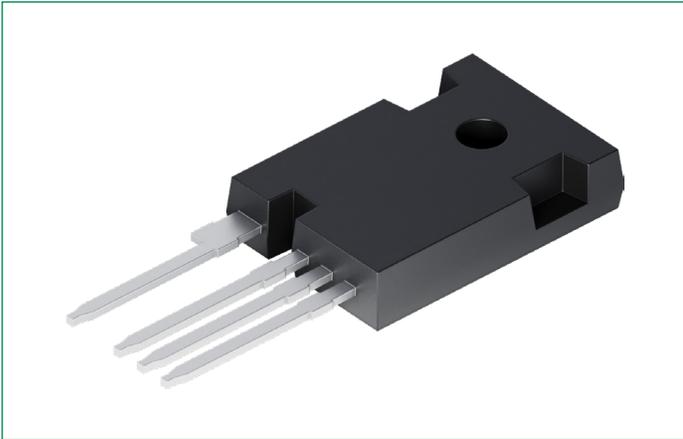


# IXSH20N120L2KHV

1200 V, 160 mΩ, 20 A SiC MOSFET

RoHS

HF



## Features

- High blocking voltage with low on-state resistance
- High-speed switching with low capacitance
- Maximum virtual junction temperature of  $T_{vj} = 175\text{ °C}$
- Ultra-fast intrinsic body diode
- Kelvin source contact
- MSL1 rated

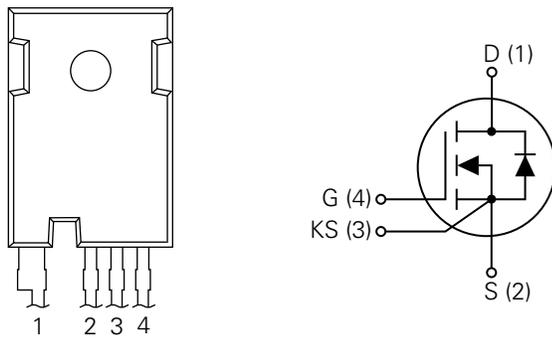
## Applications

- Switch mode power supplies
- UPS
- EV charging infrastructure
- Energy storage system

## Product Summary

Characteristic	Value	Unit
$V_{DSS}$	1200	V
$R_{DS(on)}$	160	mΩ
$I_b @ 25\text{ °C}$	20	A

## Pinout Diagram (TO-247-4L)



**D:** Drain; **G:** Gate; **KS:** Kelvin Source; **S:** Power Source

**Maximum Ratings** ( $T_c = 25\text{ °C}$  unless otherwise specified)

Symbol	Characteristic	Conditions	Value	Unit
$V_{DSS}$	Drain-source voltage Fig.27	$V_{GS} = 0\text{ V}, I_D = 100\text{ }\mu\text{A}$	1200	V
$V_{GSM}$	Maximum gate-source voltage	–	–5 to +20	V
	Transient gate-source voltage	$t_{transient} = 200\text{ ns}, D < 1\%$	–10 to +23	
$I_D$	Drain current (continuous) Fig.23	$V_{GS} = 18\text{ V}, T_c = 25\text{ °C}$	20	A
		$V_{GS} = 18\text{ V}, T_c = 100\text{ °C}$	15	A
$I_{DM}$	Peak drain current Fig. 25, 26	Pulse width limited by SOA and thermal impedance $Z_{th}$	50	A
$I_{SM}$	Diode pulsed forward current Fig. 25, 26	Pulse width limited by SOA and thermal impedance $Z_{th}$	50	A
$E_{AS}$	Non-repetitive single pulse avalanche energy	$V_{DD} = 50\text{ V}, L = 10\text{ mH}$	400	mJ
$P_{tot}$	Total power dissipation Fig. 24	$T_c = 25\text{ °C}$	136	W
$T_{vj}$	Virtual junction temperature range	–	–55 to +175	°C
$T_{stg}$	Storage temperature range	–	–55 to +175	°C
$T_{sold}$	Soldering temperature	Wave soldering only allowed at leads, 1.6 mm from case for 10 s	260	°C

**Recommended Values**

Symbol	Characteristic	Value			Unit
		Min.	Typ.	Max.	
$V_{Gson}$	Recommended turn-on voltage	15	–	18	V
$V_{Gsoff}$	Recommended turn-off voltage	–5	–3.5	–2	

**Thermal Characteristics**

Symbol	Characteristic	Value			Unit
		Min.	Typ.	Max.	
$R_{th(j-c)}$	Thermal resistance from junction to case Fig. 25	–	1.1	–	K/W

**Electrical Characteristics – Static** ( $T_c = 25\text{ °C}$  unless otherwise specified)

Symbol	Characteristic	Conditions	Value			Unit
			Min.	Typ.	Max.	
$I_{DSS}$	Drain-source leakage current	$V_{DS} = 1200\text{ V}, V_{GS} = 0\text{ V}$	–	1	100	$\mu\text{A}$
$I_{GSS}$	Gate leakage current	$V_{DS} = 0\text{ V}, V_{GS} = -5 \sim 20\text{ V}$	–	–	$\pm 100$	nA
$V_{GS(th)}$	Gate threshold voltage Fig. 8, 9	$V_{GS} = V_{DS}, I_D = 2\text{ mA}$	1.8	3.0	4.5	V
		$V_{GS} = V_{DS}, I_D = 2\text{ mA}, T_{vj} = 175\text{ °C}$	–	2.2	–	
$R_{DS(on)}$	Drain-source on-state resistance Fig. 4, 5, 6, 7	$V_{GS} = 18\text{ V}, I_D = 5\text{ A} @ T_{vj} = 25\text{ °C}$	–	160	208	m $\Omega$
		$V_{GS} = 18\text{ V}, I_D = 5\text{ A} @ T_{vj} = 175\text{ °C}$	–	260	–	
		$V_{GS} = 15\text{ V}, I_D = 5\text{ A} @ T_{vj} = 25\text{ °C}$	–	210	–	
		$V_{GS} = 15\text{ V}, I_D = 5\text{ A} @ T_{vj} = 175\text{ °C}$	–	280	–	

