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May 2014

# FCA16N60N

## N-Channel SupreMOS<sup>®</sup> MOSFET

600 V, 16 A, 199 mΩ

### Features

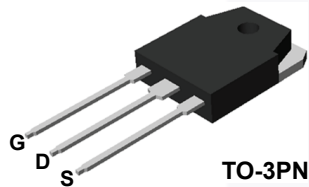
- $R_{DS(on)} = 170\text{ m}\Omega$  (Typ.) @  $V_{GS} = 10\text{V}$ ,  $I_D = 8\text{ A}$
- Ultra Low Gate Charge (Typ.  $Q_g = 40.2\text{ nC}$ )
- Low Effective Output Capacitance (Typ.  $C_{oss(eff.)} = 176\text{ pF}$ )
- 100% Avalanche Tested
- RoHS Compliant

### Application

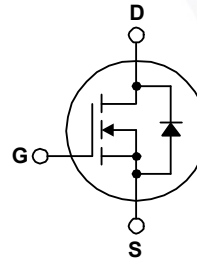
- PDP TV
- AC-DC Power Supply

### Description

The SupreMOS<sup>®</sup> MOSFET is Fairchild Semiconductor's next generation of high voltage super-junction (SJ) technology employing a deep trench filling process that differentiates it from the conventional SJ MOSFETs. This advanced technology and precise process control provides lowest  $R_{sp}$  on-resistance, superior switching performance and ruggedness. SupreMOS MOSFET is suitable for high frequency switching power converter applications such as PFC, server/telecom power, FPD TV power, ATX power, and industrial power applications.



TO-3PN



### MOSFET Maximum Ratings $T_C = 25^\circ\text{C}$ unless otherwise noted.

Symbol	Parameter	FCA16N60N	Unit
$V_{DSS}$	Drain to Source Voltage	600	V
$V_{GSS}$	Gate to Source Voltage	$\pm 30$	V
$I_D$	Drain Current	- Continuous ( $T_C = 25^\circ\text{C}$ )	16.0
		- Continuous ( $T_C = 100^\circ\text{C}$ )	10.1
$I_{DM}$	Drain Current	- Pulsed (Note 1)	48.0
$E_{AS}$	Single Pulsed Avalanche Energy	(Note 2)	355
$I_{AR}$	Avalanche Current	(Note 1)	5.3
$E_{AR}$	Repetitive Avalanche Energy	(Note 1)	1.34
dv/dt	MOSFET dv/dt		100
	Peak Diode Recovery dv/dt	(Note 3)	20
$P_D$	Power Dissipation	( $T_C = 25^\circ\text{C}$ )	134.4
		- Derate Above $25^\circ\text{C}$	1.08
$T_J, T_{STG}$	Operating and Storage Temperature Range	-55 to +150	$^\circ\text{C}$
$T_L$	Maximum Lead Temperature for Soldering, 1/8" from Case for 5 Seconds	300	$^\circ\text{C}$

### Thermal Characteristics

Symbol	Parameter	FCA16N60N	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max.	0.93	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient, Max.	40	

## Package Marking and Ordering Information

Part Number	Top Mark	Package	Packing Method	Reel Size	Tape Width	Quantity
FCA16N60N	FCA16N60N	TO-3PN	Tube	N/A	N/A	30 units

## Electrical Characteristics $T_C = 25^\circ\text{C}$ unless otherwise noted.

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
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### Off Characteristics

$BV_{DSS}$	Drain to Source Breakdown Voltage	$I_D = 1\text{ mA}, V_{GS} = 0\text{ V}, T_C = 25^\circ\text{C}$	600	-	-	V
$\Delta BV_{DSS} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 1\text{ mA}$ , Referenced to $25^\circ\text{C}$	-	0.73	-	$V/^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 480\text{ V}, V_{GS} = 0\text{ V}$	-	-	10	$\mu\text{A}$
		$V_{DS} = 480\text{ V}, V_{GS} = 0\text{ V}, T_C = 125^\circ\text{C}$	-	-	100	
$I_{GSS}$	Gate to Body Leakage Current	$V_{GS} = \pm 30\text{ V}, V_{DS} = 0\text{ V}$	-	-	$\pm 100$	nA

