LMNP2093EX6F N & P Pair Enhancement Mode MOSFET

Features

- N-Channel
- 20V/0.5A, $R_{DS(ON)}$=450mΩ@V_{GS}=4.5V
- 20V/0.4A, $R_{DS(ON)}$=600mΩ@V_{GS}=2.5V
- 20V/0.2A, $R_{DS(ON)}$=750mΩ@V_{GS}=1.8V
- P-Channel
- -20V/-0.5A, $R_{DS(ON)}$=800mΩ@V_{GS}=-4.5V
- -20V/-0.2A, $R_{DS(ON)}$=1050mΩ@V_{GS}=-2.5V
- -20V/-0.1A, $R_{DS(ON)}$=1500mΩ@V_{GS}=-1.8V
- Low-Voltage Operation
- High-Speed Circuits
- Low Battery Voltage Operation
- SOT-363 package design

Product Description

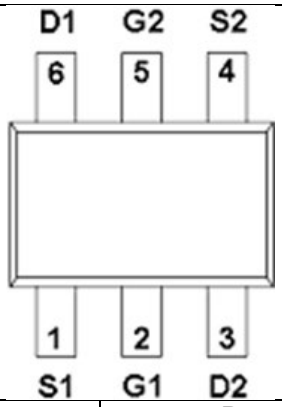
LMNP2093E is the N and P Pair enhancement mode MOSFET, uses Advanced Trench Technology to provide excellent $R_{DS(ON)}$, low gate charge.
These devices are particularly suited for low voltage power management, such as smart phone and notebook computer and other battery powered circuits, and low in-line power loss are needed in commercial industrial surface mount applications.

Applications

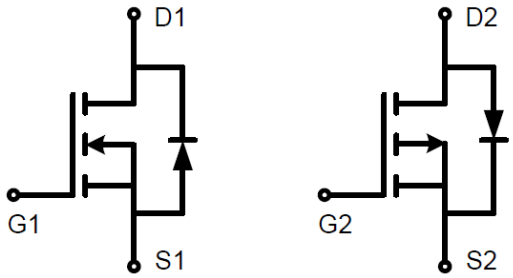
- Load Switch for Portable Devices, Smart Phones, Pagers.

Pin Configuration

LMNP2093EX6F (SOT-363)



Pin	Description
1	Source 1
2	Gate 1
3	Drain 2
4	Source 2
5	Gate 2
6	Drain 1



n-channel p-channel

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Ordering Information

Ordering Information				
Part Number	P/N	PKG code	Pb Free code	Package
LMNP2093EX6F	LMNP2093E	X6	F	SOT-363

Marking Information

Marking Information	
Part Number	LFC code
9	WM

Absolute Maximum Ratings

(T_C=25ºC Unless otherwise noted)

Symbol	Parameter		Typical		Unit
			N-Channel	P-Channel	
V_{DSS}	Drain-Source Voltage		20	-20	V
V_{GSS}	Gate-Source Voltage		±10	±8	V
I_D	Continuous Drain Current (T_J=150℃)[1]	T_A=25℃[1]	0.63	-0.47	A
		T_A=70℃	0.5	-0.38	
I_{DM}	Pulsed Drain Current		1.8	-1.4	A
P_D	Power Dissipation	T_A=25℃	0.31		W
		T_A=70℃	0.2		W/℃
T_J	Operating Junction Temperature		-55/150		℃
T_{STG}	Storage Temperature Range		-55/150		℃
$R_{\theta JA}$	Thermal Resistance-Junction to Case		400		℃/W

Note:
1. Device mounted on FR-4 substrate PC board.

