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# FDS8958A

## Dual N & P-Channel PowerTrench® MOSFET

### General Description

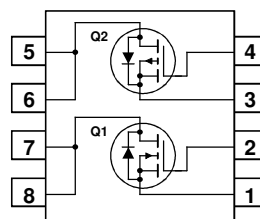
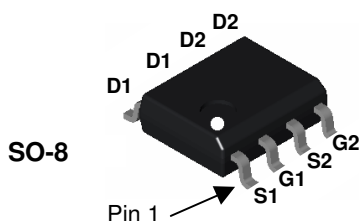
These dual N- and P-Channel enhancement mode power field effect transistors are produced using Fairchild Semiconductor's advanced PowerTrench process that has been especially tailored to minimize on-state resistance and yet maintain superior switching performance.

These devices are well suited for low voltage and battery powered applications where low in-line power loss and fast switching are required.



### Features

- **Q1:** N-Channel  
7.0A, 30V  $R_{DS(on)} = 0.028\Omega @ V_{GS} = 10V$   
 $R_{DS(on)} = 0.040\Omega @ V_{GS} = 4.5V$
- **Q2:** P-Channel  
-5A, -30V  $R_{DS(on)} = 0.052\Omega @ V_{GS} = -10V$   
 $R_{DS(on)} = 0.080\Omega @ V_{GS} = -4.5V$
- Fast switching speed
- High power and handling capability in a widely used surface mount package



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

Symbol	Parameter	Q1	Q2	Units
$V_{DS}$	Drain-Source Voltage	30	30	V
$V_{GS}$	Gate-Source Voltage	$\pm 20$	$\pm 20$	V
$I_D$	Drain Current - Continuous (Note 1a)	7	-5	A
	- Pulsed	20	-20	
$P_D$	Power Dissipation for Dual Operation	2	2	W
	Power Dissipation for Single Operation (Note 1a)	1.6	1.6	
	(Note 1c)	0.9	0.9	
$E_{AS}$	Single Pulse Avalanche Energy (Note 3)	54	13	mJ
$T_J, T_{STG}$	Operating and Storage Junction Temperature Range	-55 to +150		$^\circ\text{C}$

### Thermal Characteristics

$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient (Note 1a)	78	$^\circ\text{C/W}$
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case (Note 1)	40	$^\circ\text{C/W}$

### Package Marking and Ordering Information

Device Marking	Device	Reel Size	Tape width	Quantity
FDS8958A	FDS8958A	13"	12mm	2500 units

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

Symbol	Parameter	Test Conditions	Type	Min	Typ	Max	Units
<b>Off Characteristics</b>							
$BV_{DSS}$	Drain-Source Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$ $V_{GS} = 0\text{ V}, I_D = -250\text{ }\mu\text{A}$	Q1 Q2	30 -30			V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = 250\text{ }\mu\text{A}$ , Referenced to $25^\circ\text{C}$ $I_D = -250\text{ }\mu\text{A}$ , Referenced to $25^\circ\text{C}$	Q1 Q2		25 -23		mV/ $^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 24\text{ V}, V_{GS} = 0\text{ V}$ $V_{DS} = -24\text{ V}, V_{GS} = 0\text{ V}$	Q1 Q2			1 -1	$\mu\text{A}$
$I_{GSSF}$	Gate-Body Leakage, Forward	$V_{GS} = 20\text{ V}, V_{DS} = 0\text{ V}$	All			100	nA
$I_{GSSR}$	Gate-Body Leakage, Reverse	$V_{GS} = -20\text{ V}, V_{DS} = 0\text{ V}$	All			-100	nA

