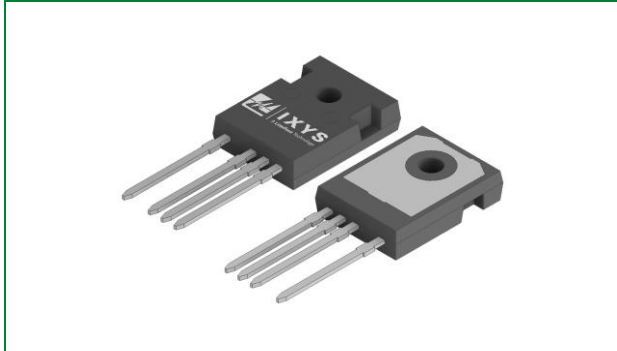


LSIC1MO120G0040  
1200 V, 40 mOhm N-Channel SiC MOSFET

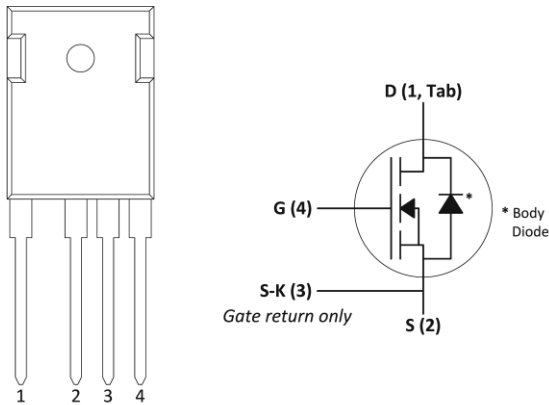


Agency Approvals and Environmental

Environmental Approvals



Pinout Diagram



Product Summary

Characteristic	Value	Unit
$V_{DS}$	1200	V
Typical $R_{DS(ON)}$	40	mOhm
$I_D$ ( $T_C \leq 100\text{ }^\circ\text{C}$ )	50	A

Features

- Optimized for high-frequency, high-efficiency applications
- Extremely low gate charge and output capacitance
- Low gate resistance for high-frequency switching
- Normally-off operations at all temperatures
- Ultra-low on-resistance
- Optimized package with separate driver source pin
- RoHS compliant, lead-free, and halogen-free

Applications

- High-frequency applications
- Solar Inverters
- Switch Mode Power Supplies
- UPS
- Motor Drives
- High Voltage DC/DC Converters
- Battery Chargers
- Induction Heating

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### 1. Maximum Ratings

Characteristic	Symbol	Conditions	Value	Unit
Drain-Source Voltage	$V_{DS}$	$V_{GS} = 0\text{ V}$	1200	V
Continuous Drain Current	$I_D$	$V_{GS} = 20\text{ V}, T_C = 25\text{ }^\circ\text{C}$	70	A
		$V_{GS} = 20\text{ V}, T_C = 100\text{ }^\circ\text{C}$	50	
Pulsed Drain Current <sup>1</sup>	$I_{D(pulse)}$	$T_C = 25\text{ }^\circ\text{C}$	130	A
Power Dissipation	$P_D$	$T_C = 25\text{ }^\circ\text{C}, T_J = 175\text{ }^\circ\text{C}$	357	W
Gate-Source Voltage	$V_{GS,MAX}$	Absolute maximum values – Steady state	-6 to +22	V
	$V_{GS,OP,TR}$ <sup>2</sup>	Transient, $t_{transient} < 300\text{ nsec}$	-10 to +25	
	$V_{GS,OP}$ <sup>3</sup>	Recommended DC operating values	-5 to +20	
Operating Junction Temperature	$T_J$	-	-55 to +175	$^\circ\text{C}$
Storage Temperature	$T_{STG}$	-	-55 to +150	$^\circ\text{C}$
Lead Temperature for Soldering	$T_{sold}$	-	260	$^\circ\text{C}$
Mounting Torque	$M_D$	M3 or 6-32 screw	1.0	Nm
			8.8	in-lb

Footnote 1: Pulse width limited by  $T_{J,MAX}$

Footnote 2: See Figure 21.  $V_{GS}$  Waveform Definition for further information

Footnote 3: MOSFET can operate with  $V_{GS(OFF)} = 0\text{ V}$ .  $V_{GS(OFF)} = -5\text{ V}$  provides added noise margin and faster turn-off speed

