

Motor Control Solutions

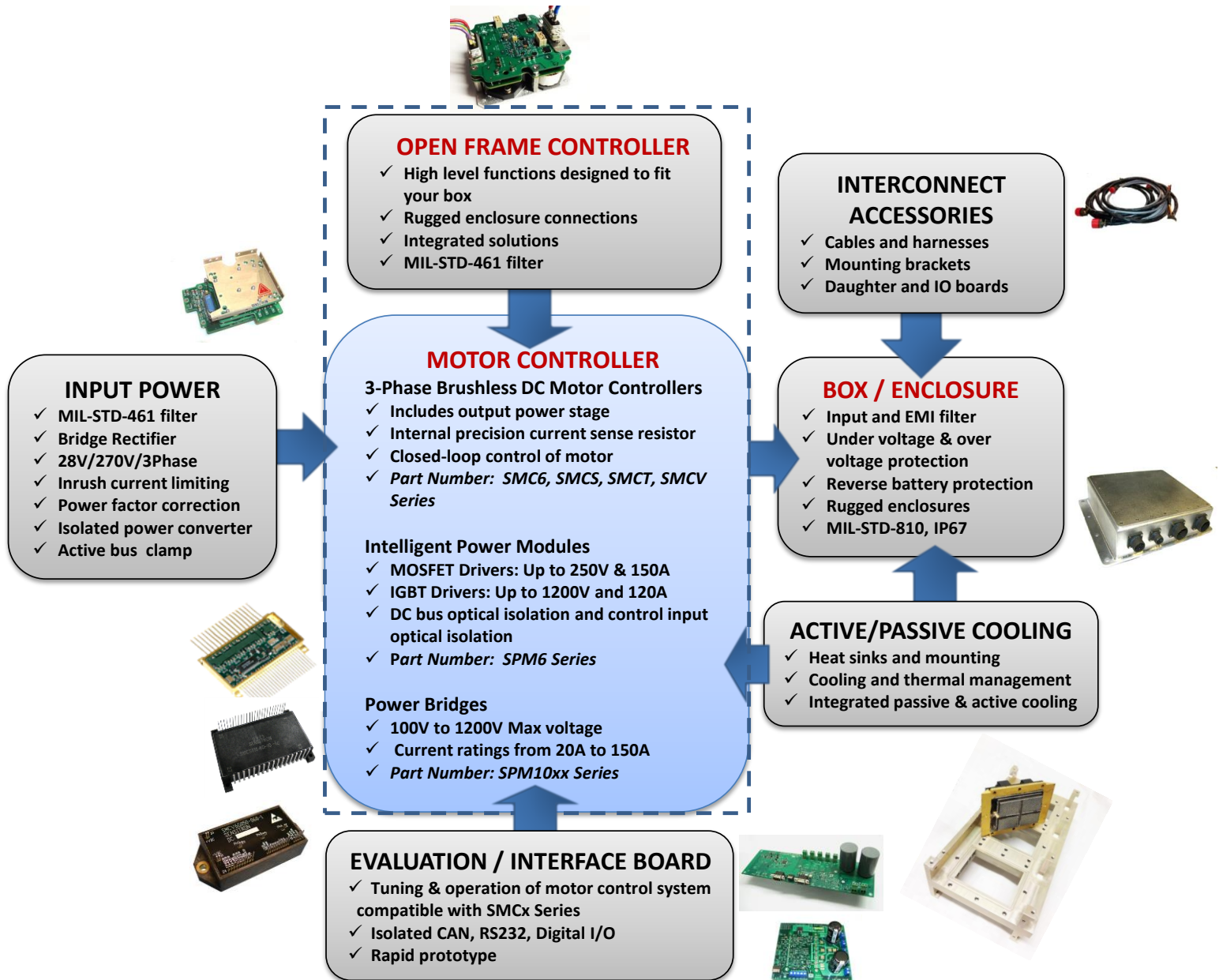


Motor Control Solutions

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Total Motion Control Solutions

