

Chapter 10

Voltage/Current Analog Input/Output Blocks

Voltage/Current 4 Input/2 Output Analog Input/Output Blocks have four independent input circuits and two independent output circuits. Two block versions are available:

- **115 VAC Analog I/O Block (IC660BBA100)**
- **24/48 VDC Analog I/O Block (IC660BBA020)**

They are identical except for the power supply.

Features

Each circuit on a Voltage/Current Analog I/O Block can accept or provide signals in one of five analog ranges: 0 to 10 volts DC, -10 volts DC to +10 volts DC, -5 volts DC to +5 volts DC, 0 to 5 volts DC, or 4 to 20 mA (1 to 5 volts DC). External resistance can be used to interface these blocks to current-loop devices with other signal ranges.

The block converts the input and output signal levels to/from digital count values and translates them into engineering units values that relate to the application.

The block's internal power supply drives current mode output loads up to 300 ohms each. For loads up to 2K ohms, an external 24 or 48 VDC power supply can be used. For current-loop applications, Current-source Analog blocks may be more suitable. See chapters 11 through 13.

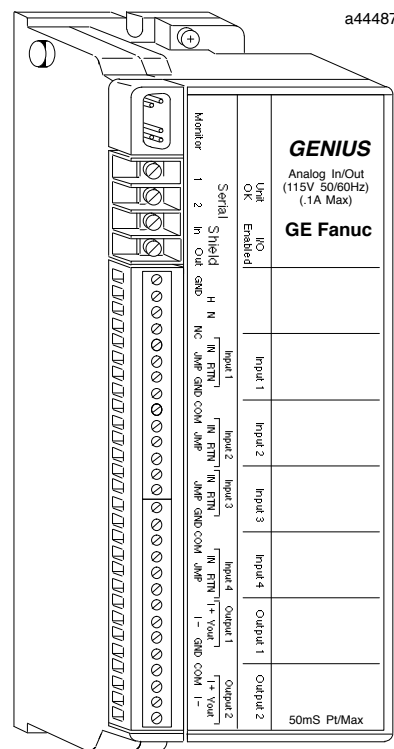
Individual inputs can be set up to operate in Alarm Input Mode. In this mode, the input's analog value is not sent to the HHM or the CPU. Instead, the block will report values that indicate whether the input signal exceeds either of its alarm levels.

Additional configurable features include:

- Selectable Input Filter Time up to 1024mS
- Output powerup defaults
- Output Hold Last State or default
- CPU Redundancy

Block diagnostics are performed automatically:

- Input Low Alarm and High Alarm detection
- Open Wire detection
- Input Underrange or Overrange
- Output Underrange or Overrange



Compatibility

These blocks are compatible with all Genius bus controllers, PCIM and QBIM modules. Any Genius Hand-held Monitor can be used.

For a Series Six™ PLC, the CPU must be rev. 105 or later. For a Series Six Plus, rev. 110 or later is required. The programming software must be Logicmaster™ Six rel. 4.02 or later.

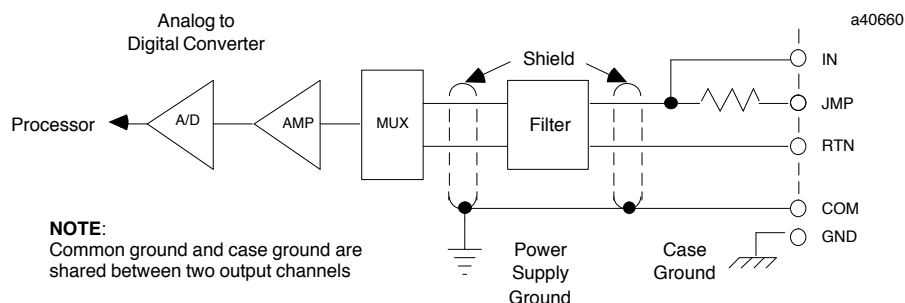
For a Series Five™ PLC, the CPU must be rev. 3.0 or later. The Logicmaster Five programming software must be rel. 2.01 or later.

