Solid State Power Management

Overview
Integration
Markets/Applications
Single Channel Controllers
Solid State Circuit Breakers
Multi-Channel Boards
Multi-Channel Enclosures
Solid State Contactors
Solid State Relays
Bi-Directional Charge/Discharge Controller
MIL-STD-1275 Modules
SAE Compliant Transorbs
Advanced Thermal Capabilities
Development Tools
The Sensitron Advantage:

- Variety of COTS Solid State Power Controllers product availability reduces lead time
- Flexible, battle-tested technology allows for reduced design time
- Efficient electrical and mechanical design optimized for small space/footprint
- Low power dissipation and wide-temperature range operation
- **Proven** solutions for tough requirements

Features:

- True I^2t and instant trip protection
- Solid state reliability
- Software and hardware current rating programmability
- Accurate current, temperature and voltage measurements
- Isolated discrete or serial interface controls and load monitoring
- EMC reduction
- Built in test features

Benefits:

Sensitron’s SSPC technology and products combine functionalities of electro-mechanical breakers, solid state relays and system monitors and provide the following benefits to our customers:

- Electrical load protection and monitoring: current, voltage and temperature measurements
- Operational improvements by allowing for diagnostics, prognostics and condition-based maintenance
- Life cycle cost savings and reduced cost of ownership
- Increased radius of operation through power budgeting and load shedding
- Power sequencing, crew off-loading and network-controlled intelligent load management

**Sensitron Solid State Power Management Solutions**

<table>
<thead>
<tr>
<th></th>
<th>Single Ch. Modules</th>
<th>Cobra</th>
<th>Diamondback</th>
<th>Boa</th>
<th>Enclosed Unit Capability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td></td>
<td>28 VDC</td>
<td>28 VDC</td>
<td>28 VDC</td>
<td>28VDC - 600 VDC</td>
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<tr>
<td></td>
<td>28 – 375 VDC</td>
<td></td>
<td></td>
<td></td>
<td>115VAC - 230 VAC</td>
</tr>
<tr>
<td></td>
<td>115/230 VAC</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current</td>
<td>Up to 150 A</td>
<td>6x 25 A (150 A)</td>
<td>(16ch) 8x 5A, 3x 15A, 5x 25A (32ch) 32x 10A</td>
<td>4x 100A</td>
<td>100A @ 375VDC</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>30A @ 610VDC</td>
</tr>
<tr>
<td>Measurements</td>
<td>Load Status Switch Status</td>
<td>Output Current Input Voltage</td>
<td>Output Current Input &amp; Output Voltage Temperature</td>
<td>Output Current Input &amp; Output Voltage Temperature</td>
<td>Output Current Input &amp; Output Voltage Temperature</td>
</tr>
<tr>
<td>Interface</td>
<td>Discrete</td>
<td>RS232, RS485</td>
<td>CAN</td>
<td>CAN</td>
<td>CAN</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>RS232, 422, 485</td>
<td>RS232, 422, 485</td>
<td>RS232, 422, 485</td>
</tr>
<tr>
<td>Temp Range</td>
<td>-40/-55 to 85</td>
<td>-55 to 100</td>
<td>-45 to 100</td>
<td>-55 to 100</td>
<td>-40 to 105</td>
</tr>
</tbody>
</table>
Smart Power Management Product Integration

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

Markets
- Aircrafts, Helicopters
- UAV, UMG
- Ground Vehicles
- Off-Road Vehicles
- Commercial Vessels

Applications
- Exploration Equipment
- Command Centers
- Test Equipment
- Weapon Launchers

Standards
- MIL-STD-1275
- MIL-STD-704
- MIL-STD-461
- MIL-STD-217

Interfaces
- RS-232, RS-422, RS-485, CAN
Programmable Single Channel Control, ≤ 50A

