

## IV2Q12160T4Z – 1200V 160mΩ Gen2 Automotive SiC MOSFET

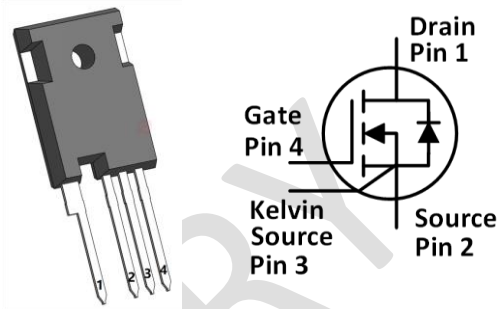
### Features

- 2<sup>nd</sup> Generation SiC MOSFET Technology with +15V~+18V gate drive
- High blocking voltage with low on-resistance
- High speed switching with low capacitance
- 175°C operating junction temperature capability
- Ultra fast and robust intrinsic body diode
- Kelvin gate input easing driver circuit design
- AEC-Q101 qualified

### Applications

- EV chargers and OBCs
- Solar boosters
- Automotive compressor inverters
- AC/DC power supplies

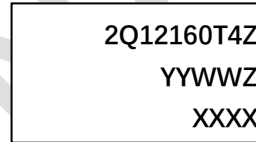
### Outline:



TO247-4



### Marking Diagram:



2Q12160T4Z= Specific Device Code  
 YY = Year  
 WW = Work Week  
 Z = Assembly Location  
 XXXX = Lot Traceability

### Absolute Maximum Ratings (T<sub>c</sub>=25°C unless otherwise specified)

Symbol	Parameter	Value	Unit	Test Conditions	Note
V <sub>DS</sub>	Drain-Source voltage	1200	V	V <sub>GS</sub> =0V, I <sub>D</sub> =100μA	Fig. 27
V <sub>GSmax</sub> (Transient)	Maximum transient voltage	-10 to 23	V	Duty cycle<1%, and pulse width<200ns	
V <sub>GSon</sub>	Recommended turn-on voltage	15 to 18	V		
V <sub>GSoff</sub>	Recommended turn-off voltage	-5 to -2	V	Typical -3.5V	
I <sub>D</sub>	Drain current (continuous)	20	A	V <sub>GS</sub> =18V, T <sub>C</sub> =25°C	Fig. 23
		15	A	V <sub>GS</sub> =18V, T <sub>C</sub> =100°C	
I <sub>DM</sub>	Drain current (pulsed)	50	A	Pulse width limited by SOA and dynamic R <sub>θ(j-c)</sub>	Fig. 25, 26
I <sub>SM</sub>	Body diode current (pulsed)	50	A	Pulse width limited by SOA and dynamic R <sub>θ(j-c)</sub>	Fig. 25, 26
P <sub>TOT</sub>	Total power dissipation	136	W	T <sub>C</sub> =25°C	Fig. 24
T <sub>stg</sub>	Storage temperature range	-55 to 175	°C		
T <sub>J</sub>	Operating junction temperature	-55 to 175	°C		
T <sub>L</sub>	Solder Temperature	260	°C	wave soldering only allowed at leads, 1.6mm from case for 10 s	

### Thermal Data

Symbol	Parameter	Value	Unit	Note
R <sub>θ(j-c)</sub>	Thermal Resistance from Junction to Case	1.1	°C/W	Fig. 25

**Electrical Characteristics** ( $T_c=25^{\circ}\text{C}$  unless otherwise specified)

Symbol	Parameter	Value			Unit	Test Conditions	Note
		Min.	Typ.	Max.			
$I_{DSS}$	Zero gate voltage drain current		1	100	$\mu\text{A}$	$V_{DS}=1200\text{V}, V_{GS}=0\text{V}$	
$I_{GSS}$	Gate leakage current			$\pm 100$	$\text{nA}$	$V_{DS}=0\text{V}, V_{GS}=-5\sim 20\text{V}$	
$V_{TH}$	Gate threshold voltage	1.8	3.0	4.5	$\text{V}$	$V_{GS}=V_{DS}, I_D=2\text{mA}$	Fig. 8, 9
			2.2			$V_{GS}=V_{DS}, I_D=2\text{mA}$ @ $T_J=175^{\circ}\text{C}$	
$R_{ON}$	Static drain-source on-resistance		160	208	$\text{m}\Omega$	$V_{GS}=18\text{V}, I_D=5\text{A}$ @ $T_J=25^{\circ}\text{C}$	Fig. 4, 5, 6, 7
			260		$\text{m}\Omega$	$V_{GS}=18\text{V}, I_D=5\text{A}$ @ $T_J=175^{\circ}\text{C}$	
			210		$\text{m}\Omega$	$V_{GS}=15\text{V}, I_D=5\text{A}$ @ $T_J=25^{\circ}\text{C}$	
			280		$\text{m}\Omega$	$V_{GS}=15\text{V}, I_D=5\text{A}$ @ $T_J=175^{\circ}\text{C}$	
$E_{AS}$	Single pulse avalanche energy		400		$\text{mJ}$	$V_{DD}=50\text{V}, L=10\text{mH}$	
$C_{ISS}$	Input capacitance		580		$\text{pF}$	$V_{DS}=800\text{V}, V_{GS}=0\text{V},$ $f=1\text{MHz}, V_{AC}=25\text{mV}$	Fig. 16
$C_{OSS}$	Output capacitance		35		$\text{pF}$		
$C_{RSS}$	Reverse transfer capacitance		2.5		$\text{pF}$		
$E_{OSS}$	$C_{OSS}$ stored energy		14		$\mu\text{J}$		
$Q_g$	Total gate charge		29		$\text{nC}$	$V_{DS}=800\text{V}, I_D=10\text{A},$ $V_{GS}=-3\text{ to }18\text{V}$	Fig. 18
$Q_{gs}$	Gate-source charge		6.6		$\text{nC}$		
$Q_{gd}$	Gate-drain charge		14.4		$\text{nC}$		
$R_g$	Gate input resistance		10		$\Omega$	$f=1\text{MHz}$	
$E_{ON}$	Turn-on switching energy		115		$\mu\text{J}$	$V_{DS}=800\text{V}, I_D=10\text{A},$ $V_{GS}=-3.5\text{ to }18\text{V},$ $R_{G(\text{ext})}=3.3\Omega,$ $L=300\mu\text{H}$ $T_J=25^{\circ}\text{C}$	Fig. 19, 20
$E_{OFF}$	Turn-off switching energy		22		$\mu\text{J}$		
$t_{d(\text{on})}$	Turn-on delay time		2.5		$\text{ns}$		
$t_r$	Rise time		9.5				
$t_{d(\text{off})}$	Turn-off delay time		7.3				
$t_f$	Fall time		11.0				
$E_{ON}$	Turn-on switching energy		194		$\mu\text{J}$	$V_{DS}=800\text{V}, I_D=10\text{A},$ $V_{GS}=-3.5\text{ to }18\text{V},$ $R_{G(\text{ext})}=3.3\Omega, L=300\mu\text{H}$ $T_J=175^{\circ}\text{C}$	Fig. 22
$E_{OFF}$	Turn-off switching energy		19		$\mu\text{J}$		

