

FCO220 Series
F-BUS commands

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REVISION RECORD

Issue	Date	Summary of changes
1	26/10/21	Initial Release
2	23/05/22	Added “Zero Outside of Limits” error to M00x enquiries.

INTRODUCTION

General Description

To meet the demand for secure control and data transfer within a factory environment, Furness Controls have implemented a proprietary communications protocol called “***F-BUS***”, which can be used to connect multiple devices to a master computer. ***F-BUS*** is available in most Furness Controls Leak Detectors, Flow Meters, Pressure Indicators and Transmitters.

The ***F-BUS*** protocol defines the way that information is transferred between a master controller (PC or PLC) and one or more slave devices. The physical connection method between instruments can use any connection method such as RS232, RS422, RS485, USB, Ethernet.

Communication Procedure

The protocol uses the Master/Slave principle, the master being the PC and the slave the Furness Controls Devices. The master initiates a data transfer by sending either a Command Block or an Enquiry Block to a slave device. The slave responds with either an acknowledge signal for a command or by returning a data block for an enquiry. Each slave has a unique address and a slave cannot initiate a data transfer.

For reliable communication, a checksum code is appended to all command and data blocks. This allows the PC and the slave device to check that the data it receives has not been corrupted.

Supporting Software

The ***F-Bus Utility*** is a Windows based program available from Furness Controls that has simple control and diagnostic functions that can help isolate communication problems. It also allows common instrument settings to be saved to or set from a PC, allows you to configure a Furness Controls instrument from the PC and has basic data capture / data logging facilities. User-programmable buttons and the display of transmitted and received data are useful to check commands and data formats when developing applications that use the Fbus protocol.

The Furness Controls ***FCS487 Data Logger*** is a Windows based program that may be used to log instrument data directly into Microsoft Excel and/or a text file.

For programmers, Furness Controls provides an ActiveX control to speed up the task of interfacing with Furness Controls instrumentation. ***The FCS477 ActiveX control*** is distributed with the FCS487 Data Logger with program examples and full documentation.

<http://www.furness-controls.com/info>

PHYSICAL NETWORK CONNECTION

USB-B Interface

The FCO220 is fitted with a USB-B port, which can connect to your PC via a USB-B to USB-A lead. Only one device can be connected to each USB port of a PC. A USB hub can be used if more ports are needed. A device driver is needed on the PC which may already be installed or may get installed automatically. If not then it may be downloaded from <http://www.furness-controls.com/info>. The driver provides a (virtual) standard serial COM port.

Communication Parameters

Both the PC and the devices connected on the network must have the same communication parameters set into them. This controls the speed at which data is sent, the data checking method used and an identification number so that each device on the network can be addressed individually.

Character Format:

Baud Rate:	The data transfer rate must be set the same on all devices and the PC.
Data Bits:	Always eight bits
Start Bit:	Always one bit.
Parity Bit:	Always 'NONE'.
Stop Bits:	Always one stop bit.

COMMUNICATION PROTOCOL

The protocol uses the Master/Slave principle, the master being the PC and the slave the Furness Controls Devices. The master initiates a data transfer by sending either a Command Block or an Enquiry Block to a slave device. The slave responds with either an acknowledge signal for a command or by returning a data block for an enquiry. Each slave has a unique address and a slave cannot initiate a data transfer.

For reliable communication, a checksum code is appended to all command and data blocks. This allows the PC and the slave device to check that the data it receives has not been corrupted.

A number of control characters are used by the communication protocol:

EOT = End Of Transmission, ctrl-D, ASCII value 4. Signifies the end of any communications and that the next two characters will be the address of the device that the Master wishes to communicate with.

ENQ = Enquiry, ctrl-E, ASCII value 5. Signifies an enquiry from the master to the slave.

ETX = End of text, ctrl-C, ASCII value 3. Signifies the end of a data block.

BCC = Block check character – a checksum generated by performing a logical exclusive OR (XOR) on the characters in the block, including the ETX character but excluding the first EOT character.

ACK = Acknowledge, ctrl-F, ASCII value 6. Used to indicate that a block was received without error.

