GembusHub Modbus Datamap

This document is intended for System Installers. It contains the detailed technical information needed to access and setup the GembusHub.

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Revision History:

Revision	Date	Comment
		Pre-release history
A	14/11/14	First draft of Modbus Memory Map.
B	6/2/15	Updated Configuration data map Added multi access to Input Data. Allocated the address map for the GembusHub data.
C	19/3/15	Updates to the Link statistics as details were coded. Changed the device addresses from 10 to 14 to 16 to 20 to avoid using the CR and LF characters as addresses. GembusHub Statistics moved from 200 to 500 to make space for settings. Moved Configuration change counts to 5200 and made them fully accessible. Moved ConfigCRC to 5100, also fully accessible. Moved read only GembusHub Status/Statistics variables out into a separate memory array. Removed fixed IP address option.
D	25/3/15	• Added "fixed IP address" back in again. • Rearranged the 100 range registers to allow the configuration of fixed IP address, router address and the net mask. • Added the actual address used at address 513. • Added example of Modbus accesses to chapter 2.
E	28/4/15	• Added 618, count of invalid IP address accesses. • Added section 5.8.1, remote reboot • Added Gemstart simulator – Set Control (106-109) = 12321. • Added Status Registers Written array at 4600. • GembusHub tested to this document from 23/4/15 to 28/4/15. Faults fixed and document updated along the way. This version of the document released after testing and firmware 2.60.1.2 released as a reference point.
F	12/05/15	• Added register 207 to test LEDs. • Copied register 1101 status to 512 as well. • MAC address used to identify boards so no separate serial number required (registers 507, 508) • Added GembusHub LED indication via Modbus (525 to 530). • Moved Data Size and broadcast settings from link control to link settings. (1301 and 1302 moved to 1007 and 1008)
G	18/6/15	• Added the CRC to the end of the configuration data read. You can read length 120 to get just the configuration or length 121 to get configuration and the CRC.
H	14/7/15	• Added the Gemstart type info at address 6000 to 6099. The Development Data at 6000 has been moved to address 7000.
		Released versions
001	15/07/2015	Initial Customer Release
002	23/09/2015	Scratchpad area added to device 16 address 9000 length 512 Cosmetic changes to some text items • V4.60.1.9. Added ability to connect a Modbus Host to one of the RS485 ports by setting register 106 to 109 to 10. • Ethernet Timeout changed to PLC Control Timeout. Timeout action is now only taken if no Modbus messages on Ethernet or RS485.

003	17/02/2016: GembusHub **4.60.1.10**	• Updated description to registers 110, 113-125. Changing these registers now restarts the Ethernet interface. • Updated register 126. The permitted IP addresses are now checked dynamically and not just at connection. • Register 511 bit 3 no longer relevant. • Added register 623: The rejected connection port • Updated description in 5.4.2, Single Data Request • Added register 1319, Requested Data Length
004	25/02/2015 GembusHub **4.60.1.11**	• If the Control Link fails and Link Control is set to 1 then Link Control is changed to 0 to stop Gembus Comms. The PLC must set the Link Control to 1 again after the Control Link is re-established.
005	19/02/2020 **4.60.2.4**	• Added Single Data Request timing info. (4.60.1.12) • Removed baud rates above 38,400 for Gembus and Modbus. (4.60.2.3) • Added TCP/IP statistics in tables 624 to 634. (4.60.2.4)

1   Contents

2   GembusHub Modbus Memory Map

GembusHub is a communications device capable of supporting 400 Gemstarts across 4 links of up to 100 Gemstarts each. GembusHub makes available all the information from these Gemstarts in a Modbus data map accessible using the Modbus TCP/IP protocol. The same address map is provided via the USB port although Serial Modbus is used for this access route.

GembusHub has lots of data to maintain. All data is available using Word Reads. Some data can be written to but may be read only and will not change. Some data ranges cannot be written to at all. There are separate data areas for the GembusHub and each of the Gemstart Links. The device address is used to specify the target data area.

The data areas are split as follows:

	Modbus TCP/IP Unit Identifier	Serial Modbus Device Address
GembusHub Data	16 (0x10)	**16 (0x10)**
Gemstart Link 1 Data	17 (0x11)	**17 (0x11)**
Gemstart Link 2 Data	18 (0x12)	**18 (0x12)**
Gemstart Link 3 Data	19 (0x13)	**19 (0x13)**
Gemstart Link 4 Data	20 (0x14)	**20 (0x14)**

2.1   GembusHub Data Summary

This data relates to the GembusHub as a whole.
- Address 100 - GembusHub Settings
- Address 500 - GembusHub Info
- Address 600 - GembusHub Statistics

2.2   Gemstart Link Data Summary

This data relates to one link of Gemstarts. A separate set of data is available at the 4 devices station addresses (17-20) used for the four ports.
- Address 1000 - Link Settings
- Address 1100 - Link Statistics
- Address 1200 - Status Flags
- Address 1300 - Link Control Registers
- Address 2000 - Output Commands Array
- Address 3000 - Input Data Array
- Address 5000 - Configuration Data

2.3 Modbus Functions

The following Modbus functions are implemented on TCP/IP and USB

> 3, Read Holding Registers
> 4, Read Input Registers
> 6, Write Single Register
> 16, Write Multiple Registers

The Holding Registers and the Input Registers access the same data map. There is no difference in how these two functions work.

