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September 2016

# FDN028N20

## N-Channel PowerTrench<sup>®</sup> MOSFET 20 V, 6.1 A, 28 mΩ

### Features

- Max  $r_{DS(on)}$  = 28 mΩ at  $V_{GS} = 4.5$  V,  $I_D = 5.2$  A
- Max  $r_{DS(on)}$  = 45 mΩ at  $V_{GS} = 2.5$  V,  $I_D = 4.4$  A
- High Performance Trench Technology for Extremely Low  $r_{DS(on)}$
- High Power and Current Handling Capability in a Widely Used Surface Mount Package
- Fast Switching Speed
- 100% UIL Tested
- RoHS Compliant

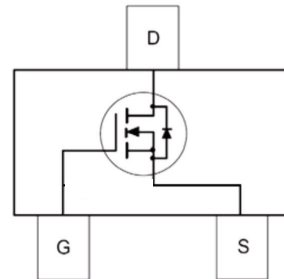
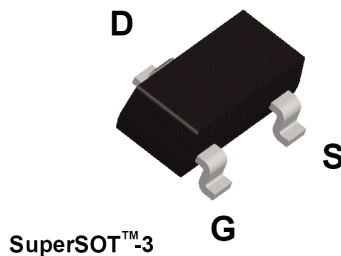


### General Description

This N-Channel PowerTrench MOSFET is produced using Fairchild's advanced PowerTrench<sup>®</sup> process that has been especially tailored to minimize on-state resistance and yet maintain low gate charge for superior switching performance.

### Applications

- Primary DC-DC Switch
- Load Switch



### MOSFET Maximum Ratings $T_C = 25^\circ\text{C}$ unless otherwise noted.

Symbol	Parameter	Ratings	Units
$V_{DS}$	Drain to Source Voltage	20	V
$V_{GS}$	Gate to Source Voltage (Note 3)	$\pm 12$	V
$I_D$	-Continuous $T_A = 25^\circ\text{C}$ (Note 1a)	6.1	A
	-Pulsed (Note 5)	52	
$E_{AS}$	Single Pulse Avalanche Energy (Note 4)	6	mJ
$P_D$	Power Dissipation (Note 1a)	1.5	W
	Power Dissipation (Note 1b)	0.6	
$T_J, T_{STG}$	Operating and Storage Junction Temperature Range	-55 to + 150	$^\circ\text{C}$

### Thermal Characteristics

$R_{\theta JC}$	Thermal Resistance, Junction-to-Case (Note 1)	75	$^\circ\text{C/W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient (Note 1a)	80	$^\circ\text{C/W}$

### Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
28N	FDN028N20	SSOT-3	7"	8 mm	3000 units

## Electrical Characteristics $T_J = 25^\circ\text{C}$ unless otherwise noted.

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
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### Off Characteristics

$BV_{DSS}$	Drain to Source Breakdown Voltage	$I_D = 250 \mu\text{A}, V_{GS} = 0 \text{ V}$	20			V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = 250 \mu\text{A}$ , referenced to $25^\circ\text{C}$		15		$\text{mV}/^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 16 \text{ V}, V_{GS} = 0 \text{ V}$			1	$\mu\text{A}$
$I_{GSS}$	Gate to Source Leakage Current	$V_{GS} = 12 \text{ V}, V_{DS} = 0 \text{ V}$			100	nA

### On Characteristics

$V_{GS(th)}$	Gate to Source Threshold Voltage	$V_{GS} = V_{DS}, I_D = 250 \mu\text{A}$	0.5	0.9	1.5	V
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate to Source Threshold Voltage Temperature Coefficient	$I_D = 250 \mu\text{A}$ , referenced to $25^\circ\text{C}$		-3		$\text{mV}/^\circ\text{C}$
$r_{DS(on)}$	Static Drain to Source On Resistance	$V_{GS} = 4.5 \text{ V}, I_D = 5.2 \text{ A}$		23	28	m $\Omega$
		$V_{GS} = 2.5 \text{ V}, I_D = 4.4 \text{ A}$		32	45	
		$V_{GS} = 4.5 \text{ V}, I_D = 5.2 \text{ A}, T_J = 125^\circ\text{C}$		30	41	
$g_{FS}$	Forward Transconductance	$V_{DS} = 5 \text{ V}, I_D = 5.2 \text{ A}$		28		S

