ACTIONI/Q®
Q498
DC Powered DC Input Field Configurable Isolator with Math Functions

Q498-0000

Provides 2 Isolated Analog Inputs, 1 Analog Output & 1 Frequency Output, as well as a Discrete Input & Output

- Multi-Function, Multi-Channel Input
- TouchCAL™ Technology
- DC-Frequency or Frequency-DC Converter
- Optional PC Based Programming Software

- High Density DIN Rail Mounting
- Math Function Capability
- SnapLoc™ Plug-in Terminals

Description

The Q498 is a DC powered, DIN rail mount, DC input signal conditioner. The unit is fully isolated to 1800V between input, output and power. It has two isolated analog inputs that each accept either a DC voltage or current input signal. The one analog output delivers either DC bi-polar voltage or uni-polar current. The Q498 also has a separate frequency input channel and a frequency output, as well as a discrete input and output channel. The field configurable input and output feature provides flexible, wide ranging capability for DC current and voltage signals. The Q498 can also be configured via a PC with the optional C698 Windows based GUI software. The Q498 is also capable of performing math calculations on the input values. This provides the ability to perform single or double input math functions. The frequency input can also have the math functions applied (with the exception of Sq and Sqroot). The available operators are: +, -, *, /, Sq, Sqroot & Average. Process control functions include Hi/Lo Select (utilizing the Digital Output for channel identification), Rate of Change Limiter and Track & Hold (utilizing the Digital Input for the hold control). A 25-point linearization function is available for the Channel 1 Analog input only. Note that all output math and process control functions require the C698 software.

The field configurable input of the Q498 can be set via DIP switches. Voltage input ranges are: ±150mV, ±1.5V, ±15V and ±150V. The current input ranges are: ±2.5mA and ±25mA. All ranges are fully adjustable over a ≈90% range from zero or span. Simply choose the range closest to your needs and perform the calibration based on zero and span values.

There are three analog output ranges, 0 to 20mA, 0 to 10VDC and –10 to +10VDC, which are also fully adjustable. If the application requires a 4-20mA output, simply choose the 0-20mA range and calibrate with the zero point at 4mA (the Math Functions can be used to scale the output).

The frequency section has two separate inputs, depending on voltage levels, only one of which can be active at a time. The LoV input supports signals with amplitudes from 150mVp to 5Vp (50Vrms max) and the HiV input supports signals between 500mVp and 20Vp (150Vrms max). The frequency range is from 2Hz to 10kHz in software selectable ranges.

Applications

The Q498 can be used in many types of operations. This section describes a few process control applications and how to configure the unit in order to perform the various operations.

Track & Hold

The Digital Input is used as the control element for Track & Hold. Short the Digital Input (Pin A6) to Digital Common (Pin A3) using an external relay or switch. The Analog Output will be held at the current output level until the connection is opened. Because the system is under microprocessor control, when the digital input is grounded, the current output level that is being processed cannot be stopped. As an extreme example, if the output has been told to make a step change from 0V to 10V, the output could still be in the process of slewing to that value (which could take as long as 700mSec). When the Hold input is applied during that 700mSec window, the output will continue to rise to the 10V level and then hold at that point. The Hold function only stops any future input changes from having an effect on the output.

If a step response is not desired when the Hold line is released, ensure that the Output Changing Limit is set to the desired amount (in the Configuration Window section of the C698 Configuration Software).

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Hi/Lo Select

This function is accomplished by selecting either the Max or Min function for F1(x). (Refer to the Output Math section of the Specifications.) After F1(x) has been assigned the Max or Min function, the higher input (or lower if Min is selected) will drive the output. If a step response is not desired when the input channels switch control, then ensure the Output Changing Limit (accessed in the Configuration window of the configuration software) is set to the desired amount. Take note that the coefficients A and B and the exponents of each channel also effect the comparison.

The digital output can be programmed to go high when CH1>CH2, or when CH1<CH2. The Yellow LED indicates the status of the digital output.

