SR- 4 SERIAL NETWORK CONTROLLER

OPERATION AND INSTALLATION

MANUAL

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STOP

FOR BEST RESULTS: CONNECT AND TEST ONLY ONE SID SYSTEM FIRST WITH SIDDEMOB.BAS!

AFTER COMPLETE CONTROL OVER ONE AXIS IS ACCOMPLISHED,

CONNECT ONE SID TO CHANNEL 0 OF ONE SR4 AND RE-ESTABLISH COMPLETE CONTROL WITH SR4DEMO.BAS. REMEMBER TO INSTALL THE TERMINATOR!!

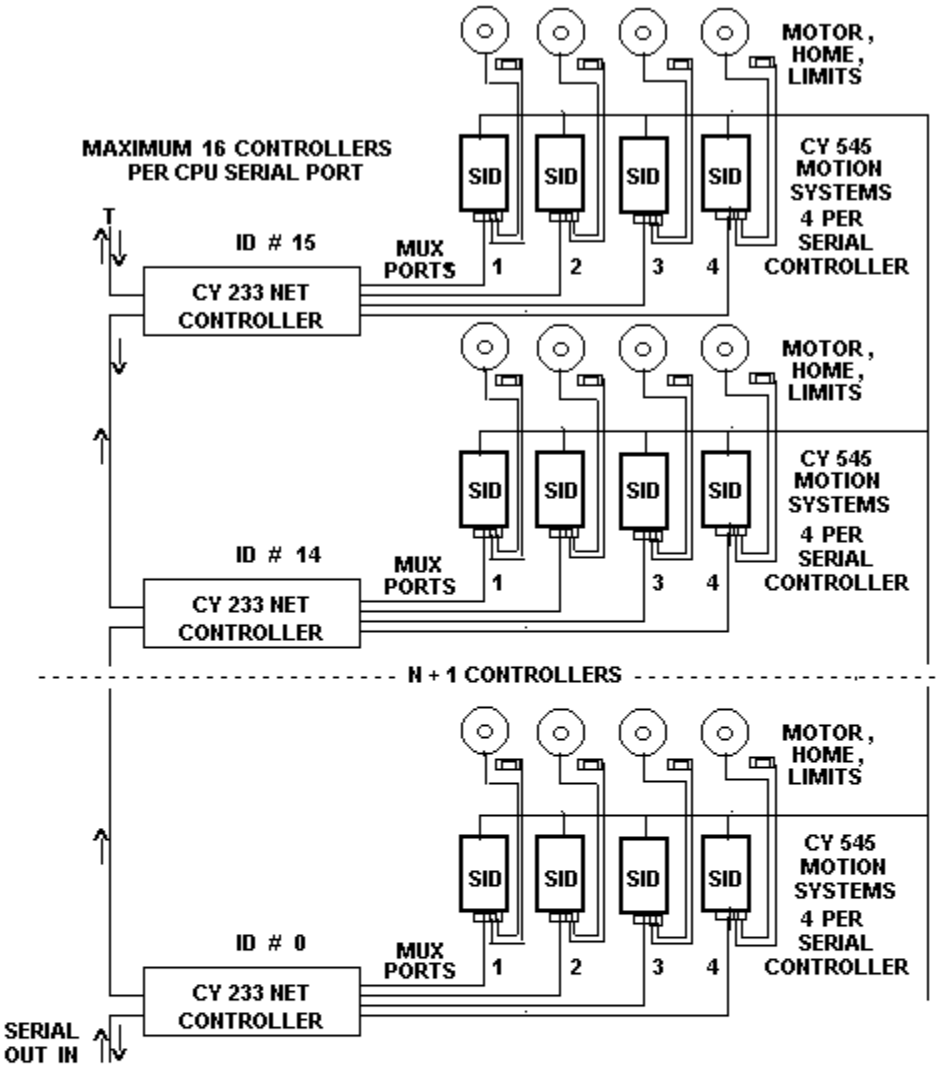
<u>THEN</u> CONNECT THE REMAINDER OF SIDS TO THE SR4 AND RE-ESTABLISH COMPLETE CONTROL WITH SR4DEMO.BAS,

NEXT, CONNECT ANY ADDITIONAL SR-4'S INTO A NET. MOVE THE TERMINATOR TO THE LAST SR-4. SET THE ADDRESS OF EACH SR-4 AS REQUIRED. RE-ESTABLISH CONTROL WITH SR4NETD.BAS.

