



**THE DATASHEET OF
FDS4559-F085**



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ON Semiconductor®

FDS4559-F085

60V Complementary PowerTrench® MOSFET

General Description

This complementary MOSFET device is produced using ON Semiconductor's advanced PowerTrench process that has been especially tailored to minimize the on-state resistance and yet maintain low gate charge for superior switching performance.

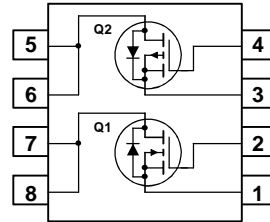
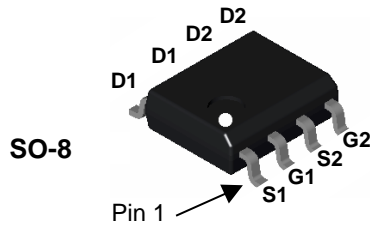
Applications

- DC/DC converter
- Power management
- LCD backlight inverter



Features

- **Q1: N-Channel**
4.5 A, 60 V $R_{DS(on)} = 55 \text{ m}\Omega @ V_{GS} = 10\text{V}$
 $R_{DS(on)} = 75 \text{ m}\Omega @ V_{GS} = 4.5\text{V}$
- **Q2: P-Channel**
-3.5 A, -60 V $R_{DS(on)} = 105 \text{ m}\Omega @ V_{GS} = -10\text{V}$
 $R_{DS(on)} = 135 \text{ m}\Omega @ V_{GS} = -4.5\text{V}$
- Qualified to AEC Q101
- RoHS Compliant



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

Symbol	Parameter	Q1	Q2	Units
V_{DSS}	Drain-Source Voltage	60	-60	V
V_{GSS}	Gate-Source Voltage	± 20	± 20	V
I_D	Drain Current - Continuous (Note 1a)	4.5	-3.5	A
	- Pulsed	20	-20	
P_D	Power Dissipation for Dual Operation	2		W
	Power Dissipation for Single Operation (Note 1a)	1.6		
	(Note 1b)	1.2		
	(Note 1c)	2		
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	$^\circ\text{C}/\text{W}$
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case (Note 1)	40	$^\circ\text{C}/\text{W}$

Package Marking and Ordering Information

Device Marking	Device	Reel Size	Tape width	Quantity
FDS4559	FDS4559-F085	13"	12mm	2500 units

Electrical Characteristics

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

Symbol	Parameter	Test Conditions	Type	Min	Typ	Max	Units
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Drain-Source Avalanche Ratings (Note 1)

W_{DSS}	Single Pulse Drain-Source Avalanche Energy	$V_{DD} = 30\text{ V}$, $I_D = 4.5\text{ A}$	Q1			90	mJ
I_{AR}	Maximum Drain-Source Avalanche Current		Q1			4.5	A

Off Characteristics

BV_{DSS}	Drain-Source Breakdown Voltage	$V_{GS} = 0\text{ V}$, $I_D = 250\ \mu\text{A}$ $V_{GS} = 0\text{ V}$, $I_D = -250\ \mu\text{A}$	Q1 Q2	60 -60			V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = 250\ \mu\text{A}$, Referenced to 25°C $I_D = -250\ \mu\text{A}$, Referenced to 25°C	Q1 Q2		58 -49		mV/ $^\circ\text{C}$
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 48\text{ V}$, $V_{GS} = 0\text{ V}$ $V_{DS} = -48\text{ V}$, $V_{GS} = 0\text{ V}$	Q1 Q2			1 -1	μA
I_{GSS}	Gate-Body Leakage	$V_{GS} = \pm 20\text{ V}$, $V_{DS} = 0\text{ V}$ $V_{GS} = \pm 20\text{ V}$, $V_{DS} = 0\text{ V}$	Q1 Q2			± 100 ± 100	nA

On Characteristics (Note 2)

