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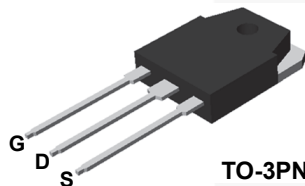# FQA170N06

N-Channel QFET® MOSFET

60 V, 170 A, 5.6 mΩ

Description

This N-Channel enhancement mode power MOSFET is produced using Fairchild Semiconductor's proprietary planar stripe and DMOS technology. This advanced MOSFET technology has been especially tailored to reduce on-state resistance, and to provide superior switching performance and high avalanche energy strength. These devices are suitable for switched mode power supplies, audio amplifier, DC motor control, and variable switching power applications.

Features

- 170 A, 60 V, $R_{DS(on)}$ = 5.6 mΩ (Max.) @ V_{GS} = 10 V, I_D = 85 A
- Low Gate Charge (Typ. 220 nC)
- Low Crss (Typ. 620 pF)
- 100% Avalanche Tested
- 175°C Maximum Junction Temperature Rating

TO-3PN
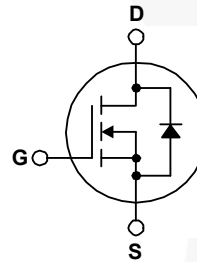
Absolute Maximum Ratings
T_C = 25°C unless otherwise noted.

Symbol	Parameter			FQA170N06	Unit
V_{DSS}	Drain-Source Voltage			60	V
I_D	Drain Current	- Continuous (T_C = 25°C)		170	A
		- Continuous (T_C = 100°C)		120	A
I_{DM}	Drain Current	- Pulsed	(Note 1)	680	A
V_{GSS}	Gate-Source Voltage			± 25	V
E_{AS}	Single Pulsed Avalanche Energy		(Note 2)	990	mJ
I_{AR}	Avalanche Current		(Note 1)	170	A
E_{AR}	Repetitive Avalanche Energy		(Note 1)	37.5	mJ
dv/dt	Peak Diode Recovery dv/dt		(Note 3)	7.0	V/ns
P_D	Power Dissipation (T_C = 25°C)			375	W
	- Derate above 25°C			2.5	W/°C
T_J, T_{STG}	Operating and Storage Temperature Range			-55 to +175	°C
T_L	Maximum lead temperature for soldering, 1/8" from case for 5 seconds.			300	°C

Thermal Characteristics

Symbol	Parameter	FQA170N06	Unit
$R_{θJC}$	Thermal Resistance, Junction-to-Case, Max.	0.4	°C/W
$R_{θJA}$	Thermal Resistance, Junction-to-Ambient, Max.	40	°C/W

Package Marking and Ordering Information

Part Number	Top Mark	Package	Packing Method	Reel Size	Tape Width	Quantity
FQA170N06	FQA170N06	TO-3PN	Tube	N/A	N/A	30 units

Electrical Characteristics T_C = 25°C unless otherwise noted.