### 2. Thermal Characteristics

Characteristic	Symbol	Value	Unit
Maximum Thermal Resistance, junction-to-case	$R_{th,JC,MAX}$	0.42	$^\circ\text{C/W}$
Maximum Thermal Resistance, junction-to-ambient	$R_{th,JA,MAX}$	40	$^\circ\text{C/W}$

### 3. Electrical Characteristics

#### 3.1. Static Characteristics ( $T_J = 25\text{ }^\circ\text{C}$ unless otherwise specified)

Characteristic	Symbol	Conditions	Value			Unit
			Min	Typ	Max	
Drain-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0\text{ V}, I_D = 100\text{ }\mu\text{A}$	1200	-	-	V
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 1200\text{ V}, V_{GS} = 0\text{ V}$	-	<1	100	$\mu\text{A}$
		$V_{DS} = 1200\text{ V}, V_{GS} = 0\text{ V}, T_J = 175\text{ }^\circ\text{C}$	-	<1	-	
Gate Leakage Current	$I_{GSS,F}$	$V_{GS} = 22\text{ V}, V_{DS} = 0\text{ V}$	-	-	100	nA
	$I_{GSS,R}$	$V_{GS} = -6\text{ V}, V_{DS} = 0\text{ V}$	-	-	100	
Drain-Source On-State Resistance	$R_{DS(ON)}$	$I_D = 40\text{ A}, V_{GS} = 20\text{ V}$	-	40	50	m $\Omega$
		$I_D = 40\text{ A}, V_{GS} = 20\text{ V}, T_J = 175\text{ }^\circ\text{C}$	-	65	-	
Gate Threshold Voltage	$V_{GS(TH)}$	$V_{DS} = V_{GS}, I_D = 20\text{ mA}$	1.8	2.7	4	V
		$V_{DS} = V_{GS}, I_D = 20\text{ mA}, T_J = 175\text{ }^\circ\text{C}$	-	1.7	-	
Gate Resistance	$R_G$	Resonance method, Drain-Source shorted <sup>1</sup>	-	0.8	-	$\Omega$

Footnote 1: For a description of the resonance method for measuring  $R_G$ , refer to the JEDEC Standard JESD24-11 test method

3.2. Dynamic Characteristics (T<sub>J</sub> = 25 °C unless otherwise specified)

Characteristic	Symbol	Conditions	Value			Unit
			Min	Typ	Max	
Turn-On Switching Energy	E <sub>ON</sub>	V <sub>DD</sub> = 800 V, I <sub>D</sub> = 40 A, V <sub>GS</sub> = -5 / +20 V, R <sub>G,ext</sub> = 2.5 Ω, L = 350 μH, FWD = LSIC2SD120A20	-	380	-	μJ
Turn-Off Switching Energy	E <sub>OFF</sub>		-	92	-	
Total Per-Cycle Switching Energy	E <sub>TS</sub>		-	472	-	
Input Capacitance	C <sub>ISS</sub>	V <sub>DD</sub> = 800 V, V <sub>GS</sub> = 0 V, f = 1 MHz, V <sub>AC</sub> = 25 mV	-	3170	-	pF
Output Capacitance	C <sub>OSS</sub>		-	140	-	
Reverse Transfer Capacitance	C <sub>RSS</sub>		-	13	-	
COSS Stored Energy	E <sub>OSS</sub>		-	45	-	
Total Gate Charge	Q <sub>g</sub>	V <sub>DD</sub> = 800 V, I <sub>D</sub> = 40 A, V <sub>GS</sub> = -5 / +20 V	-	175	-	nC
Gate-Source Charge	Q <sub>gs</sub>		-	53	-	
Gate-Drain Charge	Q <sub>gd</sub>		-	58	-	
Turn-On Delay Time	t <sub>d(on)</sub>	V <sub>DD</sub> = 800 V, I <sub>D</sub> = 40 A, V <sub>GS</sub> = -5 / +20 V, R <sub>G,ext</sub> = 2 Ω, R <sub>L</sub> = 20 Ω, Timing relative to V <sub>DS</sub>	-	13	-	ns
Rise Time	t <sub>r</sub>		-	9	-	
Turn-Off Delay Time	t <sub>d(off)</sub>		-	22	-	
Fall Time	t <sub>f</sub>		-	8	-	