**On Characteristics** (Note 2)

$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$ $V_{DS} = V_{GS}, I_D = -250\text{ }\mu\text{A}$	Q1 Q2	1 -1	1.9 -1.7	3 -3	V
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate Threshold Voltage Temperature Coefficient	$I_D = 250\text{ }\mu\text{A}$ , Referenced to $25^\circ\text{C}$ $I_D = -250\text{ }\mu\text{A}$ , Referenced to $25^\circ\text{C}$	Q1 Q2		-4.5 4.5		mV/ $^\circ\text{C}$
$R_{DS(on)}$	Static Drain-Source On-Resistance	$V_{GS} = 10\text{ V}, I_D = 7\text{ A}$ $V_{GS} = 10\text{ V}, I_D = 7\text{ A}, T_J = 125^\circ\text{C}$ $V_{GS} = 4.5\text{ V}, I_D = 6\text{ A}$ $V_{GS} = -10\text{ V}, I_D = -5\text{ A}$ $V_{GS} = -10\text{ V}, I_D = -5\text{ A}, T_J = 125^\circ\text{C}$ $V_{GS} = -4.5\text{ V}, I_D = -4\text{ A}$	Q1   Q2		19 27 24 42 57 65	28 42 40 52 78 80	$\text{m}\Omega$
$I_{D(on)}$	On-State Drain Current	$V_{GS} = 10\text{ V}, V_{DS} = 5\text{ V}$ $V_{GS} = -10\text{ V}, V_{DS} = -5\text{ V}$	Q1 Q2	20 -20			A
$g_{FS}$	Forward Transconductance	$V_{DS} = 5\text{ V}, I_D = 7\text{ A}$ $V_{DS} = -5\text{ V}, I_D = -5\text{ A}$	Q1 Q2		25 10		S

**Dynamic Characteristics**

$C_{iss}$	Input Capacitance	Q1 $V_{DS} = 15\text{ V}, V_{GS} = 0\text{ V}, f = 1.0\text{ MHz}$	Q1 Q2		575 528		pF
$C_{oss}$	Output Capacitance	Q2 $V_{DS} = -15\text{ V}, V_{GS} = 0\text{ V}, f = 1.0\text{ MHz}$	Q1 Q2		145 132		pF
$C_{rss}$	Reverse Transfer Capacitance		Q1 Q2		65 70		pF
$R_G$	Gate Resistance	$V_{GS} = 15\text{ mV}, f = 1.0\text{ MHz}$	Q1 Q2		2.1 6.0		$\Omega$

# Electrical Characteristics (continued)

$T_A = 25^\circ\text{C}$  unless otherwise noted

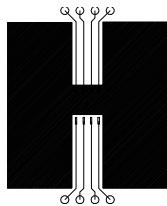
Symbol	Parameter	Test Conditions	Type	Min	Typ	Max	Units
<b>Switching Characteristics</b> (Note 2)							
$t_{d(on)}$	Turn-On Delay Time	Q1 $V_{DD} = 15\text{ V}$ , $I_D = 1\text{ A}$ , $V_{GS} = 10\text{ V}$ , $R_{GEN} = 6\ \Omega$	Q1		8	16	ns
$t_r$	Turn-On Rise Time		Q2		7	14	
$t_{d(off)}$	Turn-Off Delay Time	Q2 $V_{DD} = -15\text{ V}$ , $I_D = -1\text{ A}$ , $V_{GS} = -10\text{ V}$ , $R_{GEN} = 6\ \Omega$	Q1		5	10	ns
$t_f$	Turn-Off Fall Time		Q2		13	24	
$Q_g$	Total Gate Charge	Q1 $V_{DS} = 15\text{ V}$ , $I_D = 7\text{ A}$ , $V_{GS} = 10\text{ V}$	Q1		23	37	ns
$Q_{gs}$	Gate-Source Charge		Q2		14	25	
$Q_{gd}$	Gate-Drain Charge	Q2 $V_{DS} = -15\text{ V}$ , $I_D = -5\text{ A}$ , $V_{GS} = -10\text{ V}$	Q1		3	6	ns
			Q2		9	17	
			Q1		11.4	16	nC
			Q2		9.6	13	
			Q1		1.7		nC
			Q2		2.2		
			Q1		2.1		nC
			Q2		1.7		