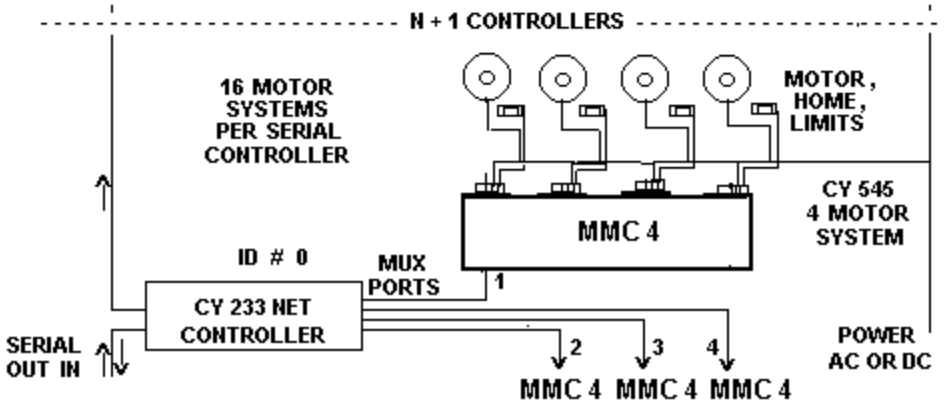
WHEN IN DOUBT, CALL 1-800-424-STEP.

SR 4 BLOCK DIAGRAM

SR 4 SERIAL LOOP CONTROLLER WITH SID / MID MOTION SYSTEMS



SR 4 SERIAL LOOP CONTROLLER WITH MMC - 4S MOTION SYSTEMS



SYSTEM COMMANDS

WRITE	**W**	**Send commands to the motion systems.**
READ	**R**	**Read status (busy) of the motion systems.**
ECHO	**J**	**Used to set SR-4 control into pass-through mode.**
ENTER	**<**	**Carriage Return terminate message; Start-up baudrate.**

INTRODUCTION

Motion Group SR4 Serial Controllers are used to expand the number of step motion systems that can be connected to a serial port from 1 to 512. Each controller can connect a serial path between one computer port and any combination of four motion systems. In addition, up to sixteen controllers can be "daisy-chained" together with simple pin-to-pin DB-9 serial cables. Power for each controller is obtained from the motion systems through the serial cables.

During operation, a three byte address is prefixed to a motion control command string. When the controller receives the address, a serial path is connected to the addressed motion system by a 1 to 4 serial data multiplexer. The motion command is passed to the motion system. The command terminator character (carriage return) also resets the multiplexer. Each command string must start with the controller address. The controller address compares to the setting of the controller switches. The multiplex code selects any combination of the four output paths to the motion system. In general, one system is selected at a time for setup commands and then all systems are directed to execute (Go) simultaneously. When requesting information from a system, only one can be selected.

When a motion system is preforming an operation, the CTS or Busy signal is input to the controller's status register. To monitor the busy status of the motion systems, a Read address, again consisting of three bytes, is sent to the controller. The first byte is the mode (Read); the second is the ID number; the last is always F HEX. The controller will return an ASCII character equal to a binary number. The first four binary bits are fixed at 4 HEX. The second four indicate the status of the four systems.

The host to controller serial ports are wired with standard RS-232 DB-9s connectors. Each controller has two, loop-in and loop out, communication ports. The first goes to the control computer and the second to the next controller in the daisy-chain. The last controller's second connector is terminated with a turn-around plug. The four motion system connectors are DB-9p.

