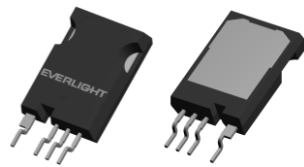


TO-247-TSC 650V N-Channel Enhancement SiC Power MOSFET EL-MAKR0365XA-TC

Preliminary



V_{DSS}	=	650	V
I_D	=	110	A
$R_{DS(on)}$	=	30	mΩ

Features

- Low on-resistance $R_{DS(on)}$
- Best thermal conductivity and behavior
- High speed switching
- High robustness of dv/dt
- Low capacitances and low gate charge
- Low gate resistance for high-frequency switching
- Easy to parallel
- Pb-Free, Halogen Free, RoHS Compliant



Benefits

- Improve System Efficiency
- Increase Power Density
- Reduce Heat Sink Requirement
- Reduction of System Cost

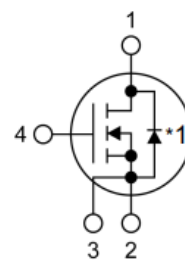
Applications

- Switching mode power supply
- PV inverter
- Uninterruptible Power Supply
- Motor Drives
- DC/DC converters
- EV charging

Key Performance Parameters

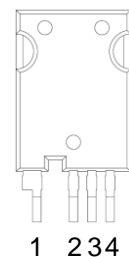
Symbol	V_{DSmin}	V_{GSS}	I_D	I_{DP}	$T_{J,max}$	P_D
Parameter	Drain-Source Voltage	Gate-Source Voltage (DC)	Continuous Drain Current	Pulse Drain Current	Junction temperature	Power Dissipation
Value	650V	-10~23V	110A	220A	175 °C	490W

Schematic



Pin Configuration

1. Drain
 2. Power Source
 3. Driver Source
 4. Gate
- *1. Body Diode



Maximum Ratings

Parameter	Symbol	Value	Unit	Test Conditions
Drain - Source Voltage	V_{DSmin}	650	V	$V_{GS}= 0V, I_D= 250\mu A$
Gate - Source Voltage (DC) Max	V_{GS}	-10 / +23	V	
Gate - Source Voltage (DC)	V_{GS}	-5 / +18	V	Recommended operating values
Continuous Drain Current	I_D^{*2}	110	A	
Pulse Drain Current	I_{DP}	220	A	
Power Dissipation	P_D^{*3}	490	W	
Operating Junction	T_J	175	°C	
Storage Temperature	T_{stg}	-55 to+ 175	°C	
Solder Temperature	T_L	260	°C	
Mounting Torque	M_d	1 8.8	Nm lbf-in	M3 or 6-32 screw

*1 Please be advised not to use SiC-MOSFETs with V_{GS} below 12V as doing so may cause thermal runaway.

*2 Limited by maximum T_a and for Max. R_{thJC}

*3 $P_W \leq 10\mu s$, Duty cycle $\leq 1\%$

*4 Tested after applying V_{GS} for 100ms.

