



**SUPERIOR • SYSTEMS • SOLUTIONS**

# **CT6000**

## **Programmable Process Counter**

### **Installation & Operation Manual**





**SUPERIOR • SYSTEMS • SOLUTIONS**

**Model CT6000  
Programmable Process Counter  
Installation and Operation Manual**

Part Number: 990-002100

Revision D

Electro-Sensors®, Inc.  
6111 Blue Circle Drive  
Minnetonka, MN 55343-9108

Contact us at:

Local: 952-930-0100

National: 1-800-328-6170

Fax: 952-930-0130

Web: [www.electro-sensors.com](http://www.electro-sensors.com)

Sales: [www.sales@electro-sensors.com](mailto:www.sales@electro-sensors.com)

Support: [www.tech@electro-sensors.com](mailto:www.tech@electro-sensors.com)

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# Introduction To This Manual

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

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**Who should use this manual (audience)** Keep in mind that the function of the CT6000 installed in a mechanical process is to monitor process, batch, totals, rates, and direction; therefore, it must be installed by qualified personnel only. This manual is designed for persons who have the primary responsibility to install, set up, operate, and test the CT6000.

The secondary audience would be those persons seeking technical information about the electrical concepts and operation of the CT6000.

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**Knowledge level** Persons installing, setting up, and operating the CT6000 should have good knowledge and understanding of electrical and mechanical concepts and principals pertaining to programmable counters and ratemeters. Again, **the CT6000 should be installed by qualified personnel only.**

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**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

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### **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:

<b>Topic</b>	<b>See Page</b>
About warnings and cautions	2
Warnings	3
Cautions	4

---

## About warnings and cautions

---

**Important notice**

Read the warnings and cautions in this section before attempting to install, set up, or operate the CT6000. Warnings and cautions appear in this section and throughout this manual.

---

**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.*

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*Continued on next page*

## Cautions

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### 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

---

### 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.*

---

#### **After unpacking the CT6000**

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.

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#### **Tools and materials**

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

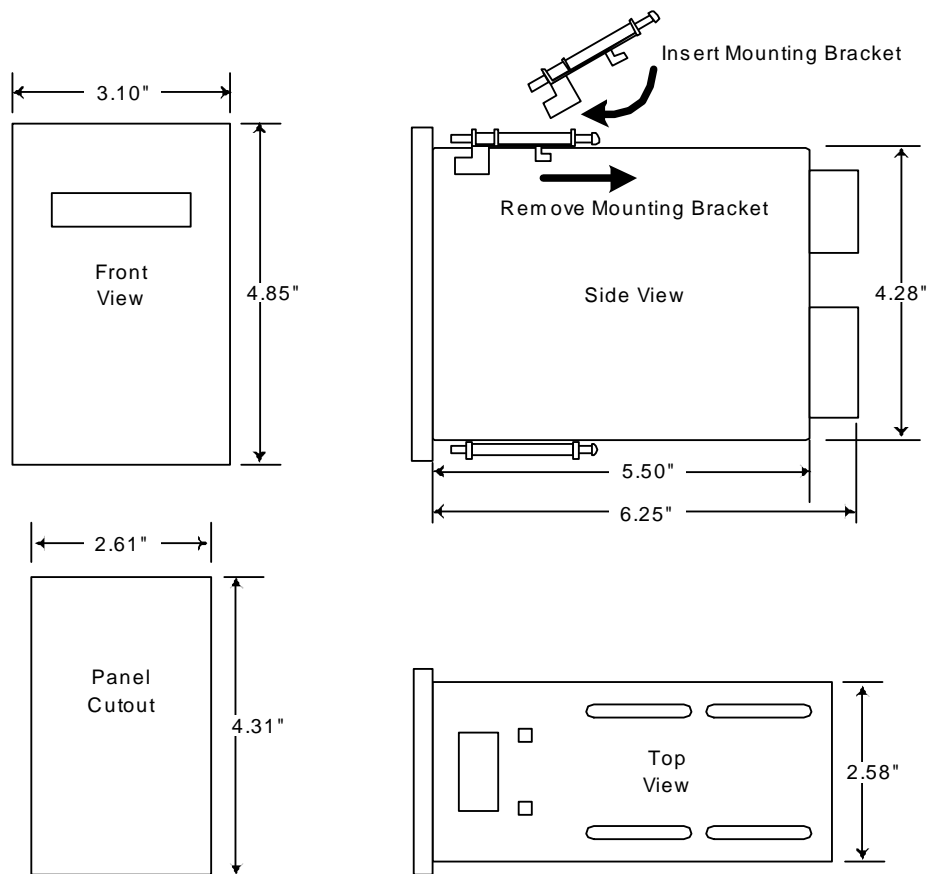
- Safety glasses
  - Power drill
  - Drill bit (#21)
  - Loctite or similar adhesive
  - Gap-measuring tool
  - Standard electrician's tools
-

## 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 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 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

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

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**In this section** These are the topics:

<b>Topic</b>	<b>See Page</b>
Recommended wiring practices	10
CT6000 wiring schematics	11
4-20 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

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## Recommended wiring practices

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### Warning

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

---

#### 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 signal-carrying 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 VAC, 230 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 ¼-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

