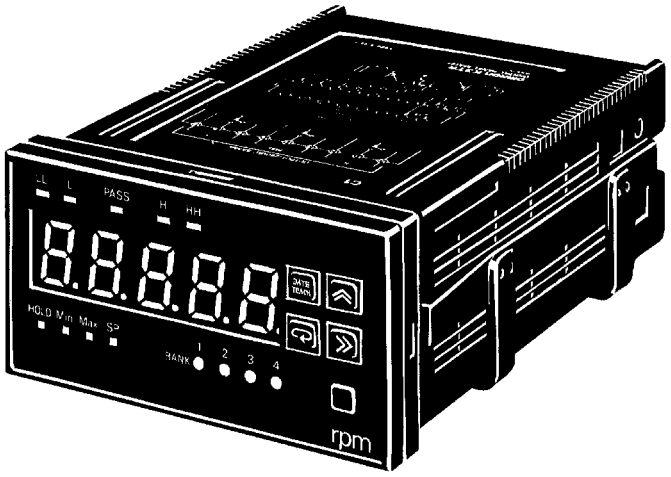
K3TR Intelligent Signal Processor

Operation Manual

Revised August 1995



Notice:

OMRON products are manufactured for use according to proper procedures by a qualified operator and only for the purposes described in this manual.

The following conventions are used to indicate and classify precautions in this manual. Always heed the information provided with them. Failure to heed precautions can result in injury to people or damage to the product.

⚠ DANGER! Indicates information that, if not heeded, is likely to result in loss of life or serious injury.

⚠ WARNING Indicates information that, if not heeded, could possibly result in loss of life or serious injury.

⚠ Caution Indicates information that, if not heeded, could result in relatively serious or minor injury, damage to the product, or faulty operation.

OMRON Product References

All OMRON products are capitalized in this manual. The word “Unit” is also capitalized when it refers to an OMRON product, regardless of whether or not it appears in the proper name of the product.

The abbreviation “Ch,” which appears in some displays and on some OMRON products, often means “word” and is abbreviated “Wd” in documentation in this sense.

The abbreviation “PC” means Programmable Controller and is not used as an abbreviation for anything else.

Visual Aids

The following headings appear in the left column of the manual to help you locate different types of information.

Note Indicates information of particular interest for efficient and convenient operation of the product.

1, 2, 3... 1. Indicates lists of one sort or another, such as procedures, checklists, etc.

About this Manual:

This manual describes the installation and operation of the K3TR Intelligent Signal Processor and includes the sections described below.

Please read this manual carefully and be sure you understand the information provided before attempting to install and operate the K3TR Intelligent Signal Processor.

Section 1 introduces the basic features of the K3TR Intelligent Signal Processor, illustrates some application examples, and provides an internal circuit block diagram.

Section 2 identifies all the major features of the front panel and gives a brief description of each function.

Section 3 identifies all the input and output features of the terminals and gives a brief description of each terminal.

Section 4 provides the dimensions and environmental conditions needed for mounting the K3TR Intelligent Signal Processor.

Section 5 briefly describes the K3TR sensor connections and their associated circuits and wiring.

Section 6 gives comprehensive descriptions on setting the parameters and the operation of the K3TR Intelligent Signal Processor.

Section 7 provides a troubleshooting guide for possible errors during operation and the corrective actions to be taken.

Appendix A provides a list of available base units and output boards.

Appendix B provides a list of sensor models and a list of factory-set parameters.

Appendix C provides a list of specifications, ratings, and interface specifications.

⚠WARNING Failure to read and understand the information provided in this manual may result in personal injury or death, damage to the product, or product failure. Please read each section in its entirety and be sure you understand the information provided in the section and related sections before attempting any of the procedures or operations given.

TABLE OF CONTENTS

SECTION 1
Introduction

This section deals with the basic features of the K3TR Intelligent Signal Processor. A brief description is given of each major feature. Possible applications of the K3TR Intelligent Signal Processor are also illustrated. An internal circuit block diagram illustrates how various internal circuits are being used when processing inputs.

1-1 Features

The basic features of the K3TR Intelligent Signal Processor are outlined below. Refer to relevant sections of this manual for details.

Operating Mode

The Intelligent Signal Processor features 13 operating modes depending on what the K3TR is measuring.

Setting the Prescale Value

For the K3TR to display rotations or rotational speed, the rotational speed (the number of pulses per revolution) must be multiplied by a factor input before the input pulses are measured. This factor is called the prescale value.

Setting Auto-zero Time

The K3TR has a function to force the frequency to set to zero if no pulse is received for a certain period. The period during which no pulse is received before the K3TR sets the frequency to zero is called “auto-zero time.”

Display Refresh Period

If display data is updated in synchronization with the normal sampling period (approximately 60 ms), the data may change too rapidly to be read. In this case, the speed at which the displayed data is updated can be slowed down. When a slow data display speed is selected, the sampling period for measurement is not changed. The comparative outputs or BCD outputs are updated in synchronization with the sampling period.

Setting the Set Values

When setting set values, the decimal point is automatically displayed according to the sensor type selected. Also, there is no limitation on the relationships among HH, H, L, and LL.

Setting Hysteresis

The set value includes a hysteresis setting to prevent the comparative output status indicators from turning ON/OFF when it should not if the measured value fluctuates in the vicinity of the set value.

Protecting, Checking, and Changing Set Values

With the basic, LED, and thumbwheel switches models, the set values can be protected, checked, and changed in RUN mode.

Setting Linear Output Range

The Intelligent Signal Processor outputs a linear voltage or current in proportion to the changes in the measured value, i.e., the value to be displayed.

Maximum/Minimum Values

The maximum and minimum of the values measured since power application or RESET signal input up to the present point are retained. When the RESET signal turns ON, both the maximum and minimum values are reset to the present value. Even though the maximum and minimum values are retained in memory, all the outputs are output in accordance with changes in the measured value, regardless of the display or even if the RESET signal is OFF except as controlled by the HOLD input (see next feature).
The Intelligent Signal Processor in operation modes 6 through 12 respectively will process the maximum and minimum values differently. Refer to pages 56 to 74, 112, and 113 for details.

Hold Measured Value

When the HOLD input is turned ON, measurement stops and the input measured just before the HOLD input turned ON is held. The displayed value, all the outputs, are also held.
The Intelligent Signal Processor in operation modes 6 through 12 respectively will process the maximum and minimum values differently. Refer to pages 56 to 74, 112, and 113 for details.

Test Mode

The Intelligent Signal Processor is provided with a test mode in which simulated signals can be input. When a simulated input signal is applied, an actual corresponding output signal is issued.

Setting Set Values/Prescale Value/Linear Output Range with the Teaching Function

The Intelligent Signal Processor is provided with a teaching function that can set an actual measured value as a set value, prescale value or linear output range.

Bank Selection

With the Intelligent Signal Processor, the set value and prescale value can be altered without key operation via the selection of an another bank when making a level change. The K3TR has four banks; each bank can output HH, H, L, and LL set values.

Estimated Frequency Calculation

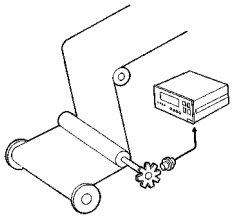
If input pulses are suddenly interrupted, the estimated frequency calculation function continuously estimates the frequency in preparation for the next pulse that may occur.

1-2 Application Examples

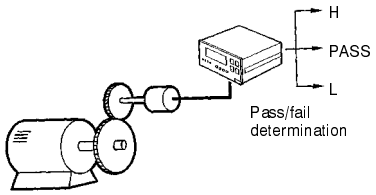
The following diagrams illustrate some potential uses of the K3TR Intelligent Signal Processor. The K3TR provides 13 operating modes for converting input pulses to display values. The mode can be selected via key operations on the front panel.

Operating Mode 1: Rotational/Circumferential Speed

Measuring Roller Winding Speed

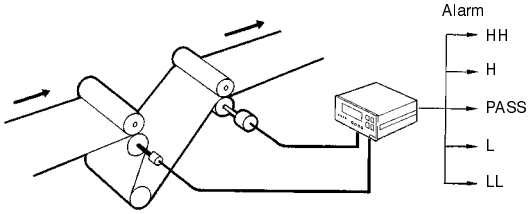


Measuring Motor Speed (for Product Testing)



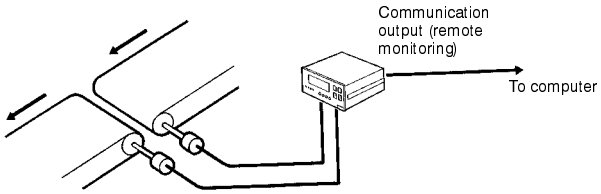
Operating Mode 2: Absolute Ratio

Measuring Ratio between Rotational Speed of Two Rollers



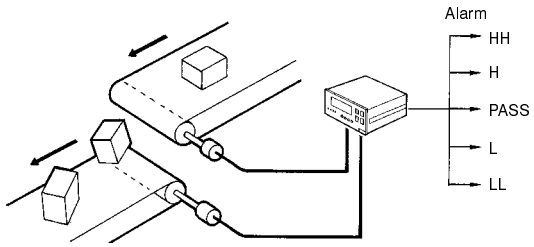
Operating Mode 3: Error Ratio

Measuring Difference between Two Line Speeds (Two Conveyors)



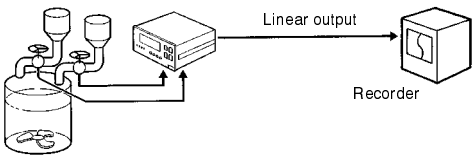
Operating Mode 4: Rotational Difference

Measuring the Absolute Difference between the Speeds of Two Conveyors



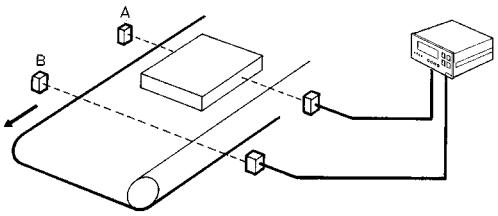
Operating Mode 5: Flow Rate Ratio

Monitoring the Concentration of a Liquid Mixture



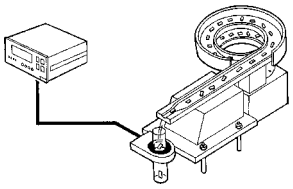
Operating Mode 6: Linear Speed

Measuring the Speed of Workpieces between Points A and B



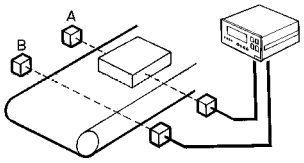
Operating Mode 7: Cycle

Measuring the Rate at which Parts are Fed

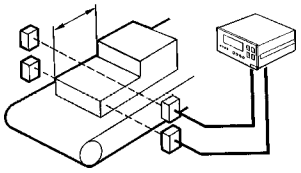


Operating Mode 8: Time Difference

Measuring the Time Required for Workpieces to Pass from Point A to Point B

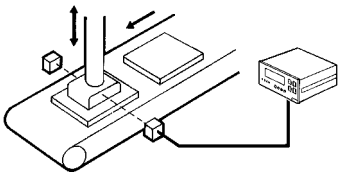


Can be Used with Scaling to Measure Lengths of Steps

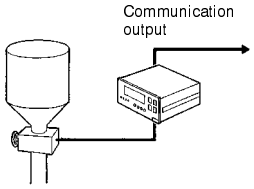


Operating Mode 9: Elapsed Time

Monitoring the Time That a Press is Activated

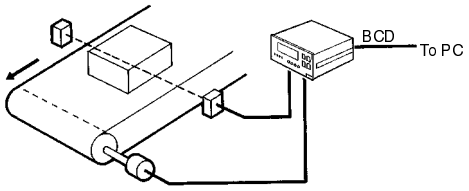


Controlling the Time That a Valve is Open



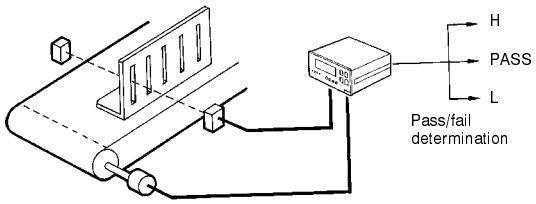
Operating Mode 10: Length Measurement

Measuring Workpiece Length



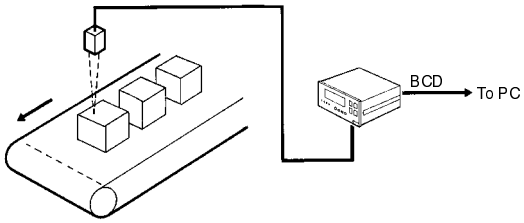
Operating Mode 11: Interval

Measuring Slot Spacing



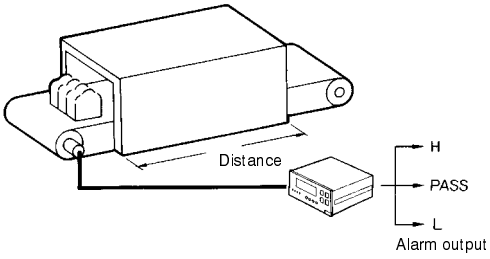
Operating Mode 12: Pulse Counting

Counting Workpieces



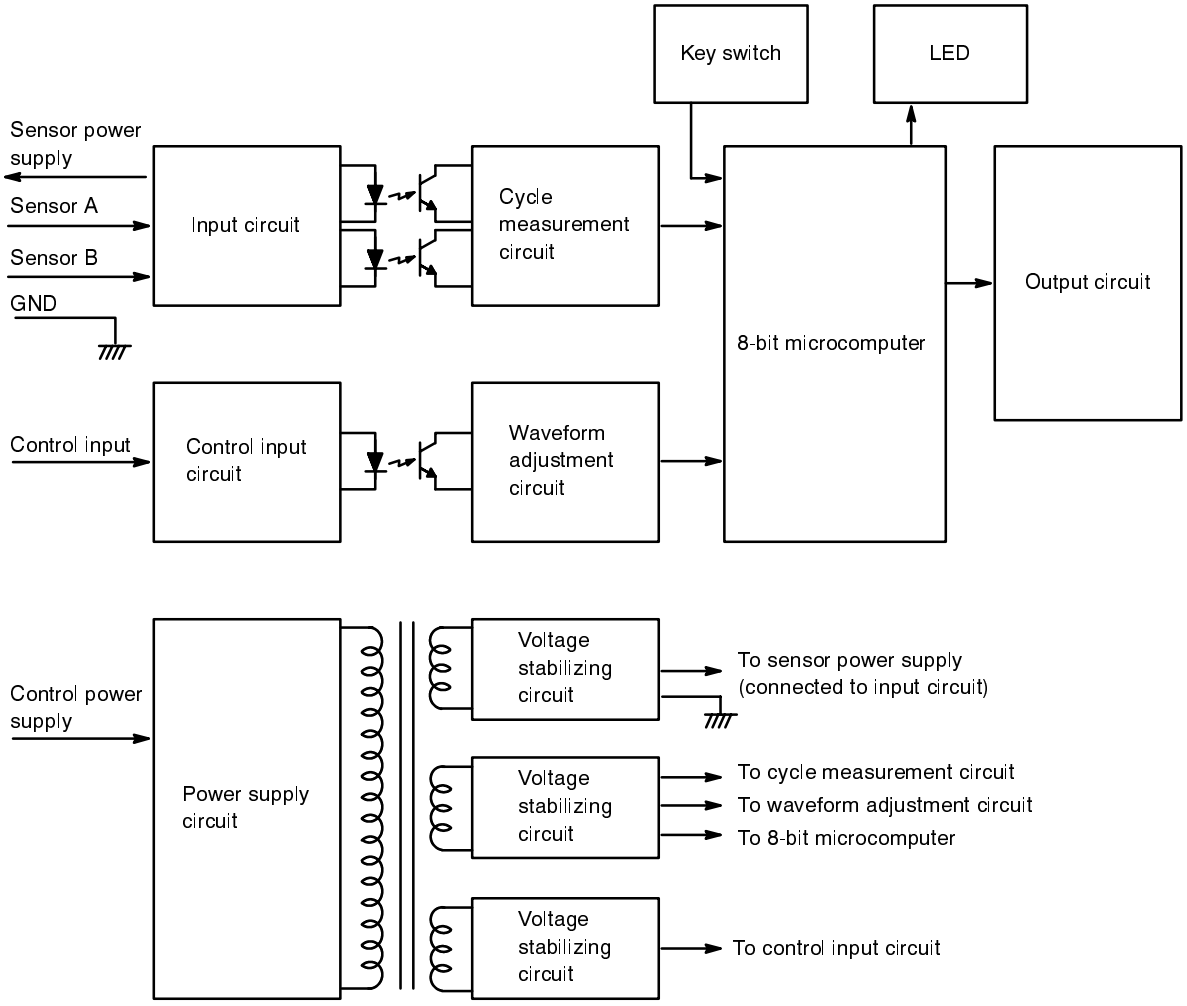
Operating Mode 13: Passing Time

Passing Time for a Conveyor Line



1-3 Internal Circuit Block Diagram

The following schematic illustrates how various internal circuits are being used when processing inputs from sources such as sensors, control inputs, and control power supply.

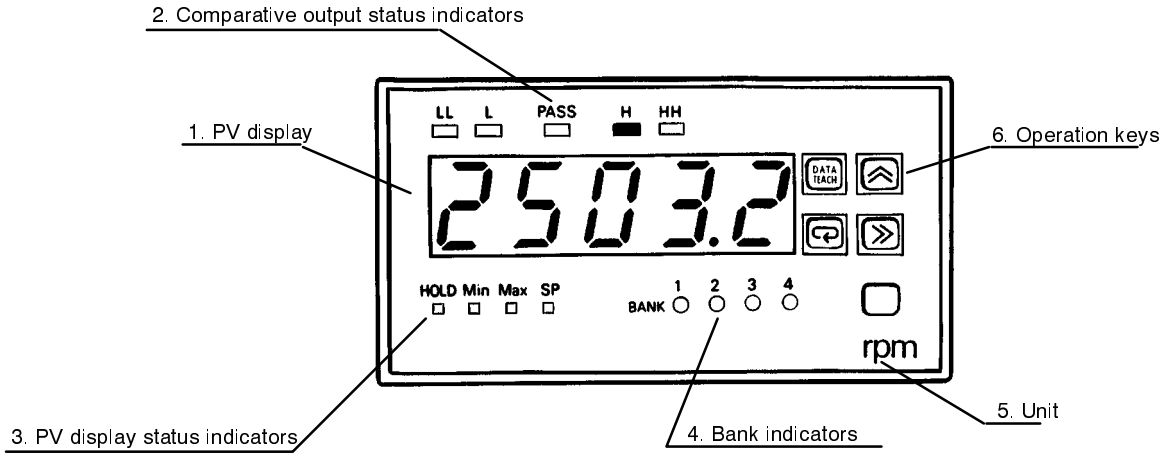


SECTION 2
Front Panel: Nomenclature and Functions

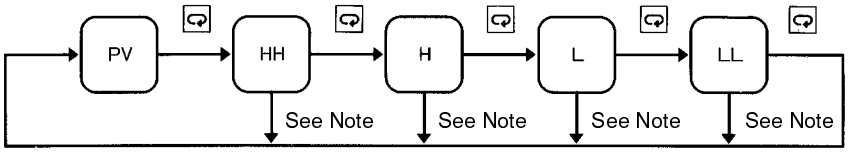
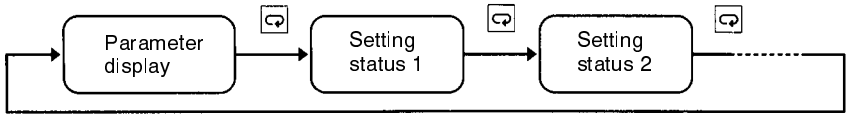
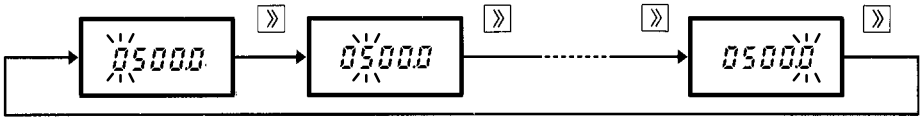
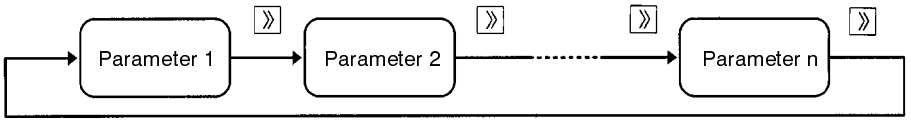
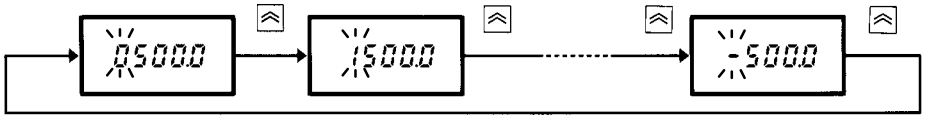
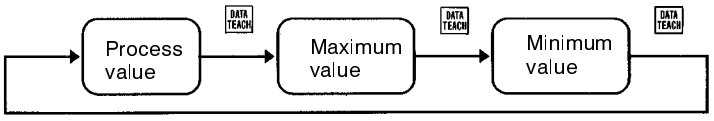
This section gives a general and introductory description of the Intelligent Signal Processor's front panel. Three front panel models are described in this section: K3TR-□B1□A (Basic Model), K3TR-□B1□C (with Set Value LED Display), K3TR-□B1□D (with Thumbwheel Switches). This description consists of the front panel nomenclature and a brief description of each of its functions.

2-1 K3TR-□B1□A (Basic Model)

The following diagram identifies the major features found on the K3TR Basic Model front panel. The table gives a brief description of the function of each front panel feature.

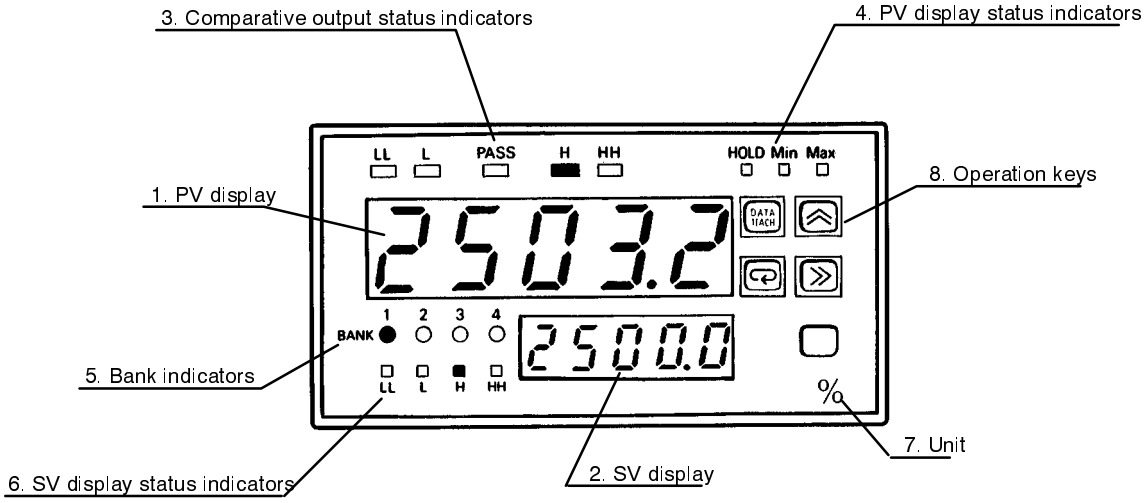


No.	Name		Functions
1.	PV (process value) display		Displays the process, maximum, and minimum values. Also displays set values while the SP indicator is lit. Displays characters indicating the set mode and set values. Displays an error message when an error occurs.
2	Comparative output status indicators	HH	Is lit when HH comparative output status is ON. HH comparative output status turns ON when the measured value exceeds the HH set value. This indicator does not light in models not provided with the comparative output function.
		H	Is lit when H comparative output status is ON. H comparative output status turns ON when the measured value exceeds the H set value. This indicator does not light in models not provided with the comparative output function.
		L	Is lit when L comparative output status is ON. L comparative output status turns ON when the measured value falls below the L set value. The L comparative output status turns ON when the measured value exceeds the L set value only when the K3TR is in pulse counting mode (operating mode 12). This is identical to when the H comparative output status turns ON when the measured value exceeds the H set value and HH comparative output status turns ON when the measured value exceeds the HH set value. This indicator does not light in models not provided with the comparative output function.
		LL	Is lit when LL comparative output status is ON. LL comparative output status turns ON when the measured value falls below the LL set value. The LL comparative output status turns ON when the measured value exceeds the LL set value only when the K3TR is in pulse counting mode (operating mode 12). This is identical to when the H comparative output status turns ON when the measured value exceeds the H set value and HH comparative output status turns ON when the measured value exceeds the HH set value. This indicator does not light in models not provided with the comparative output function.
		PASS	Is lit when PASS comparative output status is ON. PASS comparative output status turns ON when all HH, H, L, and LL comparative output status are OFF. This indicator does not light in models not provided with the comparative output function.
3	PV display status indicators	HOLD	Is lit when HOLD input is ON. By turning ON the HOLD terminal on the rear panel, the hold function can be effected.
		Min	Indicates that the value displayed on the PV display is the minimum value. To display the minimum value, use the DATA TEACH Key.
		Max	Indicates that the value displayed on the PV display is the maximum value. To display the maximum value, use the DATA TEACH Key.
		SP	Indicates that the value displayed on the PV display is a set value. To display a set value, use the Display Key. This indicator does not light in models not provided with the comparative output function; in this case, no set value can be displayed with the Display Key.

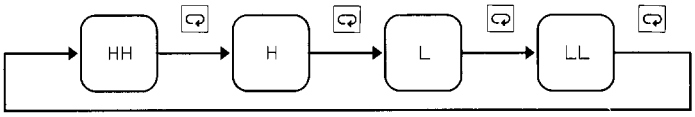
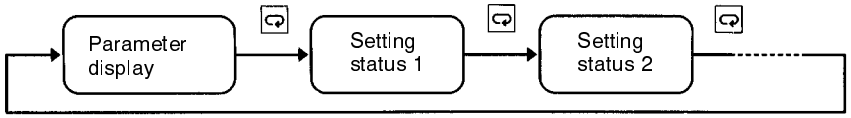
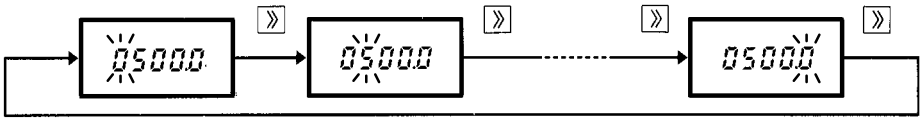
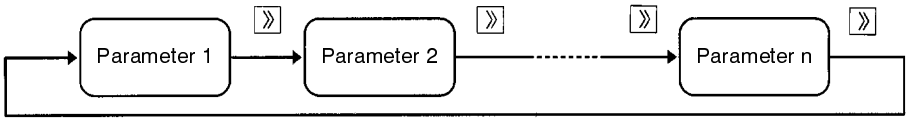
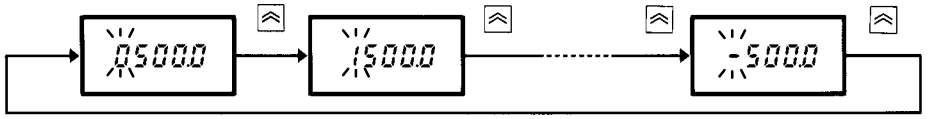
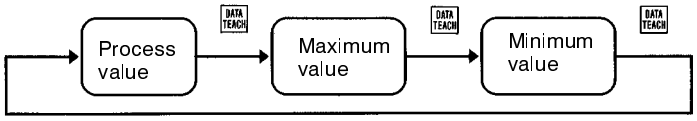
No.	Name		Functions
4	Bank indicators		Indicates the selected bank. To alter the set value without key operation, select another bank when making a level change. The K3TR has four banks; each bank can output HH, H, L, and LL set values (Models with H or L output can output H or L set values only). Select a bank with the Bank input terminal on the rear panel. Models with no output set values have no banks. The Bank indicators of those models remain unlit.
5	Unit		Attach the appropriate label (use the labels supplied as accessories).
6	Operation keys	□ Level Key	Selects the setting mode, in which the setting levels can be changed. For details on the setting levels, refer to *6-1 Before Setting the Parameters*.
		Display Key	Displays a set value on the PV display. This function is not provided on models not equipped with the comparative output function.  **Note:** Unless another operation key is pressed within 5 seconds after this key has been pressed, the process value is displayed again. In the setting mode, after a parameter is selected with the Shift Key, the selected setting is enabled or disabled or the set value is written to memory with this key. 
		Shift Key	Shifts the digit where the set value is to be changed.  Selects a parameter at each setting level.  For details on the setting parameter, refer to *Section 6 Parameter Setting and Operation*.
		Up Key	Increases the set value by one. 
		DATA TEACH Key	Displays the process, maximum, or minimum value.  In the setting mode, effects the teaching function. With this function, the set values, prescale values, and linear output range are set by means of actual input. For details on the teaching function, refer to *6-6-2 Special Functions*.

2-2 K3TR-□B1□C (with Set Value LED Display)

The following diagram identifies the major features found on the K3TR with Set Value LED Display front panel. The table gives a brief description of the function of each front panel feature.

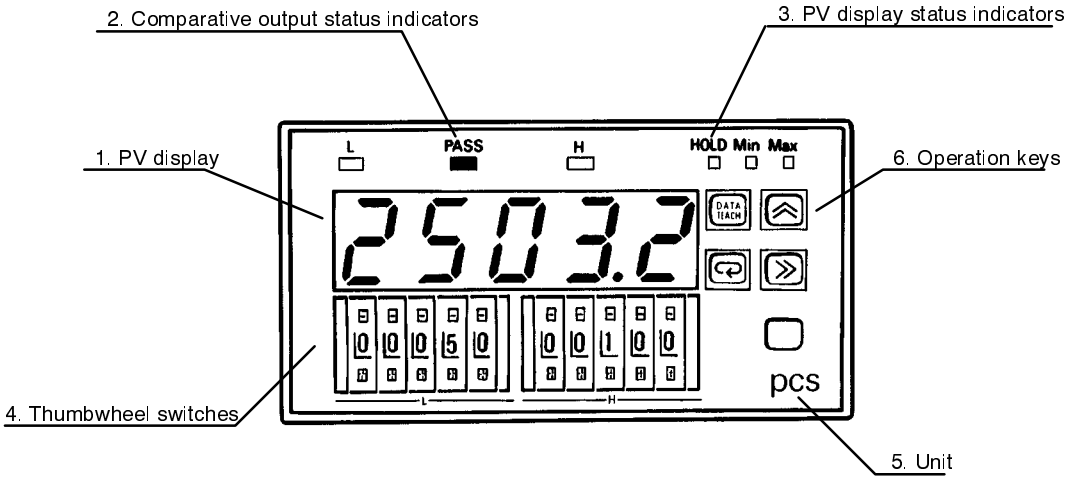


No.	Name		Functions
1	PV (process value) display		Displays the process, maximum, and minimum values. Displays characters indicating the set mode and set values. Displays an error message when an error occurs.
2	SV (set value) display		Displays the set value of a comparative output. In setting mode, displays the set parameter.
3	Comparative output status indicators	HH	Is lit when HH comparative output status is ON. HH comparative output status turns ON when the measured value exceeds the HH set value.
		H	Is lit when H comparative output status is ON. H comparative output status turns ON when the measured value exceeds the H set value.
		L	Is lit when L comparative output status is ON. L comparative output status turns ON when the measured value falls below the L set value. The L comparative output status turns ON when the measured value exceeds the L set value only when the K3TR is in pulse counting mode (operating mode 12). This is identical to when the H comparative output status turns ON when the measured value exceeds the H set value and HH comparative output status turns ON when the measured value exceeds the HH set value.
		LL	Is lit when LL comparative output status is ON. LL comparative output status turns ON when the measured value falls below the LL set value. The LL comparative output status turns ON when the measured value exceeds the LL set value only when the K3TR is in pulse counting mode (operating mode 12). This is identical to when the H comparative output status turns ON when the measured value exceeds the H set value and HH comparative output status turns ON when the measured value exceeds the HH set value.
		PASS	Is lit when PASS comparative output status is ON. PASS comparative output status turns ON when all HH, H, L, and LL comparative output status are OFF.
4	PV display status indicators	HOLD	Is lit when HOLD input is ON. By turning ON the HOLD terminal on the rear panel, the hold function can be effected.
		Min	Indicates that the value displayed on the PV display is the minimum value. To display the minimum value, use the DATA TEACH Key.
		Max	Indicates that the value displayed on the PV display is the maximum value. To display the maximum value, use the DATA TEACH Key.
5	Bank indicators		To alter the set value without key operation, select another bank when making a level change. The K3TR has four banks; each bank can output HH, H, L, and LL set values (Models that have H or L output can output H or L set values only).
6	SV display status indicators		Indicates whether the displayed set value on the SV display is HH, H, L, or LL.

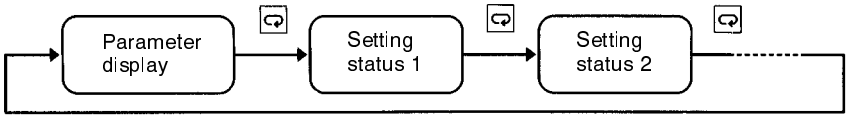
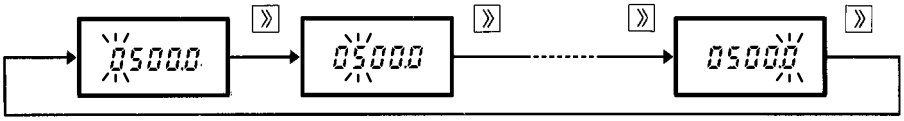
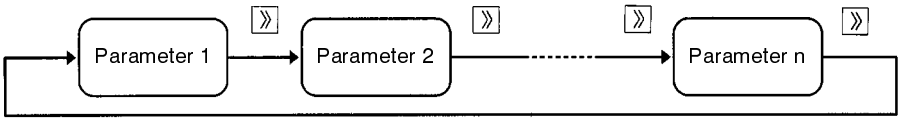
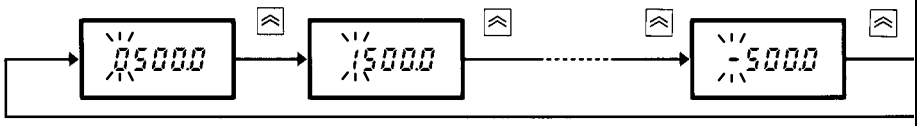
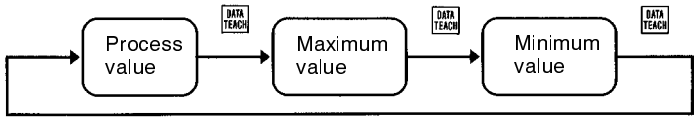
No.	Name		Functions
7	Unit		Attach the appropriate label (use the labels supplied as accessories).
8	Operation keys	□ Level Key	Selects the setting mode, in which the setting levels can be changed. For details on the setting levels, refer to *6-1 Before Setting the Parameters*.
		Display Key	Displays a set value on the SV display.  In the setting mode, after a parameter is selected with the Shift Key, the selected setting is enabled or disabled or the set value is written to memory with this key. 
		Shift Key	Shifts the digit where the set value is to be changed.  Selects a parameter at each setting level.  For details on the setting parameter, refer to *Section 6 Parameter Setting and Operation*.
		Up Key	Increases the set value by one. 
		DATA TEACH Key	Displays the process, maximum, or minimum value.  In the setting mode, effects the teaching function. With this function, the set values, prescale values, and linear output range are set by means of actual input. For details on the teaching function, refer to *6-6-2 Special Functions*.

2-3 K3TR-□B1□D (with Thumbwheel Switches)

The following diagram identifies the major features found on the K3TR with Thumbwheel Switches front panel. The table gives a brief description of the function of each front panel feature.



No.	Name		Functions
1	PV (process value) display		Displays the process, maximum, and minimum values. Displays characters indicating the set mode and set values. Displays an error message when an error occurs.
2	Comparative output status indicators	H	Is lit when H comparative output status is ON. H comparative output status turns ON when the measured value exceeds the H set value.
		L	Is lit when L comparative output status is ON. L comparative output status turns ON when the measured value falls below the L set value. The L comparative output status turns ON when the measured value exceeds the L set value only when the K3TR is in pulse counting mode (operating mode 12). This is identical to when the H comparative output status turns ON when the measured value exceeds the H set value.
		PASS	Is lit when PASS comparative output status is ON. PASS comparative output status turns ON when all HH, H, L, and LL comparative output status are OFF.
3	PV display status indicators	HOLD	Is lit when HOLD input is ON. By turning ON the HOLD terminal on the rear panel, the hold function can be effected.
		Min	Indicates that the value displayed on the PV display is the minimum value. To display the minimum value, use the DATA TEACH Key.
		Max	Indicates that the value displayed on the PV display is the maximum value. To display the maximum value, use the DATA TEACH Key.
4	Thumbwheel switches		Set H and L set values. The set values can be changed at any time regardless of the RUN or setting mode.
5	Unit		Attach the appropriate label (use the labels supplied as accessories).

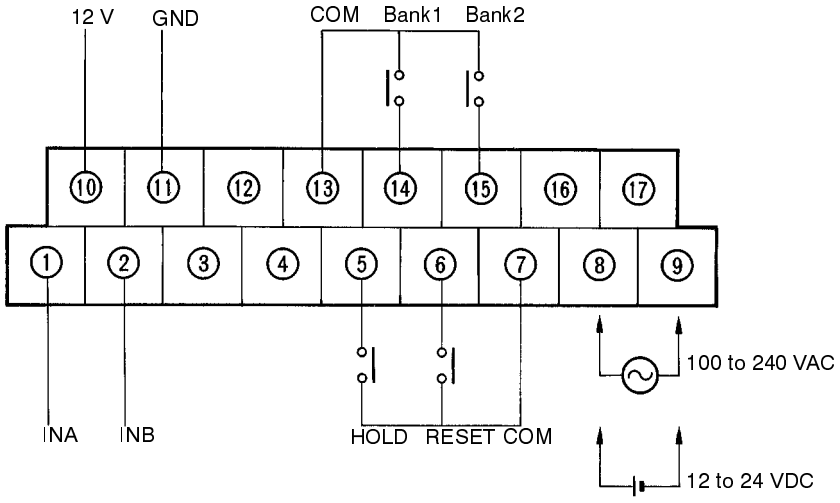
No.	Name		Functions
6	Operation keys	□ Level Key	Selects the setting mode, in which the set levels can be changed. For details on the set levels, refer to *6-1 Before Setting the Parameters*.
		Display Key	This key has no function in RUN mode. In the setting mode, after a parameter is selected with the Shift Key, the selected setting is enabled or disabled or the set value is written to memory with this Key. 
		Shift Key	Shifts the digit where the set value is to be changed.  Selects a parameter at each setting level. For details on the setting parameter, refer to *Section 6 Parameter Setting and* 
		Up Key	Increases the set value by one. 
		DATA TEACH Key	Display, the process, maximum, or minimum value.  In the setting mode, effects the teaching function. With this function, the set values, prescale values, and linear output range are set by means of actual input. For details on the teaching function, refer to *6-6-2 Special Functions*.

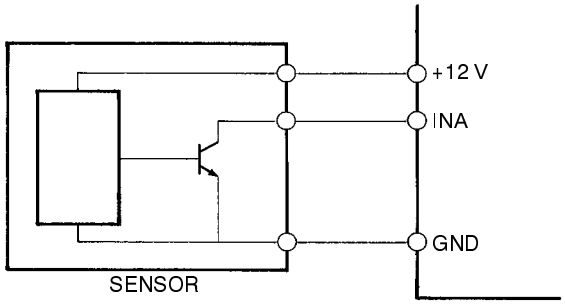
SECTION 3
Terminals: Nomenclature and Functions

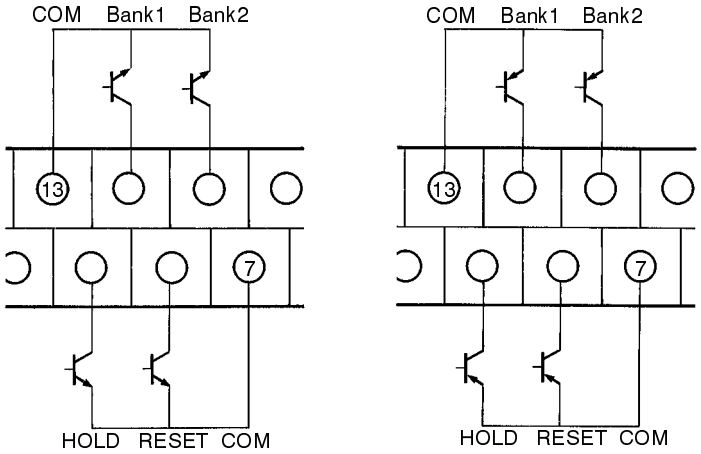
This section gives a general description of the K3TR Intelligent Signal Processor's terminals. Depending upon the requirements, one of several output models can be selected for use in the Intelligent Signal Processor.

3-1 Inputs

The K3TR Intelligent Signal Processor's terminal inputs terminal are described in the following diagram and table. The table identifies each terminal and briefly describes its input function.



No.	Name	Function
1	INA (Input A)	INA accepts pulse input from the sensor.  A series of models corresponding to PNP-type sensors is available. Use INA if only one input system is used (with operating modes 1, 7, 9, and 13). For details of operating modes, refer to *6-3-1 Operating Modes*. Connectable devices include photoelectric sensors, proximity sensors, rotary encoders, relays, and other devices. For details, refer to *Section 5 Sensor Connection*.
2	INB (Input B)	Use INB if a second input system is required (with operating modes 2, 3, 4, 5, 6, 8, 10, 11, and 12). The method of connection is identical for INA and INB.
3 4	Unused terminals	–––
5	HOLD	**Operating modes 1 to 5 or 13:** When the HOLD signal to this terminal turns ON, measurement is stopped and the measured value immediately before the HOLD signal is retained. The displayed value and all the outputs are also retained. While the HOLD signal is ON, the hold operation continues. The effect of the hold function is canceled when the HOLD signal is turned OFF. **Operating modes 6 to 11:** When the HOLD signal is ON, the K3TR holds the measured value as well as all the outputs. If the HOLD input turns ON while the K3TR is measuring, the measuring operation is canceled and the K3TR holds the displayed value. Measurement will not begin while the K3TR is in HOLD status. **Operating mode 12:** When the HOLD signal turns ON, the K3TR holds the displayed value only. While the HOLD input is ON, counting continues. Counting is suspended when INB input turns ON. All the outputs are output regardless of HOLD input. For further details, refer to the explanation of each operating mode in *6-2 Parameter Setting.*

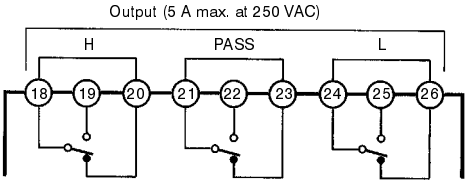
No.	Name	Function
6	RESET	**Operating modes 1 to 5 or 13**: When the RESET signal to this terminal turns ON, the present maximum and minimum values are reset to present value, and measurement of new maximum and values begins. While the RESET signal is ON, both the maximum and minimum values change with the input values. **Operating modes 6 to 11**: When the RESET signal to this terminal turns ON, the recorded maximum and minimum values are reset to zero and the K3TR is reset. While the RESET signal in ON, RESET status continues. **Operating mode 12**: When the RESET signal to this terminal turns ON, the accumulated value is reset to zero. While the RESET signal is ON, counting discontinues.
7	COM	This is the common terminal for the HOLD and RESET signals. Supply the HOLD and RESET signals as no-voltage contact input signals. To input the signals through a transistor, use the open-collector configuration shown  NPN input model PNP input model Terminals 7 through 13 are internally connected.
8 9	Power	Supply power to these terminals. Be sure to supply 100 to 240 VAC for AC-operated models, and 12 to 24 VDC for DC-operated models.
10 11	Sensor power supply (see note)	80 mA, 12 VDC. Use an external power supply if the capacity of the sensor power supply is insufficient.
12	Unused terminal	---
13	COM	This is the common input terminal for Bank1 and Bank2. Bank1 and Bank2 inputs should be non-voltage contact inputs. For transistor input, connect open collector output such as HOLD and RESET outputs. Terminals 7 through 13 are internally connected.
14 15	Bank selection	Select the bank for set values and prescale values. Control input Bank no. Bank 1 Bank 2 1 OFF OFF 2 ON OFF 3 OFF ON 4 ON ON When the banks are set to OFF, the prescale values will be set to fixed values. Thumbwheel switches models and models with no comparative outputs cannot accept bank input.
16 17	Unused terminals	---

Note An Intelligent Signal Processor requires a control power supply current of approximately 1 A the moment the Intelligent Signal Processor is turned on. Do not forget to take this into consideration when using several Intelligent Signal Processors.

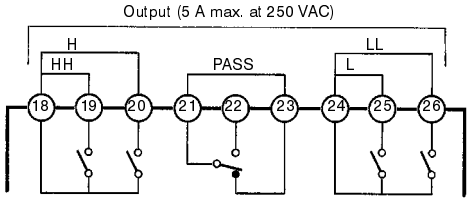
3-2 Output Boards

Depending upon the requirements of the receiving unit, the K3TR Intelligent Signal Processor can use one of the following output boards.

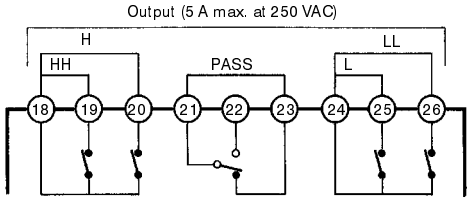
K31-C1: Relay (3 Outputs)



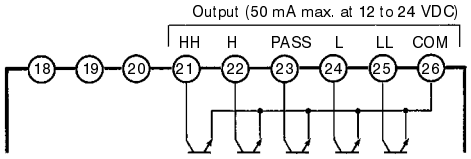
K31-C2: Relay (5 Outputs)



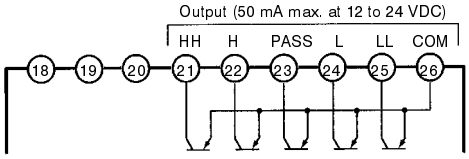
K31-C5: Relay (5 Outputs)



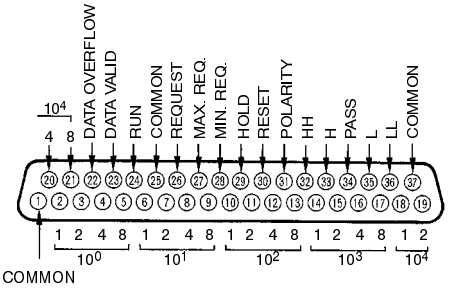
K31-T1: Transistor (NPN Open Collector)



K31-T2: Transistor (PNP Open Collector)

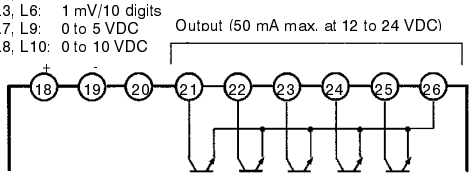


K31-B2, -B4: BCD (NPN Open Collector)
(Terminals 32 to 36 are provided only on K31-B4.)

