BETA MasterCAL 990

BETA CALIBRATORS

MARTEL ELECTRONICS

Technical Specifications Bulletin

Precision multi-function documenting calibrator and HART™ configurator/communicator in one hand-held instrument



General Features

- Precision multi-function calibrator and HART™ configurator/communicator in one hand-held instrument
- Measure/read thermocouple, RTD, Ohms, DC and AC Voltage, DC current, pressure, and frequency
- Source/simulate thermocouple, RTD, Ohms, DC Voltage and current, pressure, and frequency
- Simultaneous input and output split-screen displays
- Loop power function
- Switch testing functions
- Transmitter mode
- Automated and user-programmable procedures
- Engineering units, percent of scale, square-law inputs, or custom units
- Multi-lingual interface – English, French, German, Italian, and Spanish
- 200x240 pixel, bright white, backlit LCD display
- Rugged over-molded urethane case for field use
- Calibration automation and documentation with many popular third-party software packages
- Complies with CAN/CSA C22.2 No 1010.1-92, ANSI/ISA S82.01-1994, UL3111, and EN610-1:1993

HART Protocol Features

- Universal, common practice and device-specific commands
- Point-to-point and multi-drop operation
- Burst mode compatibility
- Read HART PV in digital mode
- Read and write HART configuration functions
- Read and clone transmitter configuration
- Re-tag smart transmitters
- Automated HART sensor and output trim

The MasterCAL 990 - A Precision Multi-Function Documenting Calibrator

First and foremost, the MasterCAL 990 is a precision, multi-function documenting calibrator that will calibrate virtually any process instrument you have – thermocouples, RTDs, Ohms, Voltage, current, pressure, and frequency. A host of convenience features, including source ramp functions, loop power, variable density data logging with a week's worth of calibration results storage, compatibility with many third-party calibration documentation software programs, and a built-in HART configuration/communicator, make the MasterCAL 990 an indispensable tool.

A large, white backlit LCD provides simultaneous display of input and output. Menu-driven, "soft" function keys provide rapid setup and measurement. The multi-lingual interface ensures the MasterCAL 990 is useful in as broad a range of applications and locations as possible. A high capacity rechargeable battery pack provides extended usage. An optional battery eliminator is available for extended monitoring applications. The MasterCAL 990 is housed in an over-molded urethane case that provides a solid grip and protection against "hard knocks".

Source/Simulation

The MasterCAL 990 will source/simulate thermocouple, RTD, Ohms, DC Voltage and current, and frequency. Auto-step and ramp functions are provided on all outputs and ranges.

Measurement/Read

The MasterCAL 990 will measure/read thermocouple, RTD, Ohms, DC and AC Voltage, DC current, pressure, and frequency. Measuring pressure requires the use of the Beta Pressure Module Adapter (Model BPPA100) with any of Beta's Pressure Modules (please refer to the separate Pressure Module data sheet for ranges and accuracies).

Switch Test Mode

Process limit switches can be tested for both upper and lower trip limits and deadband. Using a split-screen measure/source mode, the MasterCAL 990 accepts a normal process variable measurement associated with the limit switch, and the switch contacts. The 990 will automatically monitor and record the measurement as the switch is activated and then deactivated. A graphical plot of deadband is displayed, making switch test quick and accurate.

Simultaneous Measure/Source

Using a split-screen display mode, the MasterCAL 990 will simultaneously measure and source various process variables. These variables depend on whether loop power is enabled or disabled. Please refer to Table 1.

Transmitter Mode

The MasterCAL 990 can be inserted in a 4-20 mA process loop to simulate a 2-wire transmitter. The MasterCAL 990 provides the loop excitation and modulates the loop current, simulating the 2-wire transmitter.

Built-In Calculator Functions

The MasterCAL 990 features a built-in calculator with square-root function, with accessible registers containing measure and source values.

Barcode Entry Option

The MasterCAL 990 will accept input from an optional barcode wand for rapid entry of instrument serial numbers.

