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Chell Configurable Display

CCD100

OPERATING MANUAL

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http://www.chell.co.uk

900219-1.0

Please read this manual carefully before using the instrument.

Use of this equipment in a manner not specified in this manual may impair the user's protection.

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Chell's policy of continuously updating and improving products means that this manual may contain minor differences in specification, components and circuit design from the actual instrument supplied.

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TABLES

Section 1 - Instrument Overview

The CCD100 is a multi featured process display controller, capable of interfacing directly to a mass flowmeter or other process transducers. This is the third generation of the Chell CCD100 display.

The CCD100 is a single channel unit which can be used to operate a flow controller or display the output from a pressure transducer. It supports both voltage transducers (typically 5 & 10V full scale) and also millivolt transducers (max 250mV full scale). There is also a secondary channel which can be used for external command (setpoint) control (+10v full scale). The CCD100 also has the ability to power such devices with either ±15dc @ 250mA or +24vdc @ 300mA.
Interfaces to the CCD100 include RS232 (via USB), Ethernet or it can be used with just analogue signals.

Note: This manual has been written for firmware version 1.00.

Section 2 - Specification

2.1 Power Supply:

Line voltage:	24V DC. ±5%
Consumption:	less than 500mA
Protection:	Internal resettable fuse

2.2 Operating conditions:

Operating temperature range:	+5°C to +50°C (40°F to 122°F)
Storage temperature range:	-20°C to +70°C (-40°F to 158°F)
Maximum Relative humidity:	95% at 50°C (non condensing)
Warm up time to full accuracy:	15 minutes (assumes unit already stabilised at ambient and excludes transducer warm up time).

2.3 Measurement and Outputs:

Power supply out:	±15V dc @ 250mA max. +24V dc @ 300mA max. Use ±15V or +24V transducer excitation. Do Not Use Both.
DC input signal:	0-10.0V dc (guaranteed limit is +11.7V)
Input impedance:	>500 kOhm
DC output:	Retransmission of Input. Limits of ±10.8V dc, into 10 kOhm or greater.
Output accuracy (after zero):	± 0.1% of reading ± 0.01% full scale
Setpoint (Command) Output:	Configurable 0-10 V dc. Close = <-0.25 V Open = >7.0 V (@5V FS) or >12.0V (@10V FS)

Section 3 - Installation and Interconnections

The instrument is designed to be panel mounted, and is a standard 96x48mm panel meter enclosure. Note that the instrument must always be situated in such a way as to enable adequate air circulation about the unit.
If a transducer was supplied with the CCD100 a suitable cable may have been included.

3.1 Transducer socket Pinout - 15 Way 'D' Type

Pin Number	Designation
2	Signal
5	Power Gnd
6	-15V Supply
7	+15V Supply
8	Command Output (V) or Excitation (mV option)
11	Signal Return
12	Signal Return
13	+24V Supply
15	Earth/Chassis
All other pins	Not Connected

If the transducer is being powered from another source (e.g. a mains powered supply) it will only be necessary to connect to the two signal pins.
Note: The CCD100 has a fully floating differential input. For single ended use (i.e. tranducers with differential output) join 0V (pin5) & Signal Return (pin12) at the transducer. Ensure the common mode input range is not exceeded.

3.2 Interface Socket Pinout – Miniature 15 Way 'D' Type

Pin Number	Designation
1	Analogue Output
2	Relay 2 Com
3	Relay 2 NO
4	Relay 2 NC
5	0V (Signal Ground)
6	External Setpoint Return
7	N/C
8	External Setpoint
9	N/C
10	0V (Signal Ground)
11	TTL Input – Disable Menu
12	TTL Input – Disable Zero
13	Relay 1 Com
14	Relay 1 NO
15	Relay 1 NC

3.3 USB Connector – USB Type-C

The connector supports USB-C 2.0 cables without the SuperSpeed pairs. Therefore connecting a fully featured USB-C 3.1 cable will not provide SuperSpeed functionality, although the cable will still work as per the USB 2.0 specification.
USB is provided for legacy serial data comms and debugging purposes.

3.4 Power Connection Socket

The panel meter display requires a 24V, 500mA supply to operate. This must be a rectified and regulated direct current supply, capable of 15W (recommended). Although the CCD100 has an internal fuse and power supply overload shut-down protection the supply to the CCD100 should be protected by fuse or other suitable electronic method.
A standard 5mm diameter 'dc power jack' is required to connect to the CCD100.
Connect the positive conductor to the centre pin. Connect the negative (0V) conductor to the outer of the jack.

If requested, a compatible AC-DC switch mode power supply will have been supplied with the unit.

Cautions:
Ensure correct power supply rating and polarity.
Do not use a partially assembled or faulty unit.
Incorrect use of this equipment, or use in a manner not specified may impair the users protection.

3.5 Panel Mounting

A panel mount kit will have been supplied with the instrument. This consists of:
2 M3x6 screws. 2 brackets. 2 50mm screws.
Fit the M3x6 screws into the side of the unit into the diagonally opposed holes. Do not tighten these screws, to allow the bracket to slide over the screw head. Thread locking adhesive may be used but is not required as these screws cannot rotate once the bracket is tightened.
Insert the meter into the panel. A hole cut-out of 92 x 45mm is recommended.
Slip the mounting bracket over the screwhead and tighten the 50mm screw.
The unit should now be secure.

Section 4 - Front Panel Operation

4.1 Introduction

The front panel consists of a 128x32 pixel monochrome graphic OLED display with 6 membrane key switches below it. Each switch has legends on and above or below it to indicate its function under different conditions, although there are certain common functions to each screen, as detailed below.

For the purpose of the following sub-sections, the switches shall be referred to using the legends on the buttons.

4.2 Common Switch Functions

The switches on certain types of screens and in certain modes, have the same functionality as detailed here:

(a) Menu screens
On the menu screen, the '▲' & '▼' switches are used to navigate through the menu options. The '**Func**' switch is used to go back to the main screen. The '**Zero**' switch doubles up as an Enter switch and this actions the chosen menu selection. This may be to go to a sub-menu or to an editable or information screen (see HMI breakdown for more details).

