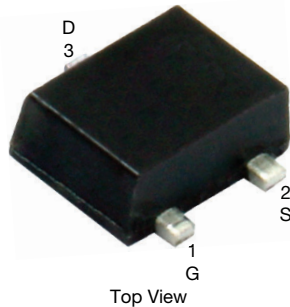


## P-Channel 20 V (D-S) MOSFET

PRODUCT SUMMARY			
V <sub>DS</sub> (V)	R <sub>DS(on)</sub> (Ω)	I <sub>D</sub> (A)	Q <sub>g</sub> (TYP.) (nC)
-20	0.760 at V <sub>GS</sub> = -4.5 V	-0.45	1
	1.040 at V <sub>GS</sub> = -2.5 V	-0.40	
	1.500 at V <sub>GS</sub> = -1.8 V	-0.32	

**SC-89 (3 leads)**


Top View

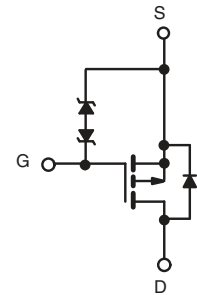
### FEATURES

- TrenchFET® power MOSFET
- 100 % R<sub>g</sub> tested
- Typical ESD protection: 1000 V (HBM)
- Fast switching speed
- Material categorization:  
for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


**RoHS**  
 COMPLIANT  
 HALOGEN  
**FREE**

### APPLICATIONS

- Load / power switch for portable devices
- Drivers: relays, solenoids, displays
- Battery operated systems



P-Channel MOSFET

**Marking Code:** 6

**Ordering Information:**

Si1013CX-T1-GE3 (Lead (Pb)-free and Halogen-free)

ABSOLUTE MAXIMUM RATINGS (T <sub>A</sub> = 25 °C, unless otherwise noted)			
PARAMETER	SYMBOL	LIMIT	UNIT
Drain-Source Voltage	V <sub>DS</sub>	-20	V
Gate-Source Voltage	V <sub>GS</sub>	± 8	
Continuous Drain Current (T <sub>J</sub> = 150 °C)	T <sub>A</sub> = 25 °C	-0.45 <sup>b, c</sup>	A
	T <sub>A</sub> = 70 °C	-0.36 <sup>b, c</sup>	
Pulsed Drain Current (t = 300 μs)	I <sub>DM</sub>	-1.5	
Continuous Source-Drain Diode Current	T <sub>A</sub> = 25 °C	I <sub>S</sub>	-0.16 <sup>b, c</sup>
Maximum Power Dissipation	T <sub>A</sub> = 25 °C	P <sub>D</sub>	0.19 <sup>b, c</sup>
	T <sub>A</sub> = 70 °C		0.12 <sup>b, c</sup>
Operating Junction and Storage Temperature Range	T <sub>J</sub> , T <sub>stg</sub>	-55 to +150	°C

THERMAL RESISTANCE RATINGS					
PARAMETER	SYMBOL	TYPICAL	MAXIMUM	UNIT	
Maximum Junction-to-Ambient <sup>a, b</sup>	t ≤ 5 s	440	530	°C/W	
	Steady State	540	650		

**Notes**

- Maximum under steady state conditions is 650 °C/W.
- Surface mounted on 1" x 1" FR4 board.
- t = 5 s.