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Electrical Characteristics(N-Channel)

(T_C=25ºC Unless otherwise noted)

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Static characteristics							
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage	V_{GS}=0V, I_D=250uA	N-Ch	20			V
		V_{GS}=0V, I_D=-250uA	P-Ch	-20			
$V_{GS\ (th)}$	Gate Threshold Voltage	V_{DS}=V_{GS}, I_D=250uA	N-Ch	0.3		1.0	
		V_{DS}=V_{GS}, I_D=-250uA	P-Ch	-0.3		-1.0	
I_{GSS}	Gate Leakage Current	V_{DS}=0V, V_{GS}=±10V	N-Ch			±10	uA
		V_{DS}=0V, V_{GS}=±8V	P-Ch			±10	
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS}=16V, V_{GS}=0V	N-Ch			1	uA
		V_{DS}=-16V, V_{GS}=0V	P-Ch			-1	
V_{SD}	Diode Forward Voltage	V_{GS}=0V, I_S=0.15A	N-Ch			1.3	V
		V_{GS}=0V, I_S=-0.15A	P-Ch			-1.3	
$R_{DS(on)}$	Drain-Source On-Resistance	V_{GS}=4.5V, I_D=0.5A	N-Ch		215	450	mΩ
		V_{GS}=-4.5V, I_D=-0.5A	P-Ch		580	800	
		V_{GS}=2.5V, I_D=0.4A	N-Ch		280	600	
		V_{GS}=-2.5V, I_D=-0.2A	P-Ch		810	1050	
		V_{GS}=1.8V, I_D=0.2A	N-Ch		380	750	
		V_{GS}=-1.8V, I_D=-0.1A	P-Ch		1050	1500	
g_{FS}	Forward Transconductance	V_{DS}=10V, I_D=0.4A	N-Ch		1.2		S
		V_{DS}=-10V, I_D=-0.4A	P-Ch		1.1		
Dynamic characteristics							
Q_g	Total Gate Charge[1,2]	N-Channel V_{DS}=10V, V_{GS}=4.5V, I_D=0.25A P-Channel V_{DS}=-10V, V_{GS}=-4.5V, I_D=-0.25A	N-Ch		0.74		nC
			P-Ch		0.63		
Q_{gs}	Gate-Source Charge[1,2]		N-Ch		0.1		
			P-Ch		0.11		
Q_{gd}	Gate-Drain Charge[1,2]		N-Ch		0.12		
			P-Ch		0.13		
C_{iss}	Input Capacitance	V_{DS}=10V, V_{GS}=0V, f=1.0MHz	N-Ch		60.7		pF
		V_{DS}=-16V, V_{GS}=0V, f=1.0MHz	P-Ch		59.8		
C_{oss}	Output Capacitance	V_{DS}=10V, V_{GS}=0V, f=1.0MHz	N-Ch		10		
		V_{DS}=-16V, V_{GS}=0V, f=1.0MHz	P-Ch		12.1		
C_{rss}	Reverse Transfer Capacitance	V_{DS}=10V, V_{GS}=0V, f=1.0MHz	N-Ch		5.37		
		V_{DS}=-16V, V_{GS}=0V, f=1.0MHz	P-Ch		6.4		
$t_{d(on)}$	Turn-On Time	N-Channel VDD=10V, RL=47Ω, ID=0.2A VGEN=4.5V, RG=10Ω P-Channel VDD=-10V, RL=47Ω, ID=-0.2A VGEN=-4.5V, RG=10Ω	N-Ch		5.1		ns
			P-Ch		5.1		
t_r			N-Ch		7.4		
			P-Ch		8.1		
$t_{d(off)}$	Turn-Off Time		N-Ch		27		
			P-Ch		29		
t_f			N-Ch		13		
			P-Ch		21		

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Typical Performance Characteristics(N-Channel)

