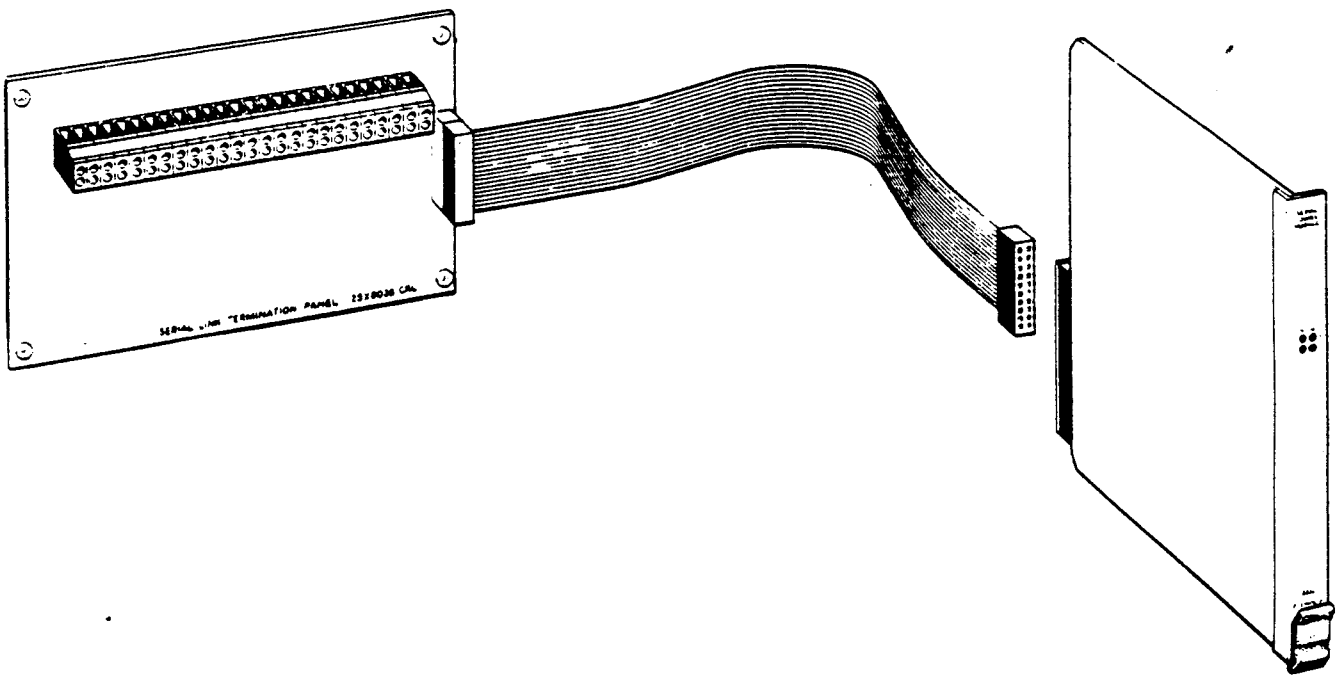
CEGELEC
INDUSTRIAL CONTROLS

SERIAL COMMUNICATIONS

8845-4101



GEM80 USER INFORMATION

Serial Communications 8845-4001

T441 Issue 1 12/86

Please incorporate the following amendments:-

Front cover

Delete -4101

All pages

Delete -4010 from title at foot of page

Page 17, Table 5, Port 1 column

Delete D31.11
Insert C31.10

Table 5, Port 2 column

Delete C31.10
Insert D31.11

Page 18, COMMISSIONING, Item 1

Delete Set fast.....host controller.

Insert Configure the module by inserting the last address of the module in the program.

Please retain this Errata Sheet with the document for reference.

CONTENTS

1. GENERAL OVERVIEW

The Serial Communications Module has been designed for application in 200 or 300 series controller systems where additional serial links are required over and above those built into the controller.

This Module plugs into the controller fast I/O spaces and provides two additional ports per 8845 module. These ports operate in 20mA current loop with ESP protocol and are set up by a program in the host controller.

2. SPECIFICATION

See Product Data Sheet.

3. HARDWARE LAYOUT

The serial communications modules backplane fits onto the rear lower of the 200 or 300 series controller subrack or fast I/O subrack.

The 8331 module then slides along the guide rails to plug into the backplanes at the rear. The ribbon cable connects the termination panel to the module through the backplane connector. See Figure 1 and 2 for details.

