

## C3M0120065J-VB Datasheet

### N-Channel 650V (D-S) SiC Power MOSFET

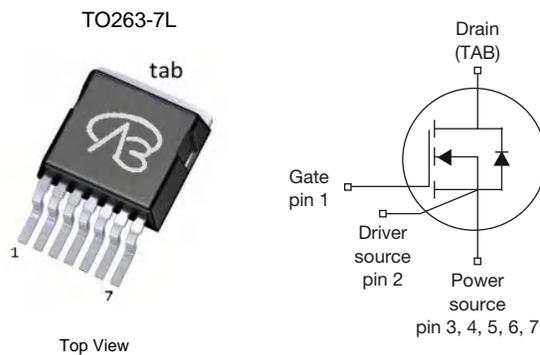
PRODUCT SUMMARY		
$V_{DS}$ (V)	650	
$R_{DS(on)}$ at 25 °C ( $\Omega$ )	$V_{GS} = 18$ V	0.055
$Q_g$ (nC)	40	

#### FEATURES

- Low figure-of-merit (FOM)  $R_{on} \times Q_g$
- Higher robustness and system reliability
- Kelvin source provides up to 4 times lower switching losses
- Ultra low gate charge ( $Q_g$ )
- Avalanche energy rated (UIS)

#### APPLICATIONS

- Server and telecom power supplies
- EV charging infrastructure
- Solar PV inverters
- DC/DC converter



ABSOLUTE MAXIMUM RATINGS ( $T_C = 25$ °C, unless otherwise noted)				
PARAMETER	SYMBOL	LIMIT	UNIT	
Drain-Source Voltage	$V_{DS}$	650	V	
Gate-Source Voltage	$V_{GS}$	-10 / +22		
Continuous Drain Current ( $T_J = 175$ °C)	$V_{GS}$ at 18 V	$T_C = 25$ °C	35	A
		$T_C = 100$ °C	25	
Pulsed Drain Current <sup>a</sup>		95		
Linear Derating Factor		2.1	W/°C	
Single Pulse Avalanche Energy <sup>b</sup>	$E_{AS}$	160	mJ	
Maximum Power Dissipation	$P_D$	187	W	
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$	-55 to +175	°C	
Drain-Source Voltage Slope	$dV/dt$	150	V/ns	
Reverse Diode $dV/dt$ <sup>d</sup>				100
Soldering Recommendations (Peak Temperature) <sup>c</sup>	for 10 s	260	°C	

#### Notes

- Repetitive rating; pulse width limited by maximum junction temperature.
- $V_{DD} = 50$  V, starting  $T_J = 25$  °C,  $L = 1$  mH,  $R_g = 25$   $\Omega$ .
- 1.6 mm from case.
- $I_{SD} \leq I_D$ ,  $dI/dt = 100$  A/ $\mu$ s, starting  $T_J = 25$  °C.

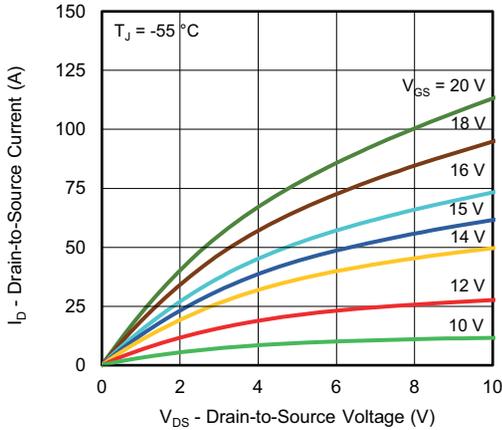
THERMAL RESISTANCE RATINGS				
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	$R_{thJA}$	-	62	°C/W
Maximum Junction-to-Case (Drain)	$R_{thJC}$	-	0.8	