### Electrical Characteristics – Dynamic ( $T_{vj} = 25\text{ °C}$ unless otherwise specified)

Symbol	Characteristic	Conditions	Value			Unit	
			Min.	Typ.	Max.		
$C_{iss}$	Input capacitance Fig. 16	$V_{DS} = 800\text{ V}, V_{GS} = 0\text{ V},$ $f = 1\text{ MHz}, V_{AC} = 25\text{ mV}$	–	580	–	pF	
$C_{oss}$	Output capacitance Fig. 16		–	35	–		
$C_{rss}$	Reverse transfer capacitance Fig. 16		–	2.5	–		
$E_{oss}$	$C_{oss}$ stored energy Fig. 17		–	14	–		$\mu\text{J}$
$Q_G$	Total gate charge Fig. 18	$V_{DS} = 800\text{ V}, I_D = 10\text{ A},$ $V_{GS} = -3\text{ to }+18\text{ V}$	–	29	–	nC	
$Q_{GS}$	Gate-source charge Fig. 18		–	6.6	–		
$Q_{GD}$	Gate-drain charge Fig. 18		–	14.4	–		
$R_{g(int)}$	Gate input resistance	$f = 1\text{ MHz}$	–	10	–	$\Omega$	
$E_{on}$	Turn-on switching energy Fig. 19, 20	$V_{DS} = 800\text{ V}, I_D = 10\text{ A},$ $V_{GS} = -3.5\text{ to }+18\text{ V},$ $R_{G(ext)} = 3.3\ \Omega, L = 300\ \mu\text{H}$	$T_{vj} = 25\text{ °C}$	–	114	–	$\mu\text{J}$
			$T_{vj} = 175\text{ °C}$	–	148	–	
$E_{off}$	Turn-off switching energy Fig. 19, 20		$T_{vj} = 25\text{ °C}$	–	15.3	–	ns
			$T_{vj} = 175\text{ °C}$	–	20.4	–	
$t_{d(on)}$	Turn-on delay time Fig. 19, 20		$T_{vj} = 25\text{ °C}$	–	2.8	–	ns
$t_r$	Rise time Fig. 19, 20		$T_{vj} = 25\text{ °C}$	–	10.8	–	
$t_{d(off)}$	Turn-off delay time Fig. 19, 20		$T_{vj} = 25\text{ °C}$	–	8.4	–	
$t_f$	Fall time Fig. 19, 20		$T_{vj} = 25\text{ °C}$	–	10.4	–	

### Reverse Diode Characteristics ( $T_{vj} = 25\text{ °C}$ unless otherwise specified)

Symbol	Characteristic	Conditions	Value			Unit
			Min.	Typ.	Max.	
$V_{SD}$	Diode forward voltage Fig. 10, 11, 12	$I_{SD} = 5\text{ A}, V_{GS} = 0\text{ V}$	–	4	–	V
		$I_{SD} = 5\text{ A}, V_{GS} = 0\text{ V}, T_{vj} = 175\text{ °C}$	–	3.7	–	V
$I_s$	Diode forward current (continuous)	$V_{GS} = -2\text{ V}, T_c = 25\text{ °C}$	–	–	23	A
		$V_{GS} = -2\text{ V}, T_c = 100\text{ °C}$	–	–	13	
$t_{rr}$	Reverse recovery time	$V_{GS} = -3.5\text{ V}/+18\text{ V}, I_{SD} = 10\text{ A}, V_R = 800\text{ V},$ $R_{G(ext)} = 15\ \Omega, L = 300\ \mu\text{H}, di/dt = 3000\text{ A}/\mu\text{s}$	–	30	–	ns
$Q_{rr}$	Reverse recovery charge		–	97.5	–	nC
$I_{rrm}$	Peak reverse recovery current		–	9	–	A

