

# Start Up Guide

## Models 155, 454FTB, 504FTB, and 534FTB.

December 2007

### 155 Line



### MFT B-Series



The following information is an abbreviated list of what you need to do for your flow meter to achieve maximum possible repeatability and accuracy. Most of the steps will be required for all products. Please read this before you start.

You will ultimately need to refer to the product manual, which is found on the attached CD. Given the Model number of your product, you can find the manual you require.



+ **Kurz Model #** =



### ***Unpacking/Expected Content***

Your flow meter has been shipped to you with the following items. Please make sure you have them and contact us if this is incomplete.

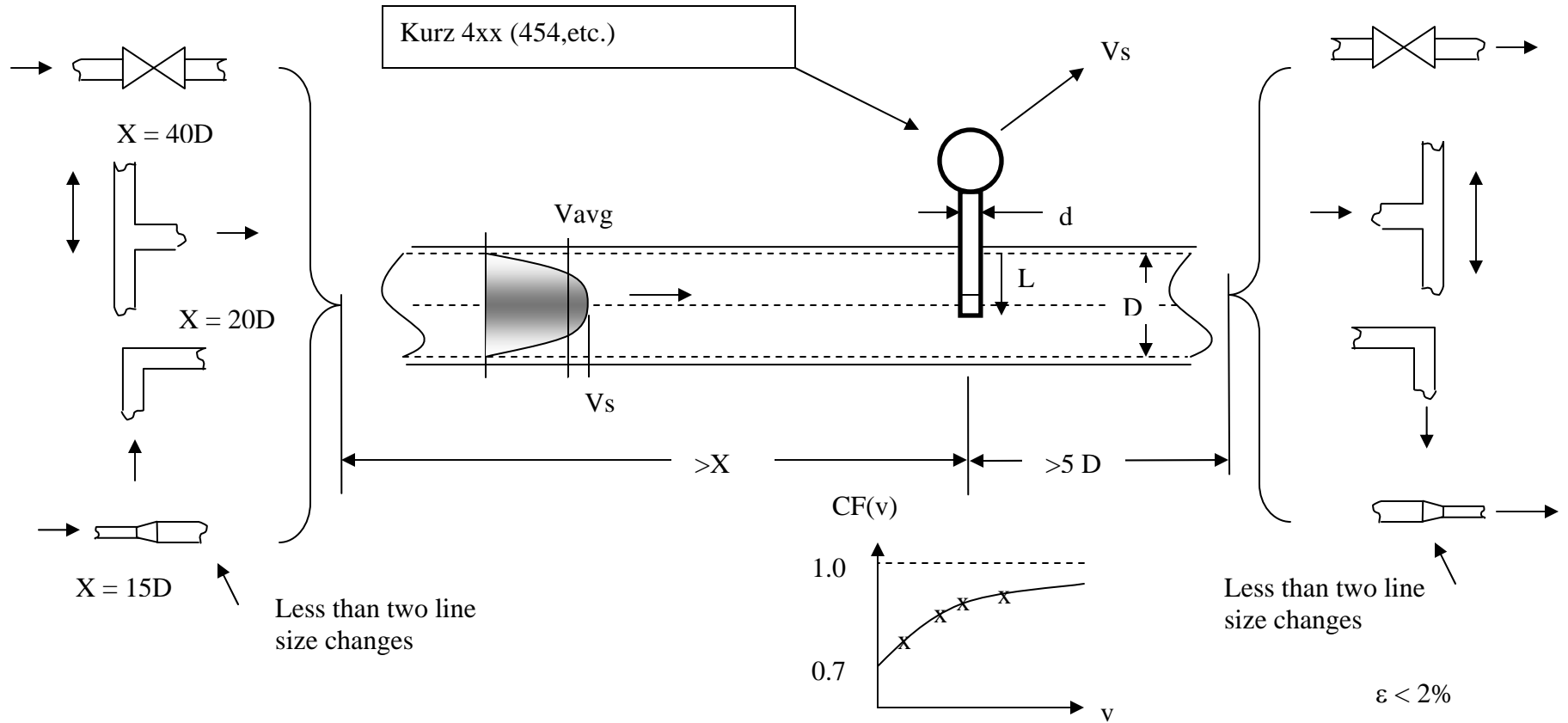
1. Flowmeter, compare the packing list against your order.
2. Calibration certificate
3. Flow Computer Input Configuration Sheet (155 only)
4. Manual on CD

### ***Mounting of the equipment (see guidelines sheet)***

You will need to remove the protective shipping covers from the sensor or flowbody before installing the unit. A thermal meter must have direct contact with the process fluid to work. The meter will need to be mounted in accordance to safe design practice accounting for the process pressures, corrosion, temperature and any potentially hazardous area requirements. The electronics head needs to be in an accessible area so you can do the wiring and access local keypad LCD if applicable. Some models have remote electronics heads, which must be mounted/wired too. Most units can be programmed with a Laptop portable computer using the USB interface and PC driver. For best results, please carefully look over the installation guidelines sheet for more on the sensor placement criteria.

**Insertion Meters** must be mounted with a compression fitting to the duct/pipe or flange mounted then checked for leaks. Make sure the insertion depth is adequate to get into the center 1/3 of the diameter where the flow profiles are the most stable. The distance from profile disruptions needs to be adhered to for the best repeatability/accuracy, see the guideline sheet for more details.

**In-Line Meters** have similar requirements for undisrupted straight runs except for the 534FTB line. Check for process fluid leaks.