NAK = Negative acknowledge, ctrl-U, ASCII value 21 (15h). Used to indicate an error with a block.

Command Block

Command Block Format (from master to slave)

EOT i/d1 i/d2 C1 C2 C3 C4 D1 D2 D3 D4 D5 Dn ETX BCC.

EOT	New message indicator forces all instruments on the network to check the next two characters to see if they correspond with their address identifier.
i/d1 i/d2	Instrument identification number 01 to 99.
C1	Command character A to Z.
C2 C3 C4	Test/Product number 001 to 300, or command modifier (always 000 for the FCO220).
D1 . . . Dn	Data stream consisting of item tags followed by values.
ETX	End of message indicator.
BCC	Calculated checksum for command block. Calculated from id1 to ETX inclusive

If the block is without errors and the command and any associated data are valid for the slave device, then the slave device responds with an ACK character.

If the block has errors or the command or any associated data are unrecognised, then the slave device responds with a NAK character.

Note that item tags are single characters, typically 'a' to 'z', and can be in any order.

Enquiry Block

Enquiry Block Format (from master to slave)

EOT i/d1 i/d2 C1 C2 C3 C4 ENQ BCC.

EOT	New message indicator forces all instruments on the network to check the next two characters to see if they correspond with their address identifier.
i/d1 i/d2	Instrument identification number 01 to 99.
C1	Command character A to Z.
C2 C3 C4	Test/Product number 001 to 300 or command modifier.
ENQ	Indicates end of command message and that it is an enquiry.
BCC	Calculated checksum for command block. Calculated from i/d1 to ENQ inclusive

If the block is without errors and the command is valid for the slave device, then the slave device responds by sending the requested data using the response block format below.

If the block has errors or the command is unrecognised, then the slave device responds with a NAK character.

Enquiry Block Response (from slave to master)

D1 D2 D3 D4 D5 Dn ETX BCC.

D1 . . . Dn	Data stream consisting of item tags followed by values.
ETX	Indicates end of reply block.
BCC	Calculated checksum for reply block. Calculated from D1 to ETX inclusive.

Note that item tags are single characters, typically 'a' to 'z', but are not in any specific order.

Please see the [examples](#) at the end of this document.

COMMAND SUMMARY

C1 to C4	Enq	Cmd	Data Block	Command Function
A000	✓	✓	✓	Global Settings
I000	✓		✓	Version Information
L000	✓		✓	Last Result (Result available flag cleared)
L001	✓		✓	Last Result
L002	✓		✓	Last Result (Result available flag cleared)
M000	✓		✓	Instrument Status
M001	✓		✓	Instrument Short Status
P000	✓	✓	✓	Security Data
S000	✓	✓	✓	RS232 Settings

Commands & Enquiries With Data Blocks

Global Settings

Command or Enquiry **A000**

PARAMETER	TAG	OPTION	VALUE
LANGUAGE	a	English	0
FILTER	b	Numeric value	0.0 to 60.0 secs
FLOW TYPE	c	Atmospheric Standard	0 1
* ¹ ENG. UNITS	d	Numeric value (see list)	e.g. 0
STD TEMP	h	Numeric value in Centigrade units	0 to 50 °C
PD TIMER ENABLED	i	No Yes	0 1
PD TIME	j	Numeric value	10 to 60 minutes
ATM Units (zero mode)	k	MB “HG	0 1
TEMP Units (zero mode)	l	°C °F	0 1

*¹ Engineering Units table

Units	Range
	0 to 300 CCM
CCM	0
CCH	1
MMS	2
MLM	3
MLH	4

Version Information

Enquiry I000

PARAMETER	TAG	OPTION	VALUE
Version Number	a	Version number in upper case	Eg. "E220A01"
Model	b	Model 1: 3.000 CCM Model 2: 30.00 CCM Model 3: 300.0 CCM Model 4: 6.000 CCM	1 2 3 4
Unit I/D number	c	8 character text	Eg. "12345678"
Serial Number	d	8 character text	Eg. "12345678"
Zero Limit Check	f	Not fitted Fitted	0 1
Language	g	English	0

Last Results

Enquiry L00x, where x is 0, 1 or 2 as defined below.

