

The Company

We are an established world force in the design and manufacture of instrumentation for industrial process control, flow measurement, gas and liquid analysis and environmental applications.

As a part of ABB, a world leader in process automation technology, we offer customers application expertise, service and support worldwide.

We are committed to teamwork, high quality manufacturing, advanced technology and unrivalled service and support.

The quality, accuracy and performance of the Company's products result from over 100 years experience, combined with a continuous program of innovative design and development to incorporate the latest technology.

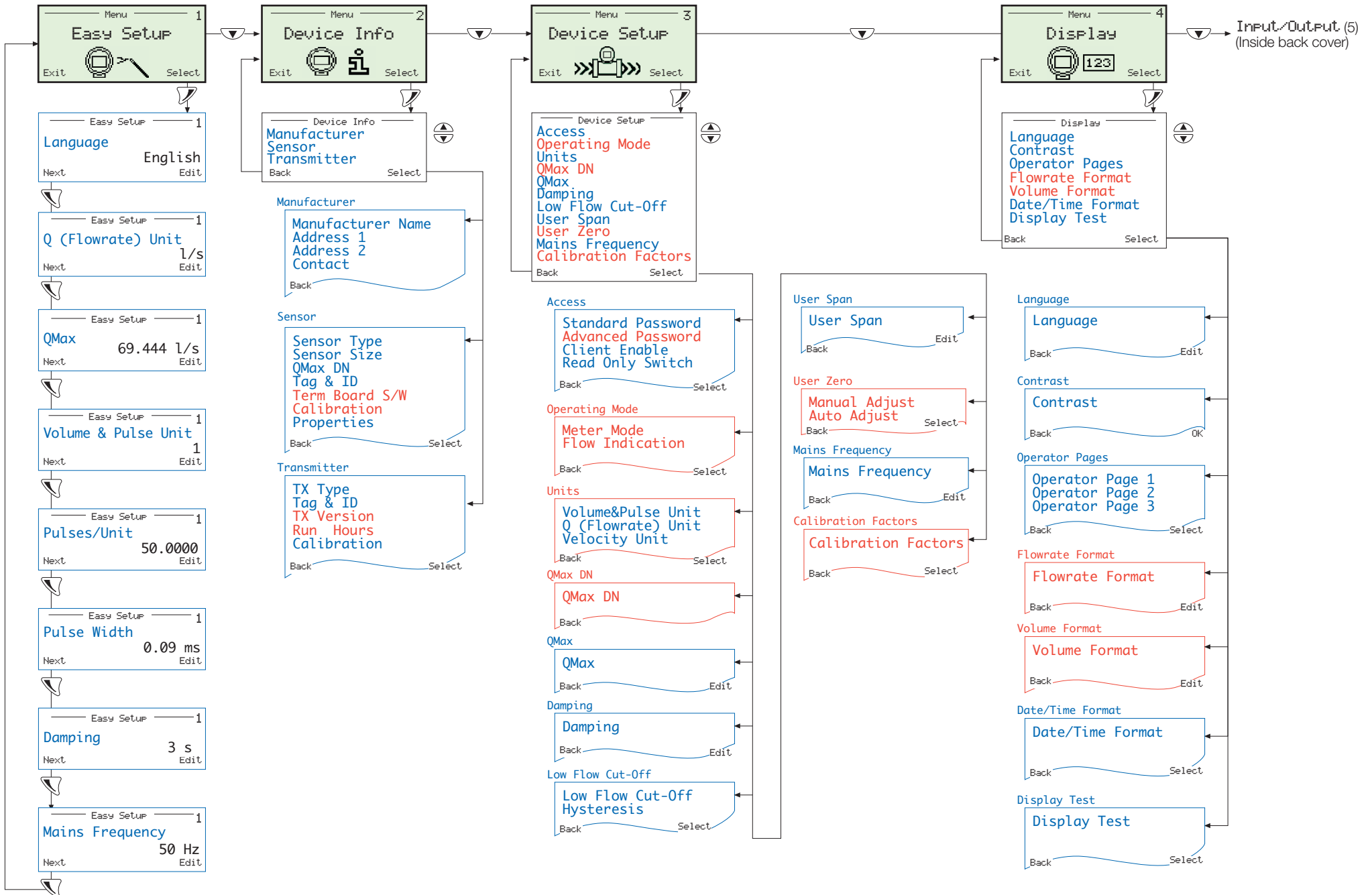


Refer to Instruction Manual IM/WM

Refer to: Section 4.2.1, page 12

Refer to: Section 4.2.2, page 14

Refer to Section 4.2.3, page 17



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1 Safety

Information in this manual is intended only to assist our customers in the efficient operation of our equipment. Use of this manual for any other purpose is specifically prohibited and its contents are not to be reproduced in full or part without prior approval of the Technical Publications Department.





1.1 Electrical Safety





This equipment complies with the requirements of CEI/IEC 61010-1:2001-2 'Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use' and complies with US NEC 500, NIST and OSHA.

If the equipment is used in a manner NOT specified by the Company, the protection provided by the equipment may be impaired.

1.2 Symbols

One or more of the following symbols may appear on the equipment labelling:

	Warning – Refer to the manual for instructions
	Caution – Risk of electric shock
	Protective earth (ground) terminal
	Earth (ground) terminal

	Direct current supply only
	Alternating current supply only
	Both direct and alternating current supply
	The equipment is protected through double insulation

1.3 Health & Safety

Health and Safety

To ensure that our products are safe and without risk to health, the following points must be noted:

- The relevant sections of these instructions must be read carefully before proceeding.
- Warning labels on containers and packages must be observed.
- Installation, operation, maintenance and servicing must only be carried out by suitably trained personnel and in accordance with the information given.
- Normal safety precautions must be taken to avoid the possibility of an accident occurring when operating in conditions of high pressure and/or temperature.
- Chemicals must be stored away from heat, protected from temperature extremes and powders kept dry. Normal safe handling procedures must be used.
- When disposing of chemicals ensure that no two chemicals are mixed.

Safety advice concerning the use of the equipment described in this manual or any relevant hazard data sheets (where applicable) may be obtained from the Company address on the back cover, together with servicing and spares information.

2 Introduction

WaterMaster™ is a range of high performance electromagnetic flowmeters for the measurement of electrically conductive fluids and systems are normally supplied factory-configured and calibrated.

This Programming Guide provides user details of the WaterMaster transmitter software for 'Read Only', 'Standard' and 'Advanced' level users.

Warning.

- System configuration must be carried out only by users or personnel with approved access rights (user privileges).
- Read all relevant sections of this guide before configuring the system or modifying system parameters.
- Install and use this equipment as detailed in the Instruction Manual (IM/WMM). Install and use associated equipment in accordance with the relevant national and local standards.

2.1 Quality Control

The UKAS Calibration Laboratory No. 0255 is just one of the ten flow calibration plants operated by the Company and is indicative of our dedication to quality and accuracy.



Fig. 2.1 UKAS Calibration Laboratory No. 0255

3 Startup Conditions

As part of the startup procedure, an automatic data integrity check is run to compare and verify data stored in the transmitter memory with data stored in the sensor memory – see Fig. 3.1.

If both sets of data match, normal operating conditions are assumed and the 'Operator Menu' is displayed – see Section 4, page 7.

If there is a data mismatch, alternative user screens are displayed according to the startup condition detected. These screens enable data and equipment to be synchronized as detailed in Section 3.3, page 5.

3.1 Data Types

Data for the system is sub-divided into three main types:

- Sensor data – comprising sensor-specific information such as: calibration factors, sensor tag and sensor serial number. Sensor data is stored in transmitter and sensor memories.
- Plant data – plant-specific information such as: flowrate, volume units and pulse/unit range. Plant data is stored in both the transmitter and sensor memories.
- Transmitter data – transmitter-specific information such as: current calibration factors, transmitter tag and transmitter serial number. Transmitter data is stored only in the transmitter memory.

3.2 Memory Configuration

Memory is allocated according to the type of system as follows:

- Remote systems have the transmitter memory fitted at the transmitter and the sensor memory fitted at the sensor.
- Integral systems and systems with remote transmitters connected to retrofit sensors have the transmitter memory and the sensor memory fitted at the transmitter (the sensor memory is mounted on the transmitter backplane).

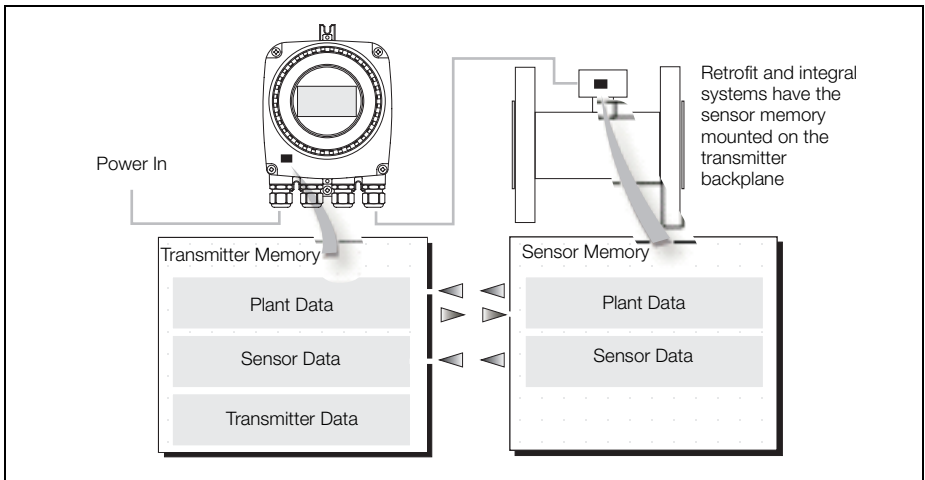
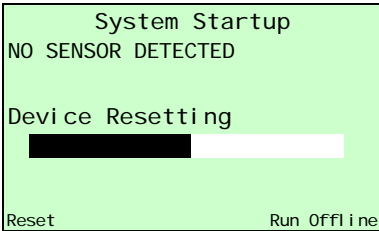


Fig. 3.1 Memory Location on Remote System


3.3 Alternative Startup Screens

Note. If a data mismatch is detected during startup (normal operating conditions are not detected) the following startup screens are displayed.

