



Controllers

GEM 80/701, 702 and 703



DESCRIPTION

Introduction

The GEM 80/700 series are powerful programmable controllers, designed for application to complex industrial plant.

These controllers are specifically designed for network operation and are ideally suited for central supervisory systems.

Input/Output Equipment

The system offers a wide choice of I/O equipment, with isolated connection to up to 8192 I/O points. Compact and Fast I/O modules are available for digital I/O, operator interface units, analog I/O and pulse train handling. Remote I/O systems can be used where I/O equipment is installed at local plant level.

Communications

A comprehensive range of communications facilities is available with this series of controller. Up to four built-in serial ports provide RS422 and 20mA current loop options. Each port offers direct multi-drop capabilities with up to eight other GEM 80 controllers.

In addition to these built-in serial ports, extra 20mA serial ports, STARNET or CORONET Systems are optionally available.

Video

With the exception of GEM 80/702 these controllers accommodate the IMAGEM Graphic Video module.

Memory Options

All controllers are available in four memory options 192K, 256K, 384K and 512K. Over and above this, providing that space is available on the central highway, memory expansion is possible to approximately 1.5MB.

Programming

These controllers run the simple to use GEM 80 ladder diagram language. The comprehensive instruction set covers the following functions:-

relay replacement, logic, maths, signal processing, closed loop control (PID), numerical and binary manipulation, data control, code conversion and handling, serial port, output functions and off-line storage.

The instruction set includes control of communications over MAP and STARNET.

Program Capacity

The program capacity depends on the memory size and number of data tables used. Typically, the 256K memory accommodates about 12,000 instructions, increasing to 36,000 instructions with a 512K memory. These controllers have a processing speed of 5 μ s per instruction.

Construction

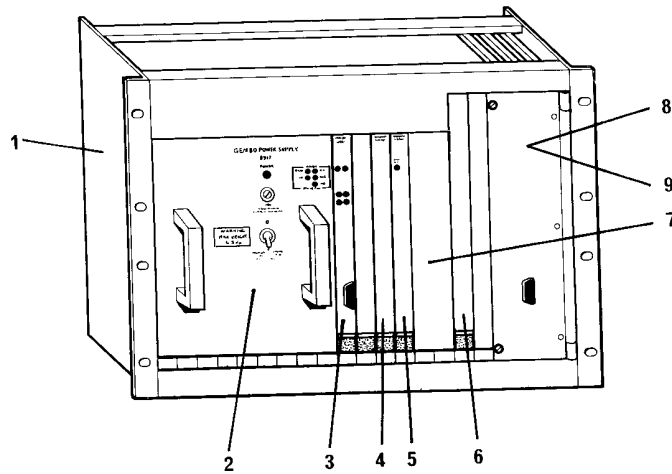
Modular construction allows fault-finding by substitution for ease of maintenance. The power module operates without the need for forced ventilation.

Applications

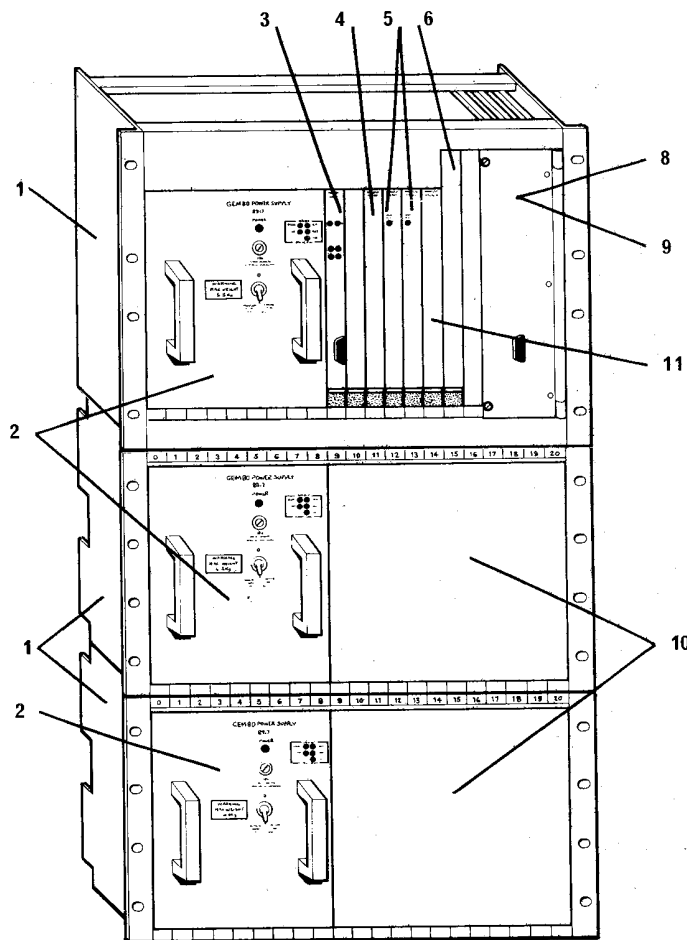
The GEM 80/700 series consist of power module, memory and processors mounted in a subrack with facilities for additional modules. The controllers are well suited to applications in complex plant control either as stand-alone or in distributed control systems.

