

# Bristol® ControlWave® GFC Corrector

## Overview

### *Far Beyond Today's Electronic Correctors*

The Bristol® ControlWave® GFC Corrector, from Emerson Process Management, is a best-fit solution for those sites, which not only require linear meter correction but also full RTU functionality, including process I/O, station automation, user programming, and live SCADA network communication using a variety of internal, wireless media.

For users who require out-of-the-box startup of a dual-meter station, the standard application program meets API 21.1 requirements.

## Hardware/Packaging Features

- 32-bit ARM9 platform is capable of multiple flow computing and process automation operations.
- Very accurate, smart, gauge pressure sensor can be removed and replaced, independently of the “top end” electronics.
- Precision RTD interface provides very accurate measurement.
- Very low power consumption minimizes costs of solar/battery power systems, which are also integrated in the package.
- Three serial communication ports are standard.
- Standard I/O includes 2 DI/PI.
- Optional I/O expansion includes 2 DI/DO, 4 DI, 2 DO, 2 High-speed Counter Inputs, 3 AI and 1 AO.
- Integral LCD with optional, 25-key keypad allows operators to view and change configurable parameters, on site, without packing a PC.



ControlWave® GFC Corrector comes in a very compact package that includes a smart P/T sensor assembly, “TeleCounter” pulser, battery/solar power system and a broad selection of modem and radio communications options.

## Firmware/Software Features

- ControlWave GFC Corrector is pre-programmed to meet API 21.1 requirements for a two-run metering station with networking via BSAP or Modbus.
- PC web style menu pages are pre-configured for all user operations.
- Using ControlWave Designer, IEC 61131-3 programming environment, any user or third party can modify the standard application or create a completely customized program—and full support from Bristol is available, every step of the way.
- Additional, standard application programs will be introduced on a continual basis.
- TeleCorrector users will appreciate the

## Remote Automation Solutions

Website: [www.EmersonProcess.com/Remote](http://www.EmersonProcess.com/Remote)

compatibility of ControlWave GFC Corrector in networking and software solutions for SCADA and EFM data editing/management, as well as the similarity in all operations.

## Application Areas

ControlWave GFC Corrector is appropriate to all applications for electronic, linear meter correction, including those that require monitoring of additional I/O points or extension to two meters, for example:

- Medium-to-large gas customers
- Industrials
- Boiler or power generation processes, which can switch fuels
- Distribution/LDC metering/gate stations
- Transmission metering stations
- Production wells
- Compressor stations
- Storage facilities

## ControlWave GFC Corrector Package Overview

ControlWave GFC Corrector is delivered in a compact, Lexan enclosure that has provisions for not only the electronics but also a display/keypad, smart pressure sensor assembly, battery/solar power system and a broad selection of modem and radio communications options.

### Specifications – Package

- Dimensions, Housing without TeleCounter Pulser Assembly: 11.73" H x 9.99" W x 7.35" D
- Dimensions: TeleCounter Pulser Assembly (optional): 4.37" H x 4.63" W x 4.38"D (including base mounting plate)
- Weight: Minimum, 10 lbs.  
Battery + MVT Assembly, 18.5 lbs.

Maximum with Radio, 20 lbs.

- Mounting: Without the TeleCounter pulser assembly, this product must be pipe-mounted or wall-mounted; a kit for affixing to a 2" pipe or mast is available.
- Solar Panel Mounting: Solar panels are delivered with all hardware necessary for 2" pipe or mast-mounting.

### Specifications – Operating Environment

- Wide operating power input voltage range of 5.0 to 18.0 Vdc
- While this product can operate with nominal power inputs as low as 6 Vdc, note that 12 Vdc nominal is required if an internal radio is used.
- Operating Temperature Range: -40 to 158°F (-40 to 70°C)
- Operating Temperature Range of Lead Acid Cell Batteries is more restrictive: -4 to 140°F (-20 to 60°C)
- Operating Humidity Range: 10 to 95% RH non-condensing
- Electrostatic Discharge: Meets IEC EN 61000-4-2, EN 61326
- RFI Immunity: In conformity with ENV 50140 Radio-frequency electromagnetic field amplitude modulated EMC
- EMC Emissions: EN 55022:1998 Class A ITE emissions requirements (EU); ICES-003 Issue 3 Class A Digital Apparatus emissions requirements (Canada); AS/NZS3548:1995/ CISPR Class A ITE emissions requirements (Australia)
- Nema Rating: Nema 3R (Nema 4x except with a battery vent)

### Hazardous Area Approvals

- UL approved as non-incendive for operation in Class I, Division 2 hazardous areas for all configurations and Class I, Division 1 for all configurations except those that include 12 Vdc power or radios.

**Performance**

- Computation Accuracy: 0.01% Corrected Flow, including all input values
- Gauge Pressure Reference accuracy: 0.075% URL
- Temperature Effects on Pressure Reading: 0.21% URL

**Selection Item Descriptions and Specifications**

ControlWave GFC Corrector is ordered using a model number specification. The complete model number specification is included at the end of this product data document.

Standard equipment includes a Lexan housing with 2-line LCD, single board electronics assembly and the standard API 21.1 flow measurement application program. Standard I/O count is 2 DI/PI (Pulse Inputs).

Also included in the base product are interfaces to Bristol's smart, gauge pressure sensor assembly, an RTD interface, AUX power output (e.g. to switch power to a radio) and shunt regulator for solar panel charging of an internal, lead acid cell battery.

The model number additionally allows a user to specify all of the following:

- Integral, Bristol gauge pressure sensor assembly and upper range limits.
- Bendable RTD assembly, pre-wired
- Thermowell – choice of three, common insertion lengths
- A two-line LCD with no pushbuttons, two-line LCD with two pushbuttons or a four-line LCD with 25-key keypad
- I/O card, including 2 DI/DO, 4 DI, 2 DO and 2 HSC/DI and, optionally, an additional 3 AI, and 1 AO
- Hazardous area approval – Class I, Division 2
- Choice of integral, battery and solar power systems
- Choice of standard model modem or radio that is installed on an internal bracket. Standard radios are those, which are commonly available from Freewave and MDS.
- Polyphaser surge suppressor for the radio
- TeleCounter integral pulser assembly
- Meter-mounting base plate for popular gas meters

- Stickers for digit blanking and meter index rate

### **Bristol Sensor Assembly**

The sensor assembly is Selection “ABC” in the model specification, e.g. “022” for the 100 psi gauge pressure sensor.

Using the sensor assembly, integrated in the instrument package is the easiest implementation for a single meter run; however, the standard application program also allows use of external transmitters, with or without the integrated sensor assembly.

Most two-run systems use the integrated sensor assembly for the first run and an external, smart transmitter, such as the Bristol 3808 MVT (which includes the exact same sensor assembly), for the second meter run.

If the sensor assembly requires a repair, the user can change it out and continue operating with the electronics, including flow information, alarms and historical archives, all intact.

Bristol recommends that users practice “depot level” service, in other words, that the sensor assembly be removed and replaced at the shop rather than out at the site.

Each sensor assembly has a nine-digit part number, which can be used to specify a replacement part (a listing is included at the end of this product data document).

### **Physical Specifications – Sensor Assemblies**

- Gauge Pressure Sensor Housing  
Material: 316 SS
- Diaphragm Material: 316 SS
- Fill Medium: DC 200 Silicone
- Process Connections: ¼” NPT female
- Connects to the Processor Board via a dedicated SPI bus cable.

