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# METROLOGY PROCESSOR MP-2, MP-4, MP-8

Version 3.0 (O3)

## OPERATION INSTRUCTIONS



# Brunswick Instrument

Sharing your commitment to quality

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## INTRODUCTION

The Brunswick "Metrology Processor" is a self contained, bench-top display and processing device specifically designed for direct interface with Solartron Metrology brand Digital Probes, Linear Encoders and other Solartron "ORBIT" compatible transducer modules. Up to four Orbit modules may be directly connected to the Model MP-4 without the need for additional power supply, data converter or T-connectors. The Metrology Processor bi-directionally communicates directly with the Orbit modules using its own RS-485 network interface and compatible protocol.

The unit is intended to provide a simple but powerful, flexible and less costly alternative to personal computer and custom software based systems where applications require eight probe inputs or less.

### "PROBES" AND "FEATURES"

Understanding the terminology of "Probes" and "Features" is key to understanding the way in which the Metrology Processor operates.

#### PROBES:

A "probe" is any one of multiple connected input modules. During initial setup the probes are each assigned a unique number identifier, #1 up to #8. The reading from any individual probe can be thought of as a variable piece of data that is assigned by the user, either by itself or in combination with other probe readings, to a "Feature" setup.

#### FEATURES:

"Features" are the user-defined setups that produce and display measurement results and perform decision-making based on tolerance limits. The term "Feature" is appropriate because, most often, each feature setup corresponds to a single dimensional feature of the part or product being measured. The Metrology Processor supports and stores multiple feature setups that are easily selected by the user at will.

Each programmed feature is provided its own unique setup parameters for:

- 1) Preset (or zero) value.
- 2) Upper and lower tolerance limits.
- 3) Measurement resolution setting.
- 4) Peak Hold mode – MAX, MIN, or TIR (MAX-MIN)
- 5) Display mode – either digital or analog (numeric or bar graph meter style).
- 6) Feature formula.

The feature "formula" is used to define:

- 1) Which probe or probes are used to produce the particular feature result.
- 2) If and how the readings from more than one probe are mathematically combined.
- 3) If and how further mathematic manipulations of the probe values are performed.

The feature formulas and other setup parameters can be entered by the user directly from the unit's front panel keypad or be created and edited as simple text files on an external PC. These files may be downloaded and uploaded to and from the unit over a serial port connection using a typical data communication program like "HyperTerminal". All setup parameters are retained in non-volatile memory.

Besides addition, subtraction, multiplication and division, formula entry supports trigonometry functions for conversions between linear and angular results, square root, absolute value, exponents and multiple levels of parenthesis.

Other special formula functions are supported that specify the highest or lowest probe or feature value from within a specified group of probe or feature values, allowing simplified flatness, straightness and alignment inspection setups.

**“INDIVIDUAL” AND “MULTI” VIEW MODES:**

The Metrology Processor can operate and display feature results in two distinctly different ways depending on the application requirements.

**INDIVIDUAL VIEW MODE** is used when gaging setups are used to inspect individual part features, one at a time. In individual view mode applications the user is looking for a single result that can be compared to a single set of tolerance limits for accept / reject decision making. Simple examples are a height or thickness measurement using a probe (or probes) mounted in a comparator stand, a bore diameter measurement using a probe mounted in a hand-held bore gage fixture or a single flatness measurement derived from the readings of multiple probes simultaneously in contact with some planar surface.



The individual view mode display can be either a digital numeric value or an analog meter style representation of the result. Accept / reject conditions are prominently displayed as either “HIGH” or “LOW” and relay contact outputs (optional) actuated accordingly.

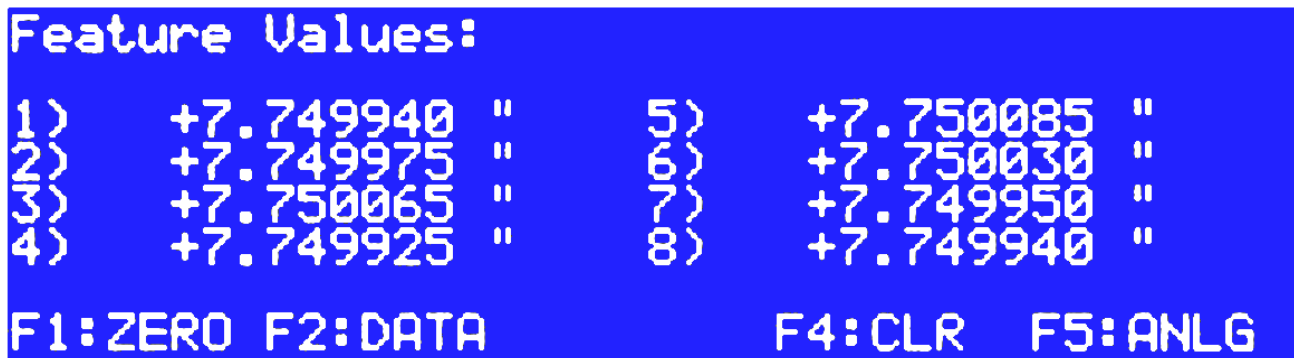


Multiple, individual features may be defined and switched between by the user, either manually by keypad selection or automatically with the “Auto-Swap” function. The Auto-Swap function monitors probe movement activity for all the connected probes and can automatically switch the display to the feature setup that corresponds to the actively moving probe. A practical example of an Auto-Swap application would be a setup where multiple bores of different sizes

