Brown&Sharpe

Operating Manual For 1025 Electronic Gage Amplifier

Model No. 599-1025

WARRANTY

We warrant that within (12) months from the date of shipment, if the product manufactured by us and sold by us is in the possession of the original buyer (or lessee) from us (or from an authorized distributor), we will replace or repair, at our option, free of charge, any part or parts which upon examination we find defective in workmanship or material, provided that on our request the product or parts thereof are returned to our plant, along with satisfactory documentation that the product has been installed, used, and maintained in accordance with instructions in the Operating Manual and has not been subject to abuse.

In addition, there may be specified Occupational Safety and Health Standards Warranties which, if applicable to the product, are set out in the attached schedule and incorporated by reference and subject to the provision hereof.

We shall not be liable or responsible for any expense or liability for repairs, additions, or modifications made upon the product without our written consent.

THIS WARRANTY IS IN LIEU OF ALL OTHER EXPRESS OR IMPLIED WARRANTIES (INCLUDING WITHOUT LIMITATION ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE). IN NO EVENT SHALL WE BE LIABLE FOR ANY SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES (INCLUDING BUT NOT LIMITED TO LOST PROFITS OR OTHER DAMAGES FROM LOSS OF PRODUCTION) CAUSED BY DEFECTIVE MATERIAL, OR BY UNSATISFACTORY PERFORMANCE OF THE PRODUCT, OR BY ANY OTHER BREACH OF CONTRACT BY US.

Brown & Sharpe reserves the right to modify or change the design of products shown in this brochure without notice.

Such modifications or changes may include, but are not limited to changes in finish, materials, specifications, etc., from descriptions and illustrations of products listed herein.

The Brown & Sharpe Warranty shall apply in all cases to all products manufactured by us and sold by us.

For warranty repairs, contact:

Brown & Sharpe Manufacturing Company
Precision Measuring Instrument Division
Precision Park, North Kingstown, RI 02852
Telephone: 800-283-3600
Fax: (401) 886-2553

Contents

Overview

PACKAGE CONTENTS

This Electronic Gage Amplifier package contains the following items:

- 1 Electronic Gage Amplifier
- 1 power unit/battery charger
- 1 instruction manual

SYSTEM DESCRIPTION

GENERAL

The amplifier connects to one or two electronic gage heads and displays the gage head(s) position in inches or millimeters. The amplifier has a maximum range of ±0.1 inches, (±2 millimeters) and a minimum resolution of 0.000001 inches, (0.00002 millimeters).

Color-coded Keypad

The keypad is divided into three major groups by color:

The WHITE keys are used to set up the amplifier to measure with either one or two gage heads.

The RED keys are used to select the amplifier operating mode: INCH or MILLIMETER mode, HOLD mode, STATISTICS mode (MAX -> MIN), or LIMIT mode.

The BLUE keys manage the amplifier system. They switch power ON/OFF, clear statistics, quit HOLD mode, lock out keypad keys, and send data out the output connector.

Complete Display

The display shows a number in digital and bargraph form, and complete information about what the number represents.

Value-added Features

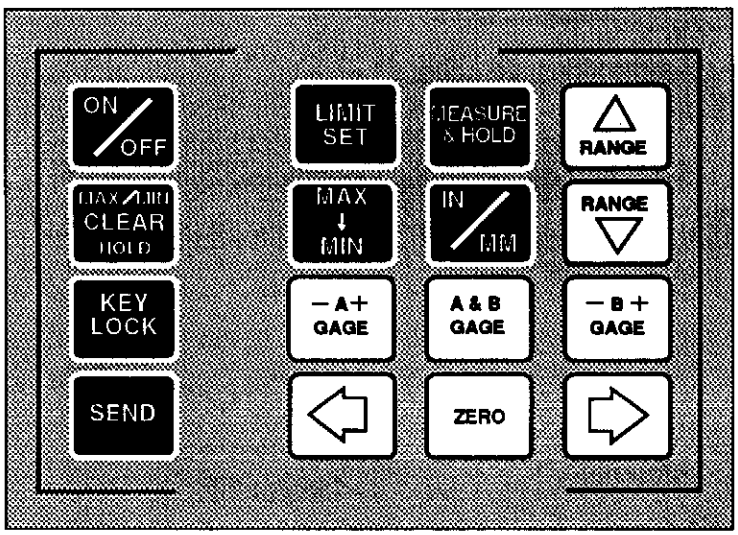
- Manual or automatic range selection.
- One keystroke zeroes all ranges.
- Display gage head position from gage head zero.
- Display limit points and gage head position.
- Set limit points from the keypad or from measurements.
- Lockable keypad.
- Send data to a digital data collector.
- Do individual or continuous measurements.
- Display the maximum, difference, average, or minimum of a group of measurements.

Overview

SUMMARY OF CONTROLS, DISPLAYS AND CONNECTORS

The following is a brief description.
For a complete description, see the "Operation" chapter of this manual.

Keypad



ON/OFF Key
Press to turn amplifier power ON or OFF. Also controls the battery charge rate. See *Battery Modes in Reference Section* for more details.

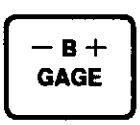
IMPARTANT: When left in storage with power off and charger disconnected, the battery will self-discharge in approximately 3 weeks. If the amplifier does not turn ON, connect the charger for a few minutes.

RANGE UP Key
Press to increase the amplifier range (decrease the magnification). and hold for 2 seconds to select the AUTOMATIC RANGE mode.

RANGE DOWN Key
Press to decrease the amplifier range (increase the magnification). Also turns off the AUTOMATIC RANGE mode.

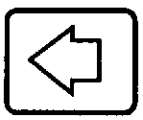
– A + GAGE Key
Press to select A GAGE. Also changes A GAGE polarity.

A & B GAGE Key
Press to select the sum of A and B GAGES.



– B + GAGE Key
Press to select B GAGE. Also changes B GAGE polarity.

Overview

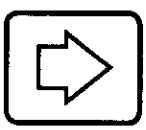


LEFT ARROW Key
Press to shift display to the left. Maximum shift = 0.010 inches, (0.25 millimeters) from gage head electrical zero.

ZERO Key
Press and release to zero all ranges. Gage head must be within ±0.010 inches (±0.25 millimeters), of gage electrical zero.

Press and hold 2 seconds to display gage head position relative to gage head electrical zero.

Press to zero a limit when in LIMIT mode.



RIGHT ARROW Key
Press to shift display to the right. Maximum shift = 0.010 inches, (0.25 millimeters) from gage head electrical zero.

LIMIT SET Key
Press to select LIMIT mode, and ENABLE, DISABLE or VIEW LIMITS.

MEASURE & HOLD Key
Press to put the amplifier in HOLD mode. Measuring process will stop, and display will hold last measurement. If already in HOLD mode, press to execute a single measurement, and hold it in the display.
To store a measurement as a limit when in LIMIT mode, press this key.

MAX –> MIN Key
Press to display Maximum, Average, Difference or Minimum.

IN/MM Key
Press to switch between inches and millimeters.