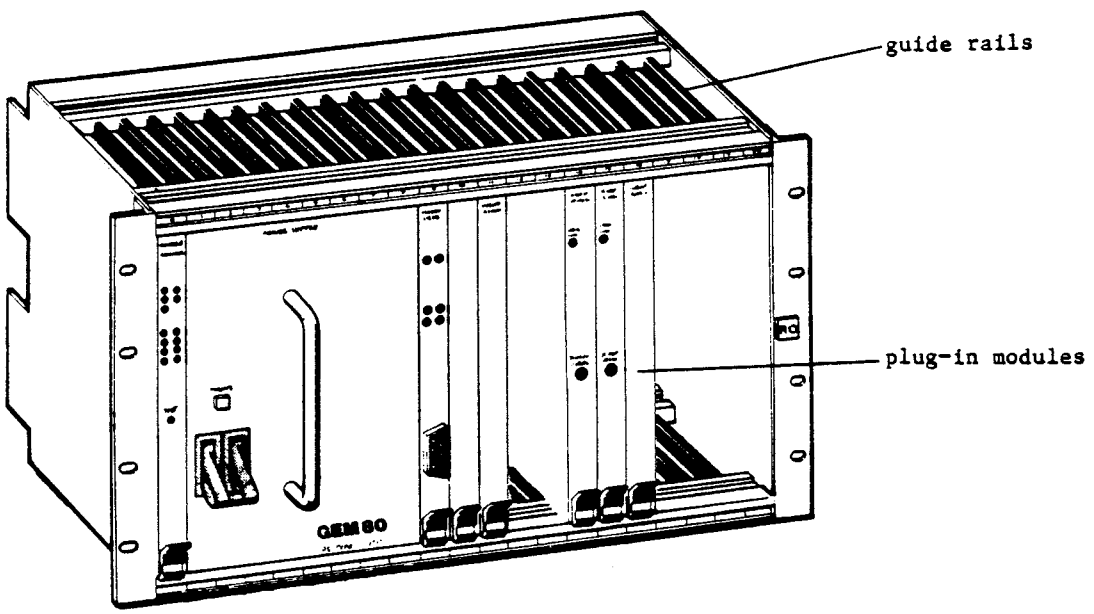
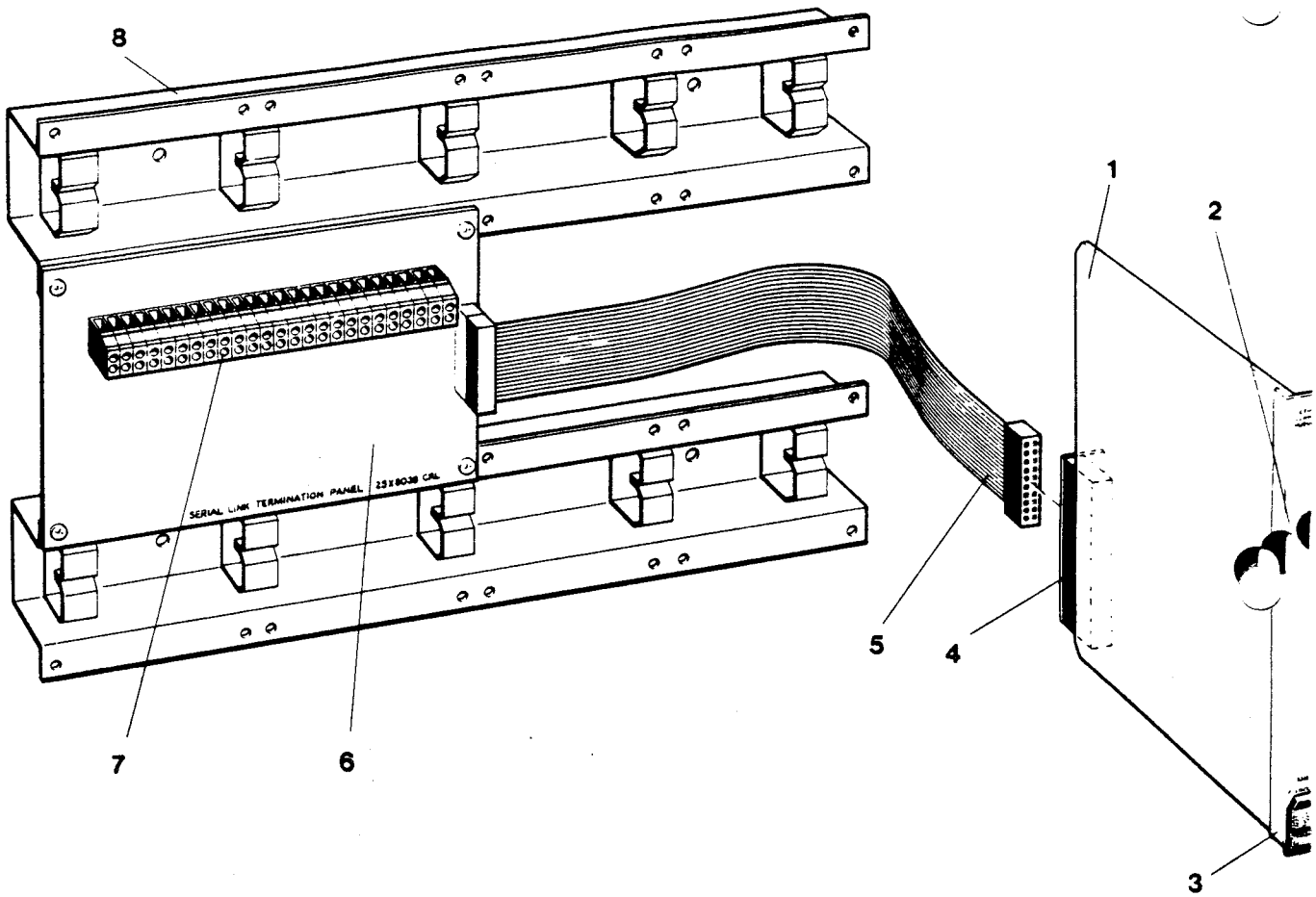


Figure 1 - Controller Subrack



1. Serial communications module type 8331-4101 (single slot width in GEM 80 fast I/O subrack).
2. Serial link activity lamps, transmit and receive for each port.
3. Withdrawal handle carrying label for module type number.
4. Backplane connector assebly for mounting at rear of subrack.
5. Ribbon cable.
6. Serial link termination panel type 8038.
7. Terminals for user cabling.
8. Optional mounting channel.

Figure 2 - 8845 Serial Communications Equipment

4.1 Data Table Exchange

The 8845 serial ports can be used for data table exchange with other GEM 80 controllers. Data to be sent out by the controller fast I/O is stored in the D data table while data received by the controller fast I/O is stored in the C Data Table. The exact address is determined by the position of the 8845 module in the fast I/O subrack. 32 data tables are reserved for each fast I/O module as shown in table 1. Table 1 shows that if the 8845 is fitted as module number 3 then data input by this module will be stored in C96 to C127 and data output by the module will be output D96 to D127. So 32 words of data can be sent out and received by the two 8845 serial ports, although the last word is not used to carry data.

Table 1 - C & D Table Addresses for each Module Number

C & D Table Address	Module Number
0 to 31	0
32 to 63	1
64 to 95	2
96 to 127	3
128 to 159	4
160 to 191	5
192 to 223	6
224 to 255	7
256 to 287	8
288 to 319	9
320 to 351	10
352 to 383	11
384 to 415	12
416 to 447	13
448 to 479	14
480 to 511	15
512 to 543	16
544 to 575	17
576 to 607	18
608 to 639	19
640 to 671	20
672 to 703	21
704 to 735	22
736 to 767	23
768 to 799	24
800 to 831	25
832 to 863	26
864 to 895	27
896 to 927	28
928 to 959	29
960 to 991	30
992 to 1023	31

Note slot numbers for each controller are detailed in Section 7 of the Controller Technical Manuals.

4.2 Point to Point Control Ports

The 8845 can be set up to operate as either a point to point control port or a tributary port.

Figure 3 shows a point to point serial link. Here two 8845 equipments interchange data. One being set up as a control port, the other as a tributary port.