4. Reverse Diode Characteristics (T<sub>J</sub> = 25 °C unless otherwise specified)

Characteristic	Symbol	Conditions	Value			Unit
			Min	Typ	Max	
Diode Forward Voltage	V <sub>SD</sub>	I <sub>S</sub> = 20 A, V <sub>GS</sub> = -5 V	-	4.3	-	V
		I <sub>S</sub> = 20 A, V <sub>GS</sub> = -5 V, T <sub>J</sub> = 175 °C	-	3.8	-	
Continuous Diode Forward Current	I <sub>S</sub>	V <sub>GS</sub> = -5 V, T <sub>C</sub> = 25 °C	-	-	60	A
Peak Diode Forward Current <sup>1</sup>	I <sub>SP</sub>		-	-	130	
Reverse Recovery Time	t <sub>rr</sub>	V <sub>GS</sub> = -5 V, I <sub>S</sub> = 40 A, V <sub>R</sub> = 800 V, di/dt = 8.4 A/ns	-	13	-	ns
Reverse Recovery Charge	Q <sub>rr</sub>		-	403	-	nC
Peak Reverse Recovery Current	I <sub>rrm</sub>		-	51	-	A

Footnote 1: Pulse width limited by T<sub>J,MAX</sub>

5. Performance Curves

Figure 1. Maximum Power Dissipation ( $T_J = 175\text{ }^\circ\text{C}$ )

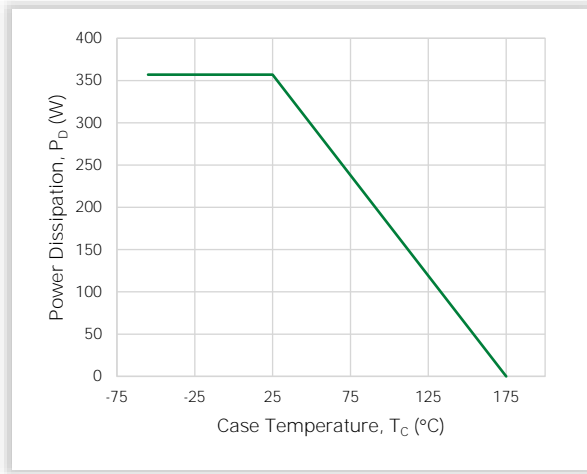


Figure 2. Typical Transfer Characteristics

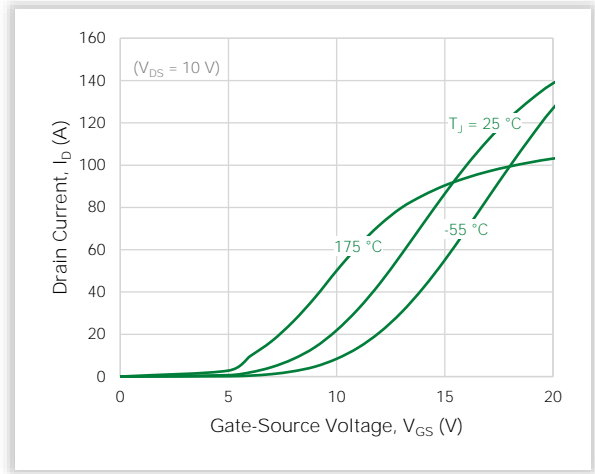


Figure 3. Typical Output Characteristics ( $T_J = 25\text{ }^\circ\text{C}$ )

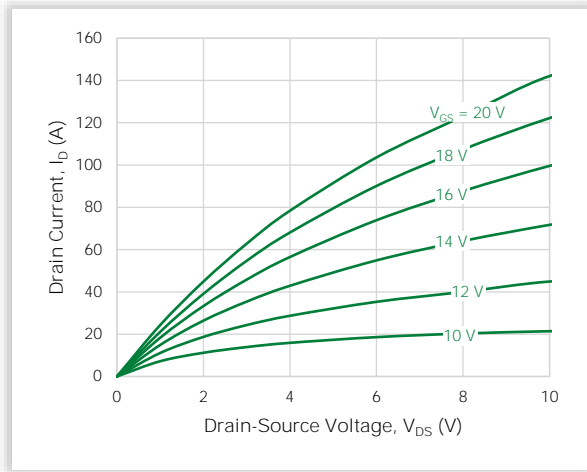


Figure 4. Typical Output Characteristics ( $T_J = 175\text{ }^\circ\text{C}$ )