### On Characteristics

$V_{GS(th)}$	Gate Threshold Voltage	$V_{GS} = V_{DS}, I_D = 250\ \mu\text{A}$	2.0	-	4.0	V
$R_{DS(on)}$	Static Drain to Source On Resistance	$V_{GS} = 10\text{ V}, I_D = 8\text{ A}$	-	0.170	0.199	$\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS} = 40\text{ V}, I_D = 8\text{ A}$	-	20	-	S

### Dynamic Characteristics

$C_{iss}$	Input Capacitance	$V_{DS} = 100\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$	-	1630	2170	pF
$C_{oss}$	Output Capacitance		-	70	95	pF
$C_{rss}$	Reverse Transfer Capacitance		-	5	10	pF
$C_{oss}$	Output Capacitance	$V_{DS} = 380\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$	-	40	60	pF
$C_{oss(eff.)}$	Effective Output Capacitance	$V_{DS} = 0\text{ V to } 480\text{ V}, V_{GS} = 0\text{ V}$	-	176	-	pF
$Q_{g(tot)}$	Total Gate Charge at 10V	$V_{DS} = 380\text{ V}, I_D = 8\text{ A}, V_{GS} = 10\text{ V}$ (Note 4)	-	40.2	52.3	nC
$Q_{gs}$	Gate to Source Gate Charge		-	6.7	-	nC
$Q_{gd}$	Gate to Drain "Miller" Charge		-	12.9	-	nC
ESR	Equivalent Series Resistance (G-S)	$f = 1\text{ MHz}$	-	2.9	-	$\Omega$

### Switching Characteristics

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 380\text{ V}, I_D = 8\text{ A}, V_{GS} = 10\text{ V}, R_G = 4.7\ \Omega$ (Note 4)	-	15.8	41.6	ns
$t_r$	Turn-On Rise Time		-	15.5	41.0	ns
$t_{d(off)}$	Turn-Off Delay Time		-	60.3	130.6	ns
$t_f$	Turn-Off Fall Time		-	20.2	50.4	ns

### Drain-Source Diode Characteristics

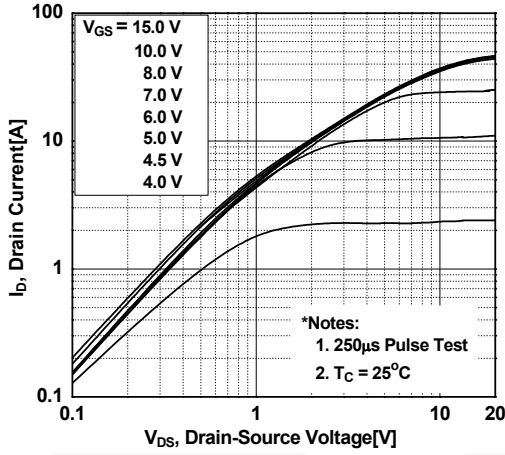
$I_S$	Maximum Continuous Drain to Source Diode Forward Current	-	-	16	A	
$I_{SM}$	Maximum Pulsed Drain to Source Diode Forward Current	-	-	48	A	
$V_{SD}$	Drain to Source Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_{SD} = 8\text{ A}$	-	-	1.2	V
$t_{rr}$	Reverse Recovery Time	$V_{GS} = 0\text{ V}, I_{SD} = 8\text{ A}, di_F/dt = 100\text{ A}/\mu\text{s}$	-	319	-	ns
$Q_{rr}$	Reverse Recovery Charge		-	4.4	-	$\mu\text{C}$

