PAK30F120F

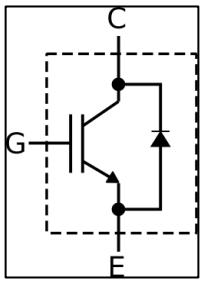
30A / 1200V Trench-Gate IGTO
IGBT Drop-in Upgrade

Features

- Pakal's Proprietary Trench IGTO Technology
- Integrated SuperBallast™ Technology
  - Safe, Simple Paralleling
- Very Low $V_{CE,SAT}$
- Excellent E_{TS}
- Square Turn-Off SOA at >3x Rated Current

30A / 1200V IGTO

V_{CEsat} = 1.37V @ T_J=25°C



Applications

- Uninterruptible Power Supplies (UPS)
- Welding Equipment
- Inverters
- Power Factor Correction (PFC)

Product Summary

Current (A)	Voltage (V)	V_{CEsat} (V)	Package
30	1200	1.37	TO-247

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Absolute Maximum Ratings

Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability; operation at conditions that exceed 80% of the absolute maximum rating conditions is not recommended. T_A = 25°C, unless otherwise specified.

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Collector-Emitter Voltage	V_{CE}				1200	V
DC Collector Current (Note 1)	$I_{C,DC}$	T_J = 25°C T_J = 100°C			120 TBD	A
Pulsed Collector Current (Note 1)	$I_{C,P}$				120	A
Diode Forward Current (Note 1)	$I_{D,DC}$	T_J = 25°C T_J = 100°C			90 30	A
Diode Pulsed Current (Note 1)	$I_{D,P}$				TBD	A
Turn-off Safe Operating Area		$V_{CE} \leq$ 650V, $T_J \leq$ 150°C, t_p = 1µs			90	A
Gate-Emitter Voltage	V_{GE}	DC Transient ($t_p \leq$ 10µs, D<0.010)	-20 -30		20 30	V
Power Dissipation	P_{MAX}	T_J = 25°C T_J = 100°C			TBD TBD	W
Operating Junction Temperature	T_J		-40		175	°C
Storage Temperature	T_{STG}		-55		150	°C

Note 1: Limited by $T_{J,MAX}$.

Thermal Resistance

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
IGTO, Junction-Case	$R_{TH(JC)}$				0.65	K/W
Diode, Junction-Case	$R_{TH(JC)}$				0.80	K/W

Electrical Specifications

Static Characteristics

T_A = 25°C, unless otherwise specified. Items in **Bold** are production tested, other specifications are guaranteed by characterization.

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Collector-Emitter Breakdown Voltage	$V_{CE,BR}$	V_{GE}=0, I_C=**250 µA**		1200			V
Collector-Emitter Saturation Voltage	$V_{CE,SAT}$	V_{GE}=15 V	I_C=15 A		1.23		V
			I_C=30 A		1.37	**1.80**	V
			T_j=175°C, I_C=30 A		1.56		V
Diode Forward Voltage	V_F	V_{GE}=0 V	I_F=2 A		0.98		V
			I_F=30 A		1.62		V
			T_j=175°C, I_F=30 A		1.34		V
Gate-Emitter Voltage Threshold	V_{TH}	I_C=30 mA, V_{CE}=20 V		2.7	3.5	4.4	V
Collector Leakage Current	I_{CES}	V_{CE}=1200 V	T_j=25°C		0.1	40	µA
		V_{GE}=0 V	T_j=175°C		2600		µA
Gate-Emitter Leakage Current	I_{GES}	V_{CE}=0 V, V_{GE}=20 V			0.1	100	nA

Dynamic Characteristics

T_A = 25°C, unless otherwise specified. Items in **Bold** are production tested, other specifications are guaranteed by characterization.

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Input Capacitance	C_{IES}	V_{GE}=0 V, V_{CE}=25 V, f=1 MHz		5037		pF
Output Capacitance	C_{OES}	V_{GE}=0 V, V_{CE}=25 V, f=1 MHz		135		pF
Reverse Transfer Capacitance	C_{RES}	V_{GE}=0 V, V_{CE}=25 V, f=1 MHz		31		pF
Gate Charge	Q_G	V_{CC}=600 V, I_C=30 A, V_{GE}=15 V		235		nC

Switching Characteristics

T_A = 25°C, unless otherwise specified. Items in **Bold** are production tested, other specifications are guaranteed by characterization.

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Turn-on Delay Time	$t_{d,on}$	T_J=25°C	I_C=30 A, V_{CC}=600 V, V_{GE}=15 V/0V, R_G=10 Ω, (Note 1)		42		ns
Rise Time	t_r				20		ns
Turn-off Delay Time	$t_{d,off}$				271		ns
Fall time	t_f				368		ns
Turn-on Energy	E_{ON}				1320		µJ
Turn-off Energy	E_{OFF}				3030		µJ
Total Switching Energy	E_{TS}				4350		µJ
Turn-on Delay Time	$t_{d,on}$	T_J=25°C	I_C=15 A, V_{CC}=600 V, V_{GE}=15 V/0V, R_G=10 Ω (Note 1)		39		ns
Rise Time	t_r				17		ns
Turn-off Delay Time	$t_{d,off}$				301		ns
Fall time	t_f				468		ns
Turn-on Energy	E_{ON}				520		µJ
Turn-off Energy	E_{OFF}				1860		µJ
Total Switching Energy	E_{TS}				2380		µJ

Note 1: Energy losses include “tail” and diode reverse recovery.

Diode Characteristics, at T_J = 25 °C

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Diode reverse recovery time	T_{rr}	T_J=25°C	V_R=600 V, I_F=30 A, di_F/dt=1000 A/µs		95		ns
Diode reverse recovery charge	Q_{rr}				2.5		µC
Diode peak reverse recovery current	I_{rrm}				44.8		A
Diode peak rate of fall of reverse recovery current	di_{rr}/dt				-760		A/µs
Diode reverse recovery time	t_{rr}	T_J=25°C	V_R=600 V, I_F=15 A, di_F/dt=1000 A/µs		91		ns
Diode reverse recovery charge	Q_{rr}				1.6		µC
Diode peak reverse recovery current	I_{rrm}				27.2		A
Diode peak rate of fall of reverse recovery current	di_{rr}/dt				-540		A/µs

Switching Characteristics

T_A = 25°C, unless otherwise specified. Items in **Bold** are production tested, other specifications are guaranteed by characterization.