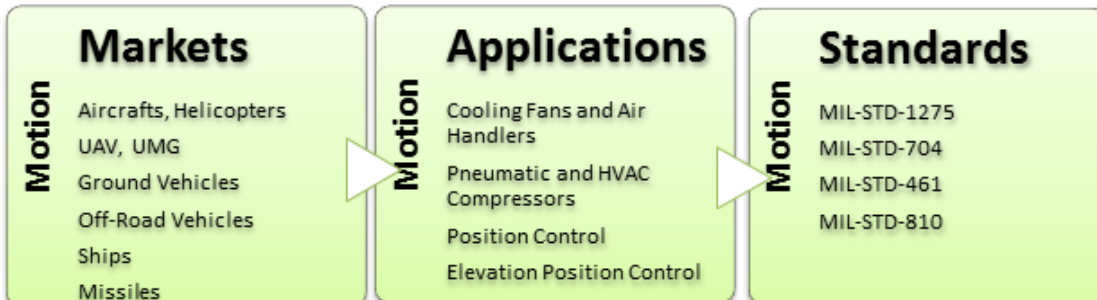
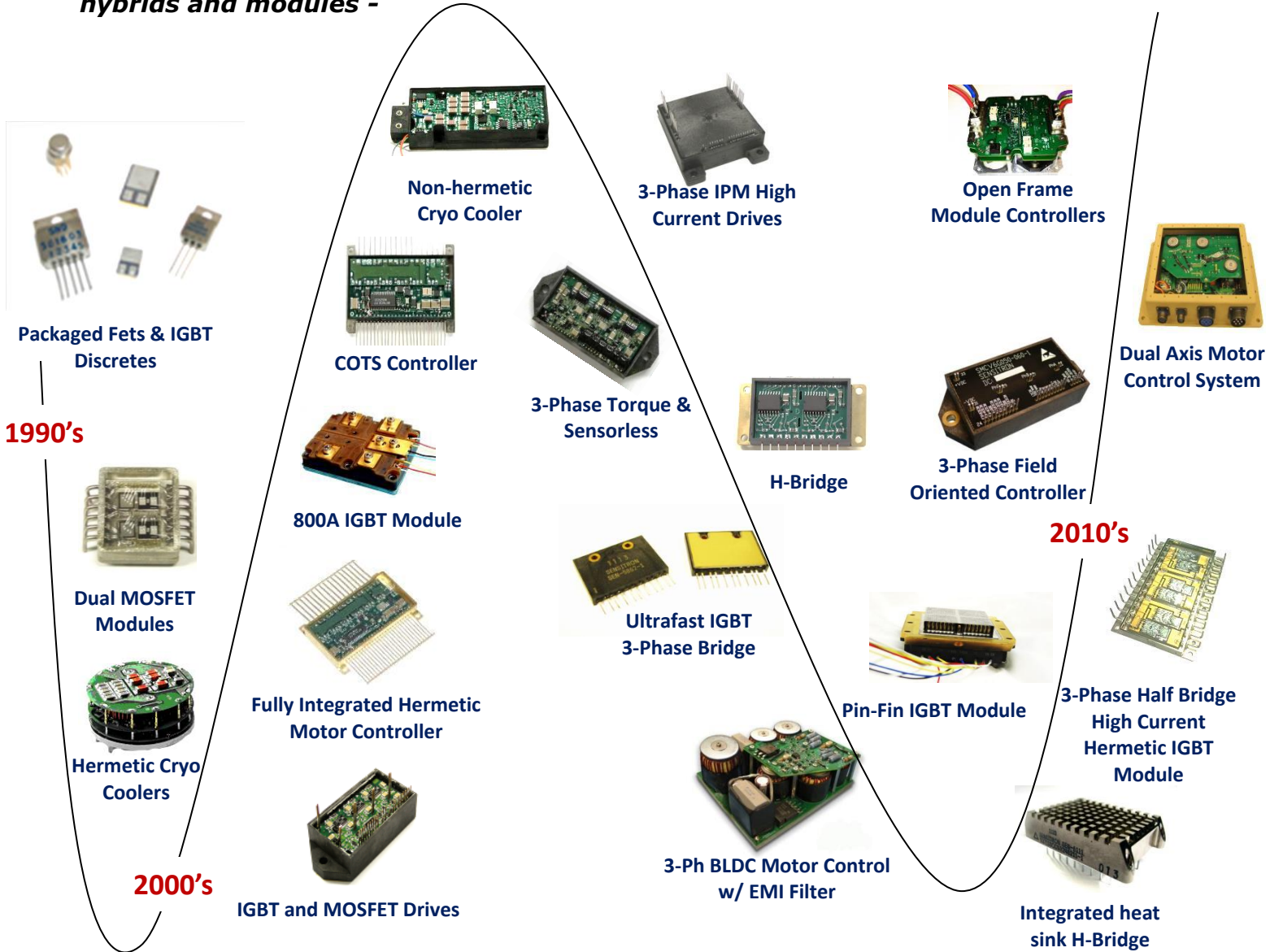
Sensitron offers an extensive line of integrated COTS Motor Control products designed to meet your motor control needs, or to be tailored for your specific requirements while meeting your time-to-market and cost objectives. Sensitron's brushless motor control expertise extends the usefulness of electronic technologies, bridging the gap between semiconductor devices and their system usage.