(b) Editable screens
On any screen that has editable fields, switches '▲' & '▼' move the selection between the possible editable fields. '**Func**' goes back to the parent screen which is usually the menu that was used to get to the screen in question. '**Zero**' activates edit mode (see below).

(c) Edit mode
When in edit mode, the edit cursor appears on the first character in the editable field (the cursor is a horizontal bar below the character being edited). If the field is bigger than 1 character then switches '◄' & '►' are used to move left and right across the field. If the field is only one character (e.g. a Yes/No selection) or has a rolling selection (e.g. for selection of a percentage) then '◄' & '►' do nothing. Switches '▲' & '▼' are used to change the character being edited within the valid range (field position dependant). '**Func**' cancels edit mode and returns the field to it's previous value. '**Zero**' accepts any changes to the field and also comes out of edit mode.

4.3 HMI breakdown

Here follows a complete breakdown of all CCD100 screens:

(a) Main Screen (not changing Setpoint)

The main screen shows the main channel input data (with range, full-scale and calibration applied) and the associated units string. If an input is over range (more than 15% above full scale voltage) then the data value is replaced with the over range error – "**RANGE**". This screen also shows the current mode of the setpoint, if not in AUTO (i.e. OPEN or CLOSE). If either of the relays have been tripped then they are also indicated as such on the far right of the screen.

Switch Functions:

Func	No function *
◄	Go to Main Menu screen
►	Enable setpoint mode override, active for 2 seconds
► (override mode)	Change setpoint mode to AUTO
▲	Change setpoint value (main screen changes as below)
▲ (override mode)	Change setpoint mode to OPEN
▼	Change setpoint value (main screen changes as below)
▼ (override mode)	Change setpoint mode to CLOSE
Zero	Perform input rezero (if held for 3 seconds)

* By default the Func switch does nothing, but special builds of the CCD100 may include functionality for this switch. In such cases an addendum to this manual will indicate the function.

(b) Main Screen (changing Setpoint)

When performing a live setpoint change, the main screen is as previously, but with the addition of the current setpoint value (initiated via an initial press of the '▲' or '▼' switches). Note that the setpoint value is not permanent – if the '▲' or '▼' switches are not pressed at all for 3 seconds, then the setpoint value disappears.

Special note for millivolt option:
If the millivolt option is fitted, then the command output is used as the excitation source for the transducer. As such the SP: will change to EXP: to indicate that the user is controlling the excitation output.

Switch Functions:

Func	No function *(see (a) above)
◄	Go to Main Menu screen
►	Enable setpoint mode override, active for 3 seconds
► (override mode)	Change setpoint mode to AUTO
▲	Change setpoint value (hold for continuous change)
▲ (override mode)	Change setpoint mode to OPEN
▼	Change setpoint value (hold for continuous change)
▼ (override mode)	Change setpoint mode to CLOSE
Zero	Perform input rezero (if held for 3 seconds)

(c) Main Screen (Setpoint Valve Control)

Rather than commanding the setpoint to a specific value, the setpoint mode can be changed to Open or Closed which overrides any previously set value. Again the main screen shows everything as normal, but with the addition of the OPEN or CLOSE identifier if this mode has been set. By putting the device into override mode it is possible to force the setpoint to be Open or Closed. This is done by pressing the override switch then the appropriate mode switch. Either mode can be cancelled by switching back to Auto mode (by effectively pressing the override switch twice).

Switch Functions:

Func	No function *(see (a) above)
◄	Go to Main Menu screen
►	Enable setpoint mode override, active for 3 seconds
► (override mode)	Change setpoint mode to AUTO
▲	Change setpoint value (hold for continuous change)
▲ (override mode)	Change setpoint mode to OPEN
▼	Change setpoint value (hold for continuous change)
▼ (override mode)	Change setpoint mode to CLOSE
Zero	Perform input rezero (if held for 3 seconds)

(d) Main Menu Screen

The Main Menu screen allows the user to select screens that are used for the configuration of the CCD100 – the setpoint (initial value, initial mode, source), input (range, full scale, units string), comms, filtering and relays can all be configured from screens selected via the main menu. It is also possible to reset settings to their factory defaults from the Main Menu screen. Only 4 options can be shown on the screen at any one time, so the menu list scrolls up until the last item is shown, and then the selection arrows move down to allow for selection of any menu item.

Special note for millivolt option:
If the millivolt option is fitted, then the Setpoint menu option will be listed as Excitation to allow for configuration of the initial excitation value only.

Switch Functions:

Func	Go back to Main screen
◄	No function
►	No function
▲	Go to previous menu selection
▼	Go to next menu selection
Zero	Go to screen associated with menu selection

(e) Setpoint Screen (Excitation Screen if millivolt option fitted)

From the setpoint screen you can edit the value of the command setpoint as well as change the mode (AUTO, OPEN, CLOSED) and the source (INTERNAL, SLAVE). If SLAVE is selected then the percentage sign (%) appears next to the SP value. For more information on the command setpoint, see the Principles section - 7.4.

Special note for millivolt option:
If the millivolt option is fitted, the only configurable item here is the initial excitation value.

Switch Functions:

Func	Go back to Main Menu screen
◄	Select previous character when in edit mode
►	Select next character when in edit mode
▲	Move edit field selection up
▼	Move edit field selection down
Zero	Go to edit mode for currently selected field

(f) Input Screen

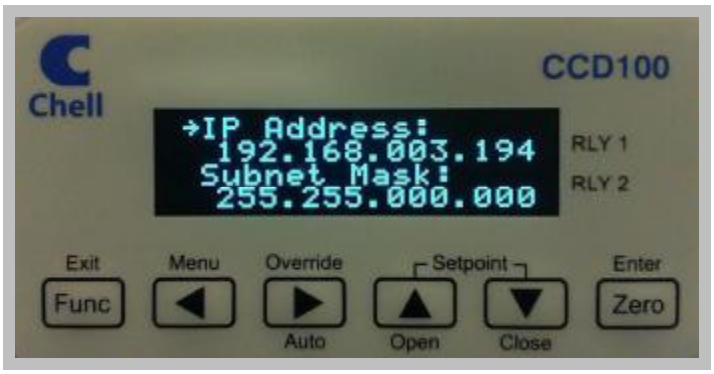
This screen allows you to change the input channel range and full-scale voltage (see the Principles section (7.2) for more information on this) and also assign a units label (up to 5 characters) for the channel data. The number of decimal places selected on the range field dictates the number of decimal places shown for the input channel data on the Main screen. To reduce the number of decimal places, change the number under the edit cursor to a decimal point and the system will auto format the field when '**Zero**' is pressed.

