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Please note: As part of the Fairchild Semiconductor integration, some of the Fairchild orderable part numbers will need to change in order to meet ON Semiconductor's system requirements. Since the ON Semiconductor product management systems do not have the ability to manage part nomenclature that utilizes an underscore (_), the underscore (_) in the Fairchild part numbers will be changed to a dash (-). This document may contain device numbers with an underscore (_). Please check the ON Semiconductor website to verify the updated device numbers. The most current and up-to-date ordering information can be found at www.onsemi.com. Please email any questions regarding the system integration to Fairchild_questions@onsemi.com.

April 2015
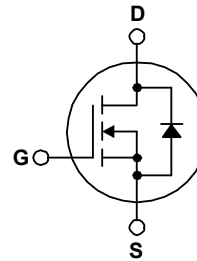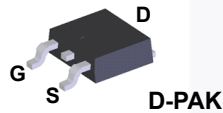
FDD770N15A

N-Channel PowerTrench® MOSFET

150 V, 18 A, 77 mΩ

Features

- $R_{DS(on)}$ = 61 mΩ (Typ.) @ V_{GS} = 10 V, I_D = 12 A
- Fast Switching Speed
- Low Gate Charge
- High Performance Trench Technology for Extremely Low $R_{DS(on)}$
- High Power and Current Handling Capability
- RoHS Compliant

Description

This N-Channel MOSFET is produced using Fairchild Semiconductor's advanced PowerTrench® process that has been tailored to minimize the on-state resistance while maintaining superior switching performance.

Applications

- DC to DC Converters
- Synchronous Rectification for Server / Telecom PSU
- Battery Charger
- AC motor drives and Uninterruptible Power Supplies
- Off-line UPS

D-PAK

Absolute Maximum Ratings T_C = 25°C unless otherwise noted.

Symbol	Parameter		FDD770N15A	Unit
V_{DSS}	Drain to Source Voltage		150	V
V_{GSS}	Gate to Source Voltage	- DC	±20	V
		- AC (f > 1 Hz)	±30	
I_D	Drain Current	- Continuous (T_C = 25°C, Silicon Limited)	18	A
		- Continuous (T_C = 100°C, Silicon Limited)	11.4	
I_{DM}	Drain Current	- Pulsed (Note 1)	36	A
E_{AS}	Single Pulsed Avalanche Energy	(Note 2)	31.7	mJ
dv/dt	Peak Diode Recovery dv/dt	(Note 3)	6.0	V/ns
P_D	Power Dissipation	(T_C = 25°C)	56.8	W
		- Derate Above 25°C	0.46	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	FDD770N15A	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max.	2.2	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient, Max.	87	

www.fairchildsemi.com

Package Marking and Ordering Information

Part Number	Top Mark	Package	Packing Method	Reel Size	Tape Width	Quantity
FDD770N15A	FDD770N15A	DPAK	Tape and Reel	330 mm	16 mm	2500 units

Electrical Characteristics T_C = 25°C unless otherwise noted.