*5 Pulsed

Electrical Characteristics

Parameter	Symbol	Value			Unit	Test Conditions	
		Min	Typ	Max			
Drain-Source Breakdown Voltage	$V_{(BR)DSS}$	650	-	-	V	$V_{GS}=0V, I_D=250\mu A$	
Gate Threshold Voltage	$V_{GS(th)}^{*4}$	2.0	-	4.0	V	$V_{DS}=10V, I_D=13.3mA$	
Zero Gate Voltage Drain Current	I_{DSS}	-	6.0 12	60 -	μA	$V_{DS}=750V, V_{GS}=0V, T_J=25^\circ C$ $V_{DS}=750V, V_{GS}=0V, T_J=150^\circ C$	
Gate-Source Leakage Current	I_{GSS+}	-	-	100	nA	$V_{GS}=23V, V_{DS}=0V$	
Gate-Source Leakage Current	I_{GSS-}	-	-	-100	nA	$V_{GS}=-10V, V_{DS}=0V$	
Drain-Source On-State Resistance	$R_{DS(on)}^{*5}$	-	20	-	m Ω	$V_{GS}=18V, I_D=26.7A, T_J=25^\circ C$	
		-	23	-		$V_{GS}=18V, I_D=26.7A, T_J=125^\circ C$	
		-	25	-		$V_{GS}=18V, I_D=26.7A, T_J=150^\circ C$	
Input Capacitance	C_{iss}	-	4300	-	pF	$V_{GS}=0V$ $V_{DS}=400V$ $f=1MHz$	
Output Capacitance	C_{oss}	-	330	-			
Reverse Transfer Capacitance	C_{rss}	-	25	-			
Turn-On Switching Loss	E_{on}	-	29	-	μJ	$V_{DS}=400V, I_D=26.7A$ $L=120\mu H$ $L\sigma=150nH$ $V_{GS}=-4/+18V$ $R_G=2.0\Omega$	
Turn-Off Switching Loss	E_{off}	-	239	-	μJ		
Turn-On Delay Time	$t_{d(on)}$	-	50	-	ns		
Rise Time	t_r	-	22	-			
Turn-Off Delay Time	$t_{d(off)}$	-	91	-			
Fall Time	t_f	-	22	-			
Gate to Source Charge	Q_{gs}	-	63	-	nC		$V_{DS}=400V$ $I_{DS}=26.7A$ $V_{GS}=18V$
Gate to Drain Charge	Q_{gd}	-	66	-			
Total Gate Charge	Q_g	-	240	-			
Gate resistance	R_G	-	1.5	-	Ω	$f=1MHz, \text{open drain}$	

Body Diode Characteristics

Parameter	Symbol	Value		Unit	Test Conditions
		Typ.	Max.		
Diode Forward Voltage	V_{SD}	3.5	-	V	$V_{GS}= 0V, I_S= 26.7A$
Continuous Diode Forward Current	I_S	-	100	A	
Reverse Recover Time	t_{rr}	36	-	ns	
Peak Reverse Recovery Current	I_{rrm}	25	-	A	$I_S= 26.7A$ $V_R= 400V$ $di/dt= 2000A/\mu s$
Reverse recovery charge	Q_{rr}	450	-	nC	

Thermal Characteristics (Measured conformable to JESD51-14.)

Parameter	Symbol	Value		Unit
		Typ	Max	
Thermal Resistance from Junction to Case	$R_{\theta JC}$	0.23	0.30	$^{\circ}C/W$

Typical Performance

Typical Output Characteristics (I)

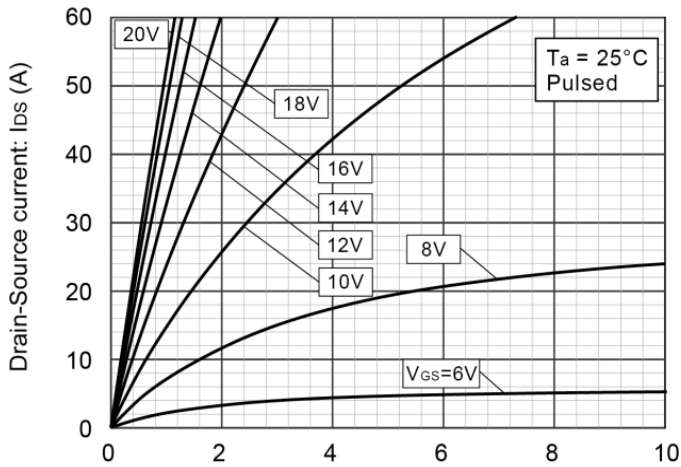


Figure1. Drain - Source Voltage: V_{DS} (V)

Typical Output Characteristics (II)