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Turn-on Delay Time	$t_{d,on}$	T_J=175°C	I_C=30 A, V_{CC}=600 V, V_{GE}=15 V/0 V, R_G=10 Ω (Note 1)		42		ns
Rise Time	t_r				19		ns
Turn-off Delay Time	$t_{d,off}$				276		ns
Fall time	t_f				468		ns
Turn-on Energy	E_{ON}				2760		µJ
Turn-off Energy	E_{OFF}				3200		µJ
Total Switching Energy	E_{TS}				5960		µJ
Turn-on Delay Time	$t_{d,on}$	T_J=175°C	I_C=15 A, V_{CC}=600 V, V_{GE}=15 V/0V, R_G=10 Ω (Note 1)		33		ns
Rise Time	t_r				11		ns
Turn-off Delay Time	$t_{d,off}$				311		ns
Fall time	t_f				470		ns
Turn-on Energy	E_{ON}				1230		µJ
Turn-off Energy	E_{OFF}				1940		µJ
Total Switching Energy	E_{TS}				3170		µJ

Note 1: Energy losses include “tail” and diode reverse recovery.

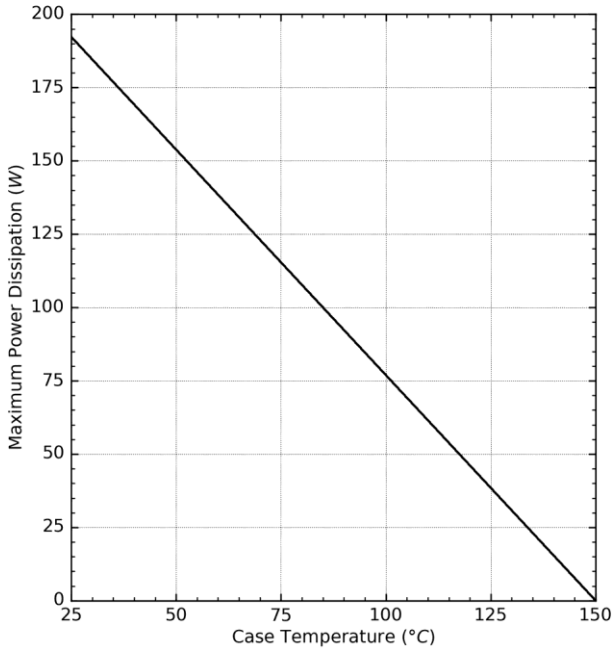
Diode Characteristics, at T_J = 175 °C

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Diode reverse recovery time	t_{rr}	T_J=175°C	V_R=600 V, I_F=30 A, di_F/dt=1000 A/µs		172		ns
Diode reverse recovery charge	Q_{rr}				6.2		µC
Diode peak reverse recovery current	I_{rrm}				71.2		A
Diode peak rate of fall of reverse recovery current	di_{rr}/dt				-615		A/µs
Diode reverse recovery time	t_{rr}	T_J=175°C	V_R=600 V, I_F=15 A, di_F/dt=1000 A/µs		**139**		ns
Diode reverse recovery charge	Q_{rr}				**4.1**		µC
Diode peak reverse recovery current	I_{rrm}				**54.4**		A
Diode peak rate of fall of reverse recovery current	di_{rr}/dt				**-750**		A/µs

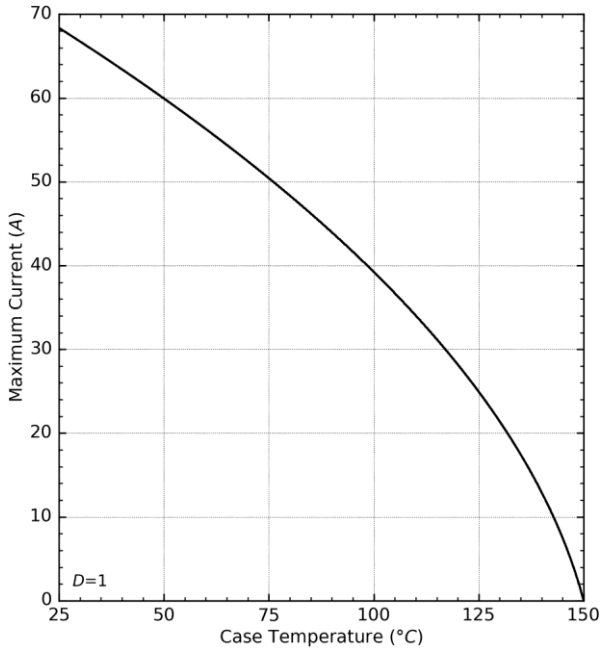
Typical Operating Characteristics

T_A = 25°C, unless otherwise specified.