### Dynamic Characteristics

$C_{iss}$	Input Capacitance	$V_{DS} = 10 \text{ V}, V_{GS} = 0 \text{ V}, f = 1 \text{ MHz}$		399	600	pF
$C_{oss}$	Output Capacitance			91	140	pF
$C_{rss}$	Reverse Transfer Capacitance			87	130	pF

### Switching Characteristics

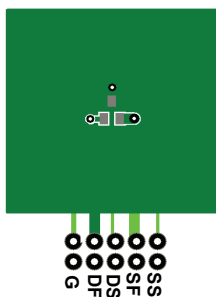
$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 10 \text{ V}, I_D = 5.2 \text{ A}, V_{GS} = 10 \text{ V}, R_{GEN} = 6 \Omega$		5	10	ns	
$t_r$	Rise Time			2	10	ns	
$t_{d(off)}$	Turn-Off Delay Time			15	29	ns	
$t_f$	Fall Time			2	10	ns	
$Q_{g(TOT)}$	Total Gate Charge		$V_{GS} = 0 \text{ V to } 4.5 \text{ V}$		4.3	6.0	nC
$Q_{g(TOT)}$	Total Gate Charge	$V_{GS} = 0 \text{ V to } 2.5 \text{ V}$	$V_{DD} = 10 \text{ V}, I_D = 5.2 \text{ A}$		2.8	3.9	nC
$Q_{gs}$	Gate to Source Charge				0.7		nC
$Q_{gd}$	Gate to Drain "Miller" Charge				1.6		nC

### Drain-Source Diode Characteristics

$V_{SD}$	Source to Drain Diode Forward Voltage	$V_{GS} = 0 \text{ V}, I_S = 5.2 \text{ A}$ (Note 2)		0.85	1.2	V
$t_{rr}$	Reverse Recovery Time	$I_F = 5.2 \text{ A}, di/dt = 100 \text{ A}/\mu\text{s}$		13	27	ns
$Q_{rr}$	Reverse Recovery Charge			3	10	nC

#### Notes:

- $R_{\theta JA}$  is the sum of the junction-to-case and case-to-ambient thermal resistance where the case thermal reference is defined as the solder mounting surface of the drain pins.  $R_{\theta JC}$  is guaranteed by design while  $R_{\theta CA}$  is determined by the user's board design.



a)  $80^\circ\text{C}/\text{W}$  when mounted on a  $1 \text{ in}^2$  pad of 2 oz copper



b)  $180^\circ\text{C}/\text{W}$  when mounted on a minimum pad.

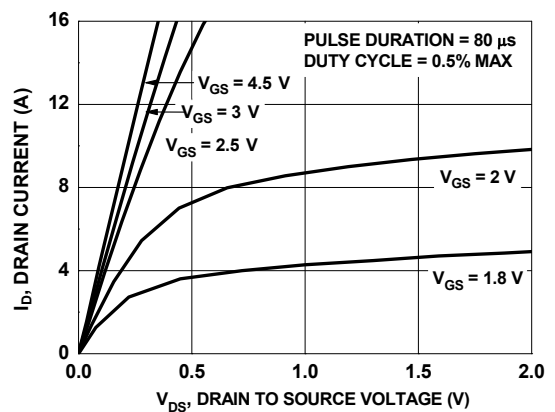
2. Pulse Test: Pulse Width < 300  $\mu\text{s}$ , Duty cycle < 2.0%.

3. As an N-ch device, the negative  $V_{GS}$  rating is for low duty cycle pulse occurrence only. No continuous rating is implied.

