User Guide IM/CM/I–EN Rev. K

ControlMaster CM15 and CMF160
Universal process indicator / DIN and fieldmount

Power and productivity
for a better world™

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.

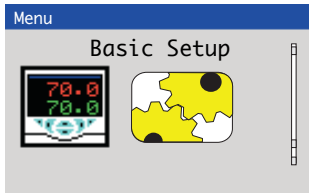
As a part of ABB, a world leader in process automation technology, we offer customers application expertise, service and support worldwide.

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.

Basic Level

Refer to Section 6, page 32*

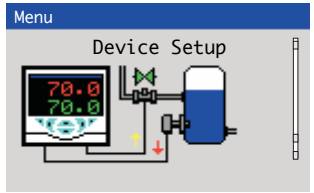


- Process Alarms
  - Alarm Trip 1
  - Alarm Trip 2
  - Alarm Trip 3
  - Alarm Trip 4
  - Alarm Trip 5
  - Alarm Trip 6
  - Alarm Trip 7
  - Alarm Trip 8

*Additional parameters may be enabled and displayed at Basic Setup level depending on the parameters selected at Advanced Level.

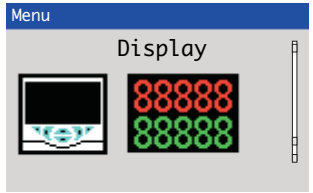
Advanced Level

Refer to Section 7.1, page 33



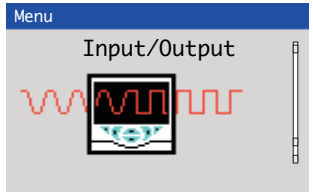
- Initial Setup
  - App. Template
  - Instrument Tag
  - Mains Frequency
  - Config Action
  - Level 1 Indicator
  - Stats. Reset Source
  - Reset to Defaults
  - Custom
- Security Setup
  - Basic Password
  - Advanced Password
  - Reset Passwords
- Custom Config
  - Loop 1 PV
  - Volume 1
  - Loop 2 PV
  - Volume 2
- IrDA Configuration
  - Setup
  - Config. Description

Refer to Section 7.2, page 37



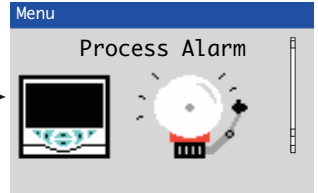
- Language
- Operator Templates
  - Page 1 (4) Template
- Operator Functions
  - Autoscroll
  - Soft Key Function
  - Alarm Ack. Enable
  - Totalizer Stop/Go
  - Totalizer Reset
  - Stats Reset Enable
- Settings
  - Brightness
- Date & Time
  - Date Format
  - Time & Date
  - Daylight Saving
- Customise Pages
  - Page Number
  - Template Type
  - Titlebar Tag
  - Parameters
  - Icons
  - Page Colors

Refer to Section 7.3, page 43



- Analog Inputs
  - Analog Input 1 (2)
- Analog Outputs
  - Analog Output 1 (2)
- Digital I/O
  - Digital IO 1 (2)
- Relays
  - Relay 1 (4)

Refer to Section 7.4, page 50



- Alarm 1 (8)
  - Type
  - Tag
  - Source
  - Trip
  - Hysteresis
  - Time Hysteresis
  - Display Enable
- Acknowledge Source
- Enable Source

See Back Cover

Note. When in Advanced Level (configuration) mode, press and hold the ⮜ key to return to the standard Operator page – see Section 5, page 28.

Contents

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 61010-1:2010 3rd edition '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
	Functional earth (ground) terminal
	Protective 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.

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, together with servicing and spares information.

2 Introduction

This manual provides details for the ControlMaster CM15 (1/8 DIN) and CMF160 fieldmount indicators.

Note.

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

2.1 EC Directive 89/336/EEC

In order to meet the requirements of the EC Directive 89/336/EEC for EMC regulations, this product must be used in an industrial environment.

2.2 End of Life Disposal

Indicators with Standard functionality and above contain a small lithium battery that must be removed and disposed of responsibly in accordance with local environmental regulations.

Indicators with Basic functionality do not contain any substance that causes undue harm to the environment and must be disposed of in accordance with the Directive on Waste Electrical and Electronic Equipment (WEEE). They must not be disposed of in Municipal Waste Collection.

3 Display, Icons and Keys

3.1 CM15 Indicator

An example of an *Operator Page* is shown in Fig. 3.1.

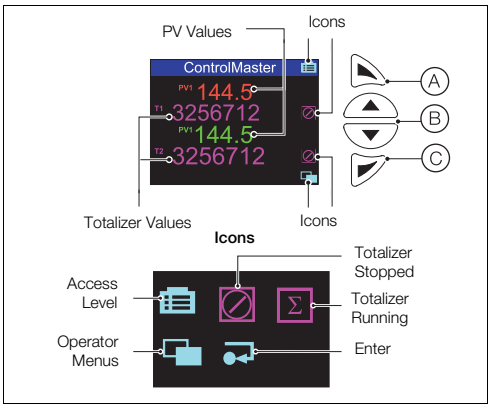


Fig. 3.1 ControlMaster CM15 Operator Page and Keys

Ⓐ	Navigation key (upper) / programmable *Soft Key* – see page 38.
Ⓑ	Up / Down keys – navigate up / down menu items and increase / decrease displayed values
Ⓒ	Navigation key (lower) / *Operator Level* access key.

Table 3.1 CM15 Front Panel Key Functions

Note. When a *Soft Key* option is assigned to the (upper) navigation key Ⓐ, the *Advanced Level* (see page 33) must be accessed using the (lower) *Operator Level* access key Ⓒ.

3.2 CMF160 Indicator

An example of an *Operator Page* is shown in Fig. 3.2.

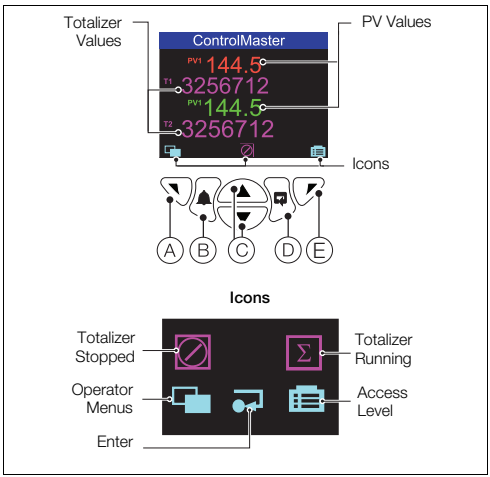


Fig. 3.2 ControlMaster CMF160 Operator Page and Keys

Ⓐ	Navigation key – left and *Operator Level* access key
Ⓑ	Alarm acknowledge key – acknowledges any active and unacknowledged alarms
Ⓒ	Up / Down keys – navigate up / down menus and increase / decrease displayed values
Ⓓ	Scroll key – scrolls through each available operator view
Ⓔ	Navigation key (right) / programmable *Soft Key* – see page 38

Table 3.2 CMF160 Front Panel Key Functions

4 Installation

4.1 Siting

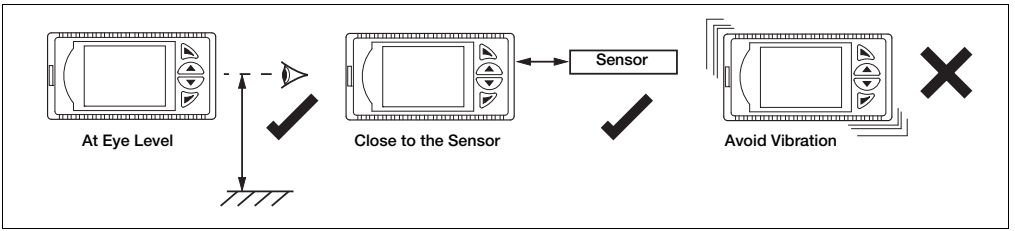


Fig. 4.1 Siting (applicable to both CM15 and CMF160 – CM15 shown for example only)

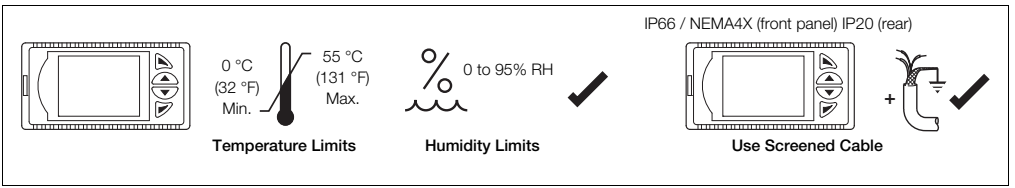


Fig. 4.2 Environmental Requirements (applicable to both CM15 and CMF160 – CM15 shown for example only)

4.2 Dimensions

4.2.1 CM15 Indicator

Dimensions in mm (in.)

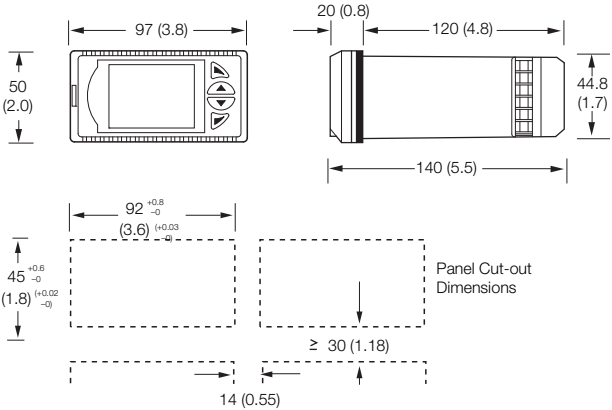


Fig. 4.3 ControlMaster CM15 Dimensions

4.2.2 CMF160 Indicator Panel-, Pipe- and Wall-mount Dimensions

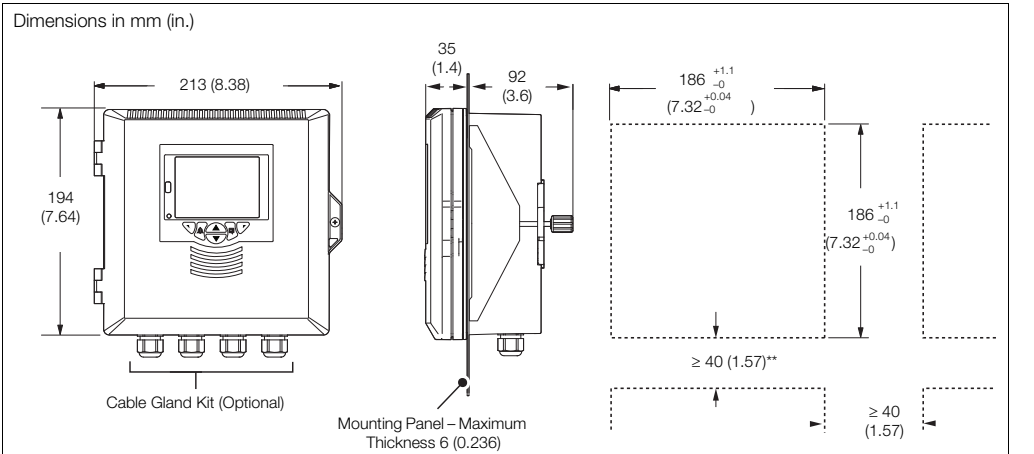


Fig. 4.4 ControlMaster CMF160 Panel-mount Option

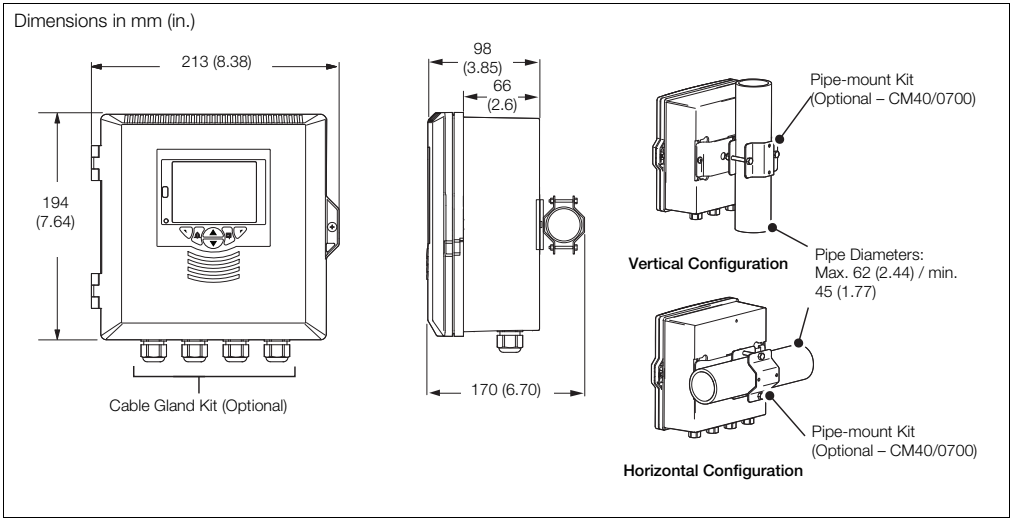


Fig. 4.5 ControlMaster CMF160 Pipe-mount Option

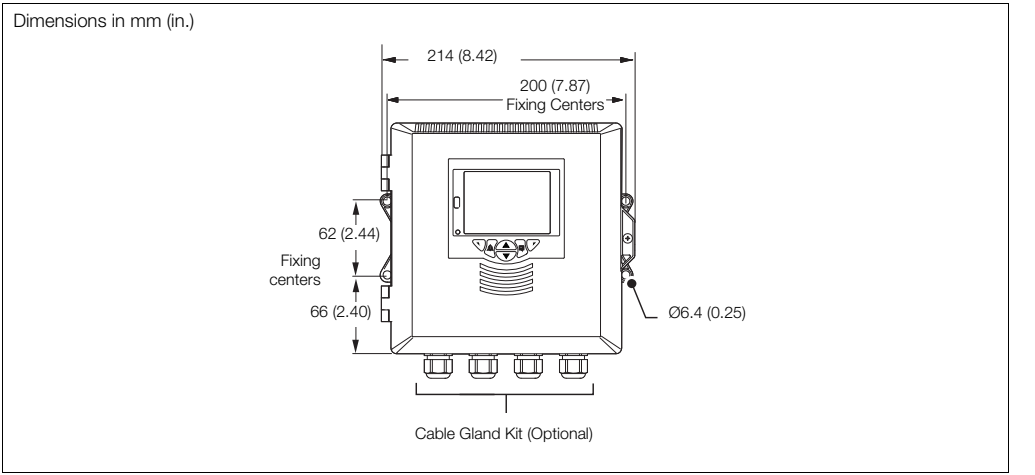


Fig. 4.6 ControlMaster CMF160 Wall-mount Option

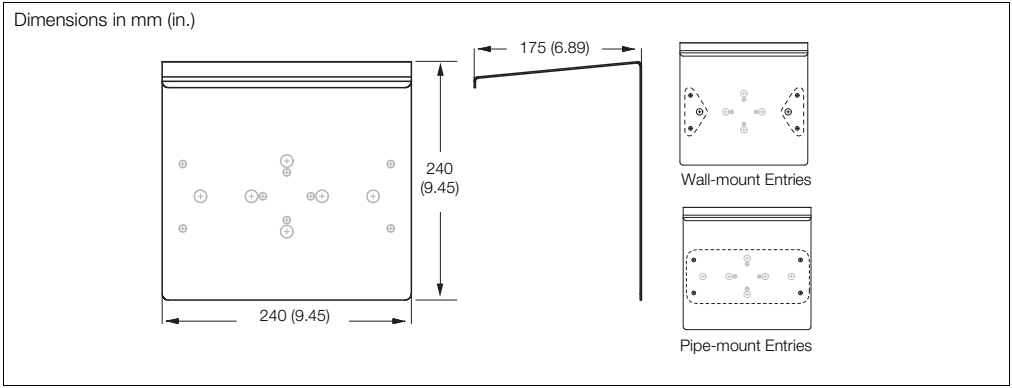


Fig. 4.7 ControlMaster CMF160 Weathershield (CM40/0702) – Pipe- and Wall-mount (CM40/0700) Options