The SR4 operates in RS-232 format using ASCII character mode and will Auto-Baud from 300 to 57K baud. Auto-Baud devices determine the baud rate automatically from two carriage returns sent during initialization of the system. Parity is none, 8 data bits, and 1 stop bit.

All MOTION GROUP (Electronic Products) motion systems connect to the SR4. The SID (Single Independent Drive) system supports up to four independent axes per controller with a maximum of 64 channels. With the MMC - 2S / 4S / 8S (Multiple Motor Controller) multiplex systems, up to 128 / 256 / 512 axes can be controlled from one serial port.

HARDWARE CONFIGURATION

The SR4 contains three sections: the CY233 Network Controller, the serial multiplexer, and the power supplies. In addition, the unit includes status LEDs and switches for setting the ID number.

THEROY OF OPERATION

The CY233 is used as an address controller for the multiplex system. When a mode command, followed by a valid ID number, is received by the 233, the 233's address lines select a multiplex channel. The remaining serial data (command string) is passed, through the multiplexer, directly to the target device (motion system) until the detection of the terminator charactor (carriage return) by the 233. After detecting the terminator, the 233 resets the address lines and waits for the next mode command. If more than one controller is connected to the serial network, invalid ID numbers and the serial data string are echoed to the next controller down the line. If the ID is invaild for all controllers, the entire message will return to the sender (echo invalid).

WRITE MODE

In general, the Mode commands are prefixed to motion commands which are to be "passed through" to the motion systems. Only two mode commands are used in this system, the write (W) and the read (R). A write command consists of a mode character (W), an ID number (two hex characters), a command string (motion system data string), and a terminator (carriage return). The ID number consists of two characters; the first or high byte is the system ID. This identifies an SR4 controller card. The system ID of a card is selected with the jumper switches located on the controller card. Valid ID numbers are from 0 to F hex (1 to 16 controllers). The second or low byte selects any combination of the four channels within the controller. Valid channel numbers are from 0 to F hex. Note that F selects no channels (normal default) and is used to send commands only to the CY233 and not the motion systems.

A typical example of a message to a CY545 motion controller would be: W0EP 1000<. This example directs channel 0 of SR4 0 (# 1) to move to position 1000.

The write command is also used to request information (query) from the motion systems. Only one motion channel can be requested to return information at a time. In a typical motion system, with a CY545 motion controller, the question mark (?) command is used to query the system. Do not program the motion system EEPROMS to respond with information without a query command first (slave mode only).

A typical command would be: W0E? p<. This requests channel 1 to return its current position.

<u>NOTE: Contary to normal CY545 procedure, in a CY233 network system, the letter in a query command MUST BE in LOWER case!</u>

READ MODE

A read command consists only of a mode character (R), the ID number (two hex characters; note that the second character is always F), and a terminator (carriage return). The read command is only used to read the status of the motion systems.

STATUS

When a motion system is busy, it can not respond, normally, to the host computer. The CTS (cleared to send) signal is used to hold off the host until, for example, a motion is completed. In the SR4 system, the status of all four CTS signals is available as a single ASCII character. This character is equal to a binary number consisting of two bytes. The high byte is always 0010 (4 hex); the low byte consists of four bits; each bit indicates the status of a channel's CTS signal. Remember that the motion system MUST be in the Hand-Shake Mode (CTS) for the status function to be valid.

A typical command would be: R0F<; if the response was N, the binary value would be 0010 (fixed) 1110. The LSB equal to 0 (zero) indicates that channel 0 is busy. Refer to Code Table.

WARNING

It is the users responsibility to insure that commands are not sent to busy systems. The motion systems can indicate they are busy but have no way to block incoming commmunications which will either be lost or jam (lock-up) the system. In some cases, the system may begin uncontrolled motion.

ECHO MODE

In network system, with more than one SR-4, it is necessary to engage the CY233 pass-through (echo-all) mode. This allows commands originating in a motion channel (CY545) to be passed through successive SR-4 cards down-stream in the network loop. A typical example is the query commands. The J command format consists of a mode character (J), the ID number (two hex characters; the second is always F), and the terminator (carriage return).