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
Off Characteristics						
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS} = 0 V, I_D = 250 µA	60	--	--	V
ΔBV_{DSS} / ΔT_J	Breakdown Voltage Temperature Coefficient	I_D = 250 µA, Referenced to 25°C	--	0.053	--	V/°C
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = 60 V, V_{GS} = 0 V	--	--	1	µA
		V_{DS} = 48 V, T_C = 150°C	--	--	10	µA
I_{GSSF}	Gate-Body Leakage Current, Forward	V_{GS} = 25 V, V_{DS} = 0 V	--	--	100	nA
I_{GSSR}	Gate-Body Leakage Current, Reverse	V_{GS} = -25 V, V_{DS} = 0 V	--	--	-100	nA
On Characteristics						
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS} = V_{GS}, I_D = 250 µA	2.0	--	4.0	V
$R_{DS(on)}$	Static Drain-Source On-Resistance	V_{GS} = 10 V, I_D = 85 A	--	0.0045	0.0056	Ω
g_{FS}	Forward Transconductance	V_{DS} = 30 V, I_D = 85 A	--	85	--	S
Dynamic Characteristics						
C_{iss}	Input Capacitance	V_{DS} = 25 V, V_{GS} = 0 V, f = 1.0 MHz	--	7200	9350	pF
C_{oss}	Output Capacitance		--	3100	4000	pF
C_{rss}	Reverse Transfer Capacitance		--	620	810	pF
Switching Characteristics						
$t_{d(on)}$	Turn-On Delay Time	V_{DD} = 30 V, I_D = 85 A, R_G = 25 Ω	--	85	180	ns
t_r	Turn-On Rise Time		--	700	1400	ns
$t_{d(off)}$	Turn-Off Delay Time		--	260	530	ns
t_f	Turn-Off Fall Time	(Note 4)	--	430	870	ns
Q_g	Total Gate Charge	V_{DS} = 48 V, I_D = 170 A, V_{GS} = 10 V	--	220	290	nC
Q_{gs}	Gate-Source Charge		--	50	--	nC
Q_{gd}	Gate-Drain Charge	(Note 4)	--	100	--	nC
Drain-Source Diode Characteristics and Maximum Ratings						
I_S	Maximum Continuous Drain-Source Diode Forward Current	(Note 5)	--	--	170	A
I_{SM}	Maximum Pulsed Drain-Source Diode Forward Current		--	--	680	A
V_{SD}	Drain-Source Diode Forward Voltage	V_{GS} = 0 V, I_S = 170 A	--	--	1.5	V
t_{rr}	Reverse Recovery Time	V_{GS} = 0 V, I_S = 170 A, dI_F / dt = 100 A/µs	--	100	--	ns
Q_{rr}	Reverse Recovery Charge		--	315	--	nC

Notes:
1. Repetitive rating : pulse-width limited by maximum junction temperature.
2. L = 40 µH, I_{AS} = 170 A, V_{DD} = 25 V, R_G = 25 Ω, starting T_J = 25°C.
3. $I_{SD} \leq$ 170 A, di/dt $\leq$ 300 A/µs, $V_{DD} \leq BV_{DSS}$, starting T_J = 25°C.
4. Essentially independent of operating temperature.
5. Continuous drain current calculated by maximum Jjnction temperature : limited by package.
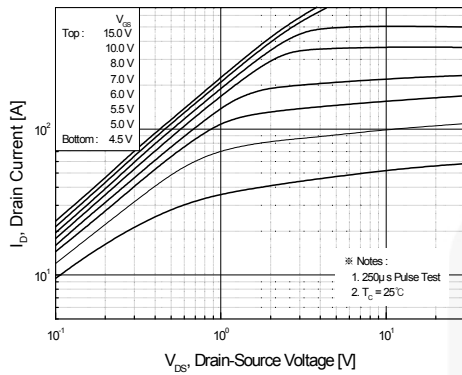
Typical Characteristics
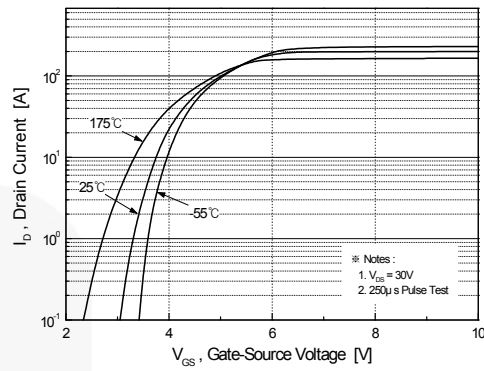

Figure 1. On-Region Characteristics.

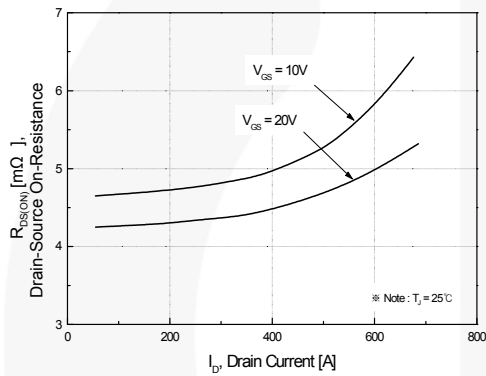**Figure 2. Transfer Characteristics.**

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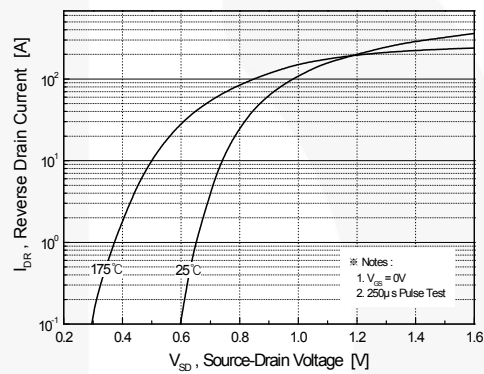

