Engineer's Guide

SMART TRAC™ PG Card

MagneTek, Inc. - Drives & Systems Division

Contents

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Important Safety Information

Warnings, Cautions and Notes

WARNING

A statement of conditions which MUST BE OBSERVED to prevent personal injury or death.

WARNING - ESD

A statement of conditions which must be observed to prevent damage to components due to ESD (ElectroStatic Discharge) and to prevent personal injury or death.

CAUTION

A statement of conditions which must be observed to prevent undesired equipment faults, Smart Trac AC1 system degradation and damage to equipment.

IMPORTANT

A statement of conditions which should be observed during Smart Trac AC DeviceNet setup or operation to ensure dependable service.

NOTE: Notes indicate information that is in addition to a discussion of the topic in adjoining text. Alternatively, it may limit or restrict the paragraph(s) that follow(s) to specific models or conditions.

TIP - Tips indicate information that should make a procedure easier or more efficient.

General Safety Precautions - Warnings

Important safety information follows. Please *read and understand* all precautions listed below before proceeding with the specification, installation, set-up or operation of your Smart Trac AC1. Failure to follow any of the following precautions may result in personal injury or death, or damage to the equipment.

WARNING - ESD

The Control Printed Circuit Board (PCB) employs CMOS Integrated Circuits that are easily damaged by static electricity. Use proper ElectroStatic Discharge (ESD) procedures when handling the Control PCB. See Smart Trac AC1 Technical Manual for details. Failure to comply may result in damage to equipment and/or personal injury.

Important Warranty Information.

Do not modify your Smart Trac AC1, its components, or any of the procedures contained in the technical documentation supplied by MagneTek. Any modification of this product by the user is not the responsibility of MagneTek and will void the warranty.

Using the Smart Trac PG Card

Basic Features

The Smart Trac PG card has:

- Two encoder inputs for closed loop flux vector control, closed loop speed control and position control.

- Digital inputs (if not needed for position control).

- Analog inputs to accommodateload cells or potentiometers.

See the diagram "Smart Trac PG Card Functions" for more information.

Monitor Output

Using function blocks, you can echo one of the encoder inputs to another drive. Connect Terminal Block J6 to the encoder input of another drive in the system.

In a Smart Trac AC1 system, for example, you might choose to provide the encoder feedback of drive No. 1 to the other drives in the system. You can connect the Monitor Output of Smart Trac AC1 No. 1 to the follower encoder input of Smart Trac AC1 No.2. Configure No.1's Monitor Output to echo the feedback encoder input using a function block.

Next, you connect the Monitor Output of Smart Trac AC1 No. 2 to the follower encoder input of No. 3 and cofigure No. 2's Monitor Output to echo the follwer encoder input using a function block. This effectively use the Smart Trac PG card as a buffer.
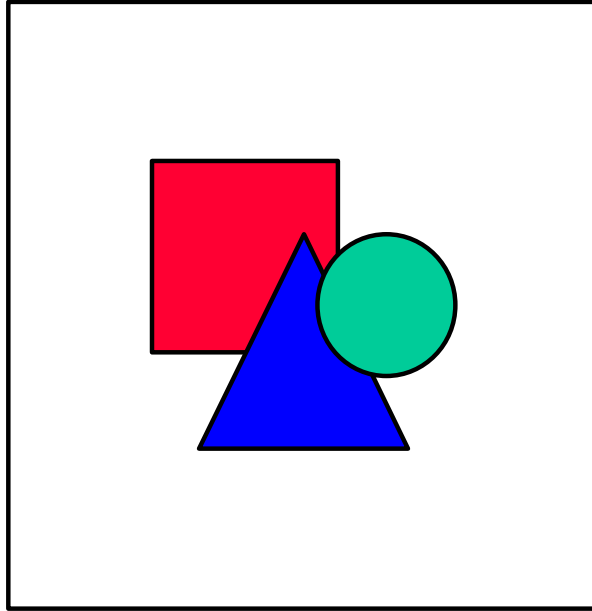
Figure 1. Using the Smart Trac PG card to Monitor Feedback and Follower Encoders.