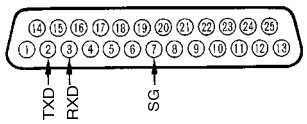


K31-L1, -L2, -L3, -L4, -L5, -L6, -L7, -L8, -L9, -L10 : Linear
(Terminals 21 to 26 are provided only on K31-L4, -L5, -L6, -L9, -L10.)

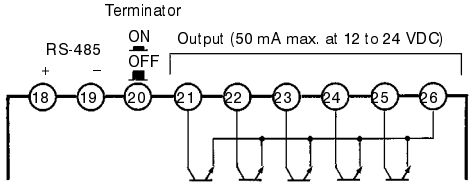
L1, L4: 4 to 20 mA
L2, L5: 1 to 5 V
L3, L6: 1 mV/10 digits
L7, L9: 0 to 5 VDC
L8, L10: 0 to 10 VDC



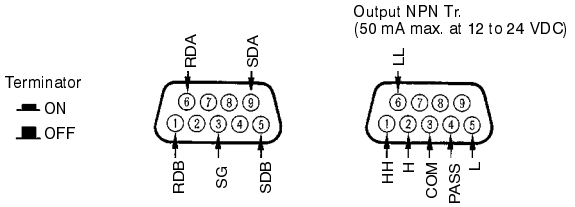
K31-S1: RS-232C



K31-S2, -S5: RS-485
(Terminals 21 to 26 are provided only on K31-S5.)



K31-S3, -S6: RS-422
(The right connector is provided only on K31-S6.)



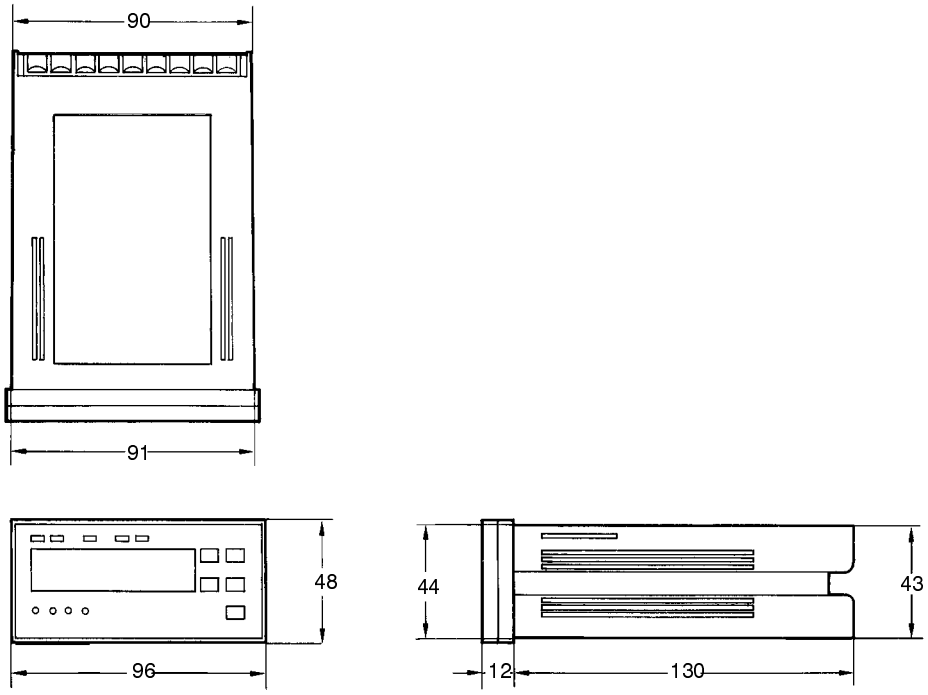
- D 37P Connectors for BCD output type (attachment)
  Plug: XM2A-3701
  Hood: XM2S-3711
- D 25P connectors for RS-232C type (order separately)
  Plug: XM2A-2501 or XM4A-2521
  Hood: XM2S-2511
- D 9P connectors for RS-422 type (order separately)
  Plug: XM2A-0901 or XM4A-0921
  Hood: XM2S-0911

SECTION 4
Mounting

This section provides the dimensions and instructions required for mounting the K3TR Intelligent Signal Processor. Mounting conditions for the Unit are also given.

4-1 Dimensions

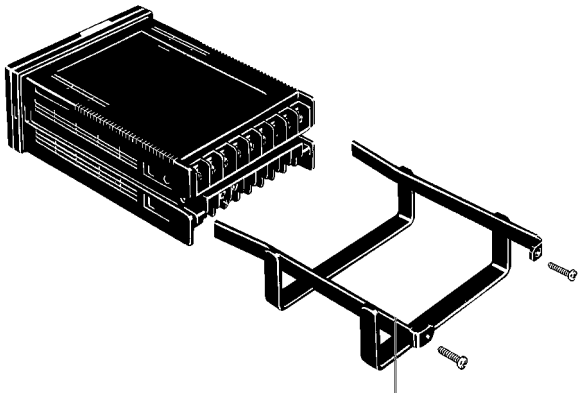
All dimensions are in millimeters.



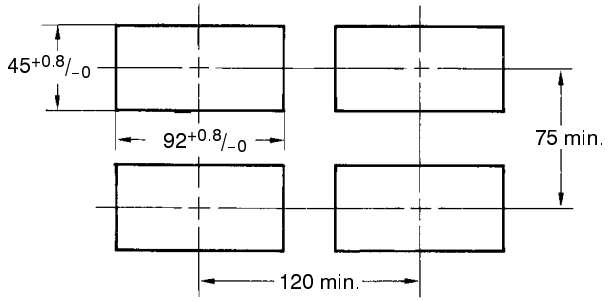
4-2 Panel Mounting

The mounting dimensions of the Intelligent Signal Processor conform to DIN 43700. Recommended panel thickness is 1 to 3.2 mm. Attach the mounting brackets supplied as accessories to the Intelligent Signal Processor from behind and tighten the mounting screws of the brackets to a torque of 5 kgf • cm (0.49 N • m).

Whenever possible, keep the Intelligent Signal Processor horizontal. Do not install the Intelligent Signal Processor where it will be exposed to corrosive gases (especially sulfurized gas and ammonia gas). Do not install the Intelligent Signal Processor where it will be subject to vibration, shock, dust, or high humidity. The ambient temperature of the installation site must be within −10° to 55°C.



Panel Cutout



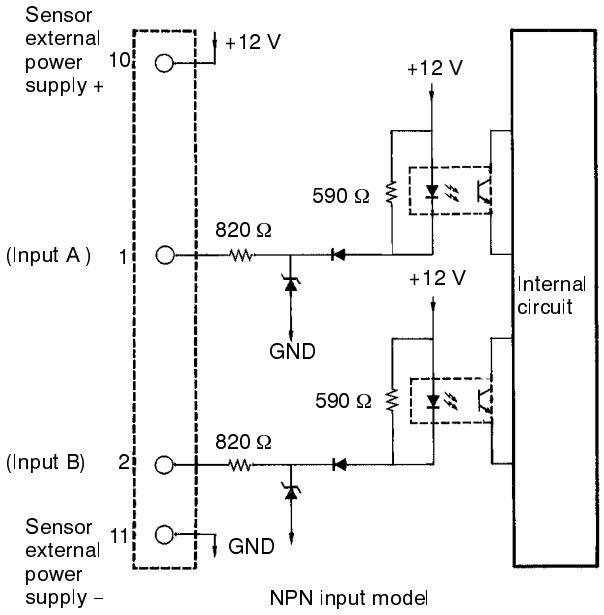
All dimensions are in millimeters.

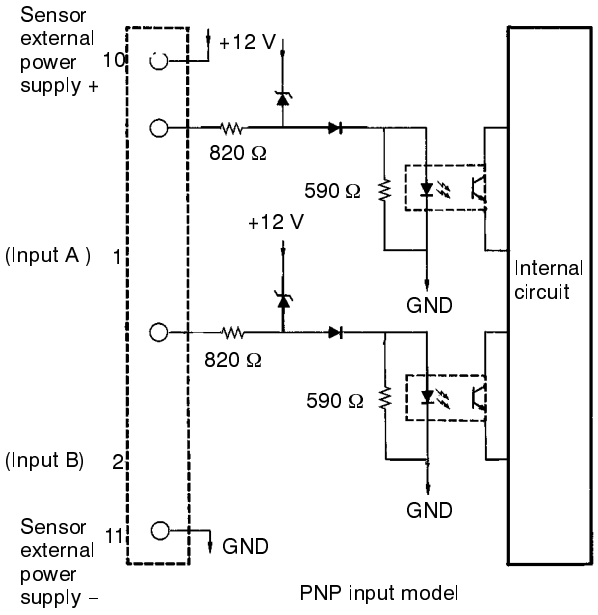
Note: Attach mounting bracket before wiring the terminals. When removing the Intelligent Signal Processor, first disconnect the wiring, then remove the mounting bracket.

SECTION 5
Sensor Connection

This section deals with the K3TR sensor connections and their associated circuits and wiring.

5-1 Input Circuits





5-2 Connectable Sensors

Photoelectric sensors, proximity sensors, rotary encoders, and relays can be used with this Unit. Also, any sensor with the following specifications can be used.

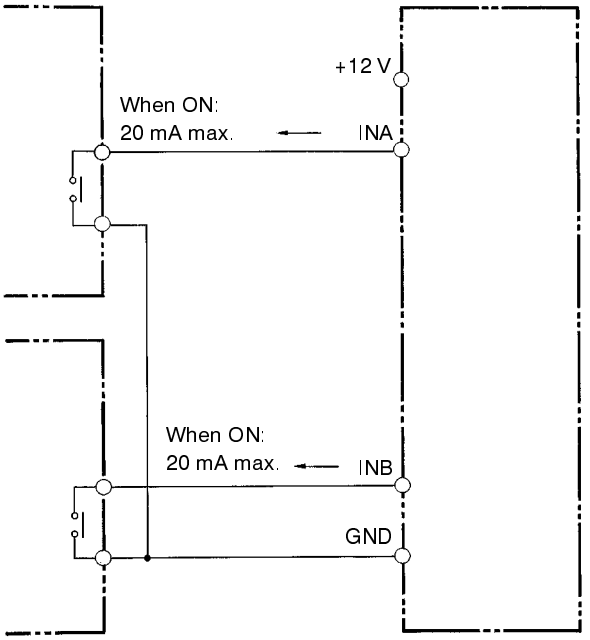
Residual voltage when sensor is ON	3 V max.
Current leakage when sensor is ON	1.5 mA max.
Load current	Switching capacity should be 20 mA minimum. A load current of 5 mA or less must be switched.

Note: The K3TR does not correspond to a tachogenerator. Some voltage output sensors or two-wire sensor models cannot be connected to the K3TR.

5-3 Sensor Wiring

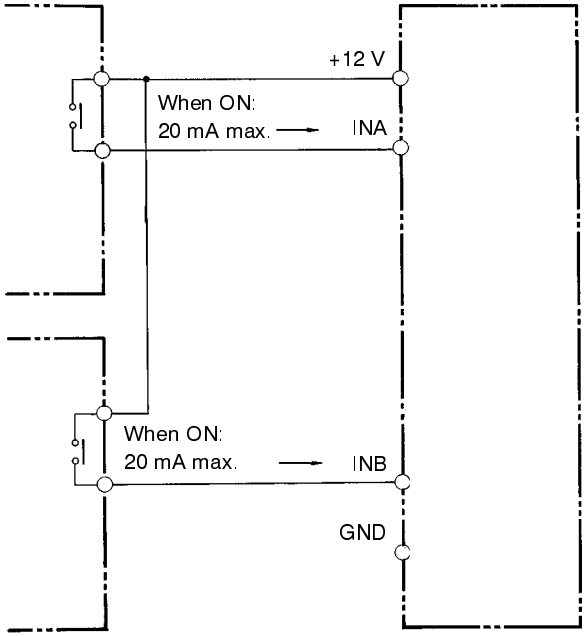
Relay Output Model

NPN Input Model



K3TR-NB1□□-□□

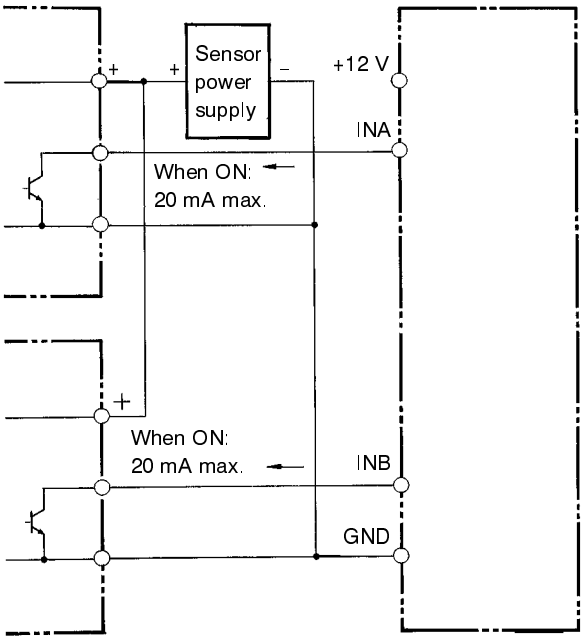
PNP Input Model



K3TR-PB1□□-□□

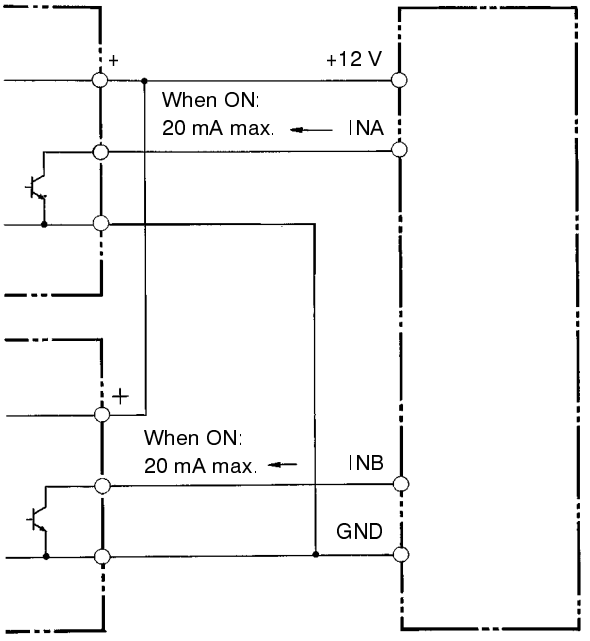
NPN Open Collector Output Model

With External Power Supply



K3TR-NB1□□-□□

Without External Power Supply

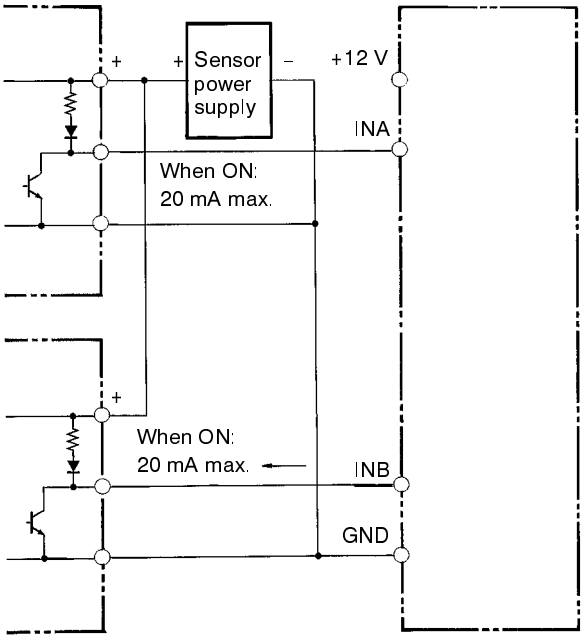


K3TR-NB1□□-□□

Use an external power supply if the operating voltage of the sensor is other than 12 VDC, or if the total power consumption exceeds 80 mA.

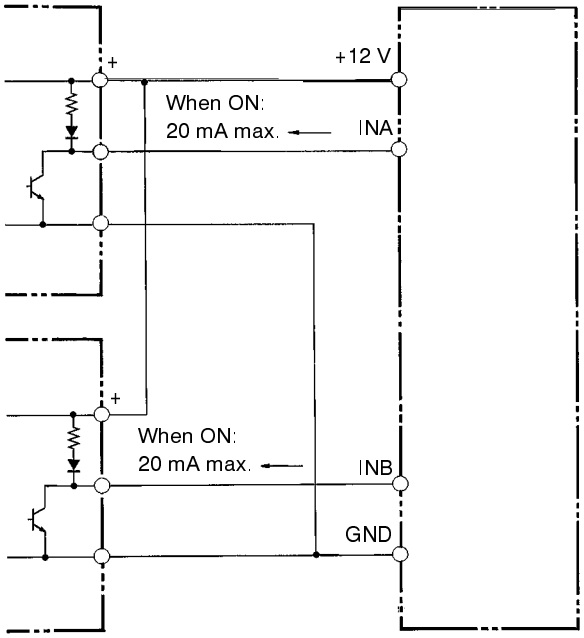
NPN Current Output Model

With External Power Supply



K3TR-NB1□□-□□

Without External Power Supply

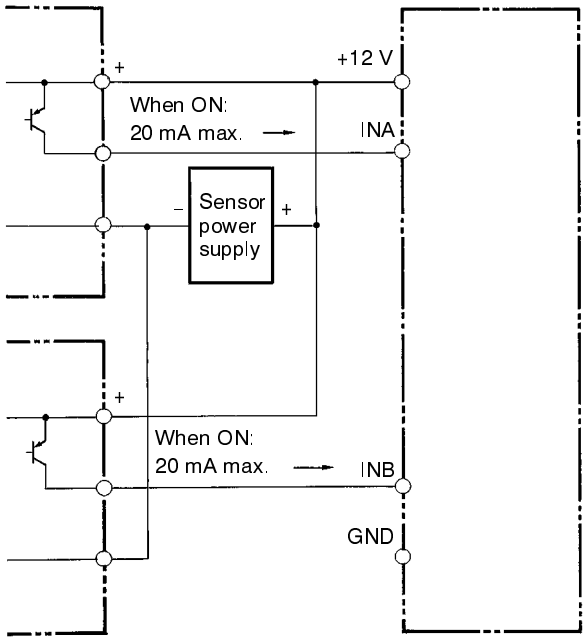


K3TR-NB1□□-□□

Use an external power supply if the operating voltage of the sensor is other than 12 VDC, or if the total power consumption exceeds 80 mA. Use an external power supply with 12 to 24 VDC output voltage

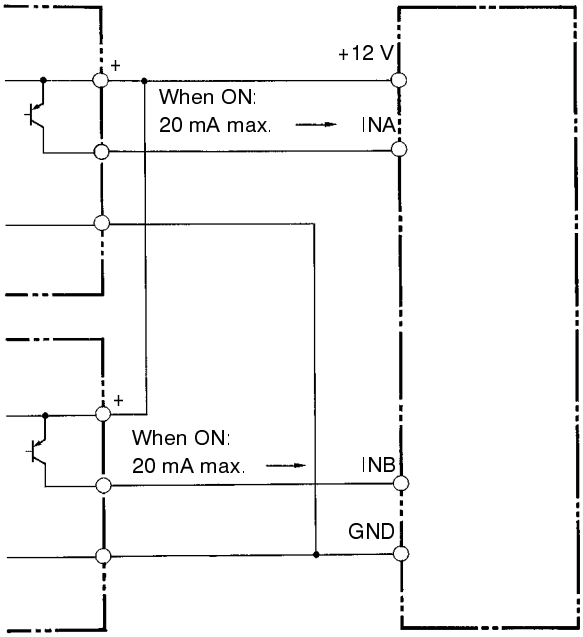
PNP Open Collector Output Model

With External Power Supply



K3TR-PB1□□-□□

Without External Power Supply

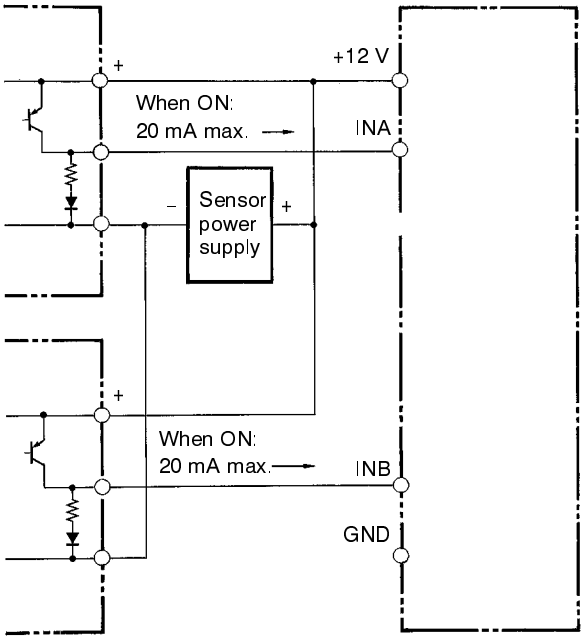


K3TR-PB1□□-□□

Use an external power supply if the operating voltage of the sensor is other than 12 VDC, or if the total power consumption exceeds 80 mA.

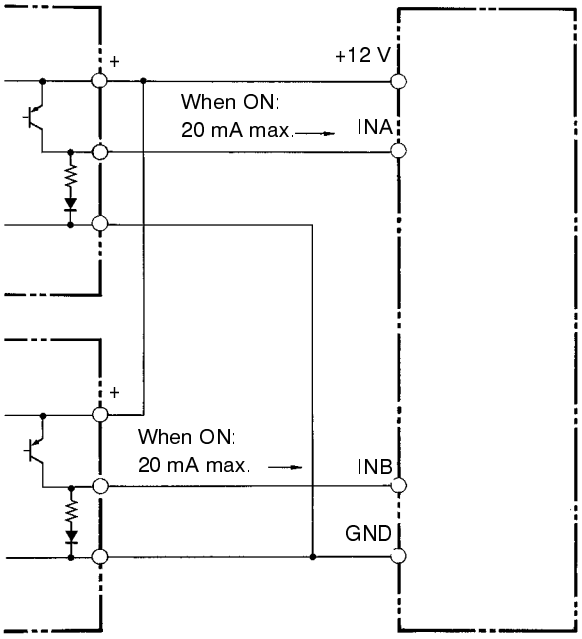
PNP Current Output Model

With External Power Supply



K3TR-PB1□□-□□

Without External Power Supply



K3TR-PB1□□-□□

Use an external power supply if the operating voltage of the sensor is other than 12 VDC, or if the total power consumption exceeds 80 mA. Use an external power supply with 12 to 24 VDC output voltage

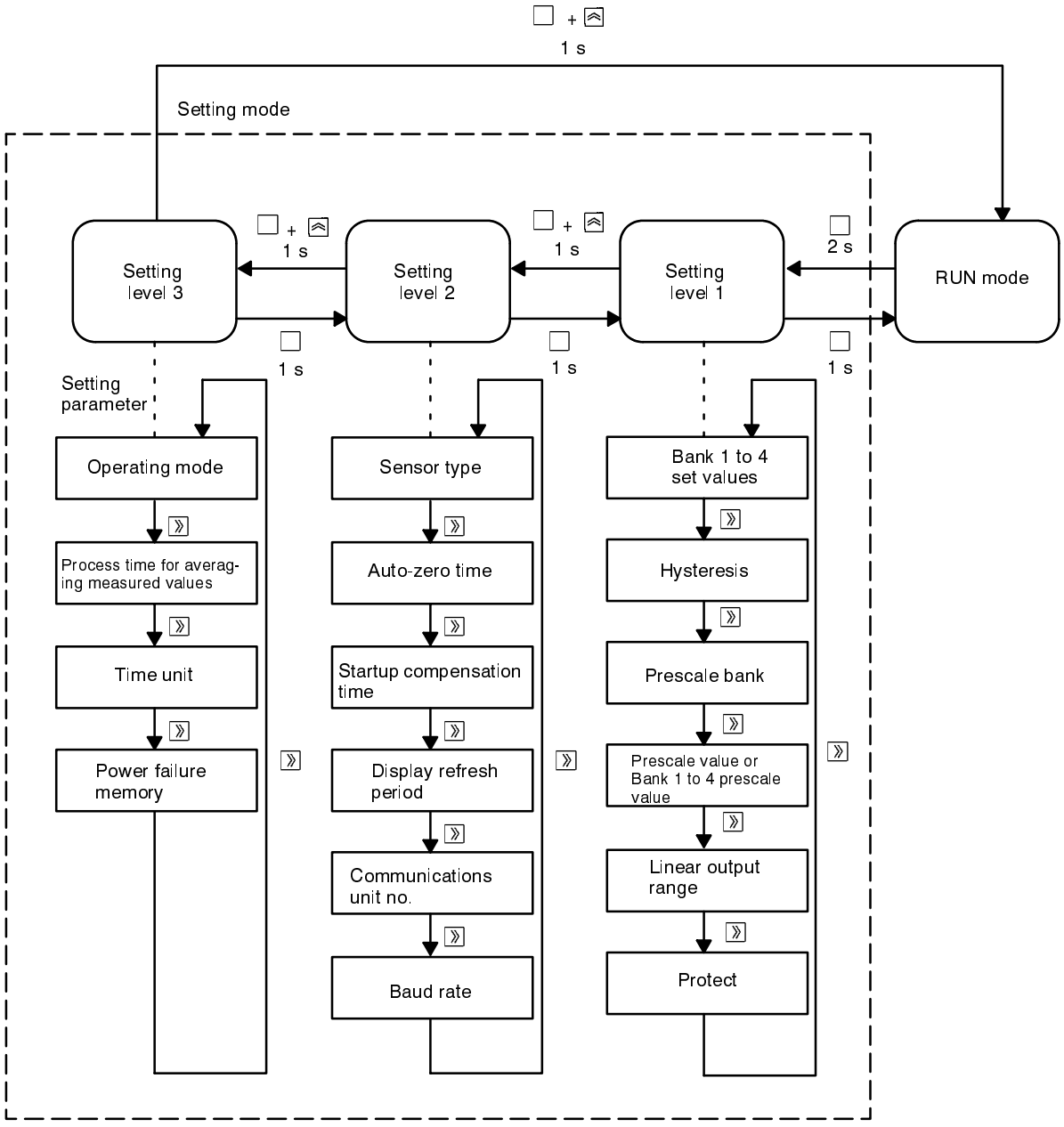
SECTION 6
Parameter Setting and Operation

This section provides instructions for the operation of the K3TR Intelligent Signal Processor. Each operational procedure is described with the aid of tables and diagrams.

6-1 Before Setting the Parameters

6-1-1 Level of Setting Mode and Parameters

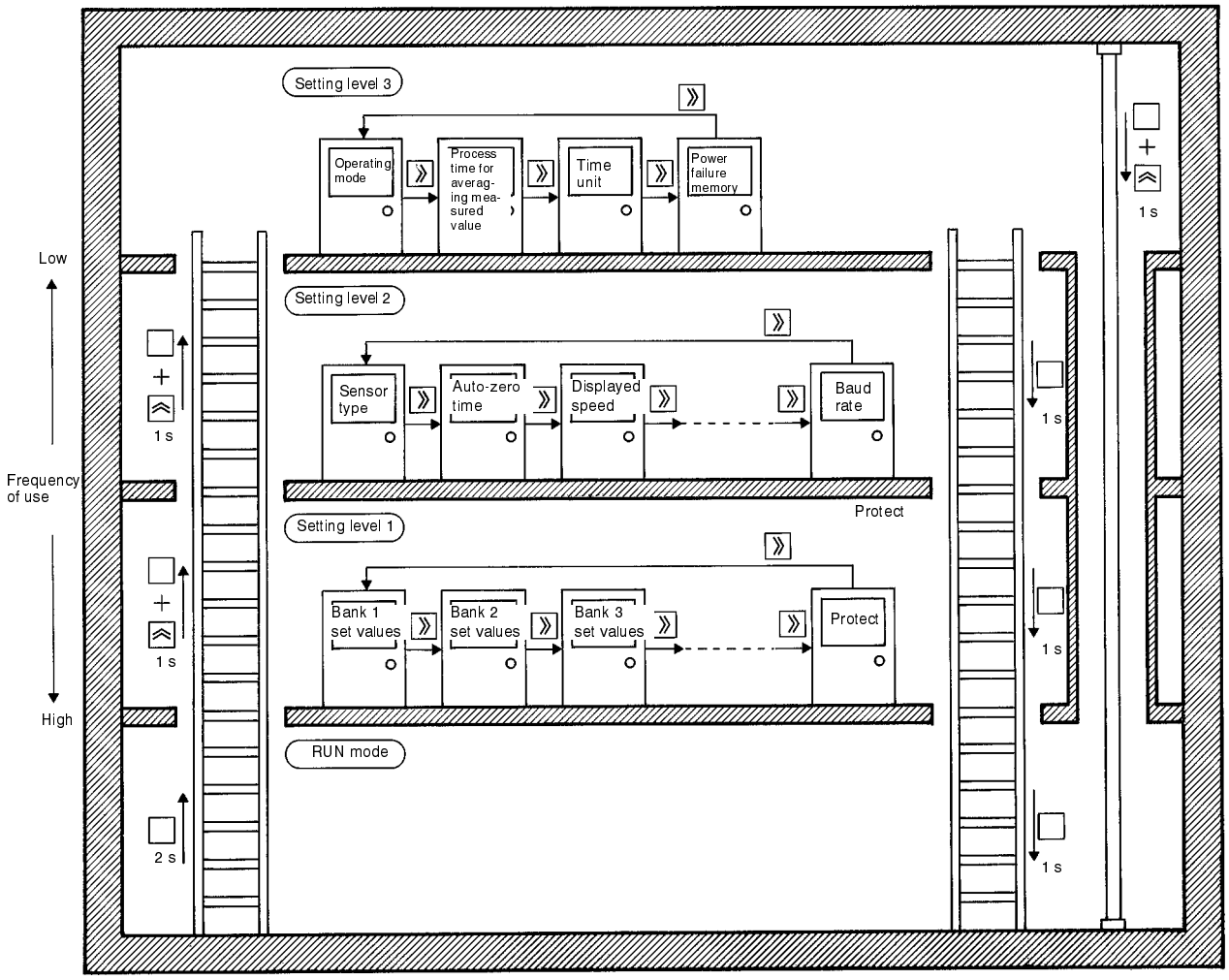
The Intelligent Signal Processor is used mainly in two modes: the RUN mode and the setting mode. In these two modes, the various parameters of the Intelligent Signal Processor can be set. The setting mode has three levels, in each of which one or more parameters can be used. To set the parameters, therefore, first select the setting mode, then select the level and parameter required, from which the necessary parameters can be set. The following diagram illustrates how this can be done.



When setting mode is selected, measurement is stopped. Some parameters may not be displayed (i.e., cannot be selected or set), depending on the operating mode selected and whether the model is a display type or output type. For details, refer to the list of valid parameters by operating mode see *6-1-3 List of Parameters for Each Model*.

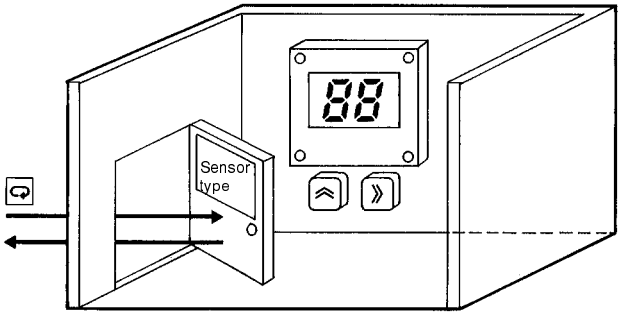
During operation, if you are unsure of the present status (such as the level or parameter with which the setting has been made), press the Level Key for one second to go one level lower. Be sure to write the set value again on that level. The following list and accompanying diagrams describe how to set levels in step-by-step fashion.

Setting Level Diagram



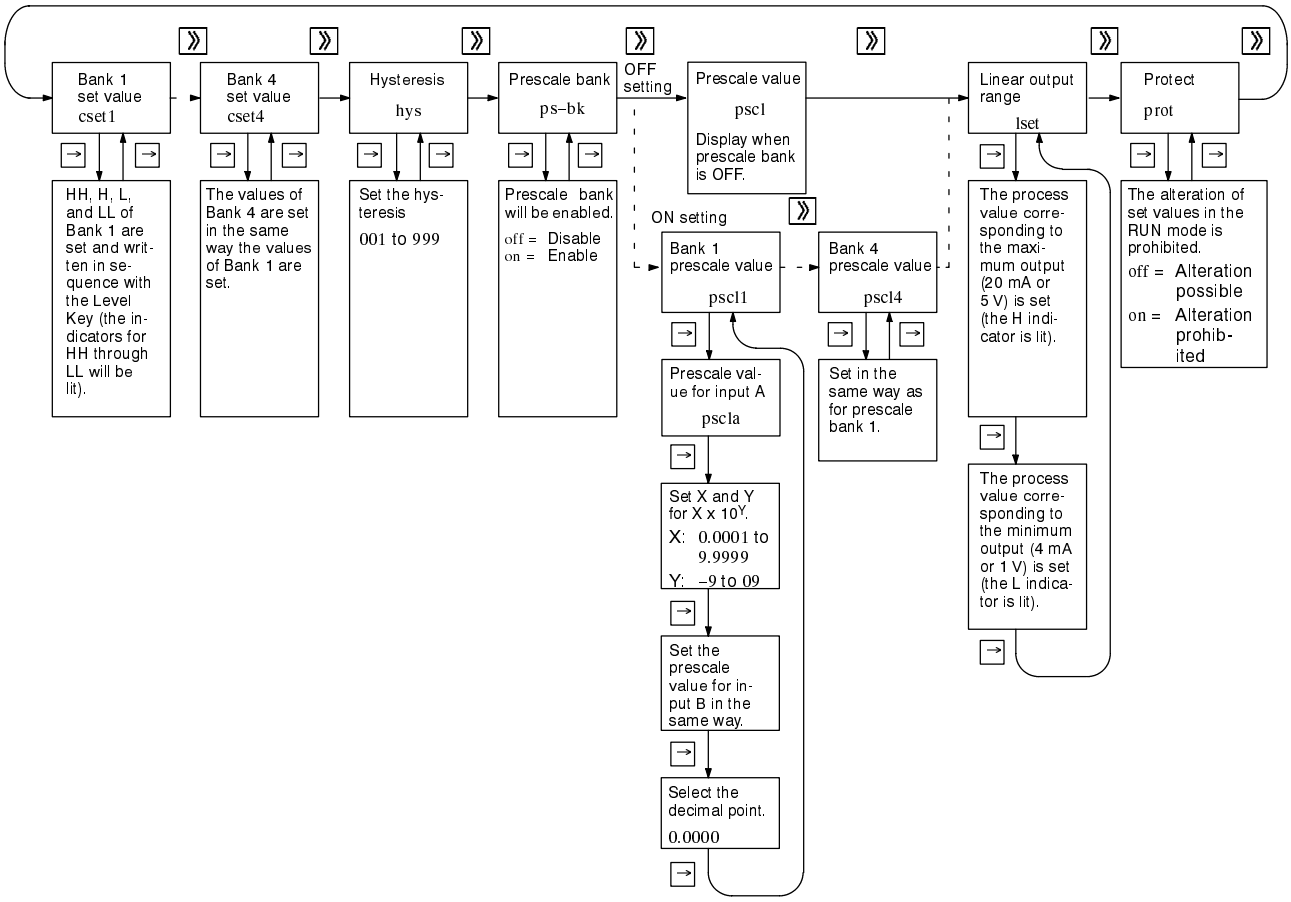
Setting procedure:

1. Go up the stairs to the level you want (Level Key or Level Key + Up Key).
2. Look for the parameter (Shift Key).
3. Access the parameter (Display Key).
4. Change the number inside (Up or Shift Key).
5. Leave the parameter (Display Key).
6. Go back to RUN mode (Level Key or Level Key + Up Key).

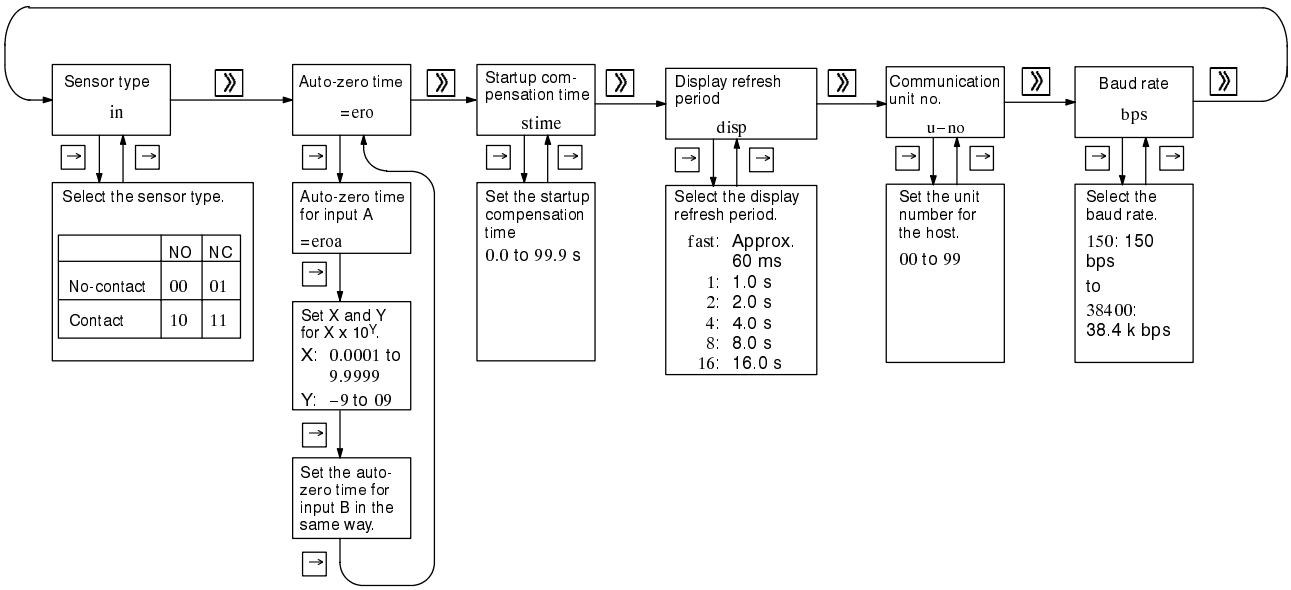


Operating Mode 1 to 5 or 13

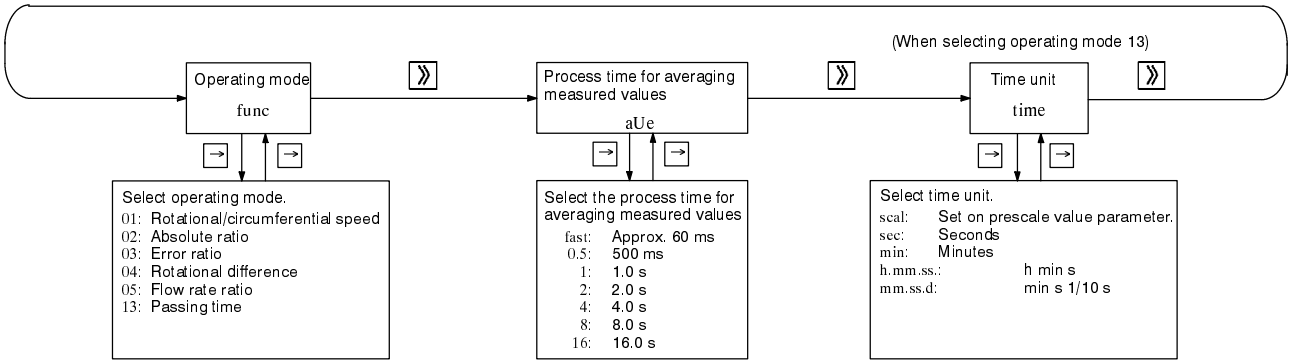
Setting Level 1



Setting Level 2

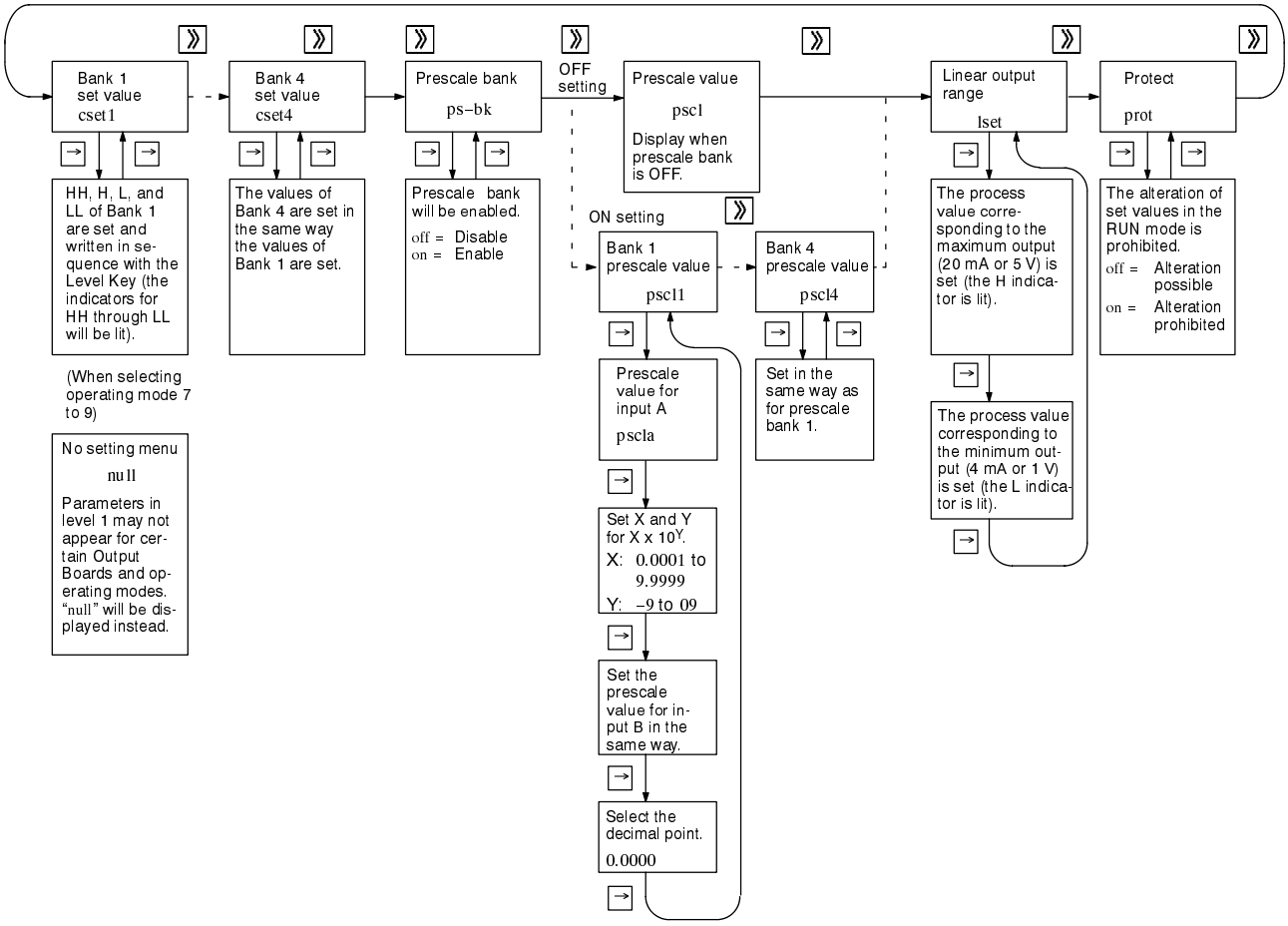


Setting Level 3

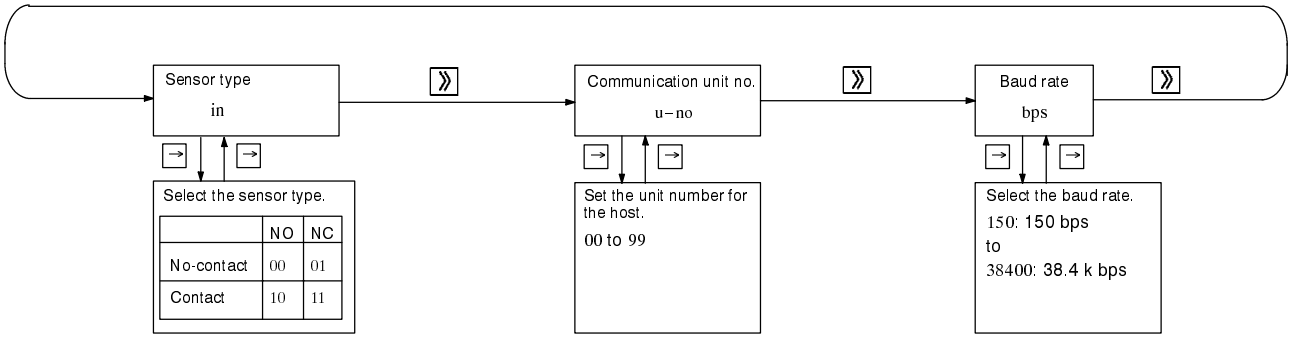


Operating Mode 6 to 12

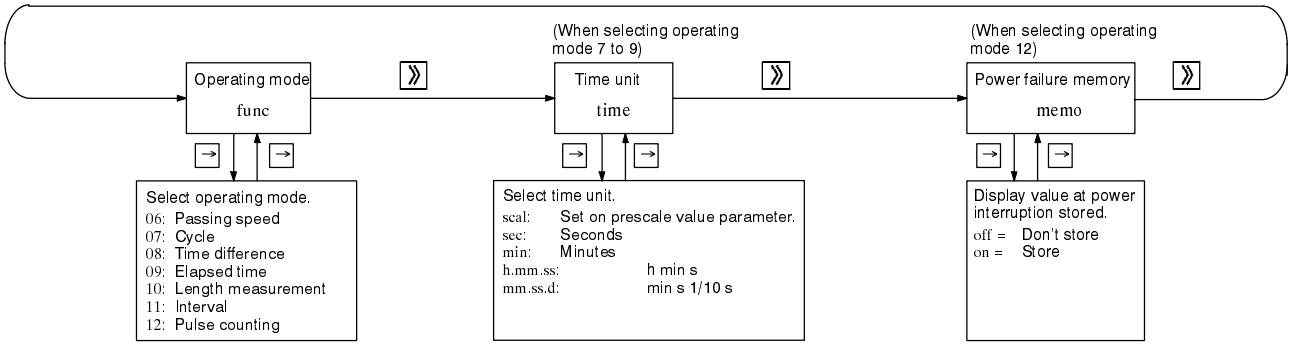
Setting Level 1



Setting Level 2



Setting Level 3



6-1-2 Parameter Setting Procedure

First, set a operating mode on setting level 3. When a new operating mode is selected during operation, all parameters on setting levels 1 and 2 are reset to initial values.