Specifications

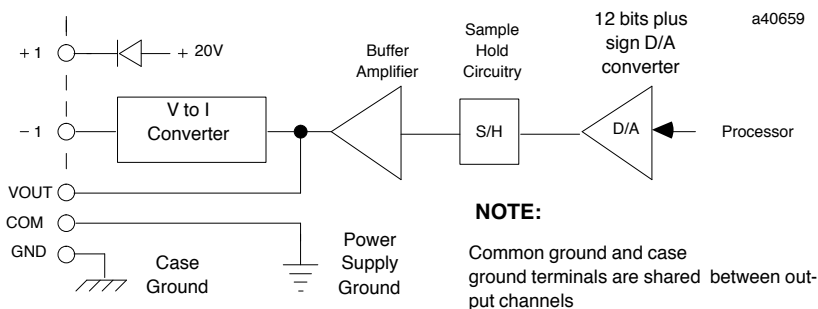
Block Type:	4input/2outputcircuits	
CatalogNumbers:		
115 VAC Analog I/O Block	IC660BBA100	
Terminal Assembly only	IC660TSA100	
Electronics Assembly only	IC660EBA100	
24/48 VDC Analog I/O Block	IC660BBA020	
Terminal Assembly only	IC660TSA020	
Electronics Assembly only	IC660EBA020	
Size (height x width x depth):	8.83" (22.44cm) x 3.50" (8.89cm) x 3.94" (10.00cm)	
Weight:	4 lbs. (1.8 kg)	
LEDs (block):	Unit OK, I/O Enabled	
Block to Block Isolation:	1500 V	
Heat Dissipation:	6 Watts	
Block Power (nominal):	115 VAC	24/48 VDC
Operating range	98–132 VAC	18–56
Maximum power	10 VA	8W
Frequency / ripple	47–63 Hz	10% max. ripple
Power supply dropout time	1 cycle	10mS
Common mode rejection:	60 dB (0–1 KHz)	
Common mode voltage:	" 170 volts, maximum	
Absolute accuracy (at 25C):	Typical: " 0.2% of full scale; Maximum: " 0.5% of full scale: within 50mV on the 10 volt range, 25mV on the 5 volt range, and 100mA on the 4 to 20 mA range.	
Thermal drift (from 25C):	Typical: 10 PPM per C; Maximum: 40 PPM per C	
Circuit range selections:	0–10 VDC, " 10 VDC, " 5 VDC, 0–5 VDC, 4–20 mA (or 1–5 VDC)	
Input Characteristics:		
Input resolution	12 bit + sign	
Input update frequency	Once every 4mS	
Input filter ranges	none, 8, 16, 32, 64, 128, 256, 512, 1024mS	
Input diagnostics	Underrange, Overrange, High Alarm, Low Alarm, Open Wire	
Output Characteristics:		
Output resolution	12 bit + sign	
Output update frequency	Once every 4mS	
Output diagnostics	Underrange, Overrange.	
Output load	Voltage mode: 2000Ω or greater; Current mode: 0 to 300Ω	
Environmental:		
Operating temperature	0 to 60C (+32 to 140F)	
Storage temperature	–40 to +100C (–40 to +212F)	
Humidity	5% to 95% (non-condensing)	
Vibration	5–10 Hz 0.2" (5.08mm) displacement; 10–200 Hz at 1G	

Block Operation

The first four circuits on a Voltage/Current Analog I/O block are inputs. One 12-bit analog to digital (A/D) converter is time-shared between the input circuits. The block converts each input signal voltage or current to a digital count value. It then scales the count value to an integer that represents the engineering units for that input.



Circuits 5 and 6 are outputs. A 12-bit digital to analog (D/A) converter serves the output circuits. The block scales the engineering units output received from the CPU to a digital count value. It then converts the count value to an output signal voltage or current.



Accuracy is within " 0.5% maximum, " .2% typical over the entire span of the reading at 25C. This means accuracy is within 50mV on the 10 volt range, 5mV on the 5 volt range, and 100μA on the 4 to 20 mA range. The blocks automatically calibrate all internal A/D and D/A circuits periodically during normal operation.

Inputs and Outputs

Each engineering units input and output is a 16-bit twos complement number. Appendix B shows reference usage for a Series 90, Series Six, or Series Five PLC.

Input Data Format

A Voltage/Current 4 Input/2 Output Analog block broadcasts 8 bytes of input data each bus scan.

Byte #	Description
0	Input channel 1, bits 0 – 7
1	Input channel 1, bits 8 – 15
2	Input channel 2, bits 0 – 7
3	Input channel 2, bits 8 – 15
4	Input channel 3, bits 0 – 7
5	Input channel 3, bits 8 – 15
6	Input channel 4, bits 0 – 7
7	Input channel 4, bits 8 – 15

Output Data Format

Each bus scan, the bus controller sends an Analog I/O block 4 bytes of output data.

Byte #	Description
0	Output channel 1, bits 0 – 7
1	Output channel 1, bits 8 – 15
2	Output channel 2, bits 0 – 7
3	Output channel 2, bits 8 – 15

Hand-held Monitor I/O Display

The Hand-held Monitor displays each input or output as a whole integer value. The Monitor Block screen shows the current value of two circuits at a time.

REF	97– 120I
I1:	10838
I2:	11637
>	

Circuit Scaling

The block automatically scales each input or output to/from a value in engineering units. This whole integer number can represent any type or increment of units meaningful to the application. For example, if the current value of a temperature input was 116.37F, it might be reported as:

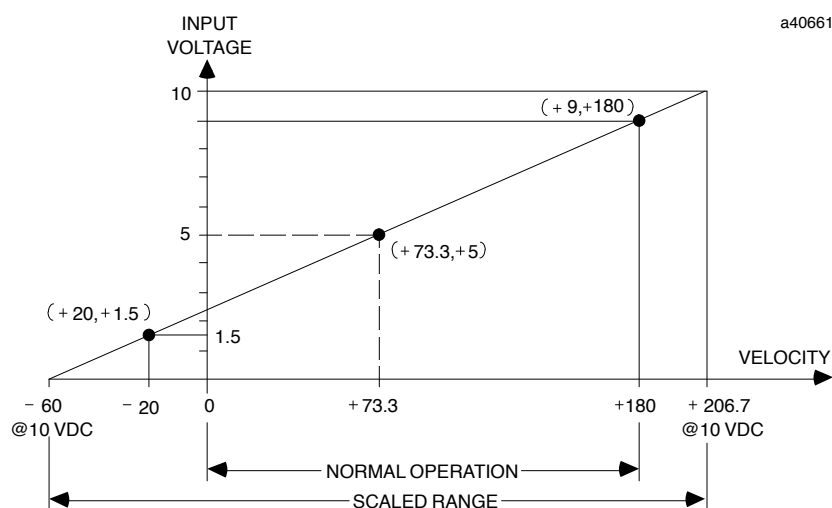
116	degrees, or
1163	tenths of degrees, or
11637	hundredths of degrees

All circuits can be scaled independently, as explained later in this chapter.

Example of Scaling an Analog Circuit

A circuit is configured in the 0 to 10 volts DC range. It measures a velocity input. Electronic sensors and mechanical linkage external to the block have determined that an input level of +1.5 volts DC is equal to -20 feet/second (-6 meters/second), and that +9 volts DC is equal to +180 feet/second (+50 meters/second).

Plotting these values on a graph shows that a signal of 5 volts DC corresponds to a speed of 73.3 feet/second.



Because engineering units values are whole integers, this would be rounded to +00073.

For better resolution, the circuit is reconfigured to units of hundredths of feet/second. New scaling values are configured which are 100 times the original values. The low engineering units value of -20 is reconfigured as -2000. The high engineering units value +180 is changed to +18000. Now, the 5 volt DC signal represents +07333 (hundredths of feet/second).

Diagnostics

If a fault occurs, the block reports it to the Hand-held Monitor and takes appropriate corrective action.

Individual circuits can be configured not to send diagnostic messages to the CPU if a fault occurs. If the CPU requests diagnostic information from the block using Read Diagnostics datagrams, the block returns current diagnostics for all circuits, including any with CPU fault reporting disabled.

Open Wire Diagnostic

The OPEN WIRE diagnostic detects an open wire at an input terminal. The diagnostic is only available for circuits set to operate from 4 to 20 mA. If the circuit current drops below 2 mA, the block sends an OPEN WIRE message. Nothing is done to alter the actual input data.

Input Low Alarm and High Alarm Diagnostics

Individual low alarm thresholds and high alarm thresholds can be configured for each input.

If an input is over its high alarm limit, the block sends a HIGH ALARM message. If an input is under its low Alarm Threshold, the block sends a LOW ALARM message. The alarm message identifies the input circuit which is in alarm. Only one message is sent upon reaching the limit. Since the input value is supplied as part of the normal input status update, the CPU can determine how much over the limit it is.

Input Underrange and Overrange Diagnostics

The block sends an UNDERRANGE or OVERRANGE message if:

- A. The input voltage or current is outside the circuit's configured range. Therefore, when the block converts the signal level to digital counts, the result is lower than -4095 or higher than +4095. To prevent this, the input signal should be clamped appropriately.
- B. The channel scaling is incorrect. When the block converts the digital counts value to engineering units, the result is lower than -32,767 or higher than +32,767. This should be corrected by adjusting channel scaling.

Output Underrange and Overrange Diagnostics

The block sends an UNDERRANGE or OVERRANGE message if conversion of the engineering units output it receives from the CPU results in a counts value that corresponds to a signal outside the circuit's configured range. For example, if the output is configured for 0 to +5V and the conversion from engineering units to counts results in a value of -2V at the output, the block sends an UNDERRANGE diagnostic.

If an underrange or overrange condition occurs, the block clamps the output to the selected range limit to protect external hardware.

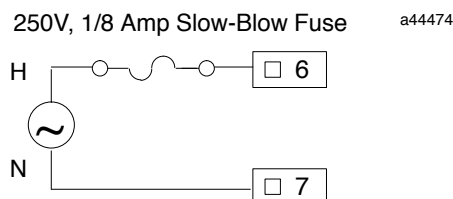
Field Wiring

Field devices are wired to terminals 5–32, which accept AWG #22 through AWG #14 wires. Do not overtorque the terminal screws.

Power Source Wiring

For block power, connect the power source to terminals 6 and 7. For a 24/48 VDC block, connect the source to the DC+ terminal and the return to the DC– terminal. For a 115 VAC block, connect the source to the H terminal and neutral to N.

For the 115 VAC block (IC660BBA100) only, if Class 1 Division 2 conditions must be met for Factory Mutual, install a 250 volt 1/8 amp slow-blow fuse in series with the Hot AC power connector:



Wiring for I/O Devices

The ground (GND) terminal (5) is for block safety. It is connected internally to the block chassis, and to terminals 12, 20, and 28, which are marked GND. Each pair of signals has one ground terminal and one common terminal, for shield termination if desired. The three common terminals are connected together internally to the source.

For a voltage input device, connect the device in series between V+ and the terminal marked IN for that input. Connect V– to RTN.

