

November 2013

# FQD10N20L

# N-Channel QFET® MOSFET

200 V, 7.6 A, 360 mΩ

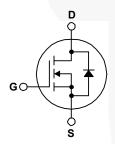
# **Description**

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, active power • 100% Avalanche Tested factor correction (PFC), and electronic lamp ballasts.

## **Features**

- 7.6 A, 200 V,  $R_{DS(on)}$  = 360 m $\Omega$  (Max.) @  $V_{GS}$  = 10 V,  $I_D = 3.8 A$
- Low Gate Charge (Typ. 13 nC)
- Low Crss (Typ. 14 pF)
- · Low Level Gate Drive Requirements Allowing **Direct Operation Form Logic Drivers**





# Absolute Maximum Ratings T<sub>C</sub> = 25°C unless otherwise noted.

Symbol	Parameter		FQD10N20LTM	Unit
$V_{DSS}$	Drain-Source Voltage		200	V
I <sub>D</sub>	Drain Current - Continuous (T <sub>C</sub> = 25°C)		7.6	Α
	- Continuous (T <sub>C</sub> = 100°C)		4.8	Α
I <sub>DM</sub>	Drain Current - Pulsed	(Note 1)	30.4	Α
V <sub>GSS</sub>	Gate-Source Voltage		± 20	V
E <sub>AS</sub>	Single Pulsed Avalanche Energy	(Note 2)	180	mJ
I <sub>AR</sub>	Avalanche Current	(Note 1)	7.6	Α
E <sub>AR</sub>	Repetitive Avalanche Energy	(Note 1)	5.1	mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)		5.5	V/ns
P <sub>D</sub>	Power Dissipation (T <sub>A</sub> = 25°C) *		2.5	W
	Power Dissipation (T <sub>C</sub> = 25°C)		51	W
	- Derate above 25°C		0.4	W/°C
T <sub>J</sub> , T <sub>STG</sub>	Operating and Storage Temperature Range		-55 to +150	°C
T <sub>L</sub>	Maximum lead temperature for soldering, 1/8" from case for 5 seconds		300	°C

## **Thermal Characteristics**

Symbol	Parameter	FQD10N20LTM	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max.		
В	Thermal Resistance, Junction to Ambient (Minimum Pad of 2-oz Copper), Max.	110	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient (*1 in <sup>2</sup> Pad of 2-oz Copper), Max.	50	

# **Package Marking and Ordering Information**

Part Number	Top Mark	Package	Packing Method	Reel Size	Tape Width	Quantity
FQD10N20LTM	FQD10N20L	DPAK	Tape and Reel	330 mm	16 mm	2500 units

# **Electrical Characteristics**

T<sub>C</sub> = 25°C unless otherwise noted.

Symbol	Parameter	Parameter Test Conditions		Тур.	Max.	Uni
Off Cha	aracteristics					
$BV_{DSS}$	Drain-Source Breakdown Voltage	$V_{GS} = 0 \text{ V}, I_D = 250 \mu\text{A}$	200			V
$\Delta BV_{DSS}$ / $\Delta T_{J}$	Breakdown Voltage Temperature Coefficient	I <sub>D</sub> = 250 μA, Referenced to 25°C		0.18		V/°C
I <sub>DSS</sub>	Zoro Coto Voltogo Droin Current	V <sub>DS</sub> = 200 V, V <sub>GS</sub> = 0 V			1	μΑ
	Zero Gate Voltage Drain Current	V <sub>DS</sub> = 160 V, T <sub>C</sub> = 125°C			10	μΑ
I <sub>GSSF</sub>	Gate-Body Leakage Current, Forward	V <sub>GS</sub> = 20 V, V <sub>DS</sub> = 0 V			100	nA
I <sub>GSSR</sub>	Gate-Body Leakage Current, Reverse	V <sub>GS</sub> = -20 V, V <sub>DS</sub> = 0 V			-100	nA
	Aracteristics Gate Threshold Voltage	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA	1.0		2.0	V
V <sub>GS(th)</sub>	Static Drain-Source	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 3.8 A	1.0	0.29	0.36	V Ω
	On-Resistance	$V_{GS} = 5 \text{ V}, I_D = 3.8 \text{ A}$		0.3	0.38	
g <sub>FS</sub>	Forward Transconductance	$V_{DS} = 30 \text{ V}, I_{D} = 3.8 \text{ A}$		9.6		S
Dynam	ic Characteristics					
C <sub>iss</sub>	Input Capacitance	$V_{DS} = 25 \text{ V}, V_{GS} = 0 \text{ V},$	\	640	830	pF
C <sub>oss</sub>	Output Capacitance	f = 1.0  MHz		95	125	pF
C <sub>rss</sub>	Reverse Transfer Capacitance			14	18	pF
Switchi	ing Characteristics	,	1		1	
t <sub>d(on)</sub>	Turn-On Delay Time	V 100 V I 10 A		13	35	ns
t <sub>r</sub>	Turn-On Rise Time	$V_{DD} = 100 \text{ V}, I_D = 10 \text{ A},$ $R_C = 25 \Omega$		150	310	ns