Additional Information

> Max Register Read or Write Length is 123

Modbus register addressing is defined as 1 to 65536. In the low level comms the address offset from 1 is used. So this document refers to the Modbus Address (range 1 to 65536). The tables below contain the Modbus addresses (1-65536).

2.4 Principles of Operation

Once the unit has been set up it will continuously poll the Gemstart devices and retain the status and configuration data for all of the Gemstart units. This information is made available to the system via the Modbus TCP/IP interface and also via the USB port if any local access is required.

GembusHub is capable of hosting Gemstart 1's, 2's and 3's on the same link as Gemstart 4's and 5's. It is recommended that if Gemstart 1, 2 or 3 are on the link then link number 0 is used.

The content of data returned by each Gemstart type will be defined by that Gemstart. To decode the data correctly please refer to the documentation for the Gemstart model in question.
This is the same for the content of any command sent to an attached Gemstart unit, please refer to the appropriate documentation to ensure the correct data is sent to each Gemstart.

3 Modbus TCP/IP

Modbus over TCP/IP allows standard Modbus messages to be sent across a TCP/IP network such as Ethernet.

GembusHub is a Modbus Server. This means that it is a passive device that responds to messages from a client. It is up to the client to initiate all data transfers. Up to 20 Modbus requests can be sent at the same time either from different IP addresses or from different ports within each IP address. Each port of an IP address can only action 1 message at a time.

> For example if GembusHub is accessed from the Modbus Poll program then only one read at a time can be actioned as only one port is used to access the GembusHub. Starting a second and third instance of the Modbus Poll program then multiple ports are created allowing 3 parallel accesses to GembusHub. If 3 or more Modbus Poll programs are started on another PC then another 3 or more parallel access paths are possible into Gemstart Hub. All in all, 20 separate programs can be accessing the GembusHub data at one time, plus 1 channel used by a program accessing GembusHub data via the USB port, plus up to 4 Modbus connections using the RS485 ports and Modbus RTU.

When GembusHub is first connected to the network it is allocated an IP address either from the fixed address defined in the settings or allocated by the DHCP server. An address allocated by DHCP address should be fixed. Ie the same unit is always allocated the same IP address. This will allow a PLC to know exactly which GembusHub it is accessing for a given IP address. As a confirmation, a PLC should always read and check the MAC address which can be read in registers 508 to 510.

The control system can read the GembusHub MAC address from the GembusHub to verify that the expected GembusHub is connected. The IP address and the GembusHub MAC address can also be read via the GembusHub USB port.

All Modbus TCP/IP messages have a MBAP header that replaces the header and checksum that are part of a normal Modbus message. The standard header contains the Slave Address. This is replaced with the Unit Identifier. The Unit Identifier is used to define which area of GembusHub is being addressed.

MBAP Header (Big Endian Data Order = High Byte Low Memory)

Byte	Description	Range	Comments
0&1	Transaction Identifier	0-65535	Echoed by GembusHub
2&3	Protocol Identifier	0	0 identifies Modbus. Message ignored if this is not 0.
4&5	Message Length		The size of the combined unit identifier, function code and data message following the header
6	Unit Identifier	16-20	16: (0x10) GembusHub Registers 17-20: (0x11-0x14) Gembus ports 1 to 4.

All Modbus TCP/IP messages use port 502 (configurable).

4   USB

GembusHub will appear as a standard COM port on the PC. An .inf file may have to be selected the first time the USB port is connected.

4.1   Modbus via USB

The USB com port can be used as a MODBUS port with Modbus device address 0x10 (16) for GembusHub registers and addresses 0x11-0x14 (17-20) for Gembus ports 1 to 4.

5 GembusHub Registers

GembusHub registers are accessed via Modbus station address 0x10.

There are a number of settings that are defined for the whole unit and statistics that relate to the whole unit rather that the individual ports. These configuration registers and statistics are defined here.

5.1 GembusHub Settings

Theses settings define how the GembusHub operates. All of them are read/write and are retained through a power cycle. Only the date and time are changed by GembusHub although the Link Control registers may be modified after a power cycle.

