K-BAR 2000B installation and operation with the 155 flow computer

The 155 flow computers (5 models, 1, 3, 6, 11 and 22 channels) perform the following system functions in a multipoint duct/stack monitoring system:

- 24 VDC power to each flow sensor electronics board
- Flow and temperature averaging
- Kickout of dead channels from the average
- Flow rate dependent correction factors for flow profile compensation
- Provides analog output for meter data
- Meter totalization and alarms

Functions performed by the sensor electronics (K-BAR-2000), not the 155 flow computer.

- Sensor control with flow rate and temperature
- Sensor level diagnostics
- Linearization from raw heat flow to standard velocity and temperature
- Compensation for temperature induced gas composition changes

- Zero-mid-span drift check
- Purge cleaning valve control and sensor data hold during the cleaning.

The following sections cover installation, operation and maintenance when using the 155 flow computer.

Installation of the 155 flow computer

Cabinet mounting

Most 155 flow computers are NEMA 4 designs so can be mounted inside or out. Some applications may need a sun shield for the keypad overlay if it is direct sunlight more than 1 hour/day.

The enclosures are generally mounted so the LCD is at eye level when standing at the flow computer. This supports both looking at the display and using the keypad but also the wring of the system.

Popular mounting methods are to bolt it to a wall, hang it from a pipe stand or Uni-Strut frame. The 155 flow computer brochure gives the dimensions of each model.

AC power requirements

The 155 flow computers are designed for permanent wiring with an external disconnect. The smaller units, 155B and lower use a simple transformer and are jumper selected for their primary voltages. The 155C-2/E-2 have universal input voltage switching power supplies to make the 24 VDC power used by both the flow computer and the sensor electronics.

155 Flow Computer Model	Maximum # sensors	Voltage, VAC 50-60 Hz, 1 phase	Maximum AC power requirement.
155A *	3	115 or 230 +/- 10%	48 W
155B	6	115 or 230 +/- 10%	84 W
155C-2 *	11	85 to 265	132 W
155E-2	22	85 to 265	276 W

* more sensor may be used if the application flow rate and temperatures are not two high.

Wiring from a K-BAR-2000B

Each K-Bar has a single common 24 VDC power connection whether it is a 2, 3 or 4 sensor K-Bar and a single return current wire for each 4-20 mA signal (one for flow , one for temperature)

Table AD-1. Wiring from the155 flow computer.

Description	2 sensor K-bar	3 sensor K-bar	4 sensor K-bar
+24 VDC and Ground	2	2	2
4-20 mA current return for flow rate	2	3	4
4-20 mA current return for temperature	2	3	4
Zero-span control	1	1	1
Total # wires	**7**	**9**	**11**

The table below assumes a full sensor load of 2 A for 4 sensor at full flow rate and high temperatures. Less power demanding applications can use greater distance between the flow computer and sensor electronics than listed in the table below.

Table AD-2, Power leads wiring requirements for 20 V min. at the K-Bar for 2 A load

Wire AWG	Cable length feet, end-end, one way distance (m)
18	130 (40)
16	205 (62)
14	330 (101)
12	520 (158)

The 4-20 mA wiring requirement are very easy. Even a 24 AWG telephone cable has only 26 ohm/1000 ft so drive voltage for the cable and 250 actual load resistor in the 155 input channel. So, any practical wire gage will work for the 4-20 mA return wires.

The power and input terminals of the different 155 models are defined on their wiring diagrams.

Table AD-3, Field wiring diagrams for the 155 models

Model	Field Wiring Diagram
155A	340155-44
155B	340155-45
155C-2/E-2,	340155-55
155C-2/E-2 with pulsed totalizer output	340155-57

Table AD-4 shown below is a comparison of the terminal block labels used on the 155A/B motherboard vs. the 155C-2/E-2 I/O panel.