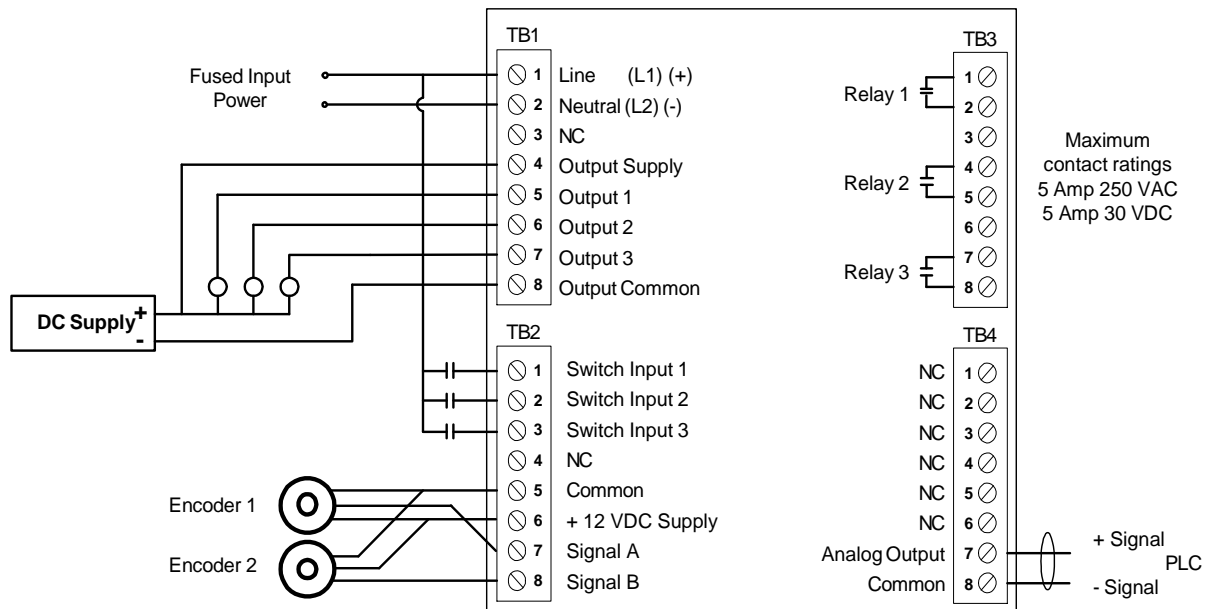
*Only qualified personnel should attempt to connect any wires to the CT6000. Failure to observe this warning could result in an injury to persons.*

## 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

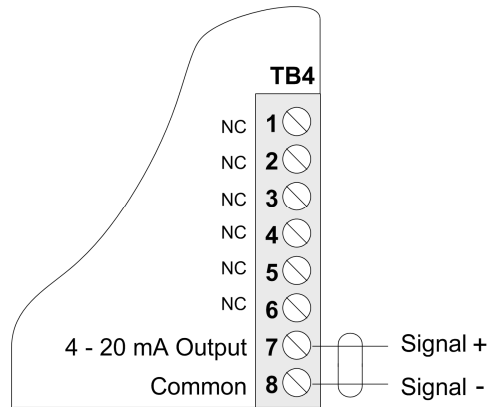
## 4-20 mA or 0-10 VDC analog output

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

The 4-20 mA analog output supports a maximum load resistance of 500Ω. 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 VAC, 6 VA at 50/60 Hz. An external **1/16 amp 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 10-30 VDC can also be ordered as an option. Fuse according to Appendix A.

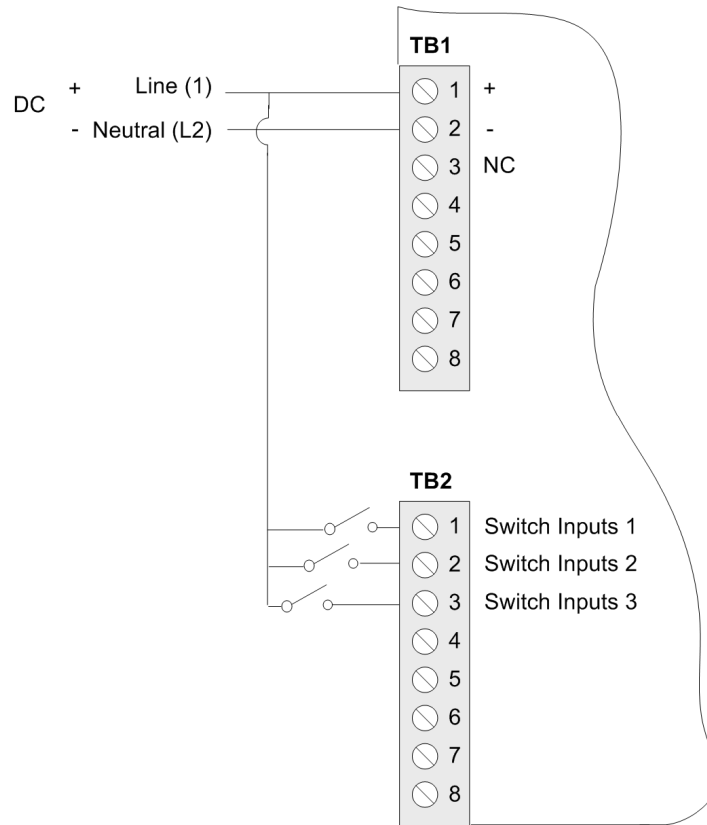
**Figure 4: AC/DC Power and Switch Wiring**

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## 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**

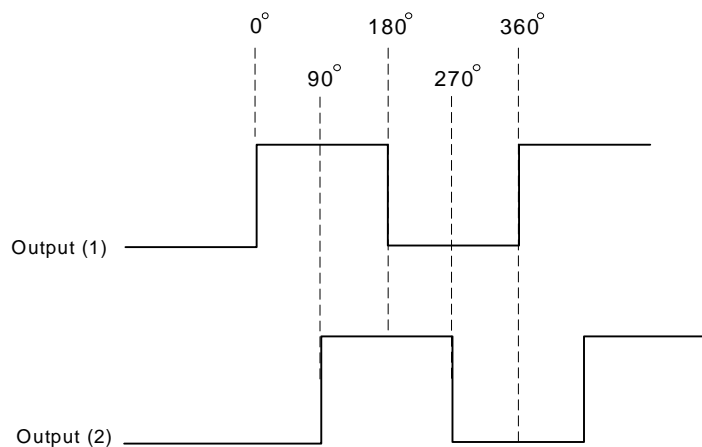
## Single-channel and quadrature signal wiring

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### 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° phase shift between the signals, as shown in Figure 6.