Register	Description	Range	Comments
100	Day	1-31	Set the date and time. Not retained through a power down.
101	Month	1-12	
102	Year	0-99	
103	Hour	0-23	
104	Minute	0-59	
105	Second	0-59	
106	Link 1 Control	0-10	0 = No transmissions 1 = Transmission enabled while PLC in control but disabled by a PLC Control Timeout or GembusHub power cycle (ie changes to 0 on a timeout or power cycle) Must be written to 1 or 2 to restart the link 2 = Transmission auto enabled after a link recovery or power cycle. After power on all commands changed to No Action. Then the PLC Timeout Action is taken. 10 = Modbus Slave for connection to PLC master
107	Link 2 Control	0-2	As above
108	Link 3 Control	0-2	As above
109	Link 4 Control	0-2	As above
110	Modbus TCPIP Port	502	Default for Modbus TCP/IP is 502. Changing this value causes an automatic restart of the ethernet port, this can be up to 4 seconds.
111	Ethernet Timeout time (ms)	0-65535	R/W. Ethernet Timeout time in ms. If no Ethernet message is received within this time then the Ethernet Timeout Action is taken. Must be non zero to enable this feature.

112	Ethernet Timeout Action	0-3	Only relevant if Link Control is set to 2 0 = Keep running 1 = Keep running and change all command to No Action. 2 = Keep running and change all commands to Stop. 3 = Stop the Gembus Comms. Set commands to No Action. Allows each Gemstart to take its own link fail action. On restart the PLC can update the commands. If Link Control is set to 1 the Commands are updated as above and Link Control is changed to 0 which stops Tx.
113	Define IP Address	0-1	Define how the IP address is obtained. 0 Get IP address from DHCP 1 Use the fixed IP details defined below Changing this value causes an automatic restart of the ethernet port, this can be up to 4 seconds.
114	Fixed IP Address byte 1	0-255	Only relevant if "Define IP Address" is set to 1. GembusHub address eg 192.168.1.2
115	Fixed IP Address byte 2	0-255	
116	Fixed IP Address byte 3	0-255	Changing this value when a fixed address is specified causes an automatic restart of the ethernet port, this can be up to 4 seconds.
117	Fixed IP Address byte 4	0-255	
118	Router Address byte 1	0-255	Only relevant if "Define IP Address" is set to 1. Router address eg 192.168.1.1 Messages not within the Net Mask are sent to the router.
119	Router Address byte 2	0-255	
120	Router Address byte 3	0-255	
121	Router Address byte 4	0-255	Changing this value when a fixed address is specified causes an automatic restart of the ethernet port, this can be up to 4 seconds.
122	Net Mask byte 1	0-255	Only relevant if "Define IP Address" is set to 1. The mask for the addresses on this network eg 255.255.255.0 Messages not within the Net Mask are sent to the router.
123	Net Mask byte 2	0-255	
124	Net Mask byte 3	0-255	
125	Net Mask byte 4	0-255	Changing this value when a fixed address is specified causes an automatic restart of the ethernet port, this can be up to 4 seconds.
126	Limit Client IP addresses		Allows the IP addresses that are allowed to connect to be limited. 0x0000 = All client IP address are accepted bit 0 set = Accept IP addresses in range 0 bit 1 set = Accept IP addresses in range 1 etc bit 15 set = Accept IP addresses in range 15 NB This is checked on each read write attempt

127	Range 0, Byte A	0-255	Only relevant if bit 0 of "Limit Client IP Addresses" is set. Range 0, The first to last addresses acceptable in the range A.B.C.D to A.B.C.E. eg 192.168.1.10 to 10 eg 192.168.1.10 to 19
128	Range 0, Byte B	0-255	
129	Range 0, Byte C	0-255	
130	Range 0, Byte D	0-255	
131	Range 0, Byte E	0-255	
132	Range 1, Byte A	0-255	Only relevant if bit 1 of "Limit Client IP Addresses" is set. Range 1, The first to last addresses acceptable in the range A.B.C.D to A.B.C.E.
133	Range 1, Byte B	0-255	
134	Range 1, Byte C	0-255	
135	Range 1, Byte D	0-255	
136	Range 1, Byte E	0-255	
	Etc		
202	Range 15, Byte A	0-255	Only relevant if bit 15 of "Limit Client IP Addresses" is set. Range 15, The first to last addresses acceptable in the range A.B.C.D to A.B.C.E.
203	Range 15, Byte B	0-255	
204	Range 15, Byte C	0-255	
205	Range 15, Byte D	0-255	
206	Range 15, Byte E	0-255	
207	LED Test	0-4	0: No testing 1: All six status LEDs Green 2: All six status LEDs Red 3: All six status LEDs Yellow 4: All six status LEDs cycle

5.2 GembusHub Info

These registers are read only.

