





MOTOR DRIVE SOLUTIONS

Energy-efficient, Integrated and Discrete Semiconductor Solutions for Your Home Appliance and Industrial Applications





Improving Energy Efficiency and Reliability in Motor Control Applications

As the demands for energy efficiency, environmental responsibility and meeting government regulations are increasing, the need for highly efficient electronic systems becomes more and more important. Since electrical motors are the single largest consumer of electrical power and account for between 40 to 50 percent of total global energy consumption, it is essential that motor control solutions are both efficient and reliable.

Making the situation more complex is the fact that there is an extremely wide range of electric motor applications. Primary applications by sector include: **residential**—refrigerators, air conditioners, fans, pumps, kitchen appliances, washers and dryers, computers, tools, etc.; **industrial/commercial**—pumps and fans, air and liquid compression, heating and air conditioning (HVAC), large computers, escalators, elevators, hoists, cranes, industrial-grade laundry, cleaning and cooking equipment; **transportation**—electric trains, trucks, cars and motorcycles in related cooling/ventilation systems.

To accommodate the hundreds of applications, there are many types of electric motors from which to choose in order to get the highest efficiency and/or lowest cost. The most commonly used motors are AC Induction Motors (ACIM), brushed DC, stepper, brushless DC and Permanent Magnet Synchronous (PMSM). Once the motor has been chosen, it becomes extremely important to carefully choose the supporting components for the system. Critical design factors and challenges for motor control architectures are efficiency, reliability, noise reduction, thermal performance, reduced board space and ease of design.



For more information, use your smart phone to scan the QR code, or visit: www.fairchildsemi.com/applications/motor-control/

Fairchild's Solutions for Successful Motor Control Applications

Our constantly expanding product portfolio—combined with manufacturing process enhancements—innovative topologies, and our systems expertise, allow circuit designers to develop the most advanced solutions to meet their needs. We offer a broad range of SPM®, IGBTs, Gate Drivers, PFC-PWM combos, MOSFETs, phototransistors and diodes for every motor control application. In addition, there are reference designs and evaluation boards to optimize your design success.

Examples From Our Portfolio Include:

- Motion SPM[®] (Smart Power Module)—integrated solutions that support low-power (20W) and high-power (7.5kW) designs
- BLDC (Brushless DC/Permanent Magnet Synchronous Motor)—mixed-signal ICs exclusively for motor control that replace complicated DSPs (Digital Signal Processors)
- **PFC (Power Factor Correction)**—PFC SPM® minimize input current distortion, reduce power loss and save energy and cost
- **Optocouplers**—provide isolation from high-voltage devices in motor control designs
- SMPS (Switched Mode Power Supply)—power management devices used in flyback converter designs



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3-PHASE MOTOR SOLUTIONS FOR BLDC, PMSM/BLAC AND ACIM INTEGRATED MOTOR DRIVE SOLUTIONS – MOTION SPM® MODULES

SPM 45H Series Modules

Designers who need to reduce board space, decrease manufacturing costs and speed time-to-market while increasing system reliability, have many options with Fairchild's SPM 45H series. These modules can replace up to 25 discrete components by integrating 3 high-side drivers, 3 low-side drivers, 6 IGBTs, 6 FRDs, 3 bootstrap diodes, 1 thermistor, and numerous passives into a fully tested compact (39mm x 23mm) package.

Design Advantages:

- Built-in advanced NPT IGBTs provide optimal conduction loss and switching loss
- Advanced STEALTH™ Diode has low t_{rr} and I_{rr} characteristic (Figure 1)
- Full protective functions included; built-in NTC for OT protection, UVLO and SC
- Integrated bootstrap diode saves the PCB space and BOM cost
- Improved ruggedness due to advanced NPT IGBTs
- \bullet Built-in bootstrap diode and independent $V_{\rm S}$ pin provides easy design and reduced board space

Applications:

- Air conditioners
- Washing machines
- Refrigerators
- Dishwashers
- Industrial inverters



Compact 39mm x 23mm x 4.5mm Package



Figure 1: t_r Waveform Comparison Between Ultrafast Diode and Advanced STEALTH™ Diode

3-PHASE MOTOR SOLUTIONS FOR BLDC, PMSM/BLAC AND ACIM MOTION SPM® MODULES

Motion SPM 45H Series Modules											
Normal Speed Ve	ersion										
Part Number	Switching Device	Breakdown Voltage (V _{CES} or V _{DSS}) (Min.) (V)	Current Rating (Max.) @ T _c = 25°C (A)	V _{cE[sat]} (Max.) @ T _J = 25°C (V)	Switching Frequency (kHz)	Isolation Voltage (Min.) (V)	Bootstrap Diode	Substrate			
FNA40560	IGBT	600	5	2.2	5	2000	Yes	Ceramic			
FNA40860	IGBT	600	8	2.2	5	2000	Yes	Ceramic			
FNA41060	IGBT	600	10	2.2	5	2000	Yes	Ceramic			
FNA41060B2	IGBT	600	10	2.2	5	2000	Yes	Ceramic			
FNA41560	IGBT	600	15	2.3	5	2000	Yes	Ceramic			
FNA41560B2	IGBT	600	15	2.3	5	2000	Yes	Ceramic			
FNC42060*	IGBT	600	20	1.85	5	2000	Yes	Ceramic			
Fast Speed Versio	on										
Part Number	Switching Device	Breakdown Voltage (V _{CES} or V _{DSS}) (Min.) (V)	Current Rating (Max.) @ T _c = 25°C (A)	V _{cE[sat]} (Max.) @ T _J = 25°C (V)	Switching Frequency (kHz)	Isolation Voltage (Min.) (V)	Bootstrap Diode	Substrate			
FNB40560	IGBT	600	5	1.9	20	2000	Yes	Ceramic			
FNB41060	IGBT	600	10	2	20	2000	Yes	Ceramic			
FNB41560	IGBT	600	15	2.1	20	2000	Yes	Ceramic			
FNB41560B2	IGBT	600	15	2.1	20	2000	Yes	Ceramic			

