CT6000<br>Programmable Process Counter Installation \& Operation Manual



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# Model CT6000 <br> Programmable Process Counter Installation and Operation Manual 

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Revision D

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## Introduction To This Manual

| What is in this | This installation and operation manual provides detailed technical information about <br> the CT6000 Programmable Process Counter. It should serve as your technical <br> manual? |
| :--- | :--- |
| resource to install, set up, operate, and test the CT6000 Process Counter. |  |

Who should use this manual (audience)

Knowledge level

Notices

- Installing Electro-Sensors, Inc., products is the responsibility of the purchaser, and is in no way guaranteed by Electro-Sensors, Inc.
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## How this manual is organized

Manual
navigation tools

This manual contains the following navigation tools:

- Table of contents
- Beginning section table of contents
- Index

Each element is designed to help you find the information that you need quickly.

## Manual sections

This manual is divided into the following sections:

- Section 1: Warnings and Cautions, discusses personal injury possibilities and potential damage to equipment.
- Section 2: CT6000 Installation, discusses installing the CT6000 into a panel.
- Section 3: CT6000 Wiring and DIP Switches, discusses practical wiring practices, wiring schematics, and configuring DIP switches.
- Section 4: CT6000 Setup, discusses the CT6000 parts and functions, and set up information.
- Section 5: CT6000 Programming, discusses programming the operational variables of the CT6000.
- Section 6: CT6000 Diagnostics, discusses the tests used to verify the operation and functionality of the CT6000.
- Appendix A: CT6000 Specifications, discusses the device specifications.
- Appendix B: Variables Worksheet.


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## Section 1

## Warnings \& Cautions

## Introduction

This section discusses warnings and cautions to guard against the possibility of injury to persons and damage to equipment. Since the CT6000 monitors the process, batch, totals, rate, and direction of various mechanical systems, observe all warnings and cautions that pertain to the mechanical system that the device monitors as well.

In this section These are the topics:

| Topic | See Page |
| :--- | :---: |
| About warnings and cautions | 2 |
| Warnings | 3 |
| Cautions | 4 |

About warnings and cautions

Important
notice

Definitions Warnings are given when there is the possibility of injury to persons.
Cautions are given when there is the possibility of damage to equipment.
The warning label will appear as follows:
Warning
The caution label will appear as follows:
Caution

Continued on next page

## Warnings

## Warning

Always turn the power source OFF before wiring the CT6000. Failure to observe this warning could result in an electrical shock or damage to the equipment.

## Warning

During a Stop condition, any slight movement of the shaft or magnetic disc could activate the control relay and start a motor. To prevent starting the motor accidentally, always use proper LOCKOUT, TAG OUT procedures. Failure to observe this warning could result in an injury to persons or damage to equipment.

## Warning

Do not touch the Pulser Disc or Wrap while it is spinning. Failure to observe this warning could result in a hand injury.

## Warning

Always wear protective eye goggles when using power tools. Failure to observe this warning could result in an eye injury or blindness.

## Warning

Practical wiring practices must be followed when wiring industrial equipment such as the CT6000. Failure to follow practical wiring practices could result in an injury to persons or damage to equipment.

## Warning

The CT6000 is a programmable process counter and must be installed by qualified personnel only. Failure to observe this warning could result in an injury to persons or damage to equipment.

## Warning

Only qualified personnel should attempt to connect any wires to the CT6000. Failure to observe this warning could result in an injury to persons or damage to equipment.

## Cautions

## Caution

Power to sensors is provided at TB2-6 (+12 VDC) and TB2-5 (common) on the CT6000. Wiring to those inputs should be shielded cable with the shield tied to TB2-5 common only. Failure to observe this caution could result in improper sensor operation.

## Caution

Always turn the power source OFF before wiring the CT6000. Failure to observe this caution could result in damage to the CT6000.

## Caution

Never use shielded cable with extra conductors. Extra conductors can act as antennas, picking up electrical noise. Failure to observe this caution could result in improper sensor operation.

## Caution

The CT6000 standard uses 115 VAC, 6 VA @ 60/50 Hz, with 230 VAC and 10-30 VDC as an option. Make sure you know the correct supply voltage before applying power to the CT6000. Failure to observe this caution could result in damage to the CT6000.

## Caution

Do not touch the Pulser Disc or Wrap while it is spinning. Failure to observe this caution could cause an interruption in pulse generation, resulting in a disruption in the mechanical process being monitored.

## Caution

When the digital input function is programmed as a Reset input, and the switch input remains closed, the relay will never turn OFF regardless of the operating condition. A momentary contact closure of the switch is advised. Failure to observe this caution could result in damage to the equipment.

## Caution

Only qualified personnel should attempt to connect any wires to the CT6000. Failure to observe this caution could result in damage to the equipment.

## Section 2

## CT6000 Installation

## Introduction

This section discusses unpacking and then installing the CT6000 into a panel.

In this section These are the topics:

| Topic | See Page |
| :--- | :---: |
| Installation overview | 6 |
| Installing the CT6000 | 7 |

## Installation overview



The CT6000 is a programmable process counter and must be installed by qualified personnel only. Failure to observe this warning could result in an injury to persons or damage to equipment.

After
unpacking the CT6000

Tools and materials

After unpacking the CT6000, save the following items:

- Packing list
- All instructions and other documentation

Verify that all parts were shipped via the packing list.

To accomplish the CT6000 installation, obtain the following tools and materials:

- Safety glasses
- Power drill
- Drill bit (\#21)
- Loctite or similar adhesive
- Gap-measuring tool
- Standard electrician's tools


## Installing the CT6000

Panel cutout To install the CT6000 into an instrument panel, do the following:

| Step | Action |
| :---: | :--- |
| 1. | Cut a rectangular hole in the panel to the dimensions shown in Figure 1. |
| 2. | Loosen the screws holding the mounting bracket to the CT6000 and <br> remove it, as shown in Figure 1. |
| 3. | Slide the CT6000 into the cutout. |
| 4. | Replace the mounting bracket and tighten the screws-do not over <br> tighten. See Figure 1. |

Note: Allow a minimum of 1.5 inches of clearance on all sides of the CT6000 (all dimensions are in inches).