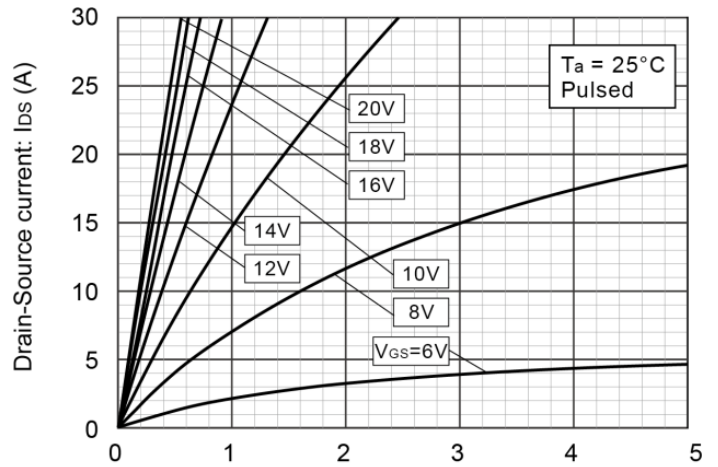


Figure2. Drain - Source Voltage: V_{DS} (V)

Typical Output Characteristics (III) $T_a = 150^\circ\text{C}$

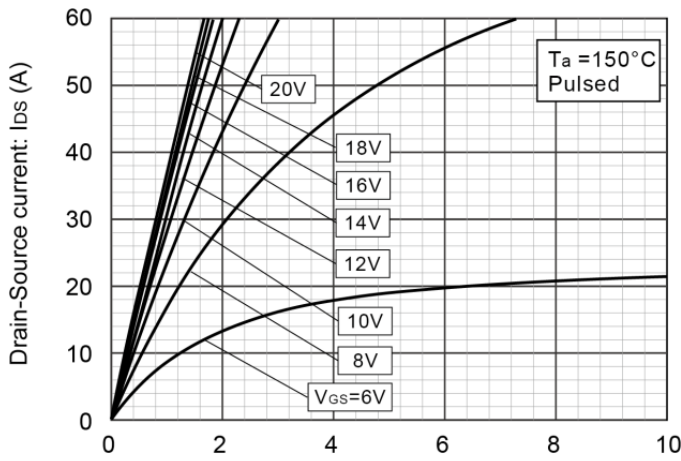


Figure3. Drain - Source Voltage: V_{DS} (V)

Typical Output Characteristics (IV) $T_a = 150^\circ\text{C}$

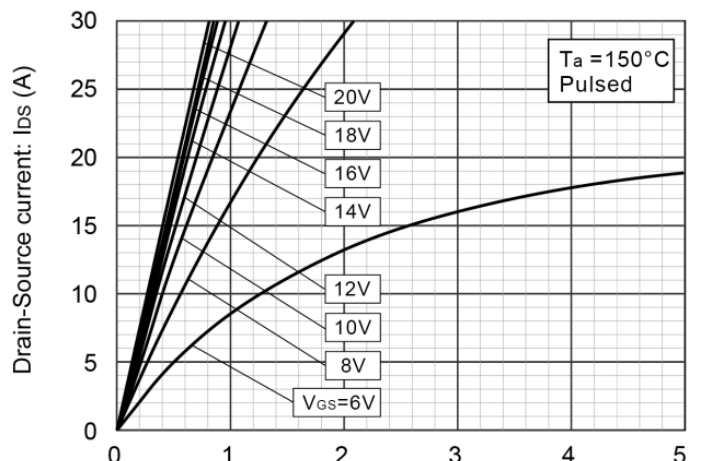


Figure4. Drain - Source Voltage: V_{DS} (V)

Typical Transfer Characteristics (I)

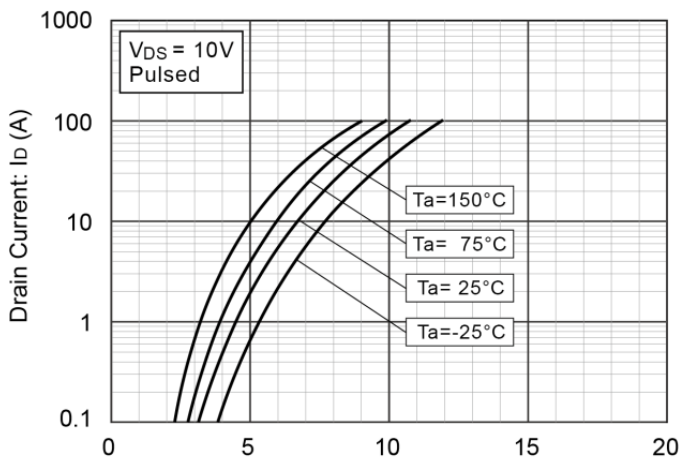


Figure5. Gate - Source Voltage: V_{GS} (V)

