Modbus RTU Serial and TCP/IP Communication Specification for Pakscan Master Stations with P3 Wireless modules fitted

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As we are continually developing our products their design is subject to change without notice.

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1. MASTER STATION MODBUS ADDRESSING

The addition of the Pakscan 3 wireless module has introduced a new database to the Pakscan master station, this database is only for the wireless components of a Pakscan P3 system. For details of the database for the 2 wire loop components of the system, refer to the full PUB059-003 (formally S171) publication.

1.1 Modbus addressing

When addressing the P3 master station using a Modbus host, the user must use the appropriate Modbus address. It is possible to fit up to 2 network option cards to the P3 master station, each option card will have its own Modbus address, therefore there are up to 2 Modbus addresses to set up, one for each option module fitted. In a system with only 1 option card fitted only the address for the appropriate option module fitted is required to be set up.

As an example, in a 2 option system, on the P3 'configuration' webpage the 2 addresses will appear as follows:

Fig 1: Web page View Configuration – Modbus address

The addresses can be changed in the admin section of the web pages, using the Master Station Config web page. 'Option 1 Modbus address' will refer to the option module fitted in the Option 1 slot and 'Option 2 Modbus address' will refer to the option module fitted in the Option 2 slot.

The Modbus addresses can also be changed using the HMI, by navigating through the settings and Host setting pages to the Modbus address page. In this page the 'Pakscan3 Modbus Address' will be for the Wireless module and the 'Pakscan2 Modbus Address' will be for the current loop module.

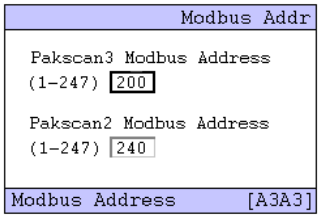

Fig 2: HMI settings – Modbus address

In the example below, which is a mixed wireless and wired system:

Option 1 (ringed in red) is a wireless module : Modbus address would be 200

Option 2 (ringed in Blue) is a 2 wire loop module: Modbus address would start at 240

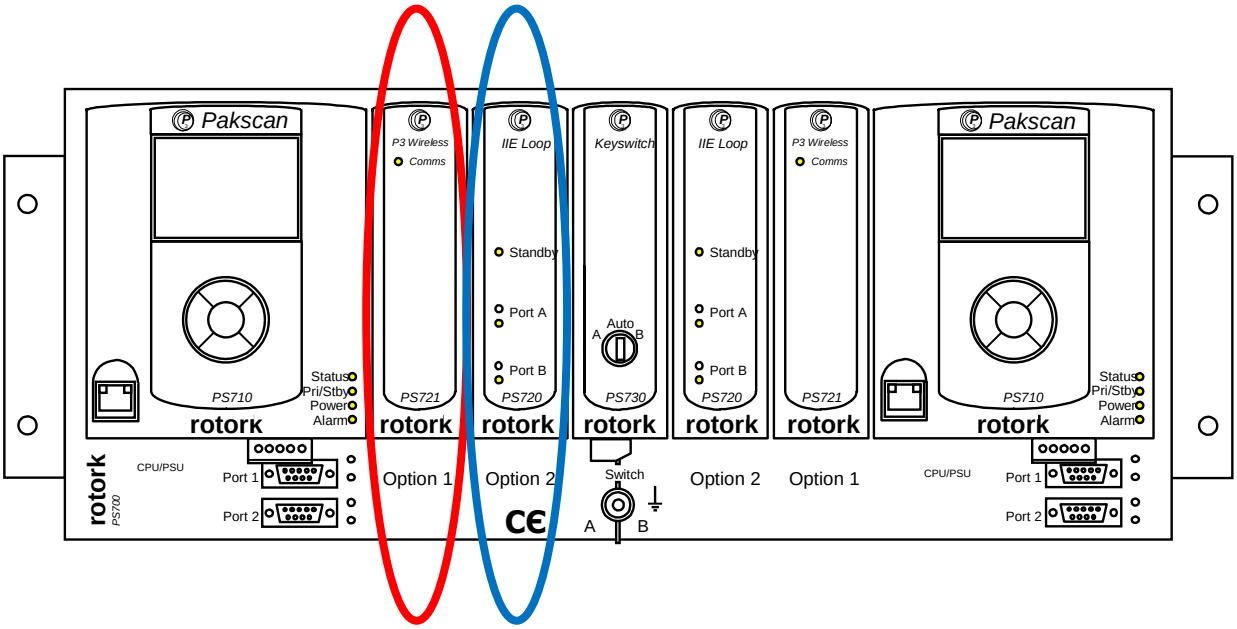

Fig 3: Locations of option 1 and option 2

Note that the 2 wire network Modbus address is a 'base address'. Depending on the number of field units available and the database chosen there may be 4 addresses relating to the 2 wire loop. For example in a 2 wired network where there are 120 field units possible on the network, if the base address were 240:

to address field units 1-60 : Modbus address 240 is used

to address field units 61-120 : Modbus address 241 is used

Refer to the full PUB059-003 publication for more details.

The wireless network database is formatted such that one Modbus address is used to access all devices on the wireless network. It is possible to communicate to 60 wireless actuator field units into a master station, these 60 devices can have 60 consecutive address within the range 1 to 300. The addresses given would depend on the set up of the complete system. For example, if the system has capabilities to have 300 devices attached and 240 will be fitted to a wired network card in slot 2, then slot 1 can have 60 devices fitted. Because the 2 wire network requires that its devices start with address 1, this network will utilise field unit addresses 1 to 240. The devices on the wireless network card will occupy field device addresses 241 to 300.

Of course if the system is only wireless, then the addresses 1 – 60 would logically be used.

1.2 Wireless database format

The wireless data base has been set up to access the field unit data in 2 orientations. Format one is where the data is accessed '**Left to Right**' and Format 2 is '**Top to Bottom**'.

In the case of format 1, the register value is incremented by 1 with the field unit address, for example in block 4 input register 1, or 'Actuator Status Flags 1':

Field unit 1 = modbus register 401
Field unit 2 = modbus register 402
Field unit 3 = modbus register 403
.....
Field unit 300 = modbus register 700

Actuator Type	Data location			
IQ / IQT	FCU1	FCU2	to	FCU 300
Actuator Status Flags 1	401	402	-	700

Therefore, it is possible to access the Actuator Status Flags for field units 1 from 10 with one multiple read from register 401 for 10 registers.

But, if you wanted to read the Actuator Status Flag 1 and 2 for a particular field unit address, in this format you would need to do 2 separate reads, for example for field unit 1 you would need to read register 401 and then register 701.

Format 1 is useful where all the general alarm bits of all the actuators in a network were required to be read, for a 50 actuator network the user would send the following Modbus request to a master station with address 200:

C8 03 55 F1 00 3C 14 7D (Holding register read from register 22001 for 60 registers)

Whereas, in the case of format 2, the register value is incremented by 1 for the next register reporting different data. For example in block 6, it can be seen that it is possible to read all the input registers from a particular field unit using one multiple register read. For example to read the 3 Actuator Status Flag registers and the 2 Actuator Alarm Flag registers for field unit 1, the following command would be sent for a master station with address 200:

C8 03 13 89 00 05 41 3E (holding register read from register 5001 for 5 registers)

Actuator Type	Data location
IQ	FCU1
Actuator Status Flags 1	5001
Actuator Status Flags 2	5002
Actuator Status Flags 3	5003
Actuator Alarm Flag 1	5004
Actuator Alarm Flag 2	5005

2. MASTER STATION REGISTERS

2.1 MASTER STATION READ ONLY REGISTERS

This set of read only registers contain information about the master station in general, for example it status. All the location numbers listed are decimal numbers and zero based.