SPECIFICATIONS ( $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted)							
PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
<b>Static</b>							
Drain-Source Breakdown Voltage	$V_{DS}$	$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}$		650	-	-	V
$V_{DS}$ Temperature Coefficient	$\Delta V_{DS}/T_J$	Reference to $25\text{ }^\circ\text{C}$ , $I_D = 1\text{ mA}$		-	0.70	-	V/°C
Gate-Source Threshold Voltage (N)	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 5\text{ mA}$		2	-	4.5	V
Gate-Source Leakage	$I_{GSS}$	$V_{GS} = +18\text{ V}$		-	-	100	nA
		$V_{GS} = -8\text{ V}$		-	-	100	nA
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 650\text{ V}, V_{GS} = 0\text{ V}$		-	10	-	$\mu\text{A}$
		$V_{DS} = 650\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$		-	-	100	
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS} = 18\text{ V}$	$I_D = 20\text{ A}$	-	0.055	-	$\Omega$
Forward Transconductance	$g_{fs}$	$V_{DS} = 0\text{ V}, I_D = 20\text{ A}$		-	10	-	S
<b>Dynamic</b>							
Input Capacitance	$C_{iss}$	$V_{GS} = 0\text{ V},$ $V_{DS} = 600\text{ V},$ $f = 100\text{ KHz}$		-	1500	-	pF
Output Capacitance	$C_{oss}$			-	90	-	
Reverse Transfer Capacitance	$C_{rss}$			-	3	-	
Effective Output Capacitance, Energy Related <sup>a</sup>	$C_{o(er)}$	$V_{DS} = 0\text{ V to } 400\text{ V}, V_{GS} = 0\text{ V}$		-	120	-	
Effective Output Capacitance, Time Related <sup>b</sup>	$C_{o(tr)}$			-	160	-	
Total Gate Charge	$Q_g$	$V_{GS} = -5/18\text{ V}$	$I_D = 20\text{ A}, V_{DS} = 400\text{ V}$	-	40	-	nC
Gate-Source Charge	$Q_{gs}$			-	20	-	
Gate-Drain Charge	$Q_{gd}$			-	23	-	
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = 400\text{ V}, I_D = 20\text{ A}$  $V_{GS} = -5/15\text{ V}$		-	12	15	ns
Rise Time	$t_r$			-	10	13	
Turn-Off Delay Time	$t_{d(off)}$			-	20	-	
Fall Time	$t_f$			-	10	-	
Gate Input Resistance	$R_g$	$f = 1\text{ MHz}, \text{ open drain}$		-	8.2	-	$\Omega$
<b>Drain-Source Body Diode Characteristics</b>							
Continuous Source-Drain Diode Current	$I_S$	MOSFET symbol showing the integral reverse p - n junction diode 		-	-	30	A
Pulsed Diode Forward Current	$I_{SM}$			-	-	90	
Diode Forward Voltage	$V_{SD}$	$T_J = 25\text{ }^\circ\text{C}, I_S = 20\text{ A}, V_{GS} = 0$		-	-	4.1	V
Reverse Recovery Time	$t_{rr}$	$T_J = 25\text{ }^\circ\text{C}, I_F = I_S = 20\text{ A},$ $di/dt = 1000\text{ A}/\mu\text{s}, V_R = 400\text{ V}$		-	12	-	ns
Reverse Recovery Charge	$Q_{rr}$			-	0.06	-	$\mu\text{C}$
Reverse Recovery Current	$I_{RRM}$			-	10	-	A

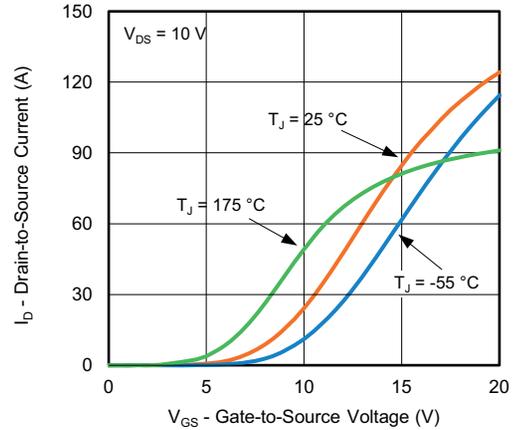
**Notes**

- a.  $C_{oss(er)}$  is a fixed capacitance that gives the same energy as  $C_{oss}$  while  $V_{DS}$  is rising from 0 % to 60 %  $V_{DSS}$ .  
 b.  $C_{oss(tr)}$  is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 % to 60 %  $V_{DSS}$ .

