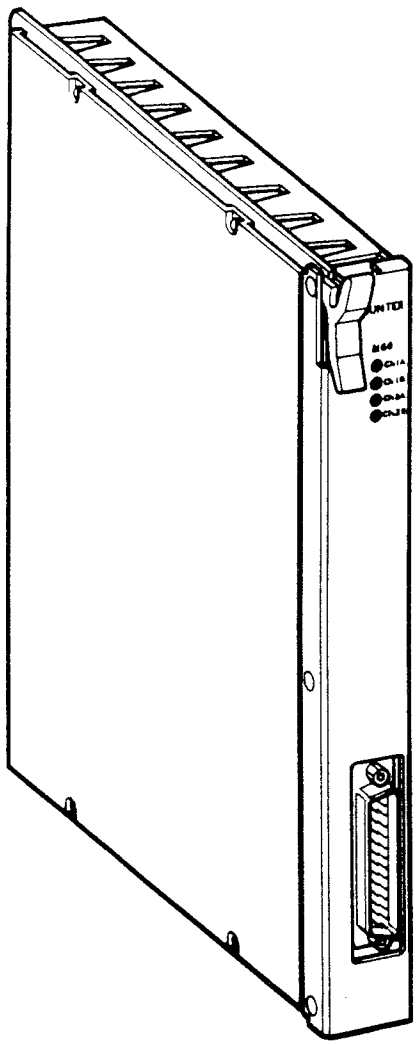
CEGELEC

COMPACT COUNTER MODULE 8160



GEM80 USER INFORMATION

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1. INTRODUCTION

This document is written specifically for the 8160-4008 Compact Counter Module. See Appendix 1 for the differences in function between this and earlier versions of the module.

This User Information leaflet provides application data and electrical connection diagrams for the Compact Counter Module. The module has been designed to enable a GEM80 controller to monitor events programmed and occurring more frequently than the controller scan rate of I/O ports.

Each time the controller scans channel 1, it latches all of the counters. The total number of pulses that have occurred since the removal of the external reset at the time channel 1 was scanned is returned as each channel is read. Thus, when channel 2 is read it will return the count as at the time channel 1 was scanned.

Both channels are latched at the same time as some applications use the difference between the 2 channel counts.

Note: The 8160-4008 should not be used on the following controllers as these scan channel 2 before channel 1. If used on these controllers, channel 2 would return a count value that was one controller-scan-period old,

GEM80/130
GEM80/140/141/142
GEM80/225/235/245
GEM80/300

The module handles signals up to 20kHz, 4 to 66V at 2 to 7mA. Inputs from a wide variety of equipment are accepted, including TTL, voltage sources, volt-free contacts, etc. The 8160 performs straightforward edge triggered counting functions or more complex counting required by shaft encoders, where direction sensing and external resets are required. The bi-phase counting of two shaft encoder pulse trains is discussed later.

The user selectable input options allow the module to be set up to accept:

a) Four pulse trains each counted by 8-bit counters to 255

or

b) Two pulse trains each counted by a 16-bit counter to 65,535

or

c) Three pulse trains, one counted by a 16-bit counter and two by 8-bit counters

or

d) Two bi-phase mode channels for a total of two shaft encoders providing counts to 16,383 with direction information and external reset facility

or

e) One bi-phase mode channel and 16-bit mode pulse train

or

f) One bi-phase mode channel and two 8-bit mode pulse trains

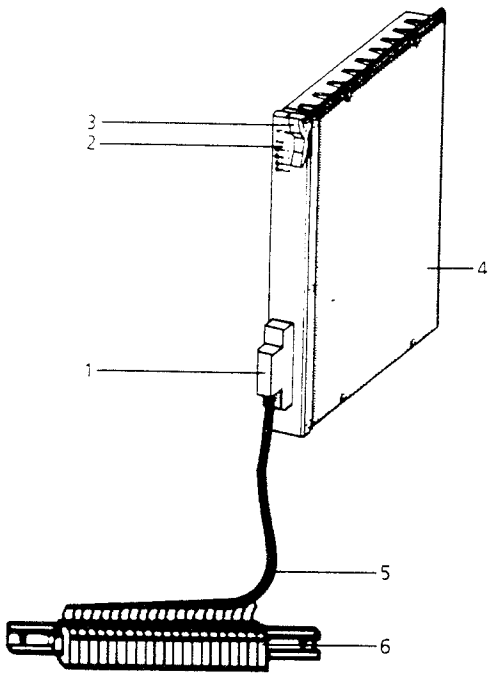
For installation purposes within a subrack, the module is classed as a 32-point single width module and as such may be fitted in any GEM80 compact subrack designed to accept 32-point modules (e.g. 8859-4003).