Table 1 – Simultaneous Measure/Source

Measure Function	Source Function					
	DC V	mA	Freq	Ω	TC	RTD
DC V	D E	D	D E	D E	D E	D E
mA	D E		D E	D E	D E	D E
AC V	D E	D	D E	D E	D E	D E
Frequency (≥20 Hz)	D E	D	D E	D E	D E	D E
Frequency (<20 Hz)						
Ω	D		D	D	D	D
Continuity	D		D	D	D	D
TC	D E	D	D E	D E		D E
RTD	D		D	D	D	D
3W RTD	D		D	D	D	D
4W RTD	D		D	D	D	D
Pressure	D E	D	D E	D E	D E	D E

Simultaneous measure/source works with:
D= Loop power disabled; E= Loop power enabled

The MasterCAL 990 - A HART Configurator/Communicator

HART Implementation

The MasterCAL 990 supports HART Version 5.7 protocol instructions. It's functions are comparable to a HART 275 Communicator; because the MasterCAL 990 does not have a DD interpreter, it does not support DD libraries. Most instrument maintenance functions can be accomplished using just the MasterCAL 990 without the need for a separate HART communicator. Hookup is simple with the supplied HART interface cable. The calibrator menus automatically branch to appropriate adjustment choices. Automatic completion of test templates and automatic fetching and sending of analog readings during trim operations make HART calibration a highly efficient operation.

Protocol Instructions

The MasterCAL 990 instruction set includes three levels of commands:

Universal Commands – provides functions for all field instruments to read manufacturer and device type, primary variable/input signal (PV), read output, tag ID, etc.

Common Practice Commands – provides functions that are common to most field instruments, such as reading multiple variables, setting damping features, etc.

Device-Specific Commands – allows the MasterCAL 990 to perform device-specific configuration functions for a wide variety of popular field instruments. Please refer to Table 2.

Operating Modes

The MasterCAL 990 supports HART Point-to-Point Operation, where a single HART instrument is connected in a loop; the calibrator is normally connected directly at the instrument's local signal terminals. The MasterCAL 990 is also compatible with multi-drop and burst mode HART installations.

Documenting Calibration

The MasterCAL 990 is compatible with many third-party calibration documentation software programs including:

- Applied Systems Technologies Cal Station and Base Station
- Emerson Process Management AMS
- Prime Technologies ProCal
- Fluke DPC Track
- Honeywell DocuMint
- Others supporting the ISA Field Calibrator Interface standard



Table 2 – Device Specific Configuration Functions

Manufacturer	Pressure Instruments	Temperature Instruments
ABB/Kent-Taylor	600T	658T [1]
ABB/Hartmann & Braun	Contrans P [1], AS 800 Series	
Endress & Hauser	CERABAR S,	TMT 122 [1], TMT 182 [1],
	CERABAR M,	TMT 162 [1]
	DELTABAR S	
Foxboro Eckardt		T1/RTT20 [1]
Foxboro/Invensys	I/A Pressure	
Honeywell	ST3000	STT25T [1], STT25H [1]
Moore Products	344 [1]	
Rosemount	1151	3044C
	2088	644
	3001C	3144
	3051, 3051S	3244, 3144P
Siemens	SITRANS P DS	
	SITRANS P ES	
SMAR	LD301	TT301 [1]
Viatran	I/A Pressure	
Wika	UNITRANS	T32H [1]
Yokogawa	EJA	YTA 110, 310, and 320

1 Sensor Trim not supported



Specifications (18 °C to 28 °C unless otherwise noted)

DC Voltage Read and Source

Measurement Range/Accuracy (% of reading + % of full scale; 1 year; 2 year)	
0.000 to 110.000 mV	±0.025% rdg. +0.015%FS
	±0.05% rdg. +0.015%FS
0.000 to 1.10000 V	±0.025% rdg. +0.005%FS
	±0.05% rdg. +0.005%FS
0.000 to 11.0000 V	±0.025% rdg. +0.005%FS
	±0.05% rdg. +0.005%FS
0.000 to 110.000 V	±0.025% rdg. +0.005%FS
	±0.1% rdg. +0.005%FS
0.000 to 300.00 V	±0.05% rdg. +0.005%FS
	±0.1% rdg. +0.005%FS
Read Input Impedance	5 MOhms
Read Common Mode Error	±0.008% FS/$V_{COMMON-MODE}$
Read Input Voltage	300 V rms maximum
Temperature Coefficient	(±0.001% rdg + 0.0015% FS)/°C; -10 °C to 18 °C, and 28°C to 50 °C

