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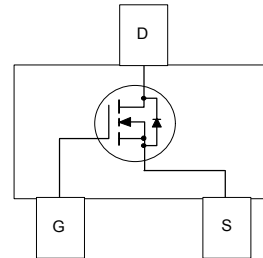
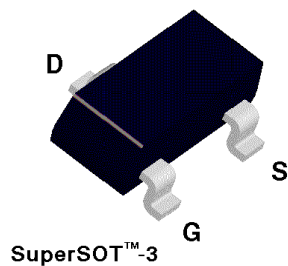
## NDS331N N-Channel Logic Level Enhancement Mode Field Effect Transistor

### General Description

These N-Channel logic level enhancement mode power field effect transistors are produced using Fairchild's proprietary, high cell density, DMOS technology. This very high density process is especially tailored to minimize on-state resistance. These devices are particularly suited for low voltage applications in notebook computers, portable phones, PCMCIA cards, and other battery powered circuits where fast switching, and low in-line power loss are needed in a very small outline surface mount package.

### Features

- 1.3 A, 20 V.  $R_{DS(ON)} = 0.21 \Omega @ V_{GS} = 2.7 \text{ V}$   
 $R_{DS(ON)} = 0.16 \Omega @ V_{GS} = 4.5 \text{ V}$ .
- Industry standard outline SOT-23 surface mount package using proprietary SuperSOT™-3 design for superior thermal and electrical capabilities.
- High density cell design for extremely low  $R_{DS(ON)}$ .
- Exceptional on-resistance and maximum DC current capability.



### Absolute Maximum Ratings $T_A = 25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	NDS331N	Units
$V_{DSS}$	Drain-Source Voltage	20	V
$V_{GSS}$	Gate-Source Voltage - Continuous	8	V
$I_D$	Maximum Drain Current - Continuous (Note 1a)	1.3	A
	- Pulsed	10	
$P_D$	Maximum Power Dissipation (Note 1a)	0.5	W
		(Note 1b)	
$T_J, T_{STG}$	Operating and Storage Temperature Range	-55 to 150	$^\circ\text{C}$

### THERMAL CHARACTERISTICS

$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient (Note 1a)	250	$^\circ\text{C/W}$
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case (Note 1)	75	$^\circ\text{C/W}$

ELECTRICAL CHARACTERISTICS (T <sub>A</sub> = 25°C unless otherwise noted)						
Symbol	Parameter	Conditions	Min	Typ	Max	Units
<b>OFF CHARACTERISTICS</b>						
BV <sub>DSS</sub>	Drain-Source Breakdown Voltage	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA	20			V
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> = 16 V, V <sub>GS</sub> = 0 V T <sub>J</sub> = 125°C			1	μA
					10	μA
I <sub>GSSF</sub>	Gate - Body Leakage, Forward	V <sub>GS</sub> = 8 V, V <sub>DS</sub> = 0 V			100	nA
I <sub>GSSR</sub>	Gate - Body Leakage, Reverse	V <sub>GS</sub> = -8 V, V <sub>DS</sub> = 0 V			-100	nA
<b>ON CHARACTERISTICS (Note 2)</b>						
V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA T <sub>J</sub> = 125°C	0.5	0.7	1	V
			0.3	0.53	0.8	
R <sub>DS(on)</sub>	Static Drain-Source On-Resistance	V <sub>GS</sub> = 2.7 V, I <sub>D</sub> = 1.3 A T <sub>J</sub> = 125°C		0.15	0.21	Ω
				0.24	0.4	
			V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 1.5 A		0.11	
I <sub>D(on)</sub>	On-State Drain Current	V <sub>GS</sub> = 2.7 V, V <sub>DS</sub> = 5 V V <sub>GS</sub> = 4.5 V, V <sub>DS</sub> = 5 V	3			A
			4			
g <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> = 5 V, I <sub>D</sub> = 1.3 A,		3.5		S
<b>DYNAMIC CHARACTERISTICS</b>						
C <sub>iss</sub>	Input Capacitance	V <sub>DS</sub> = 10 V, V <sub>GS</sub> = 0 V, f = 1.0 MHz		162		pF
C <sub>oss</sub>	Output Capacitance			85		pF
C <sub>rss</sub>	Reverse Transfer Capacitance			28		pF
<b>SWITCHING CHARACTERISTICS (Note 2)</b>						
t <sub>D(on)</sub>	Turn - On Delay Time	V <sub>DD</sub> = 5 V, I <sub>D</sub> = 1 A, V <sub>GS</sub> = 5 V, R <sub>Gen</sub> = 6 Ω		5	20	ns
t <sub>r</sub>	Turn - On Rise Time			25	40	ns
t <sub>D(off)</sub>	Turn - Off Delay Time			10	20	ns
t <sub>f</sub>	Turn - Off Fall Time			5	20	ns
Q <sub>g</sub>	Total Gate Charge	V <sub>DS</sub> = 5 V, I <sub>D</sub> = 1.3 A, V <sub>GS</sub> = 4.5 V		3.5	5	nC
Q <sub>gs</sub>	Gate-Source Charge			0.3		nC
Q <sub>gd</sub>	Gate-Drain Charge			1		nC

