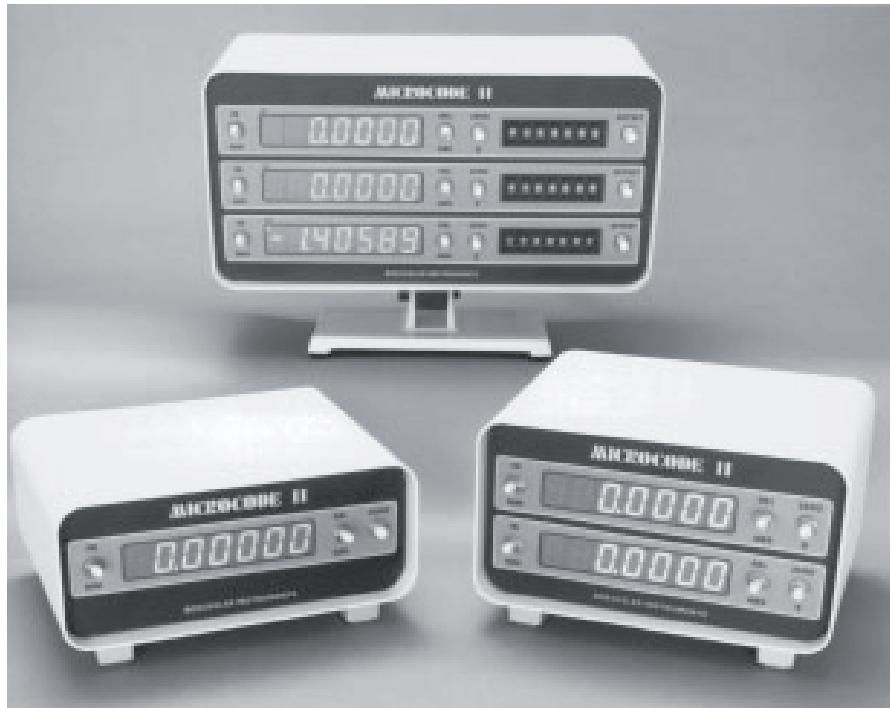


Operating Instructions



Digital Readout

Accuracy by Design

BOECKELER[®]

MICROCODE[®] II

Digital Readout

User's Manual

**BOECKELER[®]**

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INTRODUCTION

Congratulations on your selection of the Boeckeler Microcode II Digital Readout. We hope that you find your readout to be every bit as useful and reliable as it is designed to be.

Standard capabilities of the Microcode II readout include:

- **Inch/Metric** conversion
- **Absolute and Relative** measurements
- **Zero reset**

Engineering features of the Microcode II readout include:

- **VLSI parts** for increased reliability
- **Large LED display** readable to 30 feet in bright ambient light
- **Easy-set thumbwheel switches** for convenient visual reference to OFFSET or SCALER settings (in models with offset or scaler options only)

A general description and standard readout operations follow. These will provide the information necessary for proper operation. Additional operating instructions for the OFFSET and SCALER models are presented in subsequent sections, as well as special instructions for the RS-232 interface.

FCC Compliance Notice

This Boeckeler Microcode II Digital Readout complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with this instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

CE MARK Compliance Notice (European Standard)

This device complies with European Standard EN55022 and EN50082-1 concerning conducted disturbance (power line), radiated disturbance, Electrostatic Discharge (ESD), Radiated Electromagnetic Field (EMF), and Electrical Fast Transient/Burst (EFT) tests. Static charges of a sufficient level may cause the device to stop counting. If this happens, turn off the device and turn it on again. The device should then work properly.

General Description

Rear Panel Controls

POWER Turns power ON or OFF.

DIRECTION Selects direction of positive display readout.

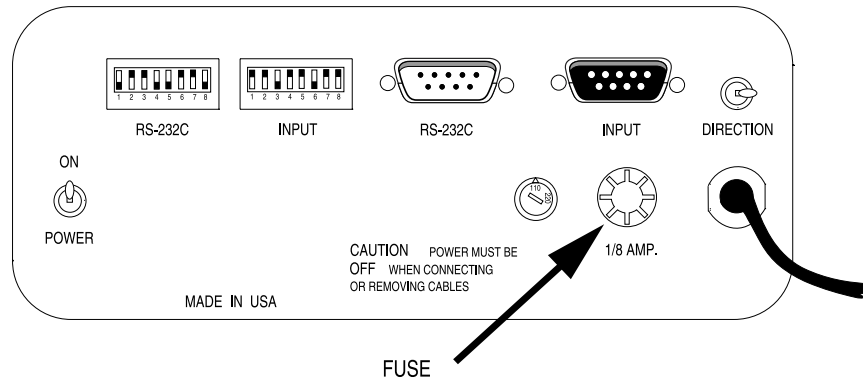


Figure 1.1
Back Panel of
1-MR Microcode II

Standard Front Panel Controls

IN/MM Selects and converts the display to inches or millimeters.

ABS/REL Selects either the absolute or relative mode.

ZERO Zeroes the display readout and establishes the absolute and/or relative reference point.

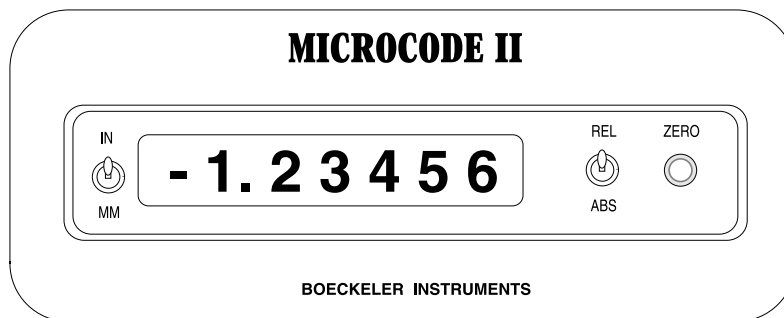


Figure 1.2
Front Panel of
1-M Microcode II

Offset Model Controls

THUMBWHEEL SWITCHES

Holds the offset dimension to be entered into the display. The dimension is not entered until the OFFSET button is depressed.

