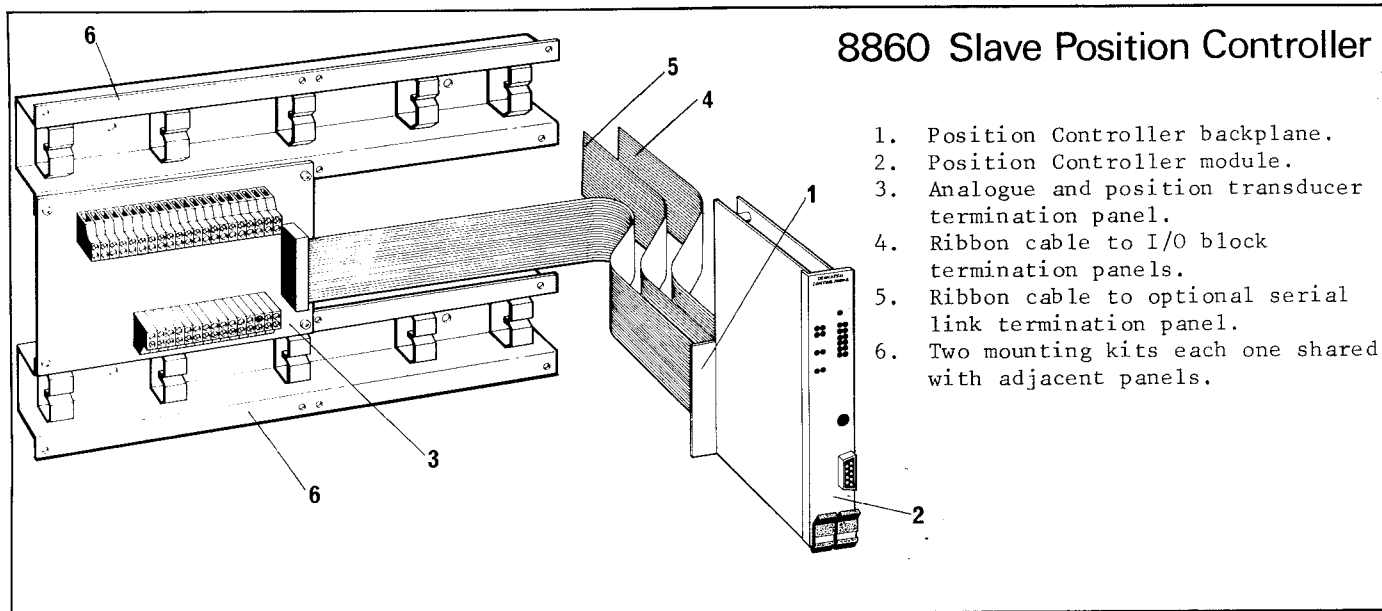
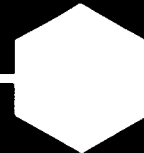


GEC Electrical Projects Limited

GEC Industrial Controls Limited

GEM 80



DESCRIPTION

The Slave Position Controller provides a comprehensive position control for many industrial applications where absolute position measurement is required. The controller performs one high resolution or two lower resolution control loops and includes datum setting and interfacing to plant signals and position transducers which can be resolvers, synchros, or an analogue voltage source.

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

- (a) Position 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.

The module plugs into a host GEM 80 controller where it occupies two subrack slots on the fast I/O highway.

A working system is completed by entering a user program in the GEM 80 Control Language.

FEATURES

- Complete position control function and associated interlocking logic in one unit.
- One high resolution or two lower resolution control loops.
- Position measurement from resolvers, synchros or analogue sources.
- Resolver/synchro excitation included.
- Scaling to engineering units, datum set and offset correction of measured position all built in.
- Datum information retained through power loss.
- Built in automatic self test and transducer checks.
- Fast response.
- Easily understood ladder diagram Control Language.

SPECIFICATION SUMMARY

Memory capacity	: 120 instructions
Local I/O	: 2 control loops
	: 4 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
 240mA @ +15V
 140mA @ -15V
 (using recommended resolver)
 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 12ms to 1s in 8ms increments.