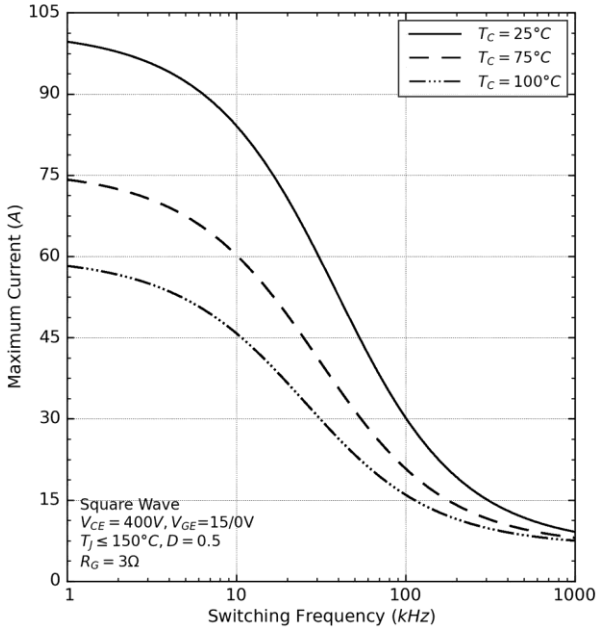
Maximum Power Dissipation



Thermally-Limited Maximum Current

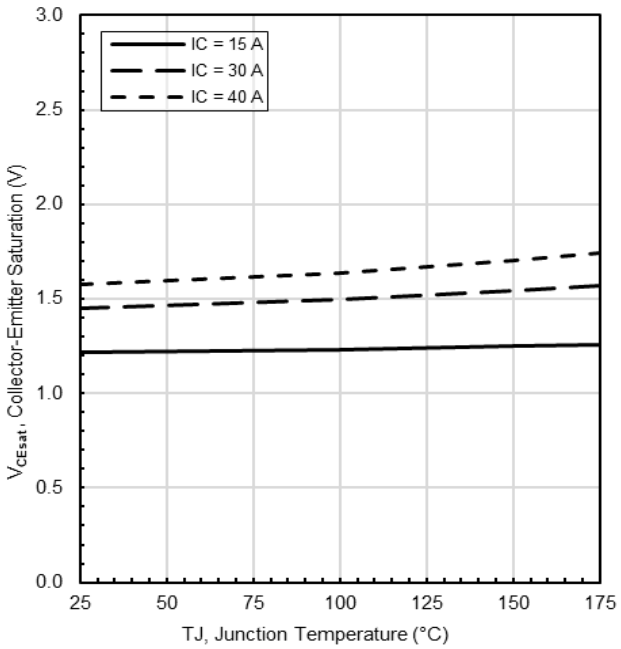


Thermally-Limited Current vs Frequency



VCEsat vs Junction Temperature

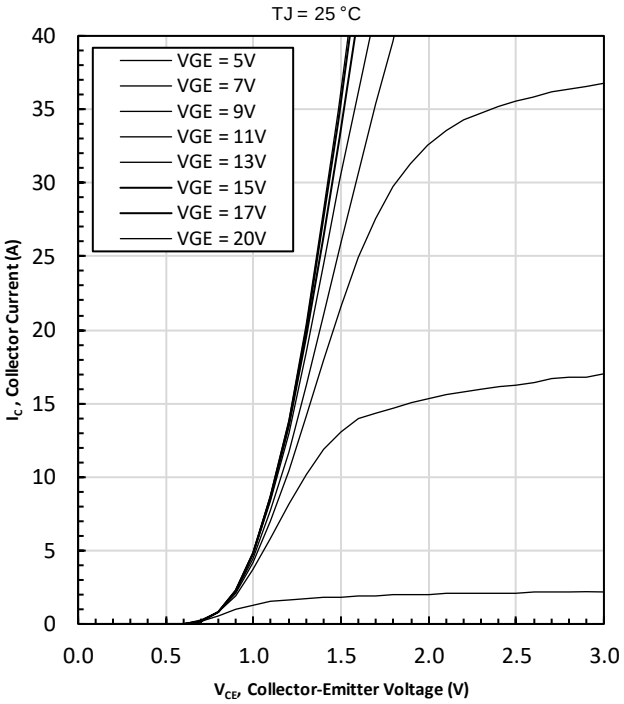
V_{GE} = 15 V



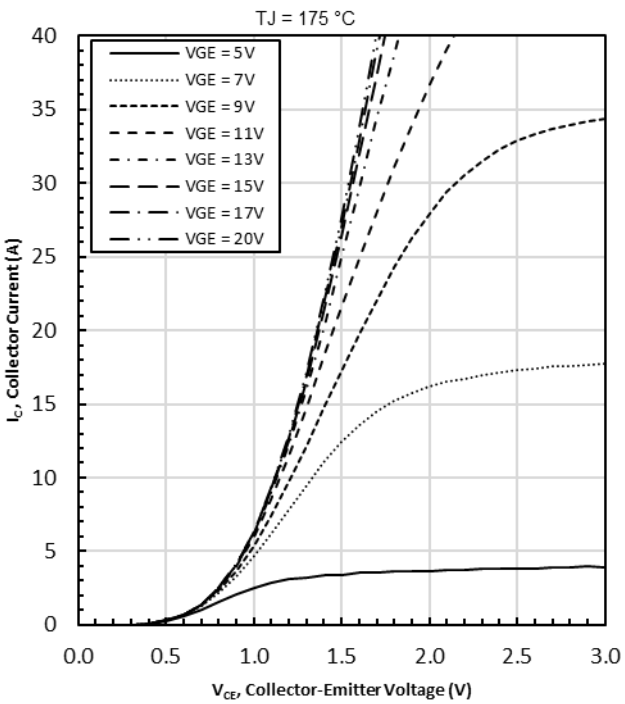
Typical Operating Characteristics

T_A = 25°C, unless otherwise specified.