$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}$, $I_D = 250\ \mu\text{A}$ $V_{DS} = V_{GS}$, $I_D = -250\ \mu\text{A}$	Q1 Q2	1 -1	2.2 -1.6	3 -3	V
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate Threshold Voltage Temperature Coefficient	$I_D = 250\ \mu\text{A}$, Referenced to 25°C $I_D = -250\ \mu\text{A}$, Referenced to 25°C	Q1 Q2		-5.5 4		mV/ $^\circ\text{C}$
$R_{DS(on)}$	Static Drain-Source On-Resistance	$V_{GS} = 10\text{ V}$, $I_D = 4.5\text{ A}$ $V_{GS} = 10\text{ V}$, $I_D = 4.5\text{ A}$, $T_J = 125^\circ\text{C}$ $V_{GS} = 4.5\text{ V}$, $I_D = 4\text{ A}$ $V_{GS} = -10\text{ V}$, $I_D = -3.5\text{ A}$ $V_{GS} = -10\text{ V}$, $I_D = -3.5\text{ A}$, $T_J = 125^\circ\text{C}$ $V_{GS} = -4.5\text{ V}$, $I_D = -3.1\text{ A}$	Q1 Q2		42 72 55 82 130 105	55 94 75 105 190 135	m Ω
$I_{D(on)}$	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	$V_{DS} = 10\text{ V}$, $I_D = 4.5\text{ A}$ $V_{DS} = -5\text{ V}$, $I_D = -3.5\text{ A}$	Q1 Q2		14 9		S

Dynamic Characteristics

C_{iss}	Input Capacitance	Q1 $V_{DS} = 25\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 1.0\text{ MHz}$	Q1 Q2		650 759		pF
C_{oss}	Output Capacitance	Q1 Q2	Q1 Q2		80 90		pF
C_{riss}	Reverse Transfer Capacitance	$V_{DS} = -30\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 1.0\text{ MHz}$	Q1 Q2		35 39		pF

Switching Characteristics (Note 2)

$t_{d(on)}$	Turn-On Delay Time	Q1 $V_{DD} = 30\text{ V}$, $I_D = 1\text{ A}$, $V_{GS} = 10\text{ V}$, $R_{GEN} = 6\ \Omega$	Q1 Q2		11 7	20 14	ns
t_r	Turn-On Rise Time		Q1 Q2		8 10	18 20	ns
$t_{d(off)}$	Turn-Off Delay Time	Q2 $V_{DD} = -30\text{ V}$, $I_D = -1\text{ A}$, $V_{GS} = -10\text{ V}$, $R_{GEN} = 6\ \Omega$	Q1 Q2		19 19	35 34	ns
t_f	Turn-Off Fall Time		Q1 Q2		6 12	15 22	ns
Q_g	Total Gate Charge	Q1 $V_{DS} = 30\text{ V}$, $I_D = 4.5\text{ A}$, $V_{GS} = 10\text{ V}$	Q1 Q2		12.5 15	18 21	nC
Q_{gs}	Gate-Source Charge		Q1 Q2		2.4 2.5		nC
Q_{gd}	Gate-Drain Charge	$V_{DS} = -30\text{ V}$, $I_D = -3.5\text{ A}$, $V_{GS} = -10\text{ V}$	Q1 Q2		2.6 3.0		nC

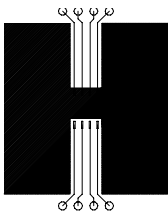
Electrical Characteristics (continued) $T_A = 25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	Test Conditions	Type	Min	Typ	Max	Units
I_S	Maximum Continuous Drain-Source Diode Forward Current		Q1			1.3	A
			Q2			-1.3	
V_{SD}	Drain-Source Diode Forward Voltage	$V_{GS} = 0\text{ V}$, $I_S = 1.3\text{ A}$ (Note 2) $V_{GS} = 0\text{ V}$, $I_S = -1.3\text{ A}$ (Note 2)	Q1		0.8	1.2	V
			Q2		-0.8	-1.2	

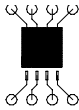
Drain-Source Diode Characteristics and Maximum Ratings

Notes:

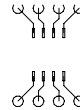
1. $R_{\theta JA}$ is the sum of the junction-to-case and case-to-ambient thermal resistance where the case thermal reference is defined as the solder mounting surface of the drain pins. $R_{\theta JC}$ is guaranteed by design while $R_{\theta CA}$ is determined by the user's board design.



a) 78°C/W when mounted on a 0.5 in^2 pad of 2 oz copper



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



c) 135°C/W when mounted on a minimum pad.