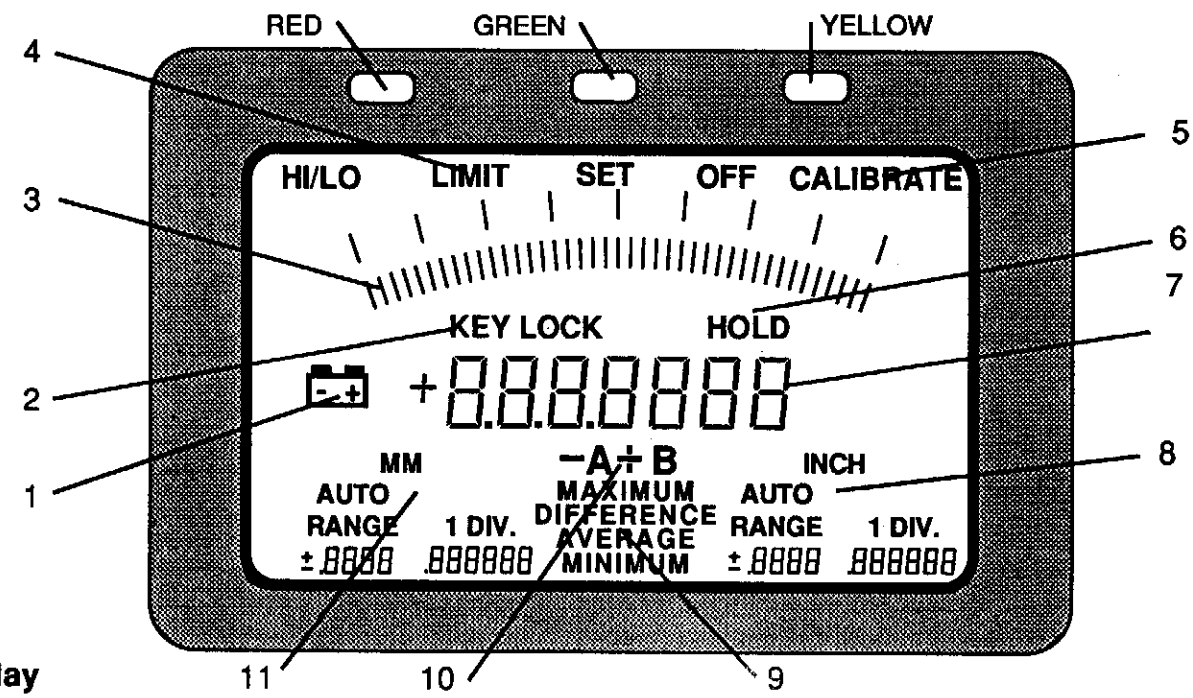
CLEAR Key
Press to clear the Maximum, Minimum, Average, and Difference. Also clears Hold.

KEY LOCK Key
Press and hold for over two seconds to lock or unlock a portion of the keypad.

SEND Key
Press to send data out the Output connector. Also clears the Maximum, Average, Difference and Minimum.

Overview

Display and Front Panel Lights



Display

1) Indicates the battery needs recharging.
2) Indicates KEY LOCK mode.
3) Bargraph (Analog) representation of digital display. See *Technical Specifications*, in the "Reference" chapter for more details.
4) Indicates LIMIT mode.
5) Indicates CALIBRATE mode. Blinks when calibration is required.
6) Indicates MEASURE & HOLD mode.
7) Digital display.
8) Indicates that the display is in inches. Also indicates the measuring range, and the value of each bargraph division.
9) Indicates whether the maximum, difference, average, or minimum is displayed.
10) Indicates which gage head(s) are selected and their polarity.
11) Indicates that the display is in millimeters. Also indicates the measuring range, and the value of each bargraph.

Front Panel Lights

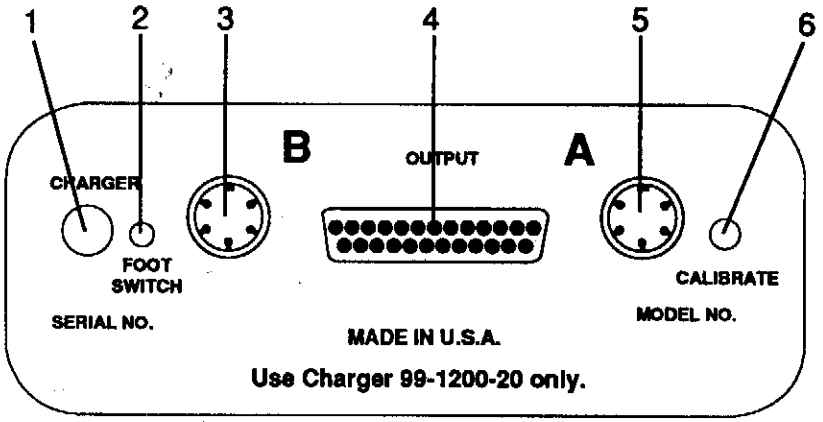
The Red, Green and Yellow lights above the display are limit indicator signals.

RED - Indicates the displayed number is outside the LO limit.

GREEN - Indicates the displayed number is within the set limits.

YELLOW - Indicates the displayed number is outside the HI limit.

Rear Panel



Rear Panel

Refer to the illustration above for locations of the following features.

1) Battery charger jack.

   Caution: This amplifier is designed to work ONLY with the 99-1200-20 charger provided. The amplifier may be permanently damaged if it is connected to any other charger.

2) Foot switch jack

3) B GAGE jack
   The gage head connected to this jack will appear as the B GAGE on the amplifier display.

4) Output connector
   Data is transmitted into and out of this connector in RS 232-C format. Also, foot switch, +5 volts and limit light signals are available at this connector. See the *Technical Specifications* section, in the "Reference" chapter for more details.

5) A GAGE jack
   The gage head connected to this jack will appear as the A GAGE on the amplifier display.

6) Calibrate cap
   Remove this cap for access to the "Calibrate Push Button". See the *Calibration* section, in the "Operation" chapter for more details.

Amplifier Base

There is a master reset access hole located in the sloped surface of the amplifier base. Use master reset only if the amplifier fails to operate properly, and troubleshooting procedures are unsuccessful. See the *Troubleshooting* section, in the "Reference" chapter for more details.

SINGLE GAGE MEASUREMENT

A GAGE MEASUREMENT

Equipment required:

Gage head
Gage head mechanical support
Reference part
Part(s) to be measured
Amplifier

Before measuring can begin, the equipment must be set up and a zero reference must be set.

The following instructions show how to set up and measure a typical part where a 1 inch nominal dimension and a tolerance of ±0.00025 inches (part dimension=1 ±0.00025 inches) is required.

(This same procedure may be used for different nominal dimensions and tolerances by changing the numbers shown.)

It is important to realize that when only A GAGE is selected, it operates independent of B GAGE. Similarly, when B GAGE is selected, it operates independent of A GAGE.

Note: The measurement displayed by the amplifier is the difference between the measured part and the reference part.

(display = measured – reference part)

Gage Head Set-up

1. Connect the gage head cable to the amplifier **A GAGE** head connector.
2. Fasten the gage head to a stable mechanical support.
3. Position the gage head so that the gage head tip is in contact with the reference part.

Amplifier Set-up

4. Press the **ON/OFF** key to switch the amplifier ON. (The display will appear when the amplifier is ON).

   If the amplifier does not turn ON, the battery may be discharged; connect the charger for 5 or 10 minutes, and try again. If the amplifier still does not turn ON, consult the *Troubleshooting* section, in the "Reference" chapter for more details.

5. Press the **IN/MM** key until INCH is displayed. (The amplifier may be switched to INCH or MM at any time, however, only the INCH mode will be discussed in this example.)

6. Press the **-A+ GAGE** key to display the A GAGE head. If the display is "-A", then press the **-A+ GAGE** key again to switch the display to "A".

7. Press the **RANGE UP** key to increase the range until the display shows: "INCH", "RANGE", "±0.1".

If "AUTO" is displayed above the word "RANGE", press the **RANGE DOWN** key once to remove it.

Note: The largest, (±0.1inch), range is recommended for setup to avoid overranging the display.

How To Set A Reference

The following two examples show how to set a reference. The correct one for a specific application depends upon the dimension of the reference part.

8. First, press and hold the **ZERO** key for 2 seconds or more to remove the amplifier zero offset. "KEY LOCK" will be displayed for a few seconds as the amplifier responds to the **ZERO** key. After "KEY LOCK" disappears, the amplifier will display gage head distance from gage head electrical zero.

   Note: "Gage head electrical zero" is usually the center, and the most accurate portion of the gage head electrical measuring range. It is good measurement practice to set up and operate a gage head near gage head electrical zero.

When the reference part dimension is **exactly equal** to the nominal part dimension, do steps 9 and 10 in the *How To Set a `Zero' Reference* example.

When the reference part dimension is **not exactly equal** to the nominal part dimension, do steps 9A and 10A in the *How To Set a `Non-zero' Reference* example.

Example 1
How To Set a "Zero" Reference

In this example, a part with a specified dimension of 1±0.00025 inches is to be measured. A reference part with a 1.00000 inch dimension is available, so the 1.00000 inch reference part will be used as a "Zero" reference.