Special note for millivolt option:
If the millivolt option is fitted, the full scale is represented in mV and shown as such on the screen.

Switch Functions:

Func	Go back to Main Menu screen
◄	Select previous character when in edit mode
►	Select next character when in edit mode
▲	Move edit field selection up
▼	Move edit field selection down
Zero	Go to edit mode for currently selected field

(g) Comms Screen



The IP address and the subnet mask of the device can be changed here. The device will need to be reset to enact these changes.

Switch Functions:

Func	Go back to Comms Menu screen
◄	Go to previous menu selection
►	Go to next menu selection
▲	No function
▼	No function
Zero	Go to screen associated with menu selection

(h) Filtering Screen

This screen allows the user to modify the band and buffer size of the adaptive filter. The filter only applies to the display and comms output readings. The band is represented as a percentage of FS and can be set between 0.00% (OFF) and 1.00% and also to ON. The buffer size allows settings between 0 and 6 seconds of filtering. For more information on the adaptive filter, see the Principles section (7.6)

Switch Functions:

Func	Go back to Main Menu screen
◄	Select previous character when in edit mode
►	Select next character when in edit mode
▲	Move edit field selection up
▼	Move edit field selection down
Zero	Go to edit mode for currently selected field

(i) Relay Screen

This screen allows you to set the trip point for when the relays switch. The relays also contains some hysteresis to stop them 'chattering'. This is configurable from this screen as well and is represented as a percentage of full scale of the input channel, with limits of 0.0% (i.e. no hysteresis) to 10.0%.

Switch Functions:

Func	Go back to Main Menu screen
◄	Select previous character when in edit mode
►	Select next character when in edit mode
▲	Move edit field selection up
▼	Move edit field selection down
Zero	Go to edit mode for currently selected field

(j) Factory Defaults Confirmation Screen

If Factory Defaults is selected from the Main Menu, this screen appears to ask for confirmation of the requested function. If confirmed then the screen changes to show a percentage of completion of the factory defaults and once completed the CCD100 will restart.

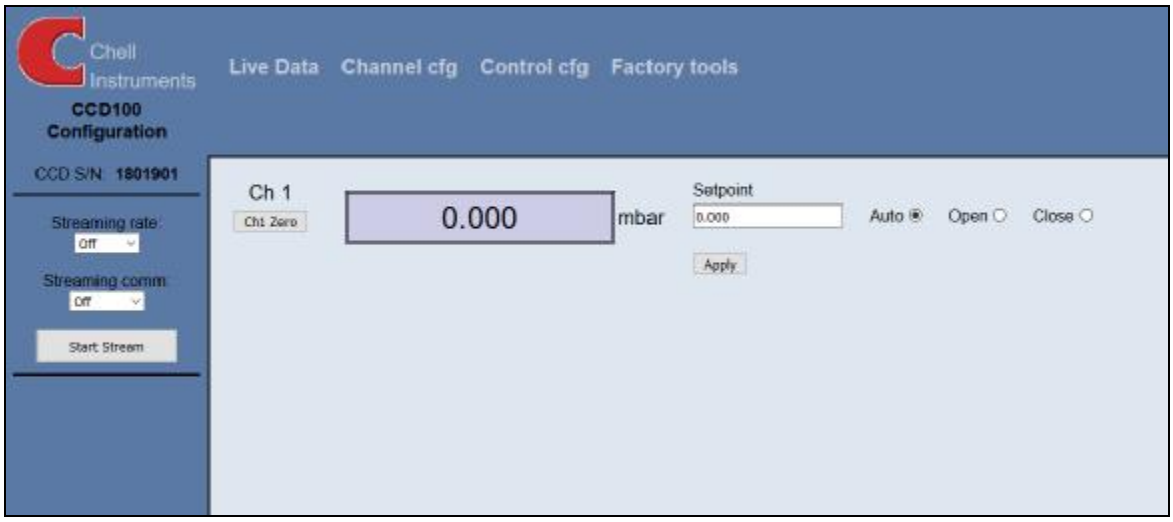
Switch Functions:

Func	Go back to Main Menu screen
◄	If held, starts factory default when Zero is pressed
►	No function
▲	No function
▼	No function
Zero	Starts factory default if ◄ is held as well.

Section 5 - Webserver

5.1 Main page

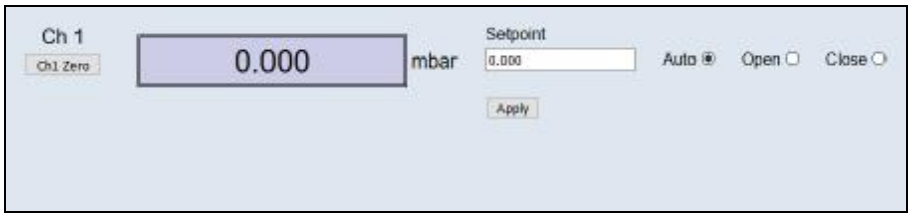
The Web server can be used by entering the IP address of the device into a browser address bar. This allows the user control of various settings within the device, and to read the devices current reading.



Along the top are a series of tabs to allow the user to switch to various sections of device control. Also along the side is the device serial number and controls to start streaming communications, note for TCP streaming to work a TCP connection on port 101 must be pre-established (the unit does not data stream over the HTTP port (80)).