FEATURES

- MAP version 2.1 for interface to other controllers and supervisory computers regardless of manufacture.
- Facilities for up/down-loading programs to any supervisory computer on the MAP network.
- Up to 4 serial links for manufacturing cell communications. Each link can multi-drop to up to eight controllers.
- Comprehensive range of pre-written software routines built in as standard.
- Regular, automatic self-test with English, German or Spanish diagnostic messages.
- Facility for transferring user program and preset data to EPROM for more secure system operation.



GEM 80/701



GEM 80/702

1. 19" subrack.

2. Power supply units either 110/220V a.c.
or optional 24/48V d.c.

3. Master I/O processor.

4. Ladder processor.

5. Read/write memory modules (1 or 2)

6. Dual port RAM.

7. Slots on the central highway for optional
modules.

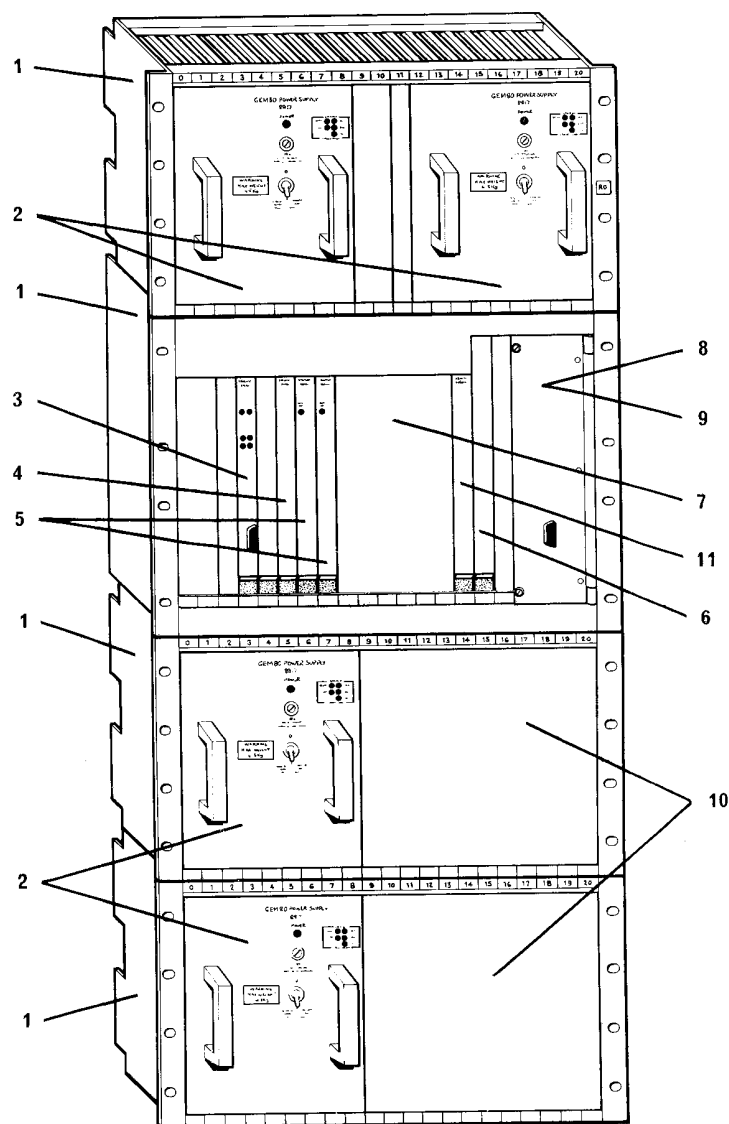
8. MAP communications processor.