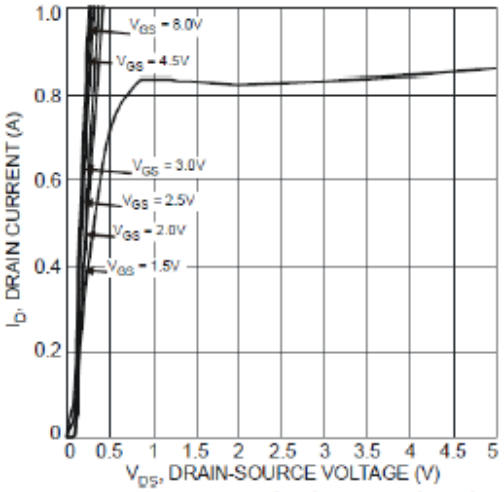

Fig. 1 Typical Output Characteristics

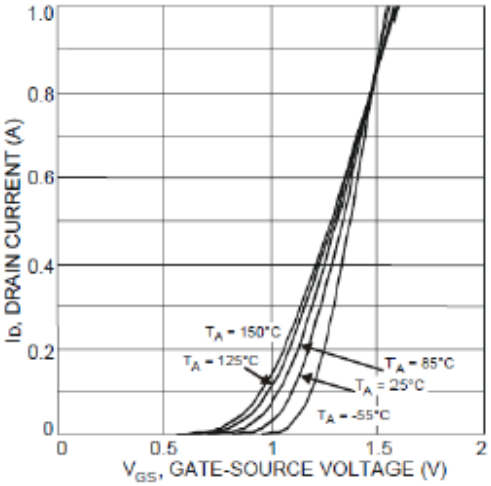

Fig. 2 Typical Transfer Characteristics

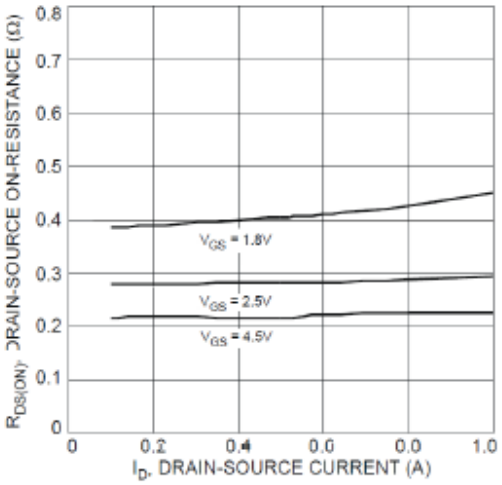

Fig. 3 Typical On-Resistance vs. I_D and V_{GS}

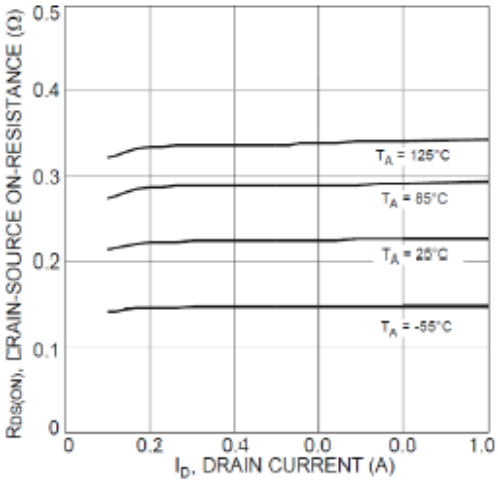

Fig. 4 Typical Drain-Source On-Resistance vs. I_D and T_J

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Typical Performance Characteristics (N-Channel Continue)