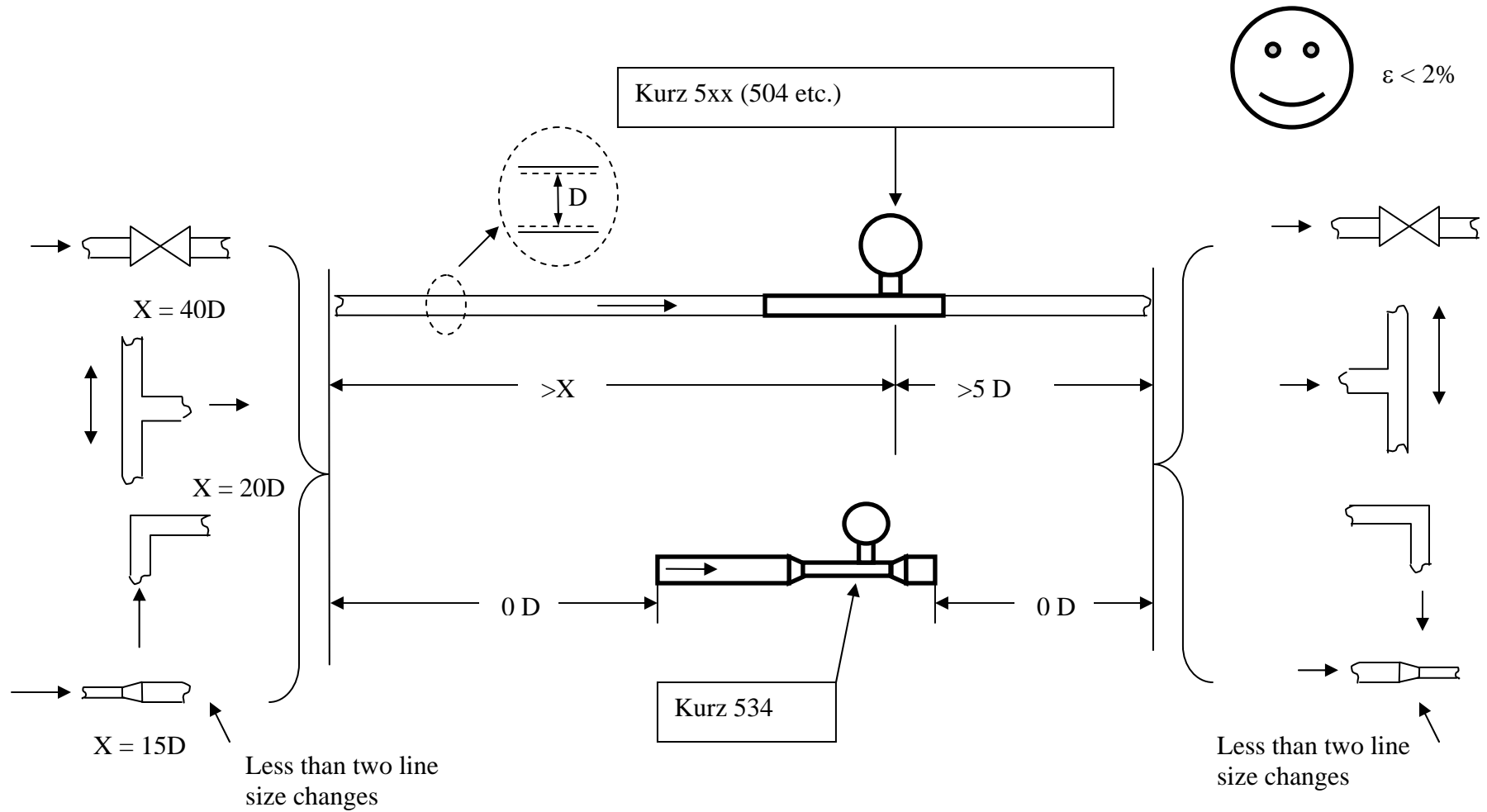
$$\begin{aligned}
 &+ \boxed{\begin{array}{l} A ? (\text{ft}^2 \text{ or } \text{m}^2) \\ A = D^2\pi/4 \end{array}} + \boxed{\begin{array}{l} L ? (\text{ft, m}), d ? (\text{in}) \\ \text{SBCF} = A/(A+12dL) \end{array}} + \boxed{\begin{array}{l} CF(v) ? \\ CF(v) = V_{avg}/V_s \\ 0.5 < CF(v) < 1.0 \end{array}} = \text{☺}
 \end{aligned}$$

## **Insertion Meter Installation Guidelines**

1. Mount Probe so its velocity sensing element is centered in the duct/pipe. This location has the most stable flow reading. Note the flow arrow direction points in the direction of the flow.
2. The upstream and downstream distance to flow profile disruptions from that of a straight pipe are “X” diameters upstream and 5 downstream. We have chosen 2% maximum error from the baseline straight pipe calibration for the distance criteria. Longer straight runs will reduce this error level. Here are four example cases in order of their disruption to the flow:
  - a. Valves change the flow profile as they open and close so the sensor should not be located too close. The gate valve is the worst and the metering valves are the best at reducing their flow profile changes between open and closed.
  - b. Branching joints also change the profile as the percentage of flow changes between the branches.
  - c. Elbows or direction changes will disrupt the long-run pipe profile. As this disruption settles down, the profile can wobble or move depending on the flow rate. Several elbows in different planes will impart a swirl that also imparts an error in the readings (flow is not straight on to the sensor) and the upstream distance should be increased. The distance from elbows may be reduced if field calibrations are used. Double elbows in different planes introduce swirl and need 50% more distance than a single elbow does.
  - d. A line size change will also disrupt the profile and can introduce instability so this should be avoided unless you have more experience on how to use this to your advantage. The distance from a line size change may be reduced if field calibrations are used.
3. The duct area or pipe inside dimensions are used to program the area of the flow meter. You enter the data in ft<sup>2</sup> or m<sup>2</sup> in the Program Mode of the meter.
4. The probe will block off some of the flow area and accelerates the velocity proportional to its area projected on to the duct/pipe cross section. This is known as the Sensor Blockage Correction Factor (SBCF) and is simply defined by entering the insertion depth (L) from the end of the window to the duct inside wall and specifying the diameter (d) of the probe in the Program Mode of the meter.
5. Field Calibration Data is the key to achieving accuracy for the insertion probe. Without this step you can have good repeatability but the absolute flow number requires a reference flow measurement be taken at the same time you record the indicated display of the insertion meter. The correction factor which is velocity dependent, CF(v), is defined as the ratio of True reading to Indicated reading. The basic calibration of the unit is a point velocity sensor. To convert this to volumetric flow rate or mass flow rate requires the proper area and the average velocity, this is where the field calibration fits in. As the field calibration method is quite long and technical, you are encouraged to do one of two things to achieve this:
  - a. Contract the field calibration with Kurz Instruments, Inc. or another reputable field calibration company.
  - b. Do it yourself if you have the experience or a test team at your disposal.

Common methods of doing reference method calibrations entail: duct traverses, tracer gas dilution method or the process Stoichiometry which requires support from your process engineering group. Sometimes the correction factors can be entered based on an ideal duct profile model or a finite element analysis (FEA) or computation fluid dynamics (CFD) program.

For more information on all the above, please refer to the full product manual provided on CD or at our website [www.kurz-instruments.com](http://www.kurz-instruments.com). Also see “Flow Measurements 2<sup>nd</sup> ed.” Edited by D. W. Spitzer, ISA Press 2001. Chapter on Insertion Flow Measurements.

