FAIRCHILD SEMICONDUCTOR®

BENCHMarks™

New Products, Tips and Tools for Power and Mobile Applications

VOL. 3, 2012

Advantages

- **Greater noise immunity: negative voltage swing (VS) down to –9.8V at 15V_{BS}**
- **Current driving capability of 4.5A/4.5A sourcing/sinking**
- **Qualified to AEC-Q100 Automotive Class 1**

Applications

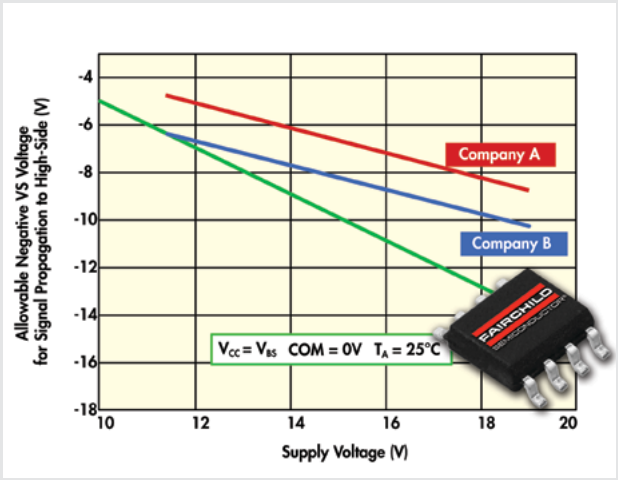
- **Body electronics**
- **Powertrain**

For more information, please visit:

fairchildsemi.com/pf/FA/FAN7171_F085.html
fairchildsemi.com/pf/FA/FAN7190_F085.html

Greater Noise Immunity, Less Power Dissipation for Automotive Applications

The FAN7171 (high-current, high-side gate driver IC) and FAN7190 (high-current, high- and low-side gate driver IC) deliver increased efficiency, higher drive current and greater noise immunity. These devices are optimized for electric and hybrid electric DC-DC power conversion, high-voltage auxiliaries, diesel and gasoline fuel injection, and other high-power MOSFET and IGBT driver applications. The FAN7171 can drive high-speed, high-side MOSFETs and IGBTs that operate up to +600V, while the FAN7190 can independently drive high- and low-side MOSFETs and IGBTs that also operate up to +600V. Both devices are highly integrated and provide increased functionality, resulting in reduced component count, bill of material costs and board space.



High-Current, High-Voltage Gate Drivers: FAN7171, High-Side and FAN7190 High- & Low-Side

Product Number	Floating Offset Voltage (Max) (V)	Recharge	Supply Voltage (Min) (V)	Supply Voltage (Max) (V)	t_{ON}/ t_{OFF} Typ (nS)	t_r/t_f Typ (nS)	Pulsed Output Current (mA)	Package
FAN7171_F085	600	Bootstrap	10	20	150/ 150	25/ 15	4000/ 4000	SO-8
FAN7190_F085	600	Bootstrap	10	22	140/ 140	25/ 20	4500/ 4500	SO-8

Advantages

- Short circuit protection
- Current limitation
- Thermal shutdown with restart
- Overvoltage protection (including load dump)
- Very low standby current
- Fast demagnetization of inductive loads
- Open load detection in ON-state
- CMOS compatible input
- ESD protection
- Optimized static electromagnetic compatibility
- Open drain fault output
- Qualified to AEC-Q100

Applications

- Body electronics
- Infotainment
- Portable navigation
- Powertrain
- Safety and control
- Vehicle security systems

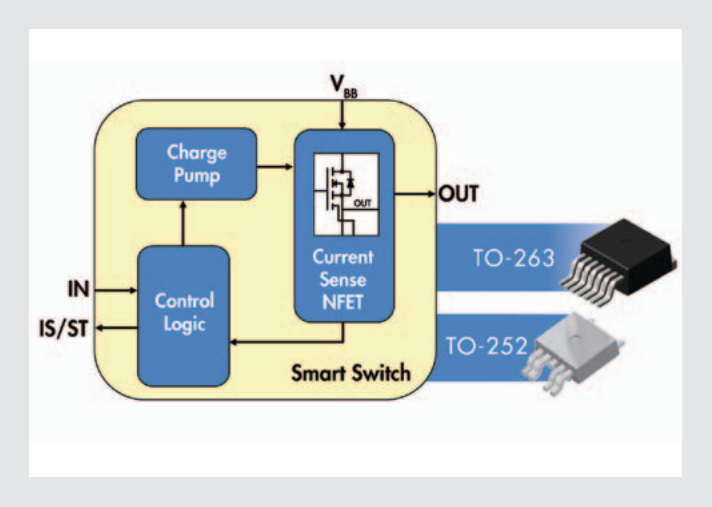
For more information, please visit:

fairchildsemi.com/pf/FD/FDBS09H04A_F085.html
fairchildsemi.com/pf/FD/FDDS10H04A.html
fairchildsemi.com/pf/FD/FDDS100H06_F085.html

Reliable, Integrated Smart High-Side Switches Offer Space-Savings

Reliably and safely switching high currents into grounded resistive or inductive loads is a necessity for designers of automotive applications. Fairchild has developed a smart high-side switch family that specifically addresses advanced electrical load—without relying on discrete MOSFET solutions. By integrating protection and diagnostic features, you benefit from reduced component count and PCB complexity, as well as better system reliability.