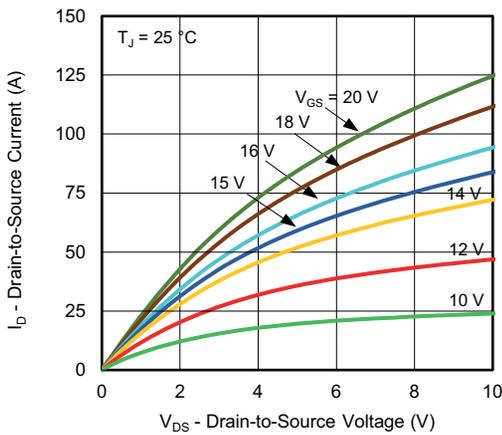
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



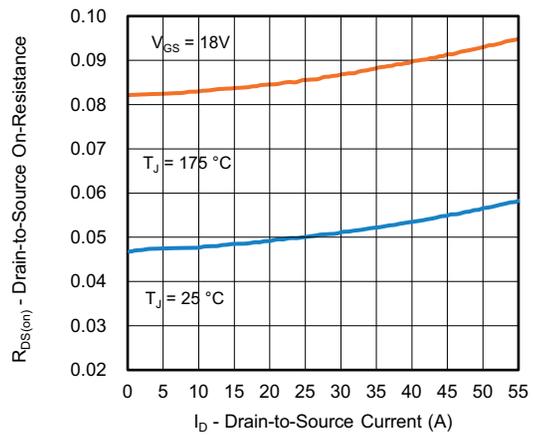
**Fig. 1 - Typical Output Characteristics**



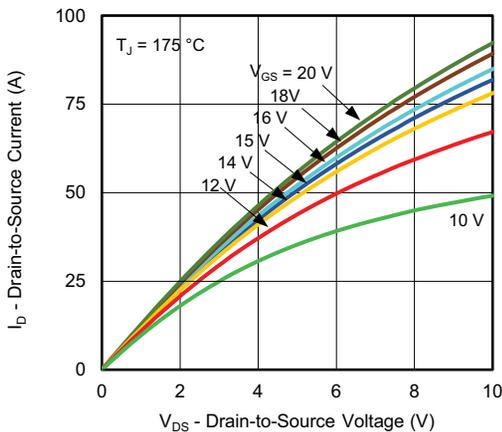
**Fig. 4 - Typical Transfer Characteristics**



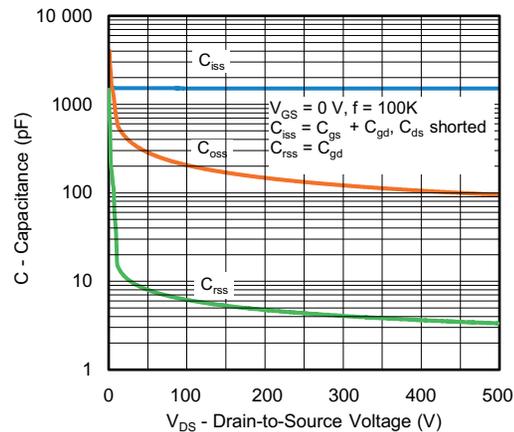
**Fig. 2 - Typical Output Characteristics**



