MOSFET - SiC Power, Single N-Channel

1200 V, 160 mΩ, 17 A

NVHL160N120SC1

Features

- Typ. $R_{DS(on)}$ = 160 mΩ
- Ultra Low Gate Charge (typ. $Q_{G(tot)}$ = 34 nC)
- Low Effective Output Capacitance (typ. C_{oss} = 50 pF)
- 100% UIL Tested
- Qualified According to AEC−Q101
- These Devices are RoHS Compliant

Typical Applications

- Automotive On Board Charger
- Automotive DC/DC Converter for EV/HEV

MAXIMUM RATINGS (T_J = 25°C unless otherwise noted)

Parameter			Symbol	Value	Unit
Drain−to−Source Voltage			V_{DSS}	1200	V
Gate−to−Source Voltage			V_{GS}	−15/+25	V
Recommended Operation Values of Gate−to−Source Voltage	T_C < 175°C		V_{GSop}	−5/+20	V
Continuous Drain Current	Steady State	T_C = 25°C	I_D	17	A
Power Dissipation			P_D	119	W
Continuous Drain Current	Steady State	T_C = 100°C	I_D	12	A
Power Dissipation			P_D	59	W
Pulsed Drain Current (Note 2)	T_A = 25°C		I_{DM}	69	A
Single Pulse Surge Drain Current Capability	T_A = 25°C, t_p = 10 μs, R_G = 4.7 Ω		I_{DSC}	140	A
Operating Junction and Storage Temperature Range			T_J, T_{stg}	−55 to +175	°C
Source Current (Body Diode)			I_S	11	A
Single Pulse Drain−to−Source Avalanche Energy ($I_{L(pk)}$ = 23 A, L = 1 mH) (Note 3)			E_{AS}	128	mJ

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.

THERMAL CHARATERISTICS

Parameter	Symbol	Value	Unit
Junction−to−Case (Note 1)	$R_{\theta JC}$	1.3	°C/W
Junction−to−Ambient (Note 1)	$R_{\theta JA}$	40	°C/W

1. The entire application environment impacts the thermal resistance values shown, they are not constants and are only valid for the particular conditions noted.
2. Repetitive rating, limited by max junction temperature.
3. E_{AS} of 128 mJ is based on starting T_J = 25°C; L = 1 mH, I_{AS} = 16 A, V_{DD} = 120 V, V_{GS} = 18 V.

ON Semiconductor®

$V_{(BR)DSS}$	$R_{DS(on)}$ MAX	I_D MAX
1200 V	224 mΩ @ 20 V	17 A

N−CHANNEL MOSFET
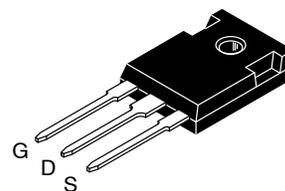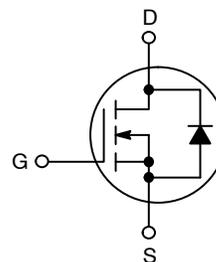
TO−247−3LD
CASE 340CX

MARKING DIAGRAM


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&Z&3&K
NVHL160
N120SC1
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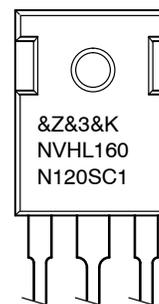
&Z	= Assembly Plant Code
&3	= Date Code (Year & Week)
&K	= Lot
NVHL160N120SC1	= Specific Device Code

ORDERING INFORMATION

See detailed ordering and shipping information on page 2 of this data sheet.