Characteristic Curves

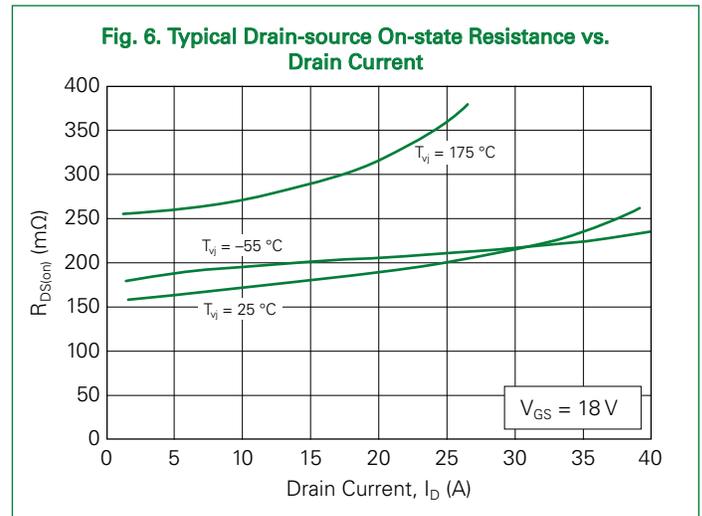
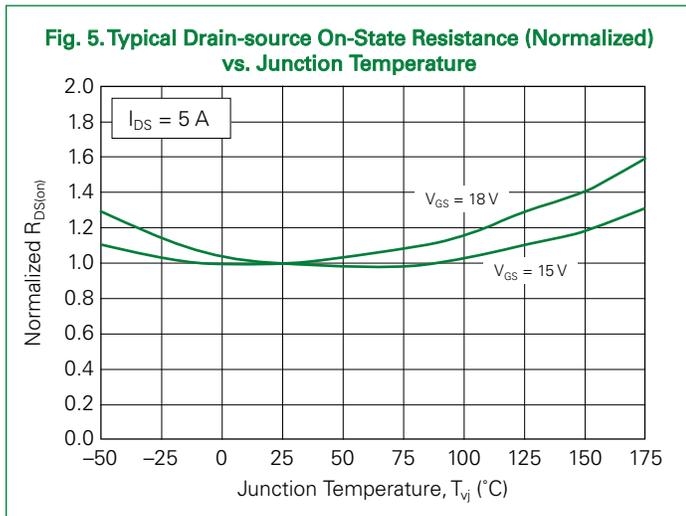
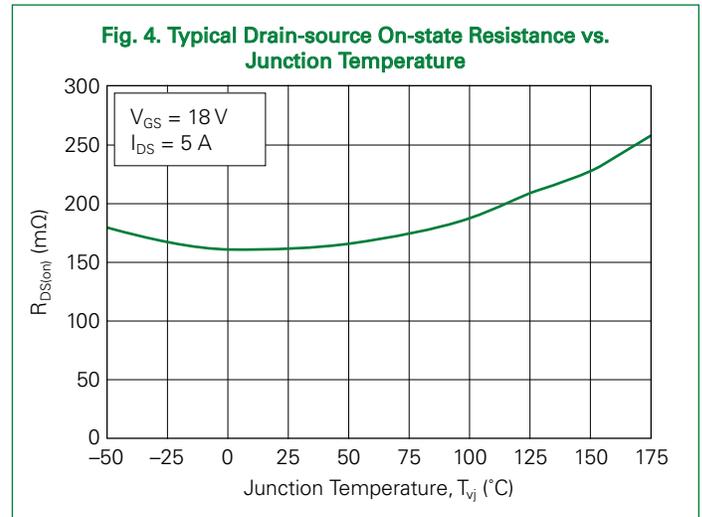
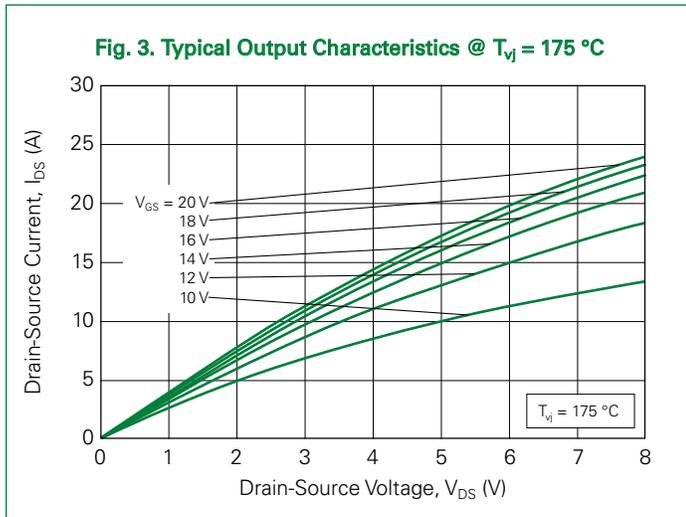
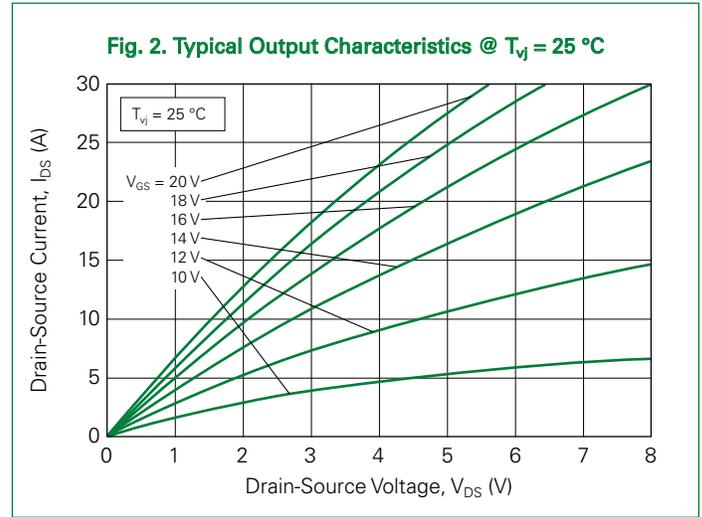
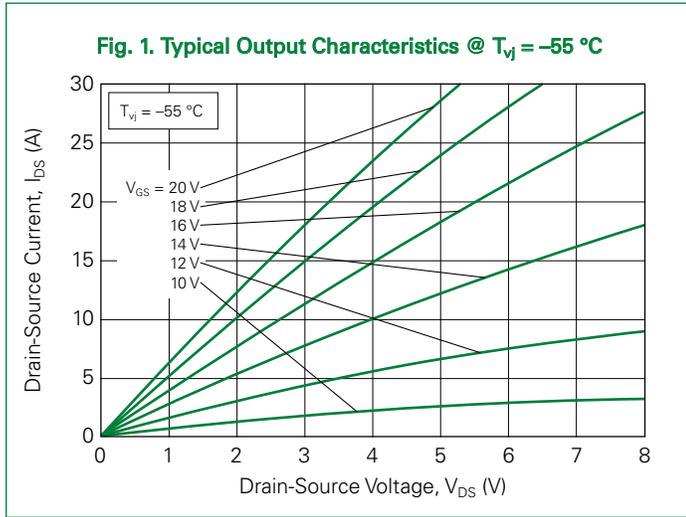