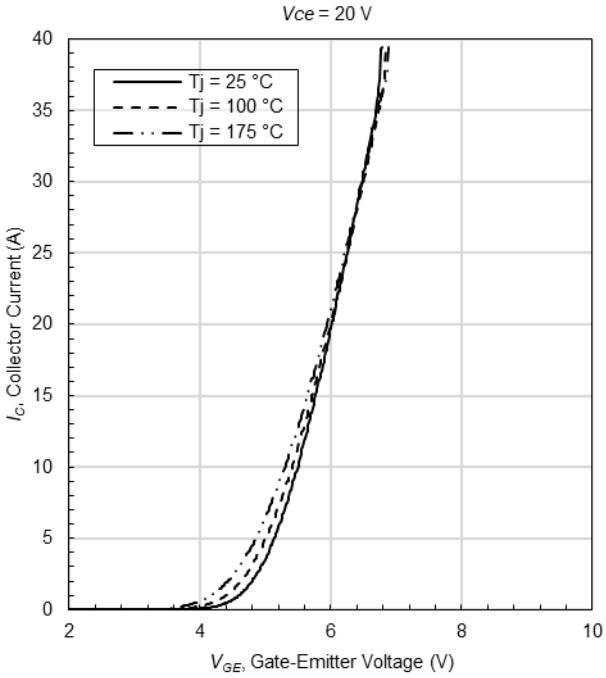
Typical Output Characteristic



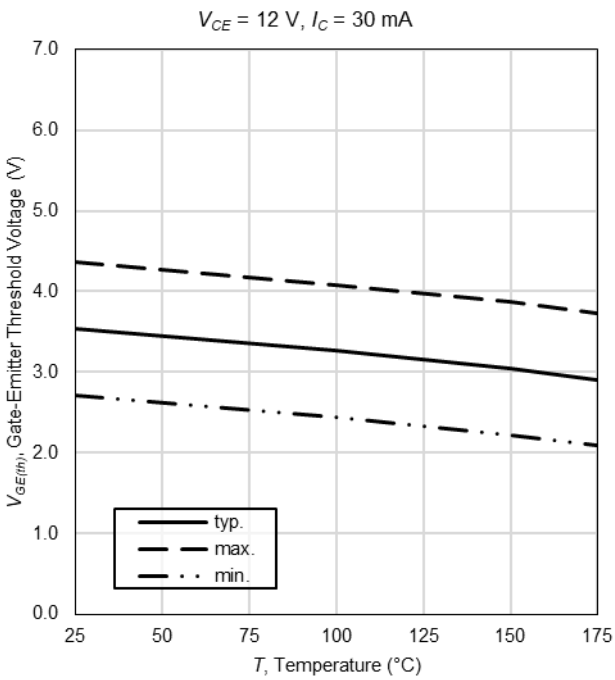
Typical Output Characteristic



Typical Transfer Characteristics



Threshold Voltage vs. Junction Temperature



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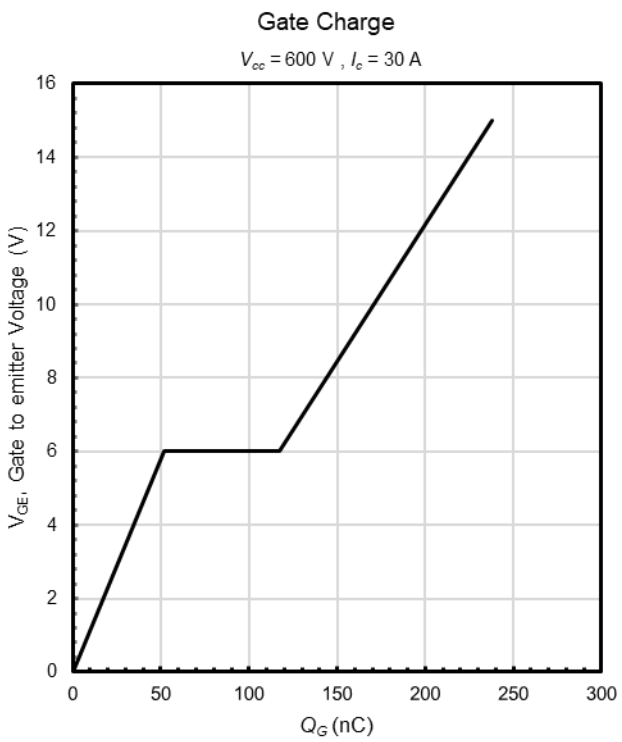
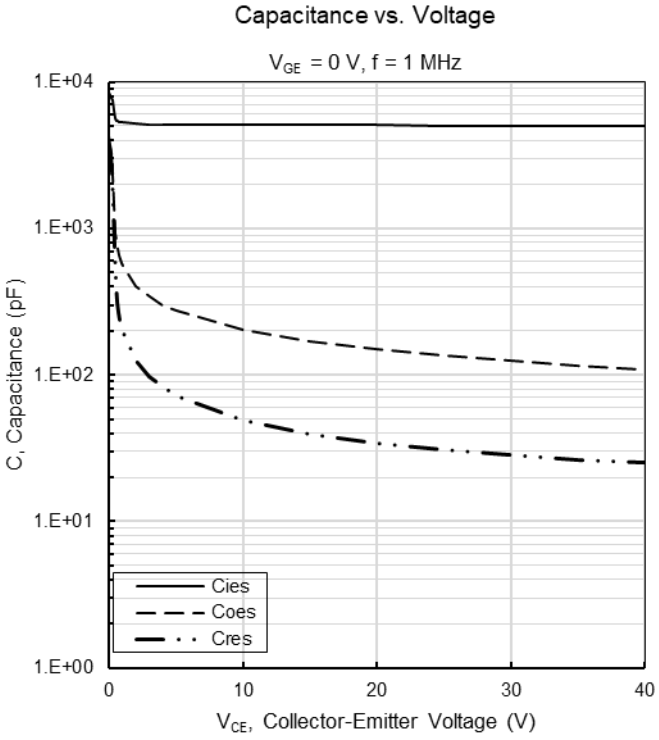
T_A = 25°C, unless otherwise specified.



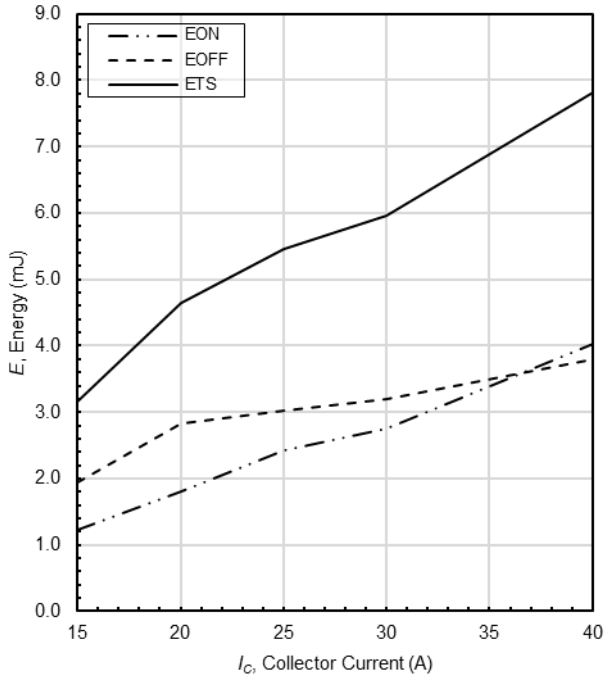


Typical Operating Characteristics

T_A = 25°C, unless otherwise specified.