The family includes the FDDS100H06_F085 smart high-side switch, an N-channel power MOSFET with charge pump, ground-referenced CMOS-compatible input and diagnostic output with integrated protection functions. The family also offers the FDBS09H04A_F085A and FDDS10H04A_F085A smart high-side switches, incorporating an N-channel power MOSFET device featuring a charge pump, current controlled input and diagnostic feedback with load current sense and integrated Smart Trench chip-on-chip technology.



Automotive Body, Lighting and Powertrain Applications

Product Number	$R_{DS(ON)}$ mΩ	I_{LOAD} (A)	Supply Voltage (V)	Package
FDBS09H04A_F085A	9	48	5.5 to 38	TO263_7L
FDDS10H04A_F085A	10	41	5.5 to 38	TO252_5L
FDDS100H06_F085	100	3	5.5 to 37	TO252_5L

30V Power33 MOSFETs

Advantages

- **High performance technology for best-in-class $R_{DS(ON)}$ of 1.3mΩ max**
- **3.3mm x 3.3mm industry-standard form factor, PQFN – saves board space**
- **Lower power conduction loss**
- **Higher power density**
- **Higher efficiency**

Applications

- **Isolated DC-DC synchronous rectification**
- **Point-of-load synchronous buck conversion**
- **High efficiency load switch and low-side switching**
- **O-ring FET**

For more information, please visit:

fairchildsemi.com/pf/FD/FDMC8010.html

Reduce Board Space with Best-in-Class Power Density

Power efficiency standards and end-system requirements are forcing designers to seek energy-efficient solutions that help shrink their applications' power supply form factor. Fairchild's FDMC8010 30V Power33 MOSFET meets these needs while improving power density—in a 3.3mm x 3.3mm PQFN form factor that has a 66% footprint area savings.

Using Fairchild's PowerTrench® technology, the FDMC8010 is well-suited for applications where the lowest $R_{DS(ON)}$ is required in small spaces. In isolated 1/16th brick DC-DC converter applications, the Power33 MOSFET's $R_{DS(ON)}$ of only 1.3mΩ max, is 25% smaller than the competitive solution in this footprint. Additionally, the device reduces conduction losses, thereby improving thermal efficiency by up to 25%.



Shrink Your Design While Delivering Best-in-Class Power Density

Product Number	BV_{DSS} (V)	I_D (A) T_A = 25°C	$R_{DS(ON)}$ Max		Q_g (nC) 0V to 4.5V	Q_{gd} (nC)	pF C_{ISS}	Package
			10V	4.5V				
FDMC8010	25	30	1.3mΩ	1.8mΩ	45	9.5	4405	PQFN 3.3mm x 3.3mm (Power33)

DUAL N-CHANNEL PowerTrench® MOSFET

Advantages

- **Control N-channel MOSFET with $R_{DS(ON)}$ = 5.4mΩ typical, (7.3mΩ max) at V_{GS} = 4.5V**
- **Synchronous N-channel MOSFET with $R_{DS(ON)}$ = 1.4mΩ typical, (2.1mΩ max) at V_{GS} = 4.5V**
- **Low inductance packaging shortens rise/fall times, resulting in lower switching losses**
- **MOSFET integration enables optimum layout for lower circuit inductance and reduced switch node ringing**

Applications

- **Computing**
- **Communications**
- **General purpose point-of-load**

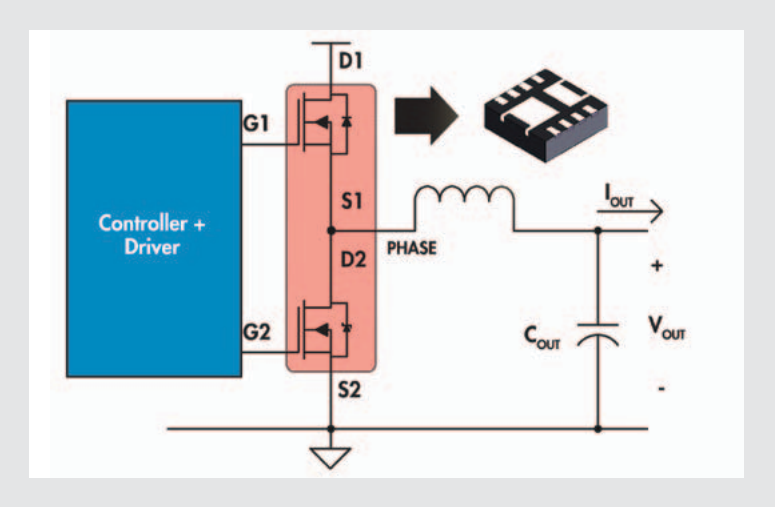
For more information, please visit:

fairchildsemi.com/pf/FD/FDPC8011S.html

Achieve Highest Power Density, Efficiency in Power Supply Designs

The challenge of providing higher power density and efficiency in less board space goes hand-in-hand with the increasing requirements to provide added functionality in high-density embedded DC-DC power supplies. A solution to this dilemma, Fairchild's FDPC8011S, has been developed to operate at higher switching frequencies, and includes two specialized N-channel MOSFETs in a dual package. The switch node has been internally connected to enable easy placement and routing of synchronous buck converters. The control MOSFET (Q1) and synchronous SyncFET™ (Q2) have been designed to provide optimal power efficiency.

The FDPC8011S consists of a 1.4mΩ SyncFET technology and a 5.4mΩ control, low figure of merit N-channel MOSFET integrated in an all-clip package, which helps reduce the capacitor count and inductor size. The device's source down, low-side allows for simple placement and routing, enabling a more compact board layout and achieving optimal thermal performance.