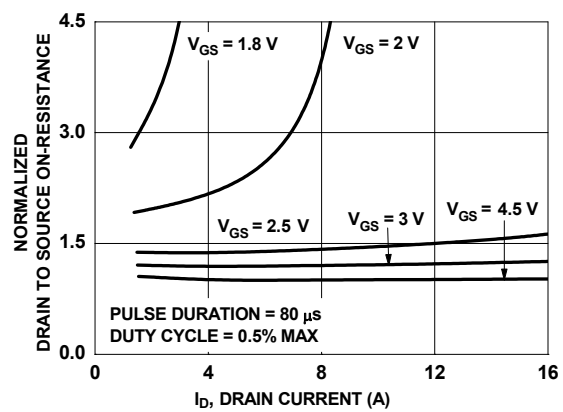
4.  $E_{AS}$  of 6 mJ is based on starting  $T_J = 25^\circ\text{C}$ ,  $L = 3 \text{ mH}$ ,  $I_{AS} = 2 \text{ A}$ ,  $V_{DD} = 20 \text{ V}$ ,  $V_{GS} = 10 \text{ V}$ . 100% test at  $L = 0.1 \text{ mH}$ ,  $I_{AS} = 7 \text{ A}$ .

5. Pulsed  $I_D$  please refer to Fig 10 SOA graph for more details.

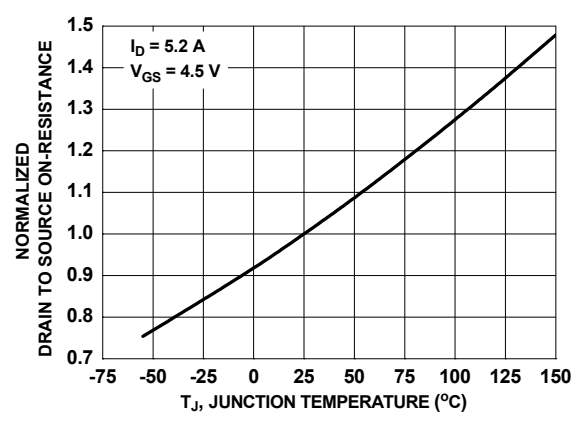
**Typical Characteristics**  $T_J = 25\text{ }^\circ\text{C}$  unless otherwise noted.



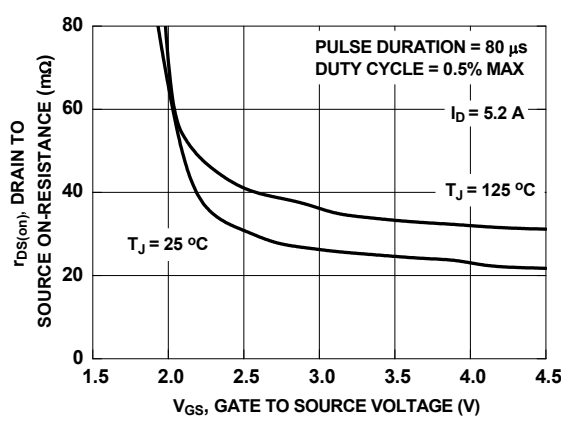
**Figure 1. On Region Characteristics**



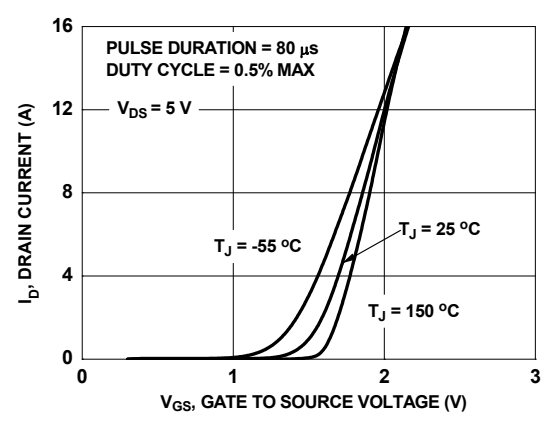
**Figure 2. Normalized On-Resistance vs. Drain Current and Gate Voltage**



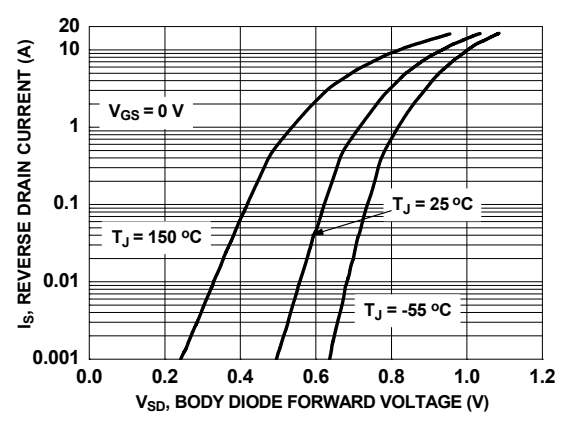
**Figure 3. Normalized On Resistance vs. Junction Temperature**