5.2 Live data

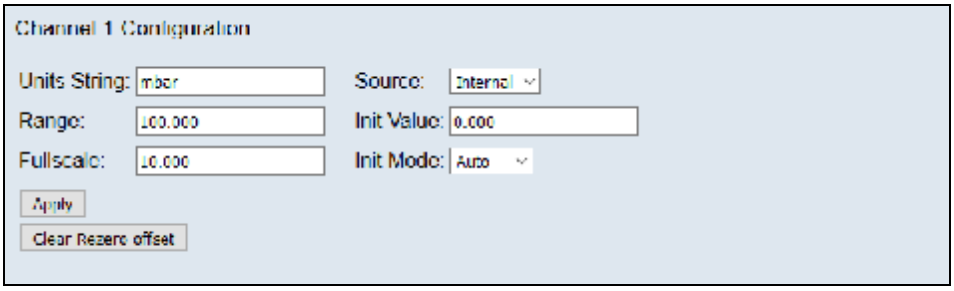
The live data page is the first page the user will see when the web server is loaded up. The main feature of this page is the live data output from the device, but it also has the capabilities to rezero the channel, to change the setpoint value and to set the setpoint valve postion.
Note: The setpoint is set in engineering units as configured by the range setting and cannot be set to more than this range configuration.



The units string and device range can be changed from the Channel cfg page.

5.3 Channel Configuration page

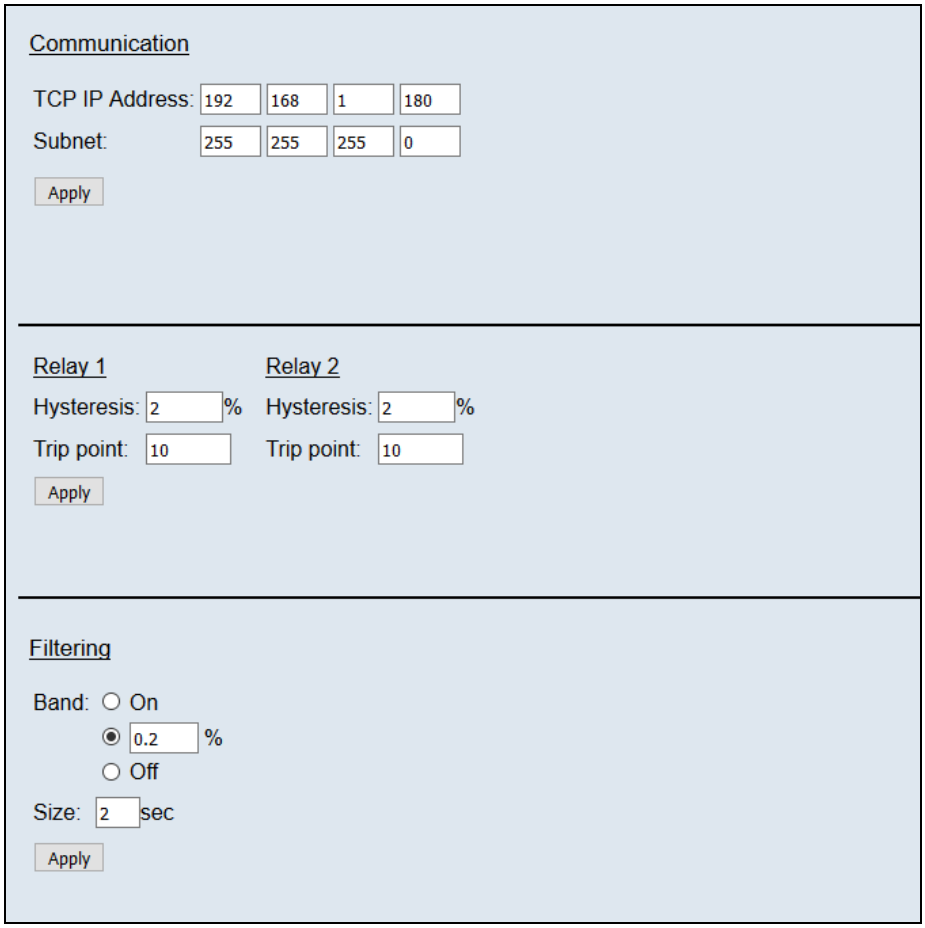
The channel configuration contains channel setup options.



- Units string allows the user to change the units of the channel.
- Range is the Engineering unit conversion of the Voltage output from the transducer (e.g. in the image above 10 Volts = 100 mbar).
- The number of decimal places set for the range dictates its display precision
- Fullscale is the maximum Voltage output of the transducer.
- Source is where the setpoint is referenced from, Internal will output the number entered as the setpoint value and Slave will output a percentage of the external input.
- Init value is the value to which the setpoint will be set to at start-up.
- Init mode is the valve position, auto is the normal setpoint mode, Open will set maximum range voltage output and closed sets minimum range

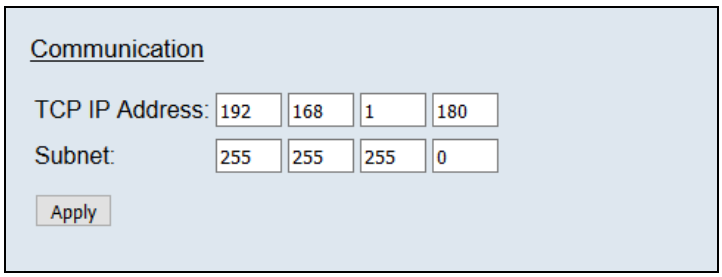
5.4 Control Configuration page

The control configuration page is made up of multiple sections each controlling a different section of the device.

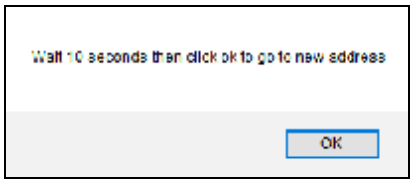


(a) Communication

The communication page allows the user to change the IP address and Subnet mask of the device.

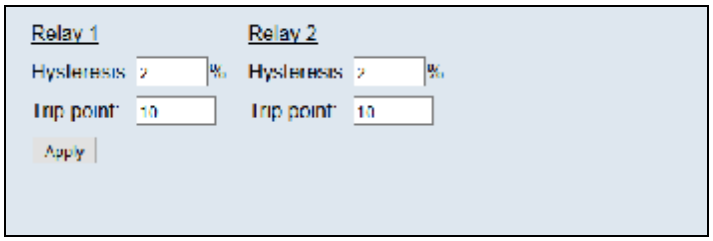


Obviously no octet in the IP Address or Subnet mask can be set to higher than '255'. Once applied the device will need to reset, so the communications page will show a pop-up (see below) that prompts the user to refresh.