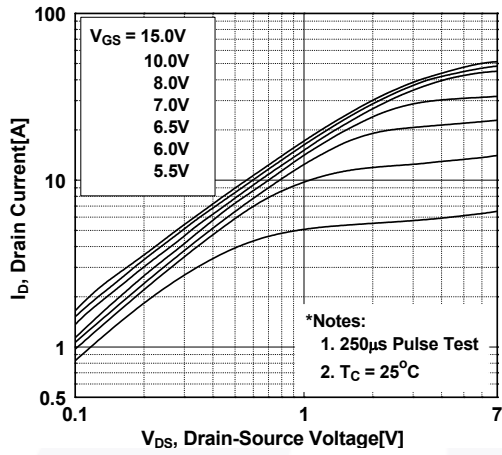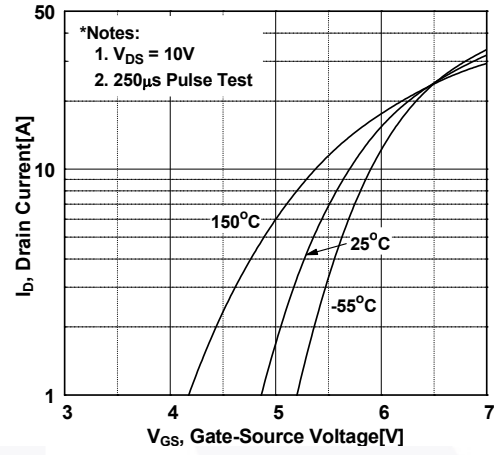| Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
Off Characteristics						
BV_{DSS}	Drain to Source Breakdown Voltage	I_D = 250 μA, V_{GS} = 0 V	150	-	-	V
$\Delta BV_{DSS} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	I_D = 250 μA, Referenced to 25°C	-	0.0824	-	V/°C
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = 120 V, V_{GS} = 0 V	-	-	1	μA
		V_{DS} = 120 V, V_{GS} = 0 V, T_C = 125°C	-	-	500	
I_{GSS}	Gate to Source Leakage Current	V_{GS} = ±20 V, V_{DS} = 0 V	-	-	±100	nA
On Characteristics						
$V_{GS(th)}$	Gate Threshold Voltage	V_{GS} = V_{DS}, I_D = 250 μA	2.0	-	4.0	V
$R_{DS(on)}$	Static Drain to Source On Resistance	V_{GS} = 10 V, I_D = 12 A	-	61	77	mΩ
g_{FS}	Forward Transconductance	V_{DS} = 10 V, I_D = 12 A	-	20	-	S
Dynamic Characteristics						
C_{iss}	Input Capacitance	V_{DS} = 75 V, V_{GS} = 0 V, f = 1 MHz	-	575	765	pF
C_{oss}	Output Capacitance		-	64	85	pF
C_{rss}	Reverse Transfer Capacitance		-	3.9	6	pF
$C_{oss(er)}$	Energy Related Output Capacitance	V_{DS} = 75 V, V_{GS} = 0 V	-	113	-	pF
$Q_{g(tot)}$	Total Gate Charge at 10V		-	8.4	11	nC
Q_{gs}	Gate to Source Gate Charge	V_{DS} = 75 V, I_D = 12 A, V_{GS} = 10 V	-	2.7	-	nC
Q_{gd}	Gate to Drain "Miller" Charge		-	1.8	-	nC
$V_{plateau}$	Gate Plateau Volatge	(Note 4)	-	5.7	-	V
Q_{sync}	Total Gate Charge Sync.	V_{DS} = 0 V, I_D = 6 A	-	6.9	-	nC
Q_{oss}	Output Charge	V_{DS} = 37.5 V, V_{GS} = 0 V	-	14	-	nC
ESR	Equivalent Series Resistance (G-S)	f = 1 MHz	-	0.5	-	Ω
Switching Characteristics						
$t_{d(on)}$	Turn-On Delay Time	V_{DD} = 75 V, I_D = 12 A, V_{GS} = 10 V, R_G = 4.7 Ω	-	10.3	30.6	ns
t_r	Turn-On Rise Time		-	3.1	16.2	ns
$t_{d(off)}$	Turn-Off Delay Time		-	15.8	41.6	ns
t_f	Turn-Off Fall Time	(Note 4)	-	2.8	15.6	ns
Drain-Source Diode Characteristics						
I_S	Maximum Continuous Drain to Source Diode Forward Current		-	-	18	A
I_{SM}	Maximum Pulsed Drain to Source Diode Forward Current		-	-	36	A
V_{SD}	Drain to Source Diode Forward Voltage	V_{GS} = 0 V, I_{SD} = 12 A	-	-	1.25	V
t_{rr}	Reverse Recovery Time	V_{GS} = 0 V, V_{DD} = 75 V, I_{SD} = 12 A, dI_F/dt = 100 A/μs	-	56.4	-	ns
Q_{rr}	Reverse Recovery Charge		-	109	-	nC

Notes:
1. Repetitive rating: pulse-width limited by maximum junction temperature.
2. L = 3 mH, I_{AS} = 4.6 A, starting T_J = 25°C.
3. $I_{SD} \leq$ 12 A, di/dt ≤ 200 A/μs, $V_{DD} \leq BV_{DSS}$, starting T_J = 25°C.
4. Essentially independent of operating temperature typical characteristics.