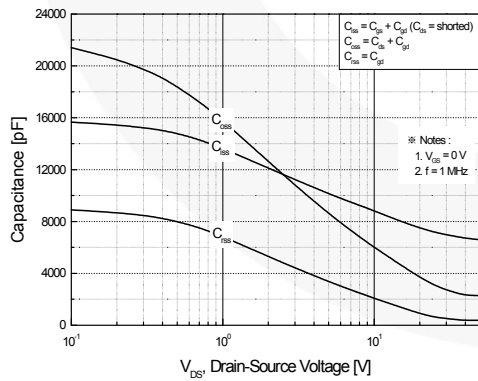**Figure 4. Body Diode Forward Voltage Variation with Source Current and Temperature.**

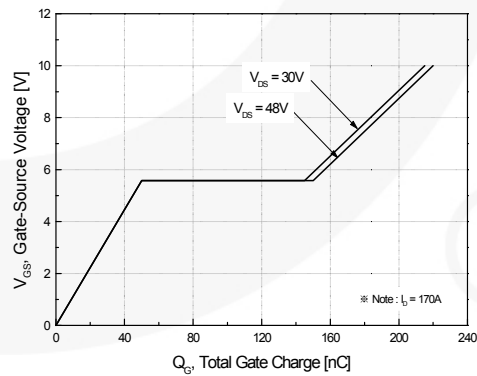**Figure 5. Capacitance Characteristics.**

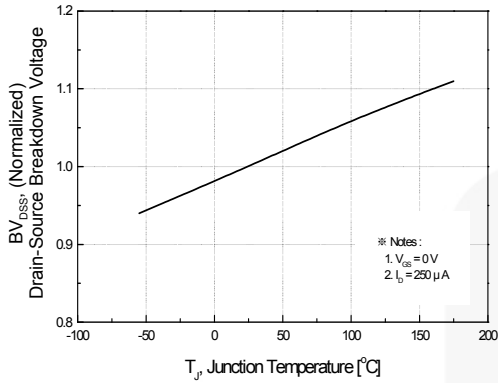**Figure 6. Gate-Charge Characteristics.**

Typical Characteristics   (Continued)
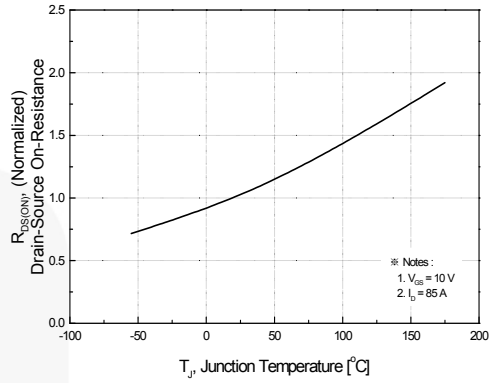

Figure 7. Breakdown Voltage Variation
vs Temperature.