SPECIFICATIONS (T <sub>J</sub> = 25 °C, unless otherwise noted)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
<b>Static</b>						
Drain-Source Breakdown Voltage	V <sub>DS</sub>	V <sub>GS</sub> = 0, I <sub>D</sub> = -250 μA	-20	-	-	V
V <sub>DS</sub> Temperature Coefficient	ΔV <sub>DS</sub> /T <sub>J</sub>	I <sub>D</sub> = -250 μA	-	-12	-	mV/°C
V <sub>GS(th)</sub> Temperature Coefficient	ΔV <sub>GS(th)</sub> /T <sub>J</sub>		-	1.8	-	
Gate-Source Threshold Voltage	V <sub>GS(th)</sub>	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = -250 μA	-0.4	-	-1	V
Gate-Source Leakage	I <sub>GSS</sub>	V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ± 8 V	-	-	± 30	μA
		V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ± 4.5 V	-	-	± 1	
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>DS</sub> = -20 V, V <sub>GS</sub> = 0 V	-	-	-1	
On-State Drain Current <sup>a</sup>	I <sub>D(on)</sub>	V <sub>DS</sub> = -20 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 85 °C	-	-	-10	A
		V <sub>DS</sub> = ≥ 5 V, V <sub>GS</sub> = -4.5 V	-1.5	-	-	
Drain-Source On-State Resistance <sup>a</sup>	R <sub>DS(on)</sub>	V <sub>GS</sub> = -4.5 V, I <sub>D</sub> = -0.4 A	-	0.630	0.760	Ω
		V <sub>GS</sub> = -2.5 V, I <sub>D</sub> = -0.2 A	-	0.865	1.040	
		V <sub>GS</sub> = -1.8 V, I <sub>D</sub> = -0.1 A	-	1.200	1.500	
Forward Transconductance	g <sub>fs</sub>	V <sub>DS</sub> = -10 V, I <sub>D</sub> = 0.4 A	-	1	-	S
<b>Dynamic <sup>b</sup></b>						
Input Capacitance	C <sub>iss</sub>	V <sub>DS</sub> = -10 V, V <sub>GS</sub> = 0 V, f = 1 MHz	-	45	-	pF
Output Capacitance	C <sub>oss</sub>		-	15	-	
Reverse Transfer Capacitance	C <sub>rss</sub>		-	10	-	
Total Gate Charge	Q <sub>g</sub>	V <sub>DS</sub> = -10 V, V <sub>GS</sub> = -4.5 V, I <sub>D</sub> = -0.4 A	-	1.65	2.50	nC
		V <sub>DS</sub> = -0 V, V <sub>GS</sub> = -2.5 V, I <sub>D</sub> = -0.4	-	1	2	
Gate-Source Charge	Q <sub>gs</sub>	-	0.2	-		
Gate-Drain Charge	Q <sub>gd</sub>	-	0.26	-		
Gate Resistance	R <sub>g</sub>	f = 1 MHz	2.4	12	24	Ω
Turn-On Delay Time	t <sub>d(on)</sub>	V <sub>DD</sub> = -10 V, R <sub>L</sub> = 33.3 Ω I <sub>D</sub> ≅ -0.3 A, V <sub>GEN</sub> = -4.5 V, R <sub>g</sub> = 1 Ω	-	9	18	ns
Rise Time	t <sub>r</sub>		-	10	20	
Turn-Off Delay Time	t <sub>d(off)</sub>		-	10	20	
Fall Time	t <sub>f</sub>		-	8	16	
Turn-On Delay Time	t <sub>d(on)</sub>	V <sub>DD</sub> = -10 V, R <sub>L</sub> = 33.3 Ω I <sub>D</sub> ≅ -0.3 A, V <sub>GEN</sub> = -8 V, R <sub>g</sub> = 1 Ω	-	1	2	
Rise Time	t <sub>r</sub>		-	8	16	
Turn-Off Delay Time	t <sub>d(off)</sub>		-	9	18	
Fall Time	t <sub>f</sub>		-	5	10	
<b>Drain-Source Body Diode Characteristics</b>						
Pulse Diode Forward Current <sup>a</sup>	I <sub>SM</sub>		-	-	-1.5	A
Body Diode Voltage	V <sub>SD</sub>	I <sub>S</sub> = -0.3 A	-	-0.8	-1.2	V
Body Diode Reverse Recovery Time	t <sub>rr</sub>	I <sub>F</sub> = -0.3 A, di/dt = 100 A/μs	-	16	24	ns
Body Diode Reverse Recovery Charge	Q <sub>rr</sub>		-	8	16	nC
Reverse Recovery Fall Time	t <sub>a</sub>		-	11	-	ns
Reverse Recovery Rise Time	t <sub>b</sub>		-	5	-	