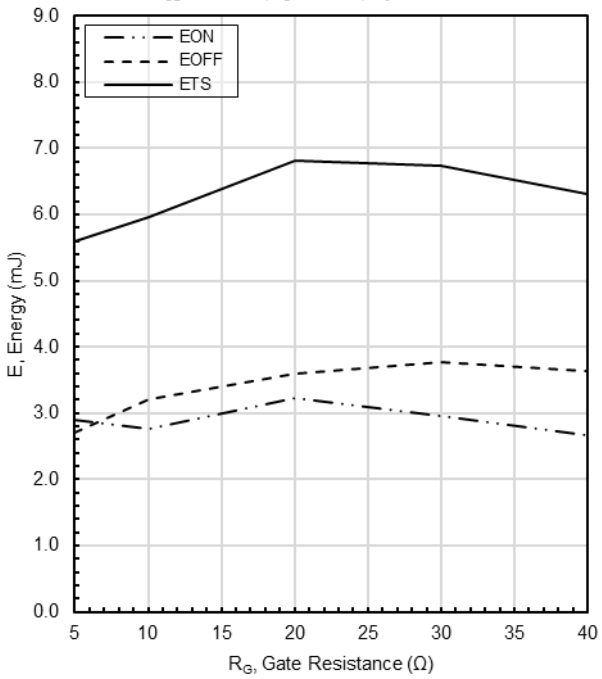
Switching Energy vs Collector Current

R_G = 10 Ω, V_C = 600 V, T_J = 175 °C



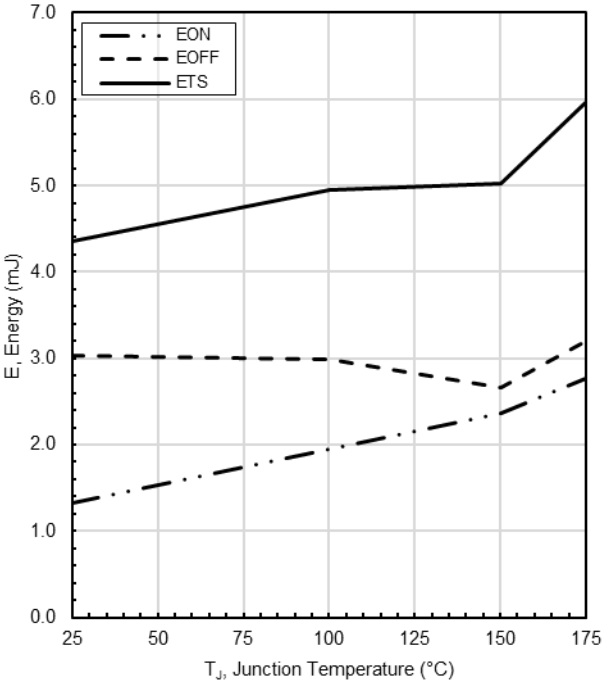
Switching Energy vs Gate Resistance

V_{CE} = 600 V, I_C = 30 A, T_J = 175 °C



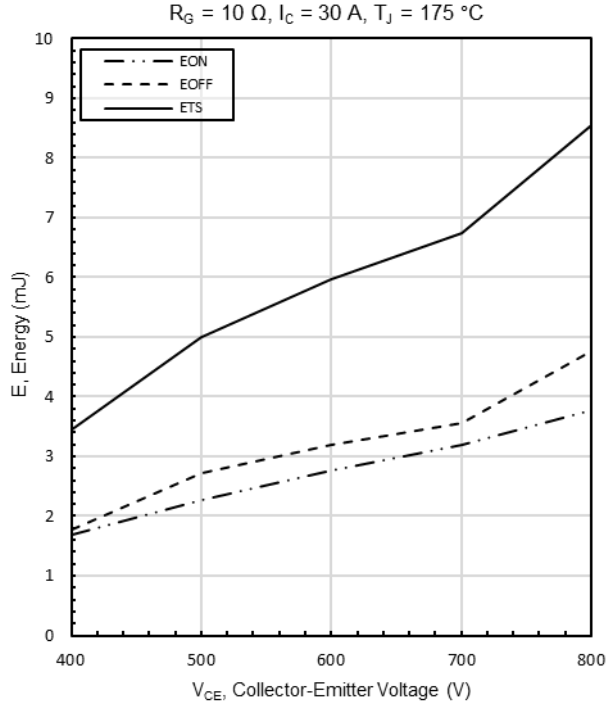
Switching Energy vs Junction Temperature

R_G = 10 Ω, V_C = 600 V, I_C = 30 A



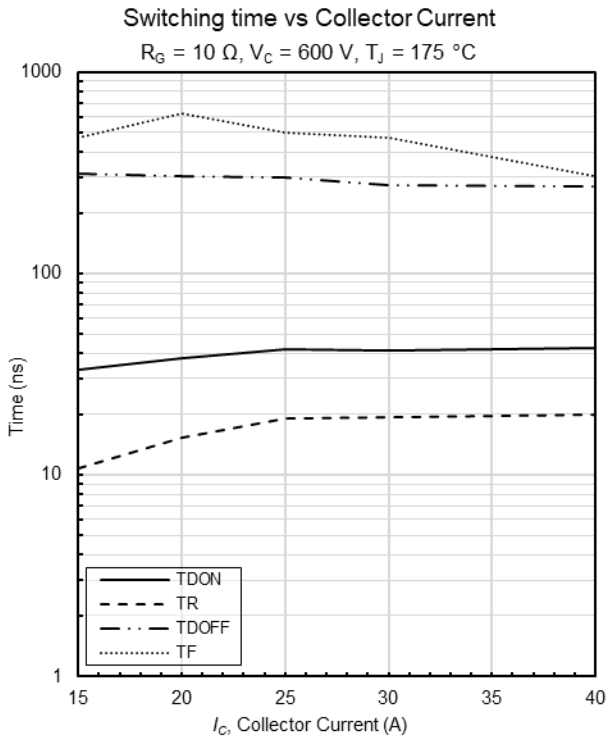
Switching Energy vs Collector-Emitter Voltage