Register	Description	Range	Comments
500	Version byte 1	1-4	1 is a development version 2 is a alpha site release 3 is a beta site release 4 is a full release
501	Version byte 2	60	60 Identifies GembusHub
502	Version byte 3	0-255	Major change count
503	Version byte 4	0-255	Minor change count. Reset after a major change.
504	Software Checksum (LSW)		Allows code verification against the release
505	Software Checksum (MSW)		paperwork
506	For future use		If writing to, write a 0 to maintain future compatibility
507	For future use		If writing to, write a 0 to maintain future compatibility
508-510	Mac Address	6 bytes of 0-255	Mac Address typically written in Hexadecimal eg 00-04-A3-12-34-56. Stored as: 0x0400, 0x12A3, 0x5634
511	Status flags		Bit 0: Date and time update required Bit 1: Network cable not present Bit 2: Ethernet Timeout Bit 3: Not used Bit 4: Bit 5: Bit 6: Bit 7: Bit 8: Bit 9: Bit 10: Bit 11: Bit 12: Bit 13: Bit 14: Bit 15:
512	More Status flags		Bits 0-3 are the same bits as register 1101. Bit 0: Port 1 Link Status = 0, no valid message received during scan = 1, valid message(s) received during scan Bit 1: Port 2 Link Status (see Port 1 Link Status) Bit 2: Port 3 Link Status (see Port 1 Link Status) Bit 3: Port 4 Link Status (see Port 1 Link Status) Bit 4: Bit 5: Bit 6: Bit 7: Bit 8: Bit 9:

			Bit 10: Bit 11: Bit 12: Bit 13: Bit 14: Bit 15:
513	Gemstart Hub IP Address		The IP address used for the GembusHub. This may have been allocated by the DHCP or have been fixed in the GembusHub settings.
514	Gemstart Hub IP Address		
515	Gemstart Hub IP Address		
516	Gemstart Hub IP Address		
517	Router IP address		The IP address of the router as defined in the fixed GembusHub settings or as informed by the DHCP.
518	Router IP address		
519	Router IP address		
520	Router IP address		
521	Net Mask		The Net Mask for this network as defined in the fixed GembusHub settings or as informed by the DHCP.
522	Net Mask		
523	Net Mask		
524	Net Mask		

525	Power LED		Each register is split into high and low bytes.
			Low byte:
			    0 = LED off
			    1 = Green - see high byte for number of flashes
			    2 = Yellow - see high byte for number of flashes
			    3 = Red - see high byte for number of flashes
			    4 = Slow 3 way cycle (1s each): G, Y, R
			    5 = Fast 3 way cycle (500ms each): G, Y, R
			    6 = 4 way cycle (500ms each): G, Y, R, Off
			    7 = 2 way cycle (500ms each): Y, G
			    8 = 2 way cycle (500ms each): Y, R
			High byte only applies if low byte is 1, 2 or 3:
			    0 = Solid colour
			    1 = Not used
			    2-10 = The number of flashes (300ms on, 200ms off, 1s between sequences)
			    11 = Slow flash (1s on, 1s off)
			    12 = Fast flash (100ms on, 100ms off)
			NB Not all options are used by GembusHub.

526	Network LED		
527	Gembus 1 LED		
528	Gembus 2 LED		
529	Gembus 3 LED		
530	Gembus 4 LED		

5.3   GembusHub Statistics

Write the registers to zero to reset them.

Register	Description	Range	Comments
600	Ethernet Tx Count	0-65535	
601	Ethernet Rx Count	0-65535	
602	Ethernet Tx Errors	0-65535	
603	Ethernet Rx Errors	0-65535	
604	Controlling device timeout	0-65535	Number of times that there has been no message from the PLC via the Ethernet port or a RS485 Modbus port for the PLC Control Timeout period. NB Only increments once for each loss of control
605	GembusHub Power On counter	0-65535	Retained and incremented after a power cycle.
606	GembusHub Watchdog count	0-65535	Increments every 100ms to confirm link connection
607	Run Time Errors		If incrementing then report back to supplier.
608	Modbus Format Errors		
609	Modbus Address Errors		
610	Modbus Length Errors		
611	Modbus CRC Errors		
612	Modbus Illegal Function Exceptions (Exception 1)		
613	Modbus Illegal Address Exceptions (Exception 2)		
614	Modbus Illegal Value Exceptions (Exception 3)		
615	Modbus Write Exceptions (Exception 4)		
616	Modbus Buffer Errors		
617	Modbus Replies		
618	Ethernet Invalid Clients Accesses		A client with an IP address not in the defined IP address range has accessed this device, The message was ignored.
619-622	The invalid IP address trying to access GembusHub		The invalid IP address trying to access GembusHub
623	Rejected Connection Port		The port the Invalid IP has tried to connect to. Normally this will be the Modbus port. Added in GembusHub version 4.60.1.10
624	Modbus TCP/IP Active connections		The number of Modbus connections that are currently active
625	Modbus TCP/IP Rx while Tx errors		Indicates that the client is not waiting for a reply before sending the next request
626	Modbus TCP/IP Total Connections		Increments each time a connection is made
627	Modbus TCP/IP Transmits		Number of messages transmitted
628	Modbus TCP/IP Retransmits		Number of messages that were not ACKed and had to be retransmitted
629	Modbus TCP/IP		Number of ACKed transmissions (and