Power Clip Dual N-Channel PowerTrench® MOSFET

Product Number	Schottky Body Diode	BV_{DSS} (V)	$R_{DS(ON)}$ Max (mΩ) @ 4.5V V_{GS}		Q_g Typ (nC) @ V_{GS} = 4.5V		C_{OSS} Typ (pF) High-Side		Dimension (mm)
			High-Side	Low-Side	High-Side	Low-Side	Low-Side	High-Side	
FDPC8011S	Yes	25	7.3	1.4	9	30	332	1126	3.3 x 3.3

Advantages

- **93% at peak and 91% at 30A, 500KHz frequency; $12V_{IN}$, $1V_{OUT}$**
- **90% at peak and 88% at 30A, 1MHz frequency; $12V_{IN}$, $1V_{OUT}$**
- **High current handling: 60A @ 100°C T_J**
- **Capable of operating up to 1.5MHz switching frequency**
- **Eliminates need for a heat sink in typical designs**

Applications

- **Notebook or UltraBook™ power systems**

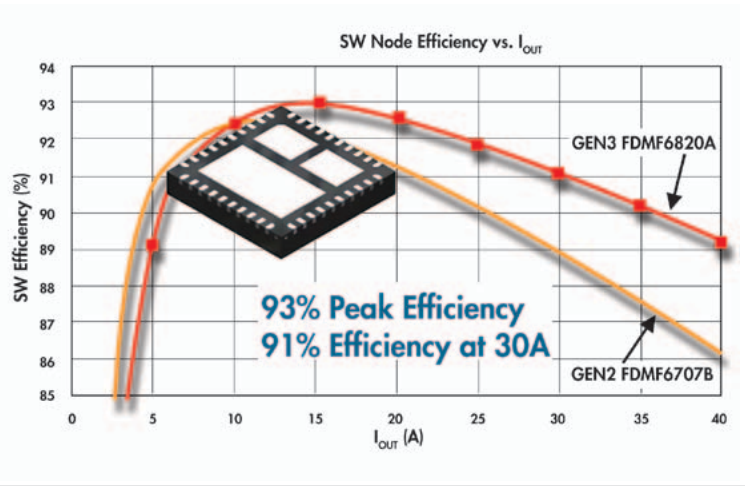
For more information, please visit:

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fairchildsemi.com/pf/FD/FDMF6833C.html
fairchildsemi.com/pf/FD/FDMF6708N.html

Highest Power Efficiency with the DrMOS Family

Achieve improved efficiency with >1MHz switching frequencies, increased maximum load current and greater power density with Fairchild's Generation III XS™ DrMOS multi-chip mode module family. The FDMF68xx family achieves efficiency standards targets, while providing up to 60A per phase in a 6mm x 6mm PQFN package. Both 3.3V and 5V Tri-State PWM input voltages for digital and analog PWM controllers, and a 30V device option make the DrMOS family a good choice for use in UltraBook™ systems.

Designed to enable a reduced inductor and output capacitor count, the FDMF68xx series saves up to 50% of board space as compared to conventional discrete solutions. The FDMF68xx series dramatically reduces switch ringing, using Fairchild's high-performance PowerTrench® MOSFET technology, eliminating the need for using a snubber circuit in most buck converter applications.



FDMS68xx Generation III XS™ Multi-chip Mode Module Family

Product Number	I_{OUT} (A)	PWM Input	Thermal Protection	SMOD or ZCD	MOSFET BV_{DSS}	Eff. @ 30A, $12V_{IN}$, $1V_{OUT}$, 500KHz	Eff. @ 40A, $12V_{IN}$, $1V_{OUT}$, 500KHz
3.3V Tri-State							
FDMF6820A	60	3.3V Tri-State	Warning	SMOD	25	91.1%	89.2%
FDMF6820B	55	3.3V Tri-State	Warning	SMOD	25	90.8%	88.6%
FDMF6820C	50	3.3V Tri-State	Warning	SMOD	25	90%	87.4%
5V Tri-State							
FMDF6823A	60	5V Tri-State	Warning	SMOD	25	91.1%	89.2%
FMDF6823B	55	5V Tri-State	Warning	SMOD	25	90.8%	88.6%
FMDF6823C	50	5V Tri-State	Warning	SMOD	25	90%	87.4%
30 BV_{DSS}							
FDMF6833C	50	5V Tri-State	Warning	SMOD	30	89.3%	86.1%
Notebook							
FDMF6708N	45	5V Tri-State	Warning	ZCD	30	87.6%	84.4%

P-CHANNEL PowerTrench® MOSFETs

Advantages

- **Occupies only 0.64mm² of PCB area**
- **Ultra-thin package: less than 0.4mm height when mounted to PCB**
- **Excellent thermal characteristics**
- **HBM ESD protection level 2kV (FDZ661PZ)**

