FAIRCHILD™

March 2015

FCB290N80

## N-Channel SuperFET® II MOSFET

800 V, 17 A, 0.29 Ω

Features

- $R_{DS(on)}$ = 0.259 Ω (Typ.)
- Ultra Low Gate Charge (Typ. Q_g = 58 nC)
- Low E_{oss} (Typ. 5.4 uJ @ 400V)
- Low Effective Output Capacitance (Typ. $C_{oss(eff.)}$ = 240 pF)
- 100% Avalanche Tested
- RoHS Compliant

Applications

- AC - DC Power Supply
- LED Lighting

Description

SuperFET® II MOSFET is Fairchild Semiconductor's brand-new high voltage super-junction (SJ) MOSFET family that is utilizing charge balance technology for outstanding low on-resistance and lower gate charge performance. This technology is tailored to minimize conduction loss, provide superior switching performance, dv/dt rate and higher avalanche energy. Consequently, SuperFET II MOSFET is very suitable for the switching power applications such as PFC, server/telecom power, FPD TV power, ATX power and industrial power applications.

G S D²-PAK
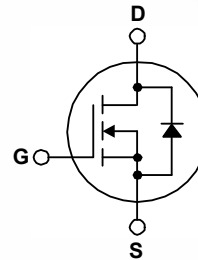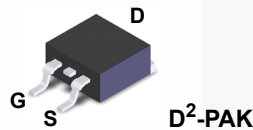
Absolute Maximum Ratings T_C = 25°C unless otherwise noted.

Symbol	Parameter			FCB290N80	Unit
V_{DSS}	Drain to Source Voltage			800	V
V_{GSS}	Gate to Source Voltage	- DC		±20	V
		- AC	(f > 1 Hz)	±30	
I_D	Drain Current	- Continuous (T_C = 25°C)		17	A
		- Continuous (T_C = 100°C)		10.8	
I_{DM}	Drain Current	- Pulsed	(Note 1)	42	A
E_{AS}	Single Pulsed Avalanche Energy		(Note 2)	882	mJ
I_{AR}	Avalanche Current		(Note 1)	3.4	A
E_{AR}	Repetitive Avalanche Energy		(Note 1)	2.12	mJ
dv/dt	MOSFET dv/dt			100	V/ns
	Peak Diode Recovery dv/dt		(Note 3)	20	
P_D	Power Dissipation	(T_C = 25°C)		212	W
		- Derate Above 25°C		1.7	W/°C
T_J, T_{STG}	Operating and Storage Temperature Range			-55 to +150	°C
T_L	Maximum Lead Temperature for Soldering, 1/8" from Case for 5 Seconds			300	°C

Thermal Characteristics

Symbol	Parameter	FCB290N80	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max.	0.59	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient (Minimum Pad of 2-oz Copper), Max.	62.5	
	Thermal Resistance, Junction to Ambient (1 in² Pad of 2-oz Copper), Max.	40	

Package Marking and Ordering Information

Part Number	Top Mark	Package	Packing Method	Reel Size	Tape Width	Quantity
FCB290N80	FCB290N80	D²-PAK	Tape and Reel	330 mm	24 mm	800 units

Electrical Characteristics T_C = 25°C unless otherwise noted.