#### Notes:

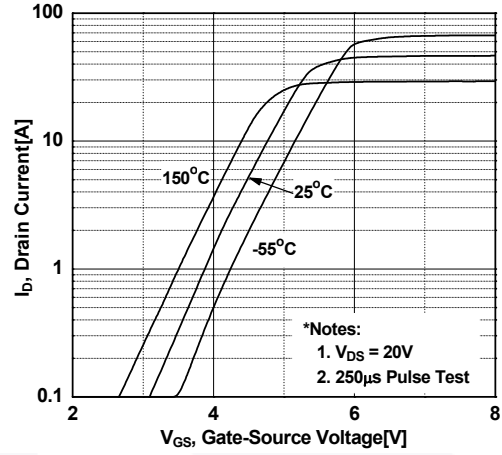
1. Repetitive rating; pulse-width limited by maximum junction temperature.
2.  $I_{AS} = 5.3\text{ A}, R_G = 25\ \Omega$ , starting  $T_J = 25^\circ\text{C}$ .
3.  $I_{SD} \leq 16\text{ A}, di/dt \leq 200\text{ A}/\mu\text{s}, V_{DD} = 380\text{ V}$ , starting  $T_J = 25^\circ\text{C}$ .
4. Essentially independent of operating temperature typical characteristics.

## Typical Performance Characteristics

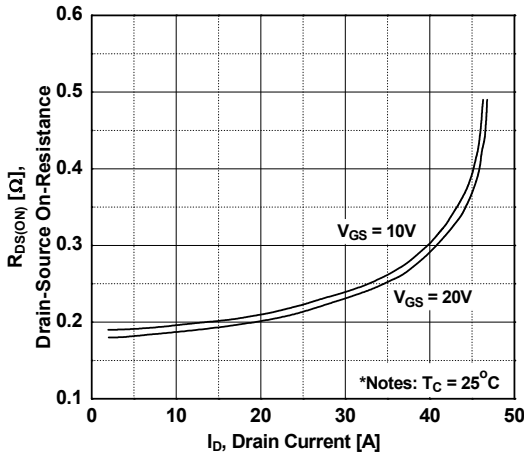
**Figure 1. On-Region Characteristics**



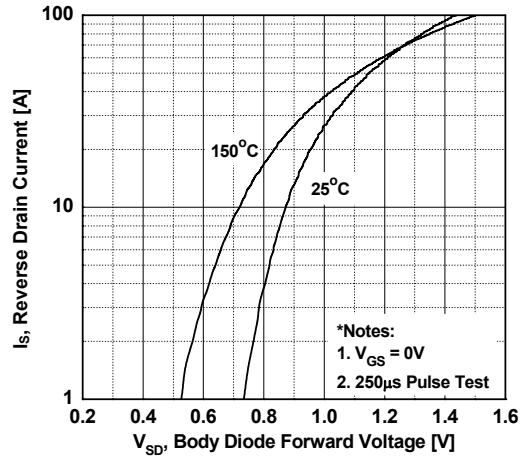
**Figure 2. Transfer Characteristics**



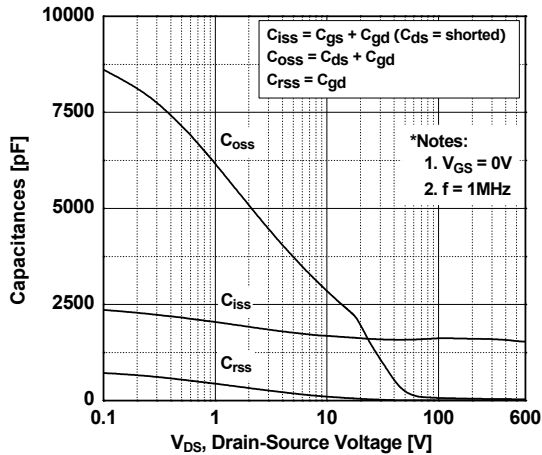
**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**



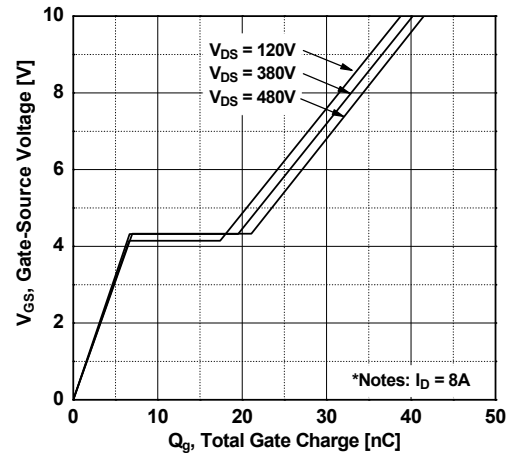
**Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature**



