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# IP-OCTAL-232

## Eight Channel RS-232
## IndustryPack™

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Hardware Revision: B
Part # 89002067 Rev. 1.0
20050119

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**IP-OCTAL-232**

**Eight Channel RS-232**
**IndustryPack™**

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# Product Description

IP-OCTAL-232 is part of the Industry Pack™ family of modular I/O components. It is based around the Signetics CMOS SCC2698 Octal Universal Asynchronous Receiver/Transmitter. This component provides eight channels of full-duplex asynchronous serial communications, baud rate generators, state change detect logic, and four 16-bit counter/timers.

A block diagram of the IP-OCTAL-232 is shown below in Figure 1.

RS-232-C communication levels are provided by CMOS MC14C88 and MC14C89 transmitters and receivers. Five signals for each channel on the RS-232-C interface are supported: Transmit Data (TxD), Receive Data (RxD), Ready-To-Send (RTS), Clear-To-Send (CTS) and ground. The MC14C89 Receivers are biased at 1.5 volts nominally to permit a variety of input signal levels to be received without additional interface circuitry. The interface circuit is shown below in Figure 2. Protection diodes are provided in the ±12 volt supply lines to permit connection to powered equipment, even if the IndustryPack is unpowered.

Vectored interrupts are fully supported. A common 8-bit vector register is provided. Channels a,b,c,d interrupt on IRQ0. Channels e,f,g,h interrupt on IRQ1.