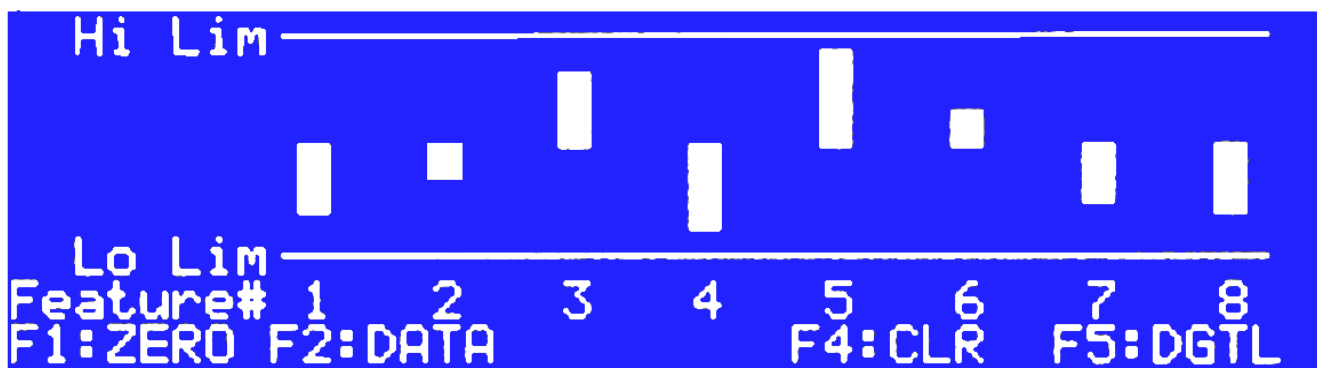
are being inspected with several different hand-held bore gage fixtures, each containing an individual probe. As each bore gage is picked up and inserted into the appropriate hole, Auto-Swap senses the activity and instantly switches the display to the corresponding feature. As another gage is used, a different corresponding feature is selected automatically.

During individual view mode operation, user inputs like Preset (or zeroing) and data output actuation are performed only for the currently displayed feature.

**MULTI VIEW MODE** is used when gaging setups are used to inspect multiple part features simultaneously. In multi view mode applications the user is generating multiple measurements that are compared to multiple sets of tolerance limits for a single accept / reject decision.



The multi view display can be either a list of the various digital numeric feature values or a multiple bar graph display that emulates a multiple column-gage setup. Often the operator is not concerned with the actual values of the measurements but only with an accept / reject decision. In the bar graph mode, the upper and lower tolerance limits for all features are proportionally unified and positioned at the top and bottom of the display. The operator can quickly visually scan the display to see that all feature results are within limits or to determine which feature values exceed them. If any of the feature values exceed their tolerance limits the reject condition is prominently displayed and relay contacts (optional) actuated accordingly.



During multi view mode operation user inputs like Preset (or zeroing) and data output actuation are performed for all displayed features simultaneously.

## INITIAL SETUP AND OPERATION

### Connecting the probes:

Two or four probe slots are present on the rear of the unit depending on the model purchased. Each probe has an electronic module or “pod” on the end of its electrical cord. **With the unit power switched OFF**, the pod end is inserted in any available probe slot on the unit. The mating connectors of the pod and slot will only align when the pod is positioned so that the cable exiting the pod is nearer to the top of the rear panel, rather than nearer the bottom. The pod is pressed firmly into the mating connector in the slot. It does not matter which probe is connected to which slot. The probes are individually identified by the unit and each is assigned a probe number from 1 to 8 regardless of which slot they are connected to. The unit power may be switched on when all the probes are connected.



### Addressing the probes:

If your unit has been supplied by Brunswick Instrument along with gage probes, it will likely have been pre-programmed to recognize the particular probes. “Addressing” of the probes will not be necessary. When the power to the unit is switched on and following a brief identification display, the unit will begin displaying measurement results for Feature #1.

If the unit and probes have been supplied from separate sources, the probes will need to be “addressed”. When the power to the unit is switched on and following a brief display identifying the unit model and software version, the unit will display a message instructing the user to “MOVE PROBE #1 or press any key for setup mode”. Displacing the probe tip from its current position instructs the probe to identify itself to the unit. Once the probe tip is moved, the unit assigns a probe number to the particular probe. Probe numbers are assigned in sequence from 1 to 8. As each probe tip is moved in sequence, the unit asks for the next probe tip to be moved. When the last probe has been addressed, pressing any key will terminate the addressing sequence and the unit will begin displaying measurement results. It is important to know which probe has been assigned which number for all further operation of the system.

### **Probe Readings and Over-Range Conditions:**

The default for digital probe readings (before any “zeroing” has been performed by the unit) is for the probe to read “zero” in the center of its travel, with increasingly positive readings as the probe plunger is moved inward and increasingly negative readings as the plunger moves outward. Regardless of the digital probe’s overall stroke range, zero will be at the center of the travel. The probe zeroing functions, feature Preset settings and feature formulas in the Metrology Processor will alter this default. Linear encoder type probes simply read zero at their position when power was applied.