9. MAP communications interface.

10. Fast I/O highway will accommodate up
to 12 single width modules.

11. Fast I/O driver.

HARDWARE LAYOUTS



GEM 80/703

- | | |
|---|---|
| <ul style="list-style-type: none"> 1. 19" subrack. 2. Power supply units either 110/220V a.c. or optional 24/48V d.c. 3. Master I/O processor. 4. Ladder processor. 5. Read/write memory modules (1 or 2) 6. Dual port RAM. | <ul style="list-style-type: none"> 7. Slots on the central highway for optional modules. 8. MAP communications processor. 9. MAP communications interface. 10. Fast I/O highway will accommodate up to 12 single width modules. 11. Fast I/O driver. |
|---|---|

SPECIFICATION

Specification Summary

	GEM 80/701			GEM 80/702			GEM 80/703							
Number of I/O Processors	1		2	1 ONLY			1				2			
Number of IMAGEM's accommodated	1	0	0	NONE			3	2	1	0	3	2	1	0
Number of STARNET's accommodated	0	1	0	NONE			0	1	2	3	0	1	2	3
Max. number of I/O points	4096		8192	4096			4096				8192			
Number of subracks (with no fast I/O equipment)	1			1			2							
Number of fast I/O subracks	0			0	1	2	0	1	2	0	1	2		
Max. number of slots for fast I/O equipment	0			0	12	24	0	12	24	0	12	24		
Number of power modules	1		1	1	2	3	2	3	4	2	3	4		
Number of serial communication ports	2		4	2			2				4			

All controller subracks contain:

Dual port RAM in slot 15

MAP communications processor

MAP communications interface

Instruction Set

Function		Instruction	Special Function	Remarks
Relay replacement functions	N/O contact	—] [—	—	Functions as a normally open relay contact
	N/C contact	—]/[—	—	Functions as a normally closed relay contact
	Coil	—()—	—	Functions as a relay coil
	Time Delay	DELAY	—	Time range 100ms to 54 minutes
	Counter Sequencer	COUNT SEQR	— —	capacity 32767 (resettable) 16 step sequencer with reset
Logic functions	Logic AND	AND	—	bit by bit ANDING of 2 x 16 bit words
	Logic AND group of words	ANDGRP	T24	bit by bit ANDING of 2 groups of 16 bit words
	Logic OR	OR	—	bit by bit ORING of 2 x 16 bit words
	Logic OR group of words	ORGRP	T25	bit by bit ORING of 2 groups of 16 bit words
	Logic exclusive OR	XOR	—	bit by bit XORING of 2 x 16 bit words
	Exclusive OR group of words	XORGRP	T26	bit by bit XORING of 2 groups of 16 bit words
	Invert	INV	—	Inverts each bit of 16 bit word
	Invert group	INVGRP	S25	Inverts each bit of a group of 16 bit words
Math functions	Addition	ADD	—	Limits ± 32767
	Array addition	ADDARRAY	T12	Limits ± 32767
	Subtraction	SUB	—	Limits ± 32767
	Array subtraction	SUBARRAY	T13	Limits ± 32767
	Multiply	MULT	T10	Integer multiplication Limits ± 32767
	Array multiplication	MULARAY	T14	Integer multiplication Limits ± 32767
	Division	DIV	T11	Integer division Limits ± 32767
	Array division	DIVARRAY	T15	Integer division Limits ± 32767
	Linear Conversion	LINCON	S11	Provides multiplication division and addition calculations
	Array Linear Conversion	CONARRAY	S10	Provides multiplication division and addition calculations for arrays of data
	Square Root	SQRT	S12	Limits ± 32767
	Mean & Standard Deviation	STDDEV	T18	
	Sequence Diagnostics	SEQDIAG	T19	

Function		Instruction	Special Function	Remarks
Signal Processing	Debounce Input Signal	DBOUNCE	S0	Provides signal conditioning to logic signals prone to spurious or transient problems
	Function generator	FGEN	S30	Four quadrant operation
	Dead Band Limiter	DEDBAND	S31	Includes offset
	Ramp Generator	LIMIT	S32	High and low limits
		RAMP	S33	Comprehensive Ramp generator (includes rounding)
	First Order Time Constant	ANALAG	S37	Smooths fluctuating numerical values
Closed Loop Control	Absolute 3 Term. Controller	PIDABS	S34	Provides absolute proportional, integral and derivative control
	Incremental 3 Term. Controller	PIDINC	S35	Provides incremental proportional, integral and derivative control
	Incremental Output	INCOUT	S36	
Binary Tests	High State	HISTATE	S3	Reports bit number of highest bit of 16 bit word set on (1)
	Bits ON	BITSON	S26	Reports number of bits set on (1) in a group of 16 bit words
	Compare Group	CMPGRP	T21	Compares two groups of 16 bits and reports details of the first difference
	Get Bit	GETBIT	T22	Performs a test of on state individual bits in group of words
Binary Manipulation	Swap 1/2 locations	SWAP	S4	Swap 1/2 location
	Shift	SHIFT	S27	Left and right shift on a group of 16 bit words
	Rotate	ROTATE	S28	Left and right rotations on a group of 16 bit words
	Put Bit	PUTBIT	T23	Allows setting and resetting bits of a word and generating specified words
	Array Initialisation	FILL	T17	Allows array list to be set or reset individually
	Shift	QSHIFT	T27	Shifts bits
	Rotate	QROTATE	T28	Rotates bits but data is unchanged
Numerical Manipulation	Negate	NEGATE	S5	Changes the sign of a number.
	Absolute Non-zero	ABS NONZERO	S6 S7	Makes a number positive. Outputs all 16 bits if input is non-zero
Block Instructions	Enclose conditionally executed rungs	START OF BLOCK	—	Conditionally executed block of ladder diagram instructions. Can be nested to a depth of 16
		END OF BLOCK	—	

