

D3-HSC
High Speed Counter

Manual Number D3-HSC-M



WARNING

Thank you for purchasing automation equipment from **PLCDirect™**. We want your new **DirectLOGIC™** automation equipment to operate safely. Anyone who installs or uses this equipment should read this publication (and any other relevant publications) before installing or operating the equipment.

To minimize the risk of potential safety problems, you should follow all applicable local and national codes that regulate the installation and operation of your equipment. These codes vary from area to area and usually change with time. It is your responsibility to determine which codes should be followed, and to verify that the equipment, installation, and operation is in compliance with the latest revision of these codes.

At a minimum, you should follow all applicable sections of the National Fire Code, National Electrical Code, and the codes of the National Electrical Manufacturer's Association (NEMA). There may be local regulatory or government offices that can also help determine which codes and standards are necessary for safe installation and operation.

Equipment damage or serious injury to personnel can result from the failure to follow all applicable codes and standards. We do not guarantee the products described in this publication are suitable for your particular application, nor do we assume any responsibility for your product design, installation, or operation.

If you have any questions concerning the installation or operation of this equipment, or if you need additional information, please call us at 1-800-633-0405.

This publication is based on information that was available at the time it was printed. At **PLCDirect™** we constantly strive to improve our products and services, so we reserve the right to make changes to the products and/or publications at any time without notice and without any obligation. This publication may also discuss features that may not be available in certain revisions of the product.



Trademarks

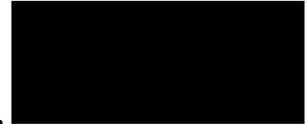
This publication may contain references to products produced and/or offered by other companies. The product and company names may be trademarked and are the sole property of their respective owners. **PLCDirect™** disclaims any proprietary interest in the marks and names of others.

Stage is a trademark of Koyo Electronics Industries Co., LTD. Texas Instruments is a registered trademark of Texas Instruments, Inc. TI, TIWAY, Series 305, Series 405, TI305, and TI405 are trademarks of Texas Instruments, Inc. Siemens and SIMATIC are registered trademarks of Siemens, AG. GE is a registered trademark of General Electric Corporation. Series One is a registered trademark of GE Fanuc Automation North America, Inc. MODBUS is a registered trademark of Gould, Inc. IBM is a registered trademark of International Business Machines. MS-DOS and Microsoft are registered trademarks of Microsoft Corporation. Windows is a trademark of Microsoft Corporation. OPTOMUX and PAMUX are trademarks of OPTO 22.

**Copyright 1997, PLCDirect™ Incorporated
All Rights Reserved**

No part of this manual shall be copied, reproduced, or transmitted in any way without the prior, written consent of **PLCDirect™** Incorporated. **PLCDirect™** retains the exclusive rights to all information included in this document.

Manual Revisions



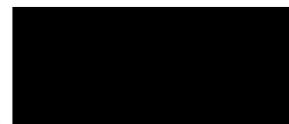
If you contact us in reference to this manual, please include the revision number.

Title: DL-305 High Speed Counter

Manual Number: D3-HSC-M

Issue	Date	Effective Pages	Description of Changes
Original	7/95	Cover/Copyright Contents 1-22 Back Cover	Original Issue
Rev. A	6/98	Entire Manual Manual Revisions	Downsize to spiral Rev. A

Table of Contents



Getting Started

Manual Overview	2
Introduction to High Speed Counters	3
What is a High Speed Counter?	3
Who Needs a High Speed Counter?	3
Types of Counting	3
Using Presets and Current Count	4
What is a Preset and Current Count?	4
Using an Offset Value for Current Count	4
Positive Value Requirement	4
The HSC Outputs	5
External Outputs OUTPUT1 and OUTPUT2	5
Two Modes of Controlling Outputs	5
Output Logic Control	5
Current Count Outputs in BCD	5
Status Flags (I/O Points)	6
Counter Reset	7
External Reset	7
Two Response Rates	7
General Specifications	8
3 Steps For Setting Up and Using the D3-HSC	9

Installation and Wiring

Installing the Module	10
Selecting a Slot for the HSC Module	10
Selecting the Response Rate	10
Inserting the Module in the Base	10
Wiring the Module	11
General Considerations	11
Soldering the Wires to the Connector Block	11
Wiring for UP/ DOWN Counting	11
Encoder Wiring Diagram	12
Output Wiring Diagram	13
Reset Wiring Diagram	14
BCD Outputs	15
I/O Specifications	16



Writing the Program

Writing the Program	17
How to Enter Your Program:	17
Setup Procedure	17
Flow Diagram of SetupLogic	17
Setting Up the Counters	18
Programming Conventions	18
Preset and Current Count	18
Relationship Between Preset and Current Count	19
What Happens After the Counter Reaches the Upper Limit?	19
Overflow	19
Setting Up the Outputs	20
How to Control The Outputs:	20
Flow Diagram of SetupLogic	20
Table 1: Status of Mode and Logic Controls in the Automatic Mode	20
Setting Mode and Output Logic Control	21

Putting It All Together - Examples

Example 1: Activating both Outputs Automatically	22
Example 2: Mixing Modes of Operation for Outputs	23
Example 3: Changing Presets On the Fly	24

D3-HSC

High-Speed Counter

In This Manual. . . .