Figure 1: CT6000 Dimensions

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## Section 3

## CT6000 Wiring \& DIP Switches

## Introduction

This section discusses electrical information concerning the CT6000, including wiring practices, wiring schematics, and DIP-switch settings.

In this section These are the topics:

| Topic | See Page |
| :--- | :---: |
| Recommended wiring practices | 10 |
| CT6000 wiring schematics | 11 |
| $4-20 \mathrm{~mA}$ or 0-10 Vdc analog outputs | 12 |
| Switch input wiring | 13 |
| Single channel and quadrature signal wiring | 14 |
| A and B channel input signal wiring | 15 |
| CT6000 DIP switch settings | 16 |

## Recommended wiring practices

Wiring practices

The following is a list of practical wiring practices for installing industrial equipment. It is critically important that you observe and follow these wiring practices when wiring the CT6000.

- All control signals must be shielded cable. The shield must be tied to common or earth ground at the receiving end only. In some environments, earth ground could contain excessive electrical noise. If you encounter problems using earth ground as a shield-tie point, switch the shields to signal common. All connections to the controller are considered signal, unless they carry AC voltage.
- Never use a shielded cable with unused conductors. The unused conductors act as antennas. Attempting to tie the unused conductors to ground or other signalcarrying wires will create different antenna configurations. In many cases, an unshielded wire could be less susceptible to electrical noise. Always make sure that a shielded cable with the correct number of conductors is used.
- All control signals must be separated from power wires. Power wiring includes any AC or DC wires carrying voltages with a current potential of greater than one (1) amp or a voltage greater than 24 volts. This includes, but is not limited to, $115 \mathrm{VAC}, 230 \mathrm{VAC}$, and 460 VAC . Do not bundle shielded cables and power wires together.
- Do not run signal cables along high magnetic or electrostatic generators. This includes, but is not limited to, motors, fans, contactors, igniters, etc. Aluminum shielded cable does not stop magnetically induced noise; braided shielded cable only partially reduces magnetically induced noise.
- An earth ground wire must be installed on microprocessor-based equipment when required. Do not rely on the enclosure's contact with the panel for earth ground. Earth ground is often used in noise-rejection circuitry as well as for safety.
- Contactors, solenoids, and relay coils connected to the same AC power source, or in the same enclosure panel as the controller, must be suppressed with a capacitor-resistor filter across the coil. These can be made with a 1 kV capacitor and a $1 / 4$-watt resistor in series, or they can be purchased in a pre-made package. Use a capacitance value of 0.1 microfarad or larger and a resistance value of 500 ohms or less.
- When stepped-down AC voltage is use with equipment, a capacitor/resistor network or a filter should be placed across the secondary.


## CT6000 wiring schematics

## Warning

Only qualified personnel should attempt to connect any wires to the CT6000. Failure to observe this warning could result in an injury to persons.

## Caution

Do not wire the CT6000 to 230 VAC , 10-30 VDC unless it has been specially wired for that voltage. The standard voltage setting is 115 VAC. Failure to observe this caution could result in damage to the CT6000.

Wiring schematic

Figure 2 shows the various aspects of wiring the CT6000.


Figure 2: CT6000 Wiring

Note: Power for the switch inputs must be the same as the power supplied to the CT6000

## 4-20 mA or 0-10 VDC analog output

4-20 mA or
0-10 VDC
analog output

The 4-20 mA analog output supports a maximum load resistance of $500 \Omega$. The analog output plus (+) signal is at TB4-7, and the negative $(-)$ signal is at TB4-8, as shown in Figure 3.
See the Diagnostics section for additional information about the analog outputs.


Figure 3: Wiring for Optional Analog Outputs 4-20 mA / 0-10 VDC

Power wiring The standard CT6000 standard comes setup for $115 \mathrm{VAC}, 6 \mathrm{VA}$ at $50 / 60 \mathrm{~Hz}$. An external $\mathbf{1 / 1 6} \mathbf{~ a m p}$ slow-blow fuse must be provided by the customer. Connect AC power to TB1-1, Line (+), and TB1-2, Neutral (-). See Figure 4. 230 VAC and 1030 VDC can also be ordered as an option. Fuse according to Appendix A.

Figure 4: AC/DC Power and Switch Wiring

## Switch input wiring

## Switch inputs and wiring

There are three (3) programmable switch inputs for variable 18. They are used to Reset the outputs, or to freeze the display. Inputs 1,2 , and 3 require a voltage equal to the supply voltage, which is at the same potential as the input Line (L1), (+DC) voltage. The opposite sides (non accessible) of these solid-state inputs are tied to input Neutral (L2), (-DC). Wire input 1 to TB2-1, input 2 to TB2-2, and input 3, to TB2-3. See Figure 5.


Figure 5: Wiring For Switch Inputs

## Single-channel and quadrature signal wiring

Signal types

There are two (2) signal types: Single Channel and Quadrature:

- Single Channel - Rate information is provided by a single-pulse generator connected to channel A, input terminal, TB2-7.
- Quadrature - Quadrature signals are configured for speed and direction. Sensor wiring is across TB2, 7 and 8 . Rate information is provided by a two-channel quadrature pulse generator with a $90^{\circ}$ phase shift between the signals, as shown in Figure 6.


Figure 6: Two-Channel Quadrature Signals $90^{\circ}$ Phase Shift

| A and B | These inputs require a frequency input relative to speed. Devices such as Hall-Effect |
| :--- | :--- |
| channel input | sensors, encoders, or magnetic pickups can be used. Voltage to these sensors is from |
| signals | TB2-6 $(+12 V D C)$ and TB2-5 (common). The maximum current draw available is |
|  | $100 \mathrm{~mA} @ 12 \mathrm{VDC}$, unregulated. |

## $A$ and $B$ channel input signal wiring

A and B channel input signal wiring

Wiring to channel inputs A and B must be shielded cable, with the shield tied to TB2-5 common only. TB2-7 is the single-channel A input signal, and TB2-8 is the channel B input signal.