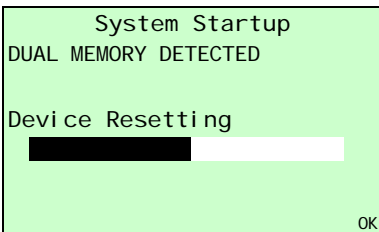


No Sensor Detected

If no sensor memory is detected during startup, an auto-recovery routine is run to look for the sensor.

If 'Run Offline' is selected during auto-recovery (by pressing the  key) the transmitter ceases to operate as a flowmeter and the following conditions apply at the transmitter:

- Plant and transmitter data can be configured (independently of the sensor location).
- Sensor data cannot be configured.

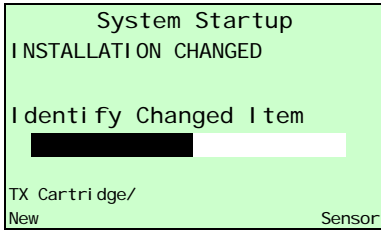


Dual Memory Detected

Integral and retrofit systems have the sensor memory mounted on the transmitter backplane board.

If two sensor types (integral and remote) are detected at startup a warning 'DUAL MEMORY DETECTED' is displayed.

To correct this condition, set dipswitch SW3 on the transmitter backplane to the 'Off' position (refer to Instruction Manual IM/WM for switch location).



Installation Changed

If the sensor data stored in the transmitter memory does not match the sensor ID and data of the connected sensor, a warning 'INSTALLATION CHANGED' is displayed.

This screen supports connection of a different transmitter to an existing sensor and then reconnection of the original transmitter after a configuration change has been made to plant data.

The changed item(s) (transmitter or sensor) can be identified and data copied as follows:

Transmitter Cartridge/New

Select this option to copy data from the sensor memory to the transmitter memory and load the totalizer from the sensor memory.

The following changes can be made:

- Remote or Integral Cartridge change
- Remote Tx change
- New installation

Sensor

Select this option to copy data from the transmitter memory to the sensor and to load the totalizer from the sensor memory.

The following changes can be made:

- Integral Backplane change
- Sensor change
- Integral – Transmitter change

4 Overview of Operator Pages and Menus

At power-up, and if startup is successful, an 'Operator' page is displayed. This is the normal operating state of the meter. Access to the 'Operator Menu' and the main menus (used for additional monitoring and to configure operation) is via an 'Operator' page – see Fig. 4.1, page 8. Each 'Operator' page can be configured to display flow information in either single or multi-line formats with a bargraph option available to three of the formats – see Section 4.2.3, page 17.

If startup is not successful at power-up (an 'Operator' page is not displayed) alternative 'System Startup' screens are displayed and the system attempts to reset itself or enables changed system items to be identified and integrated – see Section 3.3, page 5.

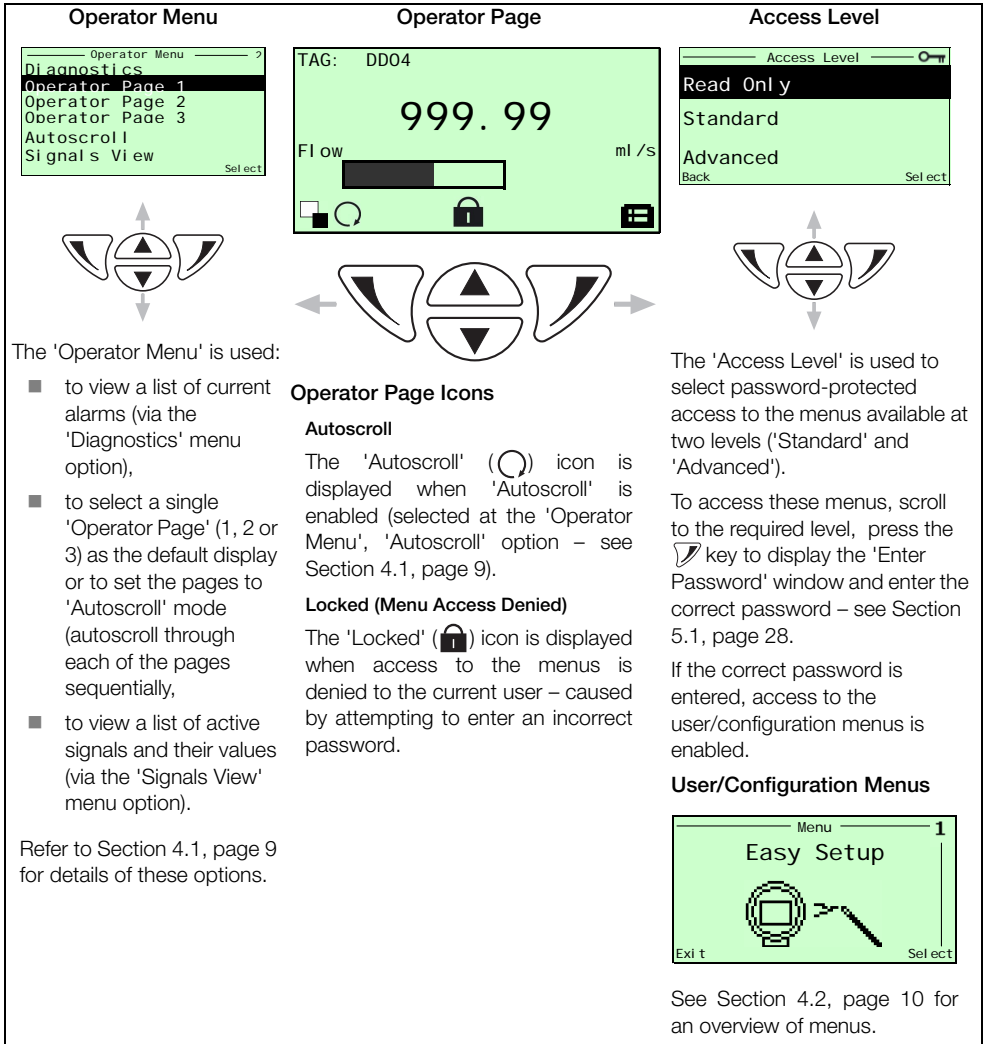
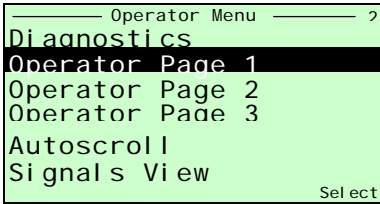


Fig. 4.1 Screen Navigation

4.1 Operator Menus

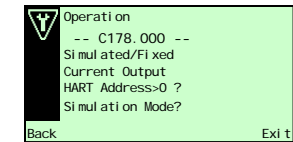


The 'Operator Menus' are accessed from an 'Operator Page' by pressing the key beneath the icon.

Three 'Operator' pages are available to monitor operation. These can be configured to display live measured values, totals and other available data.

Note. It is not possible to configure the system or to modify data from these 'Operator Menu' screens.

Display Overview	Section & Function
------------------	--------------------

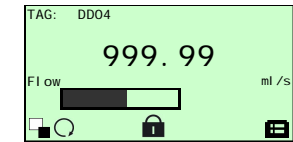


Diagnostics

Select this menu to display active diagnostic system data.

Use the and keys to scroll through all active diagnostics. Diagnostics in this screen do not include history information that is available from the 'Process Alarm', Diagnostic History' menu – see Section 4.2.5, page 21.

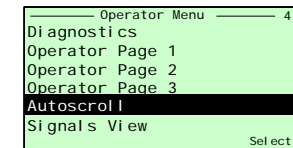
Refer to Section 7.1.1, page 33 for a list of diagnostic alarms.



Operator Page 1 (to 3)

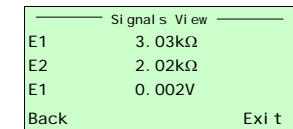
Setup of the 'Operator' pages is performed at the 'Display' menu by selecting the pre-configured display options.

When an 'Operator' page (1, 2 or 3) is selected, it is displayed and 'Autoscroll' is suspended.



Autoscroll

When 'Autoscroll' is selected, the three 'Operator' pages (1, 2 or 3) are displayed sequentially and the transmitter remains in this display mode until an individual page is selected.







Signals View

Values of active signals are displayed as follows:

- v Velocity
- E1 Electrode resistance E1
- E2 Electrode resistance E2
- E12 Inter-electrode voltage
- E1 Electrode voltage E1
- E2 Electrode voltage E2
- E12 Inter-electrode voltage
- CD1 Coil current
- CDR Coil and cable resistance (loop)

Table 4.1 Operating Menus Overview

4.2 Menus

To access menus from an 'Operator Page', press the  key beneath the  icon and enter a user password. To scroll between menus, press the  and  keys.