L001: All tags in use are transmitted and the result available flag in the status command is not affected.

L000 and L002: All tags in use are transmitted and the result available flag in the status command is cleared.

Parameter	Tag	Option	Value
Display value	a	Numeric value	e.g. 12.6
Display units	b	Text within quotes	e.g. "CCM"

Standard Status

Enquiry M000

PARAMETER	TAG	OPTION	VALUE
Diagnostic Head Out	b	Numeric value	1 to 254
* ² New Result Available	d	New result not yet available New result not yet read	0 1
Status (Hardware and Error status)	f	Operating normally Reserved EE Cal data error EE User data error ADC error (Leak) Temp sensor error Zero Outside of Limits EE Extended user checksum data error EE Extended cal checksum data error ADC error (Diagnostic) Head Voltage diagnostic error EEPROM write error Atmospheric Temp Sensor Error Atmospheric Pressure Sensor Error	0 1 - 9 10 11 12 13 14 15 16 17 19 20 21 22
* ¹ Instantaneous Flow value	h	Numeric value	e.g. 3.00000
Display value	i	Numeric value	e.g. 5.800
Display Units	j	Text within quotes	e.g. "CCM"
Ext. Temp Sensor value	k	Numeric value (in mbar units)	e.g. 22.75
Ext. Atm Sensor value	l	Numeric value (in °C units)	e.g. 1007.8
Reserved	m	Reserved	0
Current Stage (How the device is reading)	n	Reading Zeroing Over Range Under Range	0 1 2 3
Recent Faults	o	Numeric value (16 bit flags) (Cleared upon reading) -- Fault -- EE Cal data error EE User data error ADC error (Pressure) Temp sensor error Zero Outside of Limits EE Extended user checksum data error EE Extended cal checksum data error ADC error (Diagnostic) Head Voltage diagnostic error EEPROM write error Atmospheric Temp Sensor Error Atmospheric Pressure Sensor Error	0 to 65535 -- Bit position -- 0 1 2 3 4 8 9 10 12 13 14 15

Notes:

- *¹ Instantaneous Flow value returns the latest instantaneous flow value that is available. If this is read rapidly then it only responds when a new IFV is available (every 50ms), so each value will be a unique measurement. However, if zeroing occurs then the final IFV reading before the zero cycle started is returned for the duration of the cycle.
- *² The "New Result Available" flag is set when the display is updated. It is reset when the last results command is received.

Short Status

Enquiry M001

PARAMETER	TAG	OPTION	VALUE
* ¹ New Result Available	d	New result not yet available	0
		New result not yet read	1
Status (Hardware and Error status)	f	Operating normally	0
		Reserved	1 - 9
		EE Cal data error	10
		EE User data error	11
		ADC error (Pressure)	12
		Temp sensor error	13
		Zero Outside of Limits	14
		EE Extended user checksum data error	15
		EE Extended cal checksum data error	16
		ADC error (Diagnostic)	17
		Head Voltage diagnostic error	19
		EEPROM write error	20
		Atmospheric Temp Sensor Error	21
		Atmospheric Pressure Sensor Error	22

Notes:

- *¹ The “New Result Available” flag is set when the display is updated. It is reset when the last results command is received.

Security Data

Command or Enquiry P000

PARAMETER	TAG	OPTION	VALUE
Security Pin Code	a	Numeric value	0 to 9999

Communications Settings

Command or Enquiry S000

PARAMETER	TAG	OPTION	VALUE
Baud Rate	a	2400	0
		4800	1
		9600	2
		19200	3
		38400	4 (Default)
		57600	5
Fbus channel I/D	b	Numeric value	1 to 99
Response	c	Delay time in ms	0 to 50

Example Commands

Here are some basic commands to zero pressure, set a filter and set a relay Band function. The commands all assume the instrument is set to address 01.

Refer to the ASCII table at the rear of this guide to identify the differences between the ASCII name, Character code and Hexadecimal Code. All non-printable characters such as an enquiry character, are represented by names within triangular brackets, e.g. <ENQ>.