## Drain-Source Diode Characteristics and Maximum Ratings

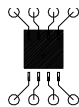
I <sub>S</sub>	Maximum Continuous Drain-Source Diode Forward Current		Q1 Q2		1.3 -1.3	A
I <sub>SM</sub>	Maximum Pulsed Drain-Source Diode Forward Current (Note 2)		Q1 Q2		20 -20	A
V <sub>SD</sub>	Drain-Source Diode Forward Voltage	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 1.3 A (Note 2) V <sub>GS</sub> = 0 V, I <sub>S</sub> = -1.3 A (Note 2)	Q1 Q2	0.75 -0.88	1.2 -1.2	V
t <sub>rr</sub>	Diode Reverse Recovery Time	Q1 I <sub>F</sub> = 7 A, d <sub>I</sub> <sub>F</sub> /d <sub>t</sub> = 100 A/μs	Q1 Q2	19 19		nS
Q <sub>rr</sub>	Diode Reverse Recovery Charge	Q2 I <sub>F</sub> = -5 A, d <sub>I</sub> <sub>F</sub> /d <sub>t</sub> = 100 A/μs	Q1 Q2	9 6		nC

### Notes:

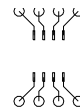
- $R_{\theta JA}$  is the sum of the junction-to-case and case-to-ambient thermal resistance where the case thermal reference is defined as the solder mounting surface of the drain pins.  $R_{\theta JC}$  is guaranteed by design while  $R_{\theta CA}$  is determined by the user's board design.



a)  $78^\circ\text{W}$  when mounted on a  $0.5\text{ in}^2$  pad of 2 oz copper



b)  $125^\circ\text{W}$  when mounted on a  $.02\text{ in}^2$  pad of 2 oz copper



c)  $135^\circ\text{W}$  when mounted on a minimum pad.

Scale 1 : 1 on letter size paper

- Pulse Test: Pulse Width  $< 300\mu\text{s}$ , Duty Cycle  $< 2.0\%$
- Starting  $T_J = 25^\circ\text{C}$ ,  $L = 3\text{mH}$ ,  $I_{AS} = 6\text{A}$ ,  $V_{DD} = 30\text{V}$ ,  $V_{GS} = 10\text{V}$  (Q1).  
Starting  $T_J = 25^\circ\text{C}$ ,  $L = 3\text{mH}$ ,  $I_{AS} = 3\text{A}$ ,  $V_{DD} = 30\text{V}$ ,  $V_{GS} = 10\text{V}$  (Q2).

# Typical Characteristics: Q1 (N-Channel)

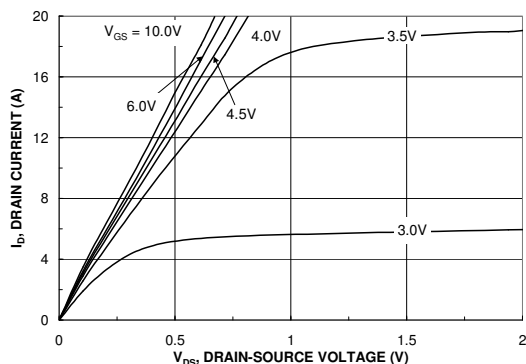


Figure 1. On-Region Characteristics.

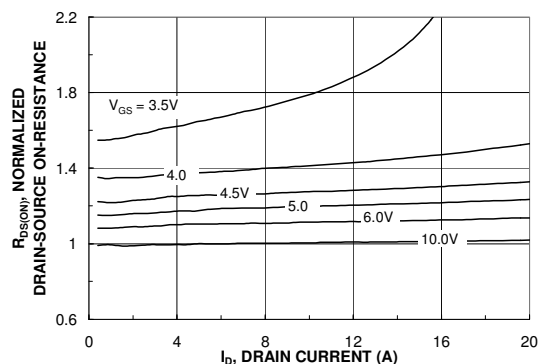


Figure 2. On-Resistance Variation with Drain Current and Gate Voltage.

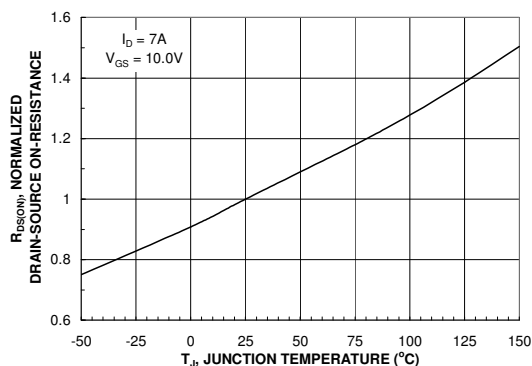


Figure 3. On-Resistance Variation with Temperature.