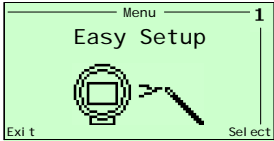
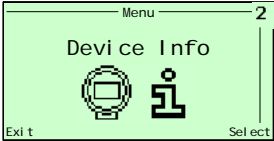
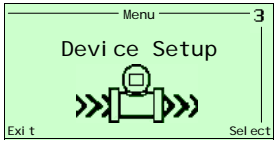

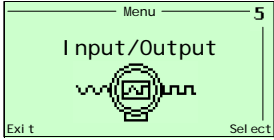
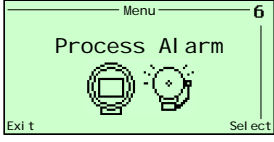
Display Overview	Section and Function
	<p>Easy Setup – see Instruction Manual (IM/WM)</p> <p>The 'Easy Setup' menu is used to set up the system quickly and offers a series of options for users with Standard and Advanced access permission. Users with 'Read Only' access cannot make selections from this menu.</p>
	<p>Device Info – see Section 4.2.1, page 12</p> <p>Identifies plant item reference details such as tag/ID information and conformance data.</p>
	<p>Device Setup – see Section 4.2.2, page 14</p> <p>Used to specify plant, transmitter and sensor data settings.</p>
	<p>Display – see Section 4.2.3, page 17</p> <p>Enables screen settings and the display format to be specified.</p>
	<p>Input/Output – see Section 4.2.4, page 19</p> <p>Used for logic and pulse setup and current output settings.</p>
	<p>Process Alarm – see Section 4.2.5, page 21</p> <p>Used to review and clear the alarm history and to set minimum and maximum flowrate alarm limits (not shown at 'Read Only' level).</p>

Table 4.2 Operating Menu Overview

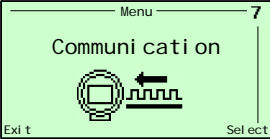
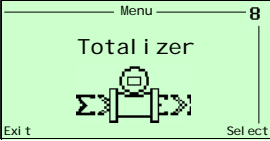

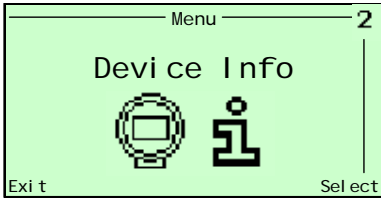
Display Overview	Section and Function
	<p>Communication – see Section 4.2.6, page 23</p> <p>Configuration of the transmitter's serial port and setup for HART communication (not shown at 'Read Only' level).</p>
	<p>Totalizer – see Section 4.2.7, page 25</p> <p>Used to reset forward, reverse and net volume totalizers (not shown at 'Read Only' level).</p>
	<p>Diagnostics – see Section 4.2.8, page 26</p> <p>Used to monitor diagnostic data and operate the meter in 'Simulation' mode.</p>

Table 4.2 Operating Menus Overview

4.2.1 Device Info

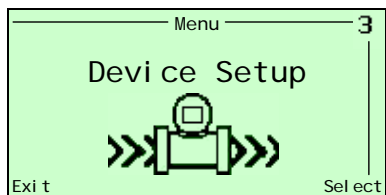


Contains equipment reference information including; version numbers, hardware location details, tag/ID details and conformance details.

Parameter	Comment/Range	[Default] Note
Manufacturer	Displays the name or ID of the transmitter manufacturer.	[ABB]
Company	The name of the manufacturer.	[Factory set]
Address 1	The first line of the manufacturer's address.	[Factory set]
Address 2	The next line of the manufacturer's address.	[Factory set]
Contact	The manufacturer's telephone number.	[Factory set]
Sensor	Contains the following sub-parameters:	
Sensor Type	The model type of the sensor (for example WM Full Bore).	[Factory set]
Sensor Size	The sensor size (for example 'DN100').	<i>Dimension in mm</i>
Probe Bore	The probe bore size – this option only appears if 'Sensor Type' is 'Probe'.	<i>Dimension in mm</i>
Special Size (Bore)	This option only appears if the 'Sensor Type' is set to 'Special'.	<i>Bore size in mm</i>
QMax DN	The nominal maximum flowrate (Q3).	<i>Populated automatically</i>
Tag & ID	Options comprise: <ul style="list-style-type: none"> ■ Location Tag ■ Sensor Tag ■ Sensor ID ■ SAP/ERP No. 	<i>Sensor-specific tag and ID numbers and SAP conformance number</i> [Factory set] [Factory set]
Term Board S/W	The software version of the sensor memory.	[Factory set]

Parameter	Comment/Range	[Default] Note
Sensor <i>(continued from previous page)</i> :		
Calibration	Options comprise: <ul style="list-style-type: none"> ■ First Cal. Date (including time) ■ Last Cal. Date (including time) ■ Cal. Cert Number ■ Last Cal. Location ■ Cal. Mode 	<i>Provides a record of sensor calibration details and sensor retrofit status.</i> [Factory set] [Geographical] [Geographical]
Properties	Options comprise: <ul style="list-style-type: none"> ■ Electrode Material ■ Lining Material ■ Sensor Run Hours 	<i>The accumulated (total) hours of sensor operation</i>
<hr/>		
Transmitter	Options comprise:	
Tx Type	Model type of transmitter.	[WaterMaster]
Tag & ID	Options comprise: <ul style="list-style-type: none"> ■ Tx Tag (description) ■ Tx ID (numerical) ■ Tx Pin (pin number) ■ SAP/ERP No. 	[Factory set]
Tx Version	Options comprise: <ul style="list-style-type: none"> ■ Application Version ■ HART F/W Version ■ Bootloader Version ■ H/W Version ■ PCB Version 	<i>(F/W) The HART firmware version</i> <i>(H/W) The transmitter hardware version</i>
Tx Run Hours	Accumulated hours transmitter of operation.	
Tx Calibration	Options comprise: <ul style="list-style-type: none"> ■ First Cal. Date (including time) ■ Last Cal. Date (including time) ■ Cal. Cert Number ■ Last Cal. Location (geographical) 	<i>Provides a record of transmitter calibration details</i> [Factory set]

4.2.2 Device Setup



Used to specify plant, transmitter and sensor data, including user access levels, security (password) codes and to set calibration parameters.

Parameter	Comment/Range	[Default] Note
Access	Used to set security access passwords.	[Timeout after 5 minutes. inactivity]
Standard Password	Alpha/numeric selection – a 'Standard' user can only edit 'Standard' passwords.	
Advanced Password	Alpha/numeric password selection of the 'Advanced' level password (not displayed at 'Standard' access level).	<i>'Advanced' users can edit 'Standard' and 'Advanced' passwords</i>
Client Enable	Options comprise: <ul style="list-style-type: none"> ■ HMI/HART ■ HMI Only ■ HART Only 	[HMI/HART] <i>Used to enable/disable the HMI or HART for control systems where local configuration changes need to be inhibited</i>
Read Only Switch	Options comprise: <ul style="list-style-type: none"> ■ Inactive ■ Active 	Displays the status of the 'Read Only' switch
Operating Mode		
Meter Mode	Options comprise: <ul style="list-style-type: none"> ■ Forward & Reverse ■ Forward ■ Reverse 	[Forward & Reverse] <i>The meter mode can be set to respond to flow in the selected direction</i>
Flow Indication	Options comprise: <ul style="list-style-type: none"> ■ Normal ■ Reversed 	[Normal] <i>Reverses the direction of flow for a meter installed backwards</i>

Parameter	Comment/Range	[Default] Note
Low Flow Cut-Off	Options comprise: <ul style="list-style-type: none"> ■ Low Flow Cut-Off (0 to 10 % of QMax) ■ Hysteresis (0.10 to 2 % of QMax) 	[0.25 %] <i>When flow is below the cut-off limit, meter output is 0</i> [0.10 %]
User Span	Range: -250 to 250 %	[100 %] <i>Adjusts meter span (%)</i>
User Zero	Options comprise*: <ul style="list-style-type: none"> ■ Manual Adjust ■ Auto Adjust 	[0] <i>Adjusts meter zero in mm/s</i> <i>Before selecting the 'Auto Adjust' option, pipe conditions must be in a state of zero flow</i>
Mains Frequency	Set to 50 or 60Hz (corresponding to the local mains frequency).	[50 Hz]
Calibration Factors	Options comprise: <ul style="list-style-type: none"> ■ Span Ss – sensor span adjustment in % ■ Zero Sz – sensor span adjustment in mm/s ■ Trim Ss ■ Calibration Mode (WaterMaster or ProcessMaster) ■ Sensor Calibration ■ Excitation Mode ■ Excitation Current ■ Factory Cutoff (in mm/s) ■ Fact. Cutoff No. Av. ■ Calibration Status 	[Factory set] [Factory set] [Factory set] [WaterMaster] [Factory set] [Factory set] [180 mA] [Factory set] [Factory set] <i>The points averaged in cutoff calculations</i> <i>Indicates if the sensor has been calibrated</i>

*The default value (0) is affected by the 'Auto Adjust' routine (the default value can be changed after an 'Auto Adjust' is run to suit operating conditions).

4.2.3 Display

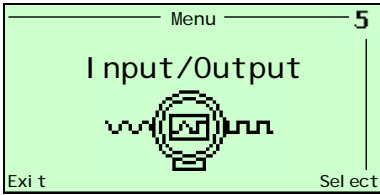


This menu is used to configure and format the information displayed, including: language, number of lines displayed (affects text size), bargraph options, screen contrast and number of decimal places for displayed data.

Parameter	Comment/Range	[Default] Note
Language	Selects the display language (English/German/French/Spanish/Italian).	[English]
Contrast	Increases/decreases the display contrast to suit local environmental conditions.	
Operator Page 1 (to 3)	Sets the number of lines and type of information to be displayed on each of the operator pages.	
Display Mode	Selects the number of lines of information and maximum number of characters displayed on each of the 'Operator' pages. Options comprise: <ul style="list-style-type: none"> ■ Off ■ 1 x 6, 1 x 6 + Bargraph ■ 1 x 9, 1 x 9 + Bargraph ■ 2 x 9, 2 x 9 + Bargraph ■ 3 x 9 	[1 x 6] <i>The unit of measure determines the number of characters displayed:</i> <i>1 x 6 displays one line with up to 6 characters,</i> <i>2 x 9 displays two lines, each with up to 9 characters,</i> <i>3 x 9 displays three lines, each with up to 9 characters,</i> <i>+ Bargraph displays a Q % bargraph on the page.</i>
1st Line (2nd Line) (3rd Line)	Specifies the type of information to be displayed on each page. Options comprise: <ul style="list-style-type: none"> ■ Volume Flow Rate ■ Q% ■ Current Out ■ Velocity ■ Volume Forward ■ Volume Reverse ■ Volume Net 	

Parameter	Comment/Range	[Default] Note
Flowrate Format	Sets the number of decimal places for the displayed flowrate value. Options comprise: <ul style="list-style-type: none">■ x■ x.x to x.xxxxx (1 to 5 decimal places)	[x.xx]
Volume Format	Sets the number of decimal places for the displayed volume value. Options comprise: <ul style="list-style-type: none">■ x■ x.x to x.xxxxx (1 to 5 decimal places)	[x.xx]
Date/Time Format	Sets the date format. Options comprise: <ul style="list-style-type: none">■ DD-MM-YYYY■ MM-DD-YYYY■ YYYY-MM-DD	[YYYY-MM-DD]
Display Test	Performs a self-test to verify the integrity of the display.	