25-Point Linearization

The Q498 provides the ability to input unique linearization tables. This feature is only available through the C698 software package, and can only be used on analog input 1 (Ch 1).

Digital & Frequency Output Loads

The digital and frequency outputs are designed to be powered with a 24VDC external supply. These outputs will each safely sink a maximum of 20mA. If an external supply is not used, the digital and frequency outputs are limited to 1mA.

Math Functions

All of the basic math functions perform percentage math, not true math. The formulas are as follows:

Addition: %Output = (%Ch1 + %Ch2)/2

Subtraction: %Output = (%Ch1 - %Ch2),
Ch1 must be $\geq$Ch2

Multiplication: %Output= (%Ch1)(%Ch2)

Division: %Output = %Ch1/%Ch2

Sq. Root: %Output = %Chx $^{0.5}$

PC Programmable

The Model Q498 is calibrated either by using a serial port from a PC or by using the onboard DIP switch and pushbutton. Math and Process Control Functions are only configurable using the optional PC Configuration Software Model C698.

The software comes with a serial cable to connect the Q498 to a serial port of a PC. The software is also available on our Website. The software is compatible with Windows 95, 98, 2000 and NT operating systems. Instructions are included in the program as Help screens.

TouchCAL™ Technology

Touch-CAL™ technology allows for the replacement of zero and span adjustment potentiometers with a pushbutton. The thermal drift and mechanical variability of the potentiometers is removed and replaced with a digitally stable circuit. Additionally, the inherent zero and span interactivity of potentiometer based analog amplifier circuitry is removed, providing 100% non-interactive adjustment.

TouchCAL enables precise calibration and provides more than 90% offset of the zero value and adjustment down to 10% of the full scale input span for most of the six switch selectable input ranges. For example, the DIP switch set for $\pm$25mA input range could be configured via the pushbutton for an offset range of 4 to 20mA (58% offset and 68% span reduction) or –25 to 0mA (a 50% span reduction). If the output was configured for 0-10V, then –25 to 0mA input would correspond to the 0-10V full scale output. Thus, input ranges such as 4-20mA or 0-5mA are possible using the $\pm$25mA range.

Diagnostic LEDS

The Q498 has three diagnostic LED's. The green (RUN) LED is used to indicate that power is on, and for diagnostics. It flashes quickly if the input signal is above the configured range or slowly if the input signal is below range. It is continuously on when the unit is functioning within the configured range. The red LED flashes when the output is over/under range. The yellow LED indicates the status of the Discrete Output. The LED's also provide indication of which steps are being performed during pushbutton calibration.

Wiring Connections

Power

Power can be applied either by means of an IQ Rail adapter (see the Accessories section), in which case pins P3 and P4 will apply the power through the adapter; or if the IQ Rail adapter is not utilized, power is applied via connector "B" on the top rear of the unit (the connector nearest the DIN rail mounting foot). Pin B1 is for the positive (+) 9-30VDC and pin B2 is for the common (-).

Analog Inputs

The DC voltage or current inputs are applied using connector "C" on the bottom front of the unit. Each channel has its own separate voltage or current input. Channel 1 (CH1) positive voltage input is pin C6. Channel 1 positive current input is pin C4. The common connection for CH1 is pin C5. The Channel 2 inputs are pin C3 for positive voltage, pin C1 for positive current and pin C2 for the common. [**Note:** In order to utilize CH2, the C698 software is required.] Either channel can be set independently for voltage or current.

Frequency Inputs

The Frequency Input is applied using connector "D" on the bottom rear of the unit (the connector next to the DIN rail mounting foot). There are two inputs shown: IN LOV for voltages of 150mV to 50Vrms max.; IN HIV for voltages of 0.5V to 150Vrms max. Note that there are NOT two separate frequency inputs - only one set of terminals can be used at a time. The Frequency Input Common is pin D4. The positive terminal for the low voltage range is pin D5, and the positive terminal for the high voltage range is pin D6. [**Note:** In order to utilize the frequency input, the C698 software is required.]