Use with Function Blocks

You may use the Smart Trac PG card with three library function blocks provided with your Smart Trac Workstation software: PG_ANALOG_IN, PG_TACH, and PG_DELTA_P.

NOTE: Use of these function blocks requires Smart Trac Workstation software. These blocks perform functions normally associated with an interface card and are used instead of configuring the Smart Trac PG card as an interface card.

Using function blocks in software instead of treating the PG card as an interface card and using a driver provides more precise control over the reading of an encoder or analog input. Reading signals (used as feedback elements) immediately before executing the regulator function enhances the stability of a regulator. A delay of even 1 or 2 milliseconds can adversely affect drive stability, especially when high bandwidth is required.

All three Smart Trac Workstation library function blocks associated with the Smart Trac PG card must use port 1.

- PG_ANALOG_IN – converts and reads one of two analog input channels on the Smart Trac PG card.

- PG_TACH – selects channel 0 (feedback) or channel 1 (follower) encoder channels as the source of its input. Use this function block with quadrature encoders connected to the Smart Trac PG card.

- PG_DELTA_P – Accumulates encoder pulses between two events, a start pulse and a stop pulse.

You will find details on these function blocks in "*Smart Trac Function Blocks*" online help, available while in Smart Trac Workstation's Function Block Editor.
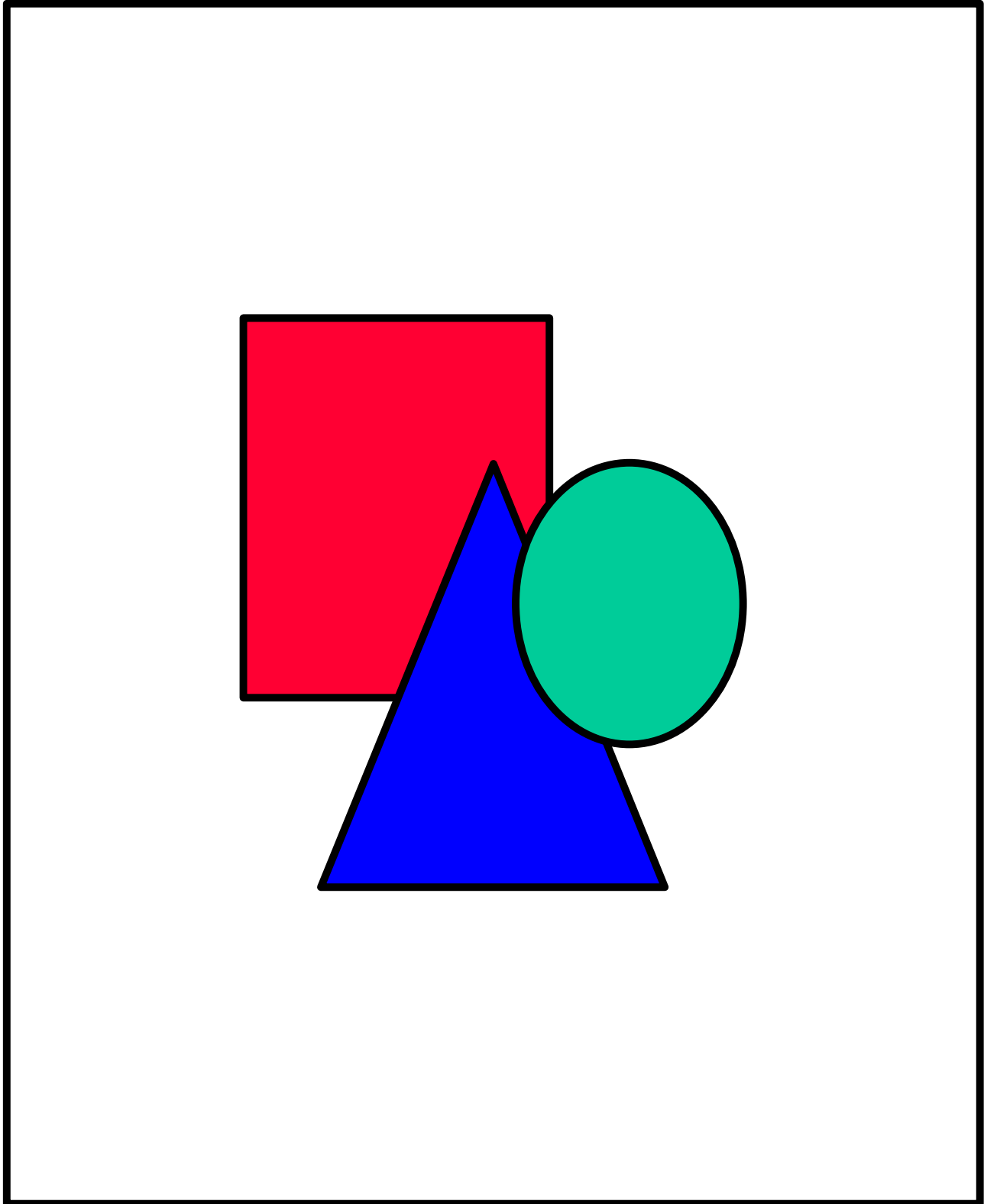
Figure 2. Smart Trac PG Card Functions