Table AD-4. 155 terminal labels for power, ground and input channels

K-BAR 2000B signal	24 VDC power input	Ground for power	Sensor outputs, velocity and temperature linearized 4-20 mA
155 Signal	**+24 VDC power**	**Ground**	**4-20 mA Input: Velocity or Temperature**
155A or 155B	TB3-2, A TB4-2, B TB5-2, C TB6-2, D TB7-2, E TB8-2, F	TB23-2, A TB24-2, B TB25-2, C TB26-2, D TB27-2, E TB28-2, F	TB3-1 or TB23-1, Channel A TB4-1 or TB24-1, Channel B TB5-1 or TB25-1, Channel C TB6-1 or TB26-1, Channel D TB7-1 or TB27-1, Channel E TB8-1 or TB28-1, Channel F
155C-2 or 155E-2	+ A + B + C + D + E + F + G + H + I +J + K + L + M + N + O + P + Q + R + S + T + U + V	GND A GND B GND C GND D GND E GND F GND G GND H GND I GND J GND K GND L GND M GND N GND O GND P GND Q GND R GND S GND T GND U GND V	- A - B - C - D - E - F - G - H - I -J - K - L - M - N - O - P - Q - R - S - T - U - V

Purge and Zero-Mid-Span contacts

Purge cleaning contact closures and daily drift check contact closures for zero-mid –

span signals are wired directly to the K-BAR-2000B power/signal distribution board (see K-Bar installation section) in the N4 enclosure head. There are no connections to the 155 needed for purge or zero/span functions. The zero/span labels on the 155 are only used for the K-BAR-2000 (previous generation, based on the MFT electronics) or the K-BAR-24 line.

Analog outputs

The 155 flow rate, mass rate or temperature signals for the multipoint meter can be seen on the local LCD but in most cases are remotely monitored using a 4-20 mA signal.

There are two popular methods the 4-20 mA can be connected as:

- **Loop powered and isolated.** Here the external PLC or DCS sends the 24 V power and reads the current from the analog output channel.
- **Self powered and non-isolated.** Here the external PLC or DCS does not provide power for the 4-20 mA loop. Since the power is coming from the 155 flow computer, its output is non-isolated. The PLC or DCS when used in this mode should have differential current sensing inputs, or isolated. In contrast, the 155 inputs are grounded on one side and are not isolated.

Table AD-4 shown next, itemizes the AO channels for each 155 model and the jumper configurations, if any, to achieve this mode.

Table AD-4. Comparison of 155 4-20 mA outputs

	Analog Output Channel	**Loop Powered 4-20 mA, Isolated output ***	**Self Powered 4-20 mA, Non-isolated ***
155A or 155B	AO1	TB11-2: +, TB12-1: -	Jumper TB11-1 to TB11-2, TB12-1: +, TB12-2: -
	AO2	TB13-2: +, TB14-1: -	Jumper TB13-1 to TB13-2, TB14-1: +, TB14-2: -
155C-2/E-2	AO1	W201 jumpers horizontal 4-20 mA output 1 +, -	W201 jumpers vertical 4-20 mA output 1 +, -
	AO2	W202 jumpers horizontal 4-20 mA output 2 +, -	W202 jumpers vertical 4-20 mA output 2 +, -
	AO3	W203 jumpers horizontal 4-20 mA output 3 +, -	W203 jumpers vertical 4-20 mA output 3 +, -
	AO4	W204 jumpers horizontal 4-20 mA output 4 +, -	W204 jumpers vertical 4-20 mA output 4 +, -
	AO5	W205 jumpers horizontal 4-20 mA output 5 +, -	W205 jumpers vertical 4-20 mA output 5 +, -
	AO6	W206 jumpers horizontal 4-20 mA output 6 +, -	W206 jumpers vertical 4-20 mA output 6 +, -
	AO7	W207 jumpers horizontal 4-20 mA output 7 +, -	W207 jumpers vertical 4-20 mA output 7 +, -
	AO8	W208 jumpers horizontal 4-20 mA output 8 +, -	W208 jumpers vertical 4-20 mA output 8 +, -

* See wiring diagrams 340155-55 or -57 for detailed jumper settings.

Meter configuration of the 155.

Each sensor has up to two signals that can used in the 155, velocity and temperature. As the 155 flow computer has lots of I/O (22 inputs, up to 8 AO, 8 alarms etc.) it must be

software configured for the specific application requirements. To make use of this I/O, the 155 flow compute uses an a virtual “meter”. There are up to 16 meters in the 155 flow computers. The input channels must be “included” with a meter and the analog output must be assigned to that meter Depending on which version of the 155 was purchased, the number of available channels, meters, alarms, AOs and available 24 V power will vary. The 155 summary guide covers the menu navigation and some of the programming steps needed for configuration of a meter.