**Figure 6: Two-Channel Quadrature Signals 90° Phase Shift**

---

### A and B channel input signals

These inputs require a frequency input relative to speed. Devices such as Hall-Effect sensors, encoders, or magnetic pickups can be used. Voltage to these sensors is from TB2–6 (+12 VDC) and TB2–5 (*common*). The maximum current draw available is 100 mA @ 12 VDC, unregulated.

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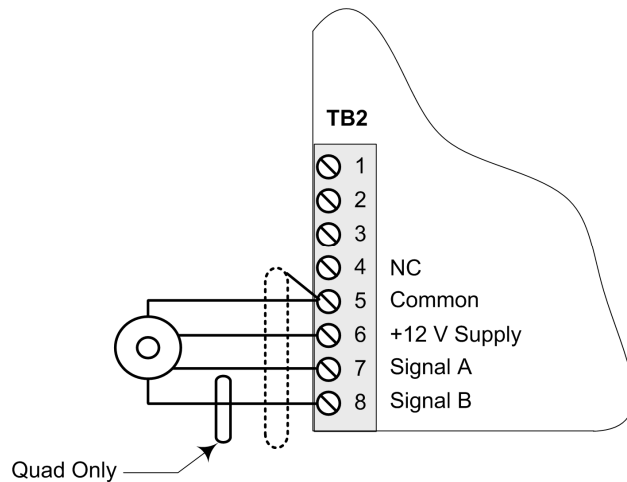
## A and B channel input signal wiring

### 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.

### 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**

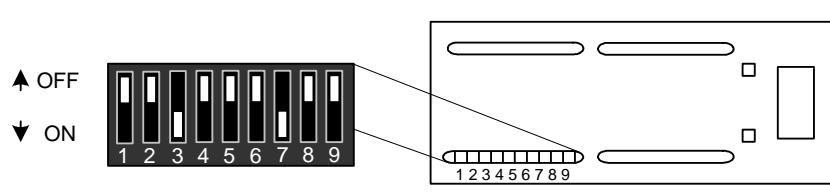
Input	Channel A TB2-7				Channel B TB2-8			
	NPN	PNP	Mag. 2 Wire	Logic Level	NPN	PNP	Mag. 2 Wire	Logic Level
Switch ON	7	8	5, 6	None	3	4	1, 2	None
Switch OFF	5, 6, 8	5, 6, 7	7, 8	5, 6	1, 2, 4	1, 2, 3	3, 4	1, 2, 3, 4

#### 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.



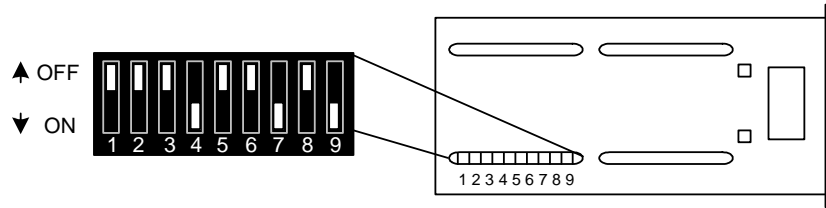
**Figure 8: Quadrature ESI Dip-Switch Setting**

*Continued on next page*

**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 connections**

Sensor connection information is shown in Table 2.

**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.

\* Present in bi-directional version only.



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## Section 4

# CT6000 Set-Up Parameters

### Introduction

---

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

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**In this section** These are the topics:

<b>Topic</b>	<b>See Page</b>
CT6000 parts and functions	20
CT6000 set-up parameters	22

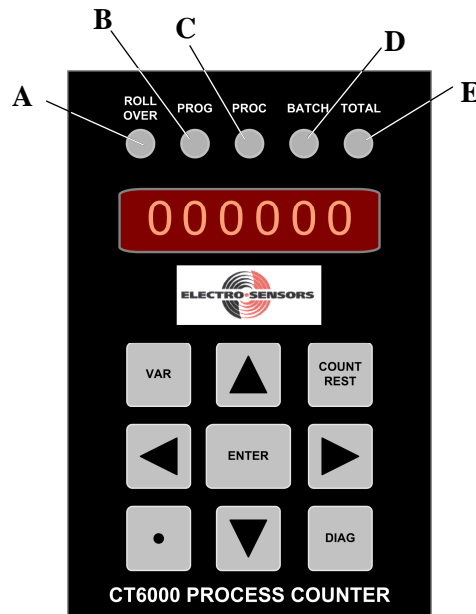
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## CT6000 parts and functions

### 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.



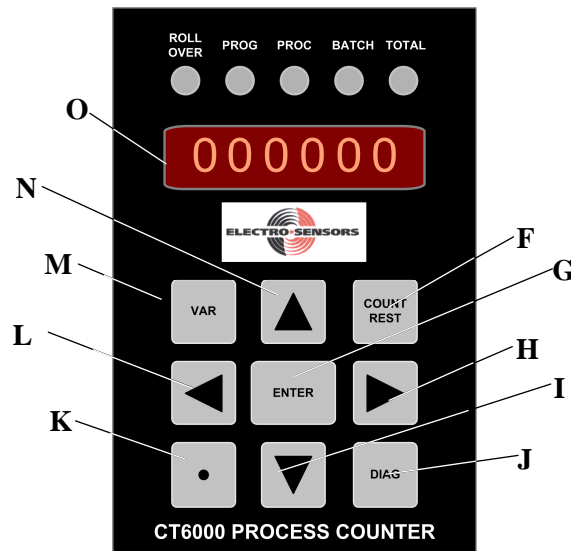
**Figure 9: CT6000 Front Panel Description**

**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 Program Mode. It also turns ON when the DIAG key is pressed, entering Diagnostic Mode.
C	The PROCESS LED will light when viewing the process count, variables 04 and 05.
D	The BATCH LED will light when viewing the batch count, variables 06 and 07.
E	The TOTAL LED will light when viewing the total count, variables 08 and 09. Rate is displayed when the LED is flashing.

