

IV2Q06040D7Z – 650V 40mΩ Gen2 Automotive SiC MOSFET

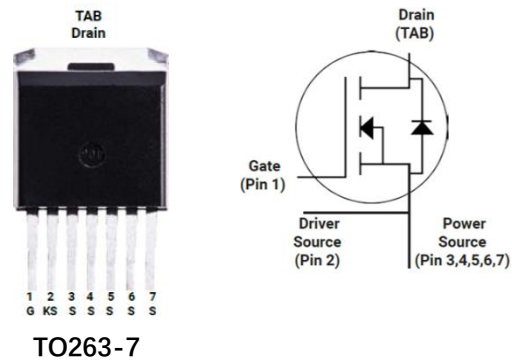
Features

- 2nd Generation SiC MOSFET Technology with +15~+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:



Marking Diagram:

YYWWZ	2Q06040D7Z = Specific Device Code
XXXX	YY = Year
2Q06040D7Z	WW = Work Week
	Z = Assembly Location
	XXXX = Lot Traceability

Absolute Maximum Ratings ($T_c=25^\circ\text{C}$ unless otherwise specified)

Symbol	Parameter	Value	Unit	Test Conditions	Note
V_{DS}	Drain-Source voltage	650	V	$V_{GS}=0V, I_D=100\mu A$	
V_{GSmax} (Transient)	Maximum transient voltage	-10 to 23	V	Duty cycle<1%, and pulse width<200ns	
V_{GSon}	Recommended turn-on voltage	15 to 18	V		
V_{GSoff}	Recommended turn-off voltage	-5 to -2	V	Typical -3.5V	
I_D	Drain current (continuous)	60	A	$V_{GS}=18V, T_c=25^\circ\text{C}$	Fig. 23
		43	A	$V_{GS}=18V, T_c=100^\circ\text{C}$	
I_{DM}	Drain current (pulsed)	150	A	Pulse width limited by SOA and dynamic $R_{\theta(j-c)}$	Fig. 25, 26
I_{SM}	Body diode current (pulsed)	150	A	Pulse width limited by SOA and dynamic $R_{\theta(j-c)}$	Fig. 25, 26
P_{TOT}	Total power dissipation	249	W	$T_c=25^\circ\text{C}$	Fig. 24
T_{stg}	Storage temperature range	-55 to 175	$^\circ\text{C}$		
T_J	Operating junction temperature	-55 to 175	$^\circ\text{C}$		
T_L	Solder Temperature	260	$^\circ\text{C}$	wave soldering only allowed at leads, 1.6mm from case for 10 s	

Thermal Data

Symbol	Parameter	Value	Unit	Note
$R_{\theta(j-c)}$	Thermal Resistance from Junction to Case	0.6	$^\circ\text{C/W}$	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		3	100	μA	V _{DS} =650V, V _{GS} =0V	
I _{GSS}	Gate leakage current			±100	nA	V _{DS} =0V, V _{GS} = -5~20V	
V _{TH}	Gate threshold voltage	1.8	2.8	4.5	V	V _{GS} =V _{DS} , I _D =7.5mA	Fig. 8, 9
			2.1			V _{GS} =V _{DS} , I _D =7.5mA @ T _J =175°C	
R _{ON}	Static drain-source on-resistance		40	53	mΩ	V _{GS} =18V, I _D =20A @T _J =25°C	Fig. 4, 5, 6, 7
			60		mΩ	V _{GS} =18V, I _D =20A @T _J =175°C	
			52		mΩ	V _{GS} =15V, I _D =20A @T _J =25°C	
			65		mΩ	V _{GS} =15V, I _D =20A @T _J =175°C	
C _{iss}	Input capacitance		2000		pF	V _{DS} =600V, V _{GS} =0V, f=1MHz, V _{AC} =25mV	Fig. 16
C _{oss}	Output capacitance		158		pF		
C _{rss}	Reverse transfer capacitance		11.4		pF		
E _{oss}	C _{oss} stored energy		31		μJ		Fig. 17
Q _g	Total gate charge		94.7		nC	V _{DS} =400V, I _D =20A, V _{GS} =-3 to 18V	Fig. 18
Q _{gs}	Gate-source charge		24.5		nC		
Q _{gd}	Gate-drain charge		47.3		nC		
R _g	Gate input resistance		2.9		Ω	f=1MHz	
E _{ON}	Turn-on switching energy		171.4		μJ	V _{DS} =400V, I _D =30A, V _{GS} =-3.5 to 18V, R _{G(ext)} =3.3Ω, L=200μH T _J =25°C	Fig. 19, 20
E _{OFF}	Turn-off switching energy		32.0		μJ		
t _{d(on)}	Turn-on delay time		7.6		ns		
t _r	Rise time		15.6				
t _{d(off)}	Turn-off delay time		18.5				
t _f	Fall time		8.8				
E _{ON}	Turn-on switching energy		219.1			V _{DS} =400V, I _D =30A, V _{GS} =-3.5 to 18V, R _{G(ext)} =3.3Ω,L=200μH T _J =175°C	Fig. 22
E _{OFF}	Turn-off switching energy		34.2				