4.2.4 Input/Output

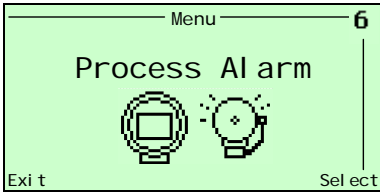


For logic and pulse setup and current output settings.

Parameter	Comment/Range	[Default] Note
Output Reading	Displays current output and pulse values.	
Current		[mA]
D01 Pulses (or)	Pulse output frequency	[Hz] Context dependent,
D01 State	(only one option is displayed).	depending on 'DO1/DO2
D02 Pulses (or)	Logic output state – open/closed	Function' setting
D02 State	(only one option is displayed).	[Open] Context dependent
D03 State	High/Low output state (open/closed).	DO3 is Logic Out only
Output Setup	Configures the function of digital outputs DO1 and DO2.	Logic/pulse options selected
D01/D02 Function	Options comprise: <ul style="list-style-type: none"> ■ FPulse/RPulse (forward/reverse pulse) ■ FPulse/Logic (forward pulse/logic output) ■ FRPulse/Logic ■ Logic/Logic 	[FRPulse/Logic]
Logic Setup	Configures the function of the logic outputs.	If DO1 = Logic, the DO1 menu is displayed
DO1 Logic	Options comprise:	If DO2 = Logic, the DO2 menu is displayed
DO2 Logic	■ No Function	[No Function]
DO3 Logic	■ F/R Signal (forward/reverse)	
	■ Digital Out Alarm	

4.2.5 Process Alarm

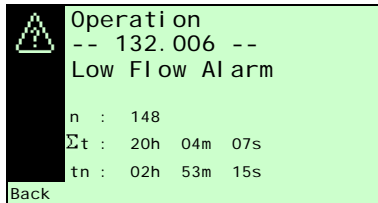
Used to review and clear the alarm history and to set minimum and maximum flowrate alarm limits.



Parameter	Comment/Range	[Default] Note
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Diagnostic History	Displays a list of alarms (since last clear alarms command). Includes a count of occurrences, total duration and time since the last occurrence.	[None] Use the ▲ and ▼ keys to scroll through the list of alarms
--------------------	--	---

Data is displayed in the following format:



n = The number of times alarm has been activated

Σt = Total time alarm has been active

tn = The elapsed time since this alarm was activated

Clear Alarm History	Clears the alarm history.	
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Group Masking	Selects groups of alarms to be masked or enabled (the 'Failure' group cannot be masked).	Alarm groups are identified in Section 7.1, page 31.
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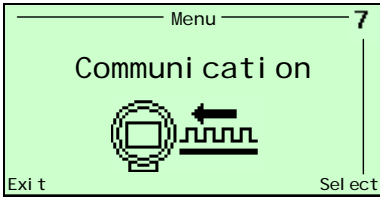
Maintenance Required	On/Off	[Off]
Function Check	On/Off	[Off]
Out of Specification	On/Off	[Off]

Individual Masking		
--------------------	--	--

Min. Alarm	On/Off	[On]
Max. Alarm	On/Off	[On]
Overrange 103%	On/Off	[On]

Parameter	Comment/Range	[Default] Note
Flowrate Limits	Min. Alarm: 0.00 to 200.00 %. Max. Alarm: 0.00 to 200.00 %.	[0] [110.00] <i>Software inhibits prevent high/low value overlap</i>
Alarm Simulation	Enables any alarm type output to be selected and simulated. Selection is made from a list of alarms such as 'No Sensor', 'Empty Pipe' etc.	[None] <i>Ensure this option is set to 'None' during normal operation</i>

4.2.6 Communication



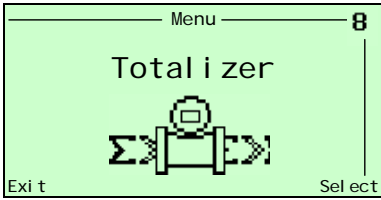
Used to configure the transmitter service port and HART parameters.

Parameters at this level are accessible only by 'Advanced' users.

Parameter	Comment/Range	[Default] Note
HART	Configures HART communication parameters.	
Device Address	Enters a device address (0 to 15).	[0]
HART Tag	Specifies a unique tag (alpha/numeric character set).	8 characters maximum
HART Descriptor	Specifies a unique description (alpha/numeric character set).	16 characters maximum
Manufacturer ID	The factory-set ID of the manufacturer.	[16]
HART Command	View last received HART command.	
Current Output HART	Sets HART current output mode (Uninterruptible/Auto).	[Uninterruptible] <i>In 'Uninterruptible' mode, HART operation over the service port is disabled. In 'Auto' mode, HART operation over the service port is enabled</i>
Device Message	Displays a device message.	<i>Note. If service port HART is in use, the current output HART is suspended</i> Up to 32 characters

Parameter	Comment/Range	[Default] Note
Cyclic Data Out	Displays a regular, updated table of information over the service port.	[1 s] <i>Cyclic data can be output to PC via the (optional) Service Port Splitter/Adaptor – refer to Section 8.5, page 46 to run a Cyclic Data Out routine</i>
Cyclic Update Rate	The rate cyclic data is updated (range: 0.1 to 3600.00 s).	
Cyclic Update Sel.	Each group can be enabled or disabled according to the cyclic data types to be updated and (optionally) output to a PC. Options comprise: <ul style="list-style-type: none"> ■ Flow Group ■ Outputs Group ■ Electrodes Group ■ Capacitances Group ■ Status Group ■ Coil Group ■ Tx Group ■ Vol. Totals Group 	[Disabled]
Service Port	Sets the Baud rate.	
Baud Rate	Baud rate options (bps): <ul style="list-style-type: none"> ■ 2400 ■ 4800 ■ 9600 ■ 19200 ■ 38400 	[38400 bps]

4.2.7 Totalizer



Enables individual resetting of forward, reverse and net volume data by 'Standard' and 'Advanced' users.

Parameter	Comment/Range	[Default] Note
Reset Vol. FWD	Resets the forward volume.	[N/A]
Reset Vol. REV	Resets the reverse volume.	[N/A]
Reset Vol. NET	Resets the net volume.	[N/A]
Reset Vol. ALL	Resets all volume totals.	[N/A]

4.2.8 Diagnostics



Enables simulations to be run. Diagnostic data is configured at the Factory and parameters can be modified by 'Advanced' users only.

Parameter	Comment/Range	[Default] Note
Simulation	When a 'Simulation' mode is selected a sub-menu appears enabling a simulation value to be entered.	
Simulation Mode	Options comprise: <ul style="list-style-type: none"> ■ None ■ Velocity ■ Q ■ Q% (-200.00 to 200.00 %) ■ IOut (3.5 to 23 mA) ■ Pulse 1 ■ Logic 2 ■ Logic 3 ■ HART Frequency (None, 1200 Hz or 2400 Hz) 	[None] [m/s] [l/s] [4 mA] <i>Display dependant on Input/Output DO1/DO2 settings</i> [1200 Hz]
Measurements	Comprising: <ul style="list-style-type: none"> ■ Elec. R E1 ■ Elec. R E2 ■ DC Back Off V (internal voltage) ■ Coil & Cable R ■ Coil L ■ Sensor L Shift ■ Tx. Av. Gain Shift 	<i>Electrode 1 resistance</i> <i>Electrode 2 resistance</i> <i>Electrode voltage differential</i> <i>Coil and cable resistance</i> <i>Coil inductance</i> <i>Coil inductance shift</i> <i>Transmitter auto-cal gain shift</i>

Parameter	Comment/Range	[Default] Note
Limits	Comprising: <ul style="list-style-type: none"> ■ Elec. R Alarm Max EP (empty pipe) ■ Elec. R Alarm Min (Electrodes) ■ Elec. V+ Limit* ■ Elec. V- Limit* ■ Elec. V Diff. Limit* ■ Coil I Alarm Band* ■ Coil O/C R Limit* ■ Coil S/C R Limit* 	*[Factory set] <i>Maximum resistance trip level</i> <i>Resistance trip for short circuit detection</i>
Velocities	Comprising: <ul style="list-style-type: none"> ■ Signal $\mu\text{V}/\text{mA}$ ■ Tx. Cal'd Velocity ■ Snsr Cal'd Velocity ■ Snsr User Velocity 	<i>The raw signal level in $\mu\text{V}/\text{mA}$</i> <i>For calibrator equipment use</i> <i>Fluid velocity in the sensor (Factory settings)</i> <i>Fluid velocity in the sensor (User settings)</i>
NVRAM	Comprising: <ul style="list-style-type: none"> ■ Write errors ■ Read Errors ■ Verify Errors 	<i>A count of errors written for the non-volatile memory</i>
Measurement State	Normal (displayed during normal operating conditions).	<i>Indicates if a measurement problem exists</i>

5 Passwords and Security Options

Password protection can be set to enable access at two levels; 'Standard' and 'Advanced'. Full end-user configuration is possible only by users who log on at the 'Advanced' level.

Note. Once the passwords have been set, the read/write permissions are as follows:

- Access at the 'Read Only' level enables a reduced set of read-only parameters to be displayed – no password is required to access these parameters.
- Access at the 'Standard' level enables a set of standard read and write parameters to be displayed.
- Access at the 'Advanced' level enables all available end-user read/write parameters to be displayed.

5.1 Setting Passwords








5.1.1 Initial Password Settings

The WaterMaster transmitter is supplied without password protection. Passwords for 'Standard' and 'Advanced' level users can be up to 6 characters and are not case sensitive. If password privileges are required, these should be set by a local System Administrator or other designated authority.

Note. When allocating passwords, record a copy of each password and store in a safe location. It is not possible to interrogate the transmitter to 'recover' passwords once they have been set.

