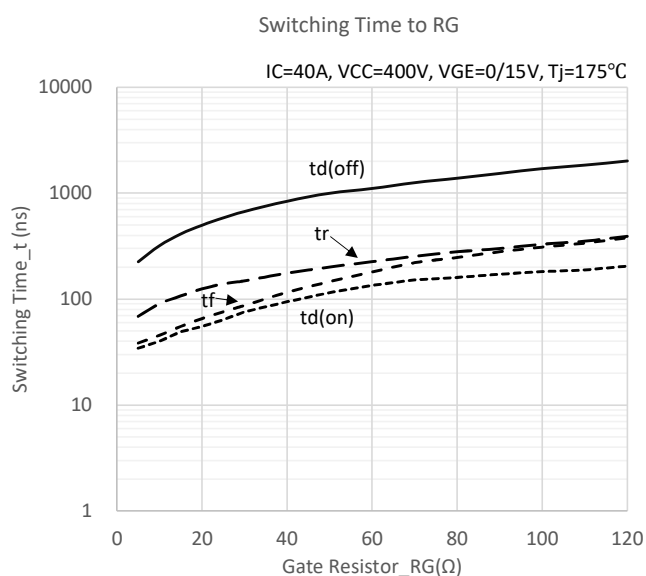
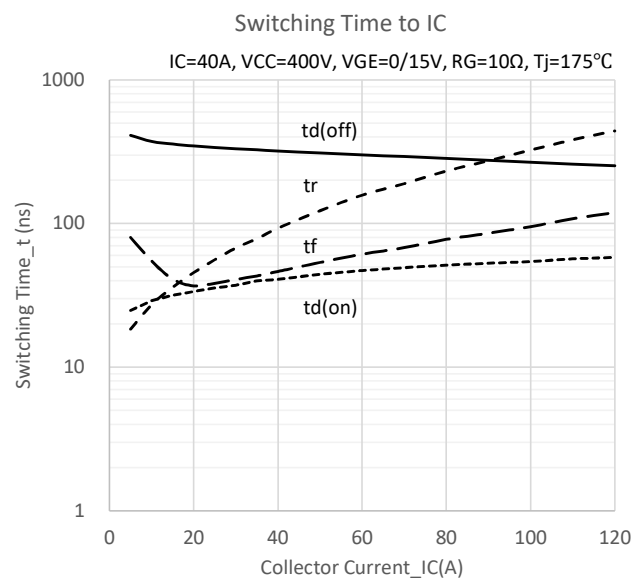
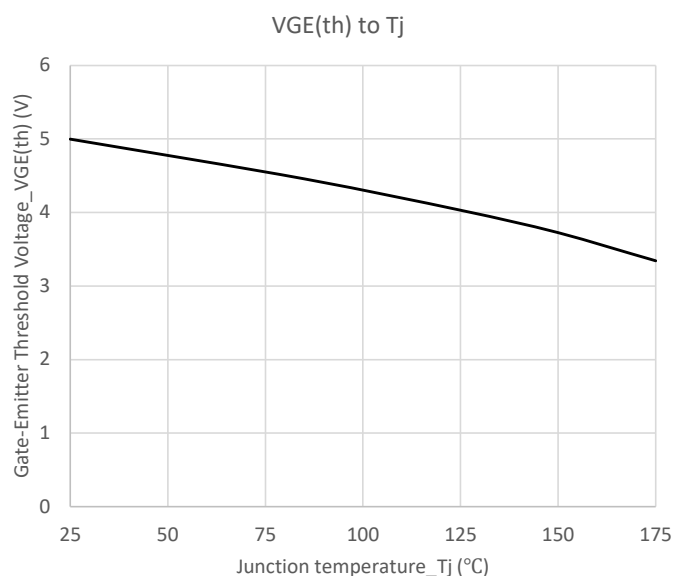
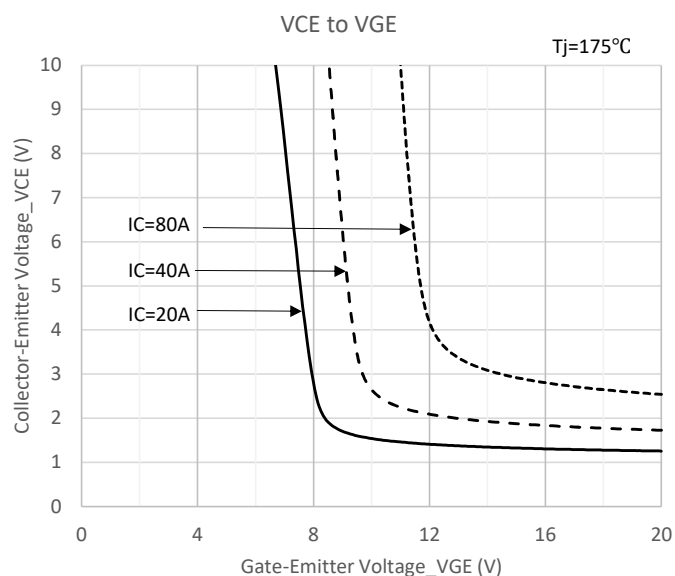
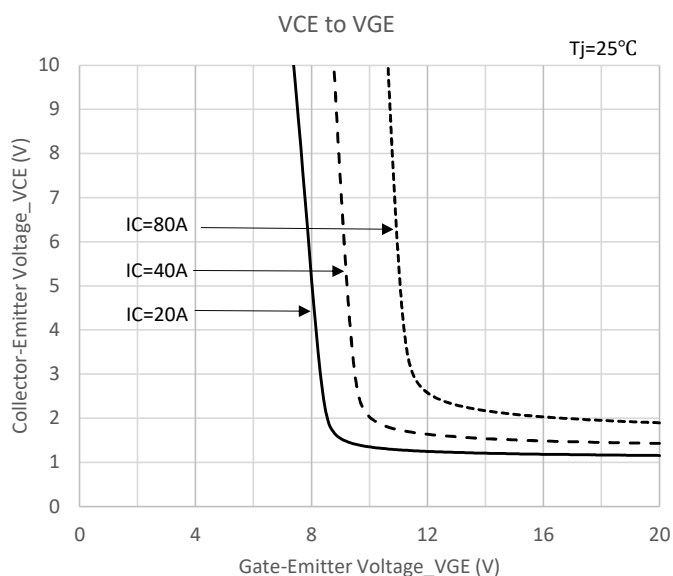
Diode Reverse Recovery Time Test Circuit