**Reverse Diode Characteristics** ( $T_c=25^\circ\text{C}$  unless otherwise specified)

Symbol	Parameter	Value			Unit	Test Conditions	Note
		Min.	Typ.	Max.			
$V_{SD}$	Diode forward voltage		4.0		V	$I_{SD}=5\text{A}, V_{GS}=0\text{V}$	Fig. 10, 11, 12
			3.7		V	$I_{SD}=5\text{A}, V_{GS}=0\text{V}, T_J=175^\circ\text{C}$	
$I_S$	Diode forward current (continuous)			23	A	$V_{GS}=-2\text{V}, T_c=25^\circ\text{C}$	
				13	A	$V_{GS}=-2\text{V}, T_c=100^\circ\text{C}$	
$t_{rr}$	Reverse recovery time		26		ns	$V_{GS}=-3.5\text{V}/+18\text{V}, I_{SD}=10\text{A}, V_R=800\text{V}, R_{G(\text{ext})}=15\Omega, L=300\mu\text{H}, di/dt=3000\text{A}/\mu\text{s}$	
$Q_{rr}$	Reverse recovery charge		92		nC		
$I_{RRM}$	Peak reverse recovery current		10.6		A		

**Typical Performance (curves)**

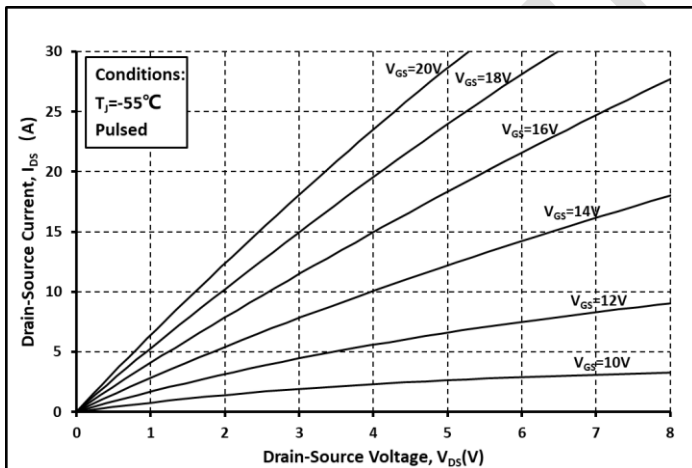


Fig. 1 Output Curve @  $T_J=-55^\circ\text{C}$

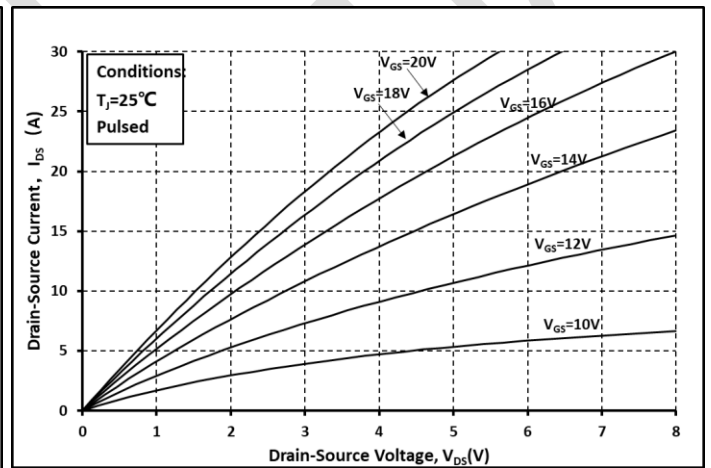


Fig. 2 Output Curve @  $T_J=25^\circ\text{C}$

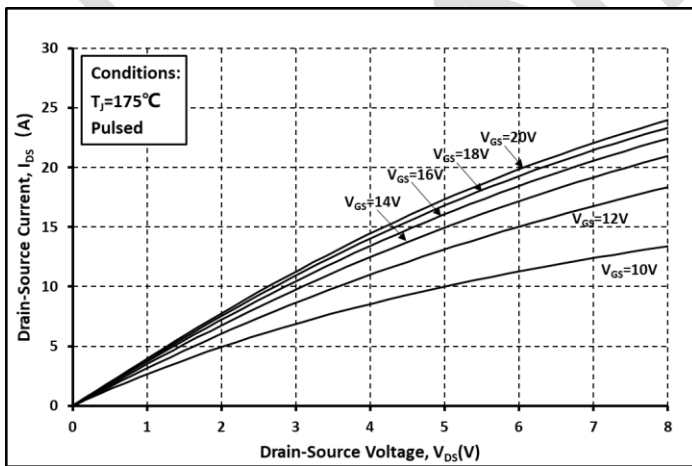


Fig. 3 Output Curve @  $T_J=175^\circ\text{C}$

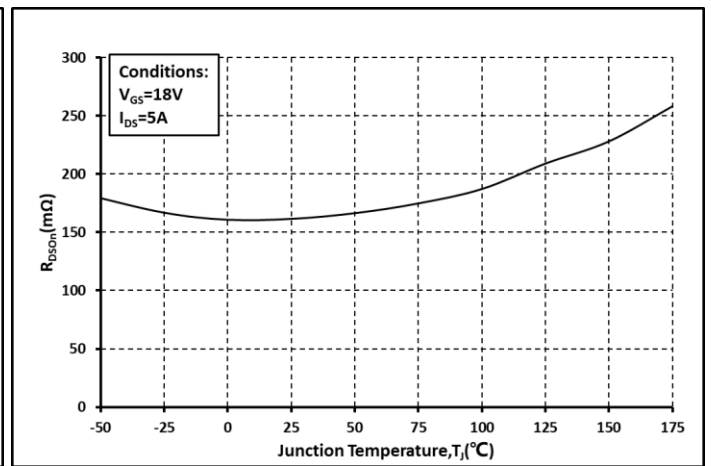


Fig. 4  $R_{DS(\text{on})}$  vs. Temperature

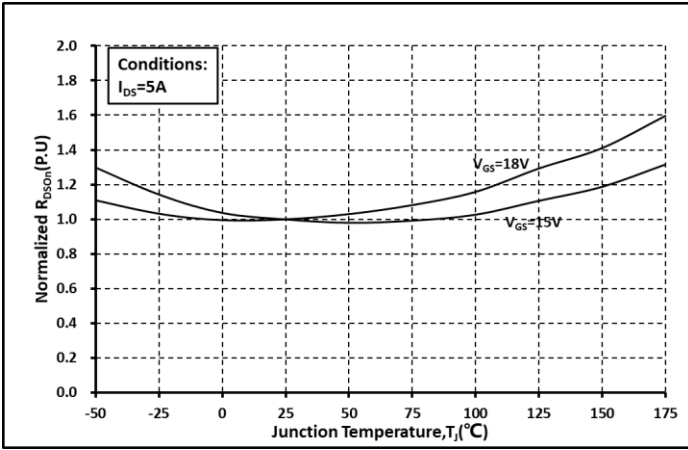