Follow steps 9 and 10 to set the gage head and amplifier to display the 1.00000 inch reference part as 0.00000 inches.

9. Adjust the gage head position on the reference part until the display shows ".0000", ±0.01 inches.

10. Press the **ZERO** key. "KEY LOCK" will be displayed for a few seconds while the amplifier zeroes all ranges.

Common "Zeroing" Problems

If the display shows "-----", (Blinking minus signs). then the amplifier is unable to zero all ranges because the gage head is not positioned within ±0.010 inches of gage head electrical zero. Press the **CLEAR** key to clear the "-----" display, then go back and repeat steps 8 and 9.

Notice that the **ZERO** key is held 2 seconds or longer in step 8.

If the display is close, but not exactly "0.0000", the gage head may have moved during the zeroing process. Check that the gage head holding fixture is stable.

Example 2
How To Set a "Non-zero" Reference

In this example, a part with a specified dimension of 1±0.00025 inches is to be measured. A reference part with a 1.00000 inch dimension is not available, so a "Non-zero" reference part will be used.

Assume the only available reference part has a dimension of 1.00074 inches. Follow steps 9A and 10A to set the gage head and amplifier to display the reference part as 0.00074 inches.

9A. Adjust the gage head position on the reference part until the display shows ".0007" ±0.01 inches. (0.0007 inches is 0.00074 inches rounded off.)

10A. Select the 0.001 inch range. Press the LEFT ARROW or RIGHT ARROW key to adjust the display to exactly ".00074".

- If the display is less than ".00074", or shows "–" (overrange), press the **RIGHT ARROW** key to increase the displayed value to ".00074".
- If the display is greater than ".00074", or shows "+" (overrange), press the **LEFT ARROW** key to decrease the displayed value to ".00074".

Common "NON-ZERO" Reference Setting Problems

If the **LEFT** and **RIGHT ARROW** keys do not work as described, it may be that the gage head is not positioned in the center of the measuring range. Repeat steps 8 and 9A. Make sure **ZERO** key is held at least 2 seconds in step 8.

A GAGE Measurement

11. To measure, set up and reference the gage head as described in steps 1 through 10 (or 10A). Select the desired measuring range, or AUTO RANGE and replace the reference part with the part to be measured.

    The display will show the dimensional difference between the measured part and the zero reference.

Measurement examples using a 1.00000 inch reference dimension as zero:

Measured Part	Amplifier display
1.00036	.00036
0.99983	-.00017
1.00078	.00078
0.99924	-.00076

If the amplifier display is not stable, drifts, or is erratic, here are some checks to locate the problem:

- Is the measuring surface clean, with no burrs ?
- Is the work surface clean and flat ?
- Is the gage head support stable ?
- Is the gage head fastened securely to the support ?
- Is the gage head cable pulling on the gage head ?
- Is there vibration ?
- Is the gage head in good condition ?
- Is the ambient temperature stable ?
- Have the fixtures and parts had time to stabilize ?
- Has the amplifier had time to stabilize ?

Operation

B GAGE MEASUREMENT

Press the **-B+ GAGE** key to select and display the B GAGE only.

Measuring with B GAGE is similar to measuring with A GAGE, except the gage head is connected to the B GAGE jack at the amplifier rear panel, and the **-B+ GAGE** key is used to select and display the B GAGE head.

When B GAGE is selected, it operates independently of A GAGE. Similarly, when A GAGE is selected, it operates independently of B GAGE.

To measure with the B GAGE, use the A GAGE MEASUREMENT instructions, and substitute B GAGE whenever A GAGE is mentioned.

DUAL GAGE MEASUREMENT

The **A&B GAGE** key selects dual gage measurement. When the **A&B GAGE** key is pressed, the A GAGE and B GAGE display values are summed, (either added or subtracted), and the result is displayed. The display will show either "A+B", "A-B", "-A+B", or "-A-B", and the measurement value.

A GAGE and B GAGE should be set up and have a reference set before selecting A&B GAGE.

How To Set Up and Set References

1. Set up A GAGE and set the A GAGE reference per *SINGLE GAGE MEASUREMENT, A GAGE Measurement* instructions. After setup, press the **-A+ GAGE** key to display "A" or "-A".

2. Set up B GAGE and set B GAGE reference as per *SINGLE GAGE MEASUREMENT, B GAGE Measurement* instructions. After setup, press the **-B+ GAGE** key to display "B" or "-B".

Measuring with Dual Gage

3. Press **A&B GAGE** key. The display will show either "A+B", "A-B", "-A+B", or "-A-B" depending on how A and B GAGES were set up.

4. Select the desired measuring range, or AUTO range, and replace the reference part(s) with the part(s) to be measured. The display will show the dimensional difference between the measured part(s) and the zero reference(s).

Common Dual Gage Measurement Problems

If the A&B GAGE display changes rapidly from zero to overrange and back, one of the gages is close to the overrange point, and vibration is causing momentary overranging. Check the position of the A GAGE then check the B GAGE, and re-position the one which is close to overrange.

If polarity of A or B is incorrect, then press **-A+ GAGE** key twice or press **-B+ GAGE** key twice. This will change A or B polarity. Then press **A&B GAGE** key to return to dual measurement.

Example:

If display shows "A+B", but "A-B" is desired:

First, press the **-B+ GAGE** key once to select B GAGE. "B" will be displayed.

Next, press the **-B+ GAGE** key again to change B GAGE polarity. "-B" will be displayed.

Then, press **A&B key** to display the sum of A and B GAGES. "A-B" will be displayed.

A-B = (+A) + (-B)

Operation

Dual Gage Measurement Technical Features

When in A&B GAGE mode, the **ZERO** key affects both A and B GAGES. If zero is pressed, the amplifier will zero A GAGE, then zero B GAGE, and will return to the A&B GAGE display. See the ***ZERO*** section for more details.

If the **LEFT** or **RIGHT ARROW** keys are pressed when the amplifier is in A&B GAGE mode, the A&B GAGE display will shift and the A GAGE display will shift. The B GAGE display will not shift.

RANGE SELECTION

The amplifier has four ranges in INCH mode and four ranges in MILLIMETER mode. The amplifier may be set to a FIXED RANGE, or to AUTOMATIC RANGE mode. In AUTOMATIC RANGE mode, the amplifier will select the range according to the value displayed.

The display shows the selected range, and the value of each bargraph division. There are 41 bargraph division lines; one in the center, 20 to the right and 20 to the left.

How To Select INCH or MILLIMETER Mode

Press the **IN/MM** key. Each time the key is pressed, the display will change from inches to millimeters or from millimeters to inches. The display will show "MM" when in millimeters, or "INCH" when in inches.

How To Select the AUTOMATIC RANGE Mode

Press and hold the **RANGE UP** key for 2 seconds or more.

The message "AUTO" will be displayed. The amplifier is now in AUTOMATIC RANGE mode.

How To Select FIXED RANGE Mode

Press the **RANGE DOWN** key.

The message "AUTO" will disappear. The amplifier is now in FIXED RANGE mode.

How To Select a FIXED RANGE or AUTOMATIC RANGE Mode

In INCH mode; press the **RANGE UP** key to move:

from	±0.0001	inch	to ±0.001	inch
from	±0.001	inch	to ±0.01	inch
from	±0.01	inch	to ±0.1	inch
from	±0.1	inch	to AUTOMATIC	inch

Press the **RANGE DOWN** key to move:

from	AUTOMATIC inch	to	±0.1	inch
from	±0.1	inch	to ±0.01	inch
from	±0.01	inch	to ±0.001	inch
from	±0.001	inch	to ±0.0001	inch

In MILLIMETER mode; press the **RANGE UP** key to move:

from	±0.002	mm	to ±0.02	mm
from	±0.02	mm	to ±0.2	mm
from	±0.2	mm	to ±2.0	mm
from	±2.0	mm	to AUTOMATIC	mm

Press the **RANGE DOWN** key to move:

from	AUTOMATIC mm	to	±2.0	mm
from	±2.0	mm	to ±0.2	mm
from	±0.2	mm	to ±0.02	mm
from	±0.02	mm	to ±0.002	mm

Operation

Overrange

Overrange occurs when the digital display goes beyond 105% of the selected range.