### **Accuracy and Performance Specifications – Gauge Pressure Sensor**

- Combined effects of nonlinearity, nonrepeatability and hysteresis at reference pressure and over the operating temperature range:  $\pm 0.075\%$  of Calibrated Span or  $0.015\%$  of URL, whichever is greater.
- Temperature effect on gauge pressure:  $\pm 0.21\%$  URL maximum combined shift of zero and span with an ambient temperature change of  $60^{\circ}\text{C}$  ( $108^{\circ}\text{F}$ )
- Long Term Stability at Constant Conditions:  $\pm 0.1\%$  URL/Year typical

### **Integral Enclosure and LCD/Keypad**

Selection “D” specifies the housing, for which there is currently one choice, and the liquid crystal display (LCD) and keypad.

The standard LCD provides two lines and operates in a continuous cycle mode. One of two optional configurations can be selected, instead: 4 line x 20 character LCD with either a two-button or 25-button keypad. Both display/keypad assemblies have the same “footprint” on the front door.

### **Features – Display/Keypads**

- 4 line by 20 character backlit liquid crystal display
- Adjustable display contrast
- Membrane keys with tactile feedback
- Self-adhesive overlay mounts to the enclosure door or panel (ControlWave GFC Corrector package is delivered with this assembly installed on the door)
- Easy configuration via ACCOL III Function Block
- Scrolling display mode
- Adjustable timer turns off display when not in use



Shown, above, is the LCD with 25-button keypad. The 2-button version is similar but includes only two “arrow” buttons to sequence through lists.

The 25-button Display/Keypad performs the same functions and additionally allows the operator to view and modify ControlWave GFC Corrector inputs, process variables, calculated variables, setpoints, tuning parameters, and outputs used in a measurement or control application. Status bits include the alarm state, alarm acknowledge, control, and manual (Auto/Man). Providing access to such variable information allows the user complete control over the process operation.



25-button display example

**Specifications – Display/Keypads**

- Window size: 1.1” H x 3.1”W (2.8cm x 7.9cm)
- Character size: 4mm H x 3mm W
- Dimensions: 7.4”H x 5.5”W (18.8cm x 14.4cm)
- Power consumption: 2.5 mA @ 3.3V (0.008 watts)
- Operating Temperature: -4 to 158°F (-20 to 70°C)

The 2-button display allows an operator to view site, configuration and process data. The screens are organized in a series of lists. The operator can select a list and then manually scroll through the data. Additionally, a “scroll list” can be defined. The ControlWave GFC Corrector can be set to automatically sequence through this list.

**Mounting Hardware**

In Selection “E,” the user can specify optional hardware for pole-mounting or wall-mounting. The “pole-mount” kit includes two, wall-mounting plates and two pipe clamps.

Without the mounting hardware, the ControlWave GFC Corrector is suitable for process-mounting to a direct-mount manifold. Note that this is appropriate only for models pulser assemblies. A unit with a gauge pressure sensor but without a pulser should not be process-mounted.



2-button display example

**Processor/ Mail Electronics Selection**

Currently, one choice is available in Selection “F.” The processor electronics assembly consists of a single circuit board, which is installed on the far, left-hand side in the enclosure. Please note that power sources are specified in Selection “G” and optional I/O is specified in Selection “L.”

**Specifications for Processor/Electronics**

- 32-bit ARM9TDMI RISC Core Processor running at 14 MHz
- Serial Real Time Clock Accurate to 1 second/day at 25 °C
- 512 KB Flash Boot/Downloader
- 2 MB SRAM
- 8 MB Simultaneous Read/write Flash
- Backup Battery for Real Time Clock and SRAM: 300 mA-Hour Lithium Coin Cell, 9000 Hour Expected Backup Time
- 3 Serial Communication Ports (see below for further information)
- 2 DI/PI I/O points (please refer to the “I/O CONFIGURATION” section for specifications).
- Display/Keypad Interface
- Idle and Watchdog LED’s—Idle LED can be disabled to conserve power
- 5.0 to 18.0 Vdc Power Supply with Power Fail Sequencer

Information on the Serial Ports:

**COM1:**

- RS 232
- Physical Interface via DB-9 connector, which is internally linked to the circular, Alden connector on the bottom of the enclosure door
- Tx, Rx, GND with DCD tied to “high” voltage when external cable is plugged in

**COM2:**

- RS 232
- Physical Interface is an 8-pin terminal block.
- Supports RTS, CTS, DTR, DCD and DSR modem control signals
- RS 232 transceivers are enabled by the port’s DTR.
- DCD remains active in power-down mode.

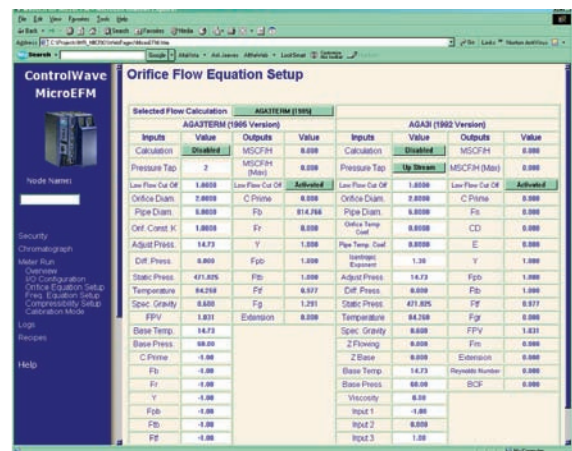
**COM3:**

- Selectable RS 232 or RS 485, 2-wire or 4-wire
- Physical Interface is a 5-pin terminal block.

**ControlWave GFC Corrector Standard Application Program**

Selection “G” allows the user to select from a variety of standard applications to be available in the future. The 1 – 2 run standard M&R application program is described, here. Also available is a TeleFlow Emulator application program.

ControlWave GFC Corrector is shipped with the program (.pro file) loaded in Flash and the Flash Configuration Program (FCP) also loaded.



The user's interface to the Standard Application Program is via a series of straight-forward web style menu pages.

**Overview of the Standard Application Program**

- Uses pre-configured web style menu pages for user readings, configuration and maintenance—PC menu pages can be modified and new pages configured to work with a modified application load
- Uses the TechView Calibration Utility for calibration of all transducers, including the integral gauge pressure sensor and external, Bristol transmitters (e.g. 3808 MVT)
- The PC menu pages, calibration utility and program load are all included on the BSI Config CD.
- Standard configuration is a one-to-two run station
- Each run can be orifice, turbine or ultrasonic meter type
- Flow calculations include the following:
  - AGA7/NX-19
  - AGA7 with selectable AGA8 Gross or AGA8 Detail
  - Auto Adjust AGA7/NX-19
  - Auto Adjust AGA7 with selectable AGA8 Gross or AGA8 Detail
  - AGA9
- Allows the user to select the integral sensor assembly or an external transmitter for a single run configuration or as run 1 in a multiple run configuration. External transmitters can be interfaced via RS 485 or analog inputs.
- Includes run switching
- Includes an auto-selector, PID flow/pressure control algorithm per run or per station
- Resides on a BSAP SCADA network
- Supports a sampler and an odorizer
- Hourly Historical Data Log
- The Hourly Data Log holds one record for every contract hour. Hourly logs hold 840 entries or 35

days; this ensures that the previous period of hourly data is always resident in ControlWave GFC Corrector FLASH memory. The following items are stored in the Hourly Data Log:

- Corrected Volume
- Uncorrected Volume
- Accumulated Energy
- Average Static Pressure
- Average Temperature
- Average Specific Gravity
- Average Heating Value
- Flow Time
- Uncorrected Count

Each log entry also contains the date and time.

ControlWave GFC Corrector has an Hourly Historical Log for each run.