Applications

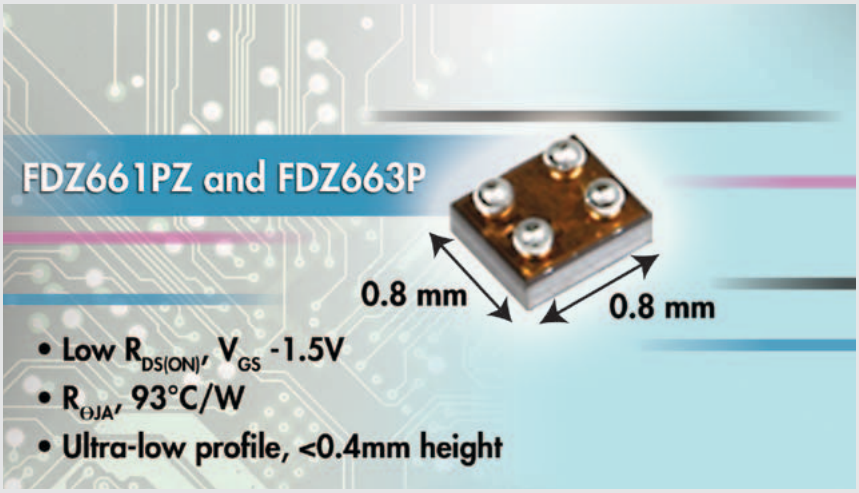
- **Battery management**
- **Load switch**
- **Battery protection**

For more information, please visit:

fairchildsemi.com/pf/FD/FDZ661PZ.html
fairchildsemi.com/pf/FD/FDZ663P.html

Save Space and Manage Thermal Issues in Mobile Designs

Designers of mobile devices are challenged to save space, increase efficiency and manage thermal issues in their end applications. Now minimizing both board space and $R_{DS(ON)}$ in a miniature form factor is possible with the FDZ661PZ and FDZ663P P-channel, 1.5V specified PowerTrench® thin WLCSP MOSFETs. These advanced WLCSP MOSFETs use a state-of-the-art "fine pitch," thin WLCSP packaging process which enables the devices to combine excellent thermal transfer characteristics, ultra-low profile (<0.4mm) and small (0.8mm x 0.8mm) packaging, low gate charge, and low $R_{DS(ON)}$.



State-of-the-Art Fine Pitch, Thin WLCSP for Mobile Devices

Product Number	BV_{DSS} (V)	V_{GS} (V)	$V_{GS(th)}$ (V) Typ		$R_{DS(ON)}$ (mΩ) Max	Q_g Typ (nC) @ V_{GS} = 4.5V	I_D (A)	P_D (W)	Package
FDZ661PZ	-20	±8	-1.5V_{GS}	- 4.5V_{GS}	6.3	8.8	-2.6	0.4	WLCSP (0.8mm x 0.8mm)
			315mΩ	140mΩ					
FDZ663P	-20	±8	-1.5V_{GS}	- 4.5V_{GS}	5.9	8.2	-2.7	0.4	WLCSP (0.8mm x 0.8mm)
			288mΩ	134mΩ					

Advantages

- **10mm minimum creepage and clearance distance (FOD8320)**
- **8mm minimum creepage and clearance distance (FOD8321)**
- **Use of P-channel MOSFETs at output stage enables output voltage swing close to the supply rail**
- **Fast switching speed over full operating temperature range**
  - **400ns max. propagation delay (FOD8320)**
  - **100ns max. pulse wide distortion (FOD8320)**
- **Under Voltage Lockout (UVLO) with hysteresis**
- **Extended industrial temperate range: –40°C to 100°C**

Applications

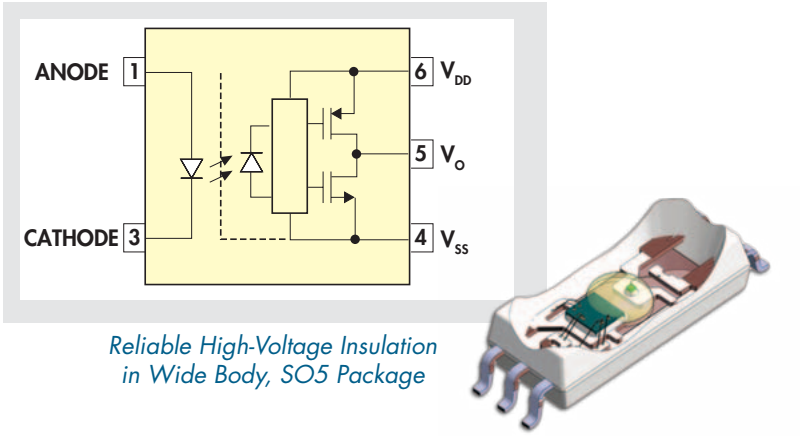
- **AC and brushless DC motor drives**
- **Industrial inverters**
- **Uninterruptible power supplies (UPSs)**
- **Induction heating**
- **Isolated IGBT/Power MOSFET gate drivers**

For more information, please visit:

fairchildsemi.com/pf/FO/FOD8320.html
fairchildsemi.com/pf/FO/FOD8321.html

High-Voltage Insulation Reliability in Small Form Factor

Achieve reliable and high-insulation voltage as well as high-noise immunity in high-power industrial applications with Fairchild's FOD8320 and FOD8321, advanced 2.5A current output gate driver optocouplers. Utilizing Fairchild's Optoplanar® packaging technology and optimized IC design, both devices are housed in a wide body 5-pin small outline package. The FOD8320 offers a compact footprint while allowing for a creepage and clearance distance of greater than 10mm and an internal insulation distance of 0.5mm. The FOD8321 is an alternative for customers who do not require the 10mm creepage and clearance distance but need the small form factor. Both devices provide an extended industrial temperature range (-40°C to 100°C) and are well suited for fast switching of power IGBTs and MOSFETs used in industrial inverter applications.