Fig. 7.  $R_{DS(on)}$  vs. Temperature

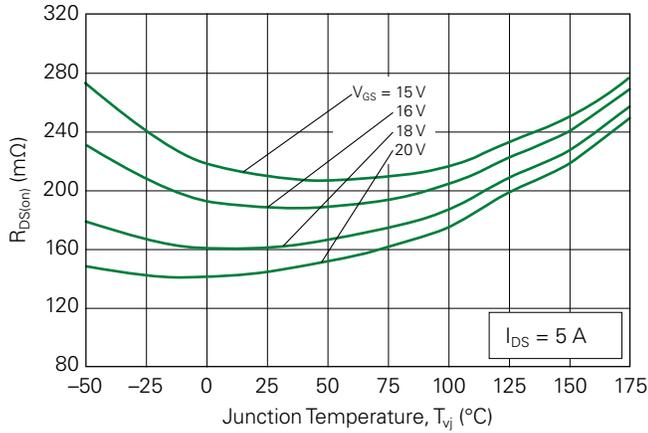


Fig. 8. Transfer Curves

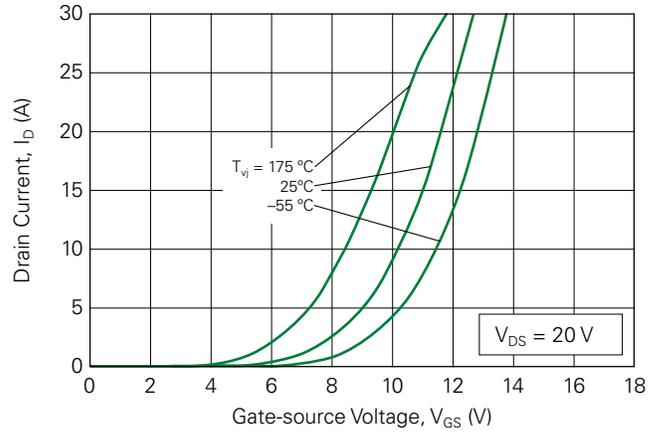


Fig. 9. Threshold Voltage vs. Temperature

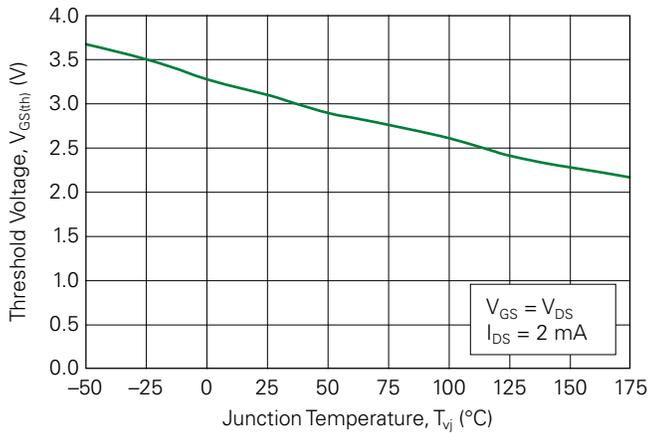


Fig. 10. Body Diode Curves @  $T_{vj} = -55\text{ }^{\circ}\text{C}$

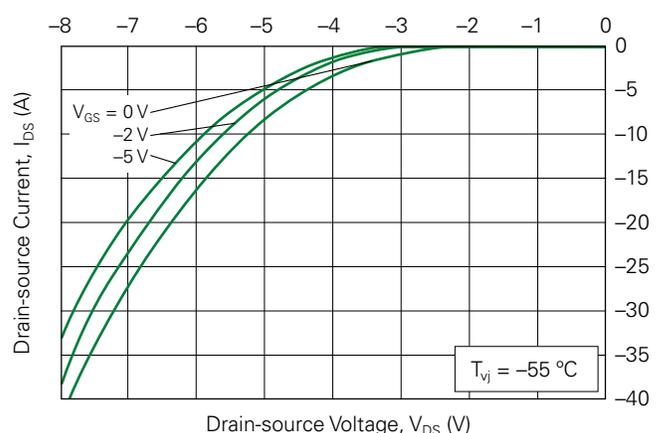


Fig. 11. Body Diode Curves @  $T_{vj} = 25\text{ }^{\circ}\text{C}$

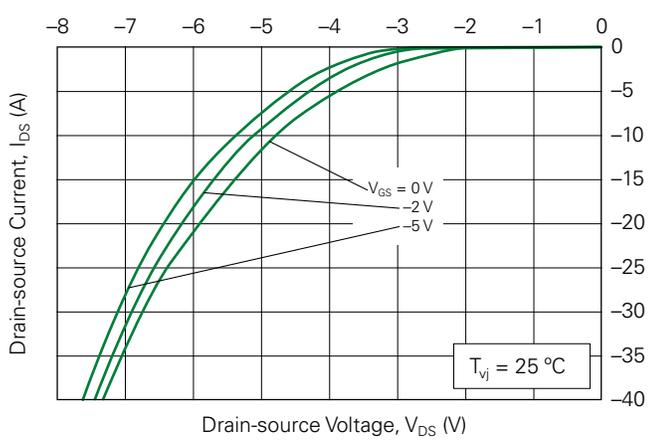
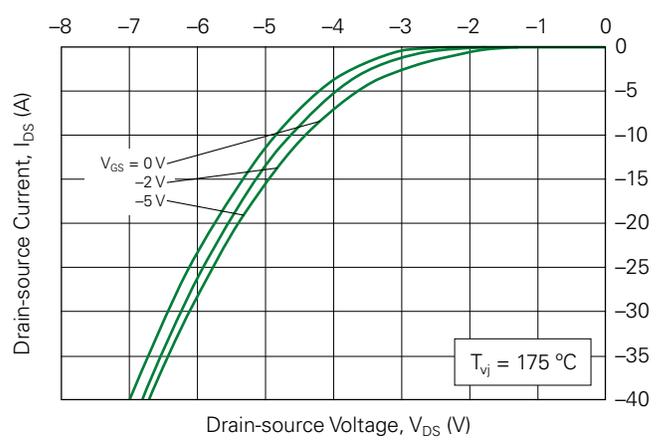
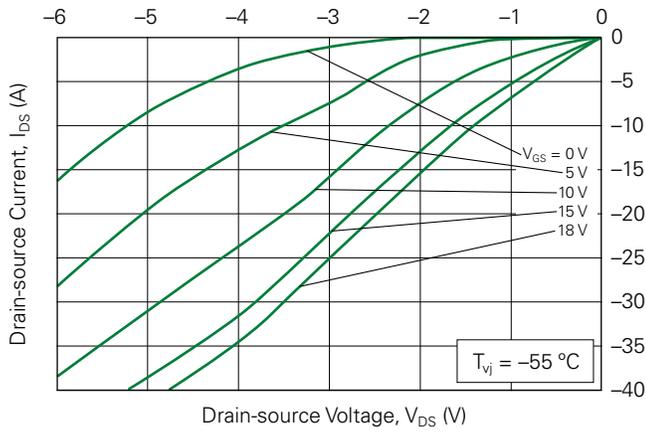