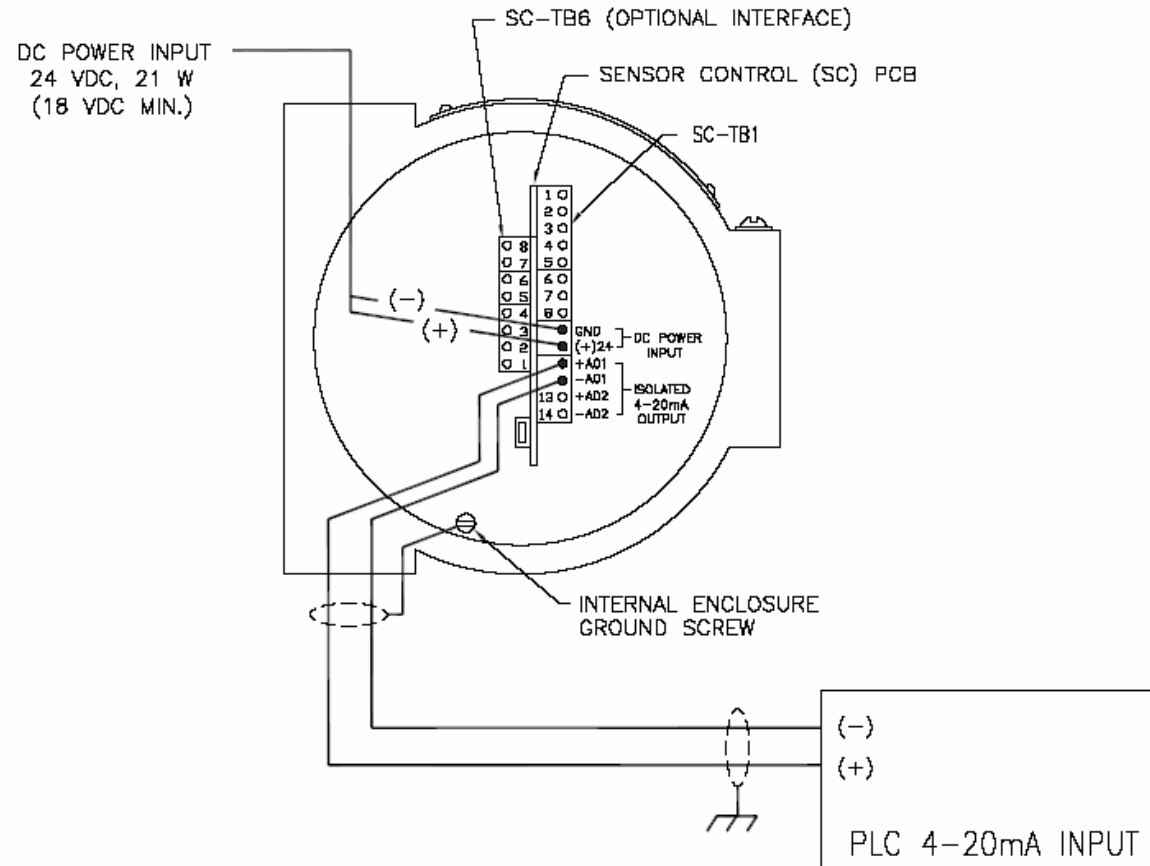


## **In-Line Meter Installation Guidelines**

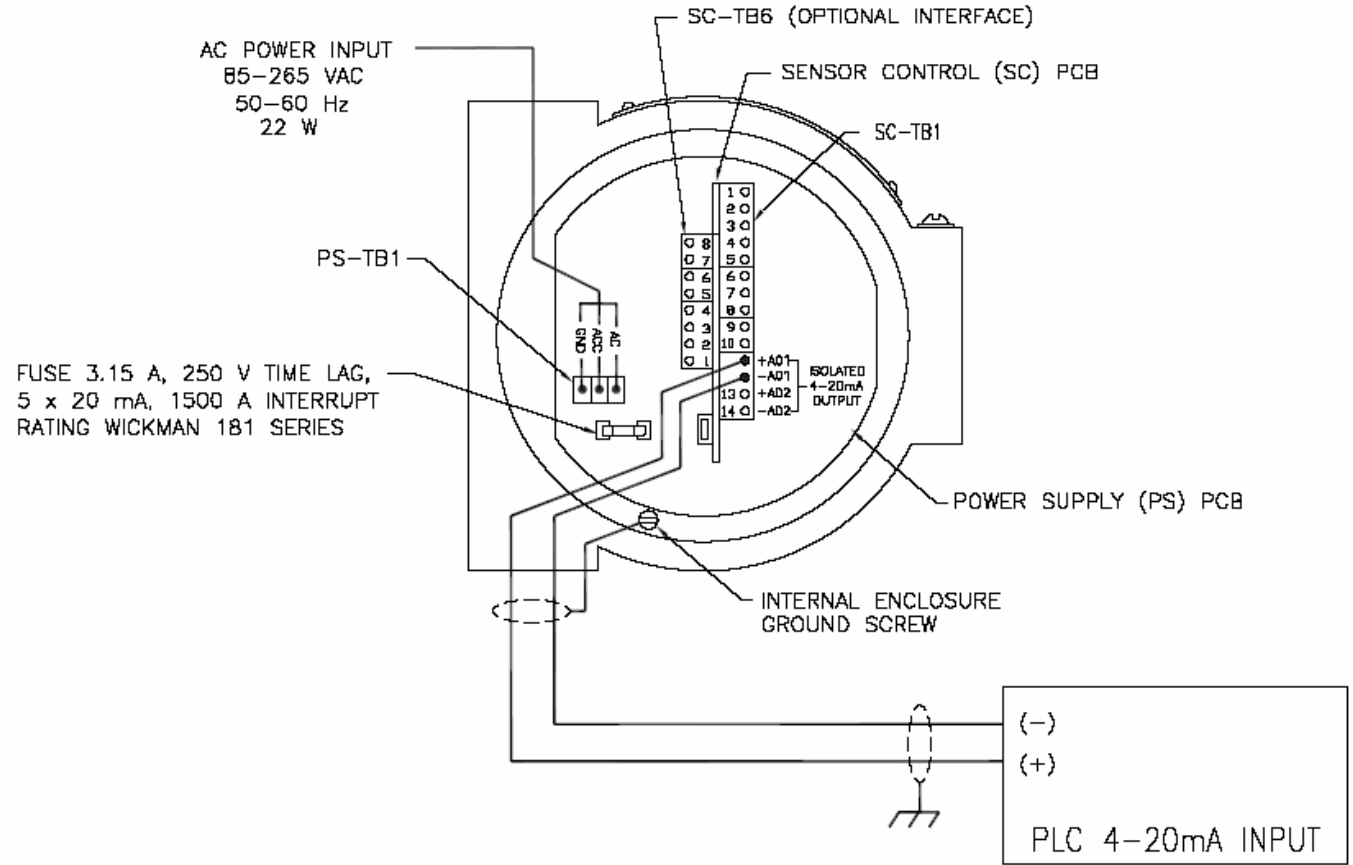
1. Mount the Meter so its sensing element meets the upstream and downstream requirements of that model:
  - a. Kurz Models 504 etc. all need “X” inside pipe diameters upstream and 5 downstream of the sensing element to ensure a repeatable and accurate reading within 2% of the initial calibration. Double elbows in different planes introduce swirl and need 50% more distance than a single elbow does. Longer straight runs will reduce this maximum error. Any discontinuity in the straight pipe flow profile will change the reading compared to its calibration conditions. The data were initially calibrated using long straight runs with short close-coupled pipe flanges that minimize the line-size discontinuity. In many applications, field calibration data can be used to reduce the upstream and downstream requirements.
  - b. Kurz Model 534 have a built in flow conditioner and all the straight run it needs so there is no upstream or downstream straight run requirements to achieve the rated accuracy.
2. If the process fluid is hot or cold compared to the ambient air, then insulation around the pipe/meter upstream for about 30 diameters or more will help reduce thermal gradients in the process fluid near the sensor to avoid these errors. As the temperature is changed, the thermal inertia of the piping will cause a lag in the thermal profile so a longer stabilization time will be required.

