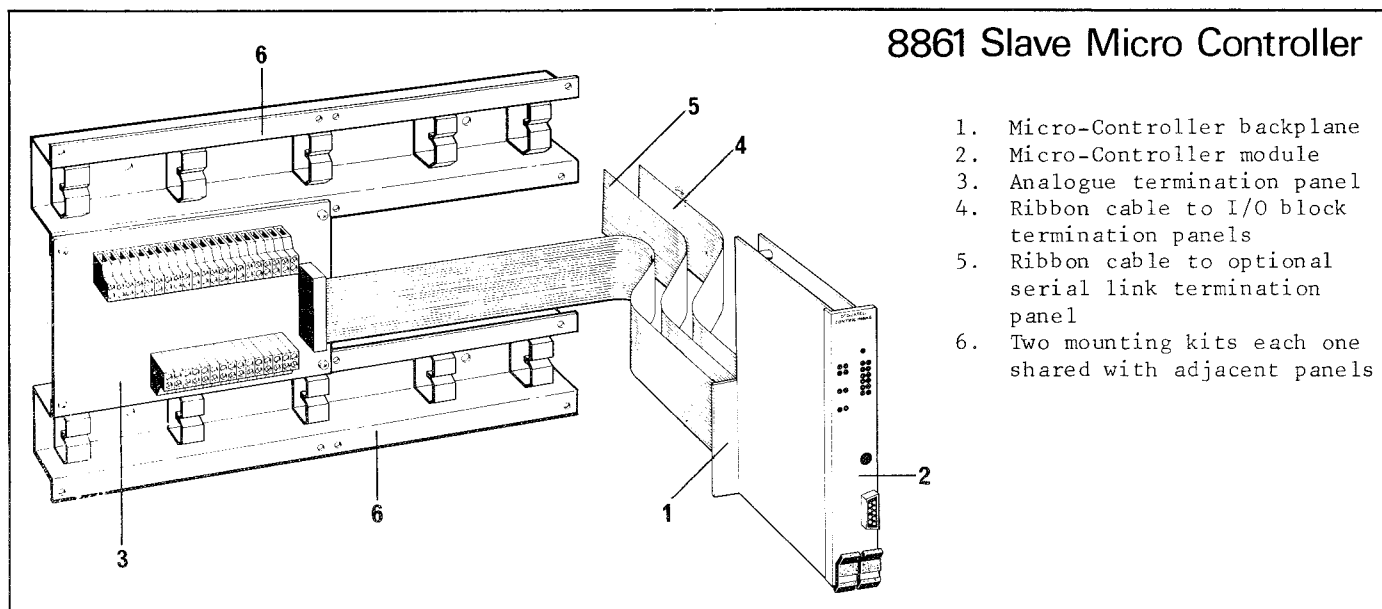
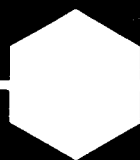


GEC Electrical Projects Limited

GEC Industrial Controls Limited

GEM 80



8861 Slave Micro Controller

1. Micro-Controller backplane
2. Micro-Controller module
3. Analogue termination panel
4. Ribbon cable to I/O block termination panels
5. Ribbon cable to optional serial link termination panel
6. Two mounting kits each one shared with adjacent panels

DESCRIPTION

The Slave Micro-Controller performs reference setting, closed loop control, logic and sequencing for a dedicated control function in one unit. It combines the capabilities of analogue amplifiers, digital logic, relays, timers, counters etc., in a single technology featuring greater flexibility and reliability.

The Slave Micro-Controller is fully compatible with the whole of the GEM 80 family and consists of:-

- a) Micro-Controller module
- b) Backplane and terminations

To this basic configuration the user may add:-

- a) Basic I/O assemblies and I/O blocks for local I/O points
- b) A serial link to another GEM 80 controller or to remote I/O

A working system is completed by plugging the module into a larger GEM 80 configuration where it occupies two subrack slots on the fast I/O highway, and entering a user program in the GEM 80 Control Language.