The control port is responsible for all activity on the serial link and the tributary responds only when a message is addressed to it inviting a reply.

Figure 4 shows an example of a point to point serial link between two 8845 equipments in 250 series controllers 4 wire. Figure 5 shows a 2 wire point to point link. The 8845 is arranged such that if it is used as a point to point control port it may only communicate with tributary address 0.

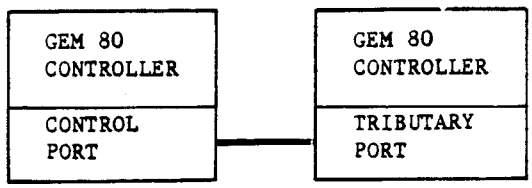


Figure 3 - Point to Point Serial Link

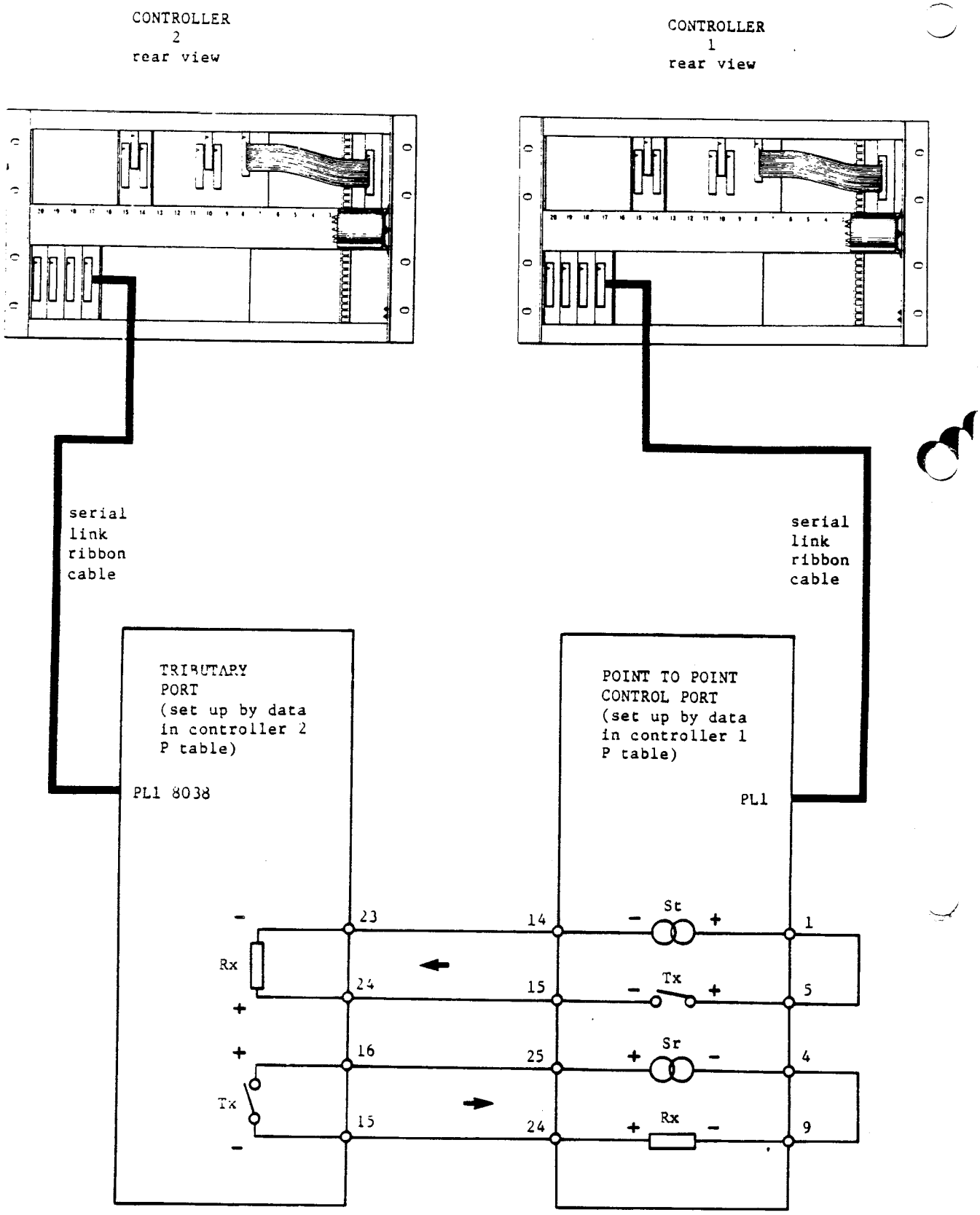


Figure 4 - Point to Point Serial Communications Link Between Two 8845 Equipments in Two 300 Series Controllers 4 Wire 20mA