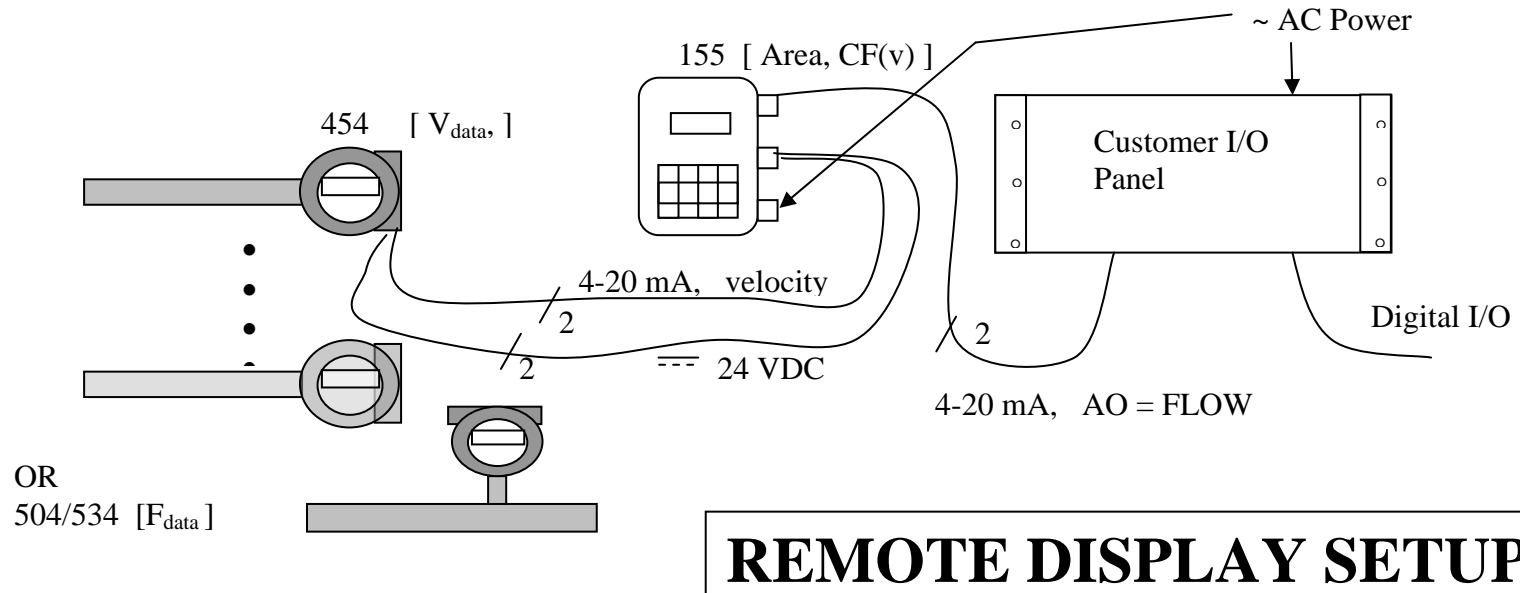
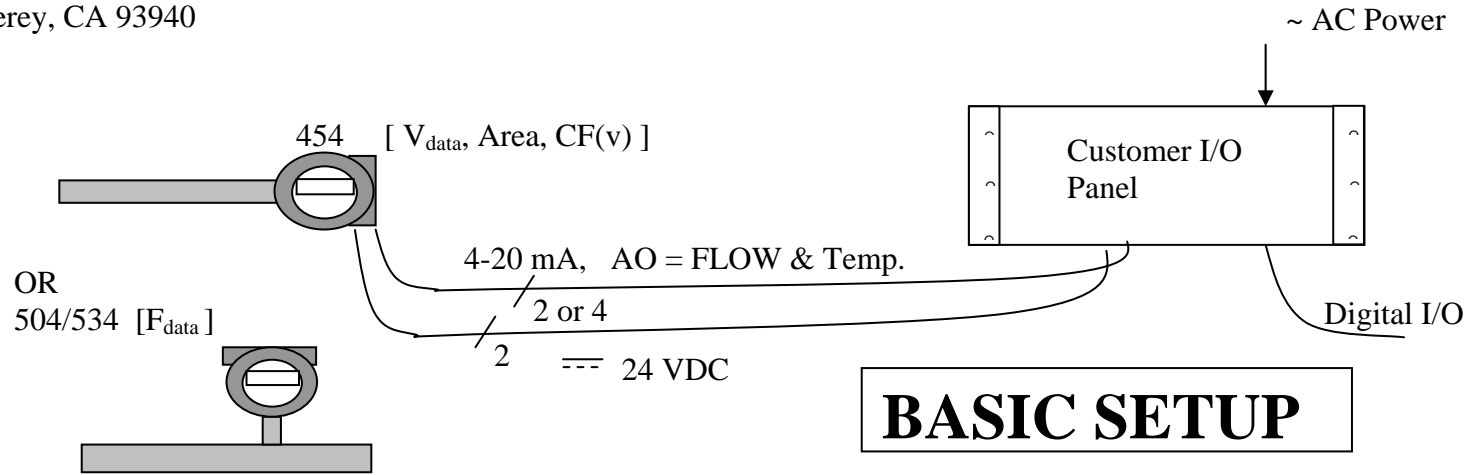
For more information on all the above, please refer to the full product manual provided on CD or at our website [www.kurz-instruments.com](http://www.kurz-instruments.com)

DC POWER INPUT W/ ONE 4-20mA OUTPUT HOOK-UP  
(FOR 454FTB, 504FTB, OR 534FTB)



AC POWER INPUT W/ ONE 4-20mA OUTPUT HOOK-UP  
 (FOR 454FTB, 504FTB, OR 534FTB)





## **Wiring, Sensor, Power and Signals**

The thermal flow meter uses several watts of power to measure flow, so it requires more than a simple 4-20 mA loop powered connection for operation. In general our products are known as a “4-wire” device, power (2) and signal (2 or 4). The exact wiring diagram for your meter can be looked up on the provided CD manual using the model number of the meter. The two AC and DC power examples (pages 7&8) for the single 4-20 mA output on the B-Series assume the PLC is connected to a loop powered device.