Figure 8. On-Resistance Variation
vs Temperature.
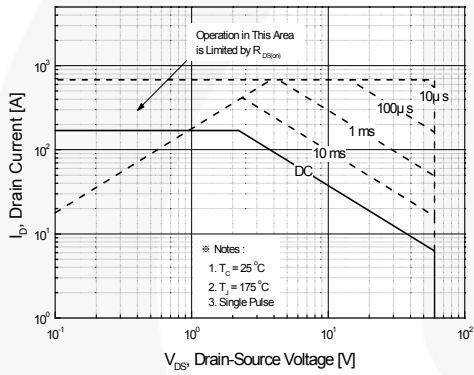
Figure 9. Maximum Safe Operating Area.
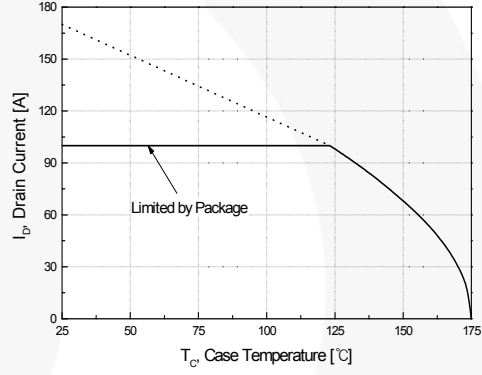
Figure 10. Maximum Drain Current
vs Case Temperature.
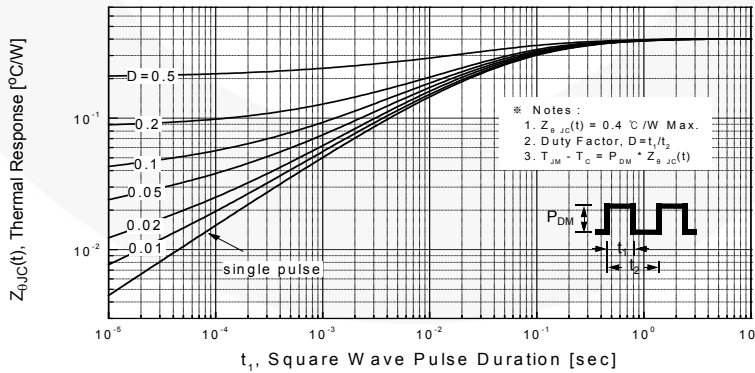
Figure 11. Transient Thermal Response Curve.

Figure 12. Gate Charge Test Circuit & Waveform

Figure 13. Resistive Switching Test Circuit & Waveforms

$$E_{AS} = \frac{1}{2} L I_{AS}^2 \frac{BV_{DSS}}{BV_{DSS} - V_{DD}}$$
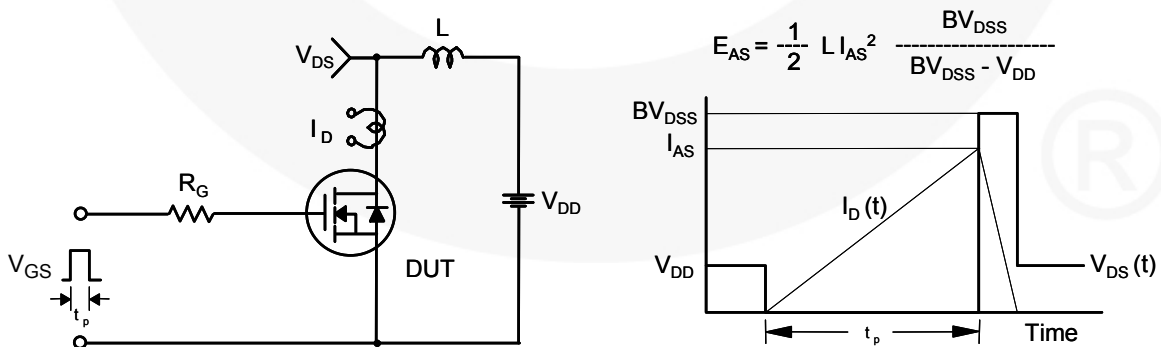
Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms

DUT

V_{DS}

I_{SD}

L

Driver

R_G

Same Type as DUT

V_{GS}

V_{DD}

• dv/dt controlled by R_G
• I_{SD} controlled by pulse period

V_{GS}
(Driver)

$$D = \frac{\text{Gate Pulse Width}}{\text{Gate Pulse Period}}$$

10V

I_{SD}
(DUT)

I_{FM} , Body Diode Forward Current

di/dt

I_{RM}

Body Diode Reverse Current

V_{DS}
(DUT)