Table 1 - Master Station read only data

BLOCK 0 – Master station Read Only data (accessed with Modbus function code 03 or 04)			Register Location
Parameter – System Status and Alarm			0 (361)
	Bit 0	Ethernet Alarm (an Ethernet cable has been removed)	
	Bit 1	Presence of ESD	
	Bit 2	Any Alarm (same as CPU relay and alarm ESD)	
	Bit 3	Option 1 module fitted	
	Bit 4	Option 1 module alarm	
	Bit 5	Option 2 module fitted	
	Bit 6	Option 2 module alarm	
	Bit 7	Host port RTU 1 activity	
	Bit 8	Host port RTU 2 activity	
	Bit 9	Host port ETH activity	
	Bit 10	Location – A / B (A = 1, B = 0)	
	Bit 11	Reserved	
	Bit 12	Reserved	
*	Bit 13	Redundancy option (hot standby = 1)	
	Bit 14	Primary / Standby (Primary = 1)	
*	Bit 15	Other Master station in Alarm, only if Hot standby (Alarm = 1)	
Parameters - Field unit status registers (1 register per field unit)			1 - 300
	Bits 0-7	Actuator type (Value 6 = IQ / Value 8 = IQT) VALUE 6 or 8	
	Bit 8	Field unit detected	
	Bit 9	Field unit Communications fail	
	Bit 10	Field unit alarm	
	Bit 11	Field unit command not acknowledged	
	Bit 12	AES (Advanced Encryption Standard) key OK	
	Bit 13	Alternate route for communications available	
	Bits 14-15	Reserved	
Parameter - Master station config			362
	Bit 0	Third party devices fitted	
	Bit 1	Monitoring wireless and control wired (on = 1 / off = 0)	
Parameter – Total number of field units that the P3 system is able to access			363
		Data = value 32, 60, 120, 180, 240, 300	
Parameter – Extra options fitted			364
		Data = 0 (none), 1 (Long Term Datalogger)	

Note: data bits marked * are not relevant to single channel mater stations

2.2 MASTER STATION WRITE ONLY REGISTERS

Only a few master station registers will accept 'writes' from a Modbus host. All except those listed below will return an error code. The 'written' data may be any value (except zero) to achieve the desired action. The master station considers all writes to be to registers, even when a coil function code command is used.

Table 2 - Master Station Write data

BLOCK 1 – Master Station Write data (accessed with Modbus function codes 05, 06, 15, 16)	Register Location
Parameter – Network option 1 ESD Data = any non-zero value to send ESD	301
Parameter – Network option 2 ESD Data = any non-zero value to send ESD	331
Parameter – Change main to standby and vice versa Data = any non-zero value to send change over command	360

Note: alarms are not latched; therefore it is not necessary to accept alarms as would be the case for the current loop database.

3. MASTER STATION OPTION MODULE REGISTERS

The block following contains data relating to the network cards in Option slot 1 and 2. It should again be noted that this database is ONLY for wireless options, therefore this data only relates to wireless options fitted in either (or both) the Option 1 and 2 slots. IF one of the Option slots contains a 2 wire option card, the data for that card is accessed using the 2 wire database – refer to PUB059-003 (formally S171) for information relating to that option.

Table 3 - Network option card Read Only data

BLOCK 2 – Network option card Read Only data (accessed with Modbus function codes 03 or 04)	Network in slot 1 Register Locations	Network in slot 2 Register Locations
Parameter – Network type Data: 0 = None 1 = Wireless 2 = reserved 3 = Pakscan2	302	332
Parameter – Network software version number Bits 0-3 Minor Software version number Bits 4-7 Middle Software version number Bits 8-15 Major software version number Example: value = 0137, software version = 1.3.7	303	333
Parameter - Network channel capacity Data = 0, 60, 120, 180, 240, 300	304	334
Parameter - Network general configuration bits Bit 0 Retain data on communications fail	305	335
Parameter - Network third party presence registers Bits 0-46 Representing Modbus addresses 201 - 247, 1 = address is a third party device for this option. Must be exclusive with other option. Bit 0 represents address 201 Bit 1 represents address 202 ..... Bit 46 represents address 247 Bits 47-48 Reserved	306/307/308	336/337/338
Parameter - Network Field unit Lowest address For example: Data = 1, 61, 121, 181, 241	309	339
Parameter - Network Number of Field units expected Data = range 1-300	310	340
Parameter - Network Number of Field units detected Data = range 1-300	311	341
Parameter - Network Status Bit 0 Configuration in Progress Bit 1 Network Healthy Bit 2 At least 1 field unit is in Alarm Bit 3 At least 1 field unit is in communications fail Bit 4 ESD mode Bit 5 Internal module 'Watchdog' Bit 6-15 Reserved	312	342

Parameter - Network status		313	343
16 bit register split into 2 separate 8 bit registers:			
Bits 0-7	8 bit Register		
Value 1	Un-initialised		
Value 2	Initialised / starting up		
Value 3	Detecting field units		
Value 4	Building map of field units		
Value 5	Detecting field units complete		
Value 6	Obtaining initial field unit data		
Value 7	Field unit data collection complete		
Value 8	Network Ready to run		
Value 9	Master station updating RF parameters		
Value 10	Re-programming Coordinator		
Value 11	Coordinator re-program complete		
Bits 8-15	8 bit Register		
Value 1	Reset occurred		
Value 2	Reset command received		
Value 3	Parameter change caused coordinator reset		
Value 4	RF Parameter change caused coordinator reset		
Parameter - Network Fault		314	344
Bit 0	Wireless Co-ordinator communications fault (active side)		
Bit 1	Wireless Co-ordinator communications fault (passive side)		
Bit 2	Insufficient neighbours (for the wireless coordinator)		
Bit 3	Insufficient neighbours (for a router)		
Bit 4	RF parameter change failed		
Bit 5	Last broad cast message failed		
Bit 6	Duplicate Field unit address detected		
Bit 7 - 15	Reserved		
Parameter - (Reserved)		315 - 330	345 - 359

4. FCU Read Data

Table 4 - FCU digital Read Only data: Input Register 1

BLOCK 4 **FCU Digital Read Only Data** **(FORMAT 1 - Left to Right)**		Actuator Type	Data location			
		IQ / IQT	FCU1	FCU2	to	FCU 300
			Register Location **(accessed with Modbus function code 03 or 04)**			
Input Register 1	RO	Actuator Status Flags 1	401	402	-	700
			Discrete location **(accessed with Modbus function code 02)**			
Bit 0	RO	Reserved	101	102	-	400
Bit 1	RO	Reserved	401	402	-	700
Bit 2	RO	Reserved	701	702	-	1000
Bit 3	RO	Reserved	1001	1002	-	1300
Bit 4	RO	Reserved	1301	1302	-	1600
Bit 5	RO	Reserved	1601	1602	-	1900
Bit 6	RO	Reserved	1901	1902	-	2200
Bit 7	RO	Reserved	2201	2202	-	2500
Bit 8	RO	Digital Input 1	2501	2502	-	2800
Bit 9	RO	Digital Input 2	2801	2802	-	3100
Bit 10	RO	Digital Input 3	3101	3102	-	3400
Bit 11	RO	Digital Input 4	3401	3402	-	3700
Bit 12	RO	Reserved	3701	3702	-	4000
Bit 13	RO	Reserved	4001	4002	-	4300
Bit 14	RO	Reserved	4301	4302	-	4600
Bit 15	RO	Reserved	4601	4602	-	4900