- Getting Started
 - Installation and Wiring
 - Writing the Program
 - Putting It All Together - Examples
-

Introduction to High Speed Counters

What is a High Speed Counter?

Literally, high speed counters count fast! The DL305 High Speed Counter (D3-HSC) has its own microprocessor that asynchronously counts and accumulates the high speed pulses. The D3-HSC will count pulses from sensors, encoders, switches, and so on, at two different response modes. You can use its 10 kHz mode when measuring the fast pulses (500 Hz to 10kHz), or you can use the 500 Hz mode when measuring pulses being transmitted at a much slower frequency (below 500 Hz). Both frequencies require 50% duty cycle.

Who Needs a High Speed Counter?

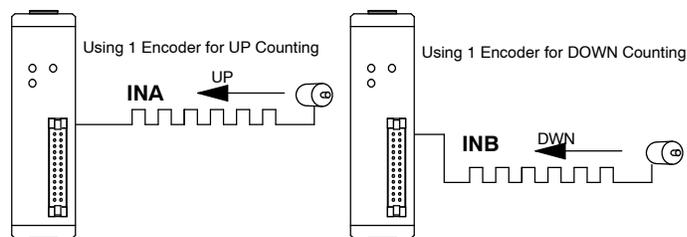
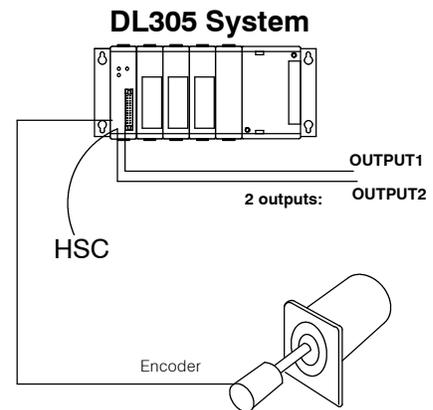
If you are using a DL305 system and have an application that needs to count pulses rapidly, then you are a prime candidate for an HSC. In most applications, the HSC counts pulses being sent from encoders.

Encoders are used to emit pulses in relation to a turning motor shaft. The encoders emit a certain number of pulses with each shaft rotation. By counting the pulses, you can easily determine the position of things being controlled by the motors. The pulses are counted at high speed, and are then compared to a preset that you define in your program. The results of this comparison control the built-in HSC outputs or can be used to perform operations within your RLL program.

An example application could be as follows: An encoder could be connected to a motor shaft that is moving boards into position for cutting. An output (OUTPUT1) could control the OFF and ON signal to a motor that advances the boards. Since the same current count and preset can be setup to affect both outputs, you could use OUTPUT2 to control the cutting blade.

Types of Counting

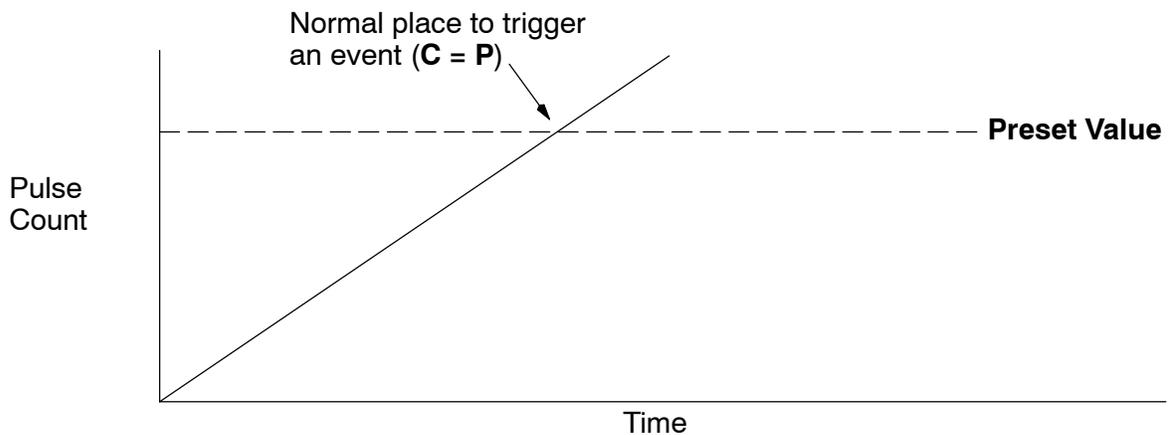
The D3-HSC can do **standard** UP and DOWN counting. *It cannot do quadrature counting, and therefore cannot be used with a quadrature encoder.* The UP/DOWN input signals can come from standard 1-channel encoders. One channel is used for UP counting and the other channel is used for DOWN counting.



Using Presets and Current Count

What is a Preset and Current Count?

High speed counters allow you to enter a target pulse count value (called the **Preset**) that you can use to make some event (or events) happen. The event could be turning on a lamp, starting a motor, tripping a switch—virtually anything. When the HSC starts counting pulses the accumulated count is continuously being written to the HSC's memory. This value is referred to as the **Current Count**. In most applications, when current count equals preset ($C = P$), the event or events will be triggered. The D3-HSC will turn ON or OFF up to two external outputs when $C = P$. You determine whether the outputs are turned ON or OFF when you write your ladder logic. Actually with the D3-HSC you are given the option to automatically turn outputs ON or OFF when $C = P$, or you can turn the outputs on manually at any time regardless of the relationship between C and P. We'll talk more about automatic and manual operation on the next page.