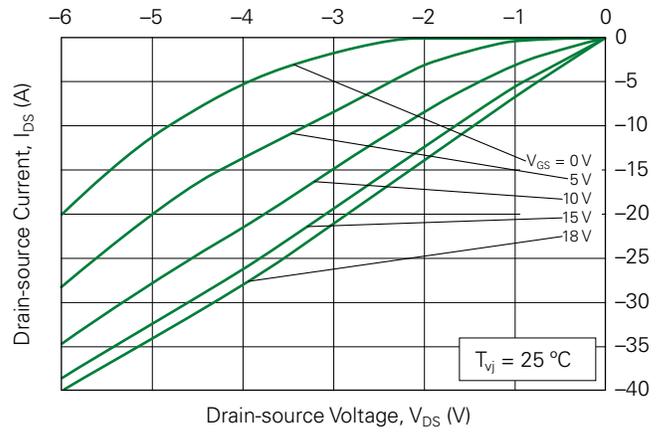
Fig. 12. Body Diode Curves @  $T_{vj} = 175\text{ }^{\circ}\text{C}$



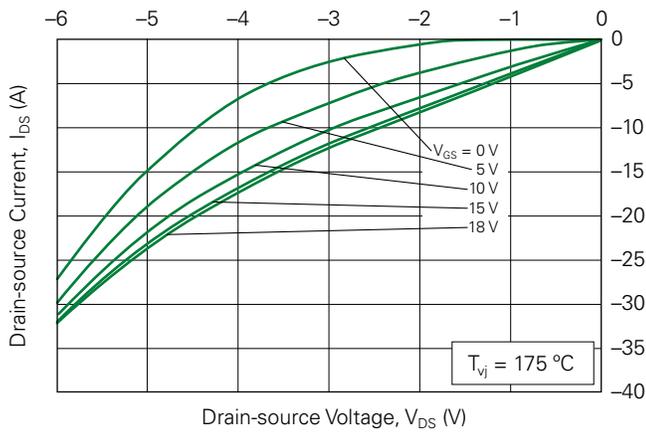
**Fig. 13. Typical Reverse Conduction Characteristics @  $T_{vj} = -55\text{ }^\circ\text{C}$**



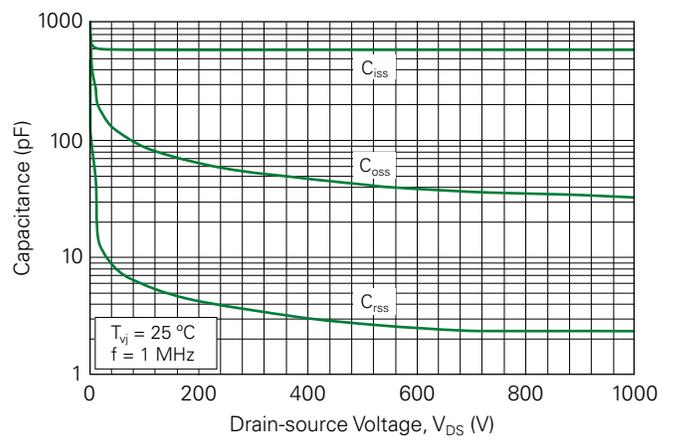
**Fig. 14. Typical Reverse Conduction Characteristics @  $T_{vj} = 25\text{ }^\circ\text{C}$**



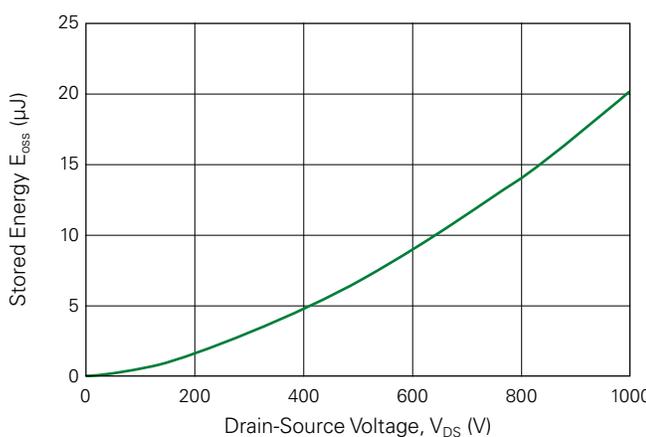
**Fig. 15. Typical Reverse Conduction Characteristics @  $T_{vj} = 175\text{ }^\circ\text{C}$**