**Fig. 5 - Normalized On-Resistance vs. Drain Current**



**Fig. 3 - Typical Output Characteristics**



**Fig. 6 - Typical Capacitance vs. Drain-to-Source Voltage**

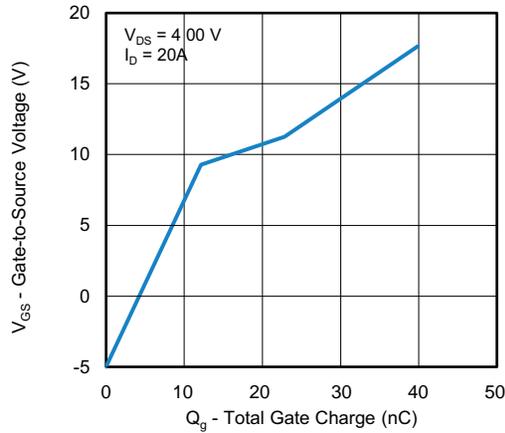


Fig. 7 - Typical Gate Charge vs. Gate-to-Source Voltage

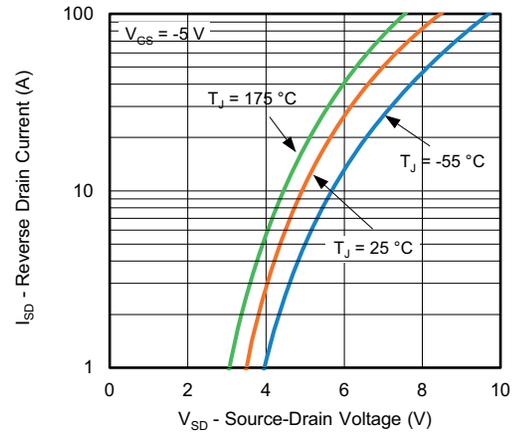


Fig. 10 - Typical Source-Drain Diode Forward Voltage

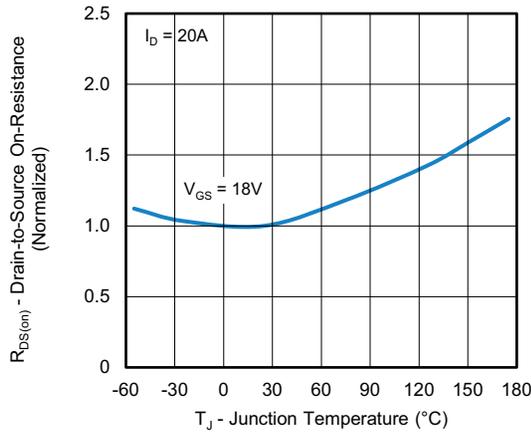


Fig. 8 - Normalized On-Resistance vs. Temperature

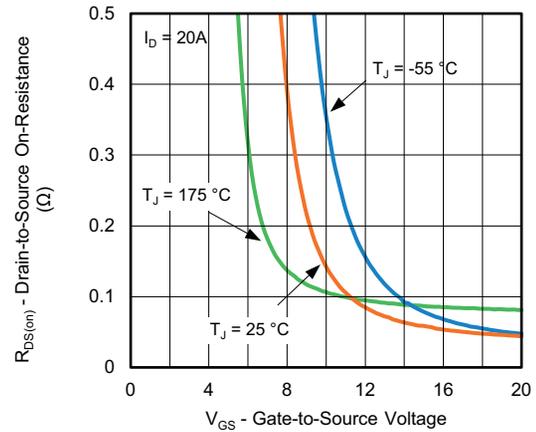


Fig. 11 - On-Resistance vs. Gate-to-Source Voltage