	Total ACKs		retransmissions)
630	Modbus TCP/IP Receives		Number of messages received
631	Modbus TCP/IP Timeouts		Number of TCP/IP timeouts
632	Modbus TCP/IP Connections Closed		Number of times a connection has been closed
633	Modbus TCP/IP Connections Aborted		Number of times a connection has been aborted
634	Modbus TCP/IP New IPs		Number of times the IP address of GembusHub has been changed by the DHCP

6 Gembus Registers

These registers are repeated for each of the 4 ports. A different unit address (0x11-0x14) is used for each port (1-4).

If one or more of the RS485 ports is set to Modbus slave then the relevant data map will still be present but mostly not used or updated. Only the registers with a "Modbus Slave" description are valid. I.e. Baud Rate at address 1002 and the message counts at 1102 and 1103. All other registers are undefined.

6.1 Link Settings

Define the parameters for how the link operates. These settings are retained through a power cycle.

Register	Description	Range	Comments
1000	GembusHub Port Number	1-4	Read Only. Identifies the hardware port that is being configured. A write to this register with the wrong value will cause the whole message to be ignored. Retained through a power cycle.
1001	Gemstart Link Number	0-15	R/W. The id used to confirm the link number to Gemstart. The Gemstart address consists of the link number and the Gemstart number 00-99 eg 123 is Gemstart 23 on link 1. Links 10 to 15 are displayed as A to F on Gemstart. Retained through a power cycle.
1002	Baud Rate / 100	3, 6 , 12, 24, 48, 96, 192, 384	R/W. The baud rate divided by 100. Not all rates will be supported by every Gemstart. Pick a rate that is common to every Gemstart on the link. Eg 19200. Higher baud rates limit the link length. Retained through a power cycle. Set the highest baud rate that does not cause the Timeouts count (1106) to increment.
1003	First Gemstart Address	00-99	R/W. Define the scan range for this link of Gemstarts. Must be <= Last Gemstart Address Retained through a power cycle.
1004	Last Gemstart Address	00-99	R/W. Define the scan range for this link of Gemstarts. Must be >= First Gemstart Address Retained through a power cycle.
1005	Config Conflict Master	0-4	R/W. 0 = No master. A fault is flagged by Gemstart and must be resolved manually. 1 = Unit Master. The GembusHub configuration is updated from the Gemstart. 2 = Host (GembusHub) Master. The Gemstart configuration is updated from GembusHub. 3 = Host (GembusHub) Read Only. Any config changes received from the Gemstart are ignored and the GembusHub configuration is written back to Gemstart. 4 = Maintenance. Configuration is never supplied by GembusHub which avoids Configuration

Register	Description	Range	Comments
			conflicts. Configuration is read from Gemstart. Retained through a power cycle.
1006	No Reply Timeout Limit	0-255	R/W. This parameter contains the maximum fail count. I.e. The number of consecutive scans that a Gemstart does not reply before the unit is flagged as offline. The default value of 10 will be used if 0 entered. Retained through a power cycle.

6.1.1 Broadcast Control

Enable to get GembusHub to send a broadcast command as soon as the command is written to the command array. Not all Gemstarts will understand the broadcast command. Has the advantage of getting the command out to lots of Gemstarts as quickly as possible. Disadvantage is that it slows down the scan time slightly.

Retained through a power cycle.

Register	Description	Range	Comments
1007	Fast Command Broadcasts	0-1	R/W 0 = Disabled. 1 = Enabled. In this mode a broadcast message is sent when GembusHub detects a change in the command to any Gemstart. This reduces the time taken to get the command from the PLC to Gemstart. Gemstart 4.3 F6 and Gemstart 4.2 F4 or later action these messages.

6.1.2 Continuous Data Request Control

Define the amount of data to request from the Gemstarts. Reducing the amount of data speeds up the scan time. Reducing the data size will leave the old data unchanged unless the Gemstart goes off line. If is up to the process to ensure the all data used is reasonably fresh.