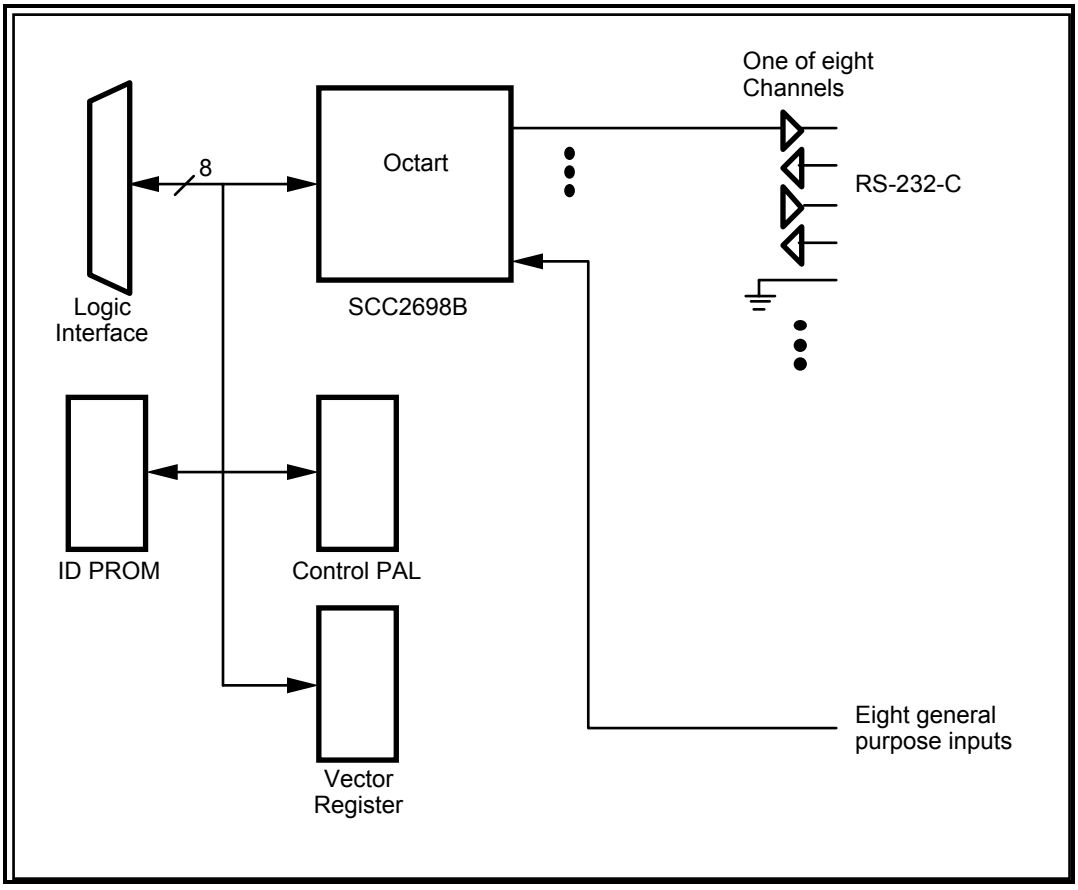



**Figure 1 Simplified Block Diagram of IP-OCTAL-232**



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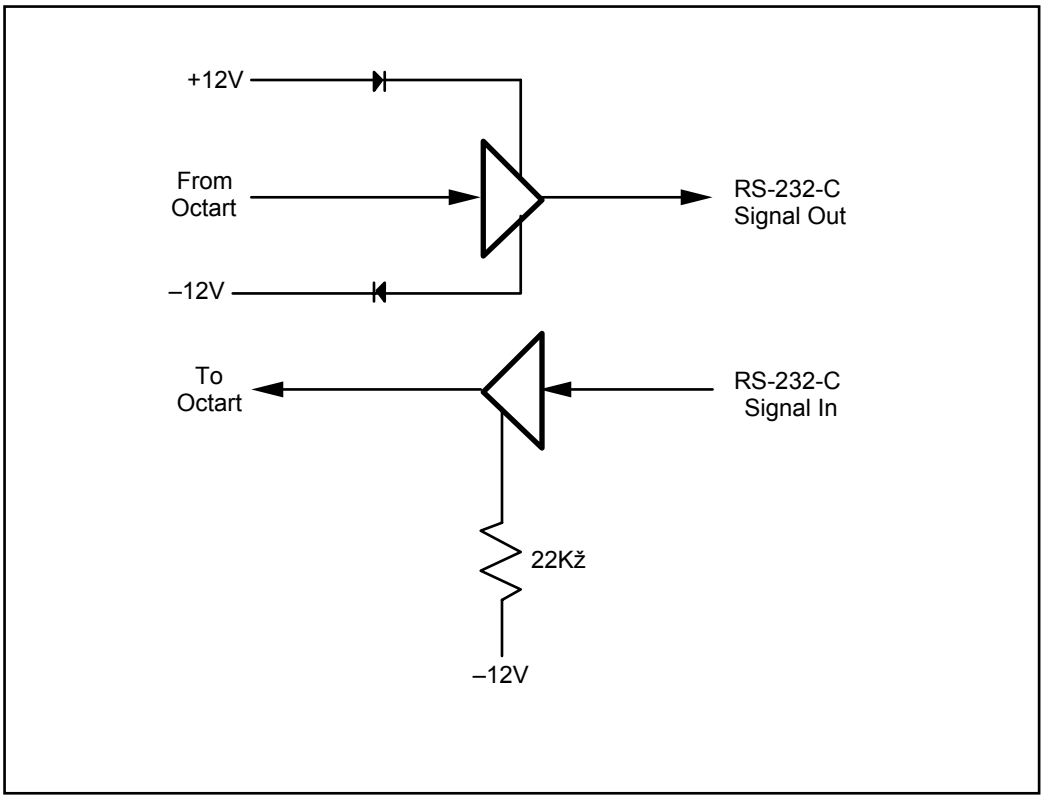



**Figure 2 I/O Buffer Circuit**

DMA is supported on channels c and d. If DMA is used, then the Request-To-Send lines on these two channels are not available .

The IndustryPack is controlled by a single CMOS 22V10 type PAL.

Connection to the IP-OCTAL-232 is via a standard 50-conductor ribbon cable. An optional connection panel is available which provides a 50-pin flat cable input with 16 DB-9 male or female connectors. The metal reinforced connection panel mounts in a standard 19 inch rack-mount space.

If compatibility with pre-1994 IP-OCTAL-232 IndustryPacks is required or for RS232D environments requiring a higher level of noise immunity, a special order option, Option-01, is available which shifts the nominal threshold slightly less than one volt. This option does not provide TTL switching thresholds.