*Continued on next page*

**CT6000 parts and functions, continued**



**Figure 9a: CT6000 Front Panel Description**

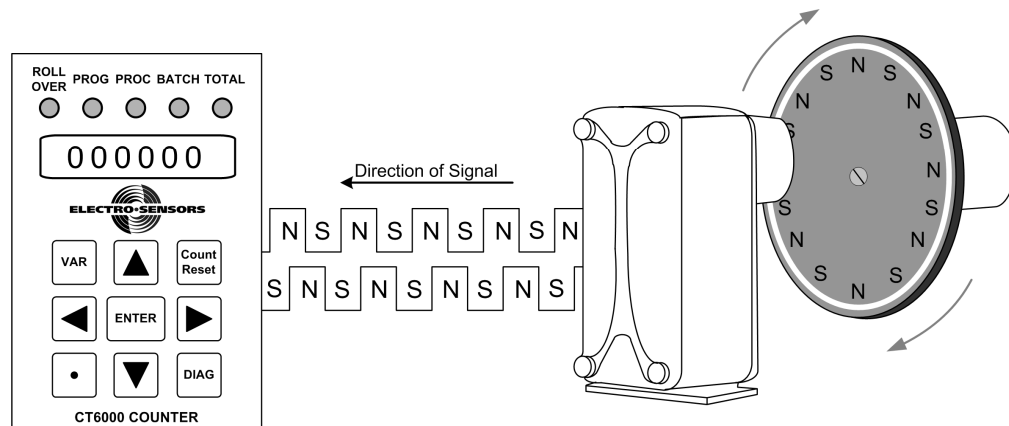
**Table 3: CT6000 Panel Parts and Functions (continued)**

Part	Function
F	The COUNT RESET key is used to clear the count that appears on the 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 variable after it has been changed.
H	The RIGHT ARROW key, when pressed, selects the next digit to the right when in Program Mode.
I	The DOWN ARROW key, when pressed in Program Mode, decrements the active digit position on the display down by one (1). Pressing the Down 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 again to exit Diagnostic Mode.
K	The DECIMAL POINT key, when pressed in Program Mode, moves the decimal point to the left, one place.
L	The LEFT ARROW key, when pressed in Program Mode, selects the next 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 active digit position on the display up by one (1). Pressing the Up arrow key 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:

<b>Topic</b>	<b>See Page</b>
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. <ul style="list-style-type: none"> <li>• If this number matches the security code number, the keypad lockout function is disabled.</li> <li>• If the number does not match the security code number, the keypad lockout function remains enabled.</li> </ul> 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

*Continued on next page*

**Programmable variables, continued**

**Table 4: CT6000 Programmable Variables (continued)**

<b>Var #</b>	<b>Variable Name</b>	<b>Description</b>	<b>Page</b>
11	Output 1 Value	The value that the output 1 will deactivate.	22 34
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.	22 34
13	Output 2 Value	The value that output 2 will deactivate.	22 34
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.	22 34
15	Output 3 Value	The value that output 3 will deactivate.	22 34
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.	22 34
17	Output Function Selection	Selects the set point function for the relay outputs.	22 33
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	unused	
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

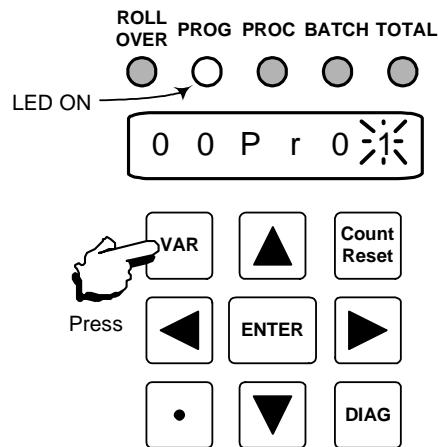
### Overview

Each 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.

### Selecting a variable

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 Pr ( <i>Program Mode</i> ) and a variable with the 1's digit position flashing. See 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*).

*Continued on next page*

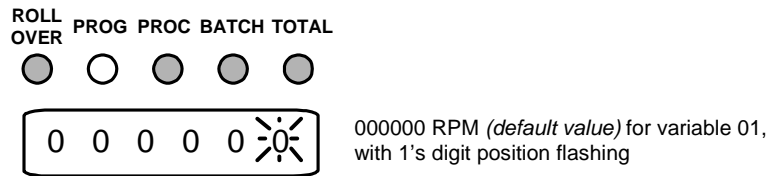


**How to select a variable and view its data, continued**

**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 000000, the ( <i>default value</i> ) for variable 01, Input Mode, with the 1's digit position flashing. See Figure 12 for a pictorial of this step.