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		4.1		V	$I_{SD}=20\text{A}$, $V_{GS}=0\text{V}$	Fig. 10, 11, 12
			3.8		V	$I_{SD}=20\text{A}$, $V_{GS}=0\text{V}$, $T_J=175^\circ\text{C}$	
I_S	Diode forward current (continuous)			47	A	$V_{GS}=-2\text{V}$, $T_c=25^\circ\text{C}$	
				27	A	$V_{GS}=-2\text{V}$, $T_c=100^\circ\text{C}$	
t_{rr}	Reverse recovery time		35.3		ns	$V_{GS}=-3.5\text{V}/+18\text{V}$, $I_{SD}=30\text{A}$, $V_R=400\text{V}$, $R_{G(\text{ext})}=10\Omega$, $L=200\mu\text{H}$, $di/dt=3000\text{A}/\mu\text{s}$	
Q_{rr}	Reverse recovery charge		144.5		nC		
I_{RRM}	Peak reverse recovery current		17.3		A		

Typical Performance (curves)

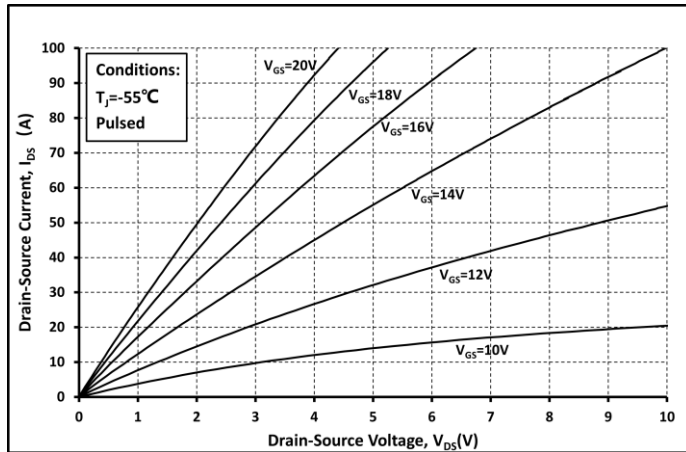


Fig. 1 Output Curve @ $T_J=-55^\circ\text{C}$

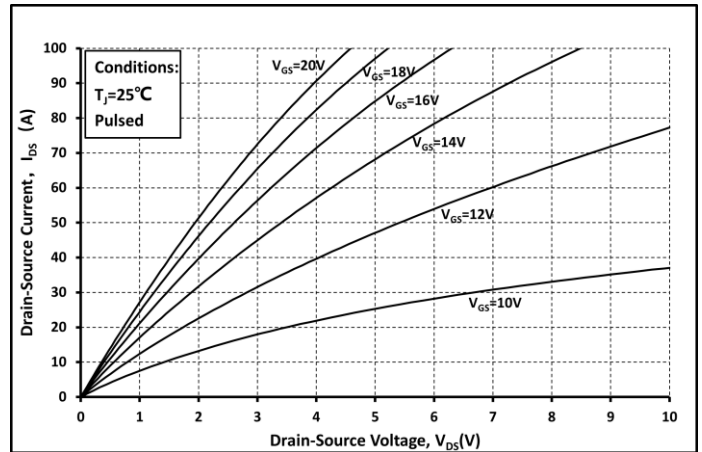


Fig. 2 Output Curve @ $T_J=25^\circ\text{C}$

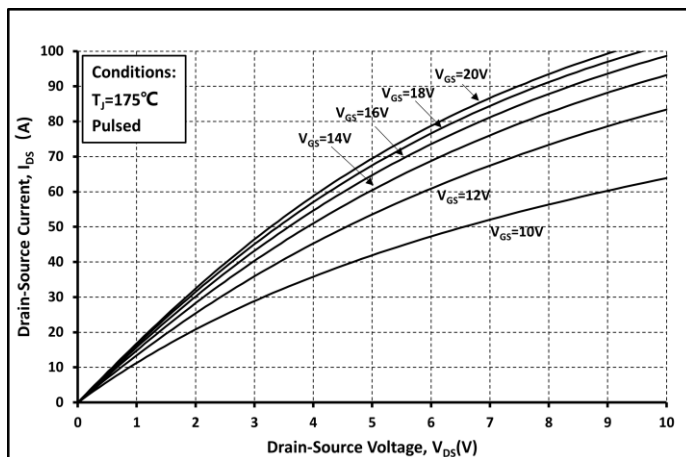


Fig. 3 Output Curve @ $T_J=175^\circ\text{C}$

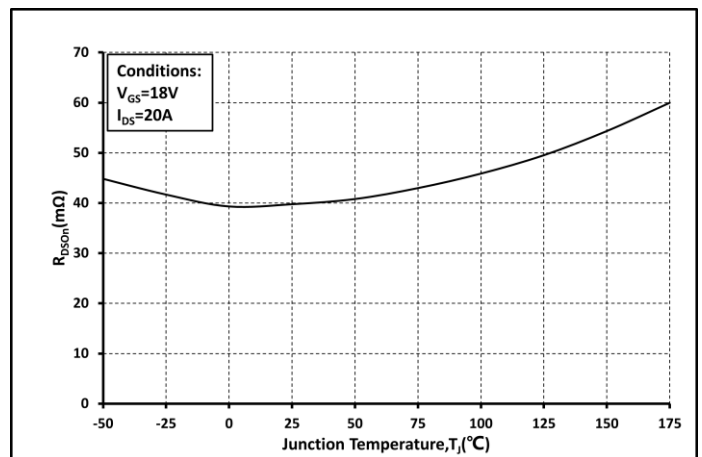