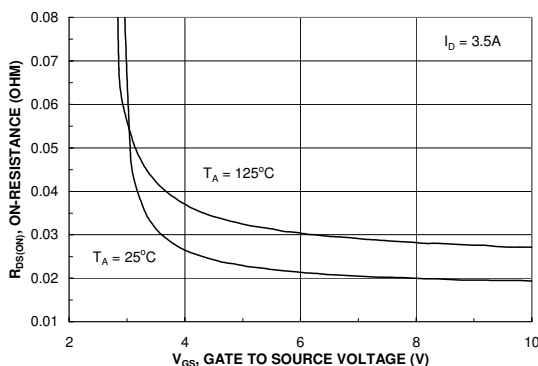


Figure 4. On-Resistance Variation with Gate-to-Source Voltage.

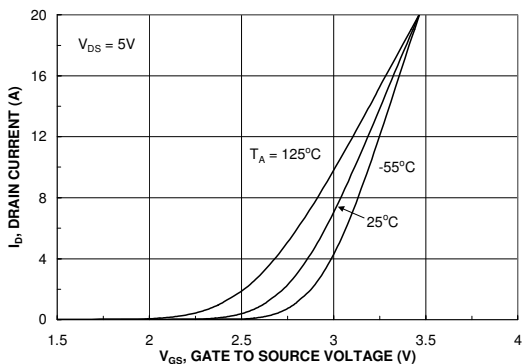


Figure 5. Transfer Characteristics.

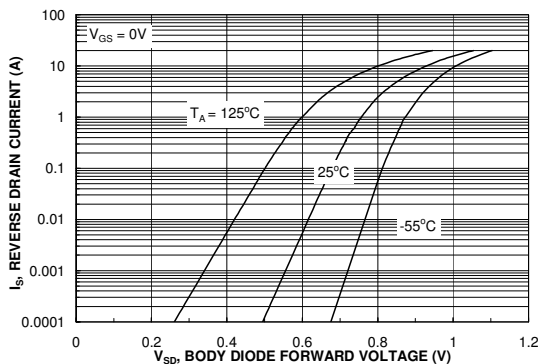


Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature.

# Typical Characteristics: Q1 (N-Channel)

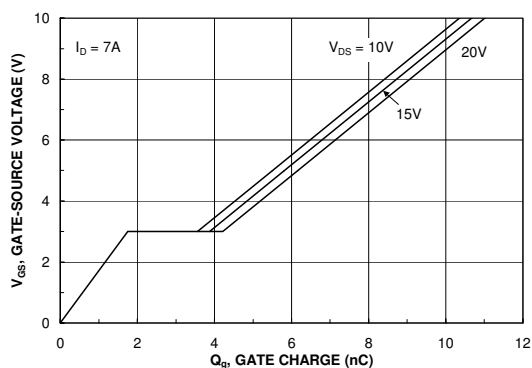


Figure 7. Gate Charge Characteristics.

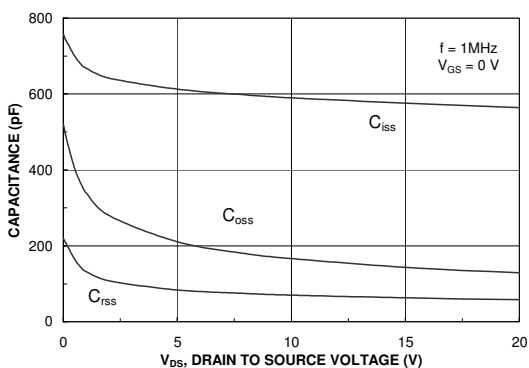


Figure 8. Capacitance Characteristics.