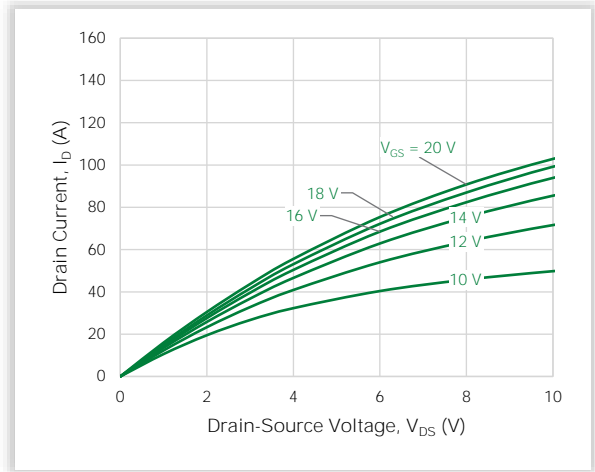


Figure 5. Typical Output Characteristics ( $T_J = -55\text{ }^\circ\text{C}$ )

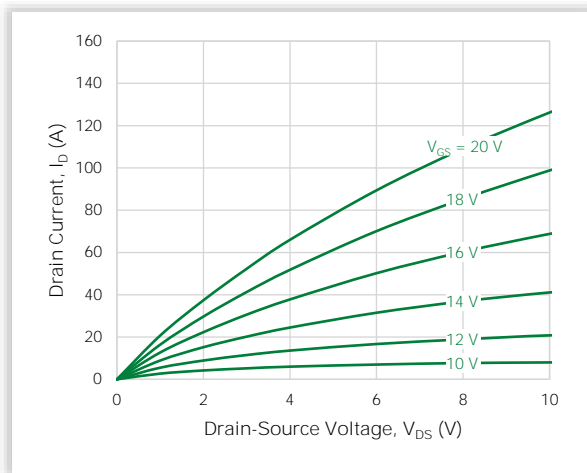


Figure 6. Typical Reverse Conduction Characteristics ( $T_J = 25\text{ }^\circ\text{C}$ )

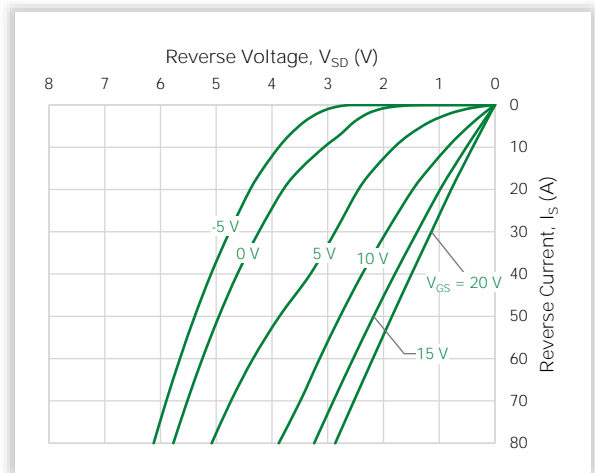


Figure 7. Typical Reverse Conduction Characteristics ( $T_J = 175\text{ }^\circ\text{C}$ )

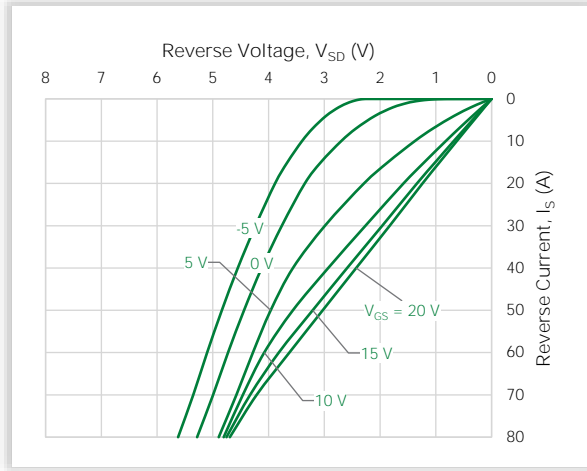


Figure 8. Typical Reverse Conduction Characteristics ( $T_J = -55\text{ }^\circ\text{C}$ )