SENSITRON SEMICONDUCTOR

Motor Controller Product Integration

Sensitron has heritage in over two decades of motion, from packaged devices to hybrids and modules -



SENSITRON SEMICONDUCTOR

Digital Speed/Torque Controllers

Features/Benefits

- ✓ Sinusoidal Drive – lower distortion, smoother torque
- ✓ Field Oriented Control with Space Vector PWM
- ✓ Program for Speed, Torque, or Sensorless applications
- ✓ Top speed over 70,000 RPM (4 pole)
- ✓ Re-configurable firmware
- ✓ GUI Interface configures controller and motor parameters
- ✓ Isolated RS-232 Interface. Larger modules also have CAN, RS485/422
- ✓ Telemetry – reports current, speed, motor & bus voltages, baseplate temperature
- ✓ -55°C to +85°C baseplate, operating temp range
- ✓ 1500Vdc pin to case isolation
- ✓ **Evaluation boards available for quick testing**

The Sensitron Advantage

Flexibility of this design allows for use of a single device/part number for multiple motor applications with few hardware changes.

Size 1 Pkg

Package Size: 3.10" x 2.10" x 0.385"
Weight: 3.0 oz

Size 2 Pkg

Package Size: 3.59" x 1.55" x 0.80"
Weight: 5.0 oz

Size 3 Pkg

Package Size: 3.70" x 2.90" x 0.80"
Weight: 13.0 oz

Open Frame Pkg

Package Size: 2.50" x 2.10" x 0.65"
Weight: 1.0 oz



Best used in high reliability military and industrial motor control applications.

Part Number	Operating DC Bus Supply Voltage	Absolute Peak DC Bus Voltage	RMS Output Motor Current	Peak Over Current Shutdown Protection	Package
SMCV6G080-120-1	600	1200	40	83	Size 3
SMCV6G040-120-1	600	1200	20	39	Size 2
SMCV6M020-060FC	350	600	19	27	Open Frame
SMCV6G120-060-1	350	600	100	128	Size 3
SMCV6G050-060-1	350	600	25	39	Size 2
SMCV6M050-025FC	150	250	39	55	Open Frame
SMCV6M120-025-1	150	250	100	128	Size 3
SMCV6M060-025-1	150	250	25	39	Size 2
SMCV6M080-010FC	60	100	68	96	Open Frame
SMCV6M150-010-1	50	100	100	158	Size 3
SMCV6M080-010-1	50	100	25	39	Size 2
SMCV6G050-060-1A	300	600	50	74	Size 2
SMCV6M060-025-1A	120	250	50	74	Size 2
SMCV6M080-010-1A	50	100	50	74	Size 2

Configuration Utility

Utilizing the application information, this motor controller can be configured for specific motor control systems with little to no impact on hardware.

Features/Benefits

- ✓ **Decreases design time by over 50%**
- ✓ Excel-based software with motor drive GUI
- ✓ GUI controls motor and modifies parameters
- ✓ Built-in data logger
- ✓ Popup explanations for most fields



3-Phase / BLDC Motor Controllers

Features/Benefits

- ✓ Tach output voltage with average output proportional to speed
- ✓ Direction input to control motor direction
- ✓ Programmable cycle by cycle current limiting
- ✓ Enable/ Disable input and cycle-by-cycle current limit
- ✓ Analog, no software certification needed

The Sensitron Advantage

Complete controller, wide standard product range to fit most motors.

The SMC6 Series is best used as two quadrant speed controller for fans, pumps, & motors

Speed/Velocity Controllers, SMC6 Series

Part Number	Operating DC Bus Supply Voltage	Absolute Peak DC Bus Voltage	RMS Output Motor Current	Absolute Peak Output Current	Package
SMC6M40-10-1	60	100	30	60	Size 1
SMC6M070-010-1	60	100	50	70	Size 2
SMC6M080-010FC	60	100	68	96	Open Frame
SMC6M40-25-1	150	250	30	60	Size 1
SMC6M050-025FC	150	250	39	55	Open Frame
SMC6G20-60	350	600	15	20	Size 1
SMC6G25-60-1	350	600	15	25	Size 1
SMC6M020-060FC	350	600	19	27	Open Frame
SMC6G070-060-1	400	600	50	70	Size 2
SMC6G060-120-1	700	1200	30	60	Size 2



The SMCT6 Series is best used for high performance/ fast dynamic servo systems requiring holding torque

Torque Controllers, SMCT6 Series

Part Number	Operating DC Bus Supply Voltage	Absolute Peak DC Bus Voltage	RMS Output Motor Current	Absolute Peak Output Current	Package
SMCT6M40-10-1	60	100	40	50	Size 1
SMCT6G150-010-1	60	100	150	180	Size 3
SMCT6M070-010-1	60	100	60	20	Size 2
SMCT6M40-25-1	150	250	30	40	Size 1
SMCT6G20-60-1	350	600	10	20	Size 1
SMCT6G120-060-1	350	600	80	120	Size 3
SMCT6G070-060-1	350	600	50	70	Size 2
SMCT6G060-120-1	700	1200	25	60	Size 2



The SMCS6 Series is best used for simple speed control applications requiring medium accuracy