Outputs

The outputs and the discrete function are applied to connector "A" on the top front of the Q498. Pin A1 is the positive terminal (+) of the Voltage or Current output. Pin A3 is the Voltage Return and Pin A2 is the Current Return. Pin A3 is also the Common Return (-) for the Discrete (digital) Input and Output, as well as the Frequency Output Common. Several wires can be twisted together for the various commons as long as the combined wire size does not exceed the 12 AWG limit of the terminal. The Discrete Output (+) is pin A4 while the Discrete Input (+) is pin A6. The Frequency Output (+) is pin A5.

Default Settings

The default settings are 4-20mA input on Analog Channel 1 (pins C4/C5) and 4-20mA output from the Analog Output (pins A1/A2). The frequency and digital inputs and outputs are not active, and require the C698 Configuration Software to utilize. The Output Math equation for the Analog Output is set as follows: A=1, F1(x)="+", B=0, F2(x)="+", C=0, D=1. Any change to the output math requires the C698 software.

Isolation

The Analog Inputs (CH1 & CH2) are isolated from each other, as well as from the Analog Output and Power. The Frequency Input circuitry is in the same isolation section as Analog Input CH2, so it is isolated from CH1, but not CH2. The Frequency Output is referenced to the same common as the Analog Output, therefore, the Frequency Output is not isolated from the Analog Output, but is isolated from the Frequency Input, Analog Inputs CH1 & CH2 and Power. The Digital Input and Digital Output are not isolated from each other and are referenced to the same common as the Analog Output and Frequency Output. The Serial Port is also referenced to the output section, so it is not isolated from the Output circuitry, but is isolated from the Analog and Frequency Input Sections. The Isolation level between all isolated sections is 1800VDC.

Serial Port

The serial port connection for using the C698 software is located below the DIP switch. The cable is provided with the C698 software option. Please refer to the software Help File for further explanation.

Calibration

For best results, calibration should be performed in the operating environment, allowing at least one hour for thermal stability of the system. If pre-calibration on a test bench is preferred then an output load equal to the input impedance of the devices connected to the Q498 output is recommended.

1. For the optimum results, install the module on to a piece of DIN rail or an I/Q Rail.

Note: An I/Q Rail is an optional accessory to deliver power to the modules. A two, four or eight position rail is available. See the ordering information.

2. Connect the analog input to be calibrated (usually starting with Ch. 1) to a calibrated DC source and the analog output to a voltage or current meter. A frequency source should be connected to the frequency input and a frequency counter to the frequency output. Apply power and allow the system to reach thermal equilibrium (approx. 1 hour).

The Q498 can be calibrated by either of two methods, manually, as described in this procedure, or by means of the C698 configuration software utility. For software calibration, first set DIP switch position SW1-10 to ON to enable PC Calibration. Refer to the information in the Help files of the software for the correct procedure.

While performing a manual calibration, refer to the flow charts in Figures 1a & 1b.

3. While it is not mandatory, less button-pushing is involved if all inputs are calibrated before calibrating the output. To start the process, the Green LED should be on.

4. Press and hold the calibration button for 4 seconds. The Green LED will be lit and the Yellow LED will be flashing. From this point, to calibrate channel 1, press and hold the button down again for 4 seconds. The Red and Yellow LED's will be lit indicating the input is ready to calibrate.

5. Press the button once. The Yellow and Green LED's will be lit.

6. Apply the maximum input signal and press the button once. The Yellow LED will be lit.

Note: After any calibration step, you can abort by pressing the button and holding for 4 seconds. This will take you back to normal operation without saving the new data. You then step back through the flowchart to return to where you were in your calibration.

7. Apply the minimum input signal and press the button once. All three LED's will be lit.

8. Press the button once again. The Channel 1 input data is saved and you are back at the beginning with the Green LED lit.

9. Press and hold the button for 4 seconds. The Green LED will be lit and the Yellow LED will be flashing. Press the button one more time and the Red LED will be lit and the Yellow LED will be flashing. From this point, to calibrate channel 2, press and hold the button down for 4 seconds. The Red and Yellow LED's will be lit.