NVHL160N120SC1

ELECTRICAL CHARACTERISTICS ($T_J = 25°C$ unless otherwise stated)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
OFF CHARACTERISTICS						
Drain–to–Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0$ V, $I_D = 1$ mA	1200	–	–	V
Drain–to–Source Breakdown Voltage Temperature Coefficient	$V_{(BR)DSS}/T_J$	$I_D = 1$ mA, referenced to 25°C	–	600	–	mV/°C
Zero Gate Voltage Drain Current	I_{DSS}	$V_{GS} = 0$ V, $V_{DS} = 1200$ V, $T_J = 25°C$	–	–	100	μA
		$V_{GS} = 0$ V, $V_{DS} = 1200$ V, $T_J = 175°C$	–	–	250	
Gate–to–Source Leakage Current	I_{GSS}	$V_{GS} = +25/-15$ V, $V_{DS} = 0$ V	–	–	±1	μA
ON CHARACTERISTICS						
Gate Threshold Voltage	$V_{GS(th)}$	$V_{GS} = V_{DS}$, $I_D = 2.5$ mA	1.8	3.1	4.3	V
Recommended Gate Voltage	V_{GOP}		–5	–	+20	V
Drain–to–Source On Resistance	$R_{DS(on)}$	$V_{GS} = 20$ V, $I_D = 12$ A, $T_J = 25°C$	–	162	224	mΩ
		$V_{GS} = 20$ V, $I_D = 12$ A, $T_J = 175°C$	–	271	377	
Forward Transconductance	g_{FS}	$V_{DS} = 10$ V, $I_D = 12$ A	–	3	–	S
CHARGES, CAPACITANCES & GATE RESISTANCE						
Input Capacitance	C_{ISS}	$V_{GS} = 0$ V, f = 1 MHz, $V_{DS} = 800$ V	–	665	–	pF
Output Capacitance	C_{OSS}		–	50	–	
Reverse Transfer Capacitance	C_{RSS}		–	5	–	
Total Gate Charge	$Q_{G(tot)}$	$V_{GS} = -5/20$ V, $V_{DS} = 600$ V, $I_D = 16$ A	–	34	–	nC
Threshold Gate Charge	$Q_{G(th)}$		–	6	–	
Gate–to–Source Charge	Q_{GS}		–	12.5	–	
Gate–to–Drain Charge	Q_{GD}		–	9.6	–	
Gate Resistance	R_G	f = 1 MHz	–	1.4	–	Ω
SWITCHING CHARACTERISTICS						
Turn-On Delay Time	$t_{d(on)}$	$V_{GS} = -5/20$ V, $V_{DS} = 800$ V, $I_D = 16$ A, $R_G = 6$ Ω, Inductive Load	–	11	–	ns
Rise Time	t_r		–	19	–	
Turn–Off Delay Time	$t_{d(off)}$		–	15	–	
Fall Time	t_f		–	8	–	
Turn-On Switching Loss	E_{ON}		–	200	–	μJ
Turn-Off Switching Loss	E_{OFF}		–	34	–	
Total Switching Loss	E_{TOT}		–	234	–	
DRAIN–SOURCE DIODE CHARACTERISTICS						
Continuous Drain–to–Source Diode Forward Current	I_{SD}	$V_{GS} = -5$ V, $T_J = 25°C$	–	–	11	A
Pulsed Drain–to–Source Diode Forward Current (Note 2)	I_{SDM}	$V_{GS} = -5$ V, $T_J = 25°C$	–	–	69	A
Forward Diode Voltage	V_{SD}	$V_{GS} = -5$ V, $I_{SD} = 6$ A, $T_J = 25°C$	–	4	10	V
Reverse Recovery Time	t_{RR}	$V_{GS} = -5/20$ V, $I_{SD} = 16$ A, $dI_S/dt = 1000$ A/μs	–	15	–	ns
Reverse Recovery Charge	Q_{RR}		–	45	–	nC
Reverse Recovery Energy	E_{REC}		–	3.9	–	μJ
Peak Reverse Recovery Current	I_{RRM}		–	6.2	–	A
Charge Time	Ta		–	7.4	–	ns
Discharge Time	Tb		–	7	–	ns