- Daily Historical Data Log

The Daily Data Log holds one record for every contract day. The contract hour may be changed by the user. The daily log holds 62 entries; this ensures that the previous calendar month of daily data is always resident in ControlWave GFC Corrector FLASH memory. The following items are stored in the Daily Data Log:

- Corrected Volume
- Uncorrected Volume
- Accumulated Energy
- Average Static Pressure
- Average Temperature
- Average Specific Gravity
- Average Heating Value
- Flow Time
- Uncorrected Count

Each log entry also contains the date and time.

ControlWave GFC Corrector has a Daily Historical Log for each run.

- **Periodic Historical Data Log**

The periodic data log holds one record for every log interval. Log interval is 15 minutes. The Periodic Historical Data Log holds 1440 records, or four days of 15 minute data. The following items are stored in the Periodic Historical Data Log:

- Flowing Static Pressure
- Flowing Temperature
- Frequency
- Each log entry also contains the date and time.

ControlWave GFC Corrector has a Periodic Historical Data Log for each run.

- **Audit Trail Alarm and Event Storage**

ControlWave GFC Corrector keeps an Audit Trail Buffer capable of storing the most recent 500 Alarms and the most recent 500 Events. Internally, these buffers are maintained separately to prevent recurring alarms from overwriting configuration audit data. Externally, they are reported to the user as a single entity. Both operate in a circular fashion with new entries overwriting the oldest entry when the buffer is full. The following circumstances cause an entry to be made in the Audit Trail Buffer:

- Any operator change to a ControlWave GFC Corrector configuration variable
- Any change in the state of a ControlWave GFC Corrector alarm signal
- A system restart
- Certain other system events

- Includes a nominations function
- Allows the user to select engineering units from a broad variety, including English and metric

- Interfaces to a chromatograph and provides energy throughput as well as composition information (note that the same port is allocated for either a chromatograph or external transmitters).

- **Self Diagnostics**

ControlWave GFC Corrector periodically runs a series of diagnostics to verify the operational status of various system components. The tests include transducer parameters, main and backup battery voltages, software sanity checks, and other indications of system health. An appropriate alarm is generated if any test fails.

### **Communication Port Configuration for the Standard Application Program**

COM1 – Local RS 232 port for configuration via a PC. Flash configuration is BSAP Slave, 115.2K baud rate. The PC port connector, that is accessible, externally, on the bottom of the front door, is connected to this port on the CPU.

COM2 – RS 232 Network port with Flash configuration of BSAP Slave, 9600 baud. The standard application program is compatible with an external communication device (via RS 232) or standard model radio. If a standard model radio is included, the model will also include a cable that connects this port, on the CPU, to the RS 232 port on the radio.

COM3 – RS 485 port with Flash configuration of BSAP Master at 9600 baud. The standard application program assumes that 3808 MVT smart multivariable transmitters for meter run measurement are to be interfaced to this port.

The standard application program also supports a chromatograph but a Flash Configuration change is required to allow the chromatograph to be interfaced to COM3.



## **Power System, Charge Regulator and Aux Output**

In Selection “H,” the user can choose from a variety of internal power systems that includes lithium batteries and rechargeable, lead acid cell batteries, the latter of which are matched with solar panels as charging sources.

All associated electronics are included on the Processor/Main Electronics board, which is located on the left-hand side of the enclosure.

Related to the power system, a charge regulator circuit and an auxiliary output (AUX Output) are standard in ControlWave GFC Corrector.

### **Specifications – Power System, Charge Regulator and AUX Output**

- Input Voltage Range: 5.0 to 18.0 Vdc
- Operating Range: 4.5/4.9V to 18.0V, shutdown occurs at 4.3V nominal (6V power source); 10.3V to 18.0V, shutdown occurs at 9.56V nominal.
- Fuses: 1.5 A from charge regulator, 3.5 A for battery input.
- Surge Suppression: 18VDC transorb meets ANSI/IEEE C37.90-1978.
- Terminations: Pluggable terminal block, max wire size is 16 gauge
- Charge regulator: Temperature-compensated charge control with cut-off
- Threshold voltage for shunt at 23°C: 7.3V for a 6V battery and 14.6V for a 12V battery
- AUX Output Max Load Current: 1.8 A continuous, 2.5 A momentary
- AUX Output “on” Resistance: 0.37 Ohms typical, 0.5 Ohms max

Power consumption: Please refer to the information at the end of the section under “I/O CONFIGURATION.”

Please also refer to the Bristol web site, [www.Emersonprocess.com/Remote](http://www.Emersonprocess.com/Remote), for data sheets on the following components in the power system:

- 7.2 Vdc lithium battery
- 6 Vdc, 7 AH lead acid cell battery
- 12 Vdc, 7 AH lead acid cell battery
- 6 Vdc, 1 watt solar panel
- 6 Vdc, 6.5 watt solar panel
- 12 Vdc, 4.5 watt solar panel

Power systems are sized for operation with all I/O but without powering field devices. The 12 Vdc supply is sized to operate a radio in “slow duty cycle” mode. Please refer to the document, ControlWave GFC Power System Sizing, for information.

### **Hazardous Area Certification**

In Selection “J,” Class I, Division 2 certification can be selected. ControlWave GFC Corrector is approved by UL as an instrument. Note that this certification strictly prohibits installation of any other hardware, not indicated by the model number, in the instrument enclosure.

Wiring to and from the I/O, communication and power connections inside the enclosure, per the ControlWave GFC Corrector manual, are, of course, allowed.

### **Bendable RTD**

Selection “K” allows the user to choose a bendable RTD that is attached to the ControlWave GFC Corrector via an armored cable of 6-foot, 15-foot or 25-foot length. The individual wires attach to a terminal block on the Processor/Main Electronics board. The terminal block accepts up to three wires.

Normally, this RTD would be used to provide the process temperature input but the standard application program also allows the user to select an external temperature transmitter, instead.

The bendable RTD is a “one size fits all” solution that is perfect for most applications and excellent for depot-level inventory situations in which the ultimate installation (and, therefore, thermowell depth) is not necessarily known.



The 12” probe can quickly be inserted in a thermowell, whereupon the user can tighten the included fitting to lock it in place and bend the excess length out of the way. Note that a thermowell is required for this bendable RTD!

### **RTD Interface Information**

A three-wire platinum RTD per DIN 43760 is supported. The temperature, T, in degrees Celsius is calculated using the Resistance vs. Temperature Tables according to the DIN EN 60751 standard for Class A & B RTDs. ControlWave GFC Corrector supports the full range in the DIN standard, -40 to 660°C.

The DIN EN 60751 equation is:

$$R(t) = R_0 * (1 + At + Bt^2)$$

Where:

$$A = 3.9083 * 10^{-3} \text{ } ^\circ\text{C}^{-1}$$

$$B = -5.775 * 10^{-7} \text{ } ^\circ\text{C}^{-2}$$

$$R_0 = 100\text{ohms}$$

In addition, the user may enter the  $R_0$ , A, and B coefficients of a custom calibrated RTD, another platinum standard or a different material (Nickel, Balco or Copper).

During the RTD calibration, the user will be able to set the coefficients, restore the factory default for these coefficients, and calibrate the internal Reference resistor.

### **RTD Input Specifications**

These specifications are for the interface, only, not including the RTD probe or wiring (please note that RTD probe interchangeability can add  $\pm 0.7^\circ\text{C}$  of uncertainty to the measurement).

- RTD Conversion Accuracy:  $\pm 0.1^\circ\text{C}$ , or  $\pm 0.1\%$  of reading, whichever is greater
- Ambient temperature effect on RTD measurement:  $\pm 0.01^\circ\text{C} / ^\circ\text{C}$  max
- Long Term Stability at Constant Conditions:  $\pm 0.25^\circ\text{C} / \text{month}$  max

### **Thermowell Options for RTD**

For new installations, or those lacking a thermowell, Selection “L” allows the user to choose one of three lengths of thermowell for the RTD.