10. Repeat steps 5 through 8.

11. After completing the analog input calibration, the Green LED is lit. Press and hold the button for 4 seconds. The Green LED will be lit and the Yellow LED will be flashing. Press the button twice. The Green LED will be lit and the Red LED will be flashing, indicating that the frequency input is ready for calibration.

12. Press and hold the button for 4 seconds. The Red LED and Yellow LED's will be flashing.

13. Repeat steps 5 through 8.

14. After completing the frequency input calibration, the Green LED is lit. Press and hold the button for 4 seconds. The Green LED will be lit and the Yellow led will be flashing. Press the button three times. The Yellow LED will be lit and the Red LED will be flashing. The analog output is now ready for calibration.

15. Press and hold the button for 4 seconds. The Red and Yellow LED's will be lit.

16. Press the button once. The Red and Green LED's will be lit.

17. While monitoring the output, increase the input (from either Ch1 or Ch2) until the desired maximum output signal level is reached. Press the button once. The Red LED will be lit.

18. Monitor the output and decrease the input until the desired minimum output signal level is reached. Press the button once. All three LED's will be lit. Press the button once again to save the data and you will be back to the Green LED lit.

19. Press and hold the button for 4 seconds. The Green LED will be lit and the Yellow LED will be flashing. Press the button 4 times (until the Green LED is flashing). The frequency output is now ready for calibration.

20. Press and hold the button down for 4 seconds. The Red and Yellow LED's will be lit. Manually calibrating the output frequency requires first selecting the desired frequency output range with DIP Switch SW1, positions 9 & 10, as described in Figure 1B. These switch settings are not required if calibrating via the software utility. After the output frequency is calibrated, the switches can be reset to their previous settings for calibration method. Press the button one more time and the Red and Green LED's will be lit.

21. Set the input frequency to maximum. While monitoring the output of the frequency output channel with a frequency counter, decrease the input until the desired maximum output is reached. Press the button once and the Red LED will be lit.

22. Set the input to minimum. While monitoring the output, increase the input until the desired minimum output value is reached. Press the button once and all three LED's will be lit.

23. Press the button once again and you are back to the Green LED lit (normal operating condition).

Table 1: Input Settings

Input Settings - SW1						
Range	**Channel 1**			**Channel 2**		
	1	2	3	4	5	6
+/-150mV						
+/-1.5V		■			■	
+/-15V			■			■
+/-150V		■	■		■	■
+/-2.5mA	■			■		
+/-25mA	■	■		■	■	
Key: ■ = 1 = ON or Closed						

Table 2: Enable 25-Point Calibration Setting

Enable 25-Point Cal - SW1	
	9
Enable 25-Point Calibration	■
Key: ■ = 1 = ON or Closed	

Table 2: Enable PC Calibration Setting

Enable PC Cal - SW1	
	10
Enable PC Calibration	■
Key: ■ = 1 = ON or Closed	

Table 5: Output Settings

Output Settings - SW1		
Range	7	8
0 - 10V		
+/-10V		■
0 - 20mA		
Key: ■ = 1 = ON or Closed		

Table 5: Manual Calibration Frequency Settings

Frequency Output Range Manual Calibration Only - SW1		
Range	9	10
0 - 5 Hz	■	■
0 - 50 Hz		■
0 - 1,000 Hz	■	
0 - 10,000 Hz		
Key: ■ = 1 = ON or Closed		