## **Potentially Hazardous Area Use and EMI Compliance**

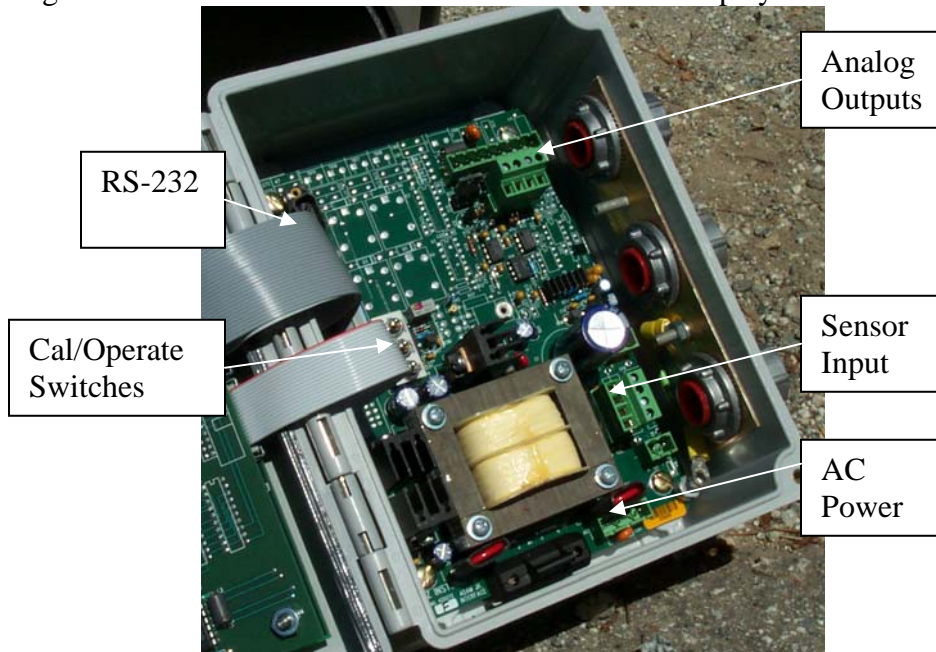
Please consult the full manual on the provided CD for safety and EMI related issues.

## **Sensor**

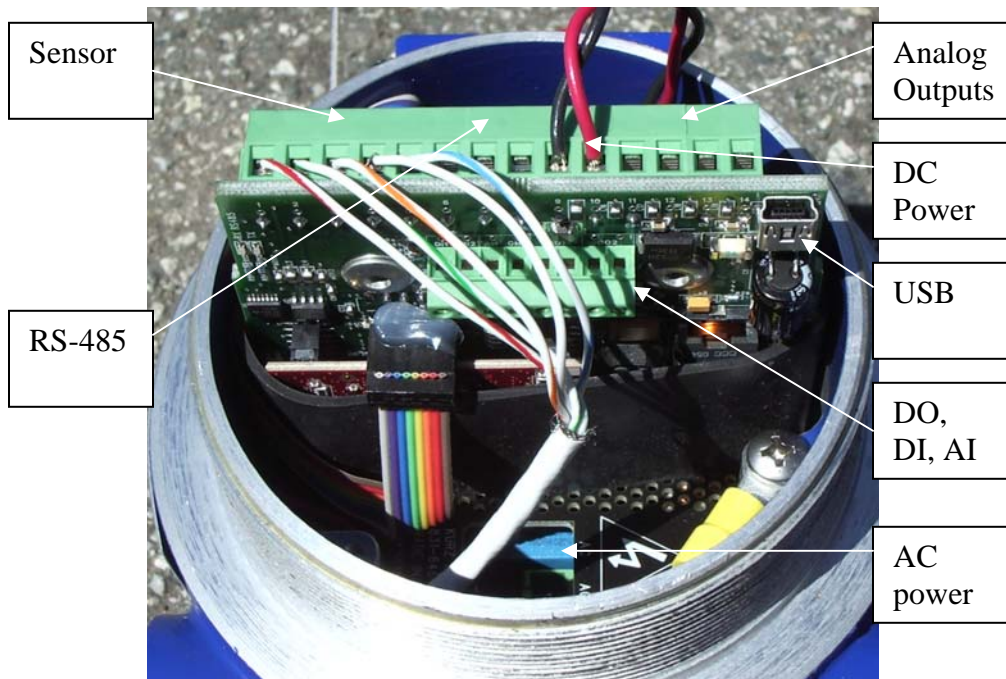
For “Remote Electronics” you need to run five wire cable for each sensor between the sensor J-box and Flow Computer. The wire gage/length and conduit/shielding requirements are found in the manual and on the field wiring diagrams. The transmitter attached versions have no sensor wiring requirements.

## **I/O wiring**

The image below is for the 155Jr. This is used on remote display versions of the product.



155Jr I/O board photo (155A/B,155C-2/E-2 are not shown).



454FTB/504FTB/534FTB I/O connections

## Power

Most 155 units are available with either 115/230 VAC or 24 VDC depending on which version you purchased. Both types require a ground wire for product safety compliance. The MFT B-Series, 454FTB, 504FTB and 534FTB have a universal input power supply, 85 to 265 VAC, 50/60 Hz or 24 VDC (18 to 30 V).

## Analog Output

This is an optional feature which can be wired two ways but you still need the 24 VDC power (or AC power option) to operate the unit as a “4-wire” connection:

1. The 4-20 mA interface can be optically isolated (also known as loop powered). In this case your 4-20 mA input circuit is providing the excitation voltage.
2. You can self power the 4-20 mA circuit from the flow meter where Kurz provides the 24 VDC excitation voltage. The output is not isolated in this case. Here your 4-20 mA input will need a differential current receiver or other method to accept the current signal which is ground referenced at the flow transmitter.

## Digital Communications (also see Protocol section near the end)

155: The 155 flow computers (Jr/A/B/C2/E2) have a fixed 9600 baud rate connection via a straight though DB-9 connector to a PC. This is for remote terminal communications.

454FTB/504FTB/534FTB. The MFT B-Series supports USB with a PC COM emulator driver(9600 baud only) to do remote terminal or keyboard communications. See disk for USB driver installation instructions. They also have a half duplex RS-485 which does Modbus. Baud rate are 9.6, 14.4, 19.2, 38.4 and 57.6 kbits/s on the Modbus.

## Alarms

Discrete contacts for closure or open on event are optionally available. These are isolated relays or SSRs also known as DO or digital outputs on the MFT B-Series. The maximum current, voltage and isolation specs are on the brochure/ product manual.

## Display Orientation

The keyboard/display on the 454/504/534 may be mounted in any 90 ° orientation for optimum viewing and keyboard access when mounted in the process. Disconnect the power first then open the explosion proof lid. You simply unscrew the cross point screws (2 or 4), move spacers as required then tighten back down (see photo below). The ribbon cable for the display is long enough if not twisted up too much to rotate into any of the four positions.