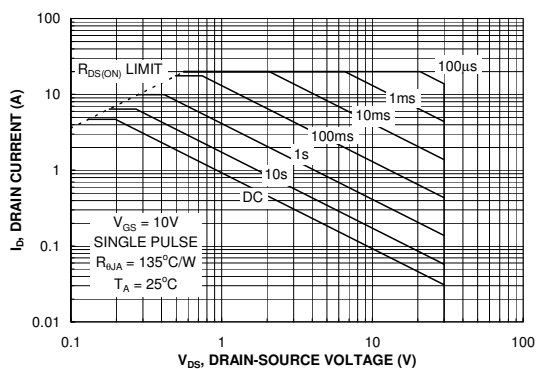


Figure 9. Maximum Safe Operating Area.

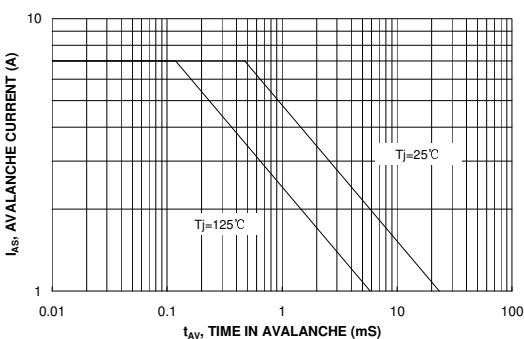


Figure 10. Unclamped Inductive Switching Capability Figure

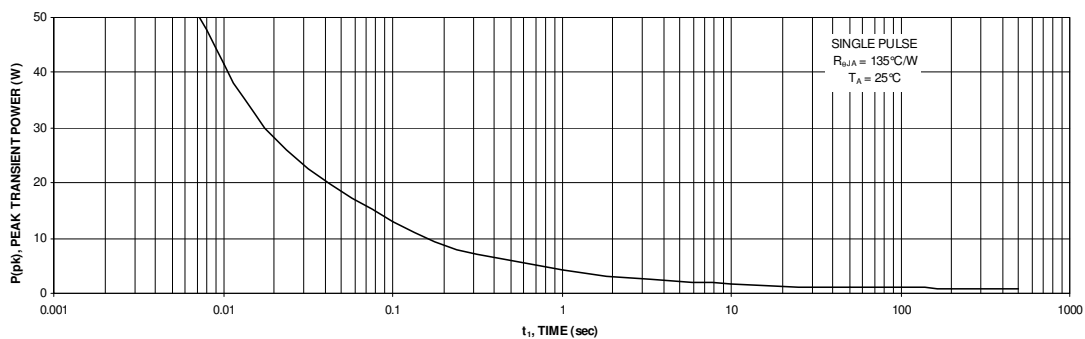


Figure 11. Single Pulse Maximum Power Dissipation.

## Typical Characteristics: Q2 (P-Channel)

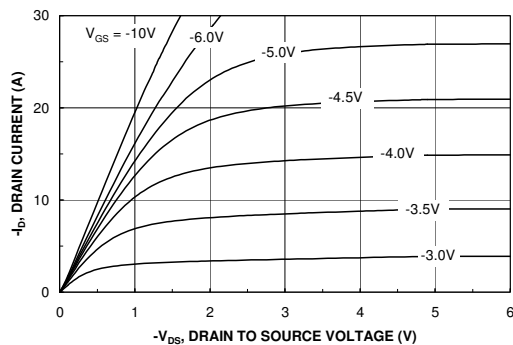


Figure 12. On-Region Characteristics.

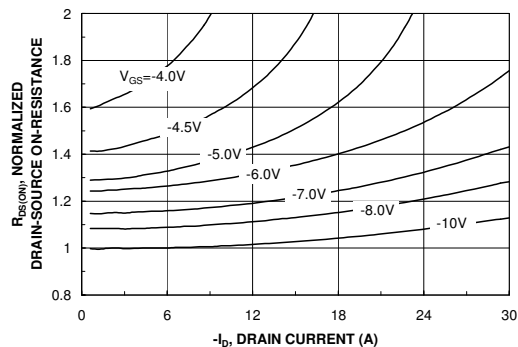


Figure 13. On-Resistance Variation with Drain Current and Gate Voltage.