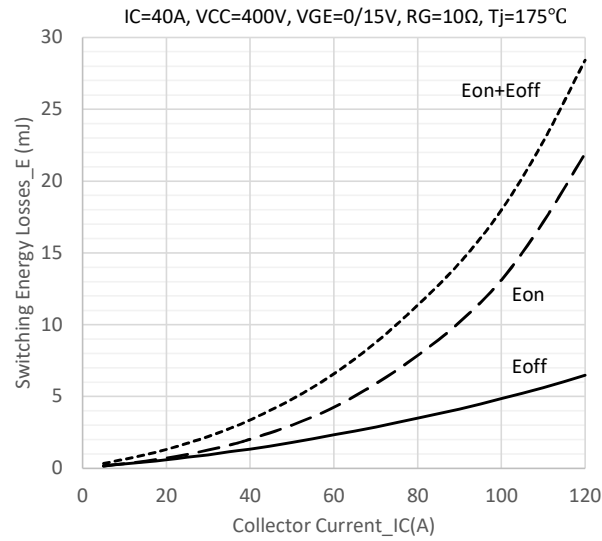
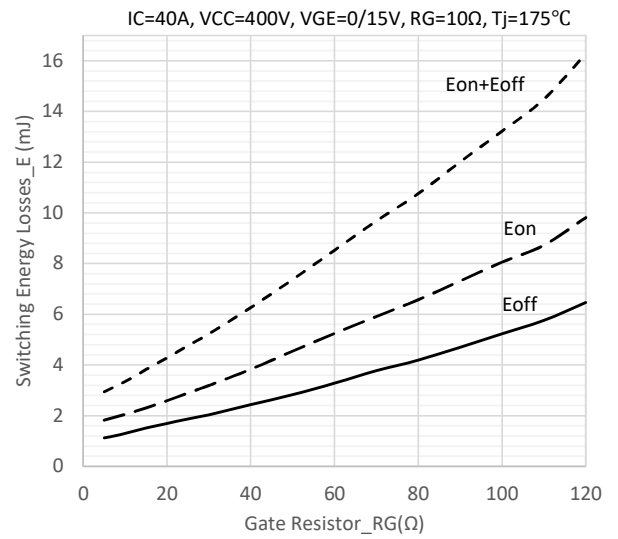
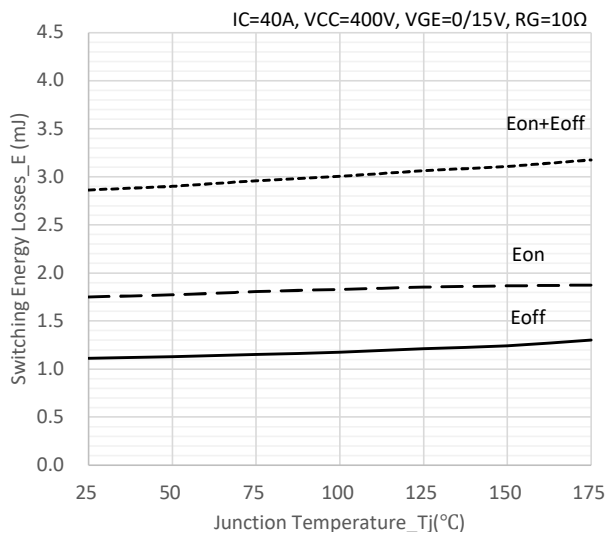