* In Development

Note: Integrated Protection Functions Include Built-In NTC Thermistor and Built-In Over Current (C_{sc})



3-PHASE MOTOR SOLUTIONS FOR BLDC, PMSM/BLAC AND ACIM MOTION SPM® MODULES

SPM 5 Series Modules

The SPM 5 series module increases reliability, energy efficiency, lowers electromagnetic interference and saves PCB board space in low-power brushless direct current (BLDC) motor applications. These modules combine 6 MOSFETs (FRFET®, UniFET™) and 3 half-bridge HVICs in compact, thermally efficient, 29mm x 12mm packages. The FRFETs feature fast and soft recovery body diodes, offering a combination of lower switching losses, lower conduction losses at low current and a wider Reverse Bias Safe Operating Area (RBSOA), when compared to IGBTs. These body diodes are free-wheeling, eliminating the need for additional components.

Design Advantages:

- Integrated thermal sensing unit (TSU) for real-time detection (Figure 1)
- Built-in bootstrap diode delivers a more simplified, compact design
- Higher reliability due to fully tested modules (HVICs and MOSFETs)
- High-active input signal logic resolves the startup and shutdown sequence constraint between the control supply and control input providing fail-safe operation with direct connection between the SPM[®] and a 3.3V CPU or DSP
- Single-grounded power supply and optocoupler-free interface due to built-in HVIC
- No need for any additional external sequence logic
- Three divided negative DC-link terminals for inverter current sensing applications

Pumps

Applications:

- Washing machines
- Indoor/outdoor fans
 Dishwashers



Figure 1: 3V/5V CMOS/TTL Compatible Perfectly Linear Characteristics

29mm x 12mm x 3.1mm Packages

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3-PHASE MOTOR SOLUTIONS FOR BLDC, PMSM/BLAC AND ACIM MOTION SPM® MODULES

Motion SPM 5 Series Modules												
Part Number	Switching Device	Breakdown Voltage (V _{CES} or V _{DSS}) (Min.) (V)	Current Rating (Max.) (A)	R _{DS(ON)} (Max.) @ T _c = 25°C (Ω)	Switching Frequency (kHz)	Isolation Voltage (Min.) (V)	Bootstrap Diode	Protections	Substrate			
FSB50250A/AS/AT*	MOSFET	500	1.2	3.8	20	1500	Yes	UVLO	Full Package			
FSB50450A/AS*	MOSFET	500	1.5	2.4	20	1500	Yes	UVLO	Full Package			
FSB50550A/AS/AT*	MOSFET	500	2	1.4	20	1500	Yes	UVLO	Full Package			
FSB50325A/AT*	MOSFET	250	1.7	1.7	20	1500	Yes	UVLO	Full Package			

*A: DIP, -AS: Surface Mount, AT: Extended Clearance DIP



3-PHASE MOTOR SOLUTIONS FOR BLDC, PMSM/BLAC AND ACIM

MOTION SPM® MODULES

SPM 3 Series Modules Optimize Wide Range (600V/3A to 30A) of Inverter Driver Applications

For increased design flexibility of a wide power range (from 0.15kW to 3kW), the SPM 3 series modules provide a range of 3A to 3OA in a single package. Fairchild's Direct Bonded Copper (DBC) technology with the product number prefix FSBB indicates this capability. The SMP 3 series consists of a suite of 17 IGBT inverter modules and 2 MOSFET modules offering excellent thermal resistance. Each module integrates 3 high-side drivers, 1 low-side driver, and 6 IGBTs with fast recovery diodes, or MOSFETs, in a compact 44mm x 26.8mm x 5.5mm package.

Design Advantages:

- Low-loss efficient NTP IGBTs, FRDs and bootstrap diodes are integrated in a single package to optimize motor driving performance
- Single-grounded power supply and optocoupler-free interface due to built-in HVIC
- Full protective functions; UVLO, SC and TSD
- Divided negative DC-link terminals for inverter current sensing applications
- Isolation voltage rating of $2500V_{rms}/min$
- Very low leakage current due to ceramic and DBC substrate

Applications:

- Air conditioners
- Washing machines
- Refrigerators
- Dishwashers
- Industrial inverters