Overrange with positive numbers is displayed as: "+" and center bargraph and 20 bargraph lines to the right of center.

Overrange with negative numbers is displayed as: "–" and center bargraph and 20 bargraph lines to the left of center.

If the amplifier is in automatic range mode, it will automatically switch to the next larger range.

Note: It is possible for the digital display to reach 150% of the selected range before overage occurs. This requires an internal adjustment by the factory. Consult the Precision Measuring Instrument Service Department for details.

ZERO

The amplifier **ZERO** key will locate gage head electrical zero, or zero all ranges. To zero all ranges, the gage head must be positioned within ±0.010 inches of gage head electrical zero. The **ZERO** key affects A, B or A&B GAGES depending on which gage head is displayed when the **ZERO** key is pressed.

How To Locate Gage Head Electrical Zero

Press and hold the **ZERO** key for 2 seconds or more. See Note 1. The amplifier zero offset will be removed, and the display will show gage head distance from gage head electrical zero.

The **ZERO** key may be used with single (A or B), or dual (A&B) gage operation.

Note 1: When the **ZERO** key is pressed, "KEY LOCK" will be displayed for a few seconds as the amplifier automatically cycles through all ranges. If dual gage is displayed, the amplifier will zero A GAGE first, then zero B GAGE.

Note 2: "Gage head electrical zero" is usually the center, and the most accurate portion of the gage head electrical measuring range. It is good measurement practice to measure with the gage head positioned near gage head electrical zero.

How To Zero All Ranges

Press the **ZERO** key momentarily and release. KEY LOCK will be displayed for a few seconds as the amplifier automatically zeroes all four ranges.

See the *Single Gage Measurement* section for information on zeroing all ranges.

Common Zero Problems

If the display shows "------", (Blinking minus signs), then the amplifier is unable to zero all ranges because the gage head is not positioned within ±0.010 inches of gage head electrical zero.

Press the CLEAR key to clear the "------" display, and see *How To Locate Gage Head Electrical Zero* section for more details.

If the display is close, but not exactly ".0000", the gage may have moved during the zeroing process. Check that the gage head holding fixture is stable.

LIMITS

The amplifier stores 2 limit values in memory. Each limit may be set to any value on any range.

When measuring with limits, (limits enabled), the amplifier compares the displayed value to the stored limits, and lights a RED, or GREEN, or YELLOW limit light to show whether the display is below, within, or above limits. The limits appear on the bargraph as blinking lines.

When measuring without limits, (limits disabled), the limit lights are off, but limit values are retained in memory.

Limits are enabled, disabled, or set only when the amplifier is in LIMIT mode.

Limit light electrical signals are accessible at the amplifier output connector. These signals may be used to control devices such as sorting machines.

(See the *Technical Specifications* section, in the "REFERENCE" chapter for more details).

Note: **LIMIT SET** key does not function when "AUTO" range is displayed. Press the **RANGE DOWN** key to turn "AUTO" range off.

How To Select LIMIT Mode

Press **LIMIT SET** key. LIMIT mode is now selected, and the display shows "HI LIMIT SET", or "LO LIMIT SET" or "LIMIT SET OFF".

If the **LIMIT SET** key is pressed repeatedly, the display cycles through these modes:

from	LIMIT SET OFF	to	HI LIMIT SET
or from	HI LIMIT SET	to	LO LIMIT SET
or from	LO LIMIT SET	to	LIMIT SET OFF

How To Quit LIMIT Mode

Press the **-A+ GAGE** or **A&B GAGE** or **-B+ GAGE** key.

How To Enable Limits

First, press the **LIMIT SET** key repeatedly until "HI LIMIT SET" or "LOW LIMIT SET" is displayed. Limits are enabled when "HI" or "LO LIMIT SET" is displayed.

Then press **-A+ GAGE** key or **-B+ GAGE** key or **A&B GAGE** key to quit LIMIT mode. Limits will remain enabled.

How To Disable Limits

First, press the **LIMIT SET** key repeatedly until "LIMIT SET OFF" is displayed. Limits are disabled when "LIMIT SET OFF" is displayed.

Then press **-A+ GAGE** key or **-B+ GAGE** key or **A&B GAGE** key to quit LIMIT mode. Limits will remain disabled.

How To Set the HIGH or the LOW Limit

To set the low limit, skip step 1 and go to step 1A.

1. To set the high limit, press the **LIMIT SET** key until "HI LIMIT SET" is displayed. The YELLOW light will be lit. Skip step 1A and go to step 2.

1A. To set the low limit, press the **LIMIT SET** key until "LO LIMIT SET" is displayed. The RED light will be lit. Go to step 2.

2. Press the **RANGE UP** or **RANGE DOWN** key to select the range where the limit will be set.

3. Press the **ZERO** key to set the limit to ".0000".

   To set a limit from a measurement, skip step 4 and go to step 4A.

4. To set the limit from the keypad: Press the **RIGHT ARROW** or **LEFT ARROW** key to set the display and bargraph to the desired limit value. The displayed value is now stored as the limit. Skip step 4A and go to step 5.

4A. To set the limit from a measurement: Press the **MEASURE & HOLD** key. The display will momentarily show "A", "B", or "A&B"; next the measurement will be displayed. The displayed value is now stored as the limit.

   Note: Gage(s) must be set up and measuring before step 4A. See *Single* or *Dual Gage Measurement* sections for more details on set-up and measurement.

5. Press the **-A+ GAGE**, or **-B+ GAGE**, or **A&B GAGE** key to quit LIMIT mode.

MEASURE & HOLD

MEASURE & HOLD mode changes the amplifier to do single measurements, rather than continuous measurements. When MEASURE & HOLD mode is selected, one measurement is collected and stored in memory each time:

- The **MEASURE & HOLD** key, or footswitch, is pressed, or
- The output connector (SEND) pin (Pin 13) is momentarily connected to Pin 7 (SIGNAL GROUND).

The display shows "HOLD" when the amplifier is in MEASURE & HOLD mode.

MEASURE & HOLD may be used while the display is "A", "A&B", "B", "MAXIMUM", "DIFFERENCE", "AVERAGE", "MIMIMUM", "HI LIMIT SET" or "LO LIMIT SET".

MEASURE & HOLD is also used to store a measurement in memory as a high or low limit. See the *Limits* section for more details.

How To Select MEASURE & HOLD Mode

Press the **MEASURE & HOLD** key. The message "HOLD" will appear in the display. The amplifier is now in HOLD mode.

Note: The amplifier must not be in AUTO RANGE, LIMIT, or KEY LOCK modes. See *Range Selection* or *Limits* sections for more details.

How To Quit MEASURE & HOLD Mode

Press the **CLEAR** key once. The message "Hold" will disappear from the display, and the amplifier will measure continuously.

How To Measure Using MEASURE & HOLD

1. Set up the amplifier and measure per *Single* or *Dual Gage Measurement* instructions.
2. Press the **MEASURE & HOLD** key. The message "HOLD" will appear in the display and the display will show the measurement present when the **MEASURE & HOLD** key was pressed.

   Note: The **MEASURE & HOLD** key will not work when the amplifier is in "AUTO" range, or when "KEY LOCK" is displayed.
3. To collect and store a single measurement, position the gage head on the part to be measured, then press the footswitch, or the **MEASURE & HOLD** key. The display will show the measurement present each time the **MEASURE & HOLD** key or footswitch is pressed.

Common Problems With MEASURE & HOLD

If "HOLD" does not appear when **MEASURE & HOLD** key is pressed then "KEY LOCK" or "AUTO RANGE" is displayed.

To remove "KEY LOCK" from the display, press and hold **KEY LOCK** key for 2 seconds or more. To remove "AUTO" from the display, press the **RANGE DOWN** key.

When "HOLD" is displayed, auto range cannot be selected. This is normal.

When "HOLD" is displayed, and range is changed, the amplifier executes a MEASURE & HOLD just as if the **MEASURE & HOLD** key was pressed. This is normal.