OFFSET

Enters the offset dimension or removes it from the display.

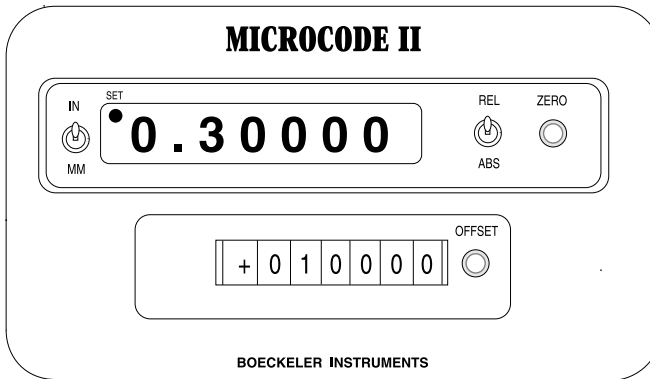


Figure 1.3
Front Panel of Microcode II 1-MO

Scaler Model Controls

THUMBWHEEL SWITCHES

Holds the multiplying scale factor for scaling the display. The factor is not entered until the SCALER button is pressed or the IN/OUT switch is set to IN.

IN/OUT

Switches the scaler function IN (display in scaled units) or OUT (display in unscaled units).

SCALER

Enters a new scale factor from thumbswitches.

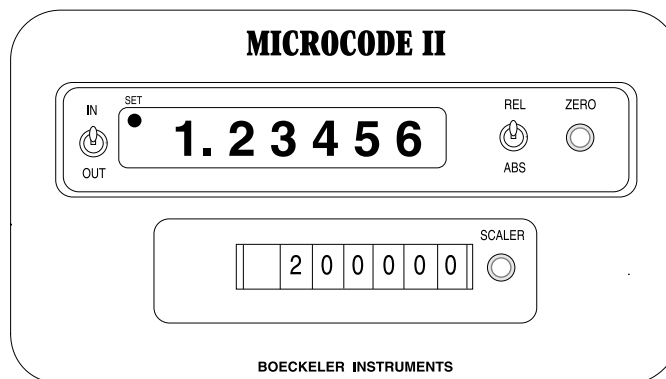


Figure 1.4
Front Panel of Microcode II 1-MS

OPERATION

Power

Turn on the readout by setting the rear panel POWER switch to ON. The display will read "HELP-00" (see "Error Messages" below). Move the measuring device to its absolute (zero) reference point and press the ZERO button on the front panel. The display will be cleared to "0.00000" and ready for use.

Error Messages

The error messages "HELP-00" and "HELP-99" may appear on the display. Their meanings and the appropriate action are described below.

The HELP-00 message means:

1. POWER TURNED ON OR INTERRUPTED: **Move the measuring device to its absolute reference point and press ZERO** to clear the display.
2. DIRECTION SWITCH POSITION CHANGED: **Re-zero the display as above -- OR -- Flip the direction switch back to its original position** to cancel the direction change.

The HELP-99 message means:

1. DISPLAY RANGE (+999999) EXCEEDED: Move the measuring device back within the display range. Measurements will not be lost.

Zero

The digital readout can be zeroed in the ABS (absolute) or REL (relative) modes. In many cases the mode will not matter, but the following points should be noted.

To zero out in ABS Mode:

1. **Press the ZERO button twice to set the absolute reference point.** The button must be pressed twice to prevent accidental loss of the absolute reference.

When the ZERO button is pressed the first time, a light (the "zero indicator") in the right corner of the LED display will blink. To cancel the zero operation, simply wait a couple of seconds for the light to stop blinking.

To zero out in REL Mode:

1. **Press the ZERO button once to set the relative reference point.** The absolute reference will not be affected.

To Zero While in HELP-00 Mode:

1. When the "HELP-00" message is displayed, press **ZERO** once. The absolute reference point will be set to zero regardless of the setting of the ABS/REL switch.

Direction

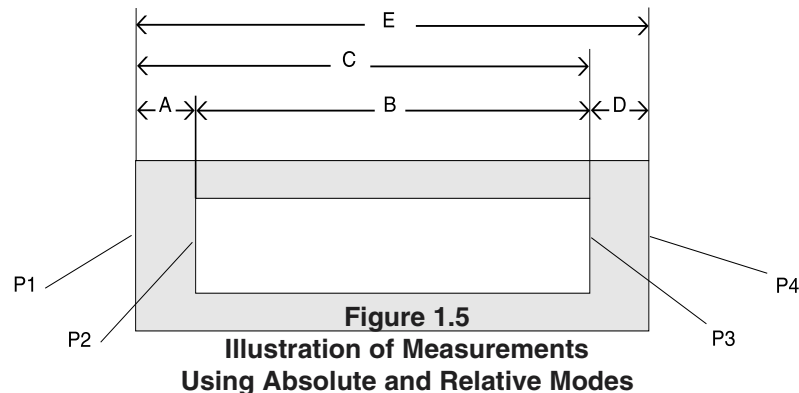
The direction that the measuring device will travel for a positive display can be changed by moving the DIRECTION switch on the rear panel of the readout. The display will read "HELP-00." Users may then:

1. Press **ZERO** once to set a new absolute reference point and confirm the direction change -- OR --
2. Move the DIRECTION switch back to its original position to cancel the direction change. Measurement will not be lost.

Absolute / Relative (ABS / REL)

The absolute/relative measuring function allows a sequence of measurements to be made 1) from an absolute reference and 2) from any other points, without the loss of the absolute reference. This is done by selecting an absolute reference and then switching to the REL Mode when measurements from a new point are desired.

The following example illustrates measurement of distances A through E.



1. At P1, switch to ABS Mode and ZERO the display.
2. Measure distance A:
 - A. Move to P2.
 - B. Read distance A.
3. Measure distances B & C:
 - A. Switch to REL Mode and ZERO the display at P2.

- B. Move to P3.
 - C. Read distance B.
 - D. Switch to ABS Mode and read distance C.
4. Measure distances D & E:
- A. Switch to REL Mode and ZERO the display at P3.
 - B. Move to P4.
 - C. Read distance D.
 - D. Switch to ABS Mode and read E.