Although other parameters can be set in any order, the following order is recommended:

1, 2, 3...

1. Setting level 3 p. 37
2. Setting level 2 p. 86
3. Setting level 1 p. 97

6-1-3 List of Parameters for Each Model

The following tables indicate which parameters are available for each model.

Basic Models: K3TR-□B1□A

Level	Parameter	Display	Output Boards									
			None	C1/2/5, T1/2	B2	B4	L1/2/ 7/8	L3	L4/5/ 9/10	L6	S1/2/3	S5/6
1	Bank 1 set values	cset1	– – –	Yes	– – –	Yes	– – –	– – –	Yes	Yes	– – –	Yes
	Bank 2 set values	cset2	– – –	Yes	– – –	Yes	– – –	– – –	Yes	Yes	– – –	Yes
	Bank 3 set values	cset3	– – –	Yes	– – –	Yes	– – –	– – –	Yes	Yes	– – –	Yes
	Bank 4 set values	cset4	– – –	Yes	– – –	Yes	– – –	– – –	Yes	Yes	– – –	Yes
	Hysteresis	hys	– – –	Yes	– – –	Yes	– – –	– – –	Yes	Yes	– – –	Yes
	Prescale bank	pr–bk	Yes	Yes	– – –	Yes	– – –	– – –	Yes	Yes	– – –	Yes
	Prescale value	pscl	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Bank 1 prescale value	pscl1	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Bank 2 prescale value	pscl2	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Bank 3 prescale value	pscl3	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Bank 4 prescale value	pscl4	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Linear output range	lset	– – –	– – –	– – –	– – –	Yes	– – –	Yes	– – –	– – –	– – –
	Set value protect	prot	– – –	Yes	– – –	Yes	– – –	– – –	Yes	Yes	– – –	Yes
	Parameter does not exist.	null	Yes	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –
2	Sensor type	in	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Auto-zero time	=ero	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Startup compensation time	stime	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Display refresh period	disp	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Communications unit no.	u–no	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	Yes	Yes
	Baud rate	bps	– – –	– – –	– – –	– – –	– – –	– – –	– – –	– – –	Yes	Yes
3	Operating mode	func	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Process time for averaging measured values	aUe	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Time unit	time	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Power failure memory	memo	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Set Value LED Display Models: K3TR-□B1□C

Level	Parameter	Display	Output				
			C1/2/5, T1/2	B4	L4/5/9/ 10	L6	S5/6
1	Bank 1 set values	cset1	Yes	Yes	Yes	Yes	Yes
	Bank 2 set values	cset2	Yes	Yes	Yes	Yes	Yes
	Bank 3 set values	cset3	Yes	Yes	Yes	Yes	Yes
	Bank 4 set values	cset4	Yes	Yes	Yes	Yes	Yes
	Hysteresis	hys	Yes	Yes	Yes	Yes	Yes
	Prescale bank	pr–bk	Yes	Yes	Yes	Yes	Yes
	Prescale value	pscl	Yes	Yes	Yes	Yes	Yes
	Bank 1 prescale value	pscl1	Yes	Yes	Yes	Yes	Yes
	Bank 2 prescale value	pscl2	Yes	Yes	Yes	Yes	Yes
	Bank 3 prescale value	pscl3	Yes	Yes	Yes	Yes	Yes
	Bank 4 prescale value	pscl4	Yes	Yes	Yes	Yes	Yes
	Linear output range	lset	---	---	Yes	---	---
	Set value protect	prot	Yes	Yes	Yes	Yes	Yes
	Parameter does not exist.	null	---	---	---	---	---
2	Sensor type	in	Yes	Yes	Yes	Yes	Yes
	Auto-zero time	=ero	Yes	Yes	Yes	Yes	Yes
	Startup compensation time	stime	Yes	Yes	Yes	Yes	Yes
	Display refresh period selection	disp	Yes	Yes	Yes	Yes	Yes
	Communications unit no.	u–no	---	---	---	---	Yes
	Baud rate	bps	---	---	---	---	Yes
3	Operating mode	func	Yes	Yes	Yes	Yes	Yes
	Process time for averaging measured values	aUe	Yes	Yes	Yes	Yes	Yes
	Time unit	time	Yes	Yes	Yes	Yes	Yes
	Power failure memory	memo	Yes	Yes	Yes	Yes	Yes

Thumbwheel Switches Models: K3TR-□B1□D

Level	Parameter	Display	Output	
			C1, T1/2	B4
1	Bank 1 set values	cset1	---	---
	Bank 2 set values	cset2	---	---
	Bank 3 set values	cset3	---	---
	Bank 4 set values	cset4	---	---
	Hysteresis	hys	Yes	Yes
	Prescale bank	pr-bk	---	---
	Prescale value	pscl	Yes	Yes
	Bank 1 prescale value	pscl1	---	---
	Bank 2 prescale value	pscl2	---	---
	Bank 3 prescale value	pscl3	---	---
	Bank 4 prescale value	pscl4	---	---
	Linear output range	lset	---	---
	Set value protect	prot	---	---
	Parameter does not exist.	null	---	---
2	Sensor type	in	Yes	Yes
	Auto-zero time	=ero	Yes	Yes
	Startup compensation time	stime	Yes	Yes
	Display refresh period selection	disp	Yes	Yes
	Communications unit no.	u-no	---	---
	Baud rate	bps	---	---
3	Operating mode	func	Yes	Yes
	Process time for averaging measured values	aUe	Yes	Yes
	Time unit	time	Yes	Yes
	Power failure memory	memo	Yes	Yes

List of Available Parameters by Operating Mode

The following parameters are not available with all Models. For further information, refer to *6-1-3 List of Parameters for Each Model.*

Level	Parameter	Display		Operating mode												
				1	2	3	4	5	6	7	8	9	10	11	12	13
1	Bank 1 set values	cset1		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Bank 2 set values	cset2		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Bank 3 set values	cset3		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Bank 4 set values	cset4		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Hysteresis	hys		Yes	Yes	Yes	Yes	Yes	---	---	---	---	---	---	---	Yes
	Prescale bank	pr-bk		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Prescale value	pscl	pscla	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
			psclb	---	Yes	Yes	Yes	Yes	---	---	---	---	---	---	---	---
	Bank 1 to 4 prescale values	pscl1 to 4	pscla	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
			psclb	---	Yes	Yes	Yes	Yes	---	---	---	---	---	---	---	---
	Linear output range	lset		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Set value protect	prot		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Parameter does not exist.	null		---	---	---	---	---	---	Yes	Yes	Yes	---	---	---	---
2	Sensor type	in	ina	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
			inb	---	Yes	Yes	Yes	Yes	Yes	---	Yes	---	Yes	Yes	Yes	---
	Auto-zero time	=ero	=eroa	Yes	Yes	Yes	Yes	Yes	---	---	---	---	---	---	---	Yes
			=erob	---	Yes	Yes	Yes	Yes	---	---	---	---	---	---	---	Yes
	Startup compensation time	stime		Yes	Yes	Yes	Yes	Yes	---	---	---	---	---	---	---	Yes
	Display refresh period	disp		Yes	Yes	Yes	Yes	Yes	---	---	---	---	---	---	---	Yes
	Communication unit no.	u-no		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Baud rate	bps		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
3	Operating mode	func		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Process time for averaging measured values	aUe		Yes	Yes	Yes	Yes	Yes	---	---	---	---	---	---	---	Yes
	Time unit	time		---	---	---	---	---	---	Yes	Yes	Yes	---	---	---	Yes
	Power failure memory	memo		---	---	---	---	---	---	---	---	---	---	---	Yes	---

6-2 Parameter Setting

There are five general parameter settings available on the K3TR Intelligent Signal Processor: Operating Mode, Sensor Type, Prescale Value, Display, and Output. Tables indicating the range of settings for each parameter type and accompanying diagrams are given as parameter setting instructions.

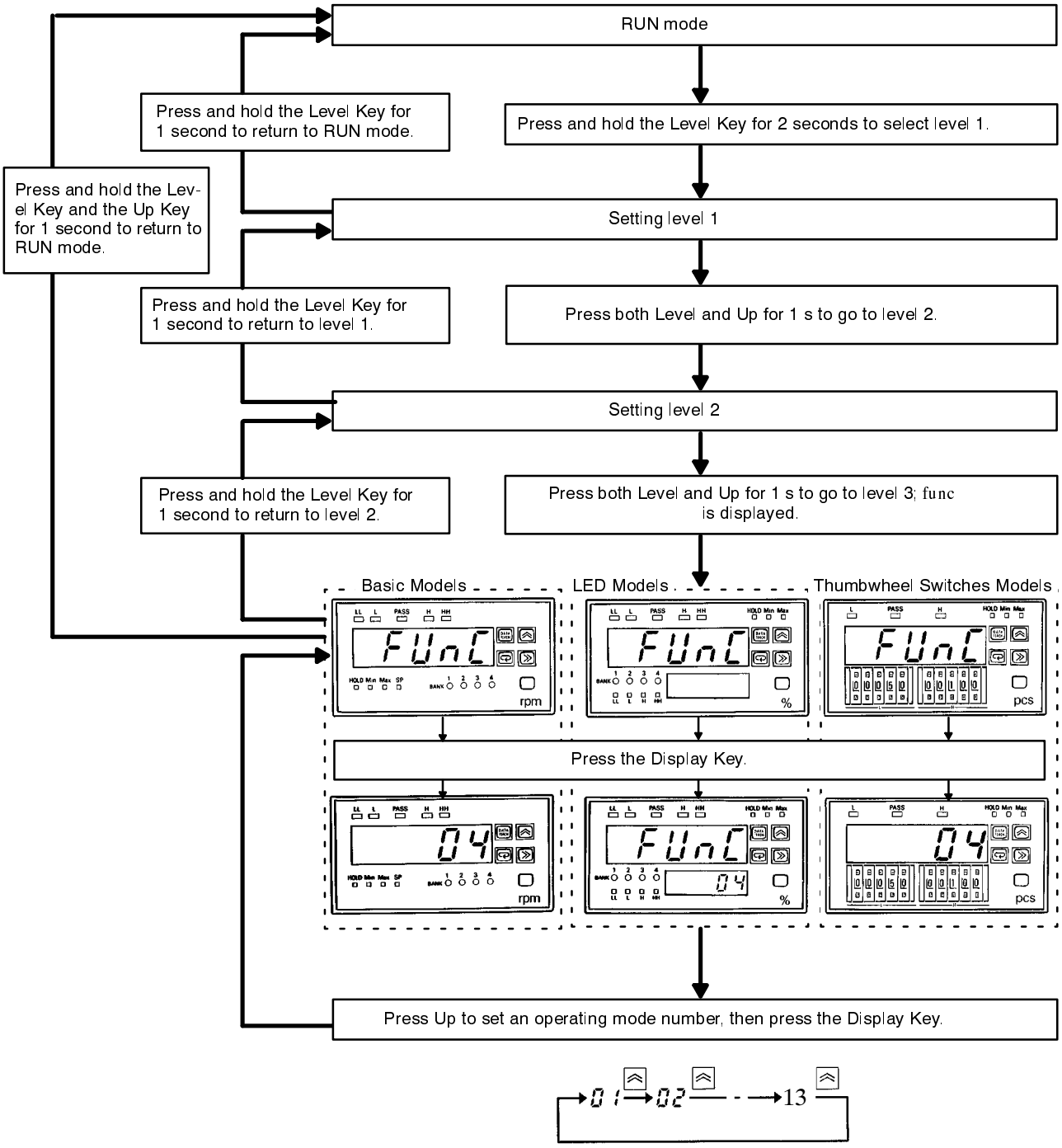
6-3 Parameter Setting at Level 3

6-3-1 Operating Modes

Setting the Operating Mode

Set operating modes according to the following instructions outlined in the table and the flow diagram.

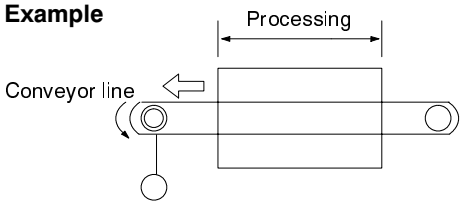
Operating mode	Display of operating mode no.	Reference page
Rotational/Circumferential speed	01	41
Absolute ratio	02	44
Error ratio	03	47
Rotational difference	04	50
Flow rate ratio	05	53
Linear speed	06	56
Cycle	07	59
Time difference	08	62
Elapsed time	09	65
Length measurement	10	68
Interval	11	71
Pulse counting	12	74
Passing time	13	77


RUN mode
Press and hold the Level Key for 1 second to return to RUN mode.
Press and hold the Level Key for 2 seconds to select level 1.
Press and hold the Level Key and the Up Key for 1 second to return to RUN mode.
Setting level 1
Press and hold the Level Key for 1 second to return to level 1.
Press both Level and Up for 1 s to go to level 2.
Setting level 2
Press and hold the Level Key for 1 second to return to level 2.
Press both Level and Up for 1 s to go to level 3; func is displayed.
Basic Models
LED Models
Thumbwheel Switches Models
FUnC
rpm
%
pcs
Press the Display Key.
04
Press Up to set an operating mode number, then press the Display Key.
01
02
13

Operating Modes 1 to 5 and 13

Rotational speed and other displays are based on calculations for continuous pulses (frequency).

Example



Operating mode no.	Use
01	Rotational/Circumferential speed
02	Absolute ratio
03	Error ratio
04	Rotation difference
05	Flow rate ratio
13	Passing time

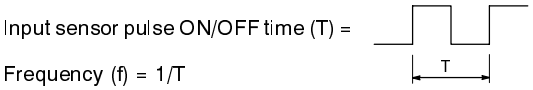
Mode No. 1: Rotational or circumferential speed display for 1 input

Mode No. 2 to 5: Display of calculations for two rotational speeds

Mode No. 13: Passing time display based on 1 input frequency and processing length

Basic Principles of Rotational Speed Displays

The ON/OFF time (T) of a sensor input or other input is measured with the internal system clock to automatically calculate the frequency. This frequency is multiplied by 60 and displayed as a rotational speed.



Rotational speed (rpm) = f x 60

Circumferential speed = Circumference x Rotational speed

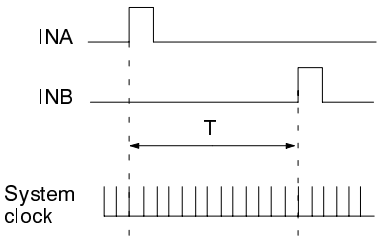
Passing time = Processing length/Circumferential speed

Automatic measuring by the K3TR is enabled simply by providing an input pulse.

Operating Modes 6 to 11

The time between pulses or the pulse ON time is measured using the internal system clock, and time and other display values are calculated accordingly.

Example: F6 Passing Speed



Operating mode no.	Use
06	Passing speed
07	Cycle
08	Time difference
09	Elapsed time
10	Length measurement
11	Interval

The time (T) between the INA pulse and the INB pulse is counted using the internal system clock.
If the count between the pulses is 100,000, then

T = System clock pulse (0.5 μs) x 100,000
= 0.05 s

For operating mode 6 (Passing Speed), 1/T x 60 (m/min) is used.
The display value is thus 1/0.05 s x 60, or 1,200 (m/min)

Operating Mode 12

The number of pulses is measured. Each pulse is counted as 1 count up to a maximum of 99,999 counts. Decrementing the count is not possible. Although the limits of the display enables displaying only up to 99,999 counts, prescaling can be used to count up to 4 gigacounts.

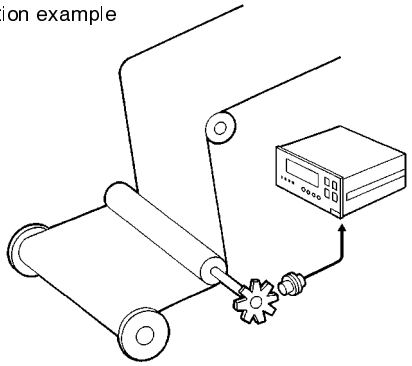
Operating mode no.	Use
12	Pulse counting

The count is reset by shorting terminals 6 and 7 (RESET ON).

Because only incrementing is possible, the L and LL comparative outputs turn ON when the measured values exceed set values.

Operating Mode 1 (Rotational/Circumferential Speed)

Application example



Measures the rotations of the roll.

Basic Operation

Multiplies the input frequency (Hz) of INA by 60 and displays the result in rpm. When the appropriate prescale value is selected, the rotational speed of the object is displayed. Obtain display value D as follows:

$D = f_A \times 60 \times \alpha$ (rpm)

f_A: Input frequency of INA (Hz)
α: Prescale value

Item	Unit of display	Prescale value
Rotations	rpm	1/N
	rps	1/60N
Frequency of input pulse	Hz	1/60
	kHz	1/60000
Rotational speed	mm/s	1000πD/60N
	cm/s	100πD/60N
	m/s	πD/60N
	m/min	πD/N
	km/h	0.06πD/N

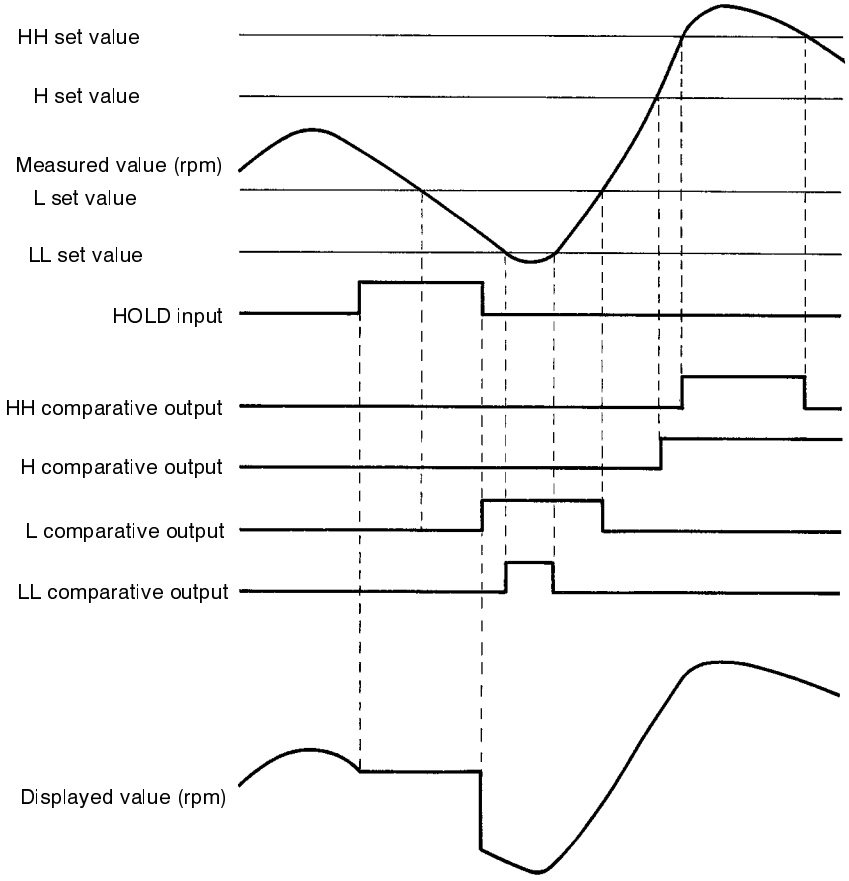
Where,
N: Number of pulses per rotation
πD: Length (m) of one rotation

With operating mode 1, INB input is ignored. To set a prescale value, refer to *6-5-4 Setting the Prescale Value.*

Hold Measured Value

When the HOLD input is turned ON, measurement stops and the input measured just before the HOLD input turned ON is held. While the HOLD input is ON, the K3TR holds display output, comparative output, and BCD output. This is illustrated in the following diagram.

When the comparative output terminals of the output board and the HOLD input terminals are connected, the value measured immediately after the occurrence of an error can be obtained.



Performance Characteristics

Accuracy of measurement	0.006 rdg ± 1 digit (ambient temperature: 25°C ± 5°C)
Measurement range	Sensor with transistor output: 0.5 mHz to 50 kHz Sensor with relay output: 0.5 mHz to 30 Hz
ON/OFF pulse width	Sensor with transistor output: 9 μs min. Sensor with relay output: 15 ms min.

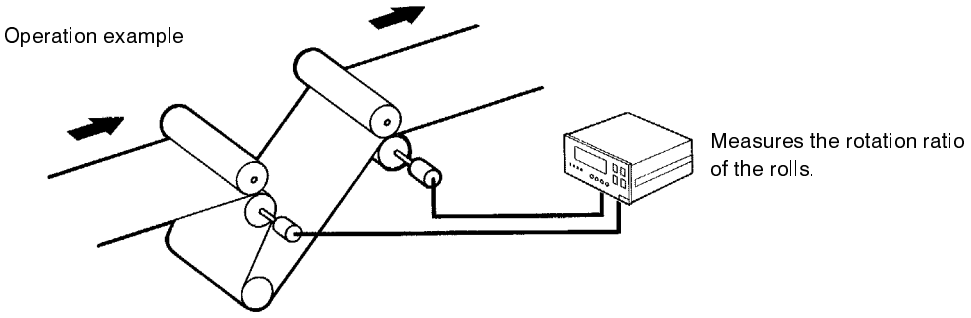
Response time	**Output configuration**				
	Relay output	**Transistor output**	**BCD and transistor output**	**Linear and transistor output**	**Communication and transistor output**
Comparative output	200 ms max.				
BCD output	---	---	Refer to page 144.	---	---
Linear output	---	---	---	220 ms max.	---

The following list indicates the availability of a variety of functions in operating mode 1. Refer to the page indicated before using the following functions:

Setting level	Parameter	Display	Availability	Reference page
	RESET and retaining of maximum/minimum values	–––	Yes	112
	Estimated frequency calculation	–––	Yes	125
1	Bank 1 to 4 set values	cset□	Yes	97
	Hysteresis	hys	Yes	98
	Prescale bank	pr–bk	Yes	100
	Bank 1 to 4 prescale values	pscl□	Yes	102
	Linear output range	lset	Yes	104
	Set value protect	prot	Yes	106
2	Sensor type	in	Yes	86
	Auto-zero time	=ero	Yes	88
	Startup compensation time	stime	Yes	90
	Display refresh period selection	disp	Yes	92
	Communications unit no.	u–no	Yes	94
	Baud rate	bps	Yes	95
3	Process time for averaging measured values	aUe	Yes	80
	Time unit	time	No	82
	Power failure memory	memo	No	84

Note Some functions cannot be used because of the difference in base unit or output board.

Operating Mode 2 (Absolute Ratio)



Basic Operation

Displays the absolute ratio of the frequencies of INA and INB in percentage. Obtain display value D as follows:

$$D = \frac{f_{B} \times \beta}{f_{A} \times \alpha} \times 100(\%)$$

f_A: Input frequency of INA (Hz)
f_B: Input frequency of INB (Hz)
α: Prescale value of INA
β: Prescale value of INB

Mode	Unit of display	Prescale value	
Absolute ratio	%	INA INB	INA and INB are Na and Nb or πDa/Na and πDb/Nb

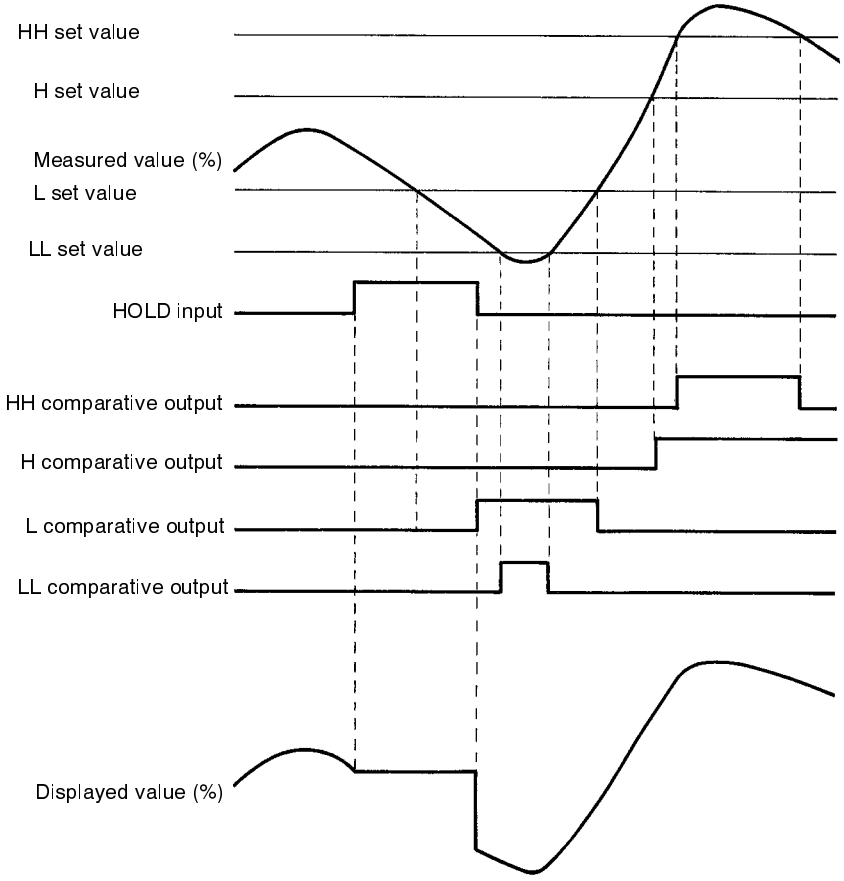
Where,
Na: Number of pulses per revolution from A input
Nb: Number of pulses per revolution from B input
πDa: Circumference (m) per revolution for A input
πDb: Circumference (m) per revolution for B input

To set prescale values, refer to *6-5-4 Setting the Prescale Value.*

Hold Measured Value

When the HOLD input is turned ON, measurement stops and the input measured just before the HOLD input turned ON is held. While the HOLD input is ON, the K3TR holds display output, comparative output, and BCD output. This is illustrated in the following diagram.

When the comparative output terminals of the output board and the HOLD input terminals are connected, the value measured immediately after the occurrence of an error can be obtained.



Performance Characteristics

Accuracy of measurement	0.02 rdg ± 1 digit (ambient temperature: 25°C ± 5°C)
Measurement range	Sensor with transistor output: 0.5 mHz to 50 kHz Sensor with relay output: 0.5 mHz to 30 Hz
ON/OFF pulse width	Sensor with transistor output: 9 μs min. Sensor with relay output: 15 ms min.

Response time	**Output configuration**				
	Relay output	**Transistor output**	**BCD and transistor output**	**Linear and transistor output**	**Communication and transistor output**
Comparative output	200 ms max.				
BCD output	---	---	Refer to page 144.	---	---
Linear output	---	---	---	220 ms max.	---

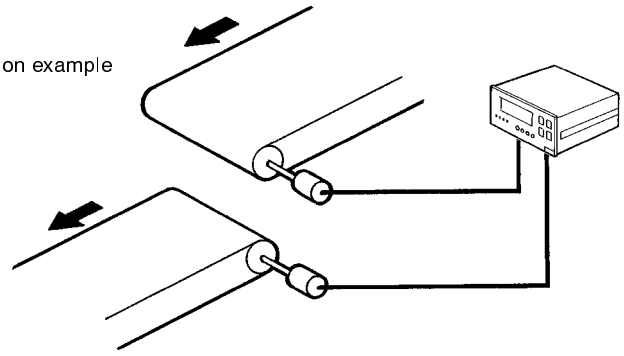
The following list indicates the availability of a variety of functions in operating mode 2. Refer to the page indicated before using the following functions:

Setting level	Parameter	Display	Availability	Reference page
	RESET and retaining of maximum/minimum values	–––	Yes	112
	Estimated frequency calculation	–––	Yes	125
1	Bank 1 to 4 set values	cset□	Yes	97
	Hysteresis	hys	Yes	98
	Prescale bank	pr–bk	Yes	100
	Bank 1 to 4 prescale values	pscl□	Yes	102
	Linear output range	lset	Yes	104
	Set value protect	prot	Yes	106
2	Sensor type	in	Yes	86
	Auto-zero time	=ero	Yes	88
	Startup compensation time	stime	Yes	90
	Display refresh period selection	disp	Yes	92
	Communications unit no.	u–no	Yes	94
	Baud rate	bps	Yes	95
3	Process time for averaging measured values	aUe	Yes	80
	Time unit	time	No	82
	Power failure memory	memo	No	84

Note Some functions cannot be used because of the difference in base unit or output board.

Operating Mode 3 (Error Ratio)

Application example



Measures the speed of the conveyor belts and the error ratio in the rotation of the conveyor belts.

Basic Operation

Displays the error ratio of the frequency of INA and INB in percentage. Obtain display value D as follows:

$$D = \frac{f\beta \times \beta - f_A \times \alpha}{f_A \times \alpha} \times 100(\%)$$

f_A: Input frequency of INA (Hz)
f_B: Input frequency of INB (Hz)
α: Prescale value of INA
β: Prescale value of INB

Mode	Unit of display	Prescale value	
Error ratio	%	INA INB	INA and INB are Na and Nb or πDa/Na and πDb/Nb

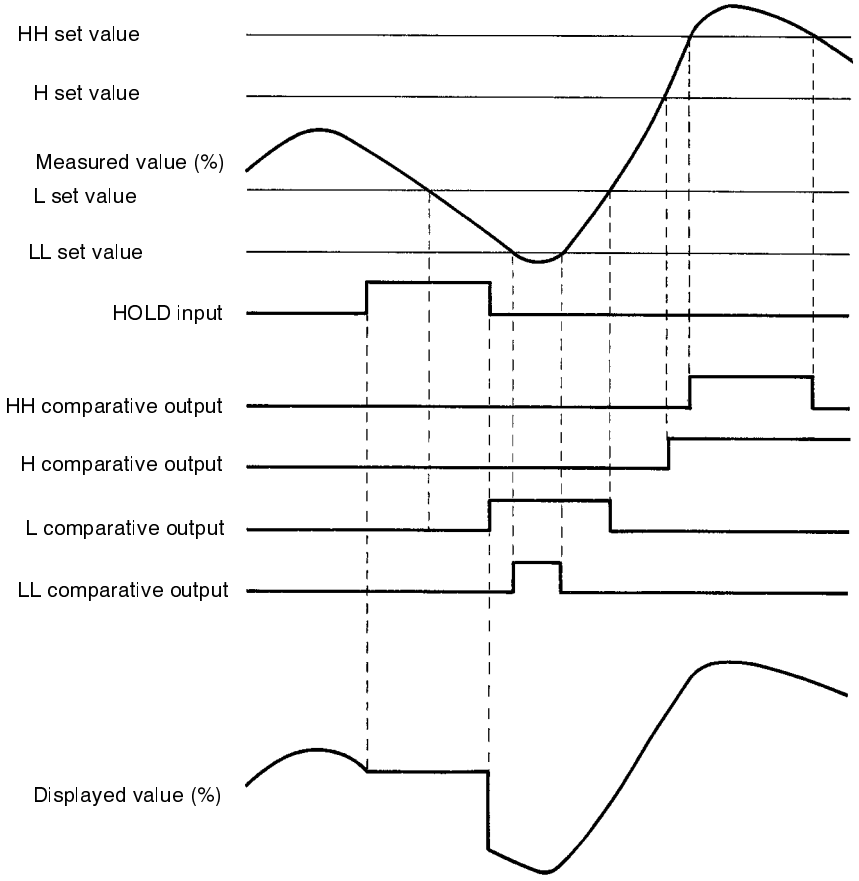
Where,
Na: Number of pulses per revolution from A input
Nb: Number of pulses per revolution from B input
πDa: Circumference (m) per revolution for A input
πDb: Circumference (m) per revolution for B input

To set prescale values, refer to *6-5-4 Setting the Prescale Value*.

Hold Measured Value

When the HOLD input is turned ON, measurement stops and the input measured just before the HOLD input turned ON is held. While the HOLD input is ON, the K3TR holds display output, comparative output, and BCD output. This is illustrated in the following diagram.

When the comparative output terminals of the output board and the HOLD input terminals are connected, the value measured immediately after the occurrence of an error can be obtained.



Performance Characteristics

Accuracy of measurement	0.02 rdg ± 1 digit (ambient temperature: 25°C ± 5°C)
Measurement range	Sensor with transistor output: 0.5 mHz to 50 kHz Sensor with relay output: 0.5 mHz to 30 Hz
ON/OFF pulse width	Sensor with transistor output: 9 μs min. Sensor with relay output: 15 ms min.

Response time	**Output configuration**				
	Relay output	**Transistor output**	**BCD and transistor output**	**Linear and transistor output**	**Communication and transistor output**
Comparative output	200 ms max.				
BCD output	---	---	Refer to page 144.	---	---
Linear output	---	---	---	220 ms max.	---

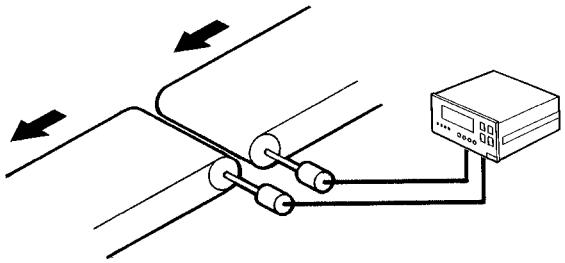
The following list indicates the availability of a variety of functions in operating mode 3. Refer to the page indicated before using the following functions:

Setting level	Parameter	Display	Availability	Reference page
	RESET and retaining of maximum/minimum values	–––	Yes	112
	Estimated frequency calculation	–––	Yes	125
1	Bank 1 to 4 set values	cset□	Yes	97
	Hysteresis	hys	Yes	98
	Prescale bank	pr–bk	Yes	100
	Bank 1 to 4 prescale values	pscl□	Yes	102
	Linear output range	lset	Yes	104
	Set value protect	prot	Yes	106
2	Sensor type	in	Yes	86
	Auto-zero time	=ero	Yes	88
	Startup compensation time	stime	Yes	90
	Display refresh period selection	disp	Yes	92
	Communications unit no.	u–no	Yes	94
	Baud rate	bps	Yes	95
3	Process time for averaging measured values	aUe	Yes	80
	Time unit	time	No	82
	Power failure memory	memo	No	84

Note Some functions cannot be used because of the difference in base unit or output board.

Operating Mode 4 (Rotational Difference)

Application example



Measures the rotational difference of the conveyor belts.

Basic Operation

Displays the rotational difference of INA and INB. Obtain display value D as follows:

$D = f_B \times 60 \times \beta - f_A \times 60 \times \alpha$ (rpm)

f_A: Input frequency of INA (Hz)
f_B: Input frequency of INB (Hz)
α: Prescale value of INA
β: Prescale value of INB

Mode	Unit of display	Prescale value	
Rotational Difference	rpm	INA	1/60Na
		INB	1/60Nb
	Hz (Input pulse frequency)	INA	1/60
		INB	1/60
	mm/sec	INA	1000πDa/60Na
		INB	1000πDb/60Nb
	m/sec	INA	πDa/60Na
		INB	πDb/60Nb
	m/min	INA	πDa/Na
		INB	πDb/Nb

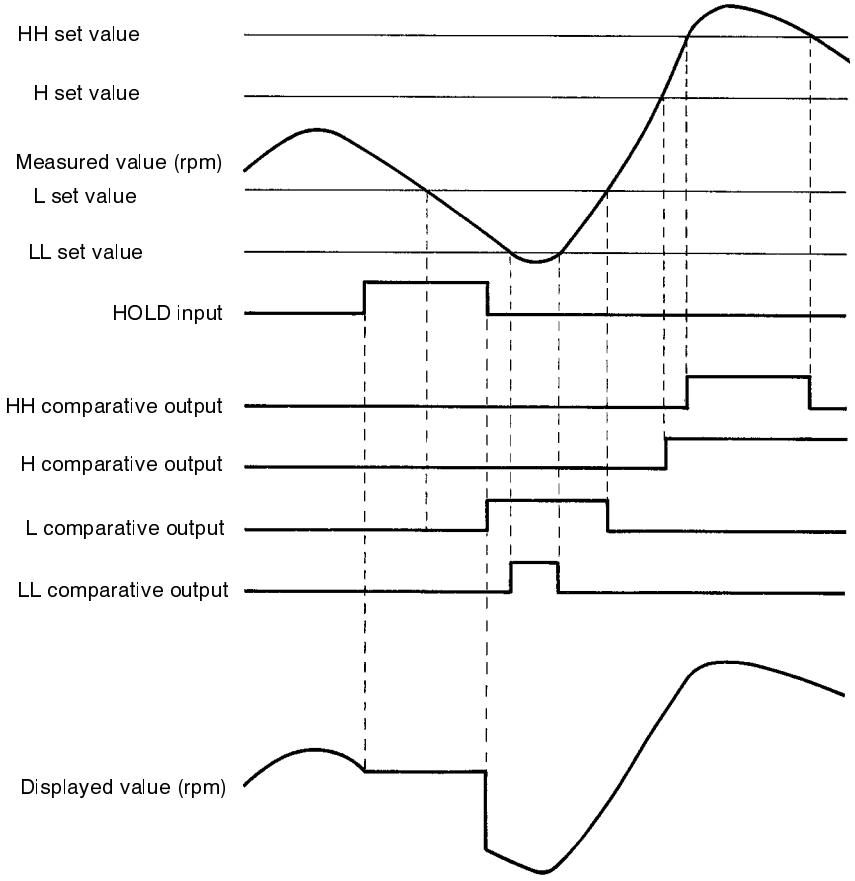
Where,
Na: Number of pulses per revolution from A input
Nb: Number of pulses per revolution from B input
πDa: Circumference (m) per revolution for A input
πDb: Circumference (m) per revolution for B input

To set prescale values, refer to *6-5-4 Setting the Prescale Value*.

Hold Measured Value

When the HOLD input is turned ON, measurement stops and the input measured just before the HOLD input turned ON is held. While the HOLD input is ON, the K3TR holds display output, comparative output, and BCD output. This is illustrated in the following diagram.

When the comparative output terminals of the output board and the HOLD input terminals are connected, the value measured immediately after the occurrence of an error can be obtained.



Performance Characteristics

Accuracy of measurement	0.02 rdg ± 1 digit (ambient temperature: 25°C ± 5°C)
Measurement range	Sensor with transistor output: 0.5 mHz to 50 kHz Sensor with relay output: 0.5 mHz to 30 Hz
ON/OFF pulse width	Sensor with transistor output: 9 μs min. Sensor with relay output: 15 ms min.

Response time	**Output configuration**				
	Relay output	**Transistor output**	**BCD and transistor output**	**Linear and transistor output**	**Communication and transistor output**
Comparative output	200 ms max.				
BCD output	---	---	Refer to page 144.	---	---
Linear output	---	---	---	220 ms max.	---

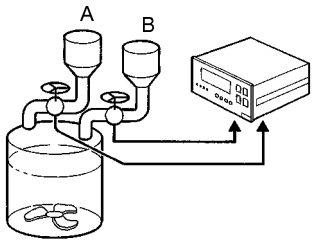
The following list indicates the availability of a variety of functions in operating mode 4. Refer to the page indicated before using the following functions:

Setting level	Parameter	Display	Availability	Reference page
	RESET and retaining of maximum/minimum values	–––	Yes	112
	Estimated frequency calculation	–––	Yes	125
1	Bank 1 to 4 set values	cset□	Yes	97
	Hysteresis	hys	Yes	98
	Prescale bank	pr–bk	Yes	100
	Bank 1 to 4 prescale values	pscl□	Yes	102
	Linear output range	lset	Yes	104
	Set value protect	prot	Yes	106
2	Sensor type	in	Yes	86
	Auto-zero time	=ero	Yes	88
	Startup compensation time	stime	Yes	90
	Display refresh period selection	disp	Yes	92
	Communications unit no.	u–no	Yes	94
	Baud rate	bps	Yes	95
3	Process time for averaging measured values	aUe	Yes	80
	Time unit	time	No	82
	Power failure memory	memo	No	84

Note Some functions cannot be used because of the difference in base unit or output board.

Operating Mode 5 (Flow Rate Ratio)

Application example



Measures the flow rate ratio of the mixture of A and B.

Basic Operation

From the frequency of INA and INB, displays the flow rate ratio of INB in percentage. Obtain display value D as follows:

$$D = \frac{f_B \times \beta}{f_A \times \alpha + f_B \times \beta} \times 100(\%)$$

f_A: Input frequency of INA (Hz)
f_B: Input frequency of INB (Hz)
α: Prescale value of INA
β: Prescale value of INB

Mode	Unit of display	Prescale value	
Flow rate ratio	%	INA	Na
		INB	Nb

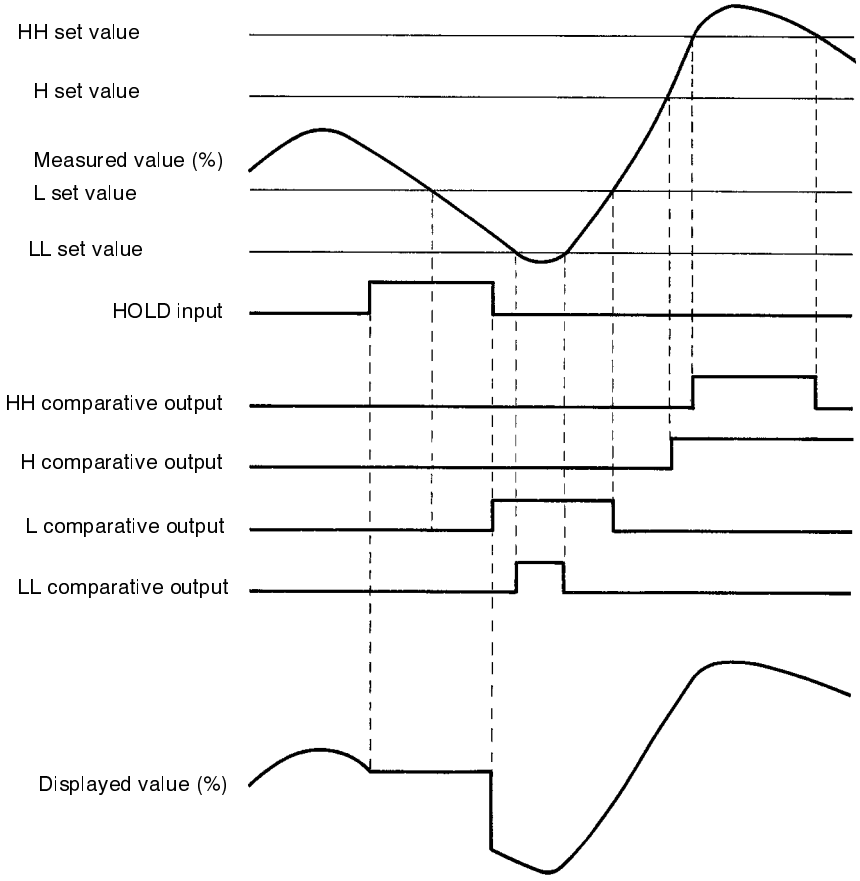
Where,
Na: Number of pulses for specific quantity of A input
Nb: Number of pulses for specific quantity of B input

To set prescale values, refer to *6-5-4 Setting the Prescale Value*.

Hold Measured Value

When the HOLD input is turned ON, measurement stops and the input measured just before the HOLD input turned ON is held. While the HOLD input is ON, the K3TR holds display output, comparative output, and BCD output. This is illustrated in the following diagram.

When the comparative output terminals of the output board and the HOLD input terminals are connected, the value measured immediately after the occurrence of an error can be obtained.



Performance Characteristics

Accuracy of measurement	0.02 rdg ± 1 digit (ambient temperature: 25°C ± 5°C)
Measurement range	Sensor with transistor output: 0.5 mHz to 50 kHz Sensor with relay output: 0.5 mHz to 30 Hz
ON/OFF pulse width	Sensor with transistor output: 9 μs min. Sensor with relay output: 15 ms min.

Response time	**Output configuration**				
	Relay output	**Transistor output**	**BCD and transistor output**	**Linear and transistor output**	**Communication and transistor output**
Comparative output	200 ms max.				
BCD output	---	---	Refer to page 144.	---	---
Linear output	---	---	---	220 ms max.	---

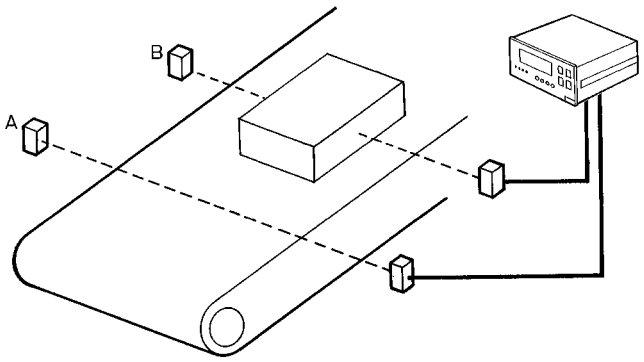
The following list indicates the availability of a variety of functions in operating mode 5. Refer to the page indicated before using the following functions:

Setting level	Parameter	Display	Availability	Reference page
	RESET and retaining of maximum/minimum values	–––	Yes	112
	Estimated frequency calculation	–––	Yes	125
1	Bank 1 to 4 set values	cset□	Yes	97
	Hysteresis	hys	Yes	98
	Prescale bank	pr–bk	Yes	100
	Bank 1 to 4 prescale values	pscl□	Yes	102
	Linear output range	lset	Yes	104
	Set value protect	prot	Yes	106
2	Sensor type	in	Yes	86
	Auto-zero time	=ero	Yes	88
	Startup compensation time	stime	Yes	90
	Display refresh period selection	disp	Yes	92
	Communications unit no.	u–no	Yes	94
	Baud rate	bps	Yes	95
3	Process time for averaging measured values	aUe	Yes	80
	Time unit	time	No	82
	Power failure memory	memo	No	84

Note Some functions cannot be used because of the difference in base unit or output board.

Operating Mode 6 (Passing Speed)

Application example



Measures the time taken by an object to travel the distance between A and B.