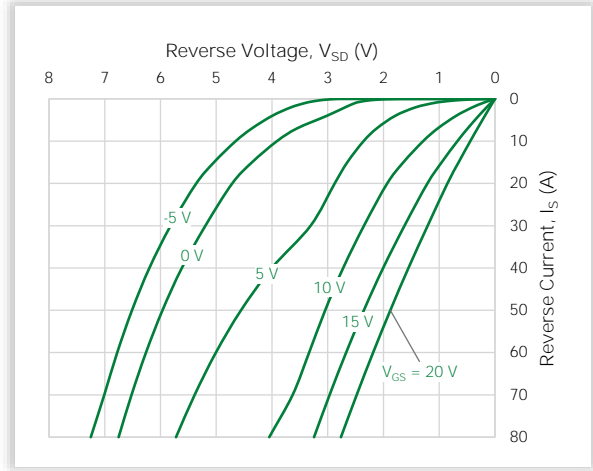


Figure 9. Transient Thermal Impedance

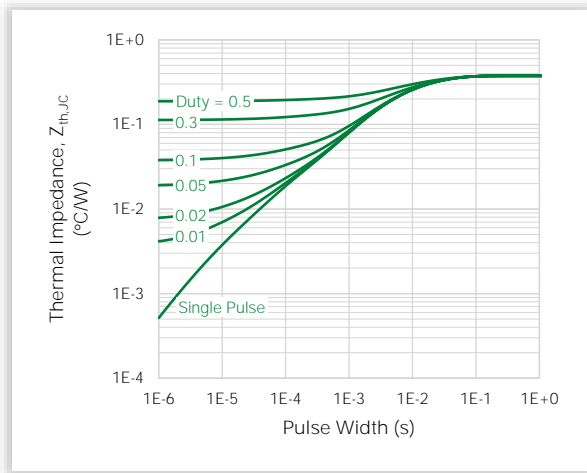


Figure 10. Maximum Safe Operating Area ( $T_C = 25\text{ }^\circ\text{C}$ )