4.3 Mounting

4.3.1 CM15 Indicator

ControlMaster CM15 is designed for panel mounting. For NEMA4X protection, a panel thickness of 2.5 mm (0.1 in.) is required.

To panel-mount the ControlMaster CM15 indicator:

1. Cut a hole of the correct size for the indicator in the panel (see page 9 for dimensions).
2. Insert the indicator into the panel cut-out.
3. Referring to Fig. 4.8:
   a. Position the upper panel clamp (A) at the top front of the case against the panel.
   b. Locate the panel clamp anchor (B) in slot (C).
   c. Tighten the panel clamp anchor screw (D) until panel clamp (A) is secured against the panel (torque 0.1 Nm [0.9 lbf/in.]).

   Note. Do not overtighten the screw.

   d. Repeat steps 3 to 5 to fit the lower panel clamp (E) and panel clamp anchor (F).

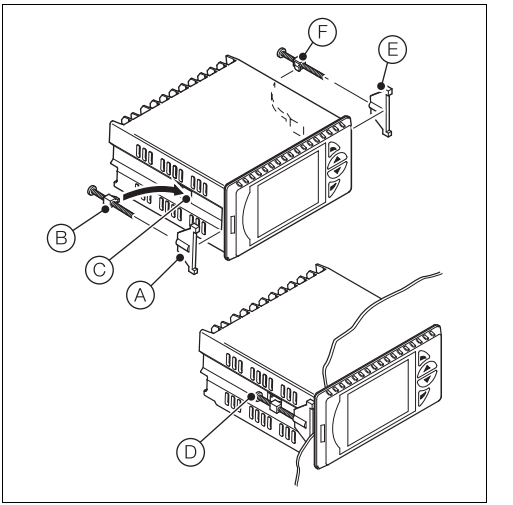


Fig. 4.8 Mounting Details – CM15 Indicator

4.3.2 CMF160 Indicator

ControlMaster CMF160 can be panel-, pipe- or wall-mounted. For NEMA4X protection, a panel thickness of 6 mm (0.236 in.) is required. (For pipe-mount details, see Fig. 4.5, page 12. For wall-mount details, see Fig. 4.6, page 12.)

To panel-mount the ControlMaster CMF160 indicator:

1. Cut a hole of the correct size for the controller in the panel (see page 10 for cut-out dimensions).

   Referring to Fig. 4.9:

   > **Note.** It may be necessary to cut a notch out of the panel at position (A) to accommodate the small rod on the lower face of the indicator (B).

2. Insert the controller (B) into the panel cut-out (C).
3. Position the panel clamps (D) at each side of the case against the panel.
4. Tighten each panel clamp anchor screw (E) until both panel clamps (D) are secured against the panel (torque 0.5 to 0.6 Nm [4.42 to 5.31 lbf/in.]).

   > **Note.** Do not overtighten the screws.

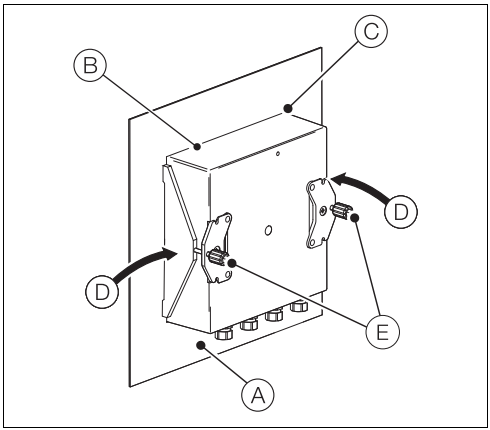


Fig. 4.9 Mounting Details – CMF160 Indicator

4.4 Jumper Links for Relay Outputs – CM15 Indicator

The factory-set default for relay action is N/O.

4.4.1 Removing the CM15 Indicator from its Case

The indicator's inner assembly must be removed from its case to access the relay contact jumper links.

Referring to Fig. 4.10:

1. Insert the bezel release tool (A) (supplied) into the front panel slot (B) to the left of the function keys.
2. Press the bezel release tool (A) fully in and then left (C) until the shoulder on the tool engages with the notch behind the indicator front plate.
3. Pull the bezel release tool (A) to withdraw the inner assembly from the case (D).

Note. If the bezel release tool is mislaid, 2 small flat-headed screwdrivers (4 mm [0.15 in.]) can be used as alternative tools, one inserted into the front panel slot and the second for leverage in the notch behind the indicator front plate. The notch is the only area that can be used as a leverage point – do not attempt to lever the front panel from any other area.

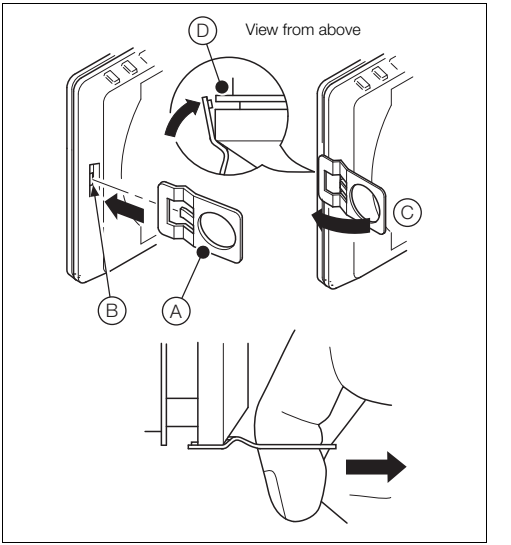


Fig. 4.10 Removing the CM15 Indicator from the Case

4.4.2 Resetting Jumper Links – CM15 Indicator

Note. The factory-set default for all jumper links is N/O.

1. The links associated with the relay outputs are shown in Fig. 4.11.
2. If necessary, move the link to select the relay action required (N/O or N/C).

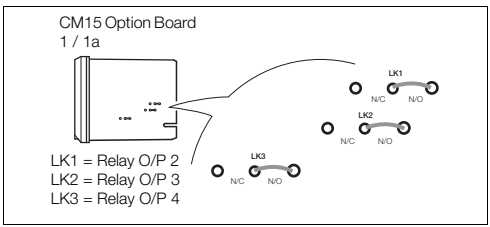


Fig. 4.11 Jumper Links for Relay Outputs – CM15 Indicator

4.4.3 Accessing the Connection board – CMF160 Indicator

> **Note.** Before fitting cable glands, identify the connections required and cable gland entries to be used.

Referring to Fig. 4.12:

1. Using a pozi-drive screwdriver, turn the (captive) electronics section door retaining screw (A) 1/4 turn counter-clockwise and open the door.
2. Turn the cover plate retaining screw (B) anti-clockwise until the cover plate (C) can be removed.
3. Make connections to connection board terminals – see Fig. 4.15, page 22.
4. Refit cover plate (C) and secure it by turning retaining screw (B) clockwise until finger-tight. Close the door and turn door retaining screw (A) 1/4 turn clockwise to secure.

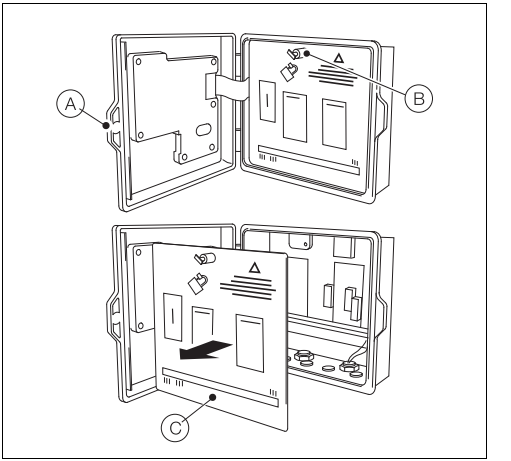


Fig. 4.12 Accessing the CMF160 Indicator Connection Board

4.5 Electrical Connections

Warning.

- The controller is not fitted with a switch therefore a disconnecting device such as a switch or circuit breaker conforming to local safety standards must be fitted to the final installation.
- The switch must be mounted in close proximity to the controller within easy reach of the operator and must be marked clearly as the disconnection device for the controller.
- Remove all power from supply, relay and any powered control circuits and high common mode voltages before accessing or making any connections.
- Use cable appropriate for the load currents. The CM15 terminals accept cables from 18 to 14 AWG (0.8 to 2.5mm^2). The CMF160 terminals accept cables from 26 to 14 AWG (0.14 to 2.5mm^2)
- Always route signal leads and power cables separately, preferably in earthed (grounded) metal conduit.
- It is strongly recommended that screened cable is used for signal inputs and relay connections.
- For I/P lead lengths greater than 30 m (98.4 ft.) screened cables must be used.
- The instruments conform to Mains Power Input Overvoltage Category 2, Pollution Degree 2 (EN601010–1).
  (The CM15 equipment is protected through double insulation – Insulation Class 2.) CMF160 Insulation Class 1.
- Analog / digital inputs and outputs, transmitter power supply and DC power supply are SELV (Safety Extra Low Voltage) circuits.
- All connections to secondary circuits must have basic insulation.
- After installation, there must be no access to live parts, for example terminals.
- Terminals for external circuits are for use with equipment with no accessible live parts only.
- If the controller is used in a manner not specified by the Company, the protection provided by the equipment may be impaired.
- All equipment connected to the controller's terminals must comply with local safety standards (IEC 60950, EN601010–1).

CM15, CMF160 Indicators – USA and Canada Only

- The supplied cable glands are provided for the connection of signal input and ethernet communication wiring ONLY.
- The supplied cable glands and use of cable / flexible cord for connection of the mains power source to the mains input and relay contact output terminals is not permitted in the USA or Canada.
- For connection to mains (the mains input and relay contact outputs), use only suitably rated field wiring insulated copper conductors rated min. 300 V, 14 AWG, 90C. Route wires through suitably rated flexible conduits and fittings.

Note. The CM15 terminal screws must be tightened to a torque of 0.1 Nm (0.9 lbf.in.). The CMF160 terminal screws must be tightened to a torque of 0.5 to 0.6 Nm (4.42 to 5.31 lbf.in.)