Reliable High-Voltage Insulation in Wide Body, SO5 Package

Product Number	Min Peak Load Current (A)	Working Voltage (V)	CMH CML (V/µs)	T_{PLH} / T_{PHL} (ns)	PWD (ns)	V_{ISO} (V)	Operating Temp (°C)	Package Type
		Max	Min	Max	Max	Min		
FOD8320	2.5	1,414	35,000	400	100	5000	-40°C to 100°C	Wide Body SO5
FOD8321	2.5	1,414	20,000	500	300	5000	-40°C to 100°C	Wide Body SO5

650V IGBTs

Advantages

- **Positive temperature co-efficient for easy parallel operation**
- **High-current capability enables high power DC-AC conversion**
- **Maximum junction temperature: T_J = 175ºC**
- **Low saturation voltage: $V_{CE\ (sat)}$ = 1.9V (typical) @ I_C = 40A/60A rated current**
- **Fast switching speed allows the system to maintain high efficiency**
- **Low conduction and switching loss**
- **Wide SOA (Safe Operating Area)—allows for higher power dissipation**
- **Tight parameter distribution**

Applications

- **Solar PV inverter**
  - **Micro converter systems**
  - **Central inverter systems**
  - **Micro inverter systems**
- **UPS, SMPS, welder and PFC applications**

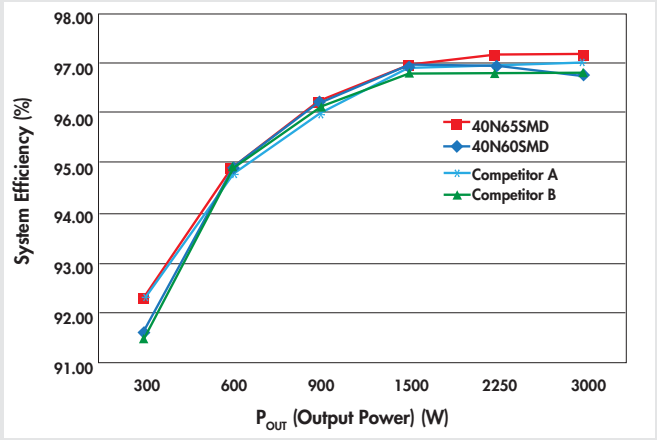
For more information, please visit:

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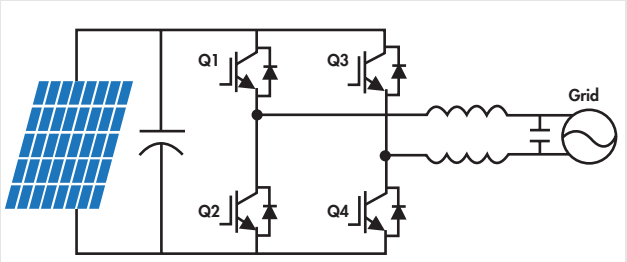
High-Voltage Blocking Capability Without Sacrificing Performance

The challenge of improving energy efficiency with heat and thermal regulation, while keeping component count low, just became easier. Fairchild's FGAxxN65SMD series of 650V IGBTs for photovoltaic inverter applications addresses this need—without sacrificing performance.

Fairchild's Field Stop IGBT technology enables designers to develop a highly reliable system design with higher input voltage while offering optimum performance where low conduction and switching losses are essential. This functionality means designs benefit from high current handling capability, positive temperature coefficient, tight parameter distribution and a wide safe operating area.



CEC (California Energy Commission) Weighted Efficiency–Tested in PV Inverter System



Application Diagram of Central MPPT System (Full-bridge Inverter)

Product Number	BV_{CES} (V)	I_C @ 100°C (A)	$V_{ce(sat)}$ Typ @ 25°C, 15V (V)	E_{OFF} Typ @ 25°C (mJ)	P_D @ 25°C (W)	V_F Typ @ 25°C (V)	t_{rr} Typ @ 25°C (ns)	T_J (max) (°C)	Package
FGA40N65SMD	650	40	1.9	0.26	349	2.1@ 20A	42 @ 20A	175	TO-3PN
FGA60N65SMD	650	60	1.9	0.45	600	2.1@ 30A	47 @ 30A	175	TO-3PN

Advantages

- **Smaller package size (Power56 and TO-220 3-lead) with maximum thermal performance to system size**
- **Lower Q_g to reduce gate driving loss**
- **Low Q_{gd}/Q_{gs} ratio to prevent undesirable turn-on, improving system reliability**
- **Low dynamic parasitic capacitances to reduce gate driving loss for high-frequency applications**

Applications

- **Synchronous rectification for server/telecom PSU**
- **Battery charger and battery protection circuit**
- **DC motor drives and uninterruptible power supplies**
- **Micro solar inverter**