Fig. 5 Normalized Ron vs. Temperature

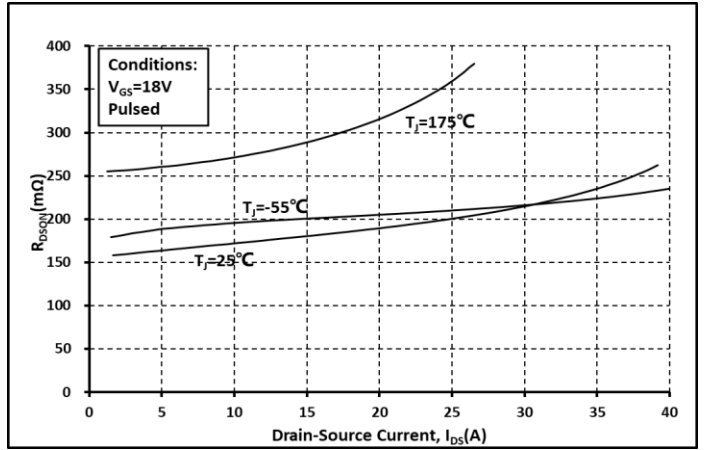


Fig. 6 Ron vs. Ids @ Various Temperature

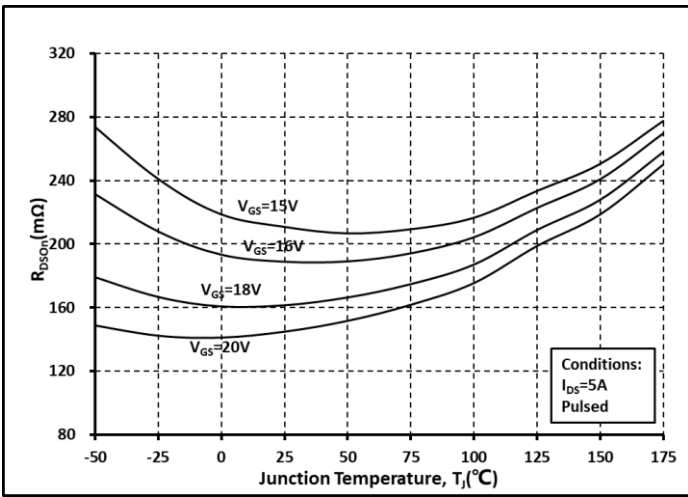


Fig. 7 Ron vs. Temperature @ Various Vgs

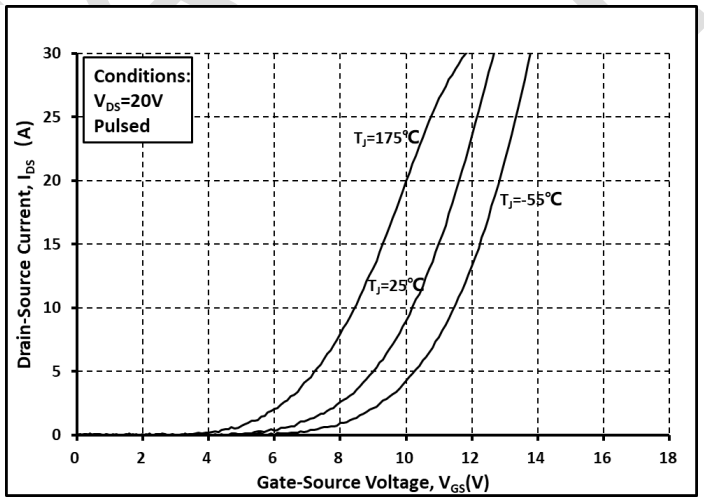


Fig. 8 Transfer Curves @ Various Temperature

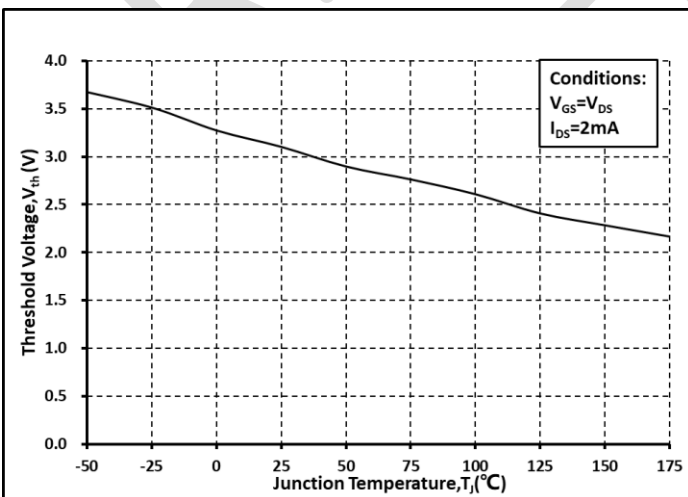


Fig. 9 Threshold Voltage vs. Temperature

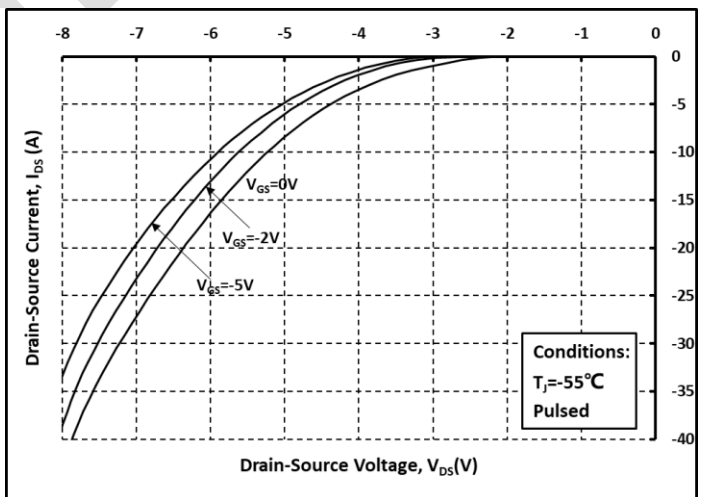


Fig. 10 Body Diode Curves @ Tj = -55°C

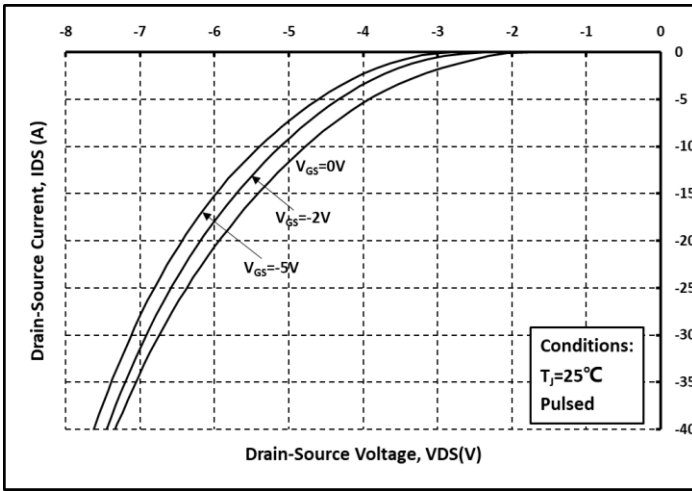


Fig. 11 Body Diode Curves @  $T_j=25^\circ\text{C}$

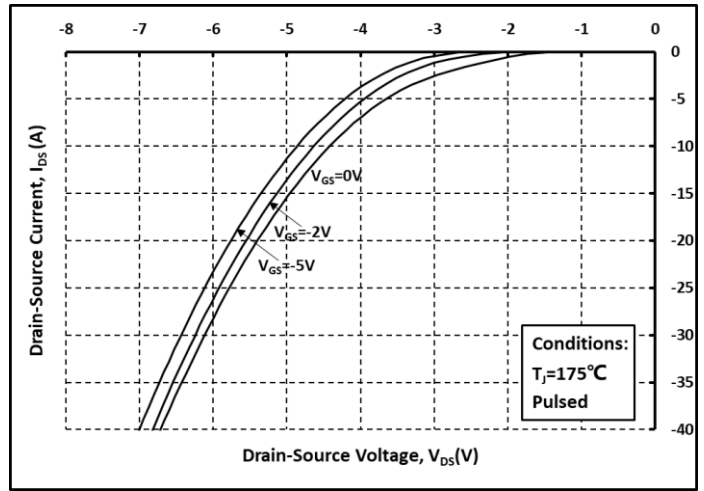