Whenever a digital probe position exceeds either its minimum or maximum measurement range limits, the display will indicate the over-range condition with a dashed line instead of a measurement value. When the probe position is within its measuring range limits the measurement value will be displayed normally. Linear encoder type probes do not produce an over-range condition and the range of readings is simply limited by mechanical stops. Linear encoders will however produce encoder “over-speed” errors if displaced too quickly.

### **Default Settings:**

The unit has many user programmable settings that are retained in non-volatile memory. Initially, these are set to factory defaults. The default settings are:

#### **Global Settings Defaults:**

Individual view mode  
Inch mode  
Auto-Swap OFF  
No probe or feature groups are defined  
Display mode normal (White characters on blue background)  
Switch input #1 triggers zero (or preset) function  
Switch input #2 triggers data output function  
Relay (if installed) option is 1  
RS232 option is 1  
No password set for setup mode

#### **Feature Settings Defaults (Features 1-8):**

Features 1 – 8 are enabled (turned on)  
Formula – Feature #1 is set to process Probe #1, Feature #2-Probe #2, etc.  
Preset, 0  
Resolution, .000005” (five millionths of an inch)  
High Limit, +.001”  
Low Limit, -.001”  
Hold mode, OFF  
Display mode, Digital

### **Front Panel Display and Controls:**

The front panel contains a numeric keypad to the right and a display with five “soft keys” below it, to the left.

The keypad is used for entry to the unit “SETUP” menus, making menu selections, entry of various setup parameters like tolerance limits, preset values, feature formulas, etc. and selection of the desired feature number for viewing of measurement results.

The five “soft keys”, F1 through F5, below the display have variable functions depending on what screen is currently being viewed. The soft key functions are always labeled by name, just above each key, on the bottom line of the display. If a particular soft key has no label displayed above it, the key is currently disabled.

### **Feature # Selection:**

When the unit power is turned on the default feature display selection is Feature #1. Other features may be selected by pressing the keypad keys 1 through 8.

### **“Individual” View Mode Controls**

While operating in “Individual” view mode the five soft keys F1-F5 are assigned the following functions:

#### **F1: Zero (or Preset)**

This key is used to “zero” the measurement value or “preset” the measurement value. If the Preset value for the particular feature is set to zero, the key is labeled “zero” and the display will be “zeroed” when the key is pressed. If the Preset value for the particular feature is set to any value other than “zero” the key will be labeled “Preset” and the displayed measurement will be set to this value when the key is pressed. Zeroing or Presetting is not allowed when the currently displayed feature is displaying a probe over-range condition.

A typical application of a Preset value is when you want the measurement displayed as an “actual” dimension like 3.5000 even though the probe may have only a short measurement stroke. The Preset value is set to 3.5 and the probe(s) positioned in contact with a setting master or part known to be 3.5000 in dimension. When the Preset key is pressed the display will be set to read 3.5000 and as the probe is displaced from that position the reading will become incrementally larger or smaller than the preset value.

#### **F2: Data (or Data ON / Data OFF)**

This key is used to trigger (or start) a transmission of the displayed measurement out the RS232 data communications port. The data may be sent to an external device like a personal computer or SPC data collector. Several options for the transmitted data format are selectable by the user and are discussed in the “Utilities” section of this manual

#### **F3: Hold**

This key is used to select three different modes of measurement “peak hold” for the current feature. The current hold mode setting is indicated on the display following the displayed “Feature #”. The label “MAX”, “MIN”, or “TIR” will appear as the F3 key is repeatedly pressed. When none of the above labels appear, the HOLD mode is off. All the connected probes continuously record the maximum and minimum values that they encounter. When set to MAX, the maximum value for the current feature is displayed. When set to MIN, the minimum value for the current feature is displayed. When set to TIR (Total Indicator Reading), the difference between the maximum and minimum readings (MAX-MIN) is displayed.

It is important to understand that when a feature result is calculated from the readings of more than one probe, ALL the probes assigned to the feature will operate in whichever HOLD mode is selected for the feature. Example: If the feature formula is defined as “P1+P2” and the HOLD mode for the feature is set to MAX, the actual mathematic operation performed is MAX



of Probe #1 PLUS MAX of Probe #2. In most cases the peak HOLD modes are intended to be applied to features that are derived from the readings of a single probe.

#### **F4: Clear**

This key is used to clear the previously held maximum and minimum peak readings. The CLEAR function operates on ALL the connected probes simultaneously and regardless of whether any HOLD modes are active for any feature. At the moment the key is pressed, the maximum and minimum peak memory for all probes is set to the current probe position and the TIR value (MAX-MIN) for each probe will become zero.

#### **F5: Step**

This key is used to step the display to the next ENABLED feature number. (Any feature may be enabled or disabled by the user as discussed in the Feature Editing section of this manual.) As an alternative to manually selecting the desired feature by number using the keypad, the STEP function selects the next feature in a sequence. After the last enabled feature in the sequence is displayed, the STEP key will again select the first in the sequence. Disabling unused or unwanted features will make the STEP function skip past them effectively removing them from the step sequence.

Either of the SW1 or SW2 external switch closure inputs on the rear of the unit can be assigned to control any of the F1-F5 soft key functions by footswitch or other remote control.