If both the MEASURE & HOLD mode and KEY-LOCK mode are selected, the **MEASURE & HOLD** key will be locked. The footswitch will not be locked.

MEASURE & HOLD Technical Features

When the display shows "HOLD", stored data may be viewed by pressing any of the following keys: **-A+ GAGE, -B+ GAGE, A&B GAGE, MAX -> MIN, IN/MM.** Pressing these keys does not change the stored data.

> **Note:** The stored information will not change until the **MEASURE & HOLD** key, the **CLEAR** key or the footswitch is pressed.

The **MEASURE & HOLD** key works as described when "-A+", "-B+" "-+A+-B", "MAXIMUM", "DIFFERENCE", "AVERAGE", or "MINIMUM" is displayed.

The **MEASURE & HOLD** key works differently when in LIMIT mode. See *Limits* section for more details.

When "HOLD" is displayed and the footswitch is pressed the amplifier executes a MEASURE & HOLD, then transmits data out the output connector. Next, the amplifier clears Maximum, Difference, Average and Minimum. See *Data*

MAXIMUM, DIFFERENCE, AVERAGE AND MINIMUM

The amplifier always stores maximum, difference, average, and minimum (Max, Diff, Ave, & Min) information on every A GAGE and B GAGE measurement. To display these stored measurements, press the **MAX -> MIN** key. To clear these stored measurements, press the **CLEAR** key.

How To Select MAX -> MIN Mode

To select MAX -> MIN mode, press the **MAX -> MIN key**.

How To Quit the MAX -> MIN Mode

To quit the MAX -> MIN mode, press the **-A+ GAGE**, or **A&B GAGE**, or **-B+ GAGE** key.

How To Display Maximum, Difference, Average and Minimum Values

To display maximum, difference, average, or minimum, first select the desired gage head or gage heads by pressing the **-A+ GAGE** or **-B+ GAGE** or **A&B GAGE** key. Next press the **MAX -> MIN** key. A message on the display shows whether Maximum, Difference, Average, or Minimum Value is displayed.

If the **MAX -> MIN** key is pressed repeatedly, the display cycles through these modes:

from	MAXIMUM	to	DIFFERENCE
or from	DIFFERENCE	to	AVERAGE
or from	AVERAGE	to	MINIMUM
or from	MINIMUM	to	MAXIMUM

How To Clear Maximum, Difference, Average and Minimum Values

Press the **CLEAR** key or the optional foot pedal to clear all A, B, and A&B GAGE Maximim, Difference, Average, and Minimum stored data.

Note 1: The foot pedal clears all stored data regardless of the display; the **CLEAR** key does not. The **CLEAR** key will have to be pressed twice to clear data when "HOLD" is displayed. The first press removes "HOLD" from the display, the second press clears the Maximum, Difference, Average and Minimum Values.

Note 2: The **CLEAR** key or foot pedal will not necessarily set the maximum, minimum and average to zero, but it will clear previously stored maximum, average and minimum values, and set the maximum, average and minimum to the present positions of A GAGE head and B GAGE head.

Example: Using the **CLEAR** key or footswitch.

Before **CLEAR** key or footswitch is pressed -

A GAGE head position	= 0.00047 inches
A GAGE stored MAXIMUM	= 0.00059 inches
A GAGE stored DIFFERENCE	= 0.00134 inches
A GAGE stored AVERAGE	= -0.00008 inches
A GAGE stored MINIMUM	= -0.00075 inches

After CLEAR key or footswitch is pressed -

A GAGE head position	= 0.00047 inches
A GAGE stored MAXIMUM	= 0.00047 inches
A GAGE stored DIFFERENCE	= 0.00000 inches
A GAGE stored AVERAGE	= 0.00047 inches
A GAGE stored MINIMUM	= 0.00047 inches

KEY LOCK

KEY LOCK mode blocks operation of the keypad white and red keys. This prevents accidental keystrokes from changing the amplifier settings. The blue keys are not blocked by KEY LOCK.

When in KEY LOCK mode, "KEY LOCK" is displayed.

How To Select KEY LOCK Mode

Press and hold the **KEY LOCK** key for 2 seconds or more. When Key Lock is active, the display shows, "KEY LOCK" and neither the blue nor the white keys will work.

How To Quit KEY LOCK Mode

Press and hold the **KEY LOCK** key for 2 seconds or more. The display message, "KEY LOCK", will disappear. All of the keypad keys will work normally.

DATA OUTPUT

The amplifier can send RS-232-C data out the output connector at the amplifier rear panel. The data normally consists of the displayed number followed by a carriage return Decimal points and minus signs are transmitted, and spaces occur before and after the numbers.

How To Send Data Out the Output Connector

There are four ways to cause the amplifier to send data out the output connector:

1. Press the SEND key.
2. Press the optional footswitch.
3. Momentarily connect the output connector pin 13 (SEND) to Pin 7 (SIGNAL GROUND).
4. Send "ENQ" (transmit answerback), "ASCII 05", or "CTRL E" from a remote device to the amplifier output connector.

Note 1: After data is transmitted, the amplifier clears maximum, difference, average and minimum stored data values.

Note 2: If the amplifier is in HOLD mode, a new measurement is collected and stored before the data is sent.

Data Output Technical Features

Data output is RS-232-C, 1200 baud, 1 start bit, 7 data bits, even parity, 2 stop bits. The amplifier is a DCE device. It outputs data on Pin 3, and uses CTS/RTS handshaking.

It is possible to send data with different baud rates, parity settings, and stop bits. Consult the factory for details

Data output other than displayed numbers, may be selected from the keypad; see the *Keypad Selectable Options* section for more details.

Common Problems With Data Output

Invalid or unusual data output is often caused by the receiving device not being set for the proper baud rate, stop bits, or parity.

No data output is often caused by a handshaking problem. The amplifier will not transmit until Pin 4 (RTS) is asserted, (+5 to +12 VDC).

KEYPAD SELECTABLE OPTIONS

There are four options which may be changed by holding one of four keys at power turn-on. Once an option has been changed, it remains changed, even after the amplifier is turned OFF. To change an option back to its original status, hold the appropriate key at power turn-on.

List of Keypad Selectable Options

To execute the changes shown below, press and hold the key shown and press the **ON/OFF** key to turn the amplifier ON. When the display shows the software version number (such as A2.04), the key may be released.

1. **LIMIT SET** key will change the bar-graph display from a single-element type to a zero-center thermometer type.
2. **MEASURE & HOLD** key will change the resolution on the 0.1 inch and 2.0 millimeter range from 0.0001 inch and 0.001 millimeter to 0.001 inch and 0.01 millimeter.
3. **MAX -> MIN** key will change the data sent out the output connector from the displayed value only to the measured, maximum, difference, average and minimum values. Each value will be separated by one or more spaces.
4. **IN/MM** key will change the data sent out the output connector from single output on command to continuous output, no output command required.

CALIBRATION

The amplifier is calibrated at the time of manufacture, and holds calibration in digital memory. Calibration should be checked when the amplifier is first set up with a gage head. The amplifier A and B GAGE channels require individual calibration.

Equipment required to calibrate the amplifier:

Gage head
Gage head mechanical support
Reference part
Calibration Part (0.01000 inches larger than reference part)
Amplifier

This procedure describes calibration of the amplifier A GAGE channel. To calibrate amplifier B GAGE channel, substitute B for A in the instructions.

If you are already familiar with calibrating this amplifier, you may prefer to skip the 16-step procedure shown, and calibrate using the **Calibration Summary** at the end of this chapter.

Set Up the Gage Head

1. Connect the gage head cable to the amplifier A GAGE connector.

2. Fasten the gage head to a stable mechanical support.

3. Position the gage head so that the gage head tip is in contact with the reference part.

Set Up the Amplifier

4. Press the ON/OFF key to switch the amplifier ON. (The display will appear when the amplifier is ON).

   If the amplifier does not turn ON, the battery may be discharged; connect the charger for 5 or 10 minutes, and try again. If the amplifier still does not turn ON, consult the *Troubleshooting* section, in the "REFERENCE" chapter for more details.

5. Press **IN/MM** key until "INCH" is displayed. (The amplifier may be switched to INCH or MM mode at any time, however, only the INCH mode will be discussed in this example.)