4.5.1 CM15 Indicator

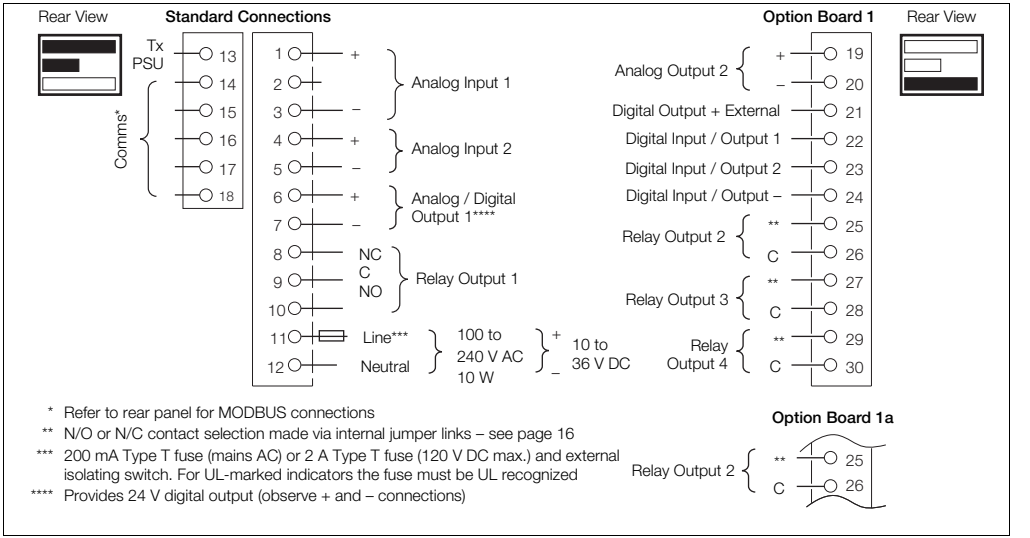


Fig. 4.13 ControlMaster CM15 Electrical Connections

4.5.2 CMF160 Indicator

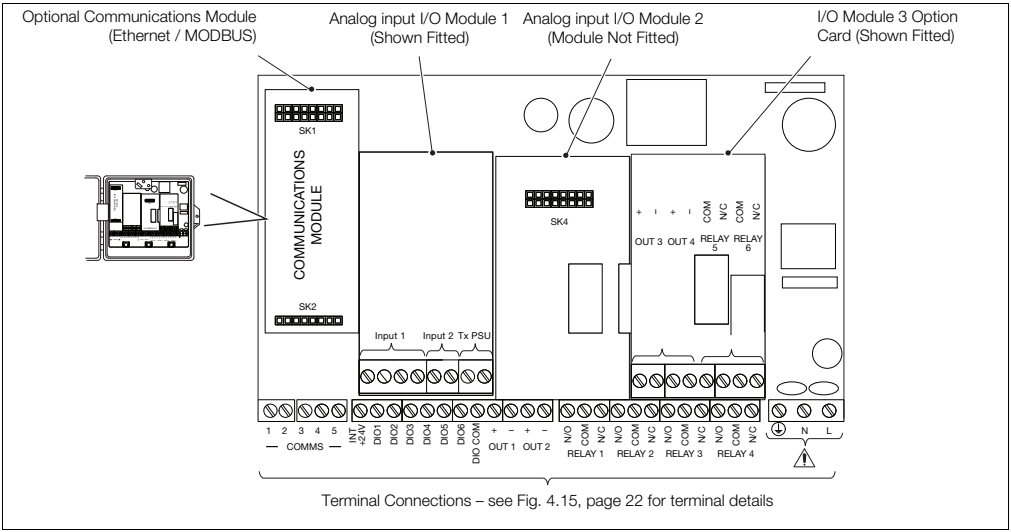


Fig. 4.14 ControlMaster CMF160 Module Locations

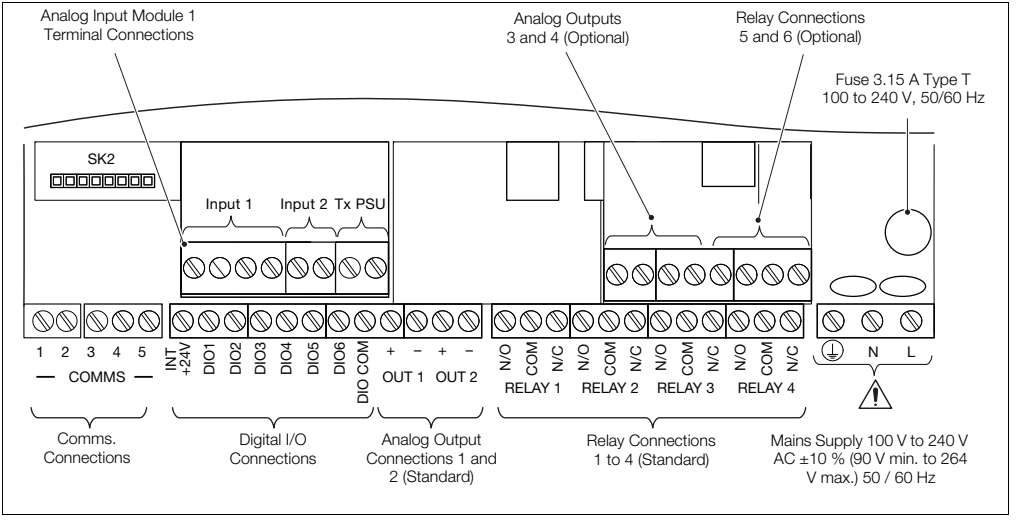
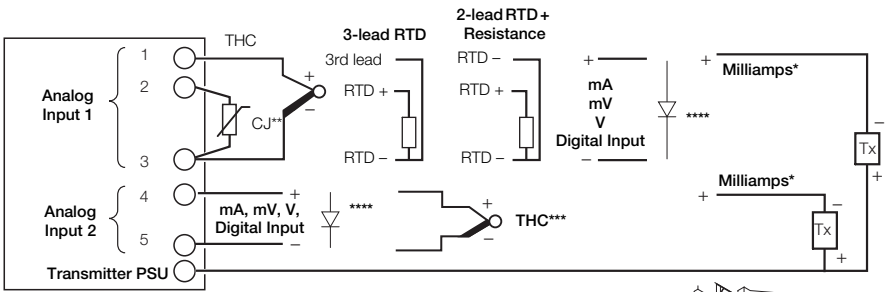


Fig. 4.15 ControlMaster CMF160 Terminal Connections

4.5.3 Analog Inputs – CM15 Indicator



* Using internal transmitter power supply.

** Fit the CJ sensor supplied if Analog Input 1 or 2 are THC inputs. (Alternatively, it is possible to use an external fixed cold [reference] junction, if the controller is programmed for use with millivolt inputs and the appropriate thermocouple linearizer is selected.)

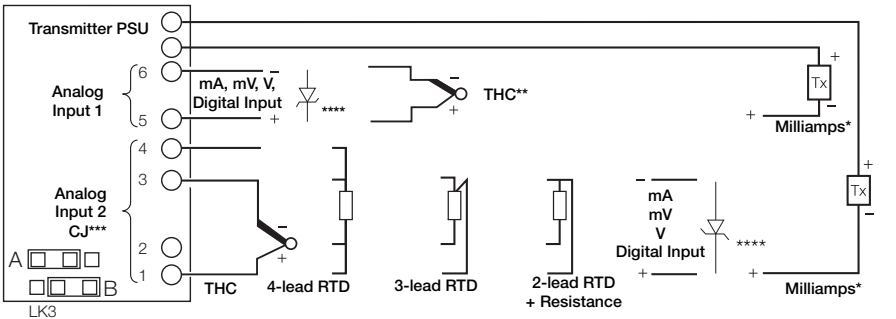
*** Analog Input 2 can be used only with THC inputs if Analog Input 1 is also used as a THC input.

**** For mA input types, to ensure loop continuity when the indicator is switched off, fit a suitably rated diode (for example, type 1N4148 or equivalent) as shown.

Note. 3-lead RTD: 3 leads must have equal resistance, not exceeding 20 Ω each.

Fig. 4.16 Standard Analog Inputs (1 and 2) – CM15 Indicator

4.5.4 Analog Inputs – CMF160 Indicator



* Using internal transmitter power supply.

** Analog Input 2 can be used only with THC inputs if Analog Input 1 is also used as a THC input.

*** To connect the CJ, put LK3 into position B. To disconnect the CJ put LK3 into position A.

**** For mA input types, to ensure loop continuity when the CMF310 controller (or CMF160 indicator) is switched off, fit a 2V7 Zener diode

Note. 3-lead RTD: 3 leads must have equal resistance, not exceeding 20 Ω each.

Fig. 4.17 Standard Analog Inputs (1 and 2) – CMF160 Indicator

4.5.5 Frequency / Pulse Input – CM15 and CMF160 Indicators

Note. This input is designed primarily for use with flowmeters.

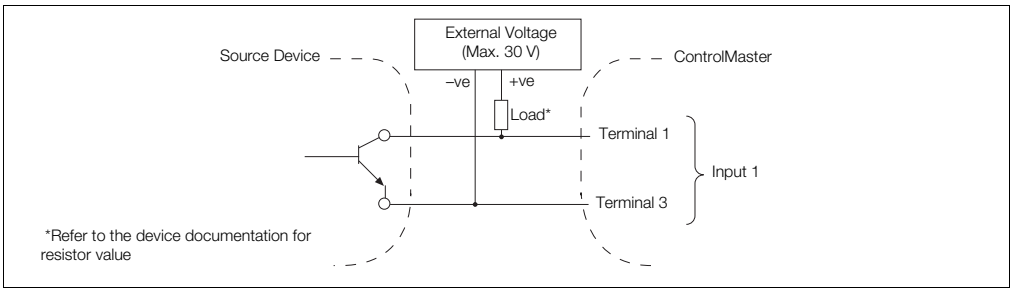


Fig. 4.18 Frequency / Pulse Input – CM15 and CMF160 Indicators

4.5.6 Digital Input / Output – CM15 Indicator

Note. Digital input and open collector digital output connections are shown in Fig. 4.19 – see page 92 for Digital Input / Output type options.

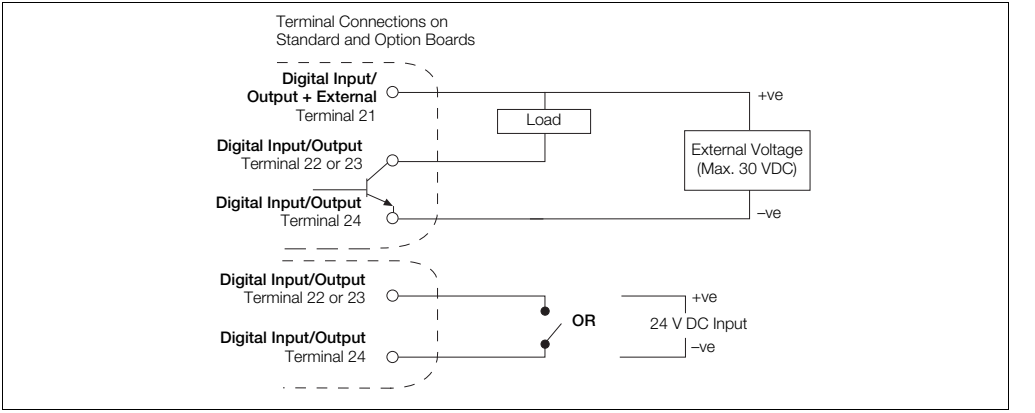


Fig. 4.19 Digital Input and Open Collector Digital Output Connections – CM15 Indicator

4.5.7 Digital Input / Output, Relays and Analog Output Connections – CMF160 Indicator

Note. Digital input and open collector digital output connections are shown in Fig. 4.19 – see page 92 for Digital Input / Output type options.

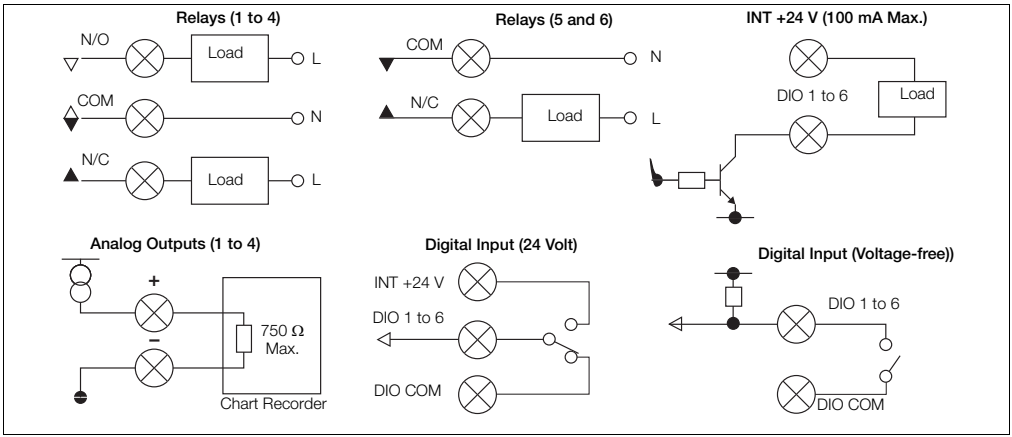
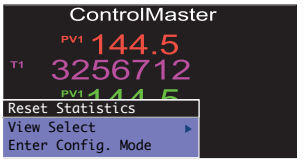


Fig. 4.20 Digital Input / Output, Relays and Analog Output Connections – CMF160 Indicator

5 Operator Level Menus



Operator level menus are used to reset statistics, select the view and to enter *Basic* and *Advanced* modes (via the *Access Level*).

To access *Operator Level* menus:

1. From the *Operator Page*, press ▽ to view the available menus.
2. Use the △ / ▽ keys to scroll through the menus and menu options.
3. Press ◁ to expand menu levels and to select menu options or press ▽ to return to the previous menu.

Reset Statistics	Resets current statistics.
View Select	Switches the view to an *Operator Page* or the *Diagnostic View*.
Enter Config. Level	Displays the *Access Level* selection views – see Section 5.4, page 31 for security options.

5.1 Diagnostic Status Bar

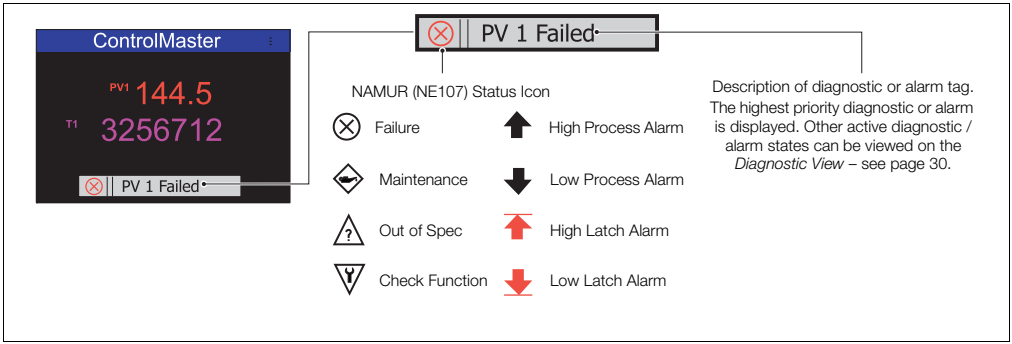


Fig. 5.1 ControlMaster Diagnostic Status Bar

5.2 Diagnostic View

The *Diagnostic View* is selected from the *Operator* / *View Select* menu. All currently active diagnostic alarm states are displayed in the *Diagnostic View*.

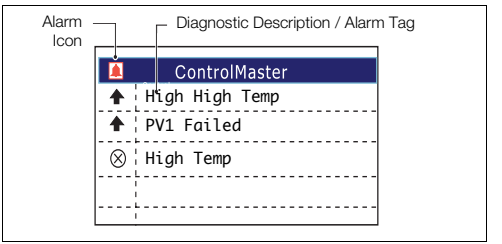


Fig. 5.2 ControlMaster Diagnostic View

5.3 Security Options

Passwords can be set to enable secure end-user access at 2 levels: *Basic* and *Advanced*. The *Service* level is password-protected at the factory and reserved for factory use only.