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

Symbol	Parameter	Conditions	Min	Typ	Max	Units
<b>DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS</b>						
$I_S$	Maximum Continuous Drain-Source Diode Forward Current				0.42	A
$I_{SM}$	Maximum Pulsed Drain-Source Diode Forward Current				10	A
$V_{SD}$	Drain-Source Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_S = 0.42\text{ A}$ (Note 2)		0.8	1.2	V

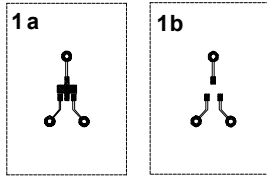
Notes:

- $R_{\theta JA}$  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.

$$P_D(t) = \frac{I_D I_A}{R_{\theta J A(t)}} = \frac{I_D I_A}{R_{\theta J C} + R_{\theta C A(t)}} = I_D^2(t) \times R_{DS(on)} \theta_{TJ}$$

Typical  $R_{\theta JA}$  using the board layouts shown below on 4.5"x5" FR-4 PCB in a still air environment:

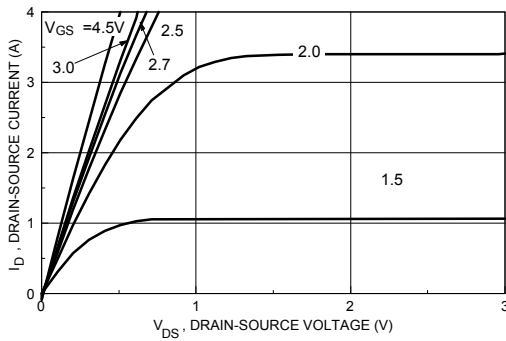
- 250°C/W when mounted on a 0.02 in<sup>2</sup> pad of 2oz copper.
- 270°C/W when mounted on a 0.001 in<sup>2</sup> pad of 2oz copper.



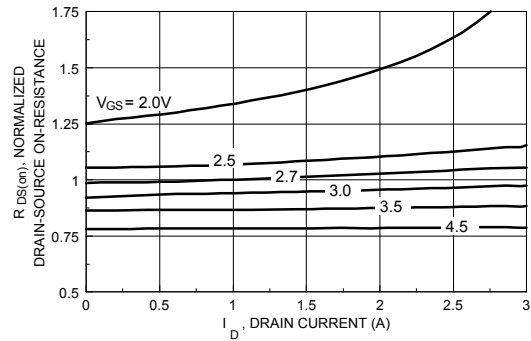
Scale 1 : 1 on letter size paper

- Pulse Test: Pulse Width  $\leq 300\mu\text{s}$ , Duty Cycle  $\leq 2.0\%$ .