5.1.2 Entering Passwords

To select password characters and enter passwords:

1. Scroll to the 'Access Level' screen and select the required password level ('Standard' or 'Advanced'). Press the  key to open the 'Enter Password' screen.
2. Use the  and  keys to scroll to and highlight the first password character to be selected.
3. Press the  key to select the highlighted character (add it to the password set).
4. Use the  and  keys to highlight the next password character to be selected.
5. Repeat the previous 3 steps (2 to 4) until all characters have been added to the password.
6. Press the  key to accept the password and display the menus available at the current access level.

5.1.3 Resetting Passwords

Passwords at both 'Standard' and 'Advanced' levels can be reset by 'Advanced' level users, but the existing password must be known before it can be changed. 'Standard' level passwords can be reset only by users with 'Standard' level access privileges.

Note. There is no limit to the number of times a user can attempt to enter an incorrect password.

5.2 Security/Anti-tamper Sealing

If additional software security is required, the transmitter software can be set to 'Read Only' mode by placing dip switch SW1 to the 'On' position. This switch option can be used in conjunction with physical anti-tamper security seals to provide maximum protection.

Refer to Instruction Manual (IM/WM) for details of dip switch SW1 positions and anti-tamper seal locations.

6 HART®-Protocol

6.1 Overview

WaterMaster transmitters are HART-compatible, factory-calibrated devices. HART-Protocol enables simultaneous indication of process variables and digital communication. The 4 to 20 mA current output signal (minimum load 250 Ω) transmits process information and the digital signal is used for bi-directional communication. The analog process value output enables analog indicators, recorders and controllers to be used, while the simultaneous digital communication uses HART-Protocol.

6.2 Hardware and Software Requirements

Item	Description
Device Manager (Hardware)	<p>Install a device manager (FSK [Frequency Shift Keyed]-Modem) for HART-Communication when connecting to a PC.</p> <p>The HART-Modem converts the analog 4 to 20 mA signal into a digital output signal (Bell Standard 202) and connects to the PC using a USB (or RS232C) connector.</p> <p>Alternatively, a hand-held terminal can be used (following).</p>
Hand-held Terminal	<p>The transmitter can be accessed and configured using a compatible hand-held terminal (such as the HART HHT Type 375 or equivalent).</p> <p>Transmitter connection is made in parallel with the 4 to 20 mA current output – refer to Instruction Manual (IM/WM), Current Output (4 to 20 mA) for terminal connection details.</p>
SMART VISION® Software – Release R4 or later	<p>SMART VISION® is a Management Software that communicates with HART-compatible instruments using 'Universal' and 'Common Practice' commands.</p> <p>The software also includes the ability to:</p> <ul style="list-style-type: none"> ■ Configure and display process relevant variables. ■ Run a periodic, self-monitoring routine to check connected field instruments. ■ Support manufacturer-specific commands so that the functional range of the installed equipment can be utilized.

Table 6.1 HART-Protocol – Hardware/Software Requirements

6.3 HART-Protocol Configuration

WaterMasters are read and configured using Common Practice and Universal commands for the following flowrates:

- Q
- QMax (PV, URV)
- Damping
- Iout
- Loop Test (4 to 20 mA)
- HART Descriptor
- HART Tag
- HART Device Message

6.4 HART-Protocol Connection

Fig. 6.1 shows HART-Protocol connection details for WaterMaster installations.

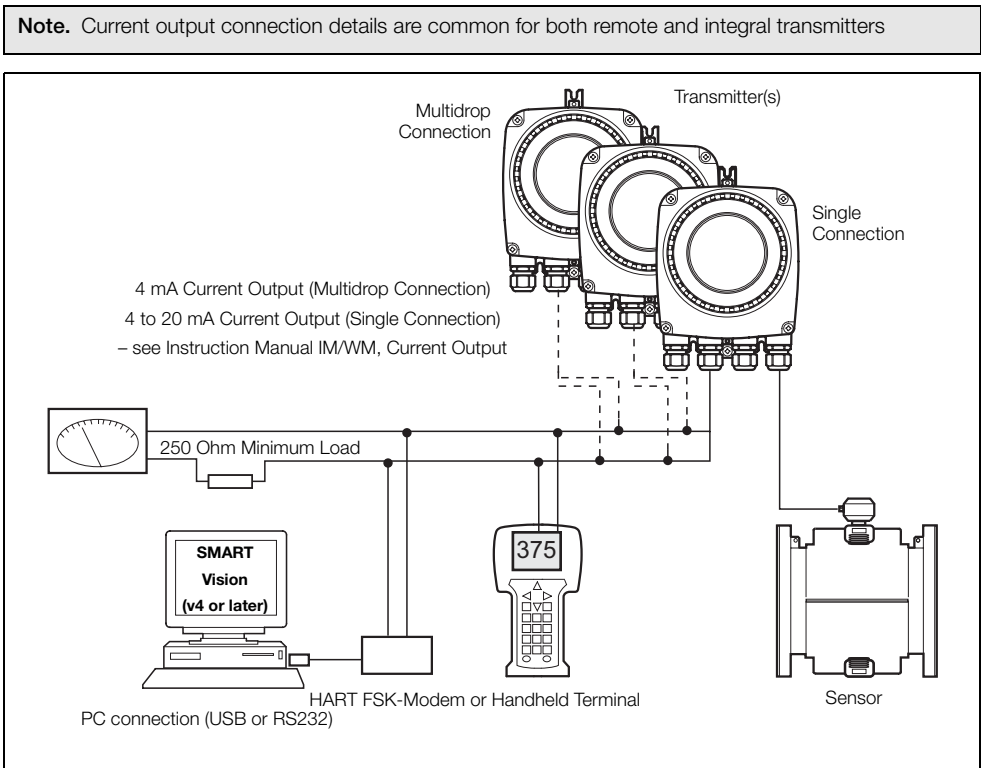


Fig. 6.1 HART-Protocol Connection (Remote Installation Shown)

7 Troubleshooting

7.1 Alarms

Alarm codes and icons conforming to the NAMUR NE107 classification code are used to define errors during operation and data entry. An overview of a typical alarm code is shown in the following diagram:

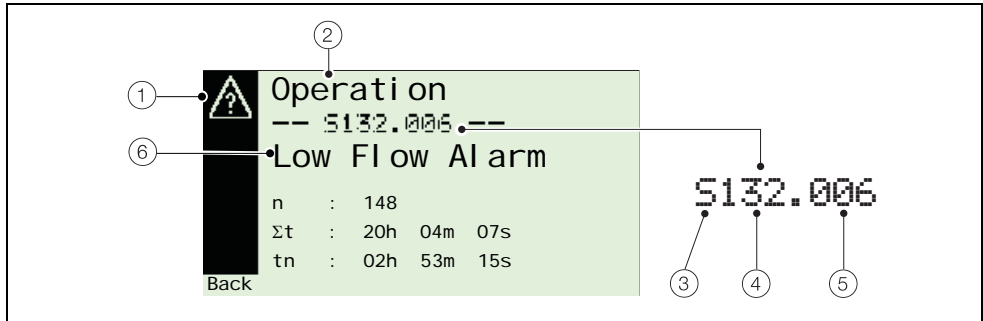


Fig. 7.1 Example Alarm Code and Components





Item	Description	Item	Description
①	<p>Status Icon (associated with NAMUR classification code) ③):</p> <ul style="list-style-type: none"> ■  Maintenance Required ■  Out of Specification ■  Check Function ■  Failure 	④	<p>Alarm Priority:</p> <ul style="list-style-type: none"> ■ None 001 to 050 ■ Maintenance 051 to 100 ■ Out of Specification 101 to 150 ■ Check Function 151 to 200 ■ Failure 201 to 250
②	<p>Group Name:</p> <ul style="list-style-type: none"> ■ Electronics ■ Sensor ■ Status ■ Operating Condition 	⑤	<p>Alarm Number:</p> <ul style="list-style-type: none"> ■ Minimum 000 ■ Maximum 099
③	<p>NAMUR Classification Code:</p> <ul style="list-style-type: none"> ■ M Maintenance Required ■ S Out of Specification ■ C Check Function ■ F Failure 	⑥	<p>Alarm Text:</p> <ul style="list-style-type: none"> ■ Text comprises a unique message associated with the alarm code displayed. ■ For alarm codes and alarm text, see Section 7.1.1, page 33

Table 7.1 Alarm Code Components

7.1.1 Alarm Codes

The following list of alarm codes can be used for troubleshooting and alarm diagnosis:

Alarm Code & Displayed Message	Description	Possible Cause(s)	Corrective Measure(s)
_030.012 Totalizer reset	The totalizer has been reset to zero.	The user requested a totalizer reset.	None
M080.011 At Qmax, Volume display overrun <1600hrs Adjust units or resolution	With a flow rate equal to Qmax, the 'Volume' display overruns in less than 1600 hours, assuming an OIML-compliant 7-digit display. In practice, WaterMaster has 11 digits.	Inappropriate 'Display Format' or 'Volume Units' choice for this meter size.	Adjust the 'Volume Display Format' setting to use less digits after the decimal point. Select different 'Volume Units' for this meter size.
M090.013 Intermittent sensor comms. Check sensor wiring?	Intermittent data communications detected between the transmitter and the remote sensor electronics.	This error occurs only on remote sensor systems that have electronics housed in the remote sensor assembly. Sensor cable defective; open or short-circuit; poor connections. Defective sensor electronics.	Check sensor cable and its connections. Contact local representative.
M094.033 Current output hardware fault Contact Service	Communications fault detected in the circuit for the current output.	Defective transmitter cartridge electronics.	Replace cartridge. Contact local representative.
S105.030 Accuracy? Warning Electrode volts Problem	Accuracy potentially affected by high electrode voltages.	High absolute electrode voltages. Absolute electrode voltage limits configuration.	Investigate/correct electrode voltage problem. Contact local representative.
S110.034 Sensor setup not complete Finish setup, set 'Cal Status	System calibration not completed correctly.	System calibration procedure not completed correctly.	If the sensor is a retrofit to an old sensor, contact local representative for an upgrade procedure.