Fig. 4 R_{on} vs. Temperature

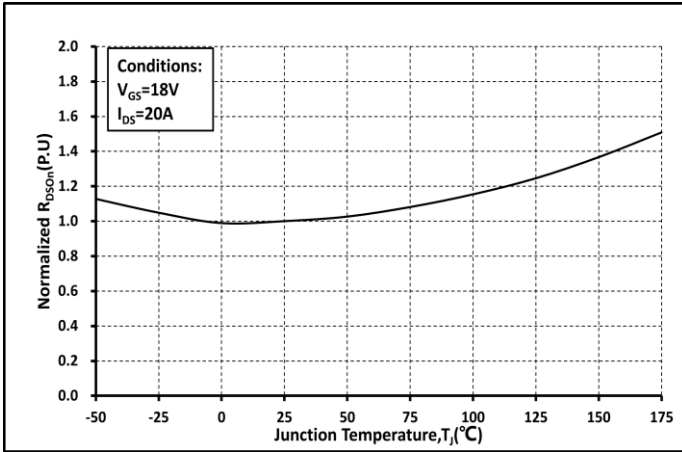


Fig. 5 Normalized Ron vs. Temperature

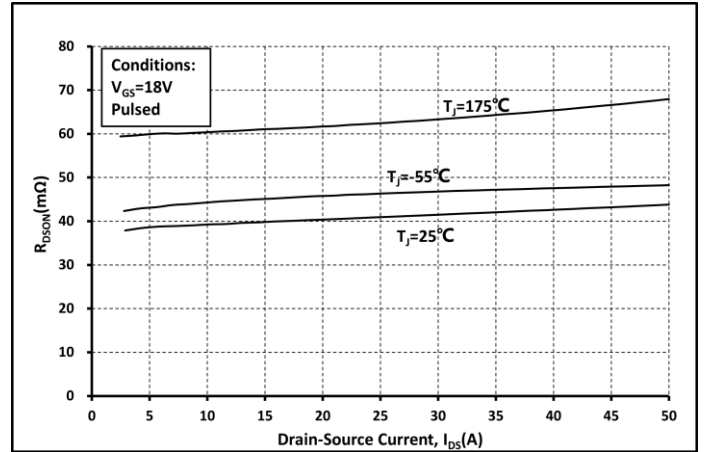


Fig. 6 Ron vs. I_{DS} @ Various Temperature

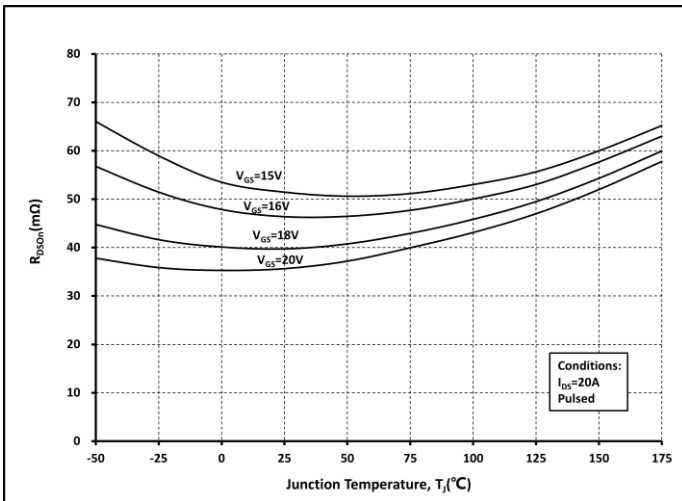


Fig. 7 Ron vs. Temperature @ Various V_{GS}

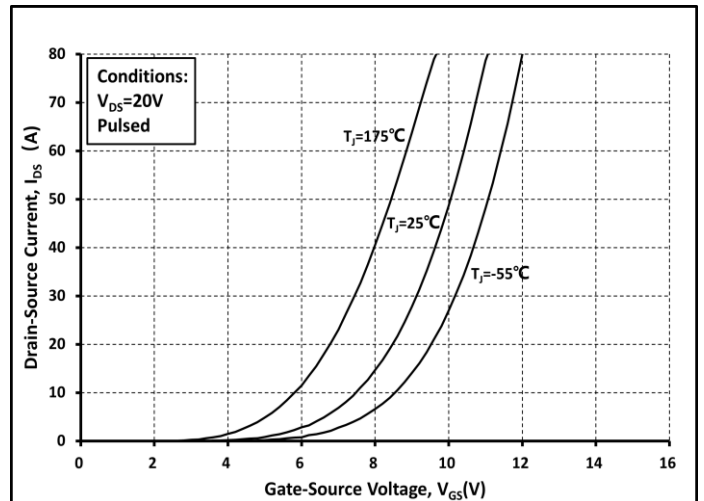


Fig. 8 Transfer Curves @ Various Temperature

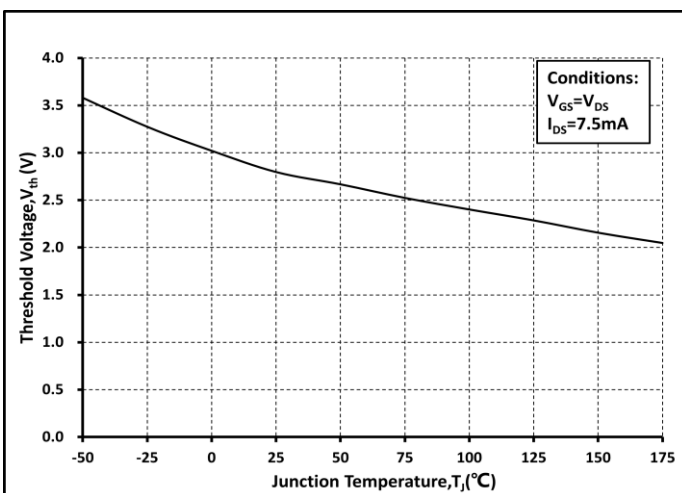


Fig. 9 Threshold Voltage vs. Temperature

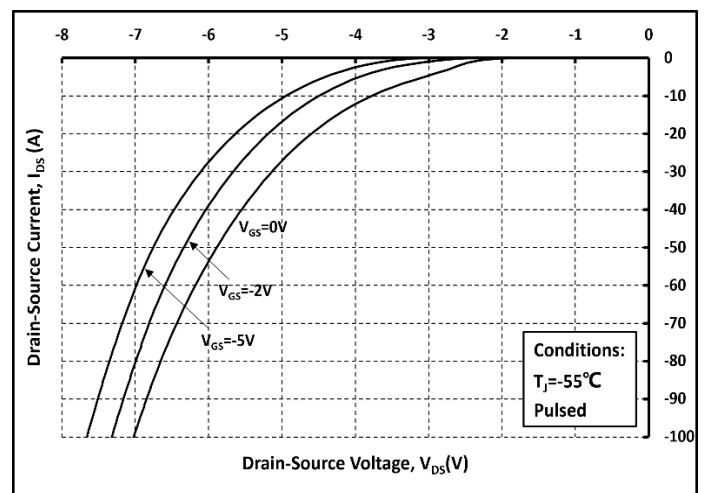