## Navigating Menus

All flow meters and their optional flow computers (Models 155) use a similar menu system for their operation. The picture below is for the 454/504/534 and shows a 2x16 character display and 20 key data entry pad.



**D** = Display Mode

**P** = Program Mode

**L**= Forced Log on the serial port.

**E** = Entry

**C** = Clear

**H** = Hold, **HH** = help

**^** = increment, yes etc.

**v** = decrement, no etc.

View only code for the MFT B-Series is 123456 and Tech or edit code is 654321.

When in a menu area, you can advance with **D** or **P** and sometimes you need to use **E** to select the area your want to enter. If typing data on the keypad, you can use **D** to backup one character or **C** to clear the whole entry. You can select items in a choice menu with the **^** and **v** keys. You can exit menus or Program Mode by pressing **C** several times progressively leaving the menu tree you are in.

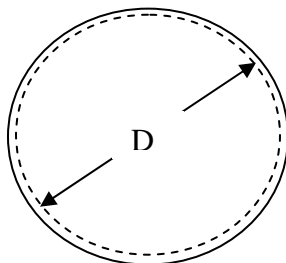
If you are using a laptop with Tera Term you can also enter letters by just typing them (helpful for doing meter tags using the meter ID parameter). Remote Keyboard commands are lower case, d, p, l, enter(for E), c and h with v and ^ being down and up. When entering meter IDs or tags, use the shift lock so that only upper case characters are used (otherwise they are interpreted as commands).

### ***Insertion Meter Programming***

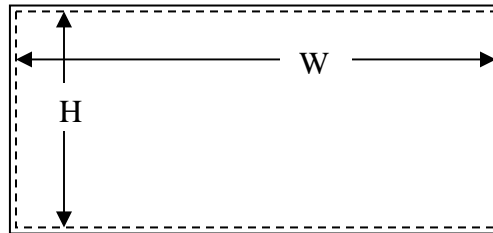
The insertion meters like the 454 all have a low up-front cost but require more work on the part of the user to achieve an accurate measurement whereas the 504 and 534 are already calibrated for flow and need a minimum of field adjustments to read accurately. The in-line meters only need the output range to be specified (see following sections)

For all insertion meters do the following:

**Area.** The duct inside flow area must be entered in the meter section of the flow computer. Depending on your units (English or International) this must be entered as ft<sup>2</sup> or m<sup>2</sup> respectively.



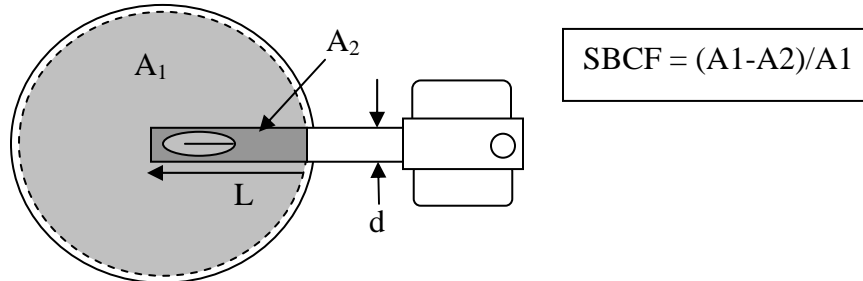
$$\text{Area} = D^2\pi/4$$



$$\text{Area} = HW$$

You press the **P** key to enter Program Mode, then the **access code** and **E**. Now press **P** to advance to the “**Set Meter Data**” menu then press **E** and select which meter (^v on the 155) then using **P** advance to the screen “**Set Meter Area**” where you type the value followed by **E**. It will say new value accepted if a change is made. Last press the **C** key a few times to exit Program Mode. More extensive programming instructions and the Menu state diagram are found in the manual.

**Sensor or Probe Blockage.** The duct/pipe area blocked off by the insertion of the sensor/probe, accelerates the flow reading. This can be adjusted using the Sensor Blockage Correction Factor (SBCF) on the 454 but is not critical as this effect is measured during the field calibration.



SBCF is performed by simply entering the following data:

1. Insertion depth (**L**) in ft or meters from the end of the probe window to the duct inside wall.
2. Probe diameter (**d**) in inches. The 454 comes in 1/2, 3/4 and 1 inch (also known as 08, 12, 16) versions and the 454P or purge version is a 1 inch unit but must be selected as such because of its higher blockage.

You press the **P** key to enter Program Mode, then the **access code** and **E**. Now press **P** to advance to the “Set Meter #1 Flow” menu then press **E** then using **P** advance to the screen “Next Probe ^v Size 0.750 in” where the ^ v arrows are used to choose the value followed by **E**. It will say “new value accepted” if you make a change. Last press the **C** key a few times to exit Program Mode.

More extensive programming instructions and the Menu state diagram are found in the manual.

**Flow/velocity Units.** The engineering units displayed by the unit are extensive and can be programmed for the following partial list (please refer to the appropriate product for more info). Note that actual velocity or flow is not available.

454/504/534 you have these options:

Velocity	SFPM, SMPS (only 454)
Flow Rate	SCFM, SCFH, SLPM, SCMh
Mass Rate	PPM, PPH, KGM, KGH
Temperature	DEGF, DEGC

155 Flow Computer

Velocity	SFPM, SMPS
Flow Rate	SCFM, SCFH, SCMM, SCMh
Mass Rate	PPH, KGM

Temperature DEGF, DEGC (only on T versions or K-BAR-2000(B) elements)

To change the type of units you press the **P** key to enter Program Mode, then the **access code** and **E**. Now press **P** to advance to the “**SET METER #1 FLOW**” menu then press **E** then using **P** advance to the screen “**DISPLAY NEXT ^v FLOW IS XXXX**” where the ^v arrows are used to choose the value XXXX followed by **E**. It will say new value accepted if you make a change. Last press the **C** key a few times to exit Program Mode.

Note: The options you see for units depends on whether the meter is an insertion or in-line type.

**Reference Temp and Pressure for Standards.** The selected standard flow or velocity is the same as actual at the temperature and pressure known as the “standard.” Typical standards are 77 °F, 14.69 PSIA, or 0 °C, 760 mmHg. With the 155 flow computer the reference conditions are determined at the factory and are not field programmable. With the 454, 504, 534 you can separately set the temperature and pressure of the standard conditions. After you have done so it will compute the new standard density then modify all the calibration data so it reads the same flow rate as before but now referenced to a new standard density.

Example Reference Condition Change.

100 SCMH at 0 °C , 760 mmHg will indicate 109.1 SCMH at 25 °C 760 mmHg.

To change the standard conditions, you enter Program Mode and advance to the “**SET FLOW CAL DATA**” menu, scroll down to the menu “**NEW TEMP REF**” or “**NEW PRESS REF.**” After making changes you press **E**. It will confirm the change and show the new reference density in this menu. Last you press **C** a few times to exit Program Mode.