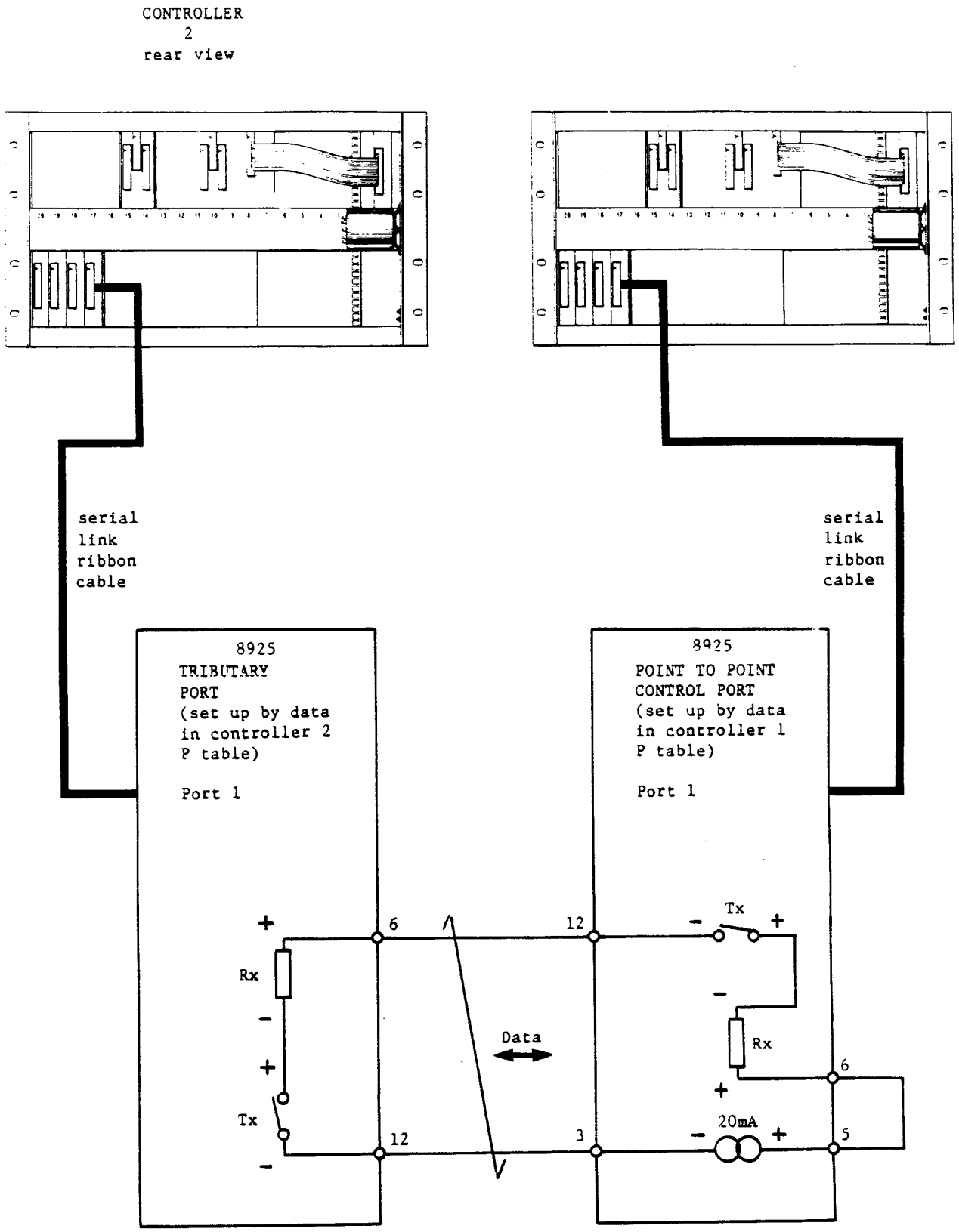


Figure 5 - Point to Point Serial Communications Link Between Two 8845 Equipments in Two 300 Series Controllers 2 Wire 20mA

4.3 Multi-drop Link

Figure 6 shows a multi-drop serial link. Here, up to 8 controllers can interchange data. One controller built-in serial communication port is set up as a multidrop control port and the 8845 equipments in the other controller are set up as tributary ports. The 8845 cannot be used as the control port in a multi-drop link but it can be used as a tributary port.

The control port communicates with each tributary on a cyclic basis. Communication directly between tributaries is not possible though data can be exchanged between tributaries via the control port.

Figure 7 shows an example of a 4 wire multi-drop link with the 8845 operating as tributaries.

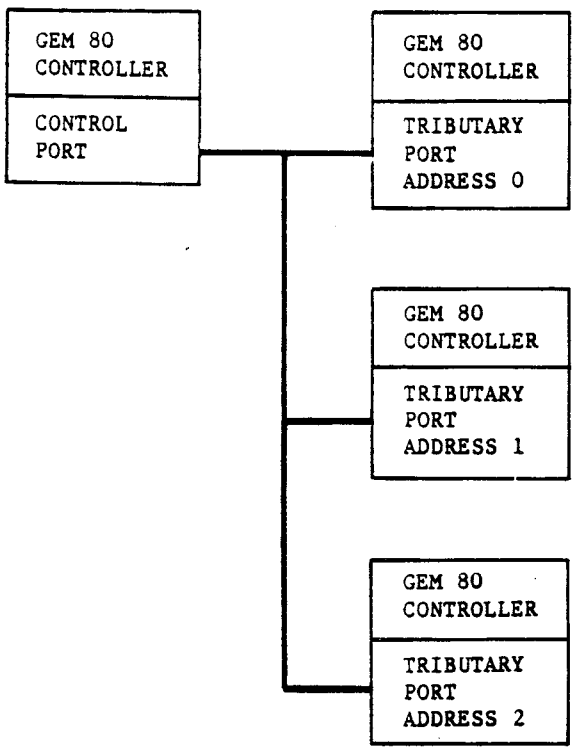


Figure 6 Multi-drop Serial Link

4.4 Maximum Length of Serial Links

The maximum link length depends on:

(a) Driving voltage provided by current sources (15V or 30V in standard GEM 80 equipment, depending on whether -15V power rail available. 15V applies to MINIGEM and GEM 80/100 series, 30V to GEM 80/200 and 300 series).

(b) Choice of single/twin pair cable.

(c) Signalling rate.

(d) Cable capacitance and resistance

(e) Quantity of tributaries in link.

(f) Presence at 20mA current source of clamping circuit, preventing cable charging through large voltage swing.

(g) Volt drop of transmit switches and rec loads. Standard GEM 80 circuits have a typical 1.0V volt drop for X, and 1.1V to 1.5V voltage drop range for Rx. The quoted figures will be applicable to non-GEM 80 equipment with equivalent volt drop characteristics.

There is an overall length limitation due to the volt drop in the cable, which is independent of signalling rate. Any link may be extended beyond the limits due to 20mA working, by introducing proprietary modems. Modems allow very long links, limited by propagation delays, which may give time-out problems if they exceed 100ms.

A further discussion of this topic is available in Serial Links User Information. This shows in more detail the improvement gained with 30V supplies. Fibre Optics, other cables a current source clamping circuits.

4.5 Further Information

Further information on serial links is available in Serial Links User Information.

