![Dy 4 Systems logo]

The future of high-integrity, embedded technology

SVME/DMV-209

IndustryPack® I/O System

Features

- VMEbus Carrier Card with four IP sites
- Up to 200 I/O lines via P2 and P0 connectors
- ANSI/VITA-4 IndustryPack® Logic Interface Specification
- ±15 V DC-DC converter
- Temperature sensor
- IP mapping to P0/P2 VITA 4.1-1996
- IP4-206 Digital I/O module
  - 16 opto-isolated I/O channels, or
  - 24 opto-isolated input channels
  - 500 mA switches
  - fully isolated with separate returns
- IP4-660 A/D module
  - 16-bit resolution
  - 16 channels single ended or
  - 8 channels differential
  - +5 V, +10 V, ±5 V, ±10 V ranges
- IP4-661 D/A module
  - 16-bit resolution
  - 3 channels
  - +5 V, +10 V, ±5 V, ±10 V ranges
- VxWorks® drivers
- Available in a range of ruggedization levels (air and conduction-cooled)

Input & output (I/O) functions are a prerequisite to building any real-life system. One of the problems that systems builders face is the incredible variety of I/O demanded by their applications. This diversity has driven many designers to develop custom solutions because there was no adequate COTS product available.

The SVME/DMV-209 IndustryPack® I/O System addresses this pressing need. It brings the most successful industrial market I/O technology, the IndustryPack I/O standard, to the harsh military environment for application in extended temperature, conduction cooled systems in addition to air cooled systems.

What are IndustryPacks®?

An IndustryPack (IP) is a small card (1.8 by 3.9 inches) that contains the circuitry to perform a given I/O function. A number of IPs are mounted to a carrier card. The carrier interfaces with the host bus and provides the external connectors. IP carriers have been
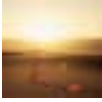
implemented for many systems including VME, VXI, ISA, EISA, PCI, CPCI, Multi-bus and Nubus. In each case the IP modules do not change. Instead, the carrier card adapts them to the system. In this case, the system is rugged air or conduction-cooled VME.

Open Standards

IndustryPacks are governed by a set of open standard specifications:

- ANSI/VITA-4 IndustryPack Logic Interface Spec –
  The comprehensive specification for IndustryPacks.
- VITA 4.1-1996 IP mapping to P0/P2 –
  Governs how IP Carriers map I/O to VME64x backplanes.

The IP open standard has seen widespread commercial adoption. IndustryPack products are available from more than 50 vendors who collectively offer hundreds of different I/O modules.

SVME/DMV-209 Carrier Card

The SVME/DMV-209 is a flexible IndustryPack carrier card that supports the VME64x specifications. It is designed to meet various I/O requirements for any VME64x embedded/real-time applications. The SVME/DMV-209 allows all I/O lines to be routed via the backplane connectors which is the preferred approach for rugged systems.

The SVME/DMV-209 design is directly evolved from the SBS GreenSpring VIPC664, the newest member of the successful VIPC61x family of VME Quad carrier cards. Dy 4 has enhanced the design to better address the requirements of military systems. These enhancements include:

- On-board ±15 V power supply to power analog IndustryPack modules. 150 mA on each rail
- Card fail indicator signal on the backplane for closed box identification of failures
- Backplane-controlled VME base address so that a single configuration item can be used in multiple slots
- Selection of components and packaging to withstand extreme temperature operation
- Elimination of jumpers
- Temperature sensor
- Removal of potentiometers

With four IndustryPack sites, the carrier card supports either four single-wide IP modules or two double-wide IP modules. 200 lines of I/O are routed to the 5-row DIN P2 connector and the 95-pin P0 connector.

The VME interface supports both A16:D16:D8 short I/O access and A32:D16:D8 extended memory access.