FEATURES

- Complete control function and associated interlocking logic in one unit
- Built in automatic self test
- Fast response
- Easily understood ladder diagram Control Language

SPECIFICATION SUMMARY

Memory capacity	: 660 or 120 instructions depending on memory option
Local I/O	: 8 analogue inputs : 2 analogue outputs : GEM 80 basic I/O (160 I/O points)
Remote I/O	: 1 standard GEM 80 serial link
Fast I/O	: Occupies 2 subrack slots on GEM 80 fast I/O highway
Power supply	: Uses +5V and +15V supplies of host GEM 80 configuration : Consumes 2.5A @ 5V : 200mA @ +15V : 100mA @ -15V : plus load due to private I/O blocks
Temperature	: 0 to 70°C operating : -20 to 70°C storage
Humidity	: 10 to 90% non-condensing

DETAILED SPECIFICATION

1. CONTROLLER OPERATION

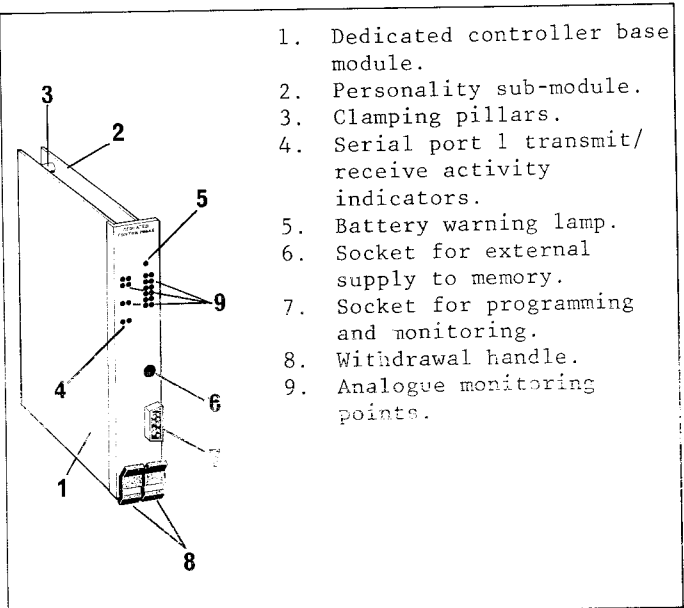
- Interlocks : communicates healthy/unhealthy status to host controller for user selectable operation into host controller's watchdogs
- Start up : performs comprehensive self test
: starts operating cycle
: sets controller status healthy
- Operating cycle : repeated at a regular time interval preset by the user from 10ms to 1s in 10ms increments or free running
- 1) scans inputs into data tables
 - 2) executes user program, placing results in data tables
 - 3) scans outputs from data tables
- Cycle time : minimum time which user can choose for program repetition interval
- $$: = t_{\text{private I/O}} + t_{\text{fast I/O}} + t_{\text{prog}}$$

(serial link activity is distributed through the cycle and loads the cycle time by up to 16% depending on signalling rate. The signalling delay affects how soon the data is received but is not added to the controller cycle time)

- Fault : sets controller status unhealthy
- Shutdown : places fault code in fault table
: ceases program execution at end of scan in progress
: ceases scanning I/O
(restart by switching power off/on)

2. USER PROGRAM

- Language : ladder diagram format
: up to 10 series elements per rung
: up to 5 parallel branches
- Instruction set : standard instruction set (Table 1)
: special functions for arithmetic scaling and closed loop control applications (Table 2)
- Means of programming : portable programmer type 8920
: flying leads into processor front panel
: instructions and preset data archive storage and transport on cassette tape
- Memory capacity : 660 instructions (120 on small memory option)
: see Table 3 for data table sizes
- Memory support : rechargeable battery on module
: socket for external supply when changing battery



1. Dedicated controller base module.
2. Personality sub-module.
3. Clamping pillars.
4. Serial port 1 transmit/receive activity indicators.
5. Battery warning lamp.
6. Socket for external supply to memory.
7. Socket for programming and monitoring.
8. Withdrawal handle.
9. Analogue monitoring points.

- t_{prog} : time taken to execute user's program, calculated as the sum of individual instructions and special function execution times as given in Tables 1 & 2
: BLOCK instructions may be used to skip execution of chunks of program
- Power off memory : 4 weeks at 25°C
: 3 weeks at 50°C
: 2 weeks at 70°C
- Battery recharge : 30 hours maximum to reach full charge
- External supply for memory : 6-15V d.c. 10mA @ 6V continuous
e.g. 6V transistor radio dry cell

Table 1 Standard Instruction Set

Symbol	Instruction	Remarks
	N/O contact N/C contact Coil	Single state input to rung Inverted single state input Output to single state in table
DELAY COUNT SEQR	Time delay Counter Sequencer	0.1s to 54 mins Full count up to 32767 16 step sequencer
BLOCK	Start/end	Conditionally executed block of instructions
AND OR XOR INV	logic AND logic OR EXCLUSIVE OR INVERT	logic executed individually for each of 16 states
ADD SUB	Addition Subtraction	Arithmetic with limits at +32767
OUT	Output	16 state or numeric output to data table location
Average execution time : 25 μs per instruction		