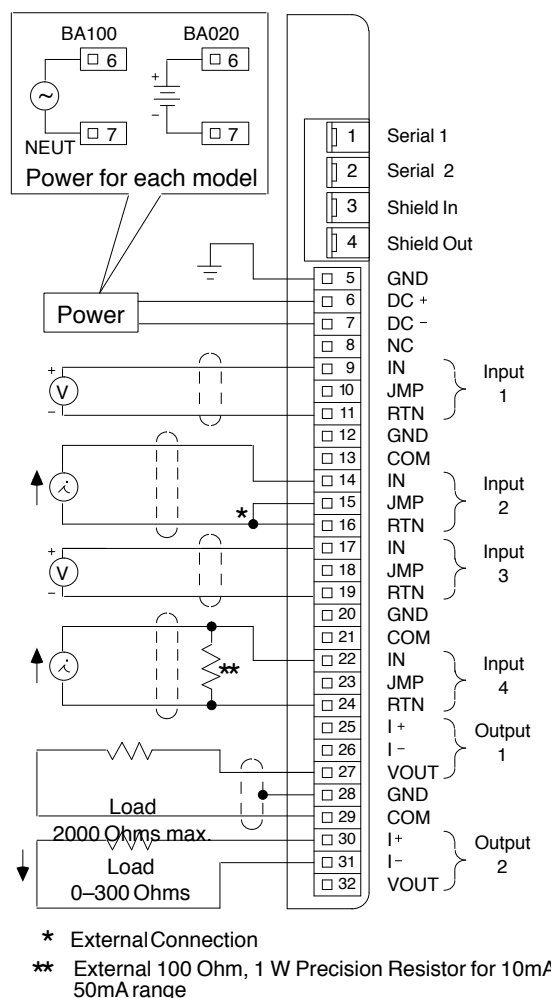
For a voltage output device, connect the load to the terminals marked VOUT and COM for that output.

If current mode (4–20mA) is used for an input circuit without an external resistor, connect a jumper from the terminal marked JMP to the terminal marked RTN for that circuit.

If an input current device operates outside the 4–20mA range, connect a resistor across the voltage inputs. For example, to measure 10mA to 50mA current loop signals, install a 100 ohm resistor.

If current mode is used for an output circuit, use the terminals marked I+ and I–. For outputs set up in current mode, the block's internal power supply can be used to drive loads up to 300 ohms per output. For loads up to 2K ohms, use an external power supply. Connect the positive lead of the external supply to one side of the load, and the negative lead of the external supply to block common on terminal 29. If the external supply is between 24V and 50V, you can use terminal 25 or 30 as a tie point for the positive connection. This point will be disconnected from the external supply by a reverse biased diode.

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Block Configuration

The configurable features of an Analog Input/Output Block are listed below. For many, the factory setting may not need to be changed.

Feature	Circuit or Block	Factory Setting	Selections
Device Number*	Block	null	0 to 31 (a number must be selected)
Reference Address*	Block	none	Depends on host CPU type
Baud Rate*	Block	153.6std	153.6 std, 153.6 ext, 76.8, 38.4 Kbd
Input Filter Time	Circuit	128mS	none, or 8–1024mS
Current/Voltage	Circuit	10VDC	0–10VDC, " 10VDC, 0–5VDC, " 5VDC, 4–20mA (1–5VDC)
Report Faults	Circuit	yes	yes, no
Hold Last Value	Circuit	no	yes, no
Output Default Value	Circuit	0	" 32,767
Scaling Points	Circuit	(" 10,000 eng. units, " 4095 counts)	(" 32,767 engineering units, " 4095 counts)
Low/High Alarms	Circuit	" 10,000	" 32,767
Alarm Input Mode	Circuit	no	yes, no
BSM Present	Block	no	yes, no
Output Default Time	Block	3 bus scans	(for bus redundancy) 2.5 or 10 seconds
Redundancy Mode	Block	none	none, standby

Features marked with an asterisk in the table are configured from the Program Block ID screen of the Hand-held Monitor, as explained in chapter 3.

The rest of the features can be configured either using a Hand-held Monitor, or by sending a Write Configuration datagram to the block from the host.

Before configuration begins, the block's features should be decided on and recorded on a copy of the Configuration Worksheet printed on the next page.

Voltage/Current 4 Input/2 Output Analog Blocks Configuration Worksheet

Block _____ Location _____

Block Features:

Configuration Protected (Y/N) _____ Block Number (0–31) _____

Reference Address _____ through _____

Baud Rate (153.6 Kb Std/153.6 Kb Ext/76.8 Kb/38.4 Kb) _____

Redundancy Features:

Redundancy Mode (None/Standby) _____

BSM Present (Y/N) _____ Outputs Default (2.5/10 sec) _____

Circuit Features:

	Input Circuits				Output Circuits	
	1	2	3	4	5	6
References: From	_____	_____	_____	_____	_____	_____
To	_____	_____	_____	_____	_____	_____
Report Faults? (Y/N)	_____	_____	_____	_____	_____	_____
Range Selection:						
–10 to +10 volts						
0 to +10 volts						
0 to +5 volts						
4mA to 20mA						
–5 to +5 volts	_____	_____	_____	_____	_____	_____
Scaling Points:						
Low Pt (eng units)	_____	_____	_____	_____	_____	_____
Low Pt (A/D or D/A units)	_____	_____	_____	_____	_____	_____
High Pt (eng units)	_____	_____	_____	_____	_____	_____
High Pt (A/D or D/A units)	_____	_____	_____	_____	_____	_____
Alarm Input Mode (Y/N)	_____	_____	_____	_____		
Input Filter Time (mS)	_____	_____	_____	_____		
Alarm Thresholds:						
Low (eng units)	_____	_____	_____	_____		
High (eng units)	_____	_____	_____	_____		
Outputs:						
Hold Last State (Y/N)					_____	_____
Default Values (eng units)					_____	_____

Report Faults to CPU

Fault reports to the host can be disabled or enabled for any circuit.

If fault reporting is enabled, the block sends a message to the host if any fault occurs on that circuit. If fault reporting is disabled, the block does not send fault reports to the CPU for that circuit.

Regardless of whether fault *reporting* is enabled, the block will detect faults on the circuit, and take appropriate actions. The Unit OK LED will blink when a fault occurs, and a fault report is sent to a Hand-held Monitor. The fault condition must be corrected for proper operation of the block.

If the CPU requests diagnostic information from the block using Read Diagnostics datagrams, the block returns current diagnostics for all circuits, including any with CPU fault reporting disabled.

Hand-held Monitor Configuration Steps

Line 3 shows the current Report Faults configuration of each circuit (circuits are shown on line 2 for reference).

```
REPORT FAULT 97
I I I I O O
Y Y Y Y Y Y
> tgl entr nxt
```

1. To move the cursor and select a circuit for configuration, press F1 (>).
2. To change a selection, press F2 (tgl). To save the new selection, press F3 (entr).
3. Press F4 (next) to advance to the next configuration display.

Range Select

For each circuit, select the voltage or current range that corresponds to the signal level of the input or output device:

0 to 10 volts DC
 -10 volts DC to +10 volts DC
 -5 volts DC to +5 volts DC
 0 to 5 volts DC
 4 to 20 mA/1 to 5 volts DC

This matches an input voltage range to the block's internal range of 4095 digital counts. It also sets the limits at which outputs are clamped by the software.

For all current-loop input or output devices, select the 4mA to 20 mA range. Current loop scaling can be changed by installing an external resistor across the voltage inputs. For example, a 100 ohm resistor would be connected across the inputs to measure 10mA to 50mA current loop signals.

The 4mA to 20 mA range can also be selected to improve noise immunity on long input leads. However, it is better to use longer communication cables and voltage sensing where practical than to use long input leads.

Note

Range Selection is a setup parameter; it is not ordinarily changed while the block is operational. If the block sends an UNDERRANGE or OVERRANGE message, adjust the circuit scaling, not the selected range. See page 10-12 for information about circuit scaling.

Hand-held Monitor Configuration Steps

Line 3 shows the range presently selected for the circuit identified on line 2.

```
RANGE SELECT
IN 1  97- 120 I
RANGE: -10V,+10V
> tgl entr nxt
```

1. To select another circuit for configuration, press F1 (>).
2. To change the range selection for the circuit, press F2 (tgl). To save the new selection, press F3 (entr).
3. Press F4 (next) when you are ready to advance to the next configuration display.

Circuit Scaling

Each circuit can be configured for a different type or increment of engineering units values. The default configuration for each circuit is to operate in the range of " 10VDC and to report engineering units of millivolts. If those selections are appropriate, the default configuration can be used.

If units of millivolts are not appropriate, or a circuit has been reconfigured to another voltage/ current range, it should be rescaled. All that is needed to scale a circuit is two pairs of associated digital count values and engineering units values. These can be taken from the following table or from actual process measurements, or they can be estimates of expected values.

Scaling Values for 1mV or 1 μ A Engineering Units

If a circuit should use 1mV or 1 μ A engineering units, configure its scaling by entering values from the table below. (It is not necessary to re-enter the default values).

RANGE Selected	To measure this voltage/ current	Enter the following engineering units value		Enter the following digital count value	
0 to +10V	0volts	(Low)	0	(Low)	0
	+10 volts	(High)	+10,000	(High)	+4,095
-10V to +10V (default)	-10 volts	(Low)	-10,000	(Low)	-4,095
	+10 volts	(High)	+10,000	(High)	+4,095
-5V to +5V	-5 volts	(Low)	-5,000	(Low)	-4,095
	+5 volts	(High)	+5,000	(High)	+4,095
0V to +5V	0volts	(Low)	0	(Low)	0
	+5 volts	(High)	+5,000	(High)	+4,095
4 to 20mA (+1V to +5V)	0mA	(Low)	0	(Low)	0
	20mA	(High)	20,000	(High)	+4,095
	4mA	(Low)	4,000	(Low)	+819
	20mA	(High)	20,000	(High)	+4,095
	0volts	(Low)	0	(Low)	0
	+5 volts	(High)	+5,000	(High)	+4,095
	+1 volt	(Low)	+1,000	(Low)	+819
	+5 volts	(High)	+5,000	(High)	+4,095

Measuring Scaling Values

If the circuit will not use mV / μ A units, the most accurate scaling values can be found by taking actual measurements of the process. The process must be set to two distinctly different conditions, so two engineering units measurements can be taken. If the block is online to the process, it will automatically provide the digital count value associated with each engineering units measurement. If the block is not online to the process, the input or output voltage or current associated with each engineering units value must also be measured external to the block.