Inch / Metric (IN / MM)

The IN/MM switch selects inch or millimeter units and converts mathematically between the two choices. In **Figure 1.6**, note that the MM display has an additional leading zero signifying the metric selection.

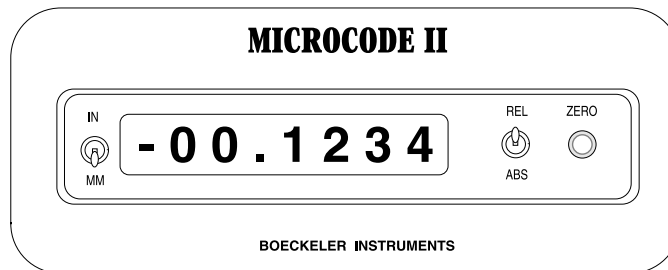


Figure 1.6
Front Panel of 1-M Microcode II
in Metric Mode (MM)

High Resolution Mode (4000 and 9000 series models)

The high resolution mode is used with Boeckeler models 4000 and 9000 series measuring devices. In this configuration, the resolution displayed in IN Mode is 0.00005". If desired, the display resolution can be changed to 0.00002(5)" by using the high resolution display feature. NOTE: The rightmost digit of the measurement value will not be displayed in this mode. The rightmost digit shown as "(5)" or "(0)" in this manual is not displayed by the Microcode II digital readout.

The high resolution feature is inoperative when the readout is turned on. It can be activated as follows:

1. **Be sure the IN/MM switch is in the IN position.**
2. **Place the REL/ABS switch in the ABS position.**
3. **Press the ZERO button once.** Do NOT press it twice or the display will be zeroed.
4. **While the zero indicator is flashing, flip the IN/MM switch to the MM position, then back to the IN position.** The zero indicator will stop flashing as soon as the switch is moved.

The high resolution feature is active. Instead of increments from 0.00000 to 0.00005 to 0.00010, etc., successive readings on the display will be 0.00000(0) to 0.00002(5) to 0.00005(0), etc. The rightmost digit of the measurement value is not displayed in the high resolution IN Mode because there are not enough places in the display for seven (7) digits. However, the seventh digit can be easily computed. Since in the high resolution mode, the readout displays measurements in increments 0.00002(5)", the seventh digit may be assumed to be a "0" or a "5." For example, readings of 0.00002 would be read as 0.00002(5); a reading of 0.00005 would be read as 0.00005(0); a reading of 0.00007 would be read as 0.00007(5), and so on.

5. **To deactivate the high resolution feature, repeat steps 1-4.**

The high resolution mode is not displayed when the IN/MM switch is set to MM (values in millimeters are always displayed in standard resolution).

Extra Precision Feature (1338 and 1398 models)

The extra precision feature is used with Boeckeler models 1338 and 1398 measuring devices. In this configuration, the standard resolution displayed in IN Mode is 0.00001". If desired, the display resolution can be changed to (.)000005" by using the extra precision feature. NOTE: The leftmost digit of the measurement value will not be displayed in this mode. Decimal points shown as "(.)" in this manual are not displayed by the Microcode II digital readout.

The extra precision feature is inoperative when the readout is turned on. It can be activated as follows:

1. **Be sure the IN/MM switch is in the IN position.**
2. **Press the ZERO button once.** Do NOT press it twice or the display will be zeroed.
3. **While the zero indicator is flashing, flip the IN/MM switch to the MM position, then back to the IN position.** The zero indicator will stop flashing as soon as the switch is moved.

The extra precision feature is active. Instead of increments from 0.00000 to 0.00001 to 0.00002, etc., successive readings on the display will be (0.)000000 to (0.)000005 to (0.)000010, etc. The leftmost digit of the measurement value is not displayed in the extra precision IN Mode because there are not enough places in the display for seven (7) digits.

4. **To deactivate the precision feature, repeat steps 1-3.**
5. **To temporarily switch between the precision feature and standard display, press the ZERO button once.**

The zero indicator light will flash and the standard resolution will be displayed while the light is flashing. When the light discontinues flashing, the display will return to its precision feature reading. This procedure is the same for the reverse circumstance, that is, when switching from the standard display to a temporary precision display.

Extra precision has no effect when the IN/MM switch is set to MM (values in millimeters are always displayed to standard precision).

Offset Model

The OFFSET Mode in the offset model ("O" option) provides the correct display reading when the measurement distance exceeds the range of the measuring device. Turning on the OFFSET Mode corresponds to the addition of a gauge block to a measurement. Turning off the OFFSET Mode corresponds to the removal of a gauge block.

To turn on the offset:

1. **Enter the offset distance by turning the thumbwheels to the desired setting.** Be sure that the unit of measure for the offset is the same as that for the display setting, i.e., IN or MM).
2. **To enter the value, press the OFFSET button.** The SET indicator will be lit, and the readout will display the added offset value. Refer to Figure 1.7.

***NOTE:** In Figure 1.7, the offset is +0.10000, causing the 0.20000 measurement to change to 0.30000. Note that the SET indicator is lit.*

To turn off the offset:

1. **Press the OFFSET button -- OR --**
2. **Press the ZERO button while in the ABS Mode.**

The SET indicator will no longer be lit, and the readout will display the measurement without the offset distance.

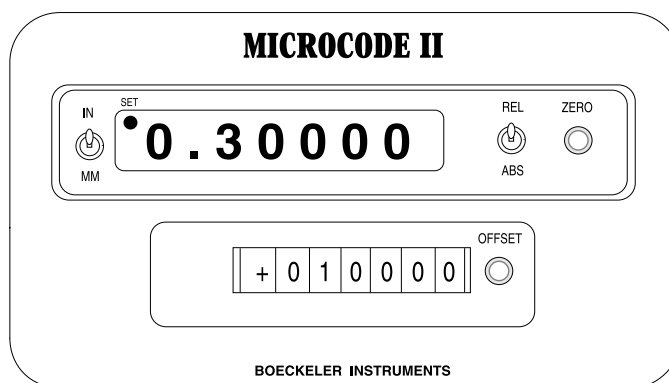


Figure 1.7
Front Panel of Microcode II 1-MO
with Offset Activated

Scaler Model

The Microcode II digital readout scaler model ("S" option) is typically used with a digital filar eyepiece on a microscope. The adjustable multiplying scaler (0 to 9.99999) converts the digital counts from the filar to match a reference distance (such as 1 micron, 0.0002", etc.) The operation is simple and is described below.