Three software-configured interrupt modes are provided by the SVME/DMV-209 for a flexible programming architecture:

- **Seven interrupt mode**: Each IP module interupt is mapped to a separate VMEbus interupt request line.
- **Single level interrupt mode**: all IndustryPack IRQ* signals can be mapped to a single VMEbus interrupt level. IRQ1* through IRQ6* can be user-selected.
- **Interrupt disable mode**: for non-interrupting applications, all interrupts can be disabled.
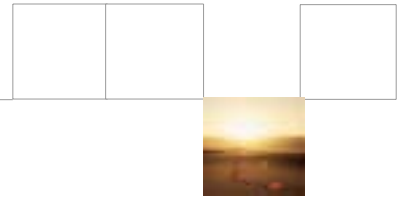
Software Support

Part of the SVME/DMV-209 product offering is software. The popular VxWorks® operating system is supported with drivers for the carrier card and all the Dy 4 IP modules. A software driver will save a few days from the software development cycle, allowing programmers to focus on developing software and not learning hardware details.

For customers using other operating systems, C language source code examples are available so they can become productive quickly.

IP4-206 Digital Opto I/O

The IP4-206 Optically Isolated I/O module provides either 16 optically isolated channels that can be used for inputs or outputs, or 24 input channels. Each input is capable of generating an interrupt. Events are latched and therefore cannot be missed. Both transmitters and receivers are double buffered. The interrupt latch circuits are edge-sensitive with programmable polarity. It is possible to use an external clock to latch the output registers. This provides a solution for systems requiring simultaneous update to all of the outputs.

The transmitters have an open collector output. An external power supply between 5 V and 32 V must be provided to power the transmitters. Writing a 1 to any output turns off the optoisolator, allowing the pull-up resistor to set the line to a logic high. Writing a 0 to any output will cause a FET switch to connect between the output and its return line. The output can sink up to 500mA, allowing the IP4-206 to drive high current devices such as relay coils. All of the output channels are fully isolated from each other with separate return lines. This isolation is critical for avoiding ground loops when connecting the IP4-206 to widely separated circuits within a vehicle.

The output circuits of the IP4-206 will withstand all of the conditions defined by MIL-STD-704D and MIL-STD-1275 (except reverse polarity as specified in section 4.3 of MIL-STD-1275).
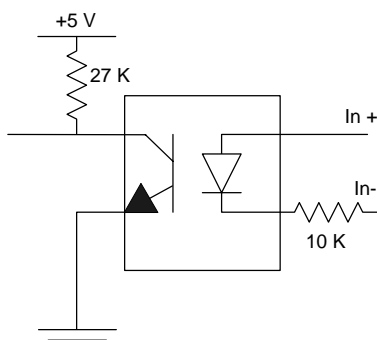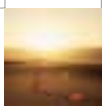
Table 1:   IP4-206 Specifications

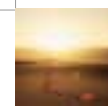| Size	Single-wide IndustryPack
Digital Interface	Option 1: 16 optically isolated latched input signal lines / double buffered output signal lines Option 2: 24 optically isolated inputs
Interface Level	Outputs: 0 V to external power supply, 32 V max 500 mA. MIL-STD-704D and MIL-STD-1275 compatible
Inputs	32 V maximum, 10 V threshold
Software Interface	Seven 24-bit registers: output, read back, input, interrupt enable, interrupt pending, interrupt polarity and interrupt clear. Two 8-bit registers: clock control and interrupt vector
Initialization	300 ms delay from reset Turns off all the output drivers, setting them to a passive high, turns off double buffering
Access Mode	Byte or word in I/O Space
Interrupts	All inputs can be programmed to generate an interrupt Programmable polarity - rising or falling edge Interrupts are cleared by writing a 1 to the appropriate interrupt clear bit. Programmable vector
Power Requirements	External Supply to output transmitters: +5.0 V to +32 V

IP4-660 A/D Module

The IP-16ADC implements 16 single-ended or 8 differential 16-bit analog-to-digital conversion channels.

Internal amplification and buffering are implemented with very low distortion differential amplifiers. Linearity is 0.001% typical. The internal reference has a temperature drift coefficient of 3ppm/°C max. Internal calibration is accurate to better than ±2 LSB.

Input circuitry consists of a multiplexer group feeding a low-noise, low-distortion instrumentation amplifier. Input impedance is 1 GΩ. The multiplexers include built-in overvoltage protection to -40 V to +55 V.