Function		Instruction	Special Function	Remarks
Numerical Tests	Compare Comparison	COMPARE COMPARISON	T0	These special functions report if:
		EQ	T1	$X = Y$
		NE	T2	$X \neq Y$
		GT	T3	$X > Y$
		LT	T4	$X < Y$
		GE	T5	$X \geq Y$
		LE	T6	$X \leq Y$
	Maximum	MAX	T7	Returns the higher of the two branch inputs
	Minimum	MIN	T8	Returns the lower of the two branch inputs
	Checksum	CHKSUM	T9	
	Compare Array	CMPARRAY	T16	
	Select maximum in array	MAXARRAY	S13	Maximum value in array
	Select minimum in array	MINARRAY	S14	Minimum value in array
Data Moving	Locate Data Table Address	LOCATE	S20	These two special functions are usually used together for moving data from one area of memory to another
	Move Data Table Address	MOVE	T20	
	Cyclic Store	STORE	T30	
	Collate	COLLATE	T37	
B.C.D. Handling	B.C.D. input conversion	BCDIN	S1	Converts up to 4 decades of binary
	B.C.D. output conversion	BCDOUT	S2	Converts binary to up to 4 decades of binary coded decimal
Serial Port Alpha-numeric Input and Output	Print Text	PRITEXT	S38	Enables messages stored in controller memory to be output on a serial port
	Print	PRINT	T38	Enables user definable messages to be output on a serial port
	Character Input	CHARIN	T39	Enables characters input on the serial ports to be stored in controller memory
Output Functions	Output	OUT	—	Outputs 16 bit word to specified data table location
	Output	OUTPUT	S8	Intermediate output from rung
Gray Code		GRAYBIN	S9	Gray code input conversion

Function		Instruction	Special Function	Remarks
STARNET		CONFIG SEND RECEIVE STATS	T33 T34 T35 T36	Configure STARNET Send STARNET Receive STARNET STARNET statistics
Off line Data Storage		GETWORD CLEAR PUTWORD PUT GET	S19 S29 T29 T31 T32	Retrieval of indirect data Clear off line stores Storage of indirect data Storage of off line data Retrieval of off line data
MAP Network Interface	Read from a REMOTE device Write to a REMOTE device Start a REMOTE device Stop a REMOTE device Read status data from a REMOTE device Get data about previous transaction Get info about data changed by REMOTE device	READ WRITE START STOP STATUS GETREP GETINFO	S50 T50 T51 T52 S51 T54 S52	Read data from a remote device via the MAP network Write data to a remote device via the MAP network Start a remote device via the MAP network Stop a remote device via the MAP network Read status information from a REMOTE device via the MAP network Get report about success/ failure of a previous transaction request on the MAP network Get info about data changed by a remote device on the MAP network

Program Capacity

	nominal controller memory size			
	192K	256K	384K	512K
Theoretical maximum number of instructions (with no datatables)	5,000	16,000	26,000	37,000
Number of instructions (with 10,000 datatables)	5,000	11,000	26,000	37,000
Number of instructions (with 20,000 datatables)	5,000	6,000	22,000	37,000

Note: There is an automatic trade off of two data tables per instruction such that if the user allocates more data table memory area, then the instruction capacity is reduced and vice versa.

Memory Size

		nominal controller memory size			
		192K	256K	384K	512K
Standard Memory Allocation	Source code + data tables	64K	64K	64K	64K
	Extension space for source code	—	—	64K	128K
	Compiled code	32K	96K	160K	224K
	Video formats (Pages 0 to 5)	96K	96K	96K	96K
In Dual Port RAM	Mailbox	64K	64K	64K	64K
Optional Additional Memory Allocation	Optional Additional Video formats (Pages 6 to 9)	64K	64K	64K	64K
	Optional additional Off-line storage (where off-line storage is used at least 64K of memory is required.)	1024K	1024K	1024K	1024K
	Maximum totals	1344K	1408K	1536K	1664K

Detailed Specification.