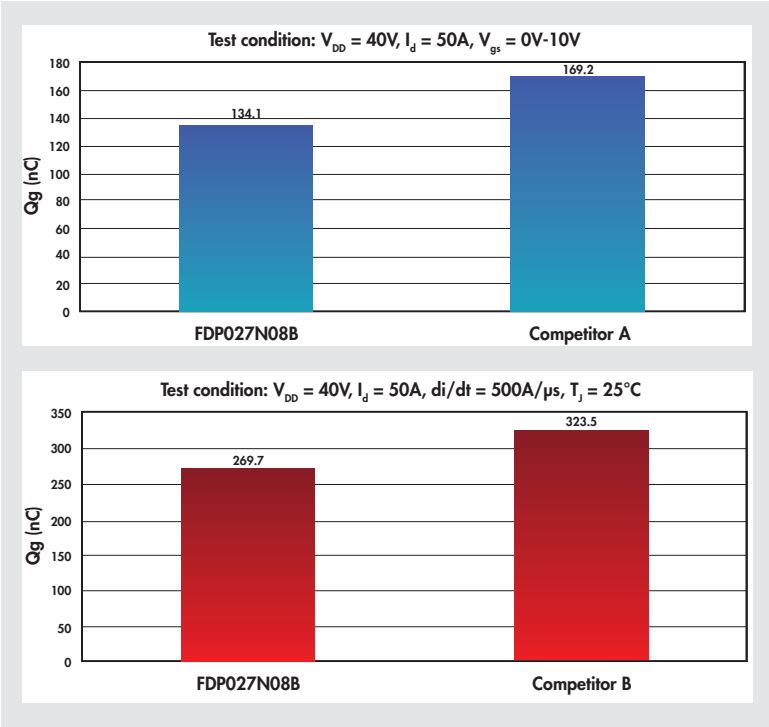
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fairchildsemi.com/pf/FD/FDP020N06B.html
fairchildsemi.com/pf/FD/FDP027N08B.html

Mid-Voltage MOSFETs Enhance Synchronous Rectification in SMPS Designs

Designers of AC-DC power systems need cost-effective power supply solutions that minimize board space while increasing efficiency and reducing power dissipation. Power density and light-load efficiency improvement are also key issues. Part of the expanded PowerTrench® MOSFET family, Fairchild's newest mid-voltage power MOSFET portfolio of optimized power switches meets these needs. The family combines a small gate charge (Q_g), a small reverse recovery charge (Q_{rr}) and a soft-reverse recovery body diode, allowing for fast switching speeds. Available in a 40V, 60V and 80V rating, these devices require less snubber circuitry due to an optimized soft-body diode that reduces voltage spikes by up to 15% over the competitor's solution.

The first devices available include the 40V FDMS015N04B and 80V FDMS039N08B available in a Power56 package, and the 60V FDP020N06B and 80V FDP027N08B available in a TO-220 3-lead package.



Benchmarking of Reduced Reverse Recovery Charge (Q_{rr}) and Reduced Gate Charge (Q_G)

Product Number	B_V (V)	$R_{DS(ON)}$ (mΩ)	Q_g (nC)	Package
FDP020N06B	60	2	204	TO220
FDP027N08B	80	2.7	137	TO220
FDMS039N08B	80	3.9	77	PQFN56
FDMS015N04B	40	1.5	87	PQFN56

INTEGRATED PWM CONTROLLER

Advantages

- **Low power consumption of 25mW with no-load**
- **No auxiliary bias winding**
- **Saves 50% board space, reduces BOM**

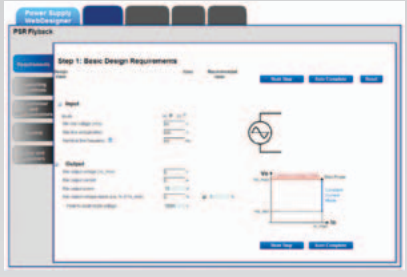
Applications

- **Motion control—home appliance and industrial motors**
- **Smart grid**
- **Smart meter**

For more information, please visit:
fairchildsemi.com/pf/FS/FSL206MR.html

Design Support:

The FSL206MRx family is supported by Fairchild's Power Supply WebDesigner (PSW), an easy-to-use, powerful online design tool that allows designers to further customize and fine tune their designs without having to build a bench prototype.



Evaluation Board

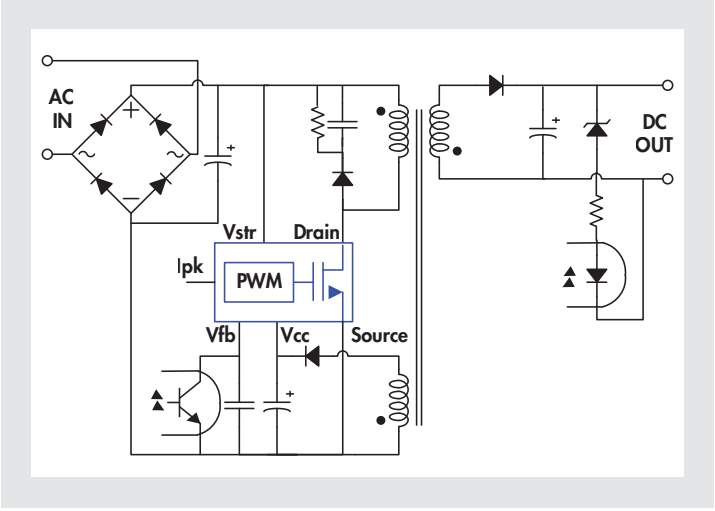
Integrated PWM Controller Evaluation Board is now available featuring the FSL206MRN, a PWM controller with integrated MOSFET. This board targets 5W auxiliary power supply applications.

The Power Supply WebDesigner and evaluation board are both available at:
www.fairchildsemi.com/pf/FS/FSL206MR.html.

Minimize Components, Achieve Higher Power Conversion Efficiency

SMPS designers face several design complexities: space constraints, along with the need for cost-effective power supply solutions with high energy efficiency, optimized system performance and improved reliability. Fairchild now offers a solution: the FSL206MR integrated pulse width modulator (PWM) controller. With integrated protection circuitry, the controller improves SMPS reliability and saves board space.