Figure 7: Wiring for Channels A and B Input Signals

## CT6000 DIP switches

Sensor DIP switches

The sensor DIP switches are located on the bottom of the CT6000, as shown in Figure 8. Sensor input and switch information is shown in Table 1.

Table 1: Sensor Input Configuration DIP Switches

| Input | Channel A TB2-7 |  |  |  | Channel B TB2-8 |  |  |  |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Input Type | NPN | PNP | Mag. 2 <br> Wire | Logic <br> Level | NPN | PNP | Mag. 2 <br> Wire | Logic <br> Level |
| Switch ON | 7 | 8 | 5,6 | None | 3 | 4 | 1,2 | None |
| Switch OFF | $5,6,8$ | $5,6,7$ | 7,8 | 5,6 | $1,2,4$ | $1,2,3$ | 3,4 | $1,2,3,4$ |

## Notes:

- When using Quadrature feedback, set switch position 9 to OFF.
- When using single channel mode, turn the inactive channel to PNP, and set switch position 9 to ON.

Quadrature ESI dip-switch settings

Since all 3-wire sensing devices produced by Electro-Sensors, Inc., are NPN open collector, for standard Quadrature operation switch positions 3 and 7 are set to ON, and all others are set to OFF, as shown in Figure 8.


Figure 8: Quadrature ESI Dip-Switch Setting

## CT6000 DIP switches, continued

Single channel ESI dip-switch settings

When using a 3-wire sensing device produced by Electro-Sensors in single channel mode, channel A is set to NPN. Channel B must be set to PNP and switch position 9 must be set to ON. The standard single channel operation switch positions 4, 7 and 9 are set to ON, and all others are set to OFF, as shown in Figure 8a.


Figure 8a: Single Channel ESI Dip-Switch Settings

Sensor Sensor connection information is shown in Table 2. connections

Table 2: Sensor Connections

| Connection | Sensor 906/907 | ESI Prox | ESI Other |
| :--- | :---: | :---: | :---: |
| TB2-5, Common | Clear/White | Blue | Black |
| TB2-6, Supply | Red | Brown | Red |
| TB2-7, Signal A | Black | Black | Clear/White |
| TB2-8, Signal B | *Green | N/A | ${ }^{*}$ Green |

Note: If the count is reversed, swap signal A and signal B wires.

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## Section 4

## CT6000 Set-Up Parameters

## Introduction

This section discusses information about the CT6000 operations panel and set-up parameters.

In this section These are the topics:

| Topic | See Page |
| :--- | :---: |
| CT6000 parts and functions | 20 |
| CT6000 set-up parameters | 22 |

## CT6000 parts and functions

## Overview

The CT6000 face contains five (5) status LEDs, a 6-digit display, and a keypad containing nine (9) keys. See Figures 9 and 9a. The letters in Figures 9 and 9a represent each part on the front panel of the CT6000, shown in Table 3. The Parts and Functions table that follows describes the function of each part.
Sensor DIP switches, located on the bottom of the CT6000, are not discussed in this section; see "CT6000 DIP Switches" in Section 3.


Figure 9: CT6000 Front Panel Description
Table 3: CT6000 Panel Parts and Functions

| Part | Function |
| :---: | :--- |
| A | ROLLOVER LED will light when the total count has been exceeded. |
| B | The PROG LED will light when the VAR key is pressed, indicating <br> Program Mode. It also turns ON when the DIAG key is pressed, entering <br> Diagnostic Mode. |
| C | The PROCESS LED will light when viewing the process count, variables <br> 04 and 05. |
| D | The BATCH LED will light when viewing the batch count, variables 06 <br> and 07. |
| E | The TOTAL LED will light when viewing the total count, variables 08 and <br> 09. Rate is displayed when the LED is flashing. |



Figure 9a: CT6000 Front Panel Description
Table 3: CT6000 Panel Parts and Functions (continued)

| Part | Function |
| :---: | :--- |
| F | The COUNT RESET key is used to clear the count that appears on the <br> display and variable 03. Resets any output associated with the count. |
| G | The ENTER key is used in Program Mode to view or set the value of a <br> variable after it has been changed. |
| H | The RIGHT ARROW key, when pressed, selects the next digit to the right <br> when in Program Mode. |
| I | The DOWN ARROW key, when pressed in Program Mode, decrements the <br> active digit position on the display down by one (1). Pressing the Down <br> arrow key will cycle the Display through the counters right to left. |
| J | The DIAG key, when pressed, enters Diagnostic Mode. Press the DIAG key <br> again to exit Diagnostic Mode. |
| K | The DECIMAL POINT key, when pressed in Program Mode, moves the <br> decimal point to the left, one place. |
| L | The LEFT ARROW key, when pressed in Program Mode, selects the next <br> digit to the left. |
| M | The VAR key, when pressed, enters Program Mode. |
| N | The UP ARROW key, when pressed in Program Mode, increments the <br> active digit position on the display up by one (1). Pressing the Up arrow key <br> will cycle the Display through the counters left to right. |
| O | The 6-digit display. |

## CT6000 set-up parameters

## Set-up parameters

The CT6000 comes from the factory set for NPN open-collector operation. In most applications, when using a standard or quad Hall-Effect sensor with the model 255 disc, only a few variables need to be programmed, such as input mode, pre-scale for 1 pulse, process control reset value, and output values. If you are using a 255 disc or standard wrap, variable 02 should be the default value of 8 PPR , which equals 0.125 , the value of one pulse. A typical shaft-monitoring scenario for the CT6000 is shown in Figure 10.


Figure 10: CT6000 Monitoring Process

Set point and relay output values

Set points, on-times, and output function selection for example:

- Variables 11,13 , and 15 : Outputs 1,2 and 3 respectively, hold the set point value.
- Variables 12,14 , and 16: On-Time values can be set from 0.1 second to 600.0 seconds, which will meet most input requirements.
- Variable 17: Output function selection sets up relay outputs 1, 2, and 3. Also, see page 33, output functions.


## Section 5

## CT6000 Programming

## Introduction

This section discusses information about programming the CT6000.