Data tables : User adjustable size

Concentrated I/O : Two GEM 80 concentrated ribbons per I/O processor each offering 128 addresses.

Expanders : Each concentrated ribbon expandable by up to four expander units type 8173 to provide eight basic I/O ribbons.

Basic I/O : Each I/O ribbon can handle up to 256 ON/OFF states or 16 numerical values (range ± 32767) or any mixture.

Fast I/O : Available on 702 and 703.
: Fast I/O driver type 8300-4003 fitted for fast I/O interface.

Serial links : 20mA current loop with ESP protocol.
: Signalling rate 110 to 9600 bits/sec.

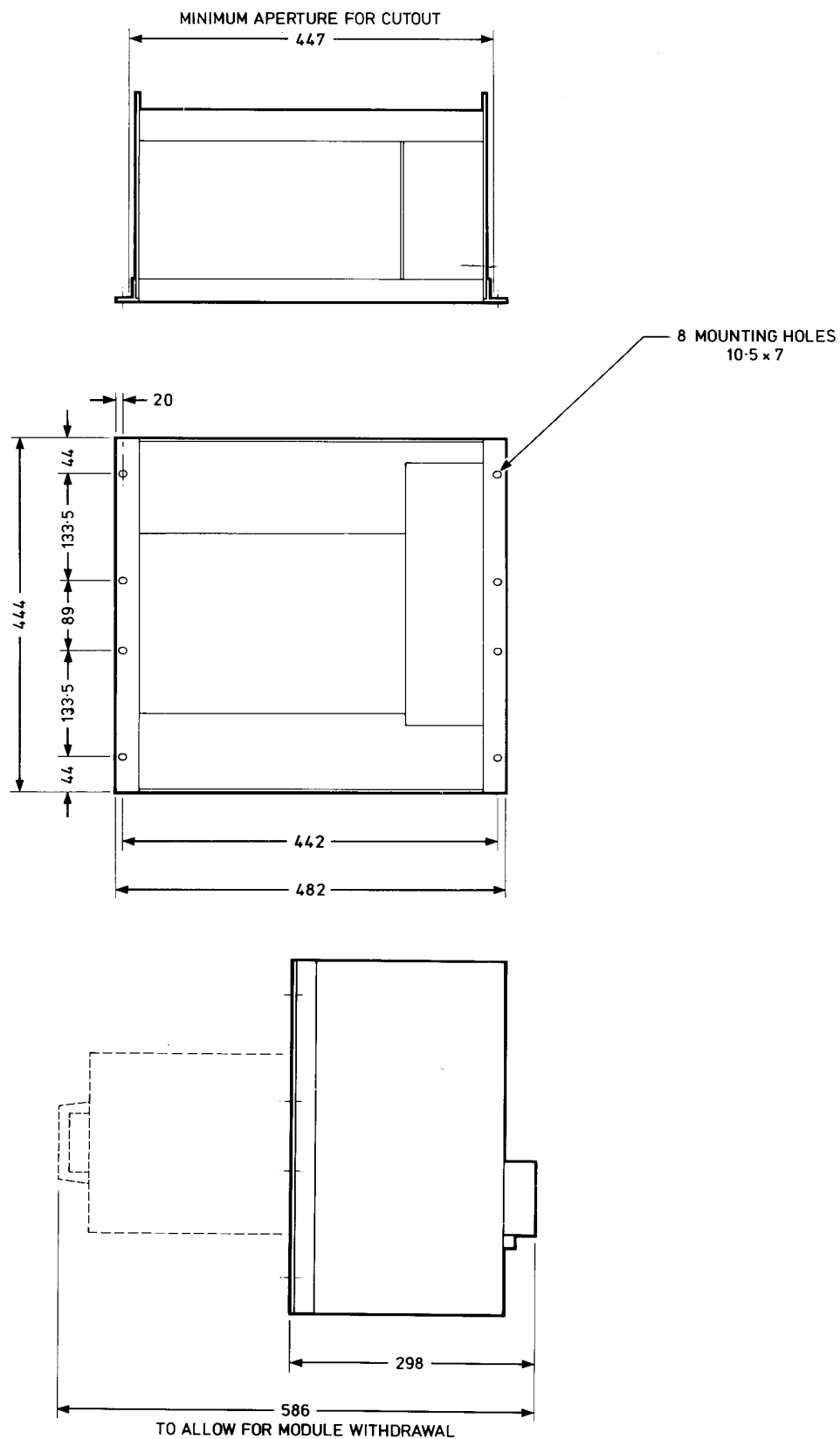
Power modules : 88-264V a.c. 45-66Hz
: 88-250V d.c.
: Inrush : 6A max at 264V ac
: 2.6A max at 121V ac
: Each power module consumes less than 360W

Weight : 14 to 18kg depending on fitted equipment.