(b) Relays

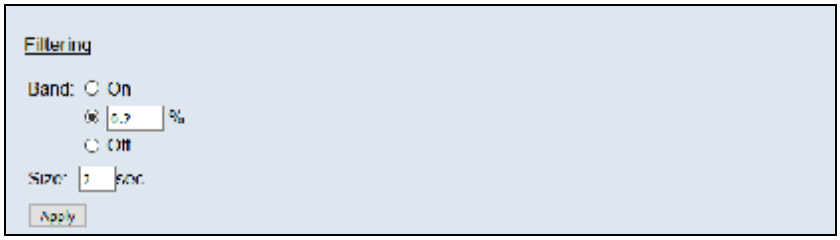
The Relays page allows the user to change the controls for the two onboard relays.



- The hysteresis is a window around the trip point at which the relays will trigger, so to trigger the relay in the image above the input must get to Trip point + 2% (of fullscale) and the relay will not switch off until the input drops to Trip point – 2% (of fullscale).
- The trip point is the Engineering unit at which the Relay will trip

(c) Filtering

Filtering is used to reduce noise in the device.



- Band relates to the filtering limits. The setting is percentage of fullscale and can be set between 0.01% and 1.00%. Other settings are On so that the filtering will be fully active, filtering all data all the time, and Off where there is no filtering.
- The size is the time the data is filtered over, a time greater than 5 will turn the filtering band to on automatically.

For more information on how the adaptive filter works, see the Principles section (7.6).

Section 6 - Serial & TCP Communication

6.1 Introduction

The CCD100 allows full control and feedback via TCP/IP and RS232 (via the USB port). All controls via the HMI are also available via comms or on the webserver and all calibration is also performed via comms commands or the webserver.

Please note that RS232 serial comms is only provided for legacy & debug purposes and is not configurable. The fixed baud rate is 57600 with other settings as follows: 8 data bits, 1 stop bit, No parity, No handshaking.

TCP/IP comms requires an IP address and subnet mask to be configured for the CCD. This can be set via the HMI. Note that on changing the IP address or subnet mask, the CCD must be re-initialised by performing a system reset. This is done automatically if setting from comms or the webserver (the CCD waits a second and then resets itself), but if setting from the HMI, you must power off & on for the new TCP/IP settings to come into effect.

Note for the host connection, the TCP port of the CCD100 is port 101.

6.2 Command/Query format

The format of the commands and queries is common between all available comms protocols for ease of use and understanding when switching between comms methods:

Format: `accc[?] [p][,p][,p]↵`

… where ‘a’ = address, ‘ccc’ = command/query, ‘?’ = query identification; ‘p’ = parameter (separated by commas if more than one)

The first letter to be entered on the command line, before any command or query, is the address identifier. The is a legacy character left in to provide some level of backwards compatibility and familiarity with Chell’s remote comms protocol from earlier display models. It can no longer be configured and is now fixed to the character ‘a’. On TCP/IP this address doesn’t really mean anything because TCP/IP uses an IP address per unit for identification.

Most commands are identified by three letters (although this is not always the case) and a query is identified by following the command letters with a ‘?’ character. For all commands with parameters, you must separate the command from its parameters with a space, and separate multiple parameters with commas.

Table 1 in Appendix A summarises all commands and queries available. Note that where a command is also a query, you do not enter any parameters for the query ‘version’ unless explicitly stated in the table.

For everything sent on the comms port, the CCD will reply by informing the user of the command/query it has just received, along with any parameters identified, any data requested (if it was a valid command/query) and a line indicating whether the command was accepted. This reply block is the same for anything sent to the CCD and is as follows. (‘↵’ indicates a carriage return/line feed pair):

For a command:

<a>:<cmd>;<params>↵

!<a>!<response>!↵

For a query:

<a>:<cmd>;<params>↵

<data>↵

!<a>!<response>!↵

where: <a> is the address letter

<cmd> is the command/query (query identified by a '?' after the three chars)

<params> is the comma separated parameter list, if any

<response> is the acceptance indicator.

<data> is the data requested if a query was sent. Note the data usually consists of some identification string, in CAPS, followed by a colon (:) and then the actual data. Some queries return multiple lines of information. See individual commands for details as appropriate.

The acceptance indicator is a single character as follows:

- 'o' = OK: if the command/query was recognised and accepted;
- 'b' = BADCMD: if the command/query was not recognised or has incorrect/invalid parameters
- 'e' = ERROR: if there was some internal comms error.
- 'w' = BUSY: if the comms is currently busy.

6.3 Main commands

(a) Output current readings – 'r'

This command tells the CCD to get the current reading of the input channel data and output to the comms. If the input voltage of the channel is more than 15% over the full scale voltage set for the channel, the <reading> below will be replaced with the over range error – "RANGE!".

The readings output format is as follows with the channel data followed by a setpoint mode indication, separated by a semi-colon:

READ:<reading>;<setpoint mode>↵

The <setpoint mode> is a single number that represents the current mode of the setpoint: 0 = Auto, 1 = Open, 2 = Closed. This number is mainly included for use with Chell's front-end software (DisplayX) and is mainly useful when outputting repeated readings, where it effectively provides a constant update of the current mode of the setpoint.

(b) Output current readings repeatedly – 'rp'

The CCD is also able to report the current readings repeatedly, at a given interval. This command starts and stops this repeat activity by setting the parameter accordingly:

0 = Repeat off
1 = Repeat every 100ms
2 = Repeat every 500ms
3 = Repeat every second
4 = Repeat every minute

The timing commences from the point at which the 'rp' command is entered.

NOTE for 100ms repeat readings: The data output is effectively lots of small data packets. On TCP networks this can cause problems when communicating with front end software running on MS Windows. It has been found that the Winsock control commonly used in TCP comms development on Windows does not handle lots of small data packets very well, coming in at speeds of around 10Hz or faster. As such it has been decided that when 100ms repeated output is used, the data will be taken every 100ms and buffered up, to be sent out every 500ms in blocks of 5 readings. This has proven to be a more robust output method. For consistency, the output from serial comms also works in the same way.

(c) Setpoint value – 'spv'

This command is used to set the value of the command setpoint. The command takes one parameter which is the actual value to set.