Table 2 Special Functions

No.	Mnemonic	Title	
S0	DBOUNCE	Debounce input	0.86
S1	BCDIN	BCD Input conversion	0.38
S2	BCDOUT	BCD Output conversion	0.40
S3	HISTATE	Find highest ON state	0.26
S4	SWAP	Swap $\frac{1}{2}$ locations	0.23
S11	LINCON	Linear conversion	1.4
S12	SQRT	Square root	1.33
S20	LOCATE	Locate data table address	0.52
S30	FGEN	Function generator	2.75
S31	DEDBAND	Dead band	0.78
S32	LIMIT	Limiter	0.89
S33	RAMP	Ramp generator	4.86
S34	PIDABS	Absolute 3 term control	7.00
S35	PIDINC	Incremental 3 term control	4.90
S36	INCOUT	Incremental output	1.18
S37	ANALAG	First order time constant	3.52
T0	COMPARE	Comparator	0.59
T10	MULT	Integer multiplication	0.48
T11	DIV	Integer division	0.77
T20	MOVE	Move block of data	0.56 + 0.024/ loc.
T30	STORE	Cyclic store	1.36

Table 3 Data Tables

Table Letter	Size	Contents	Remarks
A	10	Basic input	)Total up to 160)I/O points
B	10	Basic output	
C	62	Fast input	)Up to 62 input)and 62 output values
D	62	Fast output	
E	1	Timing, flags	0.1s/1s intervals Add/sub limit flag
F	80 (58)	Diagnostics	48 built-in diagnostics 32 for user programming
G	198 (60)	General work space	Delays, counters, sequencers etc.
H	128 (97)	Extended general work space	As G Table
I	8	Local inputs	Analogue inputs
J	16	Serial input	
K	16	Serial output	
M	10	Maintainer	User programmed tests
O	2	Local outputs	Analogue outputs
P	250 (80)	Preset data	37 configuration data 213 user presets
R	60 (-)	Retained	Remembered through power loss

All tables except P & R are cleared on power up.
All tables except P, F & R cleared on halt to run
transition unless user sets R0.0 ON to override.
Sizes shown in brackets thus () are for smaller
non-preferred memory version.

3. PRIVATE INPUT/OUTPUT

3.1 Analogue Inputs

No. of inputs : 4 referred to GEM 80 0V
4 differential

Voltage range : $\pm 10V$

Scaling in data : $\pm 2047 = \pm 10V$
table

Accuracy : $\pm 0.4\%$ of full scale

Resolution : 1 in 4096

3.2 Analogue Outputs

No. of outputs : 2

Voltage range : $\pm 10V$, minimum load
impedance 2k

Scaling in data : $\pm 2047 = \pm 10V$
table

Accuracy : $\pm 0.4\%$ of full scale 0-40°C
: $\pm 0.5\%$ of full scale 0-70°C

Resolution : 1 in 4096

Zero offset : $\pm 15mV$

3.3 Basic Input/Output

Type : standard GEM 80 basic I/O
highway (reduced capacity)

Capacity : up to 160 I/O points or
up to 10 numeric I/O
values or a mixture
: connects to 5 panels I/O
blocks each handling 32
I/O points, or to an
equivalent number of
operator interface units

Connection : 26 way ribbon cable
: plug/socket between
subrack and ribbon
and I/O assembly
: ribbon length up to
10m extendable to
30m with loading
constraints

3.4 Private I/O Scan Time ($t_{\text{private I/O}}$)

Basic overhead for : 2.8ms
2 analogue outputs
& operating system

Each analogue : $\pm 0.36ms$
input

Basic I/O if : 0.7ms + 1ms per
selected connected I/O panel

4. FAST INPUT/OUTPUT

Type	occupies 2 subrack slots of standard GEM 80 fast I/O highway (must be spaced an even no. of slots from start of fast I/O subrack space)
Capacity	up to 62 input values and 62 output values
Scan time ($t_{\text{fast I/O}}$)	28 us for each fast input value and for each fast output value
Status linking	halt/run, test/normal status optionally linked to status of host GEM 80 controller via fast I/O highway healthy/unhealthy status optionally communicated to host controller