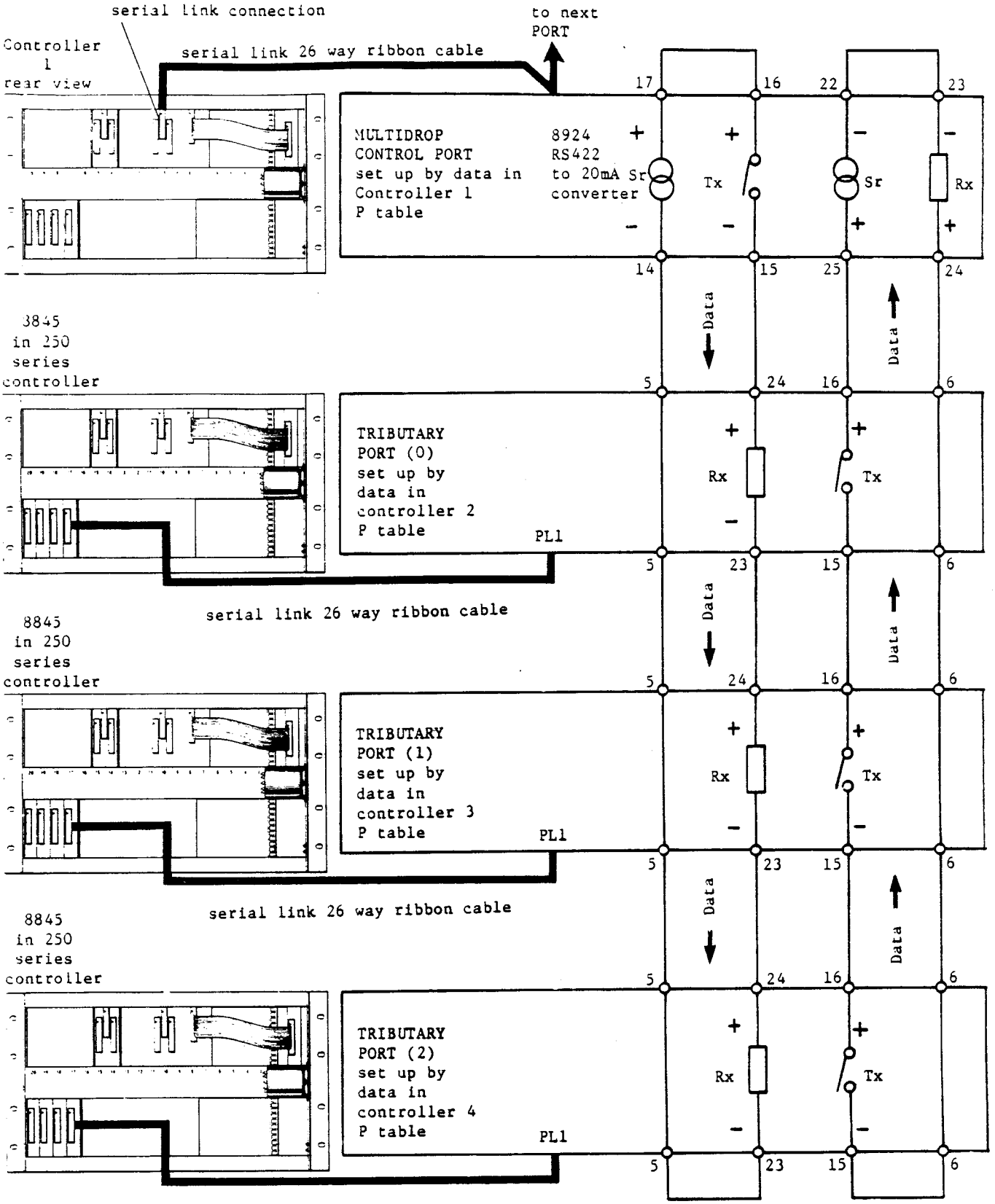


Figure 7 - Multi-drop Serial Communication Link Between Controller Port and 3 x 8845 in 250 Series Controllers 4 wire 20mA

2. Fit backplane connector assembly, mechanical coding mouldings, and module type number label at chosen subrack position. Insert mechanical coding pegs in correct positions.

   Module Mechanical Coding for 8331-4103
   upper 2,10 lower 1,2,9

3. Mount termination panel and connect to subrack via ribbon cable. Identify panel and ribbon with rack position labels. Ensure continuity relay absent on panel for ports used as control ports (see Serial Link User Information).

3. Using wire wrap tools and wire, connect reset line from enhanced processor (pin U/c27) to serial communications module (pin L/c28). If longer than 150mm run as twised pair with 0V (pin U/c32 at processor pin U/c32 at communications module).

4. Connect serial link cables. Ensure screens terminated and earthed at one end only.

Figure 8 shows a typical example of connection of 8845 to a 200 or 300 series subrack.