**Figure 4. On-Resistance vs. Gate to Source Voltage**

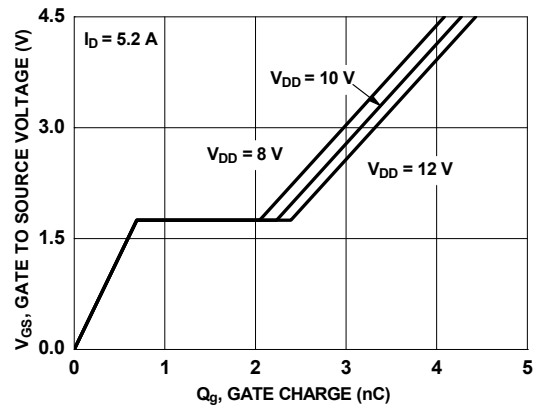


**Figure 5. Transfer Characteristics**

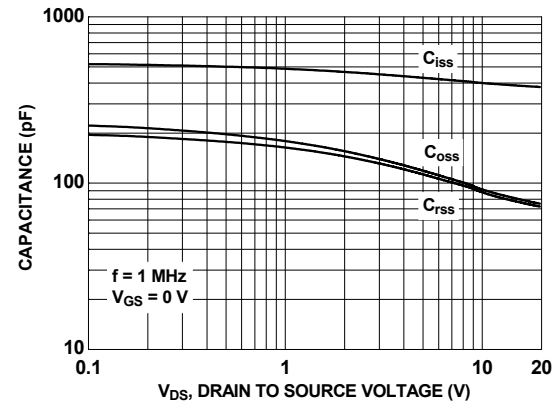


**Figure 6. Source to Drain Diode Forward Voltage vs. Source Current**

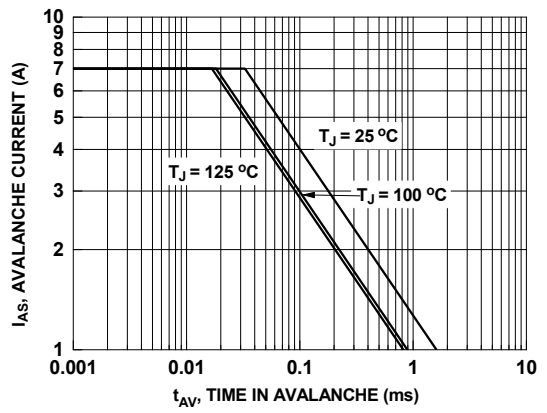
**Typical Characteristics**  $T_J = 25\text{ }^\circ\text{C}$  unless otherwise noted.



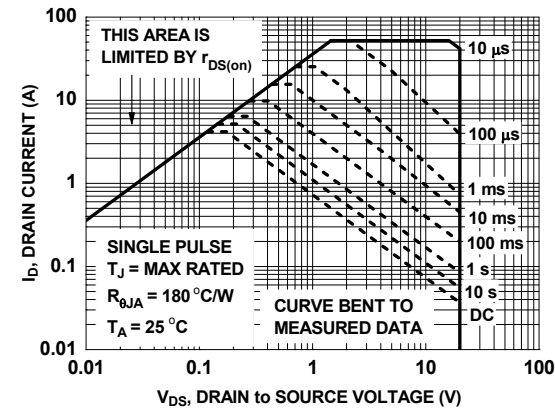
**Figure 7. Gate Charge Characteristics**