Example A, for a minimum 155 configuration with 4-20 mA analog output would have:

1 channel
1 meter
1 AO

Often there are extra channels, meters and AOs not used in the configuration as shown in the case below.

Example A, setup for this has several steps.

1. Meter 1 will have channel A included. Meter type will be insertion. The duct area will be programmed under the meter #1 menus. Any field correction factors are also programmed under the meter 1 menus.
2. Channel A will have the linearization data for the sensor velocity set with two points,
    a. 0 SFPM is 1 V and
    b. 9000 SFPM is 5 V
3. Under the Analog Output #1, it will be assigned to Meter 1 and its zero and span range defined.
    a. 0 SCFM is 0 VDC (4 mA)
    b. 60,000 SCFM is 5 VDC (20 mA)
4. The gas type is limited to the reference gas density which is a Kurz factory setting. The example below is for Air at 25 °C and 760 mmHg. The gas density is only used if the output units are mass rate, instead of standard volumetric flow as in this example.

Detailed menu screens and sequential steps for the above example are defined in the 155 menu state diagram, 360155-26 in the 155 summary guide appendix, 360204-6.81.

Example A configuration file as generated by the Kurz PC program “upload/download 6.81D”. Actual configuration has 2 input channels, 2 meters and two AOs.

```
1KAS Dump Program          6.81d        11-02-2007              15:49:25

Configuration File Date :   11-02-2007              Time :       15:42:45

KAS Version :              6.81         UPLOAD Version :          6.81d

+-----------------------------------------------------------------+
+                                                 +
+               System Configuration Data                   +
+                                                 +
+-----------------------------------------------------------------+
Number of Channels       2
Number of Meters         2
Number of Analog Outputs  2
Number of Alarms         4
Number of PID Controllers 0
Number of Pulse Outputs   0
Standard Air Density      0.07387

+-----------------------------------------------------------------+
+                                                 +
+                  Log Interval Data                      +
+                                                 +
+-----------------------------------------------------------------+
New  log at     hours     minutes
Next log at     hours     minutes

+-----------------------------------------------------------------+
+                                                 +
+                      Meter Data                       +
+                                                 +
+-----------------------------------------------------------------+
 Meter :  1  ID : METER-000001  Type : INSERTION
Flow displayed in SCFM
Included channels : A
Area : 10         SQ FT

Number of Calibration Factors : 1

  CF       CF Value   Value
 -----    --------   ---------------
  1       1.000      0.000000  SFPM

Meter :  2  ID : METER-000002  Type : INSERTION
Flow displayed in SCFM
Included channels :
Area : 1          SQ FT

Number of Calibration Factors : 1
```

```
 CF      CF Value   Value
 -----   --------   ---------------
 1       1.000      0.000000  SFPM

+-------------------------------------------------------------------+
+                                                  +
+                   Input Filter Data                    +
+                                                  +
+-------------------------------------------------------------------+
Channel : A   Time Constant : 0.5          Seconds
Channel : B   Time Constant : 0.5          Seconds

+-------------------------------------------------------------------+
+                                                  +
+                   Analog Output Data                     +
+                                                  +
+-------------------------------------------------------------------+
Analog Output :  1  Type : FLOW RATE        Meter : 1

LO : 0.000000   SCFM AT 0.0000     Vdc
HI : 60000      SCFM AT 5.0000     Vdc


Analog Output :  2  Type : TEMPERATURE       Meter : 2

LO : 0.000000   DEGF AT 0.0000     Vdc
HI : 700        DEGF AT 5.0000     Vdc


+-------------------------------------------------------------------+
+                                                  +
+                      Alarm Data                       +
+                                                  +
+-------------------------------------------------------------------+
 Alarm :  1  Status : OFF     State : N.C.    Meter : 1     Type : VELOCITY

 Alarm type :  HI
 Low  alarm at           SFPM
 High alarm at 0.000000    SFPM

Alarm :  2  Status : OFF     State : N.C.    Meter : 1     Type : VELOCITY

 Alarm type :  HI
 Low  alarm at           SFPM
 High alarm at 100         SFPM

Alarm :  3  Status : OFF     State : N.C.    Meter : 1     Type : VELOCITY

 Alarm type :  HI
 Low  alarm at           SFPM
```

```
 High alarm at 200         SFPM

+-------------------------------------------------------------------+
+                                                                   +
+                    Channel Kickout Data                           +
+                                                                   +
+-------------------------------------------------------------------+
Channel kickout is OFF
Low     kickout at -5%     full scale
High    kickout at 115%    full scale

Alarm : 4     Status : ON      State : N.C.

+-------------------------------------------------------------------+
+                                                                   +
+                         PID Data                                  +
+                                                                   +
+-------------------------------------------------------------------+

+-------------------------------------------------------------------+
+                                                                   +
+                    Pulse Output Data                              +
+                                                                   +
+-------------------------------------------------------------------+

+-------------------------------------------------------------------+
+                                                                   +
+                    Linearization Data                             +
+                                                                   +
+-------------------------------------------------------------------+
 Channel : A  S/N : 1000A-1       Data Points :  2

 Point     Voltage   Value
 -----     -------   ---------------
 1         1.0000    0.000000  SFPM
 2         5.0000    9000      SFPM

Channel : B  S/N : EXTRA         Data Points :  2

 Point     Voltage   Value
 -----     -------   ---------------
 1         1.0000    0.000000  SFPM
 2         5.0000    9000      SFPM

+-------------------------------------------------------------------+
+                                                                   +
+                Parallel Printer Configuration                     +
+                                                                   +
+-------------------------------------------------------------------+
Printer is OFF
```