Source Range/Accuracy (% of reading + % of full scale; 1 year; 2 year)	
0.000 to 110.000 mV	±0.01% rdg. +0.005%FS
	±0.015% rdg. +0.005%FS
0.000 to 1.10000 V	±0.01% rdg. +0.005%FS
	±0.015% rdg. +0.005%FS
0.000 to 15.0000 V	±0.01% rdg. +0.005%FS
	±0.015% rdg. +0.005%FS
Source Output Loading	(±0.001% FS + 1 µV)/mA
Source Common Mode Error	0.008% FS/$V_{COMMON-MODE}$
Source Output Current	10 mA maximum
Source Output Voltage	30 VDC maximum
Temperature Coefficient	(±0.001% rdg + 0.001% FS)/°C; -10 °C to 18 °C, and 28 °C to 50 °C

AC Voltage Read (10% to 100% of range)

Measurement Range/Accuracy (% of reading + counts; 1 year; 2 year)	
20 to 40 Hz	±2% rdg. +10
	±2% rdg. +10
40 to 500 Hz	±0.5% rdg. +5
	±0.5% rdg. +5
500 Hz to 1 kHz	±2% rdg. +10
	±2% rdg. +10
1 to 5 kHz	±10% rdg. +20
	±10% rdg. +20
Read Input Voltage	
Minimum	0.5 V above 1 kHz
Ranges	1.1000 V, 11.000 V, 110.00 V, 300.0 V
Maximum	300 V rms
Read Input Impedance	5 MOhms and <100 pF
Read Input Coupling	AC only
Read Common Mode Error	±0.008% FS/$V_{COMMON-MODE}$
Temperature Coefficient	±10% of spec/°C; -10 °C to 18 °C, and 28°C to 50 °C

DC Current Read and Source

Measurement Range/Accuracy (% of output + % of full scale; 1 year; 2 year)	
0.000 to 30.000 mA	±0.01% +0.015%FS
	±0.02% +0.015%FS
0.000 to 110.000 mA	±0.01% +0.015%FS
	±0.02% +0.015%FS
Read Common Mode Error	±0.01% FS/$V_{COMMON-MODE}$
Read Input Voltage	30 VDC maximum
Temperature Coefficient	(±0.001% rdg + 0.002% FS)/°C; -10 °C to 18 °C, and 28°C to 50 °C

Source Range/Accuracy (% of output + % of full scale; 1 year; 2 year)	
0.000 to 22.000 mA	±0.01% +0.015%FS
	±0.02% +0.015%FS
Transmitter simulate (current sink)	±0.02% rdg. +0.005%FS
	±0.015% rdg. +0.005%FS
Source Burden Voltage	24 V maximum
Source Common Mode Error	0.008% FS/$V_{COMMON-MODE}$
Source Input Voltage	30 VDC maximum
Temperature Coefficient	(±0.003% output + 0.003% FS)/°C; -10 °C to 18 °C, and 28°C to 50 °C

Ohms Read and Source

Measurement Range/Accuracy
(% of reading + Ohms; 1 year; 2 year)

0.000 to 11.000 Ohms	±0.05% + 50 mΩ
	±0.075% + 50 mΩ
0.000 to 110.00 Ohms	±0.05% + 50 mΩ
	±0.075% + 50 mΩ
0.000 to 1.1000 kOhms	±0.05% + 0.5 Ω
	±0.075% + 0.5 Ω
0.000 to 11.000 kOhms	±0.1% + 10 Ω
	±0.1% + 10 Ω
Read Common Mode Error	±0.005% FS/$V_{COMMON-MODE}$
Read Input Voltage	30 VDC maximum
Continuity	continuous tone <<25 Ω; no tone >400 Ω
Temperature Coefficient	(±0.01% FS + 2 mΩ)/°C; -10 °C to 18 °C, and 28°C to 50 °C