- 1) scans inputs
- 2) calculates measured position for control loop 1
- 3) copies loop 1 data to common data area
- 4) executes the user program
- 5) copies common data area to loop 1 data area

If two control loops selected then:-

- 6) calculates measured position for control loop 2
- 7) copies loop 2 data to common data area
- 8) executes the user program
- 9) copies common data area to loop 2 data area
- 10) scans the outputs from the results of the program executions

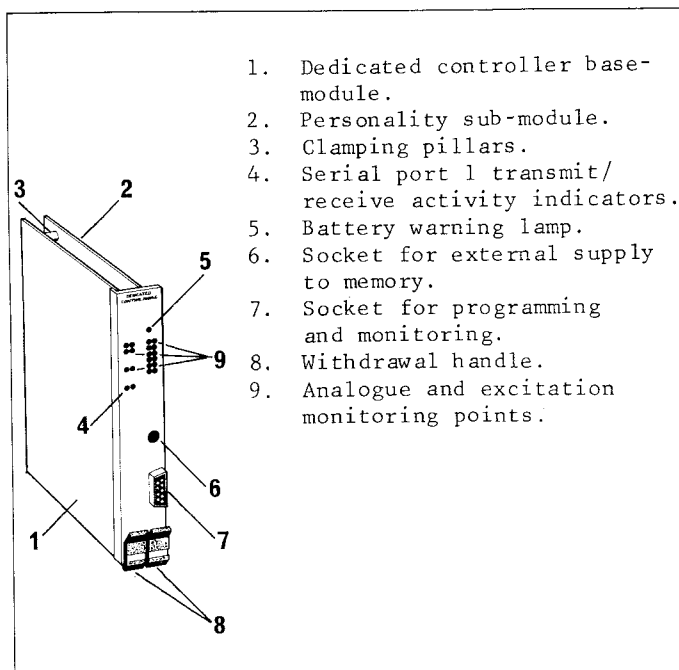
cycle time : minimum time which user can choose for program repetition interval

: $t_{\text{private I/O}} + t_{\text{prog}} + t_{\text{fast I/O}}$

(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)



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 and excitation monitoring points.

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)

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.

: for two control loops the user's program is executed twice (once for each loop) so that effective execution times are doubled.

: BLOCK instructions may be used to skip execution of chunks of program.

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 : 120 instructions
 : see table 3 for data Table sizes

memory support : rechargeable battery on module
 : socket for external supply when changing battery

power off : 4 weeks at 25°C
 memory retention : 3 weeks at 50°C
 (minimum) : 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 μ s per instructions		

Table 2 Special Functions			
No.	Mnemonic	Title	Av.Exec (ms)
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
S30	FGEN	Function generator	2.75
S31	DEDBAND	Dead band	0.78
S32	LIMIT	Limiter	0.89
T0	COMPARE	Comparator	0.59
T10	MULT	Multiply	0.48
T11	DIV	Divide	0.77

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	3	Fast input	Switched between loop 1 & loop 2 data
D	3	Fast output	
E	1	Timing, flags	0.1s/1s intervals Add/sub limit flag Loop1/loop2 flag
F	80	Diagnostics	48 built-in diagnostics 32 for user programming
G	43	General work space	Delays, counters. sequencers etc.
I	12	Local inputs	Analogue and position inputs

Table 3 continued			
J	16	Serial input	Switched between loop 1 & loop 2 preset data depending on which loop is being executed
K	16	Serial output	
L	28	Loop data	User programmed tests
M	10	Maintainer	
O	2	Local outputs	Analogue outputs
P	134	Preset data	48 configuration data 30 user presets 28 Loop 1 data & optional fast I/O 28 Loop 2 data & optional fast I/O
All tables except P are cleared on power up. All tables except P and F cleared on halt to run transition.			

3. PRIVATE INPUT/OUTPUT

3.1 Position Transducer Inputs

The two control loops each have a position input selectable as resolver synchro or analogue voltage source (e.g. potentiometer)

Analogue : Input range $\pm 10V$ differential
: Accuracy $\pm 0.05\%$ of full scale
: Resolution 1 in 4096
: Common mode error $\pm 0.07\%$

Resolver/synchro : Single resolver giving:-

: Accuracy $\pm 0.05\%$ of full scale
: Resolution 1 in 4096

or : Two resolver/synchro inputs combined as a course fine pair (gearbox ratio 128:1) giving:-

: Accuracy $\pm 0.0007\%$ of full scale
: Resolution 1 in 65535

NOTE: Figures include accuracy of recommended resolver

Excitation : Square wave resolver/synchro excitation provided at 375Hz
: $\pm 10V$. 40mA peak nominal (total for 2 resolvers)
: 200mA r.m.s. maximum
: 350mA peak maximum (peak currents in excess of 40mA will add to $\pm 15V$ power supply requirement)

3.2 Auxiliary Analogue Inputs

No. of inputs : 4 inputs for general use
(in addition to position transducer inputs)
: If resolver/synchro used as position transducer then 1 input dedicated to excitation readback.

