NGTB40N120S3WG

IGBT - Ultra Field Stop

This Insulated Gate Bipolar Transistor (IGBT) features a robust and cost effective Ultra Field Stop Trench construction, and provides superior performance in demanding switching applications, offering low switching losses. The IGBT is well suited for applications that require fast switching IGBT with low V_F diodes, e.g. phase−shifted full bridge, etc. Incorporated into the device is a free wheeling diode with a low forward voltage.

Features

- Extremely Efficient Trench with Field Stop Technology
- T_{Jmax} = 175°C
- Low V_F Reverse Diode
- Optimized for High Speed Switching
- These are Pb−Free Devices

Typical Applications

- Welding
- Uninterruptible Power Inverter Supplies (UPS)
- Motor Control

ABSOLUTE MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector−emitter voltage	V_{CES}	1200	V
Collector current @ T_C = 25°C @ T_C = 100°C	I_C	 160 40	A
Pulsed collector current, T_{pulse} limited by T_{Jmax}	I_{CM}	160	A
Diode forward current @ T_C = 25°C @ T_C = 100°C	I_F	 160 40	A
Diode pulsed current, T_{pulse} limited by T_{Jmax}	I_{FM}	160	A
Gate−emitter voltage Transient gate−emitter voltage (T_{pulse} = 5 μs, D < 0.10)	V_{GE}	±20 ±30	V
Power Dissipation @ T_C = 25°C @ T_C = 100°C	P_D	 454 227	W
Operating junction temperature range	T_J	−55 to +175	°C
Storage temperature range	T_{stg}	−55 to +175	°C
Lead temperature for soldering, 1/8″ from case for 10 seconds	T_{SLD}	260	°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.

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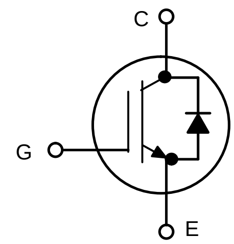
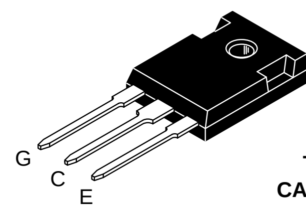
40 A, 1200 V
V_{CEsat} = 1.7 V
E_{off} = 1.1 mJ





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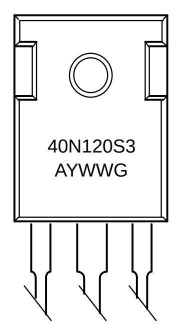
MARKING DIAGRAM



A	= Assembly Location
Y	= Year
WW	= Work Week
G	= Pb−Free Package

ORDERING INFORMATION

Device	Package	Shipping
NGTB40N120S3WG	TO−247 (Pb−Free)	30 Units / Rail

March, 2018 − Rev. 0

Publication Order Number:
NGTB40N120S3W/D

THERMAL CHARACTERISTICS

Rating	Symbol	Value	Unit
Thermal resistance junction−to−case, for IGBT	$R_{\theta JC}$	0.34	°C/W
Thermal resistance junction−to−case, for Diode	$R_{\theta JC}$	0.5	°C/W
Thermal resistance junction−to−ambient	$R_{\theta JA}$	40	°C/W

ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise specified)

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
STATIC CHARACTERISTIC						
Collector−emitter breakdown voltage, gate−emitter short−circuited	V_{GE} = 0 V, I_C = 500 μA	$V_{(BR)CES}$	1200	−	−	V
Collector−emitter saturation voltage	V_{GE} = 15 V, I_C = 40 A V_{GE} = 15 V, I_C = 40 A, T_J = 175°C	V_{CEsat}	− −	1.7 2.3	1.95 −	V
Gate−emitter threshold voltage	V_{GE} = V_{CE}, I_C = 400 μA	$V_{GE(th)}$	4.5	5.5	6.5	V
Collector−emitter cut−off current, gate−emitter short−circuited	V_{GE} = 0 V, V_{CE} = 1200 V V_{GE} = 0 V, V_{CE} = 1200 V, T_J = 175°C	I_{CES}	− −	− 0.5	0.4 −	mA
Gate leakage current, collector−emitter short−circuited	V_{GE} = 20 V , V_{CE} = 0 V	I_{GES}	−	−	200	nA
Input capacitance	V_{CE} = 20 V, V_{GE} = 0 V, f = 1 MHz	C_{ies}	−	4912	−	pF
Output capacitance		C_{oes}	−	140	−	
Reverse transfer capacitance		C_{res}	−	80	−	
Gate charge total	V_{CE} = 600 V, I_C = 40 A, V_{GE} = 15 V	Q_g	−	212	−	nC
Gate to emitter charge		Q_{ge}	−	43	−	
Gate to collector charge		Q_{gc}	−	102	−	
SWITCHING CHARACTERISTIC, INDUCTIVE LOAD						
Turn−on delay time	T_J = 25°C V_{CC} = 600 V, I_C = 40 A R_g = 10 Ω V_{GE} = 15V	$t_{d(on)}$	−	12	−	ns
Rise time		t_r	−	25	−	
Turn−off delay time		$t_{d(off)}$	−	145	−	
Fall time		t_f	−	107	−	
Turn−on switching loss		E_{on}	−	2.2	−	mJ
Turn−off switching loss		E_{off}	−	1.1	−	
Total switching loss		E_{ts}	−	3.3	−	
Turn−on delay time	T_J = 175°C V_{CC} = 600 V, I_C = 40 A R_g = 10 Ω V_{GE} = 15 V	$t_{d(on)}$	−	13	−	ns
Rise time		t_r	−	24	−	
Turn−off delay time		$t_{d(off)}$	−	153	−	
Fall time		t_f	−	173	−	
Turn−on switching loss		E_{on}	−	2.8	−	mJ
Turn−off switching loss		E_{off}	−	1.6	−	
Total switching loss		E_{ts}	−	4.4	−	
DIODE CHARACTERISTIC						
Forward voltage	V_{GE} = 0 V, I_F = 40 A V_{GE} = 0 V, I_F = 40 A, T_J = 175°C	V_F	− −	2.0 2.55	2.6 −	V
Reverse recovery time	T_J = 25°C I_F = 40 A, V_R = 400 V di_F/dt = 500 A/μs	t_{rr}	−	163	−	ns
Reverse recovery charge		Q_{rr}	−	2.9	−	μc
Reverse recovery current		I_{rrm}	−	30	−	A
Diode peak rate of fall of reverse recovery current during tb		dI_{rrm}/dt	−	137	−	A/μs

ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise specified)

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
DIODE CHARACTERISTIC						
Reverse recovery time	T_J = 175°C I_F = 40 A, V_R = 400 V di_F/dt = 500 A/μs	t_{rr}	−	250	−	ns
Reverse recovery charge		Q_{rr}	−	5.3	−	μc
Reverse recovery current		I_{rrm}	−	40	−	A
Diode peak rate of fall of reverse recovery current during tb		dI_{rrm}/dt	−	482	−	A/μs

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

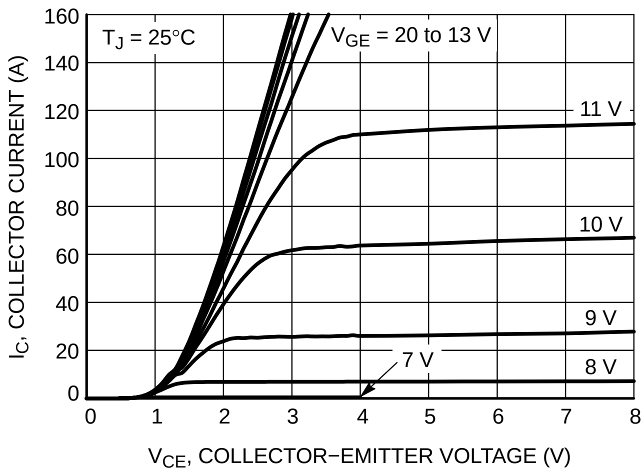