### **I/O Configuration**

Note that the base I/O, 2 DI/PI, is located on the Processor/Main Electronics board. Also, the RTD input and MVT (Multivariable sensor) interface are located on the Processor/Main Electronics board.

Additional I/O circuitry is located on an optional I/O card, which plugs in to the Processor/Main Electronics card. In Selection “M,” the user chooses the minimum I/O configuration of 2 DI/DO, 4 DI, 2 DO and 2 HSC/DI or an expanded version, which additionally includes 3 AI or 3 AI and 1 AO point.

What is the difference between a “PI” (pulse input) and “HSC” (high-speed counter input)? The HSC circuitry includes de-bounce, which is useful with form ‘C’ relays, such as those in some pulser devices. A PI does not include the de-bounce circuitry and is, therefore, not recommended with relays. Note that, in the HSC inputs, the de-bounce can be enabled/disabled by the user and they are shipped disabled.

It is recommended that users select the 3 AI / 1 AO configuration if use of analog I/O is anticipated in the future because addition of the points requires a change-out of the I/O card—due to hazardous area certification requirements, that can be done only at the factory.

### **ControlWave GFC Corrector I/O Specifications**

#### **Pulse/Discrete Inputs**

- Inputs located on Processor/Main Electronics board
- Number of points: up to 2 non-interrupting inputs
- Internally sourced, dry contact single ended inputs
- Scan rate: Once per second
- Input filter: 20 microseconds
- Voltage Range: Internally sourced dry contact input - 3.3 Vdc
- On state: >1.6 V, Off state <1.3V
- Input current: 200  $\mu$ A nominal at 3.3V per input
- Surge Suppression: meets ANSI/IEEE C37.90-1978; 30V transorb between signal and ground
- Terminations: Pluggable Terminal block accommodates up to 16 gauge wire size

#### **Used as Pulse Input**

- Frequency Range: 0-10 kHz
- Debounce: None
- Accumulator: 16 bit

#### **Discrete inputs**

- Number of points: 4 DI-only and 2 points that are selectable as inputs or outputs
- Input configuration: Dry contact
- Input filtering: 15 milliseconds

- Input current for DI points 1 – 4 (those that are DI-only): configurable as 60  $\mu$ A for low power applications or 2 mA nominal at 3.3V per input
- Input current for DI points 5 – 6 (those that are selectable as DI or DO): configurable as 200  $\mu$ A for low power applications or 2.2 mA nominal at 3.3V per input
- On state: >1.6 V, Off state <1.3V
- Maximum scan rate: once per 250 ms
- Electrical isolation: None
- Surge Suppression: meets ANSI/IEEE C37.90-1978; 30V transorb between signal and ground
- Terminations: Pluggable Terminal block accommodates up to 16 gauge wire size

#### **Discrete Outputs**

- Number of points: 2 DO-only and 2 that are selectable as input or output, per-point.
- Configuration: Open Drain MOSFET
- Operating voltage range: 10 – 31 Vdc
- Maximum load current: 400 mA @ 16V and 400 mA @ 30V
- Maximum update rate: once per 250 ms
- Electrical isolation: None
- Surge Suppression: meets ANSI/IEEE C37.90-1978; 30V transorb between signal and ground
- Terminations: Pluggable Terminal block accommodates up to 16 gauge wire size

#### **High Speed Counter Inputs**

- Number of points: 2, also operable as DI points.
- Frequency range: 0 – 10,000 Hz
- Input Range: Internally sourced dry contact input
- Input filtering: 20 microseconds
- Accumulator: 16 bit
- Maximum scan rate (program scan of the accumulator): once per 250 ms

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- Signal Conditioning: Debounce circuit for contact closures and bandwidth limiting for counter input

Note: HSC inputs on the I/O card include debounce, PI inputs on the Process/Main Electronics card do not.

- Input current: 200µA per input at 3.3V
- On state: >1.6 V, Off state <1.3V
- Electrical isolation: None
- Surge Suppression: meets ANSI/IEEE C37.90-1978; 30V transorb between signal and ground
- Terminations: Pluggable Terminal block accommodates up to 16 gauge wire size

### Analog Inputs

- Number points: 3 AI optional
- AI Resolution: 14 bit
- Input Configuration: Externally sourced. Single-ended inputs, jumper selectable 4–20 mA or 1–5 Vdc
- Input Impedance: 1 megΩ - 1.5 Vdc;
- 250 Ω - 4-20 mA
- Input Filtering: 12 Hz
- Maximum scan rate: once per 250 ms
- Channel Settling Time: 600 ms to be within 0.01% of input signal
- Input accuracy:
  - 0.1% of span at 25°C;
  - 0.2% of span -40 °C to 70 °C
- Surge Suppression: meets ANSI/IEEE C37.90-1978; 30V transorb between signal and ground
- Terminations: Pluggable Terminal block accommodates up to 16 gauge wire size

### Analog Output

- Number of Channels: 1 AO optional
- Output configurations: Selectable externally

sourced 4-20 mA or 1-5 Vdc:

- 250 ohm with 12 V external source
- 650 ohm with 24 V external source
- 1-5 Vdc @ 5mA max, 11 to 30 Vdc external source
- D/A resolution: 12 bit
- Maximum update rate: once per 250 ms
- Accuracy:
  - 0.1% of span @ 25°C for current output; 0.1% + 3% of span @ 25°C for voltage;
  - 0.3% of span @ -40 to 70 °C for current 0.3% + 3% of span @ -40 to 70 °C for voltage
- Surge Suppression: meets ANSI/IEEE C37.90-1978; 30V transorb between signal and ground
- Terminations: Pluggable Terminal block accommodates up to 16 gauge wire size

### Power Consumption Information, Processor, Main Electronics, Battery Charger and I/O

The figures, below, assume that the standard application program is running and include the processor, main electronics, battery charger and I/O:

Base unit, without analog I/O, without loop power to any I/O:

- 12 Vdc: 3 mA
- 6 Vdc: 6 mA

Above but with analog I/O, without loop power and analog output operating under-range:

- 12 Vdc: 7 mA
- 6 Vdc: 14 mA

Power Consumption with Loop Current or Power to Field Devices:

- Please refer to the information under "ControlWave GFC Corrector I/O Specifications."

### **Polyphaser Option for Radio**

If a radio is specified (and that is done, below, in Selection "PQR"), Selection "N" allows the user to specify whether or not a Polyphaser surge protector will also be included. Bristol always recommends the Polyphaser.

### **Modem or Radio Option**

The last three digits in the model number, Selection "PQR," are used to specify a modem or radio. Radios are standard models, which are widely available from Freewave and MDS. Note that modems and radios are all allocated to the network port, COM2, and are, thus, mutually exclusive.

Since some users prefer to procure the radios, separately, Bristol offers "radio ready" configurations for each of the models. Radio-ready models include literally everything except for the radio. The mounting bracket as well as all cables and connections are in place. The user or integrator/installer must simply mount the radio to the bracket and make connections.

It is important to match the radio ready configuration with the specific radio the user expects to install because cables and connections for the antenna, RS 232 port and power all vary by radio model!

### **Modem Specifications**

The auto-dial / auto-answer modem is the same, Cermetek model that is used in the TeleFlow products. This modem provides a sleep mode that conserves power while allowing it to wake up when a call comes in.

Function: Provides PSTN (Public Switched Telephone Network) communications.