Sensorless Controllers, SMCS6 Series

Part Number	Operating DC Bus Supply Voltage	Absolute Peak DC Bus Voltage	RMS Output Motor Current	Absolute Peak Output Current	Package
SMCS6M40-10-1	60	100	40	60	Size 1
SMCS6M080-010FC	60	100	68	96	Open Frame
SMCS6M40-25-1	150	250	30	40	Size 1
SMCS6M050-025FC	150	250	39	55	Open Frame
SMCS6G25-60-1	350	600	15	25	Size 1
SMCS6M020-060FC	350	600	19	27	Open Frame
SMCS6G070-060-1	350	600	50	70	Size 1
SMCS6G060-120-1	700	1200	30	60	Size 1



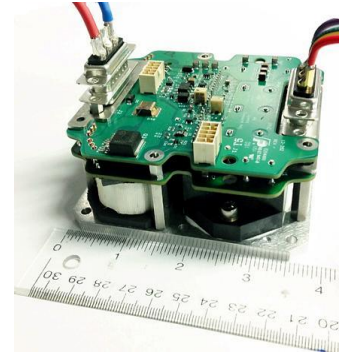
Integrated Motor Control Assemblies

3-Phase Brushless DC Motor Controller with EMI Filter/Power Supply

Features/Benefits

Includes all features of the SMC or SMCV Series, plus:

- ✓ Fully integrated 3-phase BLDC motor controller
- ✓ EMI filter and auxiliary power supply
- ✓ Nominal 40A with maximum bus voltage of 50Vdc
- ✓ Small package: 3.84" x 4.19" max x 1.24" max
- ✓ Light weight: 20 oz.
- ✓ Intended for UAV, aircraft and military applications
- ✓ Rugged design intended to drive fans, pumps, compressors



Part Number	Operating DC Bus Supply Voltage	Absolute Peak DC Bus Voltage	RMS Output Motor Current	Adjustable Peak Over Current Limit
SEC6M040-010-O	50	80	up to 65	up to 54
SECV6M040-010-O	50	80	up to 65	up to 54

Open Frame Module

Features/Benefits

- ✓ Substantial weight and cost savings, easy connections
- ✓ SMC, SMCS, and SMCV types are available in this form factor
- ✓ P suffix option has 4x 0.050" pins for each power connection
- ✓ Small Package: 2.50" x 2.10" x 0.65"
- ✓ Very Lightweight: 1 oz

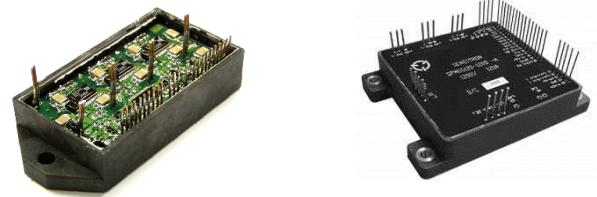


Part Number	Operating DC Bus Supply Voltage	Absolute Peak DC Bus Voltage	RMS Output Motor Current	Peak Over Current Shutdown Protection
Digital Speed/Torque				
SMCV6M080-010FC	60	100	68	96
SMCV6M050-025FC	150	250	39	55
SMCV6M020-060FC	350	600	19	27
Speed/Velocity				
SMC6M080-010FC	60	100	68	96
SMC6M050-025FC	150	250	39	55
SMC6M020-060FC	350	600	19	27
Sensorless				
SMCS6M080-010FC	60	100	68	96
SMCS6M050-025FC	150	250	39	55
SMCS6M020-060FC	350	600	19	27

Intelligent Power Modules

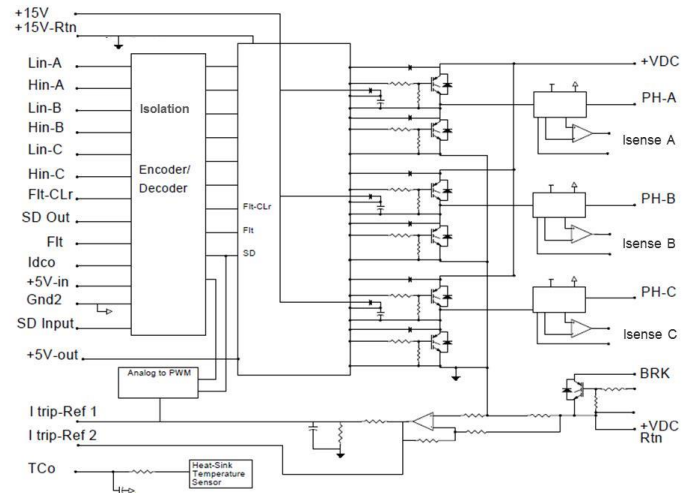
Sensitron's SPM Series of Intelligent Power Modules feature MOSFET Drivers up to 600V/150A and IGBT Drivers up to 1200V/120A. These standard off-the-shelf modules have DC bus and control optical isolation, with sensing and shutdown features that surpass industry standard drivers.