2. SPECIFICATION

Number of channels	2
Architecture	1 x 16 bit or 2 x 8 bit counters, single phase 1 x 16 bit counter bi-phase
Input trigger	Positive-going transitions for single phase operation Positive and negative-going transitions for bi-phase operations
Pulse width	10μs minimum positive or negative going
Count rate	20kHz maximum in bi-phase or single phase mode
Counter capacity	65535 - 16 bit counter 255 - 8 bit counter ±16383 - bi-phase counter
Pulses present indication	Pulse stretcher for visible flashes when pulse rate is less than 1Hz Lamp appears to be continuously illuminated when pulse rate exceeds 60Hz
Resets	External reset for datum setting
Input voltage for ON state	4V minimum, 66V maximum
Input current for ON state	Counter inputs 1.5-7mA User link inputs 6-15mA Both typically over the range 4-66V
Input voltage for OFF state	0V nominal, 3V maximum
Input current	40μA maximum
Common mode isolation voltage	1kV transient, 300V rms continuous
Differential no damage voltage	66Vdc continuous, including supply reversal
Power consumption from host controller	30-90mA @ 15V Consumption depends on configuration and input data
Temperature (operating)	0°C to 60°C
Humidity	10% to 90% non-condensing

3. HARDWARE LAYOUT

Figure 3.1 shows the 8160 Compact Counter module terminal rail and cable harness.



1. 'D' Type connector for plant signals
2. 'Pulses Present' indicator LED for up to four pulse trains
3. Ejection Handle
4. Compact counter module with moulded side covers
5. Cable harness
6. Plant terminals on DIN rail

Figure 3.1 - 8160 Compact Counter Module

4. COUNTER OPERATION

4.1 General

Figure 4.1 shows a block diagram of the 8160 Compact Counter Module. This shows that there are two separate channels, 1 and 2. Each has facilities to accept two pulse train signals, A and B. There is also an input for a counter reset for the whole channel.

Each channel stores the count in a 16-bit word, which is read into the controller memory A-Data table, once every scan.

Channel 1 is stored in the lower A-data table address. Channel 2 is stored in the upper A-date table address.

Figure 4.1 also shows 8-bit, 16-bit or bi-phase mode selection as determined by user link 1, 2 and 3. Connection details are discussed in Section 6.