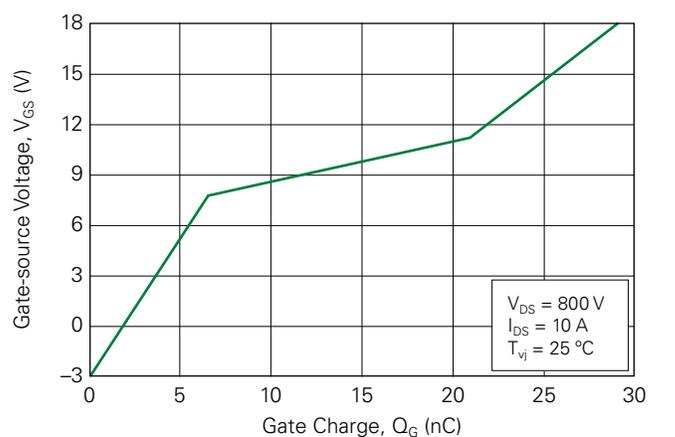
**Fig. 16. Capacitance vs.  $V_{DS}$**



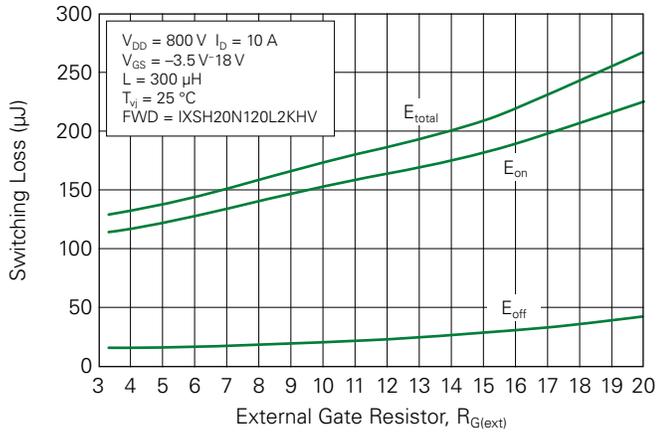
**Fig. 17. Output Capacitor Stored Energy**



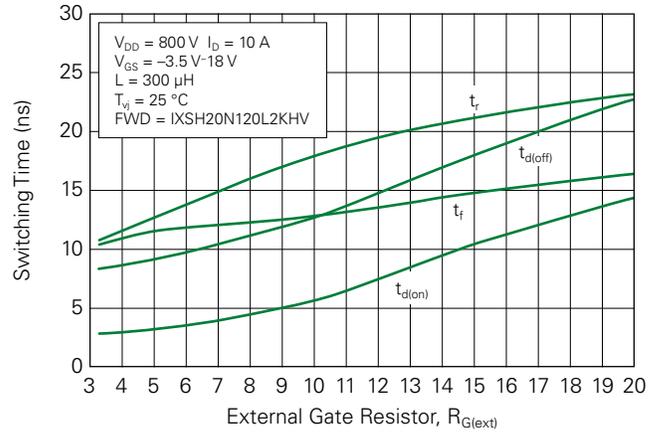
**Fig. 18. Gate Charge Characteristics**



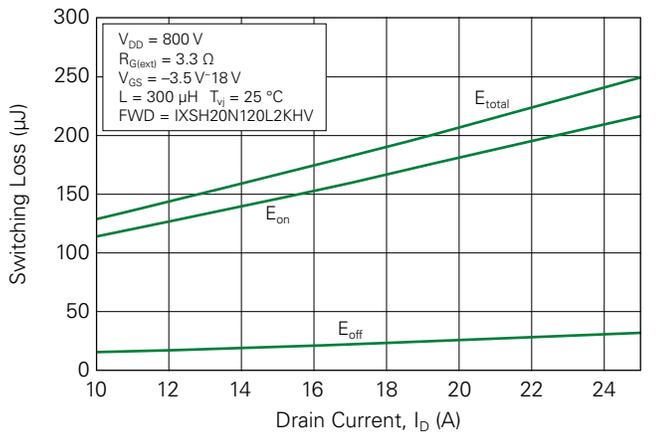
**Fig. 19. Switching Energy vs.  $R_{G(ext)}$**



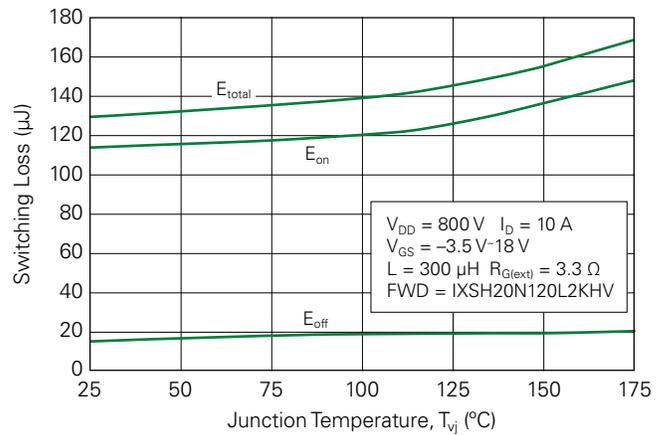
**Fig. 20. Switching Times vs.  $R_{G(ext)}$**