Using an Offset Value for Current Count

You do not have to start your current count at zero when starting your high speed counter. If you start at some number other than zero, this is called an "offset". We'll show you how to enter the offset when we explain the setup procedure in greater detail.

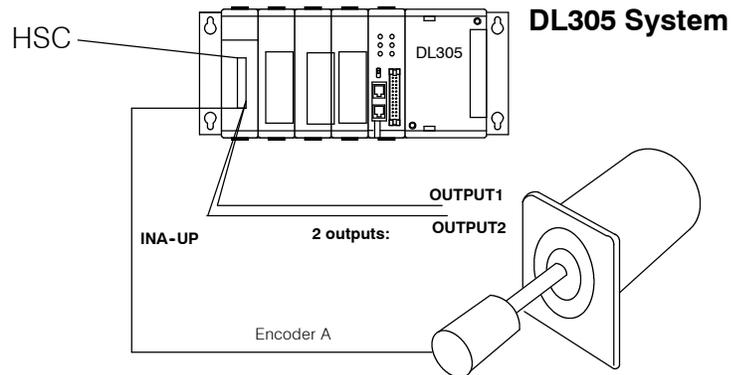
Positive Value Requirement

When setting up the preset or current count offset value, you must use a *positive* number between 0 and 9999. The D3-HSC does not understand negative numbers.

The HSC Outputs

External Outputs OUTPUT1 and OUTPUT2

In most applications, you need to take some type of action when the number of pulses (current count) received equals your preset target ($C=P$). There are two discrete external outputs (OUTPUT1 and OUTPUT2) for the D3-HSC. The outputs are triggered by a combination of your ladder logic and/or the pulses received on the count inputs of the HSC.



Two Modes of Controlling Outputs

You can control the two outputs of the D3-HSC by choosing one of two modes:

- **Automatic (Mode=1)**--If you choose the automatic mode, then the current count alone will determine when an output will change status (ON or OFF).
- **Manual (Mode=0)**--If you choose to operate the outputs manually, then the current count of the counter does not affect the outputs. Instead, you can use the outputs just like any normal output, which means you control them with your ladder logic program.

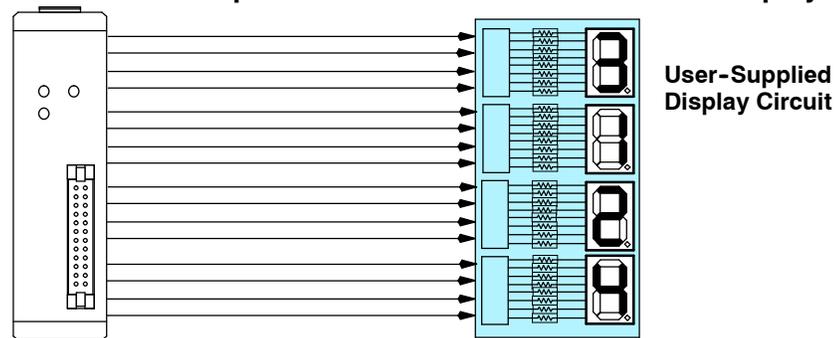
Output Logic Control

The relationship between current count and preset controls the outputs, when in automatic mode. However, there is an additional feature called Output Logic Control that lets you choose how the outputs operate. For example, in one application you may want the output to *come on* when current count equals preset ($C=P$). However, in another application, you may want the output to *go off* when current count equals preset ($C=P$). Fortunately, you can choose the method individually for each point. Pages 18-19 explain this in more detail.

Current Count Outputs in BCD

You **cannot** read the current count of the HSC by reading an internal register. This is different from the HSC modules offered in the DL205 and DL405 families. However, there are 16 outputs that can be connected to a display (or even an input module) to show the current count in BCD. We'll talk about this in a later section.

Example Interface for BCD Output of Current Count Value to LED Display

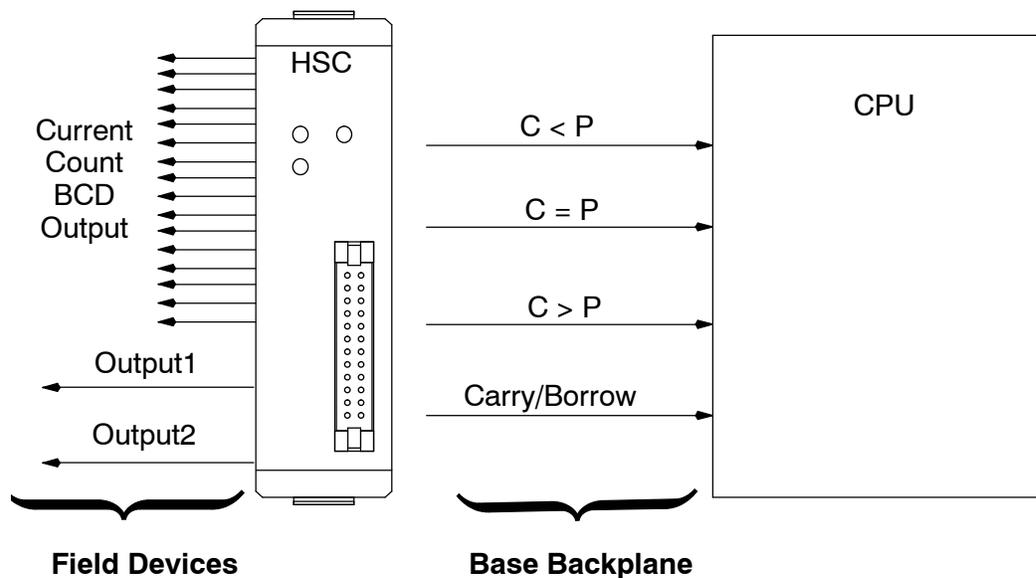


Status Flags (Internal Relays)