## **Field Calibration.**

This is the most difficult part of setting up an insertion flow meter. On the other hand, an In-Line meter does not need this step as it is already calibrated to read flow with its area, blockage and correction factors built in already.

To perform a Field Calibration, a reference flow method is used to know the true flow while noting the indicated flow from the meter. This is best left to experienced users or professionals who know how to do it. See the manual if you want more information on this.

## **Tag/Labeling of the Meter**

The best way to change a meter's label is to use the Keyboard on your Laptop because non-numeric characters are hard to do with the Kurz 4x5 numeric keyboard. (see manual if you are using the local keypad/display). Plug the USB cable between the meter and PC.

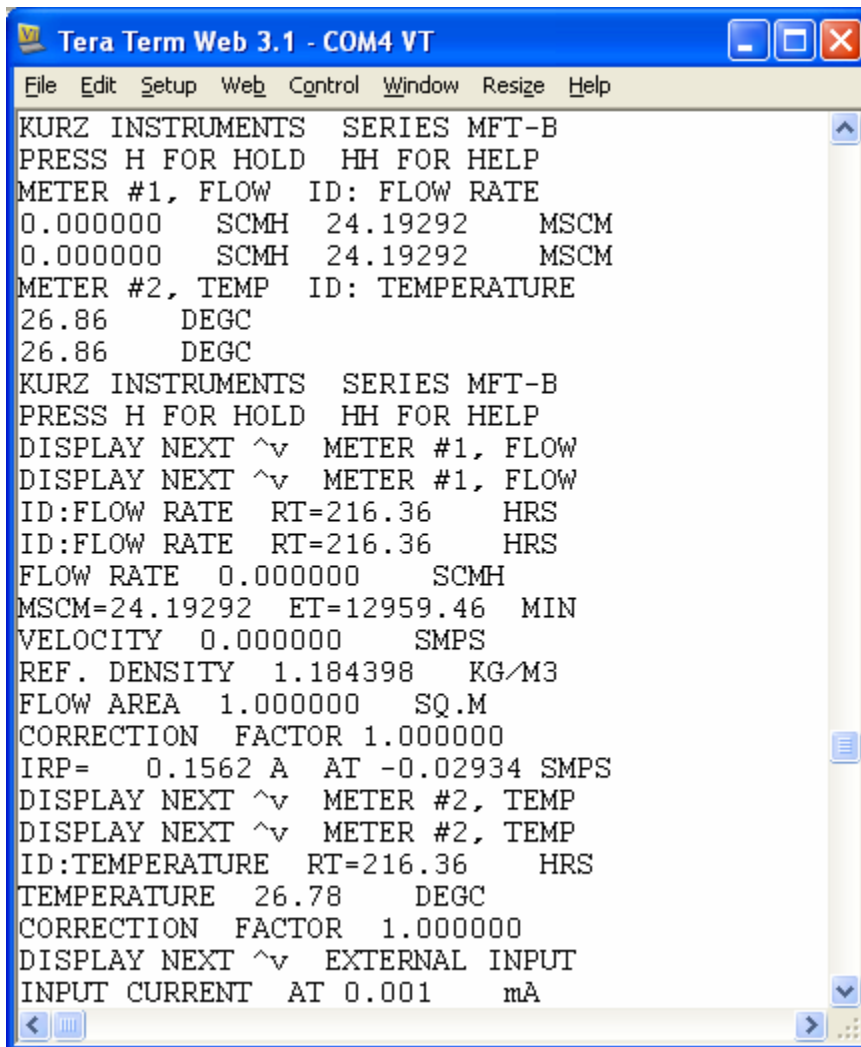
The Kurz USB driver must be installed on the PC for this to work; the USB software is on the same disk as the full product manual.

After the driver is working, the USB connection will enumerate at say COM3 (depends on the number of serial ports). You can check the COM port number using the Windows Device Manager then select Ports.

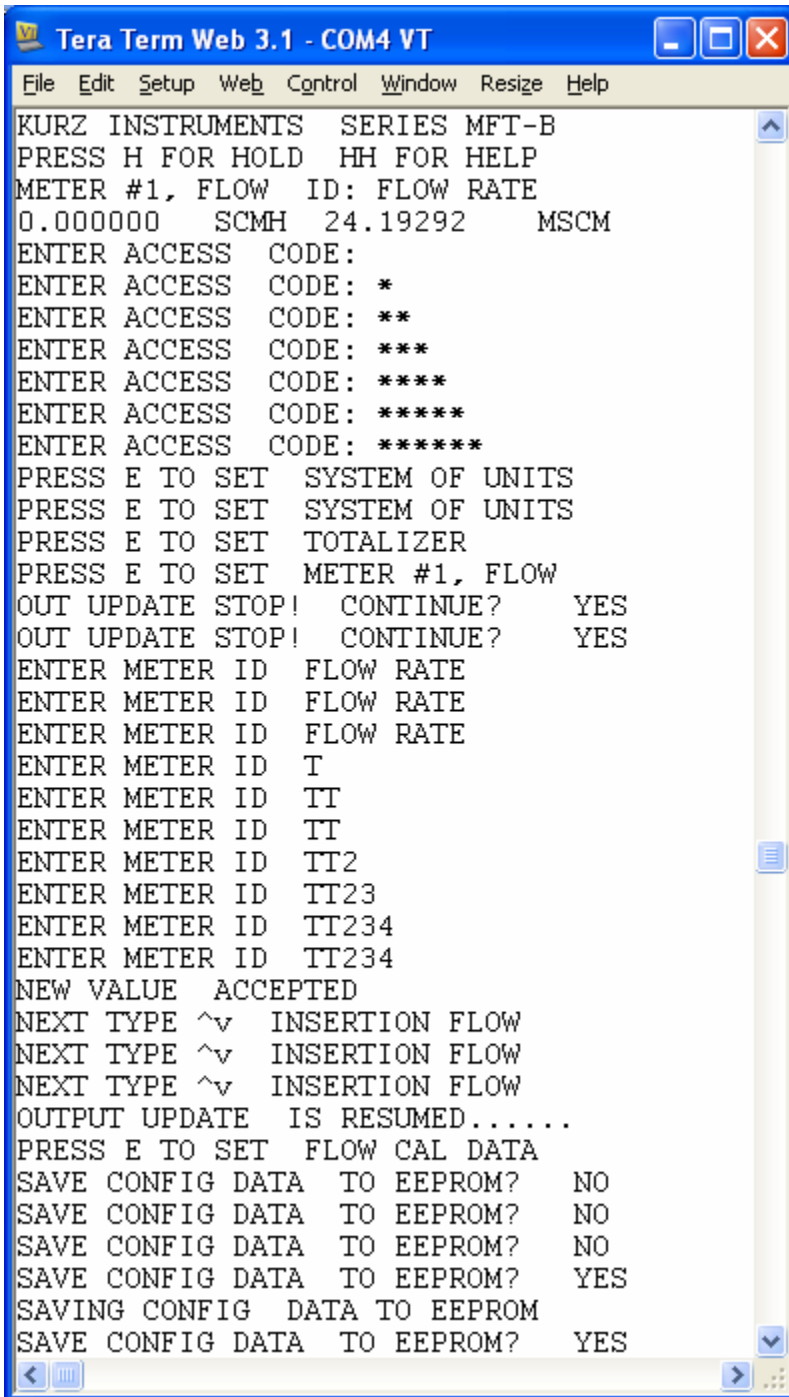


On the PC start a terminal emulator program like Tera Term, then using the lower case c, d, p, enter and other keys to navigate the menus and make changes. If it is not already echoing the LCD display, you start/stop the communications with the + key and will see a dialog like shown below. The unit shown below had its Echo turned on where a list of terminal commands was shown then it started scrolling its meter data with their tags.