Source Range/Accuracy
(% of output + Ohms; 1 year; 2 year)

0.000 to 11.000 Ohms	±0.01% + 20 mΩ
	±0.02% + 20 mΩ
0.000 to 110.00 Ohms	±0.01% + 40 mΩ
	±0.02% + 40 mΩ
0.000 to 1.1000 kOhms	±0.02% + 0.5 Ω
	±0.03% + 0.5 Ω
0.000 to 11.000 kOhms	±0.03% + 5 Ω
	±0.04% + 5 Ω
Read Common Mode Error	±0.008% FS/$V_{COMMON-MODE}$
Source Input Voltage	30 VDC maximum
Current Through Source Resistance	
11.000 Ohms range	3 mA DC max.; 0.1 mA DC min.
11.000 Ohms range	3 mA DC max.; 0.1 mA DC min.
11.000 Ohms range	3 mA DC max.; 0.01 mA DC min.
11.000 Ohms range	1 mA DC max.; 0.01 mA DC min.
Temperature Coefficient	±0.01% FS/°C; -10 °C to 18 °C, and 28 °C to 50 °C

Frequency Read and Source

(For frequencies <109.99 Hz, specification applies for signals with slew rates >5 V/ms)

Measurement Range/Accuracy (1 year; 2 year)	
1.00 to 109.99 Hz	±0.05 Hz
	±0.05 Hz
110.0 to 1099.9 Hz	±0.5 Hz
	±0.5 Hz
1.100 to 10.999 kHz	±0.005 Hz
	±0.005 Hz
11.00 to 50.00 kHz	±0.05 kHz
	±0.05 kHz
Minimum Input Amplitudes	
1 Hz to 1 kHz squarewave	300 mVP-P
1 kHz to 30 kHz squarewave	1.4 VP-P
>30 kHz	2.8 VP-P
Maximum Input Amplitudes	
1 Hz to 1 kHz	300 V rms
>1 kHz	30 V rms
Input Impedance	5 MOhms

Source Range/Accuracy
(1 year; 2 year)

0.00 to 10.99 Hz	±0.01 Hz
	±0.01 Hz
11.00 to 109.99 Hz	±0.1 Hz
	±0.1 Hz
110.0 to 1099.9 Hz	±0.1 Hz
	±0.1 Hz
1.100 to 21.999 kHz	±0.002 kHz
	±0.002 kHz
22.00 to 50.00 kHz	±0.005 kHz
	±0.005 kHz
Waveforms	squarewave with 50% duty cycle sinewave
Amplitude	0.1 to 10 VP-P; user-adjustable
Amplitude Accuracy	
1 to 1099 Hz	±3% of output + 0.5% FS
1.1 to 10. 9 kHz	±10% of output + 0.5% FS
11 to 50 kHz	±30% of output + 0.5% FS
Input Voltage	30 VDC maximum

Thermocouple Read and Source

(Accuracies with external cold junction; add 0.2 °C for internal junction; sensor inaccuracies not included)

Resolution	0.1 °C
Temperature Scale	ITS-90 or IPTS-68, selectable
Compensation	ITS-90 per Monograph 175 for E/N/J/K/T/B/R/S thermcouples IPTS-68 per IEC 584-1 for E/J/K/T/B/R/S thermcouples IPTS-68 per DIN 43710 for L and U thermocouples
Input Voltage	30 VDC maximum
Common Mode Error	0.01 °C/$V_{COMMON-MODE}$
Temperature Coefficient	0.05 ¨C/°C; -10 °C to 18 °C, and 28 °C to 50 °C

Read Type/Range/Accuracy (1 year; 2 year)