Table 5 - FCU digital Read Only data: Input Register 2

BLOCK 4 (continued) **FCU Digital Read Only Data** **(FORMAT 1 - Left to Right)**		Actuator Type	Data location			
		IQ / IQT	FCU1	FCU2	to	FCU 300
			Register Location **(accessed with Modbus function code 03 or 04)**			
Input Register 2	RO	Actuator Status Flags 2	701	702	-	1000
			Discrete location **(accessed with Modbus function code 02)**			
Bit 0	RO	Local Stop selected	4901	4902	-	5200
Bit 1	RO	Reserved	5201	5202	-	5500
Bit 2	RO	Torque Trip open active	5501	5502	-	5800
Bit 3	RO	Torque Trip close active	5801	5802	-	6100
Bit 4	RO	Slow mode active	6101	6102	-	6400
Bit 5	RO	Interrupter timer active	6401	6402	-	6700
Bit 6	RO	Motion Inhibit timer active	6701	6702	-	7000
Bit 7	RO	Stopped mid travel	7001	7002	-	7300
Bit 8	RO	Motor Running	7301	7302	-	7600
Bit 9	RO	Moving Open	7601	7602	-	7900
Bit 10	RO	Moving Closed	7901	7902	-	8200
Bit 11	RO	Close limit reached	8201	8202	-	8500
Bit 12	RO	Open Limit reached	8501	8502	-	8800
Bit 13	RO	Centre Column moving	8801	8802	-	9100
Bit 14	RO	Remote selected	9101	9102	-	9400
Bit 15	RO	local selected	9401	9402	-	9700

Table 6 - FCU digital Read Only data: Input Register 3

BLOCK 4 (continued) **FCU Digital Read Only Data** **(FORMAT 1 - Left to Right)**		Actuator Type	Data location			
		IQ / IQT	FCU1	FCU2	to	FCU 300
			Register Location **(accessed with Modbus function code 03 or 04)**			
Input Register 3	RO	Actuator Status Flags 3	1001	1002	-	1300
			Discrete location **(accessed with Modbus function code 02)**			
Bit 0	RO	ESD Active	9701	9702	-	10000
Bit 1	RO	Reserved	10001	10002	-	10300
Bit 2	RO	Reserved	10301	10301	-	10600
Bit 3	RO	Reserved	10601	10602	-	10900
Bit 4	RO	Reserved	10901	10902	-	11202
Bit 5	RO	Reserved	11201	11202	-	11500
Bit 6	RO	Reserved	11501	11502	-	11800
Bit 7	RO	Reserved	11801	11802	-	12100
Bit 8	RO	Relay 1 Status	12101	12102	-	12400
Bit 9	RO	Relay 2 Status	12401	12402	-	12700
Bit 10	RO	Relay 3 Status	12701	12702	-	13000
Bit 11	RO	Relay 4 Status	13001	13002	-	13300
Bit 12	RO	Relay 5 Status	13301	13302	-	13600
Bit 13	RO	Relay 6 Status	13601	13602	-	13900
Bit 14	RO	Relay 7 Status	13901	13902	-	14200
Bit 15	RO	Relay 8 Status	14201	14202	-	14500

Table 7 - FCU digital Read Only data: Input Register 4

BLOCK 4 (continued) **FCU Digital Read Only Data** **(FORMAT 1 - Left to Right)**		Actuator Type	Data location			
		IQ / IQT	FCU1	FCU2	to	FCU 300
			Register Location **(accessed with Modbus function code 03 or 04)**			
Input Register 4	RO	Actuator Alarm Flag 1	1301	1302	-	1600
			Discrete location **(accessed with Modbus function code 02)**			
Bit 0	RO	Manual movement to open limit by hand	14501	14502	-	14800
Bit 1	RO	End of travel movement	14801	14802	-	15100
Bit 2	RO	Actuator has stalled	15101	15102	-	15400
Bit 3	RO	Monitor relay active	15401	15402	-	15700
Bit 4	RO	Internal watchdog tripped	15701	15702	-	16000
Bit 5	RO	Battery Low	16001	16002	-	16300
Bit 6	RO	Battery Flat	16301	16302	-	16600
Bit 7	RO	Configuration updated	16601	16602	-	16900
Bit 8	RO	Configuration error	16901	16902	-	17200
Bit 9	RO	Thermostat tripped	17201	17202	-	17500
Bit 10	RO	Valve Obstructed	17501	17502	-	17800
Bit 11	RO	Valve jammed	17801	17802	-	18100
Bit 12	RO	Manual movement	18101	18102	-	18400
Bit 13	RO	Manual movement in closed direction	18401	18402	-	18700
Bit 14	RO	Manual movement in open direction	18701	18702	-	19000
Bit 15	RO	Manual movement to close limit by hand	19001	19002	-	19300

Table 8 - FCU digital Read Only data: Input Register 5

BLOCK 4 (continued) **FCU Digital Read Only Data** **(FORMAT 1 - Left to Right)**		Actuator Type	Data location			
		IQ / IQT	FCU1	FCU2	to	FCU 300
			Register Location **(accessed with Modbus function code 03 or 04)**			
Input Register 5	RO	Actuator Alarm Flag 2	1601	1602	-	1900
			Discrete location **(accessed with Modbus function code 02)**			
Bit 0	RO	Comms loss	19301	19302	-	19600
Bit 1	RO	Loss of Phase	19601	19602	-	19900
Bit 2	RO	Reserved	19901	19902	-	20200
Bit 3	RO	Control alarm	20201	20202	-	20500
Bit 4	RO	Position sensor fault	20501	20502	-	20800
Bit 5	RO	Torque sensor fault	20801	20802	-	21100
Bit 6	RO	Torque tripped mid travel	21101	21102	-	21400
Bit 7	RO	Local signal held	21401	21402	-	21700
Bit 8	RO	Datalogger updated	21701	21702	-	22000
Bit 9	RO	General Alarm	22001	22002	-	22300
Bit 10	RO	Valve alarm	22301	22302	-	22600
Bit 11	RO	Actuator alarm	22601	22602	-	22900
Bit 12	RO	Network Card fault	22901	22902	-	23200
Bit 13	RO	Reserved	23201	23202	-	23500
Bit 14	RO	Control Contention	23501	23502	-	23800
Bit 15	RO	Mains fault	23801	23802	-	24100

Table 9 - FCU digital Read Only data: Input Register 6

BLOCK 4 (continued) **FCU Digital Read Only Data** **(FORMAT 1 - Left to Right)**		Actuator Type	Data location			
		IQ / IQT	FCU1	FCU2	to	FCU 300
			Register Location **(accessed with Modbus function code 03 or 04)**			
Input Register 6	RO	Reserved	1901	1902	-	2200
			Discrete location **(accessed with Modbus function code 02)**			
Bits 0 -15	RO	Reserved	24101	24102	-	28900

Table 10 - FCU digital Read Only data: Input Registers 7 and 8

BLOCK 4 (continued) **FCU Digital Read Only Data** **(FORMAT 1 - Left to Right)**		Actuator Type	Data location			
		IQ / IQT	FCU1	FCU2	to	FCU 300
			Register Location **(accessed with Modbus function code 03 or 04)**			
Input Register 7	RO	Reserved	2201	2202	-	2500
Input Register 8	RO	Reserved	2501	2502	-	2800

Table 11 - FCU analogue Read Only data: Input Registers 9 and 10

BLOCK 5 **FCU analogue Read Only Data** **–FORMAT 1 (Left to Right)**		Actuator Type	Data location			
		IQ / IQT	FCU1	FCU2	to	FCU 300
			Register Location **(accessed with Modbus function code 03 or 04)**			
Input Register 9	RO	Actuator Torque 0 – 1200 (0.0% – 120.0%)	2801	2802	-	3100
Input Register 10	RO	Actuator Position 0 – 10000 (0.00% - 100.00%)	3101	3102	-	3400

Table 12 - FCU digital Read Only data: Input Registers 1 to 8 (Format 2)

BLOCK 6 **FCU Digital Read Data** **–FORMAT 2 (Top to Bottom)**		Actuator Type	Data location			
		IQ / IQT	FCU1	FCU2	to	FCU 300
			Register Location **(accessed with Modbus function code 03 or 04)**			
Input Register 1	RO	Actuator Status Flags 1	5001	5031	-	13971
Input Register 2	RO	Actuator Status Flags 2	5002	5032	-	13972
Input Register 3	RO	Actuator Status Flags 3	5003	5033	-	13973
Input Register 4	RO	Actuator Alarm Flag 1	5004	5034	-	13974
Input Register 5	RO	Actuator Alarm Flag 2	5005	5035	-	13975
Input Register 6	RO	Reserved	5006	5036	-	13976
Input Register 7	RO	Reserved	5007	5037	-	13977
Input Register 8	RO	Reserved	5008	5038	-	13978

See Block 4 for details of the contents of these registers.