Operating Modes: Sync or Async. 2-wire switched network - Half or Full Duplex.

Line Type: Two-wire loop start lines.

Modem Configuration: "AT" based commands.

Data Rate: V.32 bis - 9600 bps, V.32 - 9600 bps, V.22 bis - 2400 bps, V.22 - 1200 bps or 600 bps, V.21 - 300 bps, Bell 103J - 300 bps, Bell 212A - 1200 bps.

Telephone Functions: Dialing and answering by AT commands. Automatic answering is also programmable.

Approvals: Telephone - FCC Part 68 (also suitable for approval within Canada).

Trans. Output Levels: -10 dBm fixed (USA) - (0-15 dBm adjustable – firmware dependent).

PSTN Arrangements: Loop Start arrangement (transmission output does not exceed -10 dBm). Allows connection to any voice telephone jack.

Isolation: Data Access Arrangement (DAA) with 1000 Vac (Modem to PSTN).

Sleep Mode Current: 0.5 mA (max) @ 12V (Input Voltage); 1.0 mA (Max) @ 6V (Input Voltage)

Surge Capability: Withstand surge of 100A with 10 x 160 microsecond waveform.

Temperature: Operating Range: -40° to +60°C (-40° to 140°F); Storage Range: -40° to +85°C (-40° to 185°F)

Relative Humidity: 15% to 90%, non-condensing

### **Radio Specifications**

For specifications on the radios, please refer to the Bristol web site, [www.EmersonProcess.com/Remote](http://www.EmersonProcess.com/Remote), where individual data sheets are available in pdf format.

## Radio Power Consumption

NOTE: When conserving power, ControlWave GFC Corrector turns power to the radios completely off instead of operating them in the sleep mode.

Freewave FGR Spread Spectrum Radio Figures at 12 Vdc:

- Receive: 75 mA
- Transmit: 500 mA
- Idle: 20 mA

MDS TransNet 900 Spread Spectrum Radio Figures at 13.8 Vdc:

- Receive: 115 mA
- Transmit: 510 mA

MDS models 4710 and 9710 Licensed, UHF Radios with figures at 13.8 Vdc:

- Receive: 125 mA
- Transmit: 2000 mA

MDS entraNet 900 IP Radio Figures at 13.8 Vdc:

- Receive: 100 mA
- Transmit: 510 mA

MDS iNet 900 Ethernet/IP Radio Figures at 13.8 Vdc:

- Receive: 203 mA
- Transmit: 580 mA

## Proximity Sensor Interface

The Proximity Sensor Interface (ISPROX), Selection “S,” is a Snap Track-mounting board that provides a direct interface to the most common, proximity sensors used in turbine meters. The Snap Track is located inside the door of the Corrector.

This board converts the signal levels to those necessary to interface with the pulse inputs (PI) on the processor board or high-speed counter inputs (HSC) on the I/O board in the Corrector. When ordered with the Corrector, the outputs are factory-wired to the pulse inputs. The ISPROX board provides the following:

- 2-wire intrinsically safe, proximity sensor inputs
- Compatible with Pepperl+Fuchs SJ 2-N (as used in Auto Adjust) and Turck YOX (as used in Instromet meters) sensors.
- 2 outputs, which are compatible with PI and HSC inputs in the Corrector (open drain)
- Class I, Division 1 and Class I, Division 2 rated-approval
- 10 kHz minimum bandwidth

Power consumption for this board: 3.5 mA at the supply voltage (whether it is nominal 6V or 12V).

## Telecounter Pulser Assembly

The optional, TeleCounter Assembly, specified in Selection “T,” provides a direct, mechanical pick-up to the drive shaft on rotary meters. Rotations are converted to electronic, pulse outputs, which are wired to the pulse input points inside the Corrector. The TeleCounter is mounted to the bottom of the Corrector with a gasketed, water tight seal. It is secured to the Corrector enclosure with four screws. The TeleCounter can be opened in the field to set its gears for clockwise or counter-clockwise rotation. The 8-digit odometer provides a count of 0000000.0 to 9999999.9 revolutions. The magnet wheel and the odometer’s tenths wheel will increment 10 digits each time the meter completes one revolution.

### **Mounting Kit for TeleCounter**

Selection “U” is used to specify a kit that adapts the TeleCounter to the mounting configuration of a particular meter. Selections are for either a standard meter, e.g. Roots or Rockwell/Equimeter/Invensys meter or an American Meter.

If the user already has the hardware to adapt (please refer to the diagram on page 15), “None” can be selected.

### **Digit Blanking for TeleCounter**

Selection “V” is used to specify stickers, which can be placed over one or more digits on the mechanical counter. They can be used to match-up with an index on the meter or with a multiplier factor used with the meter. Stickers are available for the tenths, ones and tens digits.

### **Meter Index Rate for TeleCounter**

Selection “W” is used to specify a sticker, which shows the meter flow units. A broad variety, in either cubic feet per revolution or cubic meters per revolution, is available. Please refer to the model number specification for a listing.

## **Accessories**

### **PC Cables**

For local PC operations, users can select either a ten-foot or 25-foot cable. These cables match up to the circular connector on the bottom of the ControlWave GFC Corrector door.

10-foot Cable – p/n 395402-01-8

25-foot Cable – p/n 395402-02-6

### **Standard Application Program and PC Menu Pages**

PC menu pages are available either via the Bristol web site or on a CD. The CD is the “BSI Config” CD, which also contains the TechView user menu system as well as a copy of the Standard Application Program.

BSI Config CD – p/n 395575-02-8

For users wishing to modify the Standard Application Program, it is available as source code. Please contact Bristol Application Services for information.

## Product Family Compatibility

ControlWave GFC Corrector is compatible with Bristol's ControlWave family. It is fully software-compatible with ControlWave Express, ControlWave GFC, ControlWave XFC, ControlWave EFM, ControlWave Micro and the ControlWave Process Automation Controller (PAC). The ControlWave PAC provides the highest I/O capacity and supports up to three Ethernet ports as well as redundancy.

This family compatibility is a major benefit to users whose operations include a number of larger installations in addition to those that require flow computers. ControlWave family products are capable of all measurement & control functions at sites such as major, custody-transfer metering stations, compressor stations, off-shore platforms, processing plants and storage facilities.

Users will not only appreciate the similarity in much of the hardware but will also find the documentation, networking and software compatibilities to be key to their asset management.

### Open standards for programming, network configuration and communication

Only ControlWave brings the perfect combination of industry standards to minimize learning, engineering and implementation costs.

By adhering to such industry standards as Ethernet, TCP/IP, Microsoft Windows®, COM/DCOM, FTP, OLE and ActiveX, ControlWave is able to achieve the highest degree of openness in control system architecture and bring the optimal process efficiency and productivity needed to ensure a successful system implementation.

### ControlWave Designer with ACCOL III

To minimize your engineering and development time, we have adopted the international standard for controller programming, IEC 61131-3. ControlWave Designer is a fully IEC 61131-3-compliant programming environment for the ControlWave family of products. ControlWave Designer includes all five IEC 61131-3 process languages for batch, continuous and discrete control: Function Block Diagram,



Structured Text Sequential Function Chart, Ladder Logic Diagram and Instruction List.

ControlWave Designer includes an extensive library of more than 200 basic IEC 61131-3 functions and function blocks common to many IEC 61131-3 based products.

These include:

- Counters, Timers
- Ladder diagram functions – coils and contacts, etc.
- Numerical, Arithmetic & Boolean functions – Sine, Cosine, Add, Sub, Square Root, And, Or, etc.
- Selection & Comparison – Min, Max, Greater than, Equal, Less than, etc.
- Type conversions – Integer to Real, Boolean to Word, etc.