J Thermocouple	
-210 to -100 °C	±0.6 °C; ±0.9 °C
-100 to +800 °C	±0.3 °C; ±0.4 °C
+800 to +1200 °C	±0.5 °C; ±0.8 °C
K Thermocouple	
-210 to -100 °C	±0.7 °C; ±1.0 °C
-100 to +400 °C	±0.3 °C; ±0.4 °C
+400 to +1200 °C	±0.5 °C; ±0.8 °C
+1200 to +1372 °C	±0.7 °C; ±1.0 °C
T Thermocouple	
-250 to -200 °C	±1.7 °C; ±2.5 °C
-200 to 0 °C	±0.6 °C; ±0.9 °C
0 to +400 °C	±0.3 °C; ±0.4 °C
E Thermocouple	
-250 to -200 °C	±1.3 °C; ±2.0 °C
-200 to -100 °C	±0.5 °C; ±0.8 °C
-100 to +600 °C	±0.3 °C; ±0.4 °C
+600 to +1000 °C	±0.4 °C; ±0.6 °C
R Thermocouple	
-20 to 0 °C	±2.3 °C; ±2.8 °C
0 to +100 °C	±1.5 °C; ±2.2 °C
+100 to +1767 °C	±1.0 °C; ±1.5 °C
S Thermocouple	
-20 to 0 °C	±2.3 °C; ±2.8 °C
0 to +200 °C	±1.5 °C; ±2.1 °C
+200 to +1400 °C	±0.9 °C; ±1.4 °C
+1400 to +1767 °C	±1.1 °C; ±1.7 °C
B Thermocouple	
+600 to +800 °C	±1.3 °C; ±2.0 °C
+800 to +1000 °C	±1.0 °C; ±1.5 °C
+1000 to +1820 °C	±0.9 °C; ±1.3 °C
C Thermocouple	
0 to +800 °C	±0.6 °C; ±0.9 °C
+800 to +1200 °C	±0.8 °C; ±1.2 °C
+1200 to +1800 °C	±1.1 °C; ±1.6 °C
+1800 to +2316 °C	±2.0 °C; ±3.0 °C
L Thermocouple	
-200 to -100 °C	±0.6 °C; ±0.9 °C
-100 to +800 °C	±0.3 °C; ±0.4 °C
+800 to +900 °C	±0.5 °C; ±0.8 °C
U Thermocouple	
-200 to 0 °C	±0.6 °C; ±0.9 °C
0 to +600 °C	±0.3 °C; ±0.4 °C
N Thermocouple	
-200 to -100 °C	±1.0 °C; ±1.5 °C
-100 to +900 °C	±0.5 °C; ±0.8 °C
+900 to +1300 °C	±0.6 °C; ±0.9 °C

Source Type/Range/Accuracy (1 year; 2 year)

J Thermocouple	
-210 to -100 °C	±0.3 °C; ±0.4 °C
-100 to +800 °C	±0.2 °C; ±0.3 °C
+800 to +1200 °C	±0.2 °C; ±0.3 °C
K Thermocouple	
-210 to -100 °C	±0.4 °C; ±0.6 °C
-100 to +400 °C	±0.3 °C; ±0.4 °C
+400 to +1200 °C	±0.3 °C; ±0.4 °C
+1200 to +1372 °C	±0.3 °C; ±0.4 °C
T Thermocouple	
-250 to -200 °C	±0.9 °C; ±1.4 °C
-200 to 0 °C	±0.4 °C; ±0.9 °C
0 to +400 °C	±0.3 °C; ±0.4 °C
E Thermocouple	
-250 to -200 °C	±0.6 °C; ±0.9 °C
-200 to -100 °C	±0.3 °C; ±0.4 °C
-100 to +600 °C	±0.3 °C; ±0.4 °C
+600 to +1000 °C	±0.2 °C; ±0.3 °C
R Thermocouple	
-20 to 0 °C	±1.2 °C; ±1.8 °C
0 to +100 °C	±1.1 °C; ±1.7 °C
+100 to +1767 °C	±0.9 °C; ±1.4 °C
S Thermocouple	
-20 to 0 °C	±1.2 °C; ±1.8 °C
0 to +200 °C	±1.1 °C; ±1.7 °C
+200 to +1400 °C	±0.9 °C; ±1.4 °C
+1400 to +1767 °C	±1.0 °C; ±1.5 °C