The Sensitron Advantage
Standard off-the shelf product with a wide voltage and current range containing sensing & shutdown features not widely available in industry standard drivers



Features/Benefits

- ✓ Module includes FETs/IGBTs and drivers, protection and monitoring
- ✓ 100V to 1200V Max voltage
- ✓ Current ratings from 20A to 150A
- ✓ -40°C to 150°C operating temp
- ✓ Most have isolated signal I/O
- ✓ Most report baseplate and dc link current with analog signals
- ✓ The high current modules (>100A):
 - Provide a differential signal for each phase current
 - Include a brake switch and pin for an external brake resistor



Part Number	Recommend Max Op DC Bus (V)	Absolute Max I _o pk, 25C (A)	I _o @ hi temp (A/T _{case})	Max BV (V)	Package Footprint (LxW")	Isolated I/O	OCP	OTP	De-sat	Enable /SD	I _{dc} mon	T _{case} mon
SPM6M060-010D	60	50	50 /120C	100	2.30 x 1.70	-	-	-	-	Y	-	Y
SPM6M080-010D	60	80	60 /90C	100	3.59 x 1.55	OPTO	ADJ	Y	Y	Y	Y	Y
SPM6M150-010D	60	150	100 /120C	100	3.70 x 2.90	MAG	ADJ	-	Y	Y	Y	Y
SPM6M040-025D	150	50	39 /100	250	2.30 x 1.70	-	-	-	-	Y	-	Y
SPM6M060-025D	150	70	40 /90C	250	3.59 x 1.55	OPTO	ADJ	Y	Y	Y	Y	Y
SPM6M020-060D	350	20	10 /90C	600	3.59 x 1.55	OPTO	ADJ	Y	Y	Y	Y	Y
SPM6G070-060D	350	75	60 /80C	600	3.59 x 1.55	OPTO	ADJ	Y	Y	Y	Y	Y
SPM6G140-060D	350	140	100 /80C	600	3.70 x 2.90	MAG	ADJ	-	Y	Y	Y	Y
SPM6G060-120D	700	60	25 /90C	1200	3.59 x 1.55	OPTO	ADJ	Y	Y	Y	Y	Y
SPM6G120-120D	700	120	80 /80C	1200	3.70 x 2.90	MAG	ADJ	-	Y	Y	Y	Y

Power Bridges with Advanced Lightweight Packaging

Sensitron's modules with advanced packaging have superior temperature cycling resistance and lower overall weight compared to traditional copper base plate modules. These composite materials are specifically engineered to have a coefficient of thermal expansion (CTE) that is similar to ceramic and silicon materials, which is commonly used in power modules, while maintaining a high thermal conductivity. These two desirable properties allow these modules to efficiently dissipate power losses over the entire lifetime of the module.

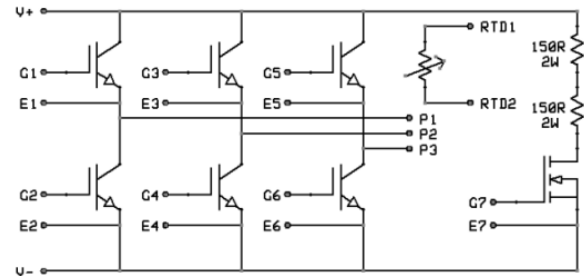
Three Phase IGBT or MOSFET Bridges with SiC diodes

Features/Benefits

- ✓ Lightweight, fully isolated package
- ✓ 600V & 1200V, 15A to 150A
- ✓ -65°C to 150°C or 175°C
- ✓ Options for integrated gate resistors, brake switches, brake resistors, thermistors
- ✓ Superior fatigue resistance & superior temperature cycling
- ✓ Integrated G-E & G-S resistors for higher ESD immunity
- ✓ Integrated brake resistor with direct heat transfer to base
- ✓ RTD to monitor module temperature