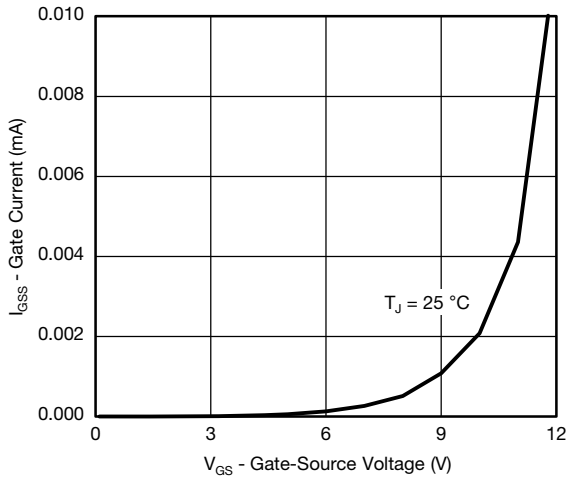
**Notes**

- a. Pulse test; pulse width ≤ 300 μs, duty cycle ≤ 2 %.
- b. Guaranteed by design, not subject to production testing.

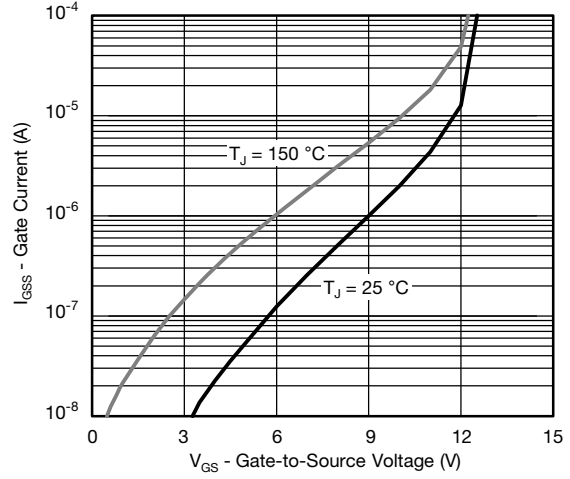
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.



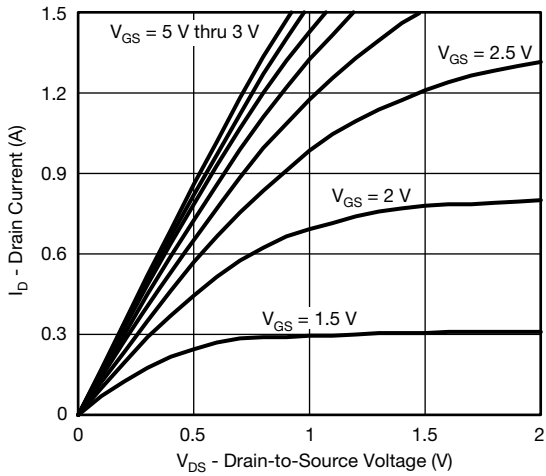
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