Programmable interrupt logic is provided to generate an interrupt when conversion is complete. Start of conversion may be initiated by software command or by external trigger. An external pacer clock may be used to

implement a semi-automatic data acquisition capability (interrupt or sample). Maximum aggregate conversion rate is 100 kHz.

Full scale input voltage ranges are 0 to +5, ±5, 0 to +10 and ±10 V.

Table 2: IP4-660 Specifications

Size	Single-wide IndustryPack
Number of A/D	16 single-ended, or 8 differential channels dynamically mix-able, additional internal channels for calibration
A/D Resolution	16 bits
A/D Input Voltage Ranges	Bipolar Range: -10 V to +10 V, -5 V to +5 V Unipolar Range: 0 V to +10 V, 0 V to +5 V Software-selectable
Input Impedance	1 GΩ shunted with 4 pF
Voltage Protection	-40 V to +55 V
A/D Calibration	Factory-calibrated gain and offset ADC is self-calibrating Gain and offset errors removed in S/W
A/D Drift	5 ppm/^{o}C typical
Voltage Reference Drift	3 ppm/^{o}C
A/D Max Conversion Rate	100 kHz
Wait States	0, read; 1, write
Power Requirements	+5 VDC, 210 mA typical, 270 mA max +15 VDC, 45 mA typical, 70 mA max -15 VDC, 45 mA typical, 70 mA max

IP4-661 D/A Module

The IP4-661 Digital to Analog Converter module provides three independent channels of high-resolution 16-bit digital to analog conversion. Applications include instrumentation, precision positioning, calibration and remote programming. Factory calibration and low drift produce high accuracy and repeatability for precision applications. Four output ranges, including both bipolar and unipolar plus remote sense provide direct interfaces to target hardware in most cases.

Sophisticated features make the IP4-661 versatile and easy to interface in demanding applications. The digital voltages (DAC registers) are readable by software. The DACs may be cleared by software or reset to bipolar or unipolar 0. External power supplies may be used to minimize system noise. DACs include internal de-glitching hardware which produces a faster settling time. This makes the IP4-661 suitable for high-resolution waveform generation.

Factory calibration is standard. The module is calibrated to ±3 LSB. Output is always monotonic. Calibration consists of correction parameters stored in the ID PROM. Driver software reads the calibration parameters to correct digital data prior to writing to the DAC.
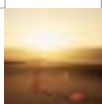
Table 3: IP4-661 Specifications

Size	Single-wide IndustryPack
Number of D/A	3 digital to analog converters
Resolution	16 bits
Output Ranges	Bipolar Range: -10 V to +10 V, -5 V to +5V Unipolar Range: 0 V to +10 V, 0 V to +5 V Factory configuration: -10 V to ±10 V
DAC Clear	Bipolar or unipolar clear on reset or software
Differential non-linearity	±1 LSB over temp
Factory Calibration	Standard, coefficients stored in PROM to ±1/8 LSB
Calibration Accuracy	±3 LSB
Drift	2 ppm/°C for DAC 2 ppm/°C for reference
Output Settling	Buffered output: 0.3 V/µs typical DAC output direct: 9 µs typical to 0.003% FSR
Wait States	0 on ID reads 1 on DAC clear 2 on DAC reads/writes

Table 4: SVME/DMV-209 Specifications

RUGGEDIZATION LEVELS*		
SVME card	Available in levels 0, 50 and 100	
DMV card	Available in levels 100 and 200	
POWER REQUIREMENTS		
+5 V +12 V -12 V	1 A (maximum) 30 mA (maximum) 0 mA (maximum)	600 mA (typical)
DIMENSIONS		
	Size	Weight
SVME carrier card	per ANSI/VITA 1-1994	<400 g (<.8 lb.)
DMV carrier card	per IEEE 1101.2	<570 g (<1.26 lbs.)

*Refer to Ruggedization Guidelines in the Appendix.
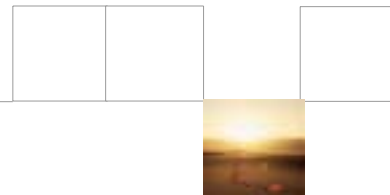
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