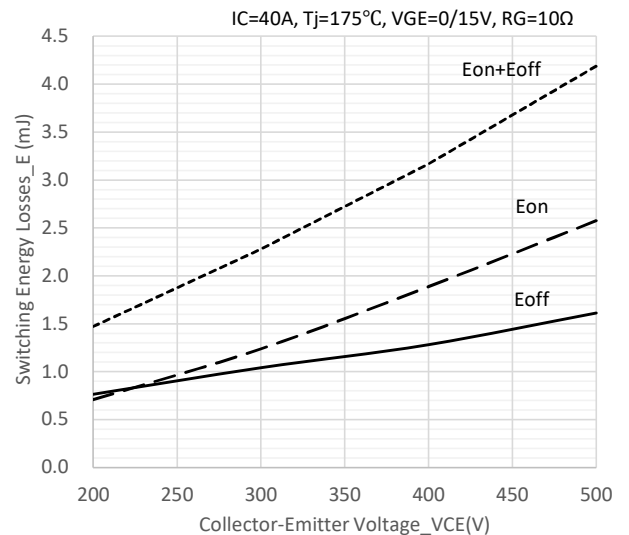
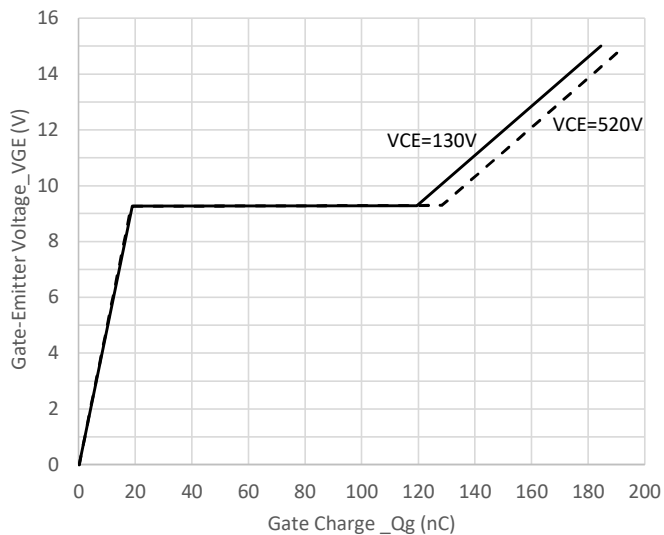
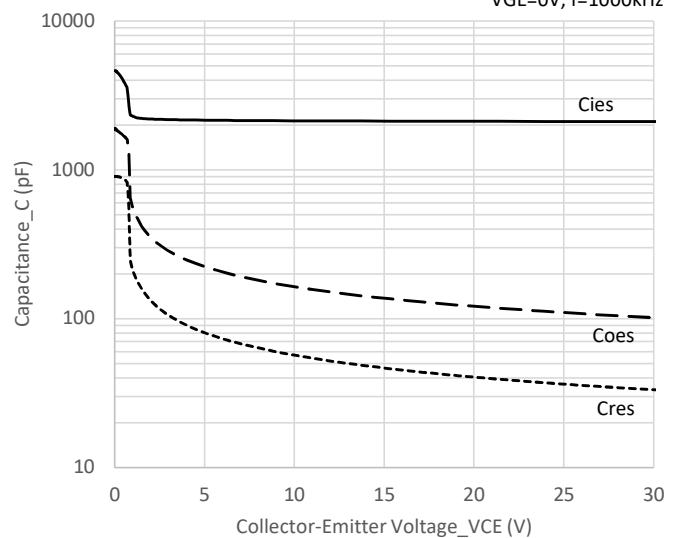