#### **“Multi” View Mode Controls**

While operating in “Multi” view mode the five soft keys F1-F5 are assigned the following functions:

#### **F1: Zero (or Preset)**

This key is used to “zero” or “preset” the measurement value for all displayed features simultaneously. The key is always labeled “zero” and the value for each feature will be set to its particular Preset value when the key is pressed. Zeroing is not performed on any displayed feature currently registering a probe over-range condition.

#### **F2: Data (or Data ON / Data OFF)**

This key is used to trigger (or start) a transmission of the ALL the displayed feature measurements out the RS232 data communications port. The data may be sent to an external device like a personal computer or SPC data collector. Several options for the transmitted data format are selectable by the user and are discussed in the “Utilities” section of this manual. .

#### **F3: Inactive**

#### **F4: Clear**

This key is used to clear the previously held maximum and minimum peak readings. The CLEAR function operates on ALL the connected probes simultaneously and regardless of whether any HOLD modes are active for any feature. At the moment the key is pressed, the maximum and minimum peak memory for all probes is set to the current probe position and the TIR value (MAX-MIN) for each probe will become zero.

## **F5: Digital / Analog / Mult**

This key is used to toggle the display mode between a list of numeric readings (Digital) for all the displayed features or a bar-graph type display (Analog) for all the displayed features. At anytime during multi view operation the user may select a feature by number (1-8) using the keypad to temporarily view the feature in an individual mode format. In this case the F5 key will become labeled "MULT" to indicate that the key will return the display to the "multi" view mode when pressed.

Either of the SW1 or SW2 external switch closure inputs on the rear of the unit can be assigned to control any of the F1-F5 soft key functions by footswitch or other remote control.

## **SETUP MENUS:**

The "SETUP" key on the keypad presents the menu of unit setup selections. The initial setup menu offers seven choices, which are selected by pressing the corresponding keypad number key (1-7).

### **1) Feature**

All the individual feature setup parameters are viewed, entered or edited using this menu function. When selected, a feature setup summary is displayed for a particular feature number (usually the last currently selected feature number, or feature #1, the default). Any feature number may be specified by pressing the corresponding key on the numeric keypad (1-8). The feature setup summary presents all the current settings for the feature: Enabled or Disabled status (on or off), Feature Formula, Resolution, Preset Value, High and Low Tolerance Limits, Hold Mode (MAX, MIN, TIR or OFF) and Display Mode (Digital or Analog). If the feature is currently OFF (disabled) the summary will not be displayed until the feature is turned ON (enabled) with the F2 key. The soft keys F1-F5 are assigned the following functions:

### **F1: Edit**

This key allows any of the feature setup parameters to be entered or edited. When selected, a further menu of six selections is presented.

### **1) Formula**

This selection allows the entry or editing of the feature formula. The second and third lines of the Feature Formula entry screen display the formula being entered or edited. The formula may contain up to 76 individual characters. The minimum and simplest formula required for any feature is the character "P" (for probe) followed by a numeral 1 through 8. This specifies which probe will supply a reading for the feature result. Formulas are entered by using the F1 and F2 keys to move a cursor left or right along a displayed list of "operator" functions. When the desired operator is highlighted with the cursor it is entered into the formula using the F3: Select key. The F4: Bksp key is used to backspace (and erase) unwanted characters from the end of the formula. The F5:Exit key exits the formula entry screen WITHOUT saving any changes to the formula. To save changes, the ENTER key at the bottom of the numeric keypad is used.

## Formula Operators:

The list of formula operators offers:

**“A” – Absolute value.** The ABS function will transform the following value, variable or expression into a positive value regardless of its negative or positive status. When selected, the ABS function is entered into the formula with a “left parenthesis” automatically following. You are required to add the “right parenthesis” following whatever value, variable or expression is specified after the ABS operator. Example: ABS(P1) would produce readings from probe #1 that are always positive regardless of the actual polarity of the probe reading.

**“Q” – Square Root.** The SQR function will transform the following value, variable or expression into its calculated square root. When selected, the SQR function is entered into the formula with a “left parenthesis” automatically following. You are required to add the “right parenthesis” following whatever value, variable or expression is specified after the SQR operator. Example: SQR(P1) would transform the reading of probe #1 to its square root.

**“^” – Exponentiation.** The ^ function will perform exponentiation of the value, variable or expression immediately preceding the ^ character by the value of the numeral immediately following. Parenthesis may be required around the entire value and exponentiation to clarify the mathematics. Example: (P1^2) would raise the value of probe #1 to the second power (multiply probe#1 reading times itself or “square” it).

**“N” – Group Minimum.** The “N” character is immediately followed by a numeral 1-8. Group definition is described further elsewhere. Example: N2 would instruct the unit to use the minimum value found within Group 2 as the feature value.

**“X” – Group Maximum.** The “X” character is immediately followed by a numeral 1-8. Group definition is described further elsewhere. Example: X3 would instruct the unit to use the maximum value found within Group 3 as the feature value. The difference between the maximum and minimum values within group #2 would be written as X2-N2.

**“F” – Previous Feature Value.** Only operates for “Multi” view applications. The feature result from a lower numbered feature may be specified as a variable in another, higher numbered feature formula. Example: the feature formula for Feature #2 may contain F1 which specifies the result of Feature 1 as a variable.

**“P” – Probe reading.** The “P” character is immediately followed by a numeral 1-8. This specifies the probe reading to use for the feature. Example: P3 specifies the reading from probe #3.