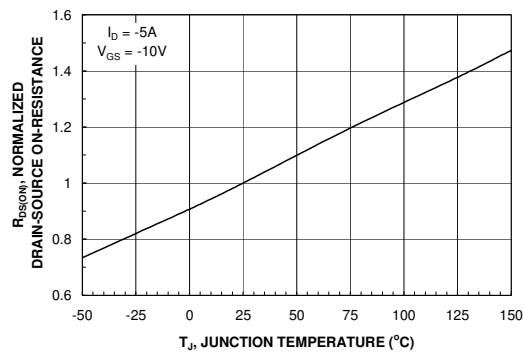


Figure 14. On-Resistance Variation with Temperature.

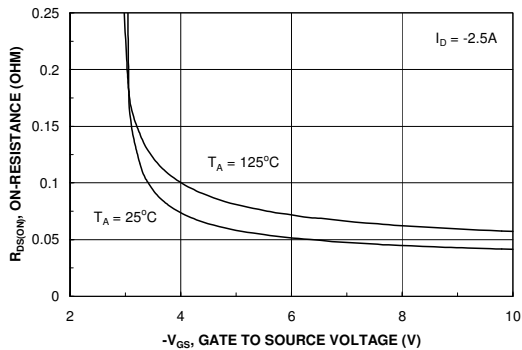


Figure 15. On-Resistance Variation with Gate-to-Source Voltage.

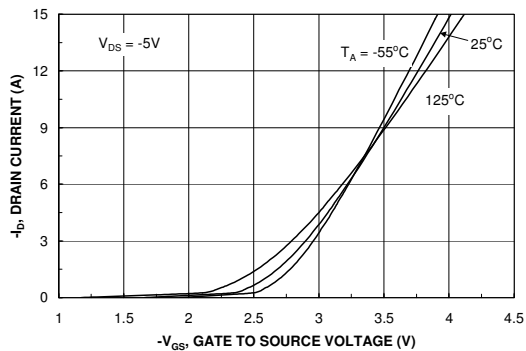


Figure 16. Transfer Characteristics.

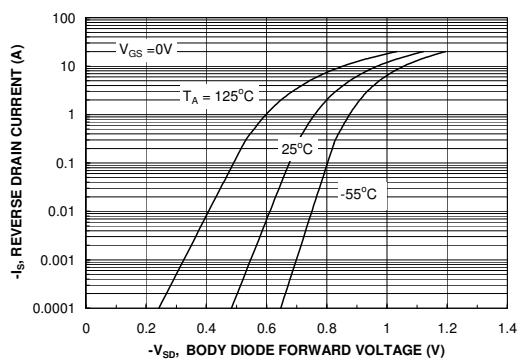
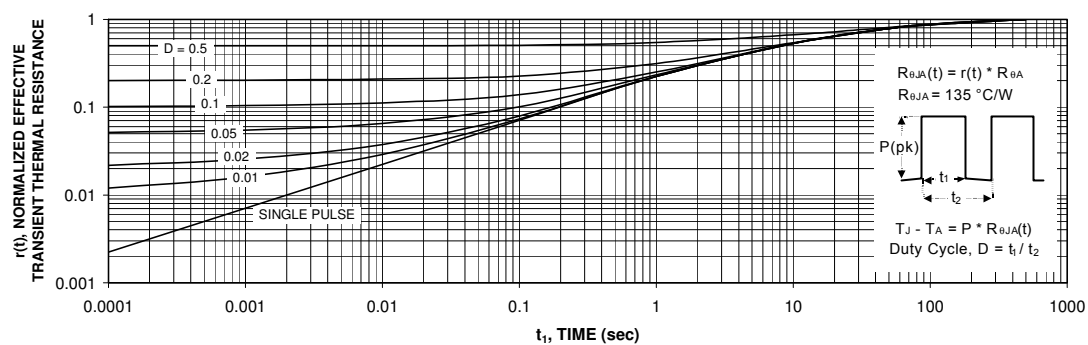


Figure 17. Body Diode Forward Voltage Variation with Source Current and Temperature.

## Typical Characteristics: Q2 (P-Channel)



**Figure 23. Transient Thermal Response Curve.**






Thermal characterization performed using the conditions described in Note 1c.  
Transient thermal response will change depending on the circuit board design.





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