Using Function Blocks with the Smart Trac PG Card

Introduction to Function Block Examples

The function blocks described in this section have been used in actual applications. An example of how each has been used follows. By understanding how the function blocks work in these real-world applications, you can apply the knowledge gained to your own situations.

Included in the examples are examples of how the PG_ANALOG_IN, PG_TACH, and PG_DELTA_P function blocks have been used.

- PG_ANALOG_IN – converts and reads one of two analog input channels on the Smart Trac PG card.

- PG_TACH – selects channel 0 (feedback) or channel 1 (follower) encoder channels as the source of its input. Use this function block with quadrature encoders connected to the Smart Trac PG card.

- PG_DELTA_P – Accumulates encoder pulses between two events, a start pulse and a stop pulse.

PG_ANALOG_IN Example Usage

This block allows reading one of two analog-to-digital converters on the Smart Trac PS card. Multiple instantiations of this block may be programmed to read the same analog channel in separate tasks.

This particular example demonstrates the use of the PG_ANALOG_IN function block with a line speed potentiometer as an analog input to the Smart Trac AC1. The potentiometer is physically wired to the Analog Input at Port 1, Channel 0. You may connect this input to any analog device, not just a line speed indicator.

To calibrate the incoming Analog Reference Signal, the function block uses the Line Speed Span and Line Speed Zero inputs. The Analog Input can vary from 0-10 VDC, depending on the setting of the Line Speed Potentiometer. The Smart Trac PG card converts the 0-10 VDC signal to a PU Value of 0-1.0.
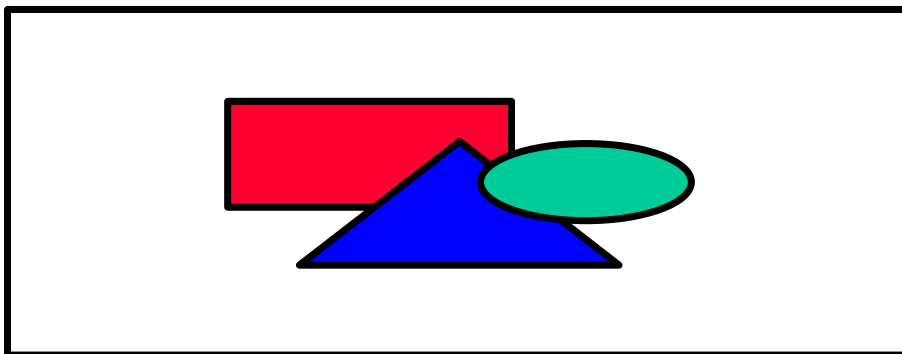
The PG_ANALOG_IN function block.