Voltage range : $\pm 10V$

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

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

Resolution : 1 in 4096

3.3 Analogue Outputs

No. of outputs : 2 (typically used for speed ref)

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

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

Accuracy : $\pm 0.4\%$ of full scale $0-40^{\circ}C$
: $\pm 0.5\%$ of full scale $0-70^{\circ}C$

Resolution : 1 in 4096

Zero offset : $\pm 15mV$

3.4 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
: connected to 5 panels of 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

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

Basic overhead for : 8.0ms
1 control loop (analogue)
2 analogue outputs
+ operating system

Scaling to engineering : $\pm 0.5ms$ per control
units of measured loop
position

Single resolver input : $\pm 0.9ms$ per control
loop

Single synchro input : $\pm 1.3ms$ per control
loop

Coarse/Fine resolver input: $\pm 2.7ms$

2nd control loop : $\pm 3.7ms$
(analogue)

Auxiliary analogue inputs : $\pm 1.3ms$

Basic I/O if selected : $0.7ms$ plus $1.0ms$
per 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 : 3 input values and 3 output
values for each control loop
: Extendable to give up to 28
additional I/O values for each
control loop

Status : Halt/Run, Test/Normal status
Linking : optionally linked to status of
host GEM 80 controller via I/O
highway
: Healthy/unhealthy status
optionally communicated to
host controller

$t_{\text{fast I/O}}$: For each additional fast input
value (max. 28 per loop) add
 $100\mu s$

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 : 9600 bit/s standard
rate : user adjustable options
 $4800, 2400, 1200, 600, 300,$
 110 bit/s

Signalling time : 12.5ms plus 2.5ms per table
at 9600 bit/s location (16 I/O points or
1 numeric value)

Signalling time : inversely proportional to
< 9600 bit/s signalling rate

Maximum link : 400m at 9600 bit/s
length : 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
(42s) whenever power applied
: I/O tests repeated every scan
: regular on line repetition of
running tests (spread over
26 mins)

Watchdog : uses watchdog of host GEM 80
controller if status linking
selected

Faults which : fault, interfering with
immediately set transfers on private basic
controller I/O highway
unhealthy : failure of validity checks on
position transducer
: failure of context checks on
configuration parameters

Faults which set : alteration detected in
controller contents of read only memory
unhealthy when : failure of any part of read/
detected by write memory to store and
running tests recall data

Faults which user : any I/O block missing
may program to : basic I/O ribbon cable
set controller unplugged
unhealthy : 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 : on line monitoring of
provided by program runs and data
connecting unit table contents
at programming : manual data input to M
monitoring link 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

Indicator 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 and Position Transducer 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

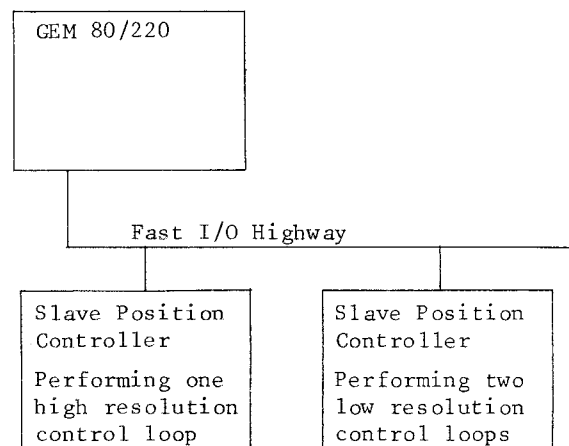
Terminals : up to 2.5mm² conductors
: slotted head screw clamp

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

APPLICATION NOTES

1. TYPICAL CONFIGURATIONS

- i) One or more slave position controllers
getting set points from a 220 Micro
Controller driving the fast I/O highway



- ii) Where synchronisation is required
between two control loops in separate
controllers and the scan time of the
controller driving the fast I/O highway
is too long, a serial link can be used
(speed dependent on chosen signalling rate)

GEM 80/220

Fast I/O Highway

Slave Position
Controller

1 high resolution
loop

Slave Position
Controller

1 high resolution
loop

Control
Port

Serial Link

Tributary
Port

2. TYPICAL SCAN TIMES

- 12ms : Simplest single control loop.
Position F/B from analogue
source
- 20ms : Single high resolution control
loop
Position F/B from coarse/fine
resolvers
- : Two simple low resolution
control loops
Position F/B's from resolvers

3. EXTERNAL CONNECTIONS

- Basic I/O : ribbon cable (optional extra)
- Serial link : ribbon cable & termination
panel (optional extra)

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

ORDERING CODES

1. EQUIPMENT

The GEM 80 Slave Position Controller consists
of:-

- 1 position controller module
- 1 position controller backplane and connectors

1 analogue/position transducer termination
panel & 2m of ribbon cable

Ordering description:-

GEM 80 Slave Position Controller 8860 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 assembly
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

Dedicated controller base module 8340 4001

Position controller personality
sub-module 8601 4001

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

Battery for position controller 20T0144/01
module

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.