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
Off Characteristics						
BV_{DSS}	Drain to Source Breakdown Voltage	V_{GS} = 0 V, I_D = 1 mA, T_J = 25°C	800	-	-	V
$\Delta BV_{DSS} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	I_D = 1 mA, Referenced to 25°C	-	0.85	-	V/°C
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = 800 V, V_{GS} = 0 V	-	-	25	μA
		V_{DS} = 640 V, V_{GS} = 0 V, T_C = 125°C	-	-	250	
I_{GSS}	Gate to Body Leakage Current	V_{GS} = ±20 V, V_{DS} = 0 V	-	-	±10	μA
On Characteristics						
$V_{GS(th)}$	Gate Threshold Voltage	V_{GS} = V_{DS}, I_D = 1.7 mA	2.5	-	4.5	V
$R_{DS(on)}$	Static Drain to Source On Resistance	V_{GS} = 10 V, I_D = 8.5 A	-	0.259	0.290	Ω
g_{FS}	Forward Transconductance	V_{DS} = 20 V, I_D = 8.5 A	-	20	-	S
Dynamic Characteristics						
C_{iss}	Input Capacitance	V_{DS} = 100 V, V_{GS} = 0 V, f = 1 MHz	-	2410	3205	pF
C_{oss}	Output Capacitance		-	75	100	pF
C_{rss}	Reverse Transfer Capacitance		-	0.36	-	pF
C_{oss}	Output Capacitance	V_{DS} = 480 V, V_{GS} = 0 V, f = 1 MHz	-	35	-	pF
$C_{oss(eff.)}$	Effective Output Capacitance	V_{DS} = 0 V to 480 V, V_{GS} = 0 V	-	240	-	pF
$Q_{g(tot)}$	Total Gate Charge at 10V	V_{DS} = 640 V, I_D = 17 A, V_{GS} = 10 V	-	58	75	nC
Q_{gs}	Gate to Source Gate Charge		-	11	-	nC
Q_{gd}	Gate to Drain "Miller" Charge	(Note 4)	-	22	-	nC
ESR	Equivalent Series Resistance	f = 1 MHz	-	0.75	-	Ω
Switching Characteristics						
$t_{d(on)}$	Turn-On Delay Time	V_{DD} = 400 V, I_D = 17 A, V_{GS} = 10 V, R_g = 4.7 Ω	-	22	54	ns
t_r	Turn-On Rise Time		-	14	38	ns
$t_{d(off)}$	Turn-Off Delay Time		-	61	132	ns
t_f	Turn-Off Fall Time	(Note 4)	-	2.6	15	ns
Drain-Source Diode Characteristics						
I_S	Maximum Continuous Drain to Source Diode Forward Current		-	-	17	A
I_{SM}	Maximum Pulsed Drain to Source Diode Forward Current		-	-	42	A
V_{SD}	Drain to Source Diode Forward Voltage	V_{GS} = 0 V, I_{SD} = 17 A	-	-	1.2	V
t_{rr}	Reverse Recovery Time	V_{GS} = 0 V, I_{SD} = 17 A, dI_F/dt = 100 A/μs	-	511	-	ns
Q_{rr}	Reverse Recovery Charge		-	12	-	μC

Notes:

1. Repetitive rating: pulse width limited by maximum junction temperature.
2. I_{AS} = 3.4 A, R_G = 25 Ω, starting T_J = 25°C
3. I_{SD} ≤ 17 A, di/dt ≤ 200 A/μs, V_{DD} ≤ BV_{DSS}, starting T_J = 25°C
4. Essentially independent of operating temperature typical characteristic.

Typical Performance Characteristics
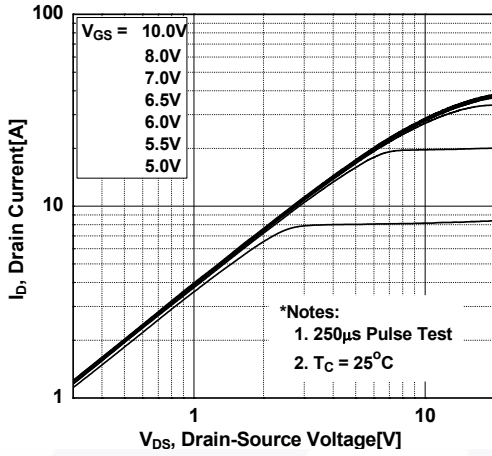
Figure 1. On-Region Characteristics

V_{GS} = 10.0V
8.0V
7.0V
6.5V
6.0V
5.5V
5.0V

I_D, Drain Current[A]

V_{DS}, Drain-Source Voltage[V]

*Notes:
1. 250µs Pulse Test
2. T_C = 25°C

Figure 2. Transfer Characteristics

I_D, Drain Current[A]

150°C
-55°C
25°C

V_{GS}, Gate-Source Voltage[V]