Passwords are set, changed or restored to their default settings at the *Device Setup / Security Setup* parameter – see page 35.

Note. When the indicator is powered-up for the first time the Basic and Advanced levels can be accessed without password protection. Protected access to these levels must be allocated on-site as required.

5.4 Access Level

Level	Access
Logout	Displayed after *Basic* or *Advanced* level are accessed. Logs the user out of *Basic* or *Advanced* level. If passwords are set, a password must be entered to access these levels again after selecting *Logout*.
Read Only	Enables all parameter settings to be viewed
Basic Setup	Enables access to the Basic level and adjustment of alarm trip points.
Advanced	Enables configuration access to all parameters.
Service	Reserved for use by authorized service personnel.

Table 5.1 Access Levels

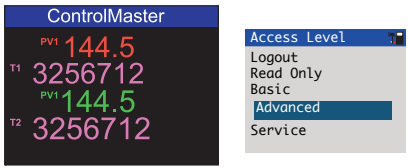
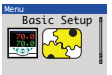


Fig. 5.3 Access Level

Note. A 5-minute time-out period enables a user to return to the *Operator* page and re-access the previous menu (displayed at exit) without re-entering the password. For periods over 5-minutes (or if Logout is selected), a password must be re-entered to access protected levels.

6 Basic Setup



Provides access to basic alarm setup parameters.

Note. Additional parameters may be displayed at *Basic Setup* level - these are dependent on the parameters selected at *Advanced Level*.

Process Alarms	
Alarm Trip 1 (8)	The alarm trip level in engineering units – see *Process Alarm* (page 50) for parameter details.

7 Advanced Level

7.1 Device Setup

Provides access to standard setup parameters to determine the type of indication required. Also provides the ability to create non-standard configurations for special application requirements.

Initial Setup	
App. Template	Application templates enable configurations for particular applications to be created as simply as possible. Select the appropriate template before configuring any other parameters. When a template is selected, the indicator assumes the preset form for that template. The inputs and function blocks are soft-wired automatically to perform the selected function. **Note**. See Section 8, page 79 for available templates.
Instrument Tag	A 16-character alphanumeric tag, displayed in the title bar on *Operator* pages.
Mains Frequency	Used to set the internal filters to reduce mains power frequency interference.

...Device Setup / ...Initial Setup

Config Action	The *Config Action* parameter is used to determine how the indicator and indicator outputs behave when the *Advanced* level is entered – see page 33.
Continue	The indicator continues to operate as in Operator level. Outputs continue to operate as normal.
Hold	Digital, relay and analog outputs are held at their value / state when *Configuration* mode is entered. When the *Advanced* level is exited, the indicator returns to the pre-*Configuration* mode of operation.
Inactive	Analog outputs are set to 0 mA. Relays de-energized, digital outputs inactive.
Level 1 (2) Indicator*	**Note**. Applicable to level applications only.
Specific Gravity	Value of the specific gravity currently applied to the process variable.
Volume Constant	The constant used to calculate the volume (maximum value 999.9).
Volume Units	The unit of measure used to calculate the volume.
Volume DPs	The number of decimal places required (maximum of 4).

*See Section 8.2.4, page 82 for examples of volume calculations.

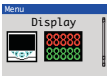
...Device Setup / ...Initial Setup

Custom Template	If this parameter is enabled, it enables the internal function blocks to be re-linked to create custom configurations for special application requirements. These sources are configured in *Device Setup / Custom Config* – see page 36.
Analog 1 Eng. Units Analog 2 Eng. Units	Configurable units that can be assigned to any analog signal (Analog I/P or Math Block).
Tot. 1 Eng. Units Tot. 2 Eng. Units	Configurable units that can be assigned to any totalizer.
Stats. Reset Source	Sets the digital source signal used to reset the statistics.
Reset to Defaults	Resets all configuration parameters to their default values.
Security Setup	2 Security access levels are provided, each protected by a password of up to 6 alphanumeric characters. **Note**. Passwords are not set at the factory and must be entered by the end user(s).
Basic Password	*Basic* level provides access to the *Basic* level.
Advanced Password	Provides access to Advanced configuration parameters – see Section 7, page 33.
Reset Passwords	Resets all passwords to factory values.

...Device Setup

Custom Config	Allows the device configuration to be backed-up (read) from the device, or written to the device over the IrDA interface to a PC – see Section 9, page 83 – PC Configuration.
Loop 1 PV	Sets the source for the (*Loop 1*) process variable.
Volume 1	Sets the source for *Volume 1*.
Loop 2 PV	Sets the source for the (*Loop 2*) process variable.
Volume 2	Sets the source for *Volume 2*.
IrDA Configuration	Allows the device configuration to be backed-up (read) from the device, or written to the device over the IrDA interface to a PC – see Section 9, page 83 (PC Configuration).
Setup	
Select Mode	Select the *IrDA Configuration* operating mode.
Off	*IrDA Configuration* mode is turned off.
Read-Only	Enable reading of the device configuration.
Read/Write	Enable reading and writing of the device configuration.
Config. Description	A 24-character alphanumeric descriptor used to assist in identifying the configuration that is read from or written to the device.

7.2 Display



Used to setup the display language, operator page template and format and type of information displayed.

Language	Selects the language on the indicator's local display.
Operator Templates	Enables up to 4 operator pages to be configured to suit the application requirements.
Page 1 (4) Template	The operator template type. The functions available in each template type are displayed as abbreviations, for example: *PV & TOT* **Key to abbreviations**: ■ PV = process variable ■ TOT = totalizer ■ VOL = volume

...Display

Operator Functions	
Autoscroll	When enabled (*On*), operator pages are scrolled continuously at intervals of 10 seconds per page.
Soft Key Function	Assigns a dedicated function to the Navigation key (right) – see page 6.
Configuration	Displays the *Access Level* enabling selection of configuration levels.
Scroll View	Scrolls through each available *Operator* view.
Alarm Ack.	Acknowledges all active unacknowledged alarms.
Toggle Signal	Provides a source that toggles between 2 states – can be assigned to outputs or used to select sources.
Edge Signal	Provides an edge-triggered source that is active on key press. Can be assigned to outputs or select sources
Alarm Ack. Enable	Turns on / off the ability to acknowledge alarms from the front panel.
Totalizer Stop/Go	Starts / stops the totalizer.
Totalizer Reset	Resets the totalizer.
Stats Reset Enable	Turns on / off the ability to reset statistics from the front panel.

...Display

Settings	Adjusts display settings to suit local environmental conditions.
Brightness	Increases / Decreases the display brightness.
Date & Time	Sets the date format, local time and date and daylight saving start / end times.
Date Format	Sets the indicator's date format.
Date & Time	Sets the indicator's time and date.
Daylight Saving	Sets daylight saving parameters.
DS Region	**Note.** Daylight saving is disabled when *DS Region* is *Off*.
Europe	Standard daylight saving start and end times are selected automatically for Europe.
USA	Standard daylight saving start and end times are selected automatically for USA.
Custom	Select to create custom daylight saving start / end times for regions other than Europe or USA and to enable *Daylight Start Time* and *Daylight End Time* parameters.
DS Start Time DS End Time	Selected from 1-hour increments. **Note**. Displayed only when the *DS Region* sub-parameter is *Custom*.

…Display / …Date & Time / …Daylight Saving

DS Start Occur DS End Occur	The day within the month that daylight starts / ends – for example, to set daylight saving to start (or end) on the second Monday of the selected month, select *Second*.
DS Start Day DS End Day	The day of the month daylight saving starts / ends – the *Daylight Start / End Occur* parameters must be valid within the month for the selected day.
DS Start Month DS End Month	The month daylight saving starts / ends.
Customise Pages	The contents and appearance of each *Operator Page* (see page 28) can be customized to meet particular user requirements.
Page Number	Selects the *Operator Page* (1 to 4) to be customized.
Template Type	Selects one of the standard operator page templates.
	Template codes:
	A = Analog value, T = Totalizer value, S = State value (see page 41)
	A (Style 1) A,A (Style 1) A,A,T A,A,A,A (Style 1) T A,T (Style 1) A,T,T A,A,A,T T,T (Style 1) A,A,T,T T,T (Style 2) A,T,A,T
Titlebar Tag	A user-programmable, 16-character alphanumeric tag.

...Display / ...Customise Pages

Parameters

Parameter Number	1 to 4 (depending on the *Template Type* selected).
Type	Enables some parameter types to be modified to provide more flexibility in the display formats available: ■ Parameters set as *Totalizer value* by the *Template Type* can be changed to analog or state parameters. ■ Parameters set as *State value* by the *Template Type* can be changed to an analog parameter.
Source	Selects the signal to be displayed.
Color	Selects the color to be used to display this parameter.

Color codes:

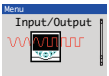
Black	Red	Yellow	Green	Cyan
Blue	Magenta	White	Grey	
Dark Cyan	Dark Magenta	Dark Grey	Dark Yellow	Dark Green
Dark Blue	Dark Red			
Theme RGB*	Theme RYG**			

*Theme RGB:	**Theme RYG
■ State 0 tag is shown in red.	State 0 tag is shown in red.
■ State 1 tag is shown in green.	State 1 tag is shown in yellow.
■ State 2 tag is shown in blue.	State 2 tag is shown in green.

...Display / ...Customise Pages / ...Parameters

Tag	A user-programmable, 3-character alphanumeric tag used to identify each parameter.
State 0 (1, 2) Tag	A user-programmable, 8-character alphanumeric tag displayed when the state of the selected parameter has a value of 0 (1, 2).
Icons	Used to configure up to 8 icons (with some custom display templates it is not possible to display all 8 icons).
Icon Number	Selects the icon number to be configured.
Type	Selects the type of icon to be displayed.
Color	Selects the color of the selected icon used on the display.
Page Colors	Used to define *Operator Page* colors and titlebar colors.
Background Color	Selects the background color of the *Operator Page* – see page 28.
Titlebar Color	Selects the background color of the titlebar.
Title Tag Color	Selects the color of the titlebar tag.
Softkey Color	Selects the color for the *Soft Key* icons.

7.3 Input/Output



Enables analog and digital inputs / outputs and relays to be configured.

Analog Inputs	
Analog Input 1 (2 – CM15)* Analog Input 1 (4 – CMF160)*	
Input Type	Input types comprise: *Millivolts, Milliamps, Volts, Resistance (Ohms), RTD, Thermocouple,* *Digital volt-free, 24V Digital, Freq. Input, Pulse Input*. Additional *Input Type* comments:
Digital Volt Free	Acts as a digital input.
Freq. Input	Sets the maximum frequency and equivalent flow rate in the engineering range 0 to 6 KHz. (A frequency of 0.01 to 6 KHz can be used to create an analog value.)
Pulse Input	This parameter counts pulses and is recommended only for use with electromagnetic flowmeters.

*Analog Input 2 and 4: *Freq Input*, *Pulse Input* and *Resistance* not available. A *Thermocouple* input type can be set only if the first input is set to *Thermocouple*.

... Input/Output / ...Analog Input 1 (4)

Elect. Low	Sets the required electrical range. **Note**. Applicable only to *Millivolts, Milliamps, Volts* and *Ohms*.		
	Linear Inputs	**Standard Analog Input**	**Accuracy (% of Reading)**
	Millivolts	0 to 150 mV	0.1 % or ±20 µV
	Milliamps	0 to 45 mA	0.2 % or ±10 µA
	Volts	0 to 25 V	0.2 % or ±20 mV
	Resistance Ω (low)	0 to 550 Ω	0.2 % or ±1 Ω
	Resistance Ω (high)	0 to 10 kΩ	0.1 % or ±5 Ω
Elect. High	Sets the required electrical range. **Note**. Applicable only to *Millivolts, Milliamps, Volts* and *Freq. Input*.		
Linearizer	Selects the linearizer type required to condition the input signal. **Notes**. For thermocouple applications using an external fixed cold junction, set *Input Type* to *Millivolts* (see page 43) and select the appropriate linearizer type. Not applicable for *Pulse Input*, *Digital volt-free*, *24V Digital* parameters – see page 43.		

... Input/Output / ...Analog Input 1 (4)

Eng Units	The selected units are used by the linearizer and displayed in the *Operator* pages. Not applicable for: *Pulse Input*, *Digital volt-free* and *24V Digital* parameters. *Thermocouple* and *RTD* inputs (see page 43) are restricted to *deg C*, *deg F*, *Kelvin* – see Appendix C, page 97 for analog input (engineering) units.
Eng. Dps	Engineering decimal places – selects the resolution required to be displayed for the input value.
Eng. Low Eng High	Specifies the engineering low (minimum) / high (maximum) value. For example, for an electrical input range of 4.0 to 20.0 mA, representing a pressure range of 50 to 250 bar, set the *Eng Low* value to 50.0 and the *Eng High* value to 250.0. Not applicable for *Pulse Input* – see page 43.
Pulse Units	Selects the unit of measure for the pulse input type.
Pulse / Unit	Sets the number of pulses required to represent 1 pulse unit (as set above). For example, if *Pulse Units* = Kl and *Pulse / Unit* = 10.00000000, each pulse represents 0.1 Kl, 10 pulses = 1 Kl.

… Input/Output / …Analog Input 1 (4)

Broken Sensor	If an input failure occurs, the input value can be configured to drive in a set direction.
None	No action taken.
Automatic	If the value of failed input is below *Eng Low (see page 45)*, the input value is driven to minimum downscale value; otherwise it is driven to the maximum upscale value.
Upscale	The input is driven to the maximum upscale value.
Downscale	The input is driven to the minimum downscale value.
Filter Time	The input is averaged over the time set.
Fault Detect	Sets a tolerance level (in % of engineering range) to allow for deviation of the input signal above or below the engineering range before an input failure is detected.
Zero Adjustment Span Adjustment	These 2 parameters enable fine tuning of the inputs to eliminate system errors. Apply a known input value and adjust until the required input value is displayed. Normally, *Zero Adjustment* is used with input values close to *Eng Low* (perform adjustment by applying an offset to the reading) and *Span Adjustment* is used with values close to *Eng High* (perform adjustment by applying a multiplier to the reading).
Reset Zero/Span	Resets the selected *Zero / Span Adjustment* parameter.
Sensor Adjust	TBA

...Input/Output

Analog Outputs	The analog outputs can be configured to retransmit any analog value and have a configurable range from 0 to 24 mA. Output 1 can also be configured to function as a digital output.	
Analog Output 1 (4)	**Note**. CM15: Analog Output 2 is available only if *Option Board 1* is fitted – see page 20. CMF160: Analog Outputs 3 and 4 available only if optional *Output / Slope Relays Board* is fitted (CM40/0235) – see page 21.	
Output Type	Selects the analog or digital output (applicable only to *Analog Output 1*).	
Source	Selects the parameter to be assigned to the output – see Appendix A.2, page 93 for description of sources.	
Elect. Low*	The current output required when the source value is equal to the *Eng Low* value – see page 45.	
Elect. High*	The current output required when the source value is equal to the *Eng High* value – see page 45.	