Basic Operation

Displays the speed of an object passing between A and B. The speed is obtained by multiplying the reciprocal of T by 60. T (time) is the time interval between INA turning ON and INB turning ON. If the distance between the INA sensor and INB sensor is 1 m, the displayed value is m/min. If the distance is other than 1 m, or if another unit of measurement is required, input an appropriate prescale value. Obtain display value D as follows:

$D = 1/T \times 60 \times \alpha$

T: Time interval between INA turning ON and INB turning ON (sec)
α: Prescale value

Mode	Unit of display	Prescale value
Passing speed	mm/sec	1000L/60
	m/sec	L/60
	m/min	L
	cm/sec	100L/60
	cm/min	100L
	km/h	0.06L

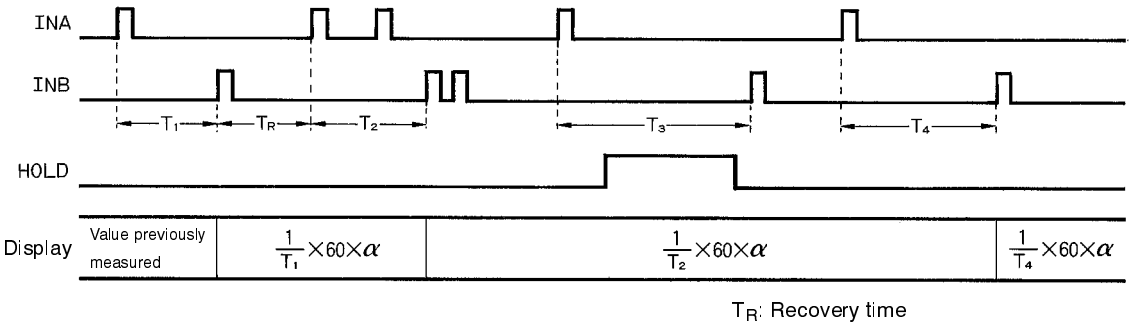
Where,
L = Distance between sensors (m)

To set a prescale value, refer to *6-5-4 Setting the Prescale Value*.

Hold Measured Value

When the HOLD input turns ON while the K3TR is measuring, the measuring operation is canceled and the K3TR holds the last measured value (displayed value). While the HOLD input is ON, the K3TR holds comparative output and BCD output. Measurement will not begin while the K3TR is in HOLD status. This is illustrated in the following diagram.

When the comparative output terminals of the output board and the HOLD input terminals are connected, the value measured immediately after the occurrence of an error can be obtained.



RESET

Immediately after power is applied, or when the RESET input turns ON, the K3TR is in an initial state, as if no measurement had been performed. This state is called “RESET status.” RESET status applies only to operating modes 6 through 11.

In RESET status, the following conditions are present:

Display	All five digits of the PV display are zero.
Comparative output	The HH, H, P, L, and LL outputs are OFF.
Maximum/minimum	All cleared. The DATA TEACH Key is not effective.

Performance Characteristics

Accuracy of measurement	0.08 rdg ± 1 digit (ambient temperature: 25°C ± 5°C)
Measurement range	10 ms to 3200 s
Response time of HOLD input	20 ms max.
Recovery time (T_R)	20 ms min.
ON/OFF pulse width	Sensor with transistor output: 9 μs min. Sensor with relay output: 15 ms min.

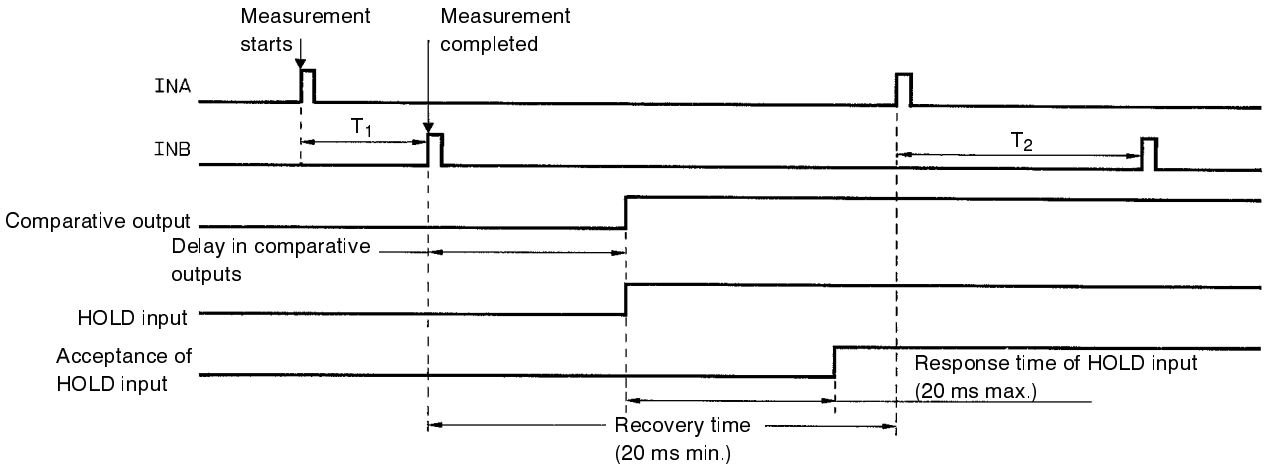
Response time	**Output configuration**				
	Relay output	**Transistor output**	**BCD and transistor output**	**Linear and transistor output**	**Communication and transistor output**
Comparative output	25 ms max.	20 ms max.	35 ms max.	35 ms max.	20 ms max.
BCD output	---	---	Refer to page 144.	---	---
Linear output	---	---	---	40 ms max.	---

Response Time of HOLD Input

The response time of the HOLD input is the time required for the K3TR to accept HOLD input after the HOLD input turns ON.

Recovery Time (T_R)

Recovery time is the period required for the K3TR to become ready for the next measuring operation after a measuring operation is completed. For Transistor Output Models, comparative output remains ON during recovery time. For other models, comparative output requires more time to turn ON. When the comparative output terminals of the output board and the HOLD input terminals are connected, set a sufficient recovery period, considering the response time of the HOLD input. This is illustrated in the following diagram.



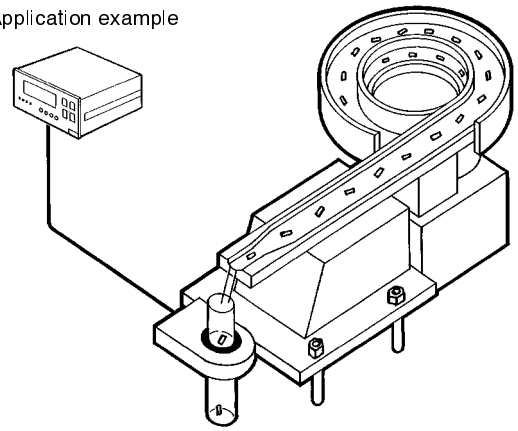
The following list indicates the availability of a variety of functions in operating mode 6. Refer to the page indicated before using the following functions:

Setting level	Parameter	Display	Availability	Reference page
	RESET and retaining of maximum/minimum values	–––	No	112
	Estimated frequency calculation	–––	No	125
1	Bank 1 to 4 set values	cset□	Yes	97
	Hysteresis	hys	No	98
	Prescale bank	pr–bk	Yes	100
	Bank 1 to 4 prescale values	pscl□	Yes	102
	Linear output range	lset	Yes	104
	Set value protect	prot	Yes	106
2	Sensor type	in	Yes	86
	Auto-zero time	=ero	No	88
	Startup compensation time	stime	No	90
	Display refresh period selection	disp	No	92
	Communications unit no.	u–no	Yes	94
	Baud rate	bps	Yes	95
3	Process time for averaging measured values	aUe	No	80
	Time unit	time	No	82
	Power failure memory	memo	No	84

Note Some functions cannot be used because of the difference in base unit or output board.

Operating Mode 7 (Cycle)

Application example



Measures the cycle with which items pass a sensor.

Basic Operation

Displays in seconds the interval between successive occurrences of INA turning ON. Input an appropriate prescale value to display units other than seconds. Obtain display value D as follows:

D = T x α (sec)

T: Interval between successive occurrences of INA turning ON
α: Prescale value

Mode	Unit of display value	Prescale value
Cycle	sec	1
	min	1/60

Where,
INB input is disregarded for operating mode 7.

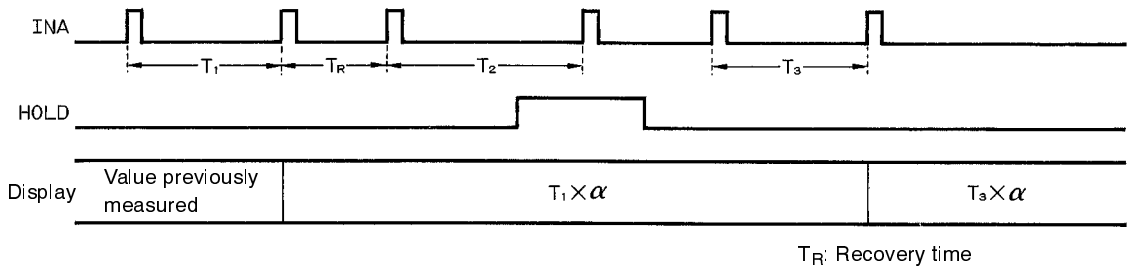
By using time in the time unit display setting parameter at level 3, the passing time can be displayed in units of hours, minutes, and seconds.

To set a prescale value, refer to *6-5-4 Setting the Prescale Value*.

Hold Measured Value

When the HOLD input turns ON while the K3TR is measuring, the measuring operation is canceled and the K3TR holds the last measured value (displayed value). While the HOLD input is ON, the K3TR holds comparative output and BCD output. Measurement will not begin while the K3TR is in HOLD status. This is illustrated in the following diagram.

When the comparative output terminals of the output board and the HOLD input terminals are connected, the value measured immediately after the occurrence of an error can be obtained.



RESET

Immediately after power is applied, or when the RESET input turns ON, the K3TR is in an initial state, as if no measurement had been performed. This state is called "RESET status." This status applies only to operating modes 6 through 11.

In RESET status, the following conditions are present:

Display	All five digits of the PV display are zero.
Comparative output	The HH, H, P, L, and LL outputs are OFF.
Maximum/minimum	All cleared. The DATA TEACH Key is not effective.

While the RESET input is ON, RESET status continues and measurement does not start.

Performance Characteristics

Accuracy of measurement	0.08 rdg ± 1 digit (ambient temperature: 25°C ± 5°C)
Measurement range	10 ms to 3200 s
Response time of HOLD input	20 ms max.
Recovery time (T_R)	20 ms min.
ON/OFF pulse width	Sensor with transistor output: 9 μs min. Sensor with relay output: 15 ms min.

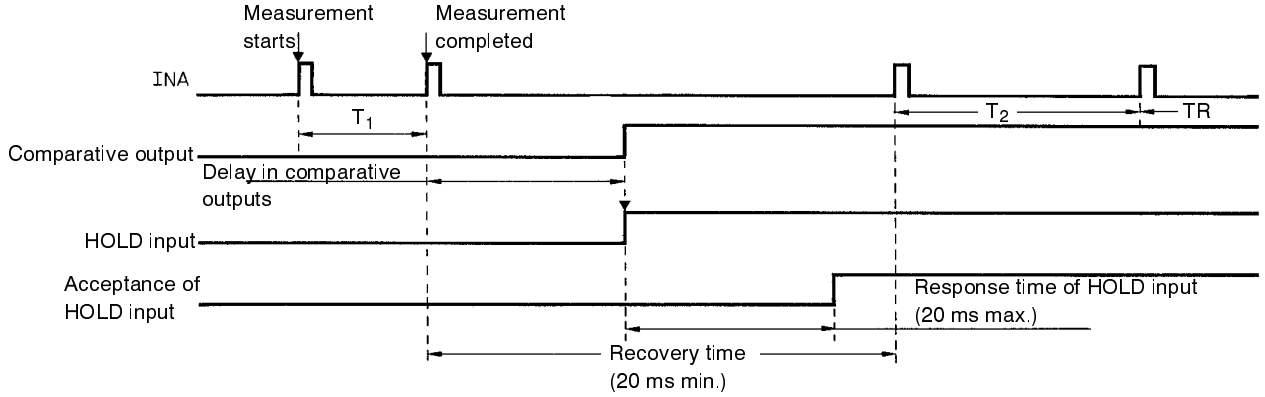
Response time	Output configuration				
	Relay output	**Transistor output**	**BCD and transistor output**	**Linear and transistor output**	**Communication and transistor output**
Comparative output	25 ms max.	20 ms max.	35 ms max.	35 ms max.	20 ms max.
BCD output	---	---	Refer to page 144.	---	---
Linear output	---	---	---	40 ms max.	---

Response Time of HOLD Input

The response time of the HOLD input is the time required for the K3TR to accept HOLD input after the HOLD input turns ON. This is illustrated in the following diagram.

Recovery Time (T_R)

Recovery time is the period required for the K3TR to become ready for the next measuring operation after a measuring operation is completed. For transistor output Models, comparative output remains ON during recovery time. For other models, comparative output requires more time to turn ON. When the comparative output terminals of the output board and the HOLD input terminals are connected, set a sufficient recovery period, considering the response time of HOLD input. This is illustrated in the following diagram.

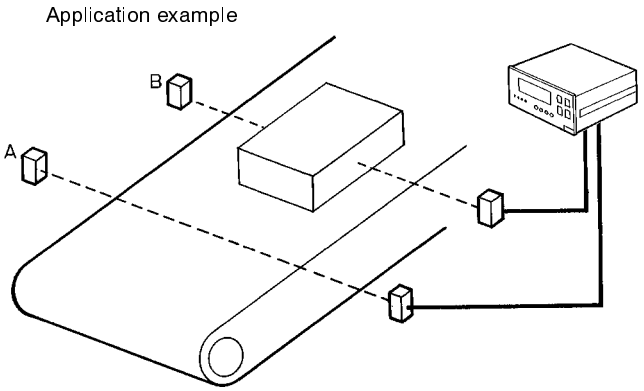


The following list indicates the availability of a variety of functions in operating mode 7. Refer to the page indicated before using the following functions:

Setting level	Parameter	Display	Availability	Reference page
	RESET and retaining of maximum/minimum values	–––	No	112
	Estimated frequency calculation	–––	No	125
1	Bank 1 to 4 set values	cset□	Yes	97
	Hysteresis	hys	No	98
	Prescale bank	pr–bk	Yes	100
	Bank 1 to 4 prescale values	pscl□	Yes	102
	Linear output range	lset	Yes	104
	Set value protect	prot	Yes	106
2	Sensor type	in	Yes	86
	Auto-zero time	=ero	No	88
	Startup compensation time	stime	No	90
	Display refresh period selection	disp	No	92
	Communications unit no.	u–no	Yes	94
	Baud rate	bps	Yes	95
3	Process time for averaging measured values	aUe	No	80
	Time unit	time	Yes	82
	Power failure memory	memo	No	84

Note Some functions cannot be used because of the difference in base unit or output board.

Operating Mode 8 (Time Difference)



Basic Operation

Displays the time (T) in seconds between INA turning ON and INB turning ON. If another unit of measurement is required, input an appropriate prescale value. Obtain the display value D as follows:

D = T x α (sec)

T: The time (sec) between INA turning ON and INB turning ON
α: Prescale value

Mode	Unit of display value	Prescale value
Time difference	sec	1
	min	1/60

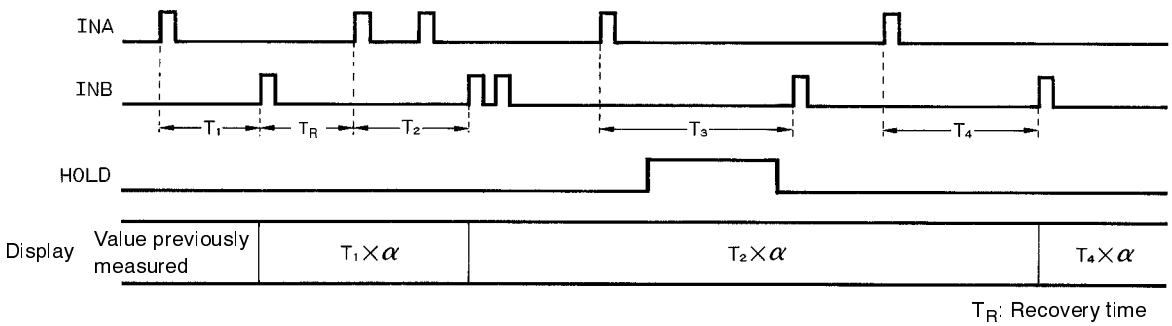
By using time in the time unit display setting parameter at level 3, the passing time can be displayed in units of hours, minutes, and seconds.

To set a prescale value, refer to *6-5-4 Setting the Prescale Value*.

Hold Measured Value

When the HOLD input turns ON while the K3TR is measuring, the measuring operation is canceled and the K3TR holds the last measured value (displayed value). While the HOLD input is ON, the K3TR holds comparative output and BCD output. Measurement will not begin while the K3TR is in HOLD status. This is illustrated in the following diagram.

When the comparative output terminals of the output board and the HOLD input terminals are connected, the value measured immediately after the occurrence of an error can be obtained.



RESET

Immediately after power is applied, or when the RESET input turns ON, the K3TR is in an initial state, as if no measurement had been performed. This state is called "RESET status." RESET status applies only to operating modes 6 through 11. In RESET status, the following conditions are present:

Display	All five digits of the PV display are zero.
Comparative output	The HH, H, P, L, and LL outputs are OFF.
Maximum/minimum	All cleared. The DATA TEACH Key is not effective.

While the RESET input is ON, RESET status continues and measurement does not start.

Performance Characteristics

Accuracy of measurement	0.08 rdg ± 1 digit (ambient temperature: 25°C ± 5°C)
Measurement range	10 ms to 3200 s
Response time of HOLD input	20 ms max.
Recovery time (T_R)	20 ms min.
ON/OFF pulse width	Sensor with transistor output: 9 μs min. Sensor with relay output: 15 ms min.

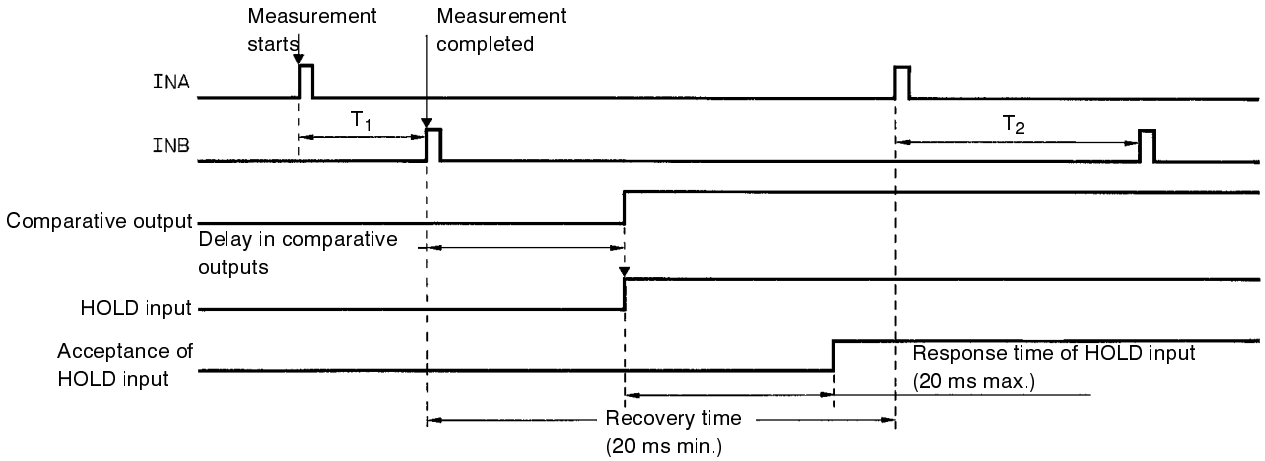
Response time	**Output configuration**				
	Relay output	**Transistor output**	**BCD and transistor output**	**Linear and transistor output**	**Communication and transistor output**
Comparative output	25 ms max.	20 ms max.	35 ms max.	35 ms max.	20 ms max.
BCD output	---	---	Refer to page 144.	---	---
Linear output	---	---	---	40 ms max.	---

Response Time of HOLD Input

The response time of the HOLD input is the time required for the K3TR to accept HOLD input after the HOLD input turns ON. This is illustrated in the following diagram.

Recovery Time (T_R)

Recovery time is the period required for the K3TR to become ready for the next measuring operation after a measuring operation is completed. For transistor output Models, comparative output remains ON during recovery time. For other models, comparative output requires more time to turn ON. When the comparative output terminals of the output board and the HOLD input terminals are connected, set a sufficient recovery period, considering the response time of the HOLD input. This is illustrated in the following diagram.



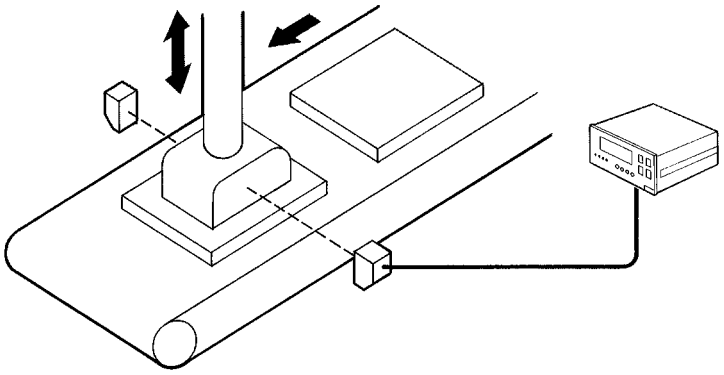
The following list indicates the availability of a variety of functions in operating mode 8. Refer to the page indicated before using the following functions:

Setting level	Parameter	Display	Availability	Reference page
	RESET and retaining of maximum/minimum values	–––	No	112
	Estimated frequency calculation	–––	No	125
1	Bank 1 to 4 set values	cset□	Yes	97
	Hysteresis	hys	No	98
	Prescale bank	pr–bk	Yes	100
	Bank 1 to 4 prescale values	pscl□	Yes	102
	Linear output range	lset	Yes	104
	Set value protect	prot	Yes	106
2	Sensor type	in	Yes	86
	Auto-zero time	=ero	No	88
	Startup compensation time	stime	No	90
	Display refresh period selection	disp	No	92
	Communications unit no.	u–no	Yes	94
	Baud rate	bps	Yes	95
3	Process time for averaging measured values	aUe	No	80
	Time unit	time	Yes	82
	Power failure memory	memo	No	84

Note Some functions cannot be used because of the difference in base unit or output board.

Operating Mode 9 (Elapsed Time)

Application example



Measures the pressing time of a printing machine.

Basic Operation

Displays in seconds the time period (T) that INA is ON. If another unit of measurement is required, input an appropriate prescale value. Obtain display value D as follows:

D = T x α (sec)

T: Time period (sec) INA is ON
α: prescale value

Mode	Unit of display value	Prescale value
Elapsed time	sec	1
	min	1/60

Where,
with operating mode 9, INB input is disregarded.

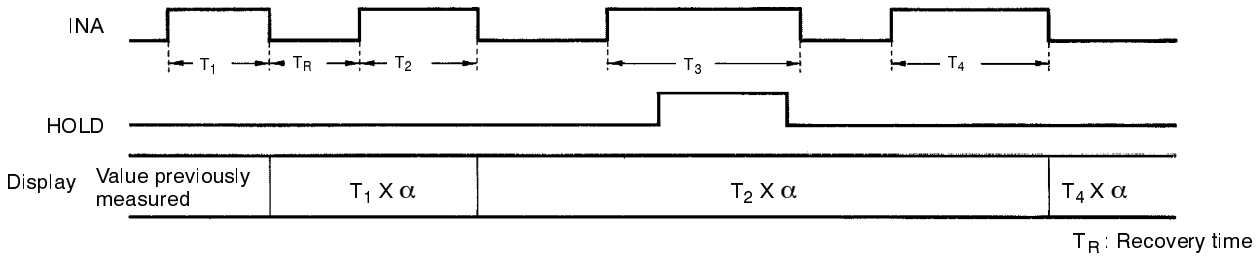
By using time in the time unit display setting parameter at level 3, the passing time can be displayed in units of hours, minutes, and seconds.

To set a prescale value, refer to *6-5-4 Setting the Prescale Value*.

Hold Measured Value

When the HOLD input turns ON while the K3TR is measuring, the measuring operation is canceled and the K3TR holds the last measured value (displayed value). While the HOLD input is ON, the K3TR holds comparative output and BCD output. Measurement will not begin while the K3TR is in HOLD status. This is illustrated in the following diagram.

When the comparative outputs are connected to the HOLD input terminal, the value measured immediately after the occurrence of an error can be obtained.



RESET

Immediately after power is applied or the RESET input turns ON, the K3TR is in the primary state, as if no measurement has been made. This state is called "RESET status." This status applies only to operating modes 6 through 11.

In RESET status, the following conditions are present:

Display	All five digits of the PV display are zero.
Comparative output	The HH, H, P, L, and LL outputs are OFF.
Maximum/minimum	All cleared. The DATA TEACH Key is not effective.

While the RESET input is ON, RESET status continues and measurement does not start.

Performance Characteristics

Accuracy of measurement	0.08 rdg ± 1 digit (ambient temperature: 25°C ± 5°C)
Measurement range	10 ms to 3200 s
Response time of HOLD input	20 ms max.
Recovery time (T_R)	20 ms min.
ON/OFF pulse width	Sensor with transistor output: 9 μs min. Sensor with relay output: 15 ms min.

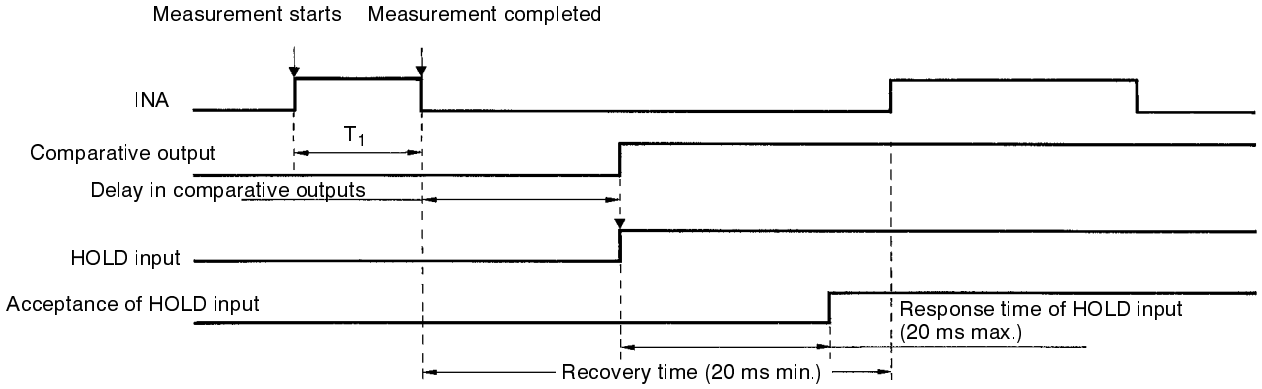
Response time	**Output configuration**				
	Relay output	**Transistor output**	**BCD and transistor output**	**Linear and transistor output**	**Communication and transistor output**
Comparative output	25 ms max.	20 ms max.	35 ms max.	35 ms max.	20 ms max.
BCD output	---	---	Refer to page 144.	---	---
Linear output	---	---	---	40 ms max.	---

Response time of HOLD Input

The response time of the HOLD input is the time required for the K3TR to accept HOLD input after the HOLD input turns ON. This is illustrated in the following diagram.

Recovery Time (T_R)

Recovery time is the period required for the K3TR to become ready for the next measuring operation after a measuring operation is completed. For transistor output Models, comparative output remains ON during recovery time. For other models, comparative output requires more time to turn ON. When the comparative output terminals of the output board and the HOLD input terminals are connected, set a sufficient recovery period, considering the response time of the HOLD input. This is illustrated in the following diagram.

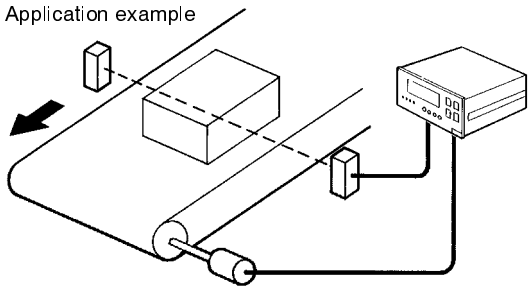


The following list indicates the availability of a variety of functions in operating mode 9. Refer to the page indicated before using the following functions:

Setting level	Parameter	Display	Availability	Reference page
	RESET and retaining of maximum/minimum values	–––	No	112
	Estimated frequency calculation	–––	No	125
1	Bank 1 to 4 set values	cset□	Yes	97
	Hysteresis	hys	No	98
	Prescale bank	pr–bk	Yes	100
	Bank 1 to 4 prescale values	pscl□	Yes	102
	Linear output range	lset	Yes	104
	Set value protect	prot	Yes	106
2	Sensor type	in	Yes	86
	Auto-zero time	=ero	No	88
	Startup compensation time	stime	No	90
	Display refresh period selection	disp	No	92
	Communications unit no.	u–no	Yes	94
	Baud rate	bps	Yes	95
3	Process time for averaging measured values	aUe	No	80
	Time unit	time	Yes	82
	Power failure memory	memo	No	84

Note Some functions cannot be used because of the difference in base unit or output board.

Operating Mode 10 (Length Measurement)



Basic Operation

Counts the number of pulses of INA while INB is ON and displays the result. Obtain display value D as follows:

D = C x α (pulse count)
C: Pulse count of INA while INB input is ON
α: Prescale value

Mode	Unit of display value	Prescale value
Length measurement	mm	1000 πDa/Na
	cm	100 πDa/Na
	m	πDa/Na

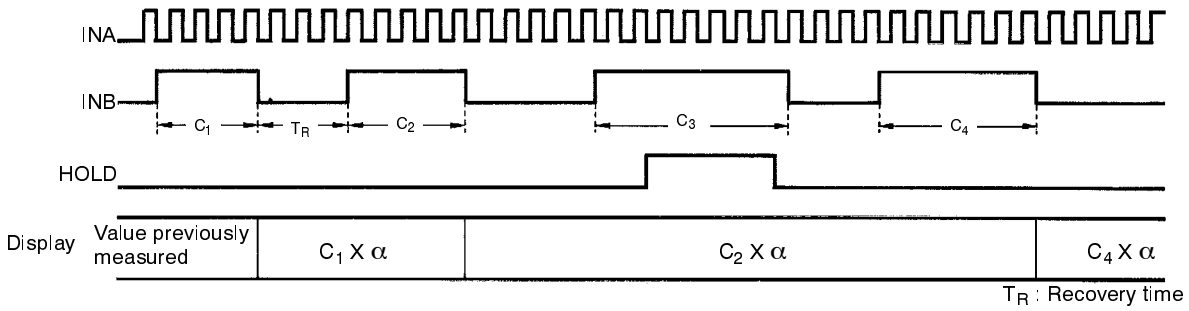
Na: Number of pulses per revolution at A input
πDa: Circumference (m) per revolution from A input

To set a prescale value, refer to *6-5-4 Setting the Prescale Value*.

Hold Measured Value

When the HOLD input turns ON while the K3TR is measuring, the measuring operation is canceled and the K3TR holds the last measured value (displayed value). While the HOLD input is ON, the K3TR holds comparative output and BCD output. Measurement will not begin while the K3TR is in HOLD status. This is illustrated in the following diagram.

When the comparative outputs are connected to the HOLD input terminal, the value measured immediately after the occurrence of an error can be obtained.



RESET

Immediately after power is applied or the RESET input turns ON, the K3TR is in the primary state, as if no measurement has been made. This state is called "RESET status." This status applies only to operating modes 6 through 11.

In RESET status, the following conditions are present:

Display	All five digits of the PV display are zero.
Comparative output	The HH, H, P, L, and LL outputs are OFF.
Maximum/minimum	All cleared. The DATA TEACH Key is not effective.

While the RESET input is ON, RESET status continues and measurement does not start.

Performance Characteristics

Maximum input frequency of INA	Sensor with transistor output: 50 kHz Sensor with relay output: 30 Hz
Measurement range (C)	0 to 4 G (with 32-bit counter)
Response time of HOLD input	20 ms max.
Recovery time (T_R)	20 ms min.
ON/OFF pulse width	Sensor with transistor output: 9 μs min. Sensor with relay output: 15 ms min.

Response time	**Output configuration**				
	Relay output	**Transistor output**	**BCD and transistor output**	**Linear and transistor output**	**Communication and transistor output**
Comparative output	25 ms max.	20 ms max.	35 ms max.	35 ms max.	20 ms max.
BCD output	---	---	Refer to page 144.	---	---
Linear output	---	---	---	40 ms max.	---

Maximum Input Frequency

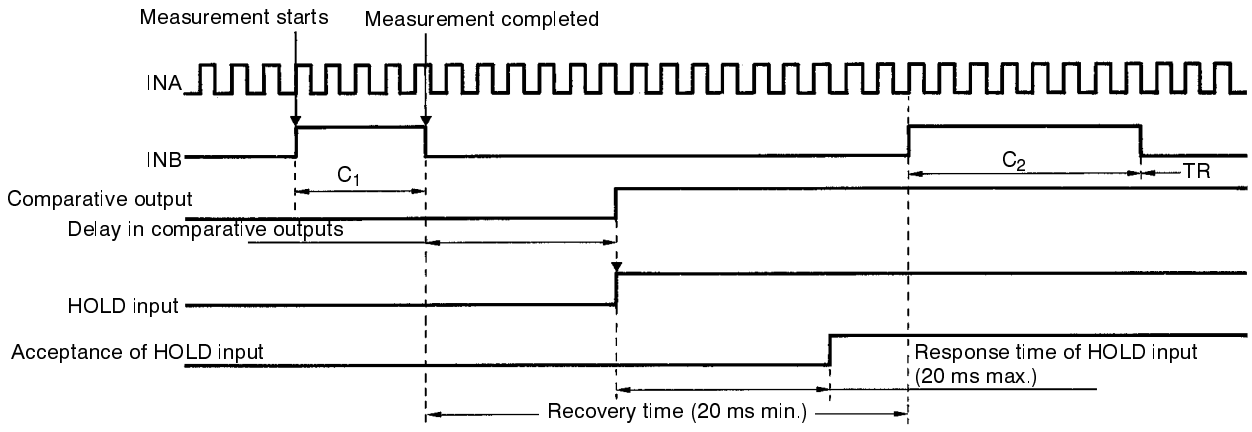
The maximum input frequency is the maximum number of INA input pulses that the K3TR can count accurately.

Response Time of HOLD Input

The response time of the HOLD input is the time required for the K3TR to accept HOLD input after the HOLD input turns ON. This is illustrated in the following diagram.

Recovery Time (T_R)

Recovery time is the period required for the K3TR to become ready for the next measuring operation after a measuring operation is completed. For transistor output Models, comparative output remains ON during recovery time. For other models, comparative output requires more time to turn ON. When the comparative output terminals of the output board and the HOLD input terminals are connected, set a sufficient recovery period, considering the response time of the HOLD input. This is illustrated in the following diagram.



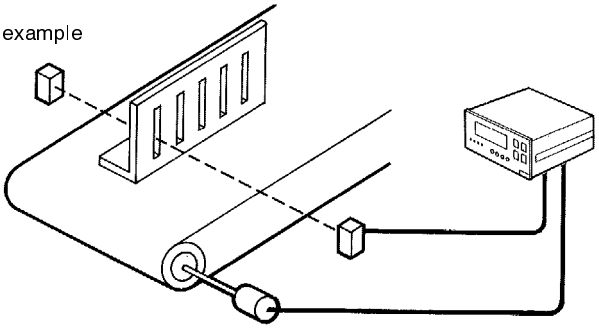
The following list indicates the availability of a variety of functions in operating mode 10. Refer to the page indicated before using the following functions:

Setting level	Parameter	Display	Availability	Reference page
	RESET and retaining of maximum/minimum values	–––	No	112
	Estimated frequency calculation	–––	No	125
1	Bank 1 to 4 set values	cset□	Yes	97
	Hysteresis	hys	No	98
	Prescale bank	pr–bk	Yes	100
	Bank 1 to 4 prescale values	pscl□	Yes	102
	Linear output range	lset	Yes	104
	Set value protect	prot	Yes	106
2	Sensor type	in	Yes	86
	Auto-zero time	=ero	No	88
	Startup compensation time	stime	No	90
	Display refresh period selection	disp	No	92
	Communications unit no.	u–no	Yes	94
	Baud rate	bps	Yes	95
3	Process time for averaging measured values	aUe	No	80
	Time unit	time	No	82
	Power failure memory	memo	No	84

Note Some functions cannot be used because of the difference in base unit or output board.

Operating Mode 11 (Interval)

Application example



Measures the distance between the slits.

Basic Operation

Counts the number of pulses of INA between successive instances of INB turning ON and displays the result. Obtain display value D as follows:

D = C x α (pulse count)

C: Pulse count of INA while INB input is ON
α: Prescale value

Mode	Unit of display value	Prescale value
Interval	mm	1000 πDa/Na
	cm	100 πDa/Na
	m	πDa/Na

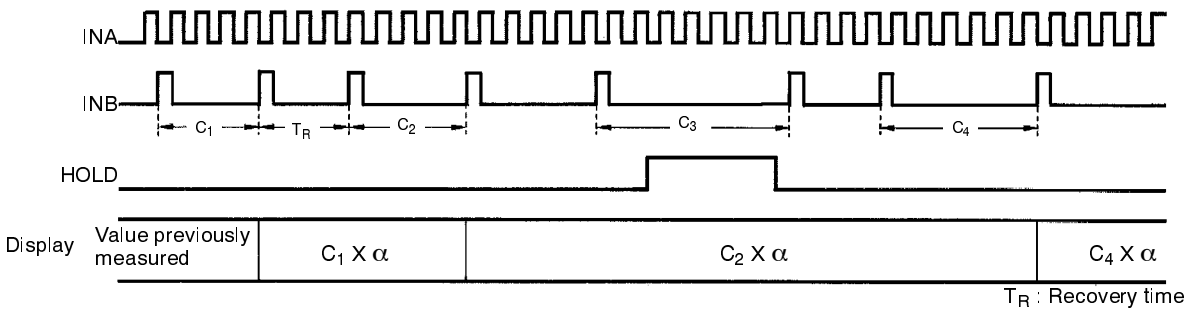
Na: Number of pulses per revolution at A input
πDa: Circumference (m) per revolution from A input

To set a prescale value, refer to *6-5-4 Setting the Prescale Value*.

Hold Measured Value

When the HOLD input turns ON while the K3TR is measuring, the measuring operation is canceled and the K3TR holds the last measured value (displayed value). While the HOLD input is ON, the K3TR holds comparative output and BCD output. Measurement will not begin while the K3TR is in HOLD status. This is illustrated in the following diagram.

When the comparative output terminals of the output board and the HOLD input terminals are connected, the value measured immediately after the occurrence of an error can be obtained.



RESET

Immediately after power is applied or the RESET input turns ON, the K3TR is in the primary state, as if no measurement had been made. This state is called ”RESET status.” RESET status applies only to operating modes 6 through 11.

In RESET status, the following conditions are present:

Display	All five digits of the PV display are zero.
Comparative output	The HH, H, P, L, and LL outputs are OFF.
Maximum/minimum	All cleared. The DATA TEACH Key is not effective.

While the RESET input is ON, RESET status continues and measurement does not start.

Performance Characteristics

Maximum input frequency of INA	Sensor with transistor output: 50 kHz Sensor with relay output: 30 Hz
Measurement range (C)	0 to 4 G (with 32-bit counter)
Response time of HOLD input	20 ms max.
Recovery time (T_R)	20 ms min.
ON/OFF pulse width	Sensor with transistor output: 9 μs min. Sensor with relay output: 15 ms min.

Response time	**Output configuration**				
	Relay output	**Transistor output**	**BCD and transistor output**	**Linear and transistor output**	**Communication and transistor output**
Comparative output	25 ms max.	20 ms max.	35 ms max.	35 ms max.	20 ms max.
BCD output	---	---	Refer to page 144.	---	---
Linear output	---	---	---	40 ms max.	---

Maximum Input Frequency

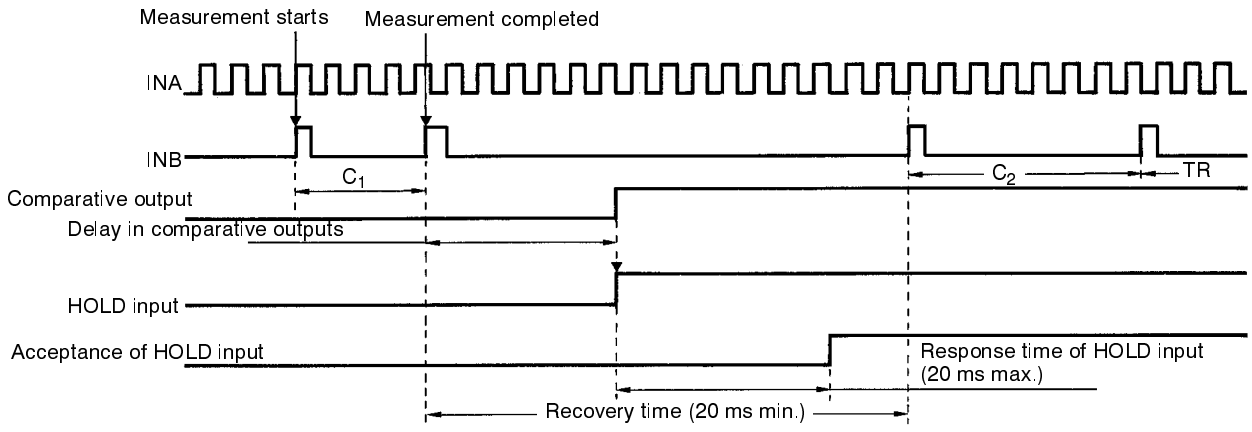
The maximum input frequency is the maximum number of INA input pulses that the K3TR can count accurately.

Response Time of HOLD Input

The response time of the HOLD input is the time required for the K3TR to accept HOLD input after the HOLD input turns ON. This is illustrated in the following diagram.

Recovery Time (T_R)

Recovery time is the period required for the K3TR to become ready for the next measuring operation after a measuring operation is completed. For transistor output Models, comparative output remains ON during recovery time. For other models, comparative output requires more time to turn ON. When the comparative output terminals of the output board and the HOLD input terminals are connected, set a sufficient recovery period, considering the response time of the HOLD input. This is illustrated in the following diagram.



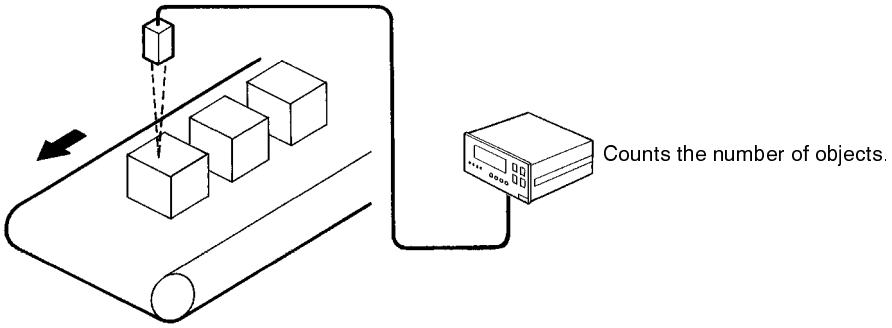
The following list indicates the availability of a variety of functions in operating mode 11. Refer to the page indicated before using the following functions:

Setting level	Parameter	Display	Availability	Reference page
	RESET and retaining of maximum/minimum values	–––	No	112
	Estimated frequency calculation	–––	No	125
1	Bank 1 to 4 set values	cset□	Yes	97
	Hysteresis	hys	No	98
	Prescale bank	pr–bk	Yes	100
	Bank 1 to 4 prescale values	pscl□	Yes	102
	Linear output range	lset	Yes	104
	Set value protect	prot	Yes	106
2	Sensor type	in	Yes	86
	Auto-zero time	=ero	No	88
	Startup compensation time	stime	No	90
	Display refresh period selection	disp	No	92
	Communications unit no.	u–no	Yes	94
	Baud rate	bps	Yes	95
3	Process time for averaging measured values	aUe	No	80
	Time unit	time	No	82
	Power failure memory	memo	No	84

Note Some functions cannot be used because of the difference in base unit or output board.

Operating Mode 12 (Pulse Counting)

Application example



Basic Operation

Counts the number of pulses of INA and displays the result. Obtain display value D as follows:

D = C x α (pulse count)

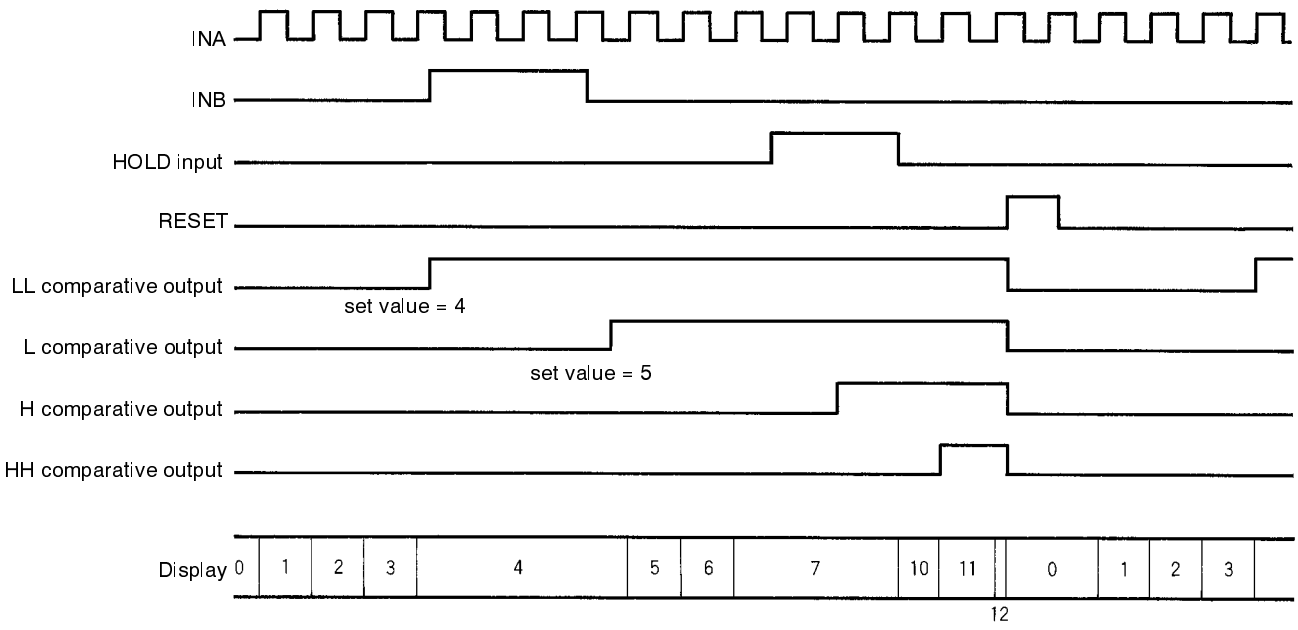
C: Pulse count of INA
α: Prescale value

Mode	Unit of display value	Prescale value
1 pulse = n counts	Count	n
n pulses = 1 count	Count	1/n

To set a prescale value, refer to *6-5-4 Setting the Prescale Value*.