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.
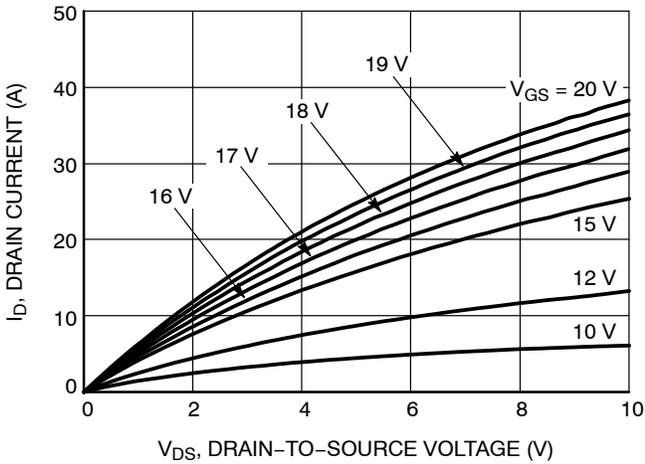
TYPICAL CHARACTERISTICS
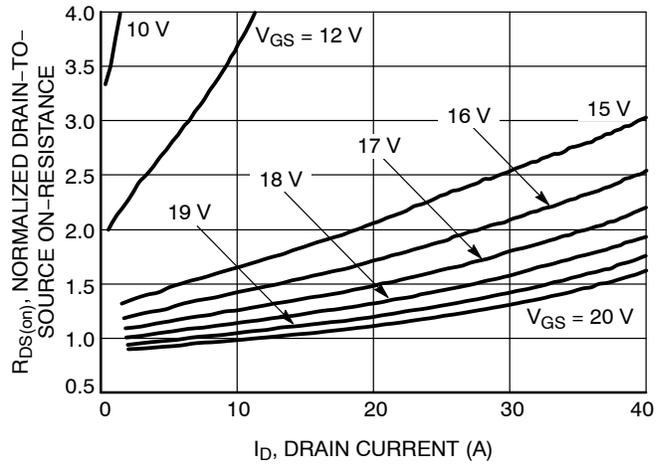

Figure 1. On−Region Characteristics

Figure 2. Normalized On−Resistance vs. Drain
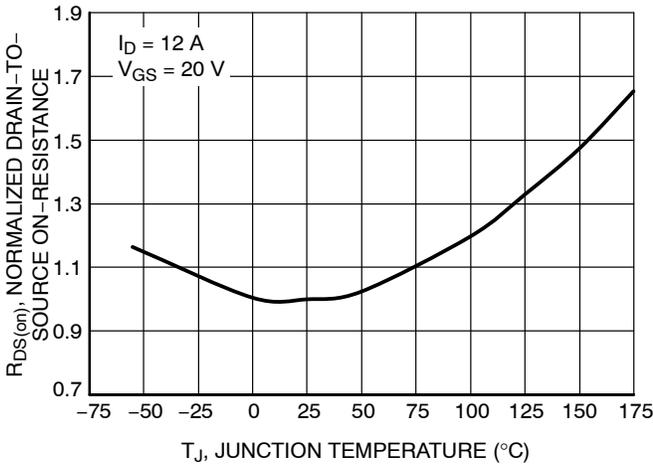Current and Gate Voltage

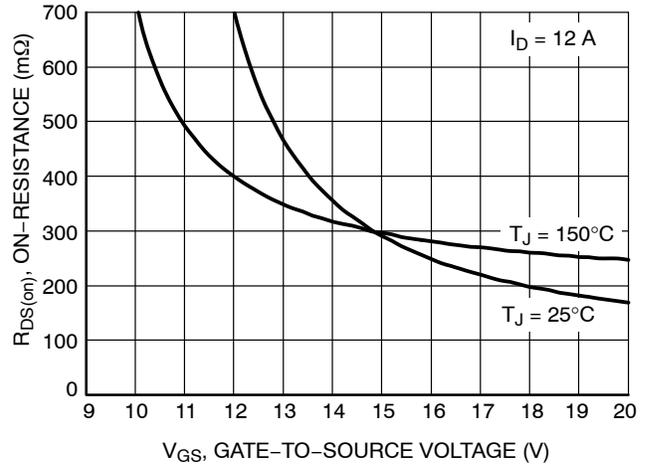Figure 3. On−Resistance Variation with
Temperature