**Figure 5. Capacitance Characteristics**



**Figure 6. Gate Charge Characteristics**



Typical Performance Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

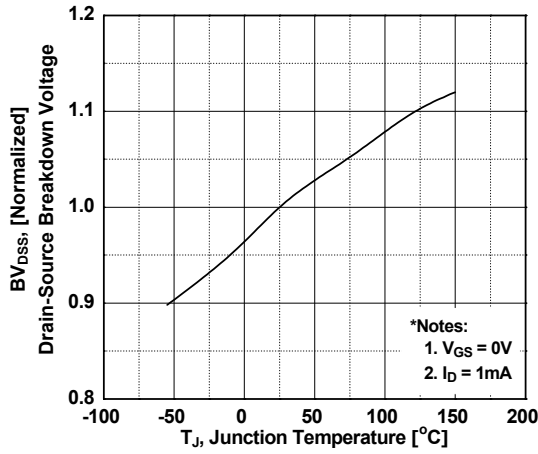


Figure 8. On-Resistance Variation vs. Temperature

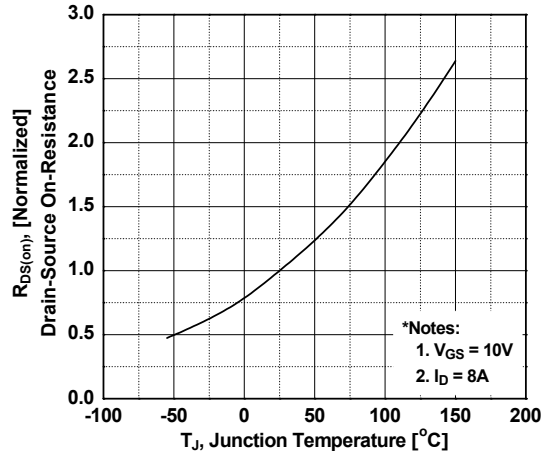


Figure 9. Maximum Safe Operating Area

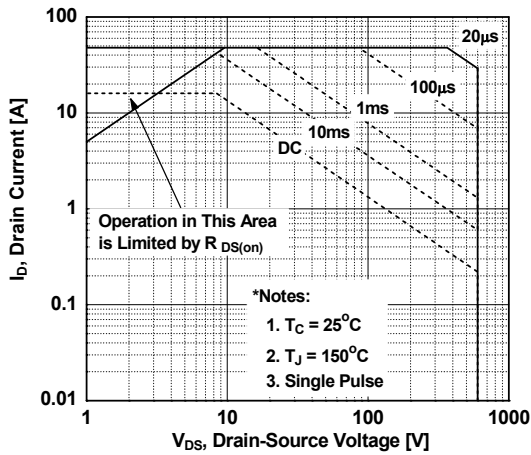


Figure 10. Maximum Drain Current vs. Case Temperature

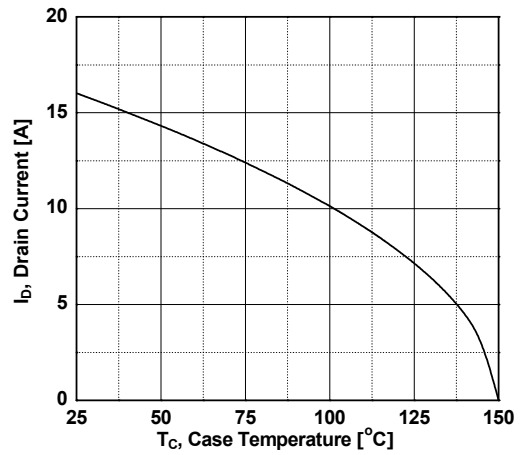
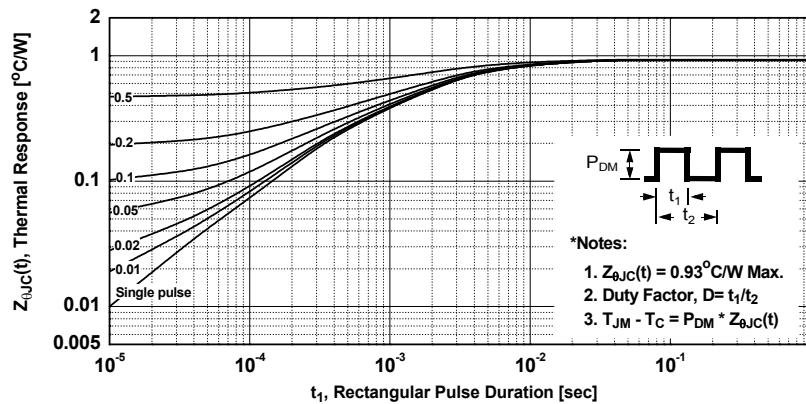