A typical command would be J0F<; the 0 is the address of the SR-4 card (CY233) and the F is a CY233 only message. Each SR-4 must be sent a J command during start-up procedure. Refer to PROGRAMMING section.

TABLE OF ID AND STATUS CODES

CONTROLLER ID ADDRESS [MSD]

HEX	BINARY	DECIMAL
F	1111	15
E	1110	14
D	1101	13
C	1100	12
B	1011	11
A	1010	10
9	1001	9
8	1000	8
7	0111	7
6	0110	6
5	0101	5
4	0100	4
3	0011	3
2	0010	2
1	0001	1
0	0000	0

OUTPUT ADDRESS [LSD]

HEX	BINARY	FUNCTION
F	1111	READ BUSY CODE
E	1110	WRITE TO PORT 1
D	1101	" 2
C	1100	" 1 & 2
B	1011	" 3
A	1010	" 3 & 1
9	1001	" 3 & 2
8	1000	" 3 & 2 & 1
7	0111	" 4
6	0110	" 4 & 1
5	0101	" 4 & 2
4	0100	" 4 & 2 & 1
3	0011	" 4 & 3
2	0010	" 4 & 3 & 1
1	0001	" 4 & 3 & 2
0	0000	" 4 & 3 & 2 & 1

READ BUSY CODE

ASCII

O = NONE
N = 1 BUSY
M = 2 BUSY
L (etc)
K
J
I
H
G
F
E
D
C
B
A
@

POWER SUPPLY

The SR4 is powered by + 5 vdc obtained from any connected motion system through pin 1 of the serial connector. It is not necessary to connect any power supplies to the SR4 system, except for test programming. The +/- 12 vdc for the RS-232 serial signals is generated on-board the SR4.

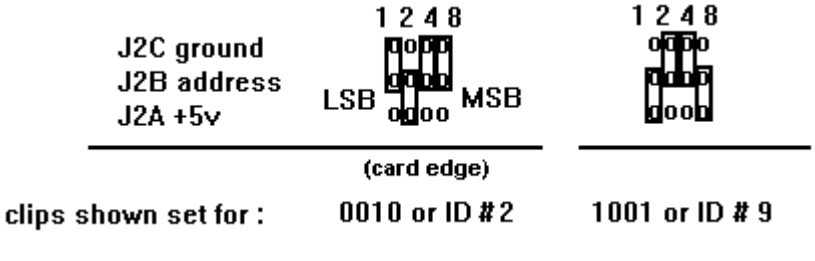
LED DISPLAYS

The displays are used with the test software program to verify and demonstrate correct operation of the SR4.

L 1	OUT 1	INDICATES TRANSMIT DATA TO CHANNEL	1
L 2	OUT 2	"	2
L 3	OUT 3	"	3
L 4	OUT 4	"	4
L 5	OUT DATA	INDICATES TRANSMIT DATA FROM HOST CPU	
L 6	IN 1	INDICATES RECEIVE DATA FROM CHANNEL1	
L 7	IN 2	"	2
L 8	IN 3	"	3
L 9	IN 4	"	4
L 10	AD 0	INDICATES MOTION CHANNEL IS SELECTED	1
L 11	AD 1	"	2
L 12	AD 2	"	3
L 13	AD 3	"	4

ID JUMPER SWITCH

The ID jumper switch assigns the ID number to an SR4 card. The switch consists of 3 rows of 4 posts. The center row is jumpered high or low according to the required number. The rows are labeled J2A (high posts), J2B (signal), and J2C (low posts). Posts not jumpered are don't care.



WARNING

SUDDEN AND UNEXPECTED MOTION CAN OCCUR DUE TO PROGRAMMING ERRORS.
STAY CLEAR OF THE MOTORS.