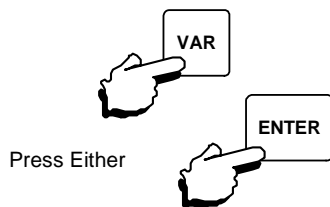
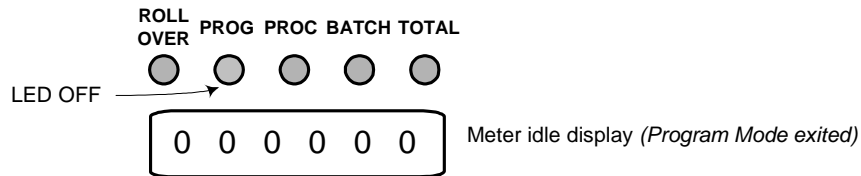


**Figure 12: Data for Variable 01**

**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 the data. See Figure 13 for a pictorial of this step.



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

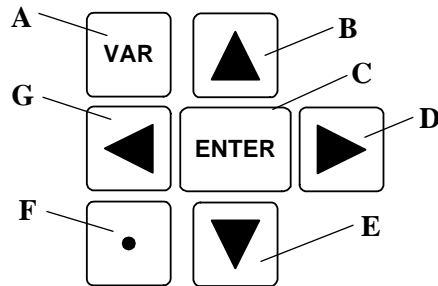
*Continued on next page*

## 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	<ul style="list-style-type: none"> <li>Press the VAR key to enter Program Mode; the display will show Pr (<i>Program Mode</i>) and the last selected programmable variable, 01 thru 23.</li> <li>Press the VAR key again to exit Program Mode.</li> </ul>
B	Press the UP ARROW key to increment the flashing digit by one (1) on the display.
C	<ul style="list-style-type: none"> <li>Press the ENTER key to go to the data-entry level for the programmable variable.</li> <li>Press the ENTER key to accept the new numerical value and exit Program Mode.</li> </ul>
D	Press the Right ARROW key to select a digit position from left to right on the display.
E	Press the DOWN ARROW key to decrement the flashing digit by one (1) on the display.
F	Press the DECIMAL key to position the decimal point at each digit position, from right to left, on the display.
G	Press the LEFT ARROW key to select a digit position from right to left on the display.

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

### An exercise

The following 7-step procedure shows:

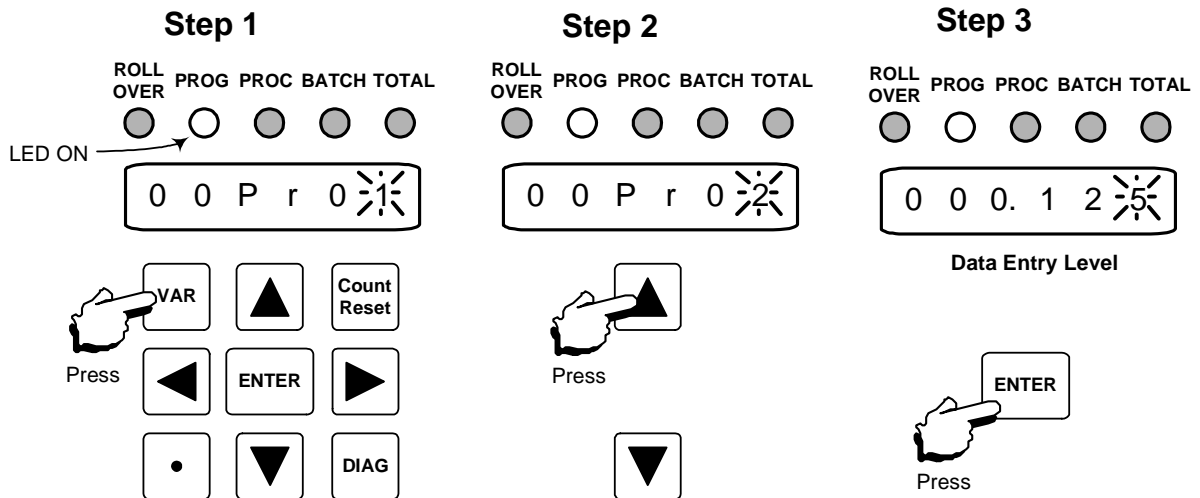
- How to enter Program Mode
- How to change from variable 01 (*Input Mode*) to variable 02 (*Prescale for 1 Pulse*)
- How to change the value of variable 02 from 000.125 to 000.133
- How to save the change, and exit Program Mode

**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 displaying a variable's data

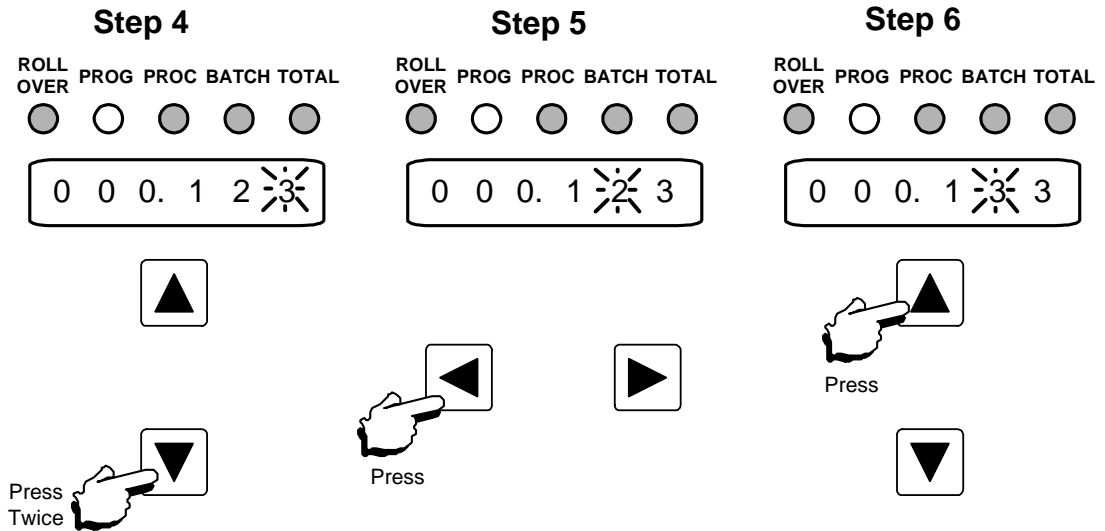
To select variable 02 and display its data, press the key sequence shown in the three (3) steps below, while viewing the results on the display.