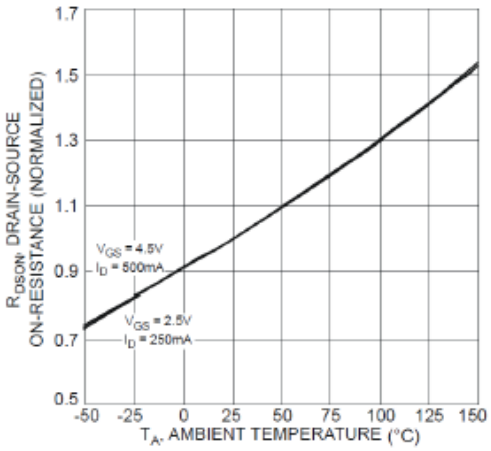

Fig. 5 On-Resistance Variation with T_A

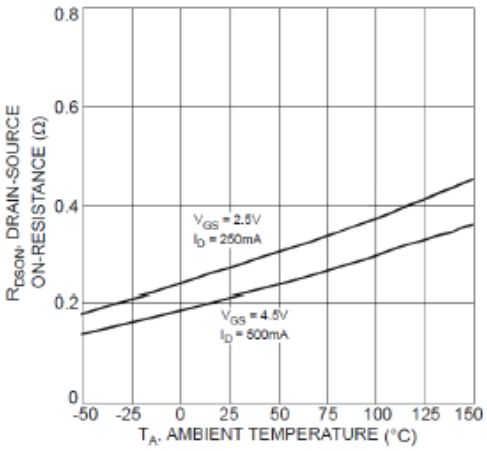

Fig. 6 On-Resistance Variation with T_A

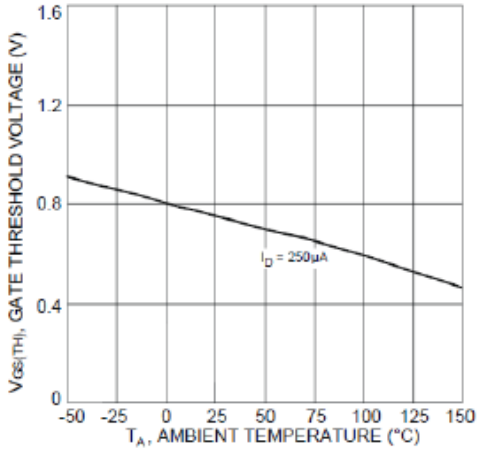

Fig. 7 Gate Threshold Variation vs. T_A

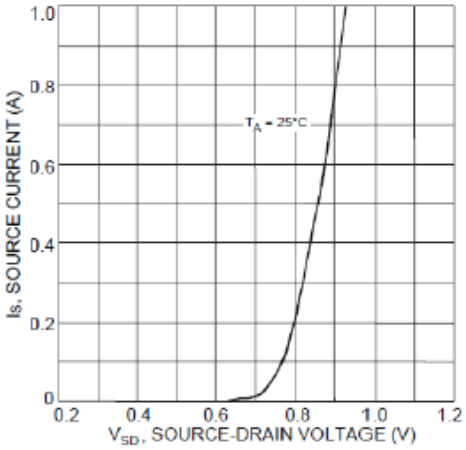

Fig. 8 Diode Forward Voltage vs. Current

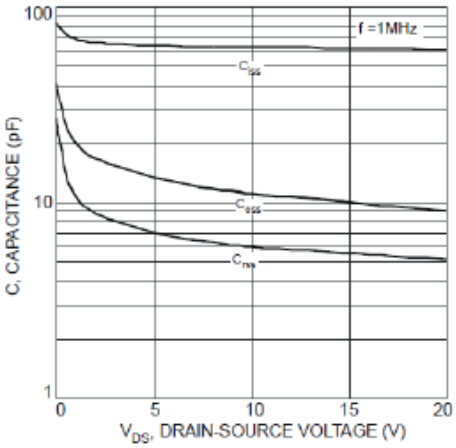

Fig. 9 Typical Capacitance

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Typical Performance Characteristics (N-Channel Continue)