*Notes:
1. V_{DS} = 20V
2. 250µs Pulse Test
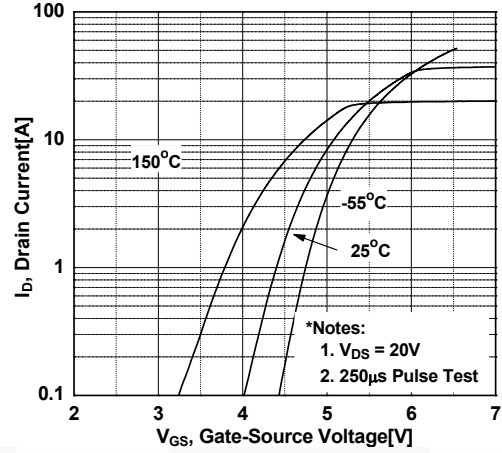
Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

$R_{DS(ON)}$ [Ω],
Drain-Source On-Resistance

V_{GS} = 10V

V_{GS} = 20V

I_D, Drain Current [A]

*Note: T_C = 25°C
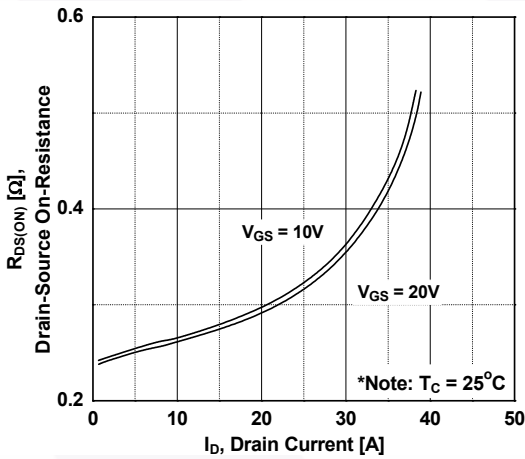
Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

*Notes:
1. V_{GS} = 0V
2. 250µs Pulse Test

I_S, Reverse Drain Current [A]

150°C
25°C

V_{SD}, Body Diode Forward Voltage [V]
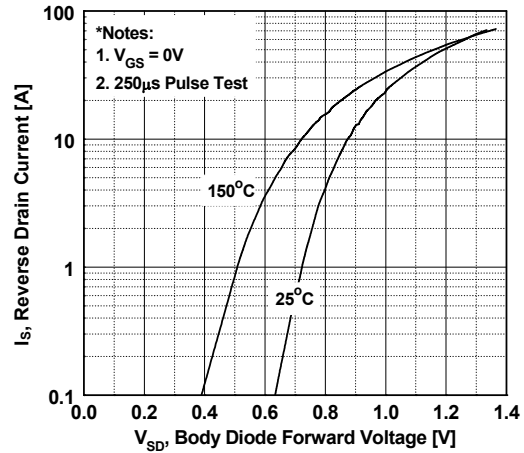
Figure 5. Capacitance Characteristics

Capacitances [pF]

C_{iss}
C_{oss}
C_{rss}

*Note:
1. V_{GS} = 0V
2. f = 1MHz

$C_{iss} = C_{gs} + C_{gd}$ (C_{ds} = shorted)
$C_{oss} = C_{ds} + C_{gd}$
$C_{rss} = C_{gd}$

V_{DS}, Drain-Source Voltage [V]
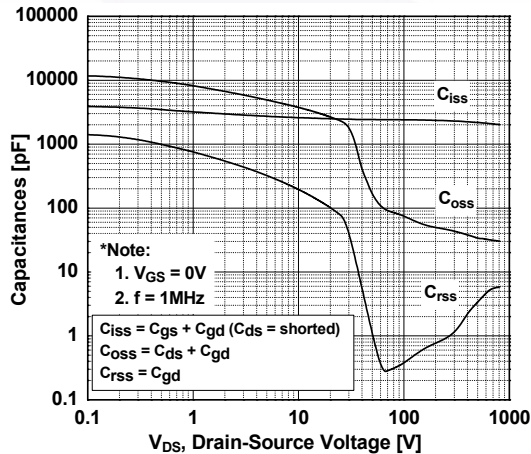
Figure 6. Gate Charge Characteristics

V_{GS}, Gate-Source Voltage [V]