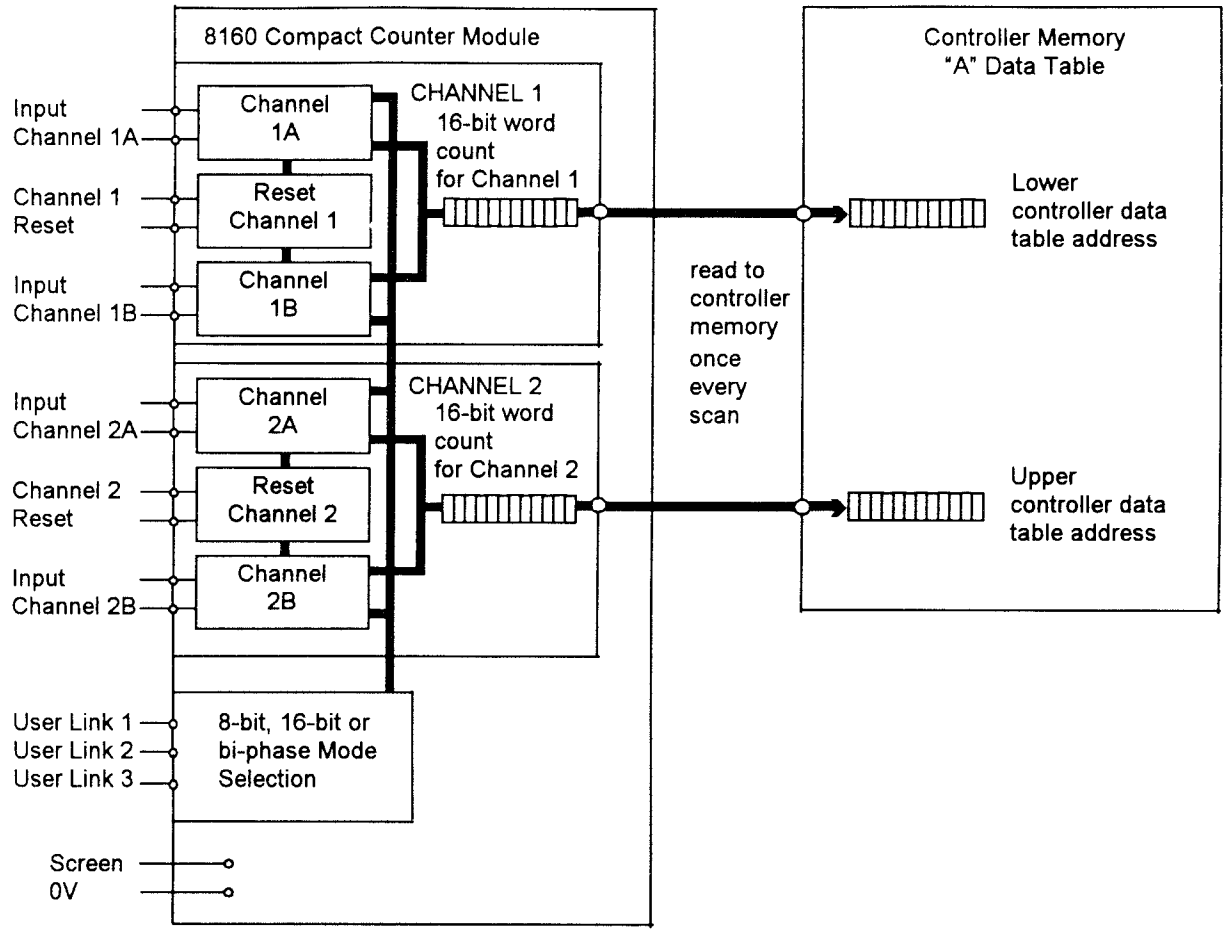


Figure 4.1 - 8160 Block Diagram

4.2 Arrangement of Count in 16-Bit Data Table Word

Figure 4.2 shows how the counts are arranged in the 16-bit words, depending on whether the 8-bit or bi-phase mode is selected. When in the 8-bit mode, channels 1A or 2A count is in bits 0 to 7 and channels 1B or 2B count in bits 8 to 15. When the 16-bit mode is selected, all the bits from 0 to 15 hold the count value. When in the bi-phase mode, bit 0 holds a reset bit and bits 1 to 15 hold the count value.

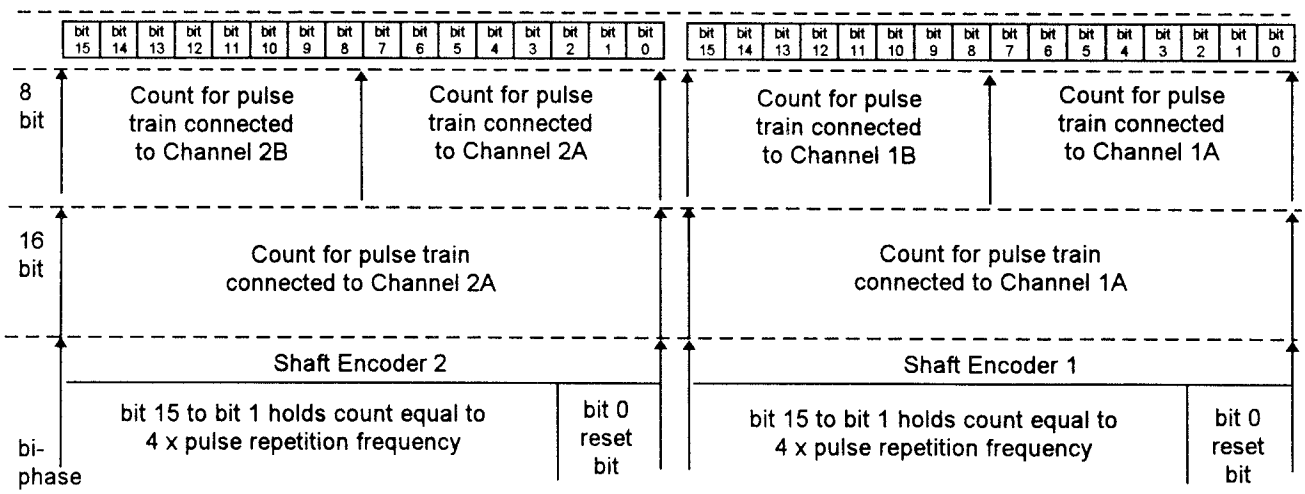


Figure 4.2 - 8160 16-Bit Data Table Word

4.3 Counter Wraparound Conditions

Each counter performs a cyclic count. Wraparound is likely to occur with a 16-bit counter after 3.3 seconds at the maximum pulse rate. However, an 8-bit counter will wraparound in only 13ms at 20kHz.