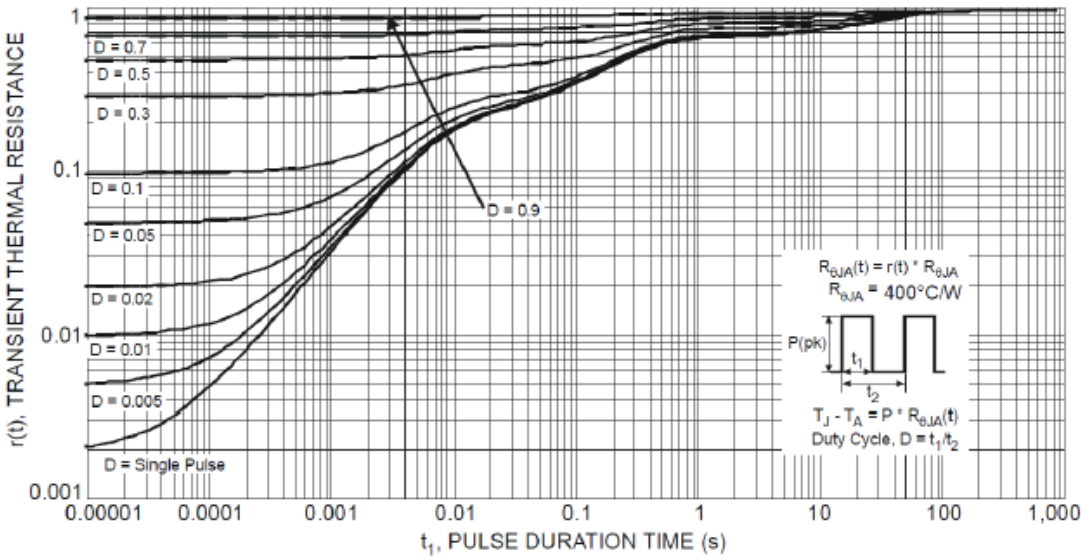

Fig. 10 Transient Thermal Response

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Typical Performance Characteristics(P-Channel)

