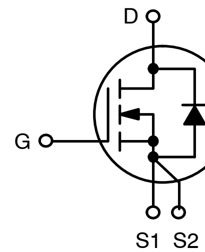
Silicon Carbide (SiC) MOSFET – 40 mohm, 1200 V, M1, TO-247-4L

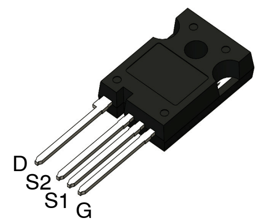
NVH4L040N120SC1

$V_{(BR)DSS}$	$R_{DS(ON)}$ MAX	I_D MAX
1200 V	56 mΩ @ 20 V	58 A



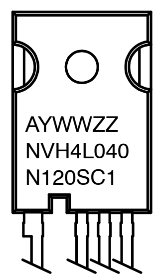
S1: Kelvin Source
S2: Power Source

N–CHANNEL MOSFET



TO247−4L
CASE 340CJ

MARKING DIAGRAM



A = Assembly Location
Y = Year
WW = Work Week
ZZ = Lot Traceability
NVH4L040N120SC1 = Specific Device Code

ORDERING INFORMATION

Device	Package	Shipping
NVH4L040N120SC1	TO247−4L	30 Units / Tube

Features

- Typ. $R_{DS(on)}$ = 40 mΩ
- Ultra Low Gate Charge ($Q_{G(tot)}$ = 106 nC)
- High Speed Switching with Low Capacitance (C_{oss} = 137 pF)
- 100% Avalanche Tested
- AEC−Q101 Qualified and PPAP Capable
- This Device is Halide Free and RoHS Compliant with exemption 7a, Pb−Free 2LI (on second level interconnection)

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 (Note 2)	Steady State	T_C = 25°C	I_D	58	A
Power Dissipation (Note 2)			P_D	319	W
Continuous Drain Current (Notes 1, 2)	Steady State	T_C = 100°C	I_D	41	A
Power Dissipation (Notes 1, 2)			P_D	160	W
Pulsed Drain Current (Note 3)	T_A = 25°C		I_{DM}	232	A
Single Pulse Surge Drain Current Capability	T_C = 25°C, t_p = 10 μs, R_G = 4.7 Ω		I_{DSC}	416	A
Operating Junction and Storage Temperature Range			T_J, T_{stg}	−55 to +175	°C
Source Current (Body Diode)			I_S	32	A
Single Pulse Drain−to−Source Avalanche Energy ($I_{L(pk)}$ = 34 A, L = 1 mH) (Note 4)			E_{AS}	578	mJ
Maximum Lead Temperature for Soldering (1/8″ from case for 5 s)			T_L	300	°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. JA is constant value to follow guide table of LV/HV discrete final datasheet generation.
2. The entire application environment impacts the thermal resistance values shown, they are not constants and are only valid for the particular conditions noted.
3. Repetitive rating, limited by max junction temperature.
4. EAS of 578 mJ is based on starting T_J = 25°C; L = 1 mH, I_{AS} = 34 A, V_{DD} = 120 V, V_{GS} = 20 V.

May, 2022 − Rev. 3
Publication Order Number:
NVH4L040N120SC1/D

Table 1. THERMAL RESISTANCE MAXIMUM RATINGS

Parameter	Symbol	Max	Unit
Junction−to−Case − Steady State (Note 2)	$R_{θJC}$	0.47	°C/W
Junction−to−Ambient − Steady State (Notes 1, 2)	$R_{θJA}$	40	

Table 2. ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise specified)