Retained through a power cycle.

Register	Description	Range	Comments
1008	Input Data Size Requested	0-3	Defines the size of the data requested from each Gemstart. Changing this does not affect the memory map size. Use a smaller size to reduce the Gemstart scan time. 0 = 2 status registers requested (Normal); 1 = 1 status register requested (Short); 2 = 3 status registers requested (Long); 3 = 8 status registers requested (Long + Grp10) This allows the data size required to be changed dynamically to speed up the link of needed without having to remap all the data.

6.2 Link Statistics

Write the registers to zero to reset them.

Register	Description	Range	Comments
1100	Configuration Error		0 = Ok 1 = Wrong port number written (previous settings restored) 2 = Gemstart link number out of range (previous settings restored) 3 = Baud rate out of range (9600 used) 4 = First Gemstart address out of range (0 used) 5 = Last Gemstart address out of range (99 used) 6 = Last Gemstart address not after first address (99 used) 7 = Config Conflict out of range (No master used) 8 = "No reply" timeout limit out of range (10 used)

1101	Link Status of all 4 Ports		Bits 0-3 are the same bits as register 512.
			Bit 0: Port 1 Link Status
			     = 0, no valid message received during scan
			     = 1, valid message(s) received during scan
			Bit 1: Port 2 Link Status (see Port 1 Link Status)
			Bit 2: Port 3 Link Status (see Port 1 Link Status)
			Bit 3: Port 4 Link Status (see Port 1 Link Status)

1102	Tx count (LSW) Modbus Slave: Rx Count		The number of messages transmitted.
1103	Tx count (MSW) Modbus Slave: Tx Count		
1104	CRC Errors		The number of corrupted replies.
1105	Last unit with CRC error		The address of the last reply that was corrupted.
1106	Timeouts		The number of short replies or no replies when a unit is online. No replies from offline units are ignored. (Does not include CRC errors)
1107	Last unit with Timeout error		The last unit to reply with a corrupted message or to not respond with a reply when it is online. No replies from offline units are ignored.
1108	Number of Gemstart replies in scan		The number of good replies received during the last scan
1109	Last Scan Time		Scan time in ms
1110	Average Scan Time		Weighted average scan time in ms
1111	Max Scan Time		Max scan time in ms since setting was last reset.

6.3 Gemstart Status Flags

Read only status bits accessible via registers. Each register contains 16 flags with 1 flag per Gemstart.
NB The Config Changed, Data Changed and Link Control flags are all cleared on reading. If two or more clients are reading these flags then only one of the clients will see a flag set. The use of these flags should therefore be considered carefully.

Register	Description	Range	Comments
1200 to 1206	Online flag		100 bits, 1 bit per Gemstart. 16 bits per register. Bit 0 of register 1300 is for Gemstart 0. Bit 2 of register 1306 is for Gemstart 99.
1207 to 1213	Config changed flags		100 bits, 1 bit per Gemstart. 16 bits per register. Set if the configuration for a unit has been changed by Gemstart. Reset on reading these flags,
1214 to 1220	Data changed flags		100 bits, 1 bit per Gemstart. 16 bits per register. Set if the contactor has changed state or if the fault present flag has changed. Reset on reading these flags,
1221	Link Control flags		Bit 0. Set when an immediate Group Control message has been sent. Reset on reading these flags, Bit 1. Set when Single Data Request has completed (may be successful or with error). Reset on reading these flags, Bit 2. Set when a fast command broadcast has been sent. Reset on reading these flags.

6.4 Link Controls

The Link Control Registers are a block of parameters used to provide data exchange facilities under the PLC program control. Separate control registers are available for Group Control and Data Request.

The Link Control registers are reset to zero by a power cycle.

6.4.1 Group Control

The group control register allows a group of Gemstarts to be started and stopped at the same time with a single broadcast command. If bit 15 is set then when the register changes a broadcast command is sent immediately. The group command is also send in every restart message regardless of the state of bit 15.

Register	Description	Range	Comments
1300	Group Control		Bits 0-3: Gemstart command Bit 8: Group 1 flag. When set the Group 1 Gemstarts will use the command in bits 0-3. Bits 9-14: As bit 8 but for groups 2 to 7. Bit 15. Send immediately.
1301	For future use		If writing to, write a 0 to maintain future compatibility
1302	For future use		If writing to, write a 0 to maintain future compatibility

6.4.2 Single Data Request

Set the Target Address and Target Data Type in the same write message. Then read the Link Control Operations flags and/or read the Request Status. Once the Request Status is "Completed" the Requested Data Address, Type, Data and length will be valid. NB It's ok to read the Request Status and the Requested Data area in a single message and use the Requested Data if the Request Status is completed.