Table 13 - FCU analogue Read Only data: Input Registers 9 and 10 (Format 2)

BLOCK 7 **FCU Analogue Read Data** **–FORMAT 2 (Top to Bottom)**		Actuator Type	Data location			
		IQ / IQT	FCU1	FCU2	to	FCU 300
			Register Location **(accessed with Modbus function code 03 or 04)**			
Input Register 9	RO	Actuator Torque 0 – 1200 (0.0% – 120.0%)	5009	5039	-	13979
Input Register 10	RO	Actuator Position 0 – 10000 (0.00% - 100.00%)	5010	5040	-	13980

Table 14 - FCU digital Read Only data: Input registers 1 to 6 (Format 2)

BLOCK 8 FCU digital Read Data –FORMAT 2 (Top to Bottom)		Actuator Type IQ / IQT	Data location FCU1	FCU2	to	FCU300
			Discrete location **(accessed with Modbus function code 02)**			
Input Register 1	RO	Actuator Status Flags 1				
Bit 0	RO	Digital Output 1	28901	28997	-	57605
Bit 1	RO	Digital Output 2	28902	28998	-	57606
Bit 2	RO	Digital Output 3	28903	28999	-	57607
Bit 3	RO	Digital Output 4	28904	29000	-	57608
Bit 4	RO	Digital Output 5	28905	29001	-	57609
Bit 5	RO	Digital Output 6	28906	29002	-	57610
Bit 6	RO	Digital Output 7	28907	29003	-	57611
Bit 7	RO	Digital Output 8	28908	29004	-	57612
Bit 8	RO	Digital Input 1	28909	29005	-	57613
Bit 9	RO	Digital Input 2	28910	29006	-	57614
Bit 10	RO	Digital Input 3	28911	29007	-	57615
Bit 11	RO	Digital Input 4	28912	29008	-	57616
Bit 12	RO	Digital Input 5	28913	29009	-	57617
Bit 13	RO	Digital Input 6	28914	29010	-	57618
Bit 14	RO	Digital Input 7	28915	29011	-	57619
Bit 15	RO	Digital Input 8	28916	29012	-	57620
Input Register 2	RO	Actuator Status Flags 2				
Bit 0	RO	Local Stop selected	28917	29013	-	57621
Bit 1	RO	Reserved	28918	29014	-	57622
Bit 2	RO	Torque Trip open active	28919	29015	-	57623
Bit 3	RO	Torque Trip close active	28920	29016	-	57624
Bit 4	RO	Slow mode active	28921	29017	-	57625
Bit 5	RO	Interrupter timer active	28922	29018	-	57626
Bit 6	RO	Motion Inhibit timer active	28923	29019	-	57627
Bit 7	RO	Stopped mid travel	28924	29020	-	57628
Bit 8	RO	Motor Running	28925	29021	-	57629
Bit 9	RO	Moving Open	28926	29022	-	57630
Bit 10	RO	Moving Closed	28927	29023	-	57631
Bit 11	RO	Close limit reached	28928	29024	-	57632
Bit 12	RO	Open Limit reached	28929	29025	-	57633
Bit 13	RO	Centre Column moving	28930	29026	-	57634
Bit 14	RO	Remote selected	28931	29027	-	57635
Bit 15	RO	local selected	28932	29028	-	57636
Input Register 3	RO	Actuator Status Flags 3				
Bit 0	RO	ESD Active	28933	29029	-	57637
Bit 1	RO	Reserved	28934	29030	-	57638
Bit 2	RO	Phase Sequence	28935	29031	-	57639
Bit 3 - 7	RO	Reserved	28936 - 28940	29032- 29036	-	57640- 57644
Bit 8	RO	Relay 1 Status	28941	29037	-	57645
Bit 9	RO	Relay 2 Status	28942	29038	-	57646
Bit 10	RO	Relay 3 Status	28943	29039	-	57647
Bit 11	RO	Relay 4 Status	28944	29040	-	57648
Bit 12	RO	Relay 5 Status	28945	29041	-	57649
Bit 13	RO	Relay 6 Status	28946	29042	-	57650
Bit 14	RO	Relay 7 Status	28947	29043	-	57651
Bit 15	RO	Relay 8 Status	28948	29044	-	57652

BLOCK 8 **FCU digital Read Data** **–FORMAT 2 (Top to Bottom)**		Actuator Type IQ / IQT	Data location FCU1 FCU2 to FCU300 Discrete location **(accessed with Modbus function code 02)**			
Input Register 4	RO	Actuator Alarm Flag 1				
Bit 0	RO	Manual movement to open limit by hand	28949	29045	-	57653
Bit 1	RO	End of travel movement	28950	29046	-	57654
Bit 2	RO	Actuator has stalled	28951	29047	-	57655
Bit 3	RO	Monitor relay active	28952	29048	-	57656
Bit 4	RO	Internal watchdog tripped	28953	29049	-	57657
Bit 5	RO	Battery Low	28954	29050	-	57658
Bit 6	RO	Battery Flat	28955	29051	-	57659
Bit 7	RO	Reserved	28956	29052	-	57660
Bit 8	RO	Configuration error	28957	29053	-	57661
Bit 9	RO	Thermostat tripped	28958	29054	-	57662
Bit 10	RO	Valve Obstructed	28959	29055	-	57663
Bit 11	RO	Valve jammed	28960	29056	-	57664
Bit 12	RO	Manual movement	28961	29057	-	57665
Bit 13	RO	Manual movement in closed direction	28962	29058	-	57666
Bit 14	RO	Manual movement in open direction	28963	29059	-	57667
Bit 15	RO	Manual movement to close limit by hand	28964	29060	-	57668
Input Register 5	RO	Actuator Alarm Flag 2				
Bit 0	RO	Comms loss	28965	29061	-	57669
Bit 1	RO	Loss of Phase	28966	29062	-	57670
Bit 2	RO	Reserved	28967	29063	-	57671
Bit 3	RO	Control alarm	28968	29064	-	57672
Bit 4	RO	Position sensor fault	28969	29065	-	57673
Bit 5	RO	Torque sensor fault	28970	29066	-	57674
Bit 6	RO	Torque tripped mid travel	28971	29067	-	57675
Bit 7	RO	Local signal held	28972	29068	-	57676
Bit 8	RO	Reserved	28973	29069	-	57677
Bit 9	RO	General Alarm	28974	29070	-	57678
Bit 10	RO	Valve alarm	28975	29071	-	57679
Bit 11	RO	Actuator alarm	28976	29072	-	57680
Bit 12	RO	Network Card fault	28977	29073	-	57681
Bit 13	RO	Reserved	28978	29074	-	57682
Bit 14	RO	Control Contention	28979	29075	-	57683
Bit 15	RO	Reserved	28980	29076	-	57684
Input Register 6	RO	Actuator Alarm Flag 3				
Bits 0 - 15	RO	Reserved	28981 - 28996	29077- 29092	-	57685 - 57700

Table 15 - FCU digital Read Only data: paired bits

BLOCK 9 FCU digital Read Data, paired bit access coil reads (accessed with Modbus function code 02) Status - Adjacent Bits per Field Unit - Discrete locations (1 bit per)

Location	Description		Location	Description	
57701	FCU 1	(CAS)	57702	FCU 1	(OAS)
57703	FCU 2	(CAS)	57704	FCU 2	(OAS)
57705	FCU 3	(CAS)	57706	FCU 3	(OAS)
57707	FCU 4	(CAS)	57708	FCU 4	(OAS)
57709	FCU 5	(CAS)	57710	FCU 5	(OAS)
57711	FCU 6	(CAS)	57712	FCU 6	(OAS)
57713	FCU 7	(CAS)	57714	FCU 7	(OAS)
57715	FCU 8	(CAS)	57716	FCU 8	(OAS)
|			|		
|	FCU 'N' = 57700 + 2N - 1		|	FCU 'N' Bit 2 = 57700 + 2N	
|			|		
58297	FCU 294	(CAS)	58288	FCU 234	(OAS)
58289	FCU 295	(CAS)	58290	FCU 235	(OAS)
58291	FCU 296	(CAS)	58292	FCU 236	(OAS)
58293	FCU 297	(CAS)	58294	FCU 237	(OAS)
58295	FCU 298	(CAS)	58296	FCU 238	(OAS)
58297	FCU 299	(CAS)	58298	FCU 239	(OAS)
58299	FCU 300	(CAS)	58300	FCU 300	(OAS)

Note that the information in these locations is also mapped to alternate locations.