44mm x 26.8mm x 5.5mm Package

Motion SPM 3 Series Modules												
Part Number	Switching Device	Breakdown Voltage (V _{CES} or V _{DSS}) (Min.) (V)	Current Rating (Max.) (A)	V _{CE[sat]} (Max.) @ T _j = 25°C (V)	Switching Frequency (kHz)	Isolation Voltage (Min.) (V)	Bootstrap Diode	Substrate				
FSBB15CH60C	IGBT	600	15	2	20	2500	Yes	DBC				
FSBB20CH60C	IGBT	600	20	2	20	2500	Yes	DBC				
FSBB20CH60CL	IGBT	600	20	2	20	2500	Yes	DBC				
FSBB20CH60CT	IGBT	600	20	2.2	20	2500	Yes	DBC				
FSBB30CH60C	IGBT	600	30	2	20	2500	Yes	DBC				
FSBF5CH60B	IGBT	600	5	2	20	2500	Yes	Full Package				
FSBF10CH60B	IGBT	600	10	2	20	2500	Yes	Full Package				
FSBF10CH60BT	IGBT	600	10	2.2	20	2500	Yes	Full Package				
FSBF10CH60BTL	IGBT	600	10	2.2	20	2500	Yes	Full Package				
FSBF15CH60BT	IGBT	600	15	2.2	20	2500	Yes	Full Package				

Note: Integrated Protection Functions Include Built-In Over Current (C_{sc}) and Built-In Over Temp (TSD)

SPM 2 Series Modules

The Motion SPM®2 series provides complete adjustable-speed motor drive control and fully-integrated circuit protection for AC motors found in applications such as washing machines and air conditioners. Compared to discrete IGBT solutions, the integrated SPM® module requires less than half the board space, while providing low-voltage control and high-voltage output stage rated at 10~30A at 220V_{AC}. This series is available in a small (60mm x 31mm), ceramic-based transfer molded-type package that optimizes heat transfer from the IGBTs, achieving 27% higher power rating than conventional TO-220F packages.

Design Advantages:

- Built-in thermistor for temperature monitoring
- Adjustable short-circuit current protection using low-side sense-IGBTs
- Low-active input signal logic resolves the startup and shutdown sequence constraint between the control supply and control input providing fail-safe operation with direct connection between the SPM[®] and a 3.3V CPU or DSP



60mm x 31mm x 7.2mm Package

- Divided negative DC-link terminals for inverter current sensing applications
- Inverter power rating covering up to 7.5kW at $230V_{AC}$ input within a single package
- Optimized IGBTs for low- and high-switching applications
- Isolation voltage rating of 2500V_{rms}/min
- Low thermal resistance due to ceramic and DBC substrate

Applications:

- Air conditioners
- Industrial inverters

Motion SPM 2 Series Modules											
Part Number	Switching Device	Breakdown Voltage (V _{CES} or V _{DSS}) (Min.) (V)	Current Rating (Max.) (A)	V _{CE(sat)} (Max) @ T _j = 25°C (V)	Switching Frequency (kHz)	Isolation Voltage (Min.) (V)	Bootstrap Diode	Substrate			
FSAM50SM60A	IGBT	600	50	2.4	5	2500	No	DBC			
FSAM75SM60A	IGBT	600	75	2.4	5	2500	No	DBC			

Note: Integrated Protection Functions Include Built-In NTC Thermistor and Built-In Over Current (C_{sc})

PFC SPM® MODULES

PFC SPM Modules

For design flexibility, Fairchild offers both discrete and integrated PFC solutions. Our integrated Power Factor Correction Smart Power Modules (PFC SPM®) are also known in the industry as IPM (Intelligent Power Modules). These solutions are optimized for a wide power range (600V/3A to 30A) for inverter driver applications. PFC SPMs have the same advantages of the SPM Direct-Copper Bond (DCB) substrate packaging. For example, this packaging enables high voltage motor drivers; and now enables PFC for high-voltage motor control. Integrated into the PFC SPM family are a front-end rectifier circuit, partial switching converter circuit, and power factor correction circuit which can be controlled by an external controller; e.g. Fairchild's BLDC/PMSM controller, third-party micro-controller (MCU), DSP controller, or FPGA (Field Programmable Gate Array).

Design Advantages:

- Optimized IGBTs, diodes and gate driver for PFC applications
- High energy efficiency by eliminating one diode conduction loss
- Best thermal resistance due to adoption of DBC substrate
- Isolation voltage rating of $2500V_{rms}/min$
- Gate driving IC Under Voltage (UV) and Over Current (OC) protection
- Package designed to satisfy the basic creepage and clearance spacing UL Certified No. E20920



PFC SPM devices have the same mechanical dimension as the motor driver SPMs; both can be installed on the same heat sink, enabling easy assembly and increased productivity.

PFC SPM Module	PFC SPM Modules												
Part Number	Topology	Breakdown Voltage (V _{CES}) (Max.) (V)	V _{cE[sat]} (Max.) @ T _j = 25°C (V)	Switching Frequency (kHz)	Isolation Voltage (Min.) (V)	Substrate	Package						
FPAM30LH60	Interleaved PFC	600	2.2	20	2500	DBC	S32EA-032						
FPAM50LH60	Interleaved PFC	600	2.2	20	2500	DBC	S32EA-032						
FPAB20BH60B	Boost PFC	600	3	20	2500	DBC	SPMIC-027						
FPAB30BH60B	Boost PFC	600	2.8	20	2500	DBC	SPMIC-027						
FPAB30BH60	Boost PFC	600	2.8	20	2500	DBC	SPMIA-027						
FPDB40PH60B	Bridgeless PFC	600	2.1	20	2500	DBC	SPMGC-027						
FPDB60PH60B	Bridgeless PFC	600	2.5	20	2500	DBC	SPMGC-027						
FPDB30PH60	Bridgeless PFC	600	3.1	20	2500	DBC	SPMGA-027						
FPDB50PH60	Bridgeless PFC	600	3.2	20	2500	DBC	SPMHA-027						
FBA42060	Boost PFC	600	3	20	2500	Ceramic	SPMAA-F26						

Interleaved PFC SPM Modules

An advanced 2-phase interleaved PFC Smart Power Module features a single-phase rectifier for AC input, 2-phase interleaved PFC, Control IC for gate driving and protection – UL Certified No. E209024.