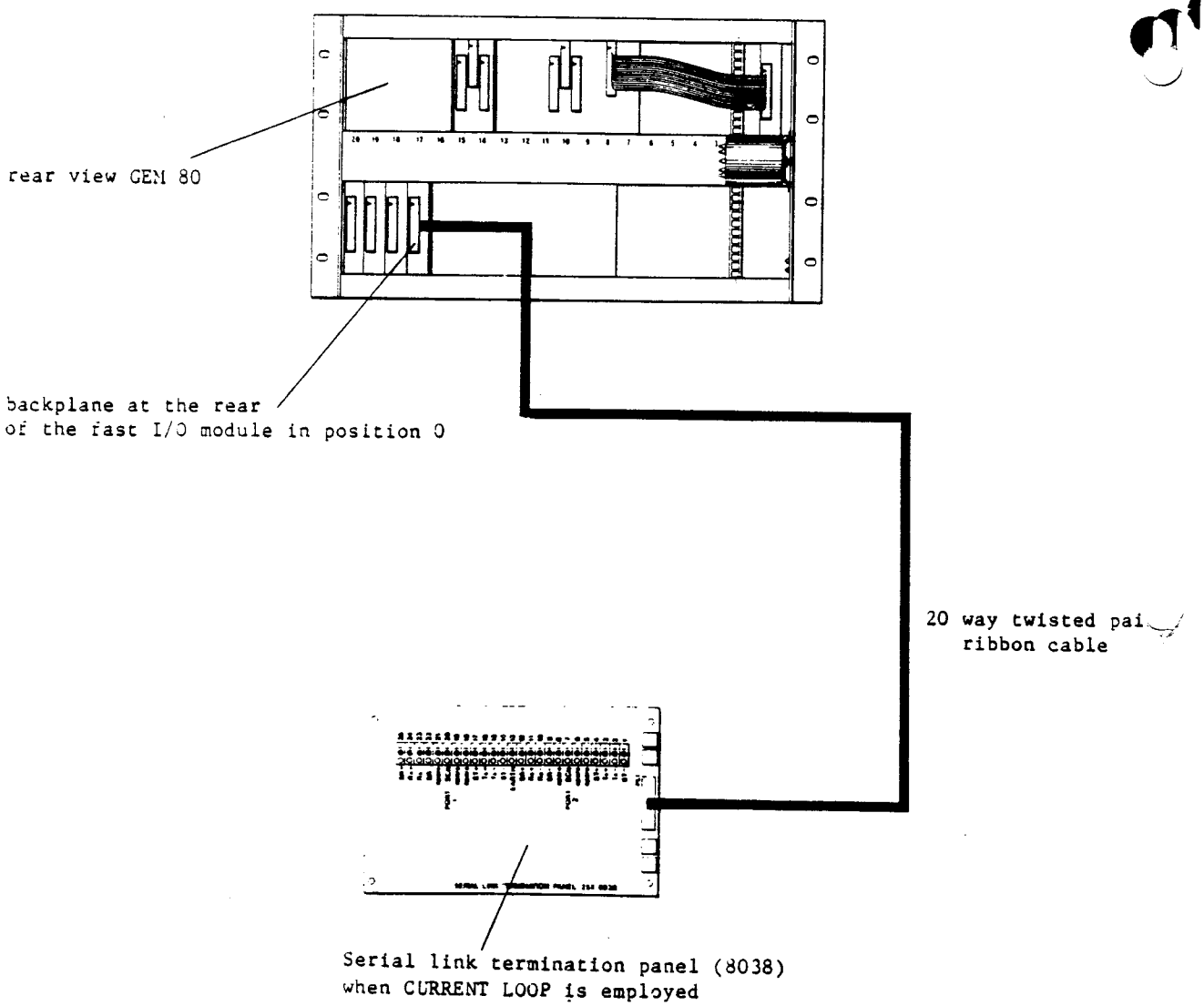


Figure 8 - 8845 Serial Communications Fitted in GEM 80/251 (position 0) Connected to 8038 (20mA Current Loop)

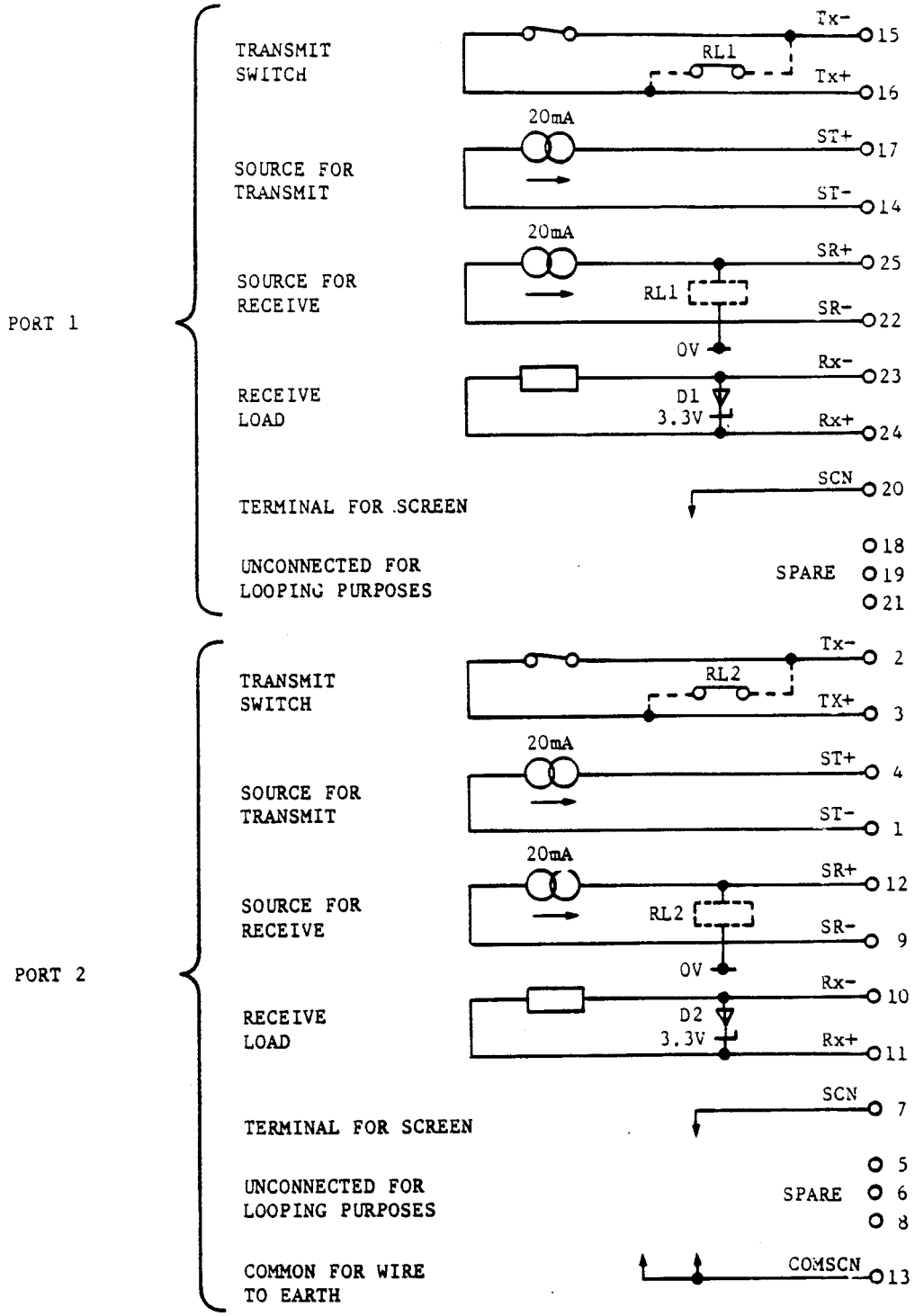


Figure 9 - Details of panel type 8038

6.1 Introduction

After any power up it is necessary to set up the serial ports before they can start operating. In fact this is done by the host controller program writing data into the D data tables. Table 2 below shows (for module position 0) the function of each data table. For other module positions add 32 x module number to the D data table addresses given below. For example if the module is number 3 the signalling rate data would be in data table D (2 + 32 x 3) = D98.