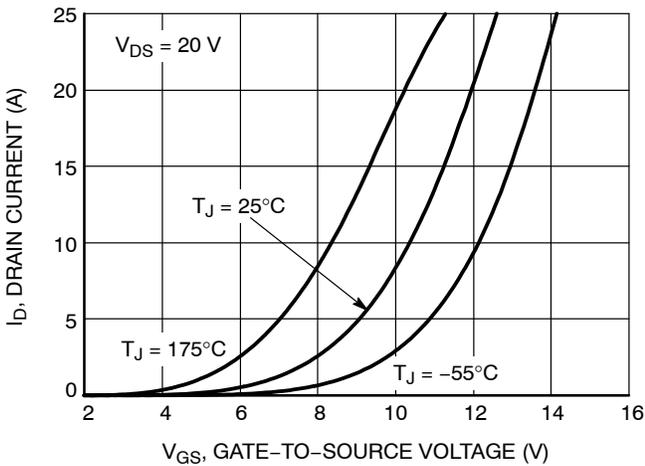Figure 4. On−Resistance vs. Gate−to−Source
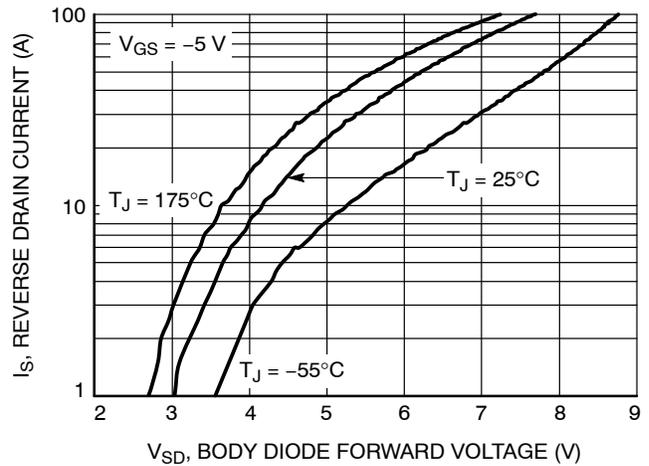Voltage

Figure 5. Transfer Characteristics

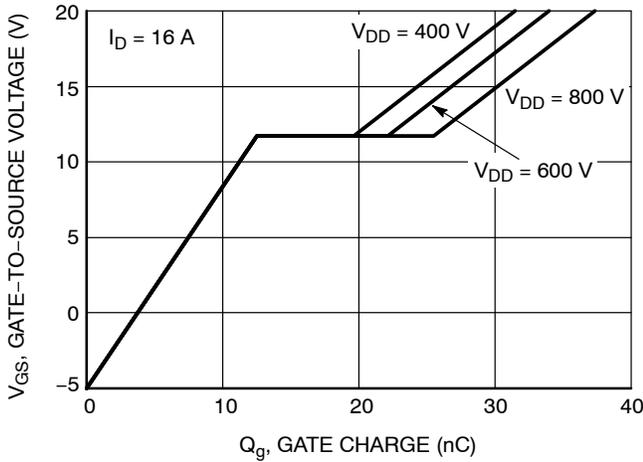Figure 6. Diode Forward Voltage vs. Current