Dimensions : Extended subrack
444 x 482 x 338mm
: Power Module subrack
267 x 482 x 338mm

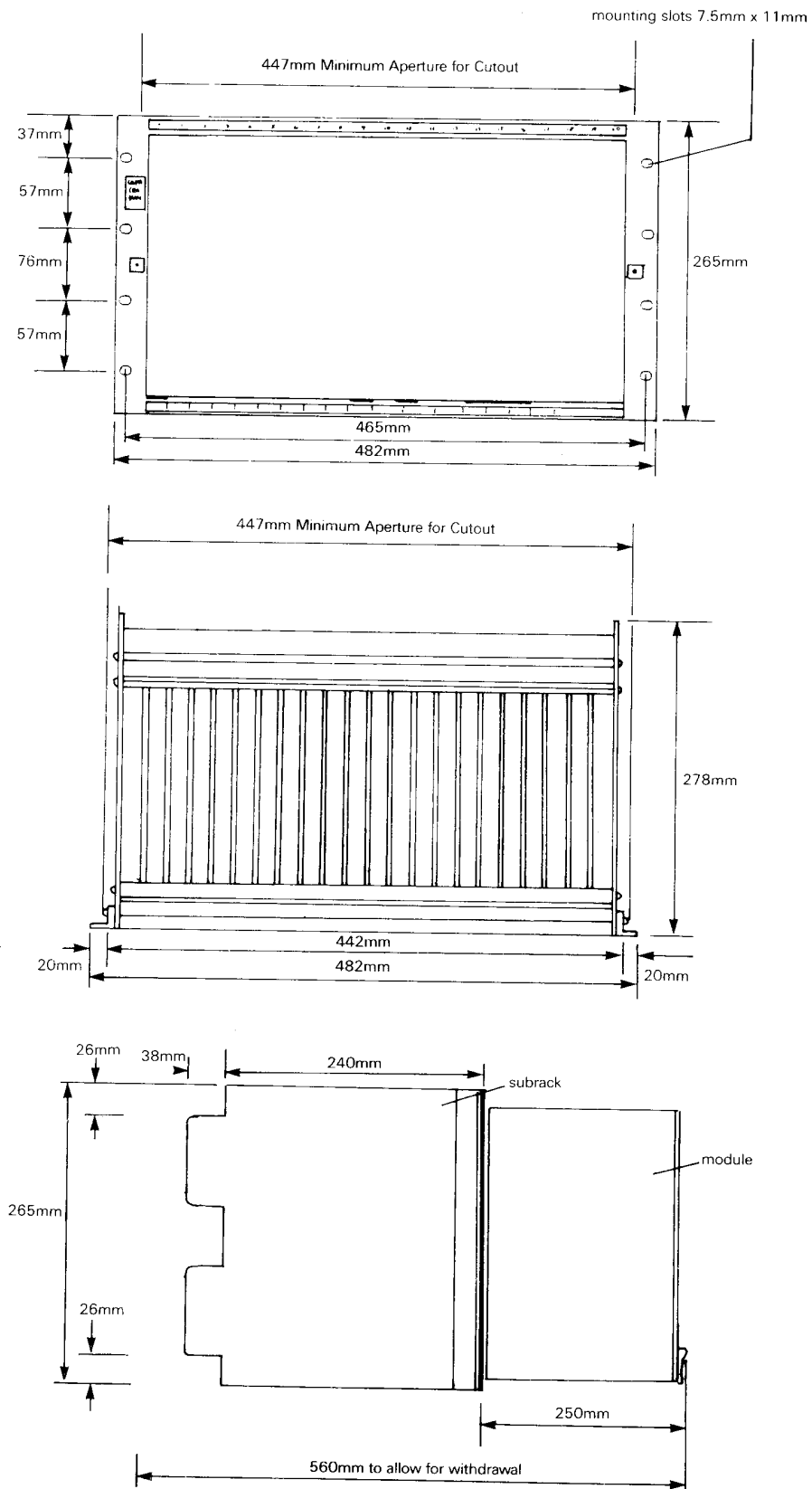
Dimensions and Fixing Centres

Extended Subrack



All dimensions in millimetres

Dimensions and Fixing Centres Power Module Subrack



All dimensions in millimetres

ORDERING CODES

1. SUBRACKS

(a) 700 Series Processor Subracks

Model	Subrack Qty	Modules included						Space for		Ordering Code
		Power module Type	Qty	I/O Proc.	Ladder Proc.	256K RAM	128K RAM	Central modules	Fast I/O driver	
701(256K)	1	110/220V ac/dc	1	1	1	1	0	2	0	8864-4011
701(256K)	1	24/48V dc	1	1	1	1	0	2	0	8864-4012
702(256K)	1	110/220V ac/dc	1	1	1	1	0	1	1	8864-4021
702(256K)	1	24/48V dc	1	1	1	1	0	1	1	8864-4022
702(384K)	1	110/220V ac/dc	1	1	1	1	1	0	1	8864-4023
702(384K)	1	24/48V dc	1	1	1	1	1	0	1	8864-4024
702(512K)	1	110/220V ac/dc	1	1	1	2	0	0	1	8864-4025
702(512K)	1	24/48V dc	1	1	1	2	0	0	1	8864-4026
703(256K)	2	110/220V ac/dc	2	1	1	1	0	7	1	8864-4031
703(256K)	2	24/48V dc	2	1	1	1	0	7	1	8864-4032
703(384K)	2	110/220V ac/dc	2	1	1	1	1	6	1	8864-4033
703(384K)	2	24/48V dc	2	1	1	1	1	6	1	8864-4034
703(512K)	2	110/220V ac/dc	2	1	1	2	0	6	1	8864-4035
703(512K)	2	24/48V dc	2	1	1	2	0	6	1	8864-4036

Note: All the above processor subracks have MAP communications using Channel 3. Consult the factory for Controllers using Channel 1 or Channel 2.

(b) Fast I/O Subracks

Model	Modules included		Space for Fast I/O modules	Ordering Code
	Power module Type	Qty		
12-slot	110/220V ac/dc	1	12	8870-4105
12-slot	24/48V dc	1	12	8870-4104
12-slot*	—	0	12	8870-4315
16-slot*	—	0	16	8870-4031

The above are for use with 702 and 703, Controllers optionally when you require fast I/O modules. Depending on the quantity of fast I/O modules, you may require either one or two subracks.

* Only for systems where there is adequate power available from a power module in another subrack.

(c) Basic I/O Subracks

Model	Power module	Space for Basic I/O modules	Expander units	Ordering Code
12-slot	0	12	1	8869-4002
8-slot	1 (type 8132)	8	0	8867-4004
4-slot	0	4	1	8866-4002

The above are for use with any model of 700 series Controller where basic I/O modules are required.