Figure 1a: Q498 Input Calibration Flow Chart
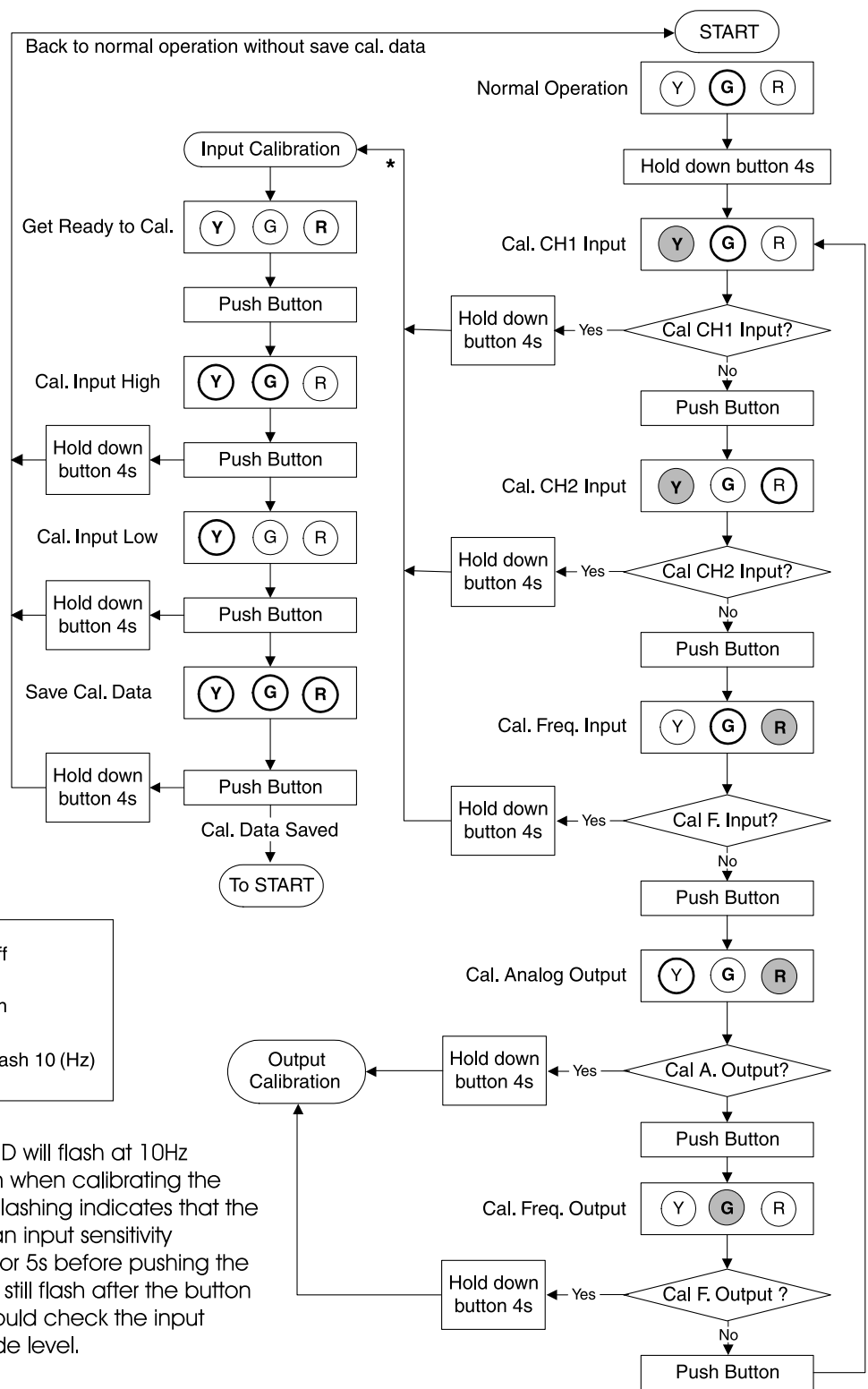
Red and Yellow LED will flash at 10Hz instead of solid on when calibrating the frequency input. Flashing indicates that the module is doing an input sensitivity adjustment. Wait for 5s before pushing the button. If the LEDs still flash after the button is pushed, you should check the input signal for amplitude level.