V_{DS} = 160V
V_{DS} = 400V
V_{DS} = 640V

*Note: I_D = 17A

Q_g, Total Gate Charge [nC]
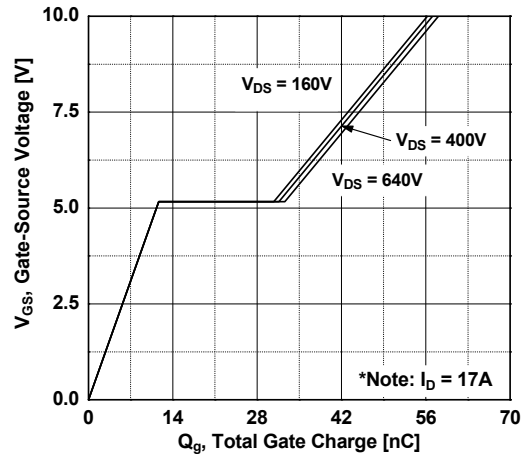
Typical Performance Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

*Notes:
1. V_{GS} = 0V
2. I_D = 1mA

X-axis: T_J, Junction Temperature [°C]
Y-axis: BV_{DSS}, [Normalized] Drain-Source Breakdown Voltage
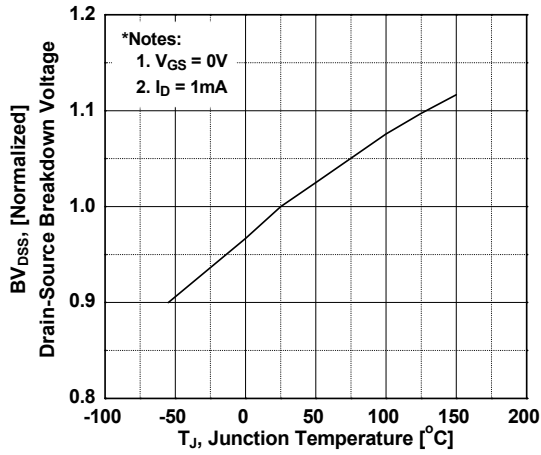
Figure 8. On-Resistance Variation vs. Temperature

*Notes:
1. V_{GS} = 10V
2. I_D = 8.5A

X-axis: T_J, Junction Temperature [°C]
Y-axis: $R_{DS(on)}$, [Normalized] Drain-Source On-Resistance
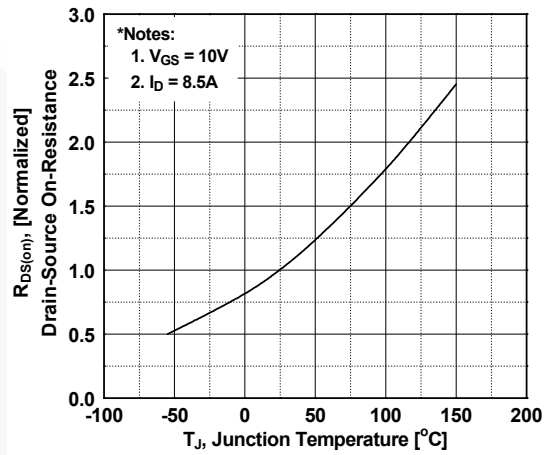
Figure 9. Maximum Safe Operating Area

10µs
100µs
1ms
DC

Operation in This Area is Limited by $R_{DS(on)}$

*Notes:
1. T_C = 25°C
2. T_J = 150°C
3. Single Pulse

X-axis: V_{DS}, Drain-Source Voltage [V]
Y-axis: I_D, Drain Current [A]
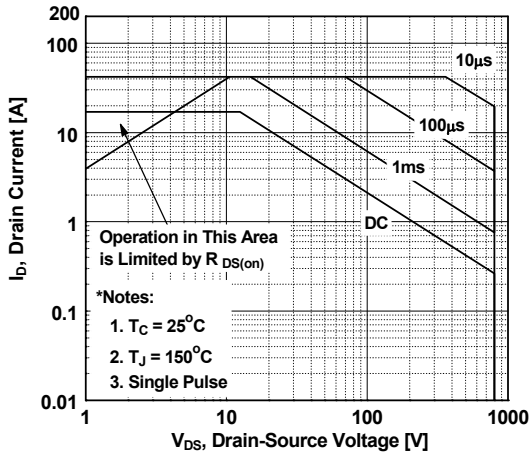
Figure 10. Maximum Drain Current vs. Case Temperature