Fig. 10 Body Diode curves @ $T_J = -55^{\circ}C$

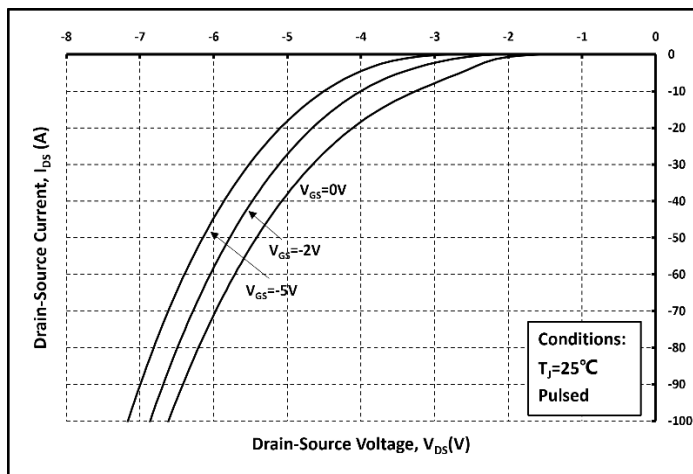


Fig. 11 Body Diode curves @ $T_j = 25^\circ\text{C}$

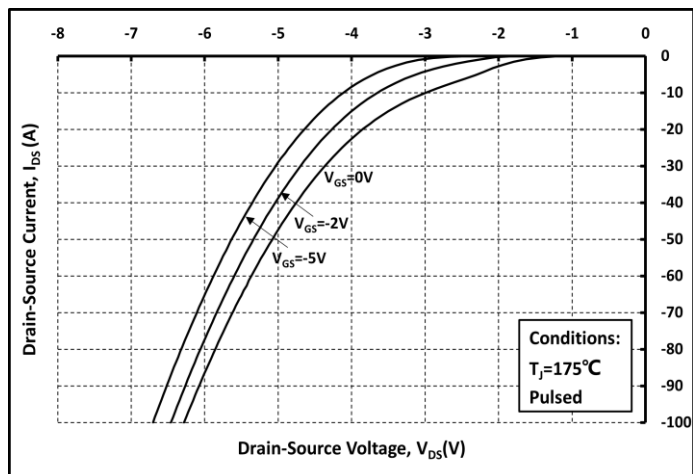


Fig. 12 Body Diode curves @ $T_j = 175^\circ\text{C}$

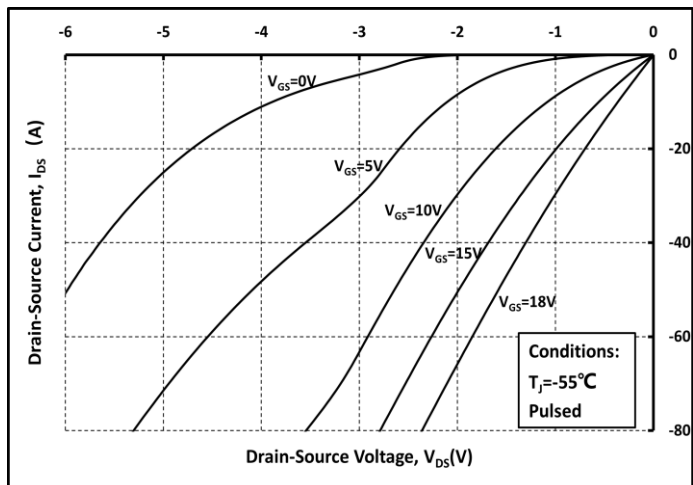


Fig. 13 3rd Quadrant curves @ $T_j = -55^\circ\text{C}$

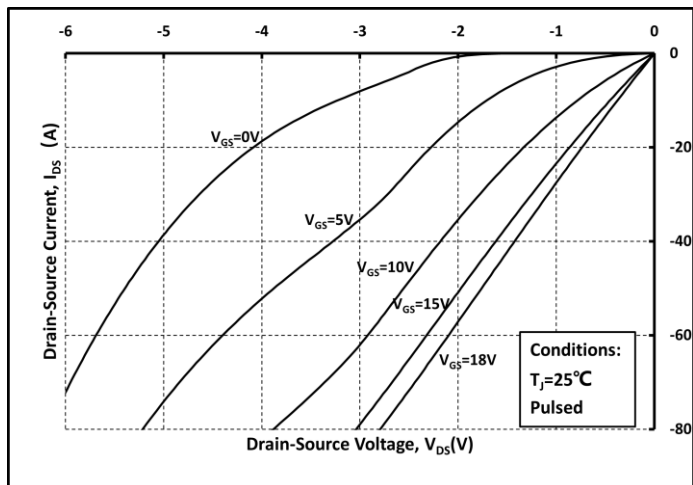


Fig. 14 3rd Quadrant curves @ $T_j = 25^\circ\text{C}$

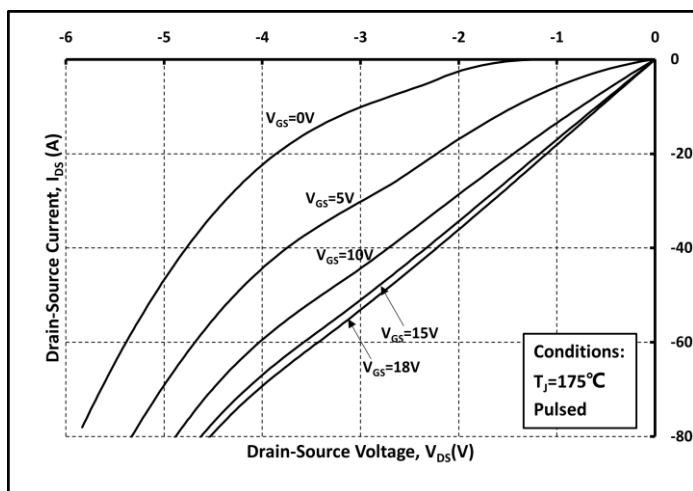