Table 7.2 List of Alarms

Alarm Code & Displayed Message	Description	Possible Cause(s)	Corrective Measure(s)
S132.006 Low Flow Alarm	Flow rate is below the 'Minimum Alarm' limit.	Low flow rate. 'Minimum Alarm' limit not configured correctly.	Increase flow rate. Decrease the value of the 'Minimum Alarm' limit.
S136.007 High Flow Alarm	Flow rate is above the 'Maximum Alarm' limit.	High flow rate. 'Maximum Alarm' limit not configured correctly.	Reduce flow rate. Increase the value of the 'Maximum Alarm' limit.
S140.008 Current Output limited Q >103% Qmax Check Qmax?	Flow rate is above 103 % of 'Qmax' limit. 4 to 20 mA output is set to 'High Alarm'. Volume totalizer still operates.	High flow rate. 'Qmax' setting too low.	Reduce flow rate. Increase the value of 'Qmax'.
S146.022 Short circuit electrode Check wiring?	A short-circuit electrode has been detected.	Electrode wiring or cable fault. Bad connection. 'Elec R Alarm Min' set too low.	Investigate/repair electrode circuit. Check the 'Electrode R Alarm Min.'. Contact local representative.
S147.021 Open circuit electrode Check wiring? Electrode coated	An open-circuit electrode has been detected.	Broken electrode wire or cable fault. Bad connection. Electrode 'Elec R Alarm Max EP' set too low.	Investigate/repair electrode circuit. Check the 'Electrode R Alarm Max. EP'. Contact local representative.
S150.018 Empty pipe If full, check EP Trip limit	Empty pipe conditions have been detected.	The pipe is empty and the electrodes are not in contact with fluid. If the pipe is full, the 'Electrode R Alarm Max. EP Limit' may not be configured correctly.	Ensure meter pipe is full. Check the 'Electrode R Alarm Max.EP Limit'. Contact local representative.
C153.038 HART frequency simulation active.	The HART output is simulating one of the two signalling frequencies.	Simulation mode is enabled and the HART frequency is being driven with a user-selected value.	Stop simulation of HART output frequency.

Table 7.2 List of Alarms

Alarm Code & Displayed Message	Description	Possible Cause(s)	Corrective Measure(s)
C160.005 Logic Simulation selected on OP3	OP3 output is being simulated.	Simulation mode is enabled and the OP3 logic output state is being driven with a user-selected value.	Stop simulation of OP3 logic output.
C164.003 Logic Simulation selected on OP2	OP2 output is being simulated.	Simulation mode is enabled and the OP2 logic output state is being driven with a user-selected value.	Stop simulation of OP2 logic output.
C168.001 Logic Simulation selected on OP1	OP1 output state is being simulated.	Simulation mode is enabled and the OP1 logic output state is being driven with a user-selected value.	Stop simulation of OP1 logic output.
C172.004 Pulse Simulation selected on OP2	OP2 output frequency is being simulated.	Simulation mode is enabled and the OP2 frequency output is being driven with a user-defined value. This enables the output frequency to be checked with a counter.	Stop simulation of OP2 frequency output.
C174.002 Pulse Simulation selected on OP1	OP1 output frequency is being simulated.	Simulation mode is enabled and the OP1 frequency output is being driven with a user-defined value. This enables the output frequency to be checked with a counter.	Stop simulation of OP1 frequency output.

Table 7.2 List of Alarms

Alarm Code & Displayed Message	Description	Possible Cause(s)	Corrective Measure(s)
C178.000 Simulated/Fixed Current Output HART address>0 ? Simulation Mode?	Current output is set to a fixed value.	The 4 to 20 mA output is being simulated using a chosen value. This enables the current at the connection terminals to be checked with test equipment. The HART Instrument Address is not 0 so HART Multidrop mode is active (current out fixed to 4mA).	Stop simulating 4 to 20 mA output. Set HART address to 0.
C182.009 Simulation Mode On	Flow rate or flow velocity value is being simulated.	Simulation Mode is enabled and either flow rate or flow velocity is being simulated using a chosen value. The outputs correspond to the simulated value set.	Stop simulation of flow rate or flow velocity.
C186.010 Tx. Simulator /Calibrator mode	The transmitter is using a calibrator or simulator.	The calibrator or simulator sensor electronics has been configured for calibrator or simulator use.	Remove transmitter from calibrator or simulator.
F220.017 Tx. Measurement suspended Contact Service	Problem with transmitter measurement system detected.	Unexpected electrical conditions detected.	Replace cartridge. Contact local representative.
M226.031 OIML self-check limits exceeded. Contact Service.	Transmitter or sensor OIML self-check values have been detected out of range.	Unexpected degradation of key transmitter or sensor measurement parts.	Contact local representative.
F230.029 Bad flow data. Check wiring ? Contact Service	Problem with data obtained by the transmitter measurement system.	Out of bounds data values detected by the measurement system. Sensor wiring or cable fault.	Investigate/repair sensor wiring and connections. Contact local representative.

Table 7.2 List of Alarms

Alarm Code & Displayed Message	Description	Possible Cause(s)	Corrective Measure(s)
F232.028 Transmitter hardware fault Contact Service	A problem with the transmitter electronics has been detected.	Defective transmitter cartridge electronics.	Replace cartridge. Contact local representative.
F234.027 Check cable+coil resistance Cable too long? Sensor fault ? Contact service.	An out-of-range loop resistance has been detected.	Sensor wiring or cable altered or faulty.	Investigate/correct loop circuit problem. Contact local representative.
F236.026 Short circuit coil/wiring Check wiring?	A short-circuit coil has been detected.	Sensor wiring or cable fault.	Investigate/correct coil circuit problem. Contact local representative.
F238.025 Open circuit coil/wiring Check wiring?	An open-circuit coil has been detected.	Sensor wiring or cable fault. 'Coil Open Circuit Resistance Limit' configuration.	Investigate/correct coil circuit problem. Check the 'Coil Open Circuit Resistance Limit' configuration. Contact local representative.
F247.024 Installation fault/condition Electrode problem?	A problem with the installation's electrode potentials has been detected.	High differential electrode voltage. Differential electrode voltage limits configuration.	Investigate/correct electrode voltage problem. Contact local representative.
F248.035 Incompatible sensor Contact Service	Incompatible transmitter and sensor calibration modes detected.	The transmitter and sensor calibration modes are not matched and the transmitter and sensor must not be used together.	Contact local representative.
F250.015 Tx. memory fault detected Contact Service	Communications fault detected with the on-board transmitter memory.	Memory circuit in the transmitter cartridge is defective.	Replace cartridge. Contact local representative.

Table 7.2 List of Alarms

Alarm Code & Displayed Message	Description	Possible Cause(s)	Corrective Measure(s)
F252.16 Sensor memory not detected. Offline Mode? Check wiring? Check Switches?	No sensor memory detected.	No sensor connected. Meter in 'Off-Line' mode.	Check sensor cable and its connections. Connect a sensor. If using an Integral meter check the backplane dip switch configuration – see Instruction Manual (IM/WM). Contact local representative.
F253.36 Tx. Code memory fault Contact Service	Corrupted firmware detected in the transmitter.	A CRC failure was detected in the ROM code memory of the transmitter. Defective transmitter cartridge electronics.	Contact local representative.
F254.37 Tx. data memory fault Contact Service	A memory fault detected in the transmitter.	A write/read failure detected in the data memory of the transmitter. Defective transmitter cartridge electronics.	Replace cartridge. Contact local representative.

Table 7.2 List of Alarms

8 Remote Computer Connection

8.1 Overview of PC Applications

Transmitters can be operated and configured from a PC if the 'Service Port Splitter' applications, drivers and utilities are installed and an (optional) service port adaptor is connected. Cyclic and parameter data can also be downloaded and saved to Excel worksheets.

The following PC-compatible software is installed from the installation CD:

Item	Description
Remote HMI Client	An ABB application used to emulate the ABB HMI loaded onto the WaterMaster transmitter.
ABB Service Port Splitter (Comms. Port Driver)	A driver used to manage data (including error detection) sent from the transmitter to a PC's physical port. When the service is running, transmitter data is multiplexed to specific client applications connected via up to four virtual COM ports.
.NET Framework	A Microsoft environment required for the Service Port Splitter service to run.
USB Driver	The software driver for the service port adaptor.

Table 8.1 Overview of PC Applications

8.2 Installing the Software

To install transmitter software and services onto a PC:

1. Insert the CD into the PC disk drive and wait for the installation screen to display.
2. Click 'Install' to install the software to the default directory on the PC.
3. At the 'Installation Complete' prompt click 'OK'.
4. Exit all applications and restart the PC.
5. Connect the service port adaptor to the transmitter and PC – see Section 8.3, page 40.
6. Configure the 'Service Port Splitter' application, see Section 8.4, page 41.

8.3 Connecting the Service Port Adaptor

Position the service port adaptor accurately on the transmitter display area and connect the USB plug to the USB port of the PC – see Fig. 8.1.