Hold Displayed Value

By turning the HOLD input ON, the displayed value can be put on HOLD. While the HOLD input is ON, the pulse counting operation continues, as does comparative output and BCD output. In this case, using the HOLD input is similar to checking a lap time with a stopwatch. This is illustrated in the following diagram.



Interruption of Pulse Counting

With INB input ON, the pulse counting operation is interrupted and the measured value, comparative outputs, and BCD output are on HOLD. Pulse counting will not begin while INB input is ON.

Clearing Accumulated Value

When the RESET input turns ON, the accumulated value is cleared to zero. Pulse counting will not start while the RESET input is ON.
The accumulated value will be stored or cleared to zero when the Intelligent Signal Processor is turned off, and depends on the setting of the power failure memory (memo) at level 3.

Note: By connecting comparative input with RESET input, the K3TR can be used as a single-mode preset counter.

Comparative Output

With operating mode 12, comparative output L, LL, H, or HH turns ON when the measured value exceeds the set value. Refer to page 139 for details.

Performance Characteristics

Maximum counting speed	Sensor with transistor output: 50 kcps Sensor with relay output: 30 cps
Counting range	0 to 4 G (with 32-bit counter)
Response time of HOLD or RESET input	25 ms max.
ON/OFF pulse width	Sensor with transistor output: 9 μs min. Sensor with relay output: 15 ms min.

Response time	**Output configuration**				
	Relay output	**Transistor output**	**BCD and transistor output**	**Linear and transistor output**	**Communication and transistor output**
Comparative output	10 ms max.	1 ms max.	20 ms max.	20 ms max.	1 ms max.
BCD output	---	---	Refer to page 144.	---	---
Linear output	---	---	---	20 ms max.	---

Maximum Pulse Counting Speed

Maximum pulse counting speed is the maximum speed at which the K3TR can count INA input pulses accurately. If comparative output is used as control output, the maximum pulse counting speed can be obtained as follows:

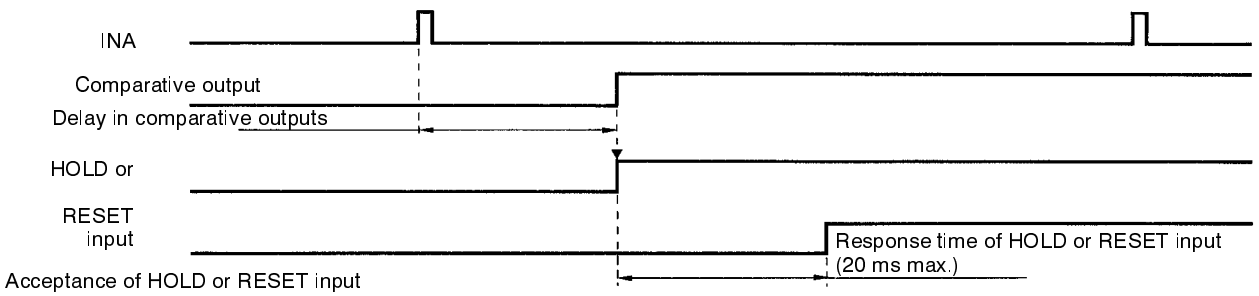
Maximum counting speed (cps) = 1/Delay in comparative outputs (sec)

If comparative output is directly connected to RESET input, the maximum pulse counting speed can be obtained as follows:

Maximum counting speed (cps) = 1/Delay in comparative outputs (sec) + Response time of RESET input (sec)

Response Time of HOLD or RESET Input

The response time of the HOLD or RESET input is the time required for the K3TR to accept HOLD or RESET input after the HOLD or RESET input turns ON. This is illustrated in the following diagram.



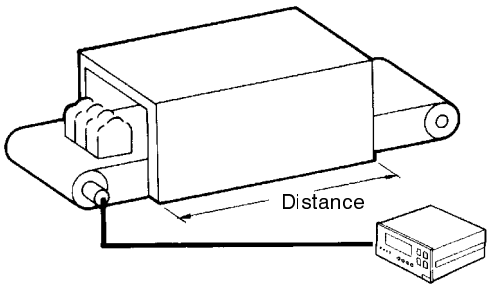
The following list indicates the availability of a variety of functions in operating mode 12. Refer to the page indicated before using the following functions:

Setting level	Parameter	Display	Availability	Reference page
	RESET and retaining of maximum/minimum values	–––	Yes	112
	Estimated frequency calculation	–––	No	125
1	Bank 1 to 4 set values	cset□	Yes	97
	Hysteresis	hys	No	98
	Prescale bank	pr–bk	Yes	100
	Bank 1 to 4 prescale values	pscl□	Yes	102
	Linear output range	lset	Yes	104
	Set value protect	prot	Yes	106
2	Sensor type	in	Yes	86
	Auto-zero time	=ero	No	88
	Startup compensation time	stime	No	90
	Display refresh period selection	disp	No	92
	Communications unit no.	u–no	Yes	94
	Baud rate	bps	Yes	95
3	Process time for averaging measured values	aUe	No	80
	Time unit	time	No	82
	Power failure memory	memo	Yes	84

Note Some functions cannot be used because of the difference in base unit or output board.

Operating Mode 13 (Passing Time)

Application example



Measures the passing time for a conveyor line.

Rotational speed = Input frequency (f) x (1/No. of pulses (N) per 1 cycle)
Circumferential speed = Circumference of roll (πd) x rotational speed
Passing time = Processing length (L)/Circumferential speed

Basic Operation

Measures and displays the input pulse frequency of INA in units of seconds. By selecting an appropriate prescale value, object passing time D in the range determined by the prescale value will be displayed. Obtain display value D as follows:

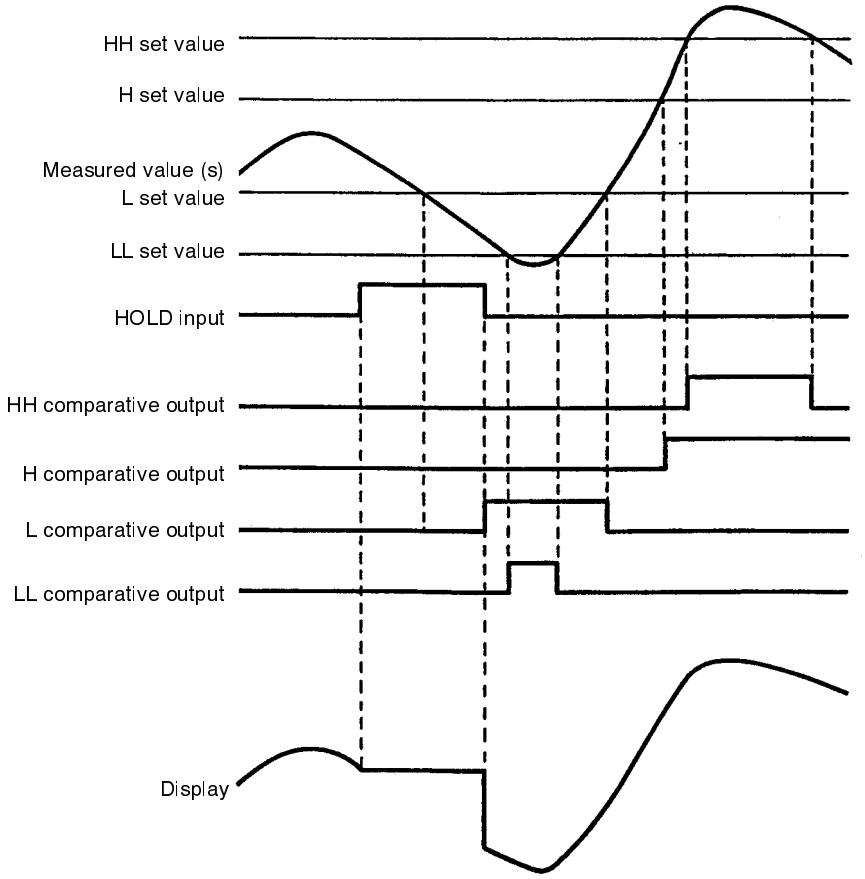
$D = 1/f_A \times \alpha$ (sec)
f_A: INA input frequency
α: prescale value

Mode	Unit of display value	Prescale value
Passing time	sec	L/(πd/N)

N = No. of pulses per 1 cycle
πd = Circumferential length (m) per 1 cycle
L = Processing length (m)

By using time in the time unit display setting parameter at level 3, the passing time can be displayed in units of hours, minutes, and seconds.

This mode ignores INB input.
To set a prescale value, refer to *6-5-4 Setting the Prescale Value*.



Hold Measured Value

When the HOLD input is turned ON, measurement stops and the input measured just before the HOLD input turned ON is held. While the HOLD input is ON, the K3TR holds display output, comparative output, and BCD output.

When the comparative output terminals of the output board and the HOLD input terminals are connected, the value measured immediately after the occurrence of an error can be obtained.

Performance Characteristics

Accuracy of measurement	0.006 rdg ± 1 digit (ambient temperature: 25°C ± 5°C)
Measurement range	Sensor with transistor output: 0.5 mHz to 50 KHz Sensor with relay output: 0.5 mHz to 30 Hz
ON/OFF pulse width	Sensor with transistor output: 9 μs min. Sensor with relay output: 15 ms min.

Response time	**Output configuration**				
	Relay output	**Transistor output**	**BCD and transistor output**	**Linear and transistor output**	**Communication and transistor output**
Comparative output	200 ms max.				
BCD output	---	---	Refer to page 144.	---	---
Linear output	---	---	---	220 ms max.	---

The following list indicates the availability of a variety of functions in operating mode 13. Refer to the page indicated before using the following functions:

Setting level	Parameter	Display	Availability	Reference page
	RESET and retaining of maximum/minimum values	–––	Yes	112
	Estimated frequency calculation	–––	Yes	125
1	Bank 1 to 4 set values	cset□	Yes	97
	Hysteresis	hys	Yes	98
	Prescale bank	pr–bk	Yes	100
	Bank 1 to 4 prescale values	pscl□	Yes	102
	Linear output range	lset	Yes	104
	Set value protect	prot	Yes	106
2	Sensor type	in	Yes	86
	Auto-zero time	=ero	Yes (see note)	88
	Startup compensation time	stime	Yes	90
	Display refresh period selection	disp	Yes	92
	Communications unit no.	u–no	Yes	94
	Baud rate	bps	Yes	95
3	Process time for averaging measured values	aUe	Yes	80
	Time unit	time	Yes	82
	Power failure memory	memo	No	84

Note Some functions cannot be used because of the difference in base unit or output board.

If the auto-zero time function is used, the present value will be forcibly set to zero when the time determined with the auto-zero time function passes. Refer to *6-4-2 Auto-zero Time, page 88* for details.

Passing time is measured in operating mode 13. Therefore, if the Intelligent Signal Processor does not receive any pulse for a certain period, the Intelligent Signal Processor estimates the passing time by the estimated frequency calculation function and increases the displayed value.

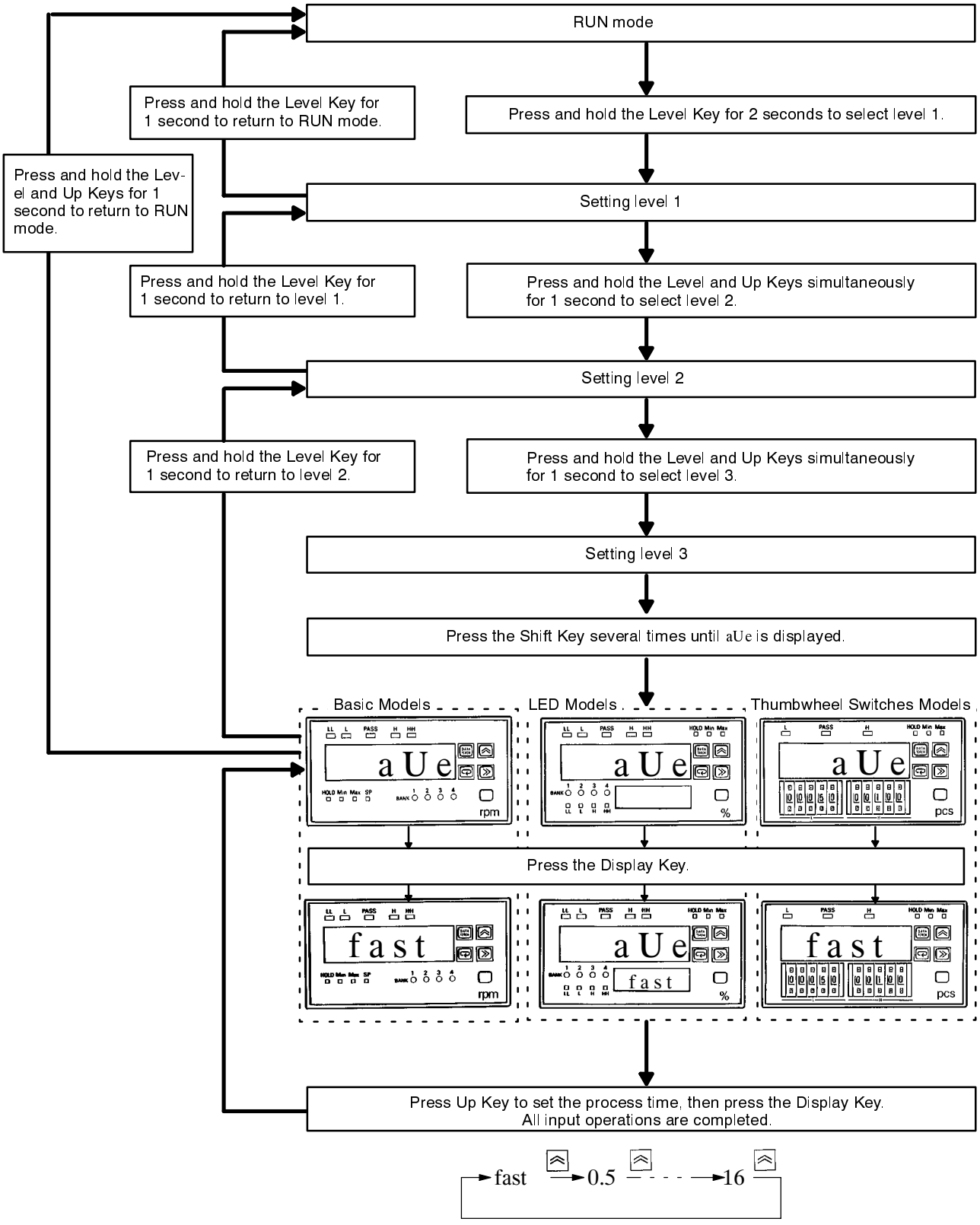
6-3-2 Process Time for Averaging Measured Values

The K3TR averages its measured value at regular preset intervals. Therefore, when the K3TR is used to measure the rpm of a machine, for example, the value indicated by the PV display will be stable without being influenced by the fluctuation of the input pulse intervals or the rotation of the machine. If the input pulse intervals are larger than the preset regular intervals, the K3TR calculates the rpm using the input pulse intervals.

In order to set the process time, follow the instructions outlined in the flow diagram (after the table) and use the following settings:

Setting range	
fast	Averaged approximately every 60 ms.
05	Averaged every 0.5 s.
1	Averaged every 1.0 s.
2	Averaged every 2.0 s.
4	Averaged every 4.0 s.
8	Averaged every 8.0 s.
16	Averaged every 16.0 s.

Note Process time cannot be set for any of the operating modes 6 through 12.


RUN mode
Press and hold the Level Key for 1 second to return to RUN mode.
Press and hold the Level Key for 2 seconds to select level 1.
Press and hold the Level and Up Keys for 1 second to return to RUN mode.
Setting level 1
Press and hold the Level Key for 1 second to return to level 1.
Press and hold the Level and Up Keys simultaneously for 1 second to select level 2.
Setting level 2
Press and hold the Level Key for 1 second to return to level 2.
Press and hold the Level and Up Keys simultaneously for 1 second to select level 3.
Setting level 3
Press the Shift Key several times until aUe is displayed.
Basic Models
LED Models
Thumbwheel Switches Models
aUe
rpm
%
pcs
Press the Display Key.
fast
Press Up Key to set the process time, then press the Display Key.
All input operations are completed.
fast
0.5
16

6-3-3 Time Unit

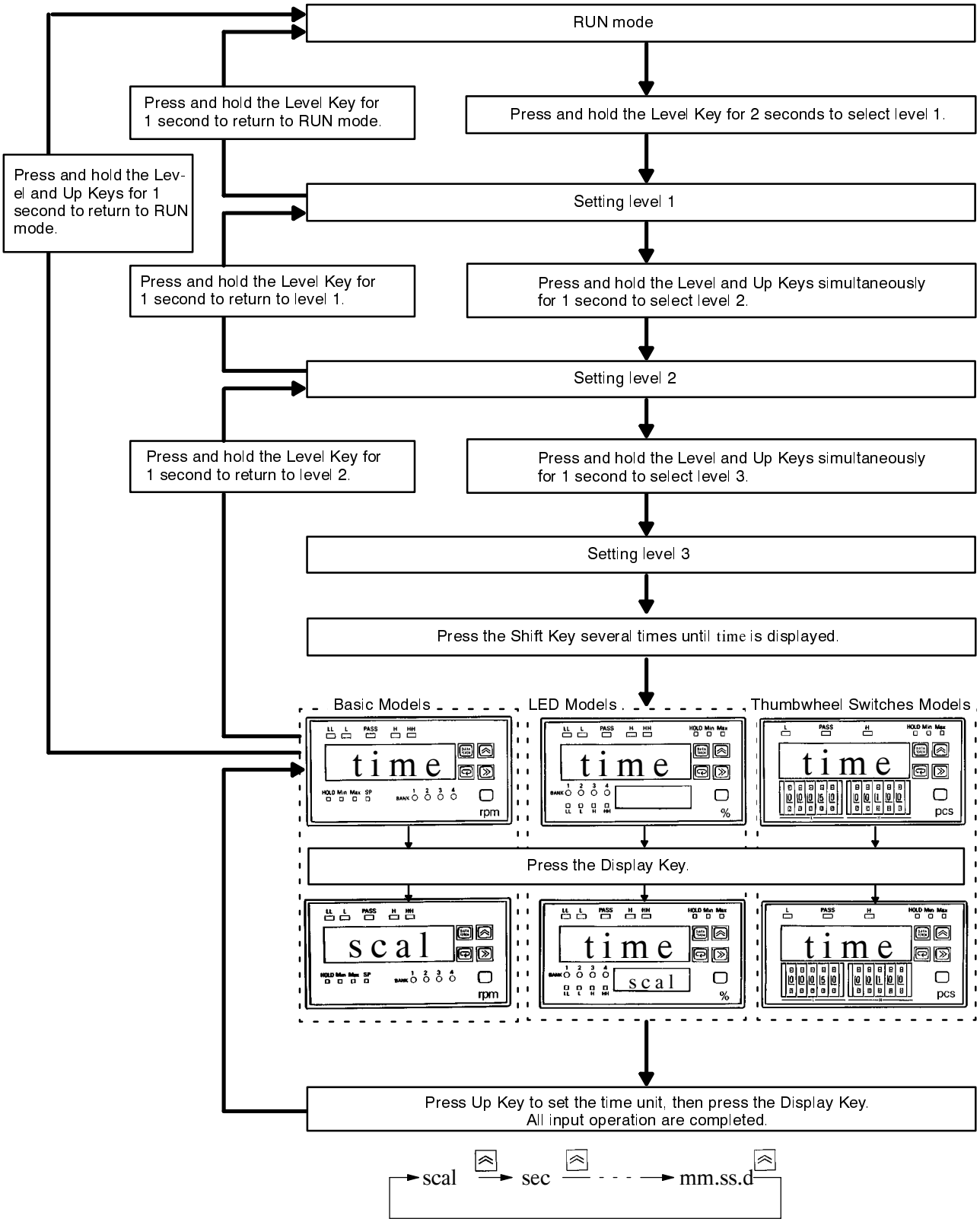
The process value can be displayed in hours, minutes, or seconds. The following can be displayed in hours, minutes, or seconds.

Cycle: If the K3TR is in operating mode 7
Time Difference: If the K3TR is in operating mode 8
Interval: If the K3TR is in operating mode 9
Passing Time: If the K3TR is in operating mode 13

In order to set the time unit, follow the instructions outlined in the flow diagram (after the table) and use the following settings:

Setting range	
scal	The unit of the process value can be freely set using the prescale value parameter at level 1.
sec	The process value will be automatically displayed in seconds within a range between 0 and 99,999 s.
min	The process value will be automatically displayed minutes within a range between 0 and 99,999 min.
h.mm.ss	The process value will be automatically displayed in hours, minutes, and seconds within a range between 0 h, 00 min, 00 s and 9 hrs, 59 min, 59 s.
mm.ss.d	The process value will be automatically displayed in minutes and seconds (1/100 s) within a range between 00 min, 00 s 0 and 59 min, 59 s, 9.

Note
1. The time unit cannot be set for operating modes 1 through 6, and 10 through 12.
2. The prescale setting value parameter at level 1 cannot be set when sec, min, h.mm.ss, or mm.ss.d is selected in the time unit setting parameter in operating modes 7, 8, or 9.


RUN mode
Press and hold the Level Key for 1 second to return to RUN mode.
Press and hold the Level Key for 2 seconds to select level 1.
Press and hold the Level and Up Keys for 1 second to return to RUN mode.
Setting level 1
Press and hold the Level Key for 1 second to return to level 1.
Press and hold the Level and Up Keys simultaneously for 1 second to select level 2.
Setting level 2
Press and hold the Level Key for 1 second to return to level 2.
Press and hold the Level and Up Keys simultaneously for 1 second to select level 3.
Setting level 3
Press the Shift Key several times until time is displayed.
Basic Models
LED Models
Thumbwheel Switches Models
time
rpm
%
pcs
Press the Display Key.
scal
Press Up Key to set the time unit, then press the Display Key.
All input operation are completed.
scal
sec
mm.ss.d

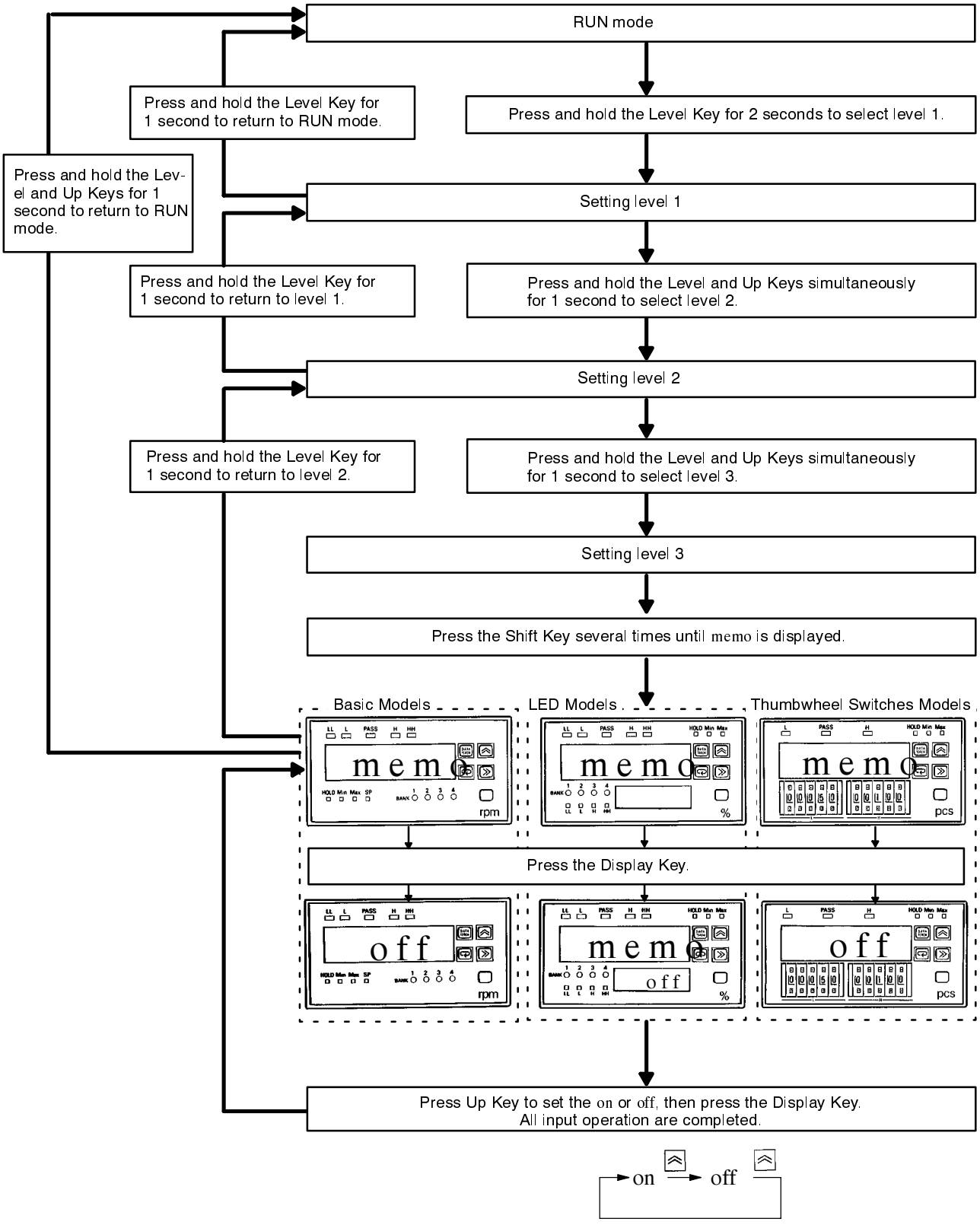
6-3-4 Power Failure Memory

If the K3TR is in pulse counting mode (operating mode 12), the measured value of the K3TR will be stored when the power supplied to the K3TR is interrupted.

In order to set the power failure memory, follow the instructions outlined in the flow diagram (after the table) and use the following settings:

Setting range	
on	Stored
off	Not stored

Note Power failure memory cannot be set for operating modes 1 through 11 and 13.


RUN mode
Press and hold the Level Key for 1 second to return to RUN mode.
Press and hold the Level Key for 2 seconds to select level 1.
Press and hold the Level and Up Keys for 1 second to return to RUN mode.
Setting level 1
Press and hold the Level Key for 1 second to return to level 1.
Press and hold the Level and Up Keys simultaneously for 1 second to select level 2.
Setting level 2
Press and hold the Level Key for 1 second to return to level 2.
Press and hold the Level and Up Keys simultaneously for 1 second to select level 3.
Setting level 3
Press the Shift Key several times until memo is displayed.
Basic Models
LED Models
Thumbwheel Switches Models
memo
off
rpm
%
pcs
Press the Display Key.
Press Up Key to set the on or off, then press the Display Key.
All input operation are completed.
on
off

6-4 Parameter Setting at Level 2

6-4-1 Sensor Type

Specify the type of sensor to be used as follows:

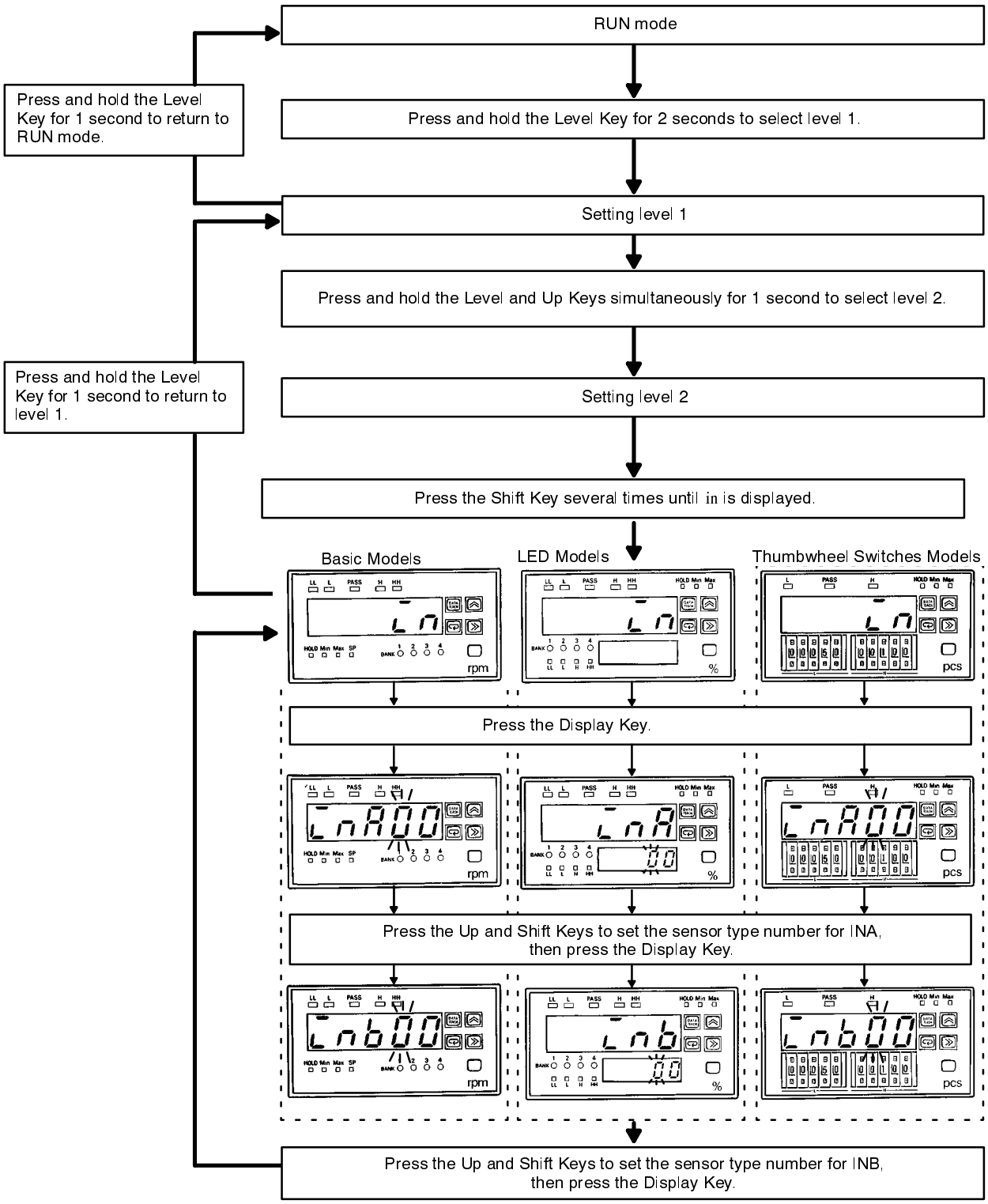
Sensor output type	Normally open	Normally closed
Transistor output	00	01
Relay output	10	11

Normally Open Model: The sensor output is OFF (open) when the sensor is not sensing an object.

Normally Closed Model: The sensor output is ON (closed) when the sensor is not sensing an object.

With a sensor providing relay output, the K3TR can remove approximately 10 ms chatter against input pulses.

Note When operating mode1 (rotational/circumferential speed), 7 (cycle), 9 (elapsed time), or 13 (passing time) is selected, inb is not displayed.


RUN mode
Press and hold the Level Key for 1 second to return to RUN mode.
Press and hold the Level Key for 2 seconds to select level 1.
Setting level 1
Press and hold the Level and Up Keys simultaneously for 1 second to select level 2.
Press and hold the Level Key for 1 second to return to level 1.
Setting level 2
Press the Shift Key several times until in is displayed.
Basic Models
LED Models
Thumbwheel Switches Models
Press the Display Key.
Press the Up and Shift Keys to set the sensor type number for INA, then press the Display Key.
Press the Up and Shift Keys to set the sensor type number for INB, then press the Display Key.

6-4-2 Auto-zero Time

The auto-zero time value can be obtained as follows: Auto-zero time = X x 10^{Y} (sec) (X: mantissa, Y: exponent) Set X and Y as well as the position of the decimal as follows:

X (mantissa)	0.0001 to 9.9999
Y (exponent)	–9 to 09

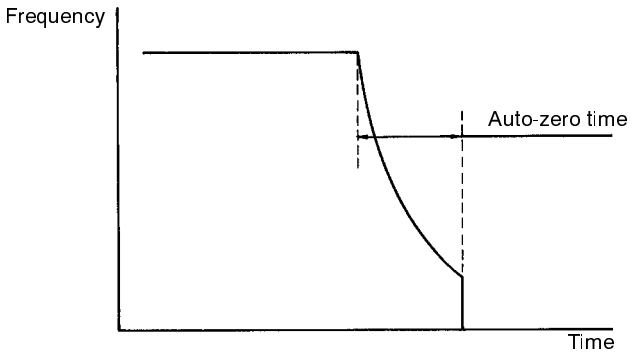
The auto-zero time value should be longer than the inverse of the minimum input frequency. Minimum setting: 0.1 sec.

Note No auto-zero time can be set when one of the operating modes 6 through 12 is selected.

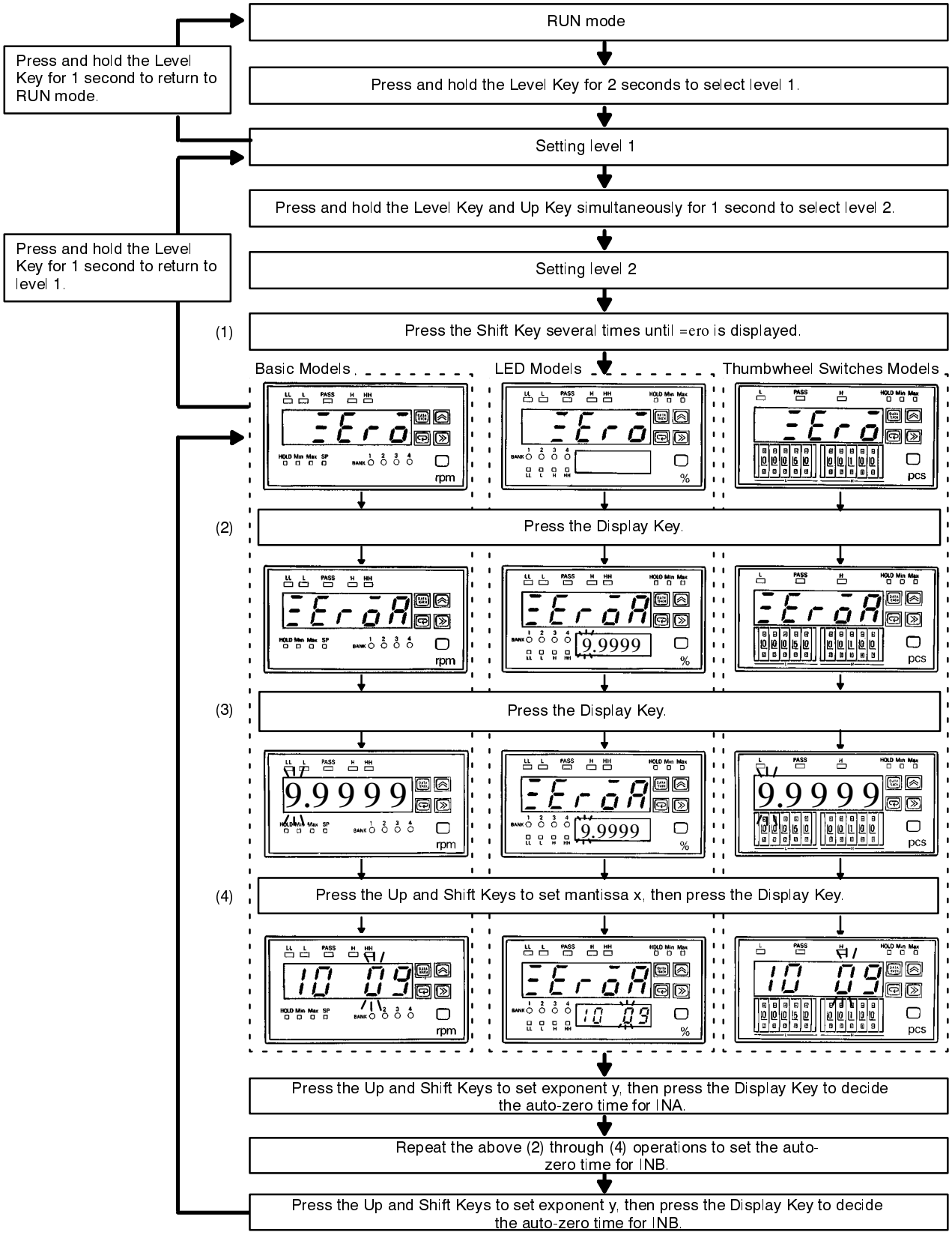
If the K3TR is in operating mode 13, the measured value will be force-set to zero after the set auto-zero time.

Auto-zero Time

Logically, the frequency cannot reach zero through estimated frequency calculation alone. The K3TR has a operating mode to force the frequency to set to zero if no pulse is received for a certain period. The period during which no pulse is received and the K3TR has set the frequency to zero is called “auto-zero time.”



For estimated frequency calculation, refer to *6-7 Estimated Frequency Calculation*.


RUN mode
Press and hold the Level Key for 1 second to return to RUN mode.
Press and hold the Level Key for 2 seconds to select level 1.
Setting level 1
Press and hold the Level Key and Up Key simultaneously for 1 second to select level 2.
Press and hold the Level Key for 1 second to return to level 1.
Setting level 2
(1)
Press the Shift Key several times until =ero is displayed.
Basic Models
LED Models
Thumbwheel Switches Models
(2)
Press the Display Key.
(3)
Press the Display Key.
(4)
Press the Up and Shift Keys to set mantissa x, then press the Display Key.
Press the Up and Shift Keys to set exponent y, then press the Display Key to decide the auto-zero time for INA.
Repeat the above (2) through (4) operations to set the auto-zero time for INB.
Press the Up and Shift Keys to set exponent y, then press the Display Key to decide the auto-zero time for INB.

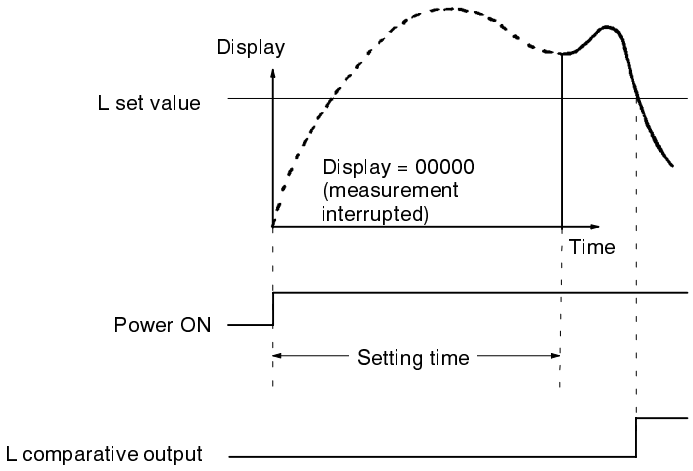
6-4-3 Startup Compensation Time

The startup compensation time parameter keeps the measurement operation from sending an unnecessary output corresponding to instantaneous, fluctuating input from the moment the K3TR is tuned ON until the end of the preset period.

In order to set the startup compensation time, follow the instructions outlined in the flow diagram (after the table) and set within the following range:

Setting range	0.0 to 99.9 (sec)

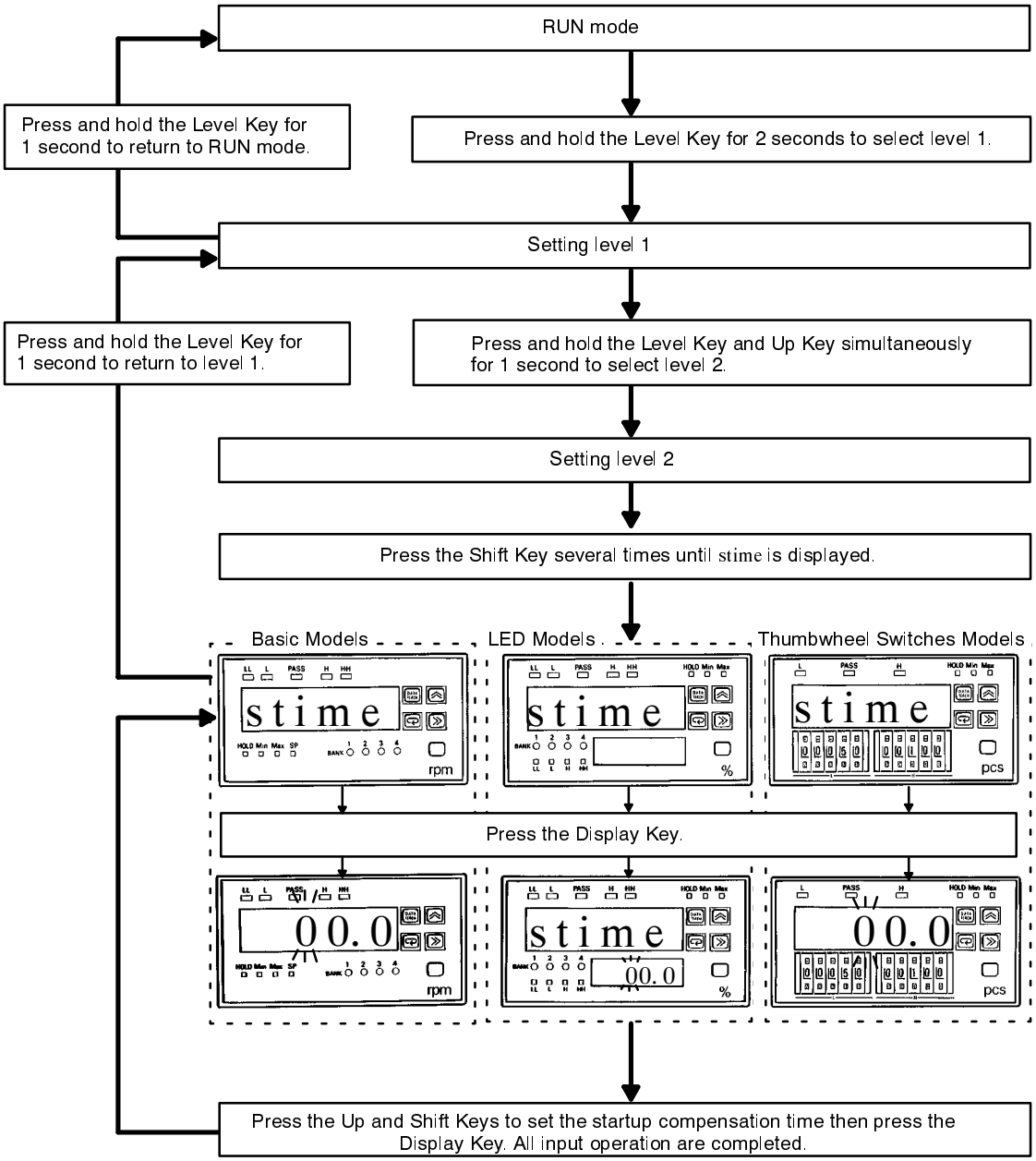
Example



The K3TR will not be in measurement operation for the period that is preset.

Output signals of the K3TR will not be ON for the preset period.

Note Startup compensation time cannot be set for operating modes 6 through 12.


RUN mode
Press and hold the Level Key for 1 second to return to RUN mode.
Press and hold the Level Key for 2 seconds to select level 1.
Setting level 1
Press and hold the Level Key for 1 second to return to level 1.
Press and hold the Level Key and Up Key simultaneously for 1 second to select level 2.
Setting level 2
Press the Shift Key several times until stime is displayed.
Basic Models
LED Models
Thumbwheel Switches Models
stime
00.0
rpm
%
pcs
Press the Display Key.
Press the Up and Shift Keys to set the startup compensation time then press the Display Key. All input operation are completed.

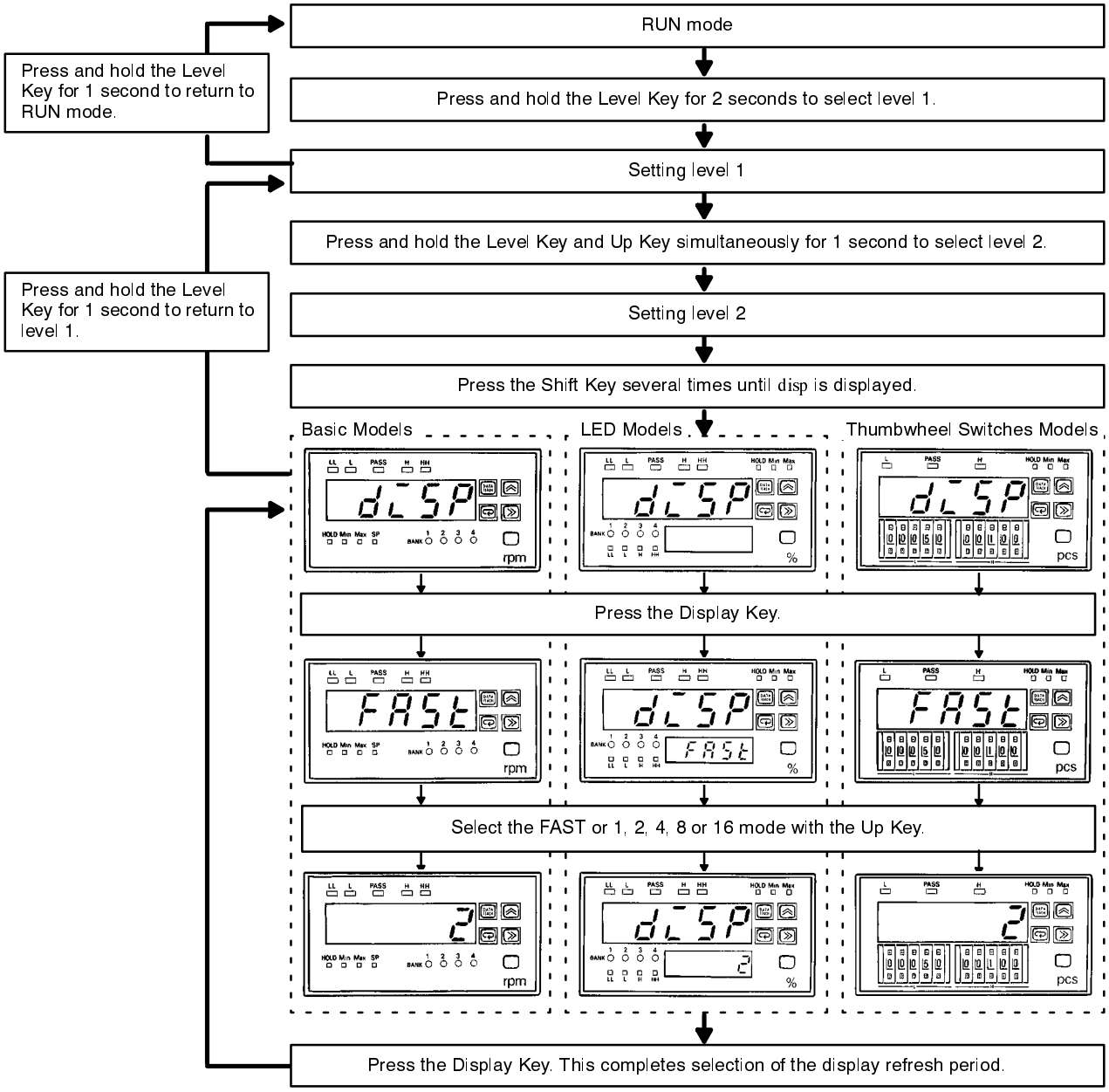
6-4-4 Display Refresh Period

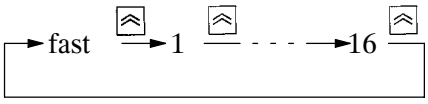
If display data is updated in synchronization with the normal sampling range (60 ms), the data may change too rapidly to be read. In this case, the speed at which the displayed data is updated can be slowed down. When a slow data display speed is selected, the sampling range for measurement is not changed. The comparative outputs and BCD output are updated in synchronization with the sampling range.