Required Values

Use600mvInput – If 1, or true, the 600mvInput may be used. If 0, the digital +10V input is used. In the example of the **PG_ANALOG_IN** function block, the line speed potentiometer uses the digital input, not the 600 mv input. This requires that **Use600mvInput** is set to zero, or false.

Each analog input has two sets of connections, one set is used for +/- 10-volt maximum signals and the other set is for +/- 600-millivolt signals. Refer to the *Smart Trac PG Card Technical Manual* for the terminal designations for each of these inputs. When this logic input is set to logic true, it expects that the signal is input via the 600-millivolt set of connections. When logic false, it expects the signal is input via the 10 volts set of connections.

PortNumber – If 0, port 0 is used. If 1, port 1 is used.

A port number assignment is required on the Smart Trac PG card to identify it to the Smart Trac controller card. This port number is set via a set of switches on the Smart Trac PG card. Refer to the *Smart Trac PG Card Technical Manual* for instructions on setting these switches.

This input identifies to the software the port number assigned to the Smart Trac PG card. This input is an integer in the range of 0 to 3. Setting a number outside that range or a number that disagrees with the setting of the switches on the card will result in the generation of a Tach Card fault and no output from this block.

ChannelNumber – If 0, channel 0 is used on the selected port. If 1, channel 1 is used on the selected port.

Each Smart Trac PG card is supplied with two analog to digital converters. This input identifies which of those converters should be read by this instantiation of this function block. This input expects an integer with a value of 0 or 1. Setting a value outside this range will result in the generation of a Tach Card fault and a zero output from this block.

Span – The *span* is the difference in the hexadecimal values at maximum line speed with each type of input. It indicates the slope of the line-speed curve and it corrects gain error.

This numeric input determines the magnitude of this blocks output when the analog signal is at its defined maximum value (i.e. 10 volts or 600 mv depending on which input is used).

Zero – The *zero* is used to calibrate the input. It indicates the intercept of the line-speed curve. It is a second, or *offset*, value applied to Analog-to-Digital conversion errors.

This numeric input allows adjustment of any offset in the analog signal.

TriesBeforeFault (not shown in example) - Variable for number of times the analog converter tries to make an analog-to-digital conversion before a fault occurs.

If this input is not addressed, or set to a value less than 2, the block will default to 2 tries. If set greater than 10, the block will use a maximum of 10 tries. Regardless of the value (set number of tries), the block will use the allotted number of tries to get a succesful conversion. If it does not get a succesful conversion in the allotted number of tries, it will declare the fault. The output of the block will be set to the last known valid conversion value.

In this example, the default of two tries will be used before a fault is declared.

Optional Values

Output - This is the value read by the analog-to-digital converter, modified by the Span and Zero inputs.

PG_TACH Example Usage

The PG_TACH function block receives digital tachometer information as the number of forward or reverse pulses accumulated since the last scan. The tachometer is physically wired to the Analog Input at Port 1, Channel 0.

This block allows reading one of two incremental encoders connected to the Smart Trac PG card. Multiple instantiations of this block may be programmed to read the same encoder in separate tasks. The card expects a quadrature type incremental encoder and includes built in times-four logic.

PG_TACH converts tachometer information to outputs "PerUnitSpeed" or "IntegerPulses." The "PerUnitSpeed" output unitizes the tachometer feedback. The "Integer Pulses" output contains the raw counts of the digital tachometer.
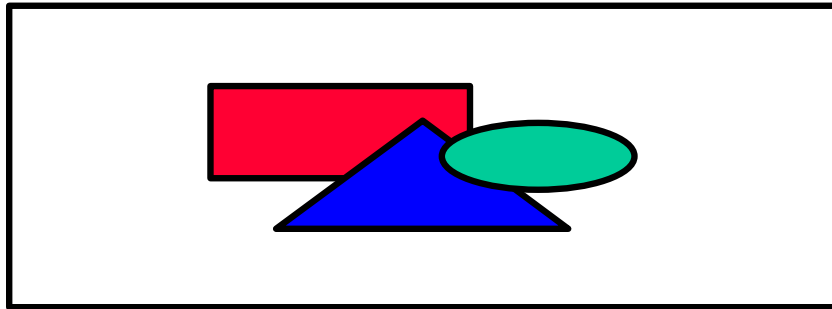
The PG_TACH function block.