Parameter	Symbol	Test Condition		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		–	0.45	–	V/°C
Zero Gate Voltage Drain Current	I_{DSS}	V_{GS} = 0 V, V_{DS} = 1200 V	T_J = 25°C	–	–	100	μA
			T_J = 175°C	–	–	1	mA
Gate−to−Source Leakage Current	I_{GSS}	V_{GS} = +25/−15 V, V_{DS} = 0 V		–	–	±1	μA
ON CHARACTERISTICS (Note 3)							
Gate Threshold Voltage	$V_{GS(TH)}$	V_{GS} = V_{DS}, I_D = 10 mA		1.8	3.0	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 = 35 A, T_J = 25°C		–	40	56	mΩ
		V_{GS} = 20 V, I_D = 35 A, T_J = 175°C		–	70	100	
Forward Transconductance	g_{FS}	V_{DS} = 20 V, I_D = 35 A		–	20	–	S
CHARGES, CAPACITANCES & GATE RESISTANCE							
Input Capacitance	C_{ISS}	V_{GS} = 0 V, f = 1 MHz, V_{DS} = 800 V		–	1762	–	pF
Output Capacitance	C_{OSS}			–	137	–	
Reverse Transfer Capacitance	C_{RSS}			–	11	–	
Total Gate Charge	$Q_{G(TOT)}$	V_{GS} = −5/20 V, V_{DS} = 600 V, I_D = 47 A		–	106	–	nC
Threshold Gate Charge	$Q_{G(TH)}$			–	16	–	
Gate−to−Source Charge	Q_{GS}			–	34	–	
Gate−to−Drain Charge	Q_{GD}			–	26	–	
Gate−Resistance	R_G	f = 1 MHz		–	2.4	–	Ω
SWITCHING CHARACTERISTICS, VGS = 10 V							
Turn−On Delay Time	$t_{d(ON)}$	V_{GS} = −5/20 V, V_{DS} = 800 V, I_D = 47 A, R_G = 4.7 Ω Inductive load		–	17	30	ns
Rise Time	t_r			–	20	36	
Turn−Off Delay Time	$t_{d(OFF)}$			–	32	51	
Fall Time	t_f			–	10	20	
Turn−On Switching Loss	E_{ON}			–	411	–	μJ
Turn−Off Switching Loss	E_{OFF}			–	205	–	
Total Switching Loss	E_{tot}			–	616	–	
DRAIN−SOURCE DIODE CHARACTERISTICS							
Continuous Drain−Source Diode Forward Current	I_{SD}	V_{GS} = −5 V, T_J = 25°C		–	–	32	A
Pulsed Drain−Source Diode Forward Current (Note 3)	I_{SDM}			–	–	232	
Forward Diode Voltage	V_{SD}	V_{GS} = −5 V, I_{SD} = 17.5 A, T_J = 25°C		–	3.7	–	V

Table 2. ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise specified) (continued)

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
DRAIN−SOURCE DIODE CHARACTERISTICS						
Reverse Recovery Time	t_{RR}	V_{GS} = −5/20 V, I_{SD} = 47 A, dI_S/dt = 1000 A/μs	–	24	–	ns
Reverse Recovery Charge	Q_{RR}		–	124.8	–	nC
Reverse Recovery Energy	E_{REC}		–	8.4	–	μJ
Peak Reverse Recovery Current	I_{RRM}		–	10.4	–	A
Charge Time	Ta		–	12.4	–	ns
Discharge Time	Tb		–	11.6	–	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