**“+” – Addition.** The “+” character operates to add two values, variables or expressions together. Example: P1+P2 sums the value of probes #1 and #2.

**“-“ – Subtraction or negation.** The “-“ character operates to subtract one value, variable or expression from another. Example: P1-P2 subtracts the value of probe #2 from the value of probe #1. The “-“ character may also be used to “negate” (invert polarity of) the following value, variable or expression. Example: -P1 reverses the polarity of the readings from probe #1 and is the means for reversing the direction of readings for a given direction of probe travel.

**“\*” – Multiplication.** The “\*” character operates to multiply one value, variable or expression by another. Example:  $P1*5$  multiplies the value of the probe #1 reading times the constant 5. Simple calibration corrections can be easily programmed with the multiplication operator and numeric constants like  $P2*.9999532$  or  $P3*1.000347$ .

**“/” – Division.** The “/” character operates to divide one value, variable or expression by another. Example:  $P1/2$  divides the value of probe reading #1 by the constant 2.

**)” and “(“ – Right and Left Parenthesis.** As feature formulas become longer and more complex, parenthesis are necessary to define the order of calculations within the formula. Example #1:  $(P1+P2+P3)/3$  sums the values of probe readings #1, #2 and #3 first and then divides the result by the constant 3, effectively calculating an average of the three readings. Example #2:  $SQR(P1^2+P2^2)$  calculates the square root of the sum of the squares of probe readings #1 and #2. The formula could also be written with additional parenthesis as  $(SQR((P1^2)+(P2^2)))$  for added clarity.

**“S” – Sine.** The SIN function is a trigonometric function that calculates the SINE of a following angular value, variable or expression stated in degrees. When selected, the SIN function is entered into the formula with a “left parenthesis” automatically following. You are required to add the “right parenthesis” following whatever value, variable or expression is specified after the SIN operator. Example:  $P1*SIN(45)$  would multiply probe reading #1 times the sine of the constant 45 degrees.

**“C” – Cosine.** The COS function is a trigonometric function that calculates the COSINE of a following angular value, variable or expression stated in degrees. When selected, the COS function is entered into the formula with a “left parenthesis” automatically following. You are required to add the “right parenthesis” following whatever value, variable or expression is specified after the COS operator. Example:  $P1*COS(60)$  would multiply probe reading #1 times the cosine of the constant 60 degrees.

**“T” – Tangent.** The TAN function is a trigonometric function that calculates the TANGENT of a following angular value, variable or expression stated in degrees. When selected, the TAN function is entered into the formula with a “left parenthesis” automatically following. You are required to add the “right parenthesis” following whatever value, variable or expression is specified after the TAN operator. Example:  $P1*TAN(30)$  would multiply probe reading #1 times the tangent of the constant 30 degrees.

**“s” (lower case) – ArcSine.** The ASN function is a trigonometric function that calculates the angle in degrees from the following value, variable or expression stated as a SINE value. When selected, the ASN function is entered into the formula with a “left parenthesis” automatically following. You are required to add the “right parenthesis” following whatever value, variable or expression is specified after the ASN operator. Example:  $ASN(P1)$   
Assuming the probe #1 reading is a linear measure of a sine value, the formula would convert the probe reading #1 to a measure of degrees.

**“c” (lower case) – ArcCosine.** The ACN function is a trigonometric function that calculates the angle in degrees from the following value, variable or expression stated as a COSINE value. When selected, the ACN function is entered into the formula with a “left parenthesis” automatically following. You are required to add the “right parenthesis” following whatever

value, variable or expression is specified after the ACN operator. Example: ACN(P1)  
Assuming the probe #1 reading is a linear measure of a cosine value, the formula would convert the probe reading #1 to a measure of degrees.

**“t” (lower case) – ArcTangent.** The ATN function is a trigonometric function that calculates the angle in degrees from the following value, variable or expression stated as a TANGENT value. When selected, the ATN function is entered into the formula with a “left parenthesis” automatically following. You are required to add the “right parenthesis” following whatever value, variable or expression is specified after the ATN operator. Example: ATN(P1)  
Assuming the probe #1 reading is a linear measure of a tangent value, the formula would convert the probe reading #1 to a measure of degrees.

### **Formula Errors:**

Formula errors can be produced under a variety of circumstances. Common formula errors are misplaced or missing parenthesis (there has to be as many left hand parenthesis in a formula as there are right hand), division by zero, attempts to calculate infinite values (like the Tangent of 90 degrees) or attempts to calculate ArcSine or ArcCosine of a value greater than 1. Under these circumstances the unit will simply return a zero value as the formula result if an error has been produced. The displayed reading may or may not be zero depending on the Preset or Zero setting for the particular feature. If after entering a formula, the display seems to be locked (always displaying the same result when the probe is moved), the likely cause is an erroneous formula definition.

### **2) Preset**

This selection allows the entry or editing of the feature preset (or zero) value. A screen is displayed showing the current Preset value for the particular feature. A new value may be entered using the numeral keys (0-9), the decimal point and the polarity (+/-) keys on the numeric keypad. The CLEAR key will clear the currently displayed value to zero. The ENTER key is used when the value has been entered and is to be saved. The F5:Exit key will exit the Preset entry screen WITHOUT saving any changes.