PROGRAMMING

The SR4 is, in general, transparent to the connected motion systems and requires only that the three byte address be pre-fixed to the existing commands. Before attempting to use the SR4, be certain that the connected devices are operating correctly and completely under the control of the user.

The demonstration software furnished with the SR4 is intended to exercise a single unit and to allow transmitting one character at a time in order to verify operation of the system. This software is a simple terminal program whose listings contain important notes. All users should read the listing for this general information about system operations. Refer to the sample program below.

INSTALLATION AND OPERATION (Single card units only)

Note: The symbol < indicates a carriage return (Enter key).

1. Verify that the SR4 jumper switches are set to 0000; SR4 0.

2. Insert the SR4 unit between the host computer and a motion system by connecting the SR4 DB9s (connector P-5) socket to the host computer and the SR4 DB9p (connector P1) of the first motion system. If a network connector is present, the terminator plug must be installed.

3. Power on the motion system. Verify the SR4 power indicator is lit.

4. Send < , < (two carriage returns) to set the auto-baud rate for the CY233. Send R0F<. After the carriage return, the SR4 will respond with busy status. Note that only the L5 indicator flashes for carriage return. Only one device is busy because only one is connected.

5. Send W00< twice. This sends two carriage returns to all channels of SR4 0. Note the L10 to L13 indicators lite (all channels selected) after the W00 but before the carriage return. Both the L5 and L1, L2, L3, L4 indicators will flash twice. Note: The baud and mode can be preset in the motion systems.

6. Send W00O 0A0H<. This enables the handshake mode in all connected channels. Send R0F<. The status of the first device is now "not busy".

7. Send W0E? p<. This sends ? p to channel 0. Note L5 and L10 will indicate the transmission of the ? p. Channel 0 will respond with p=000000. L1 will indicate the return transmission of p=000000.

8. Send W0E/B 0<. Verify that the B 0 (driver ENable) indicator of the motion system comes on. Send W0EG<. The motion system will Go in motion.

---------- SR4233.BAS ----------

```
10 PRINT "SR-4 TEST PROGRAM LISTINGS  THE MOTION GROUP 12-12-93"
11 PRINT ""
190 CLS
200 LF$ = CHR$(10): NL$ = CHR$(0): ES$ = CHR$(27)
250 OPEN "COM1:2400,N,8,1,CS0,DS0,CD0" FOR RANDOM AS #1
260 LOCATE 5, 1, 1
270 PRINT "                          THE MOTION GROUP   1-800-424-STEP
271 PRINT "     *****************SR-4 CONTROL PROGRAM FOR CY233 **************
272 PRINT "This serial network system test program sends one character at each key press.
273 PRINT "Always send two carriage returns to set the Auto-Baud after power-on.
274 PRINT "In network systems, the J command sequence (pass-through mode) is also required.
300 PRINT "CapsLock on!***UPPER CASE ONLY***Use Esc to EXIT program"         301 PRINT ""
305 PRINT "SR-4 READY TO GO!***ENTER TWO CR'S**2400 BAUD N0 PARITY 8 DATA 1 STOP
310 OPEN "SCRN:" FOR OUTPUT AS #2
440 A$ = INKEY$: IF A$ = ES$ GOTO 630
450 IF A$ <> "" THEN PRINT #1, A$; : PRINT #2, A$;
500 WHILE NOT EOF(1)
510 J% = LOC(1): B$ = INPUT$(J%, #1): LF% = 0
520 LF% = INSTR(LF% + 1, B$, LF$)
530 IF LF% > 0 THEN MID$(B$, LF%, 1) = NL$: GOTO 520
540 PRINT #2, B$;
550 WEND
560 GOTO 440
630 CLOSE #1: CLOSE #2
640 STOP
```

9. Power off the system and connect the other motion channels. Repeat the above procedure using the correct ID codes for each channel. Note that sending W00/B 0< will set all four B 0 indicators. Sending W00G< will Go all systems.