The current value of the setpoint can be retrieved using the query 'spv?'. Returned data is:

`SP VALUE:` <setpoint value>

(d) Setpoint mode – 'spm'

This command sets the mode for the command setpoint. The command takes one parameter which is a number between 0 & 2, identifying the mode, as follows:

0 = Auto mode
1 = Open mode
2 = Closed mode

(For more information on setpoint modes, see the Principles section - 7.4(a)).

The current mode of the setpoint can be retrieved by using the query 'spm?'. The returned data is:

`SP MODE: (`<x>`)` <mode string>

… where …
<x> = `0`, `1`, or `2` and <mode string> = `AUTO`, `OPEN`, or `CLOSED` respectively.

(e) Setpoint source – 'sps'

The setpoint source can be an internally set value or a percentage of the secondary CCD input (known as slave input). This source is set using this command and as with the other setpoint commands, it takes just one parameter which is as follows:

0 = Internal source
1 = Slave source

(For more information on setpoint sources, see the Principles section - 7.4(b)).
The current source of the setpoint can be retrieved by using the query 'sps?'. The returned data is:

`SP SOURCE: (<x>) <source id>`

…where…
<x> = 0 or 1 as above, <source id> = string identifier for <x> : INTERNAL or SLAVE.

(f) Setpoint initial value – 'siv'

The setpoint value set with the 'spv' command (above) is not non-volatile. This command can be used to set an initial setpoint value on system startup. It takes one parameter which is the initial setpoint value.

The current value of the setpoint can be retrieved using the query 'siv?'. Returned data is:

`SP INIT VAL:` <initial setpoint value>

(g) Setpoint initial mode – 'sim'

As with the value, the setpoint mode set using the 'spm' command (above) is a volatile setting. Again this command provides a way of setting an initial startup mode for the setpoint on power up of the CCD. It takes one parameter which is a number between 0 & 2, identifying the initial mode, as follows:

0 = Auto mode
1 = Open mode
2 = Closed mode

The current mode of the setpoint can be retrieved by using the query 'spm?'. The returned data is:

`SP INIT MODE: (<x>)` <mode string>

… where …
<x> = `0`, `1`, or `2` and <mode string> = `AUTO`, `OPEN`, or `CLOSED` respectively.

6.4 Comms commands

(a) Ethernet IP address – 'eip'

This command changes the IP address used to communicate over TCP/IP comms. The parameter should be entered as a standard 4 octet IP address. e.g. `192.168.1.180`. The max octet value is obviously 255. If a greater value is entered, that value will be capped to 255. Once the CCD has responded to the command, it will display the following and auto-restart the system.

```
UNIT SHOULD AUTO RESTART↵
IF NOT, RESTART TO APPLY CHANGES↵
```

This is necessary to re-initialise the internal TCP socket with the newly set IP address.

To retrieve the current IP address, use the query 'eip?'. The returned data is:

```
IP ADDRESS: <xxx>.<xxx>.<xxx>.<xxx>
```

…where <xxx> is <u>always</u> a three digit octet.

(b) Ethernet subnet mask – 'esm'

This command changes the Subnet mask used as part of the TCP/IP communication. As with the IP address, the parameter should be entered as a standard 4 octet mask. e.g. `255.255.255.0`. Each octet value is again capped if a value greater than 255 is entered. The CCD will respond and the display the following before auto-restarting the system (as with the IP address).

```
UNIT SHOULD AUTO RESTART↵
IF NOT, RESTART TO APPLY CHANGES↵
```

The current subnet mask can be retrieved using the query 'esm?'. The returned data is:

```
SUBNET MASK: <xxx>.<xxx>.<xxx>.<xxx>
```

…where <xxx> is <u>always</u> a three digit octet.

6.5 Channel Setup commands

(a) Input channel units string – 'uiu'

The input channel has an associated free-form text field that can be used to identify the units being used. This command is used to set this and its only parameter is a max of 5 characters for the units string.

The current units string can be retrieved using the query 'uiu?'. The data returned is as follows:

`INPUT UNITS STR: <units>`

… where…
<units> = the exact units string as displayed on the front panel

(b) Input channel range – 'uir'

Use this command to set the range of the input channel. The single parameter is the actual value for the range. The number of decimal places passed in the range value dictates the number of decimal places shown for the main data output (up to a max of 4 decimal places – any more will get chopped off)

The current range of the input channel is retrieved using the query 'uir?'. The data returned is as follows:

`INPUT RANGE: <range>`

… where…
<range> = the range of the channel (engineering units)

(c) Input channel full scale – 'uif'

This command is used to set the full scale voltage for the input channel. The single parameter is the actual full scale value.

The full scale voltage setting for the input channel is retrieved using the query 'uif?'. The data returned is as follows:

`INPUT FULLSCALE: <fs>`

… where:
<fs> = the full scale voltage of the channel

For more information on the use of input range and full scale, see the Principles section - 7.2.

6.6 Filtering commands

(a) Filter band – 'flb'

This command is used to set the point at which the adaptive filtering kicks in. It takes one parameter which is the percentage of full scale of the input. Valid values are between 0.01% and 1.00%. Additionally the parameter can be OFF which will mean the filtering will never kick in, or ON which means the filtering is always used. Note that if the filter size is set to greater than 5 seconds, the filter band command will return a Bad Command acknowledgement because the filter is always on in this situation and it therefore makes no sense to attempt to change the band setting. For more information on this see the Principles section (7.6).

To retrieve the current filter band, use the query 'flb?'. The returned data is:

`FILTERING BAND:` <band>`%`

(b) Filter size – 'fls'

Use this command to set the size of the adaptive filtering buffer. The one parameter this command takes is the buffer size in seconds, between 0 and 6 seconds. (0 can be used to effectively turn the adaptive filtering off).

To retrieve the current filter size, use the query 'fls?'. The returned data is:

`FILTERING SIZE:` <x> `sec`

… where <x> = number of seconds of filtering
[Note if current size is 0 then returned data is: `FILTERING SIZE: 0 (NO FILTER)`]

6.7 Relay control commands

(a) Relay trip point – 'rlt'

This command sets the point at which the relay switches from one state to the other. When the source data is below this point then the relay is closed, so therefore when the source data rises above this point then the relay is open. The command takes two parameters – the first is the relay whose trip point is to be set (1-2) and the second is the trip point in engineering units, as configured with the Input Channel range command (see 6.5(b)). Note that the first parameter is always required even if the second relay has not been factory fitted.