Part of the Green Mode Fairchild Power Switch (FPS™) device family, the integrated PWM controller with avalanche-rugged SenseFET includes an internal regulator, eliminating the need for an auxiliary bias winding. This highly integrated PWM controller includes a built-in, high-voltage startup and full-protection circuitry that saves board space and total bill of material (BOM) costs. Optimized for efficiency and power dissipation with burst-mode operation, when the input voltage is $265V_{AC}$, the devices can reach power loss of 150mW with no-bias winding and 30mW with bias winding at no-load condition.



Typical Application Diagram

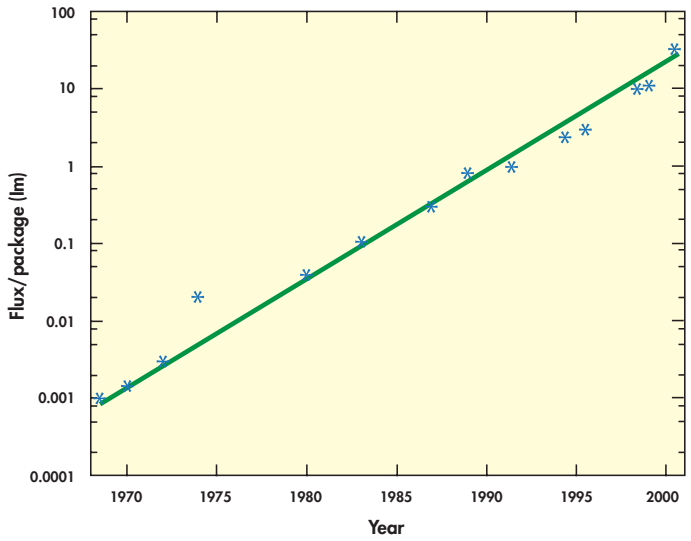
Product Number	BV_{BURH} (V)	BV_{BURH} (V)	BV_{DSS} (V)	Switching Frequency (kHz)	Max Pout Open Frame (85-265V_{AC}) (W)	$R_{DS(ON)}$ Max (W)	Current Limit (A)	Package Option
FSL206MRN	0.83	0.74	650	67	7	19	0.6	DIP-8
FSL206MRL	0.83	0.74	650	67	7	19	0.6	LSOP-8
FSL206MRBN	0.5	0.35	650	67	7	19	0.6	DIP-8

Various Protections: Overload Protection (OLP), Over-Voltage Protection (OVP), Low Under-Voltage Lockout (UVLO), Line Under-Voltage Protection (LUVP), Abnormal Over-Current Protection (AOCP), Output-Short Protection (OSP), Thermal Shutdown (TSD), Auto-Restart Mode for All Protections

Advances in LED and LED Driver Technology Pave the Way for Significant Reductions in Global Power Usage and Cleaner Environment

The following article is a condensed version of Fairchild's backgrounder on solutions to LED driver challenges.

The global demand for highly efficient LED products has grown dramatically over the past 10 years, to the extent that today's products are rapidly encroaching on the $100 billion fluorescent light market which has flourished over the past 130 years[1]. Recent improvements in this 40-year technology have resulted in "clean," reliable and highly efficient products which are already dominating in many rapidly growing applications. LEDs are now the preferred lighting source for mobile phones, full-motion signs, traffic signals, automotive dashboards, digital cameras, backlighting units for displays in notebook computers, desktop monitors, flat-panel televisions, and stadium signage.



The light output of LEDs has essentially doubled every 36 months since 1960.

Design Challenges for LEDs and LED Drivers

As LED capabilities improved, so too did the importance of driver technology. Performance criteria such as LED color temperature and shifting, efficacy and flickering, and overall operating efficiency all became associated with the LED driver. Legacy LED driver topologies that had used older solid state designs and voltage regulators cannot support new LED design performance targets. Continuous advancements in LED performance have the effect of requiring new topologies and more LED driver choices for specific output power ranges and applications.

Low Power Designs (<20W), include applications such as light strips (1.5-5.0W), R-Lamps (5-10W), bulbs (3-20W) and down lights (10-20W). The specific implementation challenges with these applications include: (1) small lamp size which limits component selection to the smallest available packages, (2) small design volume, which requires the use of low profile components and (3) cost.

Mid-Power Designs (20-50W), include applications in the range of 20-50W, such as down lights, and L-lights. The designer's challenges with these applications include: (1) limited board space, (2) available topologies that are inherently low-efficiency, (3) need for high reliability components and (4) power factor correction (PFC) is required, which then increases component count. Fairchild's solutions for mid-power designs address these challenges by utilizing a single-stage PFC flyback topology.

High-Power Designs (50-400W), include applications in the range of 50-400W such as flat lights, street, stadium, stage lighting, wall washing and signage. The designer's challenges with these applications include: (1) high component count, (2) cost, (3) low overall system efficiency and (4) increased complexity. Fairchild offers two highly integrated high-power solutions: two-stage PFC flyback and Quasi-Resonant (QR) flyback topology and the two-stage PFC flyback and LLC half-bridge topology.



Applications and Design Support

Fairchild's constantly expanding product portfolio, combined with manufacturing process enhancements, innovative topologies and our deep systems expertise allow circuit designers to develop the most advanced solution to their present and future needs.

Learn more about Fairchild's total LED solutions.