N = field unit address number in the range 1 to 300

5. FCU Write Data

Table 16 - FCU command Write data

BLOCK 10 **FCU Command Write Data – FORMAT 1 (Left to Right)**		Actuator Type IQ / IQT	Data location FCU1	FCU2	to	FCU 300
			Register Location **(accessed with Modbus function codes 03 or 04, writes with 06 or 16)**			
Demand Output register 1	R/W	Digital Control 1 = Open, 2 = Close, 4 = Stop, 8 = ESD Other values are not used and may cause control contention.	3401	3402	-	3700
			Discrete location **(Modbus function code writes 05 or 15)**			
Bit 0	RO	Open Coil	101	102	-	400
0x0000 De-energise 0xFF00 or any non-zero value = Energise						
Bit 1	RO	Close Coil	401	402	-	700
0x0000 De-energise 0xFF00 or any non-zero value = Energise						
Bit 2	RO	Stop Coil	701	702	-	1000
0x0000 De-energise 0xFF00 or any non-zero value = Energise						
Bit 3	RO	ESD Coil	1001	1002	-	1300
0x0000 De-energise 0xFF00 or any non-zero value = Energise						
Bit 4	RO	Reserved	1301	1302	-	1600
0x0000 De-energise 0xFF00 or any non-zero value = Energise						
Bit 5 - 15	RO	Reserved	1601	1602	-	4900
			Register Location **(accessed with Modbus function codes 03 or 04, writes with 06 or 16)**			
Demand Output register 2	R/W	Actuator Position Demand 0 – 10000 (0.00% - 100.00%)	3701	3702	-	4000
Demand Output register 3	R/W	Reserved	4001	4002	-	4300
Demand Output register 4	R/W	Reserved	4301	4302	-	4600

Table 17 - FCU command Write data (Format 2)

BLOCK 11 **FCU Command Data – FORMAT 2 (Top to Bottom)**		Actuator Type IQ / IQT	Data location FCU1	FCU2	to	FCU 300
			Register Location **(accessed with Modbus function code 03 or 04 writes with 06 or 16)**			
Demand Output register 1	R/W	Digital Control 1 = Open, 2 = Close, 4 = Stop, 8 = ESD Other values are not used and may cause control contention.	5011	5041	-	13981
Demand Output register 2	R/W	Actuator Position Demand 0 – 10000 (0.00% - 100.00%)	5012	5042	-	13982
Demand Output register 3	R/W	Reserved	5013	5043	-	13983
Demand Output register 4	R/W	Reserved	5014	5044	-	13984

Table 18 - FCU command Write data paired bits

BLOCK 12 - FCU command Data, paired bit access coil writes (accessed with Modbus function code 05 and 15)

When writing outputs to the field units, to assert the command (energise the coil) write 0xFF00 (or any data other than 0x0000) To remove the command (de-energise the coil) write 0x0000. Actuator control commands never require to be turned off, so there is no need to write a de-energise command.

Commands – Adjacent coils per field unit – coil locations (1 per bit)

Location	Description		Location	Description	
19301	FCU 1	(Close Cmd)	19302	FCU 1	(Open Cmd)
19303	FCU 2	(Close Cmd)	19304	FCU 2	(Open Cmd)
19305	FCU 3	(Close Cmd)	19306	FCU 3	(Open Cmd)
19307	FCU 4	(Close Cmd)	19308	FCU 4	(Open Cmd)
19309	FCU 5	(Close Cmd)	19310	FCU 5	(Open Cmd)
19311	FCU 6	(Close Cmd)	19312	FCU 6	(Open Cmd)
19313	FCU 7	(Close Cmd)	19314	FCU 7	(Open Cmd)
19315	FCU 8	(Close Cmd)	19316	FCU 8	(Open Cmd)
|			|		
|	FCU 'N' = 19300 + 2N - 1		|	FCU 'N' = 19300 + 2N	
|			|		
19887	FCU 294	(Close Cmd)	19888	FCU 294	(Open Cmd)
19889	FCU 295	(Close Cmd)	19890	FCU 295	(Open Cmd)
19891	FCU 296	(Close Cmd)	19892	FCU 296	(Open Cmd)
19893	FCU 297	(Close Cmd)	19894	FCU 297	(Open Cmd)
19895	FCU 298	(Close Cmd)	19896	FCU 298	(Open Cmd)
19897	FCU 299	(Close Cmd)	19898	FCU 299	(Open Cmd)
19899	FCU 300	(Close Cmd)	19900	FCU 300	(Open Cmd)

Note that the information in these locations is also mapped to alternate locations.

N = field unit address number in the range 1 to 300

Table 19 - FCU parameter data

BLOCK 13 **FCU parameter Data**		Actuator Type IQ / IQT	Data location FCU1	FCU2	to	FCU 300
			Register Location **(accessed with Modbus function codes 03 or 04, writes with 06 or 16)**			
Parameter Register 1	RO	Minimum position (0 to 100 = 0% to 100%)	5015	5045	-	13985
Parameter Register 2	RO	Maximum position (0 to 100 = 0% to 100%)	5016	5046	-	13986
Parameter Register 3	RO	Deadband (0 to 255 = 0% to 25.5%)	5017	5047	-	13987
Parameter Register 4	RO	Hysteresis (0 to 255 = 0% to 25.5%)	5018	5048	-	13988
Parameter Register 5	RO	MIT (0 to 255 = 0seconds to 255seconds)	5019	5049	-	13989
Parameter Register 6	RO	Slow mode (0 to 100 = 0% to 100%)	5020	5050	-	13990
Parameter Register 7 - 16	RO	Reserved	5021	5051	-	14000

Note: Parameters are **Read Only** over the Modbus interface, they are only changeable at the actuator or using the HMI / web pages of the master station.

6. Wireless Repeater Data

If the network requires repeaters, the status data for those devices will be contained in the following registers.

Table 20 – Wireless Repeater data

BLOCK 14 – Repeater module Read Only data **(accessed with Modbus function codes 03 or 04)**	
Parameter – Repeater Status register Register 379 for repeater 301, 380 for 302 and so on Bits 0-7 Reserved Bit 8 Repeater detected Bit 9 Repeater communications fail Bit 10 Repeater alarm Bit 11-15 reserved	379 - 393

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7. Actuator digital bits

For all digital bits, the active state is true; a value of 1. The inactive state is false; a value of 0.

7.1 Digital Input 1

This bit reports the status of the contact connected to the actuator hard wired **Open** terminal. The input can be used to control the actuator or simply to report the status of a plant feedback signal. The function is set in the Auxiliary Input Mask parameter which determines whether the bit is reported as true (1) for a closed contact or an open contact and whether the input controls the actuator or not. Note that the input is always reported even when it is also controlling the actuator

7.2 Digital Input 2

This bit reports the status of the contact connected to the actuator hard wired **Close** terminal. The input can be used to control the actuator or simply to report the status of a plant feedback signal. The function is set in the Auxiliary Input Mask parameter which determines whether the bit is reported as true (1) for a closed contact or an open contact and whether the input controls the actuator or not. Note that the input is always reported even when it is also controlling the actuator.