*Not applicable if *Output Type* is *Digital* or *Source* is *None*.

…Input/Output / …Analog Outputs / …Analog Output 1 (4)

Auto Eng Range*	If enabled (*On*) the *Eng High* and *Eng Low* values for the output are set automatically to the engineering range values of the source.
Eng Low*	The minimum engineering range output value.
Eng High*	The maximum engineering range output value.
Polarity**	Sets the polarity of the output signal. If *Negative*, the output is energized when source is inactive. If *Positive*, the output is energized when source is active.
Digital I/O	
Digital IO 1 (2 – CM15) Digital IO 1 (6 – CMF160	
Type	Sets the *Digital IO* to operate as an output or an input.
Off	No action taken.
Output	The *Digital IO* operates as an output.
Volt Free	High input detected when volt free switch across input is closed.
24 Volt	Digital input low < 5V, high > 11V (maximum input 30 V).
TTL	Digital input low < 0.8V, high > 2V.
Output Source	Selects the digital signal to be assigned to the output – see Appendix A.1, page 92 for description of sources.

*Not applicable if *Output Type* is *Digital* or *Source* is *None*.

**Not applicable if *Output Type* is *Analog* or *Source* is *None*.

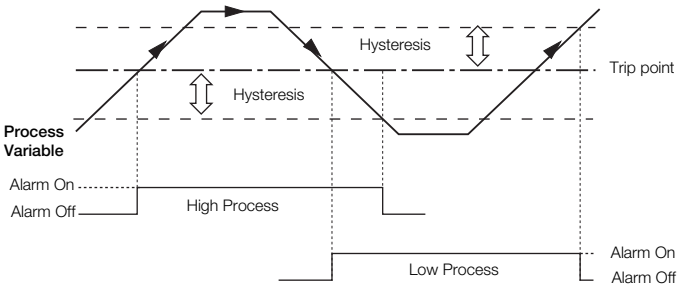
…Input/Output / …Digital I/O / …Digital IO 1 (6)

Polarity	Sets the polarity of the output signal.
Positive	For an output, the output is high if the source is active. For an input, the input is active if a high signal is detected.
Negative	For an output the output is high if the source is inactive. For an input, the input is active if a low signal is detected.
Relays	
Relay 1 (4 – CM15) Relay 1 (6 – CMF160)	
Source	Selects the digital signal to be assigned to the relay – see Appendix A.1, page 92 for description of sources.
Polarity	Sets the polarity of the relay.
Positive	The relay is energized If the source is active.
Negative	The relay is energized If the source is inactive.

7.4 Process Alarm

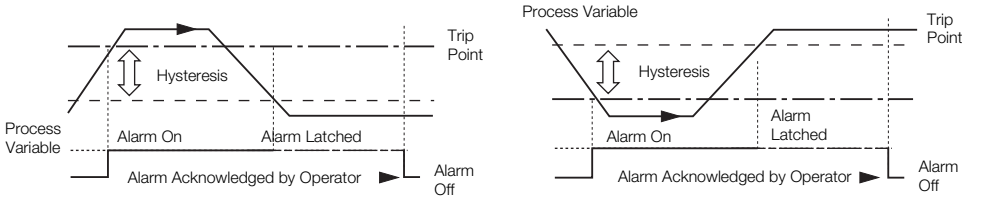
Used to configure up to 8 independent process alarms.

Process Alarm



High and Low Process Alarm Action

...Process Alarm



High Latch Alarm **Low Latch Alarm**

High and Low Latch Alarm Action

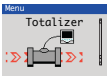
Alarm 1 (8)

Type	Alarm types comprise: High Process, Low Process, High Latch, Low Latch. (Deviation alarms are configured using a high or low process alarm and selecting *Deviation* as the source.)
Tag	The alarm *Tag* is displayed as a diagnostic message and appears in the *Diagnostic Status Bar* and the Diagnostic view in the *Operator Level*.
Source	The analog source –see Appendix A.2, page 93 for description of sources.
Trip	The alarm trip level in engineering units – see page 97 for unit options.

...Process Alarm / ... Alarm 1 (8)

Hysteresis	Hysteresis trip level in engineering units. Activated at the alarm trip level but deactivated only when the process variable has moved into the safe region by an amount equal to the hysteresis value – see Process Alarm examples on page 50.
Time Hysteresis	If an alarm trip value is exceeded, the alarm does not become active until the *Time Hysteresis* value has expired. If the signal goes out of the alarm condition before the *Time Hysteresis* has expired, the hysteresis timer is reset.
Display Enable	Enables an alarm to be used for control purposes without it appearing as an active alarm state in the *Operator* level or *Diagnostic* view.
Acknowledge Source	The source required to acknowledge all active alarms. Acknowledge occurs on rising edge of the digital signal – see Appendix A.1, page 92 for description of sources. 
Enable Source	The source required to enable alarms. If *the source* is *None*, alarms are always enabled –see Appendix A, page 92 for description of sources.

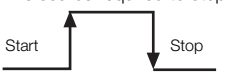
7.5 Totalizer



Two 9-digit totalizers are provided. These can be configured independently to totalize any analog or digital signal. Four modes of operation are provided.
Where possible, the count rate is calculated automatically according to source units, totalizer units and engineering range.

Totalizer 1 (2)	
Mode	
Off	Totalizer disabled.
Analog	Totalization of any analog signal.
Digital	Counting of low / high transitions of any digital signal (for example, digital input or alarm) minimum pulse duration >125 ms.
Frequency	Totalization of a frequency input on Analog input 1.
Pulse	Totalization of a pulse input on Analog input 1.
Source	The input to be totalized. The inputs available for selection are dependent on the *Mode* selected. Not displayed for frequency and pulse inputs – see Appendix A, page 92 for description of sources.

...Totalizer

Count Direction	
Up	Totalizer value increases with time.
Down	Totalizer value decreases with time.
Units	(Totalizer) units are used along with the source's units and engineering range to calculate the count rate automatically (where possible). Where the units or mode required do not allow this, the count rate must be calculated manually – see Section 7.5.1, page 56.
Count Rate	In *Analog* mode, this represents the counts (in volume units) / second when the source is at its engineering high value. In *Digital*, *Frequency* and *Pulse* mode (see page 53) this represents the number of totalizer (volume) units / pulse.
Cutoff	The lowest input value (in engineering units) the totalizer stops counting at.
Stop Go Source	The source required to stop and start the totalizer. Selection is made on the rising edge: 

...Totalizer

Total DPs	Selects the number of decimal places displayed on the totalizer value.
Preset Count	The value the totalizer counts from and the value applied when the totalizer is reset.
Predet Count	The value the totalizer stops or wraps.
Intermediate Count	The value the intermediate count digital signal is activated. This can be used as an alarm threshold to indicate when the *Predet Count* value is about to be reached.
Wrap Enable	If set to *On* the total is reset automatically to the *Preset Count* value once the *Predet Count* value is reached. The wrap digital signal is made active for a duration of 1 second. If set to Off the count stops when the *Predet Count* value is reached. The wrap digital signal is made active until the Totalizer is reset.
Reset Source	The source required to reset the totalizer value. Selection is made on the rising edge: 
Reset Days	Selects the day or days to reset the totalizer.
Reset Hour	Selects the hour to reset the totalizer (the totalizer is always reset exactly on the hour).

7.5.1 Calculating the Totalizer Count Rate Manually

Analog Mode

$$\text{Count Rate} = \frac{\text{Eng Hi (of source) x volume unit conversion}}{\text{time unit conversion}}$$

Example:

Eng Hi = 2500 l/m. Totalizer required to increment in m^3.

Volume unit conversion: 1 l = 0.001 m^3.

Source time units = minutes, count rate units = seconds.

Time unit conversion: 1 min = 60 s.

$$\text{Count Rate} = \frac{2500 \times 0.001}{60} = 0.04167 \text{ m}^3/\text{s}$$

If the input source is at a fixed rate of 2500 l/min, the totalizer increments at 0.04167 m^3/s.

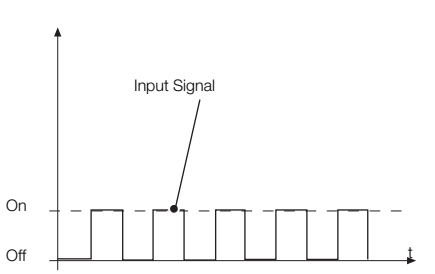
If the input source is reduced to a fixed rate of 1250 l/min, the totalizer increments at:

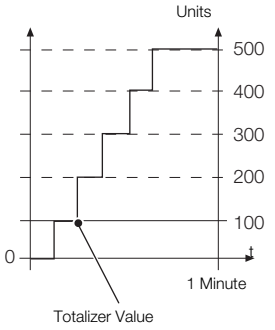
$$\frac{1250}{2500} \times 0.04167 = 0.0208 \text{ m}^3$$

Digital Mode

The count rate setting determines the scaling of the digital input pulses.

For example, with a Count Rate = 100 totalizer units / pulse, 5 digital input pulses increment the totalizer from 0 to 500 in 100 unit steps:





Frequency Mode

$$\text{Count Rate} = \frac{\text{Eng Hi (of source) x volume unit conversion x pulse duration}}{\text{time unit conversion}}$$

Example:

Eng Hi = 6000 l/m. Frequency input fullscale (Electrical High) = 500 Hz.
Totalizer required to increment in m^3.
Volume unit conversion: 1 l = 0.001 m^3.
Source time units = minutes, count rate units = seconds.
Time unit conversion: 1 min = 60 s

$$\text{Pulse Duration} = \frac{1}{\text{Analog input 1 Electrical High (Hz)}}$$

$$\text{Count Rate} = \frac{6000 \times 0.001 \times 0.002}{60} = 0.0002 \text{ m}^3/\text{s}$$

If the input source is at a fixed rate of 6000 l/min (500 Hz) the totalizer increments at 0.0002 m^3/s.
If the input source is reduced to a fixed rate of 3000 l/min (250 Hz), the totalizer increments at:

$$\frac{3000}{6000} \times 0.0002 = 0.0001 \text{ m}^3$$

Pulse Mode

$$\text{Count Rate} = \frac{\text{Volume unit conversion}}{\text{Pulse / Unit}}$$

For example:

Pulse / Unit = 50, Pulse Units = l, Totalizer required to increment in m^3.

Volume unit conversion: 1 l = 0.001 m^3.

$$\text{Count Rate} = \frac{0.001}{50} = 0.00002\ m^3/\text{pulse}$$

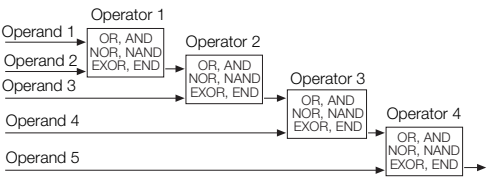
7.6 Functions

Contains parameters for setting up the math block(s), logic equations and timer functions within the indicator.

Logic Equations

Up to 8 logic equations can be configured. Each can combine up to 8 operands (digital signals) with 7 operators. The elements of each equation are calculated sequentially. Operand 1, Operator 1 and Operand 2 are evaluated first. The result is combined with Operator 2 and Operand 3. This result is then combined with the next operator and operand and so on to the end of the equation.

Note. If any of the operand sources are invalid (for example, an alarm that is not configured), the logic equation output state is zero and invalid.



Key:

OR*	Output is 1 if either or both inputs are 1; output is 0 if both inputs are 0
AND	Output is 1 if both inputs are 1; output is 0 if either input is 0
NOR	Output is 0 if either or both inputs are 1; output is 1 if both inputs are 0
NAND	Output is 0 if both inputs are 1; output is 1 if either input is 0
EXOR	Output is 0 if both inputs are 0 or both inputs are 1; output is 1 if one input is 1 and the other is 0
END	Terminates the equation.

*2 Logic equations are required to perform an exclusive OR of 3 inputs

...Functions / Logic Equations

Equation Number	Selects the logic equation to be configured.
Operand 1 (8)	See Appendix A, page 92 for description of sources.
Invert 1 (8)	Logically inverts (applies NOT function to) the digital signal. For example, if the digital signal assigned to the operand has a state of '1' it is inverted to a state of '0' before being applied to the equation.
Operator1 (7)	Selects the *Operator* type: OR, AND, NOR, NAND, EXOR, END. Select END if no more elements are required.
Math Blocks	Up to 8 math blocks can be configured. Each block can be configured as 1 of 6 different types (see *Block Type* below). The resulting analog value can be used as a source for other function blocks, for example, *Process Variable* in the *Custom Config* parameter – see page 36.
Math Block Number	The math block number (1 to 8).
Block Type	Selects the type of math block required.

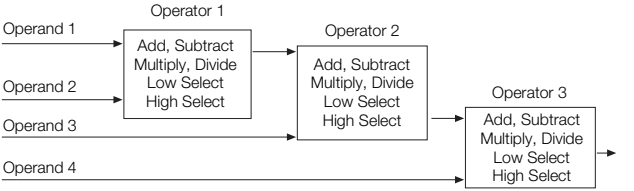
...Functions / ...Math Blocks / ...Block Type

Equation

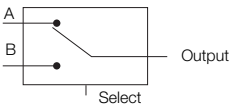
Enables an equation with up to 4 operands and 3 operators to be created. The operands can be assigned to any analog or digital signal (see Appendix A, page 92). Digital signals have a value of either '0' or '1'. With the exception of the Median operator, the equation is processed in a strict left to right order, with no operator precedence.