### **3) Resolution**

This selection allows setting of the feature measurement resolution. A screen is displayed showing the first nine available measurement resolution selections. The F1:Next key will present another nine available resolution settings. At this second screen, the F1 key is labeled “Back” and will return to the first set of selections. The selections offered are either in inch increments or millimeter increments depending on the inch / millimeter setting of the unit. The selections are numbered in the menu and selected with the corresponding numeral keys (1-9) on the keypad.

It is important to recognize that the resolution selection is applied to the “Feature” result and not the probe or probes used to generate the feature result. The probe readings themselves are always made with the maximum measurement resolution of which the probe is capable. The feature formula and preset value may transform the reading from a probe or probes into a completely different sort of measurement. For example, probe readings over a short measurement range of +/- .010” may be mathematically manipulated into angular readings ranging from maybe 0 to 180 degrees. Although the probes may be taking readings in inches, with 6 decimal place accuracy, the calculated angular result may only be usable with maybe 1 or even no decimal places displayed. A total of eighteen different resolution settings are

offered for both the inch and metric display modes to accommodate a wide variety of situations.

#### **4) Tolerance Limits**

This selection allows entry or editing of the low and high tolerance limits for the feature. A screen is displayed first showing the current Low Limit. A new value may be entered using the numeral keys (0-9), the decimal point and the polarity (+/-) keys on the numeric keypad. The CLEAR key will clear the currently displayed value to zero. The ENTER key is used when the value has been entered and is to be saved. Once the Low Limit is entered, the High Limit is entered or edited in the same manner.

The tolerance limits operate in relation to the feature Preset value. If the feature Preset value is set to zero the tolerance limits would be entered as “comparative” (plus and minus) limits. Example: Low Limit =  $-.001$ , High Limit =  $+.001$ . If the Preset is some actual dimension (like 3.5000) and the tolerance is  $\pm .001$ , then the limits would be entered as actual dimensions. Example: Low Limit = 3.499, High Limit = 3.501.

Both limits can be positive, or both negative. The high limit entered must be of greater (more positive) value than the low limit or an error message will be displayed.

The F5:Exit key will exit the Limits entry screen WITHOUT saving any changes.

#### **5) Hold**

This selection is used to set the default peak Hold mode for the feature. A screen is displayed showing the four HOLD setting options (MAX, MIN, TIR or OFF). The selections are numbered in the menu and selected with the corresponding numeral keys (1-4) on the keypad. This only sets the hold mode that will automatically be in effect for the feature when the unit is powered up. During “Individual” view operation, the hold mode for any particular feature may still be stepped through the four hold settings at will with the F3: Hold key.

#### **6) Display Mode**

This selection allows the user to choose either of two “Individual” view display modes for the feature. A screen is displayed offering the choice of a purely Digital (numeric) or Analog (meter style) display format. The choice depends on the application and user preference. Typically, digital display format is preferred for measurements that are static in nature. The analog format is typically preferred when the measurement is moving as a part feature is scanned in different positions.

The increment size and span range of the analog meter display is variable and based on the current resolution setting for the feature. The meter span range is always  $\pm 50$  resolution increments. Example: In inches mode, with a resolution setting of  $.000005$ ” (five millionths of an inch) the meter span is  $\pm .00025$ ”, in millimeter mode, with a resolution setting of  $.001$ mm (one micron) the meter span is  $\pm .05$ mm.

The meter is always displayed with “zero” at the center, positive values to the right and negative values to the left. The value of “zero” on the meter will always be equal to the feature Preset value. The upper and lower tolerance limits for the feature will be visible on the analog meter as limit marks above the meter scale. For the limit marks to be visible, a feature resolution setting must be chosen so that the limits are within the span range of the analog

meter. The digital value for the measurement is still displayed under the analog meter, but in a smaller format than that displayed in Digital mode,

### **F2: OFF/ON (Enabling / Disabling a feature)**

At the feature setup summary screen, this function will toggle between enabling or disabling (turning on or off) the particular feature. During “Individual” view operation, disabling unused or unwanted features will make the STEP function skip past them effectively removing them from the step sequence. During “Multi” view operation, disabling unused or unwanted features will make the display update faster.

### **F4: Copy (Copying a feature)**

This function offers a fast way to create multiple feature setups that are similar. Often, a multiple feature setup will have many features that share similar settings. For instance, if all features have the same +/- .005 tolerance limits, .0002 resolution setting and Analog display mode, the COPY feature can be used to quickly create these similar feature setups. First, edit one feature to have the basic parameter settings you want. Then, while viewing the feature setup summary screen for that feature, press the F4: COPY key. The display will request you to “Enter feature # to Overwrite”. Enter the number of the feature to receive the copied information by pressing the corresponding numeral key (1-8) on the keypad. Repeat this for other feature numbers that should receive the same similar setup. Once complete, the individual features may be further edited with only the changes unique to the individual features, like the formula definitions.

### **F5: Exit**

The F5: Exit key will back out from the feature setup summary screen and return to the main Setup menu.

## **2) Individual / Multi View Mode Selection**

This menu selection immediately toggles the unit between “Individual” and “Multi” view mode operation.

## **3) Inch / Millimeter Mode Selection**

This menu selection immediately toggles the unit between “Inches” and “Millimeters” mode operation. As the switch is made, all setup parameters (presets, resolutions, limits, etc.) are converted from one unit system to the other.