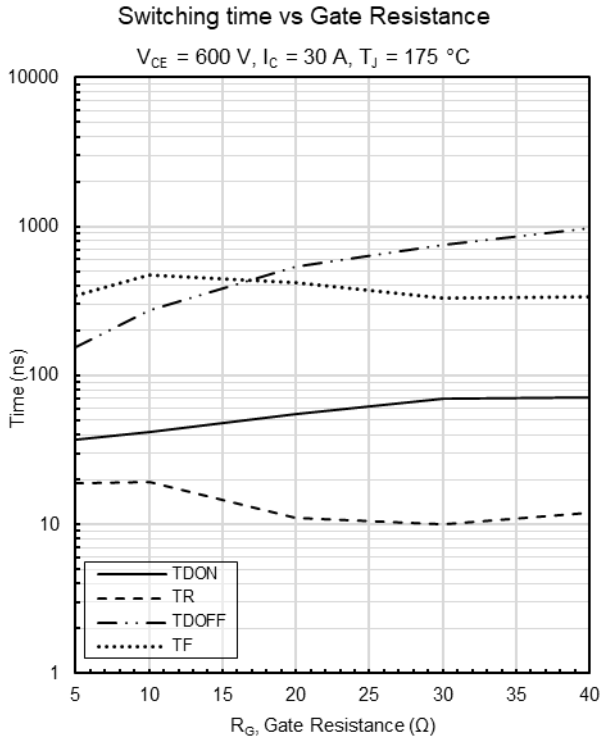
R_G = 10 Ω, I_C = 30 A, T_J = 175 °C

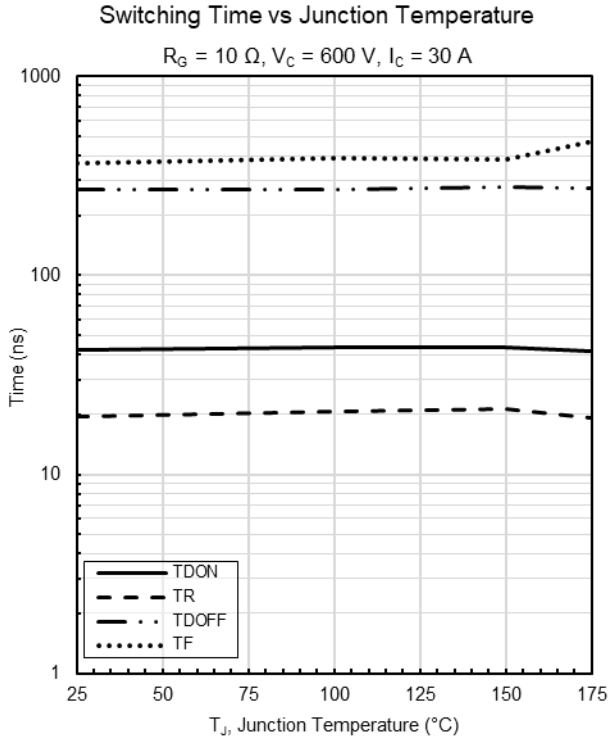


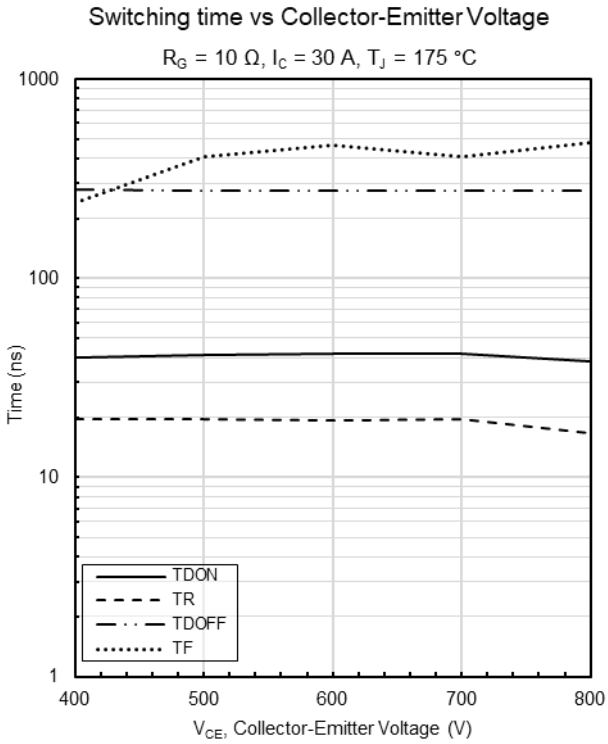
Typical Operating Characteristics

T_A = 25°C, unless otherwise specified.





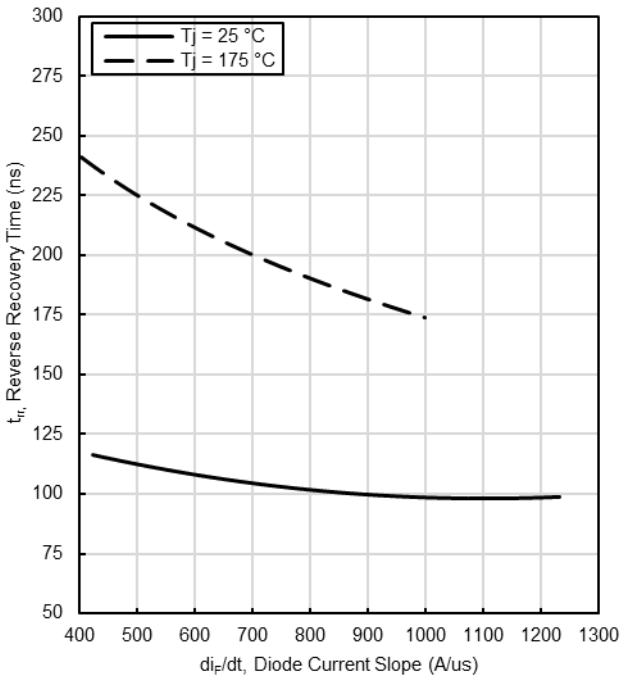




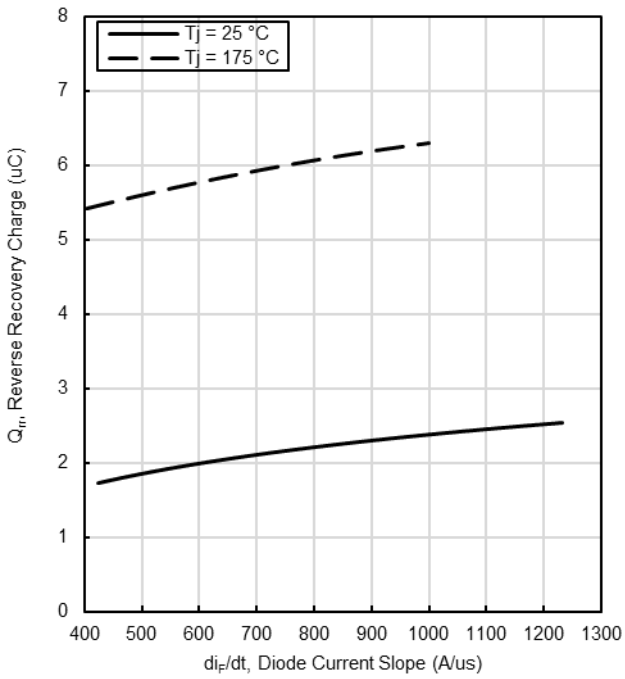
Typical Operating Characteristics

T_A = 25°C, unless otherwise specified.