Reprints of the Data Sheets for the SCC2698B, Schematic and PAL equations, and sample serial cables are available.



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# VMEbus Addressing

IP-OCTAL-232 is accessed using 8-bit bytes at odd locations only. It is usually accessed in the I/O space. Shown below in Figures 3 and 4 are the register maps of the IP-OCTAL-232. All addresses are offsets from the I/O base address of the IP as set on the IP carrier board.

The SCC2698B Octal UART has four major internal sections, called functional blocks A through D. Each functional block has two serial channels, one timer, and one I/O port.

| Hex | Dec | Binary | Read | Write |
|---|---|---|---|---|
| | | **Functional Block A** | | |
| 1 | 1 | 0000001 | MR1a, MR2a | MR1a, MR2a |
| 3 | 3 | 0000011 | SRa | CSRa |
| 5 | 5 | 0000101 | RESERVED | CRa |
| 7 | 7 | 0000111 | RHRa | THRa |
| 9 | 9 | 0001001 | IPCRA | ACRA |
| B | 11 | 0001011 | ISRA | IMRA |
| D | 13 | 0001101 | CTUA | CTURA |
| F | 15 | 0001111 | CRLB | CTLRB |
| 11 | 17 | 0010001 | MR1b, MR2b | MR1b, MR2b |
| 13 | 19 | 0010011 | SRb | CSRb |
| 15 | 21 | 0010101 | RESERVED | CRb |
| 17 | 23 | 0010111 | RHRb | RHRb |
| 19 | 25 | 0011001 | RESERVED | RESERVED |
| 1B | 27 | 0011011 | INPUT PORT A | OPCRA |
| 1D | 29 | 0011101 | START C/T A | RESERVED |
| 1F | 31 | 0011111 | STOP C/T A | RESERVED |
| | | **Functional Block B** | | |
| 21 | 33 | 0100001 | MR1c, MR2c | MR1c, MR2c |
| 23 | 35 | 0100011 | SRc | CSRc |
| 25 | 37 | 0100101 | RESERVED | CRc |
| 27 | 39 | 0100111 | RHRc | THRc |
| 29 | 41 | 0101001 | IPCRB | ACRB |
| 2B | 43 | 0101011 | ISRB | IMRB |
| 2D | 45 | 0101101 | CTUB | CTURB |
| 2F | 47 | 0101111 | CRLB | CTLRB |
| 31 | 49 | 0110001 | MR1d, MR2d | MR1d, MR2d |
| 33 | 51 | 0110011 | SRd | CSRd |
| 35 | 53 | 0110101 | RESERVED | CRd |
| 37 | 55 | 0110111 | RHRd | THRd |
| 39 | 57 | 0111001 | RESERVED | RESERVED |
| 3B | 59 | 0111011 | INPUT PORT B | OPCRB |
| 3D | 61 | 0111101 | START C/T B | RESERVED |
| 3F | 63 | 0111111 | STOP C/T B | RESERVED |