*Note, Tera Term can be installed from the CD manual or downloaded for free at <http://tssh2.sourceforge.jp/>. As of this printing it is at version 4.62 and works on all versions of Windows, 95 to Vista. The program can be installed for the English, Japanese or German language.*



To change a meter's label, using Tera Term you follow the example shown below.



Pressed **p**  
Then the **access code**  
followed by **enter**.

Then you press **p** several  
times to advance to:

Set Meter followed by  
**enter**.

Then shift to caps-lock and  
type the “tag” and **enter**.

You should see  
confirmation. Now turn off  
caps-lock and press **c**  
several times to exit  
program mode.

Save to EEPROM if you  
want the changes  
permanent.

## Output Setup

The meter output can be analog via the 4-20 mA or digital via the USB or RS-485. The 4-20 mA hardware is pre-calibrated at the factory. You may optionally re-calibrate with a 4 ½ digit multi-meter. This procedure is described in the manual. The output range of the 4-20 mA needs to be specified. If the serial output with RS-485 is used you must program the protocol, baud rate, device address. The digital output (DO) must be configured to assign the SSR number to the alarm number and its activation logic.

**Analog Output Range.** The analog output range (4.00 mA = yy flow, 20.00 mA = zz flow) is programmed using the following sequence from the keypad: You will need to program your receiving device for the same range.

Enter Program Mode by pressing **P** then the **access code** and **E** then advance the major menus using the **P** key till you see the menu “**SET ANALOG OUTPUTS**” now your press **E** to enter, then select the output channel to program, by typing the number or use the **^ v** keys then press **E**. Now you assign the meter # you want to this output channel. For the MFT line, #1 meter is the flow and #2 is the temperature. In the 155 Flow Computer, you have up to 16 meters that are completely programmable to their output being, velocity, flow, temperature, average of other meters etc. Next you see the menu “**OUT # NEXT TYPE ^ v \_\_\_\_\_**” Flow or VELOCITY on an insertion meter. The screen will show “**LOW = 0.000 SCFM AT 4 mA**” and you can enter whatever value you like followed by the **E** key for the low current value which will state new value accepted if you make a change. The next menu will read: “**HIGH = YYY.YY SCFM AT 20 mA**”. Again you enter the new value followed by **E** to make a change. The next analog output channel will come up and your can select this with the **E** or escape using the **C** key multiple times.

## Summary of Major Configuration Menus

Field Operations in Program Mode	454, 504, 534, K-BAR-2000	155 Line
Enter Data from a Calibration Certificate (pre done by Kurz)	<b>PRESS E TO SET FLOW CAL DATA</b>	<b>PRESS ENTER TO SET LINEARIZERS</b>
Change <b>Range</b> of Analog Output (page 17)	<b>PRESS E TO SET ANALOG OUTPUTS</b>	<b>PRESS ENTER TO SET ANALOG OUT</b>
Change <b>Area</b> or Correction Factors (page 11)	<b>PRESS E TO SET METER #1, FLOW</b>	<b>PRESS ENTER TO SET METER DATA</b>
Change Response Time	<b>PRESS E TO SET METER FILTER TC</b>	<b>PRESS ENTER TO SET INPUT FILTER</b>

**Serial Output.** The most common digital communications protocol used today is Modbus. It has been around for decades and is well supported with many third party OPC servers that can be configured to read parameters from our flow meters that are then used by client HMI or SCADA programs on the same computer or network like Excel, Lookout, Wonderware, Fix32, etc. Please see the manual for more on OPC and the Modbus register assignments for the MFT B-series product line. The 155 Flow Computer does not have Modbus available.

To setup the digital output we need to choose the protocol, baud rate and serial port type.

#### **A. Protocols:**

1. Remote Terminal Mode is where you talk to the meter from a Laptop using Tera Term. Both the MFT B-Series and 155 Flow Computers support this.
2. Logging a meter summary to the USB port can be generated from an internal timer or “l” command. The data can be logged as a .csv file for direct loading into a spreadsheet using Tera Term.  
For the 155 Flow Computer this is the “x” command. With the terminal echo off, you can then capture just the meter summaries by issuing the “l” or “x” commands. The 155 data is best captured and converted to a spreadsheet format using the Kurz PC data logging program.
3. Modbus, which is a multi-point protocol that can be used on the RS-485 port. Both the Modbus ASCII or RTU protocols are supported. The device address may be any number between 1 and 247. Modbus TCP/IP requires a serial to Ethernet gateway as the native interface is RS-485.

#### **B. Baud Rate:**

MFT B-Series: This can be 9.6 to 57.6 k and is set from the keypad or USB interface..

155 Flow computer: This is fixed to 9.6 k baud.

#### **C. Serial Port Type:**

155 Flow computer has an RS-232 or RS-485. It is jumper selected as there is only one port, which can be either logic level standard. The 155Jr/A/B do not have RS-485 built in.

MFT B-Series: USB and RS-485.

USB is convenient for talking to PCs but the RS-485 is designed for long distances and addressing multiple devices. When using the RS-485 connection there are bus loading resistors and other issues that are needed for reliable operation defined on the field wiring diagrams that need to be consulted. The USB interface requires a Driver to be installed on the PC to emulate a COM port

MFT B-Series gateway to Profibus DP, Device Net or Ethernet is available from Kurz based on the Anybus Communicator line.

**Kz-Comm.** Provided with the customer CD is a Windows program that communicates with the meter using either USB, Modbus serial or Modbus TCP/IP. The program can:

- extract or install a meter's configuration file
- extract the error log
- extract the min-max events log
- extract the last 56 hours of trend data provided the meter's power was not cycled.
- install new sensor calibration data.

The config file is a binary and text readable version which helps to understand what the setup is for your meter. The other three file types are for troubleshooting purposes and are saved as .csv files that you can work with in a spreadsheet like Excel. Changing a sensor's calibration data is helpful if the application gas changes and a more accurate measurement is needed. The sensor calibration data files are provided from Kurz as an option.

### ***Glossary***

See CD manual for glossary.