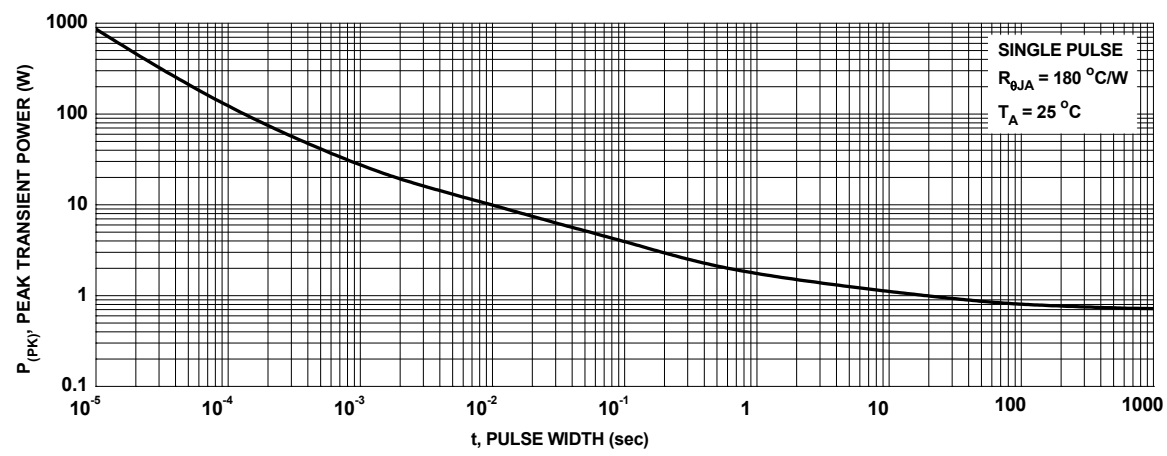
**Figure 8. Capacitance vs. Drain to Source Voltage**