Typical Transfer Characteristics (II)

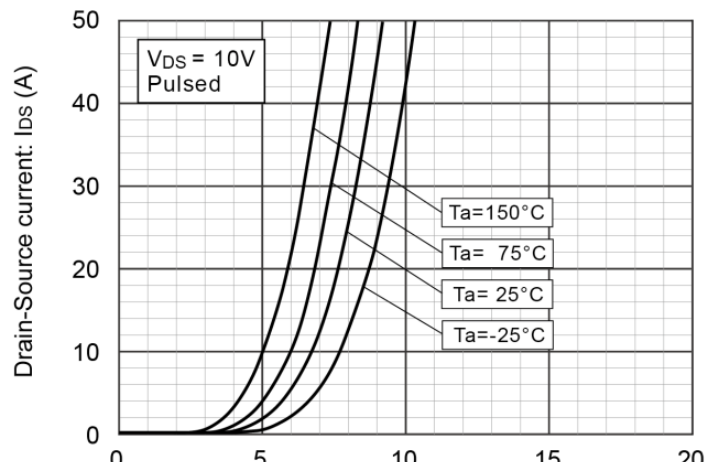


Figure6. Gate - Source Voltage: V_{GS} (V)

Drain – Source Voltage vs. Source - Drain current

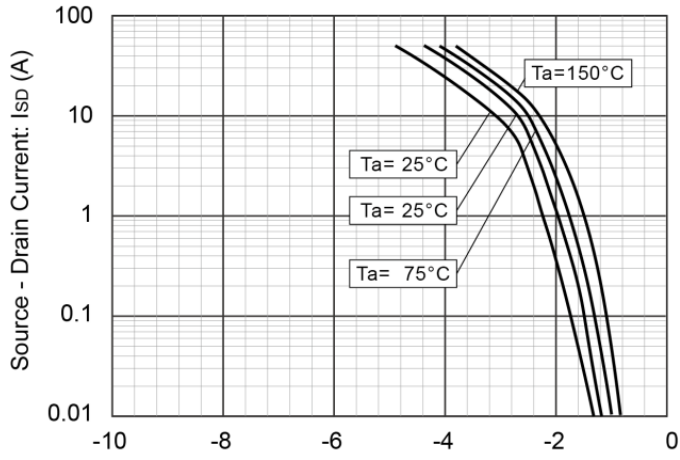


Figure7. Drain - Source Voltage: V_{DS} (V)

3rd Quadrant Characteristic $T_a = 25^\circ\text{C}$

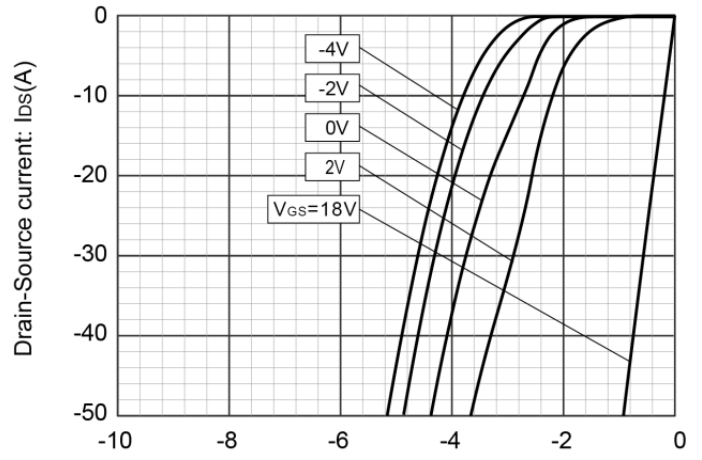


Figure8. Drain-Source Voltage: V_{DS} (V)