Scale 1 : 1 on letter size paper

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

Typical Characteristics: Q2

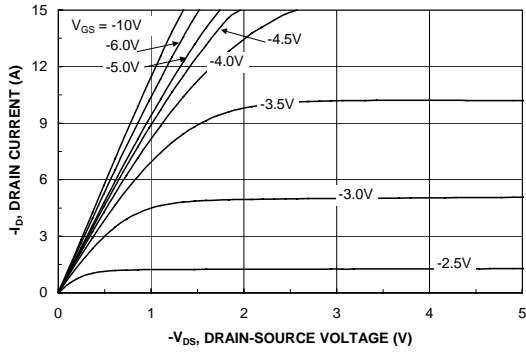


Figure 1. On-Region Characteristics.

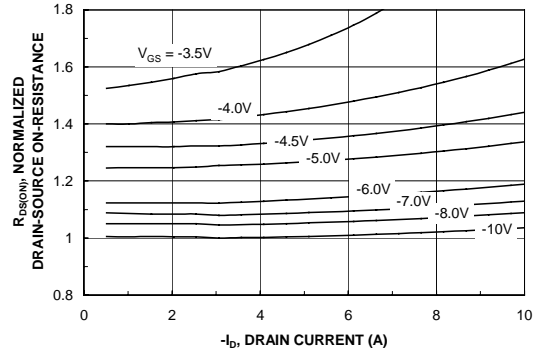


Figure 2. On-Resistance Variation with Drain Current and Gate Voltage.

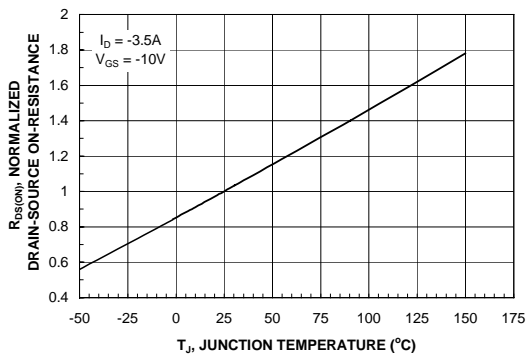


Figure 3. On-Resistance Variation with Temperature.

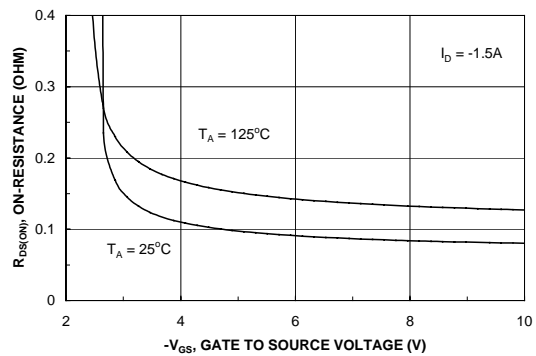


Figure 4. On-Resistance Variation with Gate-to-Source Voltage.

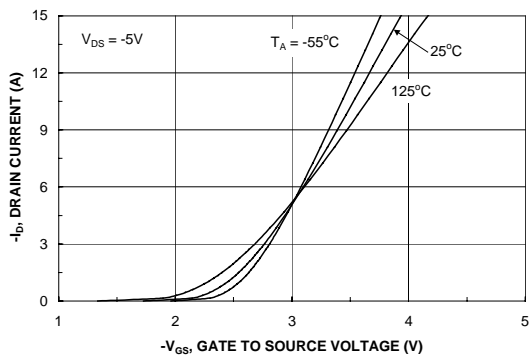


Figure 5. Transfer Characteristics.