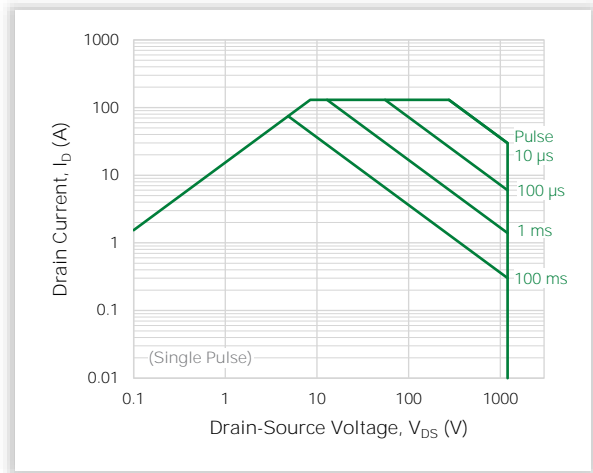


Figure 11. On-resistance vs. Drain Current

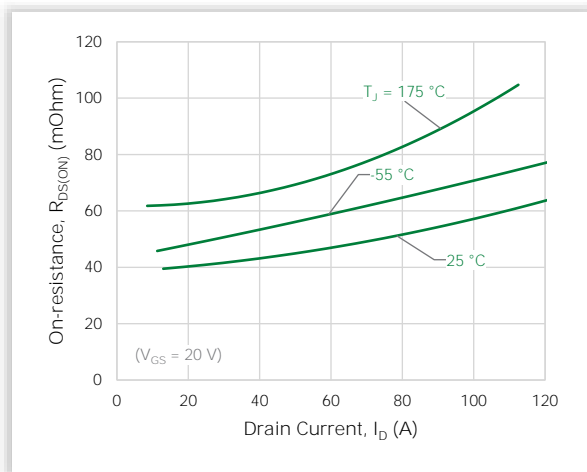


Figure 12. Normalized On-resistance vs. Junction Temperature

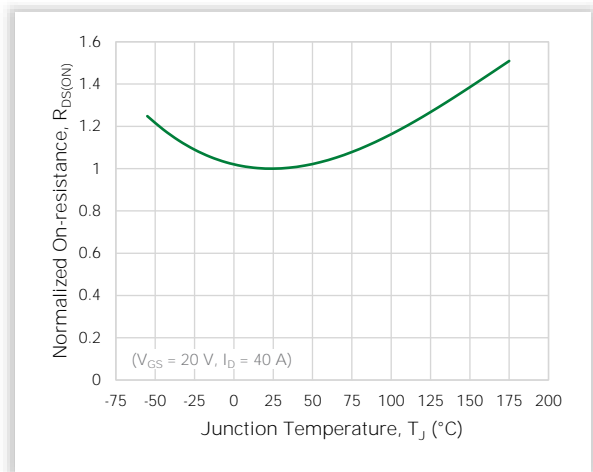


Figure 13. Typical On-resistance vs. Junction Temperature

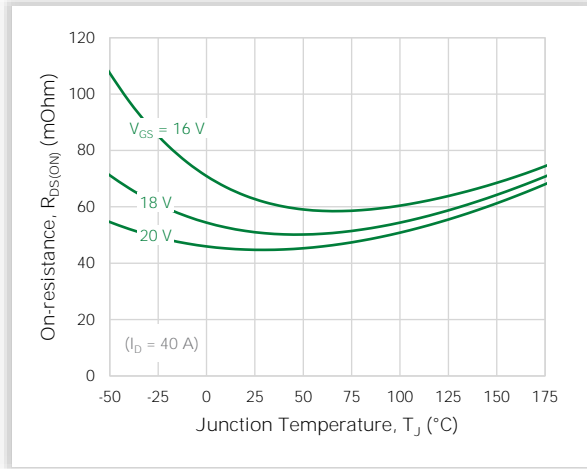


Figure 14. Typical Threshold Voltage

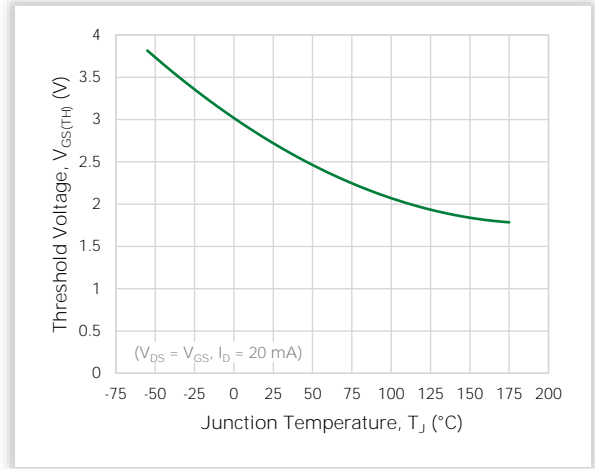


Figure 15. Typical Junction Capacitances up to 1000 V

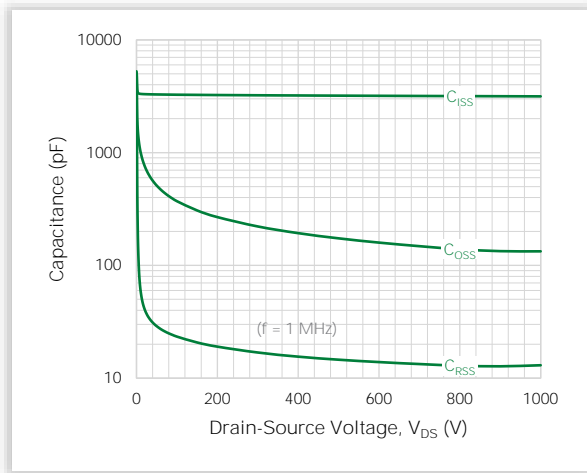


Figure 16. Typical Junction Capacitances up to 200 V

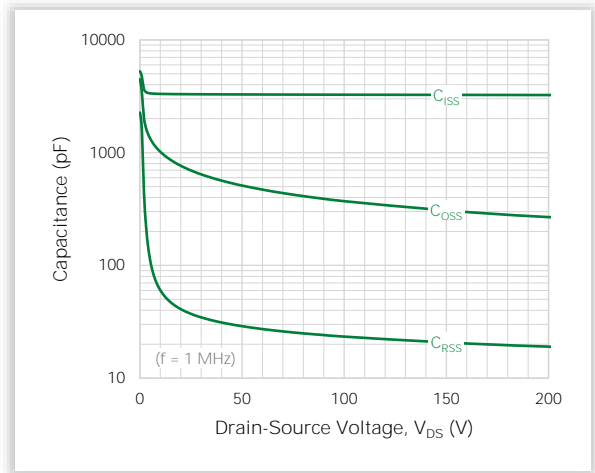


Figure 17. Typical  $C_{oss}$  Stored Energy  $E_{oss}$

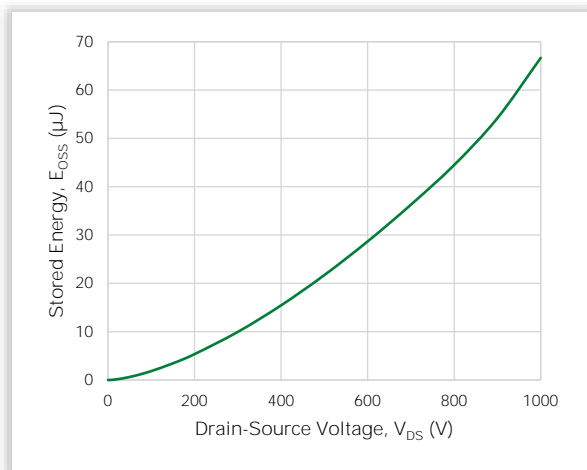


Figure 18. Typical Gate Charge

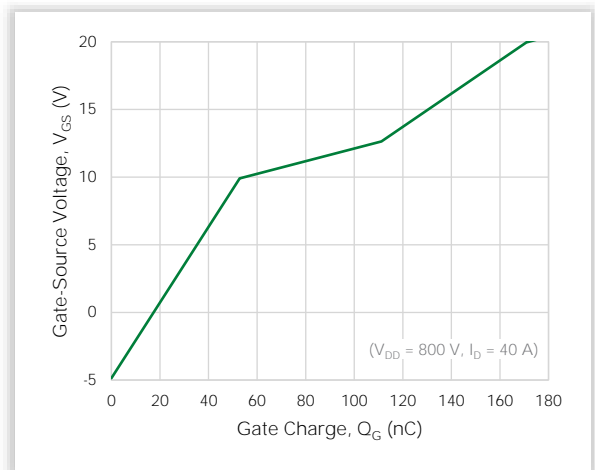


Figure 19. Typical Switching Energy vs. Drain Current