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Current Program Range</th>
<th>Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPDP05D28-1</td>
<td>1A to 5A</td>
<td>28 Vdc</td>
</tr>
<tr>
<td>SPDP10D28-1</td>
<td>2A to 10A</td>
<td>28 Vdc</td>
</tr>
<tr>
<td>SPDP15D28-1</td>
<td>3A to 15A</td>
<td>28 Vdc</td>
</tr>
<tr>
<td>SPDP20D28-1</td>
<td>4A to 20A</td>
<td>28 Vdc</td>
</tr>
<tr>
<td>SPDP25D28-1</td>
<td>5A to 25A</td>
<td>28 Vdc</td>
</tr>
<tr>
<td>SPDP30D28-1</td>
<td>6A to 30A</td>
<td>28 Vdc</td>
</tr>
<tr>
<td>SPDP40D28-1</td>
<td>8A to 40A</td>
<td>28 Vdc</td>
</tr>
<tr>
<td>SPDP50D28-1</td>
<td>10A to 50A</td>
<td>28 Vdc</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Current Program Range</th>
<th>Voltage</th>
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</thead>
<tbody>
<tr>
<td>SPDP03D270</td>
<td>0.9A to 3A</td>
<td>270 Vdc</td>
</tr>
<tr>
<td>SPDP10D270</td>
<td>3.0A to 10A</td>
<td>270 Vdc</td>
</tr>
<tr>
<td>SPDP03D375</td>
<td>0.9A to 3A</td>
<td>375 Vdc</td>
</tr>
<tr>
<td>SPDP10D375</td>
<td>3.0A to 10A</td>
<td>375 Vdc</td>
</tr>
</tbody>
</table>

Single Channel Control, up to 150A

SPDB Series, Low Current

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Current</th>
<th>Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPDB10D28</td>
<td>10A</td>
<td>28 Vdc</td>
</tr>
<tr>
<td>SPDB35D28</td>
<td>35A</td>
<td>28 Vdc</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Current</th>
<th>Voltage</th>
<th>Max Voltage Drop@ Amps</th>
</tr>
</thead>
<tbody>
<tr>
<td>SRPC80D28</td>
<td>80A</td>
<td>28 Vdc</td>
<td>175 mV</td>
</tr>
<tr>
<td>SPDC130D28</td>
<td>130A</td>
<td>28 Vdc</td>
<td>230 mV</td>
</tr>
<tr>
<td>SPDC150D28</td>
<td>150A</td>
<td>28 Vdc</td>
<td>260 mV</td>
</tr>
<tr>
<td>SPDP50D375</td>
<td>50A</td>
<td>375 Vdc</td>
<td>440 mV</td>
</tr>
</tbody>
</table>

AC Solid State Circuit Breaker

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Current</th>
<th>Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPD8A115</td>
<td>8A</td>
<td>150 Vdc</td>
</tr>
</tbody>
</table>

Features:
- 5:1 programming range for 28V
- True \(i^2T\) with thermal memory
- Instant trip at higher level
  - 10x for 28V
  - 7x for 270/375V
- Isolated Logic Control, Status
- On/Off
- Low Power Consumption
- Low Weight
  - 30 grams for 28V
  - 40 grams for 270/375V
- No heat sinking or cooling required
- Soft turn-on for EMI control
- Nuisance Trip Suppression
- 28V Status outputs
  - Load status – \(Hi \leq 5\%\), \(Low = 15\%\)
  - Gate status – indicates switch state
- 270/375V Status outputs
  - Line input
  - Overtemperature

Features:
- True \(i^2T\) with thermal memory
- Instant trip at higher level
- Isolated Logic Control, Status
- On/Off
- Low Power Consumption
- Soft turn-on for EMI control
- Nuisance Trip Suppression

Standard Features, plus:
- 115 VAC / 150 VDC
- 2 pole single throw switch (2PST)
- Overcurrent shutdown protection
- Overvoltage transient suppression
- TTL/CMOS input compatible
- Operating voltage up to 100V
Multi-Channel Boards

Sensitron’s Multi-Channel Solid State Power Controllers (SSPC) are programmable, microcontroller based, Solid State Power Controller products designed to be used in 28V DC Power Management applications. Each independent channel can be programmed to support variable loads, and can be programmed to operate in parallel with other channels in order to act as a single channel with combined current capabilities. These products feature integrated current, temperature, and voltage sensing, with a serial communications interface which allows a system controller to command channels on and off, as well as monitor measured parameters and status.