Similarly, a bi-phase counter will wraparound in 0.2 seconds at 20kHz. The counter is counting at effectively four times the input clock frequency since, in the bi-phase mode, rising and falling edges of the two pulse trains are counted. The user must ensure that, when wraparound occurs, the ladder program handles it sensibly.

4.4 Pulse Counting

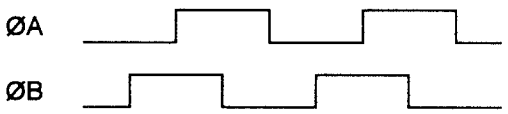
4.4.1 General

Each counter accepts inputs of 4 to 66V dc at 1.5 to 7mA typically. These can occur at up to 20kHz repetition rate.

The 16-bit counter and the 2 x 8-bit counters increment on positive going input transitions and count pulses.

4.4.2 Bi-phase Mode

The bi-phase counter increments or decrements on either polarity input transition of either input, effectively giving a counting rate of four times the input frequency of one phase.



4.5 Resets

4.5.1 Bi-phase Mode

The external reset is an active high input and resets one channel of the counter. The counter resumes counting once the reset has returned to an OFF state. An indication of a reset is given only during the scan that the reset input made the transition from an OFF to an ON state.

If the external reset input remains high, the counter remains reset, but no more indications are given. The counter resumes counting once the reset input has returned to an OFF state.

4.5.2 8-bit and 16-bit Mode

The 2 x 8-bit and 16-bit counters can be externally reset but no indication is given in the LSB of the data read by the GEM.

4.6 8160 Status When GEM80 Controller Halted

When a GEM80 controller is halted, the I/O scanning continues without the user program being executed.

5. INPUT CONNECTIONS AND TYPICAL CIRCUITS

5.1 Input Connections

Figure 4.1 shows that there are four counter inputs, Channels 1A, 1b, 2A and 2B and there are three operating modes, 8-bit, 16-bit and bi-phase, for shaft encoders. Table 5.1 shows the input connection and user link option for the various combinations. For example, from Table 5.1 it can be seen that if it is required to connect two pulse trains for 16-bit counting, they need to connect to channels 1A and 2A while channels 1B and 2B are unused. Also, the table shows that the user links for this configuration are in Section 6, Table 6.1, Option 3 in this case.

Table 5.1 - Input Connection

Mode	Channel 1A	Channel 1B	Channel 2A	Channel 2B	Mode Selection User Links Section 6, Table 6.1 Option
4 pulse trains (8-bit)	Pulse train 1	Pulse train 2	Pulse train 3	Pulse train 4	1
2 pulse trains (16-bit)	Pulse train 1	not used	Pulse train 2	not used	3
3 pulse trains (2 x 8-bit + 1 x 16-bit)	Pulse train 1	Pulse train 2	Pulse train 3 (16-bit)	not used	2
2 shaft encoders	shaft encoder 1 phase A	shaft encoder 1 phase B	shaft encoder 2 phase A	shaft encoder 2 phase B	6
1 shaft encoder + 1 pulse train (16-bit)	shaft encoder 1 phase A	shaft encoder 1 phase ZB	pulse train 1 (16-bit)	not used	5
1 shaft encoder + 2 pulse trains (8-bit)	shaft encoder 1 phase	shaft encoder 1 phase	pulse train 1 (8-bit)	pulse train 2 (8-bit)	4

5.2 Typical Input Circuits

These typical input circuits show how to connect various pulse train sources to the 8160 Compact Counter module. The connections shown apply for 8-bit or bi-phase mode channel 1. channel 2 accepts the same equipment connected in the same way. The circuits are the same for the 16-bit except that channel 1B is not used.

Figure 5.1 shows voltage source plus generators connected to the 8160. Figure 5.2 shows TTL connected to the 8160; A, B and C are each one sixth of a 74LS04. Figure 5.3 shows self-powered pulse generators connected to the 8160. The transistors are NPN type and must be capable of sinking 20mA or more. The Vce rating of these transistors must be more than +V. Figure 5.4 shows volt free contacts connected to the 8160.