Output Calibration

Get ready to cal. (Y) (G) (R)
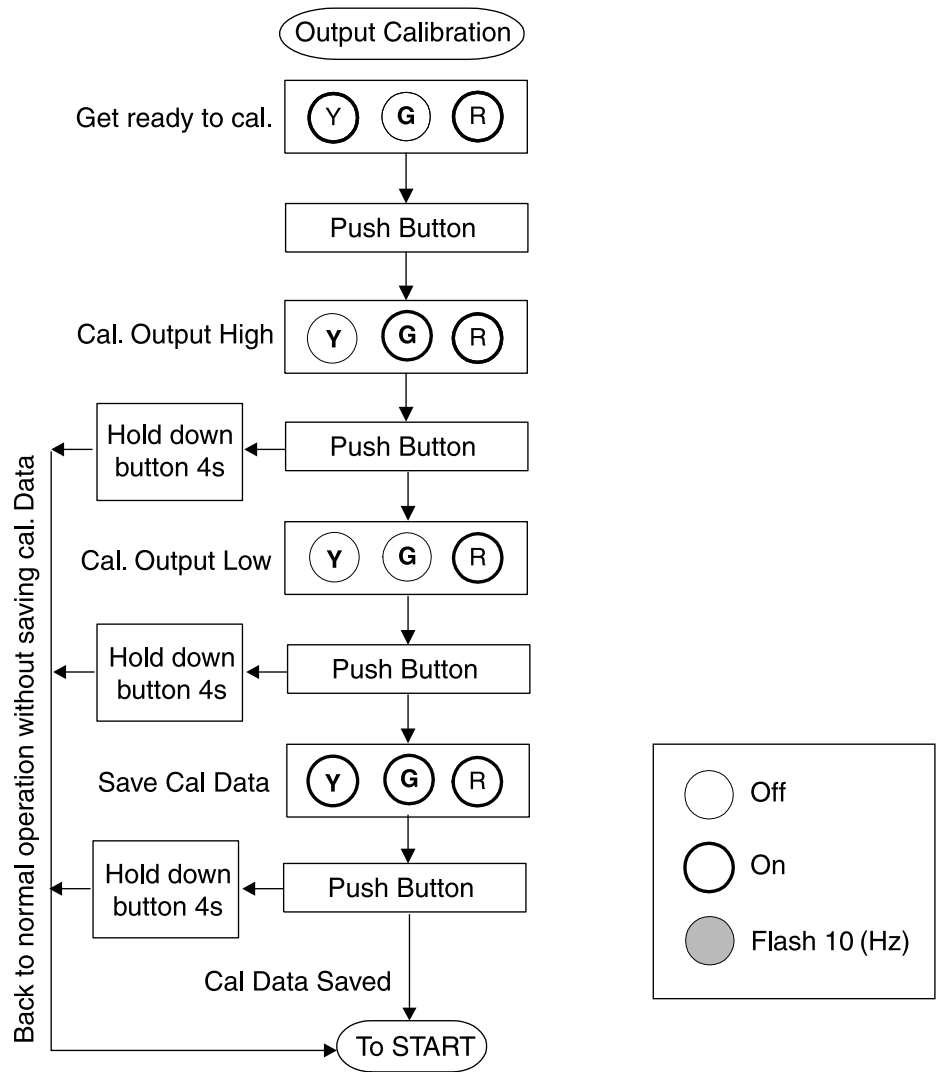
Push Button

Cal. Output High (Y) (G) (R)

Hold down button 4s ← Push Button

Cal. Output Low (Y) (G) (R)

Hold down button 4s ← Push Button

Save Cal Data (Y) (G) (R)

Hold down button 4s ← Push Button

Cal Data Saved

To START

Back to normal operation without saving cal. Data

Off
On
Flash 10 (Hz)

Figure 1b: Q498 Output Calibration Flow Chart

Specifications

Analog Input Ranges (2 Isolated Channels):

+/-150mV, +/-1.5V, +/-15V, +/-150V

+/-2.5mA, +/-25mA

Pushbutton Adjustment:

Effective zero offset: $\geq$90%

Effective span turn-down: $\geq$90%

Analog Maximum Overload (continuous):

200V DC for voltage inputs;

170mA DC or 60V DC maximum for current inputs (protected by self-resetting fuse)

Analog Output Ranges:

0-20mA, 0-10V, -10 to +10V

Analog Output Drive:

0-20mA: 12VDC compliance. (600 ohms max.)