**WARNING:** Formulas and their contents ARE NOT converted. Formulas may be created that contain constant values or other expressions that only make sense in one unit system and not the other.

## **4) Probe and Feature Groups**

Multiple groups of probe or feature values may be defined for the purpose of determining which readings from within a group are the highest or lowest. This simplifies inspection setups for many flatness, straightness and alignment applications. When this menu function is selected, a screen is displayed showing four different “probe groups” (#1-4) and four different “feature groups” (#5-8). “Feature Groups” only operate for “Multi” view applications. Selection of the group to be edited is made with the corresponding numeral keys (1-8) on the keypad. A screen is displayed first showing the current group code. A new value may be entered using the numeral keys (0-8) keys on the numeric keypad. The CLEAR key will clear the currently

displayed code to zero. The ENTER key is used when the code has been entered and is to be saved. The F5:Exit key will exit the group entry screen WITHOUT saving changes.

A group is defined by entering a code string of numerals that correspond to the individual probe or feature numbers to be included in the group. Example: If probes #3, #4 and #7 are to comprise a group, the numeric code to be entered would be "347". Once a group (or groups) has been defined, the formula operators "N" (Group Minimum) and "X" (Group Maximum) can be used in feature formulas to work with these minimum or maximum values. Any group is rendered inactive and ignored when the group code is set to zero only. A feature group can only contain feature numbers lower than the feature number that uses the group. For example, if the formula for Feature #4 specifies "N6" (minimum of group #6), then the group code for group #6 can only contain the feature numbers 1, 2 and 3.

In some applications like flatness measurement, it may not be enough to simply calculate the difference between maximum and minimum probe readings for the result. One typical flatness measurement situation has multiple probes mounted in a fixture. The fixture itself has some fixed contacts that rest on the planar surface to be measured and establish a reference plane. The multiple probes then also contact this surface. The probes are all zeroed when this fixture is in contact with some known-flat master surface. When put in contact with a sample surface to be measured, if the highest probe in the group reads +.002 and the lowest probe in the group reads -.004, the flatness can be called the difference between them, or .006. However, if the highest probe reads +.005 and the lowest probe reads +.003, the difference would be only .002. Remembering that we have fixed reference points on the fixture at the "zero" plane, .002 would be an incorrect result for the flatness. In this situation, the value "zero" must always also be considered as an additional probe reading. Then, the highest reading would be +.005 and the lowest reading would be zero, for a difference of .005 and a correct flatness result.

To accomplish this, the value "zero" can be defined within a group like it is an additional reading that always reads zero. The value "zero" can be included in any group by the addition of the numeral zero at the end of the group code. Using the group code programming example above ("347"), to include zero, it would be entered "3470". Many group MAX / MIN applications do not require the inclusion of "zero" as a probe value.

## **5) Auto-Swap ON/OFF**

This menu selection immediately toggles the setting of the "Auto-Swap" function between ON and OFF. The Auto-Swap function monitors probe movement activity for all the connected probes and can automatically switch the display to the feature setup that corresponds to the actively moving probe. Auto-Swap only functions when the unit is operating in the "Individual" view mode. Auto-Swap will not respond to probe movement for any probe that is assigned to more than one enabled feature.

## **6) Probes (Adding new probes, re-addressing probes)**

This menu selection provides the means to add new probes to the system or re-address the connected probes as the system setup requires change. To add a new probe (or probes) to the existing setup, power down the unit first before connecting the new probe(s). Then, re-power the unit, enter the setup menu and select function 6) Probes. Select option 1) Add new probe. Follow the display directions and move the probe tip position as requested. The entire



probe address setup can be erased with option 2) Re-address ALL probes. A warning message is displayed before the process of re-addressing the probes is started.

## **7) Utilities**

The utilities menu offers nine further setup functions, which are selected by pressing the corresponding keypad number key (1-9).

### **1) Display Reverse**

This immediately toggles the setting of the display mode between white-on-blue and blue-on-white. Choice is by user preference.

### **2) Display Adjust**

This displays a dummy digital reading to view and the means for adjusting both the display contrast and backlight levels up and down.

### **3) Switch Inputs**

The rear panel switch (or footswitch) inputs may be assigned to provide remote control over the five “soft key” functions while the unit is operating in either Individual or Multi view modes. For example, if you want a footswitch to operate the F1: Preset (or zero) function and another switch closure to trigger the F2: Data send function, the assignments can be made using the Switch Inputs menu selection. Similarly, the hold CLEAR and STEP functions could be controlled by remote switch closures.

### **4) Relay Outputs**

(Future expansion not yet implemented.) Offers several options for the way the relay outputs operate in relation to out-of-tolerance conditions.

### **5) RS232 Options**

Offers several options for the way the RS232 data output operates. Selection #1 “Single” offers a single burst data transmission when the F2: “DATA” key is pressed while taking measurements. Selection #2 “Stream” offers continuous data output. While measurements are being performed and the Stream mode selected, the F2 key will be labeled “DATA ON” or “DATA OFF”. Pressing the F2 key while it is labeled “DATA ON” will start the data streaming and the key will then be re-labeled “DATA OFF”. Pressing the key again will stop the data streaming and the key is again re-labeled “DATA ON”. Selection #3 (Option 3) is for future development and currently operates the same as Selection #1. More detail on the RS232 output follows in the “RS232 Details” section of this manual.