The result of a math block can be used as the operand in another math block, enabling more complex math equations to be constructed.

The math blocks are processed in ascending order; Math block 1 is processed first, then Math Block 2, then 3 to 8:



...Functions / ...Math Blocks / ...Block Type

Real Time Average	Calculates the average value of a parameter over a user-configurable duration. The output of the math block is updated at the end of the set duration only. A reset signal can be configured to restart the calculation of the average value. The average value is stored in case of power failure. If the duration of the power failure is longer than the *Average Duration* (see page 65), the math block output value is set to zero.
Max Hold	The math block output represents the highest value of the signal since it was reset.
Min Hold	The math block output represents the lowest value of the signal since it was reset.
Multiplexer	Enables 1 of 2 analog signals or constant values to be selected using a digital signal.  Select | 0 | 1 Output | A | B
Square Root	Calculates the square root of the selected sources value. If the input is less than 0, the output is set to zero and the math block output state set to invalid.

...Functions / ...Math Blocks / ...Block Type

Equation Setup:

Source 1 (2)	The source of the first operand in the equation (any analog or digital signal or user-defined constant).
Source 1 (2) Constant	Sets the constant value to be used. **Note**. Applicable only if *Source 1* is assigned to one of the Constants.
Operator 1 (3)	
End	Terminates the equation.
Add *Subtract* *Multiply* *Divide*	Standard arithmetic functions.
Low Select *High Select*	Result is the lower / higher of the 2 operands.
Median	If *Median* operators are used the median value calculated is dependent on the number of operands. The median value of 2 operands is their mean value. The median value of 3 operands is the value of the middle operand when the operands are sorted into ascending order. The median value of 4 operands is the mean value of the 2nd and 3rd operands when the 4 operands are sorted into ascending order.

...Functions / ...Math Blocks / ...Block Type

Real Time Average Setup:

Source 1 (RTA Source)	Selects the source for *Real Time Average* calculation – see Appendix A, page 92 for description of sources.
Reset Source	Selects the digital source required to reset the internal accumulative value and timer. This does not change the immediate output of the math block but restarts the calculation of the next average value – see Appendix A.1, page 92 for digital sources.
Average Duration	Sets the time duration the average is calculated over. The output value of the math block is updated at this rate.

Max Hold / Min Hold Setup:

Source 1	Selects the source for maximum / minimum value calculation – see Appendix A, page 92 for description of sources.
Reset Source	Select the digital signal to be used to reset the maximum or minimum value.

...Functions / ...Math Blocks / ...Block Type

Multiplexer Setup:

Source 1	Selects the source (any analog signal [see page 92] or user-defined constant) for the first input into the multiplexer.
Source 1 Constant	Sets the constant value to be used. **Note**. Applicable only if *Source 1* is assigned to one of the constants
Source 2	Select the source for the second input into the multiplexer.
Source 2 Constant	Sets the constant value to be used. **Note**. Applicable only if *Source 1* is assigned to one of the Constants
Mux Selector	Select the digital signal to be used to switch between the 2 multiplexer inputs. '0' selects first input (Mux A Src); '1' selects second input (Mux B Src).

Square Root Setup:

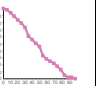
Source 1	Selects the source of the parameter that requires square root to be applied – see Appendix A, page 92 for description of sources.

...Functions / ...Math Blocks

Setup for ***All Math Block Types***:

Eng. Dps	Selects the number of decimal places (resolution) displayed for the math block result.
Eng. Low Eng. High	Selects the engineering range low / high value for display and calculation of proportional band. If the math block result exceeds the *Eng High* or *Eng Low* value by more than 10%, the math block fail state is set and its output is determined by the *Fault Action* (see below).
Eng Units	The selected units are displayed in the operator pages – see Appendix C, page 97 for description of engineering units.
Fault Action	The value returned when the math block fails can be configured.
None	Failed calculated value is used as math block output.
Automatic	If the failed calculated output value is below zero the output is driven to its minimum value. If the failed calculated output value is above zero the output is driven to its maximum value.
Upscale	If the math block fails, its output is driven to its maximum value.
Downscale	If the math block fails, its output is driven to its minimum value.

...Functions

Linearizer 1 (2)	A 20-breakpoint (custom) linearizer. Custom linearizers are applied by: 1. Selecting an analog source as the input to the linearizer. 2. Selecting the custom linearizer output as the source to be displayed. The engineering range and units of the input source are assigned to the custom linearizer output. 
Source 1 (2)	Selects the input source to be linearized – see page 92 for description of sources.
Lin 1 (2) Breakpoints	Set X and Y values as a % of the engineering range input source.
Breakpoint	Selects the breakpoint to be configured.
X	*X* is input to the linearizer expressed as a % of the electrical range.
Y	*Y* is output expressed as a % of the engineering range.
	Once configured, a custom linearizer must be soft-wired to an input or output using the custom template feature – see Section 7.1, page 33.

...Functions

Delay Timer 1 (2)	Two delay timers are provided. Each is triggered by the rising edge of its assigned source. An internal timer is started and, when the timer reaches the set *Delay Time*, its output goes high for the *On Time* that is configured. After the delay time is triggered it ignores further transitions of the source input until the end of this delay timer cycle (until end of *On Time*).
Source 1 (2)	The source signal used to trigger the delay timer. Trigger occurs on rising edge of the signal – see Appendix A, page 92 for description of sources.
Delay Time	The delay (in seconds) between the trigger received and the output of the delay timer going high.
On Time	The amount of time (in seconds) the delay timer output is held in the high state.

...Functions

Real Time Alarms	2 Independent real-time alarms can be configured for activation on particular days and times for a set duration.
Real Time Alarm 1 (2)	Sets the days, month, time and duration the alarm is activated.
Monday (to Sunday)	
Month enable	When enabled (*On*), activates the alarm on the 1st day of each month.
Every hour	When enabled (*On*), activates the alarm every hour.
On hour	Sets the hour the alarm is activated – not applicable if *Every hour* is enabled.
On minute	Set the minutes past the hour the alarm is activated.
Duration	Set the duration the alarm is active.
Display enable	If disabled (*Off*), the alarm state does not appear in the operator level diagnostics window or the alarm log
Tag	A 16-character alphanumeric diagnostic message displayed in the *Diagnostic Status Bar* and the *Diagnostic View* in the *Operator Level* – see Section 5, page 28.

...Functions

Bank Control	Bank control functionality enables a bank of output devices such as pumps, heaters or fans to be scheduled *On* and *Off* under a duty / assist strategy. If required, one of two different wear levelling schedules can be selected, *Rotate* or *FIFO* (*First In First Out*). Up to 6 stages may be configured for bank control, each of which can be assigned to a relay or digital output. Each stage has an associated *On* trip value, *Off* trip value and initial *Output*. All stages included in a wear levelling schedule must use the same schedule type (*Rotate* or *FIFO*). The example (overleaf) illustrates how the two modes operate to achieve wear levelling of 3 pumps in a duty / assist strategy.

...Functions / ...Bank Control

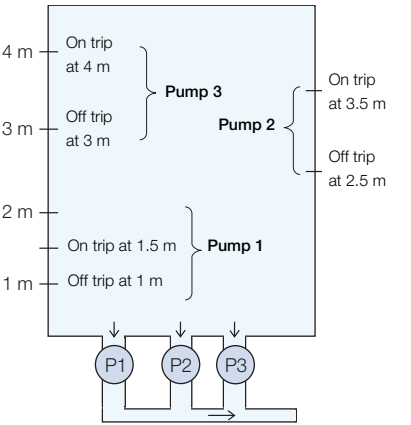
Using *First In First Out* (*FIFO*) and *Rotate* modes on a 3 pump system

First In First Out (FIFO)

	Level	P1	P2	P3		Level	P1	P2	P3
Seq. 1	1.3 m	×	×	×	Seq. 6	2.2 m	×	×	✓
Seq. 2	2.2 m	✓	×	×	Seq. 7	0.8 m	×	×	×
Seq. 3	3.6 m	✓	✓	×	Seq. 8	1.8 m	✓	×	×
Seq. 4	4.3 m	✓	✓	✓	Seq. 9	0.8 m	×	×	×
Seq. 5	2.8 m	×	✓	✓	Seq. 10	1.8 m	×	✓	×

Rotate Pump Cycling

	Level	P1	P2	P3		Level	P1	P2	P3
Seq. 1	1.3 m	×	×	×	Seq. 6	2.2 m	✓	×	×
Seq. 2	2.2 m	✓	×	×	Seq. 7	0.8 m	×	×	×
Seq. 3	3.6 m	✓	✓	×	Seq. 8	1.8 m	×	✓	×
Seq. 4	4.3 m	✓	✓	✓	Seq. 9	0.8 m	×	×	×
Seq. 5	2.8 m	✓	✓	×	Seq. 10	1.8 m	×	×	✓



...Functions / ...Bank Control

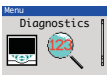
Bank Size	Select the number of stages (pumps) required for the application from *2* to *6* or *Off*. *Off* disables the *Bank Control* functionality.
Control Source	Select the analog signal to act as the control signal for the bank control. This is normally the Process Variable (PV) for most pump control applications.
Stage 1 (6)	
Off Trip	Select the *Control Source* value (PV) at which the output (pump) is turned off.
On Trip	Select the *Control Source* value (PV) at which the output (pump) is turned on.
Output	Select the initial output (relay or digital output) that the output is assigned to by default (for example, when *FIFO* or *Rotate* mode is not in operation).
Schedule	Select the wear levelling schedule required: *Off* – the output is not controlled by the bank schedule. The state of the output is controlled entirely by its associated trip points. *FIFO* – the output is controlled according to the *FIFO* schedule mode. *Rotate* – the output is controlled according to the *Rotate* schedule mode.

7.7 Communication

Used to setup communications parameters for the MODBUS / Ethernet / Profibus communication protocols – see separate User Guide (IM/CM/C-EN).

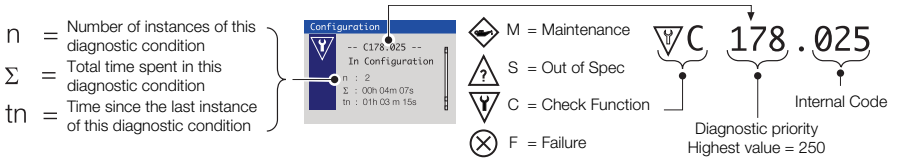
Note. Only 1 communications option can be fitted per indicator.

7.8 Diagnostics



Used to view diagnostic data – see Section 7.8.1, page 76 for description of diagnostic messages and recommended corrective action(s).

Diagnostic history Displays a log of the diagnostic messages generated by the indicator.
Each diagnostic condition has a classification code conforming to NAMUR NE107.



...Diagnostics

Source Analysis	
Analog Sources	Enables the current value of any analog source to be viewed.
Analog Source	Selects the analog signal to be viewed – see Section A.2, page 93.
View Value	Displays the value of the analog signal selected.
Digital Sources	Enables the current state of any digital source to be viewed.
Digital Source	Selects the digital signal to be viewed – see Section A.1, page 92.
View State	Displays the state of the digital signal selected.
Invalid Sources	Select edit to display any invalid analog or digital sources that are used in the configuration. Reasons for invalid sources include: ■ Hardware not fitted ■ Software not fitted ■ Digital I/O configured as wrong type ■ Alarms not configured ■ Math, logic, timer or custom linearizer not configured

7.8.1 Diagnostic Messages

Icon	Number / Message	Possible Cause	Suggested Action
⊗	F250.00 PV 1 Failed	Problem with Input assigned to Loop 1 (2) PV. Broken sensor leads, defective input source or input signal out of permitted range.	Check wiring. Check input source. Check if input signal is outside permitted limits.
⊗	F248.001 PV 2 Failed	Problem with Input assigned to Loop 1 (2) PV. Broken sensor leads, defective input source or input signal out of permitted range.	Check wiring. Check input source. Check if input signal is outside permitted limits.
⊗	F222.014 CJ 1 Failed	Error in Cold junction measurement associated with AIN1 (AIN3). Wiring fault or defective sensor.	Check cold junction device is correctly fitted. Ensure I/P 2 is turned off. Replace CJ sensor.
⊗	F220.015 CJ 2 Failed	Error in Cold junction measurement associated with AIN1 (AIN3). Wiring fault or defective sensor.	Check cold junction device is correctly fitted. Replace CJ sensor.
⊗	F216.016 NV Error Proc Bd	Failure of non-volatile memory on processor display board or permanent corruption of its data.	Check all configuration parameters and correct any errors. Acknowledge error. If problem persists contact local service organization.
⊗	F214.017 NV Error Main Bd	Failure of non-volatile memory on main board or permanent corruption of its data.	Check calibration of AO1 and AO2. Recalibrate if necessary. Acknowledge error. If problem persists contact local service organization.

Table 7.1 Diagnostic Messages

Icon	Number / Message	Possible Cause	Suggested Action
⊗	F212.018 NV Error Opt Bd 1	Failure of non-volatile memory on option board 1 or permanent corruption of its data.	Check calibration of AIN1 and AIN2. Recalibrate If necessary. Acknowledge error. If problem persists contact local service organization.
⊗	F210.019 NV Error Opt Bd 2	Failure of non-volatile memory on option board 2 or permanent corruption of its data.	Check calibration of AIN3 and AIN4. Recalibrate If necessary. Acknowledge error. If problem persists contact local service organization.
⊗	F208.020 NV Error Comm Bd	Failure of non-volatile memory on communications board or permanent corruption of its data.	Acknowledge error. Check communications board is correctly identified by device. If problem persists contact local service organization.
⊗	F206.021 NV Error SW Key 1	Failure of non-volatile memory on Software key 1 or permanent corruption of its data.	Acknowledge error. Check software key functionality is enabled. If problem persists contact local service organization.
⊗	F204.022 NV Error SW Key 2	Failure of non-volatile memory on Software key 1 or permanent corruption of its data.	Acknowledge error. Check software key functionality is enabled. If problem persists contact local service organization.