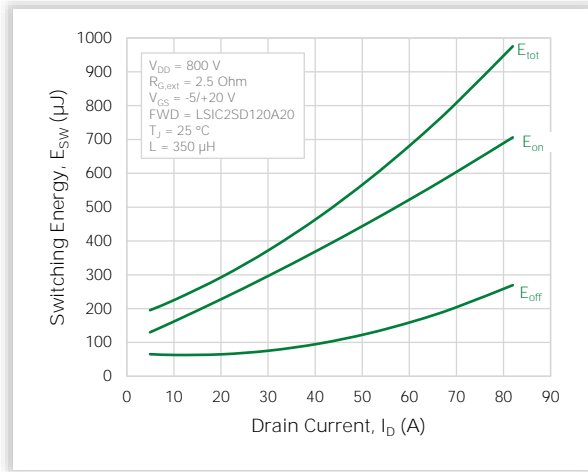


Figure 20. Typical Switching Energy vs. External Gate Resistance

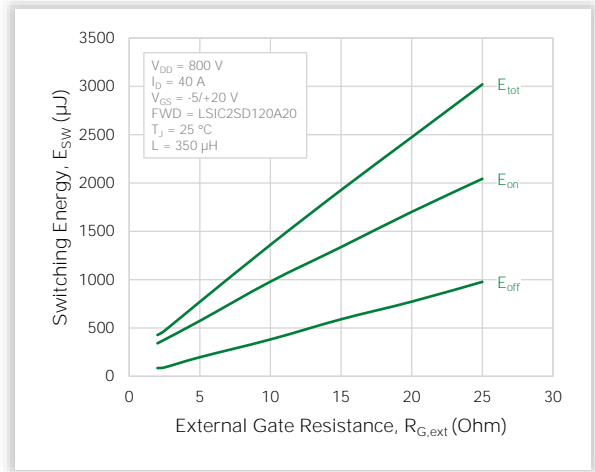
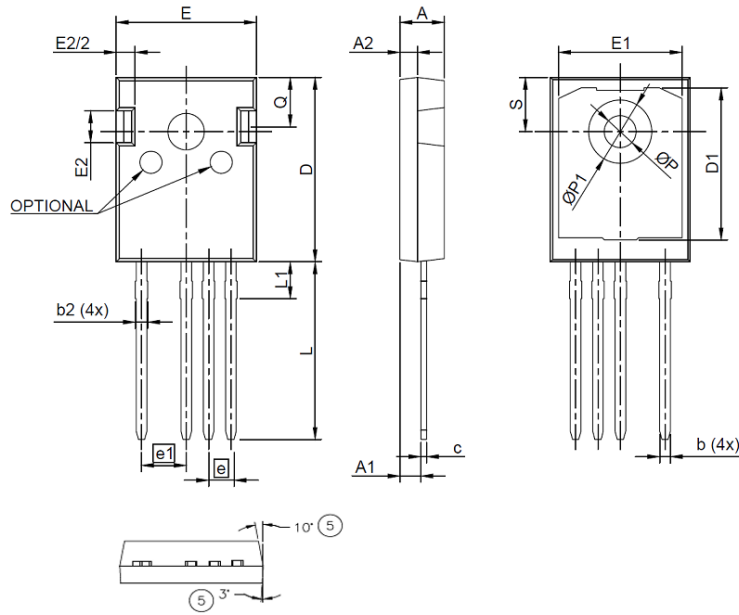


Figure 21.  $V_{GS}$  Waveform Definition



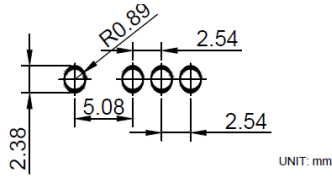


### 6. Package Dimensions



Symbol	Millimeters	
	Min	Max
A	4.70	5.31
A1	2.21	2.59
A2	1.50	2.49
b	0.99	1.40
b2	1.65	2.39
c	0.38	0.89
D	20.80	21.46
D1	13.08	-
D2	0.51	1.35
E	15.49	16.26
e	2.54 BSC	
e1	4.83	5.33
E1	13.46	-
E2	3.56	4.06
L	19.81	20.32
L1	-	4.50
$\phi P$	3.56	3.66
$\phi P1$	7.06	7.39
Q	5.38	6.20
S	6.17 BSC	

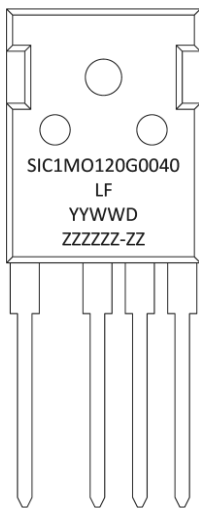
Recommended Hole Pattern Layout:



Notes:

1. Dimensioning and tolerancing as per ASME Y14.5 – 2009.
2. Package outline in compliance with JEDEC Standard Var. Ad.
3. Dimension D, E do not include mold flash.
4. Mold draft angles excluded on the table.
5.  $\phi P$  to have a maximum draft angle of 1.7° to the top with a maximum hole diameter of 3.912 mm.

### 7. Part Numbering and Marking



- SiC = SiC
- 1 = Gen 1
- MO = MOSFET
- 120 = Voltage Rating (1200 V)
- G = TO-247-4L
- 0040 =  $R_{DS(ON)}$  (40 mOhm)
- YY = Year
- WW = Week
- D = Special Code
- ZZZZZZ-ZZ = Lot Number

### 8. Packing Options

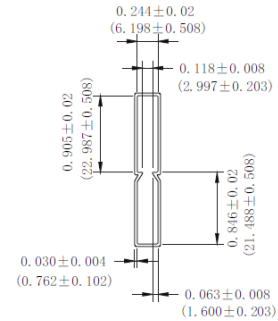
Part Number	Marking	Packing Mode	M.O.Q.
LSIC1MO120G0040	SIC1MO120G0040	Tube (30 pcs)	450

9. Packing Specifications



NOTE:

1. All pin plug holes are considered critical dimension
2. Tolerance is to be  $\pm 0.010$  unless otherwise specified
3. Dimension are in inch (and millimeters).



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