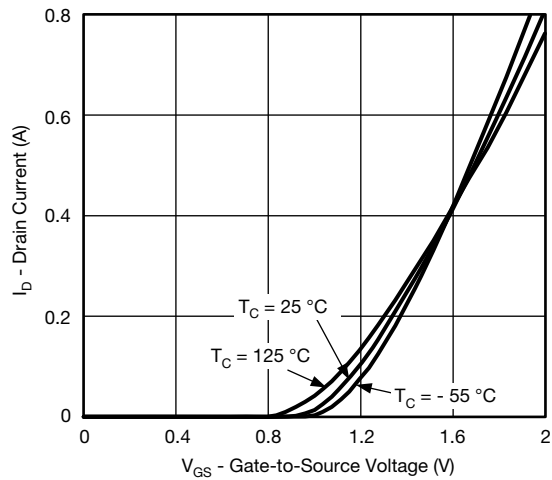
Gate Current vs. Gate-Source Voltage



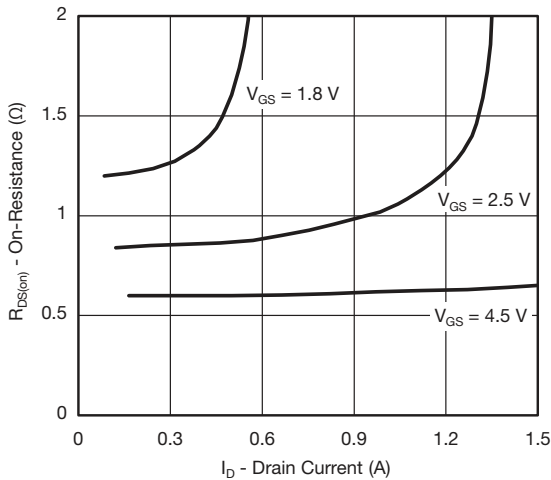
Gate Current vs. Gate-Source Voltage



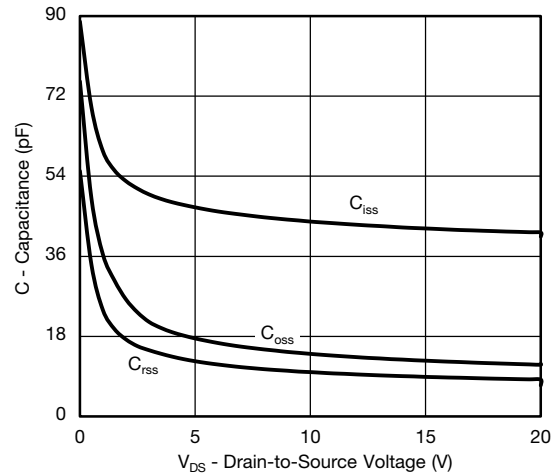
Output Characteristics



Transfer Characteristics



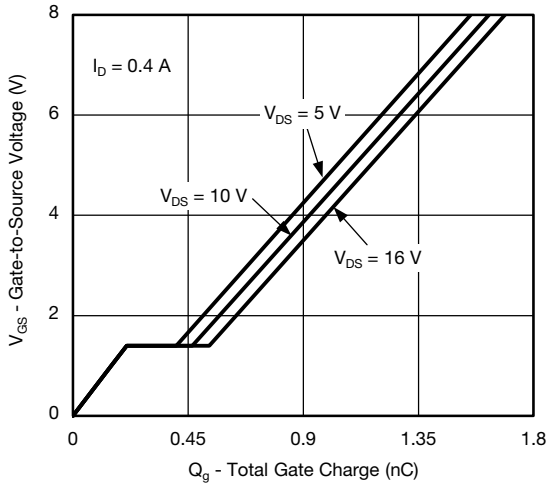
On-Resistance vs. Drain Current



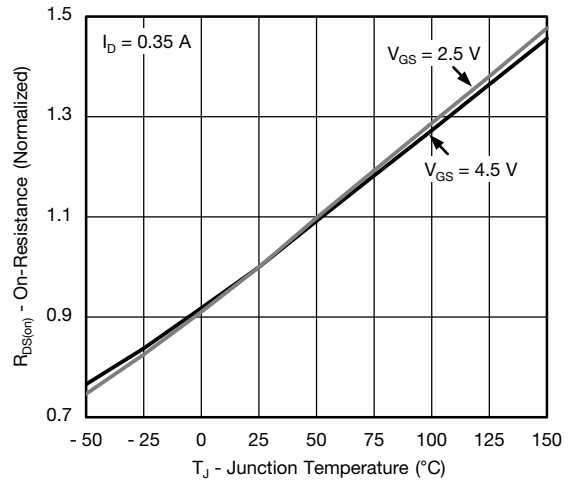
Capacitance



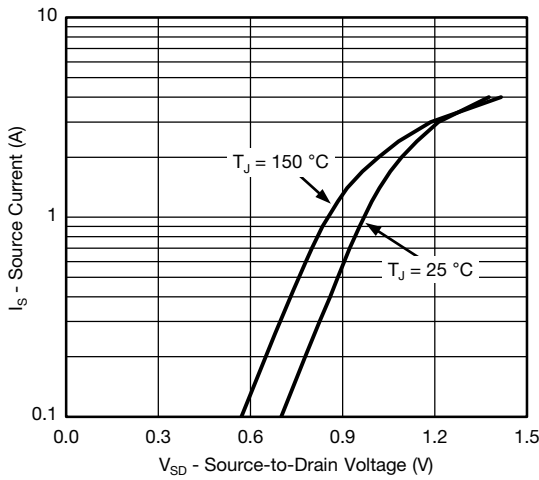
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