In this section These are the topics:

| Topic | See Page |
| :--- | :---: |
| Programmable variables | 24 |
| How to select a variable and view its data | 26 |
| Keypad keys used to access and program variables | 28 |
| How to select and change the numerical value of a variable | 29 |
| Programming rate time multiplier display | 31 |
| Programming the relay outputs | 33 |
| Programming the analog outputs | 35 |
| Programming the switch inputs | 37 |
| Programming the display features | 39 |
| Programming the input buffer | 40 |

## Programmable variables

Variables
Table 4 describes the programmable variables for the CT6000. For a place to record your values use Appendix B in the back of the manual.
Table 4: CT6000 Programmable Variables

| Var \# | Variable Name | Description | Page |
| :---: | :---: | :---: | :---: |
| 00 | Security Match Code | This value is compared to the security code number, which was programmed in diagnostics. <br> - If this number matches the security code number, the keypad lockout function is disabled. <br> - If the number does not match the security code number, the keypad lockout function remains enabled. <br> Keypad lockout is set in variable 20. | 46 |
| 01 | Input Mode | The setting of this variable determines how the counter counts. | 31 |
| 02 | Prescale for 1 Pulse | Display units per pulse-pulse prescale. The weighted value of each pulse. | 31 |
| 03 | Time Multiplier | This value determines the Rate display scaling-time base. The rate display is calculated in process counts/second, and then multiplied by this value to give a selectable rate display. An entry of 60 will give process counts per minute; 360 will give process counts per hour. | 31 |
| 04 | Process Control Initial Value | Value that the Process counter will be reset to. | 32 |
| 05 | Process Control Reset Value | Value that the Process counter will initiate a rollover into the next stage, and reset or stop. This variable determines where the decimal is displayed when displaying the Process count | 32 |
| 06 | Batch Control Initial Value | Value that the Batch counter will be reset to. | 32 |
| 07 | Batch Control Reset Value | Value at that the Batch counter will initiate a rollover into the next stage, and reset or stop. This variable determines where the decimal is displayed when displaying the Batch count | 32 |
| 08 | Total Counter Initial Value | Value that the Total counter will be reset to. | 32 |
| 09 | Total Counter Reset Value | Value that the Total counter will initiate a reset or stop. This variable determines where the decimal is displayed when displaying the Total count. | 32 |
| 10 | Totalizer Counter Mode | Dictates how the Total count is derived. | 36 |

## Programmable variables, continued

Table 4: CT6000 Programmable Variables (continued)

| Var \# | Variable Name | Description | Page |
| :---: | :---: | :---: | :---: |
| 11 | Output 1 Value | The value that the output 1 will deactivate. | 2234 |
| 12 | Output 1 Time | The time output 1 will stay inactive when a set point condition occurs-up to 600 seconds. The output latch code value is 999.9. | 2234 |
| 13 | Output 2 Value | The value that output 2 will deactivate. | 2234 |
| 14 | Output 2 Time | The time output 2 will stay inactive when a set point condition occurs-up to 600 seconds. The output latch code value is 999.9. | 2234 |
| 15 | Output 3 Value | The value that output 3 will deactivate. | 2234 |
| 16 | Output 3 Time | The time output 3 will stay inactive when a set point condition occurs-up to 600 seconds. The output latch code value is 999.9. | 2234 |
| 17 | Output Function Selection | Selects the set point function for the relay outputs. | 2233 |
| 18 | Input Switch Function Selection | The configuration function for the switch inputs | 36 |
| 19 | Count Inhibit | Programming the count inhibit will stop all the counters when the selected counter reaches the reset value. | 37 |
| 20 | Keypad Lockout | Selects the keys to be disabled when security is set. | 46 |
| 21 | Analog Output Selection | Selects the function the analog out will represent. | 35 |
| 22 | Display Value at 4 mA | The rate-display value to be represented at 4 mA output. | 35 |
| 23 | Display Value at 20 mA | The rate-display value to be represented at 20 mA output. | 35 |
| 24 | Analog response | The response time of the analog output in percent. The analog output changes with input frequency changes. | 36 |
| 25 | Analog cutoff | The percent of full scale where the analog cuts off to zero output. It can be set from 0.0 to 10.0 percent. | 36 |
| 27 | Buffer size | The number of pulses to average to smooth out the display and analog | 40 |
| 28 | Buffer window | Sets the window in which the pulses will be averaged. Exceeding it makes it operate pulse to pulse. | 40 |
| 29 | Unused | unsused |  |
| 30 | Display Unit Interval | The time in seconds for the display to update. |  |
| 31 | Display features | Leading Zero blanking and bright/dim display | 39 |

## How to select a variable and view its data

## Overview

## Selecting a

 variableEach programmable variable can be selected and its data viewed within a few key presses - the result will appear on the display. The following procedure shows how to enter Program Mode and view the data for variable 01, Input mode.

To select variable 01, do the following three steps:

| Step | Action |
| :---: | :--- |
| 1. | Press the VAR key; the PROG LED will light, and the display will show <br> Pr (Program Mode) and a variable with the 1's digit position flashing. See <br> Figure 11 for a pictorial of this step. |



Figure 11: CT6000 Placed in Program Mode Displaying Variable 01

Note: The CT6000 will remember the last variable selected and changed until the CT6000 is powered Down and then Up. This will Reset the CT6000 to display Pr01 (the first time you enter Program Mode after a power-up).

## How to select a variable and view its data, continued

Viewing the variable's data

To view the data for variable 01 , do the following:

| Step | Action |
| :---: | :--- |
| 2. | Press the ENTER key to go to the data-entry level; the display will show <br> 000000, the (default value) for variable 01, Input Mode, with the 1's digit <br> position flashing. See Figure 12 for a pictorial of this step. |

ROLL
OVER PROG PROC BATCH TOTAL
$\begin{array}{llllll}0 & 0 & 0 & 0 & 0 & 0\end{array} \begin{aligned} & 000000 \mathrm{RPM} \text { (default value) for variable 01, } \\ & \text { with 1's digit position flashing }\end{aligned}$


Figure 12: Data for Variable 01

Exiting To exit the variable without changing its value, do the following:

| Step | Action |
| :---: | :--- |
| 3. | Press the VAR or ENTER key to exit Program Mode with no change to <br> the data. See Figure 13 for a pictorial of this step. |



Figure 13: Exit Program Mode Without Changing the Variable's Value

## Keypad keys used to access and program variables

## Overview You can access and program the variables by using the VAR, LEFT ARROW, RIGHT ARROW, UP ARROW, DOWN ARROW, DECIMAL, and ENTER keypad keys. The COUNT and DIAG keys are inactive when the CT6000 is in Program Mode. Figure 14 shows only the keys used to program the variables.