Gate Threshold Voltage vs. Junction Temperature

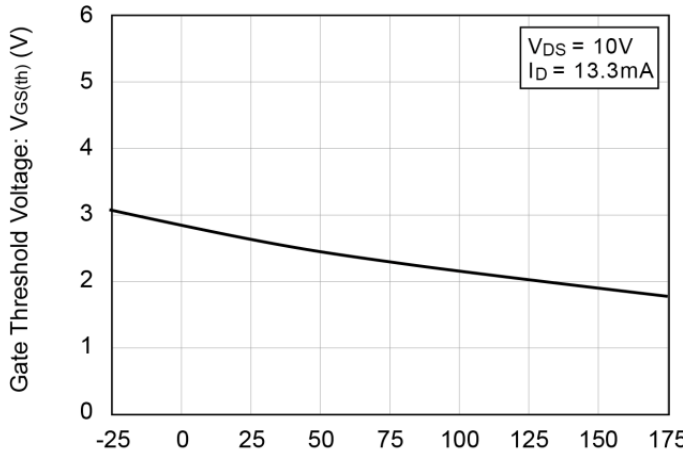


Figure9. Junction Temperature: T_j ($^\circ\text{C}$)

Static Drain - Source On - State Resistance vs. Gate - Source Voltage

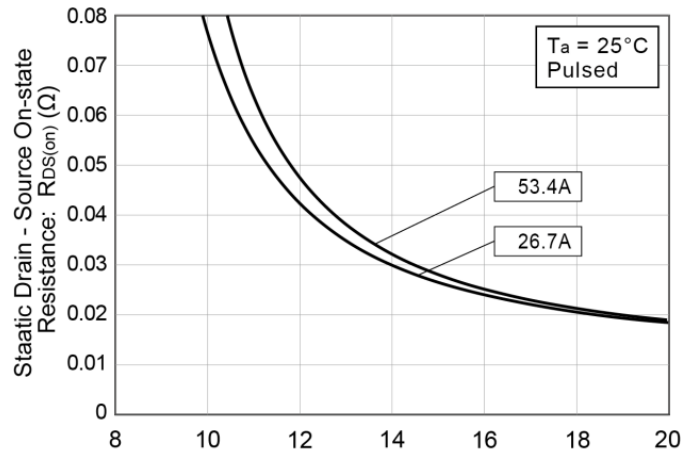


Figure10. Gate - Source Voltage: V_{GS} (V)

Static Drain - Source On - State Resistance vs. Junction Temperature

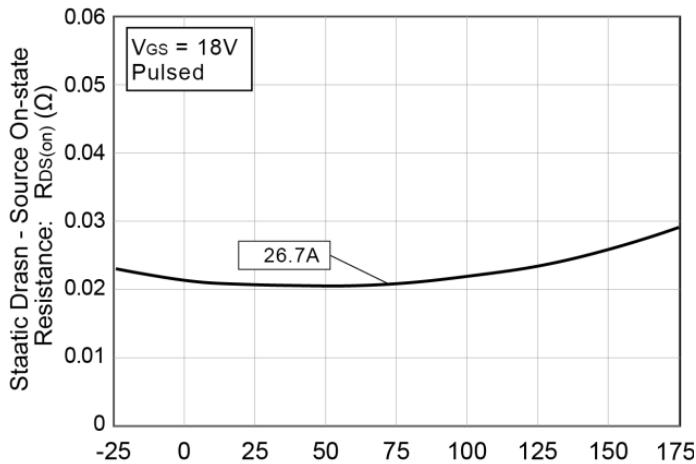


Figure11. Junction Temperature: T_j ($^\circ\text{C}$)