Table 2 Set Up Data for Module in Position 0

Function	Content	D Table Address Port 1	D Table Address Port 2
number of data table locations to be received	0 to 31 Content of D0 + D4 $\leqslant$ 31	D0	D4
number of data table locations to be transmitted	0 to 31 Content of D1 + D5 $\leqslant$ 31	D1	D5
Signalling Rate/Timeout Value (timeout details in Section 10)	Enter 110 for 110 bit/s " 300 for 300 bit/s " 600 for 600 bit/s " 1200 for 1200 bit/s " 2400 for 2400 bit/s " 4800 for 4800 bit/s " 9600 for 9600 bit/s Enter 0 Not in Use Enter -ve of above numbers for extended time out e.g. -110	D2	D6
Tributary address/point to point control/handshake (Handshake details in Section 9)	1. Tributary port without handshake - Enter address (0 to 14) 2. Tributary port with handshake - Enter address (0 to 14) plus 256 (e.g.for tributary address 1 with handshake enter 1 + 256 i.e. 257 3. Point to point control port without handshake - enter -1 4. Point to point control port with handshake - enter -2	D3	D7

To enter the set up mode it is necessary to set data table word D31 (for 8845 in module number 0) to the numeric value of "1" (i.e. set bit 0 "on").

For other module positions set data table word D(31 + 32 x module number) to the numeric value of "1". Further it is necessary that this numeric value of "1" is held for at least 50ms.

6.2 Typical Example

A typical example of a program to set up the 8845 is given below.

Requirements

Module position : 1st slot
Corresponding tables : C/D 0 to 31

Port 1 to be a control port transmitting 10 words and receiving 15 words, at 9600 bit/s.

Port 2 to be tributary address 2 on multidrop link, transmitting 6 words, receiving 5 words at 2400 bit/s.

Program

```
|                       |  Sets normal mode
|-<AND>-----( )--|  except when
|    0        D31.0 |  overriden by
|                       |  following block
|                       |
|--]/[--------OBEY  |  Block obeyed once
| G0.0          BLOCK|  on power up
|**START OF BLOCK**|
|                       |
|-<AND>---<OUT>-|  Port 1 input words
|   15        D0    |
|                       |
|-<AND>---<OUT>-|  Port 1 output words
|   10        D1    |
|                       |
|-<AND>---<OUT>-|  Port 1 rate
|  9600       D2    |
|                       |
|----------<OUT>-|  -1, Port 1 = control
|             D3    |
|                       |
|-<AND>---<OUT>-|  Port 2 input words
|    5        D4    |
|                       |
|-<AND>---<OUT>-|  Port 2 output words
|    6        D5    |
|                       |
|-<AND>---<OUT>-|  Port 2 rate
|  2400       D6    |
|                       |
|-<AND>---<OUT>-|  Port 2 tributary
|    2        D7    |  address
|                       |
|------------( )---|  Sets set up flag on
|            D31.0  |
|                       |
|------------( )---|  Remembers when
|            G0.0   |  block has been
|** END OF BLOCK **|  obeyed. G table
|                       |  cleared on power up
```

The above program runs once at power up.

It is recommended that this set up program should be the very last rungs in the user program. This ensures that any rungs elsewhere in the program which output data to the same D table locations for serial communication are overiden.

If the host controller has a free running program repetition interval less than 50ms then a delay should be included to guarantee correct initialisation e.g. last rung becomes:-

```
|                                  |
|-] [-DELAY-VALUE-( )-|  Delay G0.0 going
|G0.1   G1    1  G0.0 |  ON
|                                  |
|-----------------( )-|  Input to delay
|                 G0.1 |  must be OFF on
|                                  |  1st scan
```

Data tables exchanged

Port 1 input C0 to C14
Port 1 output D0 to D9

Port 2 input C15 to C19
Port 2 output D10 to D15

7. MODES OF OPERATION

The 8845 operates in one of three modes.

(1) Normal operating mode.

(2) Set up mode.

(3) Interrogation of Serial link statistics.

The mode is determined by the content of data table D31 for module number 0 (or D (31 + 32 x module number) for other module numbers) as shown in Table 3 below. It is necessary for the D31 operating flag to be held "ON" for at least 50ms.

8. DATA TABLES

The usage of the data tables is shown in Table 4 for module position 0. For other module positions add 32 x module position number to data table addresses.

Table 4 shows the 8845 stores incoming data in C0 to C31 and outgoing data is stored in D0 to D31, when in the normal running mode. The same data tables are used in the set up mode and also in the serial link statistics mode.

Table D31 defines the operating mode of the systems as discussed in section 6. In the normal operating mode incoming data from port 1 and 2 may be stored in the thirty one data table words from C0 to C30.

The set up data defines how many words of data can be stored for each of the two ports. See Section 6.

Output data is stored in the thirty one data table words D0 to D30 again the set up data defines the allocation. See Section 6.

Table 3 - Operating Mode

Mode	Numeric value	Bit Number ON	Comments
normal operating mode	0	-	
set up mode	1	0	
interrogation of serial link statistics	2	1	Mask with bits 10 and 11 if handshake used See Section 10

Table 4 - Data Table Usage for Module Position 0

Data Table Addresses	Normal Running Mode	Set Up Mode	Interrogation of Link Statistics Mode
C0	PORT 1 INPUT DATA	Not Used	Serial Link Statistics (see Section 12)
C14	boundary set by set up data		
C15	PORT 2 INPUT DATA		
C19	boundary set by set up data		
C20 C30	Unused		
C31	Fault Diagnosis bits 0 to 9 (See Section 12) Handshake bits 10 and 11		
D0	PORT 1 OUTPUT DATA	D0 to D7 Set Up Data (see Section 6)	Serial Link Output Data
D9	boundary set by set up data		
D10	PORT 2 OUTPUT DATA		
D15	boundary set by set up data		
D16 D30	Unused		
D31	Operating mode bits 0,1 Handshake bits 10 and 11	Operating mode bits 0,1 (Handshake bits 10 and 11)	Operating mode bit 0,1 Handshake bits 10 and 11

If the handshake option is not selected then the timing of the operation of the serial links is independent of the scanning of the fast I/O highway and the user program in the host controller will update the D table, for example while the 8845 is transmitting. Data transmitted could therefore be a mixture of old and new data. Similarly the controller will read data from the C table for example that may be a mixture of old data and new data. The handshake option is designed to ensure this does not happen.