6. Press the **-A+ GAGE** key until "A" is displayed. If the display is "-A", then press the **-A+ GAGE** key again to switch the display to "A".

7. Press the **RANGE UP** key to increase the range until the display shows: "INCH", "RANGE", "±0.1".

   If "AUTO" is displayed above the word "RANGE", press the **RANGE DOWN** key once to remove it.

   Note: The largest, (±0.1 inch), range is recommended for setup because the display will show the large gage head setup adjustments without overranging.

Position the Gage Head Close to Gage Head Electrical Zero

8. Press and hold the **ZERO** key for 2 seconds or more to remove amplifier zero offset. "KEY LOCK" will be displayed for a few seconds as the amplifier responds to the **ZERO** key. After "KEY LOCK" disappears, the amplifier will display gage head distance from gage electrical zero.

   Note: "Gage head electrical zero" is usually the center, and the most accurate portion of the gage head electrical measuring range. It is good measurement practice to set up and operate a gage head near gage head electrical zero.

9. Adjust the gage head position on the reference part until the display shows ".0000" ±0.0005 inches.

   Press the **RANGE DOWN** key once to display the "±.01" inch range.

Select Calibration Mode

10. Use a small flat tool to pry the black plastic plug from the "CALIBRATE" hole at the amplifier rear panel. There is a small white momentary touch pushbutton inside. Press the pushbutton once, then look at the display to verify the amplifier is in CALIBRATE mode.

    Suggestion: The writing end of a plastic ball point pen (retracted) works well as a calibrate button pusher.

    In CALIBRATE mode, the display will count backward from 500 to 0 as the amplifier sets up for calibration. The display will then show A GAGE position, and a steady, (not blinking), "CALIBRATE".

    Note: Calibration set-up does **not** change the gain of amplifier A or B GAGE channel. The **LEFT** or **RIGHT ARROW** keys **must** be pressed to change amplifier calibration.

Establish Zero Reference On the Reference Part

11. Momentarily press the **ZERO** key. KEY LOCK will be displayed for a few seconds while the amplifier zeroes all ranges.

Common Problems With Reference "Zero"

If the display shows "-----", (Blinking minus signs), then the gage head is not positioned within ±0.010 inches of gage head electrical zero. Press the CLEAR key to clear the "-----" display, then go back and repeat steps 8 and 9. Notice that the **ZERO** key is held 2 seconds or longer in step 8.

If the display is close, but not exactly ".0000", the gage head may have moved during the zeroing process. Check that the gage head holding fixture is stable.

Measure the Calibration Part, and Adjust the Amplifier Gain

12. Remove the reference part, and replace it with the calibration part. The display should be ".0099" to ".0100".

    If the display is less than ".0099", press the right arrow key to increase the amplifier gain until the display is ".0100" .

If the display is greater than ".0100", press the left arrow key to decrease the amplifier gain until the display is ".0100" .

Check the Reference Part

13. Remove the calibration part, and replace it with the reference part. The display should show ".0000". **Do not** press the **LEFT** or **RIGHT ARROW** keys.

    If the display does not show ".0000", remove and replace the reference part several times. If the display does not repeat, check the following list of possible problems, fix the problem, then go back to step 11.

Checklist To Locate the Source of "Repeat" Problems

- Is the fixture stable enough to repeat to 0.0001 inch ?
- Is the reference surface clean and flat, with no burrs ?
- Is the work surface clean and flat ?
- Is the gage head support stable ?
- Is the gage head fastened securely to the support ?
- Is the gage head cable pulling on the gage head ?
- Is there vibration ?
- Is the gage head in good condition ?
- Is the ambient temperature stable ?
- Have the fixtures and parts had time to stabilize ?
- Has the amplifier had time to stabilize ?

Check Calibration Several Times

14. Repeat steps 12 and 13 to verify the measurements repeat and are correct. Amplifier calibration is complete for A GAGE channel.

Calibrate Amplifier B GAGE Channel

15. To calibrate amplifier B GAGE channel, quit calibration mode and start again, substituting B for A. Suggestion: If you are familiar with the amplifier and electronic gaging, just press the **-B+ GAGE** key at this time, and use the **Calibration Summary** procedure.

To Quit the CALIBRATION Mode

16. Press the CALIBRATE pushbutton once. The message "CALIBRATE" will disappear from the display. Replace the calibrate hole plug.

Calibration

CALIBRATION SUMMARY

If you are familiar with the amplifier and electronic gaging, this checklist will allow you to calibrate the amplifier quickly. If problems or questions arise, consult the full calibration procedure.

1. Set up the gage head on the zero reference part.
2. Set up the amplifier.
3. Position the gage head near gage head electrical zero.
4. Check that the CALIBRATE mode is selected.
5. Establish zero reference.
6. Measure calibration part and adjust amplifier gain.
7. Check the zero reference part.
8. Check calibration several times.
9. Calibrate the other channel. (B or A)
10. Quit the CALIBRATE mode.

Common Problems With Calibration

When keypad arrow keys cause the zero reference to shift, it may be that the amplifier is not really in CALIBRATE mode. A steady "CALIBRATE" display means the amplifier is in CALIBRATE mode. A blinking "CALIBRATE" display means the amplifier **requires** calibration. To select CALIBRATE mode, see the *Select Calibration Mode* section for more details.

If the display is "-.0104", and pressing the **RIGHT ARROW** key makes the display bargraph shift left and go overrange, this is normal.

In CALIBRATE mode, when the **RIGHT ARROW** key is pressed the gain increases, so the display increases. A negative display will increase to a more negative value, (bargraph will shift left). A positive display will increase to a more positive value, (bargraph will shift right).

Calibration Technical Features

The amplifier calibration should be checked when a gage head is first set up. Afterwards, yearly calibration is recommended.

If the message "CALIBRATE" is blinking in the display, then amplifier has automatically switched to default calibration accuracy of ±2% of gage head position. This message will be displayed (when the amplifier is ON), if the amplifier has been left unused for 3 months or more without periodic recharging. To clear the blinking "CALIBRATE" message, calibrate the amplifier.

Calibration

There are several reasons why a dimension of 0.01000 inches, and the 0.01 inch range are recommended for calibration:

1. The two higher magnification ranges are not desirable because they require the mechanical system to repeat to less than 0.00001 and less than 0.000001 inches respectively. The "0.01" inch range requires a reasonable mechanical repeat of less than 0.0001 inches for a zero repeat error.

2. The lower magnification range, 0.1 inches, is not desirable because it is beyond the linear region of many gage heads.

3. The 0.01000 dimension is a full scale measurement on the amplifier 0.01 inch range. It is best to calibrate a digital instrument at full scale where a one count change has the least effect.

> Example:
> A one count change on a display of ".0100" is a 1% error. A one count change on a display of ".0010" is a 10% error.

If calibration at 0.01 inches is not possible, the amplifier may be calibrated on any range. However, because of the reasons previously described, calibration on the 0.01 inch range is recommended.

Calibration on only one range is satisfactory because the amplifier is a digital instrument. Calibration errors do not accumulate when changing ranges.

> Example:
> If the amplifier is calibrated to have a 1 count, (0.0001 inch), 0.5% error when measuring 0.0100 inches on the 0.0100 inch range, then it will also have a 1 count, (0.000001 inch), 0.5% error when measuring 0.000100 inches on the 0.000100 inch range.

ENVIRONMENTAL SPECIFICATIONS

The amplifier is designed to be used in a shop environment, however, immersion in liquid or exposure to spray should be avoided.

Important: Do not use sharp objects to press keypad keys.

Cleaning

The amplifier should be cleaned occasionally by wiping with a soft dry cloth. If more thorough cleaning is necessary, wipe with a cloth dampened in a mild soap solution. Do not use solvents, and do not immerse in liquid.

Storage Temperature

32°F to 140 °F, (0 to 60°C) 10 to 90 percent relative humidity, non-condensing.

Operating Temperature

68°F ± 0.5 °F (20°C ± 0.2 °C) at specified accuracy.

40°F to 120 °F (5°C to 50 °C) at reduced accuracy.