**Figure 3 Register Map of SCC2698, Blocks A and B**



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| Hex | Dec | Binary | Read | Write |
|---|---|---|---|---|
| | | **Functional Block C** | | |
| 41 | 65 | 1000001 | MR1e, MR2e | MR1e, MR2e |
| 43 | 67 | 1000011 | SRe | CSRe |
| 45 | 69 | 1000101 | RESERVED | CRe |
| 47 | 71 | 1000111 | RHRe | THRe |
| 49 | 73 | 1001001 | IPCRC | ACRC |
| 4B | 75 | 1001011 | ISRC | IMRC |
| 4D | 77 | 1001101 | CTUC | CTURC |
| 4F | 79 | 1001111 | CRLC | CTLRC |
| 51 | 81 | 1010001 | MR1f, MR2f | MR1f, MR2f |
| 53 | 83 | 1010011 | SRf | CSRf |
| 55 | 85 | 1010101 | RESERVED | CRf |
| 57 | 87 | 1010111 | RHRf | THRf |
| 59 | 89 | 1011001 | RESERVED | RESERVED |
| 5B | 91 | 1011011 | INPUT PORT C | OPCRC |
| 5D | 93 | 1011101 | START C/T C | RESERVED |
| 5F | 95 | 1011111 | STOP C/T C | RESERVED |
| | | **Functional Block D** | | |
| 61 | 97 | 1100001 | MR1g, MR2g | MR1g, MR2g |
| 63 | 99 | 1100011 | SRg | CSRg |
| 65 | 101 | 1100101 | RESERVED | CRg |
| 67 | 103 | 1100111 | RHRg | THRg |
| 69 | 105 | 1101001 | IPCRD | ACRD |
| 6B | 107 | 1101011 | ISRD | IMRD |
| 6D | 109 | 1101101 | CTUD | CTURD |
| 6F | 111 | 1101111 | CRLD | CTLRD |
| 71 | 113 | 1110001 | MR1h, MR2h | MR1h, MR2h |
| 73 | 115 | 1110011 | SRh | CSRh |
| 75 | 117 | 1110101 | RESERVED | CRh |
| 77 | 119 | 1110111 | RHRh | RHRh |
| 79 | 121 | 1111001 | RESERVED | RESERVED |
| 7B | 123 | 1111011 | INPUT PORT D | OPCRD |
| 7D | 125 | 1111101 | START C/T D | RESERVED |
| 7F | 127 | 1111111 | STOP C/T D | RESERVED |

**Figure 4 Register Map of SCC2698, Blocks C and D**

For NuBus applications see the section following, Nubus Addressing.



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# NuBus Addressing

Since the Nubus uses only 32-bit wide accesses, 8-bit wide peripherals such as the IP-OCTAL-232 appear in the host address space every fourth byte.

To calculate the RM1260 Springboard register addresses from the VMEbus address (given in the previous section in Figures 4 and 5), multiply by two and subtract one. To convert VME addresses to RM1270 SupportBoard addresses multiply by two and add one.



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# I/O Pin Assignments

This section gives the pin assignments for IP-OCTAL-232 connections.

| Pin Number | Channel | Function | Level |
|---|---|---|---|
| 1 | Channel a | GND | RS-232-C |
| 2 | Channel a | TxD | RS-232-C |
| 3 | Channel a | RxD | RS-232-C |
| 4 | Channel a | RTS | RS-232-C |
| 5 | Channel a | CTS | RS-232-C |
| 6 | Channel b | GND | RS-232-C |
| 7 | Channel b | TxD | RS-232-C |
| 8 | Channel b | RxD | RS-232-C |
| 9 | Channel b | RTS | RS-232-C |
| 10 | Channel b | CTS | RS-232-C |
| 11 | Channel c | GND | RS-232-C |
| 12 | Channel c | TxD | RS-232-C |
| 13 | Channel c | RxD | RS-232-C |
| 14 | Channel c | RTS | RS-232-C |
| 15 | Channel c | CTS | RS-232-C |
| 16 | Channel d | GND | RS-232-C |
| 17 | Channel d | TxD | RS-232-C |
| 18 | Channel d | RxD | RS-232-C |
| 19 | Channel d | RTS | RS-232-C |
| 20 | Channel d | CTS | RS-232-C |
| 21 | Channel e | GND | RS-232-C |
| 22 | Channel e | TxD | RS-232-C |
| 23 | Channel e | RxD | RS-232-C |
| 24 | Channel e | RTS | RS-232-C |
| 25 | Channel e | CTS | RS-232-C |
| 26 | Channel f | GND | RS-232-C |
| 27 | Channel f | TxD | RS-232-C |
| 28 | Channel f | RxD | RS-232-C |
| 29 | Channel f | RTS | RS-232-C |
| 30 | Channel f | CTS | RS-232-C |
| 31 | Channel g | GND | RS-232-C |
| 32 | Channel g | TxD | RS-232-C |
| 33 | Channel g | RxD | RS-232-C |
| 34 | Channel g | RTS | RS-232-C |
| 35 | Channel g | CTS | RS-232-C |
| 36 | Channel h | GND | RS-232-C |
| 37 | Channel h | TxD | RS-232-C |
| 38 | Channel h | RxD | RS-232-C |
| 39 | Channel h | RTS | RS-232-C40 |
| Channel h | | CTS | RS-232-C |
| 41 | -- | GND | -- |
| 42 | -- | +12 pullup | RS-232-C |
| 43 | Channel a | MPI - a | CMOS* |
| 44 | Channel b | MPI - b | CMOS* |
| 45 | Channel c | MPI - c | CMOS* |
| 46 | Channel d | MPI - d | CMOS* |
| 47 | Channel e | MPI - e | CMOS* |
| 48 | Channel f | MPI - f | CMOS* |
| 49 | Channel g | MPI - g | CMOS* |
| 50 | Channel h | MPI - h | CMOS* |