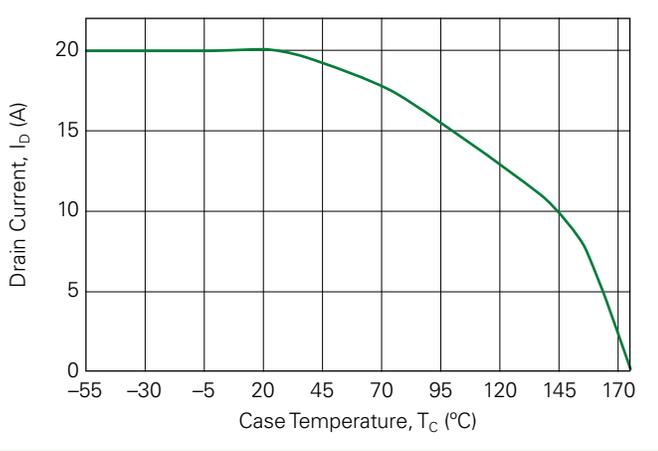
**Fig. 21. Switching Energy vs.  $I_{DS}$**



**Fig. 22. Switching Energy vs. Temperature**



**Fig. 23. Continuous Drain Current vs. Case Temperature**



**Fig. 24. Max. Power Dissipation Derating vs. Case Temperature**

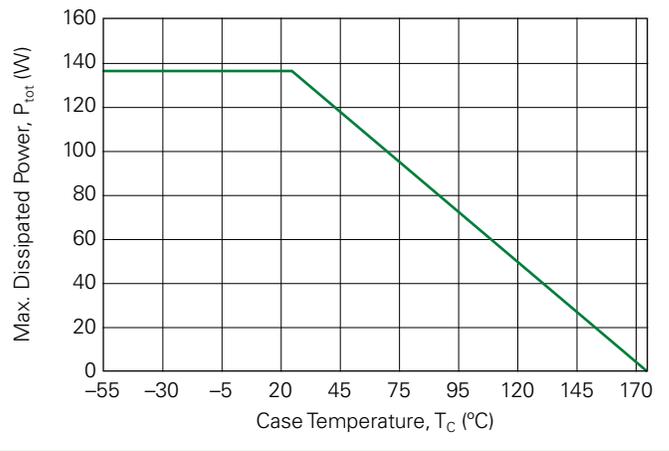


Fig. 25. Thermal Impedance

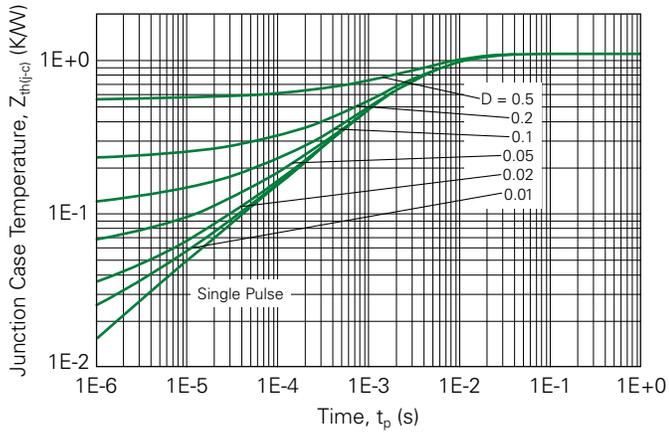


Fig. 26. Safe Operating Area

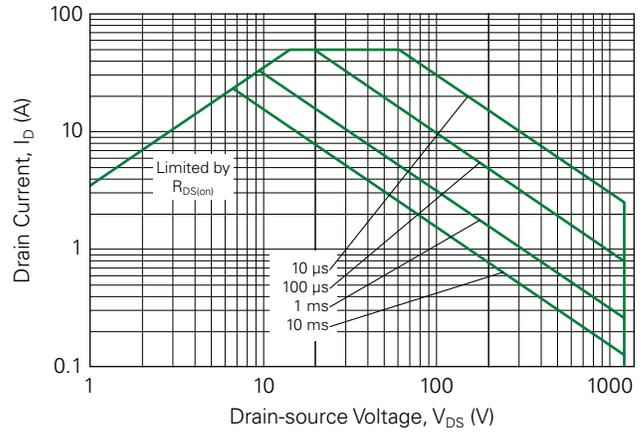
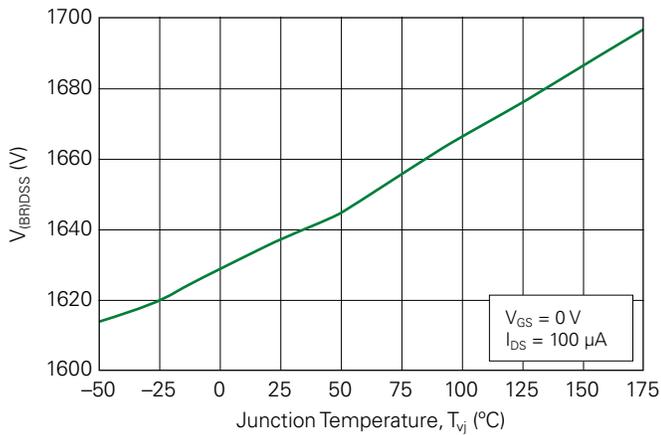
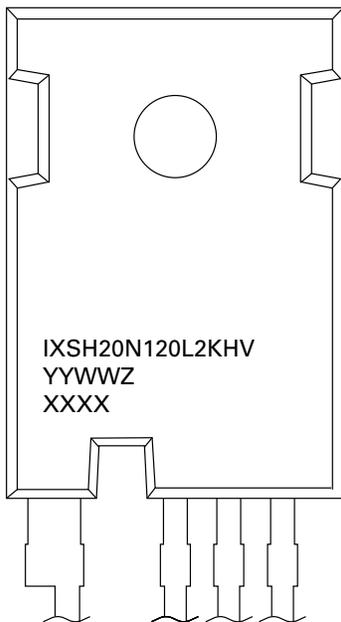