Voltage ranges: 10mA drive (1000 ohm load min.)

Analog Output Accuracy:

$\pm$0.005% of the FS Input Range ($\pm$0.05% on 150 volts range), plus $\pm$0.05% of the FS Output Range ($\pm$0.1% for output loads <200 ohms)

Analog Stability:

$\pm$0.005% of Full Scale/$^\circ$C typical ($\pm$0.01% maximum) for zero and span

Analog Response Time:

750mSec max. (10-90%)

Analog Input Impedance:

$\geq$100k ohms on voltage ranges > 1.5V

$\geq$10M ohms on voltage ranges $\leq$ 1.5V

70 ohm typ. (non-overload) on all current ranges

Analog Output Impedance:

Less than 3 ohms on voltage output ranges

$\geq$ 500k ohms on current output ranges

Frequency Input:

One frequency channel with two different voltage range inputs, LOV for 150mV to 50Vrms with 5Vp noise suppression, or HIV for 0.5V to150Vrms with 20Vp noise suppression, 2Hz to 10kHz in software selectable ranges.

Frequency Output:

2Hz to 10kHz in software selectable ranges.

Open collector pulled up through 20k to 18V, with 1mA drive. Sinks up to 20mA through a load from a 24V external supply.

Frequency Output Accuracy:

$\pm$0.1%

Discrete Output:

Open collector pulled up through 20k to 18V, with 1mA drive. Sinks up to 20mA through a load from a 24V external supply. Operation under software control.

Discrete Input:

Input active to Common, with soft pull-up (1mA) to +18V. Operation under software control.

Output Math:

$V_{out} = (A*CH1^y\ F1(x)\ B*CH2^z\ F2(x)\ C*CH3)/D$

$F_{out} = (A*CH1^y\ F1(x)\ B*CH2^z\ F2(x)\ C*CH3)/D$

CH1: Output value contributed by channel 1 input only

CH2: Output value contributed by channel 2 input only

CH3: Output value contributed by frequency input only

Where:

Fx(x) can be: +, -, *, /, Min, Max, Average, and y & z can be: 0, 1, 2, or 1/2

The constants A-D can be any number from 0 to 255 (except D cannot be equal to 0).

When using the square or square root functions, the relative input channel should be calibrated in the positive direction only.

Process Control Functions:

Hi/Lo Select (Max/Min), Rate of Change Limiter, Track & Hold and 25-Point Linearization (25-point linearization only on Analog Input Ch 1 and only effects the Analog Output channel. Also, in this mode the square and square root functions are not available.)

Default Settings:

Analog Input 1 (Ch1):

$\pm$25mA range, calibrated for 4-20mA

Analog Output:

0-20mA range, calibrated for 4-20mA

Math:

(1*CH1 + 0*CH2 + 0*CH3)/1

Analog Input 2 (Ch2):

Not active (nulled by the math)

Frequency:

Not active (nulled by the math)

(The unit can be reconfigured manually for different ranges on input and output, using only Analog Input 1 (CH1) and the Analog Output. In order to utilize scaling factors, math functions, other inputs/outputs and process control functions, the C698 software is required.)

Common Mode Rejection:

$\geq$ 90dB for 60 Hz

120 dB @ DC

Diagnostics:

Green LED Indicator flashes for over or under range

Red LED flashes for output malfunction (Voltage short circuit or current open)

Yellow LED indicates status of Discrete Output

Power Requirements:

9-30VDC, 2.5 watts max

Power Supply Current:

280mA max. @ 9VDC; limited to prevent in-rush currents from exceeding steady-state value. (At turn on, the unit appears as a capacitive load up to 100mF.)