ADDITIONAL TESTS

1. Send W10> and R1F>. Note that these invalid addresses are echoed back to the host.

2. Set the SR4 jumper switch to the above address (1). Repeat the above and note they are received correctly.

NETWORK TESTS

1. Connect all SR4s with serial cables and the terminator. Connect at least one motion system per controller (power). Set the SR4 address jumpers.

2. Power-on the system. Send << (two carriage returns set the Auto-Baud).
Note: A CY233 controller is in Pass-Through mode after reset. All controller LEDs will flash as the returns pass around the loop. Each CY233 will then automatically shift out of pass-through mode (hardwired function).

3. Send J0F<, J1F<,....JnF (J command) to all controllers in the network.

4. Initialize a motion system. Send a query command (? x). Verify that the command is echoed around the loop.

SERIAL CABLES

XT TYPE. **CPU DB-25 (IBM STYLE)** **CONTROLLER DB-9S (AT)**

PIN 1	Frame Ground <---------->	Shell (solder)
PIN 2	TX Transmit ---------->	PIN 3 RX Receive
PIN 3	RX Receive <----------	PIN 2 TX Transmit
PIN 5	CTS Clear <----------	PIN 8 DSR Ready
PIN 7	Signal Ground <---------->	PIN 5 Signal & Frame

DB-25 to DB-9 Adaptor

AT TYPE. **CPU DB-9P (IBM STYLE)** **CONTROLLER DB-9S (AT)**

Note : DB-9 Controller is wired as a Null Modem (pin to pin)

PIN 3	TX Transmit ---------->	PIN 3 RX Receive
PIN 2	RX Receive <----------	PIN 2 TX Transmit
PIN 8	CTS Clear <----------	PIN 8 DSR Ready
PIN 5	Signal Ground <---------->	PIN 5 Signal & Frame
PIN 4	DTR Ready ---------->	PIN 4 DTR Ready
Shell	Frame Ground <---------->	Shell Signal & Frame

pin to pin cable

MAC DIN. **CPU DIN-8 (EIA-422)** **CONTROLLER DB-9S (AT)**

PIN 5	RX In- <----------	PIN 2 TX Transmit
PIN 3	TX Out- ---------->	PIN 3 RX Receive
PIN 2	CTS Hand In <----------	PIN 8 DSR Ready
PIN 4	Signal Ground <---------->	PIN 5 Signal & Frame
PIN 8	RX In+ <----------'	
PIN 1	DTR ---------->	PIN 4 DTR
Shell	Frame Ground <---------->	Shell Signal & Frame

MAC to IBM Adaptor Cable

The Controller/Device signal DSR (Data Set Ready) is wired to the SR-4 status input CTS (Cleared To Send). When the controller is busy, the DRS will set HI or or busy and pull CTS HI or not Clear To Send. The host CPU should not send when the device is busy. See SR-4 Status Code Table.

If the host software ignores the CTS status signal and commands are sent to the controller, the commands will be lost or jam the controller. Typical indications of the host failing to see the CTS (increase delay value) are: motion or homing stops when host program is run, motor runs backwards at high speed forever, or only part of memory routine is completed.

It is the responsibility of the host software to check status for "not busy" before sending commands to the selected device.

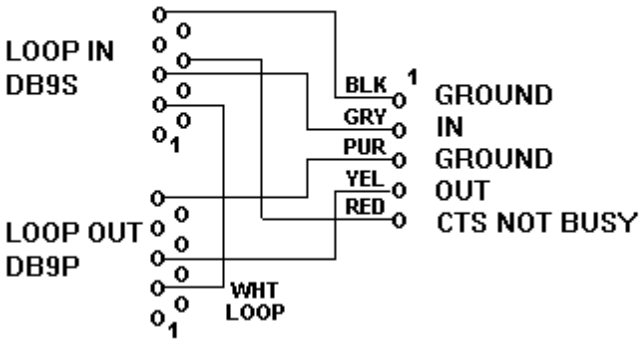
NETWORK CONFIGURATION (DAISY CHAIN) BLOCK DIAGRAM & CABLES

SR-4 HOST CABLE (NETWORK) ASSEMBLY

P5-1 GROUND	DB9S-5	GROUND	BLACK
P5-2 TXD DATA IN	DB9S-3	LOOP INPUT	GRAY
P5-3 GROUND	DB9P-5	GROUND	PURPLE
P5-4 RXD DATA OUT	DB9P-3	LOOP OUTPUT	YELLOW
P5-5 +5 VDC	DB9S-8	CTS ALWAYS NOT BUSY	RED