### **ACCOL III**

In addition to the basic functions and function blocks, ControlWave Designer brings the benefit of many years experience in measurement and SCADA to Bristol's ACCOL III function block library. ACCOL III includes over sixty function blocks that are valuable for use in oil & gas and process measurement & control applications. Further, ACCOL III is designed to take full advantage of the significant features offered by ControlWave.

Briefly, this library includes function blocks for:

- AGA gas flow and API liquids calculations
- Audit, Archive, File Handling
- Average, Compare, Totalize
- Scheduling & Sequencing
- PID & Lead/Lag

In addition, ControlWave ensures data integrity, in the event of a communication interruption, by storing critical time-stamped alarm and historical data in the controller memory. This data is then securely retrieved when communication is restored.

# Product Data Document

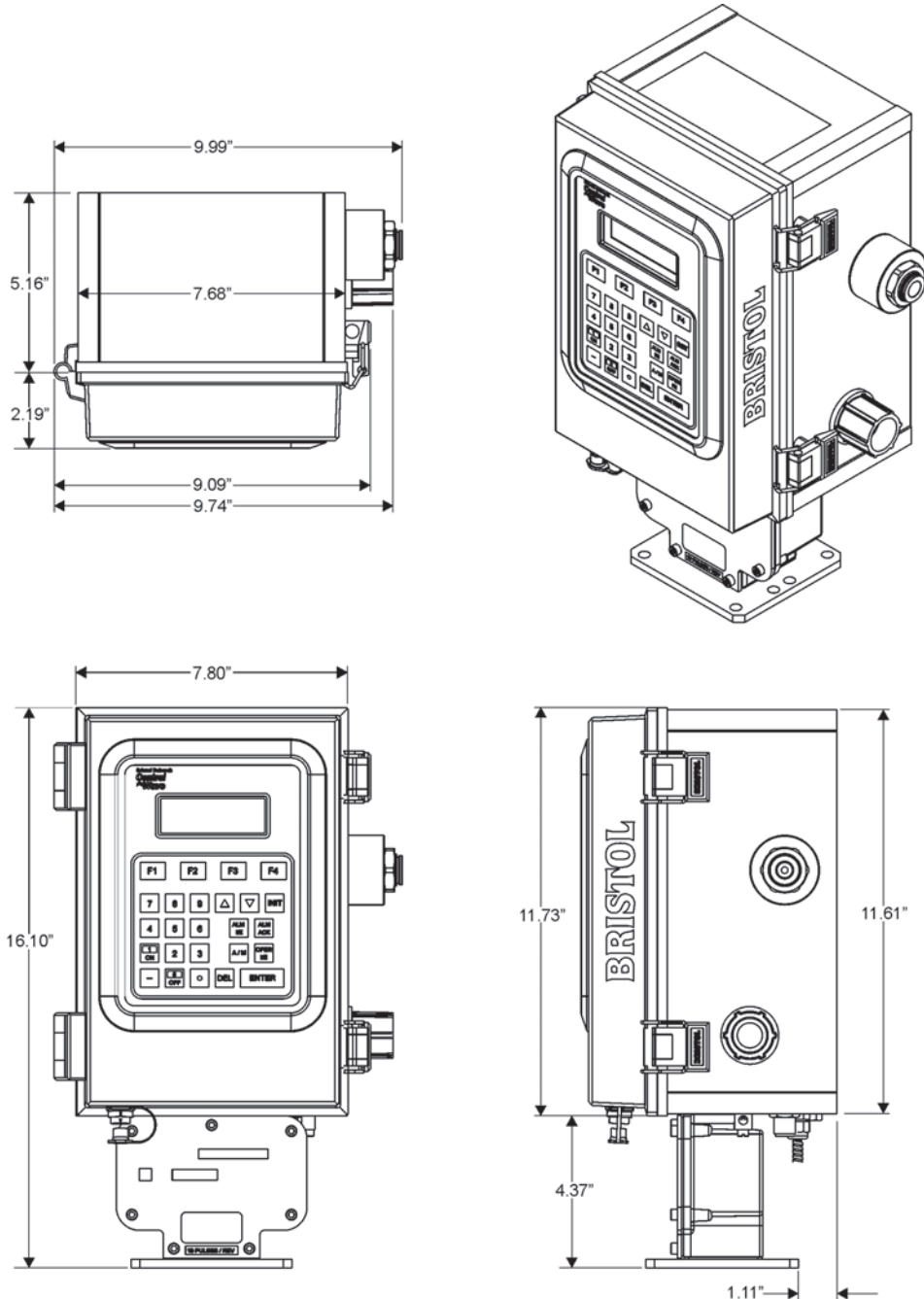
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# Bristol® ControlWave® GFC Corrector

## Dimensions

This drawing shows the TeleCounter pulser assembly and gauge pressure sensor.



# Product Data Document

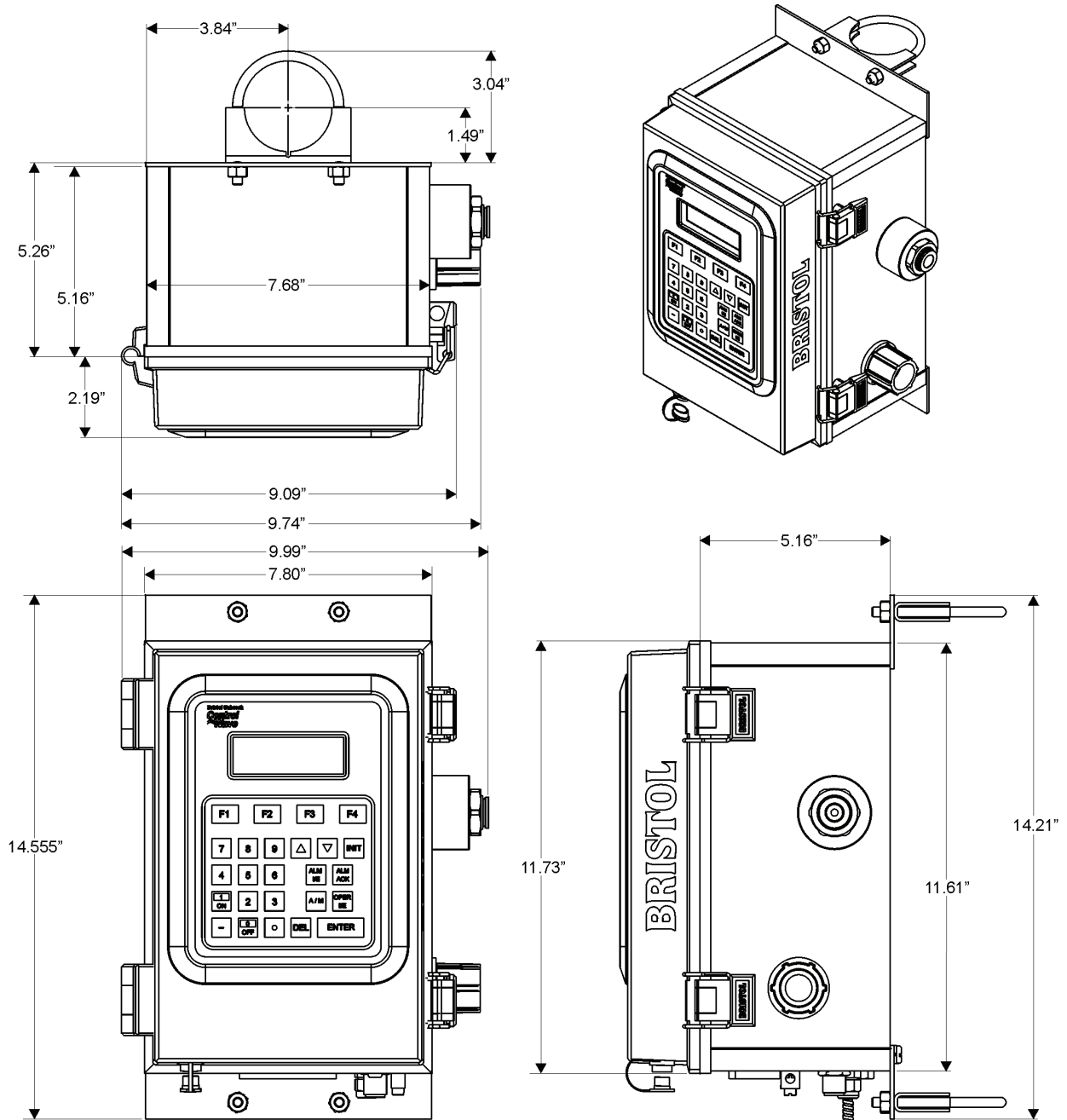
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# Bristol® ControlWave® GFC Corrector