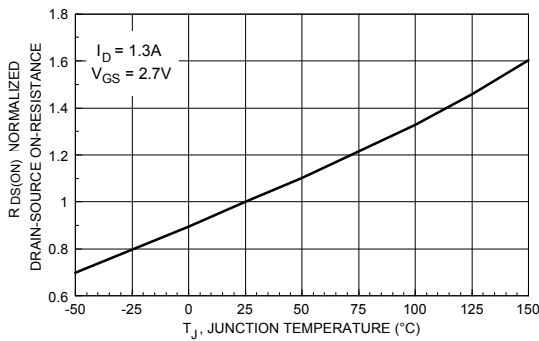
**Typical Electrical Characteristics**



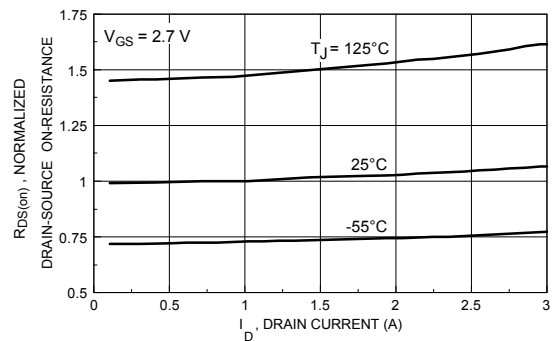
**Figure 1. On-Region Characteristics.**



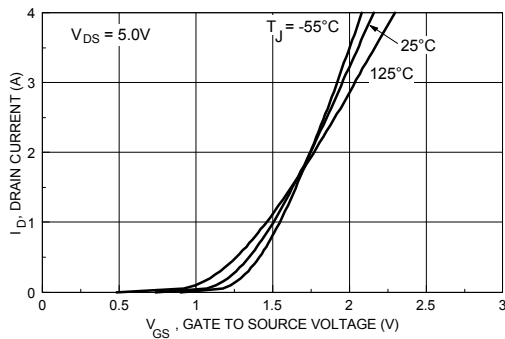
**Figure 2. On-Resistance Variation with Drain Current and Gate Voltage.**



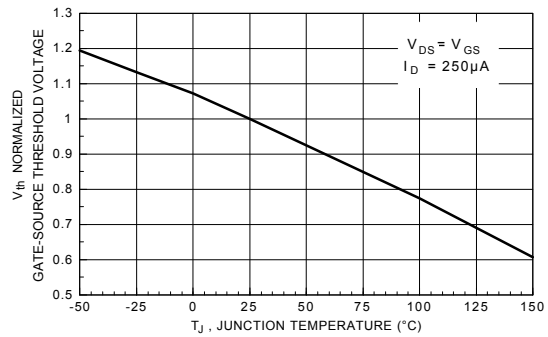
**Figure 3. On-Resistance Variation with Temperature.**



**Figure 4. On-Resistance Variation with Drain Current and Temperature.**

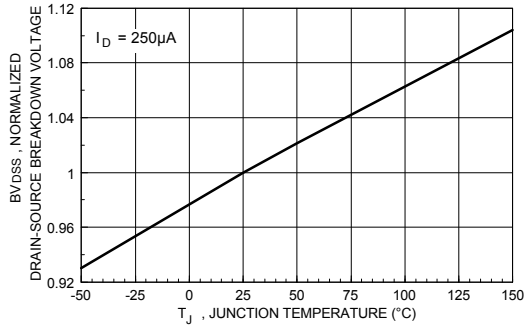


**Figure 5. Transfer Characteristics.**

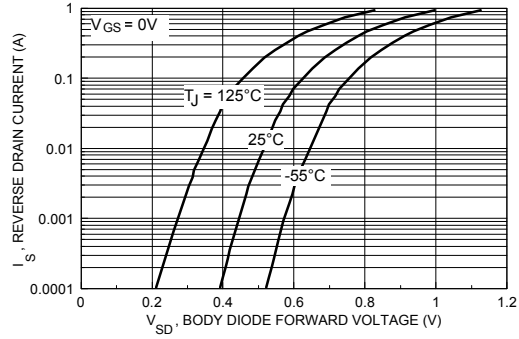


**Figure 6. Gate Threshold Variation with Temperature.**

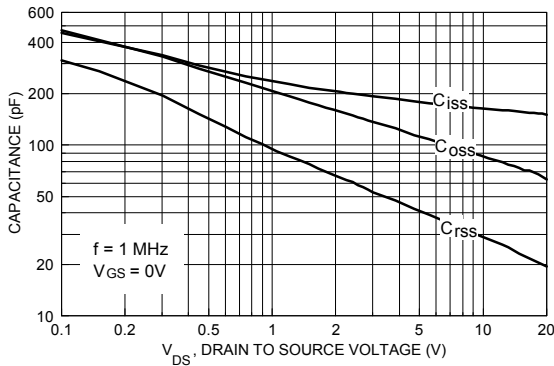
**Typical Electrical Characteristics (continued)**