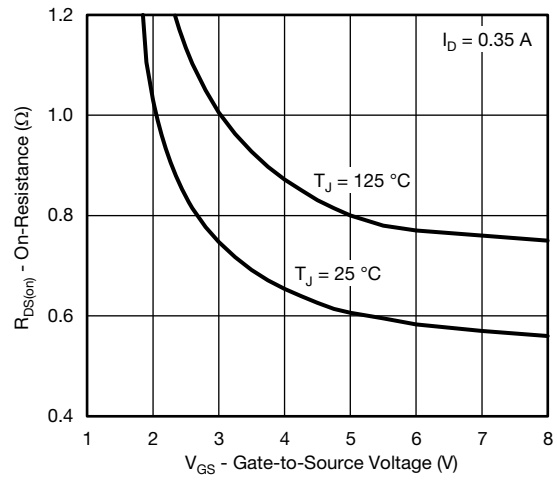
Gate Charge



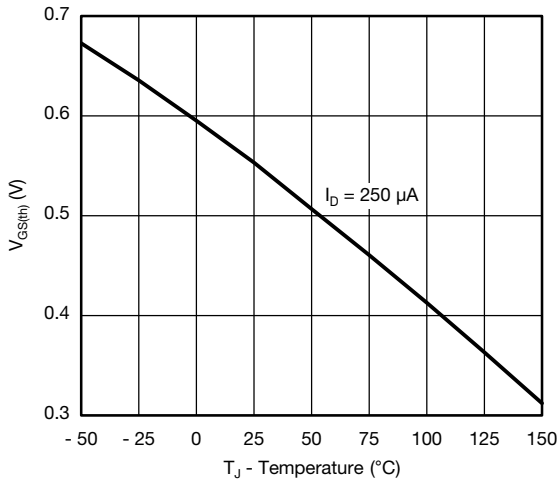
On-Resistance vs. Junction Temperature



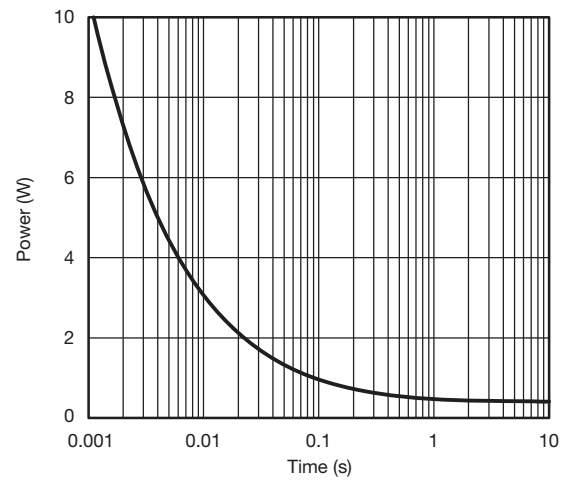
Source-Drain Diode Forward Voltage



On-Resistance vs. Gate-to-Source Voltage



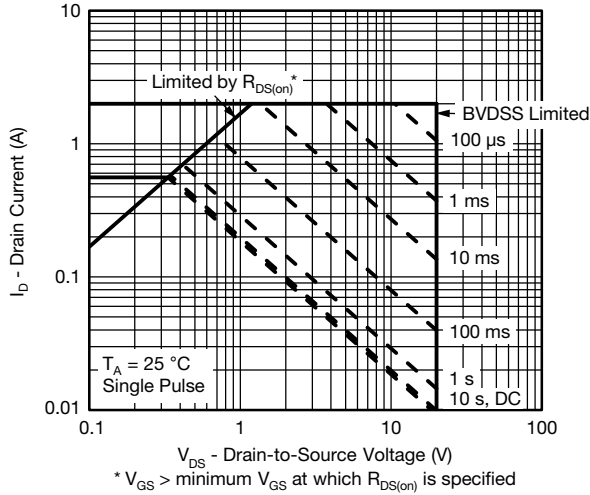
Threshold Voltage



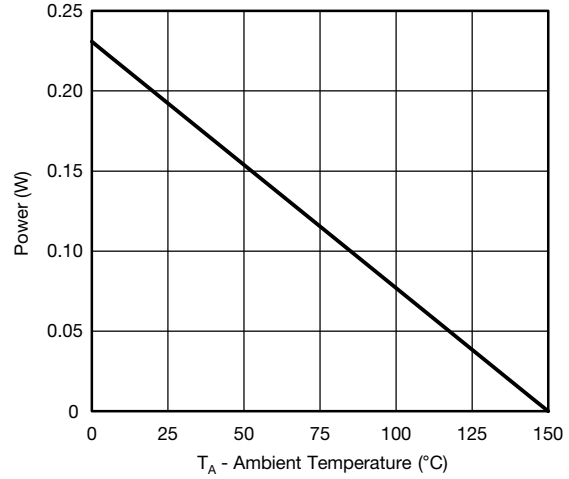
Single Pulse Power, Junction-to-Ambient



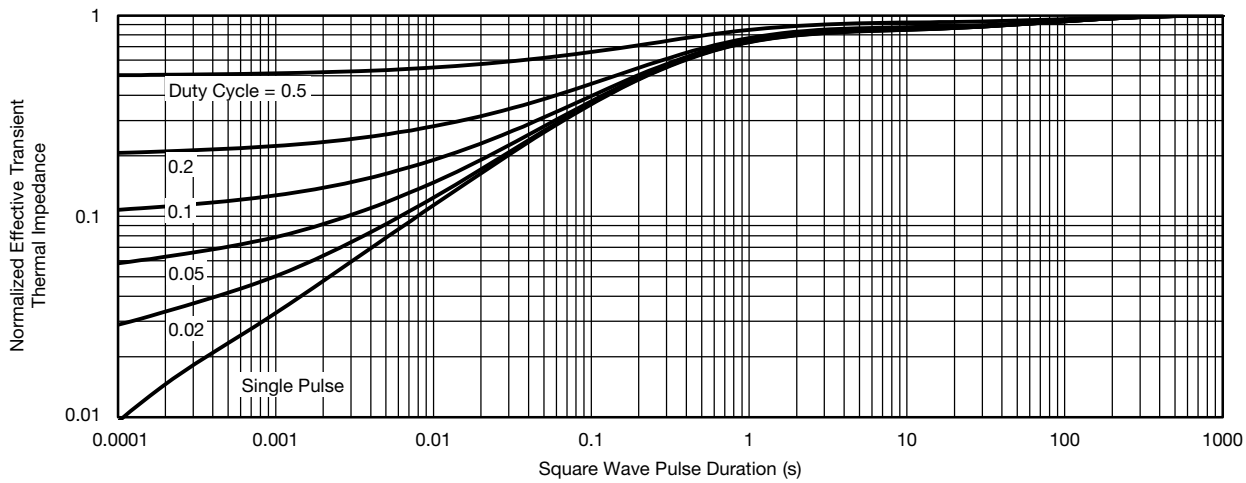
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



Safe Operating Area, Junction-to-Ambient



Power Derating, Junction-to-Ambient



Normalized Thermal Transient Impedance, Junction-to-Ambient

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SC89-3



Dim	MILLIMETERS		INCHES	
	Min	Max	Min	Max
<b>A</b>	0.60	0.80	0.024	0.031
<b>b</b>	0.23	0.33	0.009	0.013
<b>C</b>	0.10	0.20	0.004	0.008
<b>D</b>	1.50	1.70	0.059	0.067
<b>E</b>	0.75	0.95	0.030	0.037
<b>e</b>	1.00 BSC		0.040 BSC	
<b>e<sub>1</sub></b>	0.50 BSC		0.020 BSC	
<b>H</b>	1.50	1.70	0.059	0.067
<b>L</b>	0.30	0.50	0.012	0.020

ECN: S-03946—Rev. B, 09-Jul-01  
DWG: 5869

## RECOMMENDED MINIMUM PADS FOR SC-89: 3-Lead



Recommended Minimum Pads  
Dimensions in Inches/(mm)

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