TYPICAL CHARACTERISTICS
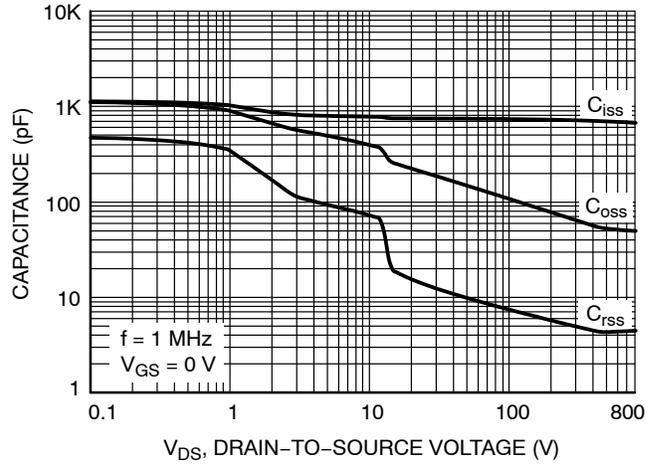

Figure 7. Gate–to–Source Voltage vs. Total Charge
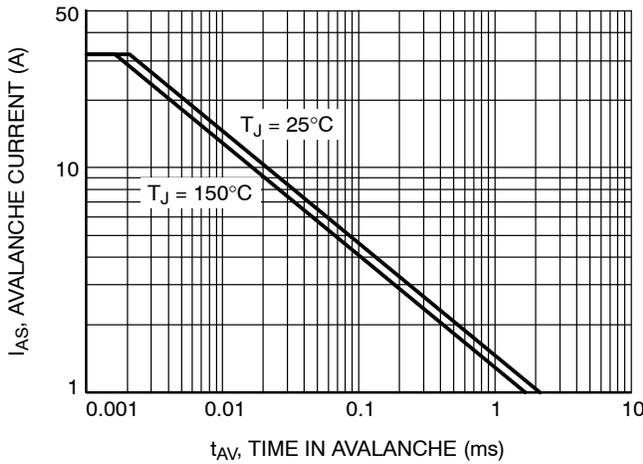

Figure 8. Capacitance vs. Drain–to–Source Voltage

Figure 9. Unclamped Inductive Switching Capability
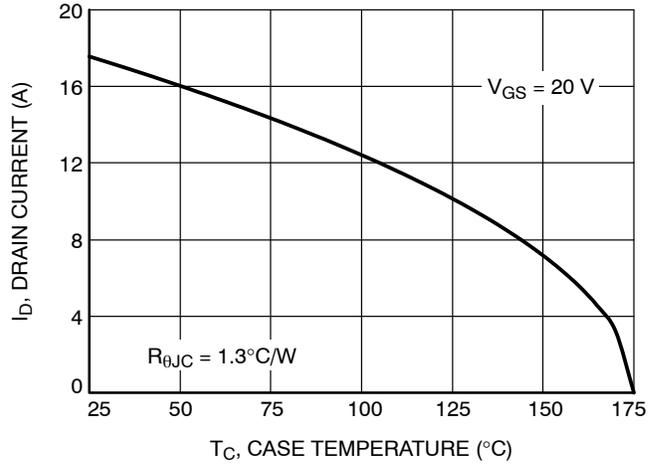
Figure 10. Maximum Continuous Drain Current vs. Case Temperature
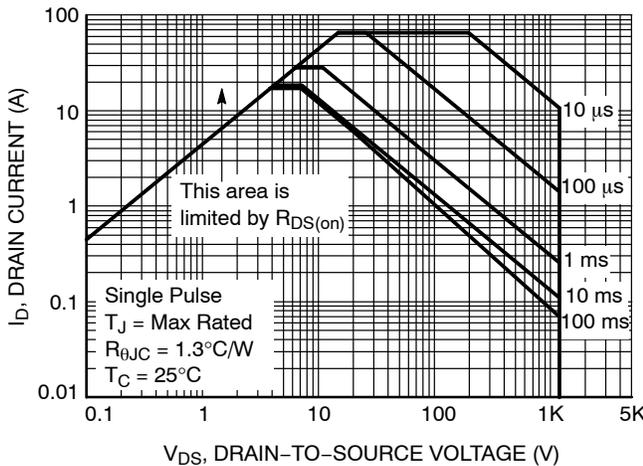
Figure 11. Safe Operating Area
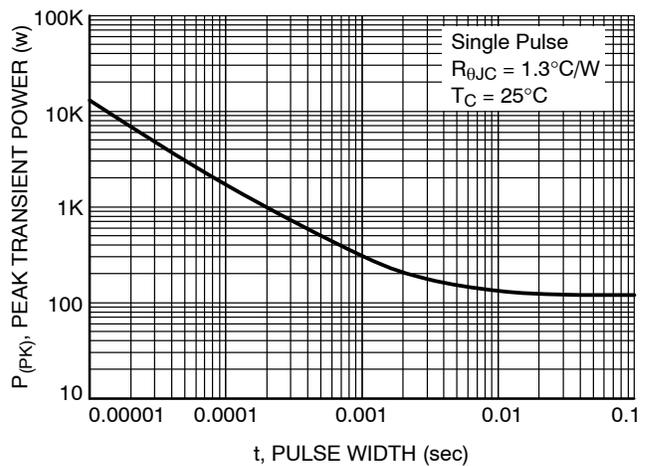
Figure 12. Single Pulse Maximum Power Dissipation