Table 5 describes the keys and their functions.


Figure 14: Keypad Keys Used to Program Variables

Table 5: CT6000 Keys and Functions for Programming Variables

| Key | Function |
| :---: | :--- |
| A | •Press the VAR key to enter Program Mode; the display will show Pr <br> (Program Mode) and the last selected programmable variable, 01 thru <br> 23. <br> - Press the VAR key again to exit Program Mode. |
| B | Press the UP ARROW key to increment the flashing digit by one (1) on the <br> display. |
| C | -Press the ENTER key to go to the data-entry level for the <br> programmable variable. <br> - Press the ENTER key to accept the new numerical value and exit <br> Program Mode. <br> D <br> E <br> Press the Right ARROW key to select a digit position from left to right on <br> the display. <br> F <br> Press the DOWN ARROW key to decrement the flashing digit by one (1) <br> on the display. |
| G | Press the DECIMAL key to position the decimal point at each digit <br> position, from right to left, on the display. |
| Press the LEFT ARROW key to select a digit position from right to left on <br> the display. |  |

## How to select and change the numerical value of a variable

## An exercise

The following 7 -step procedure shows:

- How to enter Program Mode
- How to change from variable 01 (Input Mode) to variable 02 (Prescale for 1 Pulse)
- How to change the value of variable 02 from 000.125 to 000.133
- How to save the change, and exit Program Mode

Note: You can use the following 7-step procedure to select any variable, change its value, and save the results.

Note: You can select a variable and change its value, either when the CT6000 is monitoring or when it is idle.

Selecting and To select variable 02 and display its data, press the key sequence shown in the three displaying a variable's data


Continued on next page

How to select and change the numerical value of a variable, continued

Changing the To change the pulse prescale from 000.125 to 000.133 for variable 02 , press each variable's value key the number of times shown in the three (3) steps below, while viewing the results on the display.


Saving the Value and exiting

To save the new value and exit Program Mode, press the ENTER key shown in Step 7 below, and view the result on the display - the PROG LED is OFF.

## Step 7



## Programming the way the counter counts

Variable 01,
Input Mode
Entering a 0-4 in Variable 01 determines what type of counting the counter will do and where it will get its information. The decimal point is fixed.

$$
\begin{array}{ll}
0=\text { Channel A } & \text { Counts pluses received at channel A input } \\
1=\text { Channel B* } & \text { Counts pluses received at channel B input } \\
2=(\mathrm{A}+\mathrm{B})^{*} & \text { Adds the pulses on channels A/B together } \\
3=(\mathrm{A}-\mathrm{B})^{*} & \text { Subtracts pulses on channel B from pulses on channel A } \\
4=\text { Quadrature } & \begin{array}{l}
\text { When channel A leads B, a positive pulse count results; } \\
\text { When channel B leads A, a negative pulse count results }
\end{array} \\
* \text { Factory Set Options }
\end{array}
$$

Variable 02, Prescale for 1 Pulse

Prescale examples

Display units per pulse-pulse prescale. Simply stated it is the value of one pulse.
The decimal place can be set as needed.

Example 1: if 8 pulses are needed to produce a count/display of one, variable 2 is $1 / 8$ or entered as (0.125).
Example 2: If one revolution of a roller produces 30 inches of material and has 16 pulses, the prescale to read inches is $30 / 16$ or ( 01.875 ).
Example 3: If in Example 2 you wanted feet instead of inches you would have taken the inches / 12 or 30 / 12 and got 2.5 feet per revolution. The prescale would be 2.5 feet / 16 pulses per revolution or ( 0.15625 ).

Variable 03, Time base: the rate display is calculated in process counts/second, and then time base multiplied by this value to give a user the selectable rate display. An entry of 60 will give process counts per minute- 3600 will give process counts per hour.
You can access the rate display by pressing the UP or DOWN ARROW key until the Total LED flashes.
The decimal place can be set as needed.

## Counter initial and reset values

Initial value: The initial value of all counters is the value that the counters are reset to (typically zero), after a count reset. A count reset will occur by press the Front or Back Panel Reset button, or exceeding the count reset value.

The decimal place can be set as needed.
Reset Value: The reset value is the level that the counter will return to (the initial value) unless the counter is programmed to inhibit counts at the reset value. If the counter inhibits counts at the reset value, all count registers will stop counting until the counter causing delay is reset by pressing the Front or Back Panel Reset button.
The decimal place can be set as needed.
These variables determine where the decimal is displayed during normal operation.

| Variables 4 <br> thru 9, counter <br> initial and reset | Variable numbers for counter initial and reset values: |  |  |
| :--- | :--- | :--- | :--- |
| values |  | Initial Value | Reset Value |
|  | Process | Variable 4 | Variable 5 |
|  | Batch | Variable 6 | Variable 7 |
|  | Totalizer | Variable 8 | Variable 9 |

## Programming the relay outputs

Overview $\quad$ Variables $11,12,13,14,15,16$, and 17 establish the functional operating parameters for the relay outputs.

Variable 17, output functions

The Output Function Selections selects the function of the transistor outputs. The factory optional relay functions are also programmed here. The outputs are deenergized when the programmed count equals the programmed values.