*Continued on next page*

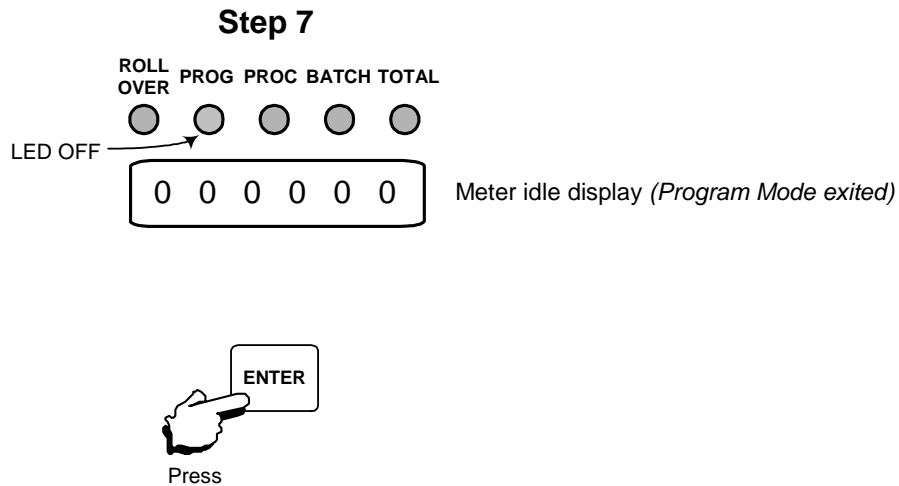
**How to select and change the numerical value of a variable, continued**

**Changing the variable's value** To change the pulse prescale from 000.125 to 000.133 for variable 02, press each 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.



## 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.

- 0 = Channel A    Counts pluses received at channel A input
  - 1 = Channel B\*   Counts pluses received at channel B input
  - 2 = (A+B)\*      Adds the pulses on channels A/B together
  - 3 = (A-B)\*      Subtracts pulses on channel B from pulses on channel A
  - 4 = Quadrature   When channel A leads B, a positive pulse count results;  
                          When channel B leads A, a negative pulse count results
- \*Factory Set Options*
- 

### Variable 02, Prescale for 1 Pulse

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

---

### Prescale examples

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

Time base: the rate display is calculated in process counts/second, and then 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 thru 9, counter initial and reset values**

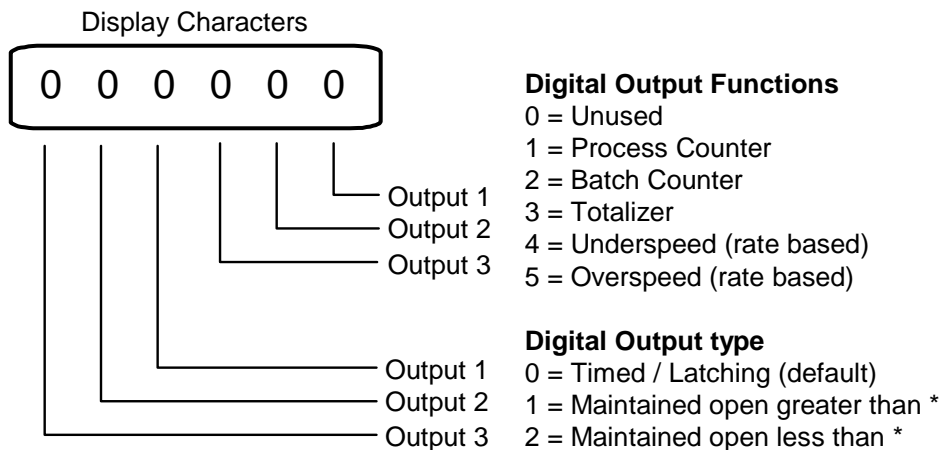
Variable numbers for counter initial and reset values:

	Initial Value	Reset Value
Process	Variable 4	Variable 5
Batch	Variable 6	Variable 7
Totalizer	Variable 8	Variable 9

## Programming the relay outputs

**Overview** 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 de-energized when the programmed count equals the programmed values.



**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: Overspeed*)—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.

*Continued on next page*

### ***Programming the relay outputs, continued***

---

#### **Relay and transistor outputs**

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.

---

#### **Output value variables 11, 13 & 15**

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.

---

#### **Set point on time variables 12, 14 & 16**

The set point on time programs the minimum time that the output will stay de-energized when the output value is reached (*0.1 to 600.0 seconds*).

Decimal point is fixed.

See Table 6 below.

---

#### **Latching output**

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.

---

#### **Variables**

Table 6 presents output programming variables.

**Table 6: Output Programming Variables**

<b>Item</b>	<b>Output 1</b>	<b>Output 2</b>	<b>Output 3</b>
Output Value	Variable 11	Variable 13	Variable 15
On-Time	Variable 12	Variable 14	Variable 16

---



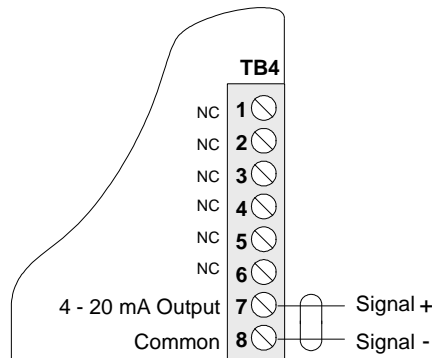
## Programming the analog outputs

---

### Overview

Any count or the count rate can be represented by the analog output and selected in Variable 21. The 4-20 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

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
- 

### Variable 22 4 mA display

This variable sets where the analog output is 4 mA. The default value is “0.”