Body Diode Recovery dv/dt

V_{SD}

V_{DD}

Body Diode
Forward Voltage Drop
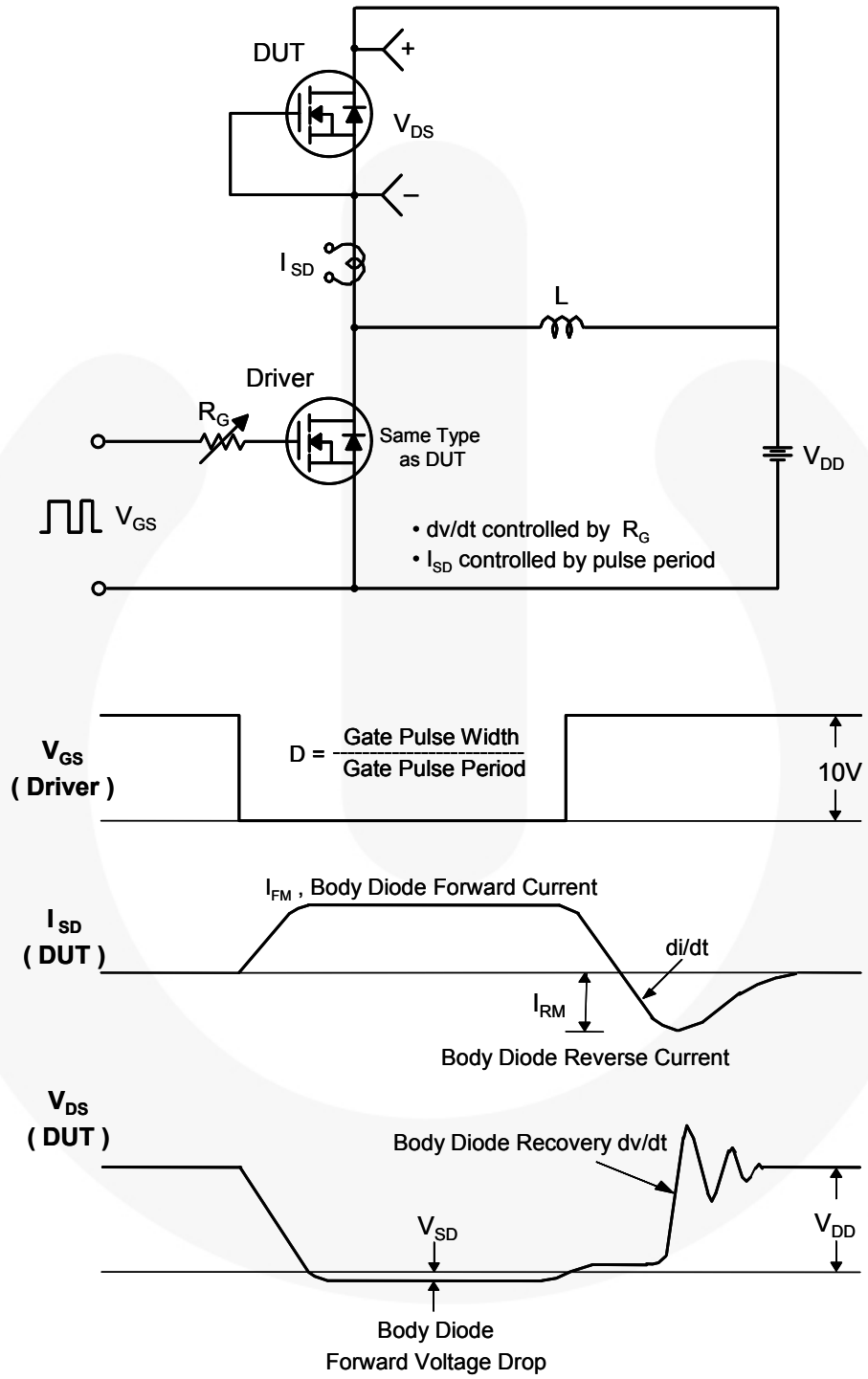
Figure 15. Peak Diode Recovery dv/dt Test Circuit & Waveforms

Mechanical Dimensions

16.20
15.40

5.20
4.80

20.10
19.70

18.90
18.50

(1.85)

2.20
1.80

3.20
2.80

3.70
3.30

1.20
0.80

⊕ ⌀ 0.55 Ⓜ

5.45   5.45

(R0.50)