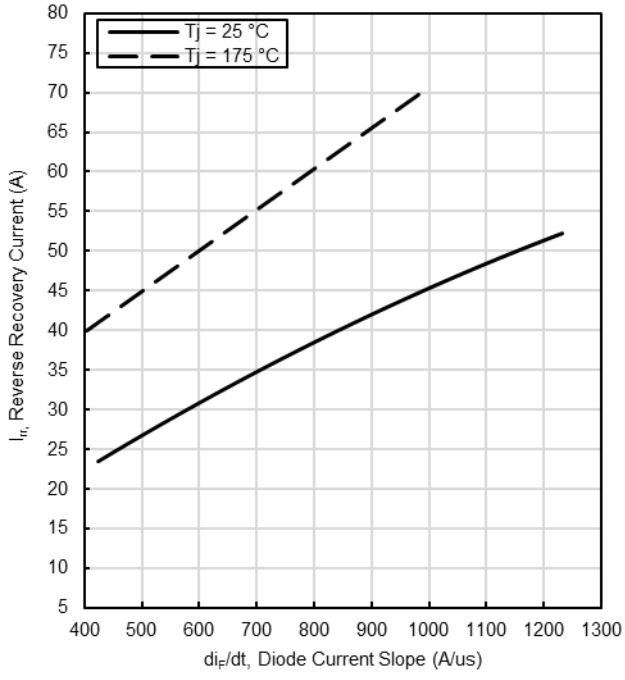
Reverse Recovery Time
as a Function of Diode Current Slope



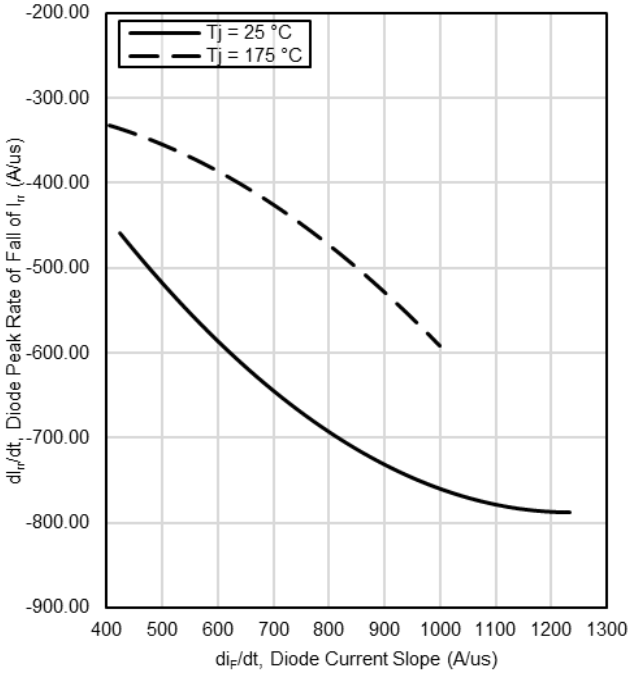
Reverse Recovery Charge
as a Function of Diode Current Slope