Boost PFC SPM Modules

An advanced PFC Smart Power Module targeting high-power applications (3kW – 6kW).



Bridgeless PFC SPM Modules

An advanced PFC Smart Power Module targeting high-power applications (3kW – 6kW).



SWITCHED MODE POWER SUPPLY (SMPS)

Fairchild Power Switch (FPS™) Controllers

The FSL1xx and FSL2xx series integrates PWM and SenseFETs, designed for high-performance Switch Mode Power Supplies (SMPS) with minimal external components.

Design Advantages:

- Avalanche rugged SenseFET (650V, 700V and 800V)
- Precision-fixed operating frequency and frequency jittering for attenuating EMI
- Advanced soft burst-mode operation for low standby power and lower audible noise
- No-load power consumption (FSL2xx):
 - <150mW at $265V_{AC}$ without bias winding
 - <25mW or 50mW with bias winding
- Ultra-low operating current: 0.3mA (FSL2xx) and 1.8mA (FSL1xx)
- Protections: Over-Voltage Protection (OVP), Overload Protection (OLP), Output-Short Protection (OSP), Abnormal Over-Current Protection (AOCP) and Thermal Shutdown (TSD) with auto restart



Protective Functions Pour (Max.) (W)		Pour (Max.) (W)	R									
Part Number	BV _{DSS} (V)	Frequency (kHz)	OLP	АОСР	OVP	LUVP	OSP	TSD	I _{umit}	Öpen Frame (85~265V _{AC})	(Max.) (Ω)	Package
FSL106HR	650	100	AR	AR	AR	N/A	AR	AR	0.7A (Adj.)	10	19	DIP-8
FSL106MR	650	67	AR	AR	AR	N/A	AR	AR	0.58A (Adj.)	8	19	DIP-8
FSL116HR	650	100	AR	AR	AR	N/A	AR	AR	1.2A (Adj.)	14	10	DIP-8
FSL116LR	650	50	AR	AR	AR	N/A	AR	AR	1.2A (Adj.)	14	10	DIP-8
FSL126HR	650	100	AR	AR	AR	N/A	AR	AR	1.5A (Adj.)	17	6	DIP-8
FSL126MR	650	67	AR	AR	AR	N/A	AR	AR	1.5A (Adj.)	17	6	DIP-8
FSL126MRT	650	67	AR	AR	AR	N/A	AR	AR	1.2A	30	6.2	TO220F-6
FSL128MRT	800	67	AR	AR	AR	N/A	AR	AR	1.2A	30	6	TO220F-6
FSL136HR	650	100	AR	AR	AR	N/A	AR	AR	2.15A (Adj.)	20	4	DIP-8
FSL136MR	650	67	AR	AR	AR	N/A	AR	AR	2.15A (Adj.)	20	4	DIP-8
FSL136MRT	650	67	AR	AR	AR	N/A	AR	AR	2.15A	40	4	TO220F-6
FSL137H	700	100	AR	AR	AR	AR	AR	AR	0.84A	25	4.75	DIP-8
FSL138MRT	800	67	AR	AR	AR	N/A	AR	AR	2.15A	40	5	TO220F-6
FSL176MRT	650	67	AR	AR	AR	N/A	AR	AR	3.5A	70	1.6	TO220F-6
FSL206MRL	650	67	AR	AR	AR	AR	AR	AR	0.6A	7	19	LSOP-8
FSL206MRN	650	67	AR	AR	AR	AR	AR	AR	0.6A	7	19	DIP-8
FSQ500N	700	130	AR	N/A	N/A	N/A	N/A	AR	0.32A	5.5	29	DIP-8
FSQ500L	700	130	AR	N/A	N/A	N/A	N/A	AR	0.32A	5.5	29	SOT-223
FSL306LR	650	50	AR	AR	AR	AR	AR	AR	0.3A (Adj)	8	18	DIP-7

AR: Auto Restart

BLDC/PMSM CONTROLLER

BRUSHLESS DC/PERMANENT MAGNET SYNCHRONOUS MOTOR

Brushless DC/Permanent Magnet Synchronous Motor

With higher efficiency and reliability, lower acoustic noise and vibration as well as longer motor/battery life, the Brushless DC (BLDC) motor is being adopted in more and more designs. All of these motor enhancements are helping to meet consumer demands in motor applications. To align with this growing trend, Fairchild has developed the BLDC/PMSM controller—a mixed-signal integrated circuit to control variable speed, 3-phase (BLDC) and Permanent Magnet Synchronous Motor (PMSM) sensored motors.