***Note:** I/O lines on pins 43–50 are ±50 µA input current, TTL thresholds.

**Figure 5 I/O Pin Assignment**



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Each channel has five RS-232-C lines. Each channel is wired identically at the 50-pin connector. The five lines are Ground, Transmit Data output, Receive Data input, Ready to Send output, and Clear to Send input. The common ground line for all channels connects to the local logic ground. There are many programming options. The two "modem control lines" RTS and CTS may also be used for other modem or terminal control functions or for general purpose functions.

There is a pullup resistor (1KΩ) to +12 volts available on pin 42. This may be connected externally to assert a "Mark" (true) signal into an RS-232-C line.

Eight general purpose input lines at non-RS-232 levels are provided on pins 43 through 50. These are unbuffered CMOS logic inputs connected directly to the SCC2698B. They may be programmed as general purpose inputs or as the counter/timer external input. The switching threshold for inputs is at TTL levels (1.5 volts nominal). Since these lines are unbuffered, the user is cautioned to observe anti-static rules in handling cabling, the IndustryPack and all connecting hardware. External equipment connected to these lines should be powered up and down at the same time as the IndustryPack.



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# IndustryPack Logic Interface Pin Assignment

Figure 6 below gives the pin assignments for the IndustryPack Logic Interface on the IP-OCTAL-232. Pins marked n/c below are defined by the specification, but not used on IP-OCTAL-232.

| | | | |
|---|---|---|---|
| GND | GND | 1 | 26 |
| CLK | +5V | 2 | 27 |
| Reset* | R/W* | 3 | 28 |
| D0 | IDSel* | 4 | 29 |
| D1 | DMAReq0 | 5 | 30 |
| D2 | MEMSel* | 6 | 31 |
| D3 | DMAReq1 | 7 | 32 |
| D4 | INTSel* | 8 | 33 |
| D5 | DMAck0* | 9 | 34 |
| D6 | IOSel* | 10 | 35 |
| D7 | DMAck1* | 11 | 36 |
| n/c | A1 | 12 | 37 |
| n/c | n/c | 13 | 38 |
| n/c | A2 | 14 | 39 |
| n/c | n/c | 15 | 40 |
| n/c | A3 | 16 | 41 |
| n/c | n/c | 17 | 42 |
| n/c | A4 | 18 | 43 |
| n/c | n/c | 19 | 44 |
| n/c | A5 | 20 | 45 |
| BS1* | Strobe* | 21 | 46 |
| –12V | A6 | 22 | 47 |
| +12V | Ack* | 23 | 48 |
| +5V | n/c | 24 | 49 |
| GND | GND | 25 | 50 |

**Note 1:** The no-connect (n/c) signals above are defined by the IndustryPack Logic Interface Specification, but not used by this IP. See the Specification for more information.

**Note 2:** The layout of the pin numbers in this table corresponds to the physical placement of pins on the IP connector. Thus this table may be used to easily locate the physical pin corresponding to a desired signal. Pin 1 is marked with a square pad on the IndustryPack.

**Figure 6 Logic Interface Pin Assignment**



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# Programming

The IP-OCTAL-232 is designed around the SCC2698B and all of the SCC2698 functions are available. The SCC2698B is divided into four Functional Blocks lettered A through D. Each functional block contains two serial channels. The channels are identified by lower case letters a through h. The SCC2698B contains 64 internal registers, 16 for each functional block. Each of these registers are accessible using a read or write to the IP-OCTAL-232 I/O space. The SCC2698 manual is included with the Technical Documentation to provide the user with detailed information about these registers.