Scaling Guidelines

1. Pick two different digital count values from -4095 to $+4095$, depending upon the range of the circuit. These count values must differ by at least 2.
2. Pick two different engineering units values from -32767 to $+32767$. These values must also differ by at least 2.
3. Check the values by drawing a graph with engineering units as the horizontal axis and counts as the vertical axis. Locate both pairs of values on the graph, and draw a connecting line between them. The line must cross the engineering units axis between -32767 and $+32767$. That is, zero (0) counts must correspond to a number of engineering units in this range. The slope of the resulting line should be between $1/200$ and 200 (for a positive slope) or between $-1/200$ and -200 (for a negative slope). Values outside this range will be accepted by the block (provided other requirements are met), but may not yield satisfactory accuracy during internal calculations.
4. The values selected should provide the greatest range of engineering units values without exceeding ± 32767 .

Entering Scaling Values

If you are NOT measuring the process while scaling the circuit, have the two pairs of scaling values ready. If you ARE measuring the process to scale the circuit, set the process to one of the two conditions being measured.

Hand-held Monitor Configuration Steps

```
IN1  97- 120I
STS ENG  A/D
    32767 4095
> scale  nxt
```

1. The next configuration screen after the Range Select screen is this status screen. Line 1 shows which circuit is selected for configuration. If you want to scale a different circuit, press F1 (>).
2. If you are NOT measuring the process with the block online, go to step 4.

If you are measuring the process with the block online, continue at step 3.
3. Line 3 shows an engineering units value and count value for the circuit. The block has calculated the engineering units value, on the left, based on the present scaling. If the scaling is wrong, the engineering units value is wrong too. With the block online, the digital count value on the right is the numerical equivalent of the actual circuit voltage or current being measured. Make a note of this value; you will need it to complete the next screen.

```

IN 1 ENG A/D
LOW 850 100
HI 30970 4000
> chng entr sts

```

4. Press F2 (scale) to scale the circuit.
5. Line 2 of the HHM screen shows the circuit's low pair of engineering unit and digital count values. Line 3 shows a higher pair. All values on this screen are configured (not measured) values. Pressing F1 (>) moves the cursor.
6. Enter the engineering units value(s). After each entry, press F3 (entr).
7. Enter the associated count value(s).
 - A. If you are measuring the process online, enter the digital count value from the HHM's status screen.
 - B. If you are measuring the process with the block offline, find the voltage or current level of the signal. Convert the voltage or current to a count value by multiplying it by the number below that corresponds to the circuit's configured range, or by looking up the count value in the table on the next page.

Range Selected for Circuit	Multiply Measured Volts or mA by this Number
0 to +5V or -5V to +5V	819
0 to +10V or -10V to +10V	409.5
4mA to 20mA	204.75

8. To save the new entries for a circuit, press F3 (entr) again.
9. If you are using measured values, set the process to a distinctly different condition. Repeat the necessary steps above.
10. Press F4 (nxt) to return to the status screen. From the status screen, select F1 (>) to select another circuit for scaling.
11. When you are finished scaling circuits, press F4 (nxt) to configure additional block features.

Equivalent Analog Voltages, Currents, and Digital Counts

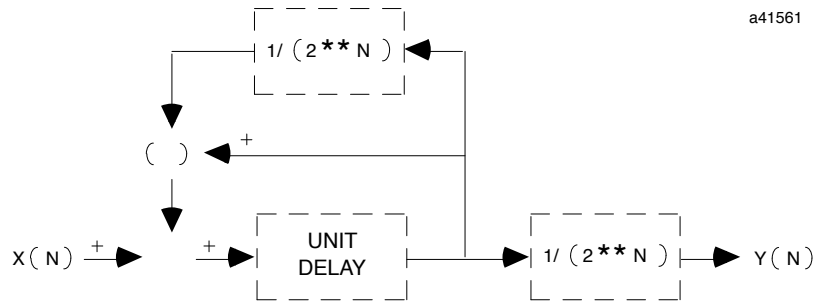
Note

The following table shows the digital counts value associated with selected voltage/current levels. If the measured voltage or current lies between these values, use the multiplier on the previous page to find its associated counts value.