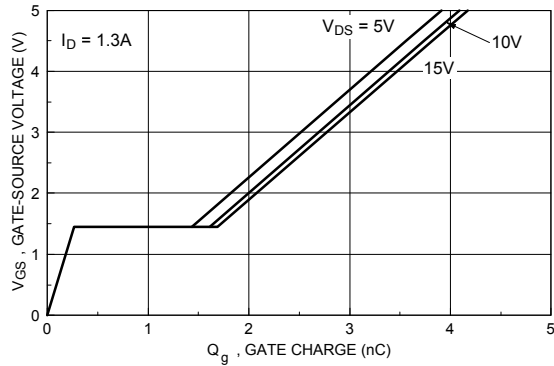
**Figure 7. Breakdown Voltage Variation with Temperature.**



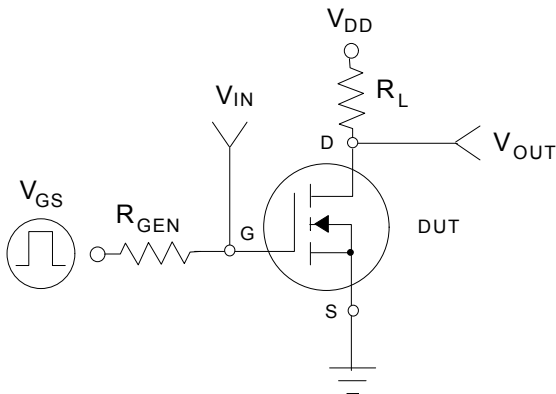
**Figure 8. Body Diode Forward Voltage Variation with Source Current and Temperature.**



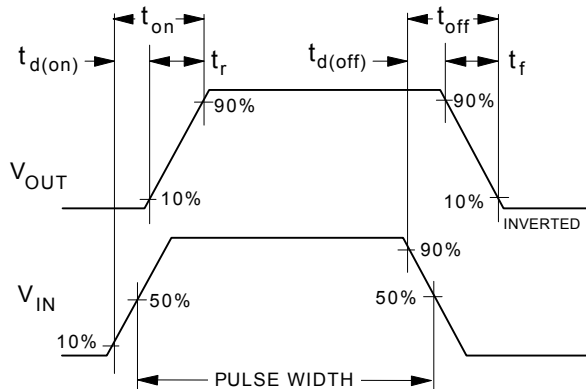
**Figure 9. Capacitance Characteristics.**