X-axis: T_C, Case Temperature [°C]
Y-axis: I_D, Drain Current [A]
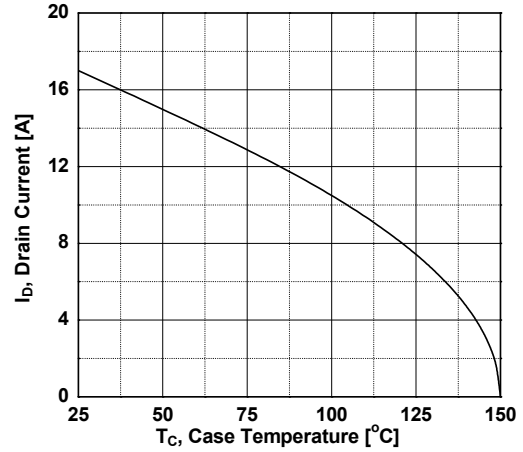
Figure 11. Eoss vs. Drain to Source Voltage

X-axis: V_{DS}, Drain to Source Voltage [V]
Y-axis: E_{OSS}, [µJ]
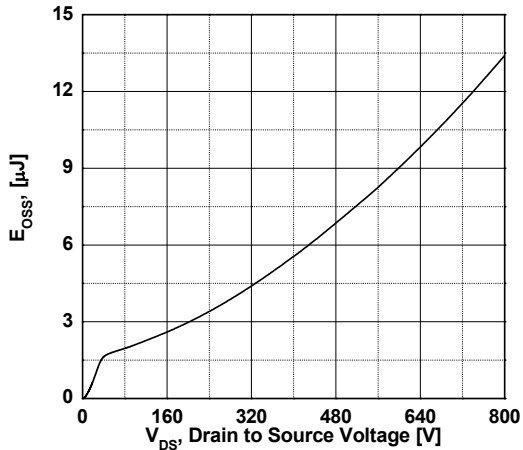
Typical Performance Characteristics (Continued)

Figure 12. Transient Thermal Response Curve

*Notes:
1. $Z_{\theta JC}(t) = 0.59\,^{\circ}C/W$ Max.
2. Duty Factor, $D = t_1/t_2$
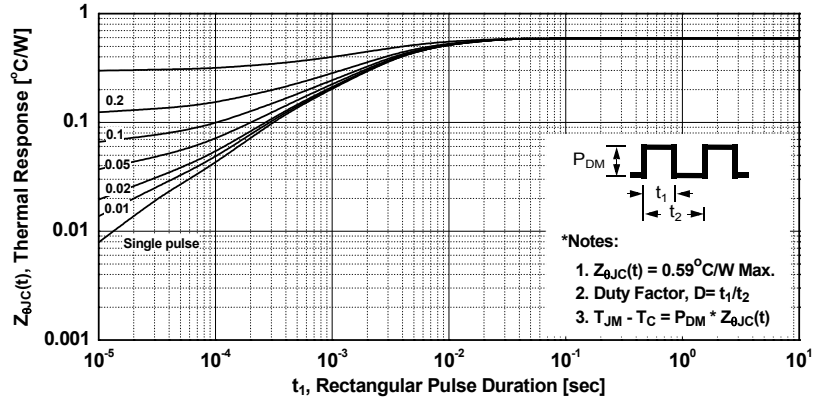3. $T_{JM} - T_C = P_{DM} * Z_{\theta JC}(t)$