Inputs

PortNumber - A port number assignment is required on the Smart Trac PG card to identify it to the Smart Trac controller card. This port number is set via a set of switches on the Smart Trac PG card. Refer to the *Smart Trac PG Card Technical Manual* for instructions on setting these switches. This input identifies to the software the port number assigned to the Smart Trac PG card. This input is an integer in the range of 0 to 3. Setting a number outside that range or a number that disagrees with the setting of the switches on the card will result in the generation of a Tach Card fault and no output from this block. The example above uses Port 1, the normal address of the first Smart Trac PG Card installed.

ChannelNumber - Each Smart Trac PG card is supplied with hardware to read two incremental encoders. This input identifies which of those encoders should be read by this instantiation of this function block. This input expects an integer with a value of 0 or 1. Setting a value outside this range will result in the generation of a Tach Card fault and a zero output from this block. The example above uses Channel Number 0.

TachCounts - This input identifies the number of pulses per revolution produced by the incremental encoder. The value input here is the number of pulses per revolutions prior to applying the times-four logic. This input should be an integer value.

RatedSpeed - The speed in RPM that will produce a 1.0 Per Unit output from this function block.

Monitor Channel - Allows selection of encoder channel 0 (logic 0) or channel 1 (logic 1) to be steered to monitor output. The example above uses Monitor Channel 0 since the it monitors the only encoder channel being used, channel 0.

Outputs

PerUnitSpeed - The Per Unit speed as measured by the incremental encoder and modified by the defined setting of the "TachCounts" and "RatedSpeed" inputs.

IntegerPulses - This is the total number of pulses (after application of the time's four logic) in the previous task period. This is the net number of pulses (i.e. the difference between the number of forward and reverse pulses generated by the incremental encoder). This output may be used in gearing type logic.

PG_DELTA_P Example Usage

The PG_DELTA_P function block has been used to control registration functions on printing presses that print individual images. The images must align with each other very closely so that they are "in registration." They must also align with a machine that cuts the web into into segments with the printed images centered in the segments.

To do this, each printer has a proximity switch physically wired into logic channel 0 and logic channel 1 of the Smart Trac PG card. Each proximity switch generates one pulse for each image printed.

An encoder, located on the machine that cuts the web into segments, has a marker pulse that is output and rotates once for each web segment cut.

The Smart Trac Workstation software obtains "Color 1" and Color 2" press phase angle information in the following sequence of events (Color 1 information only described below):

1. Input PG_DELTA_COLOR_1_RESET clears the channel 1 counter when it goes high.or arms the channel 1 counter when it goes low.

2. Output PG_DELTA_COLOR_1_READY goes low.

3. Output PG_DELTA_COLOR_1_OFFSET becomes 0.

4. The cutter encoder marker pulse starts the Channel 1 counter.

5. The Channel 1 counter counts the cutter encoder pulses (20,000 counts per revolution off a 5,000 pulse per revolution encoder) until the Color 1 proximity switch on the rotating plate cylinder closes.