Display Characters


Digital Output Functions
0 = Unused
1 = Process Counter
2 = Batch Counter
3 = Totalizer
4 = Underspeed (rate based)
5 = Overspeed (rate based)

## Digital Output type

$0=$ Timed / Latching (default)
$1=$ Maintained open greater than *
$2=$ Maintained open less than *

## Notes:

- The digital output types listed above are only on versions 1.09 and later.
- Decimal point is fixed.
- When using these modes, ensure that the relay contact is closed (not open) during normal operation because the normal failure mode of the relays is that they will drop and the contacts will open. If it is necessary to have open contacts during normal operation, use an external form-C relay with the transistor outputs.
- These two functions are illegal: 1:4 (maintained open greater than: Underspeed and 2:5 maintained open less than: Overspeed0— relays will remain open for these combinations.
- When the relay contacts are open in the maintained greater than or less than function, they are subject to the on-time delay. After the condition is cleared, the default is " 1 " second-the minimum delay is " 0.1 " second.

Programming the relay outputs, continued

Relay and transistor outputs

Output value variables 11, 13 \& 15

Set point on time variables $12,14 \& 16$

Latching output

Variables

Programming values for the transistor and relay outputs are numbered 1 thru 3. Upon power up, these outputs will energize. When the programmed value is reached, the corresponding output will de-energize.
The relay outputs are optional.

Enter the set point value, based on the selected count that will de-energize the output. This variable can be a negative value.
The decimal place can be set as needed.
See Table 6 below.

The set point on time programs the minimum time that the output will stay deenergized when the output value is reached ( 0.1 to 600.0 seconds).
Decimal point is fixed.
See Table 6 below.

Set the output on time to 999.9 seconds for the "latching output." A latching output must be cleared by a "reset input" (See Programming inputs) or by "powering down."
See Table 6 below.

Table 6 presents output programming variables.
Table 6: Output Programming Variables

| Item | Output 1 | Output 2 | Output 3 |
| :--- | :--- | :--- | :--- |
| Output Value | Variable 11 | Variable 13 | Variable 15 |
| On-Time | Variable 12 | Variable 14 | Variable 16 |

## Programming the analog outputs

## Overview

Any count or the count rate can be represented by the analog output and selected in Variable 21. The $4-20 \mathrm{~mA}$ range is then specified in variables 22 and 23 . The output is linear between the two specific points. These points can span 0 , be reversed, windowed.
See Figure 15.


Figure 15: Analog Output

Variable 21
analog output selection

Variable 22
4 mA display

Enter the function that the 4-20 mA output will follow:
Digital Output Function
$0=$ Unused
$1=$ Process Counter
2 = Batch Counter
$3=$ Totalizer Count
4 = Rate

- Rat

Variable 23 This variable sets where the analog output is 20 mA . The default value is " 1000 ." 20 mA display

Variable 24, analog output response time

The variable sets the response time of the CT6000's analog output from 0 to 100 percent. The CT6000 will limit how much the analog output can change as the input frequency changes, filtering the output. The minimum response time is " 0.0 ," which corresponds to approximately 50 msec from 0 to 100 percent. The maximum response time is ten (10) seconds. The default is "0.0."

Variable 25, This is used to set when the analog cuts off to zero. It can be set from 0.0 to 10.0 analog output cutoff
percent. This is used to speed up the zeroing of the analog output to zero out."

## Programming the switch inputs

Overview The switch inputs are configured using variable 18. The switch inputs can be configured to reset the outputs, counts, process, batch, and totalizer.
For switch input wiring, see the CT6000 Wiring \& DIP Switches section.

## Caution

When the digital input function is programmed as a reset input and the switch input remains closed, the relay will never turn OFF regardless of the operating condition. A momentary contact closing of the switch is advised. Failure to observe this caution could result in damage to the equipment.

Variable 18, input function selection

Variable 10 totalizer count mode

When the input is activated, the totalizer count will seek a value as close as possible to its initial value, and remain synchronized with whichever counter increments the totalizer. For example, if the process counter is at its initial value, it will reset to that value. Any output linked to the totalizer counter and de-energized will reset to the energized state. The following explains each mode:

| Value | Mode | Description |
| :---: | :--- | :--- |
| 0 | Independent | The totalizer count increments when the batch counter <br> exceeds its programmed rest value. |
| 1 | Totalizer Process | The totalizer increments with the process counter. |
| 2 | Totalizer Batch | The totalizer increments with the batch counter. |

Programming the switch inputs, continued

Reset outputs When the input is activated, the set point output is disabled. The output will remain

1,2 and 3

Variable 19, count inhibit

Reset display This input function mirrors the actions of the Front Panel Reset button. count disabled until the input is de-activated.

Programming the count inhibit will stop all counters when the programmed counter reaches its reset value. To restart the counters, the programmed count must be reset via the Front or Back Panel Reset button. Count inhibit configurations:
$0=$ Unused
1 = Process
2 = Batch
3 = Totalizer

Reset all counts All counts will reset to the their initial values and all outputs will reset to their energized states.

When the input is activated, the process count will go to its initial value. Any output that is linked to the process counter then de-energized, will be reset to the energized state.

When the input is activated, the batch count will reach a value close to its initial value and remain synchronized with the process counter. If the process counter is at its initial value when the batch is reset, the batch counter will reset to its initial value. Any de-energized output linked to the batch counter will reset to the energized state.

## Programming the display features

Variable 31, Leading Zero Blanking and Segment intensity

Variable 30, display update interval

This variable configures how the display appears.
The display appearance bit assignments are as shown below:
Display Characters


Leading Zero blanking - makes the leading zeros dark or not lit.
Intensity - makes the LED seven segments bright or dim to enhance the view ability based on ambient light.

The Display Update Interval enables the CT6000 to show speed averages for slow and unstable shafts. The minimum update interval is 0.5 seconds, and the maximum update interval is eight (8) seconds. The factory default is 0.5 seconds.

## Programming the input buffer

Variable 27, Pulses to Average
and
Variable 28
Averaging Window

- Variable 27, Pulses to Average - Enter the desired number of pulses to average. Valid values are 0 to 16 pulses. This is used for the Rate only
- Variable 28, Averaging window - This is a window, expressed in percent, in which pulse averaging will be used. Deviations that are greater than the window will cause the CT6000 to switch to pulse to pulse output. Ideally setting a window of about $2 \%$ greater than the actual measured is desired. Valid values are 0001 to 0030. The CT6000 will calculate and display the deviation for you while the shaft is running at a stable speed. Just Press the left arrow. The CT6000 will then display the deviation. Wait until the deviation stops growing and add at least $1 \%$ to that number ( $2 \%$ is desirable). Now enter that number into VAR 28. If during the course of operation the monitored speed exhibits jumping in the display or the analog output, the window may be set too low. The larger the window the slower the response is to a sudden change in speed. This is most noticeable at slower speeds.