Range			COUNTS	Range			COUNTS
to " 5V	to " 10V	mA		to " 5V	to " 10V	mA	
0.000	0.00	0.00	0	2.625	5.25	10.50	2149
0.125	0.25	0.50	102	2.750	5.50	11.00	2252
0.250	0.50	1.00	204	2.875	5.75	11.50	2354
0.375	0.75	1.50	307	3.000	6.00	12.00	2457
0.500	1.00	2.00	409	3.125	6.25	12.50	2559
0.625	1.25	2.50	511	3.250	6.50	13.00	2661
0.750	1.50	3.00	614	3.375	6.75	13.50	2764
0.875	1.75	3.50	716	3.500	7.00	14.00	2866
1.000	2.00	4.00	819	3.625	7.25	14.50	2968
1.125	2.25	4.50	921	3.750	7.50	15.00	3071
1.250	2.50	5.00	1023	3.875	7.75	15.50	3173
1.375	2.75	5.50	1126	4.000	8.00	16.00	3276
1.500	3.00	6.00	1228	4.125	8.25	16.50	3378
1.625	3.25	6.50	1330	4.250	8.50	17.00	3480
1.750	3.50	7.00	1433	4.375	8.75	17.50	3583
1.875	3.75	7.50	1535	4.500	9.00	18.00	3685
2.000	4.00	8.00	1638	4.625	9.25	18.50	3787
2.125	4.25	8.50	1740	4.750	9.50	19.00	3890
2.250	4.50	9.00	1842	4.875	9.75	19.50	3992
2.375	4.75	9.50	1945	5.000	10.00	20.00	4095
2.500	5.00	10.00	2047	5.000	10.00	20.00	4095

Input Filter Time

Each analog input can have its own filter time. The filter integrates the value of the input signal over time to reject noise. Operation of the filter is shown below.



In controlled, noise-free environments, signals generated by clean, solid state electronics may be unnecessarily slowed by a filter, delaying system response. In such an environment, a longer filter time is not needed.

Selections are: none, 8, 16, 32, 64, 128, 256, 512, or 1024mS. For a new block, this is set to 128mS. To remove the filter, specify the unfiltered value (code 0, filter time = none).

Hand-held Monitor Configuration Steps

```

INPUT FILTR TIME
IN1      97
FILTER=  128mS
    tgl entr nxt
  
```

1. Line 3 shows the selected filter time. If this is not appropriate, press F2 (tgl) to change it.
2. To save the new selection, press F3 (entr).
3. Press F4 (next) to advance to the next configuration display.

Alarm Input Mode

Ordinarily, the block sends the current value of each input circuit, in engineering units, to the CPU. This is referred to as the analog block's normal mode of operation. For a new block, all inputs are set to operate in Normal Mode.

For some applications, it may be preferred to send an alarm status indication instead of the actual analog input value for one or more circuits. This is referred to as Alarm Input mode. In this mode, the analog value normally sent to the CPU is replaced by the value 0, 1, or 2 (decimal):

- 0 if the signal lies between the block's two alarm thresholds.
- 1 if the signal lies at or below the low alarm threshold.
- 2 if the signal lies at or above the high alarm threshold.

Hand-held Monitor Configuration Steps

```
ALARM INPUT 97
I I I I O O
N N N N X X
> tgl entr nxt
```

1. The screen displays the present input mode of all circuits. On this screen,
 N = normal input mode (analog value is reported).
 Y = Alarm Input mode (only alarm status is reported)
 X = the circuit is an output.
2. To select a circuit, press F1 (>).
3. To change the selection for a circuit, press F2 (tgl).
4. To save the new selection, press F3 (entr).
5. Press F4 (next) to advance to the next configuration display.

Alarm Thresholds

Each input circuit can have two unique Alarm Thresholds, one for a low engineering units value and one for a high value. Maximum values are " 32,767. The high threshold should be greater than the low threshold. Threshold limits are based on circuit scaling. If scaling is changed, review and readjust the Alarm Thresholds if necessary.

Alarm Thresholds may be used for either normal-mode or alarm-mode inputs (see above). In normal mode, if an input reaches one of the thresholds, the block sends the actual value and a LOW ALARM or HIGH ALARM message. The message identifies the circuit in alarm. Only one message is sent upon reaching the limit. Alarms do not stop the process or change the value of the input.

Alarm Thresholds can be set anywhere over the dynamic range of the signal. Typically, they are set at levels beyond which the input should not operate or levels beyond which alternate processing is required. They can also be set beyond the dynamic range of the signal, ensuring that they will never be activated.

Example 1:

A circuit is expected to report engineering unit values of -20 ft/sec (-6 m/sec) to +180 ft/sec (+50 m/sec). The high alarm is set at 150 ft/sec (+40 m/sec) and the low alarm at -25 ft/sec (-7.5m/sec).

If an input reached its high alarm, a new threshold could be set. This could generate a high-high alarm or an alarm-cleared threshold.

Example 2:

An Alarm Threshold is set at 150 ft/sec. Upon receiving an alarm message, the CPU changes the Alarm Threshold to 165 ft/sec by using a Write Configuration command and sends the appropriate Clear Circuit Fault command. No alarm message is sent upon changing the threshold unless the speed is greater than 165 ft/sec. If the speed is only 157 ft/sec but increasing, a second message would be sent at 165 ft/sec. Since these two diagnostic messages are the same, it would be necessary for the program to keep track of the level of the Alarm Thresholds and recognize this as a higher alarm than that received initially. At the same time, it could move the low alarm to 140 ft/sec and use this level to detect the end of the high alarm conditions.