7.3 Digital Input 3

This bit reports the status of the contact connected to the actuator hard wired **Stop/Maintain** terminal. The input can be used to control the actuator or simply to report the status of a plant feedback signal. The function is set in the Auxiliary Input Mask parameter which determines whether the bit is reported as true (1) for a closed contact or an open contact and whether the input controls the actuator or not. Note that the input is always reported even when it is also controlling the actuator.

7.4 Digital Input 4

This bit reports the status of the contact connected to the actuator hard wired **ESD** terminal. The input can be used to control the actuator or simply to report the status of a plant feedback signal. The function is set in the Auxiliary Input Mask parameter which determines whether the bit is reported as true (1) for a closed contact or an open contact and whether the input controls the actuator or not. Note that the input is always reported even when it is also controlling the actuator.

This input can be enabled, using a setting in the actuator, to operate as a network disable input. When network disable is enabled, applying a signal to this input will disable network control of the actuator irrespective of the Auxiliary Input Mask setting.

For details of the Auxiliary Input Mask parameter **r**efer to the installation manual for the actuator for details of this setting, PUB002-003 (IQ) and PUB002-004 (IQT).

7.5 Digital Relays 1 - 8

These bits report the status of the relay contacts fitted to the actuator. For details of how to set up the relay function see installation manual for the actuator for details of this setting, PUB002-003 (IQ) and PUB002-004 (IQT).

7.6 Local Stop selected

When the actuator local control switch passes through, or is set in, the Local Stop position then the bit Local Stop is set. The actuator may be placed in Local Stop as a unique function to prevent operation of the valve by any remote means. Note that Local Stop will be generated when moving the selector switch from Remote to Local and when moving the switch from Local to Remote.

7.7 Torque Trip open / close active

If the actuator is required to generate more torque than the actuator maximum torque setting the motor will stop. These signals are generated for the direction in which the actuator was moving when the trip occurs, if the actuator were travelling in the open direction the Torque Trip open signal would become active and for travelling in the close direction the Torque Trip close would become active. These signals will only occur during a torque trip in mid travel as the actuator maybe set to torque into the seat of the valve. This means that the reason for the stopped condition and the indication must therefore be an excessive stiffness in the valve or an obstruction in the pipe preventing the valve from moving any further in the selected direction.

7.8 Slow Mode active

Applicable to IQT actuators only. In positioning mode, when the IQT actuator approaches its setpoint the motor automatically switches to 'slow mode' and the actuator runs at a lower speed. This allows any developed inertia to be dissipated and a better positional accuracy to be achieved without overshoot. The deviation from the setpoint at which slow mode is adopted is set in the associated parameter. When slow mode is in use this bit will be active.

7.9 Interrupter timer active

The Interrupter Timer in the IQ/IQT can be used over part or the entire actuator stroke to slow down the effective speed of valve travel. When the interrupter time is operating and stopping the actuator motion for a set period of time, to effectively slow it down, this bit will be set. The interrupter timer settings are part of the actuator settings. When under network control, the control signal does not need to be re-applied when this bit is true, as the control action will continue once the time has elapsed.

7.10 Motion Inhibit timer active

The Motion Inhibit Timer is used in position control to prevent the actuator from exceeding its prescribed number of starts per hour, or to reduce the effects of hunting during closed loop control. When the Motion Inhibit Timer is active and stopping the actuator motion for a set period of time, this bit will be set. This bit may be seen at the start of operation if the actuator is being operated frequently, under normal isolating operation it would not be seen. When under network control, the control signal does not need to be re-applied when this bit is true, as the control action will continue once the time has elapsed.

7.11 Stopped mid-travel

Whenever the actuator is not moving and is in-between the limit settings this bit will be active.

7.12 Motor Running

Whenever one of the internal contactors is energised and the actuator begins to move the valve, the Motor running signal will be generated regardless of direction of travel.

7.13 Moving Open / Moving Closed

There are two data bits relating to the actuator moving and the direction of travel. Whenever one of the internal contactors is energised and the actuator begins to move the valve or if the actuator is moved manually, either a Moving Open or Moving Closed signal will be generated. If operation is in the open direction then Moving Open is reported. If operation is closed then Moving Closed is reported.

These signals will be reported if the actuator is commanded to move locally, over the wireless network or if it is commanded from another remote source (remote pushbuttons or a wired network).

7.14 Open / Close limit reached - 'CAS' & 'OAS'

There are two data bits relating to the actuator set positions for open and close positions. OAS is used for open limit indication, CAS is used for close limit indication. These limit positions may be set within the actual valve stroke, as with a torque seating valve the actuator will stop when seated fully closed and the rated torque has been delivered to seat the valve. The position limit switch must be set slightly before the torque off position so as to ensure that the position is correctly reported.

7.15 Centre Column moving

The actuator senses any movement of its centre column whether this is generated by a manual (hand) operation or by the action of the motor. Whenever the centre column is in motion this data bit is present.

7.16 Remote selected

The actuator has a 3 position switch for selecting Remote, Local Stop or Local control. The switch passes from Remote to Local, or Local to Remote, through the Local Stop position. When the actuator local control switch is fully in the Remote position then the Remote bit is generated. This data bit is not present when the actuator control switch is in the Local Stop or Local positions. The bit is present as long as the switch is in the Remote position, it will clear when the switch is not in the Remote position i.e. Local or Local Stop positions.

7.17 Local - selected

When the actuator local control switch is fully in the Local position then the local bit is generated. This data bit is not present when the actuator control switch is in the Local Stop or Remote positions.

7.18 ESD Active

The ESD (Emergency Shutdown) signal is used to send the actuator to its emergency position. The position to which the actuator goes is set up in the ESD settings of the actuator. This bit is set when the actuator is performing is ESD action regardless of what that action is, the bit will be cleared when the ESD condition is removed.

8. Actuator alarm bits

8.1 Manual movement to close / open limit

If the actuator is moved manually to the close limit, the manual movement to close limit bit will be set, if the manual movement is to the open limit, the manual movement to open limit will be set.
The bits will remain active until the actuator is moved electrically by either the local controls or a network command.

8.1.1 End of travel movement

If the actuator motor continues to run for more than 5 seconds after the valve reaches the set end of travel limit switch position then this bit will be set. This is reset when the actuator is moved off the limit.

8.2 Actuator has stalled

If the actuator detects that there is no movement after a signal to move, it will report a stalled motor. This alarm will be present until the actuator is moved successfully, manually or electrically.

8.3 Monitor relay active

This signal is active when actuator remote control is not available. The actuator Monitor Relay status is a composite signal for several alarms. This signal will be set true if the actuator selector is in Local or Local Stop (not in Remote) or if the thermostat trips. The mains supply is also monitored and if one of the three phases is lost this bit is set. If the actuator is operated from a single phase supply and this is lost then communications with the actuator will also be lost. Where a 3 phase supply is used, if the phase associated with the control circuits is lost then communications with the actuator will be lost.

8.4 Internal watchdog tripped

This bit will be set if the internal network card CPU detects that it has been reset due to the internal watchdog, which monitors its operation, has tripped. This bit will be active following a watchdog trip. This alarm may only indicate that the power has been cycled quickly causing the CPU to believe the watchdog has tripped, but if the alarm is persistent the network card may require replacement.

8.5 Battery low / Battery flat

The status of the internal battery is monitored and should it fall below a critical level the battery low signal will become active, if the battery should be detected as completely devoid of power (or not present) the battery flat signal will be active as well as the battery low signal. The battery is used to power the circuits used to keep track of the valve position when the actuator mains power is switched off.

8.6 Configuration error

This bit will be set if there is an error in the configuration of the actuator.