Typical Capacitance vs. Drain – Source Voltage

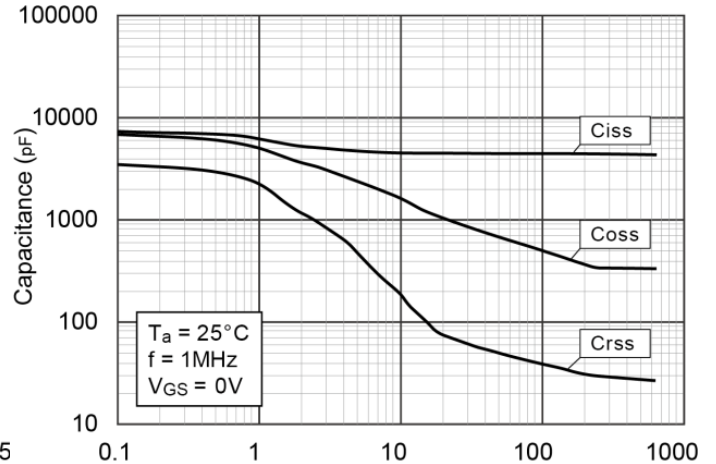
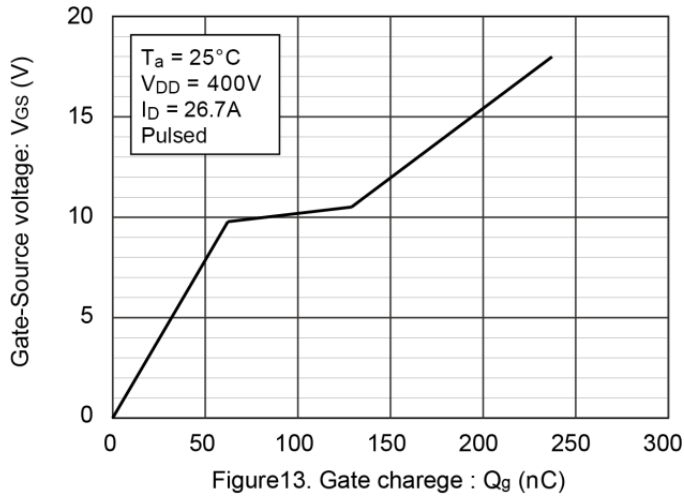
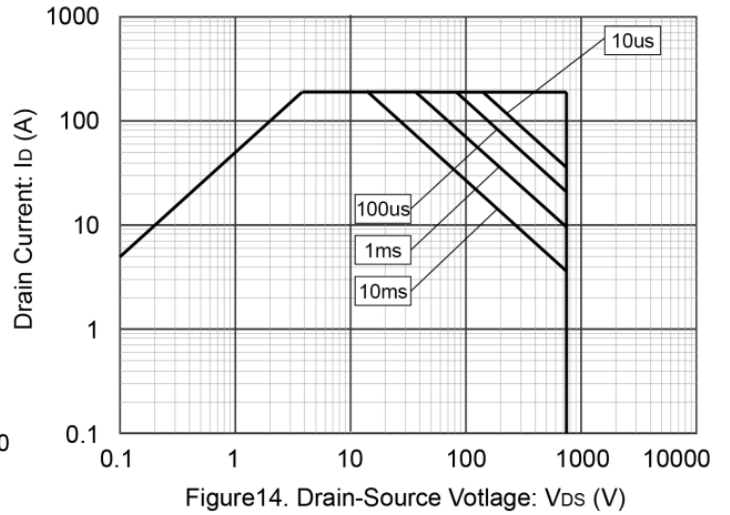


Figure12. Drain - Source Voltage: V_{bs} (V)