## Dimensions, continued

Gauge pressure sensor and pole mount hardware - but no TeleCounter - are shown, here.



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**Bristol® ControlWave® GFC Corrector**

**Model Specifications**

Model Number: CWM-GFC-TC - A B C - D E F - G H J - K L M - N P Q R - S - T U V W

	DESCRIPTION	CODE
<b>A B C</b>	<b>Integral Gauge Pressure Sensor</b>	<b>A B C</b>
	<b>Gauge Pressure Sensor URL</b>	
10	300 inH2O	014
	25 psig	020
	100 psig	022
	300 psig	023
	1000 psig	025
	2000 psig	028
	<b>Standard Application Note:</b> The standard program does not necessarily require the integral sensor assembly. It allows the user to select the integral sensor assembly or an external transmitter.	
<b>D</b>	<b>Integral Enclosure and LCD/Keypad</b>	<b>D</b>
20	7½" x 11¾" Lexan with <b>LCD only</b> , no Keypad	1
	7½" x 11¾" Lexan, LCD, <b>2 Keys</b>	2
	7½" x 11¾" Lexan, LCD, <b>25 Keys</b>	3
	<b>Standard Application Note:</b> Works with any LCD/keypad.	
<b>E</b>	<b>Mounting Hardware</b>	<b>E</b>
30	Process Mount - No Extra Hardware is Included - <i>for models with TeleCounter only</i>	0
	Pole Mount - Includes wall-mount and 2" pole-mount Hardware	1
<b>F</b>	<b>Processor/Main Electronics Board Selection</b>	<b>F</b>
35	Standard	1
<b>G</b>	<b>Application Program</b>	<b>G</b>
40	None	0
	Standard One-to-Two Run	1
<b>H</b>	<b>Power System</b>	<b>H</b>
50	None - External Power Source is Necessary	1
	7.2 V Lithium Battery, Single	2
	7.2 V Lithium Battery, Dual	3
	6 V, 7 AH Lead Acid Cell Battery and 6 V, <b>1 W</b> Solar Panel System	4
	6 V, 7 AH Lead Acid Cell Battery and 6 V, <b>6.5 W</b> Solar Panel System	5
	12 V, 7 AH Lead Acid Cell Battery and 12 V, <b>4.5 W</b> Solar Panel System	6
<b>J</b>	<b>Hazardous Area Certification</b>	<b>J</b>
60	None	0
	Class I, Division 2 Non-incendive (UL/CUL - NI)	1

**Product Data Document**

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**Bristol® ControlWave® GFC Corrector**

**Model Specifications, continued**

**Model Number: CWM-GFC-TC - A B C - D E F - G H J - K L M - N P Q R - S - T U V W**

	DESCRIPTION		CODE
<b>K</b>	<b>Bendable RTD</b>	<b>XCWMRTD</b>	<b>K</b>
80	None	<b>Standard Application Note:</b> For the temperature input, the std. load allows the user to select this RTD or an external transmitter.	0
	With RTD, 6 Foot Cable Length		1
	With RTD, 15 Foot Cable Length		2
	With RTD, 25 Foot Cable Length		3
<b>L</b>	<b>Thermowell Options for RTD</b>	<b>XCWMTHERM</b>	<b>L</b>
90	None		0
	With Thermowell, 2 1/2" Insertion Length		1
	With Thermowell, 4 1/2" Insertion Length		2
	With Thermowell, 7 1/2" Insertion Length		3
<b>M</b>	<b>I/O Configuration</b>		<b>M</b>
100	Base 2 DI / PI (Pulse Input) Only - No I/O Card is Included	<b>Standard Application Note:</b> Works with any I/O configuration; I/O is not necessarily required.	0
	Base + 2DI/DO, 4DI, 2DO, 2HSC		1
	Above + 3 AI		2
	Full I/O: Above + 1 AO		3
<b>N</b>	<b>Radio Cable/Mounting Hardware and Polyphaser Option</b>	<b>XCWMPOLY</b>	<b>N</b>
110	No Radio / No Radio Ready	<b>Don't forget to specify a "1" or "2" here if a radio is selected in 'PQR' below!</b>	0
	Without Polyphaser		1
	With Polyphaser		2

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**Bristol® ControlWave® GFC Corrector**

**Model Specifications, continued**

**Model Number: CWM-GFC-TC - A B C - D E F - G H J - K L M - N P Q R - S - T U V W**

DESCRIPTION		CODE	
P Q R	Radio or Modem Option	XCWMGRADIO P Q R	
120	None	000	
	Dial-line Modem	001	
	Standard Freewave Radio	<b>All radios are located on the Radio Bracket in the flow computer enclosure.</b>	103
	Standard Freewave Radio Ready		104
	Standard MDS Transnet Radio	<b>Standard Application Note: Works with either the modem or any radio.</b>	201
	Standard Transnet Radio Ready		202
	Standard MDS 9810 Radio with Diag	301	
	Standard MDS 4710A Radio with Diag	310	
	Standard MDS 4710B Radio with Diag	311	
	Standard MDS 9710A Radio with Diag	320	
	Standard MDS 9710B Radio with Diag	321	
	Standard MDS 4710 A/B, 9710 A/B, 9810 Radio Ready	322	
	Standard MDS EntraNet 900 Radio (Serial Remote)	401	
	Standard MDS EntraNet 900 Radio (Ethernet Remote)	402	
	Standard MDS EntraNet 900 Radio (Access Point)	403	
	Standard MDS EntraNet Radio Ready	404	
	Standard MDS iNet 900 Radio (Remote Serial Gateway)	420	
	Standard MDS iNet 900 Radio (Remote Ethernet Bridge)	421	
	Standard MDS iNet 900 Radio (Access Point/Remote Dual Gateway)	422	
	Standard MDS iNet 900 Radio Ready	423	

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**Bristol® ControlWave® GFC Corrector**

**Model Specifications, continued**

**Model Number: CWM-GFC-TC - A B C - D E F - G H J - K L M - N P Q R - S - T U V W**

	DESCRIPTION	CODE
<b>S</b>	<b>Proximity Sensor Interface Board (ISPROX) - Snap Track-mounting</b>	<b>S</b>
130	None	0
	With Proximity Sensor Interface Board	1
<b>T</b>	<b>TeleCounter Pulser Assembly</b>	<b>T</b>
140	None	0
	With Index (CW)	1
	With Index (CCW)	2
<b>U</b>	<b>Mounting Kit for TeleCounter</b>	<b>U</b>
150	None	0
	Standard (Equimeter, Roots Type)	1
	American Meter Type	2
<b>V</b>	<b>Digit Blanking - TeleCounter</b>	<b>V</b>
160	None	0
	1st Digit (tenths)	1
	2nd Digit (ones)	2
	3rd Digit (tens)	3
<b>W</b>	<b>Meter Index Rate - TeleCounter</b>	<b>W</b>
170	None	0
	1 CF / REV	1
	5 CF / REV	2
	10 CF / REV	3
	100 CF / REV	4
	1000 CF / REV	5
	0.1 M3 / REV	6
	1 M3 / REV	7
	10 M3 / REV	8
	100 M3 / REV	9