The current trip point values can be retrieved using the query 'rlt?'. The returned data is one line for each relay, as follows:

`RELAY` <x> `TRIP POINT:` <trip point, in engineering units >

… where ...
<x> = the relay number

(b) Relay hysteresis – 'rlh'

This command configures the hysteresis setting of the relay. It takes two parameters – the first if the relay in question, the second is the percentage hysteresis, represented as a percentage of full scale of the source channel, with limits of 0.0% (i.e. no hysteresis) to 10.0%.

The current hysteresis setting can be retrieved using the query 'rlh?'. The returned data is one line for each relay, as follows:

`RELAY <x> HYSTERESIS: <hysteresis percentage>%`

… where ...
<x> = the relay number

6.8 Other commands

(a) User input rezero – 'irz'

To perform a user input rezero function, use this command. Typically the command takes no parameters to perform the function, although it can take an optional parameter of '0' which clears any value already generated by a previous rezero.

To find the current user rezero value use the query 'irz?'. The data returned is as follows:

`REZERO: <rezero>`

…where…
<rezero> = the current rezero value

(b) Date of last factory calibration – 'dlc?'

This query is used to retrieve the date of the last factory calibration run. The data is returned as follows:

`LAST CAL DATE: <yymmdd>`

…where yy = year, mm = month & dd = day.
E.g. 051201 means the last calibration run was 1st December 2005.

(c) Retrieve all settings – 'ras'

As well as issuing some of the above commands as queries to retrieve individual settings, this command has been provided which will return a comma separated list of most of the settings for the input channel, setpoint, etc.

The exact settings provided by this command are detailed in Table 3 in Appendix C.

Section 7 - Principles

7.1 Introduction

This section describes the principles used in the CCD100. It details the various settings for the inputs and the outputs including setpoint control. It does not detail any servicing or calibration procedures.

7.2 Analogue Inputs

The CCD100 has two analogue voltage input channels. The main input can be configured to accept any input voltage from 0V to a full scale of up to 10V. This input is calibrated using a straight line fit method and then can be displayed on the CCD with an applied range. The secondary input is used to accept an external command setpoint and has a non-configurable full scale of 10V. This input is used when the setpoint is set to slave source.

Note for millivolt option: The full scale is represented in mV rather than V and can be configured to 250mV max.

The main input channel has a number of associated setup parameters:

(a) Range
Each device attached to the CCD will be outputting a voltage that represents some form of units and the range is used with the full scale to determine what the user sees on the screen for any input voltage.

(b) Full Scale Voltage
Each device attached to the CCD will have a full scale voltage which is the maximum voltage the device should output under normal operating conditions. Typical values are 10V, 5V and 1V. The full scale is used with the range to determine what the user sees on the screen for any input voltage. The CCD will show the over range error (“RANGE”) for any channel whose voltage input is more than 15% over the full scale voltage set for that channel.

(c) Units String
To inform the user of what units are being dealt with, each channel has an associated units string. This is a free form text field (maximum 5 characters) that is displayed on the right side of the Main screen.

Example
A device has a full scale voltage of 10V and a range of 100 mbar.

If the device now outputs 10V, the CCD100 display will nominally show 100 (pending input calibration). If the device outputs 5V, the CCD100 will show 50, and so on.

7.3 Analogue Outputs

There are two analogue outputs on the CCD100, both voltage outputs. One is for setpoint control with its own set of setup parameters (see next section) and the other is a simple retransmission of the main input voltage and has no user setup control. Typically this output can be used for data logging purposes or for providing an external setpoint control to another CCD or similar instrument.

7.4 Setpoint Control

As mentioned above, there is one analogue output that is used for command setpoint control that can be used to operate a mass flow controller or similar. The setpoint command output has a voltage full scale that matches the input channel configuration.

Example

If the input channel is setup for a 100 slpm 5V full scale device, and the setpoint value is 10.0 (assuming setpoint is in Auto mode and not a slave source), then the output voltage of the setpoint would be 0.5V.

The setpoint does have some configuration parameters that can be used to alter the function of the setpoint control and they are detailed as follows:

(a) Setpoint Mode

The setpoint can be configured in one of three modes – Auto, Open and Closed.

- In Auto mode the setpoint output is dependant on the setpoint source and value settings (see below).
- In Open mode the setpoint outputs a voltage greater than the full scale of the device. For a setpoint command full scale of 5V or less, the output in this mode is 7V. For any other setpoint command full scale (e.g. 10V), the output in this mode is 12V.
- In Closed mode the setpoint outputs a voltage less than the minimum output voltage of most devices, the setpoint output voltage is –0.25V.

(b) Setpoint Source

The setpoint source dictates where the setpoint value comes from, assuming the mode is set to Auto (see above). This can be one of two possibilities – Internal or Slave.

- Internal source – the setpoint uses the value set internally via the '▲' & '▼' switches or via the externals comms.
- Slave source – in this case the setpoint uses a percentage of an externally produced value. The percentage is set via the '▲' & '▼' switches and the external value comes from the secondary input channel (as mentioned 7.2 in above)

7.5 User Rezero

Over time it is possible that the input may 'drift' slightly due to various conditions (temperature changes, etc.). As such it may be necessary for the channel to be rezeroed by the user.

The user rezero function is provided for this task. It simply takes the current reading (sampled and averaged over 3 seconds) and uses that as an additional offset for the channel in question, subtracting the value from all subsequent readings. Ensure any process value to be zeroed, is in fact truly zero before performing this function. This would mean isolating flow devices or fully pumping a pressure device.

Note that the user rezero via comms also provides the facility for clearing any user rezero value that may have already been set. This should be used before any input calibration is performed to ensure that the calculated calibration points are not distorted by the user zero offset.

7.6 Adaptive Filtering

The CCD100 includes an adaptive averaging filter on the display and comms readings output to aid in 'smoothing out' unwanted 'noise' on the displayed readings.