Fig. 12 Body Diode Curves @  $T_j=175^\circ\text{C}$

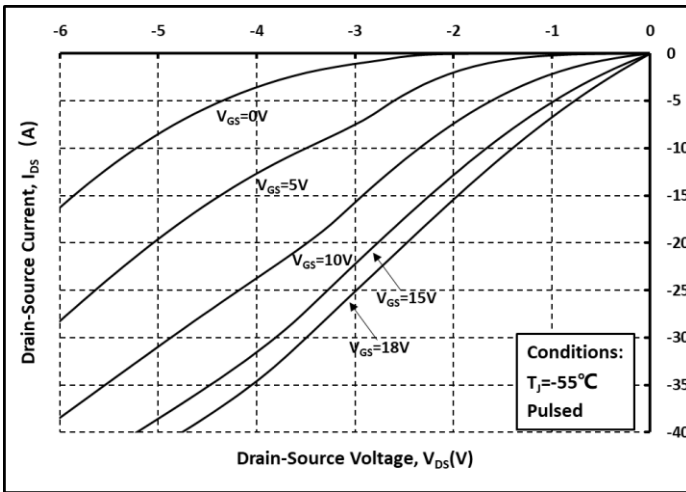


Fig. 13 3<sup>rd</sup> Quadrant Curves @  $T_j=-55^\circ\text{C}$

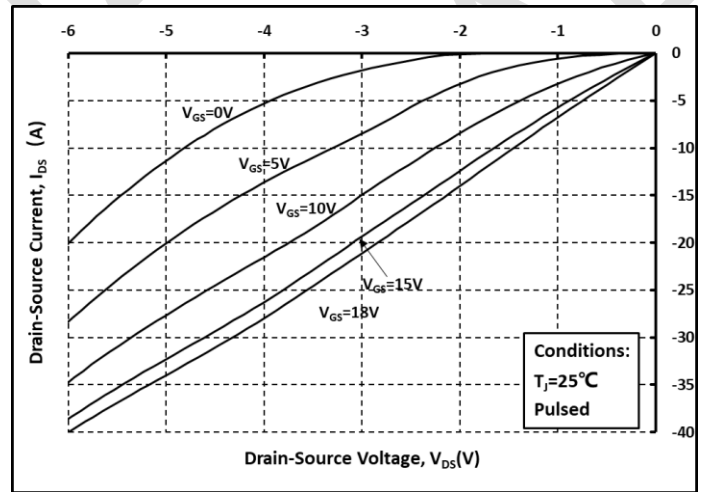


Fig. 14 3<sup>rd</sup> Quadrant Curves @  $T_j=25^\circ\text{C}$

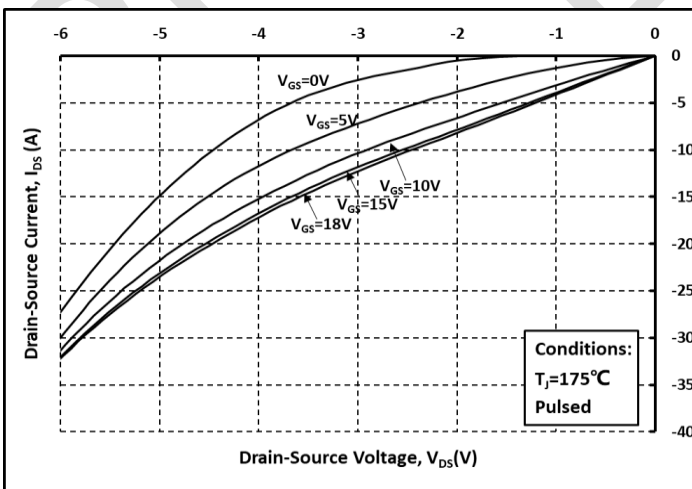


Fig. 15 3<sup>rd</sup> Quadrant Curves @  $T_j=175^\circ\text{C}$

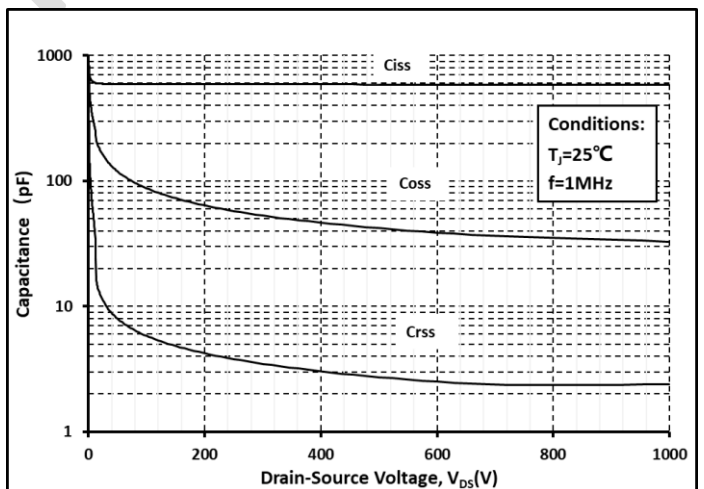


Fig. 16 Capacitance vs.  $V_{DS}$

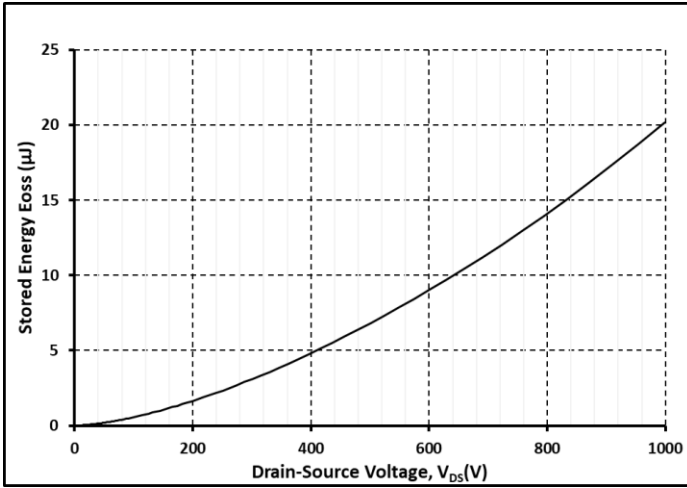


Fig. 17 Output Capacitor Stored Energy

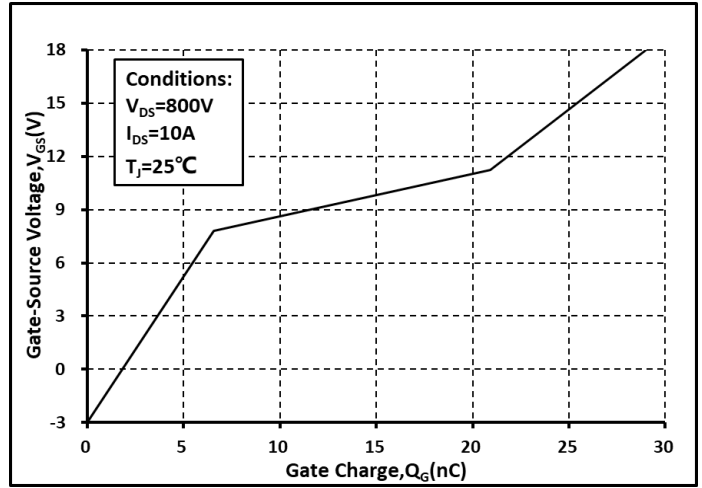