6. Output PG_DELTA_COLOR_1_READY goes high and output PG_DELTA_COLOR_1_OFFSET becomes a number between 0 and 20,000.

7. The Smart Trac software calculates the Color 1 printer phase angle with respect to the cutter.
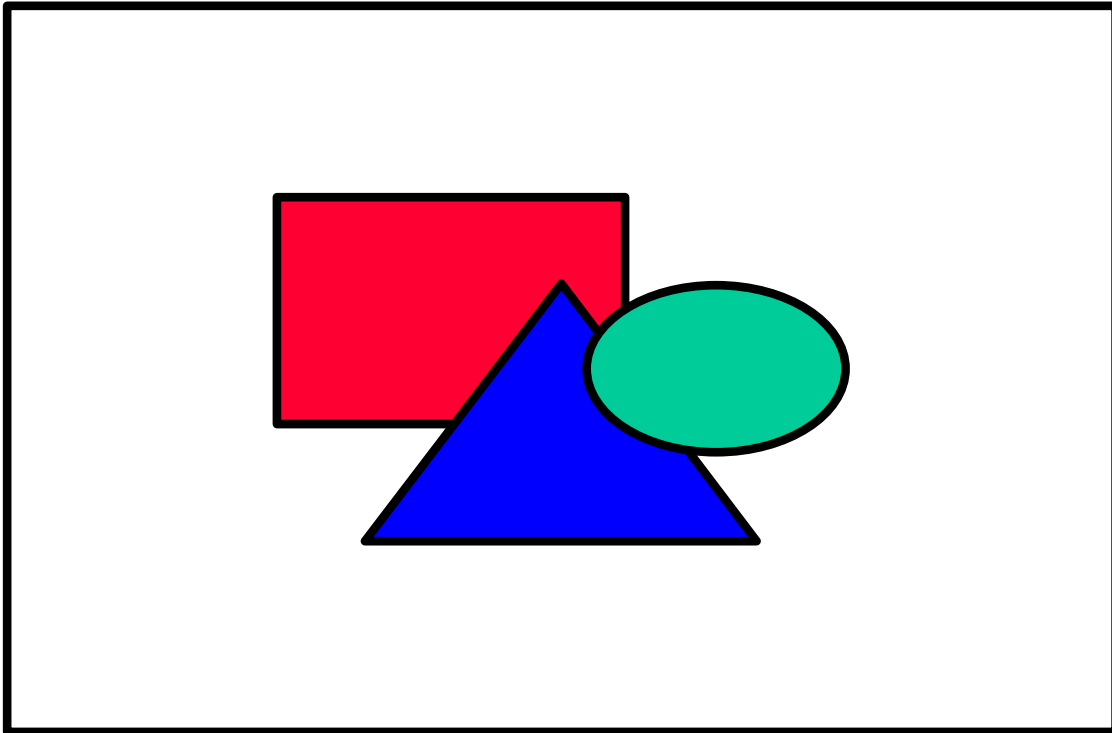
The PG_DELTA_P function block.

NOTE: The PG_DELTA_P function block may also be used to read the state of logic inputs.

A start pulse and a stop pulse determine the time frame of the accumulation. You may program the function block to specify the input source of the stop and start pulses. Start and stop pulses may be from either of two hardware logic inputs or the marker pulse from either of the two pulse encoders the board supports.The values given to start and stop source inputs determine the stop and start source. You may assign one of four values to source inputs:

1 = Logic Input 0
2 = Logic Input 1
3 = Index Pulse from channel 0 encoder (feedback encoder)
4 = Index Pulse from channel 1 encoder (follower encoder)

Any value entered other than 1-4 will result in no assignment for the channel and generates a minor fault.

Counters may count either A leading B pulses or B leading A pulses. If Chn_0_B_Leads_A is logic false and a start pulse has been received, the count is made of the rotational direction which causes A pulses to lead B pulses. Pulses where B pulses lead A pulses are not counted. Likewise, if Chn_0_B_Leads_A is logic true and a start pulse has been received, the count is made of the rotational direction which causes A pulses to follow B pulses. Pulses where A pulses lead B pulses are not counted.

Chn_0_Enable - If logic 0 (false), the function block uses SW_Start and SW_Stop logic inputs for channel 0. A true going edge causes the counter to be reset and look for a start pulse.

Chn_0_SW_Start - When Chn_0_Enable is logic 0, it allows producing a start pulse when it receives the first true going edge.from the Chn_0_Enable..