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# Bristol® ControlWave® GFC Corrector

## Spare Parts

DESCRIPTION	PART NUMBER
<b>PC Cables</b>	
PC Cable - 10 Foot, 9-pin Female-to-Circular, Alden Connector	395402-01-8
PC Cable - 25 Foot, 9-pin Female-to-Circular, Alden Connector	395402-02-6
<b>Electronics Assemblies or Boards</b>	
Processor Board Assembly	400094-02-9
I/O Board Assembly, 2DI/DO, 4DI, 2DO, 2HSC (corresponds to selection M=1)	400093-01-4
I/O Board Assembly, 2DI/DO, 4DI, 2DO, 2HSC + 3 AI (corresponds to M=2)	400093-02-2
I/O Board Assembly, 2DI/DO, 4DI, 2DO, 2HSC + 3 AI, 1 AO (corresponds to M=3)	400093-03-0
Proximity Sensor Interface Board (ISPROX) - Replacement, not incl' Snap Track	400113-02-3
<b>Fuses, Batteries</b>	
Lithium Battery for RAM backup on Processor Board, 3V, 0.3 AH (PC 853)	395620-01-5
Fuse, Processor Board, MSB 3.5A SB	395603-07-2
Fuse, Processor board, MSB 1.5A SB	395603-10-2
<b>Power System Components</b>	
7.2V Lithium Battery Pack (Dual packs are simply two of these) (PC 227)	395413-01-0
6V 7 AH Lead Acid Cell Battery (PC 227)	395407-01-0
12V 7 AH Lead Acid Cell Battery (PC 227)	395407-02-8
6V 1 Watt Solar Panel (BP Model MSX-01) (PC 227)	395404-01-0
Mounting Kit for 1 Watt Solar Panel (PC 227)	621429-03-1-kit
12V 4.5 Watt Solar Panel (BP Model SX-5M) (PC 227)	395435-02-1
Mounting Kit for 12V 4.5 Watt Solar Panel (PC 227)	621431-01-0-kit
<b>RTD Assemblies and Thermowells</b>	
12" Bendable RTD with 6 Foot Cable (PC 227)	392610-01-9
12" Bendable RTD with 15 Foot Cable (PC 227)	392610-02-7
12" Bendable RTD with 25 Foot Cable (PC 227)	392610-03-5
Spare Ferrite Bead for RTD Wires (loop wires through & around once) (PC 834)	395449-01-4
Thermowell, 2 1/2" insertion length, 316 Stainless Steel (PC 463)	388908-02-5
Thermowell, 4 1/2" insertion length, 316 Stainless Steel (PC 463)	388908-03-3
Thermowell, 7 1/2" insertion length, 316 Stainless Steel (PC 463)	388908-05-0

Remote Automation Solutions

Website: [www.EmersonProcess.com/Remote](http://www.EmersonProcess.com/Remote)





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**Bristol® ControlWave® GFC Corrector**

**Spare Parts, continued**

DESCRIPTION		PART NUMBER
<b>Smart Gauge Pressure Sensors</b>		
300"	<p><b>NOTE! This is the replacement sensor, only, and is appropriate only for products that included a gauge pressure sensor to begin with.</b></p> <p><b>A gauge pressure sensor cannot be added to a unit that was shipped without one.</b></p>	396865-02-0
25 psi		396865-04-6
100 psi		396865-06-2
300 psi		396865-07-0
1000 psi		396865-09-7
2000 psi		396865-12-7
Internal Cable to Processor Board		396612-02-4
<b>Polyphaser</b>		
Polyphaser Surge Arrestor		396115-01-2
<b>Cermetek Modem and Hardware</b>		
Cermetek Modem		400000-01-6
Hardware Kit for the Cermetek Modem		621588-02-4-kit
<b>Cables, Miscellaneous</b>		
Internal Serial Cable, Bottom of Door-to-COM 1 on Processor Board		396646-05-0
Grounding Cable (Spade Lug on One End)		396710-01-8
Grounding Cable		396081-01-0
<b>Power and RS 232 Interface Cables used with Radios</b>		
Freewave Radio Interface		396369-02-2
MDS Power Cable - all models except iNet		396610-01-3
MDS Power Cable for iNet		396652-02-6
MDS Transnet Serial Cable		396639-02-0
MDS 4710, 9710, 9810 Serial Cable		392635-03-8
MDS entraNet Serial Cable		396640-02-8
MDS iNet Serial Cable		396641-02-4
<b>Internal Coaxial Cables, Radio-to-Bulkhead or Radio-to-Polyphaser</b>		
Radio-to-Bulkhead (no Polyphaser) 'N' type for MDS 4710, 9710, 9810		395473-01-2
Radio-to-Bulkhead (no Polyphaser) 'SMA' type for Freewave Radio		396306-01-2
Radio-to-Bulkhead (no Polyphaser) 'TNC' type for MDS Transnet, entraNet and iNet		396637-01-9
Radio-to-Polyphaser, 'N' type for MDS 4710, 9710, 9810		396108-01-6
Radio-to-Polyphaser, 'SMA' type for Freewave Radio		396306-02-0
Radio-to-Polyphaser, 'TNC' type for MDS Transnet, entraNet and iNet		396638-01-5

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**Bristol® ControlWave® GFC Corrector****Spare Parts, continued**

DESCRIPTION	PART NUMBER
2" Pipe Clamp Assembly	388931-01-9
2" Pipe / Wall Mount Bracket (2 brackets are required)	396666-01-9
Screw for Pipe Mount Bracket M6x1 20 mm (2 screws per bracket are required)	396726-01-1
Dessicant Pack, X Corrode	391189-03-4
<b>TeleCounter Pulser Assembly - Replacement Hardware</b>	
Replacement TeleCounter Assembly with Housing (CW) 10 pulse/rev	396300-01-4
Replacement TeleCounter Assembly with Housing (CCW) 10 pulse/rev	396300-02-2
Replacement TeleCounter "guts," no Housing 10 pulse/rev - Specify CW or CCW	396299-01-6
Replacement TeleCounter Window	391689-01-0
Replacement Internal Circuit Board (10 pulse/rev)	400001-01-2
Standard Mounting Kit (Rockwell/Equimeter/Invensys, Roots Type)	621374-01-6-kit
American Meter Type Mounting Kit	621374-02-4-kit
<b>TeleCounter Pulser Assembly - Digit Blanking Stickers</b>	
1st Digit (tenths)	392107-01-5
2nd Digit (ones)	392107-02-3
3rd Digit (tens)	392107-03-1
<b>TeleCounter Pulser Assembly - Meter Index Rate Stickers</b>	
1 CF / REV	392106-01-9
5 CF / REV	392106-02-7
10 CF / REV	392106-03-5
100 CF / REV	392106-04-3
1000 CF / REV	392106-05-1
0.1 M3 / REV	392106-06-0
1 M3 / REV	392106-07-8
10 M3 / REV	392106-08-6
100 M3 / REV	392106-09-4

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# Bristol® ControlWave® GFC Corrector

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