## Section 6

## CT6000 Diagnostics

## Introduction

Diagnostics are used to test the functionality of the CT6000. When the DIAG key is pressed, the CT6000 will display "dIAg," and all of the LEDs will light. The LEDs will remain on until you exit Diagnostic Mode.
In Diagnostics you can do the following:

- Test the keypad and display
- Test the switch inputs
- Test the relay output
- Test the 4-20 mA / 0-10 VDC output
- Reset the variables
- Set keypad security

In this section
These are the topics:

| Topic | See Page |
| :--- | :---: |
| Keypad and display test | 42 |
| Relay output test | 43 |
| Switch input test | 44 |
| $4-20 \mathrm{~mA} / 0-10$ VDC analog output test | 45 |
| Reset the variables | 47 |
| Set and change the security code number | 48 |

## Keypad and display test

Overview

Keypad and display test

The keypad diagnostic tests the functionality of each key and bit position on the display.
$\qquad$
To perform the keypad and display test, do the following:

| Step | Action |
| :---: | :--- |
| 1. | Press the DIAG key. |
| 2. | Press the VAR key; the display will show .888888, the keypad diagnostic. |
| 3. | Press each key starting with the VAR key from left to right and the <br> display will appear as shown in Figure 16. Note the position of the <br> decimal point after each key press. |
| 4. | Press the DIAG key to exit the keypad diagnostic. |

Display


| -4 | 4 | 4. | 4 | 4 | 4 |
| :--- | :--- | :--- | :--- | :--- | :--- |

$+55.5555$

 |  |  |  |  |  |  |
| :--- | :--- | :--- | :--- | :--- | :--- |
| .+ | 7 | 7 | 7 | 7 | 7 | $\begin{array}{lllllll}-. & 8 & 8 & 8 & 8 & 8\end{array}$



Figure 16: Keypad Test Showing the Display After Each Key Press

## Relay output test

Overview

> The Relay Output diagnostic tests the functionality of the relays.

Relay output To test the relay outputs, do the following: test


Figure 17: Relay Output Test Display

| Step | Action |
| :---: | :--- |
| 3. | Use the 4 LEFT ARROW key to turn ON output 3, the $\mathbf{\Delta}$ UP ARROW <br> key to turn ON output 2, and the <br> output 1. |
| 4. | To turn OFF the outputs, press the ENTER key. |
| 5. | Press the DIAG key to exit diagnostics. |

## Switch input test

## Overview

## Switch input test

| Step | Action |
| :---: | :--- |
| 1. | Press the DIAG key. |
| 2. | Press the $\mathbf{\Delta}$ UP ARROW key and the display will show the status of the <br> three (3) switch inputs. <br> When a switch is activated at one of the inputs, the corresponding display <br> character toggles to "1." When an input turns OFF, the corresponding <br> display character toggles to "0." |
| Figure 18 shows the bit positions associated with the three (3) switch <br> inputs. |  |
| 3. | Press the DIAG key to exit diagnostics. |

Display Characters


Figure 18: Display Bit Positions Associated with the Switch Inputs

## 4-20 mA or 0-10 Vdc analog output test

Overview
The Analog Output diagnostic test puts the CT6000 into Pot Output Mode. This permits you to adjust the $4-20 \mathrm{~mA}$ or the $0-10$ VDC isolated outputs. The same hardware and procedure are used regardless of the option. There is a direct correlation between current/voltage and speed. See Figure 19.


Figure 19: 4-20 mA 12 Bit Isolated Output Display

Note: $\quad 4-20 \mathrm{~mA}$ or $0-10 \mathrm{VDC}$ output is set up at the factory.

Adjusting the output

To adjust the 4-20 mA or 0-10 VDC output, do the following:

| Step | Action |
| :---: | :--- |
| 1. | Connect a milliammeter with a maximum load resistor of $500 \Omega$ across <br> TB1-4 and 5, or a voltmeter if using the 0-10 VDC option. |
| 2. | Press the DIAG key to exit diagnostics. |

4-20 mA or 0-10 Vdc analog output test, continued

| Step | Action |
| :---: | :--- |
| 3. | Press the $\boldsymbol{V}$ DOWN ARROW key and the display will appear, as shown <br> in Figure 20. |

Display Characters


Figure 20: 4-20 mA or 0-10 VDC Output Display Percentages

| Step | Action |
| :---: | :--- |
| 4. | Turn the Offset Pot until the mA meter reads 4 mA or V meter reads 0 <br> VDC. |
| 5. | Press the $\mathbf{\Delta}$ UP ARROW key until the display reads 100\%. |
| 6. | Adjust the Span Pot until the meter reads either 20 mA or 10 VDC. |
| 7. | Press the DIAG key to exit the diagnostic. |

## Reset the variables

Overview
When necessary, the CT6000's variables can be Reset to factory default, using the default function. See Figure 21.

Reset variables To Reset the variables, do the following:

| Step | Action |
| :---: | :--- |
| 1. | Press the DIAG key. |
| 2. | Press the COUNT RESET key; the display will appear as shown in Figure <br> 21, with the factory defaults restored. See Figure 21. |
| 3. | Press the DIAG key to exit diagnostics. |

Display Characters
r E S E

Figure 21: Reset Variables Display

## Set and change the security code number


#### Abstract

Overview The CT6000 can be programmed to prevent unauthorized changes to its operating variables by setting the keypad lockout function, using a security code number. There are three elements to enabling or disabling the keypad lockout function: variable 20 (selectable lockouts), variable 00 (security access number), and the location where you set the security code number, which is in Diagnostics.


Variable 20, keypad lockout

Variable 20 is used to select the function keys that are enabled or disabled when security is set.