t <sub>d(on)</sub>	Turn-On Delay Time	V <sub>DD</sub> = 100 V, I <sub>D</sub> = 10 A,			13	35	ns
t <sub>r</sub>	Turn-On Rise Time	$R_G = 25 \Omega$			150	310	ns
t <sub>d(off)</sub>	Turn-Off Delay Time		(Note 4)		50	110	ns
t <sub>f</sub>	Turn-Off Fall Time				95	200	ns
$Q_g$	Total Gate Charge	V <sub>DS</sub> = 160 V, I <sub>D</sub> = 10 A,			13	17	nC
$Q_{gs}$	Gate-Source Charge	$V_{GS} = 5 \text{ V}$ (Not	e 4)		2.4		nC
Q <sub>gd</sub>	Gate-Drain Charge			/	6.1		nC

# **Drain-Source Diode Characteristics and Maximum Ratings**

I <sub>S</sub>	Maximum Continuous Drain-Source Diode Forward Current		 	7.6	Α
I <sub>SM</sub>	Maximum Pulsed Drain-Source Diode Forward Current		 	30.4	Α
V <sub>SD</sub>	Drain-Source Diode Forward Voltage	$V_{GS} = 0 \text{ V}, I_{S} = 7.6 \text{ A}$	 	1.5	V
t <sub>rr</sub>	Reverse Recovery Time	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 10 A,	 120		ns
Q <sub>rr</sub>	Reverse Recovery Charge	$dI_F / dt = 100 A/\mu s$	 0.57	//	μС

- Notes: 1. Repetitive rating : pulse-width limited by maximum junction temperature. 2. L = 4.7 mH,  $I_{AS}$  = 7.6 A,  $V_{DD}$  = 50 V,  $R_G$  = 25  $\Omega$ , starting  $T_J$  = 25°C. 3.  $I_{SD}$  ≤ 10 A, di/dt ≤ 300 A/ $\mu$ s,  $V_{DD}$  ≤ BV $_{DSS}$ , starting  $T_J$  = 25°C.

- 4. Essentially independent of operating temperature.

# **Typical Characteristics**

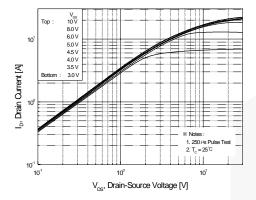


Figure 1. On-Region Characteristics

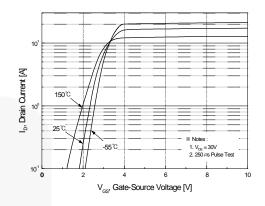


Figure 2. Transfer Characteristics

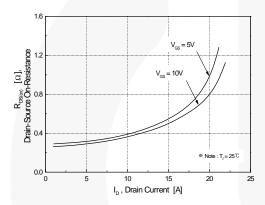


Figure 3. On-Resistance Variation vs.
Drain Current and Gate Voltage

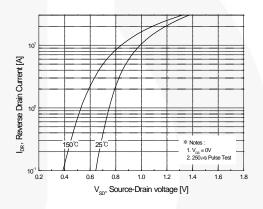


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

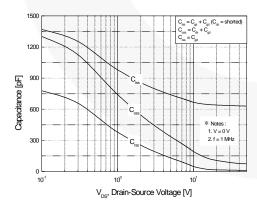


Figure 5. Capacitance Characteristics

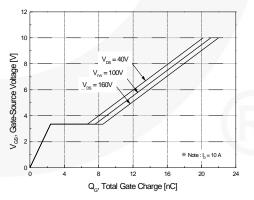


Figure 6. Gate Charge Characteristics

# 1.2 (Registration of the control of

Typical Characteristics (Continued)