Fig. 15 3rd Quadrant curves @ $T_j = 175^\circ\text{C}$

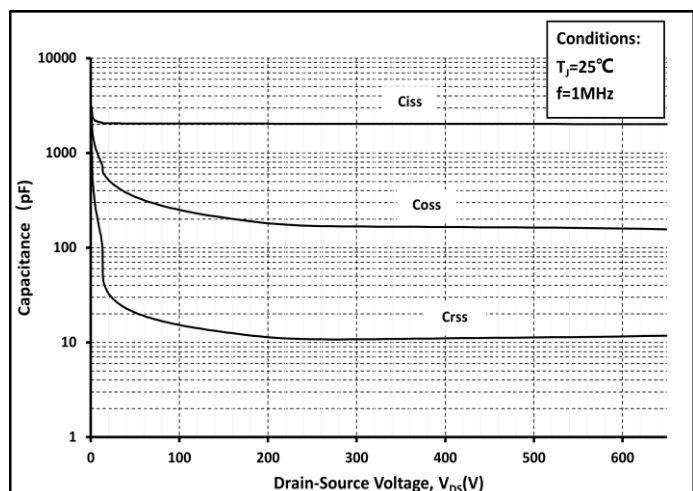


Fig. 16 Capacitance vs. V_{DS}

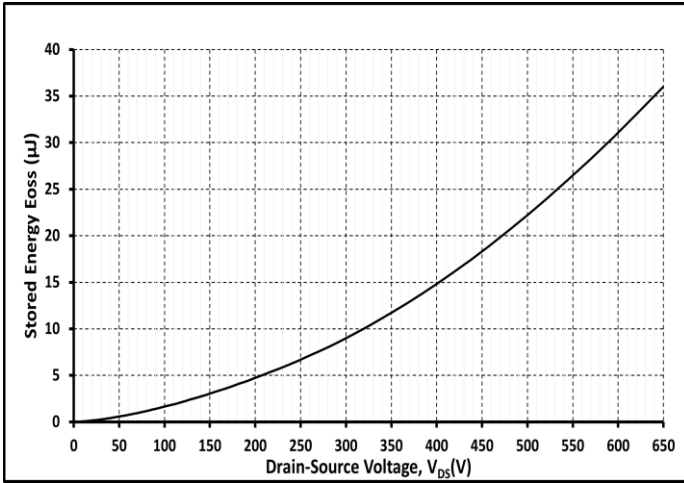


Fig. 17 Output Capacitor Stored Energy

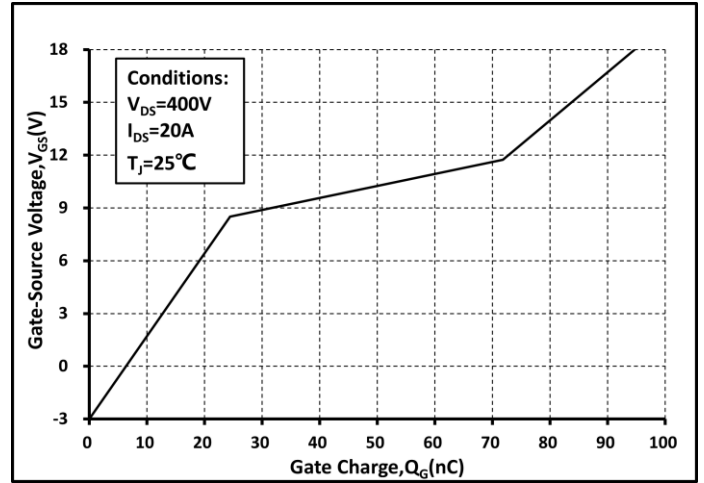


Fig. 18 Gate Charge Characteristics

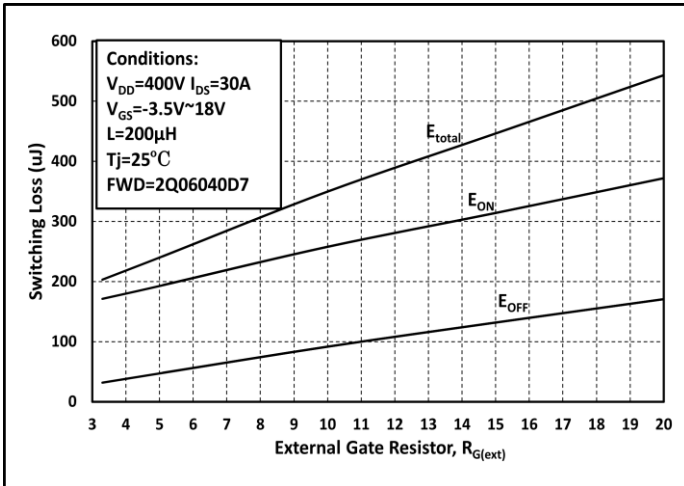


Fig. 19 Switching Energy vs. $R_{G(ext)}$

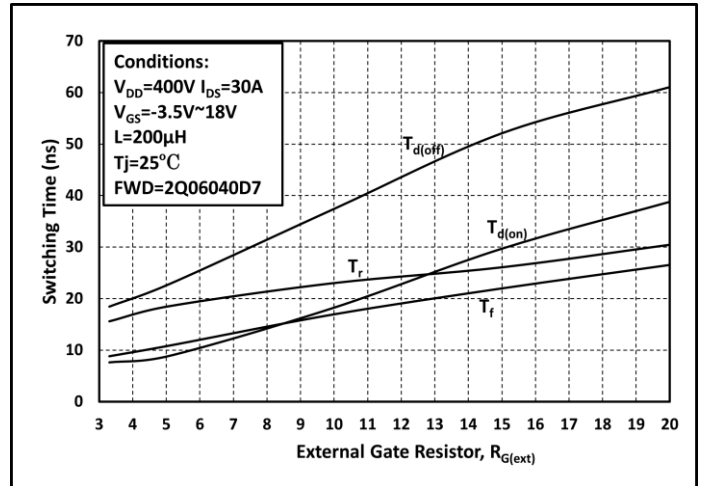


Fig. 20 Switching Times vs. $R_{G(ext)}$

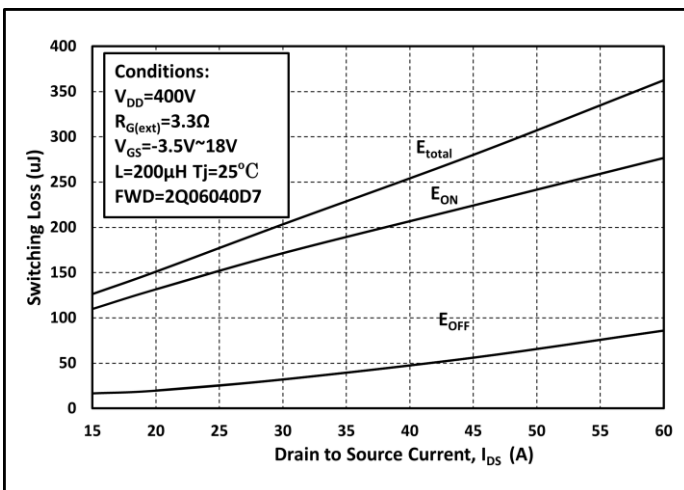