5.00
4.60

1.65
1.45

(R0.50)

3°

4°

3°

2.90
1.90

0.75
0.55

13.80
13.40

⌀ 3.30
  3.10

⌀ 7.20
  6.80

16.96
16.56

20.30
19.70
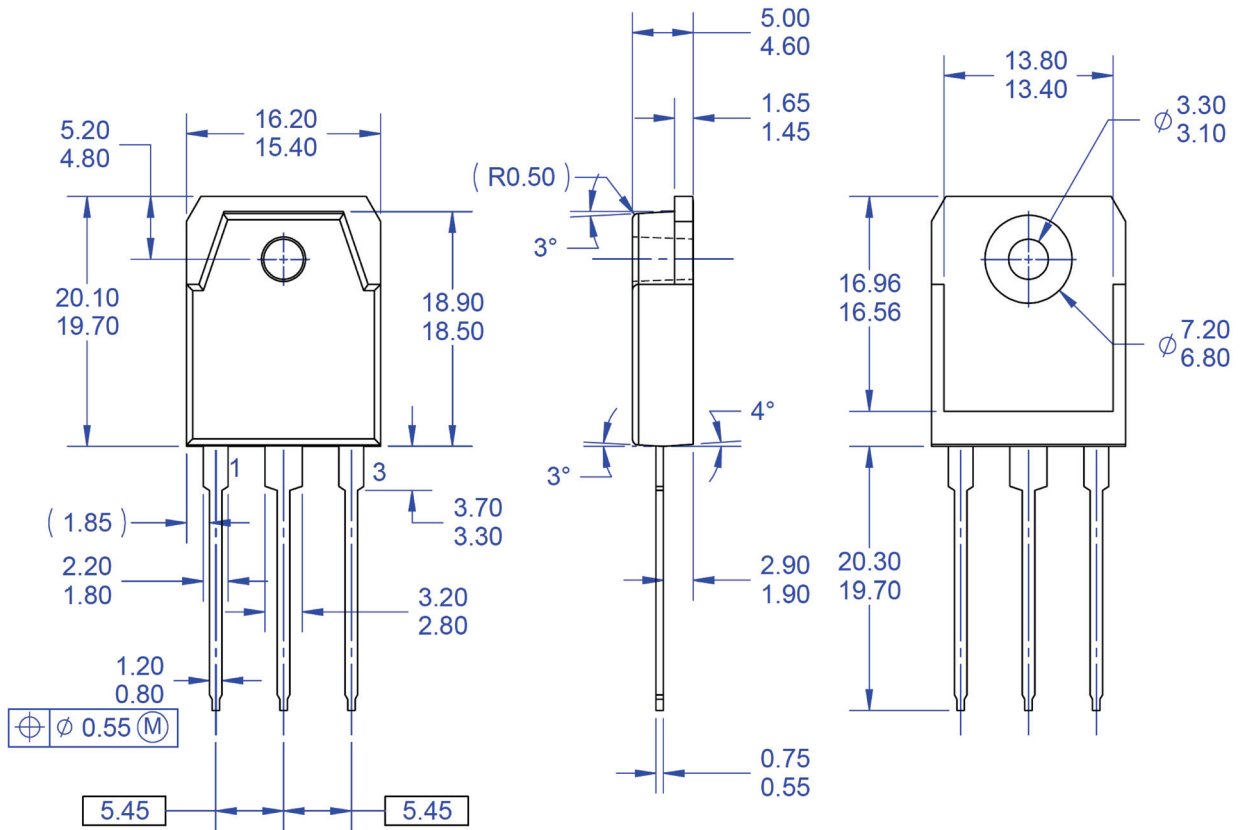
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B) ALL DIMENSIONS ARE IN MILLIMETERS.
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E) DRAWING FILE NAME: TO3PN03AREV1.
F) FAIRCHILD SEMICONDUCTOR.
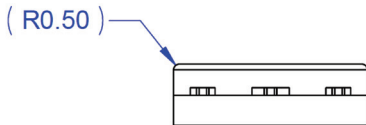
Figure 16. TO3PN, 3-Lead, Plastic, EIAJ SC-65

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