Figure 11. Transient Thermal Response Curve



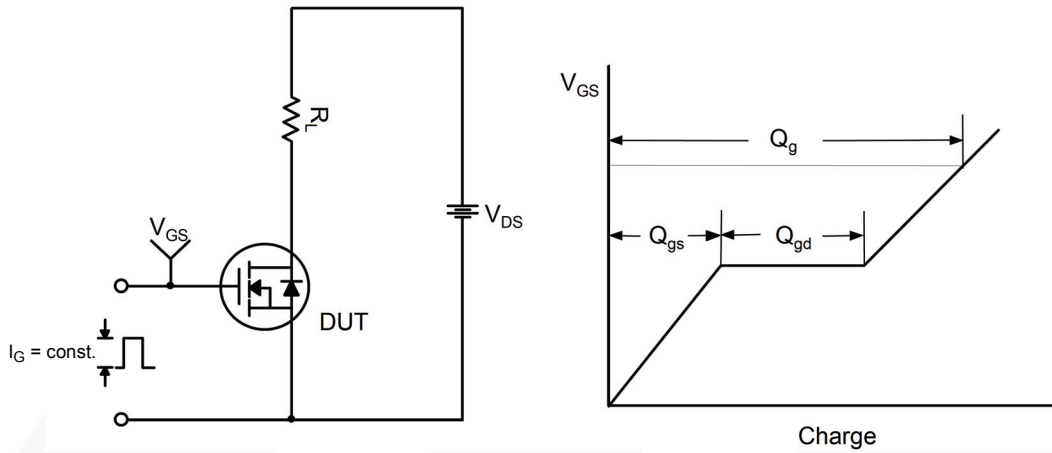


Figure 12. Gate Charge Test Circuit & Waveform



Figure 13. Resistive Switching Test Circuit & Waveforms

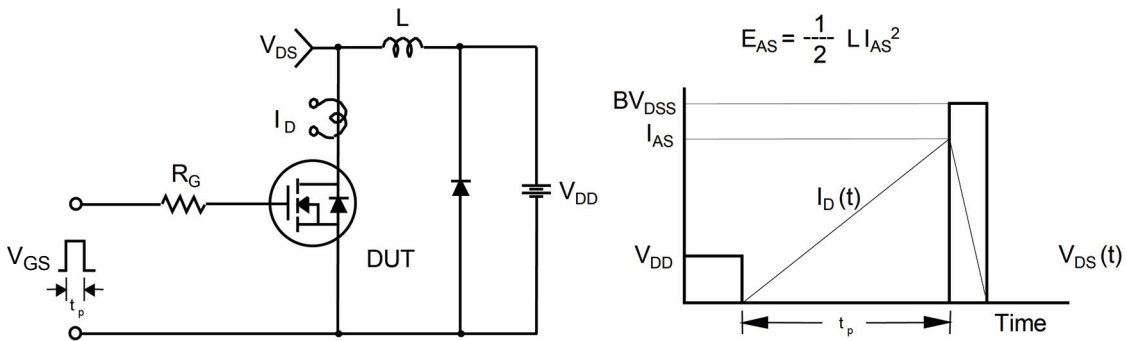
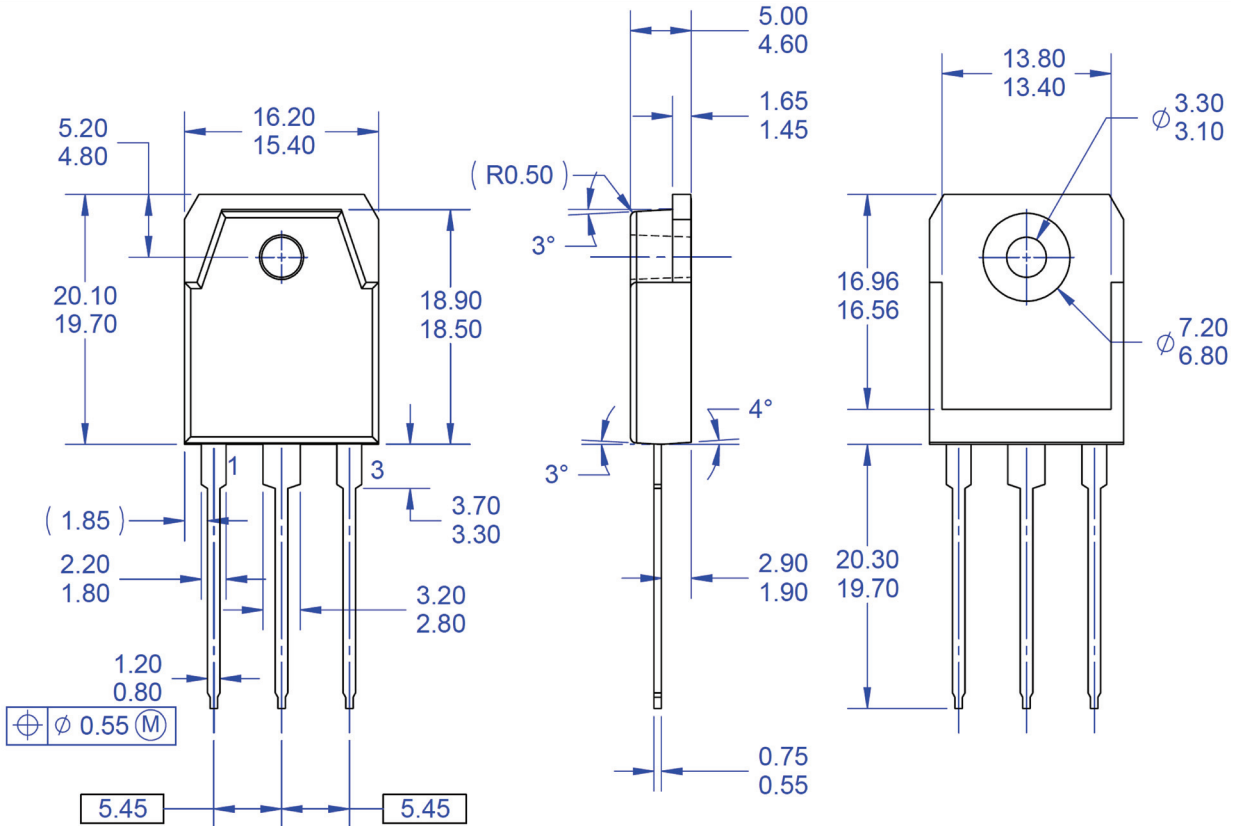


Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms



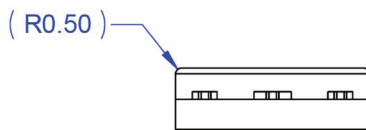
Figure 15. Peak Diode Recovery  $dv/dt$  Test Circuit & Waveforms

## Mechanical Dimensions



NOTES: UNLESS OTHERWISE SPECIFIED

- A) THIS PACKAGE CONFORMS TO EIAJ SC-65 PACKAGING STANDARD.
- B) ALL DIMENSIONS ARE IN MILLIMETERS.
- C) DIMENSION AND TOLERANCING PER ASME14.5-2009.
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**Figure 16. TO3PN, 3-Lead, Plastic, EIAJ SC-65**

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