Fig. 18 Gate Charge Characteristics

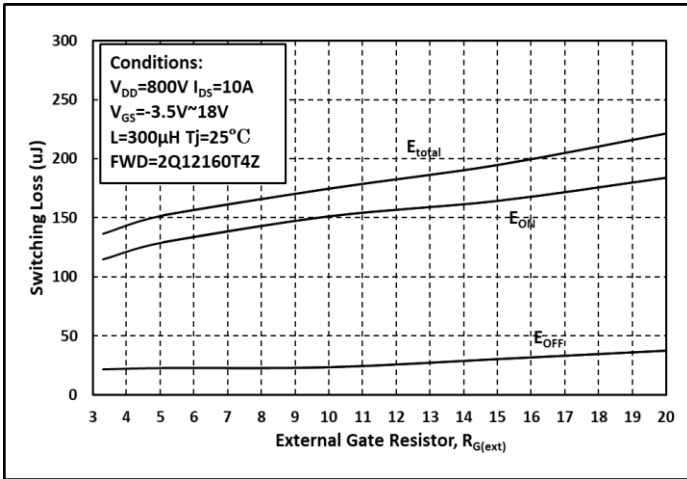


Fig. 19 Switching Energy vs.  $R_{G(ext)}$

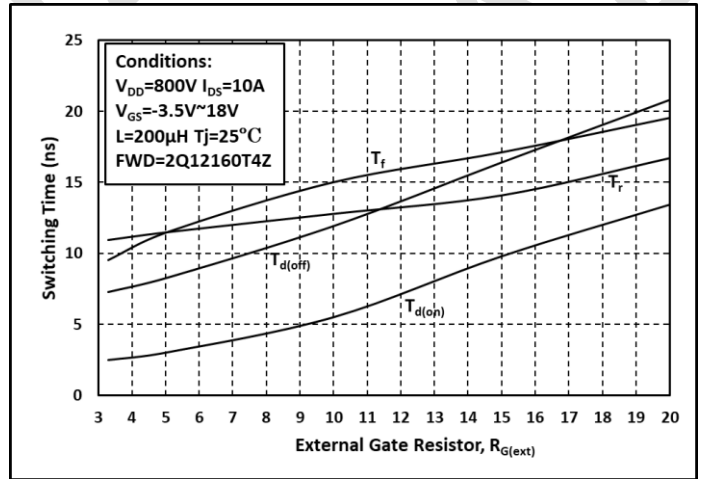


Fig. 20 Switching Times vs.  $R_{G(ext)}$

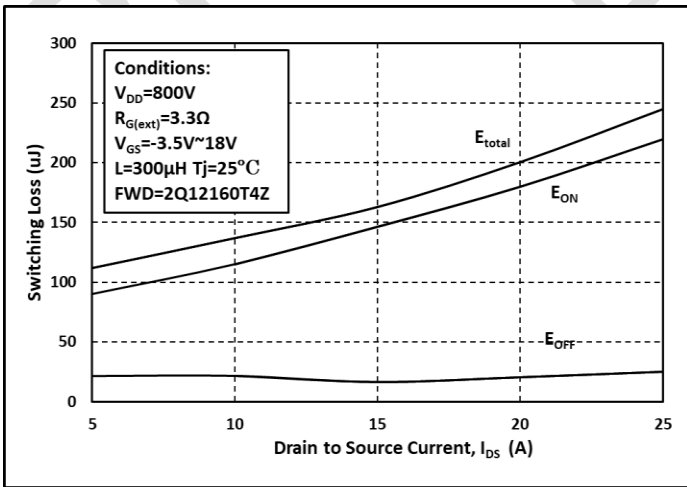


Fig. 21 Switching Energy vs.  $I_{DS}$

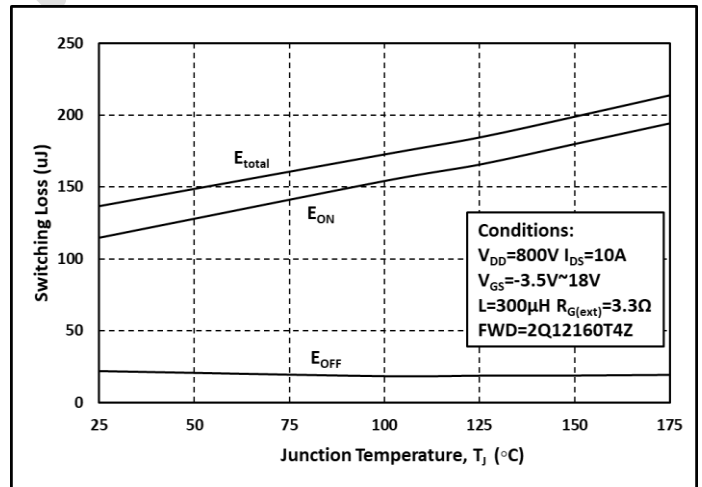


Fig. 22 Switching Energy vs. Temperature

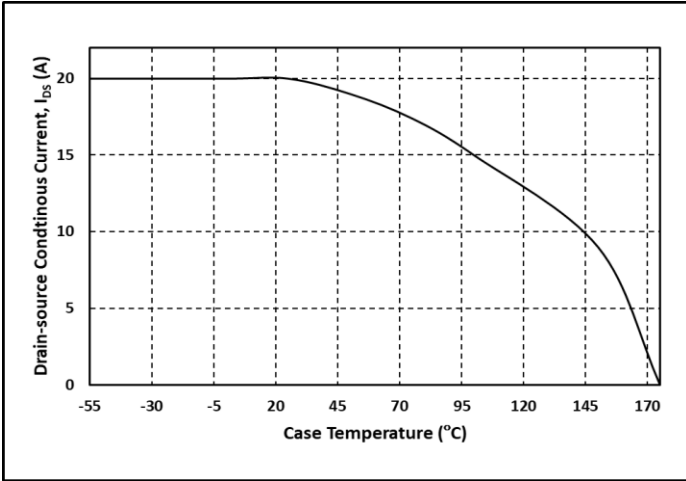


Fig. 23 Continuous Drain Current vs. Case Temperature

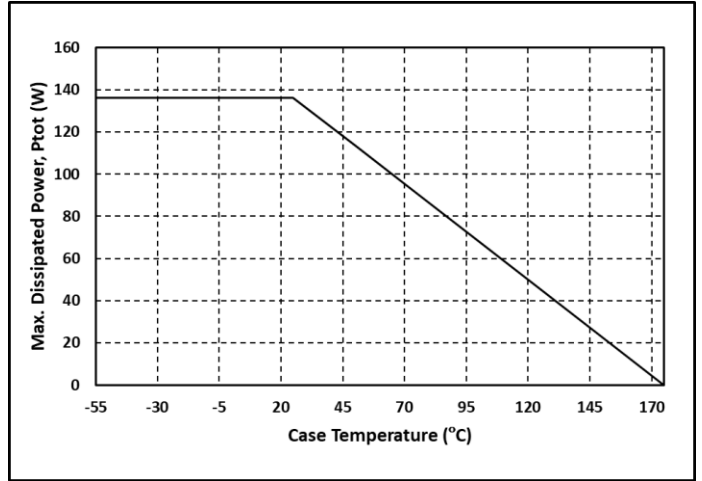


Fig. 24 Max. Power Dissipation Derating vs. Case Temperature