Design Advantages:

- Fast implementation of BLDC and/or PMSM motor control without the burden of complicated software development
- Replaces complicated Digital Signal Processors (DSPs)
- Provides hardware implemented fault detection and protection features

FCM8201:

The FCM8201 has a SPI interface to allow greater configuration control via an MCU/DSP/FPGA; e.g. clock generator, PWM modes, DAC, ADC, OC timer, watchdog timer, dead time settings, error amp IP, etc.

FCM8202:

The FCM8202 is a stand-alone solution, no SPI port; therefore, no MCU/DSP/FPGA is required. The device configuration is controlled with the I/O pin settings; delivering the same external controls as the FCM8201.



Motor Control design using an SPM® module

Couple the BLDC/PMSM controller with the Smart Power Module (SPM®) motor driver for fast time-to-market and higher manufacturing reliability of your motor control designs.



Motor Control design using discrete components

Use the BLDC/PMSM controller in discrete motor drive implementations along with Fairchild's HVIC (High-Voltage Integrated Circuits) gate drivers, IGBTs (Insulated Gate Bipolar Transistors) and MOSFETs.

HIGH-VOLTAGE GATE DRIVERS (HVIC)

High-Voltage Gate Drivers (HVIC)

Fairchild's HVICs improve system reliability with an innovative noise canceling circuit that provides excellent noise immunity. HVIC solutions save at least 50% PCB area compared to commonly used optocoupler-based or pulse transformer-based solutions. The industry-leading, high-side driver operation with negative V_s swings, of up to -9.8V (at $V_{BS} = 15V$), protects the HVIC against negative noise. Competitive products must use an additional diode to provide this protection. These HVIC products feature the industry's lowest quiescent currents for extremely low-power consumption, as well as the market's lowest temperature dependency of electrical characteristics, guaranteeing stable operation in a wide range of applications.

Design Advantages:

- Variety of topologies: low-side, high-side, half-bridge and complete 3-phase in one package
- Full protection function with high ruggedness
- Shoot-through protection, over current protection, fault out, under voltage, etc.
- High noise immunity
- Better performance on positive, negative $V_{\scriptscriptstyle B}$ and positive, negative noise on $V_{\scriptscriptstyle B}$
- Wider $V_{_{\rm I\!N\!}}$ voltage range over competitor solutions

Applications:

- 3-phase motor inverter drivers
- Air conditioners, washing machines, refrigerators, dishwashers
- Industrial inverters sewing machines, power tools

Part Number	Topology	V _s Offest	lo+/lo- (mA)	Input	Protection Functions	Package
FAN7380	Half-Bridge	600	90/180	Active High	UVLO (V _{CC} /V _{BS}), Shoot-through	SOP-8
FAN7383	Half-Bridge	600	350/650	Active High	UVLO (V _{cc} /V _{ss}), Shoot-through, Shutdown (Reset), Programmable Dead Time	SOP-14
FAN7384	Half-Bridge	600	250/500	Active High	UVLO (V _{CC} /V _{BS}), Shoot-through, Shutdown (Reset), OCP, Fault Output, Soft Shutdown	SOP-14
FAN7393A	Half-Bridge	600	2500/2500	Active High	UVLO (V _{CC} /V _{BS}), Shoot-through, Shutdown(Reset), Dead Time Control	SOP-14
FAN7382	High-Side and Low-Side	600	350/650	Active High	UVLO (V _{CC} /V _{BS})	DIP-8, SOP-8, SOP-14
FAN7390	High-Side and Low-Side	600	4500/4500	Active High	UVLO (V _{CC} /V _{BS})	DIP-8, SOP-8, SOP-14
FAN73901	High-Side and Low-Side	600	2500/2500	Active High	UVLO (V _{cc} /V _{BS})	SOP-8
FAN7392	High-Side and Low-Side	600	3000/3000	Active High	UVLO (V _{cc} /V _{BS}), Shutdown (Reset), Separated Power/Logic Ground	DIP-14, SOP-16
FAN7842	High-Side and Low-Side	200	350/650	Active High	UVLO (V _{CC} /V _{BS})	SOP-8
FAN7388	3-Phase Half-Bridge	600	350/650	Active High	UVLO (V _{BS}), Shoot-through	SOP-20
FAN7389M1	3-Phase Half-Bridge	600	350/650	Active High	UVLO (V _{CC} /V _{BS}), Shoot-through, Shutdown(Reset), OCP, Fault Output, Soft Shutdown	SOP-28
FAN73892M	3-Phase Half-Bridge	600	350/650	Active Low	UVLO (V _{CC} /V _{BS}), Shoot-through, Shutdown(Reset), OCP, Fault Output, Soft Shutdown	SOP-28
FAN7888	3-Phase Half-Bridge	600	350/650	Active High	UVLO (V _{CC} /V _{BS}), Shoot-through	SOP-28

Short Circuit Rated IGBTs

For demanding applications where there is a possibility that the device will be subject to a short circuit condition, Fairchild offers a family of high-voltage driver IGBTs capable of withstanding a 10µsec output short circuit, under worst case power supply ($V_{BB} = 150V$, $V_{CC} = 15V$) and junction temperature, 150°C. These devices also feature low conduction loss and switching loss characteristics, making them ideal for high-speed applications. The SMD packages allow for IR reflow and wave solder assembly without delamination.