The IndustryPack provides an external vector register. The address of the vector register, which may also be read normally, is in the upper half of the ID PROM space of the IndustryPack, on odd bytes. The address offsets are shown in Figure 7.

There is also provision for mapping the vector register to IP memory space. This is required primarily when the IP is installed on a Motorola MVME162 CPU board. In this mode, no address offset is required; the memory base address is sufficient.

| Carrier | Bus | Address |
|---|---|---|
| VIPC310 | VMEbus | IP I/O base + $C1 |
| VIPC610 | VMEbus | IP I/O base + $C1 |
| MVME162 | IPIC | IP Memory base |
| RM1260 | NuBus | IP ID base + $81 |
| RM1270 | NuBus | IP ID base + $83 |

**Figure 7 Location of the Vector Register**

The eight bit vector is loaded by the host software prior to enabling interrupts. The interrupts service routine polls the SCC2698B to determine the detailed cause of the interrupt. Function Blocks A and B interrupt on IRQ0. Function Blocks C and D interrupt on IRQ1. See the User Manual for your IP Carrier tor interrupt mapping to your bus. Note that although two distinct interrupt levels are provided, there is a single vector for the IndustryPack.

A Hypercard stack is available that permits quick demonstration, testing and prototyping of the IP-OCTAL-232. A user provided Apple® Macintosh® II family computer is required.



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# ID PROM

Every IP contains an IP PROM, whose size is at least 32 x 8 bits. The ID PROM aids in software auto configuration and configuration management. The user's software, or a supplied driver, may verify that the device it expects is actually installed at the location it expects, and is nominally functional. The ID PROM contains the manufacturing revision level of the IP. If a driver requires that a particular revision be present, it may check for it directly.

Standard data in the ID PROM on the IP-OCTAL-232 is shown in Figure 8 below. For more information on IP ID PROMs refer to the IndustryPack Logic Interface Specification.

The location of the ID PROM in the host's address space is dependent on which carrier is used. Normally for VMEbus carriers the ID PROM space is directly above the IP's I/O space, or at IP-base + $80. Macintosh drivers use the ID PROM automatically. RM1260 address may be derived from Figure 8 below by multiplying the addresses given by two, then subtracting one. RM1270 addresses may be derived by multiplying the addresses given by two, then adding one.

The ID PROM used is an AMD 27LS19A.

| | | |
|---|---|---|
| 3F<br><br>19 | (available for user) | |
| 17 | CRC | |
| 15 | No of bytes used | (0B) |
| 13 | Driver ID, high byte | |
| 11 | Driver ID, low byte | |
| 0F | reserved | (00) |
| 0D | Revision | (A1) |
| 0B | Model No IP-OCTAL-232 | (22) |
| 09 | Manufacturer ID GreenSpring | (F0) |
| 07 | ASCII "C" | (43) |
| 05 | ASCII "A" | (41) |
| 03 | ASCII "P" | (50) |
| 01 | ASCII "I" | (49) |

**Figure 8 ID PROM Data (hex)**



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# User Options

User options consist of connecting to the Strobe pin on the Logic Interface and connections to support DMA.

The location of the shunt groups is shown near the end of this Manual in Figure 11.

The Strobe pin on the Logic Interface (pin 46) is provided for secondary clock input or output. This pin may be driven by the Channel a Multi-Purpose Output from the SCC, or it may be connected to provide for the external input the to Counter/Timer. These options are shown below in Figure 9. Note that in most cases some corresponding programming of SCC modes is required. The SCC may be programmed to drive the connected pin for other functions that those listed in the Figure below. The IndustryPack Logic Interface Specification restricts the Strobe pin to clock functions, however. Only those functions listed below should programmed.