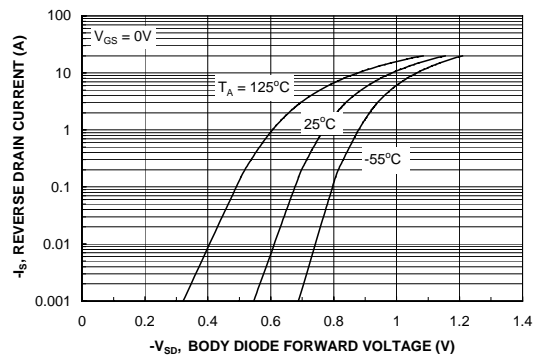


Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature.

Typical Characteristics: Q2

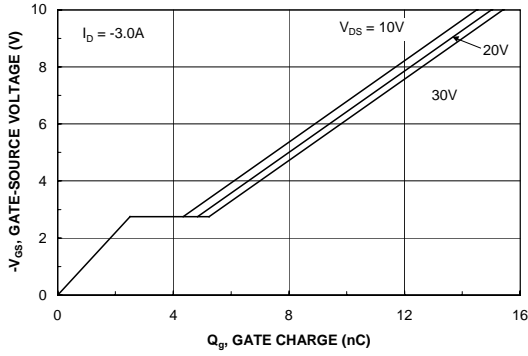


Figure 7. Gate Charge Characteristics.

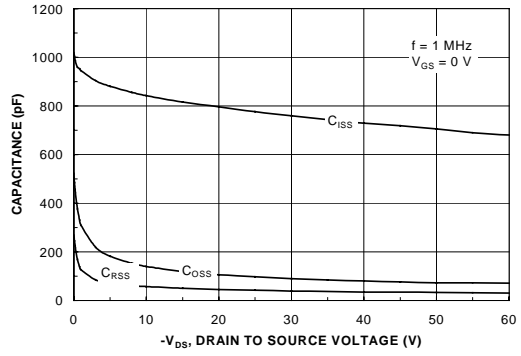


Figure 8. Capacitance Characteristics.

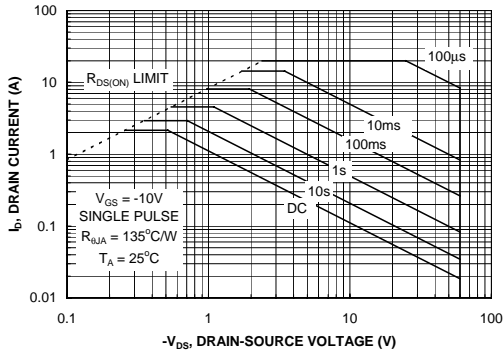


Figure 9. Maximum Safe Operating Area.

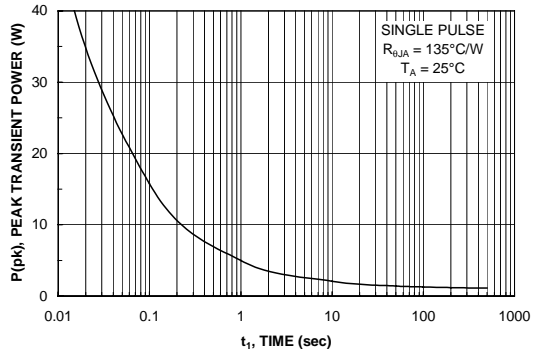


Figure 10. Single Pulse Maximum Power Dissipation.

Typical Characteristics: Q1

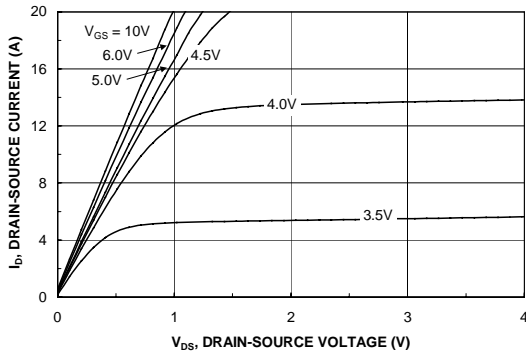


Figure 11. On-Region Characteristics.