Wire Terminals:

Socketed screw terminals for 12-22 AWG

Isolation:

Input to Input to Output to Power, 1800VDC (Analog Input 2 and the Frequency input are both considered Channel 2. The Frequency Input is isolated from Analog Input 1 but not from Analog Input 2. The Discrete Input is not isolated from the Discrete Output, but is isolated from the Analog and Frequency Inputs. All of the outputs are isolated from the Analog and Frequency Inputs.)

Size:

DIN rail case (0.88" x 4.0" x 4.59")

Operating Temperature:

0°C to +55°C (32 to 131°F)

Storage Temperature:

-25°C to +70°C (-13 to 158°F)

Operating Humidity:

15% to 95%RHNC at 45°C

Non-operating Humidity:

90%RH at 65°C for 24 hours

Agency Approvals (EMC & Safety):

UL recognized per standard UL508 (File No. E99775).

CE Compliance per EMC directive 89/336/EEC and Low Voltage 73/23/EEC.

Minimum PC for the C698 Calibration Software:

100MHz CPU, 16MB RAM, 20MB hard disk space

Terminal	Connection	Terminal	Connection
A1	Output (+) Voltage & Current	C4	Input 1 Current
A2	Current Output (-)	C5	Input 1 Common
A3	Vout, Digital I/O, Frequency Out Common (-)	C6	Input 1 Voltage
A4	Discrete Output (+)	D1	Not Used
A5	Frequency Output (+)	D2	Not Used
A6	Discrete Input (+)	D3	Not Used
B1	DC Power (+)	D4	Frequency Input Common
B2	DC Power (-)	D5	Frequency Input (Lo Voltage)
B3	Not Used	D6	Frequency Input (Hi Voltage)
B4	Not Used	P1	Not Used
C1	Input 2 Current	P2	Not Used
C2	Input 2 Common	P3	DC Power (+)
C3	Input 2 Voltage	P4	DC Power (-)

Ordering Information
**Models & Accessories**
Specify:
1. Model: **Q498-0000**
2. Optional Factory Custom Calibration, **C620** – with desired input and output ranges for 25-point linearization.
3. Optional I/QRail, and other accessories (see Accessories list).

Accessories
C698-0000	Configuration Software & PC Serial Cable (recommended)
MD02	TS32 DIN rail (2 meters)
MD03	TS35 x 7.5 DIN rail (2 meters)
IQRL-D002	2-Position I/QRail & DIN rail
IQRL-D004	4-Position I/QRail & DIN rail
IQRL-D008	8-Position I/QRail & DIN rail
WV905	0.5Amp, 24VDC Power Supply
H910	1Amp, 24VDC Power Supply
H915	2.3Amp, 24VDC Power Supply

Dimensions
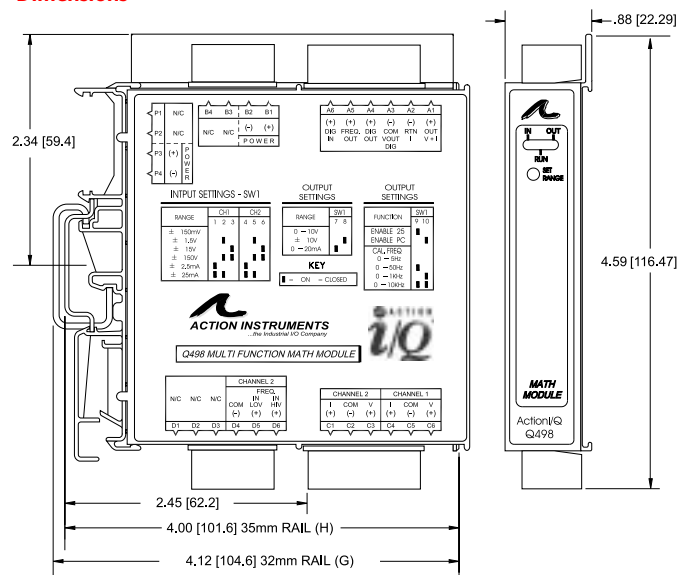
Printed on recycled paper

Factory Assistance
For additional information on calibration, operation and installation contact our Technical Services Group:

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