Figure 1. Output Characteristics

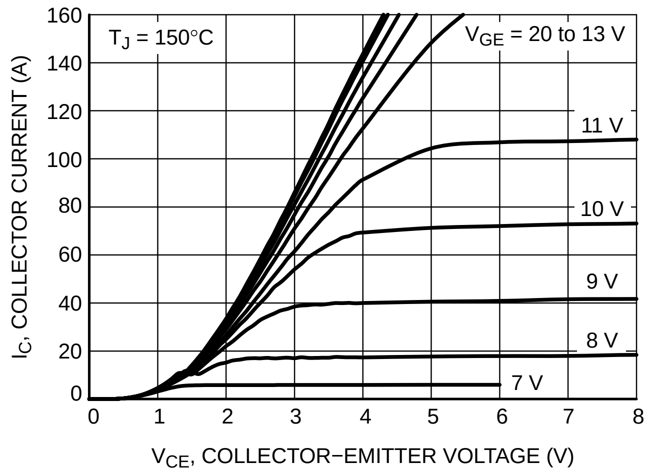


Figure 2. Output Characteristics

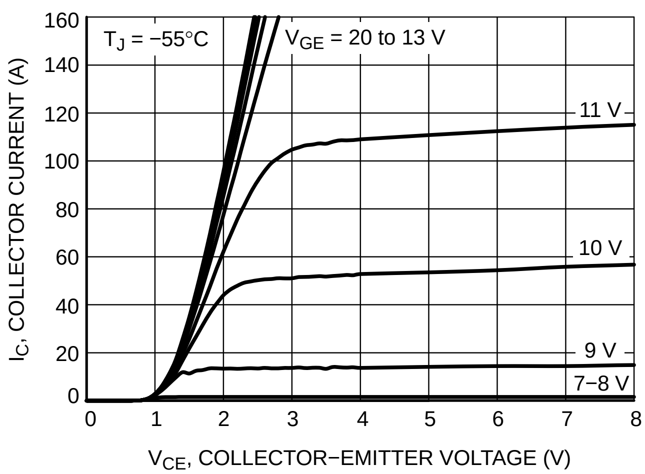


Figure 3. Output Characteristics

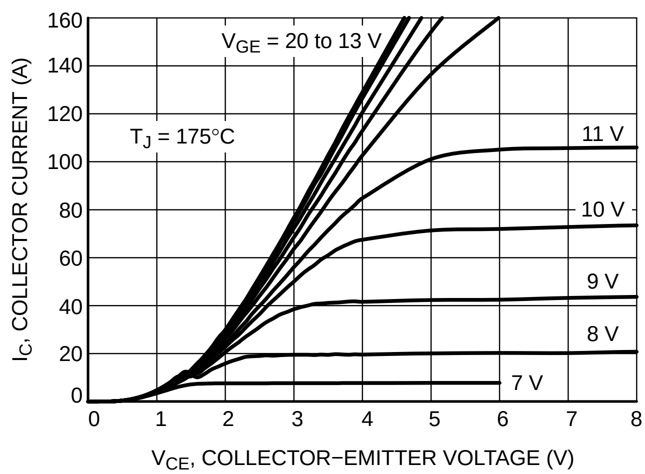


Figure 4. Output Characteristics

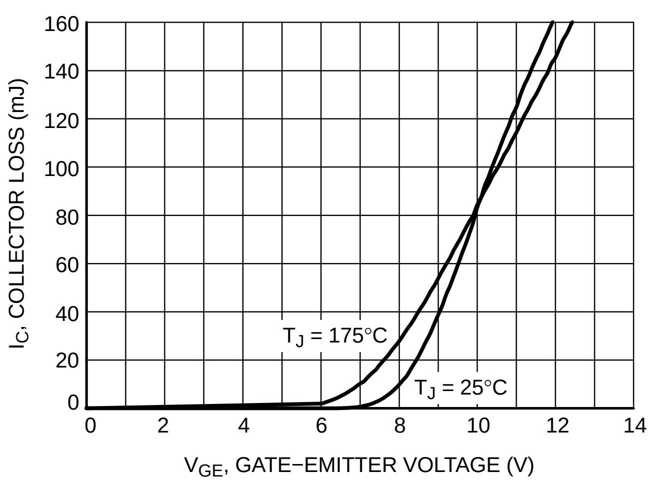


Figure 5. Typical Transfer Characteristics

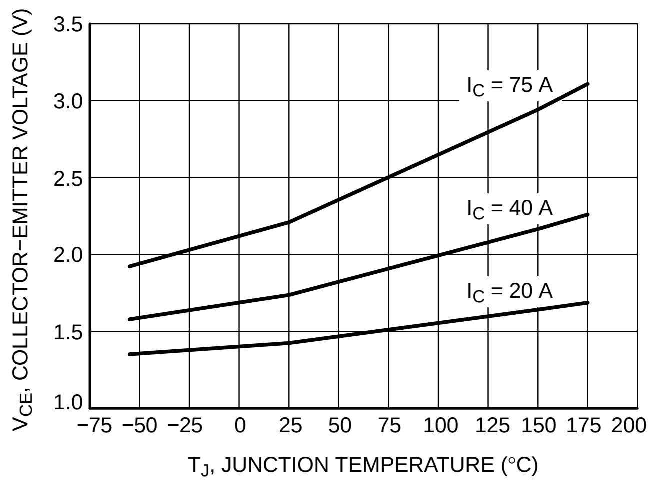


Figure 6. $V_{CE(sat)}$ vs. T_J

TYPICAL CHARACTERISTICS

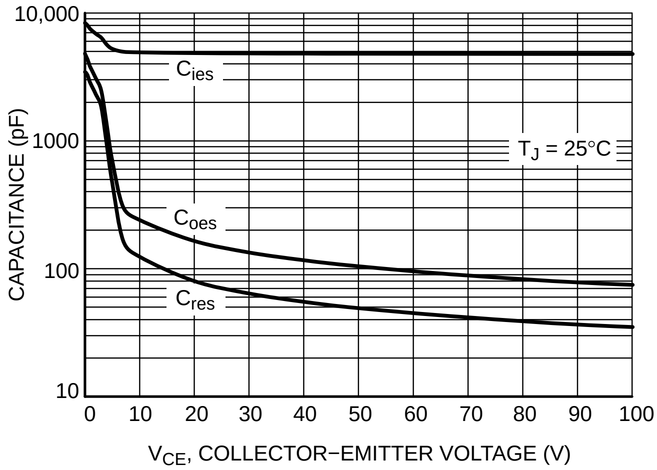