In addition to the two external outputs (OUTPUT1 and OUTPUT2) and the BCD outputs, the D3-HSC also will set several status flags (**C < P**, **C = P**, **C > P** and **Carry/Borrow**) that are assigned to certain I/O points that you can use in your ladder logic. These I/O points are internal to the HSC and have no outside connecting points on the module connector.

Later, we'll present a table that shows you what memory reference to use in your ladder logic in order for the CPU to read the status of these flags. The numbers referring to the status flag relays are uniquely determined by the base slot position that you choose for your HSC.

Below is a diagram showing the internal and external I/O of the HSC.



Counter Reset

External Reset

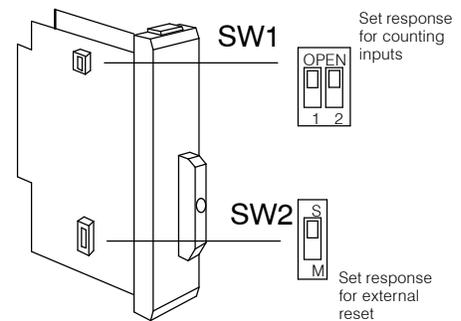
Once the pulses have been counted you need a way to reset the counter. There are two options:

- **External Reset-** You can reset the counter of the HSC externally via a device connected to pins 6A and 6B on the front of the module. The wiring diagram on Page 12 provides the electrical details. This can be a limit switch, proximity switch, photoswitch, or virtually any field device that will provide a logical high pulse (in the range of 3VDC to 7VDC) for a period of at least 100 milliseconds.
- **Internal Ladder Logic Reset-** You can also reset the counter by using the proper sequence of commands in your ladder logic. You do this by entering a new Current Count value, followed by entering a Preset Value in the same scan cycle. We'll show you how to do this in the back part of this manual when we show you how to write logic for some specific applications.

Two Response Rates

There are two dip switches located on the circuit board of the HSC--the one marked SW2 (with the letters S and M marking the switch positions) is for matching up the responsiveness of the reset switch with the counting rate. SW1 is for setting the counting rate. Consequently, when you set the counting rate on SW1 (either 500 Hz or 10 kHz), you will want to set SW2 so that it matches.

Position M= 500 Hz and Position S = 10kHz.



General Specifications

Item	Specification
Counter	UP/DOWN Counter
Counter Speed	10 kHz maximum Dip Switch Selectable Response Rates: Either 10 kHz or 500 Hz (50% Duty Cycle)
Counter Inputs	1 Count UP Input 1 Count DOWN Input
Reset	External Reset Available
Count Value	Non-Retentive Upon Power Cycle
Counter Preset	Set by CPU Ladder Logic Program
Outputs (External Points)	16-Outputs for BCD Display Output1 Output2
Status Flags (Internal Relays)	C < P Flag C = P Flag C > P Flag Carry/Borrow Flag
Output Response	0.01 ms, maximum
Base Power Requirement	9V 70 mA, maximum
Weight	4.6 ounces (130 grams)

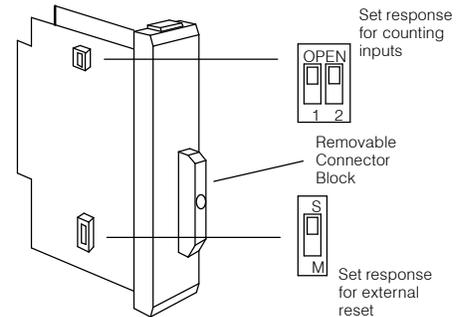
NOTE: The D3-HSC cannot perform quadrature counting. This module will not work with a quadrature type encoder.

3 Steps For Setting Up and Using the D3-HSC

Step 1: Set Response and Wire Module

(See “Installation and Wiring”, Pages 8 through 14)

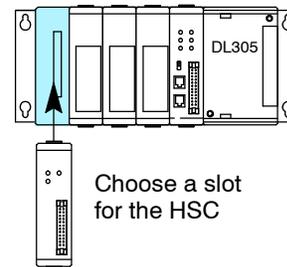
The HSC has two response speeds—either 10kHz or 500Hz. These are selectable via two sets of dip switches on the side of the module. You should set these to your choice of response speeds. Then, solder the wires to the removable connector block, following the wiring diagram in this manual.