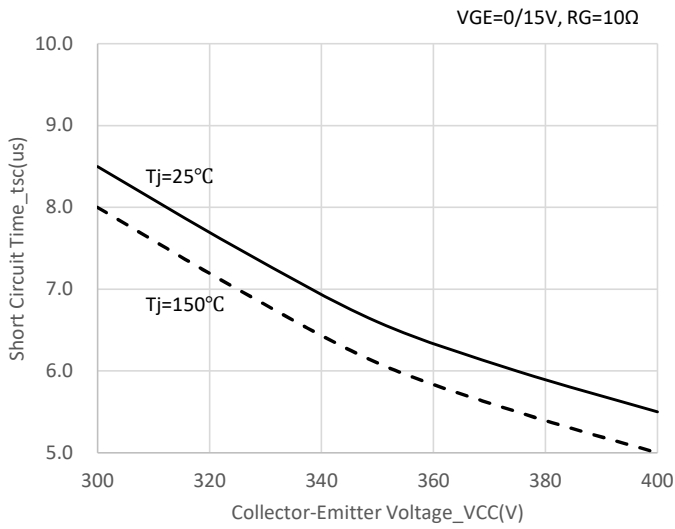
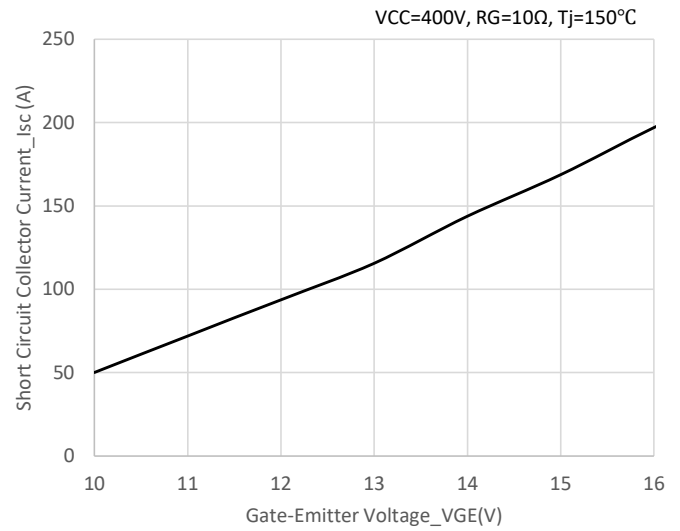
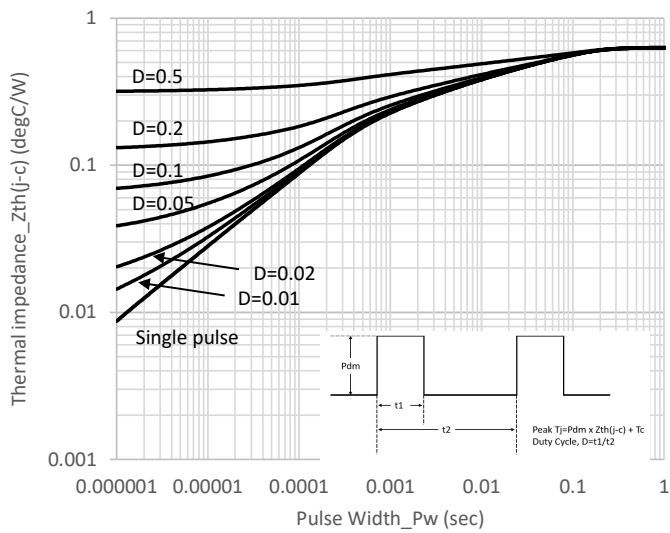
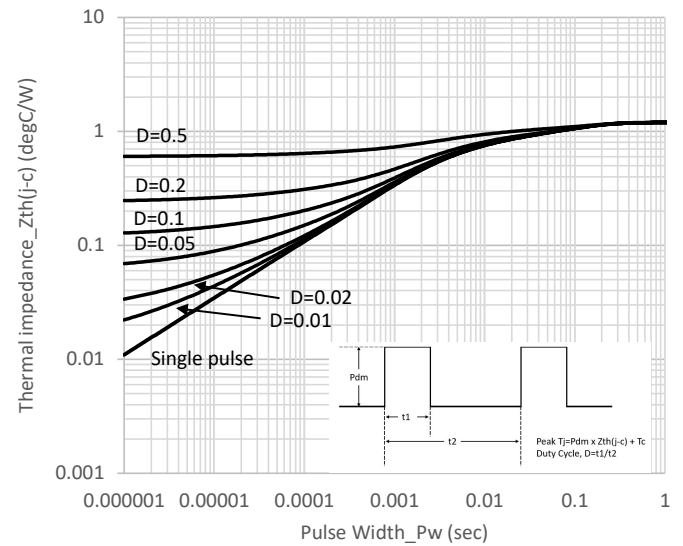