Design Advantages:

- Proven IGBT and FRD technology (whole adopting silicon is used in SPM[®] Modules)
- Included co-pack diode for free-wheeling path
- SMD packages require no delamination
- Support short circuit withstand time with high ruggedness
 Fairchild's IGE and wave sol





• Fairchild's IGBTs guarantee IR reflow and wave solder assembly



Figure 1: Fairchild's Better Withstand Time with High Ruggedness Condition $V_{DD} = 350V$, $V_{CC} = 15V$, $R_{g} = 100\Omega$, $T_{J} = 150^{\circ}C$

Part Number	V _{ces}	Ι _c @ Τ _c = 100°C	V _{cE(sat)} @ T _c = 25°C	V _F @ T _c = 25°C	Co-pack Diode	Short Circuit Withstand Time** (µs)	Package
FGD3N60UNDF*		3	TBD	TBD		10	DPAK
FGB5N60UNDF		5	1.9	1.6	\checkmark	10	D2PAK
FGB7N60UNDF		7	1.9	1.6		10	D2PAK
FGP10N60UNDF	600V	10	2.1	1.6	\checkmark	10	TO-220
FGP15N60UNDF]	15	2.1	1.6		10	TO-220
FGPF10N60UNDF		10	2.1	1.6	\checkmark	10	TO-220F
FGPF15N60UNDF]	15	2.1	1.6		10	TO-220F

* In Development

** Condition: $V_{BB} = 350V$, $V_{CC} = 15V$, $R_g = 100\Omega$, $T_J = 150^{\circ}C$

Part Number	V _{ces}	Ι _c @ Τ _c = 100°C	$V_{ce(SAT)}$ @ $T_c = 25^{\circ}C$	V _F @ T _c = 25°C	Co-pack Diode	E _{off} Typ. (mJ/A)	Package
FGH/P20N60UFD		20	1.8	1.9	\checkmark	13	TO-220/TO-247
FGB20N60SF/SFD		20	2.2	1.9	\checkmark	8	D2PAK
FGB40N60SM**	(00)(40	1.9	-	-	6.5	D2PAK
FGH40N60SMD**	8000	40	1.9	2.3	\checkmark	6.5	TO-247
FGH60N60SMD**		60	1.9	2.2	\checkmark	7.5	TO-247
FGY75N60SMD**		75	1.9	2.2	\checkmark	10	TO-247
FGA40N65SMD**	(50)(40	1.9	2.3	\checkmark	6.5	TO-3PN
FGA60N65SMD**	0000	60	1.9	2.3		7.5	TO-3PN

** Field Stop II Technology

Note: For complete product portfolio visit http://www.fairchildsemi.com/search/tree/power-management/igbts/discrete-igbts/

IGBT/MOSFET GATE DRIVER

Optocoupler Isolation for IGBT/MOSFET Gate Drivers

These IGBT/MOSFET gate driver optoelectronics complement Fairchild's well-established offering in the discrete power IGBT/MOSFET line of products. Fairchild offers one-stop shopping for most integrated and discrete motor control devices. This combined solution of optocouplers and IGBTs/MOSFETs converts the mW to kW providing electrical isolation between the primary and secondary circuits.

Design Advantages:

- Wide operating voltage range: 10V to 30V
- High output current capability
- 5000V isolation voltage rating
- High common mode immunity, 35kV/us min.
- Low supply current (ICCH, ICCL)
- >8mm creepage and clearance distance
 - Lead spacing option "T", through-hole, DIP packaging
 - Lead spacing option "TS", surface mount, DIP packaging



Optocouple	r Isolation for I	GBT/MOSFET	Gate Drivers									
Part Number	I _{FLH} (Max.) (mA)	I _{DDL} , I _{DDH} (Max.) (mA)	I _{оι} , I _{он} (Min.) (А)	t _{PHL} , t _{PLH} (Max.) (ns)	PWD (Max.) (ns)	V _{uvlo+} (Тур.) (V)	V _{UVLO-} (Typ.) (V)	CMR (Min.) (kV/µs)	V _{iso} (Min.) (V)	T _{OPR} (Min.) (°C)	T _{opr} (Max.) (°C)	Package
FOD8321	7.5	5	2	500	300	12.7	11.2	20	5000	-40	100	SO-5L WB
FOD8320	5	3.8	2	400	100	12.7	11.2	35	5000	-40	100	SO-5L WB
FOD3180	8	6	2	200	65	8.3	7.7	10	5000	-40	100	MDIP-8L
FOD3120	5	3.8	2	400	100	12.7	11.2	35	5000	-40	100	MDIP-8L
FOD3150	5	5	1	500	300	12.7	11.2	20	5000	-40	100	MDIP-8L
FOD3184	7.5	3.5	2.5	210	65	13	11.5	35	5000	-40	100	MDIP-8L
FOD3182	7.5	4	2.5	210	65	8.3	7.7	35	5000	-40	100	MDIP-8L
FOD3181	10	6	0.5	500				10	5000	-40	100	MDIP-8L

Optocoupler Isolation for SPMs and HVICs

To prevent catastrophic failure of the motor drive and to meet safety regulatory standards, Fairchild offers 3.3V/5V high-speed logic gate optocouplers that provide isolation to Smart Power Modules (SPM®).