Typical Performance Characteristics

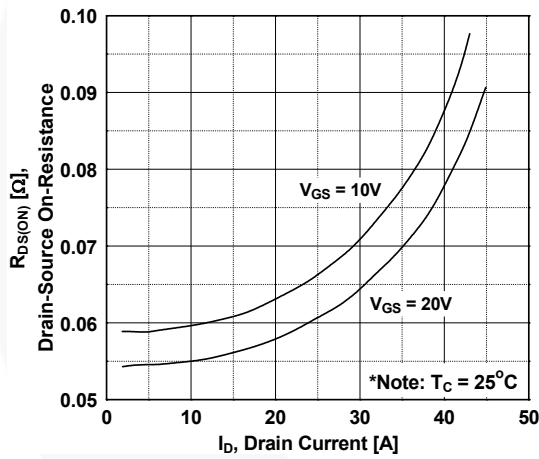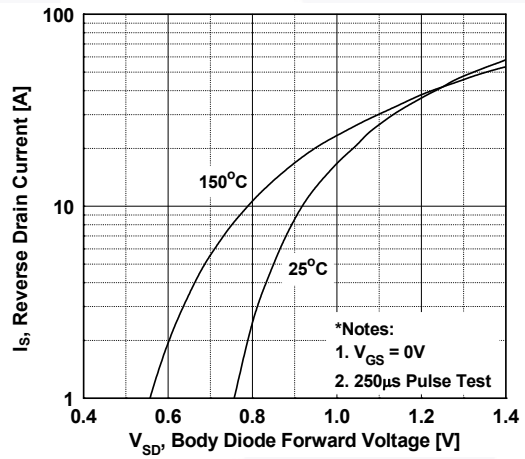### Figure 1. On-Region Characteristics

V_{GS} = 15.0V
10.0V
8.0V
7.0V
6.5V
6.0V
5.5V

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

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

Figure 2. Transfer Characteristics

*Notes:
1. V_{DS} = 10V
2. 250µs Pulse Test

150°C
25°C
-55°C

I_D, Drain Current[A]
V_{GS}, Gate-Source Voltage[V]

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

V_{GS} = 10V
V_{GS} = 20V

*Note: T_C = 25°C

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

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

150°C
25°C

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

I_S, Reverse Drain Current [A]
V_{SD}, Body Diode Forward Voltage [V]

Figure 5. Capacitance Characteristics

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}

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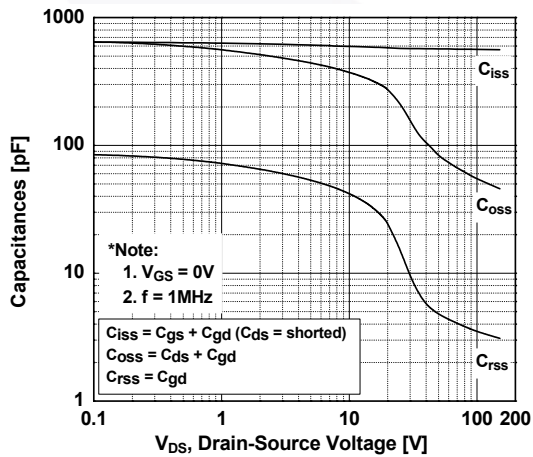
Figure 6. Gate Charge Characteristics