The default value for variable 20 is " 001001 ," as shown above. This level of security prevents two things:

- Changing the variables (except variable 00) and allowing them to be viewed only
- Entering Diagnostics Mode


## Variable 00, security code number and location

The Security Code Number is a number chosen by you. The default number is 006000. After you enter a new security code number to "enable" the keypad lockout function in Diagnostics, you must enter that same number into variable 00, to "disable" the keypad lockout function.
For example, if you enter 006001 into Diagnostics Mode for your security code number (which will enable the keypad lockout function) you must enter "006001" into variable 00 when you want to disable the keypad lockout function, which allows you access to all keys.

## Set and change the security code number, continued

Setting security To set the security code number, do the following:

| Step | Action |
| :---: | :--- |
| 1. | Determine which keys you want to lock out, using variable 20. The <br> default is 001001, which locks out the DIAG key and prevents changes to <br> operating variables, except variable 00. |
| 2. | Press the DIAG key. |
| 3. | Press the $\measuredangle$ LEFT ARROW key and the display will show the default <br> Security Code of 006000, as shown in Figure 22. |

roLL prog proc batch total
over
○ ○ ○ O O
$\begin{array}{llllll}0 & 0 & 6 & 0 & 0 & 0\end{array}$

Figure 22: Security Code Number in Diagnostics Mode

| Step | Action |
| :---: | :--- |
| 4. | Enter a new security code number, up to four digits. |

## Important

Write your security code number down on paper and keep it in a safe place; if you forget the number or lose it, you will not be able to "disable" the keypad lockout function.

| Step | Action |
| :--- | :--- |
| 5. | Press the ENTER key to set the new security code number. This will <br> enable the keypad lockout function and exit Diagnostics Mode. |

## Intentionally Left Blank

## Appendix A: <br> CT6000 Specifications

| Power | Description |
| :--- | :--- |
| Input Power | - $115 \mathrm{VAC}, 6 \mathrm{VA} @ 50 / 60 \mathrm{~Hz}$, requires external fuse $1 / 16 \mathrm{amp}$ slow- <br> blow |
| $230 \mathrm{VAC}, 6 \mathrm{VA} @ 50 / 60 \mathrm{~Hz}$, requires external fuse $1 / 32 \mathrm{amp}$ slow- <br> blow |  |
| - $10-30 \mathrm{VDC}$, requires external fuse 2 amp slow-blow |  |
| Sensor Input/supply | Switch selectable 12 VDC unregulated, 100 mA maximum |
| NPN Open Collector | 2200 ohm pull-up to $12 \mathrm{VDC}, 2.5$ volts trigger level |
| PNP Open Collector | 2200 ohm pull-down, 2.5 volts trigger level |
| Logic Level | 2.5 volts trigger level |
| Magnetic Pickup | 150 mV peak-to-peak minimum signal, 50 mV trigger level |
| Maximum Frequency | Up to 20 KHz |


| Standard I/O | Description |
| :--- | :--- |
| Switch Inputs | 3 programmable inputs |
| Transistor Outputs | 3 programmable, transistors are NPN, 30 VDC 150 mA maximum |


| Optional External Control <br> I/O | Description |
| :--- | :--- |
| Set Point Outputs (Relays) | 3 programmable-form A relays, rated 250 VAC 5 amp, 30 VDC 5 <br> amp resistive load |
| Analog Output | 1 programmable 4-20 mA or 0-10 VDC output, 12 bit resolution |


| Operational Values | Description |
| :--- | :--- |
| Response Time | Minimum .02 seconds |
| Modes of Operation | Process, Batch, Total, Rate |
| Input Modes | Channel A, Channel B, Sum, Difference, and Quadrature |
| Display Modes | • 4 programmable: Process, Batch, Total, and Rate |
|  | - Forward and reverse |
| Display Update Time | 0.1 second update time for counters <br> 1.0 second update for rate |

$\qquad$

| Mechanical | Description |
| :--- | :--- |
| Enclosure | ABS Plastic 94V-0 |
| Keypad | Polycarbonate Tactile switch pad, chemical resistant, splash proof |
| Display | 6 digit 0.3 inch height, seven-segment display, 5 status LEDs |
| Operating Temperature | $0^{\circ} \mathrm{C}$ to $50^{\circ} \mathrm{C}\left(+32^{\circ} t o+122^{\circ} \mathrm{F}\right)$ |
| Humidity | $0 \%$ to $90 \%$ non-condensing |

## Specifications are subject to change without notice.

## Appendix B:

CT6000 Variables Worksheet

| Variable | Name | Default | New Value |
| :---: | :---: | :---: | :---: |
| 00 | Security Match Code | 6000 |  |
| 01 | Input Mode | 0 |  |
| 02 | Prescale for 1 Pulse | 0.125 |  |
| 03 | Time Multiplier | 1 |  |
| 04 | Process Control Initial Value | 0 |  |
| 05 | Process Control Reset Value | 100 |  |
| 06 | Batch Counter Initial Value | 0 |  |
| 07 | Batch Control Reset Value | 100 |  |
| 08 | Totalizer Counter Initial Value | 0 |  |
| 09 | Totalizer Counter Reset Value | 10 |  |
| 10 | Totalizer Counter Mode | 0 |  |
| 11 | Output 1 Value | 100 |  |
| 12 | Output 1 Time | 1.0 |  |
| 13 | Output 2 Value | 200 |  |
| 14 | Output 2 Time | 1.0 |  |
| 15 | Output 3 Value | 300 |  |
| 16 | Output 3 Time | 1.0 |  |
| 17 | Output Function Select | 000111 |  |
| 18 | Input Switches Function Selection | 000541 |  |
| 19 | Inhibit | 0 |  |
| 20 | Keypad Lockout | 1001 |  |
| 21 | Analog Output Selection | , |  |
| 22 | Display Value @ 4 mA | 0 |  |
| 23 | Display Value @ 20 mA | 1000 |  |
| 24 | Analog response | 0 |  |
| 25 | Analog cutoff | 0 |  |
| 27 | Buffer size | 0 |  |
| 28 | Buffer window | 15 |  |
| 29 | Unused | 0 |  |
| 30 | Display update rate | 10 |  |
| 31 | Display features | 000011 |  |

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[^0]:    * Present in bi-directional version only.