---

### Variable 23 20 mA display

This variable sets where the analog output is 20 mA. The default value is “1000.”

---

**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,  
analog output  
cutoff**

This is used to set when the analog cuts off to zero. It can be set from 0.0 to 10.0 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.

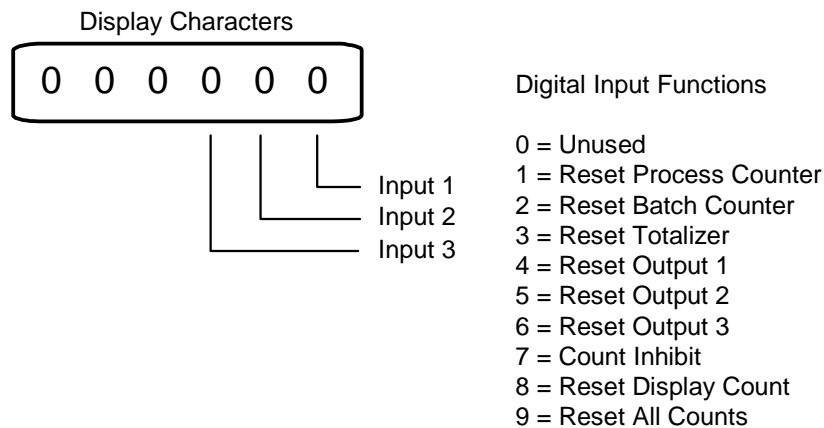
For switch input wiring, see the CT6000 Wiring & DIP Switches section.

### 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

This variable configures the function of the switch inputs. The input functions' bit assignments are shown below:



### 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 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.

*Continued on next page*

### ***Programming the switch inputs, continued***

---

<b>Reset outputs 1, 2 and 3</b>	When the input is activated, the set point output is disabled. The output will remain disabled until the input is de-activated.
<hr/>	
<b>Variable 19, count inhibit</b>	<p>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:</p> <p>0 = Unused  1 = Process  2 = Batch  3 = Totalizer</p>
<hr/>	
<b>Reset display count</b>	This input function mirrors the actions of the Front Panel Reset button.
<hr/>	
<b>Reset all counts</b>	All counts will reset to their initial values and all outputs will reset to their energized states.
<hr/>	
<b>Reset process count</b>	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.
<hr/>	
<b>Reset batch count</b>	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.
<hr/>	

## Programming the display features

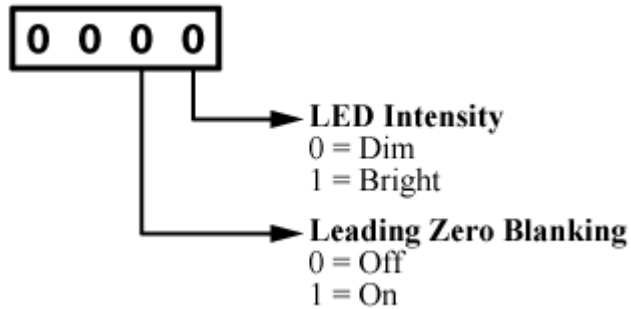
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### Variable 31, Leading Zero Blanking and Segment intensity

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.

---

### Variable 30, display update interval

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 mA / 0-10 VDC analog output test	45
Reset the variables	47
Set and change the security code number	48

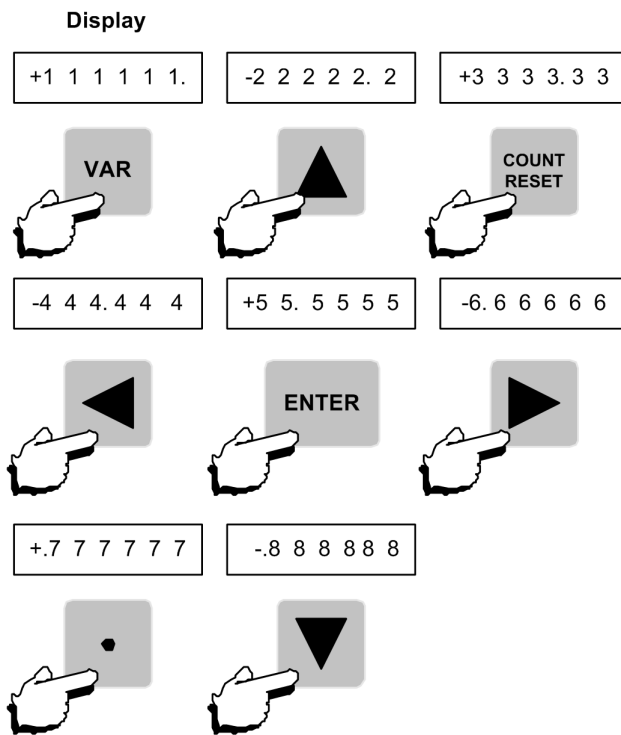
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## Keypad and display test

**Overview** The keypad diagnostic tests the functionality of each key and bit position on the display.

**Keypad and display test** 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 display will appear as shown in Figure 16. Note the position of the decimal point after each key press.
4.	Press the DIAG key to exit the keypad diagnostic.



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

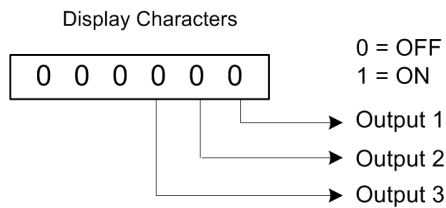


## Relay output test

**Overview** The Relay Output diagnostic tests the functionality of the relays.

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

Step	Action
1.	Press the DIAG key.
2.	Press the ► RIGHT ARROW key and the display will show the status of relay outputs. See Figure 17.