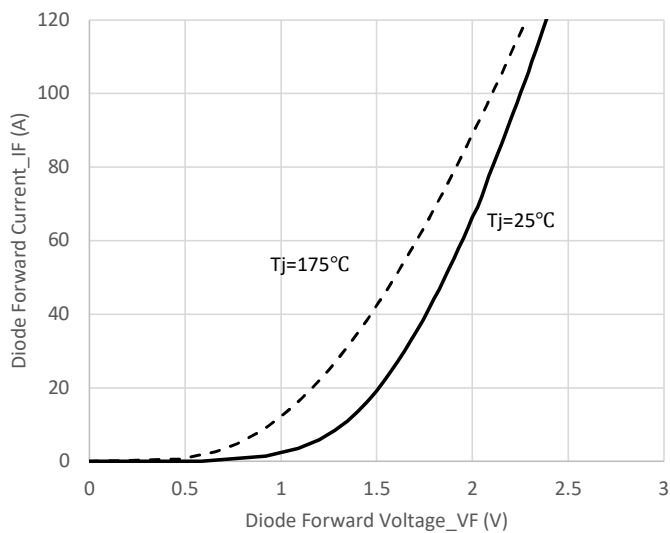
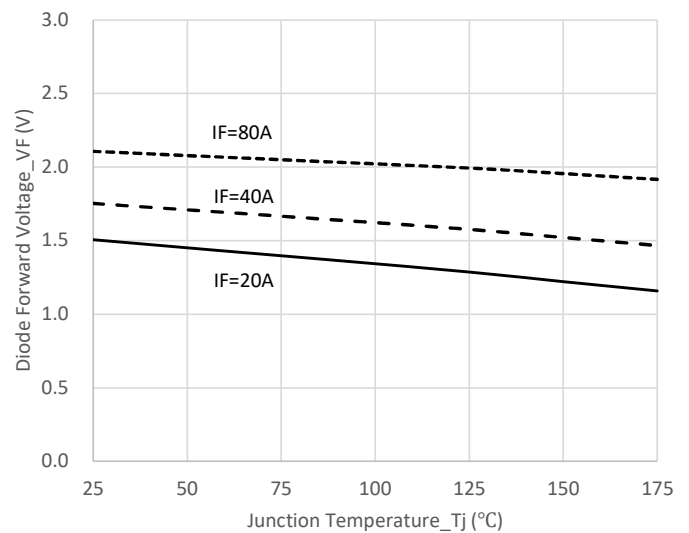
Definition of Diode Switching Characteristics