| Shunt E1 | I/O | SCC Pin | Function |
|---|---|---|---|
| 1-2 | Output | MPOa | Counter/Timer output |
| 1-2 | Output | MPOa | Transmit Clock (1X or 16X) |
| 1-2 | Output | MPOa | Receive Clock (1X or 16X) |
| 2–3 | Input | MPI1a | General Purpose Input |
| 2–3 | Input | MPI1a | Counter/Timer External Input |
| OUT | none | none | Strobe Pin floating **default** |

**Figure 9 Strobe Connection Options**

The IP-OCTAL-232 is configured to support minimum Direct Memory Access (DMA) on Channels C and D. To use DMA, program the SCC for TxRDY or RxRDY on MPOc and/or MPOd. See Figure 10 below for DMA Shunt Assignments.

| Shunt | SCC Pin | Logic Pin | Function |
|---|---|---|---|
| E2 IN | MPOc | DMAReq0 | TxRDY or RxRDY |
| E3 IN | MPOd | DMAReq1 | TxRDY or RxRDY |
| E2,E3 OUT | -- | -- | No DMA **default** |

**Figure 10 DMA Shunt Assignments**



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# Construction and Reliability

IndustryPacks were conceived and engineered for rugged industrial environments. The IP-OCTAL-232 is constructed out of 0.062 inch thick FR4 material. The six copper layers consist of a ground plane, a power plane and four signal planes.

Surface mounting of components is used extensively. IC sockets for the control PAL and ID PROM use gold plated screw-machined pins. High insertion and removal forces are required, which assists in keeping components in place. If the application requires unusually high reliability or is in an environment subject to high vibration, the user may solder the four corner pins of each socketed IC into the socket, using a grounded soldering iron.

The IndustryPack connectors are keyed, shrouded and gold plated on both contacts and receptacles. They are rated at 1 Amp per pin, 200 insertion cycles minimum. These connectors make consistent, correct insertion easy and reliable.

The IP is optionally secured to the carrier with four metric M2 stainless steel screws. The heads of the screws are countersunk into the IP. The four screws provide significant protection against shock, vibration, and incomplete insertion. For most applications they are not required.

The IndustryPack provides a low temperature coefficient of 0.89 W/°C for uniform heat. This is based on the temperature coefficient of the base FR4 material of .31 W/m-°C, and taking into account the thickness and area of the IP. This coefficient means that if 0.89 Watts is applied uniformly on the component side, that the temperature difference between the component and the solder side is one degree Celsius.



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# Repair

## Service Policy

Before returning a product for repair, verify as well as possible that the suspected unit is at fault. Then call the Customer Service Department for a RETURN MATERIAL AUTHORIZATION (RMA) number. Carefully package the unit, in the original shipping carton if this is available, and ship prepaid and insured with the RMA number clearly written on the outside of the package. Include a return address and the telephone number of a technical contact. For out-of-warranty repairs, a purchase order for repair charges must accompany the return. SBS will not be responsible for damages due to improper packaging of returned items. For service on SBS products not purchased directly from SBS contact your reseller. Products returned to SBS for repair by other than the original customer will be treated as out-of-warranty.