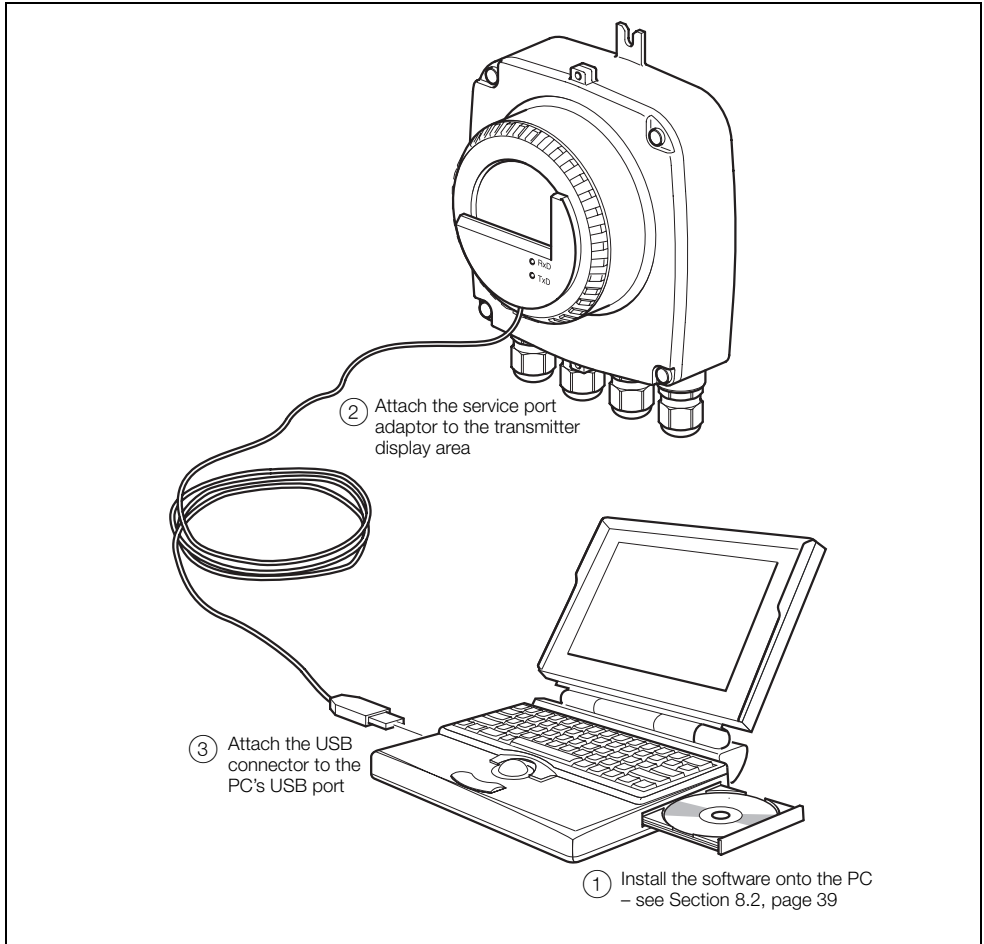


Fig. 8.1 Connecting the Service Port Adaptor

8.4 Configuring the Service Port Splitter

8.4.1 Configuration Overview

The Service Port Splitter can be configured to assign up to four virtual COM ports to individual client applications. Data can be transmitted to different virtual ports concurrently.

A typical virtual port configuration could contain the following settings:

- Client 1 – assigned to the remote HMI application.
- Client 2 – assigned a HART-compatible application.
- Client 3 – assigned to output cyclic data (to an Excel worksheet).
- Client 4 – assigned to output parameter data (to an Excel worksheet or a text file). The parameter data includes configuration settings.

Fig. 8.2 is a representation of a typical virtual port configuration (COM numbers are selected during configuration – see Section 8.4.2, page 42):

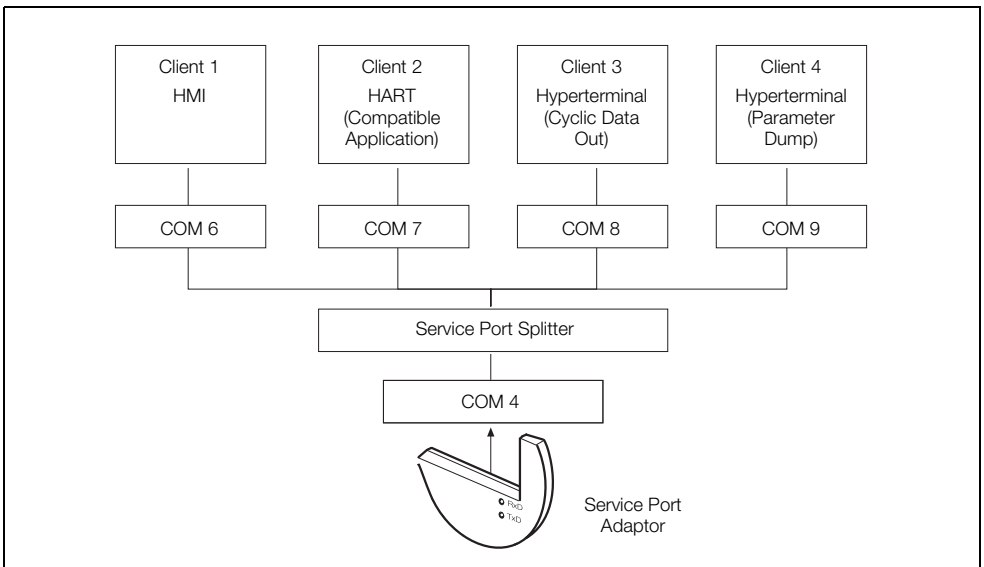


Fig. 8.2 Typical Service Port Splitter Configuration

8.4.2 COM Port and Client Configuration

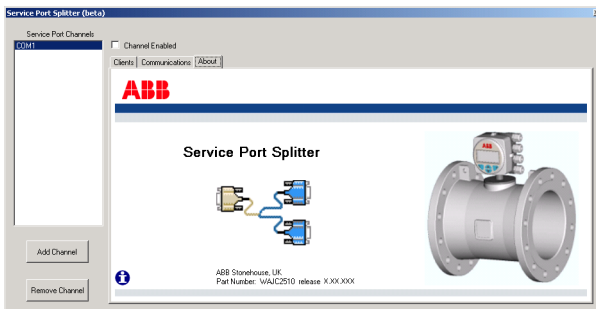
To configure the COM ports and clients:

1. Connect the service port adaptor to the transmitter – see Section 8.3, page 40.
2. Launch the 'Service Port Splitter' from the Windows 'Start' menu (Start\Programs\ABB\Service Port Splitter) or, if the service is already running, double-click the desktop tray icon:

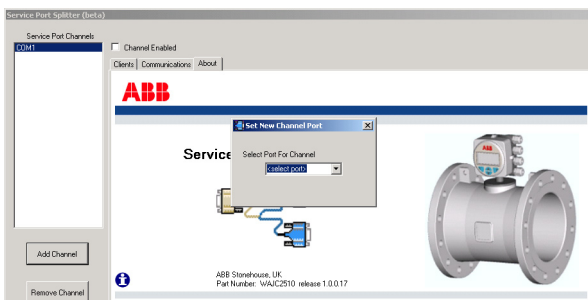
'Service Port Splitter' Icon



3. The 'Service Port Splitter' splash screen is displayed.

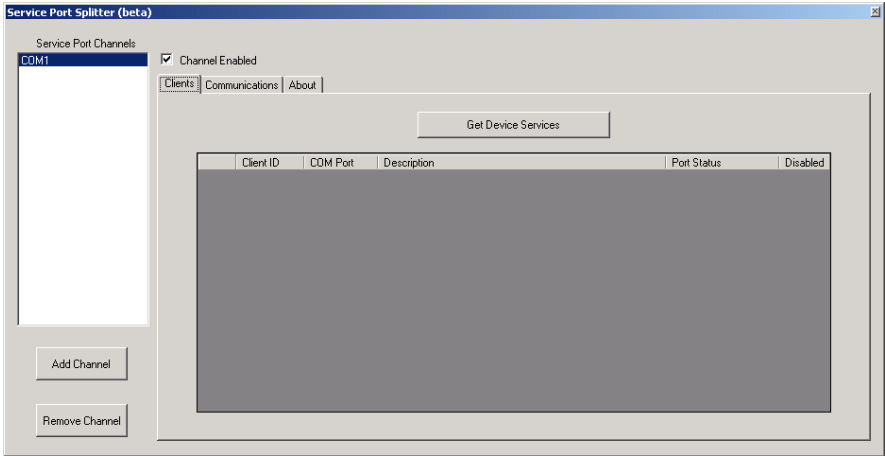


4. Click the 'Add Channel' button. The 'Set New Channel Port' dialog is displayed:

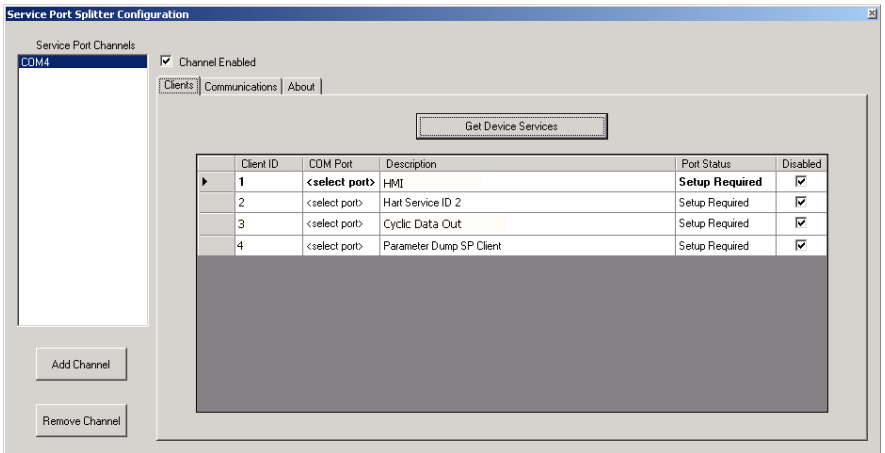


5. In the drop-down list, select a port number. Click in the 'Channel Enabled' check box.
6. Click in the 'Channel Enabled' check box. The selected port number is displayed in the 'Service Port Channels' pane.