To set and display the scale factor:

1. **Set the scale factor by turning the thumbwheel switches to the desired setting.** The scale factor range is 0 to 9.99999 .
2. **Set the IN/OUT switch to the IN position.** The IN/OUT switch selects the condition of the digital display -- IN displays scaled counts, OUT displays unscaled counts.
3. **Press the SCALER button.** The scaler is now applied, which means that the unscaled counts have been multiplied by the scale factor. The SET indicator light will be on signifying that the displayed value is in scaled counts. Refer to **Figure 1.8**.

To turn off the scale factor:

1. **Set the IN/OUT switch to the OUT position.** The SET indicator light will be turned off signifying that the displayed value is now in unscaled counts.

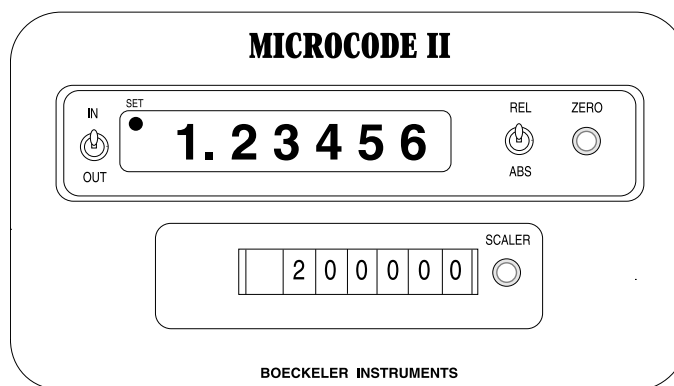


Figure 1.8
Front Panel of Microcode II 1-MS
with Scaler Activated

Calculating a Scale Factor

The scale factor is determined by the following procedure.

1. **Determine a reference distance to which the display is to be scaled.**

EXAMPLE:
0.001 000"

NOTE: This example means that the user has an accurate reference of 0.001" and the desired resolution is 0.000 001".

2. **Set the IN/OUT switch to OUT.**
3. **Press ZERO to zero out the display at the start of the reference distance.**
4. **Move the filar reticle to the other end of the reference distance.** The display reflects an unscaled count.

EXAMPLE:
1128

5. **Calculate the appropriate scale factor using the following formula.**

$$\text{Scale Factor} = \frac{\text{Desired Reading}}{\text{Unscaled Count}} = \frac{1000}{1128} = .8865248$$

6. Round the resulting scale factor to five (5) decimal digits.

EXAMPLE:
.8865248 = 088652

7. **Enter this scale factor into the scaler by using the thumbwheel switches.** Remember that the thumbwheel scaler display has an implied decimal point to the right of the leftmost digit.
8. **Set the IN/OUT switch to the IN position.** The display now reflects the scaled value.

EXAMPLE:
1000

CONFIGURATION

The Microcode II digital readout is designed to operate with all Boeckeler measurement devices. The readout is configured for a particular device by setting dip switches located on the back panel. The set of eight (8) dip switches for use with measuring devices are labeled "INPUT." Each readout axis has its own set of dip switches, so, instead of one set of INPUT dip switches as shown in **Figure 1.9**, a 3-axis digital readout would have three sets of INPUT dip switches.

NOTE: Power down before changing dip switch settings.

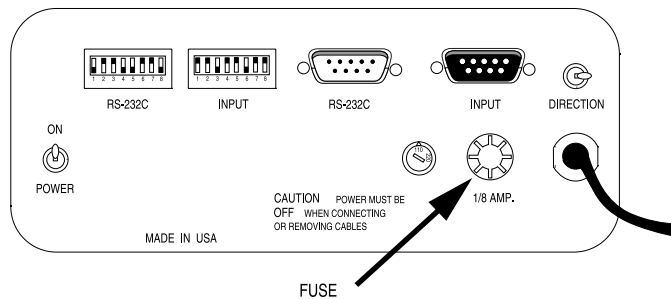


Figure 1.9
Back Panel of Microcode II 1-MR

Below in **Table 1.1** are the standard INPUT dip switch settings for most Boeckeler devices. The section following the table describes the functions of each individual switch, which may be useful for producing special configurations. For most purposes, this table will be all that is needed. **NOTE:** The "X" means "ON" or "UP." The "O" means "OFF" or "DOWN."

Boeckeler Measuring Device	1	2	3	4	5	6	7	8	Readout Set Up Code
1338/1398	O	X	O	O	O	X	X	X	A
4038/4098/9498/9438/9598/9538	O	X	X	O	O	X	X	O	B
LM	O	O	X	O	X	O	X	X	D
301E/302E/31.25E	O	X	X	O	X	O	O	O	E
101/102/104/301M/302M/LMH	O	O	X	O	X	O	O	O	F
401E/402E/404E	O	X	X	O	X	O	O	X	G
401M/402M/404M	O	O	X	O	X	O	O	X	H
501M/502M/504M	O	O	X	O	X	O	O	X	H
201E	O	X	X	O	O	X	X	X	I
20.5E	O	X	X	O	O	X	O	O	J
FILAR (scaler)	X	X	X	X	X	O	O	O	K
FILAR Decimal Pt. .00000	X	X	X	O	O	X	O	O	
4037/4097	O	O	X	O	O	X	X	X	L
1337/1397	O	O	X	O	O	X	O	O	M
125 SLOT 9300/6098/6038	O	X	O	O	X	O	X	X	N
1/2 Micron Linear	O	O	X	O	O	X	X	X	
10 Micron Linear	O	O	O	O	X	O	X	O	

Dip Switch Descriptions

This section describes the functions of the individual dip switches.

Switch Number 1: SELECT MODEL TYPE

OFF = Standard or Offset Model

ON = Scaler Model

This switch controls the functions of the IN/MM (IN/OUT) switch, the thumbwheel switches, and the OFFSET (SCALER) button.