Step 2: Install the Module

(See “Installation and Wiring”, Pages 8 through 9)

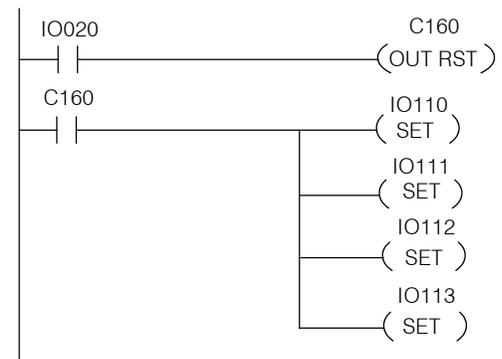
You will decide which slot to use for the HSC. You have your choice of Slots 0, 1, 2, or 3. This will, in turn, determine the memory locations assigned to the HSC inputs and outputs.



Step 3: Write the Setup Program (See “Writing the Program”, Pages 15 through 19)

With a segment of ladder logic entered via *DirectSOFT* or a handheld programmer, you will write ladder logic that sets up the counter and optionally determines the logic and mode of control for the outputs. The setup sequence is as follows:

- Set up the current count and preset for the counter.
- Select the mode—automatic or manual
- If you choose the automatic mode, you must select the Output Logic Control method (ON-to-OFF or OFF-ON) for OUTPUT1 and OUTPUT2
- If you choose the manual mode, you must write the logic to control OUTPUT1 and OUTPUT2 directly.

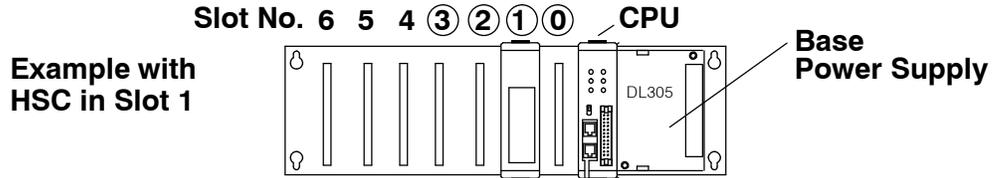


Only the first bullet point in Step 3 is necessary if you plan to use no outputs.

Installing the Module

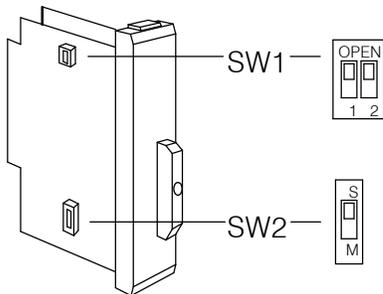
Selecting a Slot for the HSC Module

The D3-HSC can occupy Slots 0, 1, 2, or 3 of any DL305 base. **The module will not function in any other slots.** The memory assignments for the HSC's inputs and outputs (to be used in your ladder logic) are affected by the slot you choose. Pages 17 through 19 of this manual show you the specific memory assignments for inputs and outputs. For example, the following diagram is of a D3-08B 8-slot base. Notice that the CPU slot has no number.



Selecting the Response Rate

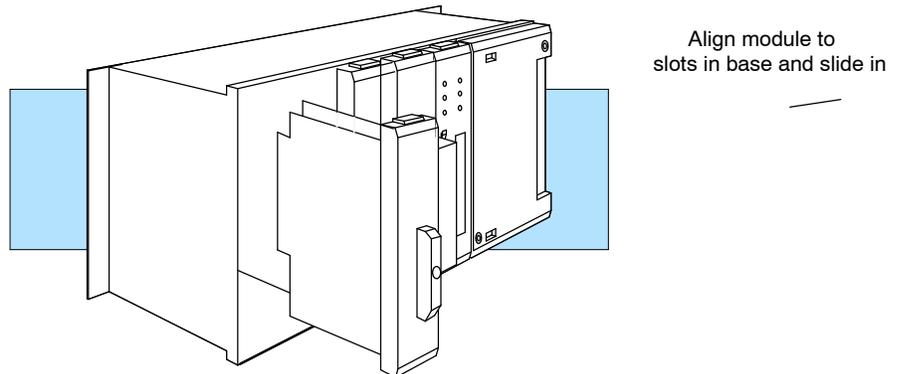
As mentioned earlier, the response rate for **counting** is dip switch selectable. Also the speed at which the **reset** input can be detected is selectable. These switches are on the component side of the module's internal circuit board. SW1 is at the top and SW2 at the bottom. Use the table below to select the rate. If the pulses are being sent at a rate higher than 500 Hz, then you need to choose the 10 kHz setting. *Be aware that the frequency response rate of SW1 must match that of SW2 if you plan to use the external reset.*



SW1	10 kHz	500 Hz
Counting Inputs:		
Position 1	OPEN	CLOSED
Position 2	OPEN	CLOSED
SW2		
External Reset	S Position	M Position

Inserting the Module in the Base

When inserting components into the base, align the PC board of the HSC module with the grooves on the top and bottom of the base. Push the module straight into the base until it is firmly seated in the backplane connector.



WARNING: Never connect or install a module into the base while the power is applied. Failure to remove the power prior to the installation can result in damage to the module, other installed modules, the power supply and/or the CPU itself.

Wiring the Module

General Considerations

Consider the following guidelines when connecting the field wiring to the D3-HSC.

