KURZ
INSTRUMENTS INC.

Series 155 Jr
Flow Computer/Transmitter
User's Guide

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Introduction

This section describes the procedure for returning damaged equipment, an overview of the Series 155 Jr, and the NIST-traceable calibration and unit specifications.

Receipt of Equipment

When you receive your equipment, carefully check that your order has been filled correctly and that no damage has occurred:

1. Check the outside packing carton for damage incurred in shipment. If the packing carton is damaged, the local carrier should be notified at once regarding their liability. Submit a report to:

   Kurz Instruments, Inc.
   2411 Garden Road
   Monterey, CA 93940

   Attn: Customer Service

2. Remove the packing slip from its envelope and check that the carton contains all parts listed.
3. Ensure that spare parts or accessories are not discarded with the packing material.

   If any parts are missing, call Customer Service toll-free at (800) 424-7356 – or you can send a facsimile (FAX) to (408) 646-1033.

Return Shipment

If equipment must be returned to Kurz for warranty repair, the customer pays for transportation charges. Kurz will return the equipment under warranty prepaid.

To return equipment to Kurz, follow these steps:

1. Obtain a Return Authorization (RA) from Kurz Customer Service;

   Telephone **(800) 424-7356**

   FAX **(408) 646-1033**

   DO NOT return any equipment without a RA.

2. Your correspondence must include,

   - The Kurz sales order number on the customer invoice
   - Reference all documents and correspondence to the RA number
   - The name and telephone number, including the area code and extension (if any), of the person Kurz can contact regarding the equipment
   - A description the problem and an authorization for corrections to be performed at the Kurz factory

NOTE: Kurz requires a confirmed purchase order before performing non-warranty work.

3. Return the equipment and report to this address:

   Kurz Instruments, Inc.
   2411 Garden Road
   Monterey, CA 93940

   Attn: Customer Service
   RA: _____

Product Description

The Series 155 Jr is a microprocessor-based flow computer/ transmitter. The Series 155 Jr sends power to and receives signals from a flow element. A flow element consists of a sensor and probe support that attaches to a sensor electronics card.

There are two sensor electronics configurations:

- With the Transmitter Attached (TA) configuration, the sensor electronics card is mounted in an enclosure, directly attached to the sensor support.
- With the Transmitter Separate (TS) configuration, the electronics card is mounted in a remote enclosure connected by a sensor extension cable from the sensor support.

Before shipment, Kurz Instruments configures the Series 155 Jr to meet the customer's application.

The standard system transmitter enclosure is constructed of either painted steel or fiberglass. UL listed and CSA certified enclosures are constructed to these specifications:

- NEMA 4X fiberglass enclosure
- NEMA 4 painted steel enclosure
- NEMA 7 and 9
- NEMA 7 and 9 with window

Features of the Series 155 Jr include the following:

- 20-key keypad, two-line 16 character LCD display/exterior, and user-friendly help screens, 24-hour clock/calendar
- American or International (metric) units, such as SCFM or SCMM
- One "primary" RS-232 terminal (or serial printer) port to receive output from the Series 155 Jr. You can order a "secondary" serial printer port. The Series 155 Jr port connections are DB-9.
- Displays user-entered meter I.D. number, 24 hour clock/calendar, flow rate (SCFM or PPH), average velocity (SFPM), specific gravity (if PPH selected), variable velocity profile factor for each defined meter, user-entered flow area and averaged channels.
- User and Technician security codes limit access to critical areas of the system.

- Easy, all-digital input calibration
- Lagrangian polynomial linear interpolation for maximum accuracy
- Conditions and linearizes up to 2 sensor inputs (1 flow rate and 1 temperature)
- Outputs up to 2 externally powered, loop-powered AC/DC isolated, or self-powered, AC isolated, 4–20 mA signals indicating flow measurement for selected meters.
- Outputs up to 2 scaled linear 0–5 Vdc analog signals indicating the flow measurements for selected meters
- Four 120 Vac, 5 amp., 24 Vdc alarm relays
- One flow control driver to operate the Model 730 valve
- Zero/Span calibrator
- User-selected digital filtering
- Sensor kickout for readings outside of a specified range
- Input voltage read and displayed from each sensor
- Built-in flow totalizers for each meter

The Series 155 Jr has user-level, technician-level, and factory-level access codes that limit the user's access to specific menus and commands. For security, access to areas of the program critical to the system configuration requires knowledge of the other access codes.