V_{DS} = 30V
V_{DS} = 75V
V_{DS} = 120V

*Note: I_D = 12A

V_{GS}, Gate-Source Voltage [V]
Q_g, Total Gate Charge [nC]
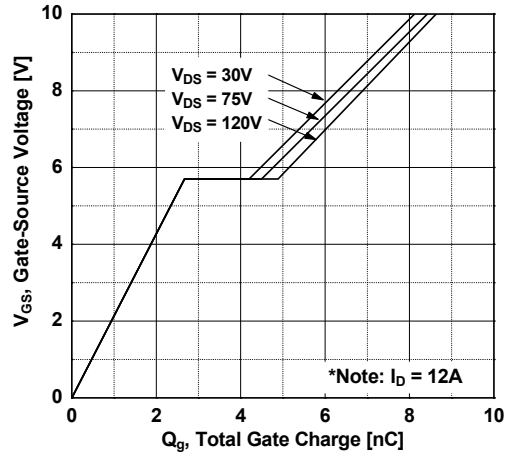
Typical Performance Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

*Notes:
1. V_{GS} = 0V
2. I_D = 250µA
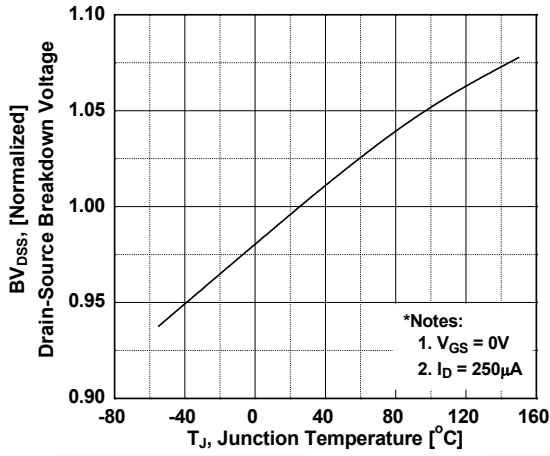
Figure 8. On-Resistance Variation vs. Temperature

*Notes:
1. V_{GS} = 10V
2. I_D = 12A
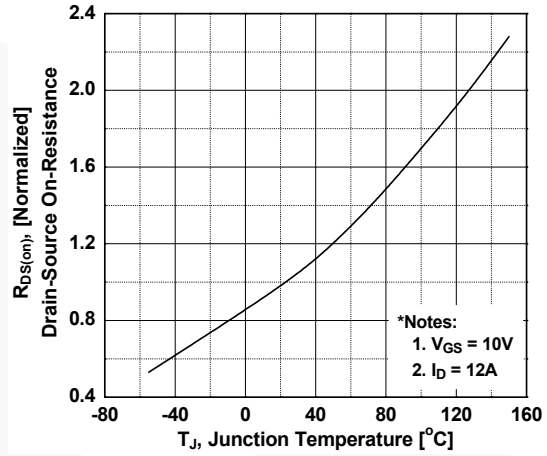
Figure 9. Maximum Safe Operating Area

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

SINGLE PULSE
T_C = 25°C
T_J = 150°C
$R_{\theta JC}$ = 2.2°C/W

100µs
1ms
10ms
100ms
DC
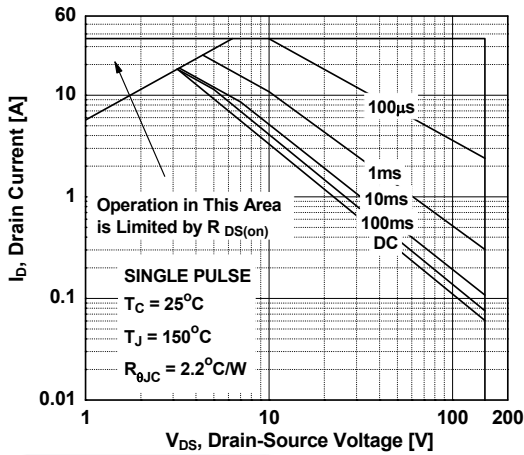
Figure 10. Maximum Drain Current vs. Case Temperature