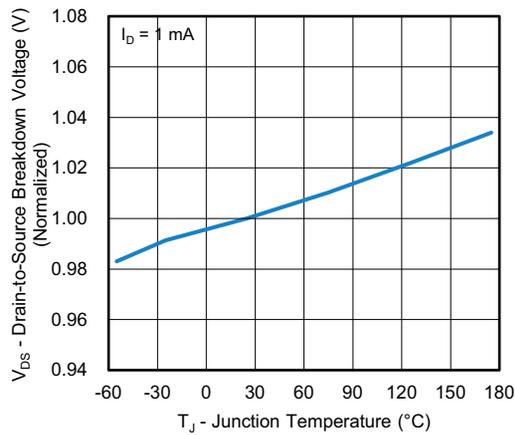


Fig. 9 - Drain-to-Source Voltage vs. Temperature

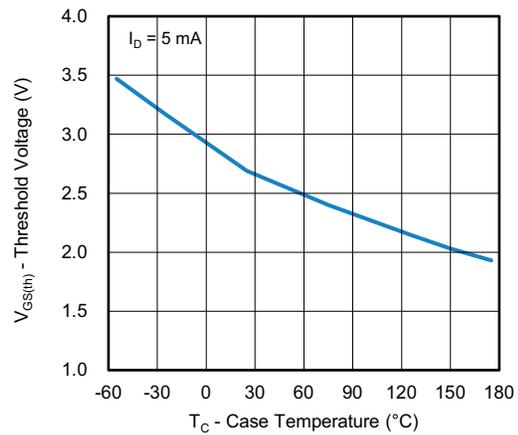


Fig. 12 - Threshold Voltage vs. Case Temperature

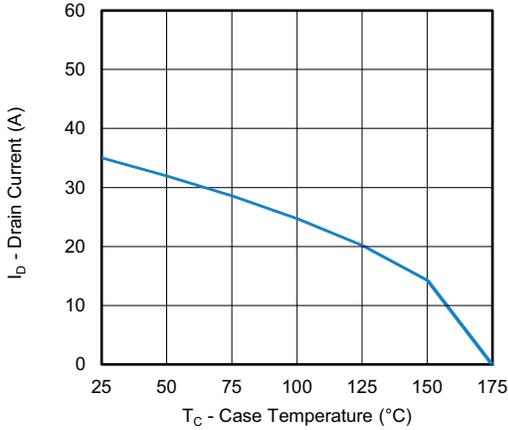


Fig. 13 - Drain Current vs. Case Temperature

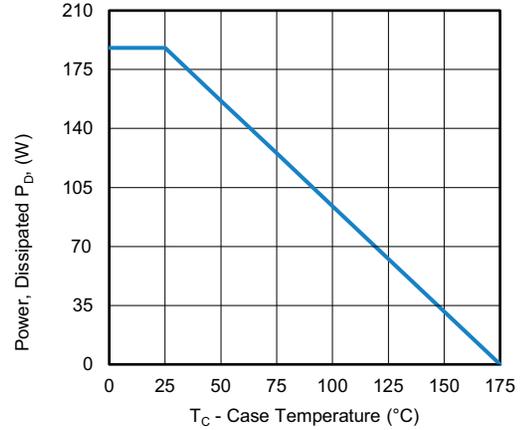


Fig. 15 - Power, Dissipated P<sub>D</sub> vs. Case Temperature

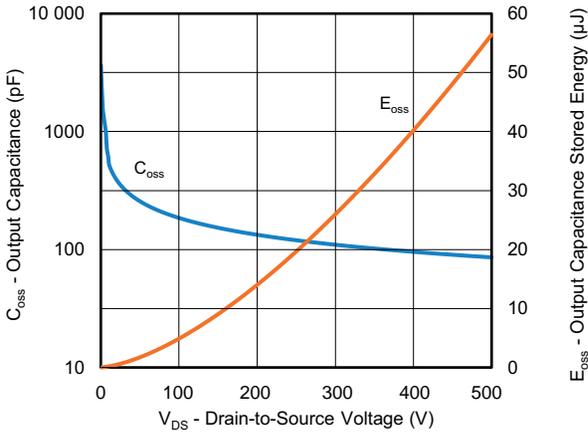


Fig. 14 - Output Capacitance and its Stored Energy vs. Drain-to-Source Voltage

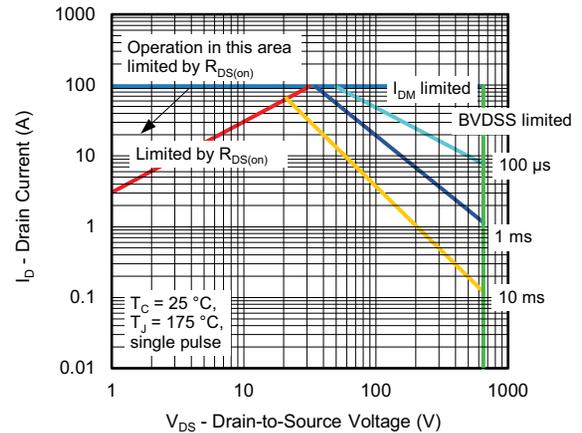


Fig. 16 - Safe Operating Area