Note: The earlier 8869-4001, 8867-4002 and 8866-4001 subracks were suitable for 8-bit I/O modules only.

2. MODULES

(a) Additional Central Modules

The ordering codes below call up additional central modules, plus their associated backplanes, ribbon cables, and isolating termination panels as appropriate.

Module type	Function	Slots used	Equipment called up by ordering code	Ordering Code
Second I/O Processor (maximum 1 per subrack)	For doubling the amount of I/O on the Controller.	2	I/O processor module. Processor backplane. 1-off basic I/O expander.	8800-4024
IMAGEM Graphic Video (maximum 4 per subrack)	For displaying data taken from the Controller's data tables on a video monitor.	2	Video processor module. Video output module. Video backplane. Ribbon cable. Isolating termination panel.	8815-4001
256K memory module	For additional video formats, (128K) and off-line data storage (128K).	1	Memory module. Socket.	8810-4017
256K memory module	For off-line data storage (256K).	1	Memory module. Socket.	8810-4027
128K memory module	For additional video formats.	1	Memory module. Socket.	8810-4019
128K memory module	For off-line data storage.	1	Memory module. Socket.	8810-4029
256K RAM/EPROM module	For more secure storage of ladder program, presets and video.	1	RAM/EPROM memory module, without EPROM submodule.	8810-4020
256K EPROM submodule	For more secure storage of ladder program, presets and video.	1	EPROM memory submodule, including unprogrammed EPROM's.	9210-4001
STARNET module	For inter-controller communications with block message facility.	2	STARNET module. Backplane.	8816-4001
Fast I/O Driver	Required whenever the system contains fast I/O modules. Must not be fitted if there is no fast I/O.	1	Module only.	8300-4003
Note: The quantity of slots used must be taken into account when assessing how many modules can be fitted into a GEM 80/700 series processor subrack.				

(b) Fast I/O Modules

Details of fast I/O modules are given on individual data sheets in the number ranges 884x and 886x, and are therefore omitted from this data sheet.

(c) Basic I/O Modules

Apart from the items given below, details of basic I/O modules are given on individual data sheets in the number range 81xx, and are therefore omitted from this data sheet.