Response to Temperature Changes

For operation at rated accuracy, allow the amplifier to stabilize 2 hours before measuring.

TECHNICAL SPECIFICATIONS

Power Requirements

The amplifier will operate over 10 hours from internal rechargeable batteries or continuously on standard U.S. line voltage of 105 to 125 VAC, 60 HZ. Power consumption from line voltage is 7.5 W max.

Linearity Error

The linearity error is less than one count of digital resolution. That is less than 0.5% of the full scale range for the three smaller ranges. For the largest range of .200" (±.100") or 4mm (±2mm) the linearity error is less than 0.05% of the full scale range.

Zero Drift

Automatically compensated to less than 0.000001 in., ±1 count (0.00002 mm, ±1 count). (Test conditions: fully charged battery with the power unit/charger connected.)

Repeatability Error

± 1 count.

Response Time

0.0001" or 0.002 mm. ranges = less than 1 sec. All other scales = less than 0.5 sec.

Gain Stability

Automatically compensated to less than 0.5% of full scale.

Amplifier Range And Resolution Chart

	Inch Mode	
Full-scale Range	Digital Resolution	Bargraph Resolution
Automatic*	Automatic*	Automatic*
±0.1"	0.0001"	0.005"
±0 .01"	0.0001"	0.0005"
±0.001"	0.00001"	0.00005"
±0.0001"	0.000001"	0.000005"
	Metric Mode	
Full-scale Range	Digital Resolution	Bargraph Resolution
Automatic*	Automatic*	Automatic*
± 2.0 mm	0.001 mm	0.1 mm
±0.2 mm	0.001 mm	0.01 mm
±0.02 mm	0.0001 mm	0.001 mm
±0.002 mm	0.00002 mm	0.0001 mm

* If the Automatic range is selected, the amplifier will automatically switch to the optimum range for the part being measured.

Maximum, Difference, Average and Minimum Values Technical Information

The maximum and mininimum stored data is updated at approximately 4 times per second.

AVERAGE = (Max. + Min.) / 2.

DIFFERENCE = Max. - Min.

Modes of Operation

± A GAGE only, ± B GAGE only, or any combination: A+B, A-B, -A+B, or -A-B.

OPERATING SPECIFICATIONS

RS-232-C Output/Input

The 25-contact connector at the rear panel is connected as a DCE device: Handshaking is provided by CTS and RTS. Wiring is as follows:

Pin 1 - Protective ground
Pin 2 - Transmit Data (Input)
Pin 3 - Receive Data (Output)
Pin 4 - Request to Send (Input)
Pin 5 - Clear to Send (Output)
Pin 7 - Signal ground
*Pin 8 - Red (Output)
*Pin 9 - Green (Output)
*Pin 10 - Yellow (Output)
*Pin 12 - Tx2 (Output)
*Pin 13 - Send (Input)
*Pin 14 - Rx2 (Input)
*Pin 25 - +5V (Output)

***Note: Non-RS-232-C pins. Do not connect to a RS-232 device. The purpose of these pins is explained below.**

Data format is ASCII, 1200 baud, 1 start bit, even parity, 7 data bits, 2 stop bits. Baud rate, parity, # data bits, and # stop bits may be changed by the factory. Consult the Precision Measuring Instrument Service Dept. for detailed information.

Data transmission may be initiated by pressing the **SEND** key, pressing the footswitch, or momentarily connecting the output connector (SEND) pin (Pin 13) to Pin 7 (SIGNAL GROUND). The peripheral can also transmit an ENQ, (transmit answerback message which is ASCII Ø5, or CTRL E).

A data transmission consists of: one or more spaces, the digital display, (including decimal points and the negative polarity sign), one or more additional spaces and a CR (carriage return).

Pin 12 (TX2) and pin 14 (RX2) are for factory use only. Do not connect to these pins.

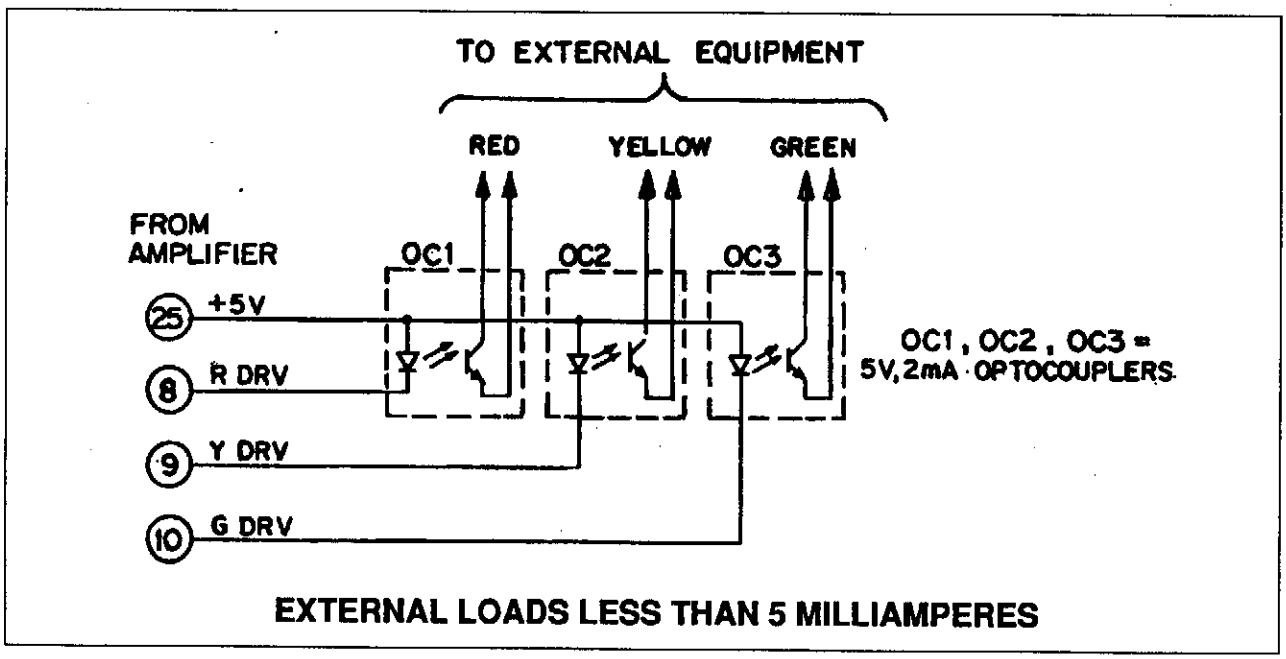
The Red, Green and Yellow limit signals (pins 8, 9 and 10), may be used to control external devices or processes such as sorters or grinder feed rates. Relays or optocouplers should be used to provide large signal switching capability and to electrically isolate pins 8, 9 and 10 from the external devices.

Output pins 8, 9 or 10 can switch direct current +5 volt circuits of up to 400 milliamperes. Inductive, resistive, or incandescent loads are acceptable.