Diamondback Series

16 Channel Board
- 16 Programmable Channels
- Like channels can be paralleled
- Up to 210A of Total Current
- Measurements:
  - Output Currents, Input & Output Voltages, Board Temperature
- Flags – per channel
  - Load Present (20% of rating threshold)
- Faults—OCP Trip, BIT Failure, Vout Low
- CAN Interface (up to 1Mbaud) J1939
- 100°C Operation, 5VDC Aux Power – Internal/External options

32 Channel Board
- 32 Programmable Channels
- Like channels can be paralleled
- Up to ~300A of Total Current
- Measurements:
  - Output Currents, Input & Output Voltages, Board Temperature
  - CAN Interface (up to 1Mbaud) J1939
  - 100°C Operation
  - 5VDC or 28VDC Aux Power
- New connectors optimum for rack mounting

Enclosures
- Support for return current wires
- One or two 16-CH Cards
- One or two 32-CH Cards
- Circular, Rugged Connectors
- Design and Production Capability
- Build-to-Print Capability
- Price / Performance Leader
- Can be waterproof
- Can be EMI-tight

Cobra Series: 6 Channel Board
- Up to 6 channels, can be used individually or in parallel combinations
- Programmable from 1 Amp to 25 Amps rated current
- Parallel channel capability up to 150 amps
- RS-232, RS-422, or RS-485 serial interface bus
- BATTLESHORT setting to prevent tripping in extreme circumstances
- MAINTENANCE MODE for safe maintenance

Boa Series: 4 Channel Board
- Four Individual Channels Programmable to 100A
- Up to 200A with Channel Paralleling
- Total Current up to 400 amps
- 28VDC-derived auxiliary power
- True I2t and thermal memory protection
- J1939 CAN bus communications
- Soft Turn-On/Off to Reduce EMI
- Battle short and Maintenance modes
- Power-up and continuous Self-Test (BIT)
- -55°C to 100°C operating temperature range
High Current/High Voltage DC Solid State Contactor: SSR Series

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Max Contact Voltage (Vout)</th>
<th>Continuous Contact Current (I_{out})</th>
<th>Voltage drop @ I_{out} (V_{drop})</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSR033D005</td>
<td>50</td>
<td>33</td>
<td>0.080</td>
</tr>
<tr>
<td>SSR066D005</td>
<td>50</td>
<td>66</td>
<td>0.152</td>
</tr>
<tr>
<td>SSR100D005</td>
<td>100</td>
<td>100</td>
<td>0.230</td>
</tr>
<tr>
<td>SSR033D010</td>
<td>100</td>
<td>33</td>
<td>0.103</td>
</tr>
<tr>
<td>SSR066D010</td>
<td>100</td>
<td>66</td>
<td>0.205</td>
</tr>
<tr>
<td>SSR100D010</td>
<td>100</td>
<td>100</td>
<td>0.310</td>
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<tr>
<td>SSR033D020</td>
<td>200</td>
<td>33</td>
<td>0.139</td>
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<tr>
<td>SSR066D020</td>
<td>200</td>
<td>66</td>
<td>0.278</td>
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<tr>
<td>SSR100D020</td>
<td>200</td>
<td>100</td>
<td>0.420</td>
</tr>
</tbody>
</table>

Features/Benefits:
- 2000V Input to Output / Output to Baseplate Isolation
- Up to 1200V Blocking, Up to 100A Continuous Current
- Up to 400A Surge Capability
- -55°C to 100°C Operation
- Single wide range DC input signal 4.6V to 36V
- Fast turn on/turn off, less than 1 us
- Low power control, 0.5W Typ
- Low “on” state resistance

AC Solid State Relay: SCP-5285

Features/Benefits:
- Back-to-back SCR output for high reliability
- 75A rating upto 85°C base plate temperature
- 1600V surge voltage withstand capability
- Zero voltage turn-ON switching to reduce EMC issues
- Flexible design configuration
- Customizable terminal & device options
- Similar to Teledyne SSR1600660D75

Also Available: Integrated Carrier Boards for Single Channel Modules

Features/Benefits:
- Up to four loads and total board current of 120A
- Configurable mix of 10, 20, 30 and 40A devices
- On-board current rating programmability
- Power connectors for 28Vdc bus and return
- 5V available on the connector to control the devices
- Integrated auxiliary power supply, Low board & connector power dissipation
- High current bus bar system, low power current routing
- Balanced current distribution

Bidirectional Charge/Discharge Controller: SPAF01Cxx

Features/Benefits:
- Useful for SuperCapacitor control & protection
- Programmable Current Limit to 150A max continuous
- No auxiliary power required
- Control & status monitoring over CAN bus
- Configurable isolated discrete control
- External Bypass Relay control and monitoring
- 500V isolation from chassis
- -45°C to 100°C operating temperature range