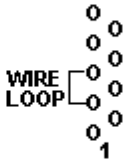
DB9S-2 LOOP RTN DB9P-2 LOOP RTN WHITE JUMPER

HOST CABLE ASSY



TERMINATOR ASSY

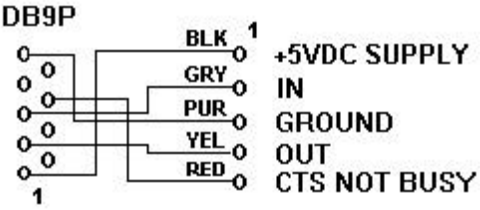
DB9S-2 — DB9S-3



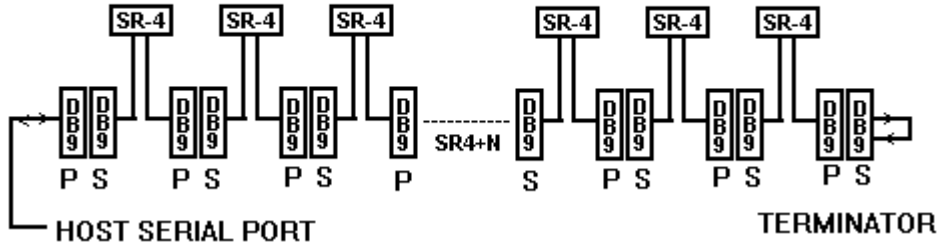
DB9P DEVICE CABLE ASSY 4 EA. / CARD

P5-1 +5 VDC	DB9P-1	+5 V	BLACK
P5-2 TXD DATA IN	DB9P-3	IN	GRAY
P5-3 GROUND	DB9P-5	GND	PURPLE
P5-4 RXD DATA OUT	DB9P-2	OUT	YELLOW
P5-5 CTS (NOT BUSY)	DB9P-8	CTS	RED