5. SERIAL INPUT/OUTPUT

Type	1 standard GEM 80 serial link (reduced capacity) automatic data checking recovery by automatic retry
Ports	port 1 user selectable as tributary or control port tributary port suitable for point-to-point or multidrop link control port suitable for point-to-point link only
Application	exchange of data table information with another controller link to remote I/O
Capacity	exchange of up to 16 input and 16 output data table locations (up to 512 I/O points) remote I/O up to 256 I/O points
Connection	termination panel (optional extra)
Signalling rate	9600 bit/s standard user adjustable options 4800, 2400, 1200, 600, 300, 110 bit/s
Signalling time at 9600 bit/s	12.5ms plus 2.5ms per table location (16 I/O points or 1 numeric value)
Signalling time < 9600 bit/s	inversely proportional to signalling rate

Maximum link length	: 400m at 9600 bit/s
	: 1000m at 4800 bit/s
	: 2000m at 2400 bit/s
	: 3500m at 1200 bit/s
	: 5000m at 600 bit/s

6. SELF TEST

Execution	full cycle of start up tests ($\approx 2s$) whenever power applied I/O tests repeated every scan regular on line repetition of running tests (spread over ≈ 6 mins)
Watchdog	uses watchdog of host GEM 80 controller if status linking selected
Faults which immediately set controller unhealthy	fault, interfering with transfers on private basic I/O highway
Faults which set controller unhealthy when detected by running tests	alteration detected in contents of read only memory failure of any part of read/write memory to store and recall data
Faults which user may program to set controller unhealthy	any I/O block missing basic I/O ribbon cable unplugged serial link disconnected or repeated message corruption application dependent tests
Fault diagnosis	fault codes presented in fault data table

7. MONITORING AND MANUAL TESTING

facilities provided by connecting unit at programming/monitoring link	on line monitoring of program rungs and data table contents manual data input to M table reserved for user programmed test routines * halt/run/single cycle of user program * test mode for bypassing scan of plant inputs
* authorised personnel only e.g. by use of key operated switch on portable programmer	
Signal monitoring	2mm dia. sockets on front panel for analogue I/O and excitation
Indicating lamps	serial link activity battery warning

8. TERMINATIONS

Serial Link Terminations (optional extra)

Panel dimensions : 156 x 238 x 30mm (HxWxD)

Mounting : half rack width on two mounting channels at 5U (222mm) centres

Weight : 0.4kg panel + ribbon cable
: 2.5kg mounting channel

Terminals : up to 2.5mm² conductors
: slotted head screw clamp

Recommended cable : 2 twisted pairs with 0.5mm² cores and overall screen

Analogue Terminations

Panel dimensions : 156 x 238 x 30mm (HxWxD)
: half rack width on two mounting channels at 5U (222mm) centres

Weight : 0.4kg panel + ribbon cable
: 2.5kg mounting channel

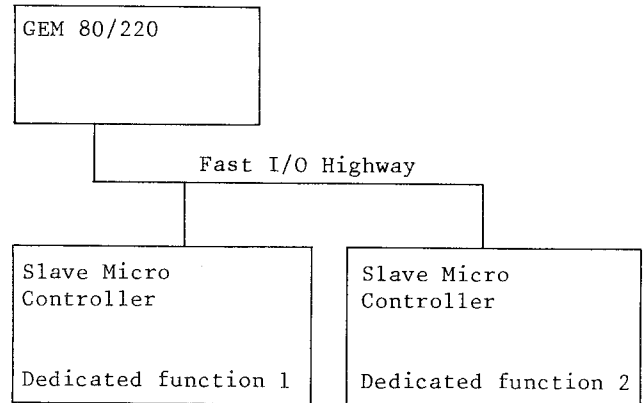
Terminals : up to 2.5mm² conductors
: slotted head screw clamp