B Thermocouple	
+600 to +800 °C	±1.0 °C; ±1.5 °C
+800 to +1000 °C	±0.8 °C; ±1.2 °C
+1000 to +1820 °C	±0.8 °C; ±1.2 °C
C Thermocouple	
0 to +800 °C	±0.6 °C; ±0.9 °C
+800 to +1200 °C	±0.7 °C; ±1.0 °C
+1200 to +1800 °C	±0.9 °C; ±1.4 °C
+1800 to +2316 °C	±1.3 °C; ±2.0 °C
L Thermocouple	
-200 to -100 °C	±0.3 °C; ±0.4 °C
-100 to +800 °C	±0.2 °C; ±0.3 °C
+800 to +900 °C	±0.2 °C; ±0.3 °C

U Thermocouple	
-200 to 0 °C	±0.4 °C; ±0.6 °C
0 to +600 °C	±0.3 °C; ±0.4 °C
N Thermocouple	
-200 to -100 °C	±0.6 °C; ±0.9 °C
-100 to +900 °C	±0.5 °C; ±0.8 °C
+900 to +1300 °C	±0.3 °C; ±0.4 °C

Note: When simulating temperature in As Found/As Left procedures, steps may be either linear by temperature or linear by mV potential.



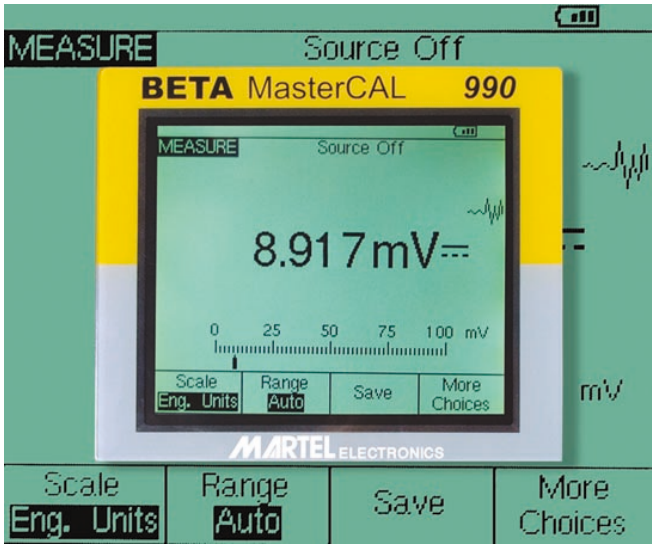
RTD Read and Source

(For 2-wire or 3-wire measurements, add 0.4 °C; sensor inaccuracies not included)