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**Shunt Locations**

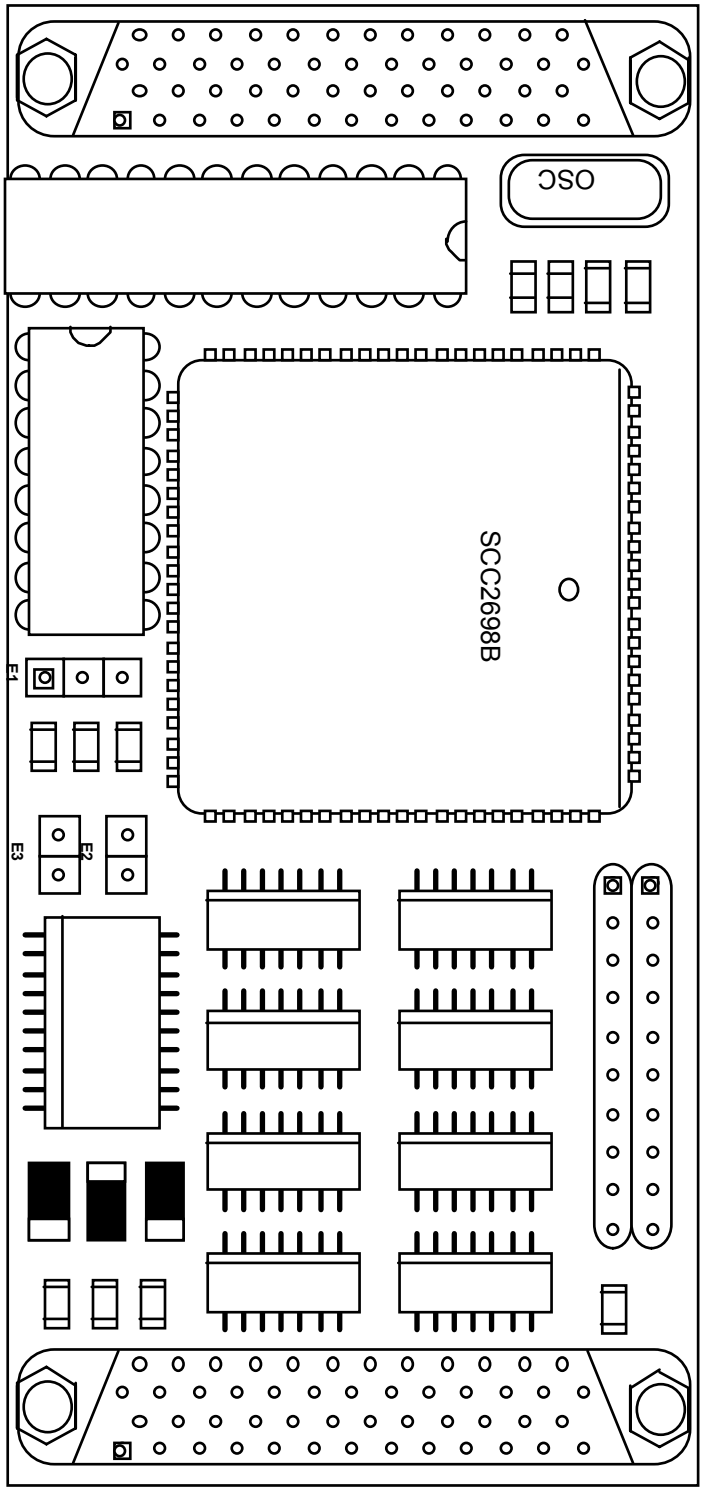



**Figure 11 Shunt Locations**



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# Specifications

| | |
|---|---|
| Logic Interface | IndustryPack logic Interface |
| Wait States | Zero on ID and Interrupts,<br>One on SCC accesses |
| Number of Channels | Eight |
| Type of Channels | Full-duplex asynchronous RS-232C |
| Baud Rates | 18 fixed rates from 50 to 38.4K<br>Four user-defined rates using timers |
| Implemented Signals | TxD, RxD, RTS, CTS, GND |
| Stop Bits | 1, 1.5, 2 in $^{1}/_{16}$ bit increments |
| Clock Source | Local crystal oscillator, or external |
| Error Detection | Parity, framing, overrun, false start bit, break |
| Channel Modes | Full duplex, automatic echo, local loopback, remote loopback |
| Number of Timers | Four |
| Type of Timers | 16-bit, multi-function, programmable |
| Interrupt Sources | 32, maskable, vectored |
| Interrupt Vector | Eight bits, may be independently read/writable |
| Auxiliary Input lines | Eight TTL/CMOS inputs, programmable bit input or state change detect causes interrupt or counter/external clock input |
| IP Strobe Options | Timer output, or baud rate clock input, or none |
| Power Requirements | +5 VDC, 170 mA<br>+12 VDC, 22 mA<br>–12 VDC, 9 mA |
| Dimensions | 1.800 by 3.900 by 0.340 inches maximum |
| Environmental | Operating temperature: +10° to +50°C<br>Humidity: 5% to 95% non-condensing<br>Storage: –10° to +85°C |



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