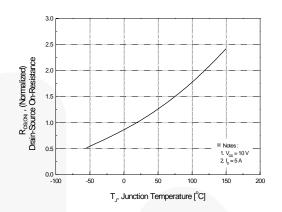
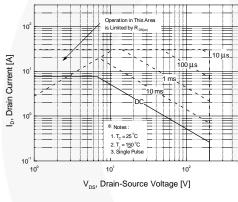


Figure 7. Breakdown Voltage Variation vs. Temperature

Figure 8. On-Resistance Variation vs. Temperature



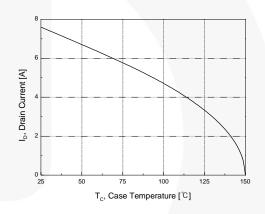


Figure 9. Maximum Safe Operating Area

Figure 10. Maximum Drain Current vs. Case Temperature

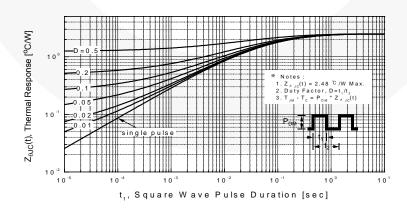


Figure 11. Transient Thermal Response Curve

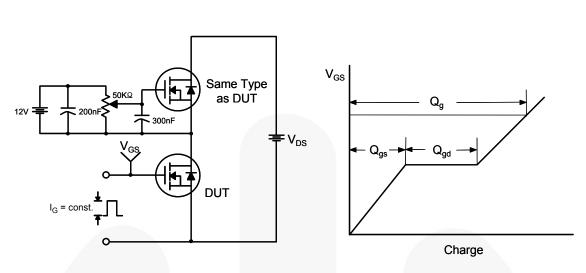


Figure 12. Gate Charge Test Circuit & Waveform

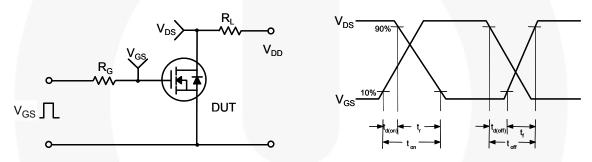


Figure 13. Resistive Switching Test Circuit & Waveforms

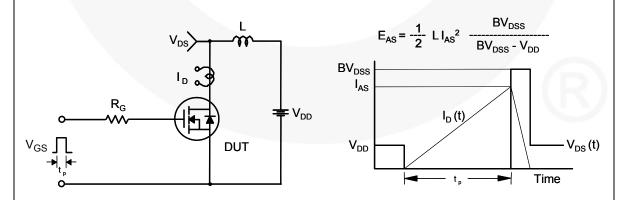
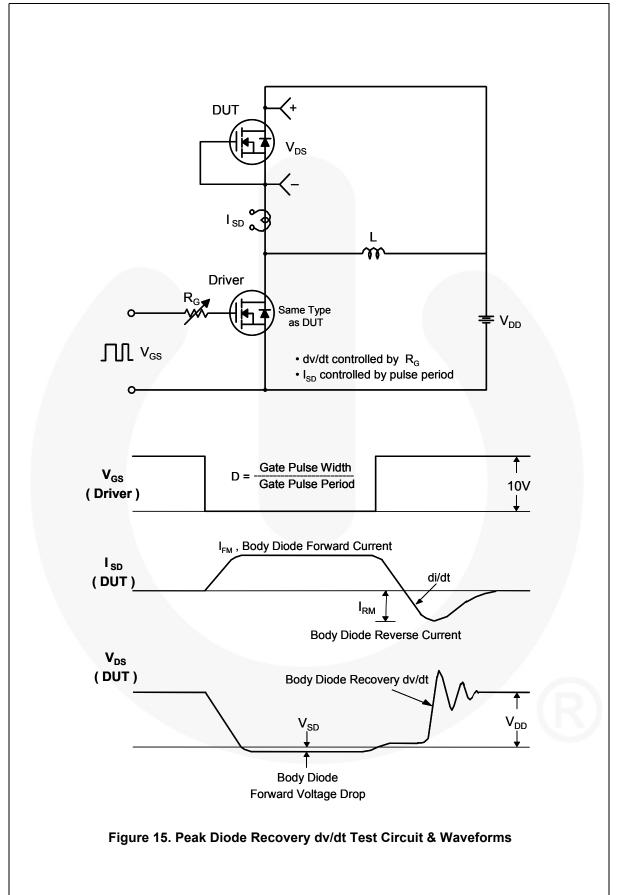
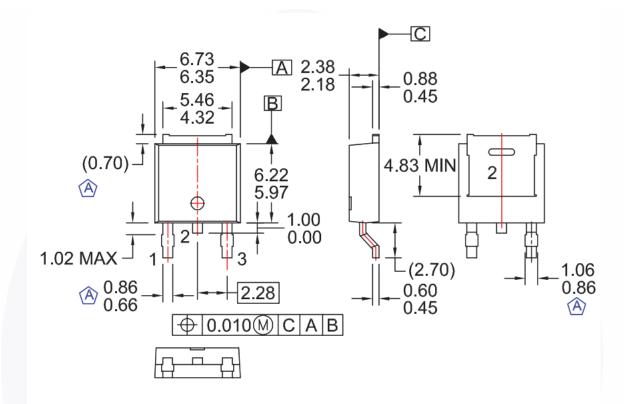


Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms



# **Mechanical Dimensions**



NOTES: UNLESS OTHERWISE SPECIFIED

- (A) CONFORMS TO JEDEC TO-252 VARIATION AB EXCEPT WHERE NOTED
- B) ALL DIMENSIONS ARE IN MILLIMETERS.
- C) DRAWING CONFORMS TO ASME Y14.5M-1994
- D) DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.
- E) FORMERLY NAMED BD1733
- F) DRAWING FILE NAME: MKT-TO252D03REV1

Figure 16. TO-252 (D-PAK), Molded, 3-Lead, Jedec TO-252 VAR. AB, Surface Mount

Package drawings are provided as a service to customers considering Fairchild components. Drawings may change in any manner without notice. Please note the revision and/or date on the drawing and contact a Fairchild Semiconductor representative to verify or obtain the most recent revision. Package specifications do not expand the terms of Fairchild's worldwide terms and conditions, specifically the warranty therein, which covers Fairchild products.

Always visit Fairchild Semiconductor's online packaging area for the most recent package drawings:

http://www.fairchildsemi.com/package/packageDetails.html?id=PN\_TO252-003





#### **TRADEMARKS**

The following includes registered and unregistered trademarks and service marks, owned by Fairchild Semiconductor and/or its global subsidiaries, and is not intended to be an exhaustive list of all such trademarks.

AccuPower™ AX-CAP® BitSiC™ Build it Now™ CorePLUS™ CorePOWER™  $CROSSVOLT^{\text{TM}}$ 

CTI ™ Current Transfer Logic™ DEUXPEED®

Dual Cool™ EcoSPARK® EfficentMax™ ESBC™

Fairchild<sup>®</sup> Fairchild Semiconductor® FACT Quiet Series™ FACT® FAST® FastvCore™

F-PFS™ FRFET® Global Power Resource<sup>SM</sup> GreenBridge™ Green FPS™

Green FPS™ e-Series™

G*max*™ GTO™ IntelliMAX™ ISOPLANAR™

Marking Small Speakers Sound Louder

and Better™ MegaBuck™ MICROCOUPLER™ MicroFET™ MicroPak™ MicroPak2™

MillerDrive™ MotionMax™ mWSaver® OptoHiT™ OPTOLOGIC® OPTOPLANAR® PowerTrench® PowerXS™

Programmable Active Droop™

**QFET** QS™ Quiet Series™ RapidConfigure™

Saving our world, 1mW/W/kW at a time™ SignalWise™

SmartMax™ SMART START™

Solutions for Your Success™

STEALTH™ SuperFET® SuperSOT™-3 SuperSOT™-6

SuperSOT™-8 SupreMOS® SvncFET™

SYSTEM®\* TinyBoost<sup>®</sup> TinyBuck<sup>®</sup> TinyCalc™ TinyLogic<sup>®</sup> TINYOPTO™ TinvPower™ TinyPWM™ TinyWire™ TranSiC™ TriFault Detect™ TRUECURRENT®\*

Sync-Lock™

UHC<sup>®</sup> Ultra FRFET™ UniFFT™ VCX™

μSerDes™

VisualMax™ VoltagePlus™ XS™

\*Trademarks of System General Corporation, used under license by Fairchild Semiconductor.