Fig. 21 Switching Energy vs. I_{DS}

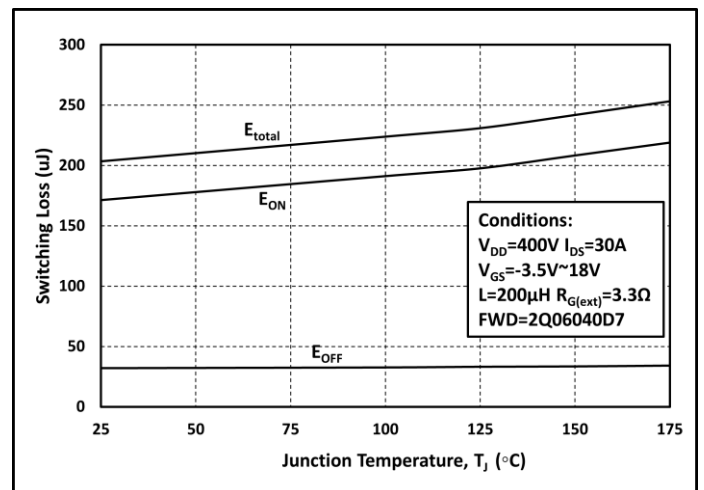


Fig. 22 Switching Energy vs. Temperature

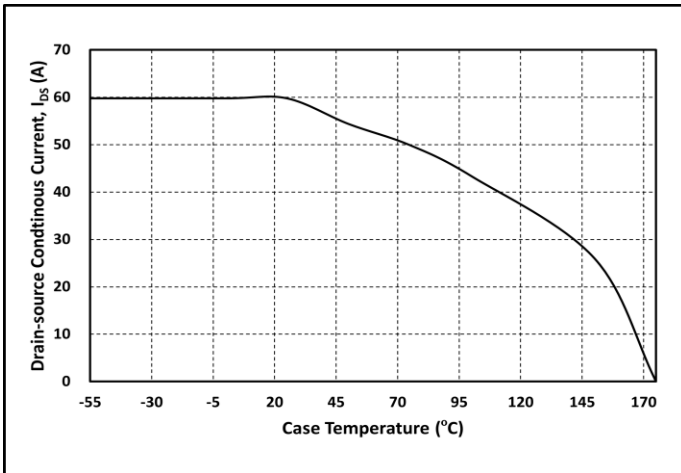


Fig. 23 Continuous Drain Current vs. Case Temperature

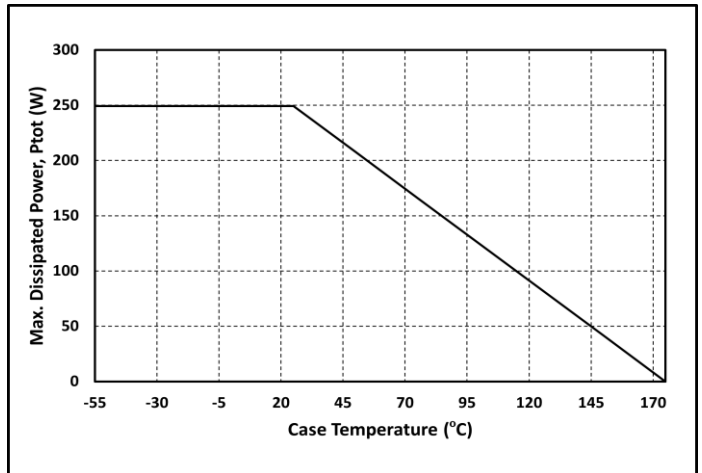


Fig. 24 Max. Power Dissipation Derating vs. Case Temperature

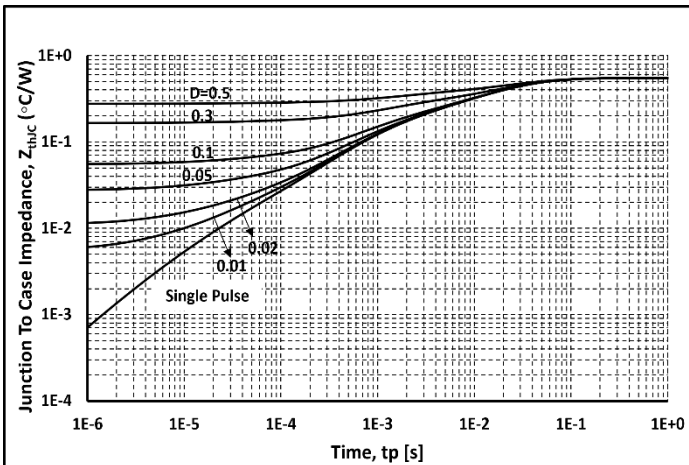


Fig. 25 Thermal impedance

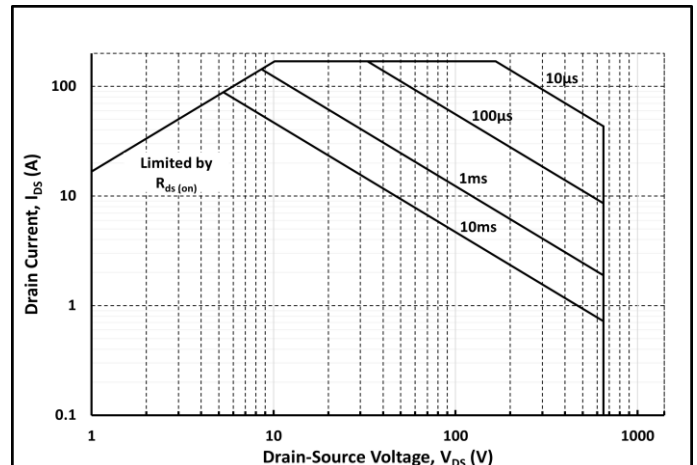
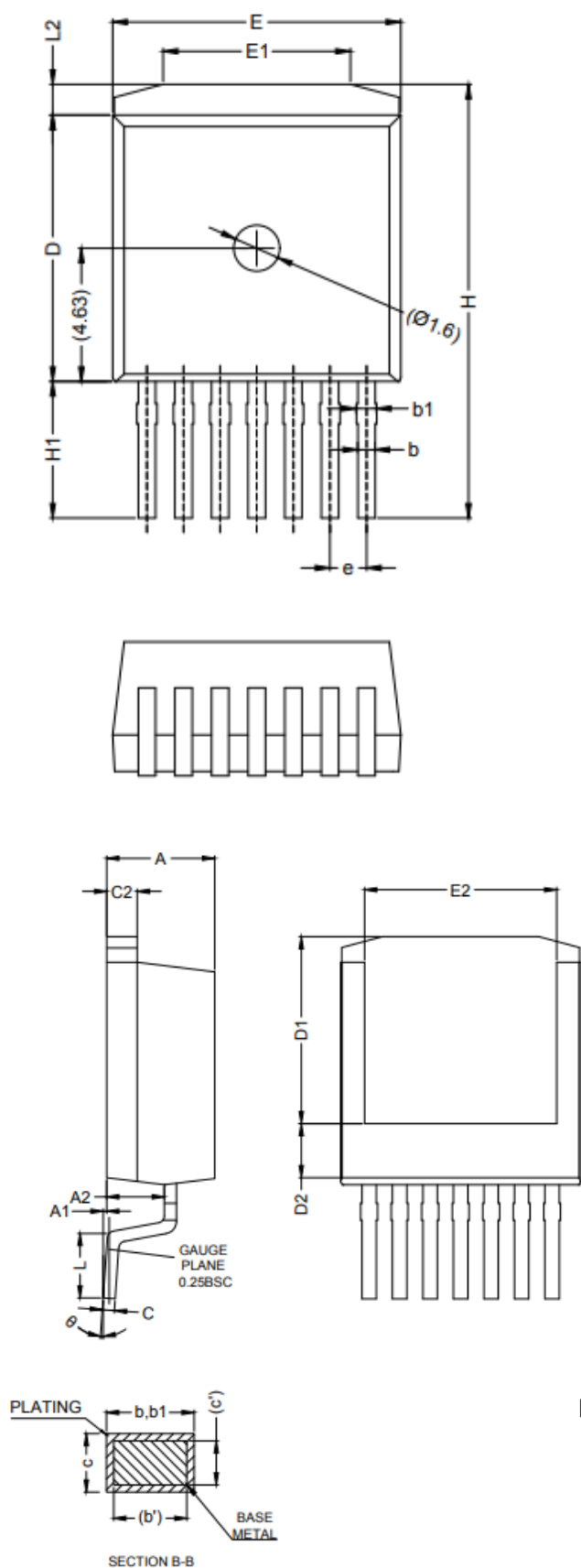


Fig. 26 Safe Operating Area

Package Dimensions



Items	Min	Max
A	4.30	4.70
A1	-	0.25
A2	2.20	2.60
b	0.52	0.72
b'	0.50	0.70
b1	0.60	0.80
c	0.42	0.62
c'	0.40	0.60
c2	1.07	1.47
D	9.05	9.45
D1	7.58	7.98
D2	2.05	2.45
e	1.27 BSC	
E	9.80	10.20
E1	6.30	6.70
E2	7.80	8.20
L	2.48	2.88
L2	0.87	1.27
H	14.87	15.27
H1	4.55	4.95
θ	0°	8°

Note:

1. Package Reference: JEDEC TO263, Variation AD
2. All Dimensions are in mm
3. Subject to Change Without Notice

Notes

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