Once you enter the user-level access code, you enter "Program Mode." The Series 155 Jr software program is a "tree-structured" menu. Each menu contains commands that you can select to see data displayed or to modify existing configurations. After you select a menu, you drop down a sub-level, where you select commands. If a command has several options available, you can drop down to lower sub-levels. For more information on how to use the Series 155 Jr software program, see Chapter 2. See Appendix A for a visual representation (state diagram) of the Series 155 Jr software program.

Accessories to the Series 155 Jr

You can purchase the following accessories for the Series 155 Jr:

- An IBM-PC compatible, laptop Personal Computer with the Upload/Download software program.
- Upload/Download software programs that you can use on an IBM-PC compatible computer connected to the Series 155 Jr, which functions as a remote terminal and data recorder.

Control Driver Output

If you purchased the control driver output feature for the Series 155 Jr, your system has the 730 valve. The 730 flow control valve is an electrical metering valve. The standard valve incorporates a high torque DC gear motor designed to be operated by "error signals" from the 114 H-driver board. The 114 H-driver board converts the low-level logic signal from the Series 155 Jr to ± 24 VDC signals, which the 730 valve interprets as open valve and close valve.

The flow coefficient (C_V) of the 730 valve is linear over a wide flow range. This is due to the approximate 300° rotation between a complete flow shutoff and full open. The standard time from full open to full close is 30 seconds, unless an optional valve speed has been specified. The valve remains in its last position during constant flow or during power shutoff.

Because the motor is used only when the valve moves to a new position during flow control, the motor operates briefly and is usually idle. In this application, the motor should have an extremely long life and should not require replacement of the brushes.

Alarm Relays

If your system has the alarm relay feature, you have four definable alarm relays, which can be used to provide an audible or visual indication that an alarm condition has occurred. For example, you define an alarm to indicate a non-isokinetic condition or sensor kickout failure.

End of Introduction

1 Installation

Portions of the installation procedures described in this section might not apply to your system configuration, however, we recommend that you read this section. If further assistance is needed with your installation, contact your Kurz sales representative or contact Customer Service.

To install the 155 Jr, follow these steps:

1. If possible, locate the flow element at least ten pipe or duct diameter upstream and five diameter downstream from the nearest bend, elbow, or other obstruction in the pipe or duct to be monitored.
2. Check that the location provides clearance for inserting and removing the flow element; the clearance from the pipe or duct and any obstruction should be at least the flow element's length, plus the transmitter electronics enclosure, and 2–3 inches for maneuverability.

NOTE: Do not install the transmitter electronics enclosure close to a hot duct or stack. The ambient temperature around the enclosure should not exceed 50°C.

3. Mount the sensor in the pipe or duct where the velocity closely approximates the average velocity. For some applications, you can assume that the center point of the pipe or duct represents a point of average velocity, such as:

   - a high degree of accuracy is not critical
   - the pipe or duct is so small that it is impractical to mount the sensor anywhere other than the center
   - the flow profile is turbulent and of high velocity; many points of average velocity are likely
   - the flow profile is known to be uniform

   Even under these circumstances, you might want to calculate a half-traverse or double-traverse average before deciding on center mounting. If you need information about how to perform these calculations, contact Kurz Customer Service, (800) 424-7356.

4. Rotate the flow element so that the sensor shield window allows unobstructed air flow over the sensor. The shorter element should be upstream of the longer element.
5. Connect the wire from the transmitter electronics enclosure to the Series 155 Jr enclosure. The wire connects to a terminal block on the Series 155 Jr input/output board. Connect the shield to the ground lug. See the engineering drawings in Appendix A to identify and locate terminal specifics.
6. Connect the Series 155 Jr to the power source.

NOTE: Thoroughly check all wiring connection. Do not supply power to the system without connecting the sensors; otherwise, you could overheat the board components.