Figure 13. Gate Charge Test Circuit & Waveform

Figure 14. Resistive Switching Test Circuit & Waveforms
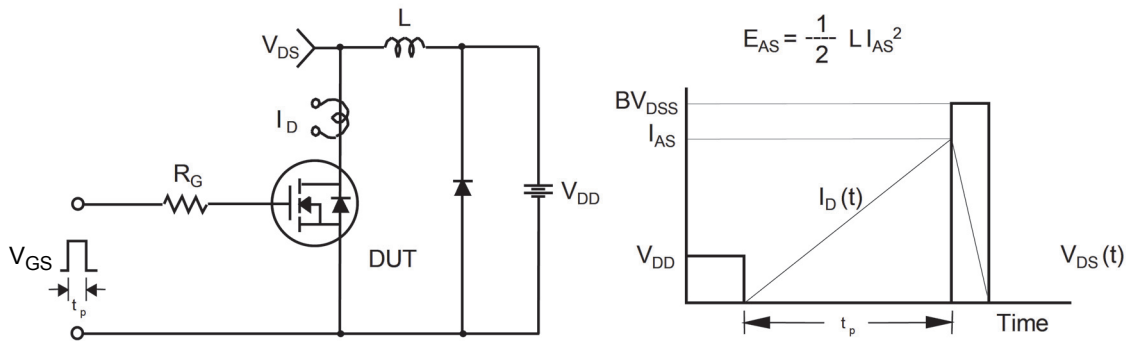

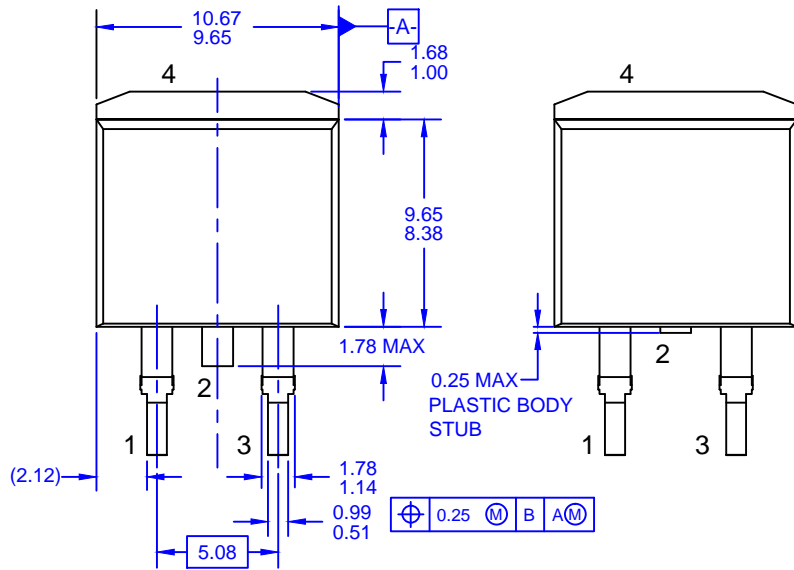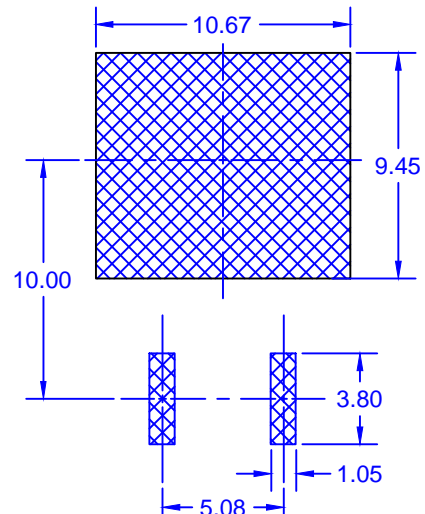
$$E_{AS} = \frac{1}{2} L I_{AS}^2$$

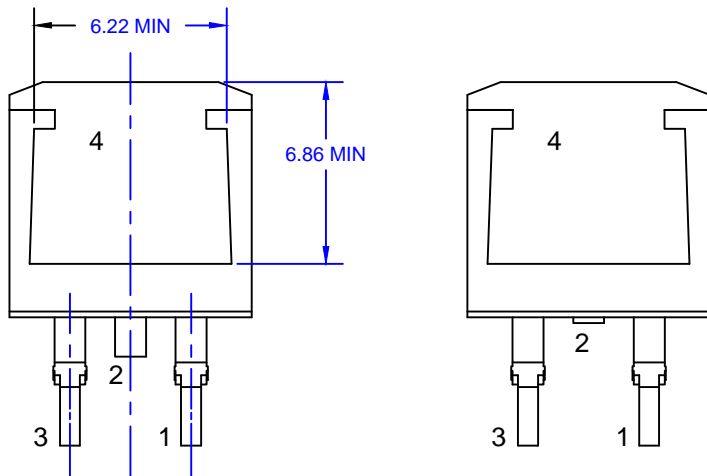**Figure 15. Unclamped Inductive Switching Test Circuit & Waveforms**