**Figure 10. Gate Charge Characteristics.**

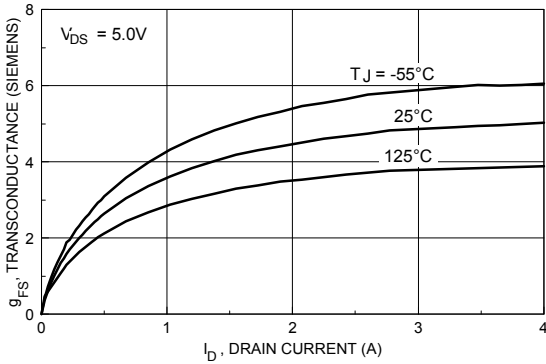


**Figure 11. Switching Test Circuit.**

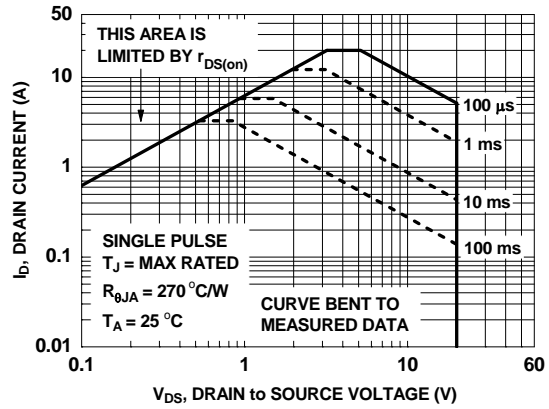


**Figure 12. Switching Waveforms.**

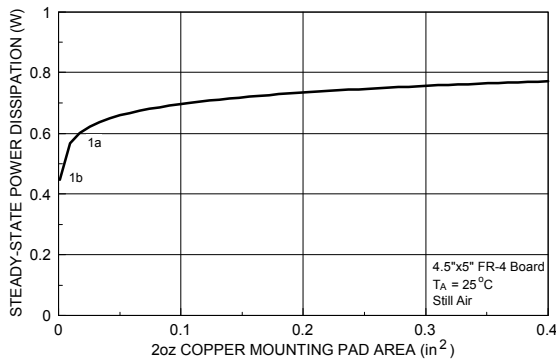
**Typical Electrical Characteristics (continued)**



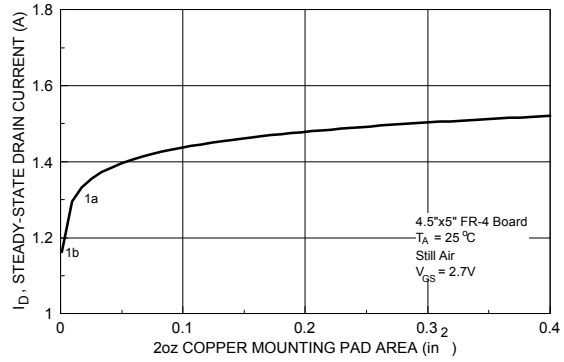
**Figure 13. Transconductance Variation with Drain Current and Temperature.**



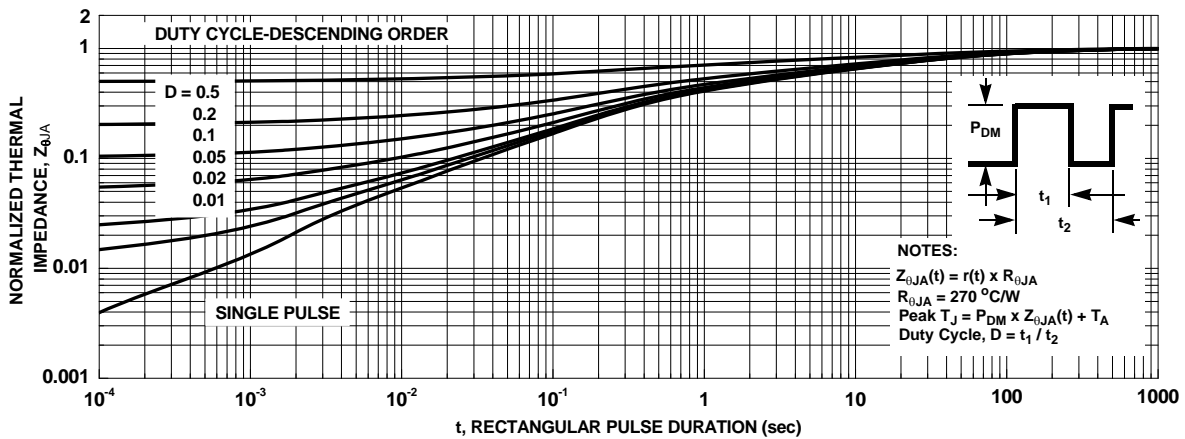
**Figure 14. Maximum Safe Operating Area.**