In order to set the display refresh period, follow the instructions outlined in the flow diagram (after the table) and operate using one of following settings:

Setting range	
fast	Display is updated approximately every 60 ms.
1	Display is updated every 1.0 seconds.
2	Display is updated every 2.0 seconds.
4	Display is updated every 4.0 seconds.
8	Display is updated every 8.0 seconds.
16	Display is updated every 16.0 seconds.

Note No display refresh period can be set for any of the operating modes 6 through 12.


RUN mode
Press and hold the Level Key for 1 second to return to RUN mode.
Press and hold the Level Key for 2 seconds to select level 1.
Setting level 1
Press and hold the Level Key and Up Key simultaneously for 1 second to select level 2.
Press and hold the Level Key for 1 second to return to level 1.
Setting level 2
Press the Shift Key several times until disp is displayed.
Basic Models
LED Models
Thumbwheel Switches Models
Press the Display Key.
Select the FAST or 1, 2, 4, 8 or 16 mode with the Up Key.
Press the Display Key. This completes selection of the display refresh period.


fast
1
16

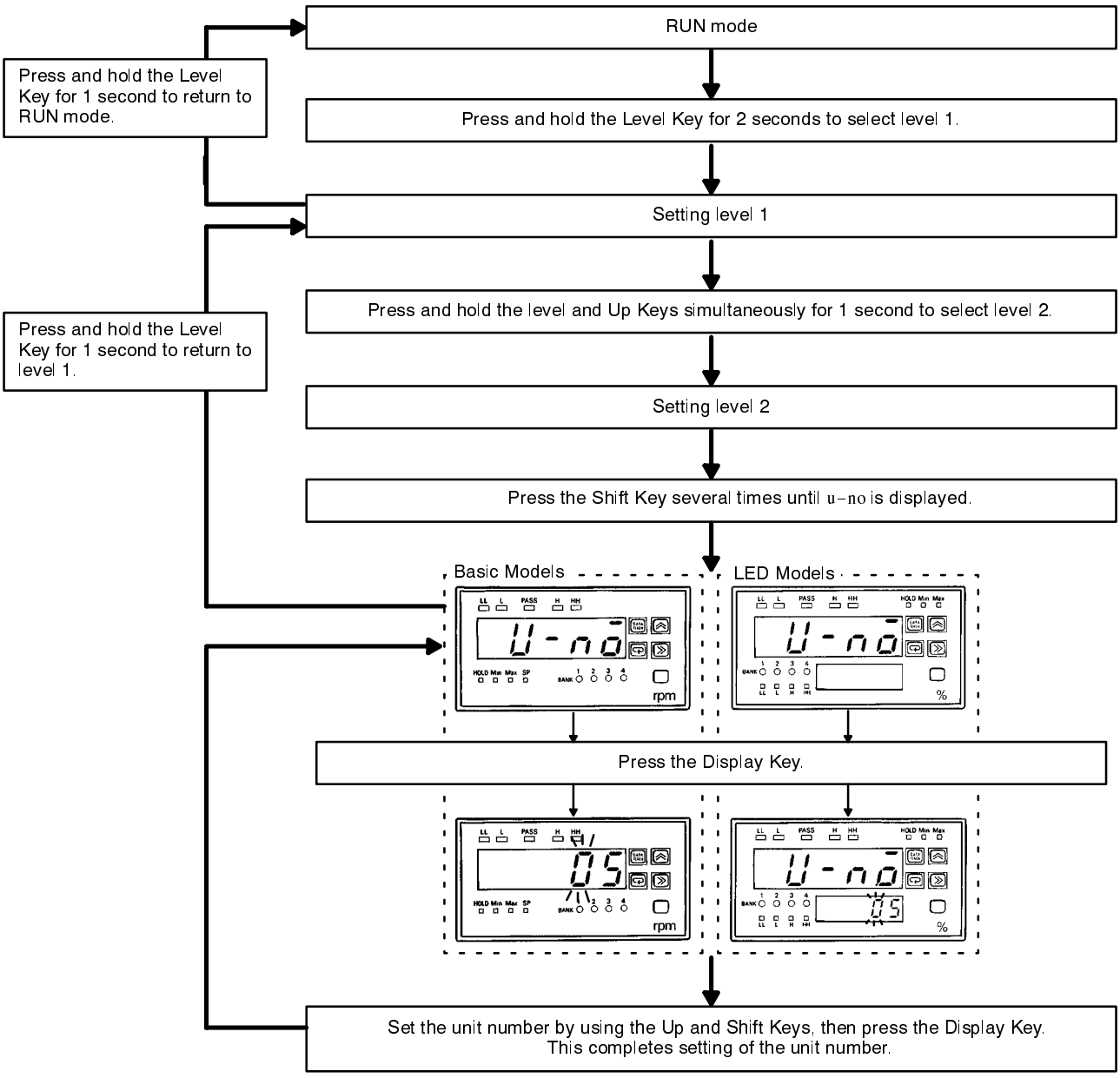
6-4-5 Communications Unit Number

The communications unit number is an identification number by which the host computer to which the Intelligent Signal Processor is connected identifies the Intelligent Signal Processor.

In order to set the communications unit number, follow the instructions outlined on the flow diagram (after the table) and set within the following range:

Setting range	00 to 99

Note The Thumbwheel Switches Models are not provided with the communications output function; therefore, communications unit number setting is not required. For details, refer to the *K3TH/K3TR/K3TX Communication Output-type Intelligent Signal Processor Operation Manual.*



6-4-6 Baud Rate

The Thumbwheel Switches Models are not provided with a communications output function; therefore, setting of the baud rate is not required. For details, refer to the *K3TH/K3TR/K3TX Communication Instruction Manual*.

In order to set the baud rate, follow the instructions outlined in the flow diagram (after the table) and set within the following range:

Display	Meaning
150	150 bps
300	300 bps
600	600 bps
1200	1200 bps
2400	2400 bps
4800	4800 bps
9600	9600 bps
19200	19.2k bps
38400	38.4k bps

RUN mode

Press and hold the Level Key for 1 second to return to RUN mode.

Press and hold the Level Key for 2 seconds to select level 1.

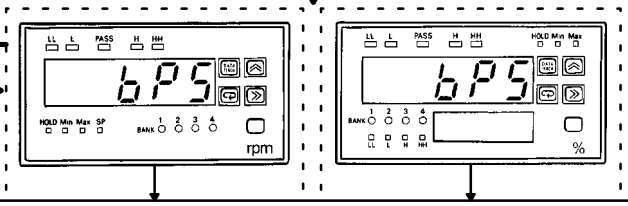
Setting level 1

Press and hold the level and Up Keys simultaneously for 1 second to select level 2.

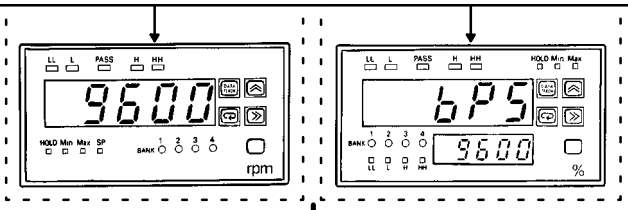
Press and hold the Level Key for 1 second to return to level 1.

Setting level 2

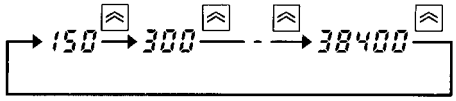
Press the Shift Key several times until bps is displayed.



Press the Display Key.



Set the unit number by using the Up Key, then press the Display Key.
This completes setting of the baud rate.



6-5 Parameter Setting at Level 1

6-5-1 Set Values

When setting set values, the decimal point is automatically displayed according to the sensor type selected. Also, there is no limitation on the relationship among HH, H, L, and LL.

Follow the example below when setting the set values for Bank 1 (cset1). (To set the set values in Banks 2 through 4, follow the same procedure after cset2 to cset4 is displayed):

In order to establish set values, follow the instructions outlined in the flow diagram (after the table) and set within the following range:

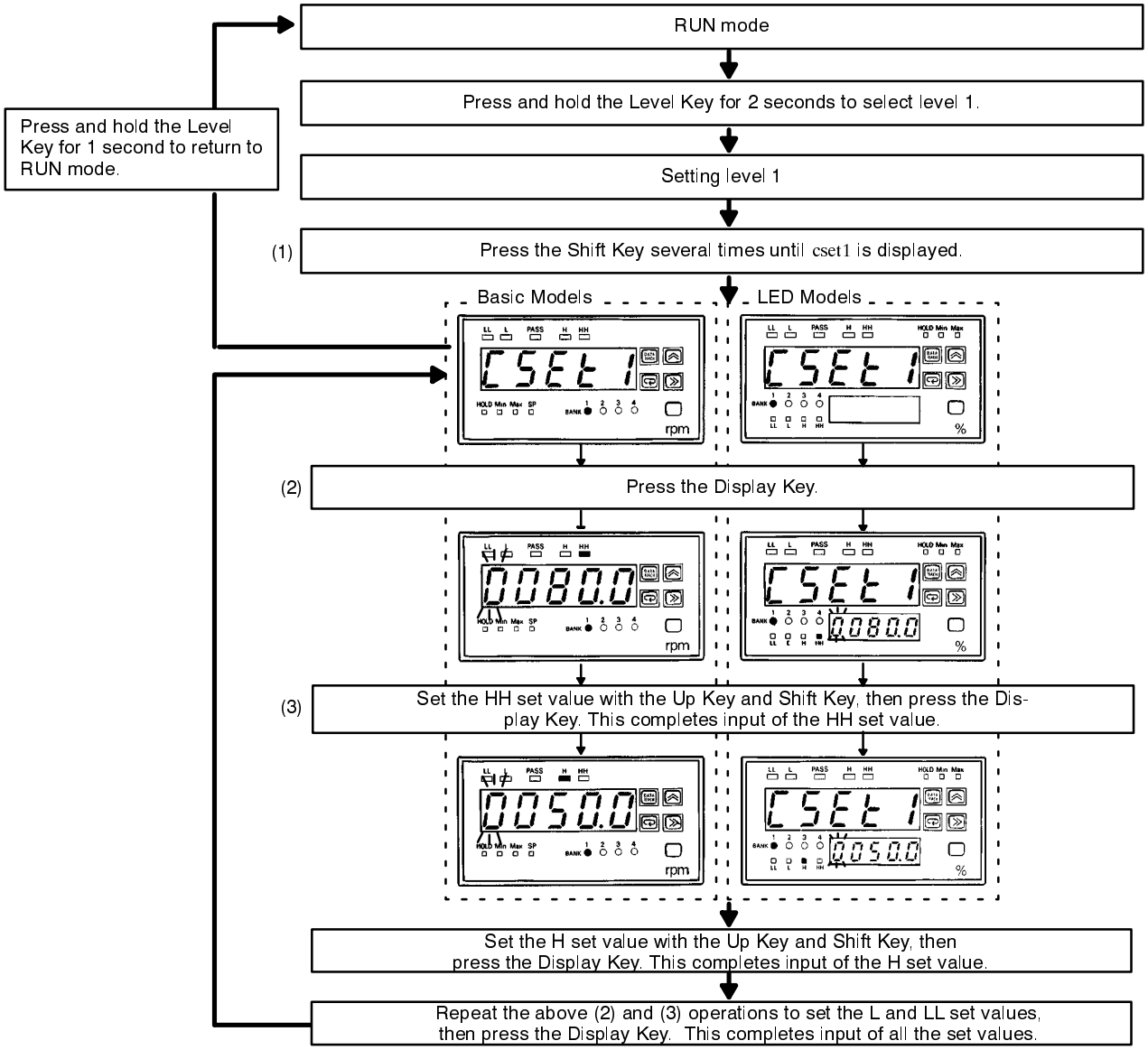
Setting range	–9999 to 99999

The decimal is displayed at the position set in the prescale parameter. Note that the set value does not shift if the position of the decimal is changed after the set value has been set.

Setting set value –> Changing decimal position – > Set value

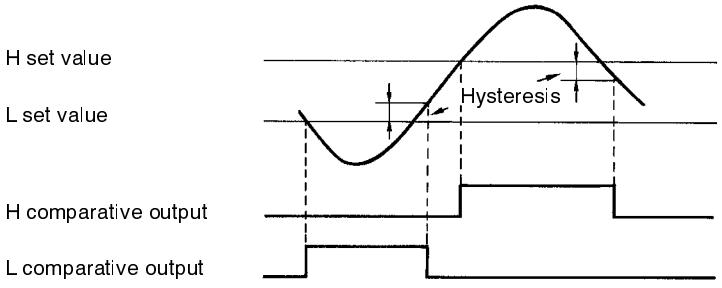
0050.0 %%%.%.% 005.00

Note On the Thumbwheel Switches Models, the set value parameter is not displayed. In this case, set the set values with the thumbwheel switches on the front panel. If the values are set with the thumbwheel switches, the set values are registered (in 1.5 seconds) and the Intelligent Signal Processor operates according to the new set values. Models provided with only H and L outputs do not allow HH and LL set values to be set.



6-5-2 Hysteresis

The established set value includes a hysteresis to prevent the comparative output status from turning ON/OFF when it should not if the measured value (displayed value) fluctuates in the vicinity of the established set value. The hysteresis can be set in a range of 1 to 99 digits (lower 3 digits), and all inputs (HH, H, L. and LL) operate in the same range of hysteresis. In principle, the hysteresis cannot be 0. If set to 0, 1 is assumed. The following graph illustrates the concept of hysteresis.

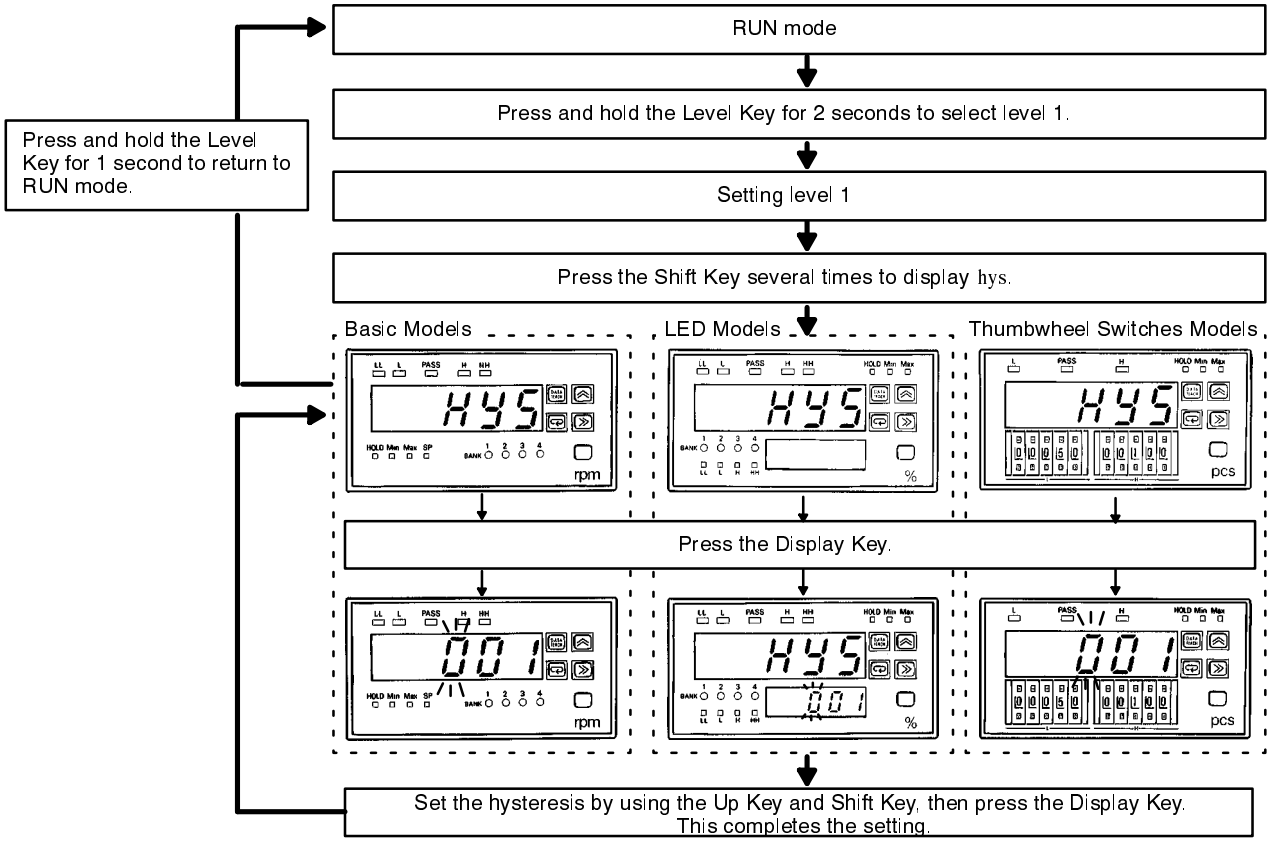


No hysteresis can be set for any of the operating modes 6 through 12, as they, unlike 1 through 5, or 13 are not sequential measurement operating modes. In order to set hysteresis, follow the instructions outlined in the flow diagram (after the table) and set within the following range:

Setting range	001 to 999

Note The following hysteresis setting ranges will be available only in passing time mode (operating mode 13) if h.mm.ss or mm.ss.d is selected with the time unit parameter.

Setting range	
h.mm.ss	001 to 999 s (1 s to 16 min, 39 s)
mm.ss.d	00.1 to 99.9 s (0.1 s to 1 min, 39 s, 9)



6-5-3 Prescale Bank

Basic Models and Set Value LED Display Models have a maximum of four banks each storing a prescale value. Any bank can be selected.

In order to set the prescale bank, follow the instructions outlined in the flow diagram (after the table) using the following settings:

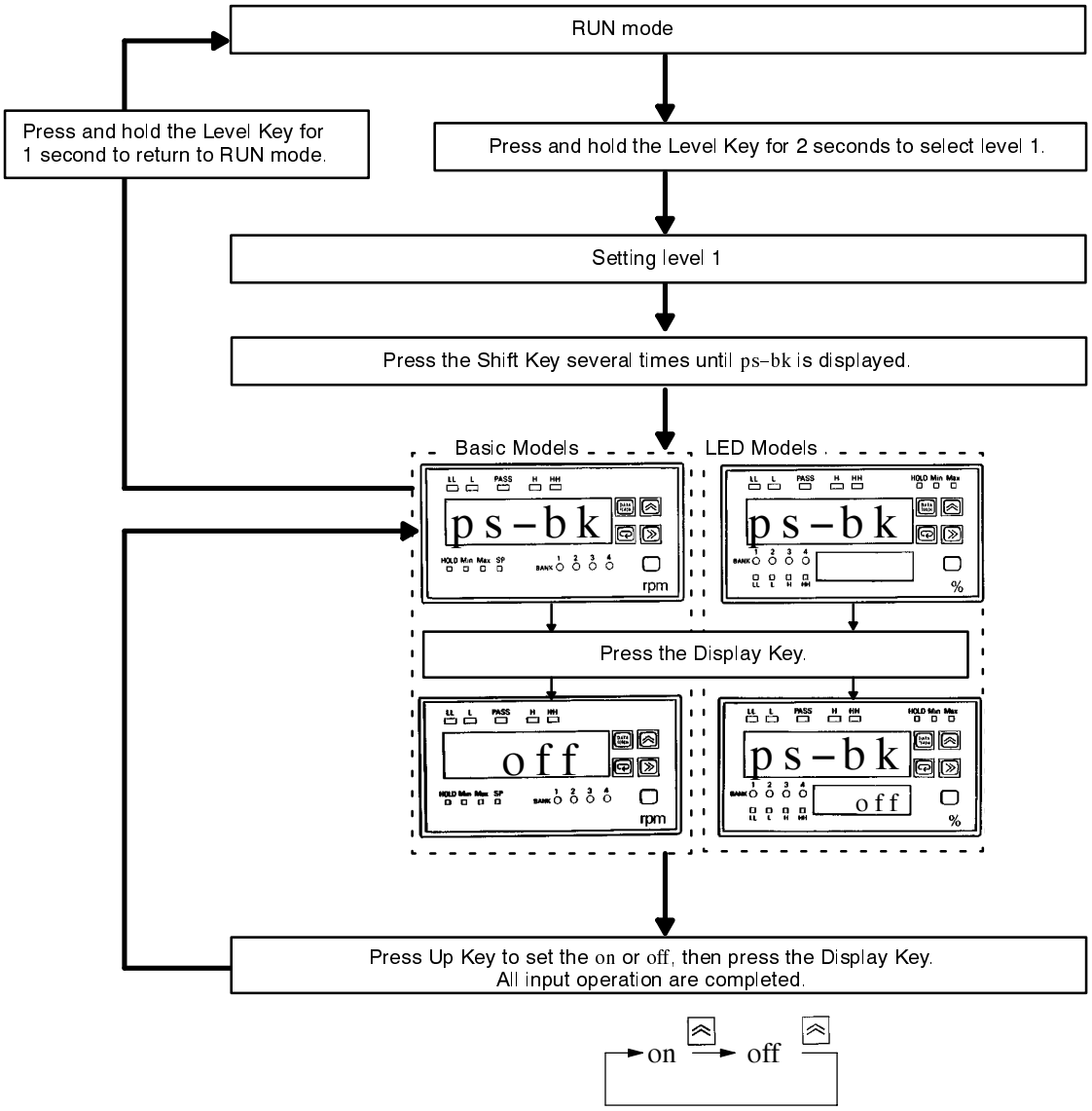
Setting range	
on	Enable
off	Disable

When the prescale banks of the K3TR are set to ON, refer to the following for the relationship among control input, set values, and prescale values.

Bank No.	Control input		Set value	Prescale value
	Bank 1	Bank 2		
1	OFF	OFF	Bank 1 set value cset1	Bank 1 prescale value pscl1
2	ON	OFF	Bank 2 set value cset2	Bank 2 prescale value pscl2
3	OFF	ON	Bank 3 set value cset3	Bank 3 prescale value pscl3
4	ON	ON	Bank 4 set value cset4	Bank 4 prescale value pscl4

When the prescale banks of the K3TR are set to OFF, the prescale value determined with the prescale value parameter at setting level 1 will be fixed for each set value bank of the Intelligent Signal Processor.

Note Thumbwheel Switches Models do not have a prescale bank parameter because these models do not have a bank selecting function.


RUN mode
Press and hold the Level Key for 1 second to return to RUN mode.
Press and hold the Level Key for 2 seconds to select level 1.
Setting level 1
Press the Shift Key several times until ps-bk is displayed.
Basic Models
LED Models
ps-bk
rpm
%
Press the Display Key.
off
Press Up Key to set the on or off, then press the Display Key.
All input operation are completed.
on
off

6-5-4 Prescale Value

A prescale value can be obtained as follows: Prescale value = X x 10^{Y} (X: mantissa, Y: exponent) Set X and Y as well as the position of the decimal as follows:

Setting range		
X (mantissa)		0.0001 to 9.9999
Y (exponent)		–9 to 09
Position of decimal	Operating modes 3 and 4	%%.%.%.%
	Operating modes other than 3 or 4	%.%.%.%.%

Example:
For an input value of 60 rpm and a prescale value of 1 in operating mode 1.

If the decimal is between the first and second digits from the right, the PV display will be as follows: □□60.0

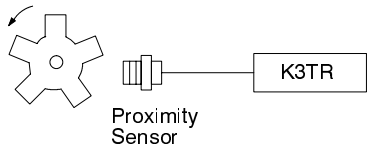
If the decimal is between the second and third digits from the right, the PV display will be as follows: □60.00

Note When operating mode 1, or 6 to 13 is selected, psclb is not displayed.

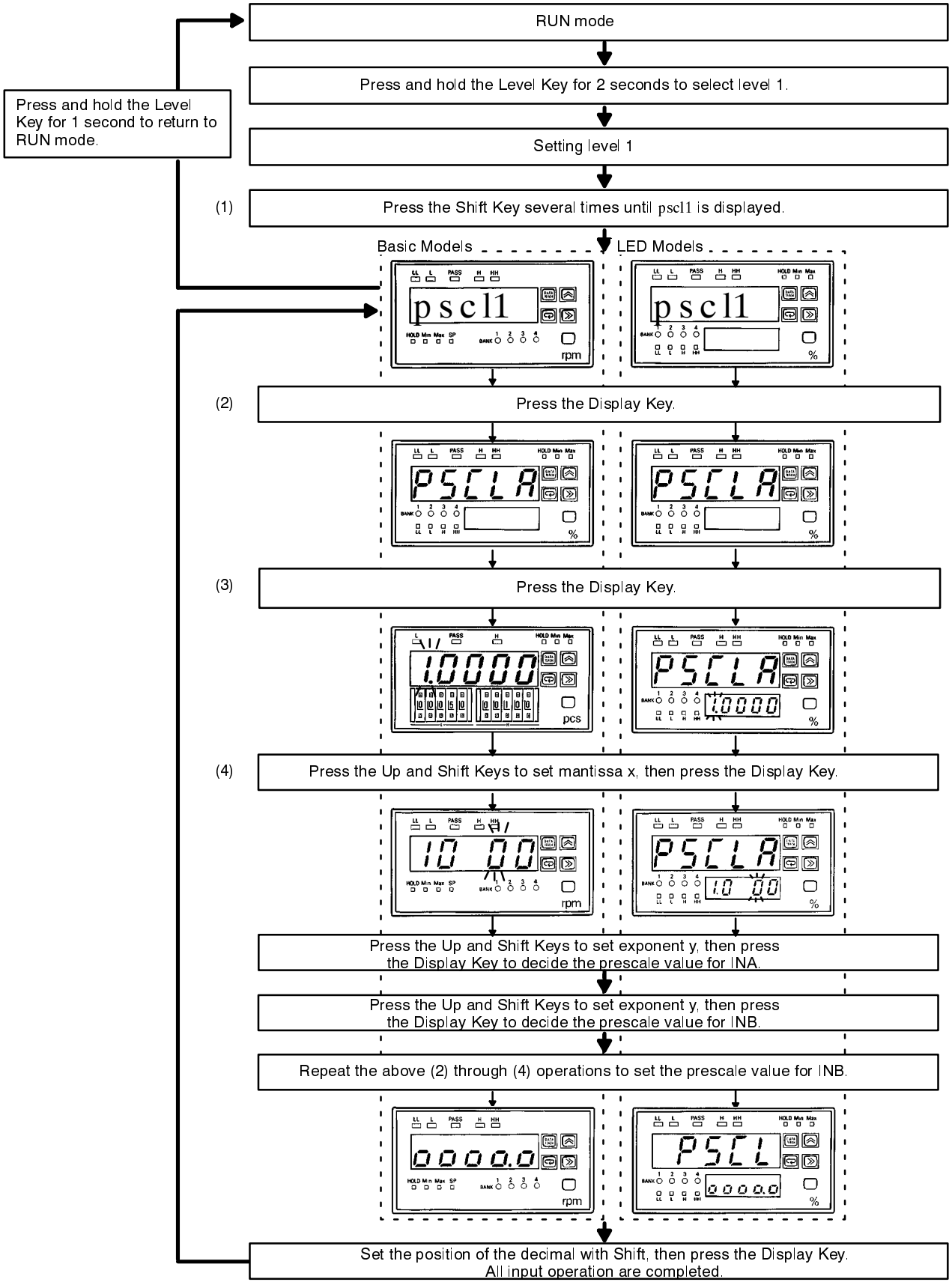
Prescaling

To display rotational speeds, circumferential speeds, or other values based on input pulse calculations, the rotational speed must be multiplied by a factor input before the input pulses are measured. This factor is called a prescale value.

Prescale Value Example

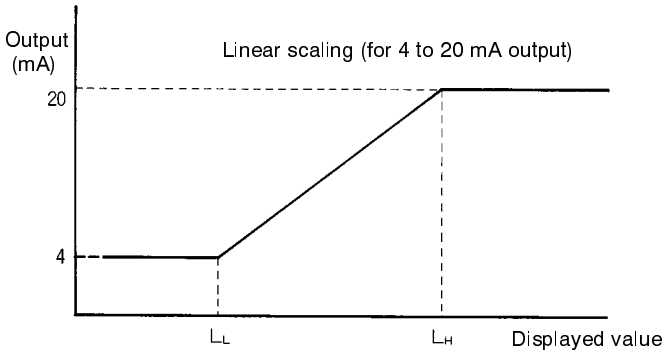


rpm = f x 60 x α
Where,
f: Input pulse frequency (p/s)
α: Prescale value
If there are 5 pulses per rotation, then an accurate rotational speed can be calculated if α = 1/5 (= 0.2 = 2 x 10^{-1}).


RUN mode
Press and hold the Level Key for 2 seconds to select level 1.
Press and hold the Level Key for 1 second to return to RUN mode.
Setting level 1
(1)
Press the Shift Key several times until pscl1 is displayed.
Basic Models
LED Models
pscl1
rpm
%
(2)
Press the Display Key.
PSCLA
(3)
Press the Display Key.
1.0000
pcs
(4)
Press the Up and Shift Keys to set mantissa x, then press the Display Key.
10 00
Press the Up and Shift Keys to set exponent y, then press the Display Key to decide the prescale value for INA.
Press the Up and Shift Keys to set exponent y, then press the Display Key to decide the prescale value for INB.
Repeat the above (2) through (4) operations to set the prescale value for INB.
0000.0
PSCL
Set the position of the decimal with Shift, then press the Display Key.
All input operation are completed.

6-5-5 Linear Output Range

This setting is only for models with 4 to 20 mA, 1 to 5 V linear output.



The Intelligent Signal Processor outputs a linear voltage or current in proportion to the changes in the measured value. In the example above, a displayed value corresponding to the L_H maximum output value (20 mA or 5 V) and a displayed value corresponding to the L_L minimum output value (4 mA or 1 V) is set. This function is not provided on the 1 mV/10-digit output type.

Do not set $L_L = L_H$; otherwise, it is assumed that L_L + 1 digit = L_H.

The Intelligent Signal Processor in operating modes 6 through 12, unlike operating modes 1 though 5, or 13, is not in sequential measurement operation. Therefore, the Intelligent Signal Processor in operating modes 6 through 12 refreshes the linear output whenever the Intelligent Signal Processor processes the present value.

The decimal is displayed at the position set in the prescale parameter. Note that neither L_H nor L_L shift if the position of the decimal is changed after L_H and L_L have been set.

Setting L_H –> Changing decimal position – > L_H
0100.0 %%%.%.% 010.00

Do not set L_L and L_H to the same value.

In order to set the linear output range, follow the instructions outlined in the flow diagram and operate the Intelligent Signal Processor as follows:

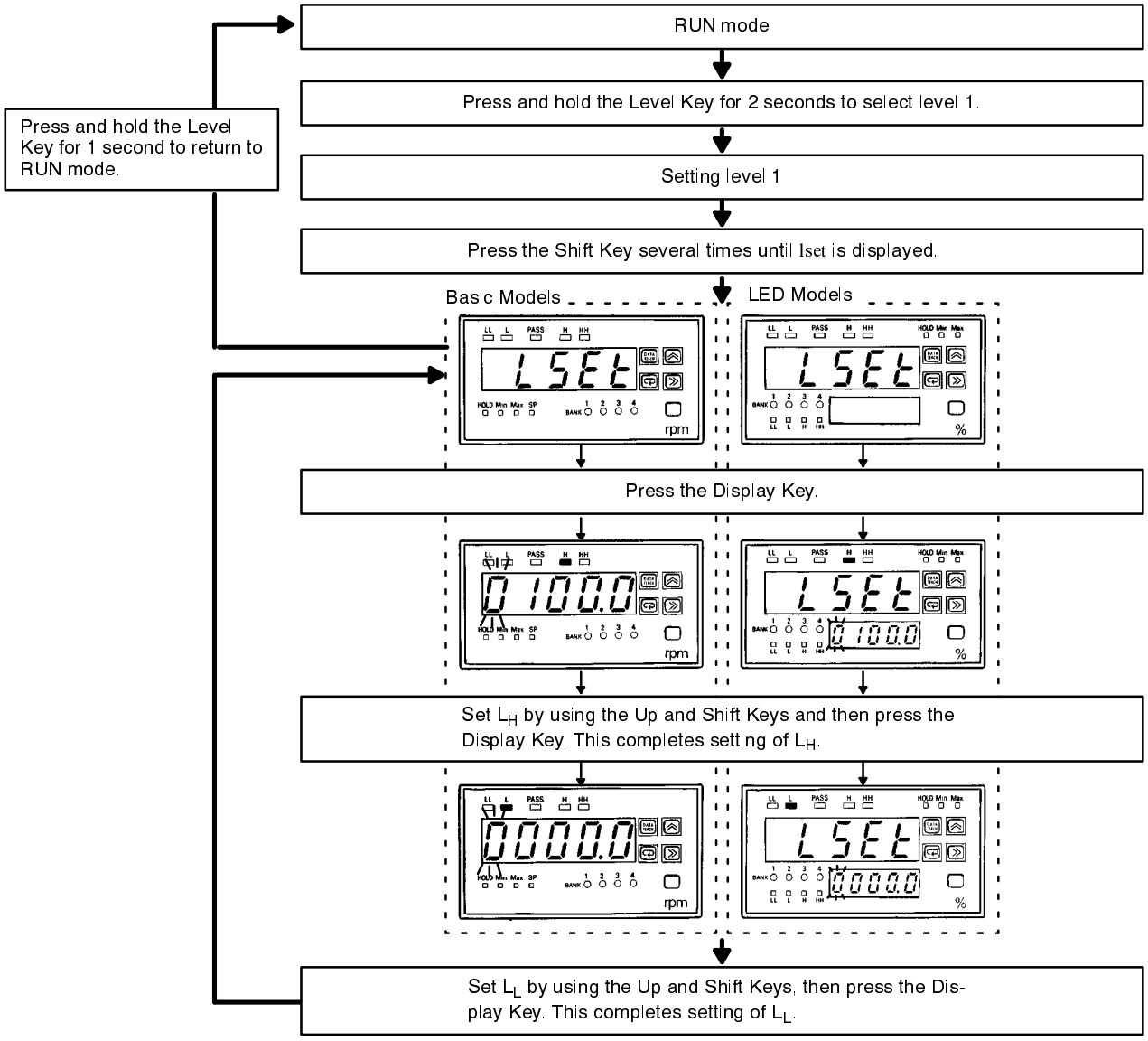
Example:

L_H	Decimal point set by prescaling	Output result
01000	%%%%.%	Outputs 20 mA for an indication of 100.0.

Decimal point position changes.

01000	%%%.%.%	Outputs 20 mA for an indication of 10.00.

Note No linear output range can be set with 1 mV/10-digit Output Models. However, regardless of the position of the decimal, 0.1 mVDC is output per digit displayed. (For example, if the displayed value is 150.00, the output is 1500.0 mV.) A linear output range cannot be set with Thumbwheel Switches Models.

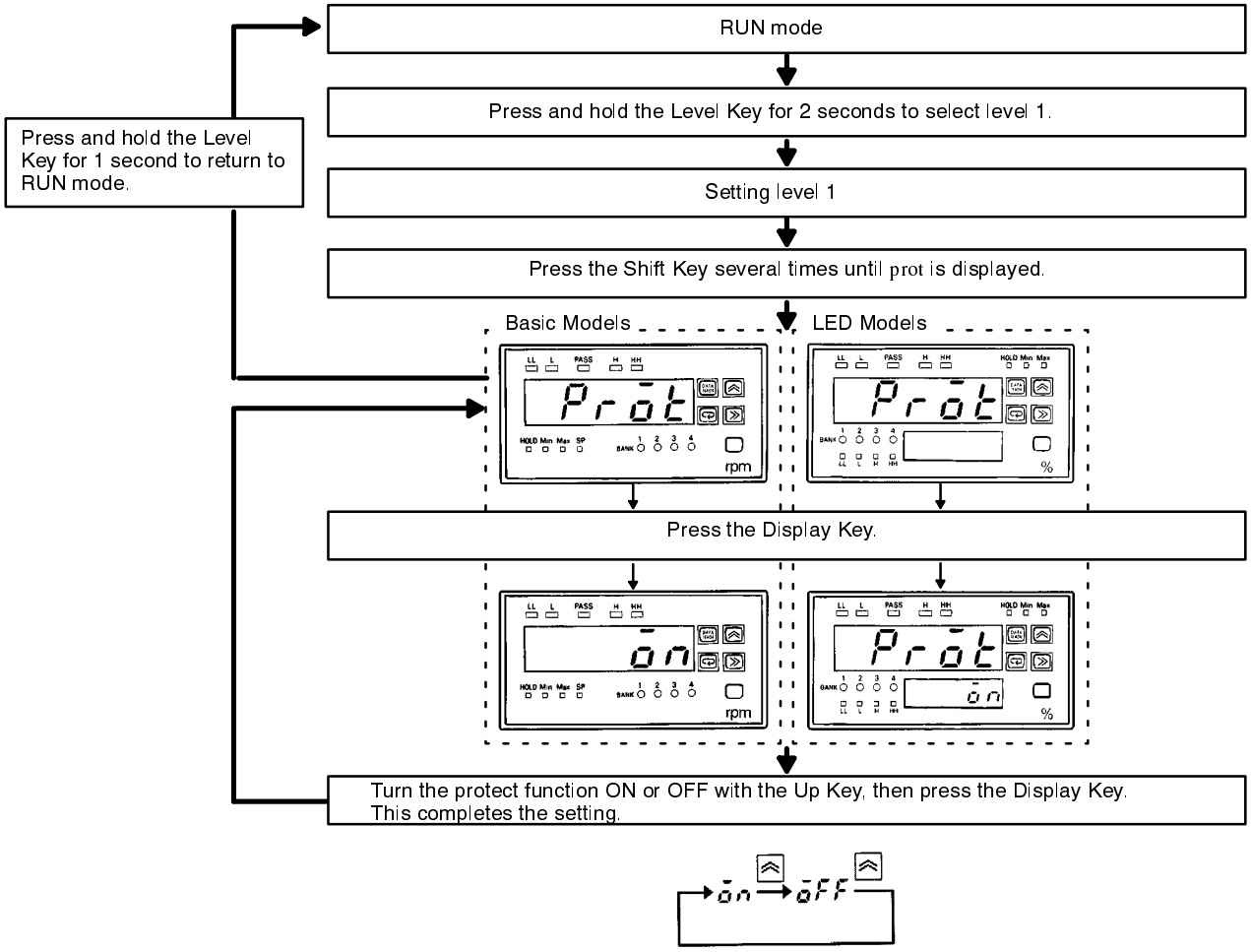

RUN mode
Press and hold the Level Key for 2 seconds to select level 1.
Press and hold the Level Key for 1 second to return to RUN mode.
Setting level 1
Press the Shift Key several times until Iset is displayed.
Basic Models
LED Models
Press the Display Key.
Set L_H by using the Up and Shift Keys and then press the Display Key. This completes setting of L_H.
Set L_L by using the Up and Shift Keys, then press the Display Key. This completes setting of L_L.

6-5-6 Protecting Set Values

With the Basic, LED, and Thumbwheel Switches Models, the set values can be changed in RUN mode. However, this feature can be disabled to protect the set values.

In order to protect set values, follow the instructions outlined in the flow diagram (after the table) and operate using one of two settings:

Setting	Display
Protect ON	on
Protect OFF	off



Note The Thumbwheel Switches Models are not provided with the protection function; therefore, no protect parameter will be displayed.

6-6 Operations

In order to perform operations in RUN mode and other special functions, graphs and flow diagrams are given as explanations.

6-6-1 Operations in RUN Mode

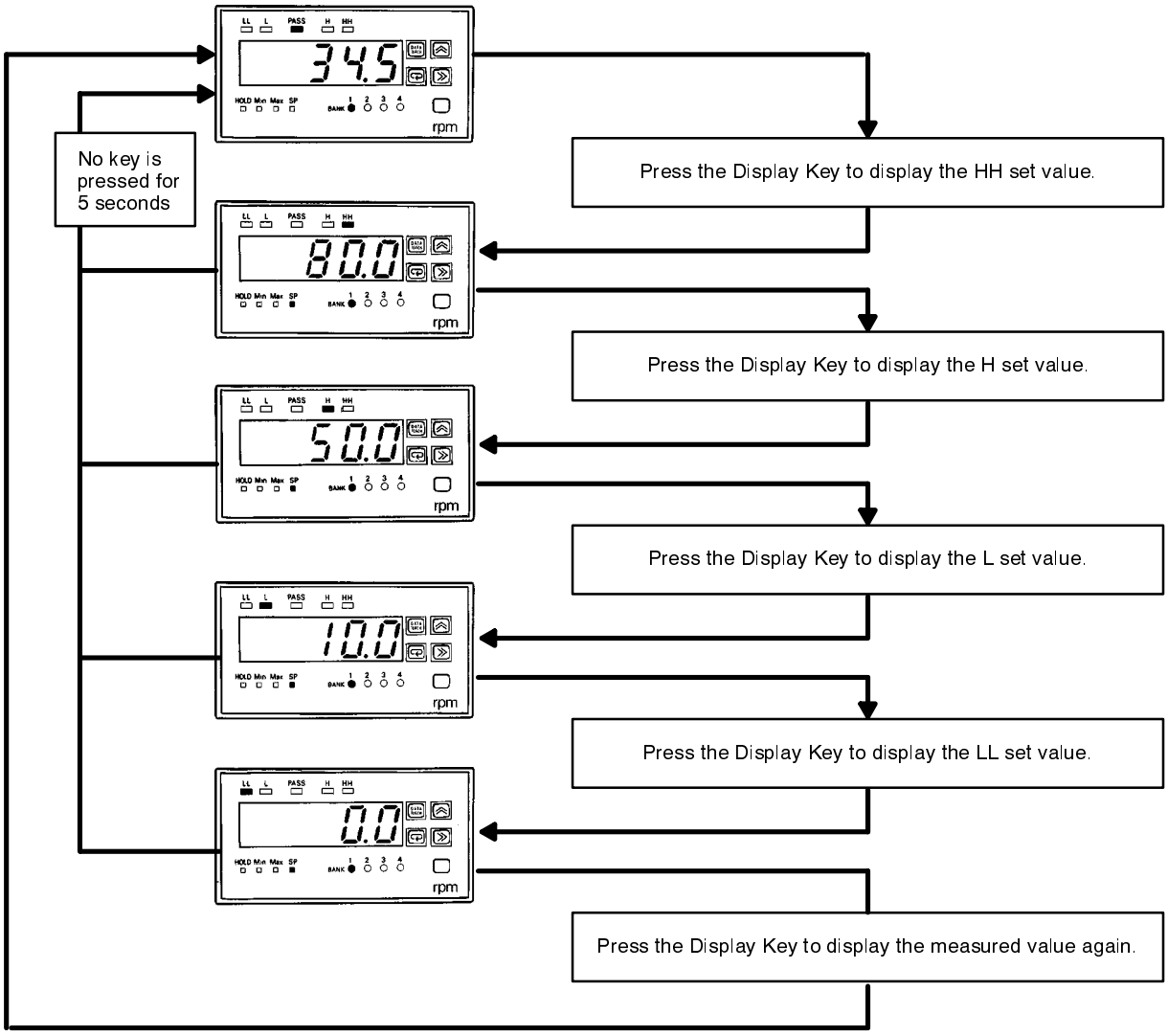
Checking Set Values

The Intelligent Signal Processor allows set values to be checked even in RUN mode. The set values or prescale values of the bank selected can be checked. Thumbwheel Switches Models always display the set value of H and L.

Basic Models

If no key is pressed for 5 seconds, the current measured value will be displayed. On models provided with only H and L comparative output status indicators, the set values HH and LL cannot be displayed.

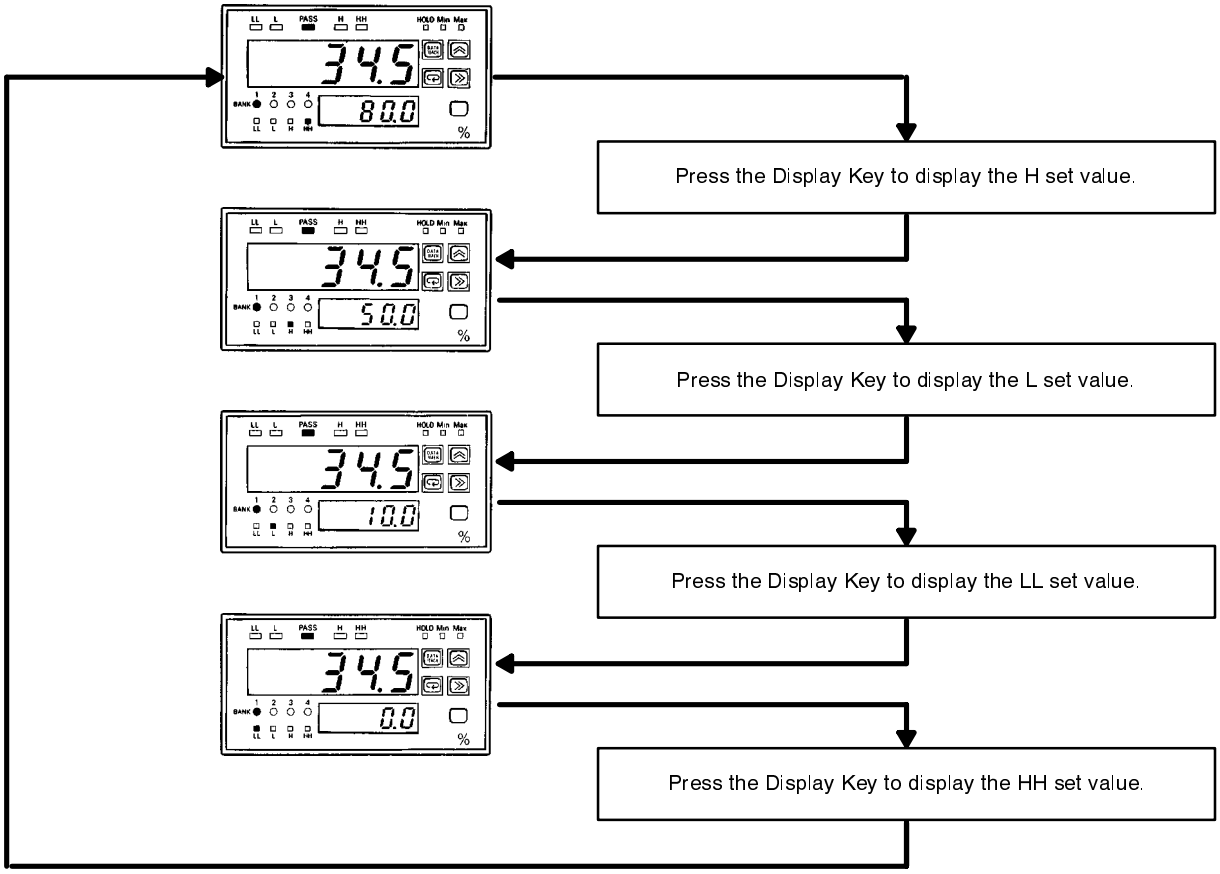
In order to check the set values on the Basic Models, follow the instructions outlined in the flow diagram:



Set Value LED Display Models

Of the four set values LL, HH, L, and H, one set value is always displayed on the SV display.