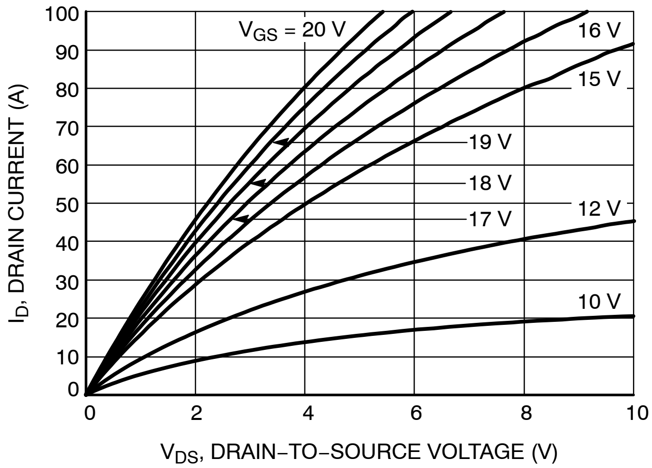


Figure 1. On−Region Characteristics

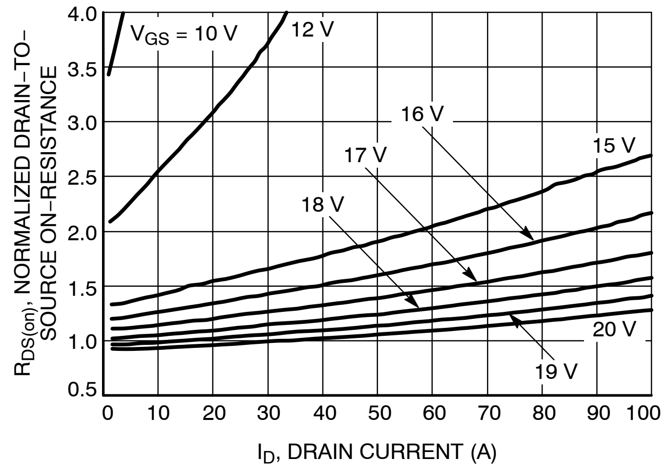


Figure 2. Normalized On−Resistance vs. Drain Current and Gate Voltage

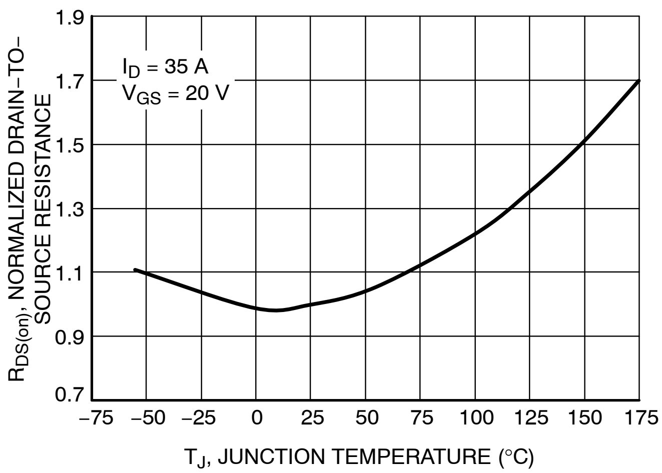


Figure 3. On−Resistance Variation with Temperature