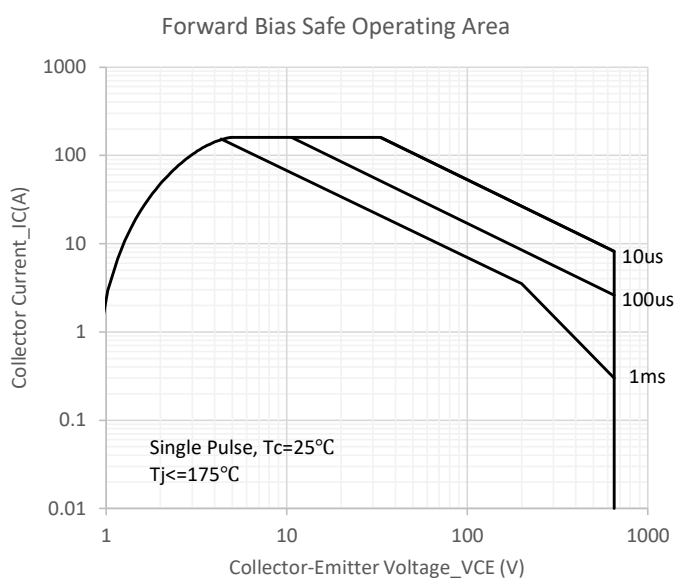
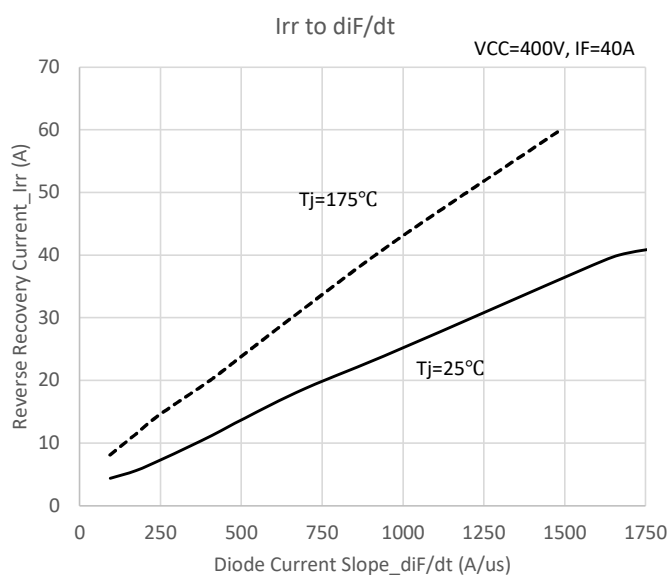
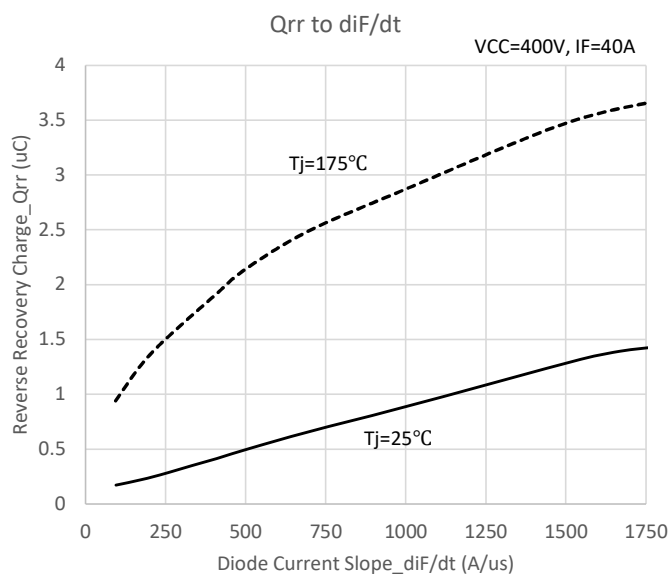
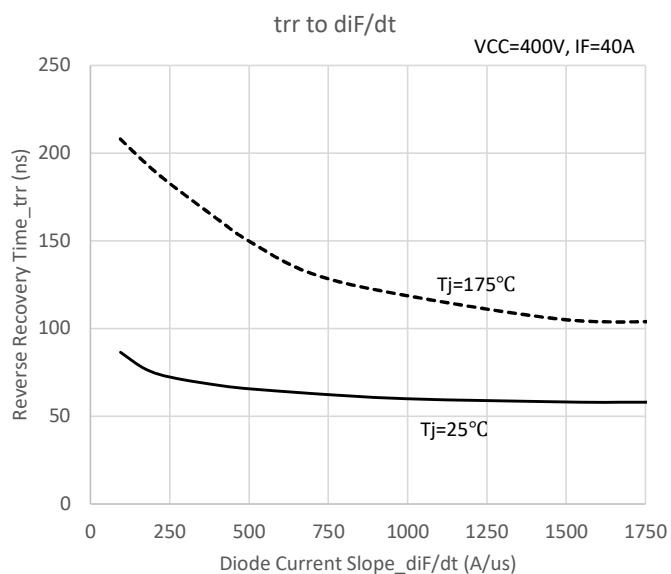