Writing to the Target Address and/or Target Data Type will always restart the request cycle.
Registers 1306 to 1319 will be set to 0 as soon as a request is started and will only become valid when the Request Status changes to Completed.

Register	Description	Range	Comments
1303	Target Address	0-99	The address of the unit to be read
1304	Target Data Type	0-10	Data type to request: 0 Static Data 1 Group Data 1 2 Group Data 2 3 Group Data 3 4 Group Data 4 5 Group Data 5 6 Group Data 6 7 Group Data 7 8 Group Data 8 9 Group Data 9 10 Group Data 10
1305	Request Status		Read only. Automatically changes to 1, Busy, when Target Address or Target Data Type are written to. 0 No data requested 1 Busy 2 Completed (the following 13 registers are valid) 3 Unit Not Present 4 Request failed 7 Target outside scan range 8 Request timed out
1306	Requested Data Address		Read only. The address of the unit that supplied the data
1307	Requested Data Type		Read only. The type of data supplied by the Gemstart. The same codes as for the Data Request Type are used.
1308 to 1318	Requested Data		Read only. Up to 11 registers of data depending on the request type. Static data uses 11 registers and Group data uses 5 registers. Unused registers are written to 0.
1319	Requested Data Length	0 - 11	Read only. The number of registers (1308 to 1318) updated with data from the Gemstart. The remaining registers will have been zeroed. Added in GembusHub version 4.60.1.10

Timing

A Single Data Request is only sent out on "even" scans i.e. every other scan. Gemstart will reply with the data on the next scan. The data is immediately available in the registers.

      Best Case Timing   1 scan (see 1110)

      Worst Case Timing   3 scans (see 1110)

6.5 Output Command Array

One register per Gemstart.
The Output Command registers are reset to 0x03, No Action, after a power cycle.

Register	Description	Range	Comments
2000	Output command for Gemstart 0		See the Gemstart manual for a definition of the command register. Bits 0-3 sent in the command message. If bits 8 to 15 are non zero they are sent in an additional data byte added to the message.
To			
2099	Output command for Gemstart 99		

After issuing a command the controlling device should set the command register to 0x03 after a small delay, or when feedback confirms that the command has been actioned.

6.6 Input Data Array

Eight registers per Gemstart are allocated. The amount of data read from each Gemstart is defined in the Continuous Data Request setting. All 8 registers are cleared out and the Not Responding status (1) is loaded into the status word if the Gemstart goes offline. Other than that any old data is not cleared out if the Continuous Data request size is reduced. It is up to the application to ensure that old data is not assumed to be current.

To allow for easy access to useful data there are a number of address maps that can be used to read selective data from the Input data.

From 3000 length 800 – the full data map of all the data from all the Gemstarts.
From 3800 length 100 – the Status Word for each of the Gemstarts
From 3900 length 100 – the Load Word for each of the Gemstarts
From 4000 length 100 – the Fault Code for each of the Gemstarts
From 4100 length 200 – the Status Word and Load Value for all 100 Gemstarts
From 4300 length 300 – the Status Word, Load Value and Fault Code for all 100 Gemstarts

All status registers are read only.

Register	Description	Range	Comments
3000	Gemstart 0 Status Word		
3001	Gemstart 0 Load Value		
3002	Gemstart 0 Fault Code		
3003	Gemstart 0 Group 10 Word 1		
3004	Gemstart 0 Group 10 Word 2		
3005	Gemstart 0 Group 10 Word 3		
3006	Gemstart 0 Group 10 Word 4		
3007	Gemstart 0 Group 10 Word 5		
3008-3015	Gemstart 1 Data		
Etc			
3792 3799	Gemstart 99 Data		

Register	Description	Range	Comments
3800	Gemstart 0 Status Word		
3801	Gemstart 1 Status Word		
Etc			
3899	Gemstart 99 Status Word		

Register	Description	Range	Comments
3900	Gemstart 0 Load Value		
3901	Gemstart 1 Load Value		
Etc			
3999	Gemstart 99 Load Value		

Register	Description	Range	Comments
4000	Gemstart 0 Fault Code		
4001	Gemstart 1 Fault Code		
Etc			
4099	Gemstart 99 Fault Code		

Register	Description	Range	Comments
4100	Gemstart 0 Status Word		
4101	Gemstart 0 Load Value		
4102	Gemstart 1 Status Word		
4103	Gemstart 1 Load Value		
Etc			
4298	Gemstart 99 Status Word		
4299	Gemstart 99 Load Value		

Register	Description	Range	Comments
4300	Gemstart 0 Status Word		
4301	Gemstart 0 Load Value		
4302	Gemstart 0 Fault Code		
4303	Gemstart 1 Status Word		
4304	Gemstart 1 Load Value		
4305	Gemstart 1 Fault Code		
Etc			
4597	Gemstart 99 Status Word		
4598	Gemstart 99 Load Value		
4599	Gemstart 99 Fault Code		

As it is not always clear how many status registers have been updated the next set of registers tells you how many registers were written on the last successful update. The value is cleared to 0 if the unit goes offline.