Example commands:

Function	Command as a Character string	Command in Hexadecimal Format
Set a 1 second filter	<EOT>01A000b1<ETX><SPC>	{04}{30}{31}{41}{30}{30}{30}{62}{31}{03}{20}

When the instrument receives one of these commands, it will respond with <ACK> (Hexadecimal {06}) if the command is accepted or <NAK> (Hexadecimal {15}) if rejected.

Example enquiry:

Standard Status Command	<EOT>01M000<ENQ>y	{04}{30}{31}{4D}{30}{30}{30}{05}{79}
Instrument Response	a00.01b"PA"d1e31200f0g0h0i53j51<ETX>f	{61}{30}{30}{2e}{30}{31}{62}{22}{50}{41}{22}{64}{31}{65}{33}{31}{32}{30}{30}{66}{30}{67}{30}{68}{30}{69}{35}{33}{6a}{35}{31}{03}{66}

The FBUS utility (FCS432) should be used on a PC to check the instrument and cable are correct. It may be downloaded from: www.furness-controls.com/info

ASCII CODES

Name	Control	Char	Hex	Dec	Char	Hex	Dec	Char	Hex	Dec	Char	Hex	Dec
null	ctrl @	NUL	00	0	SPC	20	32	@	40	64	`	60	96
start of heading	ctrl A	SOH	01	1	!	21	33	A	41	65	a	61	97
start of text	ctrl B	STX	02	2	"	22	34	B	42	66	b	62	98
end of text	ctrl C	ETX	03	3	#	23	35	C	43	67	c	63	99
end of xmit	ctrl D	EOT	04	4	\$	24	36	D	44	68	d	64	100
enquiry	ctrl E	ENQ	05	5	%	25	37	E	45	69	e	65	101
acknowledge	ctrl F	ACK	06	6	&	26	38	F	46	70	f	66	102
bell	ctrl G	BEL	07	7	'	27	39	G	47	71	g	67	103
backspace	ctrl H	BS	08	8	(	28	40	H	48	72	h	68	104
horizontal tab	ctrl I	HT	09	9	)	29	41	I	49	73	i	69	105
line feed	ctrl J	LF	0A	10	*	2A	42	J	4A	74	j	6A	106
vertical tab	ctrl K	VT	0B	11	+	2B	43	K	4B	75	k	6B	107
form feed	ctrl L	FF	0C	12	,	2C	44	L	4C	76	l	6C	108
carriage return	ctrl M	CR	0D	13	-	2D	45	M	4D	77	m	6D	109
shift out	ctrl N	SO	0E	14	.	2E	46	N	4E	78	n	6E	110
shift in	ctrl O	SI	0F	15	/	2F	47	O	4F	79	o	6F	111
data line escape	ctrl P	DLE	10	16	0	30	48	P	50	80	p	70	112
device control 1	ctrl Q	DC1	11	17	1	31	49	Q	51	81	q	71	113
device control 2	ctrl R	DC2	12	18	2	32	50	R	52	82	r	72	114
device control 3	ctrl S	DC3	13	19	3	33	51	S	53	83	s	73	115
device control 4	ctrl T	DC4	14	20	4	34	52	T	54	84	t	74	116
negative ack	ctrl U	NAK	15	21	5	35	53	U	55	85	u	75	117
synchronous idle	ctrl V	SYN	16	22	6	36	54	V	56	86	v	76	118
end of tx block	ctrl W	ETB	17	23	7	37	55	W	57	87	w	77	119
cancel	ctrl X	CAN	18	24	8	38	56	X	58	88	x	78	120
end of medium	ctrl Y	EM	19	25	9	39	57	Y	59	89	y	79	121
substitute	ctrl Z	SUB	1A	26	:	3A	58	Z	5A	90	z	7A	122
escape	ctrl [	ESC	1B	27	;	3B	59	[	5B	91	{	7B	123
file separator	ctrl \	FS	1C	28	<	3C	60	\	5C	92		7C	124
group separator	ctrl]	GS	1D	29	=	3D	61	]	5D	93	}	7D	125
record separator	ctrl ^	RS	1E	30	>	3E	62	^	5E	94	~	7E	126
unit separator	ctrl _	US	1F	31	?	3F	63	_	5F	95	DEL	7F	127