Technical data
PD to Tj

IC to Tj

IC to VCE
Tj=25°C

IC to VCE
Tj=175°C

IC to VGE

VCE(sat) to Tj


Technical data


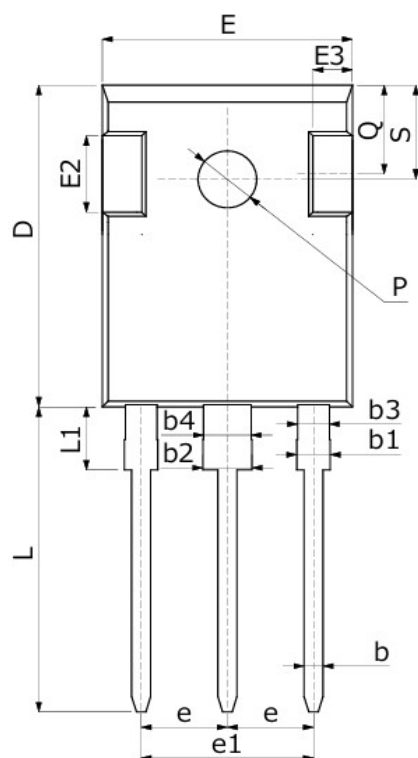
Technical data
E-Losses to IC

E-Losses to RG

E-Losses to Tj

E-Losses to VCE

Gate Charge

Capacitance to VCE


Technical data
tsc to VCC

Isc to VGE

Transient thermal impedance for IGBT

Transient thermal impedance for Diode

IF to VF

VF to Tj


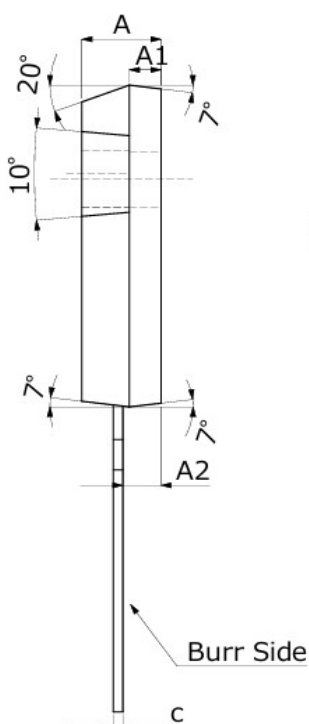
Technical data


Package Drawing TO-247-3L

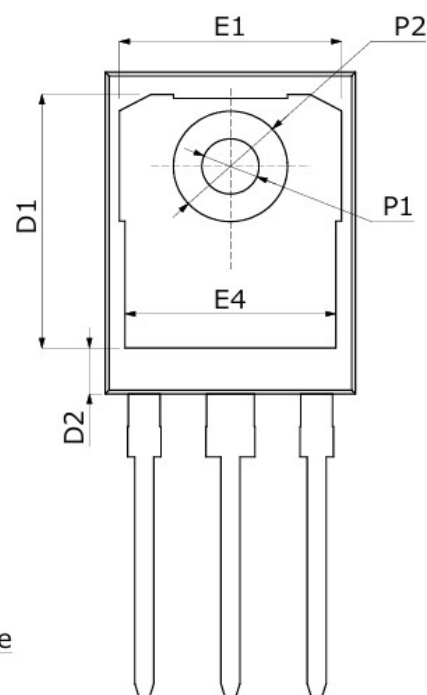
Top View



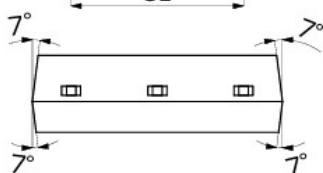
Side View



Bottom View



Side View



Symbol	Dimensions In Millimeters		
	MIN	NOM	MAX
A	4.850	5.000	5.150
A1	1.900	2.000	2.100
A2	2.260	2.410	2.560
b	1.150	1.200	1.300
b1	2.000	2.100	2.200
b2	3.000	3.100	3.200
b3	1.950	2.000	2.100
b4	2.800	3.000	3.200
c	0.500	0.600	0.700
D	20.800	21.000	21.200
D1	16.350	16.550	16.750
D2	2.800	3.000	3.200
E	15.650	15.800	15.950
E1	13.820	14.020	14.220
E2	4.850	5.000	5.150
E3	2.350	2.500	2.650
E4	13.110	13.310	13.510
e	5.390	5.440	5.490
e1	10.780	10.880	10.980
L	19.710	19.910	20.110
L1	4.020	4.120	4.220
P	3.600	3.700	3.800
P1	3.450	3.600	3.750
P2	7.000	7.200	7.400
Q	5.650	5.800	5.950
S	6.000	6.150	6.300

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