7. After plugging in the power cord, turn on the power switch.

If you ordered the Series 155 Jr flow control driver feature, you must additionally follow these installation procedures:

1. Install the Series 730 valve, and vacuum pump (or other vacuum system) in the appropriate location(s). In some installations, the valve, and pumps are housed in the system enclosure. Other systems connect the flow meter, the valve, two pumps, and the pump switchover components on a single pump skid.

   The drawings in Appendix A provide detailed information on the installation of these components.
2. Orient the valve so that the sample line can be connected between the inlet of the valve and the outlet (short pipe section) on the flow element. The outlet of the 730 valve should be oriented so that the sample line can be connected to the inlet of the pump. The inlet (IN) and outlet (OUT) are marked on the valve.
3. Install the vacuum pump(s) or other system used to draw the sample through the sampling nozzles. Orient the pump so that the pump inlet can be connected to the sample line from the 730 valve.

4. Connect the sample line from the manifold system to the inlet of the flow element. If the flow element outlet is not directly connected to the 730 valve inlet, connect a sample line between them. Connect the sample line between the pump inlet and the valve outlet (OUT) if it is not already installed. Finally, connect the sample return line to the pump outlet.
5. Connect the appropriate secondary sample lines to the sample flow splitter, if appropriate.
6. Mount the base of the system enclosure.

NOTE: Use the highest quality fasteners in an installation as a safety precaution.

To ensure a successful installation, do not locate the enclosure subject to sudden temperature changes, drafts, or near equipment radiating significant heat. Allow adequate space for cable connectors and wiring. Proper clearance ensures easy access for routine maintenance and trouble-shooting.

NOTE: Refer to the engineering drawings in Appendix A for the outline dimensions and mounting holes for the system transmitter enclosure.

1.1 Electrical Connections

Connect all wires as shown in the engineering drawings in Appendix A.

If not already connected by the Kurz factory before shipment, the wiring connections pertaining to the Series 155 Jr consist of the following:

- Input power wiring connections
- Cable connections
- Output device connections

NOTE: All input and output wiring should be housed in rigid metal conduit to reduce the effects of RFI (Radio Frequency Interference).

1.1.1 Power Input Wiring Connections

Power sources to the system should be checked to ensure that the power is fairly clean and stable, for example 115 VAC ± 10.0% at 60 Hz (Standard), 230 VAC ± 10.0% at 50/60 Hz, and 24 VDC, 0.5% regulation. After you check all connections, you can turn on the power to the system.

Tables 1-1 and 1-2 list the power input connections for the Series 155 Jr input/output board.

Table 1-1. *AC Power Input Wiring.*

Terminal Placements	A.C. Power
TB1-1	AC
TB1-2	ACC
TB1-3	GND

Table 1-2. *DC Power Input Wiring.*

Terminal Placements	D.C. Power
TB2-1	+24.000 VDC
TB2-2	GND

1.1.2 Two-Wire Conductor Cable Connections

Kurz Instruments provides a limited length of test cable (18 AWG) for bench-test purposes only. Do not use the test cable for process operations. It is your responsibility to replace the test cable as required.

The two-wire conductor cable connects the Model 465 Current-Transmitter Board from the flow element to the Series 155 Jr. There is one Model 465 board for each flow sensor. For systems with a temperature input, the two-wire conductor cable connects as indicated in the wiring diagram (see Appendix A). The Model 465 board transmits the nonlinear current from the flow element to the Series 155 Jr.

One wire of the conductor cable supplies a voltage to the current-transmitter board from the linearizer board; the other wire transmits the sensor's return signal from the current-transmitter board to the system transmitter (linearizer board).

NOTE: If you are using shielded cable, connect the shield as shown on the field wiring drawing in Appendix A.

Select a cable length and wire gauge so that the maximum loop resistance does not exceed 4.0 Ω. If you use heavier wire, you can position the system transmitter enclosure further from the sensor electronics enclosure.

If you need assistance installing the cable, contact your Kurz representative or Kurz Customer Service. You can order five-wire extension cable and two-wire conductor cable up to 250 feet that is shielded, with vinyl insulation, 18 gauge, and radiation-resistant.

Table 1-3 applies to stranded copper wire at 65°F (18°C). Resistance in other kinds of wire or in stranded copper wire at different temperatures varies. AWG numbers are inversely proportional to the size of wire. For example, the smallest AWG number specifies the largest diameter wire.