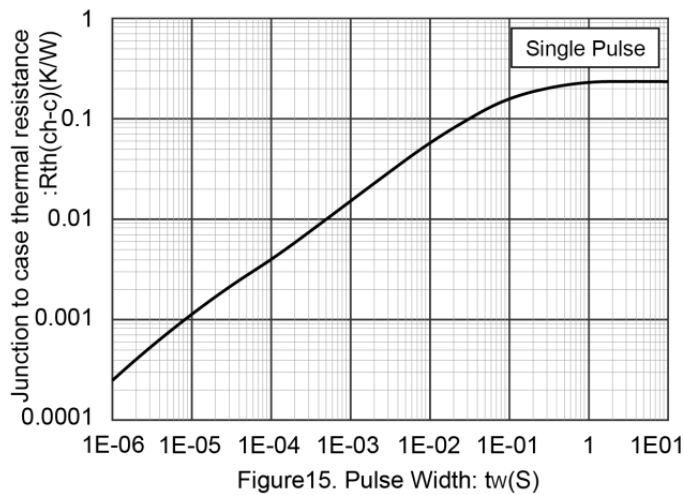
Typical Gate Charge



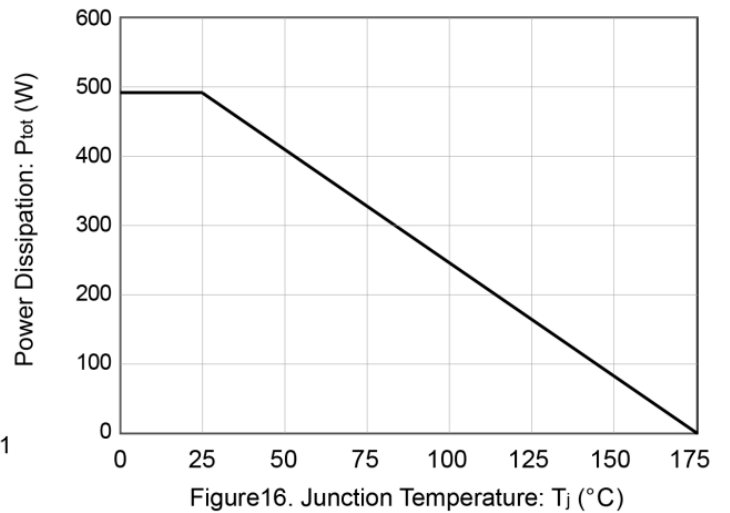
Maximum Safe Operating Area (SOA)



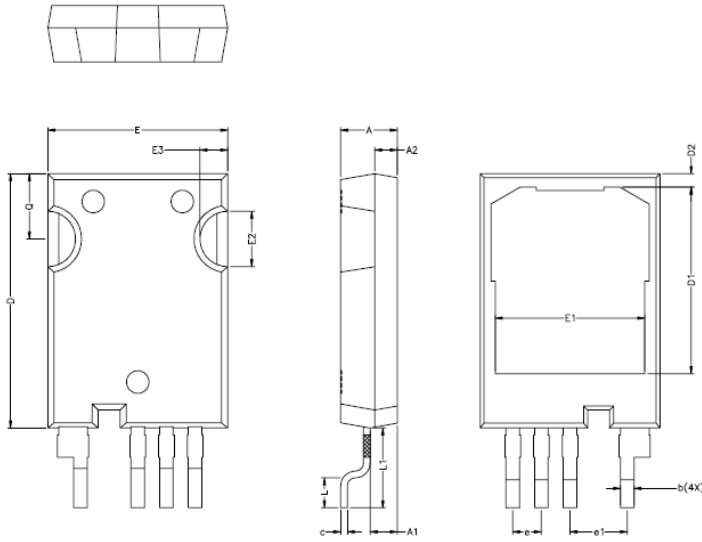
Typical Transient Thermal Resistance Vs. Pulse Width



Power dissipation vs. Junction Temperature



Package Outlines



DIM	MILLIMETERS		
	MIN	TYP.	MAX
A	4.82	5.02	5.22
A1	2.21	2.41	2.61
A2	1.8	2	2.2
b	0.95	1.2	1.45
c	0.35	0.6	0.85
D	22.34	22.54	22.74
D1	16.3	16.55	16.8
D2	0.99	1.19	1.39
E	15.74	15.94	16.14
E1	13.01	13.26	13.51
E2	4.71	4.91	5.11
E3	2.26	2.46	2.66
e	2.54 B S C .		
e1	5.08 B S C .		
L	-	-	-
L1	-	-	-
Q	5.59	5.79	5.99

Unit : mm

Drawing and Dimensions

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