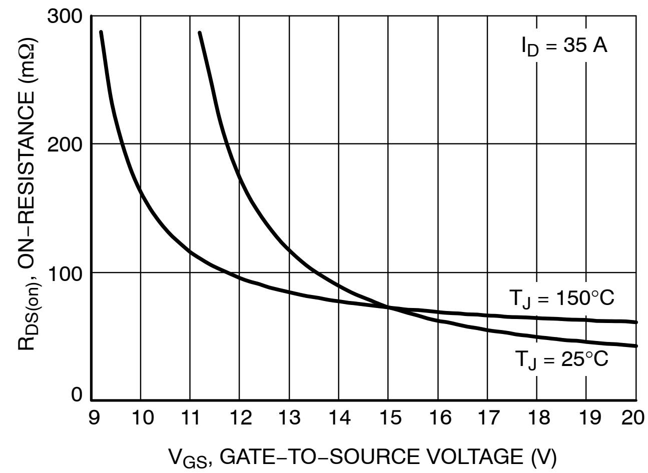


Figure 4. On−Resistance vs. Gate−to−Source Voltage

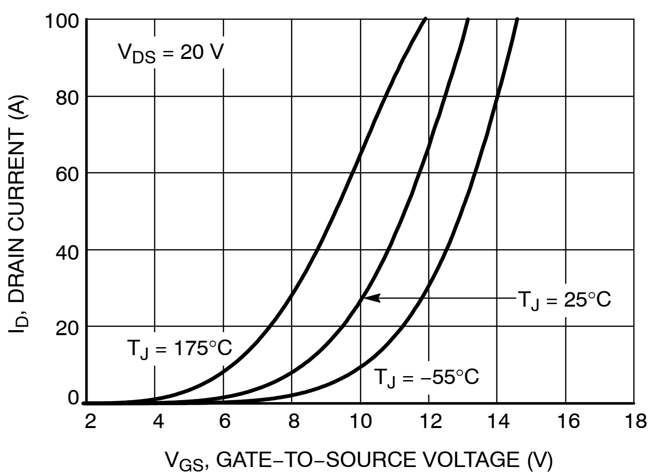


Figure 5. Transfer Characteristics

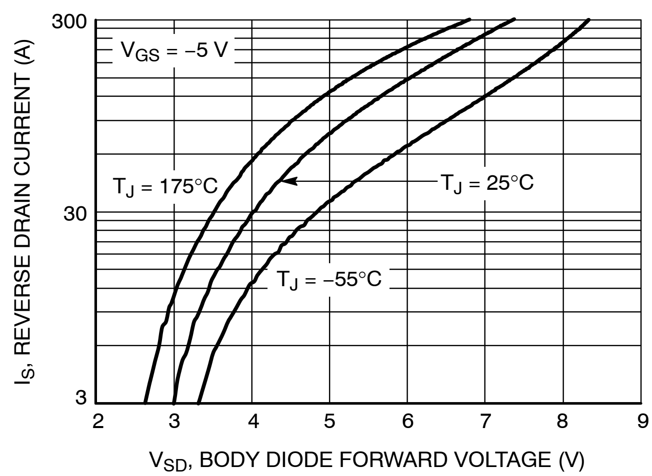


Figure 6. Diode Forward Voltage vs. Current

TYPICAL CHARACTERISTICS (continued)