Table 1-3. *Two-Wire Loop Resistance.*

APPROXIMATE LOOP RESISTANCE AT 65°F (18°C)			
AWG Number	Ohms Per Feet	Maximum Cable Per Feet	
		Loop	Run
4	.0003	13,333	6,667
8	.0005	8,000	4,000
10	.0008	5,000	2,500
12	.002	2,000	1,000
14	.003	1,333	667
16	.005	800	400
18	.008	500	250
20	.012	333	167
22	.019	211	105
24	.030	133	67
28	.077	52	26

1.1.3 Five-Wire Extension Cable Connections

If Kurz Instruments did not supply your five-wire extension cable, you must supply your own. The wires of the cable must match within 0.02 Ω of each other. Ensure that the installer uses the same AWG (American Wire Gauge) and length for each wire.

If you need assistance installing the cable, contact your Kurz representative or Kurz Customer Service. You can order five-wire extension cable and two-wire conductor cable up to 250 feet that is shielded, with vinyl insulation, 18 gauge, and radiation-resistant.

Table 1-4 lists the approximate loop resistance at 65°F (18°C) for five-wire extension cables. Resistance in other types of wire or in stranded copper wire at different temperatures varies. AWG numbers are inversely proportional to the size of wire; for example, the smallest AWG number specifies the largest wire.

Table 1-4. *Five-Wire Loop Resistance.*

APPROXIMATE LOOP RESISTANCE AT 65°F (18°C)			
AWG Number	Ohms Per Feet	Maximum Cable Per Feet	
		Loop	Run
4	.0003	6667	3333
8	.0005	4000	2000
10	.0008	2500	1250
12	.002	1000	500
14	.003	667	333
16	.005	400	200
18	.008	250	125
20	.012	167	83
22	.019	105	53
24	.030	67	33
26	.077	26	13

You must connect the sensor's five-wire extension cable to the correct terminals on the Model 465 Current-Transmitter Board. If you purchased a "TA" sensor electronics configuration, these connections have been made at the Kurz factory. Refer to the engineering drawings in Appendix A to see the sensor's five-wire extension cable placements on the Model 465 Current-Transmitter Board.

1.1.4 Connecting Series 155 Jr Outputs

You can connect your own external devices to the signal outputs and alarm contact outputs. Refer to Appendix A for all engineering drawings.

1.2 Verifying Wiring Connections

To verify the wiring connections on the Series 155 Jr, follow these steps:

1. Check system wiring against the Kurz system drawings provided with your equipment and against the architect/engineer or OEM equipment vendor drawing to ensure that terminations have not changed during the design process or installation.
2. Perform point-to-point tests to ensure that signal cables, power cables, ground wires, and other system connections are complete. This test minimizes equipment failures caused by improper wiring.
3. Do **NOT** supply power to the system until this check-out procedure is satisfactorily completed.

CAUTION: Ensure that all connections from the flow element to the Series 155 Jr input terminals are correct. You can permanently damage the system if you improperly connect the wiring.

End of Section 1

2 Operation

This section describes the Series 155 Jr keys and functions, what happens at startup, and how to use the Series 155 Jr menus and user-definable commands.

NOTE: Keep in mind that not all the menus and commands described in this manual might pertain to your specific system configuration; however, this section describes each command and function.

You can find more information about the Series 155 Jr in these sections:

- Section 3 contains the Technician-Level menus and commands
- Section 4 contains the PID (Proportional Integral Derivative) displays and menus
- Section 5 describes the Upload/Download Program
- Section 6 explains the Series 155 Jr Serial Port Connections.
- Appendix A contains a state diagram of Series 155 Jr operation.

2.1 Keys and Functions

You can operate the Series 155 Jr directly using the Series 155 Jr display and keypad, or you can use an ASCII terminal, or Personal Computer (PC) executing ASCII terminal emulation software. Using an ASCII terminal or PC offers the advantages of being remote from the system (up to 50 feet) and displaying more data at one time than the 32-character Series 155 Jr display.

Each Series 155 Jr key has a corresponding key on the ASCII terminal or PC keyboard. You press these keys to program and display information about the system setup and status. The Series 155 Jr key functions are described in Table 2-1.