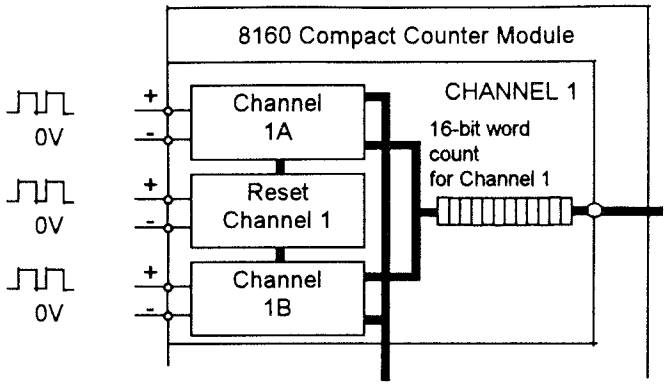


Figure 5.1 - Voltage Pulse Source Pulse Generators Connected to the 8160

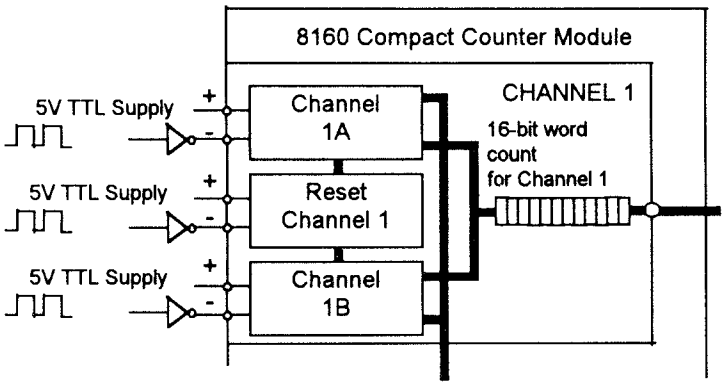


Figure 5.2 - TTL Connected to the 8160

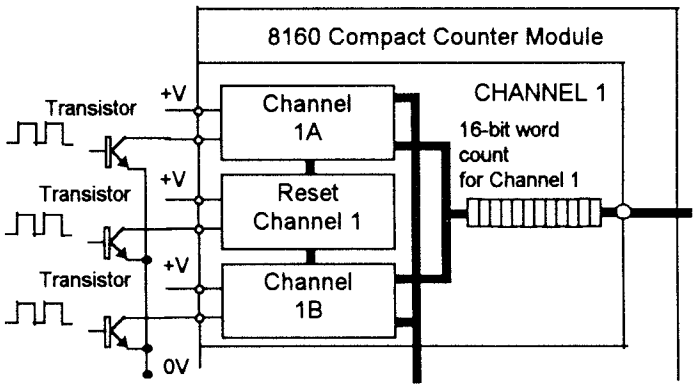


Figure 5.3 - Self-Powered Pulse Generators Connected to the 8160

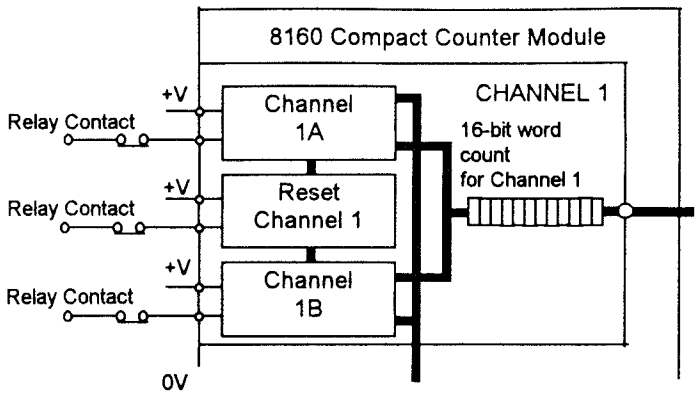


Figure 5.4 - Volt Free Contacts Connected to the 8160

6. MODE SELECTION

8-bit, 16-bit or bi-phase mode selection is achieved by connecting the user links either to 0V or a voltage +v, where +V is from 4V to 66V dc. Table 6.1 details which user links (UL1, UL2 and UL3) to connect to 0V or +V. For example, if it is required to set up the 8160 as two channels of 16-bit counters, Table 6.1 shows that UL2 and UL3 must be connected to 0V and UL1 must be connected to +V. In fact each user link draws up to 15mA.