7. Click the 'Clients' tab. The 'Clients' pane is displayed:



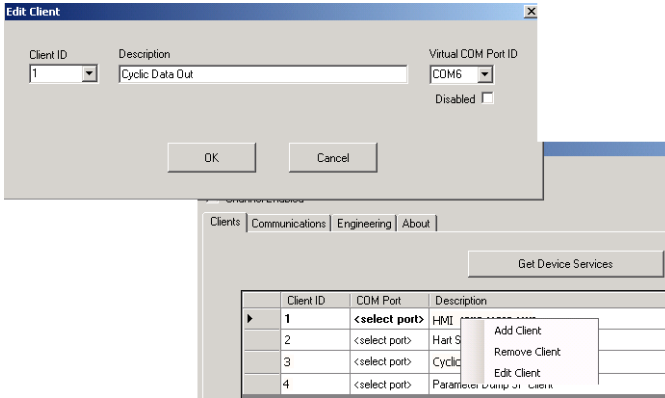
8. Click 'Get Device Services'. The 'Get Device Services' pane is populated with the available services:



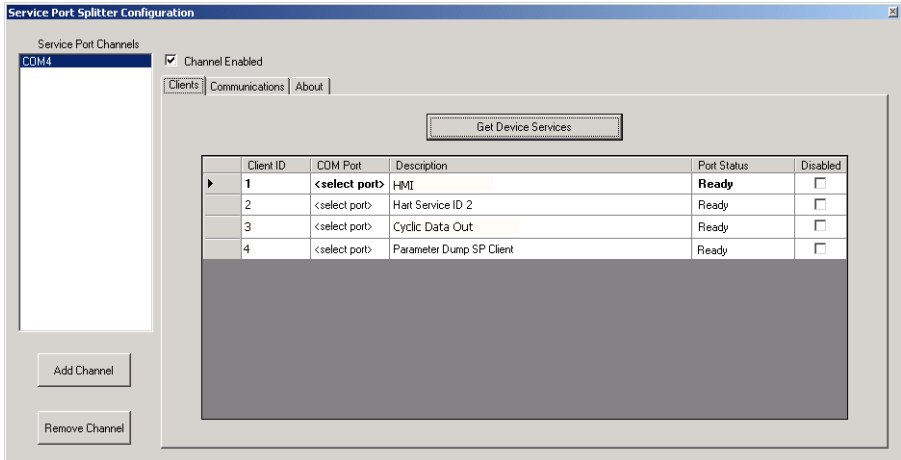
9. Position the cursor in top row, 'Client ID' title field and right-mouse click to display the context menu.

10. Select 'Edit Client'.

11. The 'Edit Client' dialog is displayed:



12. In the drop-down 'Client ID' field, select a number to specify the client ID.
13. In the 'Description' field, add a description for the client.
14. In the drop-down 'Virtual COM Port ID' field, select a free port number for this client.
15. Deselect the 'Disabled' check box.
16. Click 'OK' to display the modified client's configuration details in the 'Clients' pane.
17. Repeat steps 12 to 16 to configure each of the remaining virtual ports (four maximum).



8.4.3 Stopping the Service

To stop the 'Service Port Splitter' service for any reason:

1. Right-mouse click the 'Service Port Splitter' tray icon. A context menu is displayed.

'Service Port Splitter' Icon



2. Select 'Stop Service'.
3. The driver exits and connection to the virtual ports is terminated.

8.4.4 Starting the Service

To (re)start the 'Service Port Splitter' service:

1. From the Windows 'Start' menu select \Programs\ABB\Service Port Splitter.
2. The service is (re)started, the 'Service Port Splitter' icon (re)appears in the tray and connection to the virtual ports is reinstated.

8.5 Cyclic Data Out

Cyclic data can be saved and output to an Excel spreadsheet or as text. The update rate and data groups enabled for output are selected at the 'Communication'/'Cyclic Data Out'/'Cyclic Update Rate' parameter – see Section 4.2.6, page 23.

To output cyclic data:

1. Launch a terminal application (such as Hyperterminal or similar).
2. Configure the terminal application to communicate with the COM port specified for cyclic data output (a example is detailed in Section 8.4.1, page 41, where COM 8 is assigned to Client 3 (Cyclic Data Out)).
3. To start the output routine, press 'P' on the PC keyboard (press 'S' to stop). A header row is created and enabled data groups are output at the rate set in the 'Communication'/'Cyclic Data Out'/'Cyclic Update Rate' parameter – see Section 4.2.6, page 23.

T(s)	Q(%)	Q(l/s)	v(m/s)
2032.4	18.177	12.623	1.6072
2033.4	18.176	12.622	1.6071
2034.4	18.182	12.626	1.6077
2035.4	18.192	12.634	1.6085
2036.4	18.198	12.637	1.6091
2037.4	18.197	12.637	1.6090
2038.4	18.196	12.636	1.6089
2039.4	18.190	12.632	1.6083
2040.4	18.189	12.631	1.6082
2041.4	18.188	12.631	1.6082
2042.5	18.236	12.664	1.6125
2043.4	18.226	12.657	1.6115
2044.4	18.214	12.649	1.6105
2045.4	18.207	12.644	1.6098
2046.4	18.209	12.645	1.6100
2047.4	18.201	12.640	1.6093
2048.4	18.193	12.634	1.6087
2049.4	18.198	12.638	1.6091
2050.4	18.201	12.640	1.6093
2051.4	18.198	12.638	1.6091
2052.4	18.200	12.639	1.6092

4. To output the data to a spreadsheet, use the capture capability to save a text (.txt) file and open it into Excel, selecting the file type as 'Delimited' at the Excel 'Text Import Wizard'. Data is then labelled and formatted automatically for display and analysis.

8.6 Parameter Dump

The parameter dump option enables two types of information to be gathered:

- Configuration information
- Signals and Alarm information

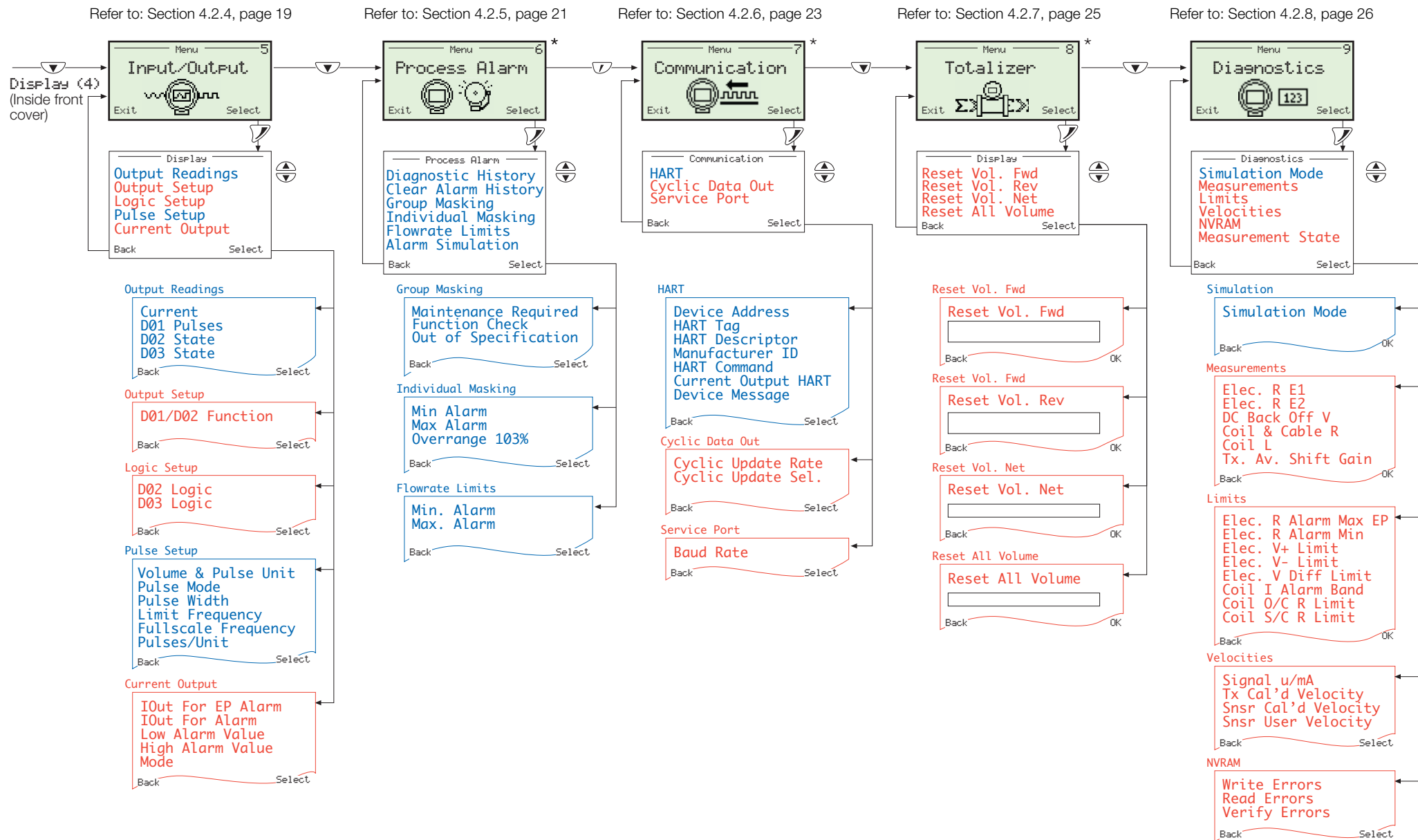
To run a **Configuration** parameter dump:

1. Launch a terminal application.
2. Configure the terminal application to communicate with the COM port specified for cyclic data output (an example is detailed in Section 8.4.1, page 41, where COM 9 is assigned to Client 4 [Parameter Dump]).
3. To start the output routine, press 'C' on the PC keyboard. Parameter data and configuration settings are displayed by the terminal application.
4. To output the data to a spreadsheet, capture the data as a text (.txt) file, open it into Excel and select the file type as 'Delimited' using a ';' delimiter at the Excel 'Text Import Wizard'.

To run a **Signals and Alarm** parameter dump:

1. Launch a terminal application.
2. Configure the terminal application to communicate with the COM port specified for cyclic data output (an example is detailed in Section 8.4.1, page 41, where COM 9 is assigned to Client 4 [Parameter Dump]).
3. To start the output routine, press 'I' on the PC keyboard. A header row is created and parameter data and configuration settings are imported into Hyperterminal.
4. To output the data to a spreadsheet, capture the data as a text (.txt) file, open it into Excel and select the file type as 'Delimited' using a ';' delimiter at the Excel 'Text Import Wizard'.

Notes



*These screens are not displayed at 'Read Only' level

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Client Warranty

Prior to installation, the equipment referred to in this manual must be stored in a clean, dry environment, in accordance with the Company's published specification.

Periodic checks must be made on the equipment's condition. In the event of a failure under warranty, the following documentation must be provided as substantiation:

1. A listing evidencing process operation and alarm logs at time of failure.
2. Copies of all storage, installation, operating and maintenance records relating to the alleged faulty unit.



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