**Figure 9. Unclamped Inductive Switching Capability**

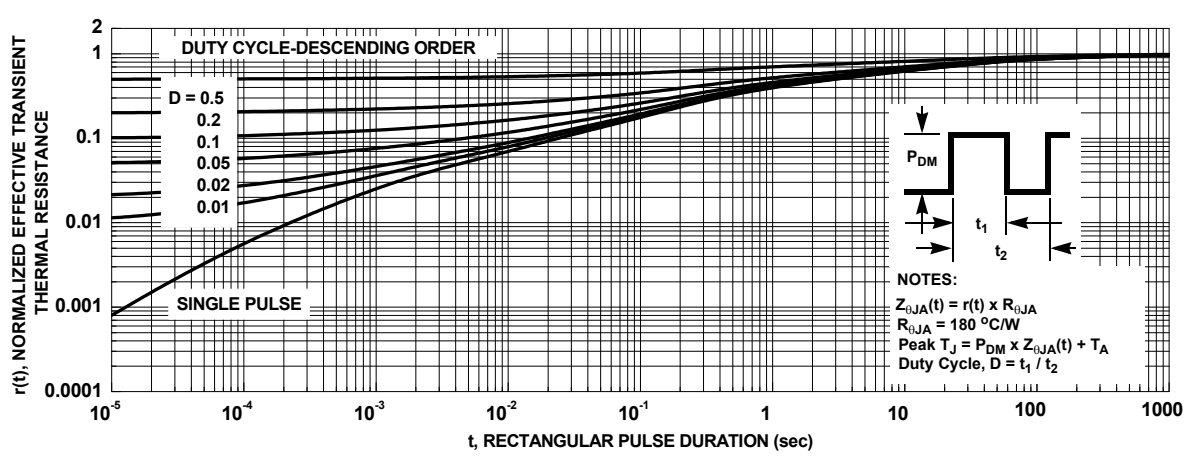


**Figure 10. Forward Bias Safe Operating Area**

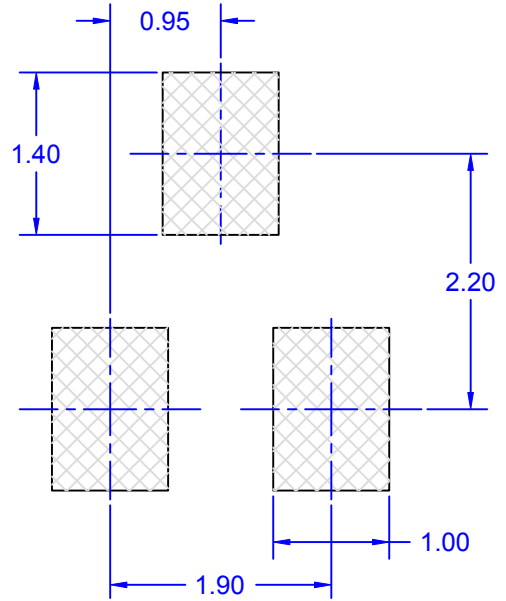
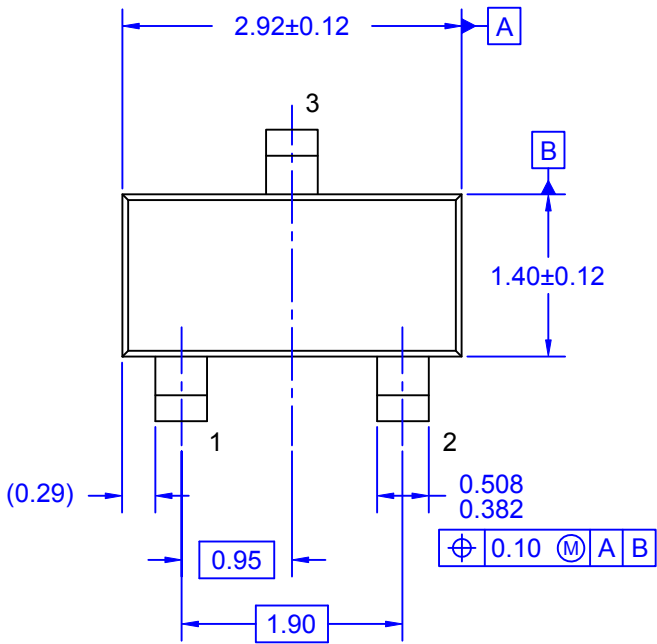


**Figure 11. Single Pulse Maximum Power Dissipation**

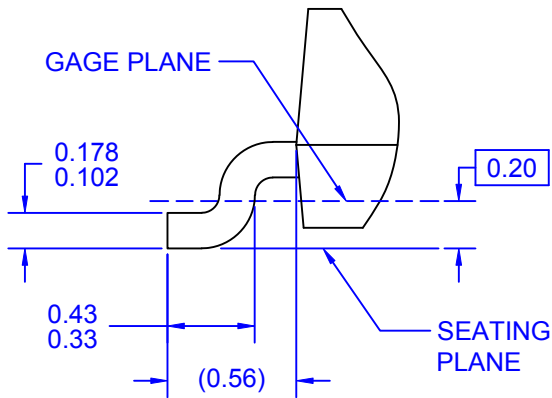
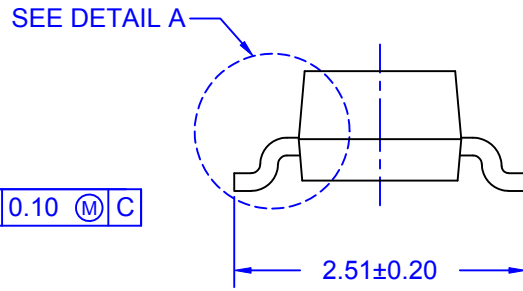
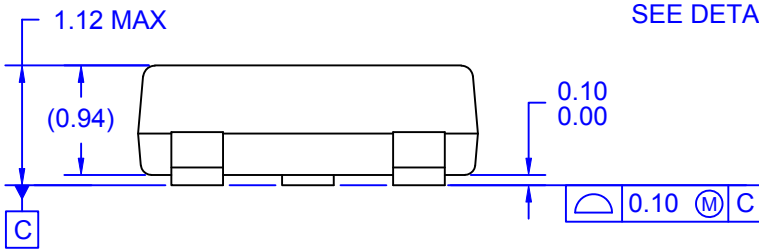
**Typical Characteristics**  $T_J = 25^\circ\text{C}$  unless otherwise noted.



**Figure 12. Junction-to-Ambient Transient Thermal Response Curve**



LAND PATTERN RECOMMENDATION



**DETAIL A**  
 SCALE: 50:1

NOTES: UNLESS OTHERWISE SPECIFIED

- A) NO JEDEC REFERENCE AS OF AUGUST 2003
- B) ALL DIMENSIONS ARE IN MILLIMETERS.
- C) DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR EXTRUSIONS.
- D) DIMENSIONING AND TOLERANCING PER ASME Y14.5M - 2009.
- E) DRAWING FILE NAME: MKT-MA03BREV3



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