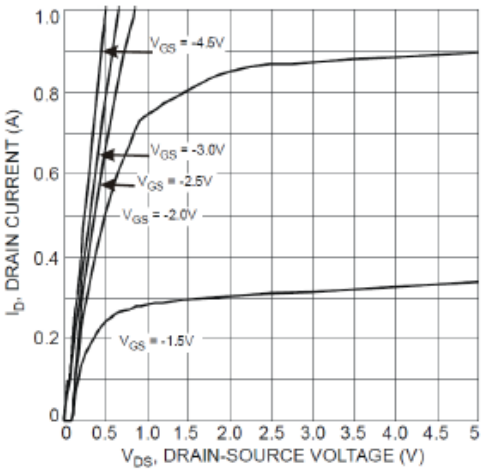

Fig. 1 Typical Output Characteristics

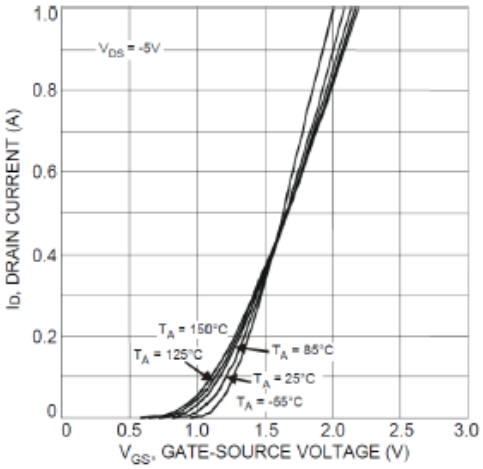

Fig. 2 Typical Transfer Characteristics

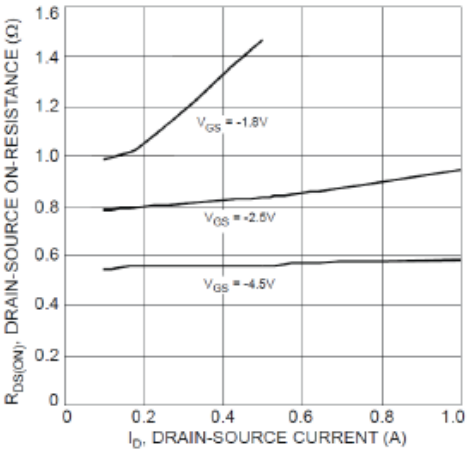

Fig. 3 Typical On-Resistance vs. I_D and V_{GS}

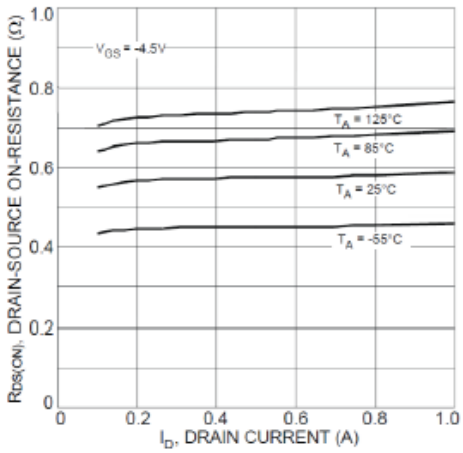

Fig. 4 Typical Drain-Source On-Resistance vs. I_D and T_A

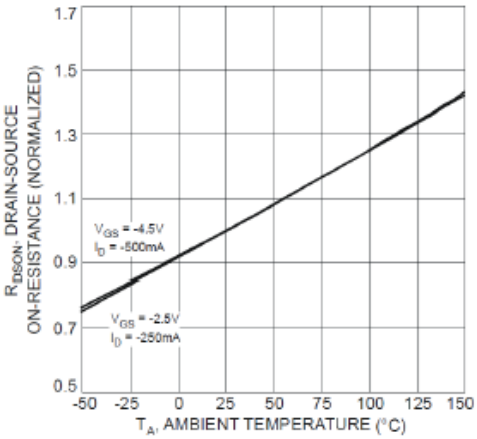

Fig. 5 On-Resistance Variation with T_J

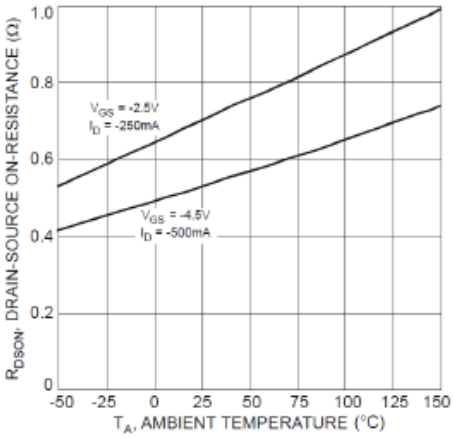

Fig. 6 On-Resistance Variation with T_J

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Typical Performance Characteristics (P-Channel Continue)