SPM1001/1002

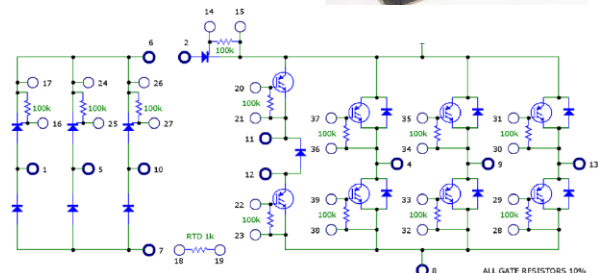


P/N	PIV, 25°C (V)	I _o , 25°C (A)	R _{θJC} (C/W°C)	Features	Packaging Base	L in	W in	H in
SPM1001	600	50	1.0	3-PH IGBT Bridge with SiC Diodes, Brake MOSFET and Integrated Brake Resistor	AlSiC	3.2	1.6	0.46
SPM1002	600	30	1.0	3-PH IGBT Bridge with SiC Diodes, Brake MOSFET and Integrated Brake Resistor	AlSiC	3.2	1.6	0.46
SPM1003	1200	150	0.42	3-Ph IGBT Bridge Brake IGBT + Inrush SCR	AlSiC	4.6	3.365	0.8
SPM1004	1200	150	0.42	3-Ph IGBT Bridge Brake IGBT + High Side Brake IGBT	AlSiC	4.6	3.365	0.8
SPM1005	600	30	3	Low Loss Ultrafast IGBT 3-Ph Bridge Module with SiC Freewheeling Diodes	AIN	1.90max	1.05	0.22 max
SPM1006	600	60	2	Low Loss Ultrafast IGBT 3-Ph Bridge Module	AIN	1.90max	1.05	0.22 max
SPM1007	1200	29	1.7	3-Ph SiC MOSFET Bridge with SiC Diodes, Hi Temp	AIN	1.90max	1.05	0.22 max
SPM1008	1200	30	1.0	3-Ph SiC MOSFET Bridge	AIN	1.90max	1.05	0.22 max
SPM1009	600	30	3	Low Loss Ultrafast IGBT 3-Ph Bridge Module, Ultrafast Freewheeling Diodes	AIN	1.90max	1.05	0.22 max

Three Phase IGBT Bridge with Brake IGBT plus Three Phase Bridge Rectifier with Inrush SCR

Features/Benefits

- ✓ 1200V, 150A, three-phase IGBT bridge
- ✓ 1200V, 133A SCR input bridge w/63A diodes (P/N:SCM1001)
- ✓ 1200V, 32A SCR for half-controlled bridge w/80A diodes (P/N:SHM1001)
- ✓ Upper and lower regenerative brake IGBT switches
- ✓ Use of latest 4th generation IGBTs & diodes to minimize total losses
- ✓ AlSiC baseplate for high temperature cycling capability
- ✓ Low profile, light weight package with near-hermetic construction
- ✓ **Leapfrog device in the Bridge Market**



Boxes and Enclosures

Features/Benefits

- ✓ Sensorless field oriented sinewave BLDC motor speed controller
- ✓ EMI to MIL-STD461
- ✓ IP 67 and Nema rated enclosures available
- ✓ Open frame available
- ✓ MIL-STD circular connectors
- ✓ Power conditioning and DC bus filtering
- ✓ Re-configurable firmware
- ✓ Isolated CAN, RS232, RS485 interface, CAN 2.0 compliant SAE J1939 available
- ✓ Operating baseplate temperature: -40°C to 80°C

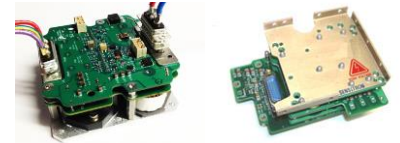


Part Number: SEC Series	Rec Operating DC Bus Supply Voltage	Absolute Peak DC Bus Voltage	Rec RMS Output Motor Current	Peak Over Current Shutdown Protection
SECV6G040-120-67	600	700	40	83
SECV6G060-060-67	300	400	60	158
SECV6M070-025-67	120	200	70	158
SECV6M090-010-67	28	60	90	158

Custom Assemblies

3-Phase Open Frame BLDC Motor Control w/ EMI Filter

- 400HZ 3 phase input driver , output to 10A peak
- Hall sensor commutation, with 6 pulse 3 phase output drive
- Locked rotor operation and protection, 25 RPM to 5000 RPM closed loop operation
- 12 Pole motor operation with internal tach
- MIL-STD-704 and MIL-STD-461 compliant



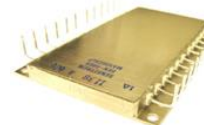
Power Conditioning Module & Motor Control, PCM Series

- 400HZ, 3 phase AC rectifier, available from 100V/80A to 1200V/42A
- 500V, 100 joules active bus voltage clamping
- Isolated 28V, 28W auxiliary converter with storage capacitors
- In rush current limiting
- MIL-STD-704 Compliant, EMI filter meets MIL-STD-461



3-Phase Bridge IGBT Hybrid

- 600V, 150Amps in a space qualified hermetic package
- Low CTE
- Moly/copper base plate
- Very large, 4.3" x 2.9" package
- MIL-PRF-38534 and MIL-STD-883 Compliant



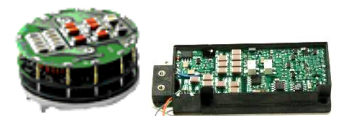
High Current Half Bridge IGBT Module

- 600V, 1000A in a hermetic core construction
- Increased creepage and clearance distances for high altitude operation
- High frequency switching
- Operation at temperature extremes
- Internal layout with minimized stray inductances



High Performance Cryogenic Cooler Temperature Controller / Driver

- Designed to be compatible with a 1/3W cryogenic cooler
- Converts standard 28VDC aircraft power to AC out
- Operating input voltage 17VDC to 33VDC
- Operating temperature range -54°C to +100°C continuous operation case temperature