### **6) Password**

Access to the entire SETUP menu section can be denied unless a numeric password is entered. A numeric password having 1 to 9 digits can be defined. The password cannot begin with “zero”. The password can be removed by changing it to the single digit “zero”.

### **7) Set Probes**

This utility function presents a screen that displays the positions of all the currently connected probes. It is useful to view this screen while initially mounting, positioning and locking down probes in fixtures. The measuring range and current position of each probe can be tested and observed and the over-range conditions seen without being affected by Feature Formulas or Preset settings. The F1:ZERO ALL and F2:ZERO # keys can be used to “zero” the readings of

all probes or of any specified probe. These “zero” offsets are stored in memory and applied each time the unit is powered up. If any probe has been previously zeroed, the F3:UNZERO function will be available to allow all zero offsets to be removed from memory. This screen is also useful for troubleshooting probe group calculations and formula definitions that don’t seem to be working. The raw probe values being generated can be observed, providing clues as to why the probe group results or formula calculations are behaving as they are.

**8) Reset All**

This function resets all the unit and feature setting parameters to their factory defaults. This does not remove probe addresses and identities. A warning message is displayed before parameters are reset.

**9) Transfers**

This utility function provides the means to either 1) Dump Memory to, or 2) Load Memory from, text files on an external PC. All the unit and feature setup parameter programming can be transferred into or out of the unit, through the RS232 communications port, using a typical data communications program running on an external PC like HyperTerminal (supplied with Microsoft Windows software). Furthermore, the setup parameter text files may be edited on the external PC with a common text editor program like “NotePad” (also supplied with Microsoft Windows software) and then be loaded back into the unit. This allows a faster, less tedious way to create and edit complex feature formulas and a means to store or archive multiple Metrology Processor setups outside the unit.

The data transfers utilize “X-Modem” protocol, a common data transfer method. An appropriate RS-232 serial interconnect cable is required for connecting the unit to the external PC.

**RS232 Port Details:**

The Metrology Processor is equipped with a RS-232 serial data output port. Data may be transmitted electronically to other devices such as data collectors, personal computers or SPC systems.

Data Output Connector Wiring:

The 9 pin female "D-Sub" connector is organized and wired as follows:

Metrology Processor pin#, name	Connects to device pin name
2 - Transmitted Data (output)	Received Data (input)
3 - Received Data (input)	Transmitted Data (output)
5 – Ground	Ground
All other pins are not connected	

The data communications protocol is fixed as:

9600 baud, 8 data bits, 1 stop bit, no parity. No handshaking is implemented.

The character codes output are standard ASCII codes recognized by most data communications software and printers. The data output stream is always 16 characters long.

The output is formatted as follows:

+ .XXXXXX " (inch mode)

+ .XXXXmm (metric mode)

The first through twelfth characters form the reading value and are always a space, + or - polarity sign, decimal point ., or the numerals 0 through 9.

The thirteenth and fourteenth characters are always either a space followed by the inch mark " or the letters mm depending on Inch or Metric mode selection on the unit.

The fifteenth and sixteenth characters output are "Carriage Return" (decimal ASCII value 13) followed by "Line Feed" (decimal ASCII value 10).

With RS232 option #1 "Single" selected, the unit will output data each time the F2: DATA button is pressed. With RS232 option #2 "Stream" selected, and streaming turned on, the unit will output data continuously.

When operating in "Individual" view mode, only the measurement result for the currently selected feature is output. When operating in the "Multi" view mode, the 14 character measurement result for each active feature is output, one after another, with a single carriage return and line feed sequence following at the end of the transmission.

When a probe OVER RANGE condition is present for any actively displayed feature, the data output will be a series of dashes (minus signs) indicating an invalid measurement.

### **Relay connections (optional)**

If the unit has been supplied with the MP-RLY option, a six-position terminal block connector on the rear panel is supplied for the relay contact connections. Two, single-pole, double-throw, relays are provided that work in conjunction with the tolerance limit and probe over-range conditions.

When operating in "Individual" view mode, Relay #1 is actuated when the measurement exceeds the High tolerance limit, Relay #2 is actuated when the measurement exceeds the Low tolerance limit.

When operating in "Multi" view mode, Relay #1 is actuated when any active feature measurement exceeds EITHER of the feature's High or Low tolerance limits. Relay #2 is actuated when any active feature registers a probe "Over-range" condition. In this mode, Relay #2 may be useful as an indication of part "presence" or "absence" in the gage fixture.

Both relays have a common contact, a normally open contact and a normally closed contact. The contacts are rated to switch up to 5 amps. The 6 position connector is wired as follows:

Pin 1 – Relay #1 (NC)	Pin 4 – Relay #2 (NC)
Pin 2 – Relay #1 (NO)	Pin 5 – Relay #2 (NO)
Pin 3 – Relay #1 (COM)	Pin 6 – Relay #3 (COM)

### **DESIGN CONSIDERATIONS:**

The Brunswick Metrology Processor has been designed with both hardware and software flexibility in mind. Solutions to special application problems can be quickly developed through software modifications and additions as well as hardware modifications and additions.

Contact Brunswick Instrument for details.



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