(a) Operational band

The filter can be configured to only operate within a certain band, meaning that excursions between subsequent readings that fall outside that band are shown as real (and not filtered) readings. The band is configurable between 0.01% and 1.00% of the full scale range of the input channel. It can also be set to OFF, which means that no filtering is performed (i.e. every reading is a 'real' one) and can also be set to ON which means that filtering is always shown no matter how big of an excursion occurs.

(b) Filter size

The size of the filter is currently configurable between 0 and 6 seconds and simply indicates the amount of readings that are taken and buffered to calculate and show the averaged reading. A filter size of 0 will naturally turn of the filtering, irrespective of the band setting.

It should be noted that this type of adaptive filtering can cause readings to be displayed abnormally, particularly if the buffer size is one of the larger available settings, where the displayed readings seem to 'jump about' as the filter is disabled and then re-enabled when the data excursions fall into the pre-set band. This is because outside of the band, the display will show the 'real' unfiltered readings (whilst constantly taking an average in the background). When the excursions fall into the band then the display will switch to showing the filtered data. If this data is quite significantly slugged (due to a large buffer size) then the display will appear to nearly reach the new data value (due to 'real' values being shown) and then jump back to the filtered data which could be several seconds behind. Because of this, the setting of a buffer size greater than 5 seconds will automatically change the band to ON, meaning that filtered data will always be shown.

Selecting different filter band/size combinations will reduce these anomalies, turning the band OFF and ON will stop this anomaly.

Section 8 - Service and Calibration

8.1 Service

There are no user serviceable parts inside the instruments. Should any difficulties be encountered in the use of the CCD100, it is recommended that you contact Chell Instruments Ltd for advice and instructions.

8.2 Calibration

There is no user calibration for the CCD100. It is recommended that the instrument be returned annually to Chell Instruments Ltd for a ‘factory calibration’. This will ensure optimum performance throughout the life of the product.

8.3 Adjustment

There are no user adjustments in the instrument, indeed, the presence of lethal voltages within the instrument means that the user is strictly forbidden from removing the covers without invalidating Chell’s obligations under both Warranty and COSSH.

8.4 Cleaning

A dirty instrument may be wiped clean with a soft cloth that has been sprayed with a proprietary ‘foaming cleaner’, then wiped dry immediately.

Under no circumstances should the instrument be wetted directly or left damp

8.5 End of Life

Chell Instruments Ltd complies with the WEEE legislation and is registered as a manufacturer and importer of Electrical and Electronic Equipment.
Once this equipment reaches its end of life, or is no longer required it may be returned to Chell Intruments Ltd to be reused or recycled in accordance with the legislation. Please contact Chell Instruments Ltd for full details. Terms and conditions apply.

Section 9 - Appendices

9.1 Appendix A

Table 1 – CCD100 Command Set Summary

Purpose	Cmd	Query	Parameters	Notes
Output current readings	r	---	---	
Output current readings repeatedly	rp	---	0-4	P1: 0 = Repeat off 1 = Repeat every 100ms 2 = Repeat every 500ms 3 = Repeat every second 4 = Repeat every minute
Setpoint value	spv	spv?	#	P1: Real value to set
Setpoint mode	spm	spm?	0-2	P1: 0 = Auto mode 1 = Open mode 2 = Closed mode
Setpoint source	sps	sps?	0-1	P1: 0 = Internal source 1 = Slave (External) source
Setpoint initial value	siv	siv?	#	P1: Real value to set
Setpoint initial mode	sim	sim?	0-2	P1: 0 = Auto mode 1 = Open mode 2 = Closed mode
Retrieve all settings	ras	---	---	Comma separated string returned See Table 3 for actual settings
Ethernet IP address	eip	eip?	IP octets	P1: xxx.xxx.xxx.xxx
Ethernet subnet mask	esm	esm?	IP octets	P1: xxx.xxx.xxx.xxx
Input channel units str	uiu	uiu?	ccccc	P1: Max length 5 chars
Input channel range	uir	uir?	#	P1: Real value for range to set
Input channel full scale	uif	uif?	#	P1: Real value for full scale to set
Adaptive filter band	flb	flb?	#	P1: Band percentage (0.01-1.00) or OFF, or ON
Adaptive filter size	fls	fls?	0-6	P1: Buffer size in seconds
Relay switch threshold	rlt	rlt?	1-2,#	P1: Relay number P2: Real number for switching point
Relay hysteresis	rlh	rlh?	1-2,0.0-10.0	P1: Relay number P2: Hysteresis percentage value
User input rezero function	irz	irz?	[0]	P1 (optional): clears current user input rezero setting
Date of last calibration	---	dlc?		Returned date format: yymmdd

9.2 Appendix B

Table 2 – Factory Defaults

Setting	Default Value	Additional Information
Repeat Rate (for output readings)	0	Repeat off
Ethernet IP Address	192.168.1.180	
Ethernet Subnet Mask	255.255.255.0	
Input Channel Units String	“”	No units strings set
Input Channel Range	10.000	
Input Channel Full Scale	10.000 (V) or 100.00 (mV)*	* If millivolt option fitted
Input Channel Display Precision	3	3 decimal places
Input Channel User Rezero	0.0	No rezero set
Setpoint Value	0.0	
Setpoint Slave Value	100.0%	
Setpoint Source	0	Internal source
Setpoint Mode	0	Auto mode
Date of Last Factory Calibration	010101	
Adaptive Filter Band	0.2%	
Adaptive Filter Buffer Size	2	2 seconds
Relay Trip Point (for both relays)	10.0	
Relay Hysteresis (for both relays)	2.0%	

9.3 Appendix C

Table 3 – Settings in 'ras' command string

Description	Type and size
Input channel units string	5 char string
range	8 char string representation of a float
full scale	8 char string representation of a float
Setpoint value	8 char string representation of a float
slave value	8 char string representation of a float
mode	1 byte (0-2 as for spm? query)
source	1 byte (0-1 as for sps? query)
initial value	8 char string representation of a float
initial slave value	8 char string representation of a float
initial mode	1 byte (0-2 as for sim? query)
Adaptive filter band	4 char string representation of a float
size	1 byte (0-6 as for fls? query)
Relay 1 trip point	8 char string representation of a float
hysteresis value	4 char string representation of a float
Relay 2 trip point	8 char string representation of a float
hysteresis value	4 char string representation of a float
Last factory calibration date	6 char string (format as for dlc? query)