Module type	Function	Equipment called up by ordering code	Ordering Code
Power module	To provide additional power for basic I/O modules.	Module for 110/220V a.c. (isolated) or 24-60V d.c. (non-isolated, negative earth only). Mounts in 8867-4004 subracks.	8132-4005
Basic I/O expander unit	To provide basic I/O ribbons for 512 points of basic I/O.	Expander unit only. Mounts in either 8869-4004 or 8867-4002 basic I/O subracks.	8173-4002

3. OPTIONAL EXTRAS

20mA serial link termination unit (provides terminals for one port).	8924-0000
HDLC serial link termination unit (provides terminals for one port).	8587-4001
Ribbon cable for connecting either of the above to the Controller (connects up to 2-off 8924 units to the processor subrack; max. 1-off per I/O processor, or 2-off per star network module).	8891-4077
Fibre optic interface unit (converts 20mA serial link from an unit to fibre optic)	8927-0000
Cable loom for serial ports 1 or 3 (for connecting the above to an 8924-0000 unit)	8891-4079
Cable loom for serial ports 2 or 4 (for connecting the above to an 8924-0000 unit)	8891-4083
Subrack mounting kit (for one subrack)	8890-4048
Mounting channel (for I/O panels and termination panels)	8959-0000

4. SPECIAL PROCESSOR SUBRACKS

Where you wish to add further central modules to a processor subrack after it has been delivered, it is a difficult job to fit the necessary backplanes and wire links, etc., which may involve the subrack having to be returned to the factory. We therefore **strongly recommend** that you consider possible future module additions at the ordering stage. A subrack can be **prepared** to accept further modules, even though these modules might not be purchased until a later date.

(a) Subrack Preparation

For second I/O processor	8899-4214
For IMAGEM graphic video	8899-4222
For STARNET module	8899-4224
For 256K or 128K RAM, or 256K EPROM, memory module	8899-4208

Note: You must define the usage of each 64K block of RAM, e.g. whether required for extension program memory, for formats, or for off-line storage, etc.

(b) Module additions subsequent to original order

Module	Subrack preparation required	Equipment called up by ordering code	Ordering Code
Second I/O processor	8899-4214	Module only. When ordering, replace the asterisk by the last digit of the ordering code for the first I/O processor already fitted.	8213-470*
IMAGEM graphic video	8899-4222	Video processor module. Video output module. Ribbon cable. Isolating termination panel.	8815-4002
STARNET module	8899-4224	Module only.	8218-4001
Note: You must specify ribbon cables and termination units separately, depending on how many ports, and of what type, you are using.			
256K RAM memory	8899-4208	Module only.	8220-4001
128K RAM memory	8899-4208	Module only.	8220-4012
256K RAM/EPROM memory	8899-4208	Module only, without EPROM submodule	8222-4001
EPROM submodule	For 8222-4001	Submodule including set of unprogrammed EPROM's.	9210-4001

5. SPARES

Power module for processor and fast I/O subracks For 110/220V input	8917-4001	IMAGEM graphic video processor	8219-4001
For 24/48V d.c. input	8918-4001	IMAGEM graphic video output module	8216-4001
Power module for basic I/O	8132-4005	STARNET module	8218-4001
For 110/220V a.c. (isolated) or 24-60V d.c. (non-isolated, negative earth only).		256K RAM memory module (for ladder program and presets, video formats or off-line data storage)	8220-4001
Ladder processor module (See note)	8211-470*	128K RAM memory module (for memory extension)	8220-4012
I/O processor module (See note)	8213-470*	EPROM module (including set of unprogrammed EPROM's)	8222-4001
Note: Replace the asterisks with the final digit appearing on the modules originally supplied; this digit must be identical on the ladder and I/O processors.		Dual port RAM module	8221-4001



Higher layers MAP interface module 78801/241
(Intel SBC 86/35 card with MAP firmware fitted)

Lower layers MAP interface module 78801/242
(Intel iSXM554/3 card with modem for Channel 3
(83.75-95.75 MHz transmit band, 276-288 MHz
receive band) and with MAP firmware fitted)

Consult the factory for modules with modems
for Channel 1 or Channel 2.

Power fuse for 8917-4001 power supply 82030/111
(10A time delay, high breaking capacity).

GEC Industrial Controls Limited
Programmable Controllers Division,
Kidsgrove, Stoke-on-Trent,
Staffordshire ST7 1TW, England.
Tel: Kidsgrove (07816) 3511
FAX (Group 3) Kidsgrove (07816) 76329
Telex: 36293 GECICK

Also at:
Mill Road, Rugby,
Warwickshire CV21 1BD.
Tel: Rugby (0788) 2121

Registered at London No. 540682
Holding Company: The General Electric Company p.l.c.,
1 Stanhope Gate, London W1A 1EH.

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