V_{GS} = 10V

$R_{\theta JC}$ = 2.2°C/W
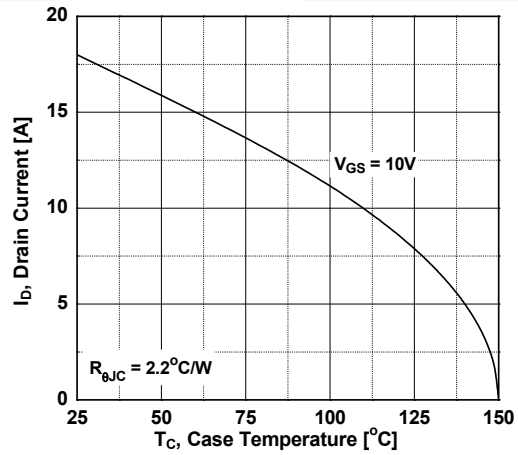
Figure 11. Eoss vs. Drain to Source Voltage
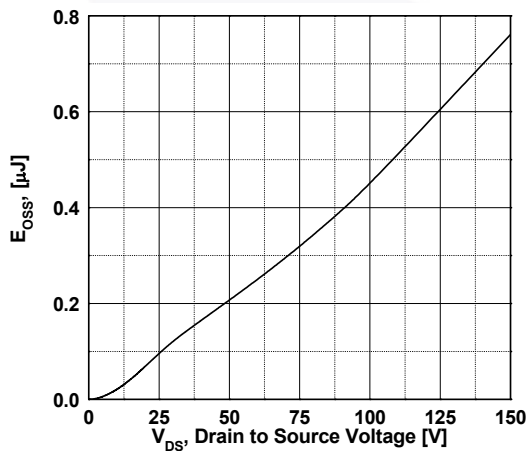
Figure 12. Unclamped Inductive Switching Capability

T_J = 25 °C

T_J = 125 °C
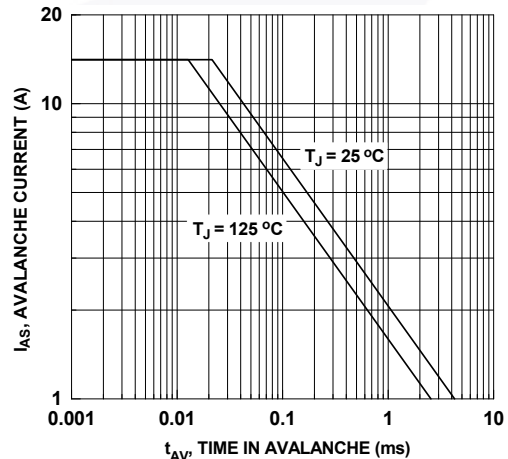
Typical Performance Characteristics (Continued)

Figure 13. Transient Thermal Response Curve

*Notes:
1. $Z_{\theta JC}(t) = 2.2$ °C/W Max.
2. Duty Factor, $D = t_1/t_2$
3. $T_{JM} - T_C = P_{DM} * Z_{\theta JC}(t)$

$Z_{\theta JC}(t)$, Thermal Response [°C/W]