Table 6.1 - 8160 Compact Counter Mode Selection

Option	Channel 1	Channel 2	User Links		
1	Two 8-bit counters	Two 8-bit counters	0V	0V	0V
2	Two 8-bit counters	One 16-bit counter	+V	0V	+V
3	One 16-bit counter	One 16-bit counter	+V	0V	0V
4	One bi-phase counter	Two 8-bit counters	+V	+V	0V
5	One bi-phase counter	One 16-bit counter	0V	0V	+V
6	One bi-phase counter	One bi-phase counter	0V	+V	0V

7. POWER SUPPLIES

7.1 Power Drawn from Host Controller

Each 8160 module used in a subrack system draws a current from the host controller of between 30 and 90mA at 15V; actual power consumption is dependent on system configuration and input data.

When designing or configuring an installation, it is necessary to calculate the total current required for the I/O to ensure that the host controller is not overloaded.

7.2 Plant-Side Power Requirements

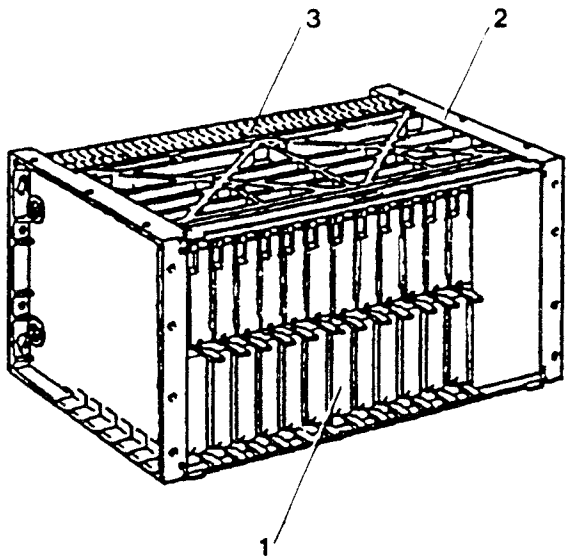
Each 8160 module requires an input voltage of between 4 and 66V dc to the three user links. In fact, each user link draws up to 15mA. The two reset inputs, if used, each draw up to 6mA.

8. FITTING MODULES IN THE SUBRACK

8.1 Subracks

Figure 8.1 shows an 8859 subrack with twelve compact I/O modules fitted. The modules slide along guide rails and plug into the backplane at the rear of the subrack.

Each module is mechanically coded and section 8.3 details the coding.



1. Compact Module
2. Subrack
3. Backplane

Figure 8.1 - 8859 Subrack fitted with Compact Modules

8.2 Subrack Layout and Data Table Addresses

Subrack layout and Data Table addresses are covered in the 8859-4003 User Information, Publication No. T1504 and also the Controller Technical Manuals. The 8160 Compact Counter module should be treated as a 32-point module.

8.3 Mechanical Coding

8.3.1 General

The edge connector at the rear of the Compact I/O module is a mechanically coded connector. This mechanical coding ensures input modules can only be fitted in subrack locations allocated to input modules and output modules can only be fitted in subrack locations allocated to output modules.

The subracks are supplied with mechanical coding fitted in positions 5, 10, 12, 18 and 31 as shown in Figure 8.2.

8.3.2 Fitting Input Modules

Input modules are supplied with cutouts in positions 5, 10 and 31 as shown in Figure 8.3.

Therefore, to fit an input module in the subrack, the coding pegs fitted in the subrack edge connector at positions 12 and 18 should be removed with a pair of pliers.

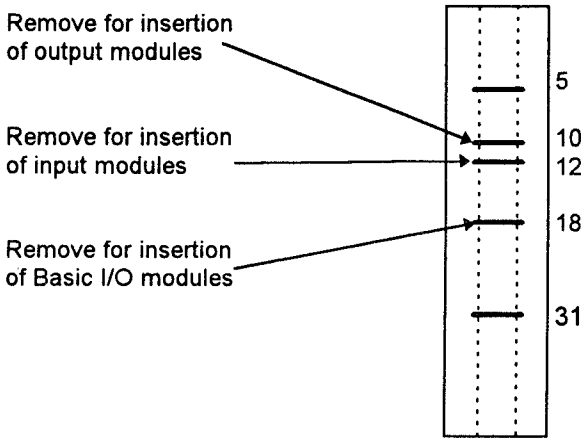


Figure 8.2 - Mechanical Coding in Subrack Edge Connector

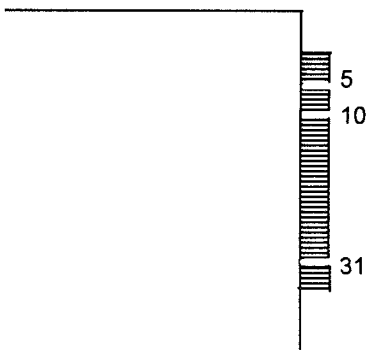


Figure 8.3 - Input Module Mechanical Coding Cutouts

8.4 Fitting a Module

To insert a module locate the rear edge of the circuit board in the top and bottom guide rails. Push the module home using gentle force only. Should the module jam, release it by pulling it out a short distance and try again. Excessive force will make the problem worse and may damage the equipment. When the module reaches the rear of the subrack, apply firm pressure to locate the circuit board fingers in the backplane connector.