8.7 Thermostat tripped

If the temperature of the motor windings rises above the thermostat trip value, the thermostat contact will open and this signal will be present. There are no adjustments for the temperature at which the thermostat trip operates. The motor will be stopped if the thermostat trips. Only once the motor has cooled down and the thermostat has reset itself can a new Remote, Host or Local command to move the actuator be carried out. A setting on the actuator main board allows the ESD command to override the thermostat. The bit will remain set at logic 1 until the motor cools down and the thermostat resets itself.

8.8 Valve obstructed

This bit will be active if the actuator stops in mid travel when not expected to do so after receiving a command to move. If the actuator torque exceeds the trip value set during commissioning then the motor will stop and motion will cease. The reason for the actuator stopping will be the high torque due to an obstruction and not a 'Stop' signal or reaching the desired setpoint position. The bit will remain active until the actuator position changes by 2% or more.

> ***Note**:* *Attempting to restart the actuator to move towards the obstruction (even if the obstruction no longer exists) is not possible, the actuator will not restart. The actuator must be electrically reversed away from the obstruction before attempting to continue in the original direction.*

8.9 Valve Jammed

This bit will be active if the actuator is stationary at the end of travel and fails to move away from the seat of the valve when a network command requests it to do so. The actuator will trip on excessive torque due to the valve being jammed in the seat. The PFU fails to see movement and reports this status after the time set in the associated parameter during the PFU set up. The bit will remain active until the actuator position changes by 2% or more.

> ***Note**:* *Attempting to restart the actuator to move out of the seated position is not possible. The actuator must be reversed before it will run in the same direction again. The jammed seat must first be released manually before electrical control is attempted. The problem may be overcome by adjusting the actuator torque setting which is designed to provide extra power on leaving the seated position.*

8.10 Manual movement / manual movement in closed / open direction

The manual movement of the valve is reported as active if the actuator is moved by the handwheel away from the last position. If the actuator is moved manually closed, the manual movement in closed direction bit will be set, if the manual movement is open, the manual movement in open direction bit will be set. The bits will remain active until the actuator is moved electrically by either the local controls or a network command.

8.11 Comms loss

Communications with each device is monitored periodically. This bit will be set if the master station has lost communication with the device addressed. If a command is being sent to a particular device, and it losses communication with the master station during this time, the communications loss is immediately reported. If the field unit is not being specifically addressed by a command from the master station, the communications loss is detected after the field units fails to report status to the master station in a timely fashion.

Each field devices reports by exception i.e. when its status changes it will update the master station. If it has no change of state it will report on a timed basis to ensure the master station knows it is still connected. The master station will expect an update from each device within a time that is dependent on the network size. The calculation for the time between periodic reports is:

[(2 x Number of Field Units expected) +10] seconds

Therefore, in a network of 10 actuators, the periodic updates will occur every 30 seconds. The master station will communicate the update time to each field unit.

8.12 Loss of Phase

The mains supply is monitored and if one of the three phases is lost this bit is set. If the actuator is operated from a single phase supply and this is lost then communications with the actuator will also be lost. Where a 3 phase supply is used, if the phase associated with the control circuits is lost then communications with the actuator will be lost.

8.13 Control alarm

The actuator will create this alarm, which can also been seen on its local display, under the following circumstances:

ESD active

Interlock active

It will be present until the cause of the alarm is removed.

8.14 Position sensor failure
If the actuator detects a fault in its position sensor assembly, this bit will be active. If this is active, the user should check the position sensor assembly for defects.

8.15 Torque sensor failure
If the actuator detects a fault in its torque sensor assembly, this bit will be active. If this is active, the user should check the torque sensor assembly for defects.

8.16 Torque tripped mid travel
If the actuator is required to generate more torque than the actuator maximum torque setting the motor will stop. This signal is generated if the actuator is not at a limit when this occurs. This means that the reason for the stopped condition and the indication must therefore be an excessive stiffness in the valve or an obstruction in the pipe preventing the valve from moving any further in the selected direction.

8.17 Local control held
If the actuator detects a fault in its local control assembly, such that the local controls appear to be held on, this bit will be active. If this is active, the user should check the local controls assembly for defects.

8.18 General alarm
This bit will be set when either of the Actuator, Control or Valve alarms are set.

8.19 Valve alarm
The actuator will create this alarm, which can also been seen on its local display, under the following circumstances:

Torque tripped close (not at limit)
Torque tripped open (not at limit)
Motor stalled

8.20 Actuator alarm
The actuator will create this alarm, which can also been seen on its local display, under the following circumstances:

Phase loss
Thermostat tripped
Local controls fault
24 volts lost (customer and network supply)
Configuration error
Position sensor failure
Torque sensor failure

8.21 Network card fault
The network card is continually monitor itself for correct operation. If it detects that it has a issue it will set this bit to indicate that it requires attention. If this bit is set it is advised return the card to default settings, then update setting for the application. If this does not remove the alarm it is advisable to change out the network card.

8.22 Control contention
If an incorrect value is transmitted in the control registers such that multiple control bits are set, there will be no control action and this bit will be active. This is active until a valid control command is received.

9. FCU Analogue registers

9.1 Torque
The currently developed torque value is reported as an Integer Value in the range 0 to 1200 (0-4B0 hex) representing the percentage of actuator rated torque generated.

9.2 Valve Position
The current valve position is reported as an Integer Value in the range 0 to 10000 (0 – 2710 hex) representing the percentage position to 0.01% resolution. The IQ and IQT actuator automatically scales the valve position value reported from the setting of the limit switches.
If Limited Range Positioning is invoked by setting the appropriate parameters, then the reported valve position 0 to 100% follows the limited range of valve travel.

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10. FCU control

10.1 Command Outputs

The actuator is able to be commanded either from the local controls, the Pakscan wireless network unit, or the Remote Auxiliary Inputs. The control have priorities as indicated in Figure 3. The actuator will always respond to the last Open/Stop/Close input or DV command. If the command is an ESD then it will override any other command.

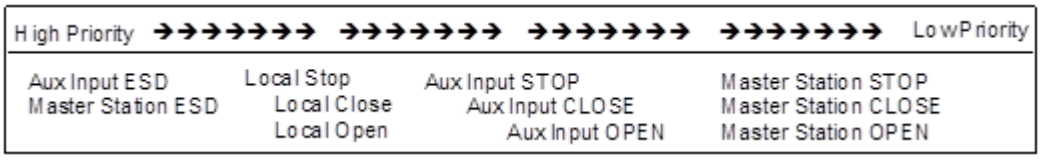

Fig 4: Command Priorities

10.1.1 Local Controls (Open, Stop, Close)

The selector switch must be in Local for the Local Open or Local Close controls to be actioned. When commanded the actuator will move in the desired direction. The actuator is able to accept instantaneous reversal of direction of travel without the need for a stop signal. Local Stop is a unique position for the selector switch and causes the actuator to stop.

Whenever the actuator is in Local or Local Stop no input, other than ESD, from Pakscan or the Remote Auxiliary Inputs will cause actuator motion.

10.1.2 Wireless Pakscan Controls (Open, Stop, Close and Set dv)

The actuator selector switch must be in Remote for Pakscan control to be enabled. The field unit is able to command the actuator to move full travel or to a particular position.

Full Travel Control

The field unit outputs Open, Stop and Close commands that are actioned by the actuator. When the field unit issues a command the actuator actions it until another command is issued or the instruction has been completed. For example the field unit will issue a command to 'open' the valve, the actuator will then action this command until the valve is fully open or until a close or stop command is issued from the field unit, whichever is the sooner.

The command to the field unit from the wireless network is a momentary 'write' of data. Once initiated the field unit does not require the command to be cancelled before another is issued.

If multiple commands are sent to the same field unit the command received last will be obeyed. If single coil write commands are used on the host data link this possibility is eliminated.

It is acceptable to reverse the actuator in mid travel without issuing a stop command.

It is not possible to induce a 'push to run' action with a Pakscan system. The actuator will run in the chosen direction to the end of travel unless stopped by another command.