Switch Number 2: SELECT ENGLISH OR METRIC MEASURING DEVICE

OFF = Metric Device

ON = English Device

This switch has no affect on scaler models. On standard or offset models, it determines whether the measuring device is metric (millimeters) or English (inches).

Switch Number 3, 7, 8: SET DEVICE COUNT RATE

Switches 3, 7, and 8 determine the device count rates, that is, the amount by which the rightmost digit of the display changes for each count from the measuring device. For example, a model 501M digital dial indicator produces one count for every 0.002 mm of travel, so its count rate is 1. A count rate less than 1 means that the far right digit does not change on every count. For example, a count rate of 0.2 means that the far right digit changes by 1 on every fifth count (2 for every tenth).

Switches 3, 7, and 8 have no affect on scaler models. On standard and offset models, they set the count rate when the IN/MM switch is set to the device's "base" mode (i.e., IN for an English device, or MM for a metric device).

<u>Switch Number and Setting</u>			<u>Count Rate (Digits per Count)</u>
<u>3</u>	<u>7</u>	<u>8</u>	
OFF	OFF	OFF	0.1
OFF	OFF	ON	0.2
OFF	ON	OFF	0.25
OFF	ON	ON	0.5
ON	OFF	OFF	1
ON	OFF	ON	2
ON	ON	OFF	2.5
ON	ON	ON	5

Switch Number 4, 5, 6: SET DECIMAL POINT POSITION

Switches 4, 5, and 6 set the position of the decimal point on the display.

<u>Switch Number and Setting</u>			<u>Display Inch & Scaler</u>	<u>Display Millimeters</u>
<u>4</u>	<u>5</u>	<u>6</u>		
OFF	OFF	OFF	NOT ALLOWED	NOT ALLOWED
OFF	OFF	ON	0.00000	00.0000
OFF	ON	OFF	0.0000	00.000
OFF	ON	ON	0.000	00.00
ON	OFF	OFF	0.00	00.0

ON	OFF	ON	0.0	00
ON	ON	OFF	0	0
ON	ON	ON	NOT ALLOWED	NOT ALLOWED

Special Configuration Example

The Boeckeler model 501M digital dial indicator produces one count every 0.002 mm. The readout configuration is determined as follows:

Switch Number 1: OFF (Standard or Offset Model)
 Switch Number 2: OFF (Metric-based device)
 Switch Number 3: ON (Count rate of 2 digits per count)
 Switch Number 4: OFF (Metric-mode display of 00.000)
 Switch Number 5: ON
 Switch Number 6: OFF
 Switch Number 7: OFF
 Switch Number 8: ON

The readout configuration is:

<u>Switch Number:</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>
Setting:	0	0	X	0	X	0	0	X

SERVICE

The Microcode II digital readout was designed to eliminate the need for field service. If trouble is encountered, follow the checkpoints below before contacting Boeckeler Instruments.

1. **Verify that all cable connections are tight.**
2. **Be sure that power is available.**
3. **Check the fuse.**

If the difficulty is not corrected during the above check, contact Boeckeler Instruments for assistance at (800) 552-2262 or (520) 745-0001.

***NOTE:** When the digital readout was shipped, it was set up to operate with a particular Boeckeler measurement device. This configuration can be changed by following the instructions under the section entitled **Configuration**, which begins on page 17.*

SPECIFICATIONS

POWER	Standard -- 115 volt -- 50/60 cycle Optional -- Switchable 115/220 volt -- 50/60 cycle NOTE: Must be connected to a grounded outlet. Do not remove ground pin.
FUSE	Replace only with the same type and current rating. Use of incorrect fuse will void the warranty.

RS-232 OPTION (R)

Introduction

The RS-232 interface option can be ordered with any Microcode II digital readout model ("R" option). The interface is located within the Microcode II, and is used to transmit information from the Microcode II to any terminal, computer, or printer which accepts standard RS-232 serial input. Data can be transmitted on command from a remote switch or from the receiving device.

When the interface is installed in a Microcode II equipped with either the offset or scaler option, it can be used to include a date and/or batch number in the output data. When used in this mode, the thumbwheel switches on the front of the readout are utilized to enter the date and batch numbers.

The RS-232 interface can also be ordered with an option for calculating the average of a series of measurement readings. This option is normally used only with a printer, and includes a special printer cable with two foot switches. The first switch provides a transmit command to the interface which functions exactly like the standard version. The second switch commands the interface to calculate and print the average of the measurement readings.

The RS-232 interface supports data transmission rates ranging from 300 to 19,200 baud.

General Description

The rear panel of Microcode II digital readouts equipped with the RS-232 interface include a DB-9 type female connector as shown in **Figure 1.10** below. Several cables are available from Boeckeler Instruments for connecting the Microcode II to a variety of devices including printers and computers. The front panel of a Microcode II readout that is equipped with an RS-232 interface is identical to a readout without the interface.

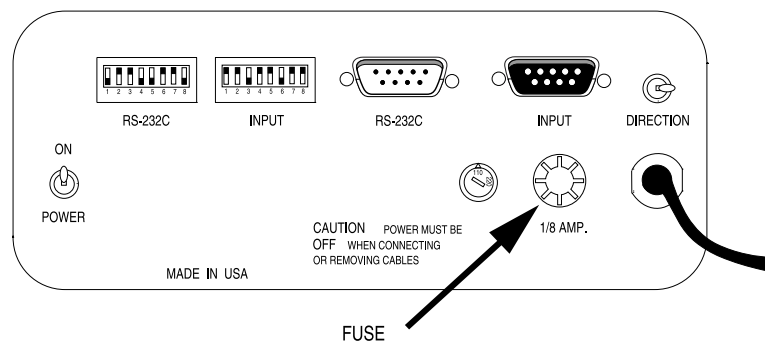


Figure 1.10
Back Panel of Microcode II 1-MR
with RS-232 Interface

Output Format

The RS-232 interface can output data in several formats.