Design Advantages:

- Excellent noise immunity characterized by Common Mode Transient Immunity (CMTI) and Power Supply Rejection (PSR) specifications
- High bandwidth up to 25Mbps and 6ns pulse width distortion
- Dual supply voltages, 3.3V and 5V, enabling CMOS and level translation capabilities
- Electrical characteristics guaranteed beyond the full industrial temperature range (-40°C to +110°C)
- UL1577 (3,750 VAC_{RMS} for 1 min) and DIN EN/IEC60747-5-2 certified for increased reliability



High-Speed	Logic Gate	Optocouplers											
Part Number	Data Rate (Mbps)	Number of Channels	I _{FT} (Max.) (mA)	V _{ol} (Max.) (V)	I _{ccl} (Max.) (mA)	t _{PHL} (Max.) (ns)	t _{PHL} (Max.) (ns)	PWD (Max.) (ns)	CMR (Min.) (kV/µs)	V _{iso} (Min.) (V)	T _{opr} (Min.) (°C)	T _{OPR} (Max.) (°C)	Package
FOD2200	2.5	1	1.6	0.5	6	300	300	-	10	5000	-40	85	MDIP-8L
HCPL2611	10	1	5	0.6	13	100	100	35	10	2500	-40	85	MDIP-8L
HCPL2631	10	2	5	0.6	21	100	100	35	10	2500	-40	85	MDIP-8L
HCPL0638	10	2	5	0.6	21	100	100	35	15	3750	-40	85	SO-8L NB
HCPL0611	10	1	5	0.6	13	100	100	35	20	3750	-40	85	SO-8L NB
FODM611	10	1	5	0.6	10	100	100	35	20	3750	-40	85	MFP-5L

High-Performance Transistor Optocouplers														
Part Number	Data Rate (Mbps)	Number of Channels	CTR (Min.) (%)	CTR (Max.) (%)	CTR Tested @I _F (mA)	V _{oL} (Max.) (V)	I _{ccl} (Max.) (mA)	t _{on} (Max.) (µs)	t _{off} (Max.) (µs)	CMR (Typ.) (kV/µs)	V _{iso} (Min.) (V)	T _{opr} (Min.) (°C)	T _{opr} (Max.) (°C)	Package
FODM453	1	1	20	50	16	0.4	0.2	0.8	0.8	40	3750	-40	85	MFP-5L
HCPL4503M	1	1	19	50	16	0.5	0.2	0.8	0.8	30	5000	-40	100	MDIP-8L
HCPL0453	1	1	19	50	16	0.4	0.2	0.8	0.8	40	2500	-40	85	SO-8L NB

Note: For complete product portfolio visit http://www.fairchildsemi.com/search/tree/optoelectronics/high-performance-optocouplers/high-speed-logic-gate/



DESIGN TOOLS MOTION CONTROL DESIGN AND POWER SUPPLY WEBDESIGNER (PSW)

Motion Control Design Tool Easily Calculates Power Losses and Temperature Changes

The Motion Control Design Tool assists in the selection of the optimum Fairchild Motion SPM® module for a specific application. This tool addresses three-phase inverter sinusoidal modulation for variable speed drive applications powering permanent magnet synchronous motor (PMSM) and AC induction motors. Part selection is based on a detailed entry of application specific I/O information. The program output includes module component losses, junction temperature increases, cooling requirements and junction temperature ripple at the motor/output frequency.



IGBT or MOSFET Losses and Junction Temperature vs. Time





Flyback Design & Simulation in Minutes — at No Expense

Faster power supply designs—whether you are a power supply expert or not—are now a reality with Fairchild's Power Supply WebDesigner (PSW). This online design and simulation tool takes your specifications and provides a complete Primary-Side Regulated (PSR) Flyback Converter or Secondary-Side Regulated (SSR) Flyback Converter design. You get a schematic, simulated verification, and bill of material in minutes. Fine-tune design parameters without a bench prototype, swap component choices and perform detailed simulations and analyses—all with the ability to confidentially save your design for future reference.

R Flyback		SSR Flyback				
Stop 1: Basic Design 1 The second stop 1 The seco	Verbar Latrada Latrada Verbar Latrada		Step 1: Basic Design Requirements set as input set as input set of the output set the Constant set the Constant Set The Conjunt as Constant Set Set output set the Conjunt set output set set output set output set set output set output set set output set output	Annual R and C and		
	Normal Do		a 12: Cutput regulation a 12: Operating Conditions & Inpu	it Capacitor	Mas DCM Operation	



Secondary-Side Regulated Flyback Converter Tool

Fairchild's Global Power Resources[™] supports your designs with automated tools. For more information, visit www.fairchildsemi.com/design_tools



for a complete listing of sales representatives and sales offices, visit: www.fairchildsemi.com/cf/sales contacts

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Automotive Smart Power Switches

Reverse Bias Protection Switches

Transient Voltage Suppressors (TVS)Mid Power TVS

CIRCUIT PROTECTION

Blocking Diodes

• Schottky diodes

Reverse Polarity Protection

Power TVS (> 400W)

Solutions for Your Success[™]

For data sheets, application notes, samples and more, please visit: www.fairchildsemi.com