Hand-held Monitor Configuration Steps

Line 3 first displays the low and high Alarm Thresholds for the block's first input.

```
ALARM INPUT 97
I1 LOW I1 HI
-10000 10000
> chg      nxt
```

1. To select the next circuit, press F1 (>) to move the cursor from LOW to HI, then press F1 (>) again.
2. To change the threshold shown at the cursor location, press F2 (tgl). To save the new selection, press F3 (entr).
3. Press F4 (next) to advance to the next configuration display.

Hold Last State

Each output can be configured to either hold its last value or go to its powerup default value if the block loses CPU communications for at least 3 bus scans.

For a new block, Hold Last State is disabled for both outputs. With Hold Last State disabled, the block sets the output to its powerup default if CPU communications are lost.

If Hold Last State is enabled, the block continues to hold the output at its current value instead of setting it to the powerup default.

Outputs remain in their last value or default indefinitely or until one of the following occurs:

- Communications with the CPU are restored.
- The Hand-held Monitor changes the output by forcing it.
- Power is removed from the block.

Hand-held Monitor Configuration Steps

```

HOLD LAST ST 97
I I I I O O
Y Y Y Y N N
> tgl entr nxt

```

1. The screen displays the current Hold Last State configuration of all outputs. On this screen,
 - X = the circuit is an input.
 - Y = the circuit is configured to hold last its value.
 - N = the circuit is configured to go to its default value (configured on the next HHM screen)
2. To select a circuit, press F1 (>).
3. To change the selection for a circuit, press F2 (tgl).
4. To save the new selection, press F3 (entr).
5. Press F4 (next) to advance to the next configuration display.

Output Default Value

An output goes to its powerup default value when the block is first powered up. For a new block, the output default value for each output is 0.

If Hold Last State is NOT enabled, the block will also default the output if CPU communications are lost. On a non-redundant system, this occurs approximately 250mS after the third bus scan passes with no CPU communications. If the block is on a redundant bus downstream of a Bus Switching Module, more time is needed. . (Additional default time for redundancy is explained on page 10-21).

Hand-held Monitor Configuration Steps

Line 3 shows the default value of the block's first output.

```
OUTPUT DEFAULT
OUT1 97- 112 0
DEFAULT:      0
> chng      nxt
```

1. To select the other output, press F1 (>).
2. To change a default, press F2 (chng) then enter the new value.
3. To save the new value, press F3 (entr).
4. When you are ready to advance to the next configuration screen, press F4 (next).

BSM Present

If the block is connected to a single bus or to just one trunk of a dual bus, BSM Present should be set to NO.

Select YES if the block is located in a cluster connected to dual busses via a Bus Switching Module.

Hand-held Monitor Configuration Steps

```
BSM PRESENT ?
REF 97— 128A
STATUS = YES
    tgl entr nxt
```

1. To change the configuration, press F2 (tgl).
2. To save the new selection, press F3 (entr).
3. Press F4 (next) to advance to the next configuration display.

Output Default Time

When a Bus Switching Module is used, the Output Default Time must be long enough to allow the BSM to switch without causing outputs to default. Therefore, when BSM Present is selected (above), the block automatically changes its Output Default Time from 3 bus scans to 2.5 seconds.

If Hold Last State was selected, outputs will remain in their last value while the BSM switches, instead of defaulting, so there is no need to change this selection.

If Hold Last State was set to NO for any output on a block, and total bus scan time will exceed 100mS, change this selection to 10 seconds.

Hand-held Monitor Configuration Steps

```
OUTPUT DEF.TIME
REF 97— 128A
TIME = 2.5 SECS
    tgl entr nxt
```

1. To change the configuration, press F2 (tgl).
2. To save the new selection, press F3 (entr).
3. Press F4 (next) to advance to the next configuration display.

CPU Redundancy

The block can be configured for No Controller redundancy or Hot Standby redundancy. For new blocks, it is set for No Controller Redundancy. It must be changed only if the block should be able to receive output data from two CPUs.

In Hot Standby mode, a block receives output data from both CPUs but uses the data from only one of them to drive its outputs. The block prefers outputs sent by the bus interface module (Bus Controller or PCIM) with Device Number 31. If those outputs are not available, the block will use outputs from the bus interface module with Device Number 30. If no outputs from a CPU are available, a Genius I/O block's outputs will either Hold Last State or go to their predefined Output Default state.

Hand-held Monitor Configuration Steps

```

CPU REDUNDANCY
REF  97— 128A
HOT STBY MODE
    tgl entr nxt
  
```

1. To change the current selection, press F2 (tgl).
2. Press F3 (entr) to save the new selection.
3. Press F4 (next) to advance to the next configuration display.

Configuration Protection

After the block is configured, its Configuration Protection should be enabled to prevent unwanted changes (from a Hand-held Monitor and from the CPU). Configuration Protection can only be set and removed by a Hand-held Monitor. For a new block, Configuration Protection is disabled.

Hand-held Monitor Configuration Steps

```

CONFIG PROTECT
REF  97— 128A
DISABLED
    tgl entr nxt
  
```

1. To change the current selection, press F2 (tgl).
2. Press F3 (entr) to save the new selection.
3. Press F4 (next) to return to the first configuration display.