- Reading can be sequentially numbered or the sequence numbers can be omitted.
- Output can be "long form" with units (inch/mm), scaled or unscaled, and the presence of an offset indicated; or "short form" with only the numerical value transmitted.
- All axes on a multi-axis readout can be output on a single line (horizontal mode), or with a single line for each axis (vertical mode).

Short and Long Forms

The short form output for an axis includes the axis identification (X, Y, Z or A), the direction sign (+ or -) and the numerical reading for that axis, as in the following example:

X+0.25935

If no decimal point is shown on the display, the format is displayed as follows:

X+999999

The long form output also includes the axis identifier, the direction sign (+ or -), the numerical reading for that axis, the units (IN, MM, S_ or U_ for scaled or unscaled) and the offset flag (0 for offset and _ for no offset).

X+0.25935 IN	(reading in inches)
X+1.72935 IN O	(reading in inches, with an offset)
X+06.5875 MM	(reading in millimeters)
X+43.9255 MM O	(reading in millimeters, with an offset)
A+003410 U	(scaler output, unscaled)
A+008662 S	(scaler output, scaled)

Horizontal and Vertical Modes

In the horizontal mode, a data set of two or more axes is output on one line as in the following example (VERT = OFF, SEQ = ON, LONG = ON):

001 X+0.23425 IN	Y+0.00030 IN O	Z-5.12500 IN O
002 X+0.23555 IN	Y+0.00030 IN O	Z-0.12500 IN O

In the horizontal mode using the short form, the display would look like this (VERT = OFF, SEQ = ON, LONG = OFF):

001 X+0.23425	Y+0.00030	Z-5.12500
002 X+0.23555	Y+0.00030	Z-0.12500

In the vertical mode, each axis is output on a separate line, as in the following example (VERT = ON, SEQ = ON, LONG = ON):

001 X+0.23525 IN
Y+0.00030 IN
Z-5.2500 IN
002 X+0.23555 IN
Y+0.00030 IN
Z-0.12500 IN

In the vertical mode using the short form, the output would look like this (VERT = ON, SEQ = ON, LONG = OFF):

001 X+0.23525
Y+0.00030
Z-5.2500
002 X+0.23555
Y+0.00030
Z-0.12500

NOTE: Axes are output in the sequence X, Y, Z, A.

Sequence Numbering

When sequence numbering is active, the first line of each data set includes a three-digit sequence number (or three blank spaces for the remaining axes), the display reading and the long form information (if selected, as shown in example).

011 X+9.99999 U

NOTE: For data communications (outputting to a computer), it is recommended that the sequence option be disabled.

Sequence numbering starts at 001 when the interface is powered on. The numbering can be reset to 001 without turning the unit off.

To reset sequence numbering:

1. **Flip the DIRECTION switch(es) on the back of the readout.** The display will read "HELP-00."
2. **Flip the DIRECTION switch(es) back to its original position.** The interface will begin numbering from 001 again.

Error Messages

If one of the axis displays is showing a "HELP-00" or "HELP-99" message, the RS-232 interface will also output that message.

X HELP-99
Y HELP-00

The message "ERROR" will be output if one of the inputs is connected improperly or has some other fault, as in the following example:

X+0.25935 IN Y+06.5875 MM Z ERROR

Date and Batch Number

When used with a Microcode II digital readout scaler or offset model, the RS-232 interface can include a date and batch number in the output. The scaler/offset thumbwheel switches are used to enter the date and batch number.

To enter the date:

1. **Set the sign in the first thumbwheel switch to "+" .**
2. **Enter the date using the remaining switches, as in the example below.**

+032195 (this means "March 21, 1995")
3. **Set the ABS/REL switch in the ABS position.**
4. **Press the ZERO button once.** The ZERO indicator will begin to flash.
5. **Press the SCALER or OFFSET button.** When this button is pressed, the date is output. If a batch number was also entered, it will be output at this time, as well.

To enter the batch number:

1. **Set the sign in the first thumbwheel switch to " - " .**
2. **Enter a six-digit batch number using the remaining switches, as in the example below.**

-001033 (this means that the batch number is #1033)
3. **Place the ABS/REL switch in the ABS position.**
4. **Press the ZERO button once.** The ZERO indicator will begin to flash.
5. **Press the SCALER or OFFSET button to output the batch number.** If a date was also entered, it will be output at this time, as well.

Date and Batch Number Format

The format in which the date and batch number will be output depends on the setting of the long form and vertical format options. They may be displayed as follows:

DATE 09-22-96 (short form, horizontal mode)
BATCH 001033

DATE 09-22-96 (short form, vertical mode)
BATCH
001033

If sequence numbers are selected, each line of the date/batch output will be preceded by four blank spaces in order to align the date and batch numbers with the readings.

Configuring the Interface

The output format and RS-232 transmission rate are set using eight configuration switches labelled "RS-232" on the back panel of the readout. The description of each switch follows.

Switch Number	Switch Name	Description
1	Vert	Selects vertical or horizontal format. ON = Vertical format OFF = Horizontal format
2	LF	Controls whether or not a line-feed is sent after each carriage return. ON = Insert line-feed OFF = Do not insert line-feed
3	BL	Controls whether or not a blank line is output after each complete data set. ON = Print blank line OFF = Do not print blank line
4	SEQ	Controls whether or not sequence numbers are printed. ON = Print sequence numbers OFF = Do not print sequence numbers
5	LONG	Controls whether long form information (scaling and offset) is output with each axis. ON = Include long form information OFF = Do not include long form information
6,7,8	BAUD	Selects the data transmission rate.

Switch No.			Baud Rate
6	7	8	
OFF	OFF	OFF	300
OFF	OFF	ON	600
OFF	ON	OFF	1200
OFF	ON	ON	2400
ON	OFF	OFF	4800
ON	OFF	ON	9600
ON	ON	OFF	19200

Standard Configuration

Character data is output from the interface as 8 data bits in ASCII (American Standard Code for Information Interchange) with one stop bit, no parity.

All Microcode II interfaces are delivered with the following configuration.