Position Control (set dv)

The field unit is able to accept a 'Desired Value' signal to cause the actuator to move to a particular position in the valve stroke. The action of sending a DV signal to the field unit places it in 'positioning mode'. The positioning signal must be in the range 0-100% where 0% is towards the close position of the valve. Once a desired value has been sent to the actuator the field unit will maintain control of the actuator and position it such that the measured value position signal equals the desired value sent. This control will be continued until it is replaced with a new command. If at any time an alarm occurs the control action will be cancelled.

When the actuator has been set for limited range position reporting it will take the 0-100% position range over a portion of the total valve stroke. If a Desired Value position is sent to the actuator it will use the same limited range for positioning the actuator as it uses for reporting the actual position. A full travel command will move the actuator over the full range to the appropriate limit switch position.

The command to the field unit from the wireless network is a momentary 'write' of data for the Desired Value. Once initiated the field unit does not require the command to be cancelled before another is issued.

It is acceptable to send a new Desired Value at any time, there is no need to issue a stop command or cancel the existing value. If a full travel command (such as Open, Stop or Close) is sent to the field unit this will cause the Desired Value command to be removed and replaced with the most recent command.

In situations where multiple register writes to the master station are sent to the same field unit then the last Desired Value command received by the field unit will be the command actioned, following expiry of the MIT period.

If an alarm is already present on the actuator and a DV command is sent to the field unit then the command will not be actioned and it will be discarded. For example if the actuator selector is in Local Stop and a DV position command is sent to the field unit, when the selector is moved to Remote the actuator will NOT run to obey the DV command.

Actuator protection in position control mode
The actuator includes several settings designed to prevent damage to the actuator when a DV signal is being actioned. These can be set over the wireless network or at the actuator using the Rotork setting tool. These settings are explained later in this document, Motion Inhibit Timer / Deadband / hysteresis.

11. Parameters

There are only a limited number or parameters that can be viewed using the modbus database, these are described in the following pages.

11.1 Limited Range Position Minimum and Maximum (Parameter 1 and 2)

These parameter registers are used to define the positions in the range of valve travel that will be reported as 0 to 100% if it the whole travel from the closed position to the open position is not used. In addition the position demand setpoint output value will also be modified to follow this limited range.

It is possible to make the position data reported and the position controller relate to a reduced span of actual valve travel. In this mode the position data relates to the reduced portion of the valve stroke. This is sometimes used where the valve is required to have a 0% position (or 100% position) that is not the same as the fully closed position (or fully open position). These parameters define the actual limited range of valve travel that will be used for the position reporting and control by the positioner. Note that

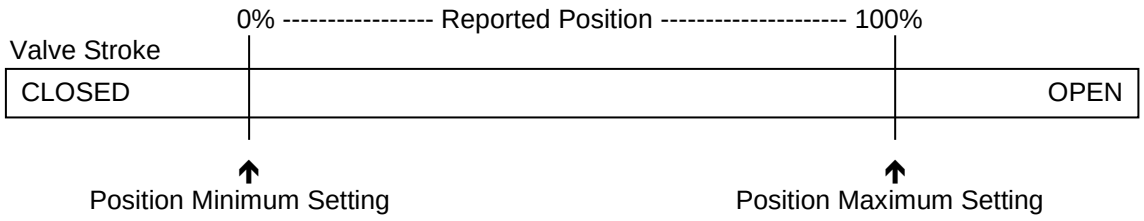

Fig 5: Limited Range Position Control and Reporting

the digital open and close commands will still make the valve travel over its full stroke. The special case analogue commands of 0% and 100% that would otherwise cause the actuator to travel to the limit switch or torque off positions are inhibited if values other than 0 and 100 are set in these parameters.

The values inserted relate to the maximum total valve travel between closed and open and represent the point in the full stroke which will now be used for the limited stroke 0 and 100 values.

11.2 Deadband and Hysteresis (Parameter 3 and 4)

When using position control by sending a value to the Actuator Position DV setpoint there are a number of parameter registers used to tune the position controller and reduce the possibility of damage to the actuator. These two registers are set to prevent hunting around the setpoint due to high inertia of the valve. They will require adjustment for each specific application. In addition the Motion Inhibit Timer is used to ensure the actuator does not carry out an excessive number of starts in a given period.

11.2.1 Deadband

The control used for the positioner is proportional only. The field unit will run the actuator to the desired position and then it stops. As the actuator and valve combination have some inertia there is a possibility that the desired position may be overrun and the positioner will then reverse the direction of travel to make the valve adopt the desired position. This overshoot and return may continue for a number of cycles and is known as hunting, the valve and actuator combination will hunt around the setpoint if the inertia is high. To prevent this from happening there is a Deadband setting whereby once the actuator enters the deadband the motor will be stopped. For example a 5% deadband will cause the motor to be stopped once the actual position is within 5% of the desired position. The inertia will then bring the actual position nearer the desired position. The desired position must also be greater or less than the current position by the deadband amount for the actuator to start to position.

The deadband is the allowable error around the setpoint.

11.2.2 Hysteresis

In addition to the deadband a second setting, hysteresis, further refines the performance of the position controller. The positioner will run the actuator towards the setpoint DV until the actual position is within the deadband minus the hysteresis setting. This has the effect of instructing the actuator to stop when it is nearer the DV. The actuator will not restart unless it overshoots and runs outside the deadband or a new command places the new desired position outside the deadband.

The Hysteresis is the amount of movement inside the deadband permitted before the motor stops.

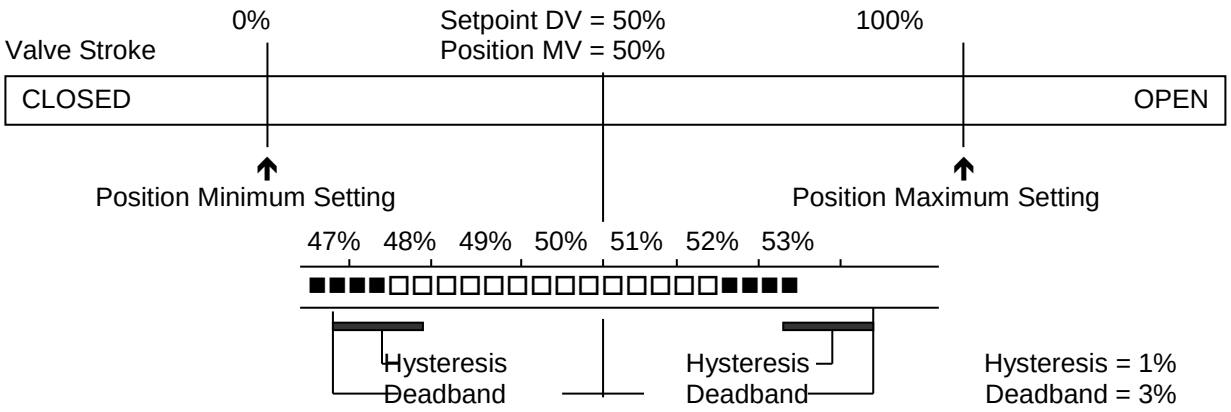

Fig 6: Deadband and Hysteresis settings

11.3 Motion Inhibit Timer (Parameter 5)

The Motion Inhibit Timer setting is the period that must elapse between consecutive starts of the actuator motor when in positioning mode. The idle period will prevent the actuator motor from exceeding its rated number of starts per hour.

11.4 Slow Mode Range (Parameter 6)

This parameter register is only applicable to IQT actuators. The Slow Mode Range sets the deviation between the setpoint and current position in positioning mode inside which the actuator motor will slow to minimum speed.

If the setpoint (DV) is 50% and the setting for this parameter is 10%, then when the actuator moves within the range 40% to 60% the motor will adopt low speed. The actuator does not use slow mode for digital (Open/Close) commands.

In addition, when tuning the valve positioner the setting can be used to allow the plant dynamics to stabilise between valve movements.

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