Table 7.1 Diagnostic Messages (Continued)

7.9 Device Info

Used to display read-only factory-set parameters for the indicator.

Instrument Type	The indicator's model number (for example, CM15).
I/O Build	The input / output (I/O) configuration.
No. Analog Inputs	The number of analog inputs available.
No. Analog Outputs	The number of analog outputs available.
No. Relays	The number of relays available.
No. Digital I/O	The number of digital inputs / outputs available.
Functionality	The current functional setting of the indicator (for example, *Single Channel PV*).
Serial No.	The factory serial number.
Hardware Revision	The indicator's hardware version number.
Software Revision	The indicator's software version number.

8 Templates and Functionality

ControlMaster CM15 and CMF160 indicators fitted without a software key have basic templates and functionality. ControlMaster CM15 and CMF160 indicators fitted with 2 software keys have dual templates and functionality.

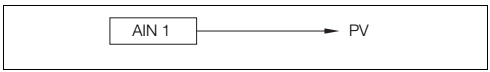
Note.

- Input assignments can be changed in Device Setup / Custom Config – see page 35.
- Output assignments can be changed in Input / Output configuration – see page 43.

8.1 Basic Templates

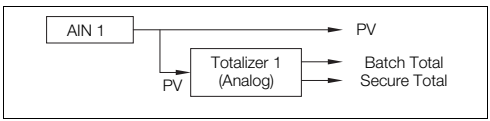
8.1.1 Single Channel PV

This template enables the indication of a single PV.



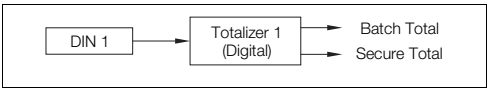
8.1.2 One PV / Totalizer

This template enables a single PV along with totalization of that PV, providing the ability to show either the Batch Total (default) or Secure Total.



8.1.3 One Channel Totalizer

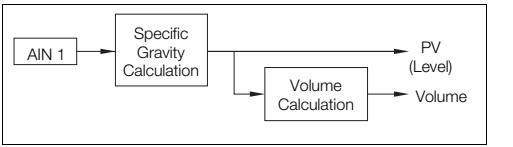
This template enables totalization from a digital signal, to provide a counter function.



8.1.4 Single Channel Level

This template adds level functionality to the Single Channel template. This consists of applying a Specific Gravity calculation to the PV to provide the level of a liquid within a vessel.

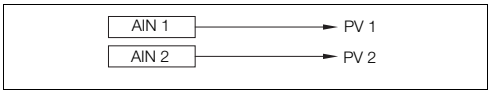
A volume calculation can also be applied to the level to provide the volume contained within a vessel.



8.2 Dual Templates

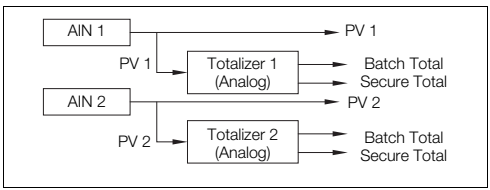
8.2.1 Dual Channel PV

This template enables all the functions available on the Single PV indication but allows 2 separate PVs to be displayed on the Indicator.



8.2.2 Dual PV / Totalizer

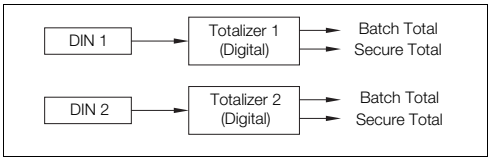
This template enables 2 separate PVs along with separate totalization of those PVs, providing the ability to show both the Batch Totals or Secure Totals.



8.2.3 Dual Channel Totalizer

This template enables 2 channels of totalization from separate digital signals.

The primary function of this template is to provide 2 independent counters.

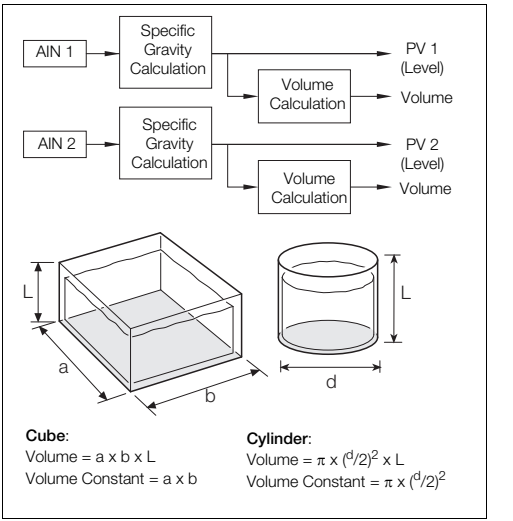


8.2.4 Dual Channel Level

This template adds Level functionality to the Dual Channel PV template.

For each channel, this consists of applying a Specific Gravity calculation to the PV to provide the level of a liquid within a vessel.

A volume calculation can also be applied to the level to provide the volume contained within a vessel.



Cube:
Volume = a x b x L
Volume Constant = a x b

Cylinder:
Volume = $\pi \times (^{d}/_{2})^{2} \times L$
Volume Constant = $\pi \times (^{d}/_{2})^{2}$

9 PC Configuration

To augment local configuration of the device via the front panel keys, a PC utility is available that enables configurations to be uploaded from and downloaded to the device via the IrDA interface. This allows a configuration to be backed up from one device and saved for future use.

The infrared interface is activated from the *Advanced* configuration level and can be configured to operate in *Read-Only* or *Read/Write* modes. For further information please contact your sales representative.

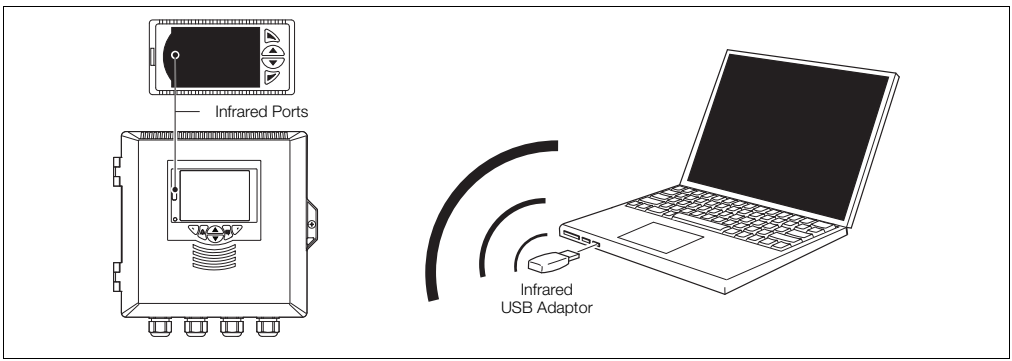


Fig. 9.1 PC Configuration via Infrared Port

10 Specification

Operation

Display

Color, 1/4 VGA TFT, liquid crystal display (LCD) with built-in backlight

Language

English, German, French, Italian and Spanish

Operator keypad

CM15: 4 tactile membrane keys

CMF160: 6 tactile membrane keys

Security

Password protection

Basic / Advanced – user-assigned (not factory-set)

Standard functions

Templates

Base	Single PV indication Single PV indication + totalizer Counter Single PV indication + level
Dual	Dual PV indication Dual PV indication + totalizer Dual counter Dual PV indication + level

Process alarms

Number

8

Types

High / Low process and High / Low latch

Source

Fully configurable
(for example – PV, Analog input, Math block inbuilt)

Hysteresis

Level and time

Alarm enable

Enable / Disable individual alarms via a digital signal

Acknowledgement

Via front panel keys or digital signals

Real-time alarms *

Number	2
Programmable	Time
	Day
	Duration

*Functionality level 'Standard' and above only

Math blocks*

Number:

8

Operators:

+, –, x, /

Average, Maximum, Minimum

High / Low / Median select

Square root

Multiplexer

Delay timers*

Number

2

Programmable

Delay

Duration

Logic equations*

Number

8

Elements

15 per equation

Operators

OR, AND, NOR, NAND, NOT, EXOR

Custom linearizer*

Number

2

Elements

Bank control*

Number of outputs

6

Wear levelling

Rotate or FIFO

**Functionality level 'Standard' and above only

Analog inputs

Universal process inputs

Number	1 standard 1 optional (CMF160 only)
Type	Voltage Current Resistance (ohms) 3-Wire RTD 4-wire RTD (CMF160 only) Thermocouple Digital volt-free Digital 24 V Frequency

Non-universal process inputs

Number	1 standard 1 optional (CMF160 only)
Type	Voltage Current Thermocouple* Digital volt-free Digital 24 V

Thermocouple types

B, E, J, K, L, N, R, S, T
*Only if universal input 1 on the same input module is configured as 'Thermocouple'

Resistance thermometer

Pt100

Other linearizations

$\sqrt{x}$, $x^{3/2}$, $x^{5/2}$, custom linearization

Digital filter

Programmable 0 to 60 s

Display range

–9999 to 99999

Update rate

125 ms

Common mode noise rejection

> 120 dB at 50 / 60 Hz with 300 Ω imbalance resistance

Normal (series) mode noise rejection

> 60 dB at 50 / 60 Hz

CJC rejection ratio

0.05 °C/°C change in ambient temperature

Temperature stability

0.02 %/°C or 2 µV/°C (1 µV/°F)

Long term (input) drift

< 0.1 % of reading or 10 µV annually

Input impedance

> 10 MΩ (mV input)

10 Ω (mA input)

Inputs

Thermocouple	Maximum range °C (°F)	Accuracy (% of reading)
B	–18 to 1800 (0 to 3270)	0.1 % or ±2 °C (3.6 °F) (above 200 °C [392 °F]) *
E	–100 to 900 (–140 to 1650)	0.1 % or ±0.5 °C (0.9 °F)
J	–100 to 900 (–140 to 1650)	0.1 % or ±0.5 °C (0.9 °F)
K	–100 to 1300 (–140 to 2350)	0.1 % or ±0.5 °C (0.9 °F)
L	–100 to 900 (–140 to 1650)	0.1 % or ±1.5 °C (2.7 °F)
N	–200 to 1300 (–325 to 2350)	0.1 % or ±0.5 °C (0.9 °F)
R	–18 to 1700 (0 to 3000)	0.1 % or ±1 °C (1.8 °F) (above 300 °C [540 °F]) *
S	–18 to 1700 (0 to 3000)	0.1 % or ±1 °C (1.8 °F) (above 200 °C [392 °F]) *
T	–250 to 300 (–400 to 550)	0.1 % or ±0.5 °C (0.9 °F) (above –150 °C [–238 °F]) *

* Accuracy is not guaranteed at temperatures below this value

RTD	Maximum range °C (°F)	Accuracy (% of reading)
Pt100	–200 to 600 (–325 to 1100)	0.1 % or ±0.5 °C (0.9 °F)

Linear inputs	Standard analog input	Accuracy (% of reading)
Millivolts	0 to 150 mV	0.1 % or ±20 µV
Milliamps	0 to 45 mA	0.2 % or ±10 µA
Volts	0 to 25 V	0.2 % or ±20 mV
Resistance (low)	0 to 550 Ω	0.2 % or ±1 Ω
Resistance (high)	0 to 10 kΩ	0.1 % or ±5 Ω
Sample Interval	125 ms per sample	

Digital inputs	
Type	**Volt-free or 24 V**
Minimum pulse duration	Single input configured – 250 ms Both inputs configured as analog or digital – 500 ms
Volt-free	Contact open > 10 MΩ / contact closed < 100 kΩ

Frequency input*	
Frequency range	0 to 6000 Hz
1-signal	15 to 30 V
0-signal	–3 to 5 V

*For use with devices with open collector outputs

Outputs

Retransmission outputs

Number	CM15: 2 (1 standard, 1 optional) CMF160: 4 (2 standard, 2 optional)
Isolation	Galvanically isolated from the rest of the circuitry, 500 V for 1 minute
Analog range	0 to 20 mA programmable
Load	750 Ω max.
Accuracy	0.25 % of output or ±10 µA

Relays

Number	CM15: 4 (1 standard, 3 optional) CMF160: 6 (4 standard, 2 optional)
Type	Standard with changeover contacts CM15 only – optional contacts selectable as NO or NC (by jumper)
CM15: relay 1 contact rating	5 A, 240 V
CM15: relay 2, 3 and 4 contact ratings at maximum ambient temperature of 40 °C (104 °F)	5 A, 240 V
CM15: relay 2, 3 and 4 contact ratings at maximum ambient temperature of 55 °C (131 °F)	2 A, 240 V
CMF160: contact ratings	2A 240 V
Update rate	125 ms

Digital I/O

Number	CM15: 2 (optional) CMF160: 6 (standard)
Type	User-programmable as input or output
	Minimum input pulse duration – 125 ms
Input	Volt-free contact open > 10 MΩ / contact closed < 100 kΩ 24 V DC 1-signal 15 to 30 V / 0-signal –3 to 5 V TTL low: 0 to 0.8 V / high: 2 to 5 V
	Conforms to IEC 61131-2
Output	Open collector output
	30 V, 100 mA max. switched
	Conforms to IEC 61131-2
Update rate	125 ms

2-Wire transmitter power supply

Number	CM15: 1 (standard) CMF160: 1 (optional)
Voltage	24 V DC
Drive	2 loops, 45 mA max.

Communications

Note. Only one communications option can be fitted per indicator.

IrDA service port (standard)

Baud rate	Up to 115 kBaud
Distance	Up to 1 m (3 ft)
Functions	Firmware upgrade
	Configuration upload / download

Ethernet (optional)

Type	10BaseT
Connector	RJ 45
Protocols	TCP/IP
	HTTP
	MODBUS TCP (Slave)
Web server	Built-in – enables remote monitoring using standard web browsers
Email	Can be configured to be sent on the occurrence of a specified event
	Up to 3 recipients
	Up to 4 trigger sources with configurable tag

MODBUS* RTU (optional)

Baud rate	Up to 115 kBaud
Isolation	Galvanically isolated from the rest of the circuitry, 500 V DC for 1 minute

*MODBUS is a registered trademark of the MODBUS-IDA organization

EMC

Emissions & immunity

Meets requirements of IEC 61326 for an Industrial Environment

Environmental

Operating temperature range

0 to 55 °C (32 to 131 °F) *

Operating humidity range

5 to 95 % RH (non-condensing)

Storage temperature range

–20 to 70 °C (–4 to 158 °F)

Enclosure sealing

CM15:	
Front face	IP 66 & NEMA 4X
Rest of enclosure	IP20
CMF160:	
Front face / rest of enclosure	IP 66 & NEMA 4X

Vibration (CM15)

Conforms to EN60068–2–6

*Restrictions may apply – refer to Relay specification, page 88.