Baud Rate:	9600 Baud	Long Form:	On
Line Feed:	Off	Seq. #	On
Mode:	Vertical	Blank Line	Off

Interface Connections

The RS-232 interface model may be connected to any printer, terminal or computer which accepts RS-232 transmissions at rates from 300 to 19,200 baud. The interface signals are described below. "Low" means a voltage below -3 volts, and "high" means a voltage above +3 volts.

Pin Number	Pin Name	Description
1	DCD	Not Used.
2	RXD	RXD Transmitted Data (output). This line is active both high and low whenever the interface data is transmitted on this pin.
3	TXD	TXD Received Data (input). This pin may be used by a remote device to trigger data transmission by a high-to-low pulse of at least 100 microseconds duration. Normally, TXD would be connected to the RS-232 output of a computer, and transmission would be triggered by sending an ASCII NUL character. If desired, the signal polarity of this pin can be reversed by Boeckeler at the factory.
4	DTR	DTR Data Terminal Ready (input). The remote device must set this line high to allow the interface to transmit data. If DTR goes low at any time, the interface will stop transmitting until it goes high again. The interface will not stop in the middle of a character. IMPORTANT: <i>If this pin is not used, it must be connected to pin 6 at the RS-232 connector.</i>
5	GND	GND Signal Ground. Pin 5 must be connected to signal ground at the remote device connector.
6	DSR	DSR Data Set Ready (output). The interface sets this line high whenever it is on and functioning properly.
7	RTS	Not Used.
8	CTS	CTS Clear to Send (output). This line is high whenever the interface is ready to accept a request for data from the remote device. When CTS is low, requests for data on pin 2 (RXD) or 9 (SEND) are ignored. CTS will not go high until RXD is low.
9	SEND	Send Data Block (input). Grounding this pin for at least 1 msec causes the interface to send a block of data. This is the normal method for initiating transmission when the interface is connected to a printer. The line must be brought high and then low again to cause the next transmission in to take place.

Averaging Option R(C)

General Description

An optional version of the RS-232 interface model is available which allows calculation and printing of the average in a series of readings. This option is normally used with a printer. The printer cable supplied with this option has two foot switches, one labeled PRINT and one labeled AVG. The PRINT switch functions like the foot switch on the standard version of the interface. The AVG switch causes the interface to calculate and print the average of the readings, as in the example below.

```
001 X+00.4072 MM
002 X+00.4081 MM
003 X+00.4084 MM
004 X+00.4070 MM
005 X+00.4073 MM
AVG X+00.4076 MM
```

There are several important points to note about the averaging option:

1. Only one average can be calculated at a time. In the case of multiple-axis displays, only the X-axis can be averaged.
2. All readings to be averaged must be in the same units (inches, millimeters, etc.) Further, readings made with an offset can not be averaged with readings made without an offset. Generally, all readings in a series must have the same label, as in the above example which is entirely in millimeters.
3. A series to be averaged may contain up to 255 readings.
4. Printing an average automatically resets the sequence counter to 001 to start a new series. Clearing the sequence counter cancels the current series and starts a new one.
5. If the average cannot be calculated because of mixed units, more than 255 readings, or no readings in a series, the following message will be output when the AVG switch is pressed:

AVG X ERROR

An error in averaging will not interfere with normal printing. Users can print a series of readings with mixed units; however, they will not be averaged.

Dip Switches

Two of the dip switches in the averaging RS-232 interface have different functions than those in the standard RS-232 interface. These switches are number 2 and 3 (LF and BL on the standard interface). The LF and BL functions are not available with the averaging option. The functions of these switches in the averaging option are as follows:

Switch Number	Switch Name	Description
2	APD	Disables automatic printing. Some custom versions of the Microcode II will print automatically when a reading is complete without using a PRINT switch. When this switch is on, only the PRINT switch can be used to transmit a reading.
3	SWAP	Swaps the functions of the PRINT and AVG switches. ON = Normal operation of AVG and PRINT switches. OFF = Swaps functions of the AVG and PRINT switches.

Interface Connections

Two pins on the interface connector are also redesignated for the averaging interface option.

Pin Number	Pin Name	Description
1	ASEND	Alternate Send (input). Grounding this pin for at least 1 msec triggers the PRINT or AVG function, depending on the setting of the SWAP switch.
9	SEND	Primary Send (input). Grounding this pin for at least 1 msec triggers the PRINT or AVG function, depending on the setting of the SWAP switch.

Special Printer Option R(B)

General Description

The optional R(B) version of the RS-232 interface model is specifically designed for compatibility with most Mitutoyo SPC printers. This option may also be retrofitted to many of the Boeckeler Microcode II digital readouts. The readout is connected to the printer using the cable supplied by Boeckeler. The cable's 9-pin connector is attached to the RS-232 port on the back of the readout, and its 10-pin connector is attached to the input port on the side (DP-1 model) or back of the printer (DP-2, DP-3). **IMPORTANT:** *The connector to the Mitutoyo printer must be inserted with the cable leading out from the bottom of the connector, rather than from the top.*

Whenever possible, the printer should be turned on before the readout and turned off after the readout. If the readout is turned on first, press the printer's CLEAR or AC key before proceeding.

Data Output

The DP-1 and DP-2 printers can be used as simple printers without making use of their statistical capabilities. This is accomplished by setting readout's dip switch 1 (LIT) to the ON position. When the printer's foot pedal or DATA button is pressed, the current readout is printed. The exact output format depends on the printer being used and the setting of the DP-2 switches, as well as the setting of dip switch 4 (SEQ) on the readout.

The DP-2 printer can produce output with or without sequence numbers. The readout's dip switch 2 (DP-2) should be set to ON for this printer. If dip switch 4 (SEQ) is OFF, output will not have sequence numbers, as shown below.

0.01045 I
0.01053 I
0.01044 I

NOTE: *In this mode, there is no way to distinguish between readings from the several axes of a two-axis or three-axis readout.*

If dip switch 4 (SEQ) is set to ON, the first line of each reading is provided with a sequence number, shown below.