**Figure 15. SuperSOT™-3 Maximum Steady-State Power Dissipation versus Copper Mounting Pad Area.**

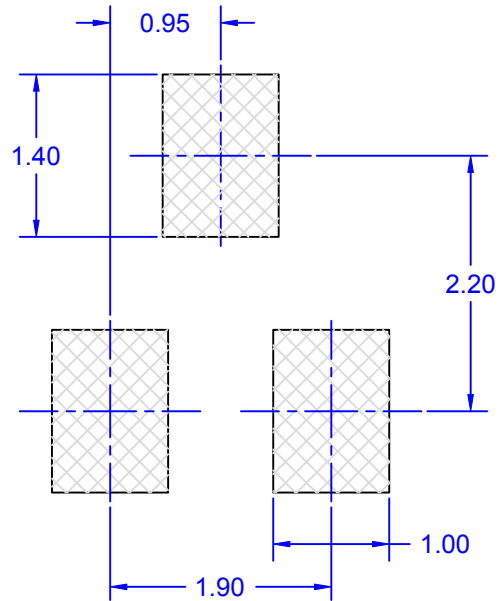
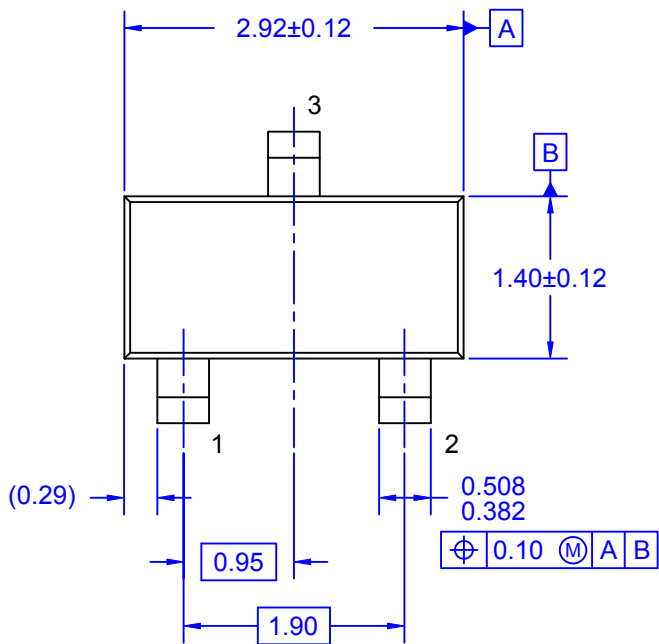


**Figure 16. Maximum Steady-State Drain Current versus Copper Mounting Pad Area.**

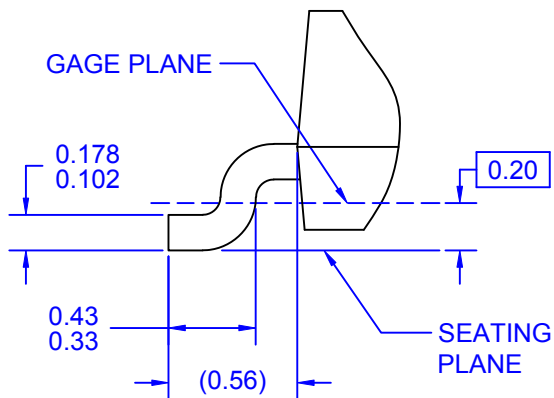
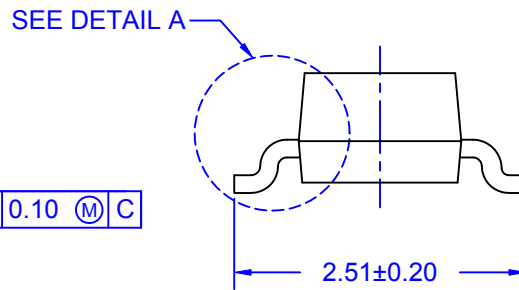
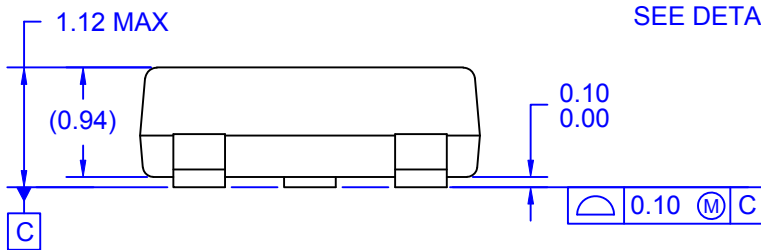


**Figure 17. Transient Thermal Response Curve.**

Note : Thermal characterization performed using the conditions described in note 1b. response will change depending on the circuit board design.



LAND PATTERN RECOMMENDATION



**DETAIL A**

SCALE: 50:1

NOTES: UNLESS OTHERWISE SPECIFIED

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- B) ALL DIMENSIONS ARE IN MILLIMETERS.
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