t_1, Rectangular Pulse Duration [sec]
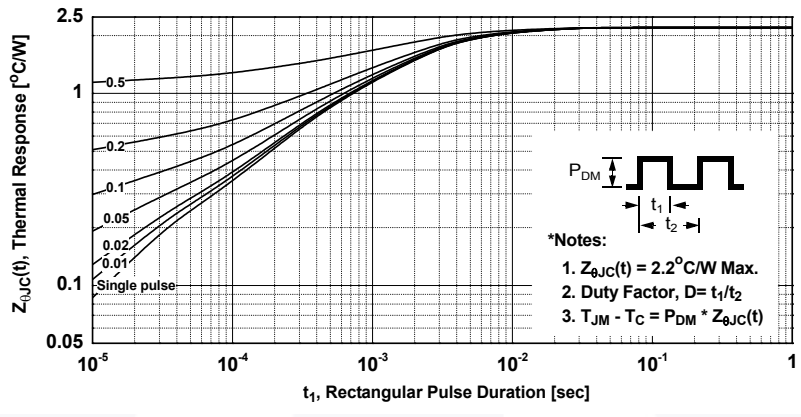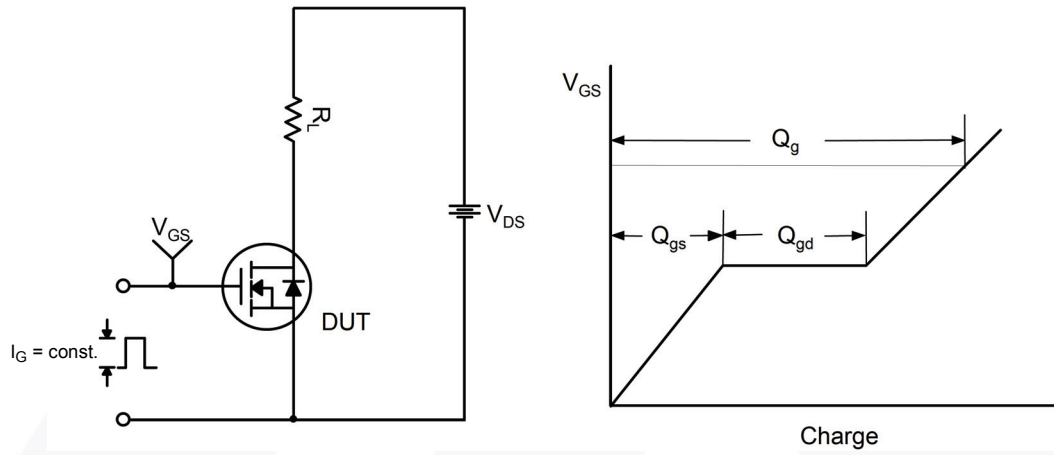
Figure 14. Gate Charge Test Circuit & Waveform

Figure 15. Resistive Switching Test Circuit & Waveforms

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

Figure 16. Unclamped Inductive Switching Test Circuit & Waveforms

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

DUT

V$_{DS}$

I$_{SD}$

L

Driver

R$_{G}$

Same Type
as DUT

V$_{DD}$

V$_{GS}$

• dv/dt controlled by R$_{G}$
• I$_{SD}$ controlled by pulse period

Figure 17. Peak Diode Recovery dv/dt Test Circuit & Waveforms

$$Qsync = \frac{1}{R_G} \cdot \int V_{R_G}\left(t\right)\ dt$$
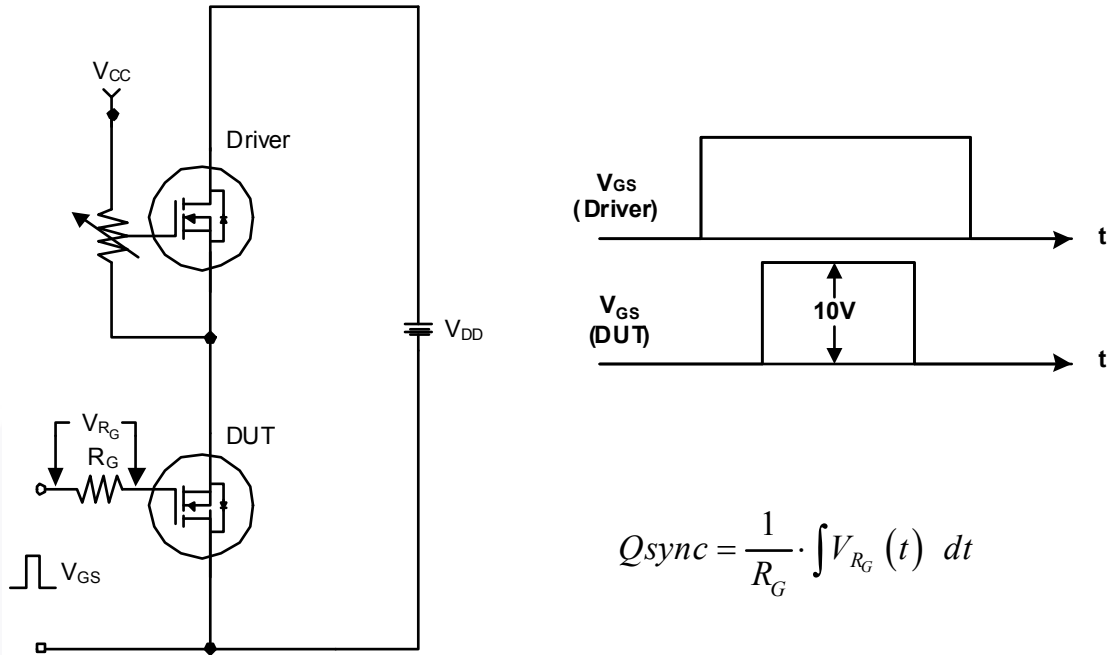
Figure 18. Total Gate Charge Qsync. Test Circuit & Waveforms