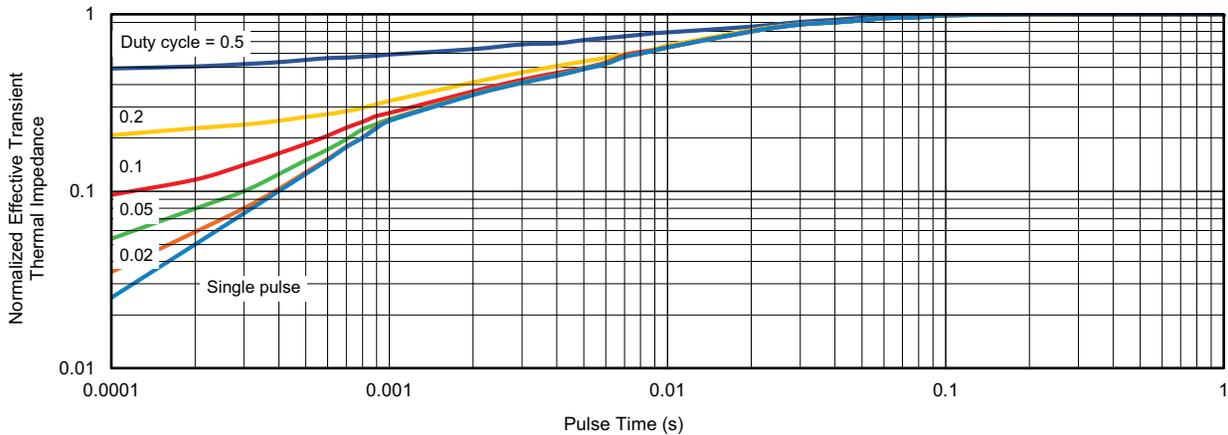


Fig. 17 - Transient Thermal Impedance

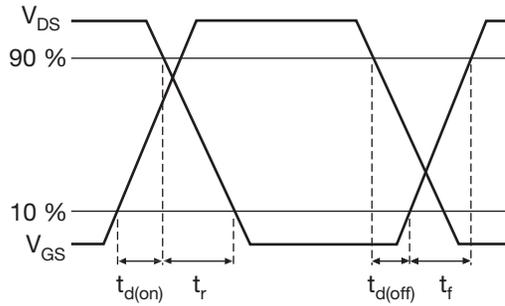


Fig. 18 - Waveforms of Switching Time

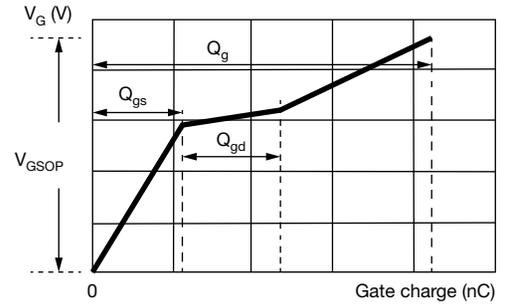


Fig. 21 - Waveforms for Gate Charge

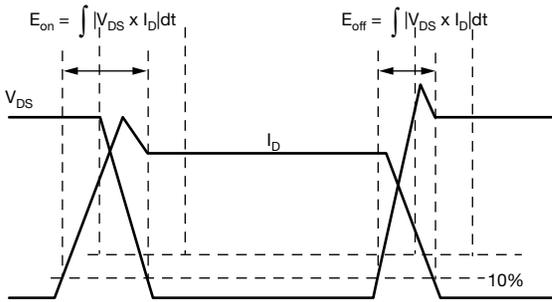


Fig. 19 - Waveforms for Switching Energy

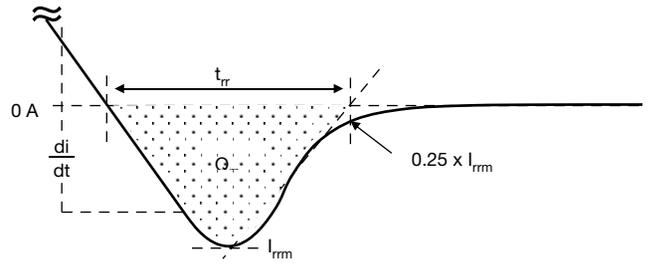


Fig. 22 - Waveforms for Reverse Recovery

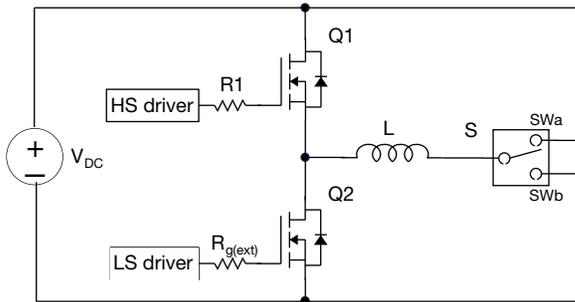


Fig. 20 - Switching and Reverse Diode Characteristics Measurement Circuit

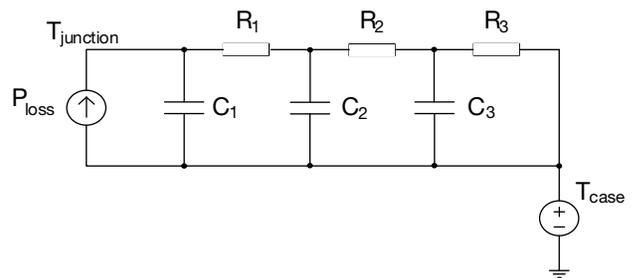