**Figure 17: Relay Output Test Display**

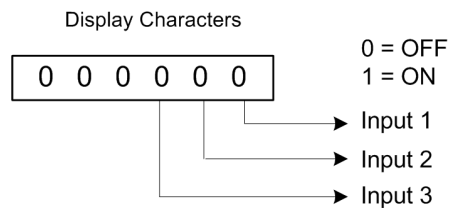
Step	Action
3.	Use the ◀ LEFT ARROW key to turn ON output 3, the ▲ UP ARROW key to turn ON output 2, and the ► RIGHT ARROW key to turn ON output 1.
4.	To turn OFF the outputs, press the ENTER key.
5.	Press the DIAG key to exit diagnostics.

## Switch input test

**Overview** The Switch Input diagnostic tests the CT6000's ability to recognize switch inputs tied to TB-1. When a closed switch is tied to TB-2, screw tap 1, 2, or 3, the corresponding bit position will toggle to "1."

**Switch input test** To test the switch inputs, do the following:

Step	Action
1.	Press the DIAG key.
2.	Press the ▲ UP ARROW key and the display will show the status of the three (3) switch inputs.  When a switch is activated at one of the inputs, the corresponding display character toggles to "1." When an input turns OFF, the corresponding display character toggles to "0."  Figure 18 shows the bit positions associated with the three (3) switch inputs.
3.	Press the DIAG key to exit diagnostics.

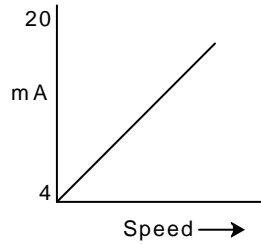


**Figure 18: Display Bit Positions Associated with the Switch Inputs**

## 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 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:** 4-20 mA or 0-10 VDC output is set up at the factory.

### Adjusting the output

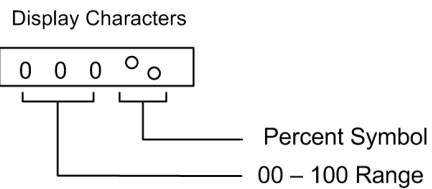
To adjust the 4-20 mA or 0-10 VDC output, do the following:

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

*Continued on next page*

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

Step	Action
3.	Press the ▼ DOWN ARROW key and the display will appear, as shown in Figure 20.



**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 VDC.
5.	Press the ▲ 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 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**

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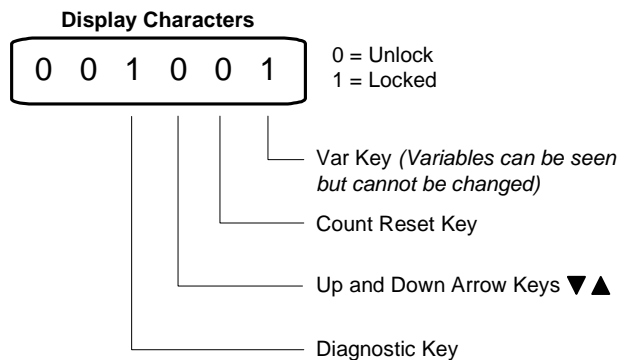
## Set and change the security code number

### 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.

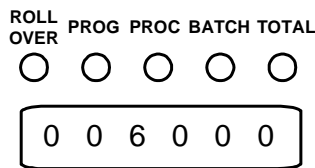
For example, if you enter 006001 into Diagnostics Mode for your security code number (*which will enable the keypad lockout function*) you must enter “006001” into variable 00 when you want to disable the keypad lockout function, which allows you access to all keys.

*Continued on next page*

**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 default is 001001, which locks out the DIAG key and prevents changes to operating variables, except variable 00.
2.	Press the DIAG key.
3.	Press the ◀ LEFT ARROW key and the display will show the default Security Code of 006000, as shown in Figure 22.



**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 enable the keypad lockout function and exit Diagnostics Mode.

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# Appendix A: CT6000 Specifications

Power	Description
Input Power	<ul style="list-style-type: none"> <li>• 115 VAC, 6 VA @ 50/60 Hz, requires external fuse 1/16 amp slow-blow</li> <li>• 230 VAC, 6 VA @ 50/60 Hz, requires external fuse 1/32 amp slow-blow</li> <li>• 10-30 VDC, requires external fuse 2 amp slow-blow</li> </ul>
Sensor Input/supply	Switch selectable 12 VDC unregulated, 100 mA maximum
NPN Open Collector	2200 ohm pull-up to 12 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 I/O	Description
Set Point Outputs ( <i>Relays</i> )	3 programmable-form A relays, rated 250 VAC 5 amp, 30 VDC 5 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	<ul style="list-style-type: none"> <li>• 4 programmable: Process, Batch, Total, and Rate</li> <li>• Forward and reverse</li> </ul>
Display Update Time	0.1 second update time for counters 1.0 second update for rate

*Continued on next page*

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<b>Mechanical</b>	<b>Description</b>
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° C to 50° C (+32° to + 122° F)
Humidity	0% to 90% non-condensing

***Specifications are subject to change without notice.***

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## 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	1	
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	
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Electro-Sensors®, Inc.  
6111 Blue Circle Drive  
Minnetonka, MN 55343-9108

Contact us at:

Local: 952-930-0100

National: 1-800-328-6170

Fax: 952-930-0130

Web: [www.electro-sensors.com](http://www.electro-sensors.com)

Sales [www.sales@electro-sensors.com](mailto:www.sales@electro-sensors.com)

Support: [www.tech@electro-sensors.com](mailto:www.tech@electro-sensors.com)