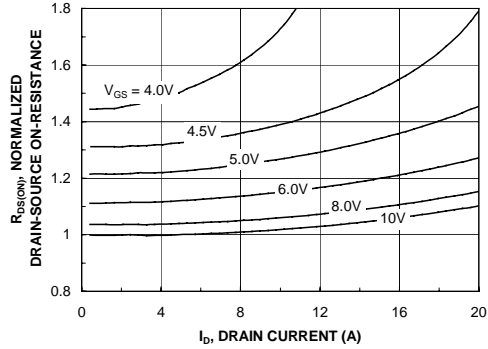


Figure 12. On-Resistance Variation with Drain Current and Gate Voltage.

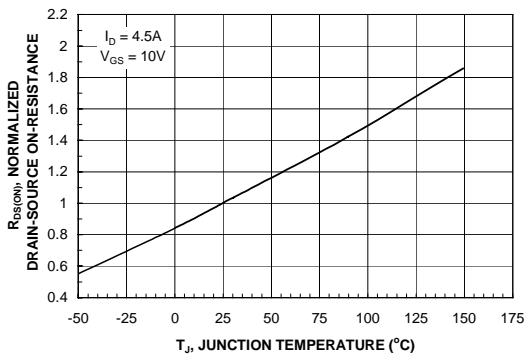


Figure 13. On-Resistance Variation with Temperature.

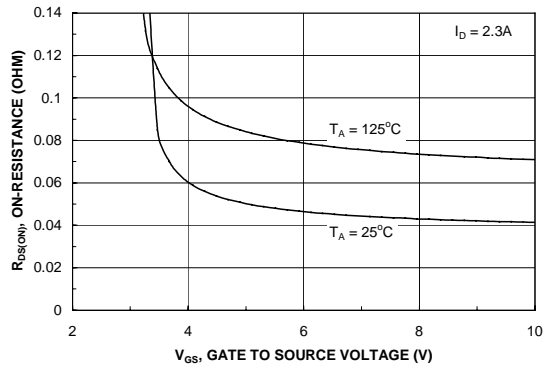


Figure 14. On-Resistance Variation with Gate-to-Source Voltage.

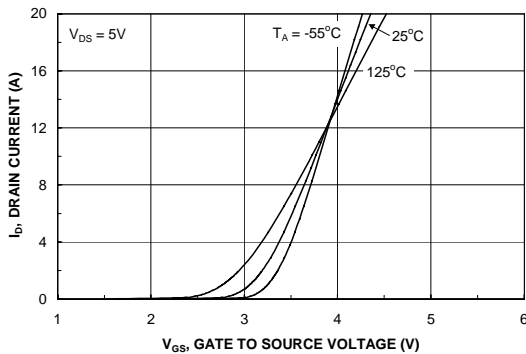


Figure 15. Transfer Characteristics.

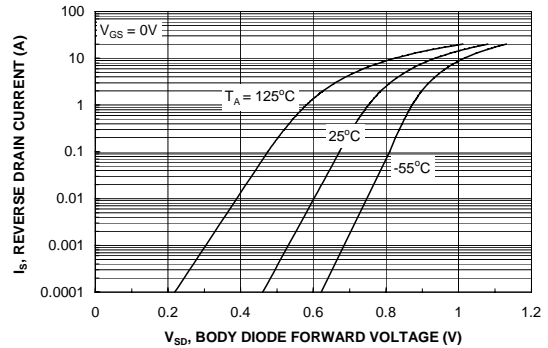


Figure 16. Body Diode Forward Voltage Variation with Source Current and Temperature.