#### DISCLAIMER

FETBench™

FPS™

FAIRCHILD SEMICONDUCTOR RESERVES THE RIGHT TO MAKE CHANGES WITHOUT FURTHER NOTICE TO ANY PRODUCTS HEREIN TO IMPROVE RELIABILITY, FUNCTION, OR DESIGN. FAIRCHILD DOES NOT ASSUME ANY LIABILITY ARISING OUT OF THE APPLICATION OR USE OF ANY PRODUCT OR CIRCUIT DESCRIBED HEREIN; NEITHER DOES IT CONVEY ANY LICENSE UNDER ITS PATENT RIGHTS, NOR THE RIGHTS OF OTHERS. THESE SPECIFICATIONS DO NOT EXPAND THE TERMS OF FAIRCHILD'S WORLDWIDE TERMS AND CONDITIONS, SPECIFICALLY THE WARRANTY THEREIN, WHICH COVERS THESE PRODUCTS.

LIFE SUPPORT POLICY
FAIRCHILD'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE
EXPRESS WRITTEN APPROVAL OF FAIRCHILD SEMICONDUCTOR CORPORATION.

As used here in:

- Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body or (b) support or sustain life, and (c) whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury of the user.
- A critical component in any component of a life support, device, or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

## ANTI-COUNTERFEITING POLICY

Fairchild Semiconductor Corporation's Anti-Counterfeiting Policy. Fairchild's Anti-Counterfeiting Policy is also stated on our external website, www.Fairchildsemi.com, under Sales Support.

Counterfeiting of semiconductor parts is a growing problem in the industry. All manufactures of semiconductor products are experiencing counterfeiting of their parts. Customers who inadvertently purchase counterfeit parts experience many problems such as loss of brand reputation, substandard performance, failed application, and increased cost of production and manufacturing delays. Fairchild is taking strong measures to protect ourselves and our customers from the proliferation of counterfeit parts. Fairchild strongly encourages customers to purchase Fairchild parts either directly from Fairchild or from Authorized Fairchild Distributors who are listed by country on our web page cited above. Products customers buy either from Fairchild directly or from Authorized Fairchild Distributors are genuine parts, have full traceability, meet Fairchild's quality standards for handing and storage and provide access to Fairchild's full range of up-to-date technical and product information. Fairchild and our Authorized Distributors will stand behind all warranties and will appropriately address and warranty issues that may arise. Fairchild will not provide any warranty coverage or other assistance for parts bought from Unauthorized Sources. Fairchild is committed to combat this global problem and encourage our customers to do their part in stopping this practice by buying direct or from authorized distributors.

#### PRODUCT STATUS DEFINITIONS Definition of Terms

Datasheet Identification	Product Status	Definition
Advance Information	Formative / In Design	Datasheet contains the design specifications for product development. Specifications may change in any manner without notice.
Preliminary First Production		Datasheet contains preliminary data; supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design.
No Identification Needed	Full Production	Datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve the design.
Obsolete Not In Production		Datasheet contains specifications on a product that is discontinued by Fairchild Semiconductor. The datasheet is for reference information only.

Rev. 166

ON Semiconductor and in are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at <a href="www.onsemi.com/site/pdf/Patent-Marking.pdf">www.onsemi.com/site/pdf/Patent-Marking.pdf</a>. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor and see no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and h

## **PUBLICATION ORDERING INFORMATION**

### LITERATURE FULFILLMENT:

Literature Distribution Center for ON Semiconductor 19521 E. 32nd Pkwy, Aurora, Colorado 80011 USA Phone: 303-675-2175 or 800-344-3860 Toll Free USA/Canada Fax: 303-675-2176 or 800-344-3867 Toll Free USA/Canada Email: orderlit@onsemi.com N. American Technical Support: 800–282–9855 Toll Free USA/Canada
Europe, Middle East and Africa Technical Support: Phone: 421 33 790 2910
Japan Customer Focus Center
Phone: 81–3–5817–1050

ON Semiconductor Website: www.onsemi.com

Order Literature: http://www.onsemi.com/orderlit

For additional information, please contact your local Sales Representative