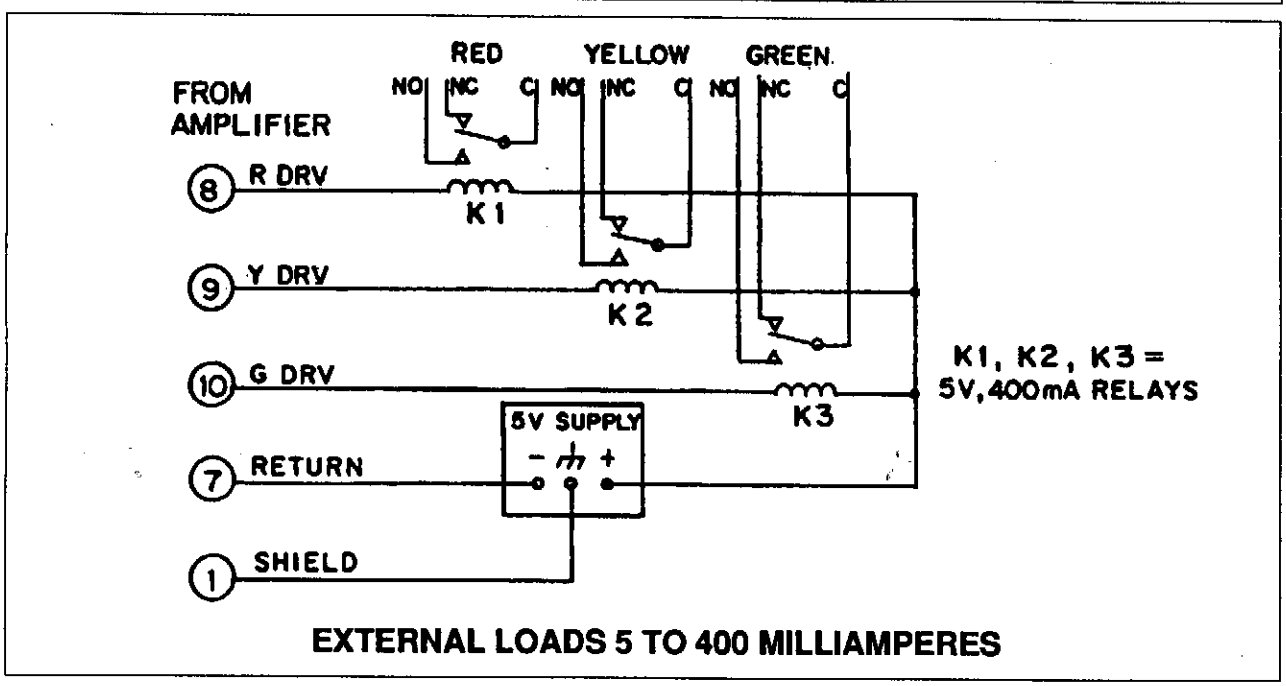
External loads of less than 5 milliamperes may use pin 25 as a +5 volt power source.

External loads of 5 to 400 milliamperes require an external power supply.

In the circuits shown, the relays or optocouplers are normally off. When the red, yellow or green limit light on the amplifier is lit, the red, yellow or green relay will be on (closed).



EXTERNAL LOADS LESS THAN 5 MILLIAMPERES



EXTERNAL LOADS 5 TO 400 MILLIAMPERES

Tolerance Limits

User definable up to ± 0.100" (± 0.2 mm).

Zero Range

The Zero key may be used to Zero the display when the gage head is positioned within the range of approximately ±.010" (±0.25mm) of gage head electrical zero. The Left and Right Arrow keys may be used to shift the display zero within the range of approximately ±.010" (±0.25mm) from gage head electrical zero.

Size

9.5" L x 6.75" W x 5.6" H, (250mm L x 171mm W x 142mm H).

Weight

5 Lbs. (2.27 Kg).

BATTERY SPECIFICATIONS

The battery is a custom nickle-cadmium assembly rated at 5V, 1.8 AH. The battery will last several years under normal usage.

When the amplifier is ON and the charger is connected, a maintenance charge is applied to the battery which will keep it in a fully charged state without affecting performance.

When the amplifier is OFF and the charger is connected, the battery is being charged at a rate which will recharge a fully discharged battery in approximately 14 hours. This rate may be maintained for several days without seriously affecting the performance of the battery Continuously overcharging the battery will eventually degrade its performance.

Important: The charger must NEVER be connected with the battery disconnected from the circuit boards.

OPTIONAL EQUIPMENT

A foot pedal may be plugged into the jack at the rear panel of the amplifier. Consult your product representative for detailed information.

The foot pedal performs the same function as the **SEND** key.

If HOLD is displayed, a MEASURE & HOLD will take place previous to a SEND.

COMPATIBILITY WITH OTHER GAGEHEADS

This amplifier can also accept several popular gageheads supplied by other manufacturers. Since such products are subject to constant design changes, none are specified here. Instead, we recommend you contact your sales representative for advice on which ones can now be used.

TROUBLESHOOTING

If the amplifier will not turn on, the battery may require charging. Connect the charger for 5 or 10 minutes and then try to turn the amplifier on. If this is successful, the amplifier may then be operated with the charger connected.

To fully recharge the battery, turn the amplifier off. Attach the charger to the amplifier for approximately 14 hours.

If the amplifier still does not turn on or if the amplifier is on but will not respond to the keypad, a master reset may be necessary.

To perform a master reset follow these steps:

1. Attach a charger to the amplifier.
2. Turn the amplifier upside down and locate the small hole in the sloped surface of the amplifier base.
3. Insert the end of a paper clip into the hole approximately 3/4" to make contact with a micro-switch. Press the switch in about 1/32" to turn off and reset the amplifier.
4. Wait at least 5 minutes before using the ON/OFF key to power up the amplifier. If the battery is severely discharged, it may take even longer to reach the minimum voltage required for turn-on.

If problems persist, consult the factory or your nearest authorized distributor. There are no user serviceable components or calibration adjustments inside the amplifier case.

Note: If the amplifier is left unused for several months or more without periodic recharging the battery will become significantly discharged and references stored in memory may be lost. After the amplifier is recharged and turned ON, the accuracy will automatically be set to the default value of 2%, and all keyboard selectable options will be set to default values. When this happens, the display will count backward from 500 to 0, then "A GAGE" head will display. The "CALIBRATE' message will remain blinking to indicate that calibration is required.

BATTERY MODES

For full portability, the amplifier contains a rechargeable battery. With proper care this battery will provide years of trouble-free operation. Operation under 4 different modes directly affects the battery:

Operating Mode - Amplifier ON, Charger Connected - As this mode maintains a slight charge on the battery, it makes the battery last the longest. Be sure to leave the amplifier ON with the chargeer connected unless CHARGING MODE (see below) is required.

Charging Mode - Amplifier OFF, Charger Connected - In this mode, a discharged battery is fully recharged after 14-16 hours. However, if the amplifier is left charging for more than 3-4 days, an overcharge occurs and battery life is shortened.

Battery Mode - Amplifier ON, Charger Disconnected - A fully charged battery operates the amplifier for 10 hours or longer. When the battery reaches the end of its charge, the battery warning indicator appears on the display. If the charger is not connected, the amplifier automatically shuts OFF soon after the warning occurs. Recharge the battery as soon as possible.

To use the amplifier without waiting for a full recharge, just connect the charger for a few moments and then operate the amplifier with the charger connected. **Note:** the battery will not recharge completely when the amplifier is operating. Full charge is achieved by recharging with the amplifier switched off.

Storage Mode - Amplifier OFF, Charger Disconnected - Storage overnight or over a weekend has no effect on the battery. However, after several week's storage, the battery may have to be charged before the amplifier can operate.

If the amplifier has been left in storage for an extended period (months), the amplifier may have to be reset **before** the battery can be recharged. See the instructions under TROUBLESHOOTING for performing a master reset.

ACCESSORIES

Description		Part Number	EDP Number
Accessories			
Foot switch		599-573-15-1	25288
Interface Cable (25 pin)†		599-1025-82	25287
Interface Cable (10 pin)		595-G-0235R-B	25841
Hite-Check® Height Transfer Stand			
18"/450mm		599-5842-18	44803
24"/600mm		599-5842-24	44804
† To connect Data-Stat requires adapter		599-1025-83	25601
To connect Serial Printer requires adapter		599-1300-83	59816
Gage Heads			
Bi-directional Lever Gage Head-.024" Range		599-988	44760
Cartridge type with axial cable-.08" Range		599-982-10	44752
Cartridge type with lateral cable-.08" Range		599-982-18	44753
Miniature Cartridge type/axial cable-.024" Range		599-989	55764
Miniature Cartridge type/ lateral cable-.024" Range		599-989-1	44765
Miniature Cartridge type/lateral cable-.08" Range		599-989-2	51679
Multi-angle Lever Gage Head-.04" Range		599-999	25094
Gage Head Extender Cable	-1m Long	032-40201	96237
	-2m Long	032-40202	96238
	-3m Long	032-40203	96239
Replacement Parts			
Power unit/battery charger		99-1200-20	*
Rechargeable battery assembly		99-1025-4	*
Rubber feet for base (4 required)		99-1025-19	*

** Replacement parts do not have EDP numbers.*