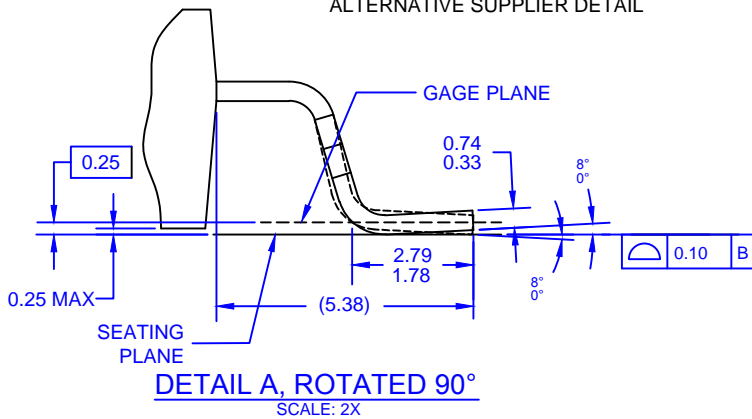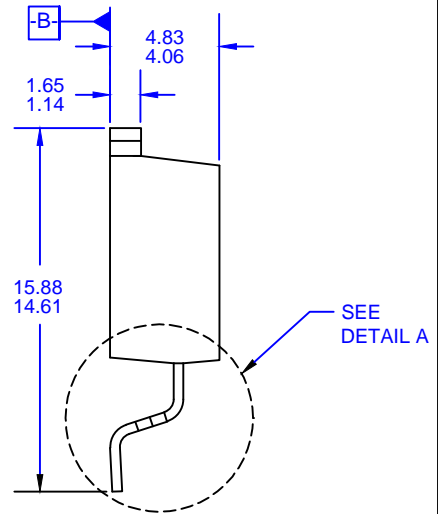**Figure 16. Peak Diode Recovery dv/dt Test Circuit & Waveforms**

10.67
9.65

-A-

1.68
1.00

4

9.65
8.38

1.78 MAX

0.25 MAX
PLASTIC BODY
STUB

2

4

2

1

3

1

3

(2.12)

1.78
1.14

0.99
0.51

5.08

⊕ | 0.25 Ⓜ | B | AⓂ

FRONT VIEW - DIODE PRODUCTS VERSION
ALTERNATIVE SUPPLIER DETAIL

10.67

9.45

10.00

3.80

1.05

5.08

LAND PATTERN RECOMMENDATION
UNLESS NOTED, ALL DIMS TYPICAL

6.22 MIN

4

6.86 MIN

-B-

4.83
4.06

1.65
1.14

15.88
14.61

SEE
DETAIL A

4

2

3

1

3

1

2

BACK VIEW - DIODE PRODUCTS VERSION
ALTERNATIVE SUPPLIER DETAIL

NOTES: UNLESS OTHERWISE SPECIFIED
  A) ALL DIMENSIONS ARE IN MILLIMETERS.
  B) REFERENCE JEDEC, TO-263, VARIATION AB.
  C) DIMENSIONING AND TOLERANCING PER
     DIMENSIONING AND TOLERANCING PER
     ASME Y14.5 - 2009.
  D) LOCATION OF THE PIN HOLE MAY VARY
     (LOWER LEFT CORNER, LOWER CENTER
     AND CENTER OF THE PACKAGE).
  E) LANDPATTERN RECOMMENDATION PER IPC
     TO254P1524X482-3N
  F) FILENAME: TO263A02REV8

GAGE PLANE

0.25

0.74
0.33

8°
0°

0.25 MAX

2.79
1.78

8°
0°

⌒ | 0.10 | B

SEATING
PLANE

(5.38)

DETAIL A, ROTATED 90°
SCALE: 2X

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