1. There is a maximum size wire the module can accept. We recommend that you use wire that is no smaller than 22 AWG and no larger than 18 AWG.
2. Always use a continuous length of wire, do not combine wires to attain a desired length.
3. Use the shortest possible cable length.
4. Use wire trays for routing where possible
5. Avoid running wires near high energy wiring.
6. Avoid running input wiring in close proximity to output wiring where possible.
7. To minimize voltage drops when wires must run a long distance , consider using multiple wires for the return line.
8. Avoid running DC wiring in close proximity to AC wiring where possible.
9. Avoid creating sharp bends in the wires.

Soldering the Wires to the Connector Block

The D3-HSC is shipped with the connector block and snap-together wire cover packaged separately. This block fits on the 32-pin male connector slot on the front of the module. Before you connect it to the HSC, you may find it easier to solder the wires that you will be connecting from the encoders, the external power supply, the optional BCD outputs, the external reset, and two discrete outputs (OUTPUT1 and OUTPUT2). Refer to the wiring diagram on the next few pages for details.

Be careful not to create cold solder joints or place so much solder on a connecting pin that it shorts out against a neighboring pin. Make sure you refer to Page 13 for connecting the BCD outputs correctly. Note which bit of the 16-bit word goes with the each weighted position of the BCD value (4 bits per numeral). You don't want to mix up the bits; otherwise, you will get a current count number that is incorrect.

Take care also to position the wires while soldering so that the cover can be snapped securely around the wires. The cover consists of two pieces. They are held together by small screws and hex nuts. Two long-shaft thumb screws attach the cover securely to the module as a final step.

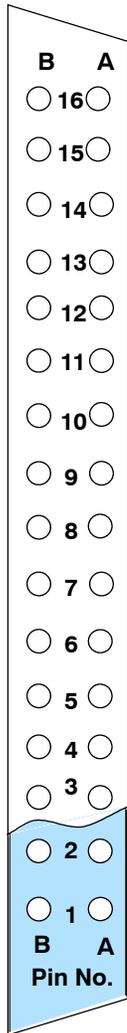
WARNING: To minimize potential shock, turn off power to the I/O base and any modules installed in the base before inserting or removing a module. Failure to do so may result in potential injury to personnel or damage to the equipment.

Wiring for UP/ DOWN Counting

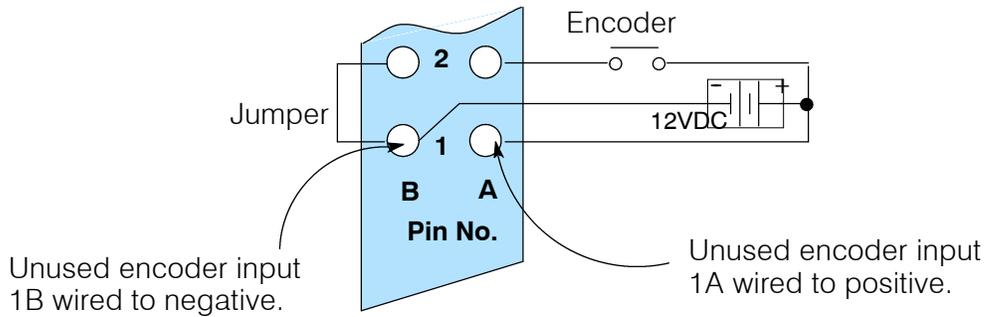
On Page 10 of this manual you will be shown how to wire encoders for UP counting or for DOWN counting. Different connecting pins are used for each task.

IMPORTANT: When one channel is counting (either UP or DOWN), the other channel must be held high. If you are using only one encoder, tie the (+) connecting pin for the unused input to the high (positive) side of the encoder's power supply ; and the (-) pin to the negative side.