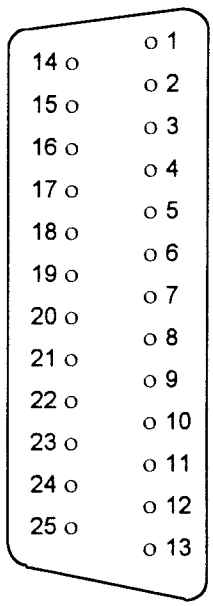
To release a module, lift the ejection handle at the top. This separates the rear connector, pushing it out sufficiently for the module to be grasped and withdrawn completely.

9. PLANT CONNECTIONS

9.1 Electrical Connection

Electrical connections to the module can be made directly to the plant connector, although it is preferable to use the termination rail, allowing easier fault diagnosis and subsequently faster changes to the wiring.

Figure 9.1 shows the plant connector pin designation for the 8160 Compact Counter.



1. Input CH 1A+
2. Input CH 1A–
3. Reset CH 1+
4. Reset CH 1–
5. Input CH 2A+
6. Input CH2A–
7. Reset CH2+
8. Reset CH2–
9. Not Used
10. User Link 2
11. User Link 3
12. Not Used
13. Not Used
14. Do Not Use
15. Input CH 1B+
16. Input CH 1B–
17. Coding
18. Input CH 2B+
19. Input CH 2B–
20. Not Used
21. Not Used
22. User Link 1
23. 0V
24. Not Used
25. Not Used

Figure 9.1 - 8160 Compact Counter Module - Plant, 'D' Type Connector Pin Designation

9.2 Compact Counter Module Input Termination Rail

The Compact Counter Input Termination Rail simplifies connection to the 8160 module. The rail carries 32 screw clamp terminals for the necessary connections and links for each channel, logically arranged and clearly labelled.

Table 9.1 shows the connections to the Termination Rail.

Table 9.1 - 8160 Compact Counter Module Termination Rail Connections

Function	Termination Rail		Wiring Harness	Module D-Type Connector
	Terminal Number	Input Legend	Wire Colour	Pin Number
Clean Earth (signal ground)	1	SCN	Overall screen	-
Not Used	2	-	blue	14
Screen	3	SCN	-	-
Input Channel 1A+	4	1A+	red	1
Input Channel 1A–	5	1A–	green	2
Input Channel 1B+	6	1B+	yellow	15
Input Channel 1B–	7	1B–	black	16
Reset Channel 1+	8	R1+	white	3
Reset Channel 1–	9	R1	brown	4
Screen	10	SCN	-	-
Not Used (M/Coding)	11	-	violet	17
Input Channel 2B–	12	2B–	grey	19
Input Channel 2B+	13	2B+	pink	18
Input Channel 2A+	14	2A+	orange	5
Input Channel 2A–	15	2A–	turquoise	6
Screen	16	SCN	-	-
Screen	17	SCN	-	-
Not Used	18	-	green/red	20
Reset Channel 2+	19	R2+	red/blue	7
Reset Channel 2–	20	R2–	yellow/red	8
Not Used	21	-	white/red	21
User Link 1	22	UL1	red/brown	22
Screen	23	SCN	-	-
User Link 2	24	UL2	yellow/blue	10
Not Used	25	-	red/black	9
0V	26	0V	white/blue	23
User Link 3	27	UL3	blue/black	11
Not Used	28	UL4	orange/blue	24
Screen	29	SCN	-	-
Not Used	30	-	white/green	25
Not Used	31	-	orange/green	13
Not Used	32	-	yellow/green	12

10. USER PROGRAM AND COUNTER EXTRACTION

10.1 Extraction of 2 x 8-bit Counter Data

Section 4.2 shows the 2 x 8-bit counter mode, the 16-bit word storing the count holds data for one of the two counts in bits 0 to 7 and the second in bits 8 to 15 (as in figure 10.1).