Safety

Approvals and certifications

EN 61010-1

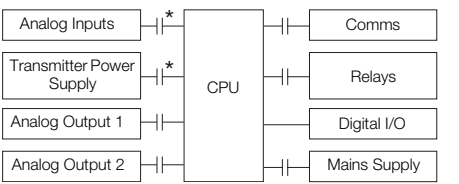
cULus

General safety

Overvoltage Class III on mains, Class II on inputs and outputs

CM30 / CM50:	Pollution Degree 2, Insulation Class 2
CMF310:	Pollution Degree 2, Insulation Class 1

Isolation



Key

⊣| |⊢ = Isolation

*Isolated on CMF160 only

Electrical

Supply ranges

100 V to 240 V AC ±10 % (90 V min. to 264 V max.) 50 / 60 Hz

10 to 36 V DC (optional – CM15 only)

Power consumption

CM15: 10 W max.
CMF160: 25 W max.

Power interruption protection

No effect for interrupts of up to 60 ms

Physical

Size

CM15: 50 x 97 x 141 mm (2.0 x 3.8 x 5.5 in.)

CMF160: 214 x 194 x 98 mm (8.42 x 7.64 x 3.85 in.)

Weight

CM15: 0.38 kg (0.84 lb) approx. (unpacked)

CMF160: 1.5 kg (3.3 lb) approx. (unpacked)

Panel cutout

CM15: 45 x 92 mm (1.8 x 3.6), 120 mm (4.8 in.) behind panel

CMF160: 186 x 186 mm (7.32 x 7.32 in.),

92 mm (3.6 in.) behind panel

Case material

Glass-filled polycarbonate

DS/CM15–EN Rev. J
DS/CMF160-EN

Appendix A – Digital and Analog Sources

Note. Numbers in brackets indicate additional parameters, for example, 'Alarm 1 (8) Ack. State indicates that 8 *Alarm Ack. State* parameters are available.

A.1 Digital Sources

Source Name	Description [Comment]
Alarm 1 (8) Ack. State	Acknowledged alarm = 0 Unacknowledged alarm = 1
Alarm 1 (8) State	Alarm state
Anlg IP 1 (2) Fail (CM15) Anlg IP 1 (4) Fail (CMF160)	Analog input failure (active when the signal detected at the analog input is outside the fault detect level specified during configuration).
AO1 (2) Loop Break	Analog output
Delay Timer 1 (2)	Delay timer state
IP 1 (2) Digital State (CM15) IP 1 (4) Digital State (CMF160)	Input 1 (2) digital state
Linearizer 1 (2) Fail	Custom linearizer failure

Source Name	Description [Comment]
Logic Equation 1 (8)	Logic equation result
Math Block 1 (8) Fail	Maths failure
RTA 1 (2) State	Real time alarm state
Softkey Toggle	Front panel soft key toggles the source's state.
Softkey Edge	Front panel soft key sets the source active on key press.
T1 (2) Int Pulse	Totalizer intermediate pulse. Active for 1 second when the intermediate count is reached.

Source Name	Description [Comment]
T1 (2) Run State	Totalizer run state 1 = Totalizer running
T1 (2) Wrap Pulse	Totalizer wrap pulse If *Wrap Enable* is set to *On* – active for 1 second when the predetermined count is reached. If set to *Off* – active when the predetermined count has been reached and remains active until the totalizer is reset.

A.2 Analog Sources

Source Name	Description
Anlg IP 1 (2) (CM15) Anlg IP 1 (4) (CMF160)	Analog input
Constant 1 (8)	Math block constant
Linearizer 1 (2)	Custom linearizer
Math Block 1 (8)	Math block

Appendix B – Error Codes

B.1 Configuration Error Codes

Configuration errors are generated when a signal assigned as a source for something has failed. Configuration errors are displayed as numerical codes and a description of each code is shown in the following tables:

Error Code	Error Description
1	Analog Input Value A1 (I/P 1)
2	Analog Input Value A2 (I/P 2)
3	Analog Input Value B1
4	Analog Input Value B2
5	Analog Input Value C1
6	Analog Input Value C2
22	Totalizer Batch total 1
23	Totalizer Secure Total 1
24	Totalizer Batch total 2
25	Totalizer Secure Total 2

Error Code	Error Description
26	Maths Block Value 1
27	Maths Block Value 2
28	Maths Block Value 3
29	Maths Block Value 4
30	Maths Block Value 5
31	Maths Block Value 6
32	Maths Block Value 7
33	Maths Block Value 8
34	Maths Block Constant 1
35	Maths Block Constant 2
36	Maths Block Constant 3
37	Maths Block Constant 4
38	Maths Block Constant 5
39	Maths Block Constant 6
40	Maths Block Constant 7
41	Maths Block Constant 8
50	PV Maximum Value 1

Error Code	Error Description
51	PV Minimum Value 1
52	PV average Value 1
53	Volume Value 1
54	PV Maximum Value 2
55	PV Minimum Value 2
56	PV average Value 2
57	Volume Value 2
58	Customer Linearizer Value 1
59	Customer Linearizer Value 2
64	Template Block PV Value 1
65	Template Block PV Value 2
70	Analogue Input Fail State A1
71	Analogue Input Fail State A2
72	Analogue Input Fail State B1
73	Analogue Input Fail State B2
74	Analogue Input Fail State C1
75	Analogue Input Fail State C2

Error Code	Error Description
76	Maths Block Fail State 1
77	Maths Block Fail State 2
78	Maths Block Fail State 3
79	Maths Block Fail State 4
80	Maths Block Fail State 5
81	Maths Block Fail State 6
82	Maths Block Fail State 7
83	Maths Block Fail State 8
84	Custom Linearizer Fail State 1
85	Custom Linearizer Fail State 2
94	Analog Input State A1 (I/P 1)
95	Analog Input State A2 (I/P 2)
110	Digital Input State 1
111	Digital Input State 2
112	Digital Input State 3
113	Digital Input State 4
114	Digital Input State 5

Error Code	Error Description
115	Digital Input State 6
123	Totalizer Run State 1
124	Totalizer Wrap Pulse 1
125	Totalizer Intermediate Pulse 1
126	Totalizer Run State 2
127	Totalizer Wrap Pulse 2
128	Totalizer Intermediate Pulse 2
131	Logic Equation Result 1
132	Logic Equation Result 2
133	Logic Equation Result 3
134	Logic Equation Result 4
135	Logic Equation Result 5
136	Logic Equation Result 6
137	Logic Equation Result 7
138	Logic Equation Result 8
139	Real Time Alarm State 1
140	Real Time Alarm State 2

Error Code	Error Description
141	Alarm State 1
142	Alarm Ack State 1
143	Alarm State 2
144	Alarm Ack State 2
145	Alarm State 3
146	Alarm Ack State 3
147	Alarm State 4
148	Alarm Ack State 4
149	Alarm State 5
150	Alarm Ack State 5
151	Alarm State 6

Error Code	Error Description
152	Alarm Ack State 6
153	Alarm State 7
154	Alarm Ack State 7
155	Alarm State 8
156	Alarm Ack State 8
167	Analog O/P Loop break A1
168	Analog O/P Loop break B1
177	Delay Timer State 1
178	Delay Timer State 2
189	Toggle Signal
190	Edge Signal

B.2 Profile Error Codes

Error Code	Error Description
1	*Jump Target Invalid* Current active program is configured to jump to another program, upon the completion of this action it is found that the next program has been configured incorrectly.
2	*Retort Rampback Invalid* Retort Rampback value is a negative number and must be changed.
3	*Retort Previous Invalid* There is no previous segment therefore the program is unable to jump back to the last ramp rate.
4	*PV Invalid* The Process Variable has failed.
5	*Local Setpoint has Failed* The Local setpoint has become invalid. This may be that it has travelled outside of its permissible limits.
9	*Validation* The current program is configured incorrectly and therefore judged invalid by the software validation.

Appendix C – Analog Input (Engineering) Units

Unit	Description
%	%
% sat	% saturation
%dO2	% dissolved oxygen
%HCl	% hydrochloric acid
%N2	% nitrogen
%O2	% oxygen
%OBS	% obscuration
%RH	% relative humidity
A	amps
bar	bar
CUMEC	cubic metre per second
Custom Units	User-assigned units
deg C / F	degrees Celsius / Fahrenheit
Feet	imperial feet
ft^3/d, ft^3/h, ft^3/m, ft^3/s	cubic feet per day, hour, minute, second.
FTU	formazine turbidity units
g/d, g/h, g/l	grams per day, hour, liter
gal/d (UK)	imperial gallons per day
gal/d (US)	US gallons per day

Unit	Description
gal/h (UK) / (US)	imperial / US gallons per hour
gal/m, s (UK) / (US)	imperial / US gallons per minute, second.
Hz	hertz
Inches	imperial inches
Kelvin	degrees Kelvin
kg/d, kg/h, kg/m	kilograms per day, hour, minute.
kg/s	kilograms per second
kHz	kilohertz
l/d, l/h, l/m, l/s	liters per day, hour, minute, second.
lb/d, lb/h, lb/m, lb/s	pounds per day, hour, minute, second.
m WG	meters water gauge
m^3/d, m^3/h, m^3/m, m^3/s	cubic meters per day, hour, minute, second.
mbar	millibar
mg/kg	milligrams per kilogram
Mgal/d (UK)	imperial mega gallons per day
Mgal/d (US)	US mega gallons per day
mho	conductance
Ml/d, Ml/h	megaliters per day, hour.

Unit	Description
ml/h, ml/m	milliliters per hour, minute.
Ml/s	megaliters per second
mS/cm, mS/m	milliSiemens per centimeter, meter
mV	millivolts
MV	megavolts
NTU	nephelometric turbidity units
pb	parts per billion
pH	potential Hydrogen
pm	parts per million
psi	pounds per square inch
S	Siemens
SCFM	standard cubic feet per minute

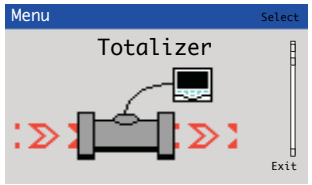
Unit	Description
T/d, T/h, T/m	metric tonnes per day, hour, minute.
T/s	metric tonnes per second
ton/d, ton/h, ton/m, ton/s	imperial tons per day, hour, minute, second.
ug/kg	micrograms per kilogram
uS/cm, uS/m	microSiemens per centimeter / meter
uV	microvolts

Appendix D – Output Type Assignments

Output Type	AO 1	AO 2	DIO 1	DIO 2	RLY1	RLY2	RLY3	RLY4
Analog	OP	PV			ALM 1	ALM 2	ALM 3	ALM 4

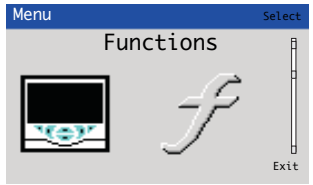
...Advanced Level

Refer to Section 7.5, page 53



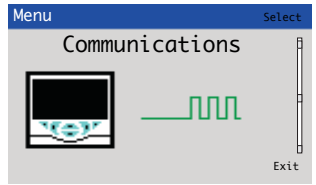
- Totalizer 1 (2)
  - Mode
  - Source
  - Count Direction
  - Units
  - Count Rate
  - Cutoff
  - Stop Go Source
  - Total DPs
  - Preset Count
  - Predet Count
  - Intermediate Count
  - Wrap Enable
  - Reset Source
  - Reset Days
  - Reset Hour

Refer to Section 7.6, page 60



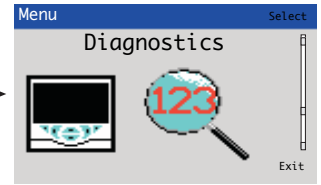
- Logic Equations
  - Equation Number
  - Operand 1 (8)
  - Invert 1 (8)
  - Operator 1 (7)
- Math Blocks
  - Math Block Number
  - Block Type
  - Eng. DPS
  - Eng. Low
  - Eng. High
  - Eng. Units
  - Fault Action
  - Source 1 (2)
  - Source 1 (2) Constant
  - Reset Source
  - Average Duration
  - Operator 1 (3)
  - Mux Selector
- Linearizer 1 (2)
  - Source
  - Lin 1 (2)
  - Breakpoints
- Delay Timer 1 (2)
  - Source 1 (2)
  - Delay Time
  - On Time
- Real Time Alarms
  - Real Time Alarm 1 (2)
- Bank Control
  - Bank Size
  - Control Source
  - Bank 1 (6)

Refer to Section 7.7, page 74



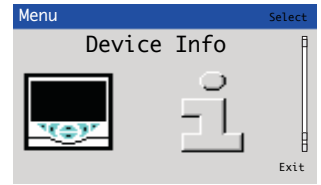
Refer to IM/CM/C-EN for Communication parameter details.

Refer to Section 7.8, page 74



- Diagnostic History
- Source Analysis
  - Analog Source
  - Digital Source
  - Invalid Sources

Refer to Section 7.9, page 78



- Instrument Type
- I/O Build
- No. Analog Inputs
- No. Analog Outputs
- No. Relays
- No. Digital I/O
- Functionality
- Serial No.
- Hardware Revision
- Software Revision

Customer Support

We provide a comprehensive after sales service via a Worldwide Service Organization. Contact one of the following offices for details on your nearest Service and Repair Centre.

UK

ABB Limited
Tel: +44 (0)1480 475321
Fax: +44 (0)1480 217948

USA

ABB Inc.
Tel: +1 215 674 6000
Fax: +1 215 674 7183

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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IM/CMI–EN Rev. K 03.2015

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