Either port may be configured by the user to handshake with the host controller via the user program. This enables message integrity to be achieved.

The handshake option provides 4 flags, ready to send port 1, ready to send port 2, initiate exchange port 1 and initiate exchange port 2. Table 5 shows these data table locations for module number 0.

Table 5 shows these flags are bits 10 and 11 of word 31. For other module numbers the data table location is D(31 + 32 x module number).

Table 5 - Handshake Flags for module number 0		
	port 1	port 2
Initiate Exchange IX	D31.10	C31.10
Ready to send (RTS)	D31.11	C31.11

Program to use handshakes

The user program required to satisfy the handshake is:-

For port 1

```
      RTS                    IX
 -----] [------------------( )----
     C31.10                D31.10
```

For port 2

```
      RTS                    IX
 -----] [------------------( )----
     C31.11                D31.11
```

While IX is ON the user should ensure that associated message data in the D table is not changed or message integrity may be lost.

The user should only consider associated message data in the C table to be integral while RTS is ON.

Typically if data is being received in multiplexed blocks over the link then data can be extracted from the C table using the type of rung shown on the following page.

```
       LOCATE         RTS     MOVE
-<AND>--SPEC-VALUE--] [----SPEC-VALUE---(  )-
  0     S20   C1    C31.10  T20    30      F100.0
                              +
        MULT  LOCATE          |
-<AND>--SPEC- -SPEC-VALUE--+
  C0    T10    S0     G0
        +
        |
-<AND>--+
  30
```

Timing

The handshakes are arranged in such a way that an interposing host GEM 80 scan is ensured between receiving one message and transmitting the next. If the handshake is not echoed immediately then the next message transmission will be held up until IX has been set ON.

10. TIMEOUTS

In the event of no acknowledgement from the tributary of receipt of messages sent by the control port the 8845 includes automatic retry.

These retries continue until the timeout value is reached. When the timeout value is reached a fault is automatically flagged up as a loss of communication and this may be interlocked with the user program to implement a recovery procedure. The 8845 allows the selection of either of two timout values. These are as shown in Table 6 and may be allocated in the set up data as detailed in Section 6 Table 2.

Table 6 - Timeout value

Signalling rate bit/s	Timout Value: Standard (seconds)	Timout Value: Long (seconds)
9600	0.75	1.5
4800	1.00	2.0
2400	1.25	2.5
1200	1.75	3.5
600	2.75	5.5
300	5.00	10.0
110	13.75	27.5

11. COMMISSIONING

1. Set fast I/O configuration data in P table of host controller.
2. Check that all four port activity lamps flash momentarily on power up. If not, check wiring of reset line.
3. Enter user program rungs to set up configuration data for serial communications module.
4. Set serial port configuration data at other end of each link.
5. Write data into highest and lowest output locations at each end of link. Check for satisfactory reception at other end of link.
6. Inspect serial link statistics at control port of each link. A few failures are likely during power sup, thereafter failure counts are symptoms of excessive noise, inadequate cable segregation of screening, cable too long for chosen signalling rate, or degradation of transmit/receive hardware.

NOTE: If additions are made to an existing system, the user should check the subrack power supply loading and corresponding operating temperature limitations.

12.1 General

The 8845 includes built in fault diagnosis and also serial link statistics.

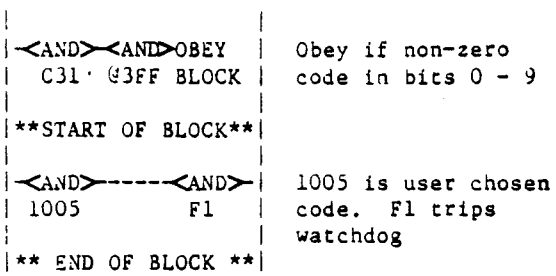
12.2 Fault Diagnosis Information

Fault diagnosis information is to be found in data table word C31 for module position 0 (C(31 + 32 x module position) for other module positions).

However bits 10 and 11 of C31 are handshake bits so these bits should be masked before reading the fault codes. The meaning of these is shown in Table 7.

12.3 Fault Diagnosis and the User Program

Under service conditions it is advisable to include program rungs to take appropriate action if a fault arises. If the links are vital to the system operation it may be appropriate to trip the watchdog using the type of rung shown on the following page:-



12.4 Serial Link Statistics

Table 8 shows the serial links.

Table 8 - Serial Link Statistics

Port 1	Port 2	
0 - 1	16-17	Requests
2 - 3	18-19	Attempts (requests + retries)
4 - 5	20-21	Framing/overrun errors
6 - 7	22-23	Timeout failures
8 - 9	24-25	Check code (CRC) errors
10-11	26-27	Negative acknowledgements
12-13	28-29	Termination errors
14-15	30-31	Data errors (wrong control chars)

D table offset:-

0 to 30 Serial links output data
31 Value 2 for statistics mode

Statistics apply only to control ports; data will be all zero for tributary.

Each count is a 32 bit binary number in two adjacent locations. Add 65536 to any value monitored as a negative number. Total count = (65536 x upper location) + lower location.

Table 7 - Fault Codes

Decimal	Hex	Bit No "ON"	Meaning
0	@ 0	-	Normal
1	@ 1	0	Module failure (substitute spare)
3	@ 3	2&0	Fault detected in "on board" RAM
9	@ 9	3&0	Fault detected in "on board" EPROM
256	@ 100	8	Link 1 loss of communication
512	@ 200	9	Link 2 loss of communication
768	@ 300	8&9	Link 1 & 2 loss of communication
770	@ 302	1,8 & 9	Initialisation fault (invalid data set by user in set up mode)

13. USE WITH BASIC LANGUAGE HOST

The BASIC language option for the 225/235/245 controllers scans the fast I/O highway in whatever order C and D table references are encountered in the BASIC program. The user should take care to set the output flag after setting up the output data, and to read the input flag before reading the input data.

14. SPARES

	Order Code
Serial Communications Module	8331-4103
Backplane Connector	8503-4001
Termination Panel Assembly	8871-4002

CEGELEC
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