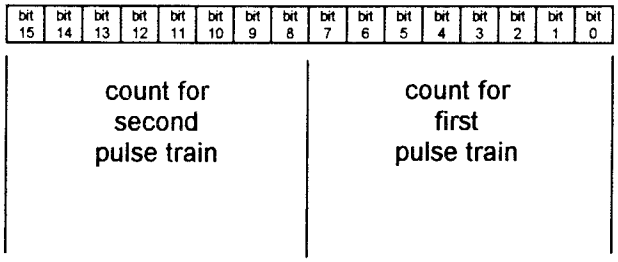


Figure 10.1 - 2 x 8-bit count

A rung in the GEM80 control program can be used to extract the two counts. In compiling the rung, a special function 'SWAP' and a masking-out instruction 'AND' are required. These terms are covered fully in the GEM80 Software Manual - to which reference must be made for supplementary information. Figure 10.2 shows an example

```
 COUNTS                          COUNT 1    | Rung 1
-<AND>----<AND>-------------<OUT>---        | Extracts
   A0      @00FF                 G1         | First Count

 COUNTS              SPEC        COUNT 2    | Rung 2
-<AND>----<AND>----<SWAP>----<OUT>---       | Extracts
   A0      @FF00      S4         G2         | Second Count
```

Figure 10.2 - Extracting 2 x 8-bit Counts from 16-bit Word

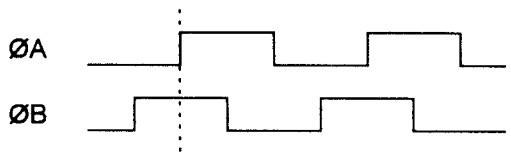
If, for example, the 16-bit data table word address A0 contained the two 8-bit binary counts then, after running the above program address, G1 would hold the first count and G2 would hold the second.

10.2 Extraction of 1 x 16-bit Counter Data

From section 4.2, it can be seen that in the 16-bit count mode, the 16-bit word gives a direct reading of the count without further processing.

10.3 Extraction of Shaft Encoder or Bi-Phase Mode Counts

When two phases, A and B are counted, both the rising and falling edges of all input pulses are counted - this provides the effect of a count rate of four times the input frequency of any one phase.



As the bi-phase counter returns 16 bits of signed data, the LSB being the external reset indicator, and the remaining 15 bits containing the count data, a rung must be provided in the GEM80 control program to extract the correct count and reset indications. A typical rung could be as shown in Figure 10.3.

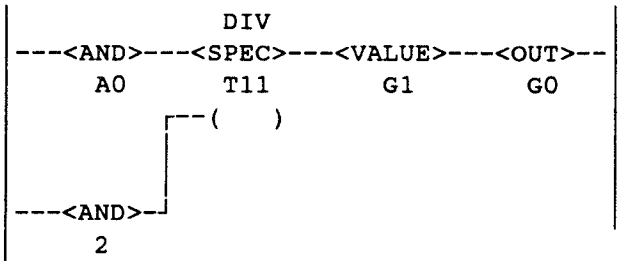


Figure 10.3 - Extracting Bi-phase Counts

A0 is the 16-bit word including reset and the count. This is divided by 2 and the quotient put in G0 while the remainder is put in G1. Since the 16-bit word is in binary, the effect of dividing by 2 is that, if there is a remainder this will be because bit 0 is 1 and there is therefore a reset, so G1 holds the reset. Also, G0 now holds a count value since dividing a number to the base 2 by 2 is equivalent to simply a shift of one place to the right (c.f. divide any number to the base 10 by 10).

Remember that the count value returned will be four times the frequency of the input pulse train.

11. ORDERING CODES

Compact Counter Module	8160-4008
Connector and 3m cable for above module	8891-4094
Terminal Rail for 8160-4008	8891-4029

APPENDIX 1 - VERSION DIFFERENCES

8160-4002

This version latches each channel's count and resets the count as that channel is read.

This can be used on any GEM80 controller apart from Remote I/O systems, as the Remote I/O Controller may scan and reset the counts many times per host controller I/O scan.

8160-4004

This version latches each channel's count as each channel is read and returns the accumulated count since the last external reset.

Although this version may be used on any system, there may be a slight difference (up to 100μs) in the timings for channel 1 and channel 2.

8160-4006

This version latches both channels' counts as channel 2 is scanned. It also resets the counts each time the module is scanned.

The following list are the only controllers with which this version may be used:

GEM80/130
GEM80/200 series (e.g. 225/235/245)
GEM80/300
GEM80/140/141/142

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