Evaluation Boards

Features/Benefits

- ✓ Fast product evaluation
- ✓ Rapid prototyping and system integration testing
- ✓ Offer Evaluation Boards and FAE support
- ✓ Offer higher level assemblies by leveraging on evaluation cards
- ✓ Stackable daughter boards for other communication options
- ✓ Evaluation board design information available to aid customers' assembly design



Advanced Thermal Capabilities

Heat Sink Features/Benefits

- ✓ Passive and active heatsinks/exchangers
- ✓ Highly integrated baseplate for rugged environments
- ✓ Conduction and convection cooling schemes
- ✓ Numerical simulation methods and analysis-based design
- ✓ Electrical operations up to 175 degrees Celsius
- ✓ COTS and purpose-built options

Integrated Cross-Hatched Heatsink

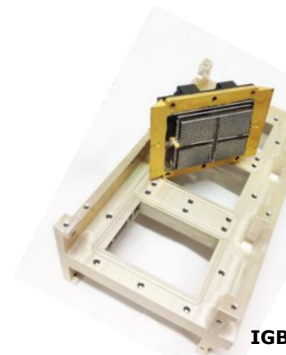
- High transient power capability
- Very compact package
- Low thermal resistivity
- Multilayer structure capable
- Integrated, cross-hatched heat sink for greater efficiency and installation versatility



H-Bridge Motor Module

Integrated Module and Heatsink Assemblies

- Module operation temperature above 130°C
 - Pin fin heatsink base for silicone cooling
 - No-flow / start-up operation capability
- Integrated heat sink with membrane and gasket inserts
 - Uniformly distributed coolant flow
 - Light, multi-piece design
- Complete design analysis:
 - Computational Fluid Dynamics Analysis
 - Pressure Drop Computations
 - Conjugate Heat Transfer Analysis
 - Steady-State / Transient Thermal Computations
 - Stress Analysis (Thermal Stress and Burst Pressure)



IGBT Pin-Fin Module with Heatsink

Lightweight Packaging Technology

- Lower profile and light weight
- Lowest possible thermal resistance
- Higher temperature applications
- Lower cost
- Automation friendly



Ultrafast 3-Phase Bridge

Lightweight Packaging Technology

Sensitron's Advanced Baseless Packaging Technology is a cost effective packaging solution that generates maximum weight savings with high thermal conductivity and fatigue resistance. Sensitron is positioned as a world leader in the advanced technology industry, with products that are designed, manufactured, tested, and qualified for high reliability applications where size, weight, and reliability are critical to mission success. From engineering design to finished product, our advanced simulation and modeling tools enable us to provide you with innovative product to meet your power solution requirements.

Product Features

- ✓ Lower profile and light weight
- ✓ Lowest possible thermal resistance
- ✓ Higher temperature applications
- ✓ Removes CTE mismatch between substrate & baseplate
- ✓ Higher reliability
- ✓ Lower cost
- ✓ Automation friendly

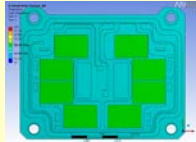
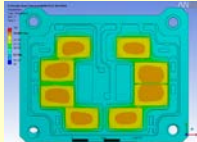
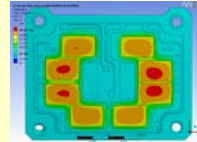
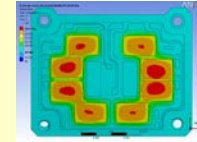
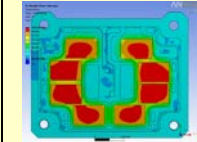
Typical Applications

- ✓ Aircraft Power Electronics
- ✓ Severe Environment
- ✓ Weight Sensitive Applications
- ✓ Long Cycle Life

Performance Options

- ✓ Low cost (*Alumina*)
- ✓ High thermal conductivity (*Aluminum Nitride*)
- ✓ High Strength (*Silicon Nitride*)

Attribute Comparison by Composition

	<i>Advanced</i>	<i>Traditional</i>			
	<i>Baseless Packaging Technology</i>	<i>Copper Baseplate</i>	<i>AlSiC Baseplate</i>	<i>Aluminum Baseplate</i>	<i>IMS Technology (Al)</i>
<i>Thermal Performance</i>					
<i>Thermal resistance index</i>	0.4	1.0	1.1	1.2	1.4
<i>Max usable temperature</i>	200°C	150°C	150°C	150°C	150 °C
<i>Fatigue resistance</i>	superior	fair	good	poor	excellent
<i>Flatness (per inch)</i>	<=0.003	>=0.005	N/A**	>= 0.005	>= 0.005
<i>Cost factor</i>	\$	\$\$\$\$	\$\$\$\$\$	\$\$\$	\$\$
<i>Weight index</i>	0.2	1.0	0.5	0.5	0.5
<i>Typical package height (for a comparable module)</i>	0.2 inch	0.325 inch	0.37 inch	0.325 inch	0.325 inch