In order to check the set values on the LED Models, follow the instructions outlined in the flow diagram:



Thumbwheel Switches Models

On the Thumbwheel Switches Models, set values H and L are always displayed.

Changing Set Values

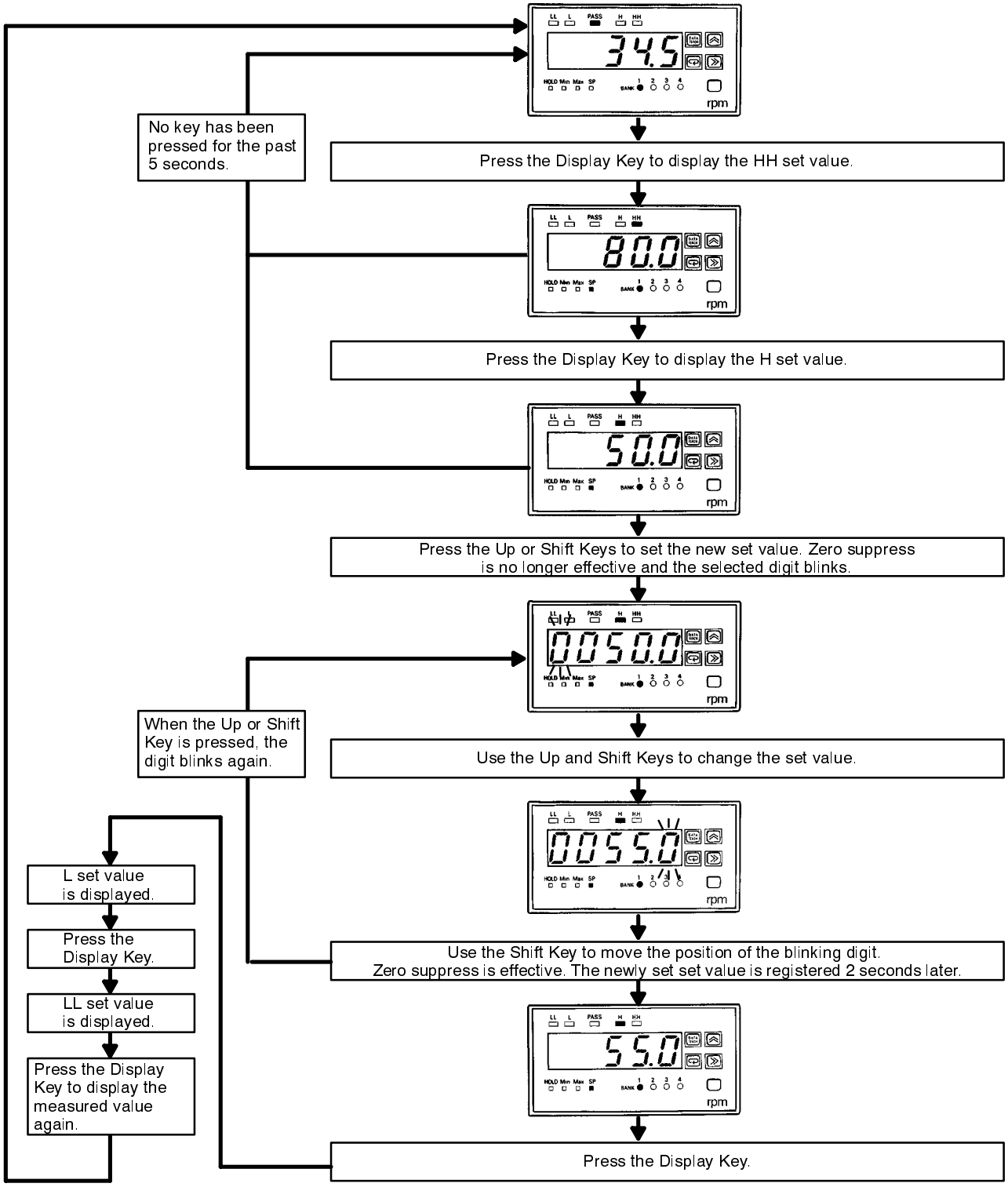
Set values can be changed even in RUN mode.

Only the set values of the bank presently selected can be changed.

Basic Models

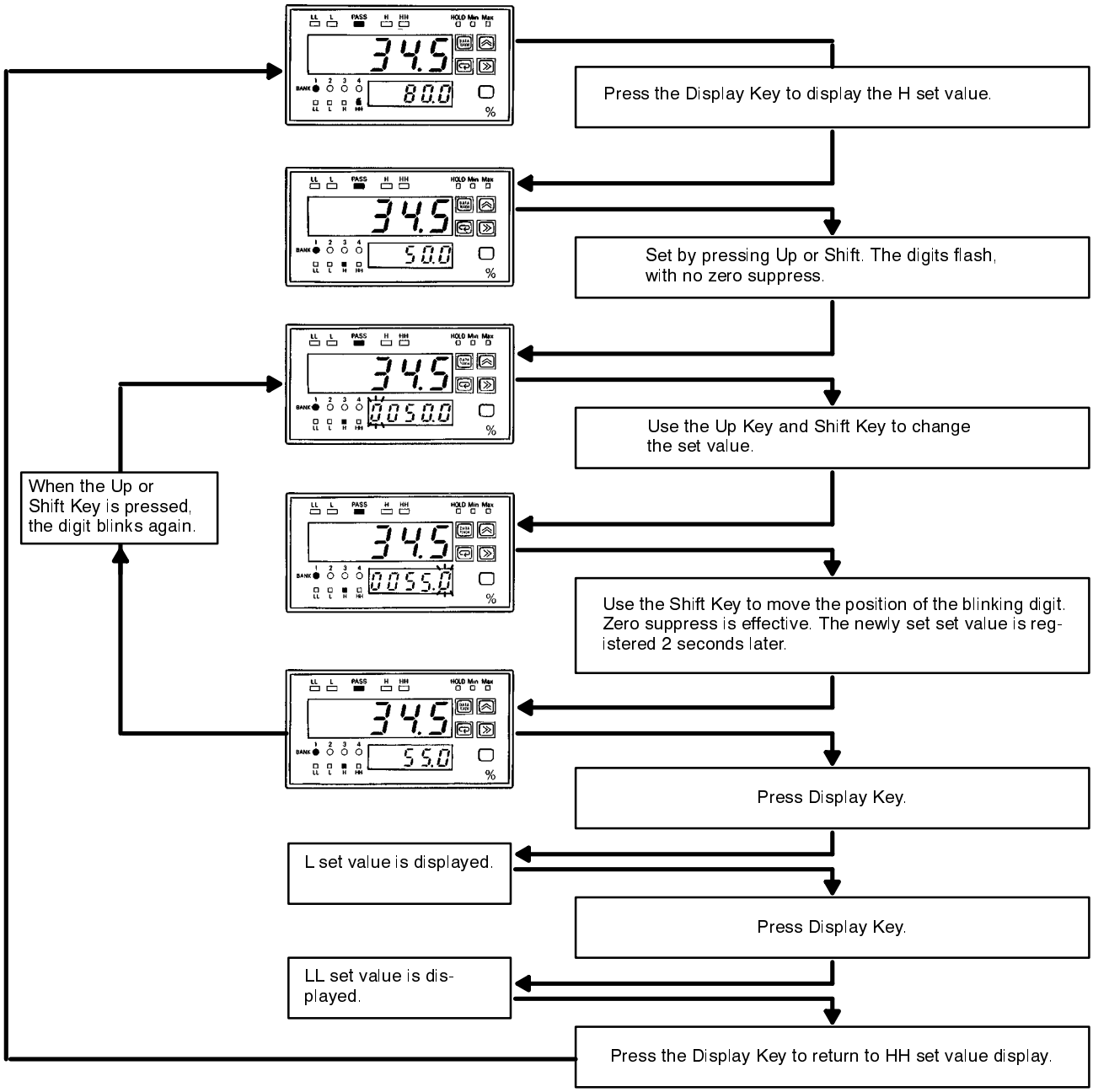
On models provided with only the H and L comparative output status indicators, the set values HH and LL are not displayed.

In order to change the set values on the Basic Models, follow the instructions outlined in the flow diagram, which shows how to change set value H from 50.0 to 55.0:


No key has been pressed for the past 5 seconds.
Press the Display Key to display the HH set value.
Press the Display Key to display the H set value.
Press the Up or Shift Keys to set the new set value. Zero suppress is no longer effective and the selected digit blinks.
When the Up or Shift Key is pressed, the digit blinks again.
Use the Up and Shift Keys to change the set value.
Use the Shift Key to move the position of the blinking digit.
Zero suppress is effective. The newly set set value is registered 2 seconds later.
Press the Display Key.
L set value is displayed.
Press the Display Key.
LL set value is displayed.
Press the Display Key to display the measured value again.

Set Value LED Display Models

In order to change the set values on the Basic Models, follow the instructions outlined on the flow diagram, which shows how to change set value H from 50.0 to 55.0:



Thumbwheel Switches Model

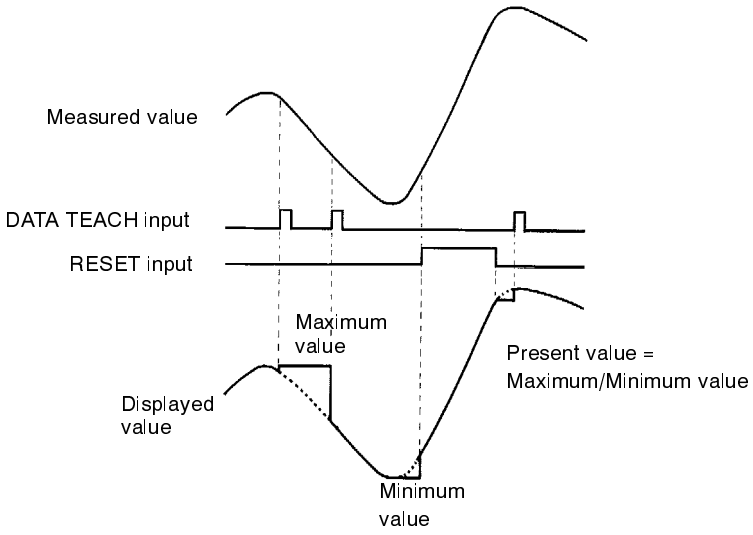
With the Thumbwheel Switches Models, set values can be changed at any time with the thumbwheel switches. The set values are registered 1.5 seconds after the values have been set with the thumbwheel switches and the Intelligent Signal Processor operates according to the new set values.

Retaining, Resetting Maximum/Minimum Values

The operation method varies with the selected operating mode.
All the outputs will be output according to the measured value, regardless of the display.

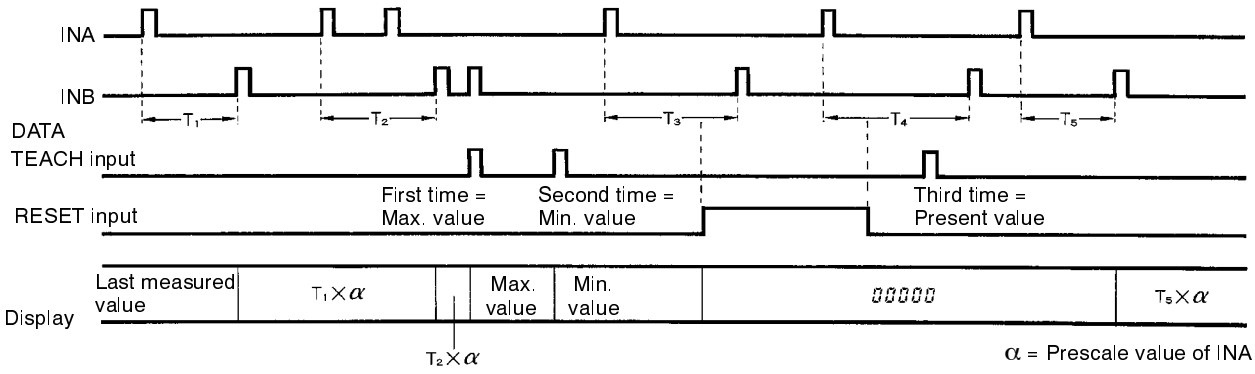
If One of the Operating Modes, 1 through 5 or 13, is Selected:

The maximum displayed (measured) value and the minimum displayed (measured) value measured since power application or RESET signal input up to the present point. Each time the DATA TEACH Key is pressed, the maximum value, minimum value, and process value will be displayed in sequence on the PV display in this order. When the RESET input turns ON, both the maximum and minimum values are reset to present value.



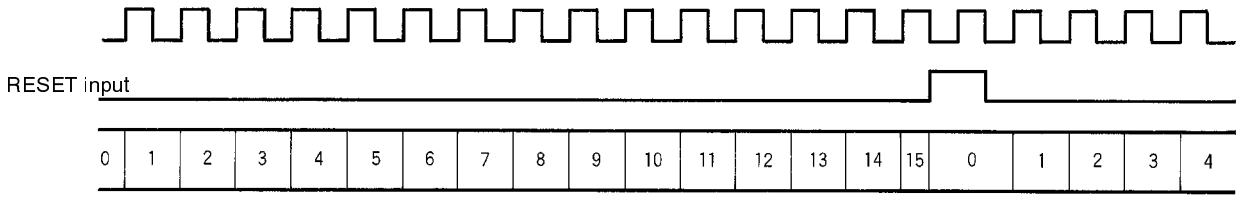
If One of the Operating Modes, 6 to 11, is Selected (In the Following Example, 8 is Selected):

The maximum and minimum values measured since power application or RESET signal input up to the present point will be retained.
Each time the DATA TEACH Key is pressed, the maximum value, minimum value, and present value will be displayed in sequence on the PV display in this order.
When the RESET input turns ON, both the maximum and minimum values will be reset to 0. These values cannot be displayed with the DATA TEACH Key until the next measurement operation starts after the RESET input is OFF.
When the next operation starts after the RESET input is OFF, a new maximum and minimum value will be retained in memory and the DATA TEACH Key will be effective.

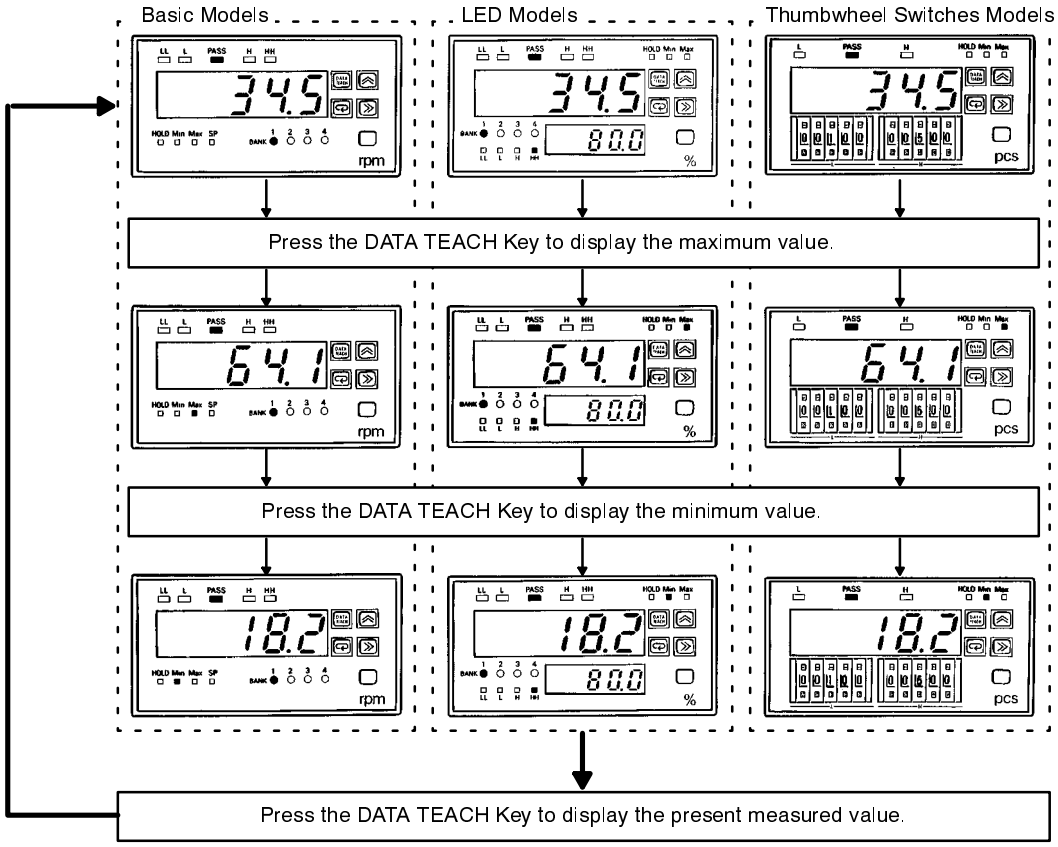


Selection of Operating Mode 12:

Maximum and minimum values cannot be retained. The DATA TEACH Key is not effective. The RESET input resets the accumulated value.



The following diagram illustrates the retained maximum/minimum value (operating mode 1, with a maximum value of 64.1 and a minimum value of 18.2):



Hold Measured Value

HOLD operations vary with the selected operating mode. Refer to the explanation of each operating mode in detail in *3-1 Inputs* or *6-2 Parameter Setting.*

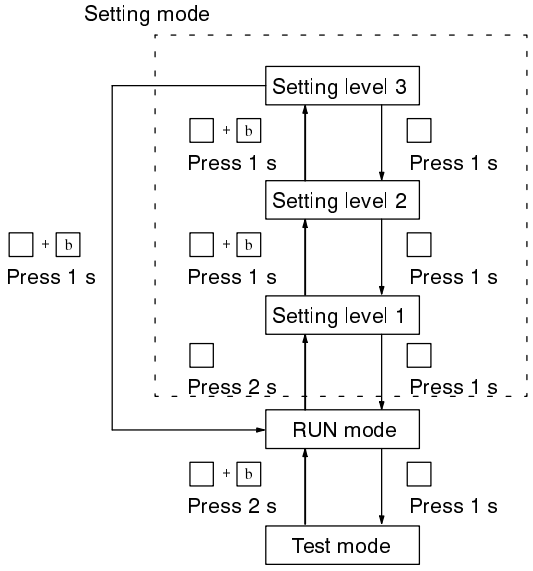
Note If you change set values while the K3TR is holding the measured value, the comparative outputs will change according to the new set value. If power is switched ON while the HOLD input is ON, the K3TR holds 0 as the input value. 0 is displayed in this case. Make sure the HOLD input is OFF before applying power.

6-6-2 Special Functions

The K3TR Intelligent Signal Processor is provided with two special functions: test mode and teaching function.

1. Test mode: This function is convenient for checking a system to which the Intelligent Signal Processor is connected, especially when some inputs cannot be operated. The Intelligent Signal Processor simulates the input to change the display and output conditions.
2. Teaching function: This function allows the measured values to be retrieved and set as set values or prescale values while actual measurement is being carried out. This function is useful for setting parameters while checking the operating status of the Intelligent Signal Processor.

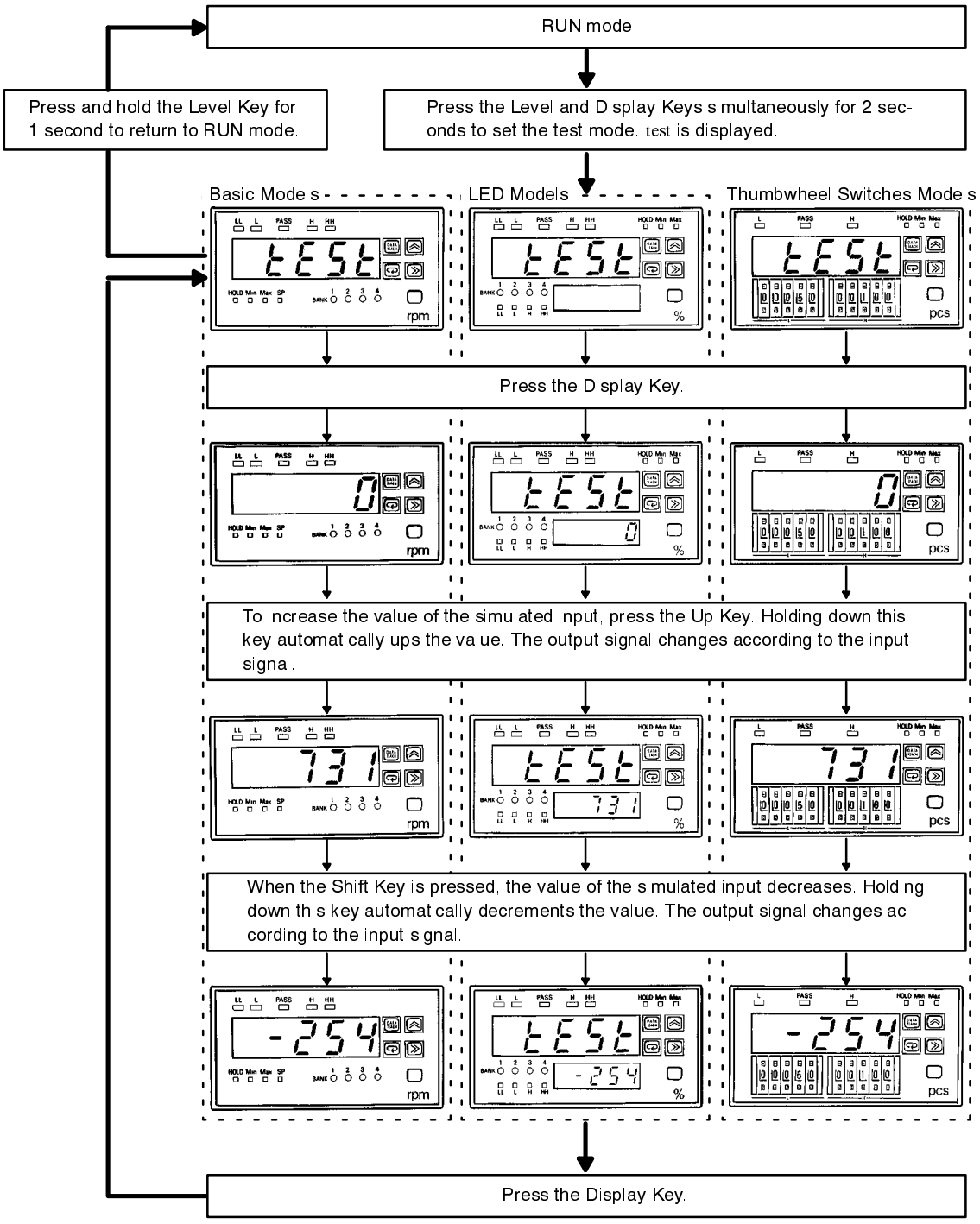
   The prescale value can be automatically calculated by setting the desired display value such as rotational value, circumferential speed, etc., after simulating input.



Test Mode

The Intelligent Signal Processor is provided with a test mode in which simulated signals can be input. When a simulated input signal is applied, an actual corresponding output signal is issued. Confirm the status of the equipment connected to the output side of the Intelligent Signal Processor.

In order to perform this operation, follow the instructions outlined in the flow diagram:



Teaching Function

The Intelligent Signal Processor is provided with a teaching function that can set an actual measured value as a set value, a prescale value, or linear output range. This function cannot be used in the following cases.

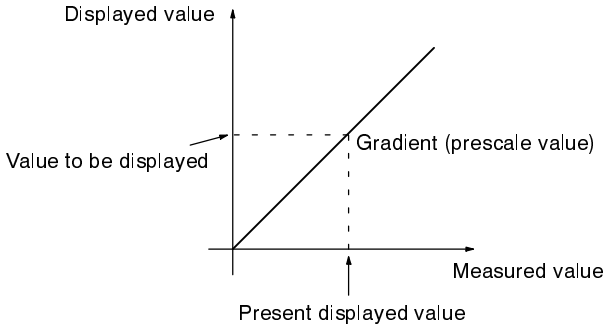
- The Thumbwheel Switches Models in linear output range or set value setting operation.
- The Intelligent Signal processor is in operating mode 6, 7, 8, 9, 10, 11, or 12

Prescale Value Setting with Teaching Function

The Intelligent Signal Processor is provided with a teaching function that can set an actual measured value as a prescale value. To perform this operation, follow the instructions outlined in the following diagram.

The prescale value will be automatically calculated by setting the present value displayed by the DATA TEACH Key to an appropriate value. If the Intelligent Signal Processor has two inputs, prescale values A and B must be calculated.

Example: Setting the Prescale Value and Linear Output Range when the Intelligent Signal Processor is in Operating Mode 1



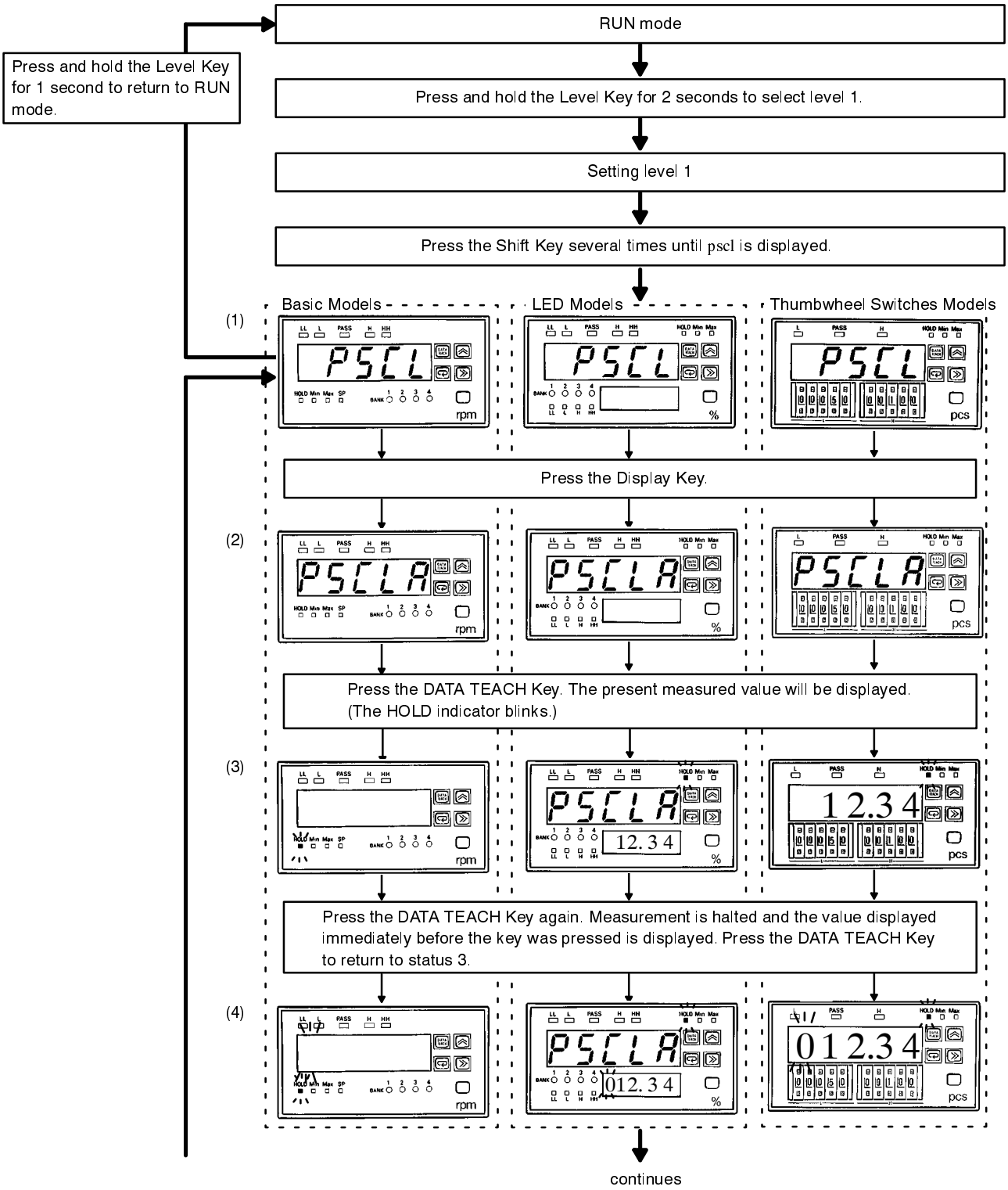
If the displayed value overflows or the displayed value flashes when the DATA TEACH Key is pressed, change the prescale value into a value that can be displayed, and then repeat the above operation.
If zero is displayed when the DATA TEACH Key is pressed, the present measured value will be regarded as 1.

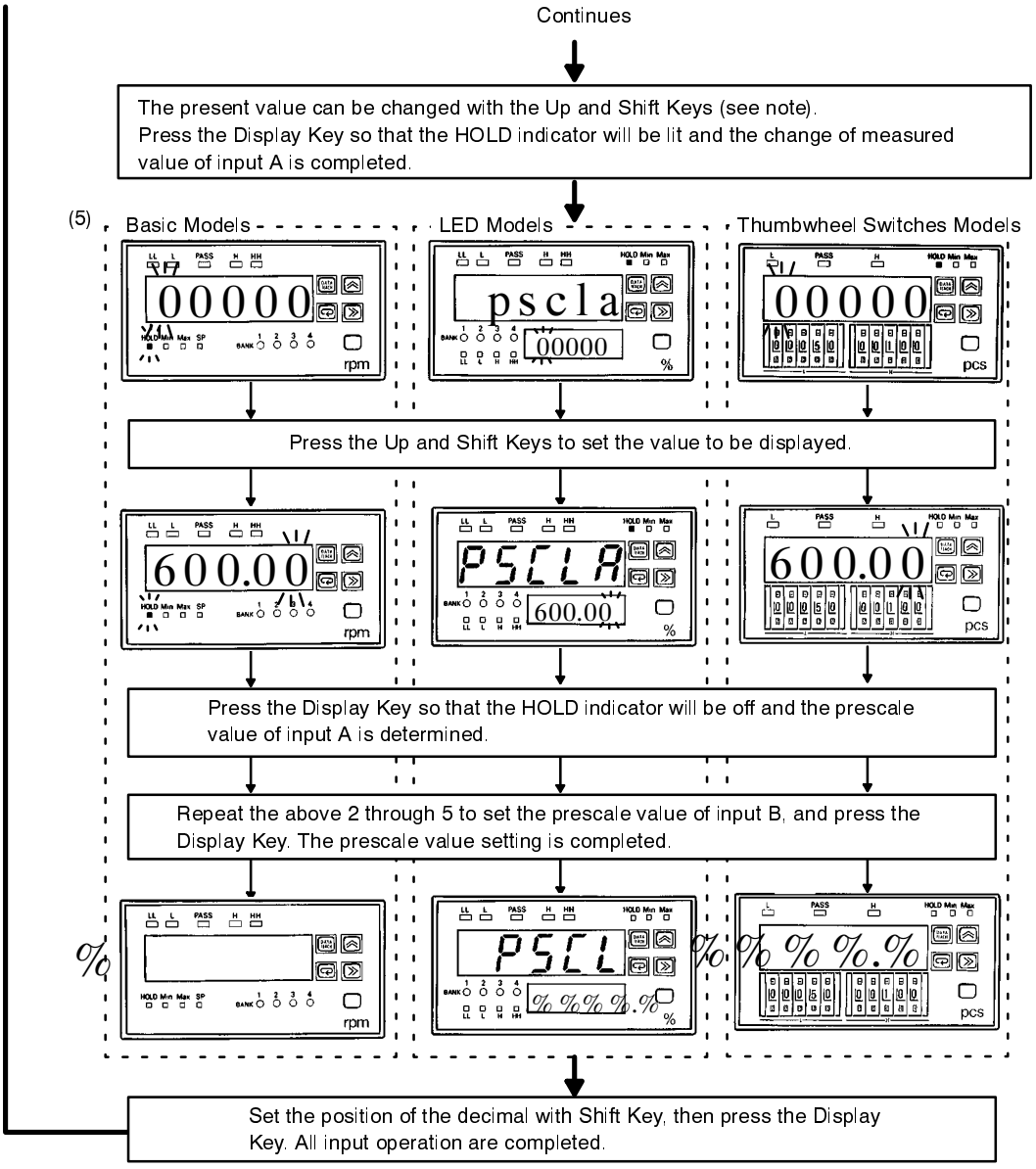
The following diagram shows how to change prescale A (i.e., 12.34) into 600.0 and prescale B (i.e., 37.92) to 600.0 using the teaching function when the Intelligent Signal Processor is in operating mode 4.

In this example, the prescale banks are OFF.

Indicators during Prescale Teaching

- The HOLD indicator is flashing and the present value is displayed during the teaching operation.
- The HOLD indicator is lit during appropriate value setting.
- The HOLD indicator turns off when the prescale teaching is complete.


RUN mode
Press and hold the Level Key for 2 seconds to select level 1.
Setting level 1
Press the Shift Key several times until pscl is displayed.
Press and hold the Level Key for 1 second to return to RUN mode.
Basic Models
LED Models
Thumbwheel Switches Models
(1)
PSCL
rpm
%
pcs
Press the Display Key.
(2)
PSCLA
Press the DATA TEACH Key. The present measured value will be displayed. (The HOLD indicator blinks.)
(3)
12.34
Press the DATA TEACH Key again. Measurement is halted and the value displayed immediately before the key was pressed is displayed. Press the DATA TEACH Key to return to status 3.
(4)
012.34
continues



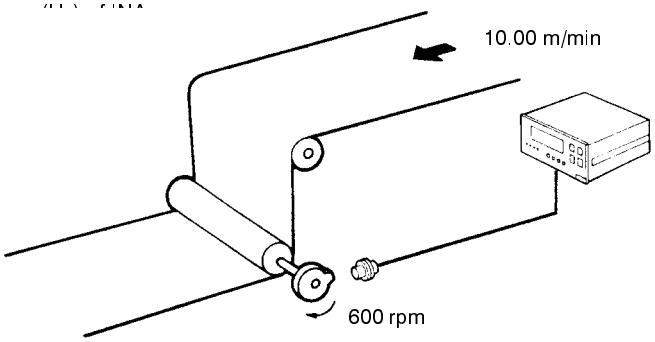
The teaching function is not available when the Intelligent Signal Processor is in operating modes 6 through 12.

Note By using the teaching function, the prescale value can be set even when some inputs cannot be operated (i.e., the Intelligent Signal Processor is in test mode). Refer to the following page.

Application Example

In this example, the Intelligent Signal Processor is set to operating mode 1, in which the Intelligent Signal Processor can measure revolutions or rotational speeds, with the prescale value set to 1 (i.e., 1.0000 x 10^0 rpm) to display 10.00 m per minute with an input of 600 rpm. (The prescale value is factory-set to 1.)

D (value to be displayed) = f x 60 x α
f: Input freque
α: Prescale v



In step 4 on page 118, use the Up and Shift Keys to select 600 and press the Display Key.

Use the Up and Shift Key to select 10 next and press the Display Key.

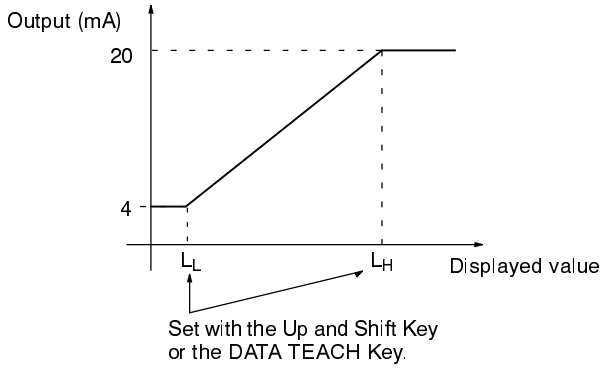
Locate the decimal point %%%.%% and press the Display Key to complete the prescale value so that 10.00 will be displayed.

Actual prescale value α will be set to 1.67667 x 10^{-2}.

Linear Output Range with Teaching Function

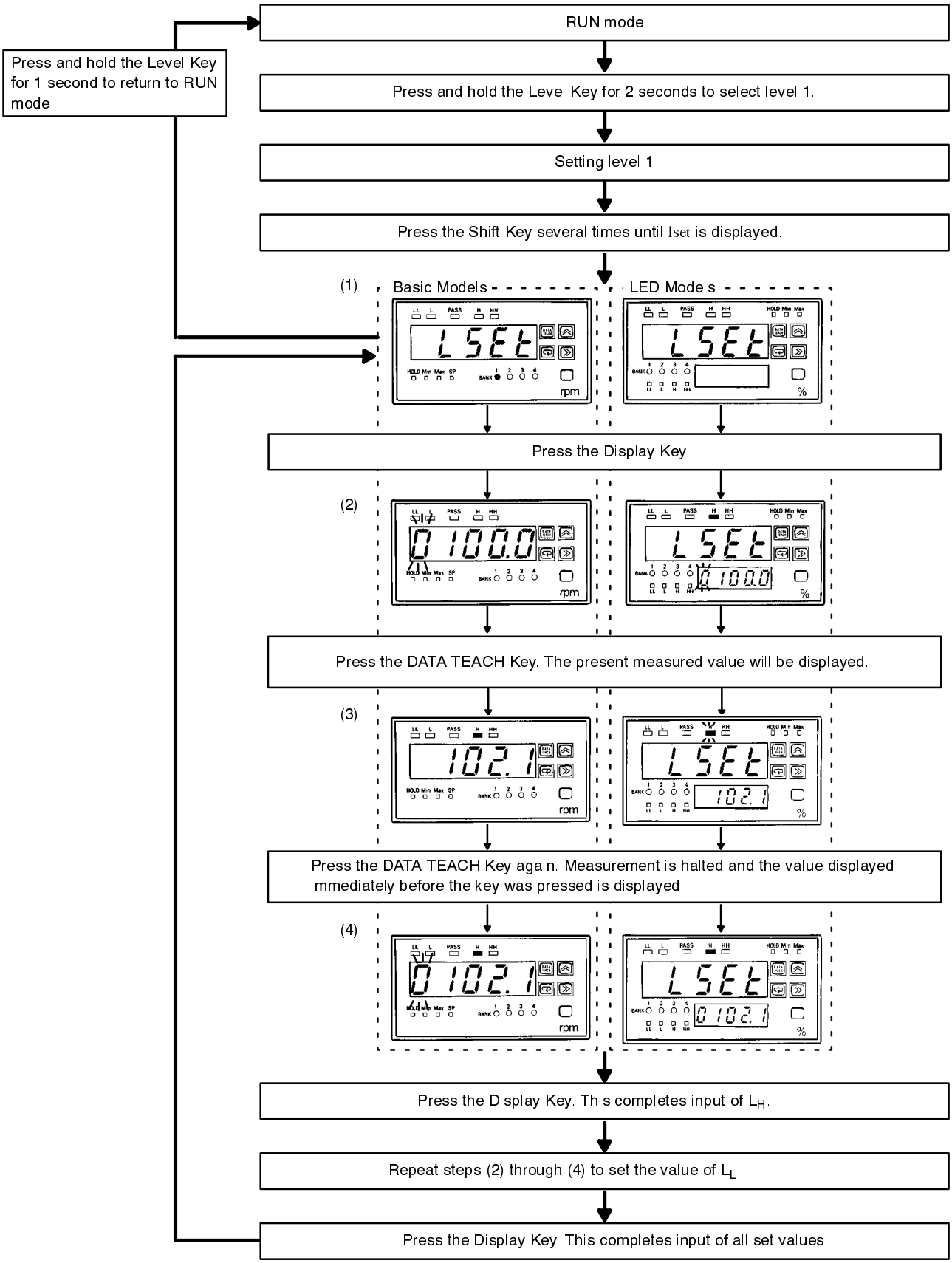
The Intelligent Signal Processor is provided with a teaching function that can set an actual measured value as a set value. To perform this operation, follow the instructions outlined in the following diagram.

When setting the linear output range values such as L_L and L_H, press the DATA TEACH Key to use the appropriate actual measured values as upper- and lower-limit linear output range values.



In this example, L_H is changed from 100.0 into 102.1 with the teaching function.

Note The Thumbwheel Switches Models are not provided with this function.

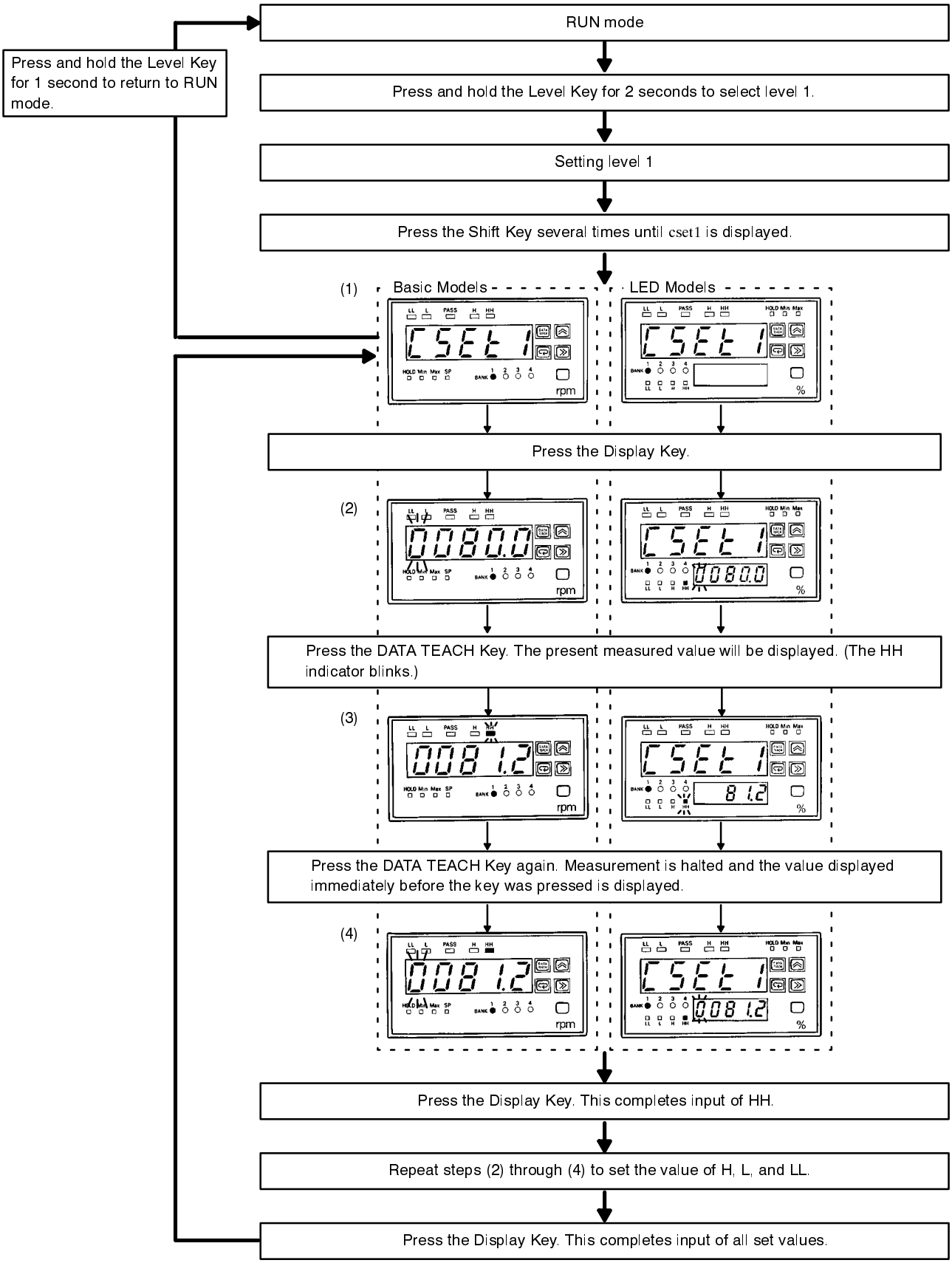

RUN mode
Press and hold the Level Key for 2 seconds to select level 1.
Setting level 1
Press the Shift Key several times until Iset is displayed.
(1)
Basic Models
LED Models
Press the Display Key.
(2)
Press the DATA TEACH Key. The present measured value will be displayed.
(3)
Press the DATA TEACH Key again. Measurement is halted and the value displayed immediately before the key was pressed is displayed.
(4)
Press the Display Key. This completes input of L_H.
Repeat steps (2) through (4) to set the value of L_L.
Press the Display Key. This completes input of all set values.
Press and hold the Level Key for 1 second to return to RUN mode.

Set Value with Teaching Function

The Intelligent Signal Processor is provided with a teaching function that can set an actual measured value as a set value. To perform this operation, follow the instructions outlined in the following diagram.

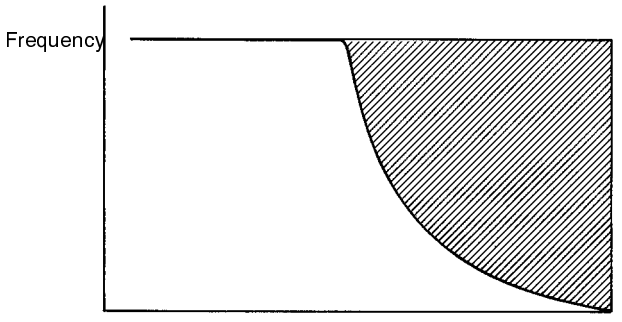
In this example, the HH set value is changed from 80.0 to 81.2 with the teaching function.

Note The Thumbwheel Switches Models are not provided with this function.