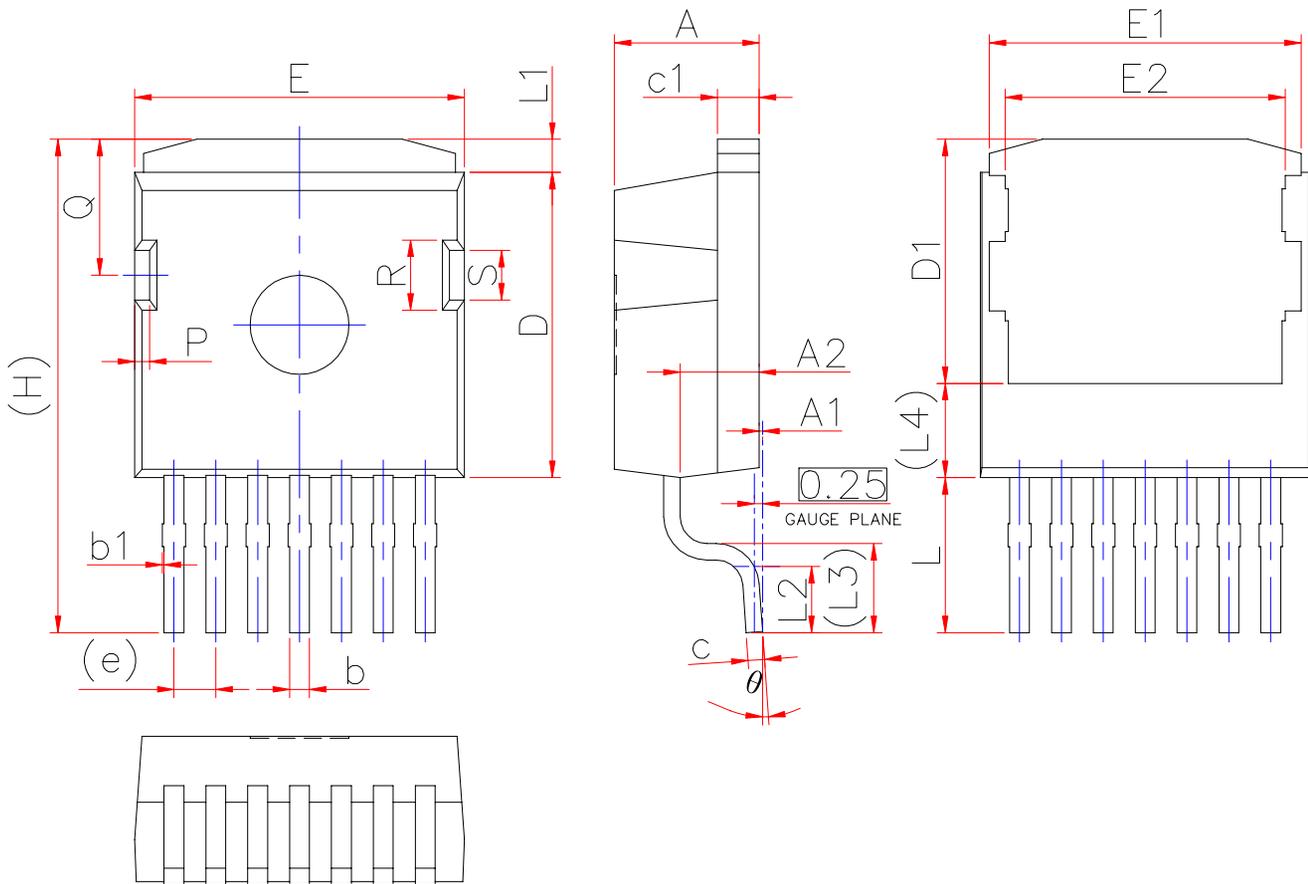


Fig. 23 - Thermal Equivalent Circuit

TO-263-7L(HV) PACKAGE OUTLINE DIMENSIONS



Symbol	Dimensions In Millimeters			Dimensions In Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	4.300	4.400	4.500	0.169	0.173	0.177
A1	0.000	0.100	0.200	0.000	0.004	0.008
A2	2.300	2.400	2.500	0.091	0.094	0.098
b	0.500	0.600	0.700	0.020	0.024	0.028
b1	0.000	0.075	0.150	0.000	0.003	0.006
c	0.400	0.500	0.600	0.016	0.020	0.024
c1	1.170	1.270	1.370	0.046	0.050	0.054
D	9.050	9.250	9.450	0.356	0.364	0.372
D1	7.300	7.400	7.500	0.287	0.291	0.295
E	9.800	10.000	10.200	0.386	0.394	0.402
E1	9.360	9.460	9.560	0.369	0.372	0.376
E2	8.400	8.500	8.600	0.331	0.335	0.339
e	1.270 REF.			0.050 REF.		
H	15.000 REF.			0.591 REF.		
L	4.200	4.700	5.200	0.165	0.185	0.205
L1	0.700	1.000	1.300	0.028	0.039	0.051
L2	1.700	2.000	2.300	0.067	0.079	0.091
L3	2.700 REF.			0.106 REF.		
L4	2.850 REF.			0.112 REF.		
P	0.350	0.450	0.550	0.014	0.018	0.022
Q	4.020	4.120	4.220	0.158	0.162	0.166
R	2.030	2.130	2.230	0.080	0.084	0.088
S	1.400	1.500	1.600	0.055	0.059	0.063
theta	0°	4°	8°	0°	4°	8°

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