PRODUCTS	APPLICATIONS DESIGN SUPPORT	ABOUT FAIRCHILD	
POWER MANAGEMENT	Off-Line & Isolated DC-DC	Interface	LIGHTING ICs
Advanced Load Switches	AC-DC Linear Regulators	• LVDS	 Fluorescent Lamp ICs
 Advanced Current Limited 	 Flyback & Forward 	Serializers/Deserializers	HID ICs
Load Switches	PWM Controllers	(µSerDes™)	 LED Lighting ICs
 Slew Rate Controlled Load Switches 	 Flyback & Forward 	USB Transceivers	 Portable LED Drivers
Devel-Backetterer (11-1)	PWM Controllers with	si la livi i	
	Integrated MOSFET		OPTOELECTRONICS
CCFL Inverter ICs	 LLC Resonant & Asymmetric Half 	Video Filter Drivers Video Suiteb Martin (Multiplanese)	High Performance Optocouplers
• LED BLO Driver ICs	Bridge PWM Controllers	 video Switch /vidifix/ /viuitiplexers 	 High Speed Logic Gate
Battery Management	 LLC Resonant & Asymmetric 	Signaling, Sensing & Timing	 High Performance Transistor
 Battery Charger ICs 	Halt Bridge PWM Controllers	 Signaling, Sensing & Timing 	 Low Voltage, High Performance
 Current Sensing 	with Integrated MOSFETs	Timing	Specific Function
D'ada e Davifian	 Primary-Side Regulation 	с ». I	
	CV/CC Controllers	Switches	IGBT/MOSFET Gate Drivers
Bridge Rectifiers	 Primary-Side Regulation CV/CC 	Accessory Switches	 IGBT/MOSFET Gate Drivers
 Diacs Destifiers 	Controllers with Integrated MOSFET		Infrared
	 Standard PWM Controllers 	Audio Jack Detection Switches	Ambient Light Sensors
 Schottky Diodes & Rectifiers Small Simple Diades 	 Supervisory/Monitor ICs 	Audio Switches Due Switches	Emitting Diodes
Small Signal Diodes Transient Veltage Suppresses (TVS)	Power Factor Correction	DUS SWITCHES	Optical Interrupt Switches
Transient volidge Suppressors (1v3) Zener Diedee	Continuous Conduction	 Milli Switches Multi modia Switches 	Photo Sensors
Zener Diodes	Mode (CCM) PEC Controllers	ISP Switches	 Photo Sensor – Transistors
Ground Fault Interrupt (GFI) Controllers	Critical /Boundary Conduction	 USB Switches Video Switches 	Reflective Sensors
 Ground Fault Interrupt 	Mode (CrCM/BCM)	• video Switches	
(GFI) Controllers	PEC Controllers	1000	Phototransistor Optocouplers
ICPT-	Interleaved PEC Controllers	LOGIC Ruffers Drivers Transcrivers	 Isolated Error Amplifier
Discrete ICPTs	PEC + PWM Combination	Duffers, Drivers, Iransceivers	 Photo Darlington Output
	(Combo) Controllers	Duffers	Phototransistor Output -
MOSFET and IGBT Gate Drivers		Transcoivers	DC Sensing Input
All Drivers	Transistors		Phototransistor Output -
3-Phase Drivers	• BJIs	Flip Flops, Latches, Registers	AC Sensing Input
Half-Bridge Drivers	• Darlingtons	Counters	TRIAC Driver Optocouplers
 High-Side Drivers 	 Digital/Bias-Resistor Transistors 	 Flip Flops 	Random Phase TRIAC Driver
 Low-Side Drivers 	• JFEIs	 Inverters 	Zero Crossing TRIAC Driver
 Synchronous Rectifier Drivers 	• KF Iransistors	 Latches 	Zere crossing have birter
MOSTET	 Small Signal Transistors 	 Registers 	AUTOMOTIVE PRODUCTS
MOSFEIS	Voltage Regulators	Gates	Automotive Discrete Power
Discrete MOSFEIs	• LDOs	AND Gates	Automotive Ignition IGBTs
Integrated Load Switches	 Positive Voltage Linear Regulators 	Configurable Gates	Automotive IGBTs
• MOSTET/ Scholiky Combos	 Negative Voltage Linear Regulators 	NAND Gates	Automotive N-Channel MOSFETs
Motion Control	 Shunt Regulators 	NOR Gates	Automotive P-Channel MOSFETs
 BLDC/PMSM Controller 	 Voltage Detector 	OR Gates	Automotive Rectifiers
 SPM[®] 	 Voltage Stabilizer 	Schmitt Triggers	
(Smart Power Modules)	 Voltage to Frequency Converter 		Automotive Gate Drivers
 PFC SPM[®] (Smart Power Modules) 		Multiplexer/Demultiplexer/	High Voltage
Non-Icolated DC-DC	ANALOG & MIXED SIGNAL	Decoders	Gate Drivers (HVICs)
Charge nump Convertere	Amplifiers & Comparators	Decoders	Automotive Smart Power Switches

- 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)

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Step-up Regulators (Integrated Switch)

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- Amplifiers & Comparators **Comparators**
- Operational Amplifiers

Audio Amplifiers

- Audio SubsystemsAudio Headphone Amplifiers
- Audio Speaker Amplifiers
- Digital Microphone Amplifiers

Battery Protection ICs

Battery Protection ICs

- Demultiplexers Multiplexers
- Multivibrators
- **Voltage Level Translators** Voltage Level Translators