RUN mode
Press and hold the Level Key for 1 second to return to RUN mode.
Press and hold the Level Key for 2 seconds to select level 1.
Setting level 1
Press the Shift Key several times until cset1 is displayed.
(1)
Basic Models
LED Models
Press the Display Key.
(2)
Press the DATA TEACH Key. The present measured value will be displayed. (The HH indicator blinks.)
(3)
Press the DATA TEACH Key again. Measurement is halted and the value displayed immediately before the key was pressed is displayed.
(4)
Press the Display Key. This completes input of HH.
Repeat steps (2) through (4) to set the value of H, L, and LL.
Press the Display Key. This completes input of all set values.

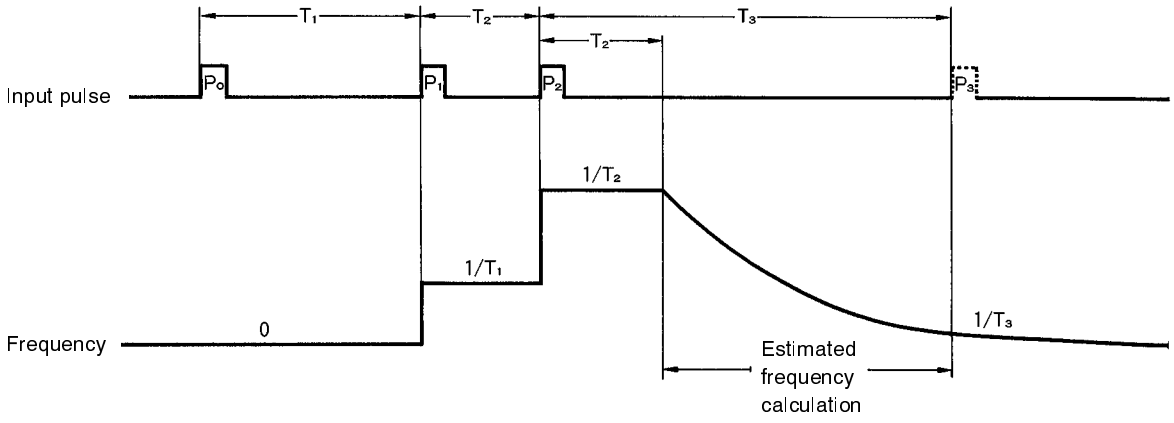
6-7 Estimated Frequency Calculation

If input pulses are suddenly interrupted, the estimated frequency calculation function continuously estimates the frequency in preparation for the next pulse that may occur. This function ensures improved response to any pulse occurring within the time period represented by the shaded area of the accompanying graph.



Estimated frequency calculation

Estimated frequency calculation graph:



The input frequency cannot be calculated with pulse P0 only. Therefore, the result remains 0. With pulse P1, T1 (from P0 to P1) is measured as one cycle, and the input frequency is calculated from 1/T1. With pulse P2, if T1 is larger than T2 (if the input frequency increases, i.e. the cycle is shorter), 1/T2 is adopted as the input frequency at that moment. If no pulse is detected for the T2 period after P2, the new input frequency cannot be known until the next pulse is detected. The estimated value is 1/T3 if no pulse is detected for period T3. If P3 is detected at that time, the input frequency then is 1/T3. Therefore the K3TR produces a fast and accurate response as a result of its estimate. It is better to estimate the input frequency than to keep the frequency, 1/T2, until pulse P3 is actually detected. With this function, the K3TR can react to sudden changes in the input frequency.

SECTION 7
Troubleshooting

If an error message appears while using the K3TR Intelligent Signal Processor, the problem may originate from either the incorrect use of the Intelligent Signal Processor or from external sources such as a faulty sensor. This troubleshooting section suggests some possible sources of error and the corrective actions to be taken.

Troubleshooting Guide

The following table shows possible errors during the K3TR Intelligent Signal Processor operation and corrective actions to be taken.

Item	Condition	Error message	Output status				Corrective action
			Comparative outputs	BCD output	Linear output	Communications	
Device failure	Memory data error, EEPROM error.	error	OFF	OFF (All outputs are H.)	OFF (Minimum value) (see note)	OFF (An error response will be returned.)	Turn the power OFF and then ON again once. If the error persists, repairs are necessary.
	Corrupted data.	err–s	OFF	OFF (All outputs are H.)	OFF (Minimum value) (see note)	OFF (An error response will be returned.)	Turn the power OFF and then ON again once. If the error persists, press the Display Key and set all parameters again.
Overflow, underflow	Input value or display value outside range.	***** Blinks	Continues	Continues OVER ON	Continues	Continues OVER ON	Keep the input value and display value within the range.
Output type change	When output type has changed.	chg–o	OFF	OFF (All outputs are H.)	OFF (Minimum value) (see note)	OFF (An error response will be returned.)	Check the output board. If correct, press the Display Key. At this time, the parameters are initialized; therefore, set the parameters again.
Output type error	Output type other than specified.	err–o	OFF	OFF (All outputs are H.)	OFF (Minimum value) (see note)	OFF (An error response will be returned.)	Turn the power OFF and then ON again once. If the error persists, repairs are necessary.

Note 0 V for 1 mV/10-digit output board.

Appendix A
Standard Models

The K3TR Intelligent Signal Processor is suited to essentially any application. The following lists the standard models available:

K3TR - □ □ □ □ □ **-** □ □
1 2 3 4 5 6 7

1, 2: Input Sensors Codes
NB: NPN inputs
PB: PNP inputs

3: Series number
1: Current series

4: Power supply voltage
1: 100 to 240 VAC
2: 12 to 24 VDC

5: Type of display
A: Basic
C: Set value LED display
D: Thumbwheel switches

6, 7: Output Type Codes

C1: 3 comparative relay contact outputs (H, PASS, L: SPDT)
C2: 5 comparative relay contact outputs (HH, H, L, LL: SPST-NO; PASS: SPDT)
C5: 5 comparative relay contact outputs (HH, H, L, LL: SPST-NC; PASS: SPDT)
T1: 5 comparative transistor outputs (NPN open collector)*
T2: 5 comparative transistor outputs (PNP open collector)*
B2: BCD output (NPN open collector)**
B4: BCD output + 5 transistor outputs (NPN open collector)* (special specifications)
L1: Linear output (4 to 20 mA)**
L2: Linear output (1 to 5 VDC)**
L3: Linear output (1 mV/10 digits)**
L4: Linear output, 4 to 20 mA + 5 transistor outputs (NPN open collector) (special specifications)
L5: Linear output, 1 to 5 V + 5 transistor outputs (NPN open collector) (special specifications)
L6: Linear output, 1 mV/10 digits+ 5 transistor outputs (NPN open collector) (special specifications)
L7: 0 to 5 VDC (special specifications)
L8: 0 to 10 VDC (special specifications)
L9: 0 to 5 VDC + 5 transistor outputs (NPN open collector) (special specifications)
L10: 0 to 10 VDC + 5 transistor outputs (NPN open collector) (special specifications)
S1: Communication RS-232C**
S2: Communication RS-485**
S3: Communication RS-422**
S5: RS-485 + 5 transistor outputs (NPN open collector) (special specifications)
S6: RS-422 + 5 transistor outputs (NPN open collector) (special specifications)

Note Refer to the *Output Board Combinations* table on page 130 or ask your OMRON representative for details on combining Output Boards.

*Only H, PASS, and L outputs are available as transistor outputs on Thumbwheel Switches Models.
**These output types are available on Basic Models only.

Base Units

Input type		NPN		PNP	
Supply voltage		100 to 240 VAC	12 to 24 VDC	100 to 240 VAC	12 to 24 VDC
Basic Models These models provide a present value LED and front-panel control keys. Can be connected to any Output Board, or can be used for display only without an Output Board.		K3TR-NB11A	K3TR-NB12A	K3TR-PB11A	K3TR-PB12A
Set Value LED Models These models provide a present value LED, set value LED, and front-panel control keys. Can be connected to Relay, Transistor, or Combination Output Boards.		K3TR-NB11C	K3TR-NB12C	K3TR-PB11C	K3TR-PB12C
Thumbwheel Switches Models These models provide a present value LED, thumbwheel switches for the set value, and front-panel control keys. Can be connected to K31-C1, K31-T1, K31-T2, and K31-B4 Output Boards.		K3TR-NB11D	K3TR-NB12D	K3TR-PB11D	K3TR-PB12D

Available Output Board Combinations

Output type	Output configuration	Output boards	Base units		
			Basic	Set value LED Display	Thumbwheel Switches
Relay contact	3 outputs: H, PASS, L (SPDT)	K31-C1	Yes	Yes	Yes
	5 outputs: HH, H, L, LL (SPST-NO), and PASS (SPDT)	K31-C2	Yes	Yes	---
	5 outputs: HH, H, L, LL (SPST-NC), and PASS (SPDT)	K31-C5	Yes	Yes	---
Transistor	5 outputs (NPN open collector)	K31-T1	Yes	Yes	Yes**
	5 outputs (PNP open collector)	K31-T2	Yes	Yes	Yes**
BCD*	5-digit output (NPN open collector)	K31-B2	Yes	---	---
Linear	4 to 20 mA DC	K31-L1	Yes	---	---
	1 to 5 VDC	K31-L2	Yes	---	---
	1 mV/10 digits	K31-L3	Yes	---	---
	0 to 5 VDC	K31-L7***	Yes	---	---
	0 to 10 VDC	K31-L8***	Yes	---	---
Communication boards*	RS-232C	K31-S1	Yes	---	---
	RS-485	K31-S2	Yes	---	---
	RS-422	K31-S3	Yes	---	---
Combination output and communication boards	BCD output + 5 transistor outputs (NPN open collector)	K31-B4***	Yes	Yes	Yes**
	4 to 20 mA + 5 transistor outputs (NPN open collector)	K31-L4***	Yes	Yes	---
	1 to 5 V + 5 transistor outputs (NPN open collector)	K31-L5***	Yes	Yes	---
	1 mV/10 digits + 5 transistor outputs (NPN open collector)	K31-L6***	Yes	Yes	---
	0 to 5 VDC + 5 transistor outputs (NPN open collector)	K31-L9***	Yes	Yes	---
	0 to 10 VDC + 5 transistor outputs (NPN open collector)	K31-L10***	Yes	Yes	---
	RS-485 + 5 transistor outputs (NPN open collector)	K31-S5***	Yes	Yes	---
	RS-422 + 5 transistor outputs (NPN open collector)	K31-S6***	Yes	Yes	---

*For details, refer to *K3TH/K3TR/K3TX Communication Output-type Intelligent Signal Processor Operation Manual*.
**Only H, PASS, and L outputs are available as transistor outputs on Thumbwheel Switches Models.
*** Special specifications

Appendix B
Sensor Models

The following lists the applicable sensor models that can be used with the K3TR Intelligent Signal Processor along with the K3TR factory-set parameters associated with the use of these sensors.

Applicable Sensors

The following list provides some typical examples of connectable OMRON Sensors. For further details, please refer to the OMRON sensor catalog.

Photoelectric Sensors

D: Directly connectable to up to two inputs.
S: Directly connectable to one input, but a separate power supply is necessary for two inputs.
C: Connectable, but a separate power supply is needed.
N: Not connectable.

Classification		Model	NPN inputs K3TR-NB1□□-□□	PNP inputs K3TR-PB1□□-□□
3-wire DC	NPN	E3X-A/F/VG/H	D	N
		E3S-A/B		
		E3S-CL		
		E3S-LS□C4		
		E3S-LS3C1D		
		E3S-GS/VS		
		E3S-R		
		E3HQ		
		E3HF/HS/HT/HC		
		E3V (see note)		
		E3S-C (see note)		
		E3R (see note)		
		E3L (see note)		
		E3S-X3 (see note)		
		E3X-NT	S	
		E3X-NV/NVG		
		E3C-GE4		
		E3C-WE4		
		E3C-WH4F		
		E3C-JC4P		
		E3S-5E4S-45		
		E3X-NM	N	
	PNP	E3X-A/F	N	D
		E3X-NM/NT		
		E3S-A/B		
		E3S-CL		
		E3S-LS5B4/LS20B4		
		E3S-C (see note)		
		E3V3 (see note)		

Note: A separate power supply is required for two inputs depending on the model.

Proximity Sensors

D: Directly connectable to up to two inputs.
S: Directly connectable to one input, but a separate power supply is necessary for two inputs.
C: Connectable, but a separate power supply is needed.
N: Not connectable.

Classification		Model	NPN inputs K3TR-NB1□□-□□	PNP inputs K3TR-PB1□□-□□
3-wire DC	NPN	E2E-X□E(-P)	D	N
		E2E-□C		
		E2C-GE4		
		E2C-WH4A		
		E2C-JC4A	S	
		E2C-AM4A		
		E2EC	D	
		TL-G3D-3		
		TL-W5E		
		TL-W□MC		
		TL-N□E		
		E2K-F□C		
		E2K-X□E		
		E2EV		
	PNP	E2E-□B	N	D
		E2E-X□F		
		E2F-X□F		
		TL-W□F		
	Amplifier	E2C-GF4	D	D
		E2C-WH4A		
		E2C-AM4A	S	S
2-wire DC	NPN	E2E-XD	N	D
		E2EC-D		

Rotary Encoder (Incremental Type)

D: Directly connectable to up to two inputs.
S: Directly connectable to one input, but a separate power supply is necessary for two inputs.
C: Connectable, but a separate power supply is needed.
N: Not connectable.

Classification		Model	NPN inputs K3TR-NB1□□-□□	PNP inputs K3TR-PB1□□-□□
3-wire DC	NPN	E6H-CWZ1C	C	N
		E6H-CWZ1E		
		E6H-CWZ2C		
		E6A2-CS3C	D	
		E6A2-CW3C		
		E6A2-CWZ3C		
		E6A2-CS5C		
		E6A2-CW5C		
		E6A2-CS3E		
		E6A2-CW3E		
		E6A2-CWZ3E	S	
		E6B2-CWZ6C		
		E6B2-CWZ3E	C	
		E6C-CWZ5C	S	
		E6C-CWZ3E		
		E6D-CWZ2C	C	
		E6D-CWZ1E		

List of Factory-set Parameters

These values are factory-set for temperature sensors.

Setting level	Parameter	Displayed characters			Initial value
Level 1	Set value	cset1 to 4	HH		99999
			H		99999
			L		00000
			LL		00000
	Hysteresis	hys	–––		001
	Prescale bank	ps–bk	–––		off
	Prescale value	pscl or pscl1 to 4	pscla	Mantissa	1.0000
				Exponent	10 00
				Decimal	%%%%%
			psclb	Mantissa	1.0000
				Exponent	10 00
				Decimal	%%%%%
	Linear output range	lset	LH		99999
			LL		–9999
	Set value protect	prot	–––		off
Level 2	Sensor type	in	ina		00
			inb		00
	Auto–zero time	=ero	=eroa	Mantissa	9.9999
				Exponent	10 09
			=erob	Mantissa	9.9999
				Exponent	10 09
	Startup compensation time	stime	–––		0.0
	Display refresh period	disp	–––		fast
	Unit no.	u–no	–––		00
	Baud rate	bps	–––		9600
Level 3	Operating mode	func	–––		01
	Process time for averaging measured values	aUe	–––		fast
	Time unit	time	–––		scal
	Power failure memory	memo	–––		off

Appendix C
Specifications

Specifications and Ratings

The following lists the ratings and characteristics of the K3TR Intelligent Signal Processor:

Ratings

Supply voltage	100 to 240 VAC (50/60 Hz); 12 to 24 VDC
Operating voltage range	85% to 110% of supply voltage
Power consumption (see note)	15 VA max. (max. AC load with all indicators lit) 10 W max. (max. DC load with all indicators lit)
Built-in sensor power supply	80 mA max. at 12 VDC
Insulation resistance	10 MΩ min. (at 500 VDC) between external terminal and case
Dielectric withstand voltage	2,000 VAC min. for 1 min between external terminal and case (Insulation provided between inputs, outputs, and power supply.)
Noise immunity	±1,500 V on power supply terminals in normal or common mode ±1 μs, 100 ns for square-wave noise with 1 ns
Vibration resistance	Malfunction: 10 to 55 Hz, 0.5-mm for 10 min each in X, Y, and Z directions Destruction: 10 to 55 Hz, 0.75-mm for 2 hrs each in X, Y, and Z directions
Shock resistance	Malfunction: 98 m/s^2 (approx. 10G) for 3 times each in X, Y, and Z directions Destruction: 294 m/s^2 (approx. 30G) for 3 times each in X, Y, and Z directions
Ambient temperature	Operating: −10°C to 55°C (with no icing) Storage: −20°C to 65°C (with no icing)
Ambient humidity	Operating: 35% to 85% (with no condensation)
Ambient atmosphere	Must be free of corrosive gas
Approved standards	UL (File No. E4151), CSA (File No. LR67027)
Weight	Approx. 450 g

Note: An Intelligent Signal Processor requires a control power supply current of approximately 1 A the moment the Intelligent Signal Processor is turned on. Do not forget to take this into consideration when using several Intelligent Signal Processors.

Characteristics

Input signal	Non-voltage contact (30 Hz max., ON/OFF puls width: 15ms min.) Open collector (50 kHz max., ON/OFF puls width: 9μs min.) (see note 1) **Connectable Sensors** ON residual voltage: 3 V max. OFF leakage current: 1.5 mA max. Load current: Must have switching capacity of 20 mA min. Must be able to dependably switch a load current of 5 mA max.
Measuring accuracy (at 25±5°C)	Operating modes 1 and 13: ±0.006%rdg±1 digit Operating modes 2 to 5: ±0.02%rdg±1 digit Operating modes 6 to 9: ±0.08%rdg±1 digit
Measuring modes and ranges	Operating mode 1: Rotational/circumferential speed 0.0005 to 50,000 Hz Operating mode 2: Absolute ratio 0.0005 to 50,000 Hz Operating mode 3: Error ratio 0.0005 to 50,000 Hz Operating mode 4: Rotational difference 0.0005 to 50,000 Hz Operating mode 5: Flow rate ratio 0.0005 to 50,000 Hz Operating mode 6: Passing speed 10 ms to 3,200 seconds Operating mode 7: Cycle 10 ms to 3,200 seconds Operating mode 8: Time difference 10 ms to 3,200 seconds Operating mode 9: Elapsed time 10 ms to 3,200 seconds Operating mode 10: Length measurement 0 to 4G count (32-bit counter) Operating mode 11: Interval 0 to 4G count (32-bit counter) Operating mode 12: Pulse counting 0 to 4G count (32-bit counter) Operating mode 13: Passing time 0.0005 to 50,000 Hz
Max. displayed digits	5 digits (−9999 to 99999)
Display	7-segment LED
Polarity display	"−" is displayed automatically with a negative input signal.
Zero display	Leading zeros are not displayed.
Sampling period	Approx. 60 ms (when selecting operating modes 1 to 5 or 13)
Prescale function	Programming via front-panel key inputs. (0.0001×10^{-9} to 9.9999×10^{9}, decimal: 10^{-1} to 10^{-4}) Can be set using prescale teaching.
HOLD functions (see note 3)	PV hold, Max. value (peak) hold, Min. value (bottom) hold
External control	HOLD (Process value held) RESET (Maximum/minimum data reset, measurement reset) BANK (Selection of one bank out of 4 banks of set values) (Selection of one bank out of 4 banks of prescale values)
Other functions	Set value teaching Set value write-protection (only on Processors with comparison outputs) Linear output range teaching (only on Processors with linear outputs) (see note 2) Variable linear output range (only on Processors with linear outputs) (see note 2)
Output configuration	Relay contact output (5, and 3 outputs), transistor output (NPN open collector and PNP open collector), parallel BCD (NPN open collector), linear output (4 to 20 mA, 1 to 5 V, 1 mV/10 digit) (see note 2), communication functions (RS-232C, RS-485, RS-422)
Delay in comparative outputs	Operating modes 1 to 5 or 13: 200 ms max. Operating modes 6 to 11: 20 ms max. Operating mode 12: 1 ms max. (at transistor output)
Linear output response time	Operating modes 1 to 5 or 13: 220 ms max. Operating modes 6 to 11: 40 ms max. Operating mode 12: 20 ms max. (at transistor output)
Enclosure rating	Front panel: Refer to IEC standard IP50 Rear case: Refer to IEC standard IP20 Terminals: Refer to IEC standard IP00
Memory protection	Non-volatile memory (EEPROM)

Note 1. Voltage pulses cannot be read.

2. The linear output range cannot be set when connected to a 1 mV/10-digit Linear Output Board.

3. Not effective for operating mode 12.

I/O Ratings

The following tables list the various I/O Ratings. These I/O Ratings are categorized according to: Relay Output, Transistor Output, BCD Output, and Linear Output.

Relay Contact Output

Item	Resistive load (cosϕ = 1)	Inductive load (cosϕ = 0.4, L/R = 7 ms)
Rated load	5 A at 250 VAC; 5 A at 30 VDC	1.5 A at 250 VAC, 1.5 A at 30 VDC
Rated carry current	5 A max. (at COM terminal)	
Max. contact voltage	380 VAC, 125 VDC	
Max. contact current	5 A max. (at COM terminal)	
Max. switching capacity	1,250 VA, 150 W	375 VA, 80 W
Min. permissible load	10 mA at 5 VDC	

Transistor Output

Rated load voltage	12 to 24 VDC $^{+10\%}/_{-15\%}$
Max. load current	50 mA
Leakage current	100 μA max.

BCD Output

I/O signal name		Item	Rating
Inputs	REQUEST, HOLD, MAX REQ. MIN REQ., RESET	Input voltage	No-voltage contact input
		Input current	10 mA
		Operating voltage	ON: 1.5 V max. OFF: 3 V min.
Outputs	DATA, POLARITY, OVERFLOW, DATA VALID, RUN	Rated load voltage	12 to 24 VDC $^{+10\%}/_{-15\%}$
		Max. load current	10 mA
		Leakage current	100 μA max.

Note: Logic method: negative logic

Linear Output

Item	4 to 20 mA	1 to 5 V	1 mV/10 digits (see note)
Resolution	4,096		
Output error	±0.5% FS		---
Permissible load resistance	600 Ω max.	500 Ω min.	1 KΩ min.

Note: For the 1 mV/10-digit output, the output voltage changes for every 40 to 50 increment in the display value.

Communications Specifications

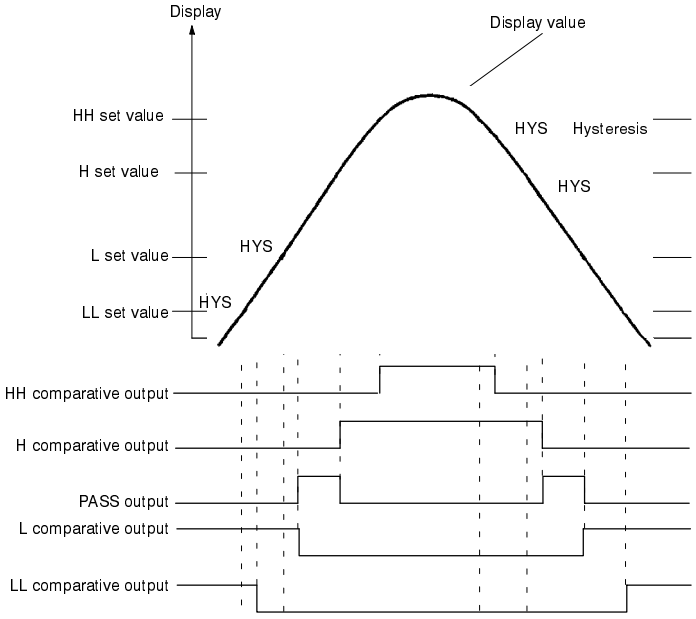
The following lists the Intelligent Signal Processor specifications related to communications (for more details, refer to the operation manual for the communications-output model).

Item		RS-232C, RS-422	RS-485
Transmission method		4-wire, half-duplex	2-wire, half-duplex
Synchronization method		Start-stop synchronization	
Baud rate		150/300/600/1,200/2,400/4,800/9,600/19,200/38,400	
Transmission code		ASCII (7-bit)	
Communications	**Write to K3TR**	Set values, reset control (maximum/minimum values)	
	Read from K3TR	Set values, process value, maximum/minimum values, model data, error code, etc.	

Output Operation Timing in RUN Mode (Relay or Transistor Outputs)

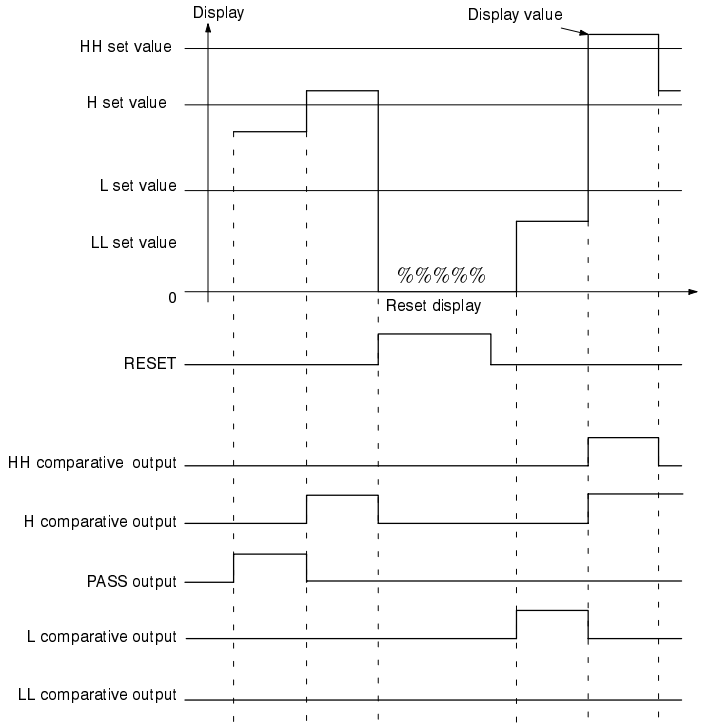
The following timing chart is for a 5-comparative Output Board.

For Operating Mode 1 to 5 or 13



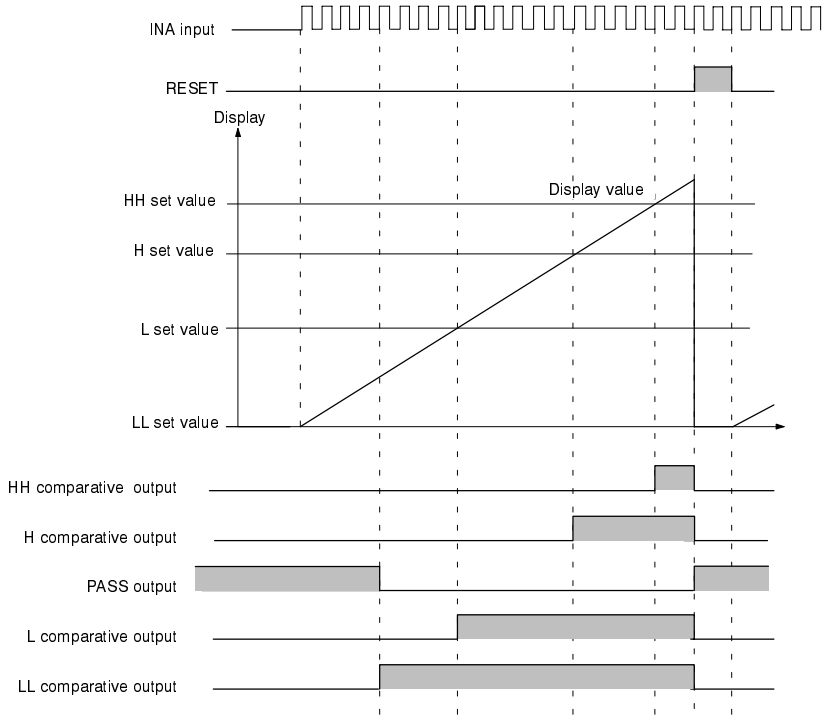
Note: The hysteresis is set in setting level 1 and the hysteresis value will be applied to all set values.

For Operating Mode 6 to 11



Note: Because measuring is not continuous (as it is for operating modes 1 to 5 and 13), the comparative output turns ON when the measuring operation is completed.

For Operating Mode 12



Note: Comparative output L or LL turns ON when the measured value exceeds the set value.

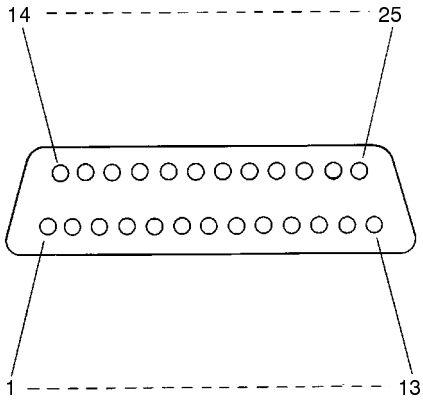
Interface Specifications

RS-232C

Electrical characteristics: Conforms to EIA RS-232C

Communications Signals

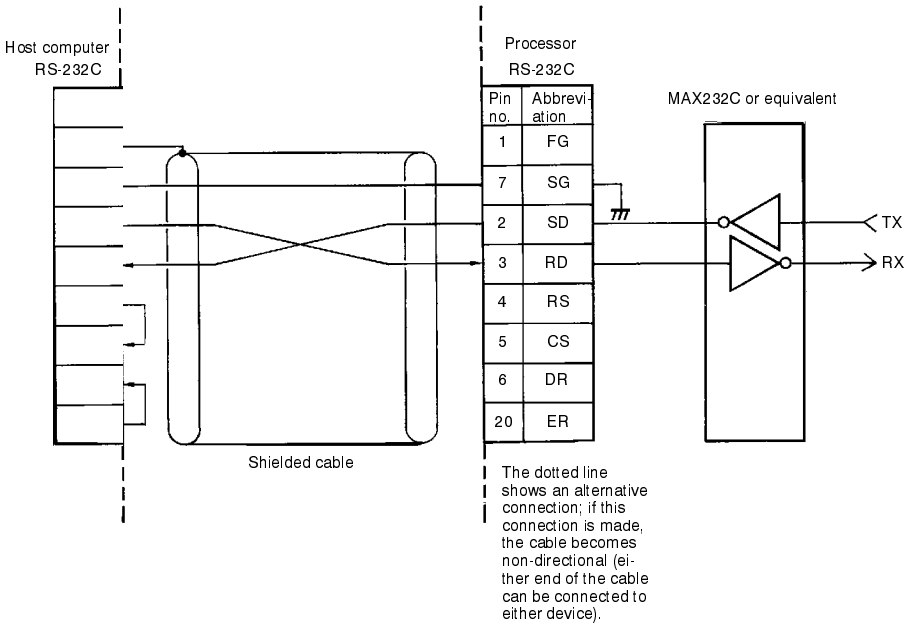
The following information identifies the key input/output signals of the interface.



Signal	Abbreviation	Signal direction	Pin no.
Frame Ground (safety ground)	FG	---	1
Signal Ground or common return	SG	---	7
Send Data	SD	Output	2
Receive Data	RD	Input	3
Request To Send	RS	Output	4
Can Send	CS	Input	5
Data Set Ready	DR	Input	6
Data Terminal Ready	ER	Output	20

Connection Diagram

The following example provides information on how the RS-232C Intelligent Signal Processor is to be connected to the host computer.



Synchronization clock: Internal clock

Cable length: 15 m maximum. If increasing the cable length, use OMRON's RS-232C optical interface (Z3RN).

Applicable connectors: Plug: XM2A-2501 (OMRON) or equivalent
Hood: XM2S-2511 (OMRON) or equivalent

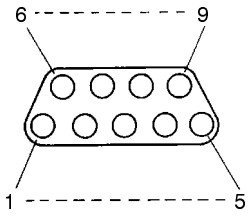
Connection method (RS-232C direct connection): 1:1 connection only

RS-422

Electrical characteristics: Conforms to EIA RS-422

Communications Signals

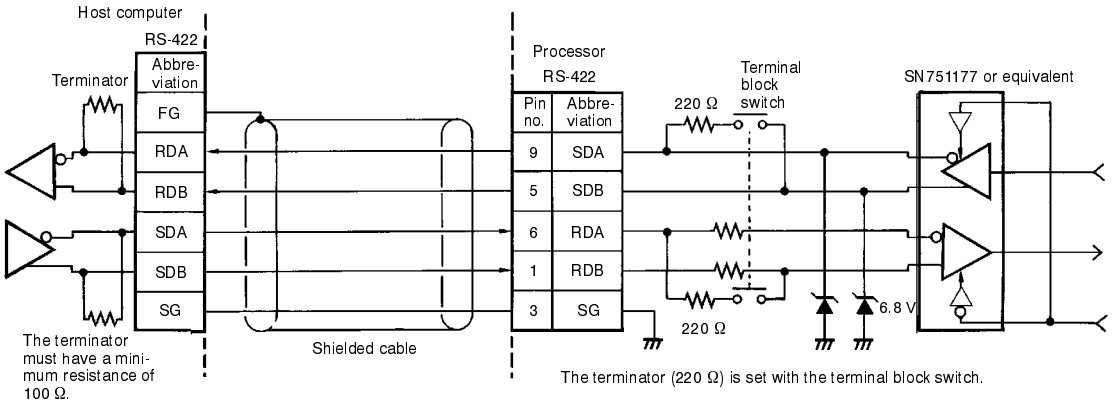
The following information identifies the key input/output signals of the interface.



Signal	Abbreviation	Signal direction	Pin no.
Send Data A	SDA	Output	9
Send Data B	SDB	Output	5
Receive Data A	RDA	Input	6
Receive Data B	RDB	Input	1
Signal Ground	SG	–––	3
Frame Ground (safety ground)	FG	–––	7

Connection Diagram

The following example provides information on how the RS-422 Intelligent Signal Processor is to be connected to the host computer.



Synchronization clock: Internal clock

Total line length: 500 m maximum

Recommended cable: CO-HC-ESV-3P x 7/0.2 (Hirakawa Densen)

Applicable connectors: Plug: XM2A-0901 (OMRON) or equivalent
Hood: XM2S-0911 (OMRON) or equivalent

Connection method (RS-422 connection): Maximum 1:32 connection

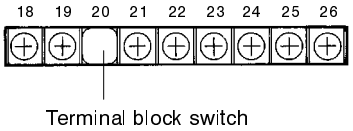
When using this connection:
Turn ON the terminal block switch at the end station.
Turn OFF all other terminal block switches.

RS-485

Electrical characteristics: Conforms to EIA RS-485

Communications Signals

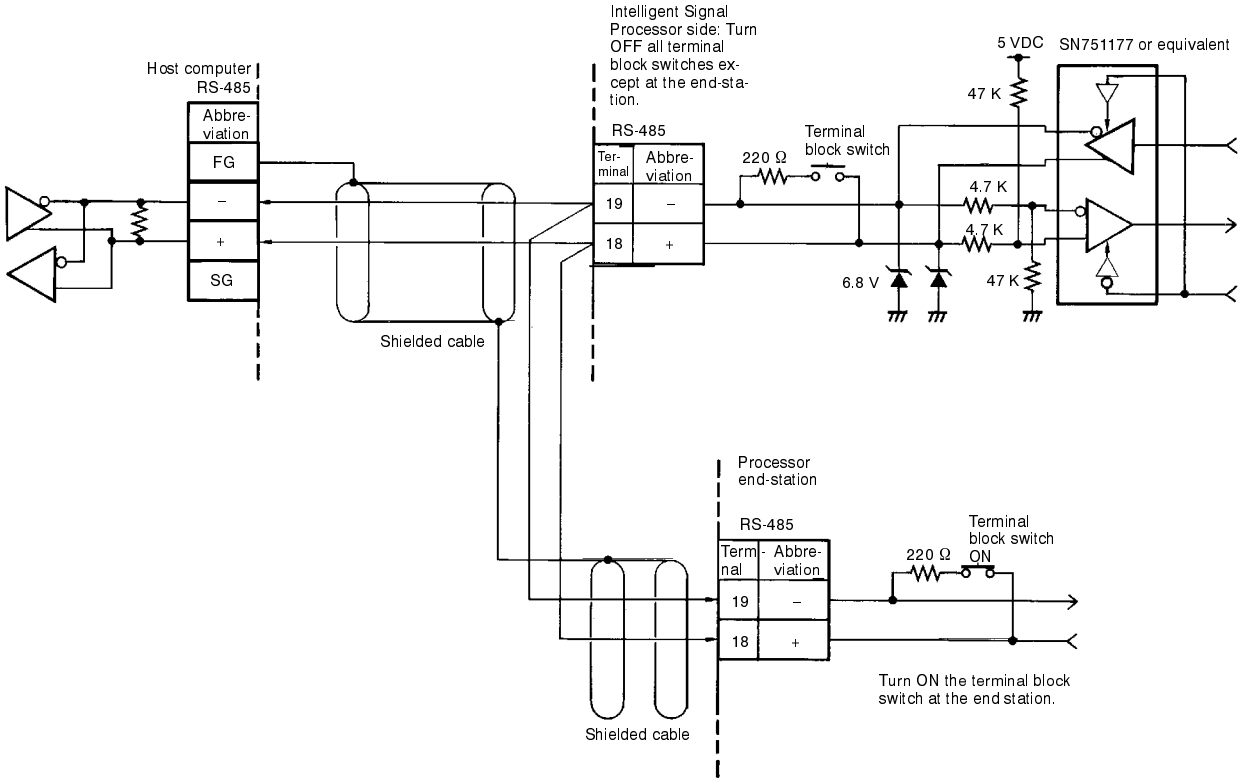
The following information identifies the key input/output signals of the interface.



Signal	Abbreviation	Signal direction	Terminal No.
Inverted output	Negative (–) side	Input/output	19
Non-inverted output	Positive (+) side	Input/output	18

Connection Diagram

The following example provides information on how the RS-485 Intelligent Signal Processor is to be connected to the host computer.



Synchronization clock: Internal clock

Total line length: 500 m maximum

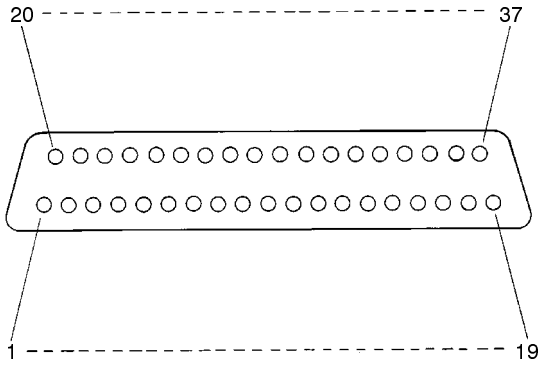
Recommended cable: CO-HC-ESV-3P x 7/0.2 (Hirakawa Densen)

Connection method (RS-485 connection): Maximum 1:32 connection

In this case, the SYSMAC SYSBUS wire type cannot be connected.

BCD (NPN Open Collector)

Terminal Numbers



Terminal no.	Signal name	Signal direction	Description
1	COM	–––	GND: VO (See Note 1)
2	DATA	Output	1 Read data: 10^0 digit
3		Output	2 Read data: 10^0 digit
4		Output	4 Read data: 10^0 digit
5		Output	8 Read data: 10^0 digit
6		Output	1 Read data: 10^1 digit
7		Output	2 Read data: 10^1 digit
8		Output	4 Read data: 10^1 digit
9		Output	8 Read data: 10^1 digit
10		Output	1 Read data: 10^2 digit
11		Output	2 Read data: 10^2 digit
12		Output	4 Read data: 10^2 digit
13		Output	8 Read data: 10^2 digit
14		Output	1 Read data: 10^3 digit
15		Output	2 Read data: 10^3 digit
16		Output	4 Read data: 10^3 digit
17		Output	8 Read data: 10^3 digit
18		Output	1 Read data: 10^4 digit
19		Output	2 Read data: 10^4 digit
20		Output	4 Read data: 10^4 digit
21		Output	8 Read data: 10^4 digit
22	OVER	Output	Output when input value exceeds display range
23	DATA VALID	Output	Data confirmation signal
24	RUN	Output	Operation signal
25	COM	–––	GND: VO (See Note 1)
26	REQ	Input	PV output request
27	Max.	Input	Maximum value output request
28	Min.	Input	Minimum value output request
29	HOLD	Input	Hold input
30	RESET	Input	Reset input
31	POL	Output	Positive/negative polarity signal
32	HH	Output	HH comparative output

Terminal no.	Signal name	Signal direction	Description
33	H	Output	H comparative output
34	PASS	Output	PASS comparative output
35	L	Output	L comparative output
36	LL	Output	LL comparative output
37	COM	Output	GND: VO (see note)

Note: Terminals No. 1, 25, and 37 have the same COM.

Applicable Connectors

Plug: XM2A-3701 (OMRON) or equivalent
Hood: XM2S-3711 (OMRON) or equivalent

Operation

When a REQ signal is input to the Processor from a PC, the data is confirmed after an interval of 30 ms, and a DATA VALID (D.V.) signal is output from the Processor. Read the data when the DATA VALID signal is ON.

Connection between PC and Processor should be performed with a rear panel transmission connector.

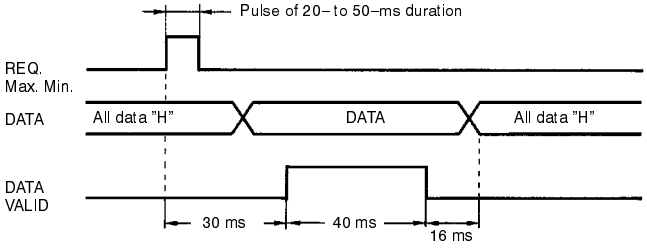
When one PC Unit is connected with several Processor Units, it is possible to achieve a wired OR connection between the DATA (POL, OVER) and DATA VALID signals.

Data cannot be written from a PC to a Processor.

BCD Output Timing Charts

Sampling Data Output (at Each Sample)

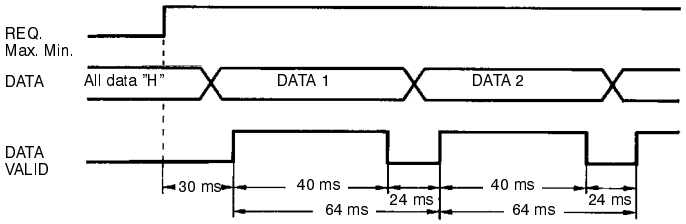
Data is confirmed after 30 ms from the REQ signal rising time, and DATA VALID signal is output. Read data while DATA VALID signal ON. The DATA VALID signal is turned OFF after an interval of 40 ms, then data is turned OFF after an interval of 16 ms.



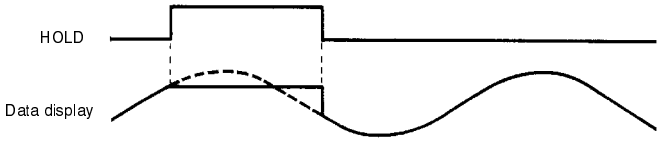
Continuous Data Output

When the REQ signal remains ON, measurement data is output at intervals of 64 ms. When a hold operation or another operation is performed during the change from DATA 1 to DATA 2, the BCD data output is either DATA 1 or DATA 2 at the hold signal timing. However, output data will never be low. Read maximum or minimum data when DATA VALID signal turns ON, after a 30 ms interval from maximum or minimum signal ON time to confirm measurement data.

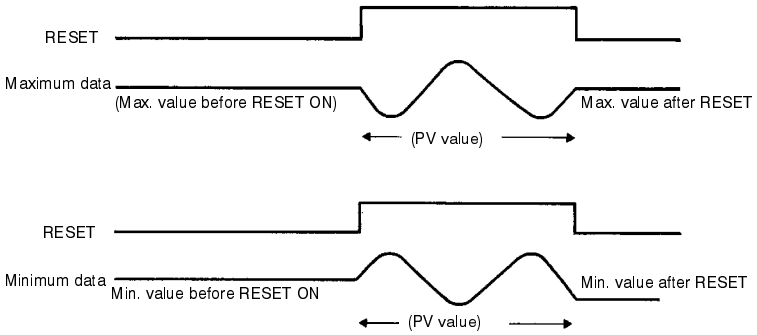
The RUN signal is ON during RUN mode or TEST mode. (Note that the RUN signal is turned OFF when an error other than overflow or underflow occurs.)



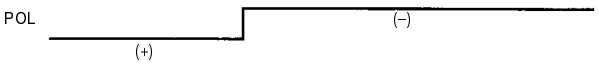
When a HOLD signal is input, the Processor stops accepting input and the data received just before the HOLD signal is retained and displayed. The same function is available in (5)-(7) terminal ON.



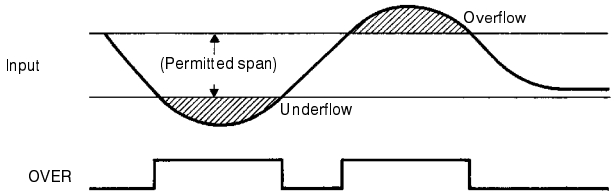
When RESET signal is input (ON), the maximum or minimum value becomes the current PV value.



POL output becomes L at positive (+) pole or H at negative (–) pole.



OVER output is formed when BCD output data becomes overflow or underflow data.



In set value parameter or prescaling parameter, no BCD output is formed (All outputs become ”H”.). In TEST mode, the test PV value currently input is output in both REQ maximum and REQ minimum signals. When two or more input signals are input simultaneously, or when a signal is input during another input, all the output data is turned OFF. Do not turn ON two or more input signals at the same time (except for the HOLD signal).

Index

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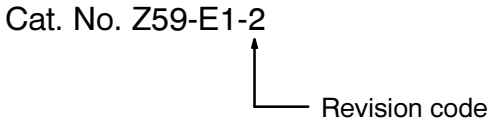
Revision History

A manual revision code appears as a suffix to the catalog number on the front cover of the manual.



The following table outlines the changes made to the manual during each revision. Page numbers refer to the previous version.

Revision code	Date	Revised content
1	May 1991	Original production
1A	October 1991	The term “Mode Key” has been replaced by “Display Key” throughout the manual. **Page 17:** Changes made to Bank 1 and Bank 2 in Bank selection. **Page 22:** Additional information in Input Circuits graphics. **Pages 23 to 25 :** 12 V replaced by +12 V in all graphics. **Page 31:** Columns added to table. **Page 32:** Columns added to Set Value LED Models table. **Pages 54, 57, 60, 63, 66:** Linear and transistor outputs delay of 20 ms replaced by 35 ms in Performance Characteristics table. **Page 98:** First sentence of “teaching function” has been replaced. **Page 113:** 500 Ω replaced by 600 Ω in Linear Output table.
2	August 1995	**Pages 2, 3:** Number of operating modes changed from “12” to “13.” Page references added. **Page 4:** Operating Mode 13 added. **Pages 8, 10, 12:** Functions added to comparative output status indicators LL and/or L. **Pages 9, 11, 13:** Prescale values added to the DATA TEACH Key functions. **Pages 16 to 18:** Corrections and additions made to the inputs and outputs. **Pages 28 to 101:** Major corrections and additions made to Section 6. **Page 105:** Standard models completely updated. **Pages 107 to 109:** Sensor models completely updated. **Pages 111 to 113:** Specifications completely updated.