Resolution	0.1 °C, except 1 °C for 10 Ω Cu
Input Voltage	30 VDC maximum
Input Current for RTD Source Function	
10, 100, 120 Ù RTDs	8 mA DC
200, 500, 1000 Ù RTDs	1 mA DC addresses pulsed transmitters and PLCs with pulses as short as 1 ms
Temperature Coefficient	0.02 °C/°C; -10 °C to 18 °C, and 28°C to 50 °C
Read Type/Range/Accuracy (1 year; 2 year)	
Cu10	
-100 to 0 °C	±2.0 °C; ±2.0 °C
0 to +260 °C	±2.0 °C; ±2.0 °C
Pt100 (3916)	
-200 to -190 °C	±0.3 °C; ±0.4 °C
-190 to 0 °C	±0.3 °C; ±0.4 °C
0 to +630 °C	±0.5 °C; ±0.8 °C
Pt100 (3926)	
-200 to 0 °C	±0.3 °C; ±0.4 °C
0 to +630 °C	±0.5 °C; ±0.8 °C
Pt100 (385)	
-200 to 0 °C	±0.3 °C; ±0.5 °C
0 to +400 °C	±0.5 °C; ±0.8 °C
+400 to +800 °C	±0.8 °C; ±1.0 °C
Pt200 (385)	
-200 to 0 °C	±0.3 °C; ±0.5 °C
0 to +400 °C	±0.5 °C; ±0.8 °C
+400 to +630 °C	±0.8 °C; ±1.0 °C
Pt500 (385)	
-200 to 0 °C	±0.3 °C; ±0.5 °C
0 to +400 °C	±0.5 °C; ±0.8 °C
+400 to +630 °C	±0.8 °C; ±1.0 °C
Pt1000 (385)	
-200 to 0 °C	±0.3 °C; ±0.5 °C
0 to +400 °C	±0.5 °C; ±0.8 °C
+400 to +630 °C	±0.8 °C; ±1.0 °C
Ni120 (672)	
-80 to +260 °C	±0.3 °C; ±0.4 °C
Source Type/Range/Accuracy (1 year; 2 year)	
Cu10	
-100 to 0 °C	±1.0 °C; ±1.0 °C
0 to +260 °C	±1.0 °C; ±1.0 °C
Pt100 (3916)	
-200 to -190 °C	±0.3 °C; ±0.4 °C
-190 to 0 °C	±0.1 °C; ±0.2 °C
0 to +630 °C	±0.2 °C; ±0.4 °C
Pt100 (3926)	
-200 to 0 °C	±0.1 °C; ±0.2 °C
0 to +630 °C	±0.2 °C; ±0.4 °C
Pt100 (385)	
-200 to 0 °C	±0.1 °C; ±0.2 °C
0 to +400 °C	±0.2 °C; ±0.4 °C
+400 to +800 °C	±0.4 °C; ±0.5 °C
Pt200 (385)	
-200 to 0 °C	±0.1 °C; ±0.2 °C
0 to +400 °C	±0.2 °C; ±0.4 °C
+400 to +630 °C	±0.4 °C; ±0.5 °C
Pt500 (385)	
-200 to 0 °C	±0.1 °C; ±0.2 °C
0 to +400 °C	±0.2 °C; ±0.4 °C
+400 to +630 °C	±0.4 °C; ±0.5 °C
Pt1000 (385)	
-200 to 0 °C	±0.1 °C; ±0.2 °C
0 to +400 °C	±0.2 °C; ±0.4 °C
+400 to +630 °C	±0.4 °C; ±0.5 °C
Ni120 (672)	
-80 to +260 °C	±0.1 °C; ±0.2 °C

Pressure Read and Source

Please refer to the Beta Pressure Module Data Sheet, 030606R0 for ranges and accuracies. Requires use of included BPPA100 Pressure Module Adapter.



General

Loop Power	
Voltage	24 V or 28 V, selectable
Maximum Current:	22 mA, short-circuit protected
Input Voltage	30 VDC maximum
Accuracy	5%

Note: A 250Ù series resistance is automatically supplied whenever looppower is enabled.

Ramp Functions	
Source Functions	Voltage, current, Ohms, frequency, temperature
Rate	4 steps/second
Trip Detect	continuity or voltage; continuity detection not availablewhen sourcing current
Data Log Function	
Measure Functions	Voltage, current, Ohms, frequency, temperature, pressure
Reading Rate	1, 2, 5, 10, 20, 30, or 60 readings/minute
Maximum Record Length	8,000 readings 7,980 for 30 or 60 readings/minute
Environmental	
Operating Temperature	-20 °C to +50 °C
	-10 °C to +50 °C for in spec frequency and AC read
Storage Temperature	-20 °C to +60 °C
Altitude	9,186 ft (2800 m) above mean sea level
Stability (90 day)	Typical 90-day measurement/read and source/simulate accuracy can be estimated by dividing the one year "% of reading" or "% of output" specifications by 2. Floor specifications, expressed as "% of FS" or "counts" or "Ohms" remain constant
Power Requirements	7.2 VDC
Battery	NiMH rechargeable, 3500 mAH; included
Battery Life	>8 hours, typical usage
Physical	
Dimensions	9.3"H x 5.1"W x 2.4"D (236 x 130 x 61 mm)
Weight	3 lbs, 1 oz. (1.4 kg)
Connectors/Ports	Pressure module connector
	RS232 serial
	External power in
Included Accessories	Test lead set (4 leads, test clips, test probes)
	NimMH battery pack
	Battery pack charger
	Deluxe carrying case
	BPPA100 Pressure Module Adapter
	Serial port cable
	HART communications cable
	NIST-traceable calibration certificate, with data
	Multi-lingual instruction manual on CD
	Warranty registration card
Optional Accessories	Barcode wand

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