Reverse Recovery Current
as a Function of Diode Current Slope



Peak Rate of Fall of Reverse Recovery
as a Function of Diode Current Slope



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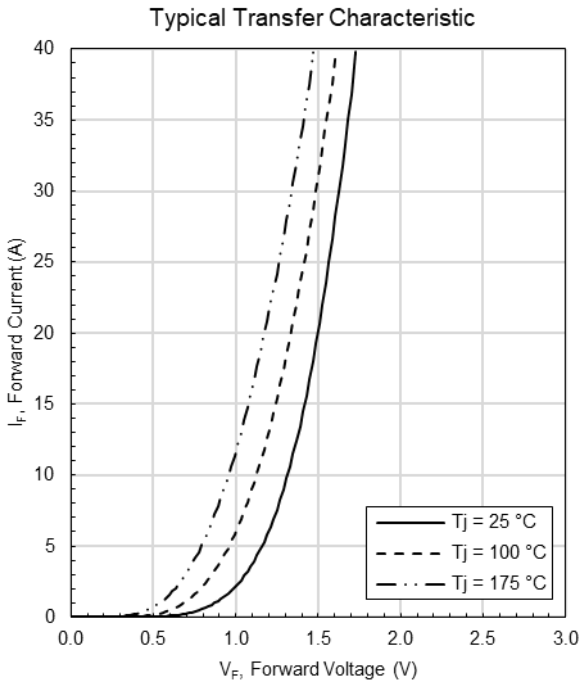
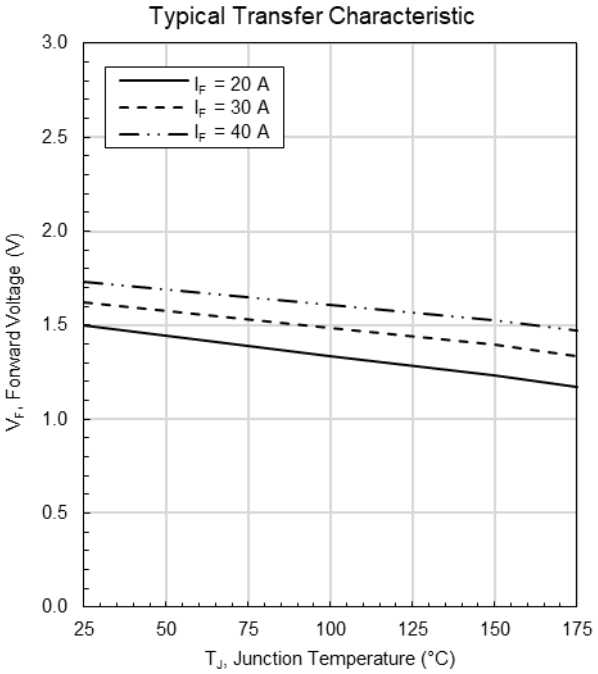
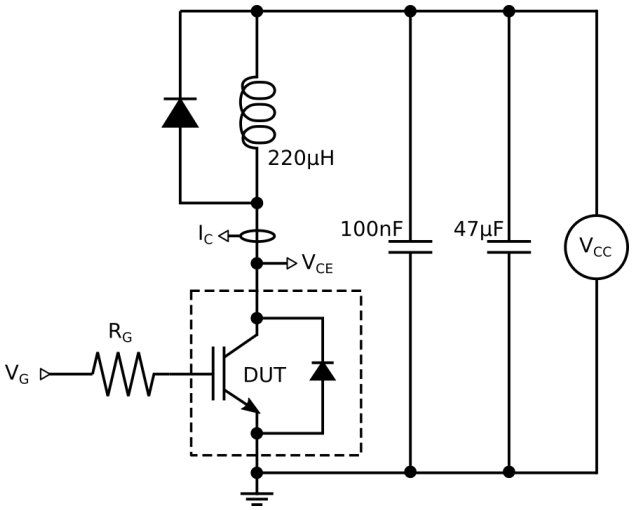
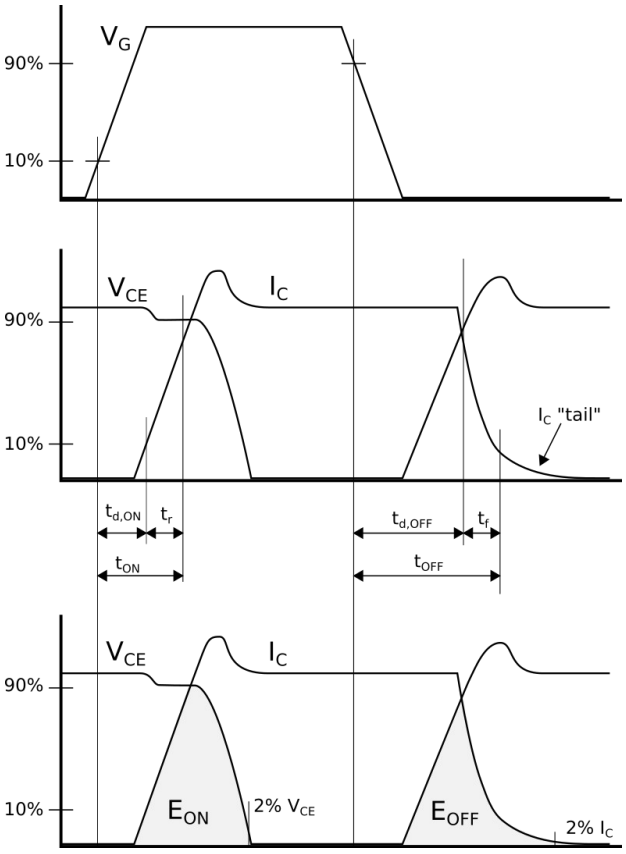




Diagrams

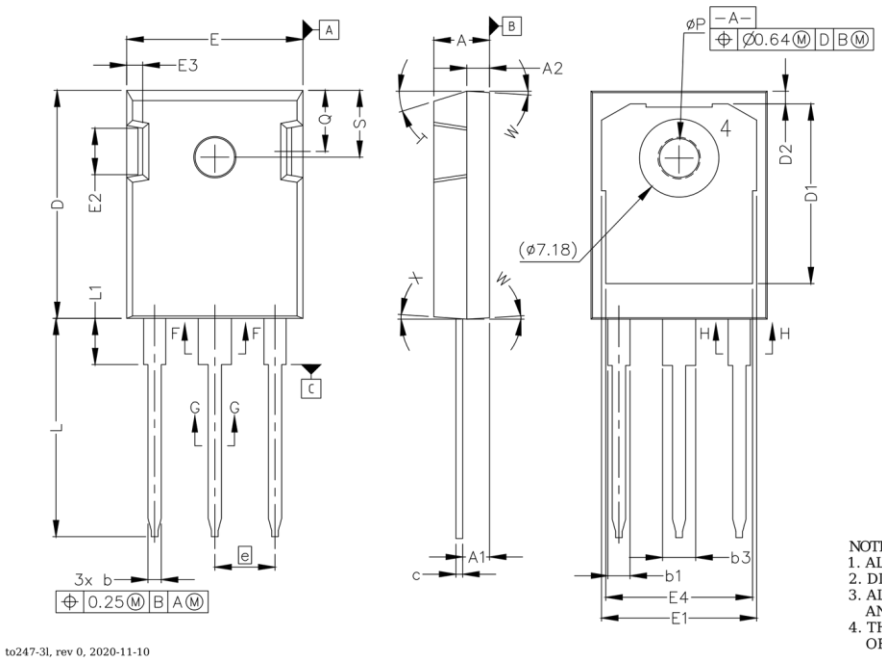


Switching Test Circuit



Switching Waveforms

Package Drawing



to247-3l, rev 0, 2020-11-10

SYMBOL	MIN	MAX
A	4.83	5.21
A1	2.29	2.54
A2	1.91	2.16
b'	1.07	1.28
b	1.07	1.33
b1	1.91	2.41
b2	1.91	2.16
b3	2.87	3.38
b4	2.87	3.13
c'	0.55	0.65
c	0.55	0.68
D	20.80	21.10
D1	16.25	17.65
D2	0.95	1.25
E	15.75	16.13
E1	13.10	14.15
E2	3.68	5.10
E3	1.00	1.90
E4	12.38	13.43
e	5.44 BSC	
N	3	
L	19.81	20.32
L1	4.10	4.40
P	3.51	3.65
Q	5.49	6.00
S	6.04	6.30
T	17.5°REF.	
W	3.5°REF.	
X	4°REF.	

NOTE;
1. ALL METAL SURFACES: TIN PLATED,EXCEPT AREA OF CUT
2. DIMENSIONS & TOLERANCES CONFORM TO ASME Y14.5M-1994
3. ALL DIMENSIONS ARE IN MILLIMETERS.
   ANGLES ARE IN DEGREES.
4. THIS DRAWING MEETS ALL DIMENSION REQUIREMENTS
   OF JEDEC OUTLINES TO-247 AD.

Pin Configuration

PIN NUMBER	DESCRIPTION
1	Gate
2	Collector
3	Emitter

Important Notice

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