Figure 7. Typical Capacitance

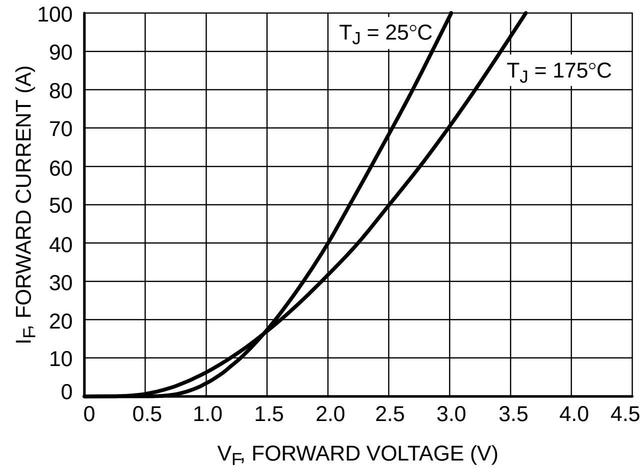


Figure 8. Diode Forward Characteristics

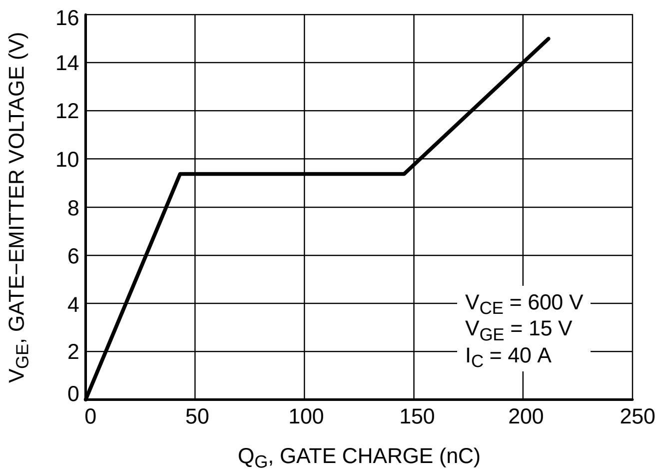


Figure 9. Typical Gate Charge

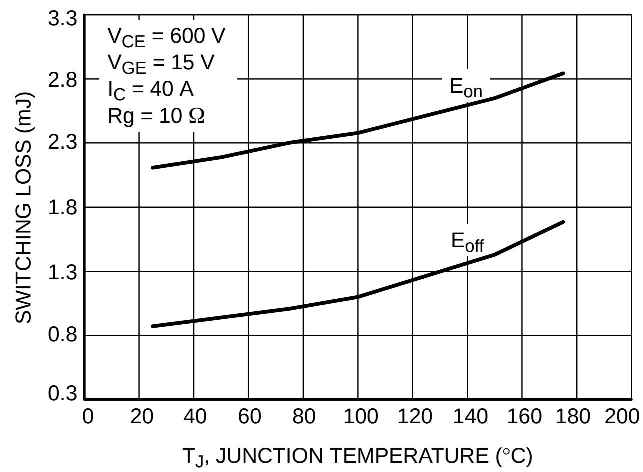


Figure 10. Switching Loss vs. Temperature

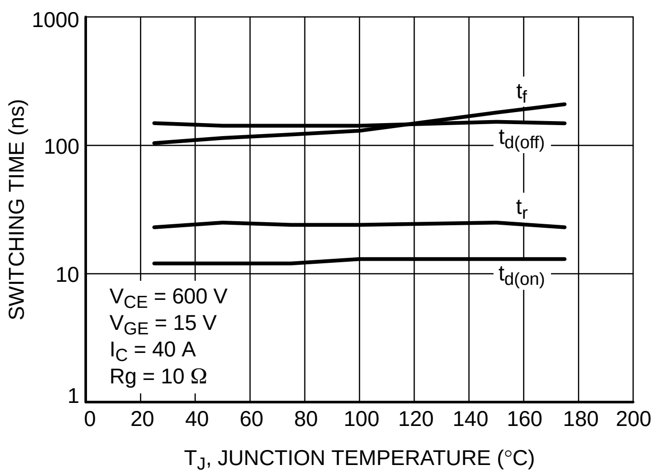


Figure 11. Switching Loss vs. Temperature

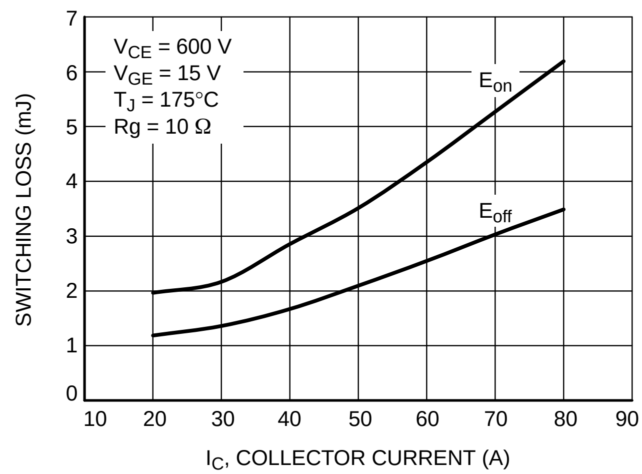


Figure 12. Switching Loss vs. I_C

TYPICAL CHARACTERISTICS

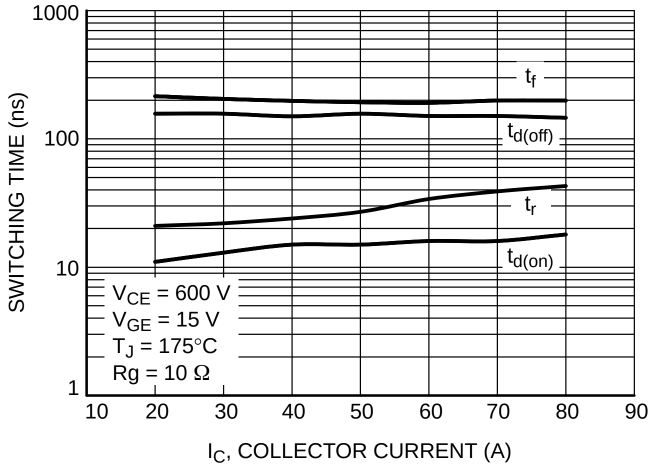