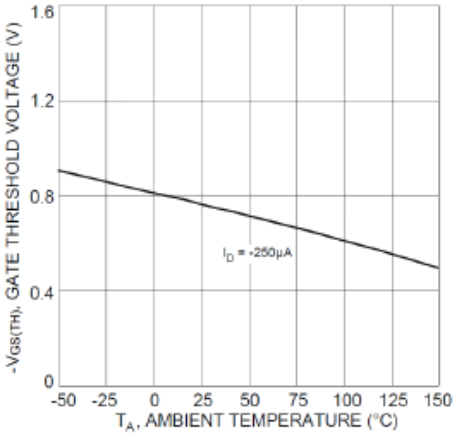

Fig. 7 Gate Threshold Variation vs. T_A

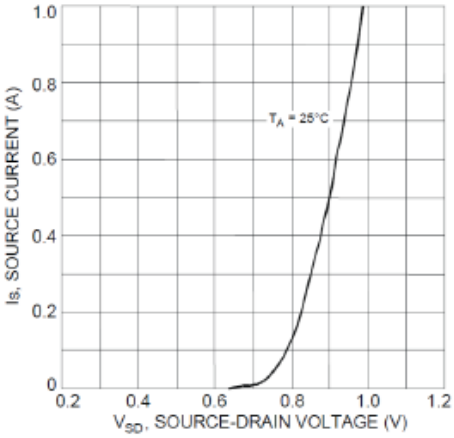

Fig. 8 Diode Forward Voltage vs. Current

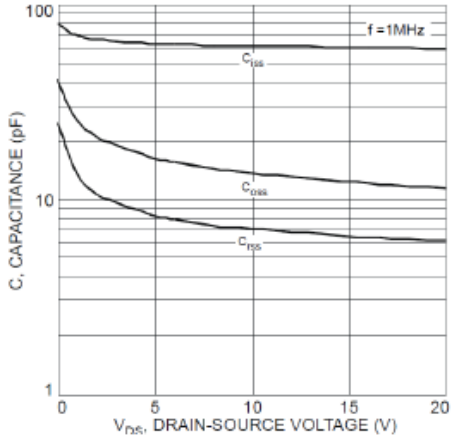

Fig. 9 Typical Capacitance

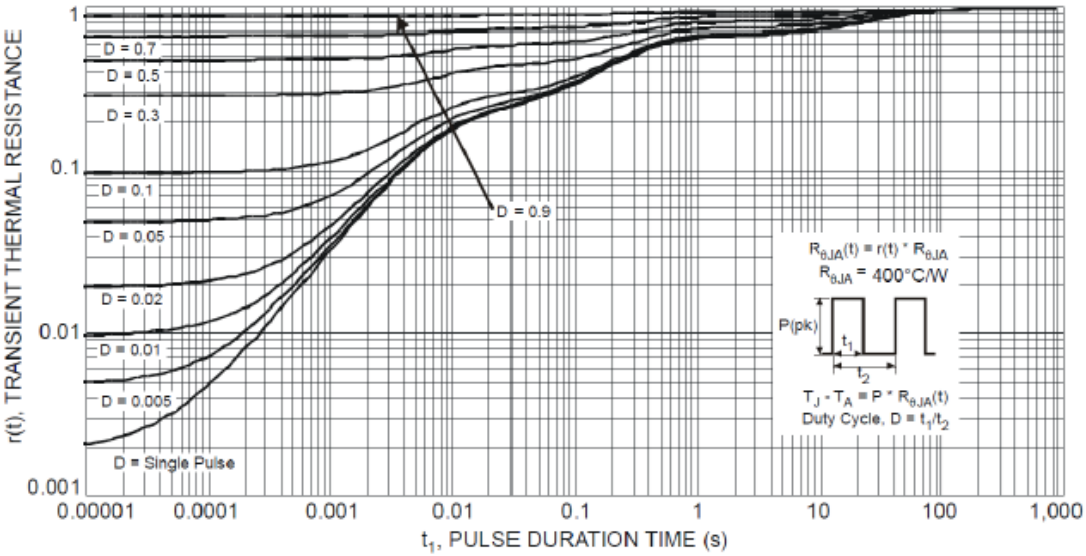

Fig. 10 Transient Thermal Response

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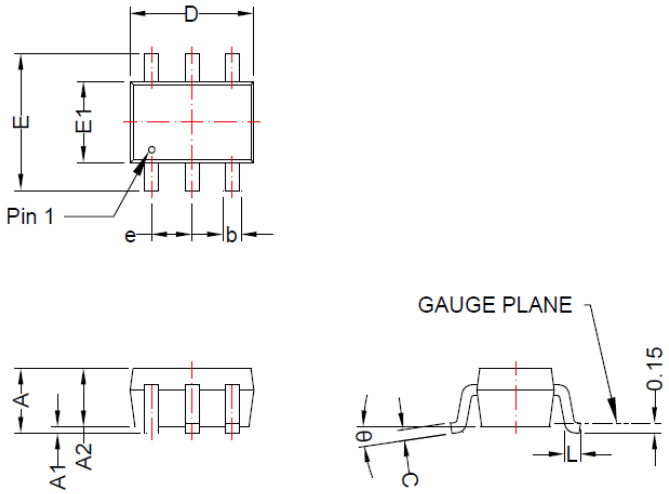
Package Dimension:

SOT-363



THE D DIMENSION DOES NOT INCLUDE MOLD FLASH,PROTRUSIONS OR GATE BURRS,MOLD FLASH,PROTRUSIONS OR GATE BURRS SHALL NOT EXCEED 0.2mm END. THE E1 DIMENSION DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION,INTERLEAD FLASH OR PROTRUSION SHALL NOT 0.20mm PER SIDE.

Dimensions				
Symbol	**Millimeters**		**Inches**	
	Min	Max	Min	Max
A	0.80	1.10	0.031	0.043
A1	0.00	0.10	0.000	0.004
A2	0.70	1.00	0.028	0.039
b	0.15	0.30	0.006	0.012
c	0.08	0.25	0.003	0.010
D	1.80	2.20	0.071	0.087
E	1.80	2.40	0.071	0.094
E1	1.15	1.35	0.045	0.053
e	0.65 BSC		0.026 BSC	
L	0.26	0.45	0.010	0.018
θ	0°	8°	0°	8°

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