TYPICAL CHARACTERISTICS

r(t), NORMALIZED EFFECTIVE TRANSIENT THERMAL RESISTANCE (°C/W)

50% Duty Cycle
20%
10%
5%
2%
1%
Single Pulse

Notes:
$Z_{\theta JC}(t) = r(t) \times R_{\theta JC}$
$R_{\theta JC} = 1.3°C/W$
Peak $T_J = P_{DM} \times Z_{\theta JC}(t) + T_C$
Duty Cycle, $D = t_1/t_2$

t, RECTANGULAR PULSE DURATION (sec)
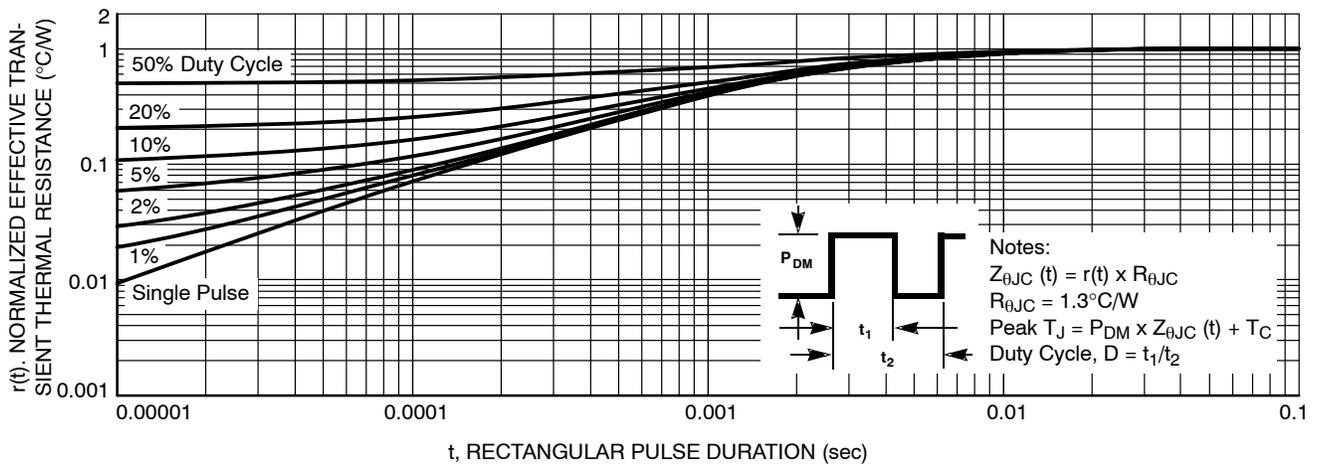
Figure 13. Junction−to−Ambient Thermal Response

PACKAGE MARKING AND ORDERING INFORMATION

Part Number	Top Marking	Package	Packing Method	Reel Size	Tape Width	Quantity
NVHL160N120SC1	NVHL160N120SC1	TO−247 Long Lead	Tube	N/A	N/A	30 Units

MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS

ON Semiconductor®

TO−247−3LD
CASE 340CX
ISSUE A

DATE 06 JUL 2020

$$\oplus \; 0.25 \; \textcircled{M} \; B \; A \textcircled{M}$$
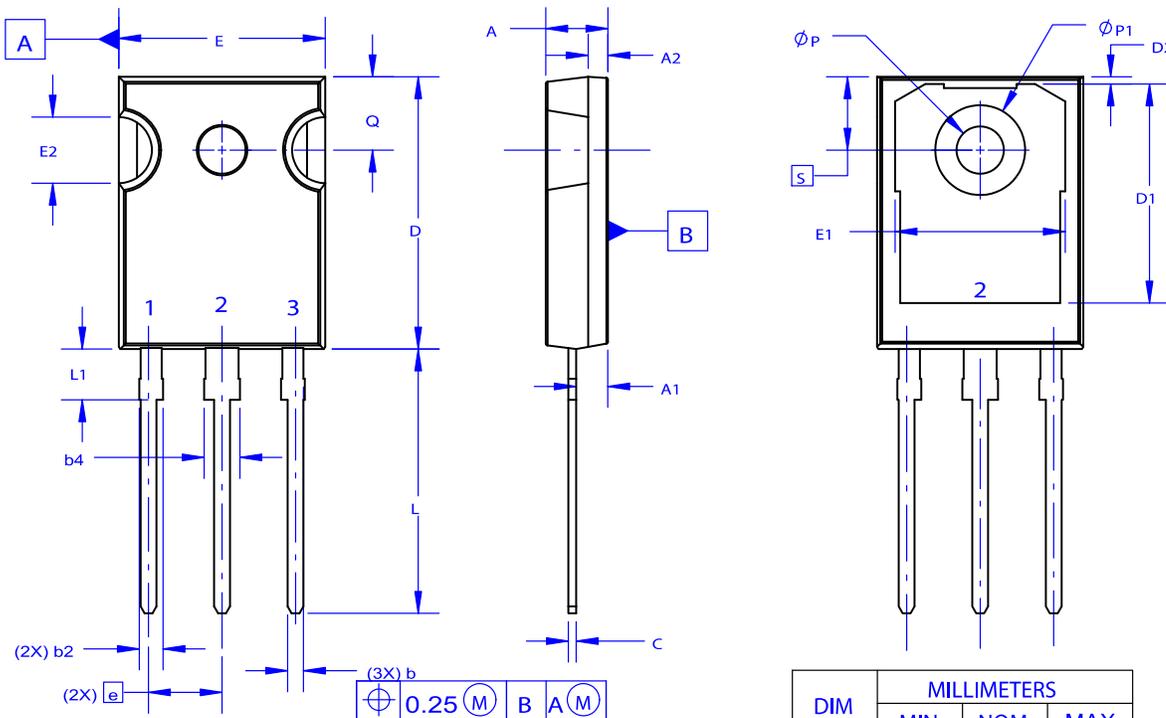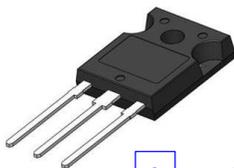
NOTES: UNLESS OTHERWISE SPECIFIED.

A. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD
    FLASH, AND TIE BAR EXTRUSIONS.
B. ALL DIMENSIONS ARE IN MILLIMETERS.
C. DRAWING CONFORMS TO ASME Y14.5 - 2009.
D. DIMENSION A1 TO BE MEASURED IN THE REGION DEFINED BY L1.
E. LEAD FINISH IS UNCONTROLLED IN THE REGION DEFINED BY L1.

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. Some products may
not follow the Generic Marking.

DIM	MILLIMETERS		
	MIN	NOM	MAX
A	4.58	4.70	4.82
A1	2.20	2.40	2.60
A2	1.40	1.50	1.60
D	20.32	20.57	20.82
E	15.37	15.62	15.87
E2	4.96	5.08	5.20
e	~	5.56	~
L	19.75	20.00	20.25
L1	3.69	3.81	3.93
$\varnothing$P	3.51	3.58	3.65
Q	5.34	5.46	5.58
S	5.34	5.46	5.58
b	1.17	1.26	1.35
b2	1.53	1.65	1.77
b4	2.42	2.54	2.66
c	0.51	0.61	0.71
D1	13.08	~	~
D2	0.51	0.93	1.35
E1	12.81	~	~
$\varnothing$P1	6.60	6.80	7.00

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PUBLICATION ORDERING INFORMATION

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