Figure 13. Switching Time vs. I_C

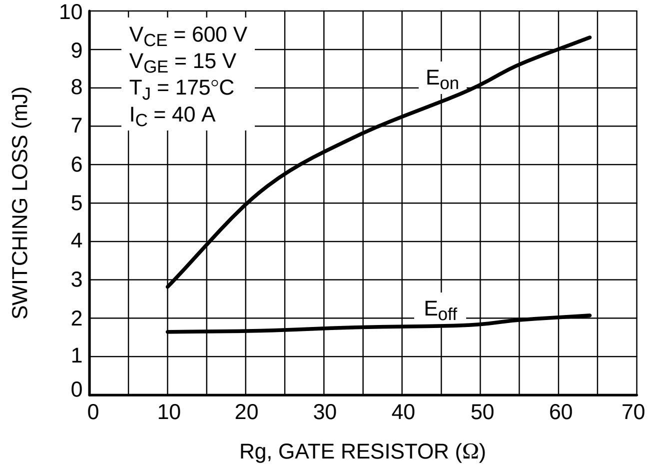


Figure 14. Switching Loss vs. R_G

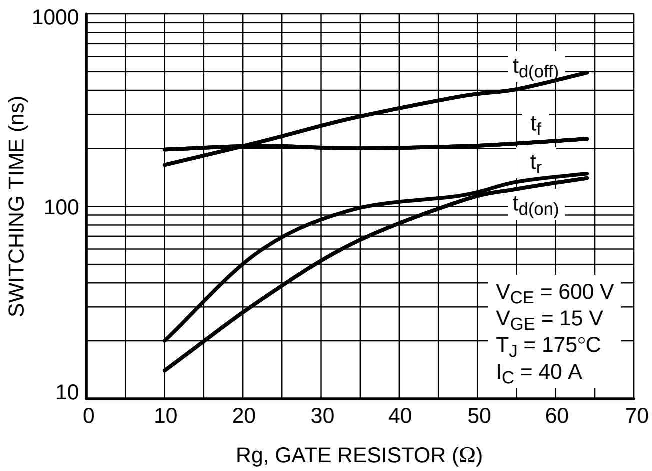


Figure 15. Switching Time vs. R_G

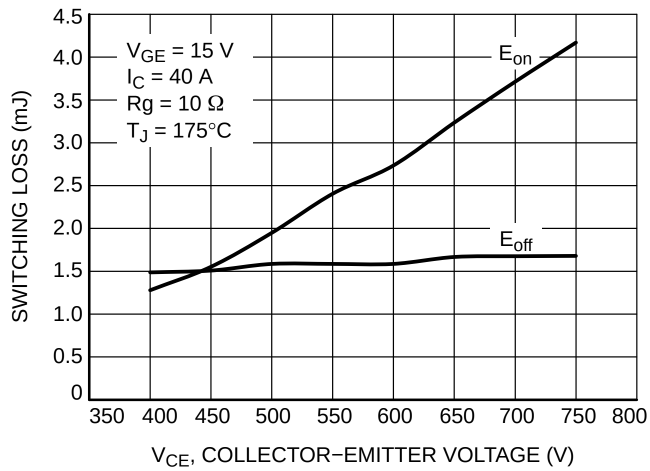


Figure 16. Switching Loss vs. V_{CE}

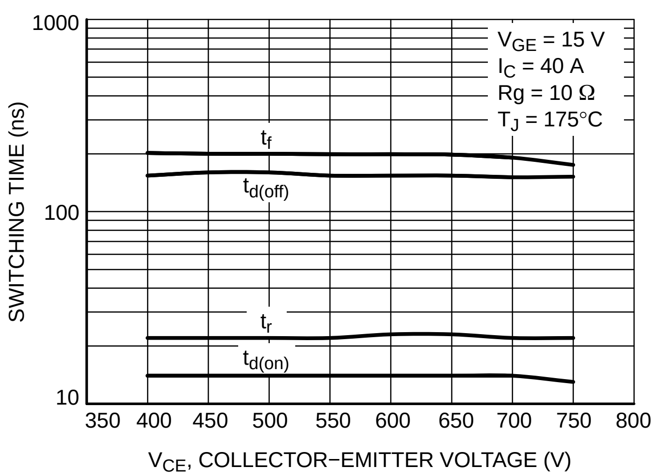


Figure 17. Switching Time vs. V_{CE}

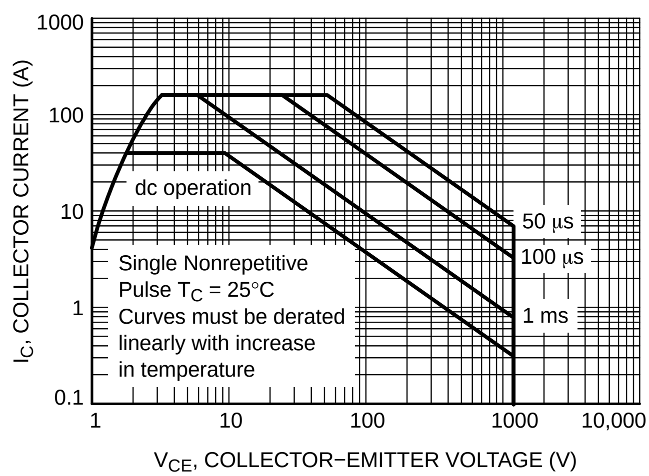


Figure 18. Safe Operating Area

TYPICAL CHARACTERISTICS

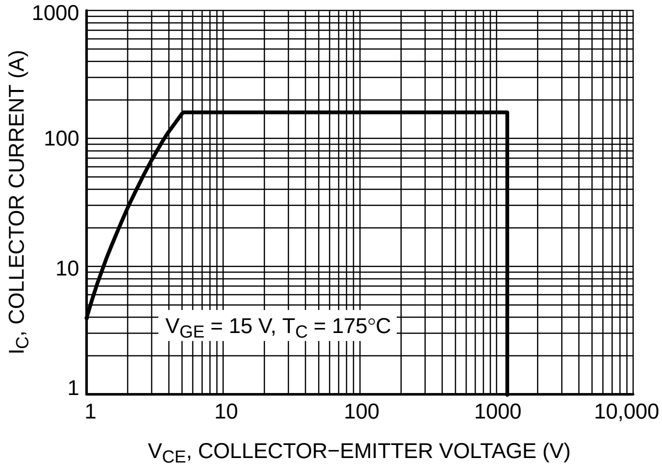