Encoder Wiring Diagram

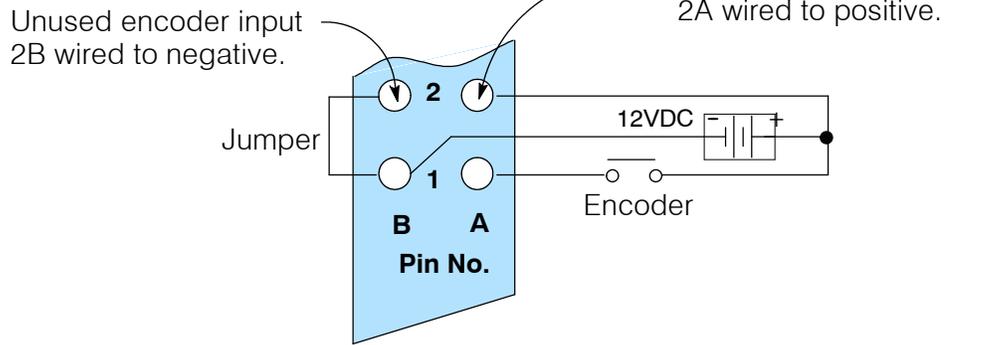


DOWN Counting

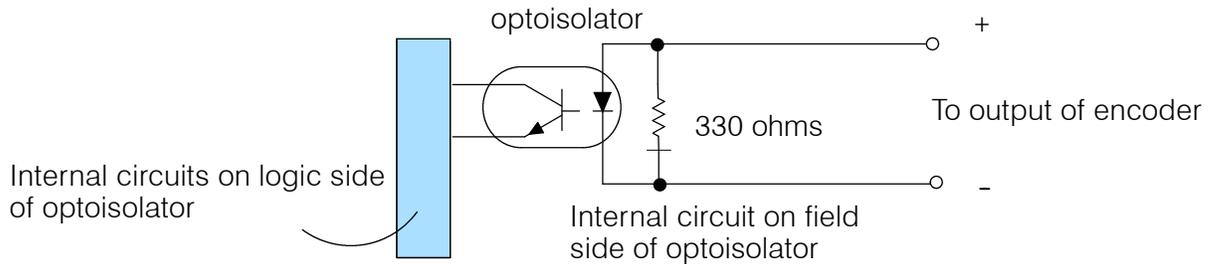


NOTE: There are two pairs of encoder connecting pins. 1A and 1B are for UP counting and 2A and 2B are for DOWN counting. You must hook your encoder to one set of pins. The unused set of pins must have the (A) pin connected to the positive side of the encoder supply, and the (B) pin connected to the negative side.