One axis readout (1-M)

1 0.01045 I
2 0.01053 I
3 0.01044 I

Two axis readout (2-M)

1 0.01045 I
0.00220 I
2 0.01053 I
0.00225 I
3 0.01044 I
0.00218 I

The DP-1 printer will produce output only with the sequence numbers; they may not be omitted. Switch 2 would be OFF for use with the DP-1 printer. Switch 4 (SEQ) would be ON, but turning it off will have no affect. Since each line must have a sequence number, multiple

axis readouts will show the same number for each line of a single reading, as shown below in the example for a two axis readout:

```
1 0.01045 I
1 0.00220 I
2 0.01053 I
2 0.00225 I
3 0.01044 I
3 0.00218 I
```

In literal output mode, the sequence numbers are produced by the Boeckeler Microcode II digital readout, not by the printer. Sequence numbering may be reset to begin again with a "1" by following the steps below:

To reset sequence numbering:

1. **Flip the DIRECTION switch on the back of any of the readouts connected to the printer interface.** The readout will display "HELP-00."
2. **Flip the DIRECTION switch back to its original position.** The interface will begin numbering from "1" again.

Statistical Data Output

The DP series miniprocessors may be used for performing statistical calculations on the collected data. When dip switch 1 (LIT) is set to OFF, data output is in a form suitable for statistical processing. For details, consult the operating instructions for the printer.

When data is printed in the statistical mode, the sequence numbers output are provided by the printer, not by the readout. Sequence numbering can be reset only by clearing the printer memory.

Inch/Metric Conversions

The DP series printers assume that all data printed will be in a single format, with the same number of decimal places. Changing the readout's IN/MM switch setting moves the displayed decimal position, but the printer will not recognize the change. In literal output mode, operators should press the printer's CLEAR or AC key when changing the IN/MM mode. In statistical mode, operators should avoid mixing inch and metric output.

Dip Switches

The dip switches in the special R(B) RS-232 interface have different functions than those in the standard RS-232 interface. The new functions are as follows:

Switch Number	Switch Name	Description
1	LIT	Selects literal or statistical data output. Must be OFF for use with DP-3 printer. ON = Literal data output OFF = Statistical data output

2	DP2	Swaps the functions of the PRINT and AVG switches. ON = Normal operation of AVG and PRINT switches. OFF = Swaps functions of the AVG and PRINT switches.
3	TRUNC	Causes the output to be truncated after the first axis reading. ON = Print only the first axis reading. OFF = Print all axis readings.
4	SEQ	Controls whether or not sequence numbers are printed when LIT is set to ON. Sequence numbers are optional only on the DP-2 printer. If switch 2 is OFF, sequence numbers will always be printed. ON = Print sequence numbers. OFF = Do not print sequence numbers.
5-8		Not used.

Programs to Test RS-232 Port

To test the RS-232 computer connection to the Microcode II digital readout, a program will need to be written for the computer. The requirements for such a program are as follows:

1. A personal computer with at least one serial port.
2. A version of BASICA, GWBASIC or Quick BASIC installed on the computer (other versions of BASIC may or may not have the same syntax as the program printed below).
3. A cable to connect the Microcode II RS-232 port to the computer port (Microcode II units have DB-9 connectors for RS-232 output).
4. The Microcode II readout powered up and displaying a measurement.

There are four different programs that may be used, depending on the number of axes the Microcode II displays and the baud rate that is desired for testing.

NOTE: Line 100 of these programs can be changed to specify any COM port the user prefers. When this program is run on the computer, the measurement reading on the Microcode II will be displayed on the computer monitor. If there are any questions, users are welcome to call the Service Department at Boeckeler Instruments, Inc., at (800) 552-2262 or (520) 745-0001.

Program 1

```
10 '
20 ' Model M RS-232 Demonstration Program 1
30 '
40 ' The display is a single-axis Model M with RS-232 interface
50 ' in its standard configuration: 600 baud, 8 bits; VERT, SEQ, and
60 ' LONG are on; LF and BL are off.
70 '
100 OPEN "COM1:600,N,8,1,CS,DS" AS #1
110 PRINT #1,CHR$(0); ' Request data from Model M
120 INPUT #1,M$ ' Input data string
130 M = VAL(MID$(M$,6,8)) ' Extract data value from string
140 PRINT M
150 GOTO 110
```

Program 2

```
10 '
20 ' Model M RS-232 Demonstration Program 2
30 '
40 ' The display is a dual-axis Model M with RS-232 interface
50 ' in its standard configuration: 600 baud, 8 bits; VERT, SEQ, and
60 ' LONG are on; LF and BL are off.
70 '
100 OPEN "COM1:600,N,8,1,CS,DS" AS #1
110 PRINT #1,CHR$(0); ' Request data from Model M
120 INPUT #1,M$: Input #1,M2$ ' Input X and Y data string
130 M1 = VAL(MID$(M1$,6,8)) ' Extract X value from string
140 M2 = VAL(MID$(M2$,6,8)) ' Extract Y value from string
150 PRINT M1,M2
160 GOTO 110
```

Program 3

```
10 '
20 ' Model M RS-232 Demonstration Program 3
30 '
40 ' The display is any single, dual, or triple Model M with RS-232
50 ' interface in its standard configuration: 600 baud, 8 bits; VERT,
60 ' SEQ, and LONG are on; LF and BL are off.
70 '
100 OPEN "COM1:600,N,8,1,CS,DS" AS #1
110 IF EOF(1) THEN PRINT #1,CHR$(0); ' Request data if buffer is empty
120 INPUT #1,M$ ' Input data (could be any axis)
130 PRINT M$ ' Print raw data string
140 GOTO 110
```

Program 4

```
10 '
20 ' Model M RS-232 Demonstration Program 4
30 '
40 ' The display is a single-axis Model M with the RS-232 interface
50 ' set at 9600 baud, 8 bits; VERT is on; LF, BL, SEQ and LONG are
60 ' off.
70 ' DIP switch number :    1    2    3    4    5    6    7    8
80 '                      ON OFF OFF OFF OFF ON OFF ON
90 '
100 OPEN "COM1:9600,N,8,1,CS,DS" AS #1
110 PRINT #1,CHR$(0); ' Request data from Model M
120 INPUT #1,M$ ' Input data string
130 M = VAL(MID$(M$,2,8)) ' Extract data value from string
140 PRINT M
150 GOTO 110
```