Figure 19. Reverse Bias Safe Operating Area

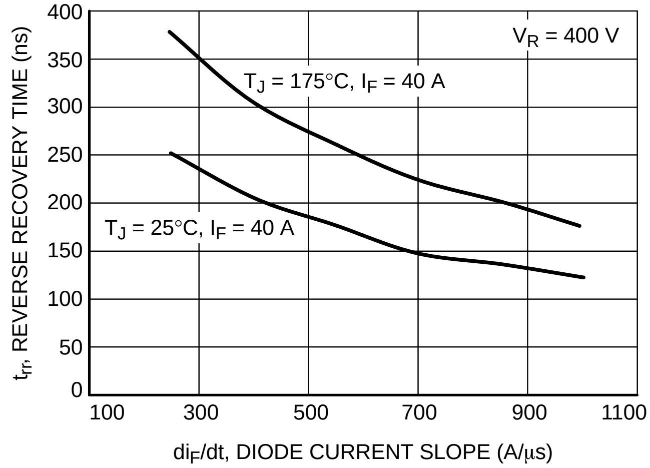


Figure 20. t_{rr} vs. di_F/dt

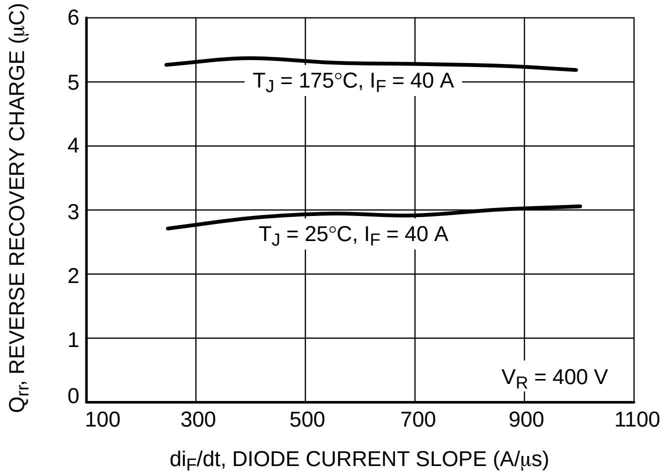


Figure 21. Q_{rr} vs. di_F/dt

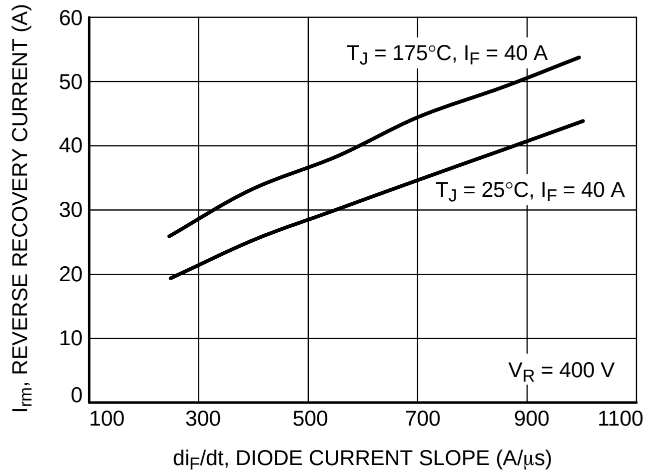


Figure 22. I_{rm} vs. di_F/dt

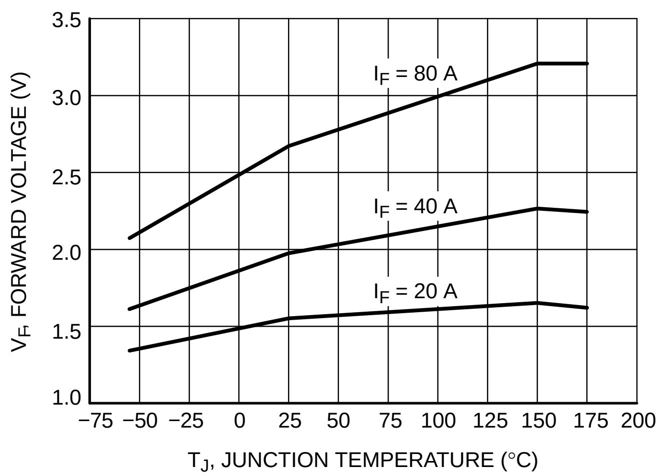


Figure 23. V_F vs. T_J

TYPICAL CHARACTERISTICS

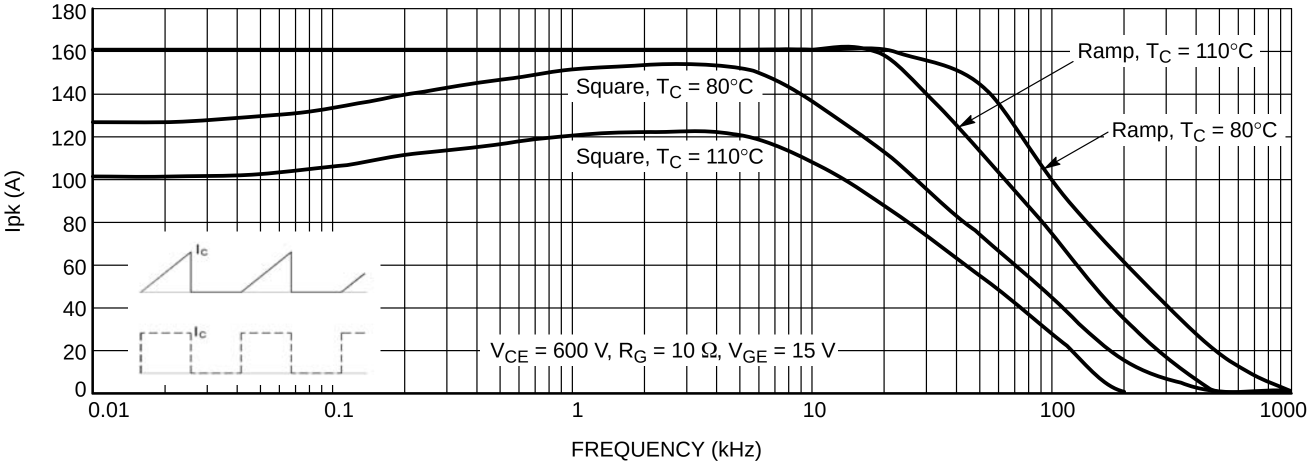
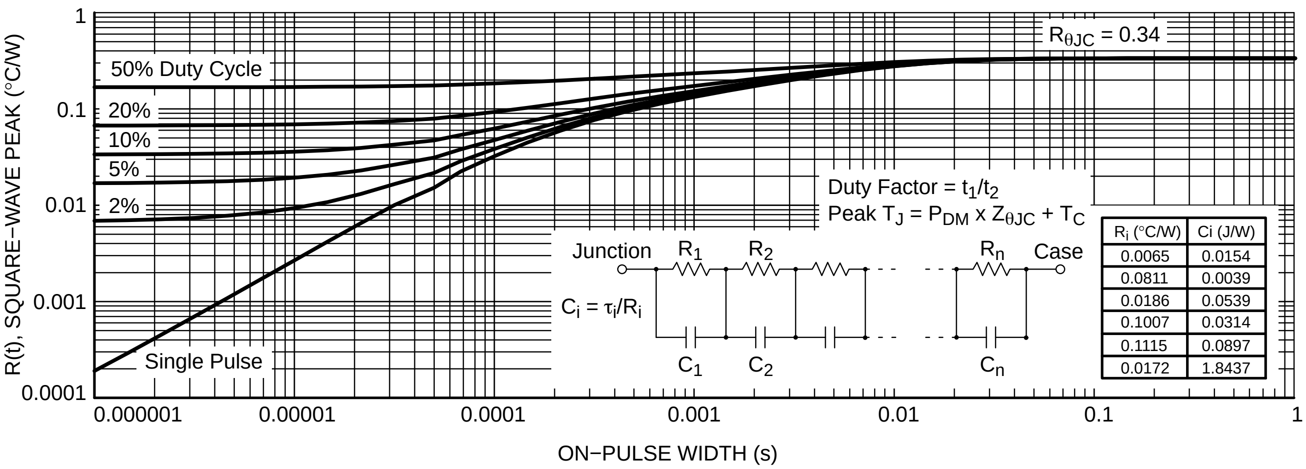
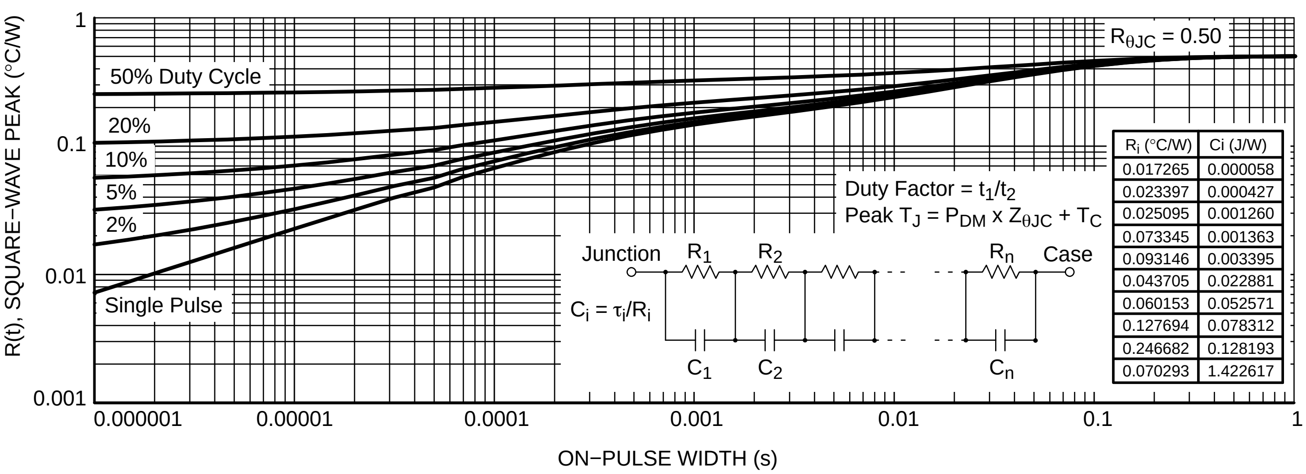