Chn_0_SW_Stop - When Chn_0_Enable is logic 0, it allows producing a stop pulse when it receives the first true going edge from the Chn_0_Enable.

Chn_0_B_Leads_A - Determines polarity of pulse accumulation on channel 0.

ResetChn_0 - A true going edge causes the associated counter to be reset to zero.

Chn_0_Start_Source - Assigns the source of the start pulse on channel 0 according to a value of 1-4 as described in the introductory paragraph above.

Chn_0_Stop_Source - Assigns the source of a stop pulse on channel 0 according to a value of 1-4 as described in the introductory paragraph above.

Chn_0_Counts_Fbk_Tach - Determines which pulse is used for channel 0 pulse accumulation.

Chn_1_Enable - If logic 0 (false), the function block uses SW_Start and SW_Stop logic inputs for channel 1. A true going edge causes the counter to be reset and look for a start pulse.

Chn_I_SW_Start - When Chn_1_Enable is logic 0, it allows producing a start pulse when it receives the first true going edge from the Chn_1_Enable.

Chn_1_SW_Stop - When Chn_1_Enable is logic 0, it allows producing a stop pulse when it receives the first true going edge from the Chn_1_Enable.

Chn_1_B_leads_A - Determines polarity of pulse accumulation on channel 1.

ResetChn_1 - A true going edge causes the associated counter to be reset to zero.

Chn_1_Start_Source - Assigns the source of the start pulse on channel 1 according to a value of 1-4 as described in the introductory paragraph above.

Chn_1_Stop_Source - Assigns the source of a stop pulse on channel 1 according to a value of 1-4 as described in the introductory paragraph above.

Chn_1_Counts_Follow_Tach - Determines which pulse is used for channel 0 pulse accumulation.

Debounce_Logic_Out - If logic 1, determines that logic input Chn_0_Enable should be software debounced.

PortNumber - Defines the bus address of the Smart Trac PG Card to the function block. Since the card is normally port "1", the value for this input must be "1".

Chn_0_DataReady - Set true when channel 0 first receives a start pulse and a stop pulse, indicating that the data on the DATA output is new data. It stays true until the user program acknowledges receipt of that data by producing a true going edge on the Chn_0_Enable input. A true going edge on Reset_Chn_0 resets this input.

Chn_0_Data - Holds the total number of accumulated pulses on channel 0 between the start and stop pulses to a maximum of 4,294,967,295. If a stop pulse is not received before reaching the maximum, the counter is reset to 0 and starts accumulating pulses again.

Chn_1_DataReady - Set true when channel 1 first receives a start pulse and a stop pulse, indicating that the data on the DATA output is new data. It stays true

until the user program acknowledges receipt of that data by producing a true going edge on the Chn_1_Enable input. A true going edge on Reset_Chn_1 resets this input.

Chn_1_Data - Holds the total number of accumulated pulses on channel 1 between the start and stop pulses to a maximum of 4,294,967,295. If a stop pulse is not received before reaching the maximum, the counter is reset to 0 and starts accumulating pulses again.

Chn_0_Counting - If logic 1, Indicates that channel 0 is counting pulses. When it receives a stop pulse, it stops counting pulses and is a logic 0.

Chn_1_Counting - If logic 1, Indicates that channel 1 is counting pulses. When it receives a stop pulse, it stops counting pulses and is a logic 0.

Logic_Chn_0 - An output which indicates the status of the corresponding logic input for channel 0, either de-bounced or not de-bounced, dependent on the "Debounce_Logic_Out" input.

Logic_Chn_1 - An output which indicates the status of the corresponding logic input for channel 1, either de-bounced or not de-bounced, dependent on the "Debounce_Logic_Out" input.

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Troubleshooting the Smart Trac PG Card

Introduction

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Glossary of Terms

encoder	A device that changes one digital code to another digital code.
instantiations	An abstract representation of a concrete instance.
quadrature	An encoder output of two channels, one of which is 90 degrees out of phase with the other. The phase relationship changes depending on the direction of rotation.

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