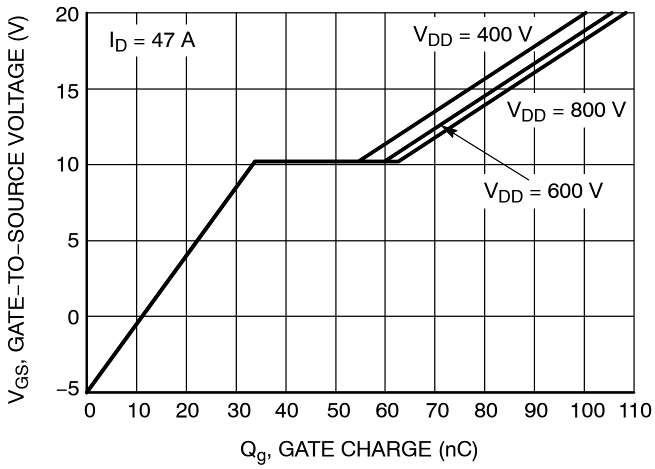


Figure 7. Gate−to−Source Voltage vs. Total Charge

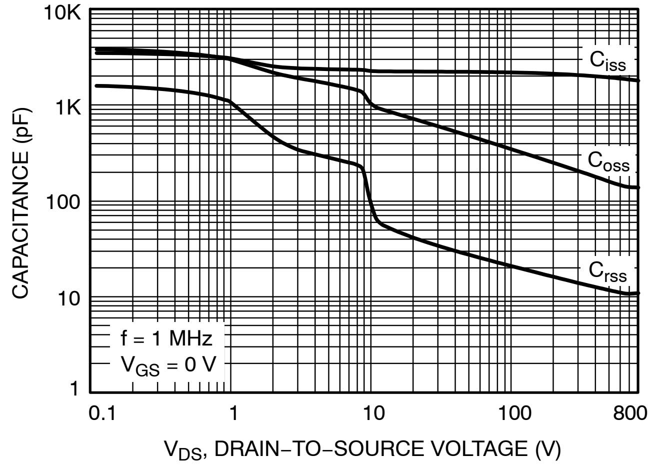


Figure 8. Capacitance vs. Drain−to−Source Voltage

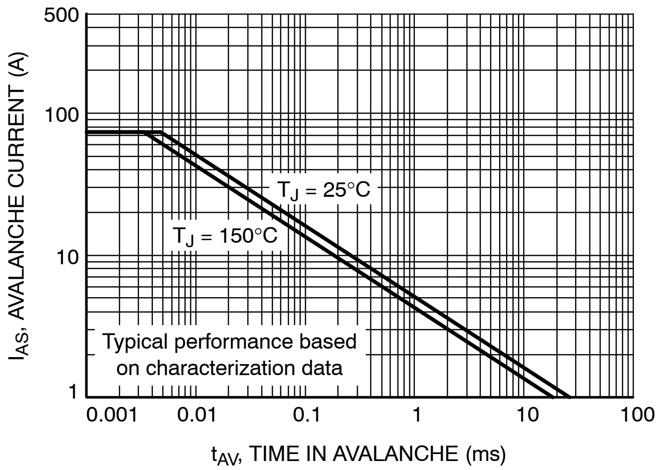


Figure 9. Unclamped Inductive Switching Capability

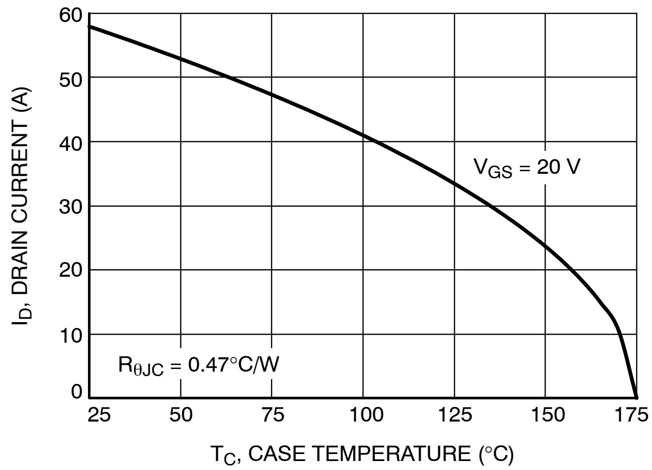


Figure 10. Maximum Continuous Drain Current vs. Case Temperature

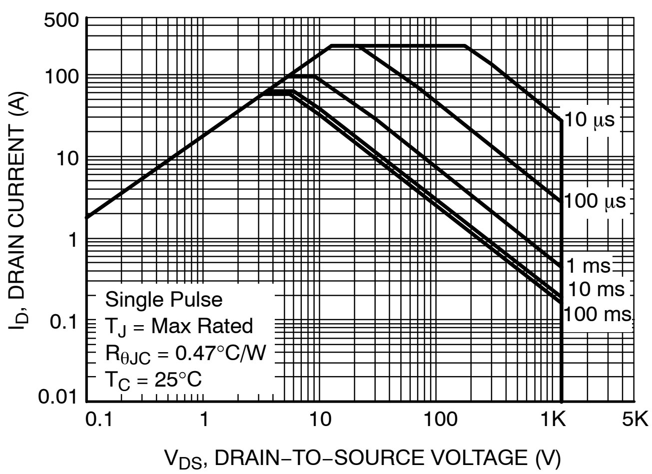


Figure 11. Safe Operating Area

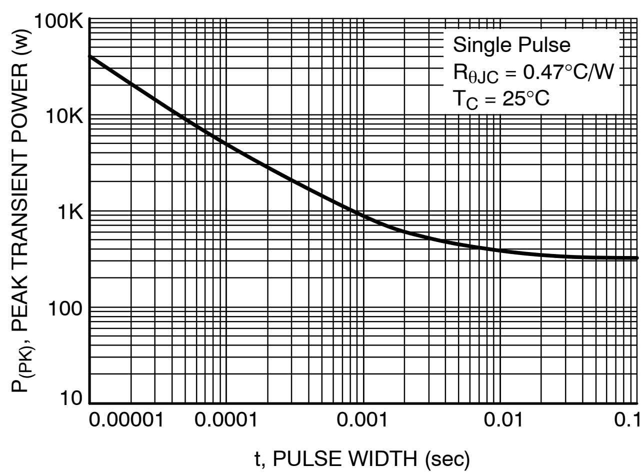


Figure 12. Single Pulse Maximum Power Dissipation

TYPICAL CHARACTERISTICS (continued)