Figure 24. Collector Current vs. Switching Frequency



R_i (°C/W)	Ci (J/W)
0.0065	0.0154
0.0811	0.0039
0.0186	0.0539
0.1007	0.0314
0.1115	0.0897
0.0172	1.8437

Figure 25. IGBT Transient Thermal Impedance



R_i (°C/W)	Ci (J/W)
0.017265	0.000058
0.023397	0.000427
0.025095	0.001260
0.073345	0.001363
0.093146	0.003395
0.043705	0.022881
0.060153	0.052571
0.127694	0.078312
0.246682	0.128193
0.070293	1.422617

Figure 26. Diode Transient Thermal Impedance

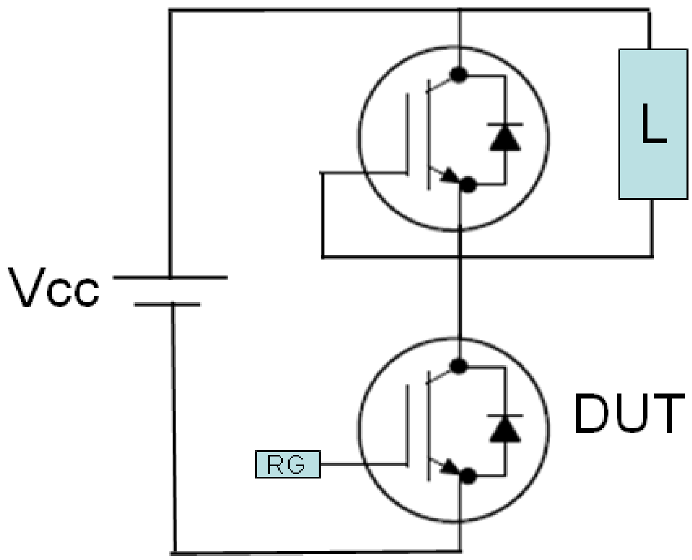


Figure 27. Test Circuit for Switching Characteristics

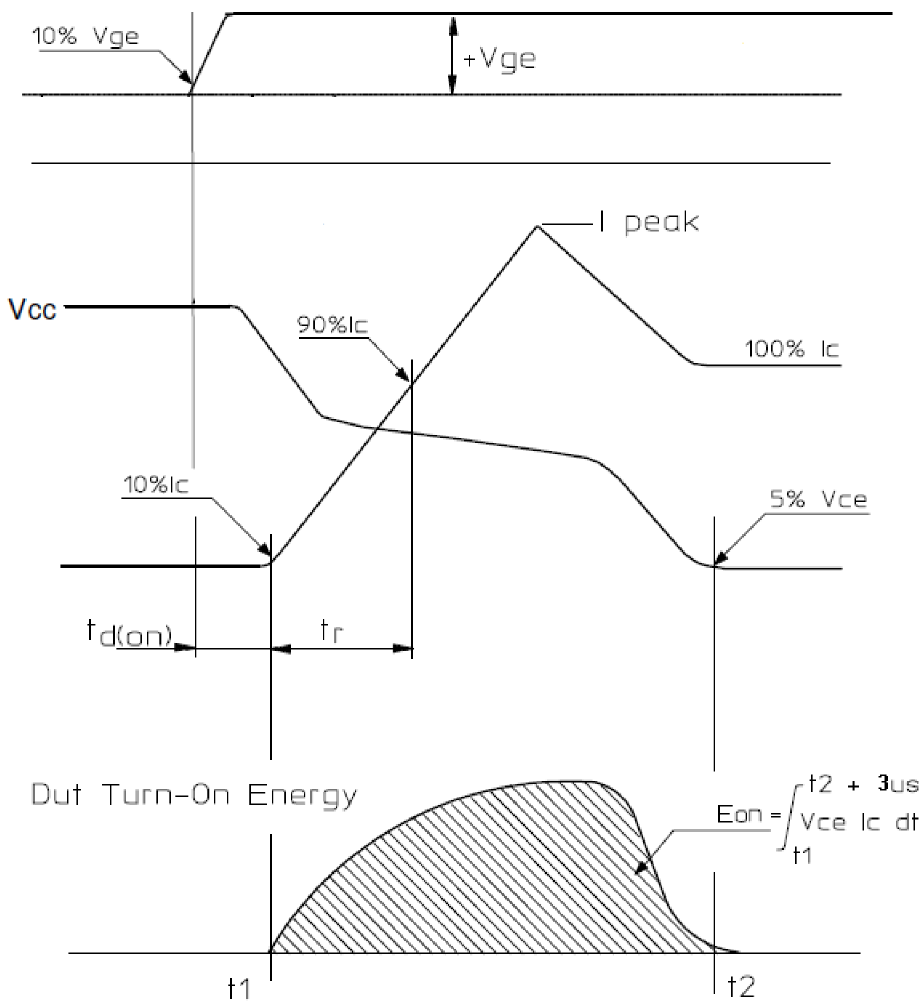


Figure 28. Definition of Turn On Waveform

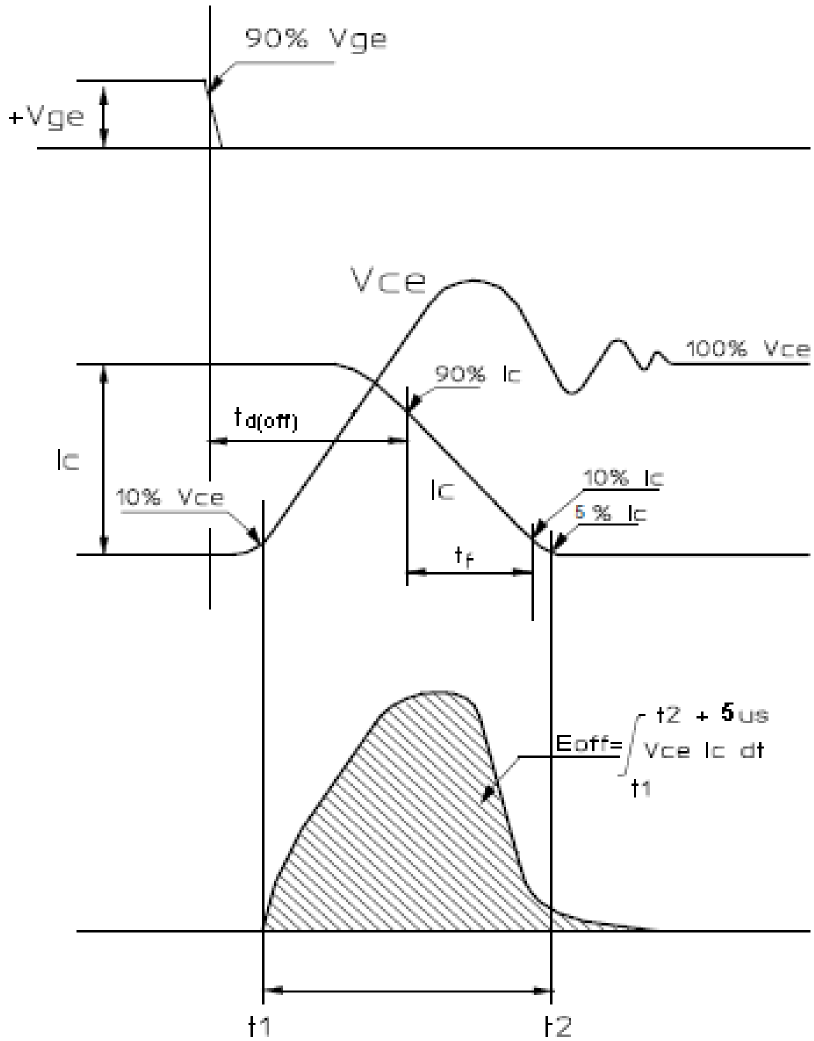


Figure 29. Definition of Turn Off Waveform

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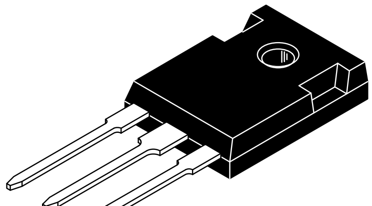
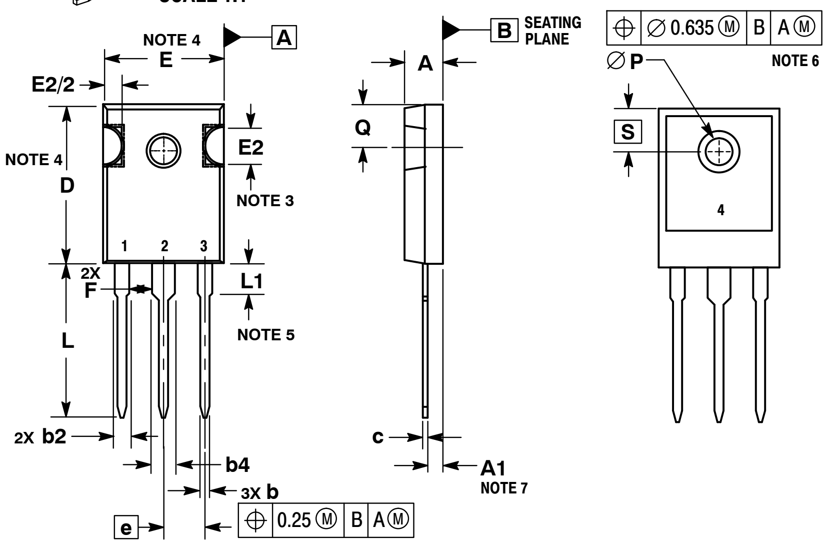


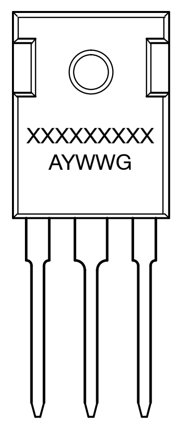
SCALE 1:1



NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. SLOT REQUIRED, NOTCH MAY BE ROUNDED.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.13 PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREME OF THE PLASTIC BODY.