Table 2-1. The Series 155 Jr Keypad and ASCII Keyboard.

155 JR KEY	FUNCTION	DESCRIPTION	ASCII KEY
P	Program	Starts Program Mode where you enter an access code, then can reset totalizers, system time and date, log interval, meter data, box filter, and so on.	p
D	Display	Starts Display Mode where you can see Meter ID, time and date, flow rate, totalized flow and elapsed time, average velocity, and so on.	d
L	Log	If you have a printer connected to the Series 155 Jr, pressing this key sends data to the printer port.	l
E	Enter	Enters setup variables in Program Mode.	[CR]
H	Hold	Holds current display until the Clear key is pressed.	h
∧ Yes	Up Arrow Yes	Press this key to move to the next item down in a menu, or to move right to the next menu. When selecting alphanumeric characters using the Series 155 Jr keypad, pressing the Up-Arrow key increments to the next letter or number (A,B,C... or 1,2,3...).	∧
v No	Down Arrow No	Press this key to move to the previous item in a menu, or to move left to the previous menu. When selecting alphanumeric characters using the Series 155 Jr keypad, pressing the Down-Arrow key decrements to the previous letter or number (...C,B,A or ...3,2,1).	‡
C	Clear	Press this key to cancel a response and return to the previous command or menu. Pressing the Clear key repeatedly returns you to the Executive Mode.	c
–	Hyphen	For text entry. Minus sign.	–
•	Period	For text entry.	•
0–9	0–9	For text entry.	0–9

NOTE: If you are using an ASCII terminal or PC with the Series 155 Jr, refer to your hardware's documentation for information regarding the location and function of keys. The ASCII terminal or PC keyboard key that corresponds to Series 155 Jr's "E" key (Enter) can differ from terminal to terminal. Sometimes "Enter" is denoted by "Carriage Return" [CR].

If your system is connected to an ASCII terminal or PC, you can:

- Echo Series 155 Jr displays to the terminal or PC (by means of the "primary" RS-232 port)
- Send Series 155 Jr configuration data to the terminal or PC (by means of the "primary" RS-232 port)
- Send Series 155 Jr log data to the terminal or PC (by means of the "secondary" RS-232 port – if you purchased this option)

Table 2-2. Series 155 Jr ASCII Key Functions.

ASCII KEY	FUNCTION
+	Toggles echo on and echo off to a terminal or PC screen. When echo is on, information sent to the Series 155 Jr display echoes to the ASCII terminal or PC screen. Pressing " + " again turns off the echo.
q	Sends system configuration data, which are not in a data log, to an ASCII terminal or PC display.
?	Displays a list of help functions for selection.

2.2 Startup

When you turn on the power to the microprocessor module, the data logging system initiates a memory check. As the Series 155 Jr passes the memory test, you see messages indicating the following information:

- System time of day clock
- Initialization messages
- Allows the analog inputs to stabilize
- Calculates the time of the next scheduled printout
- Starts Executive Mode

2.3 Executive Mode

After startup, the Series 155 Jr automatically enters the Executive Mode. In Executive Mode, the Series 155 Jr has an Automatic Display Loop to which it returns any time the keypad is inactive for 5 minutes. If the system is not in Executive Mode, you can press "C" repeatedly to return there.

The Automatic Display Loop cycles through display screens providing this information:

- "Kurz Instruments" information and the system time and date
- Press "D" to exit the Automatic Display Loop and enter an alternate display loop that displays additional information
- Press "P" to exit the Automatic Display Loop and enter the Program Mode
- Press "H" to hold and update one of the displays in the Automatic Display Loop. Press "H" twice to see the Help screens
- Press "L" to log the system status to a serial printer

2.4 Display Mode

From Executive Mode, you press "D." If your system has a PID loop configured and it's turned on, you can press "D," and then "E" to display values other than those in the Automatic Display Loop. You can press "C" to return to Executive Mode.

To display meter information:

1. Press YES/UP–ARROW and NO/DOWN–ARROW to select a meter, and then press "D."
2. You will see the meter identification (if you assigned one) or a preassigned meter number, and the time and date; press "D" to start the display.