Typical Characteristics: Q1

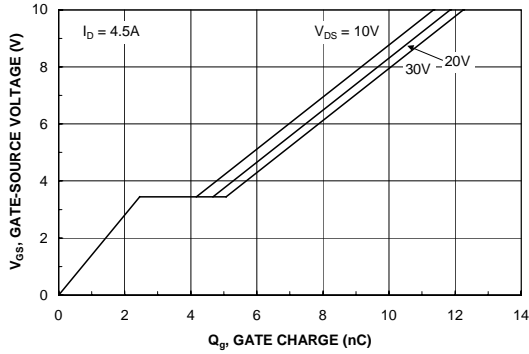


Figure 17. Gate Charge Characteristics.

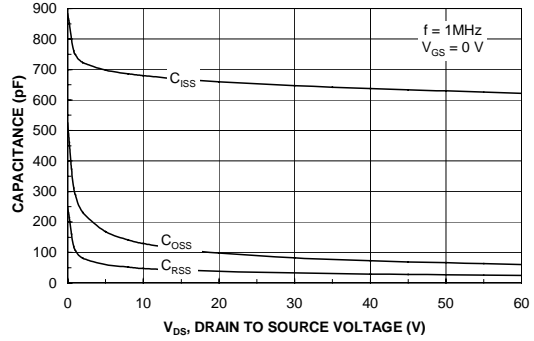


Figure 18. Capacitance Characteristics.

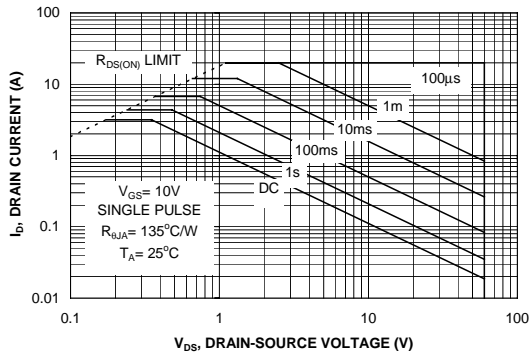


Figure 19. Maximum Safe Operating Area.

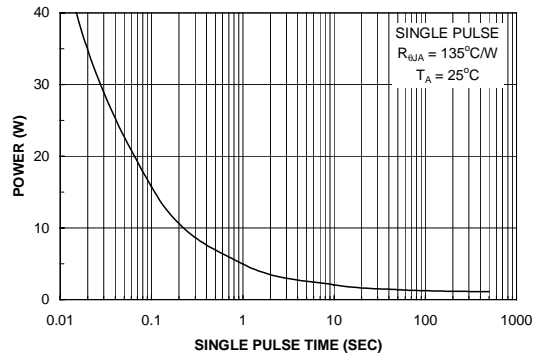


Figure 20. Single Pulse Maximum Power Dissipation.

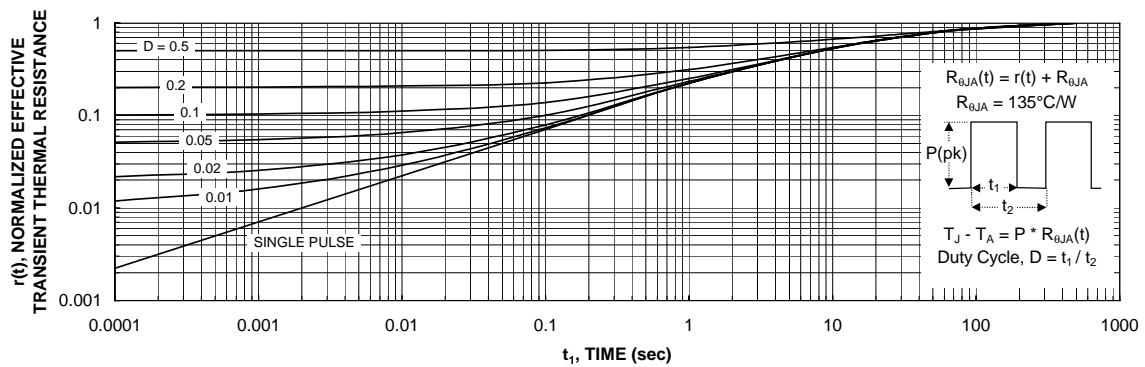


Figure 21. Transient Thermal Response Curve.

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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