5. LEAD FINISH IS UNCONTROLLED IN THE REGION DEFINED BY L1.
6. ∅P SHALL HAVE A MAXIMUM DRAFT ANGLE OF 1.5° TO THE TOP OF THE PART WITH A MAXIMUM DIAMETER OF 3.91.
7. DIMENSION A1 TO BE MEASURED IN THE REGION DEFINED BY L1.

	MILLIMETERS	
DIM	MIN	MAX
A	4.70	5.30
A1	2.20	2.60
b	1.07	1.33
b2	1.65	2.35
b4	2.60	3.40
c	0.45	0.68
D	20.80	21.34
E	15.50	16.25
E2	4.32	5.49
e	5.45 BSC	
F	2.655	---
L	19.80	20.80
L1	3.81	4.32
P	3.55	3.65
Q	5.40	6.20
S	6.15 BSC	

GENERIC MARKING DIAGRAM*



XXXXX = Specific Device Code
A = Assembly Location
Y = Year
WW = Work Week
G = Pb−Free Package

*This information is generic. Please refer to device data sheet for actual part marking.
Pb−Free indicator, “G” or microdot “ ▪”, may or may not be present.

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DESCRIPTION:	TO−247	PAGE 1 OF 1

ADDITIONAL INFORMATION

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For additional information, please contact your local Sales Representative at www.onsemi.com/support/sales

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