Register	Description	Range	Comments
4600	Gemstart 0 registers written	0,1,2,3 or 8	Confirms the amount of data being written to the status registers.
4601	Gemstart 1 registers written		
Etc			
4699	Gemstart 99 registers written		

6.7 Configuration Data

One Gemstart's configuration is 128 registers long but only 123 registers can be read at a time. Removing the change count bytes from the configuration allows the configuration to be read as 120 registers. You must read the whole configuration for one and only one Gemstart at one time.

The register address's increase by 1 for each Gemstart. So reading address 5000 length 120 gets all of Gemstart 0's configuration. Read from address 5010 and get all of Gemstart 10's configuration. Reading length 121 will return the configuration data and the CRC register.

Writing 120 registers of config to GembusHub will update Gemstart if it is present. Writing config will clear a Config Conflict.

Writing to the configuration registers with all zeroes will cause GembusHub to requests the configuration from Gemstart. It will take 36 Gemstart scans to read the configuration from Gemstart. Read the change counts to monitor progress. When all 16 change counts are all non zero then the configuration has been read.

The configuration data for all 400 Gemstarts is retained in GembusHub through a power cycle.

Register	Description	Range	Comments
5000	Gemstart 0 Config		Read length 120 registers to get 16 pages of 15 bytes each. Read length 121 registers to get the CRC as well.
5001	Gemstart 1 Config		As above
	Etc		As above
5099	Gemstart 99 Config		As above

6.7.1 Config CRCs

Read from register 5100 to 5199 to get some or all of the Config CRCs. This CRC value should match the value displayed on GEMPRO or the HHP. Writing to the Config CRCs is not allowed. The Config CRCs are retained through a power down.

5100	Gemstart 0 Config CRC		The CRC of bytes 0 to 14 of pages 0 to 14 of the configuration area. Should be the same value displayed by the HHP/GEMPRO.
5101	Gemstart 1 Config CRC		As above
	Etc		As above
5199	Gemstart 99 Config CRC		As above

6.7.2 Configuration Change Counts

Read from address 5200 to 5999 to get the change counts for each Gemstart. There are 16 changes count bytes packed into 8 registers for each Gemstart. Gemstart 0 starts at address 5200, Gemstart 1 at address 5208 etc. You cannot write to the Change Counts registers. The Change Counts are retained through a power down.

5200 to 5207	Gemstart 0 Config Change Counts		Read 8 registers to get the 16 change counts for 1 Gemstart.
5208 to 5215	Gemstart 1 Config Change Counts		As above
	Etc		As above
5992 to 5999	Gemstart 99 Config Change Counts		As above

6.7.3 Gemstart Type

GembusHub's best guess as to what type of Gemstart the loaded configuration belongs to. If it can't determine which type of Gemstart it is the EPROM number is shown. Read only registers.
Note: Only updated when page 15 of the config is read from the Gemstart.

6000	Gemstart 0 Type	The type of Gemstart configuration. 0 = Unknown 10 = Gemstart 1 20 = Gemstart 2 30 = Gemstart 3 31 = Enhanced Gemstart 3 41 = Gemstart 4.2 42 = Gemstart 4.2E 43 = Gemstart 4.3 50 = Gemstart 5 If the Gemstart type cannot be determined but there is an EPROM number present (GS4 or GS5 config) then the 4 digit EPROM number is returned in this location.
6001	Gemstart 1 Type	
		As Above
6099	Gemstart 99 Type	

6.8 Development Data

Data useful for debugging faults during and after development. These may be indications of unusual occurrences or unexpected values encountered by the code etc. It is not expected that these tables will normally be accessed. If read then access using station address 16.

Register	Description	Comments
7000	Run Time indication count	Indication of how many run time indications are occurring
7001	Run Time indication line number	The line number in the file of the run time indication
7002-7009	Run Time indication file name	Up to 16 characters of the file name for the last run time indication.

6.9 Scratchpad

A free area of 512 non-volatile registers on device 16, address 9000 is available for general useage. Any data written to these registers will be maintained across a power cycle. Data can be read and written freely although registers that will change more that 1 million times should be avoided as the non-volatile ram may start to fail.

Register	Description	Comments
9000 to 9511	For general data storage	Non-volatile scratchpad memory. Not used by GembusHub but made available for attached devices to freely read and write any data required.