(1) CFL Market Profile, March 2009, U.S. Department of Energy

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POWER MANAGEMENT

Power Factor Correction
- Continuous Conduction Mode (CCM) PFC Controllers
- Critical/Boundary Conduction Mode (CrCM/BCM) PFC Controllers
- Interleaved PFC Controllers
- PFC + PWM Combination (Combo) Controllers

Off-Line and Isolated DC-DC
- AC-DC Linear Regulators
- Flyback & Forward PWM Controllers
- Flyback & Forward PWM Controllers with Integrated MOSFET
- LLC Resonant & Asymmetric Half Bridge PWM Controllers
- LLC Resonant & Asymmetric Half Bridge PWM Controllers with Integrated MOSFETs
- Primary-Side Regulation CV/CC Controllers
- Primary-Side Regulation CV/CC Controllers with Integrated MOSFET
- Standard PWM Controllers
- Supervisory/Monitor ICs

Non-Isolated DC-DC
- Charge-pump Converters
- DrMOS FET plus Driver Multi-Chip Modules
- Step-down Controllers (External Switch)
- Step-down Regulators, Non-Synchronous (Integrated Switch)
- Step-down Regulators, Synchronous (Integrated Switch)
- Step-up Regulators (Integrated Switch)

MOSFET and IGBT Gate Drivers
- 3-Phase Drivers
- Half-Bridge Drivers
- High-Side Drivers
- Low-Side Drivers
- Synchronous Rectifier Drivers

Voltage Regulators
- LDOs
- Positive Voltage Linear Regulators
- Negative Voltage Linear Regulators
- Shunt Regulators
- Voltage Detector
- Voltage Stabilizer
- Voltage to Frequency Converter

Motion Control
- BLDC/PMSM Controller
- SPM® (Smart Power Modules)
- PFC SPM® (Smart Power Modules)

Diodes & Rectifiers
- Bridge Rectifiers
- Transient Voltage Suppressors (TVS)
- Diacs
- Rectifiers
- Schottky Diodes & Rectifiers
- Small Signal Diodes
- Zener Diodes

IGBTs
- Discrete IGBTs

MOSFETs
- Discrete MOSFETs
- Integrated Load Switches
- MOSFET/Schottky Combos

Transistors
- BJTs
- Darlingtons
- Digital/Bias-Resistor Transistors
- JFETs
- RF Transistors
- Small Signal Transistors

Advanced Load Switches
- Advanced Current Limited Load Switches
- Slew Rate Controlled Load Switches

Battery Management
- Battery Charger ICs
- Current Sensing

Ground Fault Interupt Controllers
- Ground Fault Interrupt (GFI) Controllers

Backlight Unit (BLU)
- CCFL Inverter ICs

ANALOG & MIXED SIGNAL

Amplifiers & Comparators
- Comparators
- Operational Amplifiers

Audio Amplifiers
- Audio Subsystems
- Audio Headphone Amplifiers
- Digital Microphone Amplifiers
- Audio Speaker Amplifiers

Battery Protection ICs
- Battery Protection ICs

Interface
- LVDS
- Serializers/Deserializers (µSerDes™)
- USB Transceivers

Signal Conditioning
- Video Filter Drivers
- Video Switch Matrix/Multiplexers

Signaling, Sensing & Timing
- Signaling, Sensing & Timing
- Timing

Switches
- Accessory Switches
- Analog Switches
- Audio Jack Detection Switches
- Audio Switches
- Bus Switches
- MIPI Switches
- Multi-media Switches
- USB Switches
- Video Switches

LOGIC

Buffers, Drivers, Transceivers
- Buffers
- Line Drivers
- Transceivers

Flip Flops, Latches, Registers
- Counters
- Flip Flops
- Inverters
- Latches
- Registers

Gates
- AND Gates
- NAND Gates
- OR Gates
- NOR Gates
- Schmitt Triggers
- Configurable Gates

Multiplexer/Demultiplexer/ Decoders
- Decoders
- Demultiplexers
- Multiplexers
- Multivibrators

Voltage Level Translators
- Voltage Level Translators

LIGHTING ICs
- Fluorescent Lamp ICs
- HID ICs
- LED Lighting ICs
- Portable LED Drivers

OPTOELECTRONICS

High Performance Optocouplers
- Low Voltage, High Performance
- High Speed Logic Gate
- High Performance Transistor
- Specific Function

Infrared
- Emitting Diodes
- Photo Sensors
- Photo Sensor – Transistors
- Ambient Light Sensors
- Reflective Sensors
- Optical Interrupt Switches

Phototransistor Optocouplers
- Isolated Error Amplifier
- Phototransistor Output - DC Sensing Input
- Phototransistor Output - AC Sensing Input
- Photo Darlington Output

TRIAC Driver Optocouplers
- Random Phase TRIAC Driver
- Zero Crossing TRIAC Driver

IGBT/MOSFET Gate Drivers
- IGBT/MOSFET Gate Drivers

AUTOMOTIVE PRODUCTS

Automotive Discrete Power
- Automotive Ignition IGBTs
- Automotive IGBTs
- Automotive N-Channel MOSFETs
- Automotive P-Channel MOSFETs
- Automotive Rectifiers

Automotive Gate Drivers (HVICs)
- High Voltage Gate Drivers (HVICs)

Automotive Smart Power Switches
- Automotive Smart Power Switches

CIRCUIT PROTECTION

Reverse Polarity Protection
- Reverse Bias Protection Switches
- Schottky diodes
- Blocking Diodes

Transient Voltage Suppressors (TVS)
- Power TVS (> 400W)
- Mid Power TVS

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