Printer size is narrow
Printer does not get linefeeds

+--+
+ +
+ Serial Printer Configuration +
+ +
+--+
Printer is OFF
Printer size is narrow
Printer gets linefeeds

+--+
+ +
+ User Access Code +
+ +
+--+
User Access Code is 123456

+--+
+ +
+ Technician Access Code +
+ +
+--+
Technician Access Code is 654321

+--+
+ +
+ System Units +
+ +
+--+
System units are English System

+--+
+ +
+ Calibration Units +
+ +
+--+
Calibration units are English System

Channel Kick-out

In a multi-point system, a sensor which fails to work properly must be excluded from the flow average calculations. The 155 does this if the velocity or temperature signal is above or below the linearized data range. The MFT and MFT B Series both generate an NE-43 alarm if a defective sensor is detected. These signals correspond to 3.6 mA or lower or 21 mA or higher. Based on a percentage of the input channel range, this would

need a kick-out setting of -2% on the low kickout and 105% on the high kickout. These setting are factory configured depending on what type of flow element or transmitter is connected to the flow computer. The default settings are -5% to 115% and are setup for the 452/502/ K-BAR-24 product line which are non-linear flow signals and have a much larger signal swing when there is a faulty sensor.

Table AD-5. Recommended Channel Kickout Settings

	MFT, MFT B-Series 454FT, 504FT, 534FT, K-BAR-2000, 454FTB, 504FTB, 534FTB and K-BAR-2000B Linearized flow signal input	450, 500, 452, 502, K-BAR-24, -16 Non-linear flow signal input
Low Kick-out	-2 %	-5%
High Kick-out	105%	115%

155 Flow Computer, analog input/output calibration.

The calibration of the input channels or the analog output matches an external voltage or current meter is covered in the 155 Summary Guide. This requires the use a quality DVM to use as the tracable reference standard. We recommend a 4 ½ digit meter with 0.1% basic DC voltage accuracy.

Correction Factors

Following a field calibration procedure (CAL-016) the correction factors needed to convert the raw indicated flow reading to an accurate value are entered in the meter. This is covered in the variable correction factor section and the 155 Summary Guide.

Analog Output Zero/Span

The typical interface to the plant DCS or PLC etc. is via the analog 4-20 mA outputs. This too is covered in the 155 Summary Guide.

Viewing Data on the 155 LCD

After a power cycle of the 155, it will scroll the help menus and not show any flow or temperature data. You must press the **D** key and select the meter # you want to monitor with the **^v** keys, followed by **E** then press **D** to advance to the menu of interest. If you want this menu to display at all times, you press the **H** key to hold the screen. The most popular display screen is:

```
FLOWRATE
41,045.4 SCFM
```

If there are alarms set on the meter, these may override the normal display screens. You can clear these with the **C** key if needed.

For more discussion on the display mode options of the 155, consult the Summary Guide.