** Bottom surface of AlSiC baseplates is normally designed to have curvature.

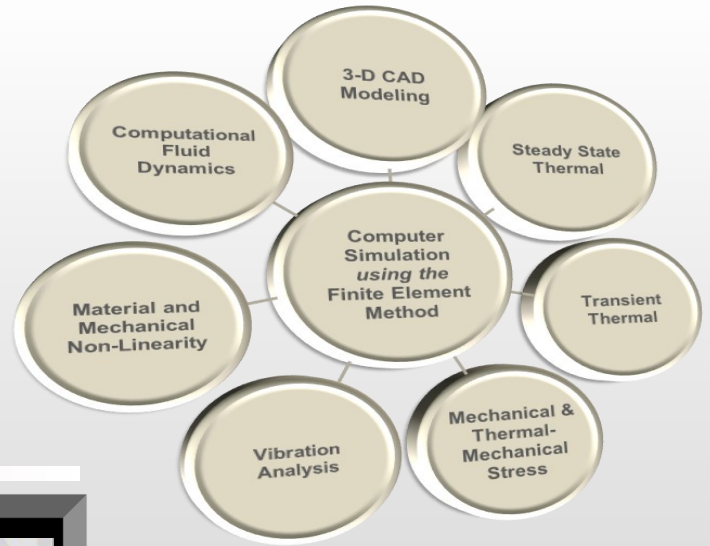
Tools and Capabilities (Engineering & Production)

Product Development Equipment

- 4 Dual quadcore simulation workstations
- Dukane ultrasonic welder
- SST DAP sealer
- SSEC seam welder
- Sonix ultrasonic scanner
- BTU belt reflow furnaces
- Orthodyne 360 fully automatic wirebonder
- K&S 4526 semi-automatic wirebonder
- Dage bond pull tester
- Polaris percussion welder
- Trebor eutectic die bonder
- Trebor epoxy pick & place
- K&S semi-automatic pick & place
- ESPEC thermal cycling machine

Software Tools

- AutoCAD 2005
- Inventor 9
- Solidworks 2010
- Design Modeler
- ANSYS Mechanical v.13
- CFX v.13
- MTBF Computational Tool
 - Relux Architect 2008
- Mathematical Tools
 - MathCAD 14
 - Visual Basic
 - APDL
 - C++
 - Origin 8.1
- Rapid Prototyping Tool
 - ZCorp 3D Plus



Visit us online at: www.sensitron.com

SENSITRON SEMICONDUCTOR

Part Number: GO

Product Type: Select a Product Group GO

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PRODUCT HIGHLIGHT: RADIATION HARDENED N-CHANNEL POWER MOSFETS

Sensitron offers Radiation Hardened N-Channel Power MOSFETs. Available as Single Channel, Quad Arrays or Three Phase Bridges, the N-Channel MOSFETs are drop in replacements for industry standard products more...

YOUR POWER SOLUTIONS PROVIDER

Sensitron is a leading manufacturer of high reliability power electronic solutions. Markets served include the complete spectrum of high reliability markets including space, aerospace, and defense.

Discrete Diodes and Die Products

JANS, JANTY, V, JAN, Diodes, Zener Diodes, TVS Diodes, Power Rectifier Diodes, Schottky Diodes, Small Signal Switching Diodes, Space Level Diodes, Zener Die, TVS Die, Schottky Rectifier Die, more...

Motor Controllers and Drivers

Fully Integrated Motor Controllers with Ethernet, CAN, Discrete or Analog Controls, MOSFET and IGBT Drivers, Three-Phase Brushless DC Motor Control, Field Oriented Controller, more...

In The News:

November 2014-Sensitron has received a patent for liquid technology can withstand repeated thermal stress during typical device packaging processes as well as more...

September 2014-Sensitron offers a line of vehicle power surge protection products compliant to MIL-STD-1275 for 28V systems and SAE compliant for 12V systems more...

Power Rectification

Schottky Rectifiers, Discrete Power Rectifier Diodes, SiC Schottky Rectifiers and Bridges, Three Phase Bridge Rectifier Assemblies, Primary Power Generation more...

Solid State Power Management

Multi-Channel Solid State Power Controller boards, Remote Power Controllers, High Current / High Voltage Modules, Solid State Power Controller Modules, Solid State Relays more...

New Product:

SENSITRON SEMICONDUCTOR IS A CERTIFIED JANS FACILITY

Sensitron has received qualification for various JANS, JANTY, JAN QPL Diodes, per MIL-PRF-19500 slash sheets including /228, /286, /359, more...

Powered By Sensitron

Sensitron Semiconductor

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About Sensitron: Sensitron is a leading manufacturer of high reliability power electronic solutions including motor controllers, diodes, smart power management and conversion, voltage protection components and embedded boards, with over 40 years heritage serving space, aerospace, and defense markets.