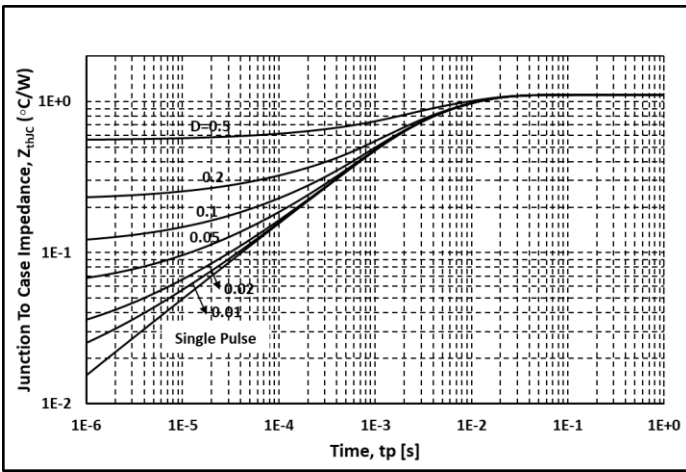


Fig. 25 Thermal Impedance

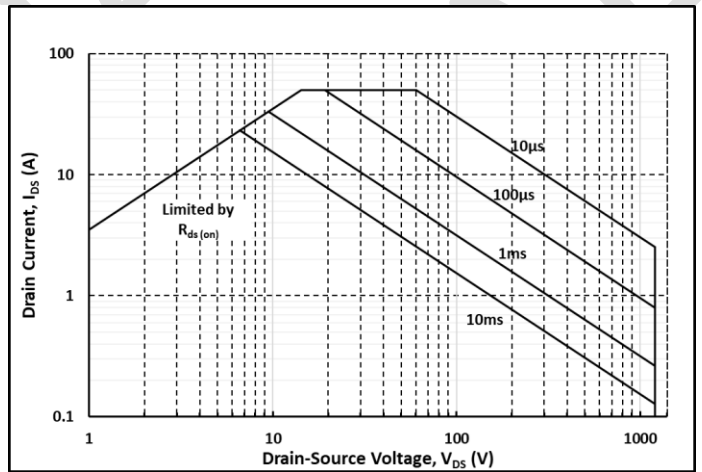


Fig. 26 Safe Operating Area

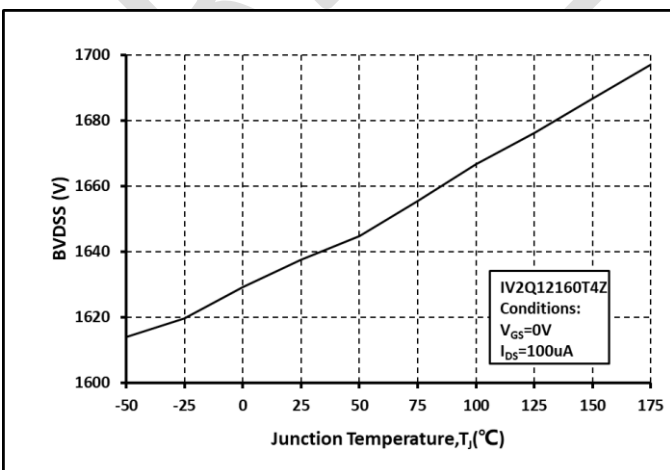
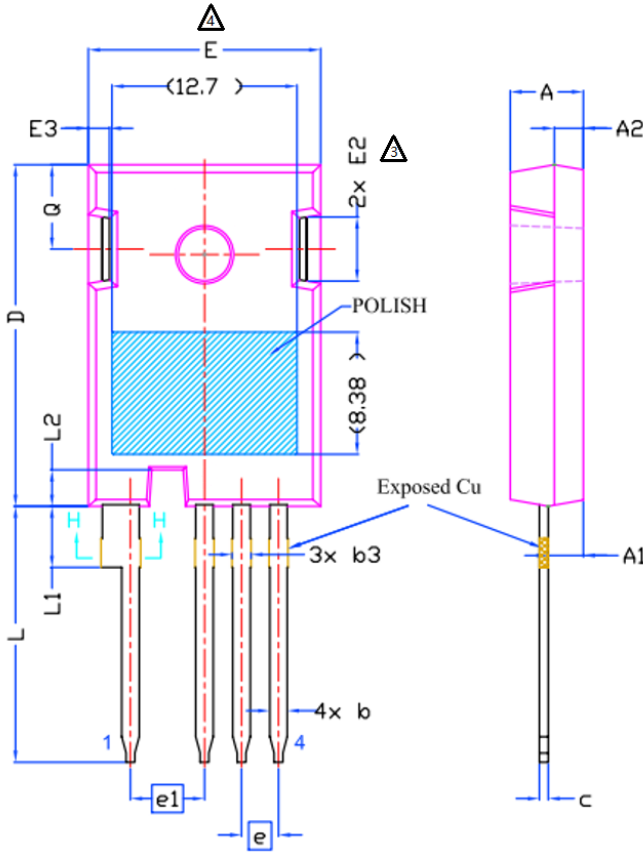
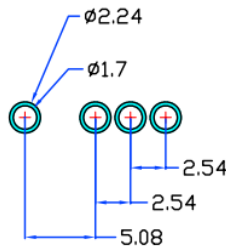
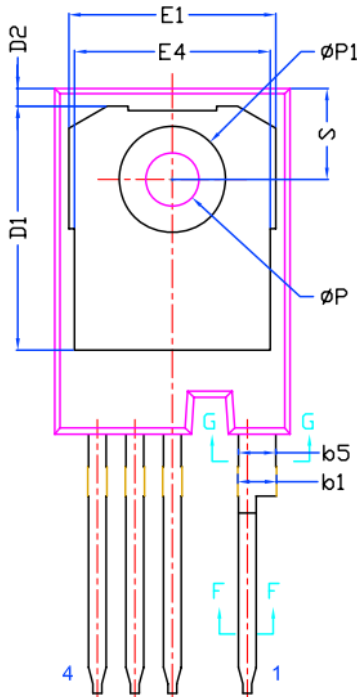


Fig. 27 BVDSS vs. Temperature

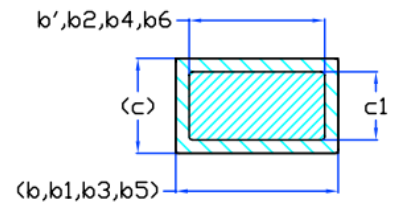
# Package Dimensions



Dimensions In Millimeters		
SYMBOL	MIN.	MAX.
A	4.83	5.21
A1	2.29	2.54
A2	1.91	2.16
b	1.07	1.33
b'	1.07	1.28
b1	2.39	2.94
b2	2.39	2.84
b3	1.07	1.60
b4	1.07	1.50
b5	2.39	2.69
b6	2.39	2.64
c	0.55	0.68
c1	0.55	0.65
D	23.30	23.60
D1	16.25	17.65
D2	0.95	1.25
E	15.75	16.13
E1	13.10	14.15
E2	3.68	5.10
E3	1.00	1.90
E4	12.38	13.43
e	2.54 BSC	
e1	5.08 BSC	
L	17.31	17.82
L1	3.97	4.37
L2	2.35	2.65
N	4	
φP	3.51	3.65
φP1	7.18 REF.	
Q	5.49	6
S	6.04	6.3



Recommended Solder Pad Layout



Section F--F, G--G, H--H

**Note:**

1. Package Reference: JEDEC TO247, Variation AD
2. All Dimensions are in mm
3. Slot Required, Notch May Be Rounded
4. Dimension D&E Do Not Include Mold Flash
5. Subject to Change Without Notice



## Notes

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