6.73
6.35

5.46
5.21

A

1.27
0.89

6.22
5.97

C

E
1.02 MAX

1   2   3

(0.59)

1.14
0.76

0.89
0.64

2.29

0.25 MAX

ISOLATED PLASTIC
BODY STUB

1   2   3

DIODE
PRODUCTS VERSION

⌖ 0.25 Ⓜ A Ⓜ C

4.57

NON-DIODE
PRODUCTS VERSION

5.55 MIN

4

6.50 MIN

6.40

1   3

2.85 MIN

1.25 MIN

2.28

4.56

LAND PATTERN
RECOMMENDATION

SEE
NOTE D

4.32 MIN

4

5.21 MIN

3   2   1
E

NON-DIODE
PRODUCTS VERSION

3   2   1

DIODE
PRODUCTS VERSION

B

2.39
2.18

0.58
0.45

10.41
9.40

SEE DETAIL A

⌒ 0.10 B

GAGE PLANE

0.51

0.61
0.45

10°
0°

(1.54)

1.78
1.40

0.127 MAX

(2.90)

SEATING PLANE

DETAIL A
(ROTATED -90°)
SCALE: 12X

FAIRCHILD™

NOTES: UNLESS OTHERWISE SPECIFIED
A) THIS PACKAGE CONFORMS TO JEDEC, TO-252,
ISSUE C, VARIATION AA.
B) ALL DIMENSIONS ARE IN MILLIMETERS.
C) DIMENSIONING AND TOLERANCING PER
ASME Y14.5M-2009.
D) SUPPLIER DEPENDENT MOLD LOCKING HOLES OR CHAMFERED
CORNERS OR EDGE PROTRUSION.
E) TRIMMED METAL CENTER LEAD IS PRESENT ON FOR NON-DIODE PRODUCTS
F) DIMENSIONS ARE EXCLUSIVE OF BURS,
MOLD FLASH AND TIE BAR EXTRUSIONS.
G) LAND PATTERN RECOMMENDATION IS BASED ON IPC7351A STD
TO228P991X239-3N.
H) DRAWING NUMBER AND REVISION: MKT-TO252A03REV11

PUBLICATION ORDERING INFORMATION
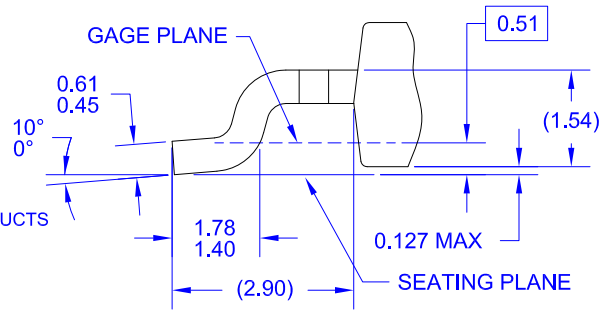
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