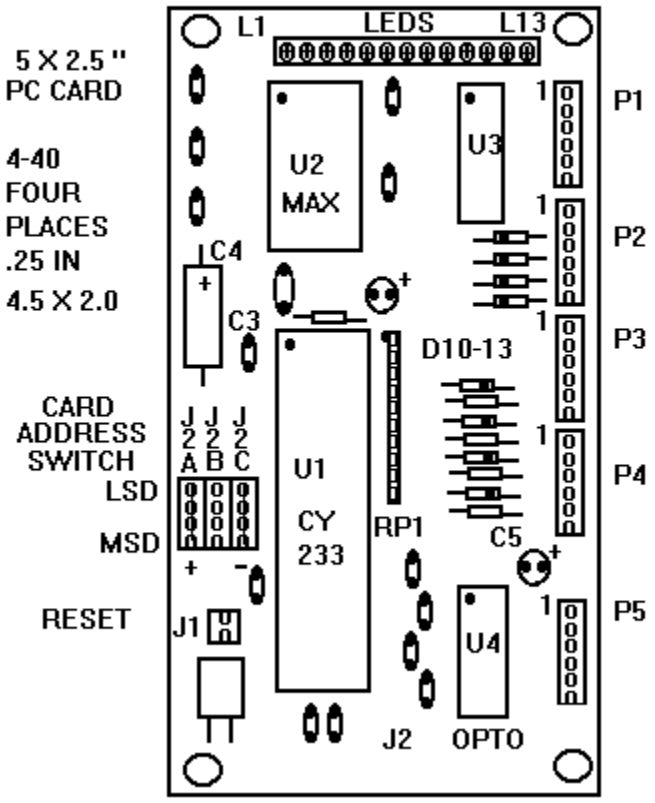
DB9P



NETWORK CABLING DIAGRAM



SR - 4 CARD & CABLE PINOUTS



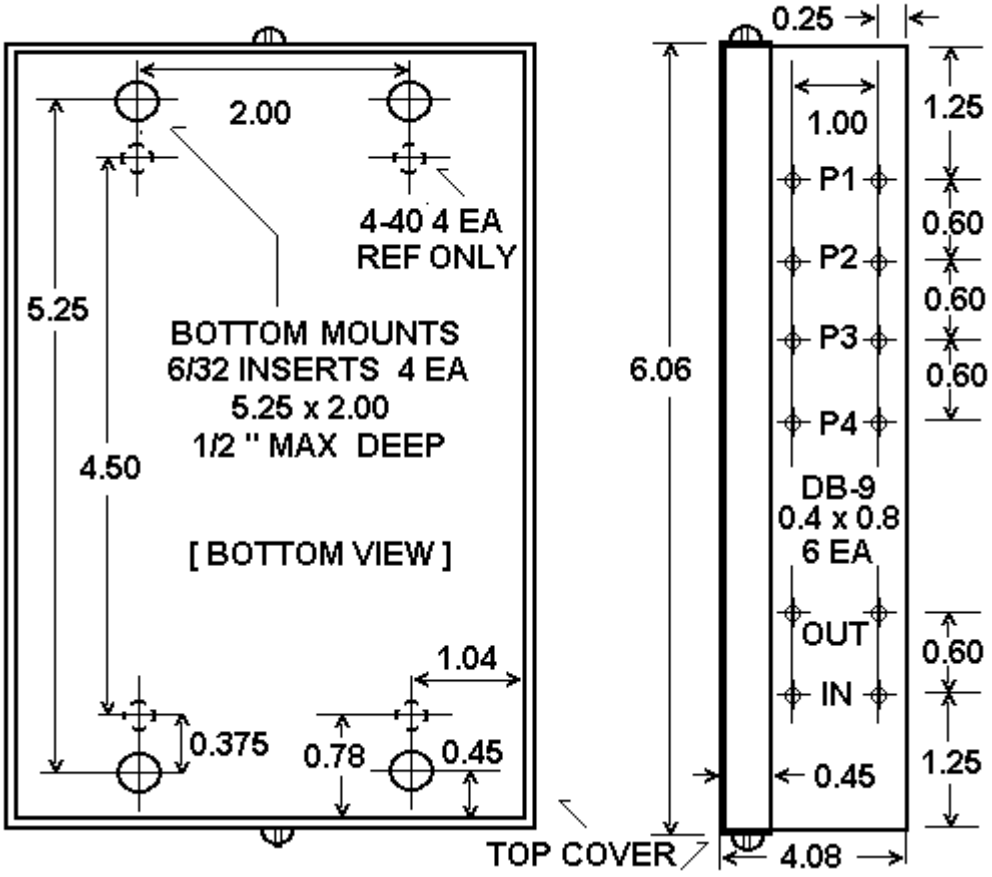
CHANNEL CONNECTORS
P1 P2 P3 P4 TYPICAL DB9S

P1-1 +5 VDC	DB9 -1
P1-2 TXD DATA OUT	DB9 -3
P1-3 SYSTEM GND	DB9 -5
P1-4 RXD DATA IN	DB9 -2
P1-5 CTS BUSY	DB9 -8

SINGLE CARD
HOST CONNECTOR DB9 S

P5-1 SYSTEM GND	DB9 -1
P5-2 TXD DATA OUT	DB9 -3
P5-3 SYSTEM GND	DB9 -5
P5-4 RXD DATA IN	DB9 -2
P5-5 +5 VDC {CTS}	DB9 -8

SR-4 METAL CASE DRAWING & MOUNTS



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