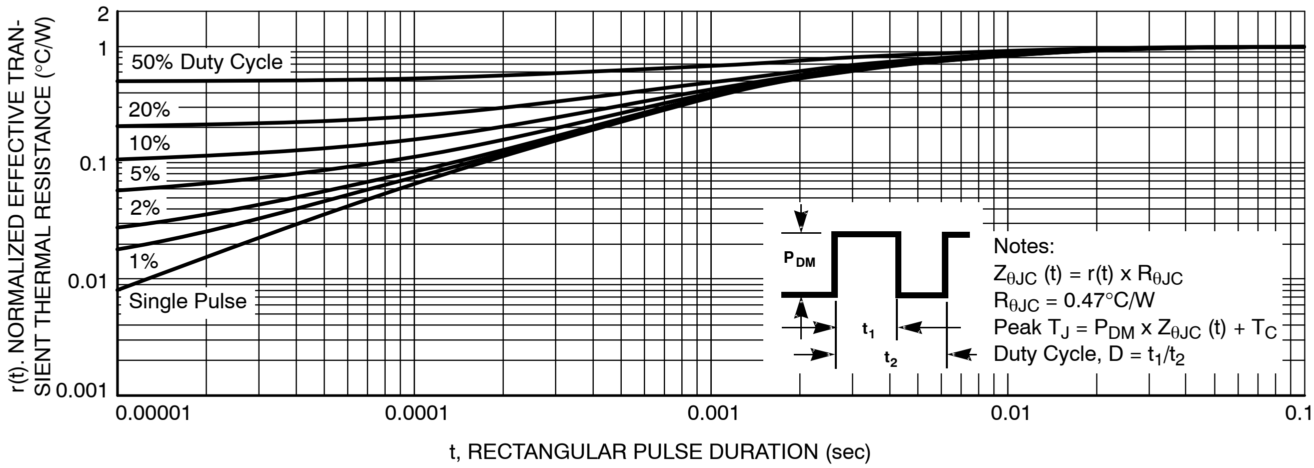


Figure 13. Junction−to−Ambient Thermal Response

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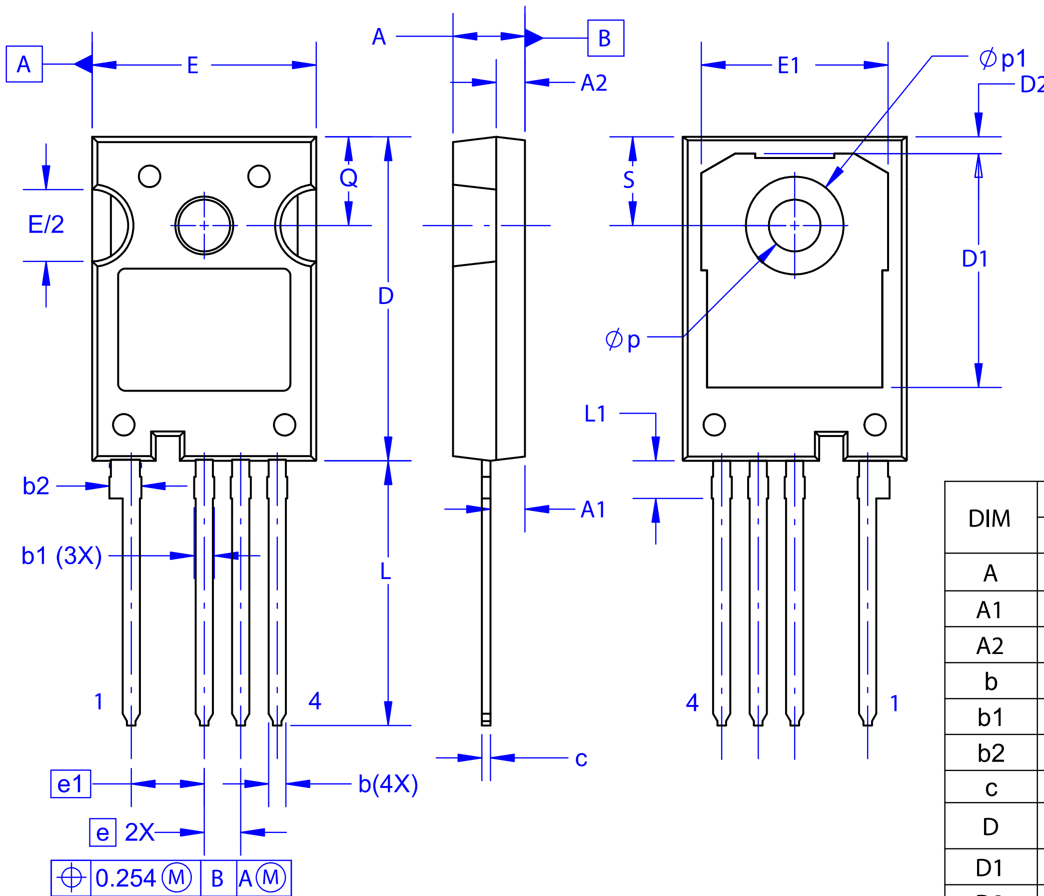
DATE 16 SEP 2019



DIM	MILLIMETERS		
	MIN	NOM	MAX
A	4.80	5.00	5.20
A1	2.10	2.40	2.70
A2	1.80	2.00	2.20
b	1.07	1.20	1.33
b1	1.20	1.40	1.60
b2	2.02	2.22	2.42
c	0.50	0.60	0.70
D	22.34	22.54	22.74
D1	16.00	16.25	16.50
D2	0.97	1.17	1.37
e		2.54 BSC	
e1		5.08 BSC	
E	15.40	15.60	15.80
E1	12.80	13.00	13.20
E/2	4.80	5.00	5.20
L	18.22	18.42	18.62
L1	2.42	2.62	2.82
p	3.40	3.60	3.80
p1	6.60	6.80	7.00
Q	5.97	6.17	6.37
S	5.97	6.17	6.37

NOTES:

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