Recommended cable : 5 twisted pairs with 0.5mm² cores and overall screen

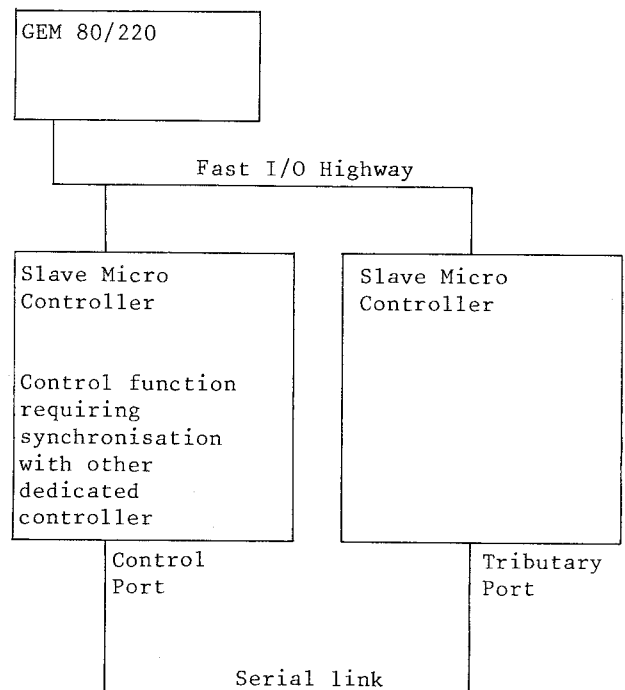
APPLICATION NOTES

1. TYPICAL CONFIGURATIONS

- i) One or more, Slave Micro Controllers performing dedicated control functions. Set points, control information etc. passed from 'host controller' driving fast I/O highway.



- ii) Where communication is required between the two dedicated controllers and the, scan time of the 'host controller' driving the fast I/O highway is too long, a serial link can be used to give a faster data transfer (speed dependent on signalling rate)



2. EXTERNAL CONNECTIONS

Basic I/O : ribbon cable (optional extra)

Serial link : ribbon cable and termination panel (optional extra)

Analogue I/O : twisted pair ribbon cable and termination panel

ORDERING CODES

1. EQUIPMENT

The 8861 Slave Micro-Controller consists of:-

- 1 - Micro-controller module
- 1 - Micro-controller backplane and connectors
- 1 - Analogue termination panel and 2m of ribbon cable

Ordering descriptions:-

Large Memory :- GEM 80 Slave Micro-Controller 8861 4002 (preferred)

Small Memory :- GEM 80 Slave Micro-Controller 8861 4001

2. OPTIONAL EXTRAS

Factory assembled basic I/O ribbon cables:-

Length subrack to 1st panel	Qty.of I/O panels	Connector Spacing	Ordering Code
2.65m	4	0.63m	40Y2484/10
2.65m	8	0.63m	40Y2484/20
3.5m	4	0.63m	40Y2484/30
3.5m	8	0.63m	40Y2484/40

Pack of inscribed buttons for labelling up to 8 panels of I/O blocks 8890 4011

Serial termination kit comprising panel type 8038 4002 & 2m ribbon cable 8871 4002

Mounting kit (for termination panels) comprising 1 length of steel channel with cable clips 8959

3. SPARES

a) Large memory (660 instructions)

Dedicated Controller base-module 8340 4001
Micro-Controller personality sub-module 8606 4001

b) Small memory (120 instructions)

Dedicated Controller base-module 8340 4001
Micro-Controller personality sub-module 8601 4002

NOTE:- The micro-controller module is normally handled as a personality sub-module clamped to a dedicated controller base-module to form a single unit.

Battery for micro-controller module 20T0144/01

Note The Company's policy is one of continuous development and improvement and therefore the right is reserved to supply products which may differ in detail from those described and illustrated in this publication. All our products and materials are sold subject to Conditions of Sale available from us on request

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Errata Sheet

For

8860 Slave Position Controller - Product Data Sheet T237 Issue 1 09.81

8861 Slave Micro Controller - Product Data Sheet T238 Issue 1 10.81

Page 2 SECTION 2 USER PROGRAM

Page 6 ORDERING CODES 3. Spares

The battery fitted to these modules has been changed from rechargeable silver zinc cells to primary lithium cells.

Module type	Old battery	New battery
8601 Processor sub-module	20T-0144/01	20T-0318

Each module has been modified to disconnect the charging circuit, and match the battery warning circuit to the voltage of the replacement battery.

The modification was performed retrospectively on all equipments in the field, and there was no associated change in the controller or module order numbers.

WARNING. On no account must new lithium batteries be fitted to unmodified modules. If the charging circuit is still connected, then the lithium battery is liable to explode violently. Observe correct safety procedures for disposal of exhausted lithium batteries.

Resulting change in specification:-

memory	: primary battery (lithium)
support	on processor module and each memory module

Battery life depends on proportion of time battery is supporting memory i.e. battery link is in service position and main power is switched off.

% of time supporting memory life

100%	1.5 yrs.
75%	2.0 yrs.
50%	3.0 yrs.
<30%	5.0 yrs.