Fig. 27.  $V_{(BR)DS}$  vs. Temperature

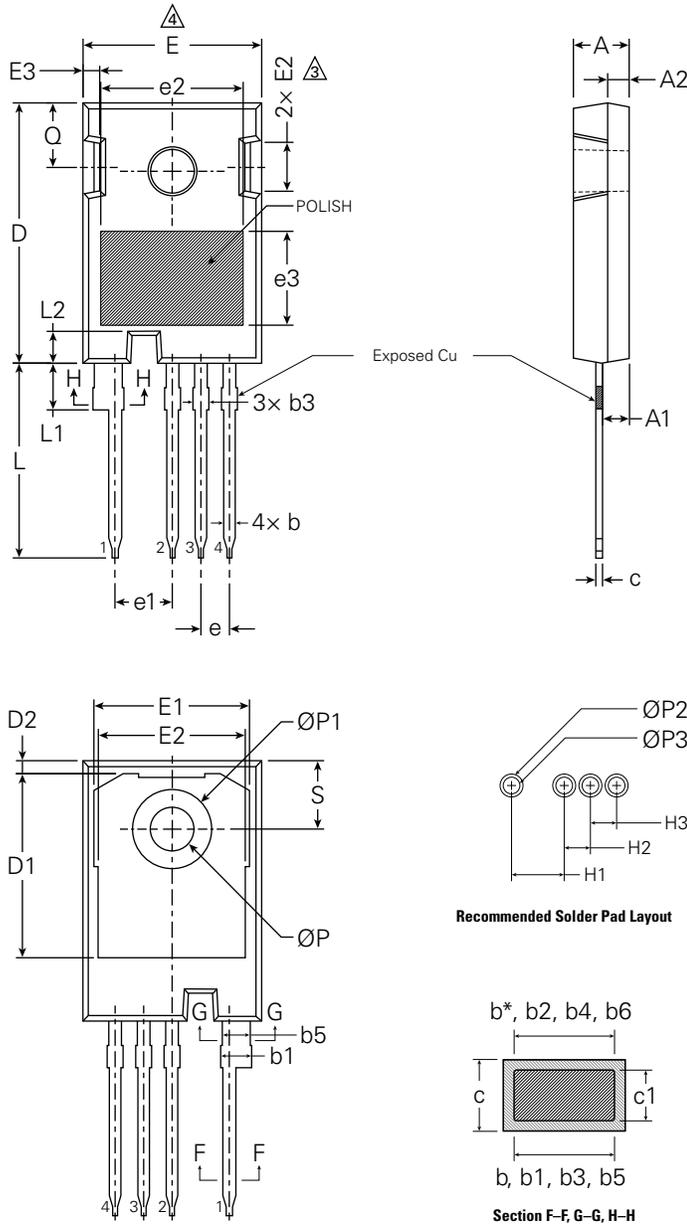


Part Number and Marking



IXSH20N120L2KHV = Specific Device Code  
 YY = Year  
 WW = Work Week  
 Z = Assembly Location  
 XXXX = Lot Traceability

Part Outline Drawing (TO-247-4L)



Note:

1. Package reference: JEDEC TO247, Variation AD
- △ Slot required, notch may be rounded
- △ Dimension D&E do not include mold flash
4. Subject to change without notice

Symbol	Inches			Millimeters		
	Min.	Typical	Max.	Min.	Typical	Max.
A	0.190	-	0.205	4.83	-	5.21
A1	0.090	-	0.100	2.29	-	2.54
A2	0.075	-	0.085	1.91	-	2.16
b	0.042	-	0.052	1.07	-	1.33
b*	0.042	-	0.050	1.07	-	1.28
b1	0.094	-	0.116	2.39	-	2.94
b2	0.094	-	0.112	2.39	-	2.84
b3	0.042	-	0.063	1.07	-	1.60
b4	0.042	-	0.059	1.07	-	1.50
b5	0.094	-	0.106	2.39	-	2.69
b6	0.094	-	0.104	2.39	-	2.64
c	0.022	-	0.027	0.55	-	0.68
c1	0.022	-	0.026	0.55	-	0.65
D	0.917	-	0.929	23.30	-	23.60
D1	0.640	-	0.695	16.25	-	17.65
D2	0.037	-	0.049	0.95	-	1.25
E	0.620	-	0.635	15.75	-	16.13
E1	0.516	-	0.557	13.10	-	14.15
E2	0.145	-	0.201	3.68	-	5.10
E3	0.039	-	0.075	1.00	-	1.90
E4	0.487	-	0.529	12.38	-	13.43
e	0.100 BSC			2.54 BSC		
e1	0.200 BSC			5.08 BSC		
e2	-	0.500	-	-	12.70	-
e3	-	0.330	-	-	8.38	-
H1	-	0.200	-	-	5.08	-
H2	-	0.100	-	-	2.54	-
H3	-	0.100	-	-	2.54	-
L	0.681	-	0.702	17.31	-	17.82
L1	0.156	-	0.172	3.97	-	4.37
L2	0.093	-	0.104	2.35	-	2.65
ØP	0.138	-	0.144	3.51	-	3.65
ØP1	0.283 REF.			7.18 REF.		
ØP2	-	0.088	-	-	2.24	-
ØP3	-	0.067	-	-	1.70	-
Q	0.216	-	0.236	5.49	-	6.00
S	0.238	-	0.248	6.04	-	6.30

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