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Vehicle Power Surge Protection

MIL-STD-1275 Military Vehicles, 28V

Features/Benefits:
- 28V power system voltage transient protection including load dump
- Clamping below 55V DC for both 100V and 250V pulse
- Power savings by allowing lower FET voltage ratings to be used
- Reliability: 100% production tested to meet MIL-STD-1275 test method

The Sensitron Advantage:
- Low leakage at working voltage means no significant power loss at normal conditions
- Protection without power interruption

Product Options:
- SCP-5282-3,-5/A are also designed to meet SAE J1113-xx requirements
- SCP-5282-3 also meets ISO16750 & ISO7637 requirements
- SCP-5282-6 tested to 1275 & Aircraft DO-160 spec

<table>
<thead>
<tr>
<th>PN</th>
<th>Config</th>
<th>Peak Pwr</th>
<th>Vwm, Min</th>
<th>Leakage Max @Vwm</th>
<th>Vbr, Min</th>
<th>Ippm</th>
<th>Vclamp @ Ippm Max</th>
<th>100% Tested To:</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCP-5282-1</td>
<td>Bi</td>
<td>60kW</td>
<td>33V</td>
<td>25 uA</td>
<td>36.7V</td>
<td>100A</td>
<td>49V</td>
<td>100A/80ms square</td>
</tr>
<tr>
<td>SCP-5282-1U</td>
<td>Uni</td>
<td>60kW</td>
<td>33V</td>
<td>25 uA</td>
<td>36.7V</td>
<td>100A</td>
<td>49V</td>
<td>100A/80ms square</td>
</tr>
<tr>
<td>SCP-5282-2</td>
<td>Bi</td>
<td>60kW</td>
<td>33V</td>
<td>25 uA</td>
<td>36.7V</td>
<td>100A</td>
<td>49V</td>
<td>5x 100A, 50ms sq</td>
</tr>
<tr>
<td>SCP-5282-3</td>
<td>Bi</td>
<td>100kW</td>
<td>33V</td>
<td>40 uA</td>
<td>36.7V</td>
<td>135A</td>
<td>49V</td>
<td>5x 110A, 50ms sq</td>
</tr>
<tr>
<td>SCP-5282-5/A</td>
<td>Uni</td>
<td>50kW</td>
<td>33V</td>
<td>30mA</td>
<td>-</td>
<td>120A</td>
<td>43V/42V</td>
<td>120A/100ms</td>
</tr>
<tr>
<td>SCP-5282-6A/B</td>
<td>Bi</td>
<td>65kW</td>
<td>52V</td>
<td>30uA</td>
<td>60V</td>
<td>54A</td>
<td>77V</td>
<td>1275 waveform</td>
</tr>
</tbody>
</table>

MIL-STD-1275 Transorb
SCP-1275, Replacement for GPZ1275
- Voltage transient protection / load dump function
- Clamping below 55V DC for both 100V and 250V pulse
- 100% production tested to Meet MIL-STD-1275 test method
- Advantages: No power consumption under clamping voltage threshold, no power interruption, high pulse power capability, low cost & small size

SAE Compliant Military Vehicles, 12V

SAE Compliant Transorb
- SAE compliant high pulse power transorb for +12 Vdc systems, clamping below 32Vdc for 100V pulse with 142A peak current
- SAE J1113-11 compliant; 100V surge withstand
- dinging with 0.5 Ohm source impedance, 400 msec pulse
- Allows the use of 40V high efficiency FET

<table>
<thead>
<tr>
<th>PN</th>
<th>Config</th>
<th>Peak Pwr</th>
<th>Vwm, Min</th>
<th>Leakage Max @Vwm</th>
<th>Vbr, Min</th>
<th>Ippm</th>
<th>Vclamp @ Ippm Max</th>
<th>100% Tested To:</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAE-5282-12</td>
<td>Uni</td>
<td>4kW/400ms</td>
<td>18V</td>
<td>250 uA</td>
<td>25.1V</td>
<td>142A</td>
<td>32V</td>
<td>J1113-11, 142A/400ms</td>
</tr>
</tbody>
</table>
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
- Relex Architect 2008

Mathematical Tools
- MathCAD 14
- Visual Basic
- APDL
- C++
- Origin 8.1

Rapid Prototyping Tool
- ZCorp 3D Plus

Sensitron Semiconductor

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

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.