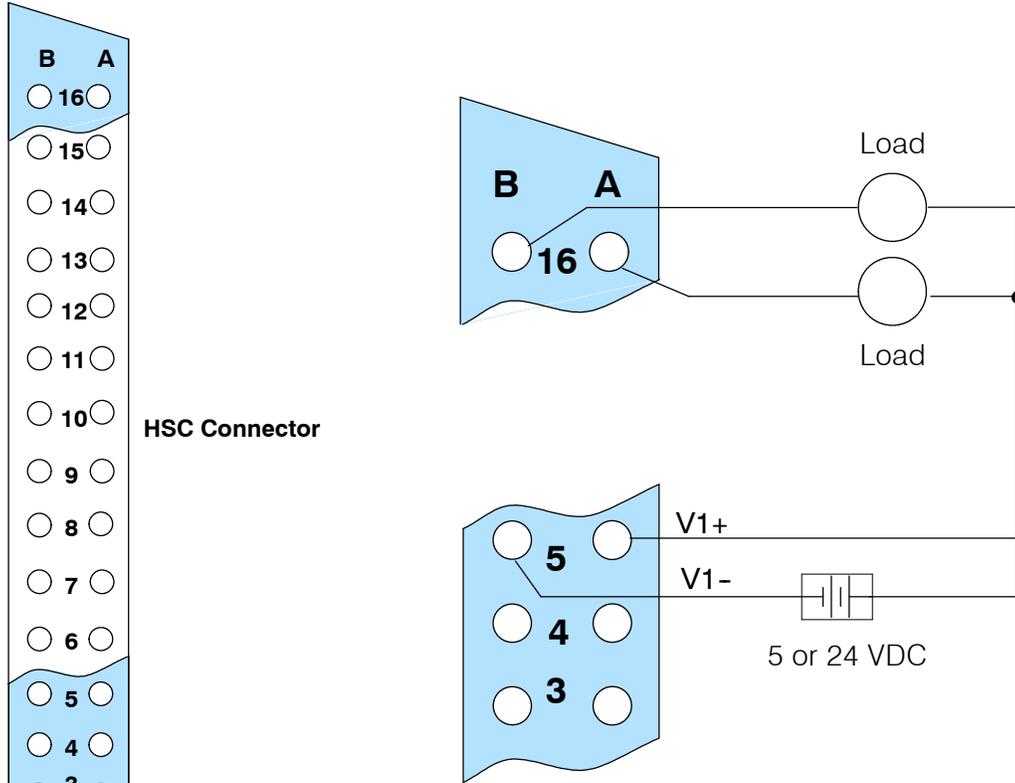
UP Counting



Internal Circuitry

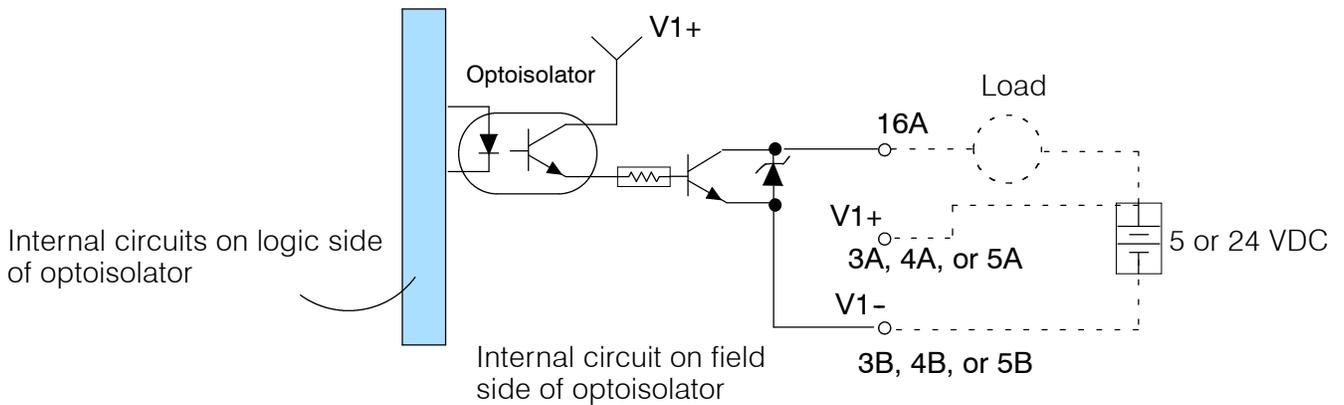


Output Wiring Diagram

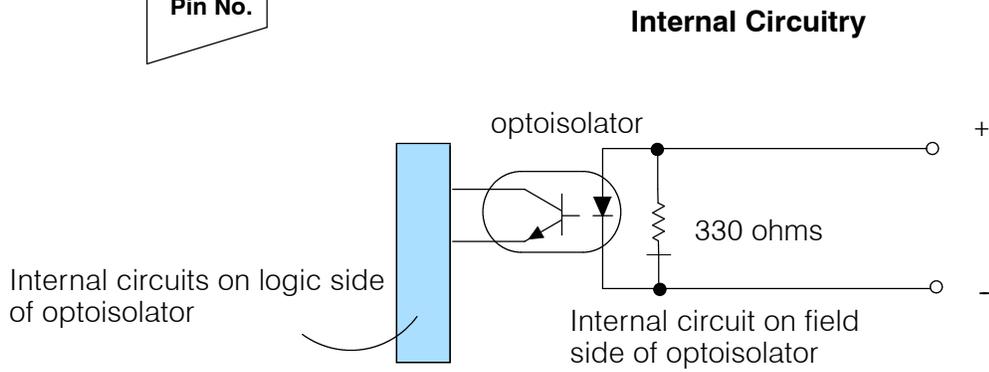
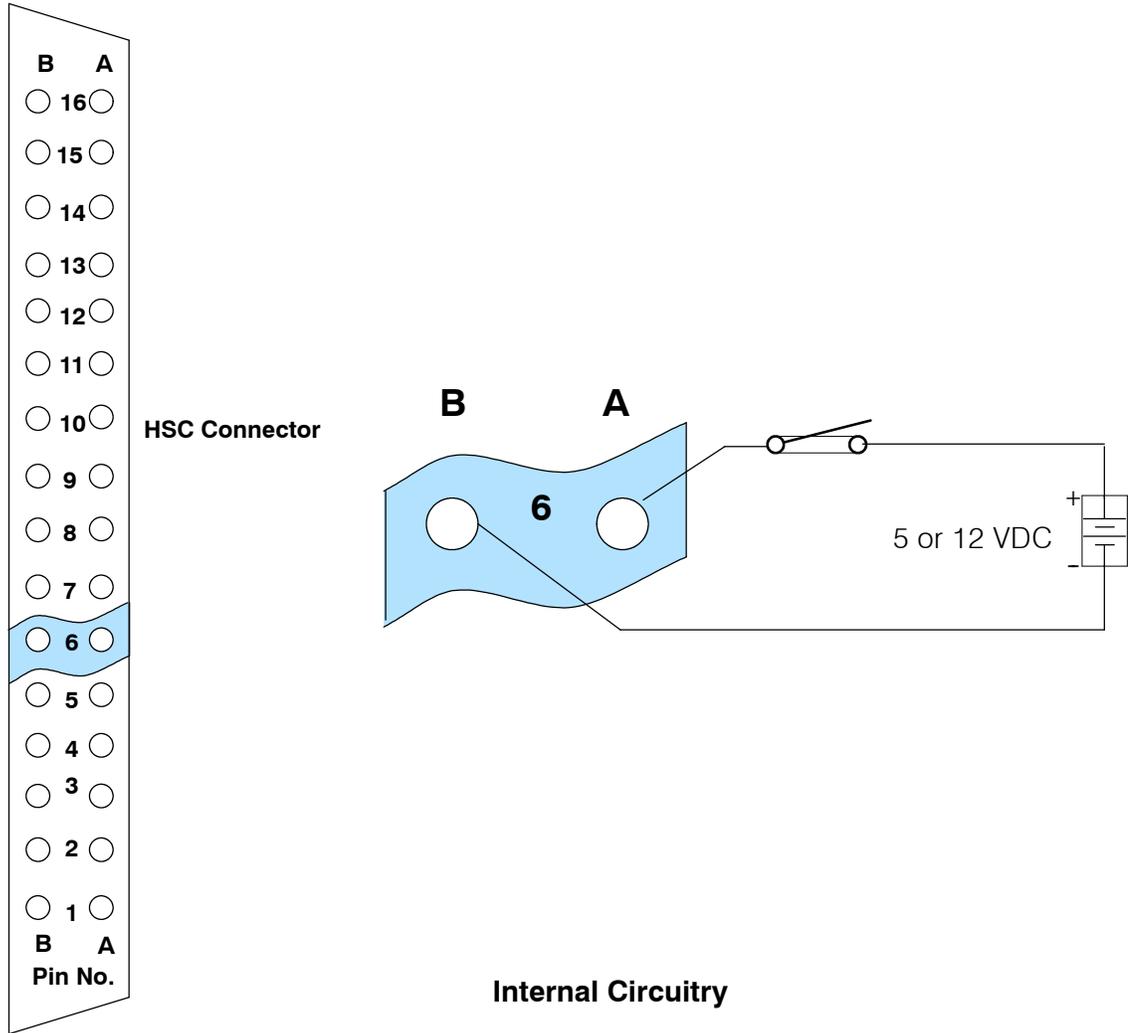


NOTE: Pins 3, 4 and 5 are internally connected. Any one of these pins can be used for the supply wiring.

Internal Circuitry



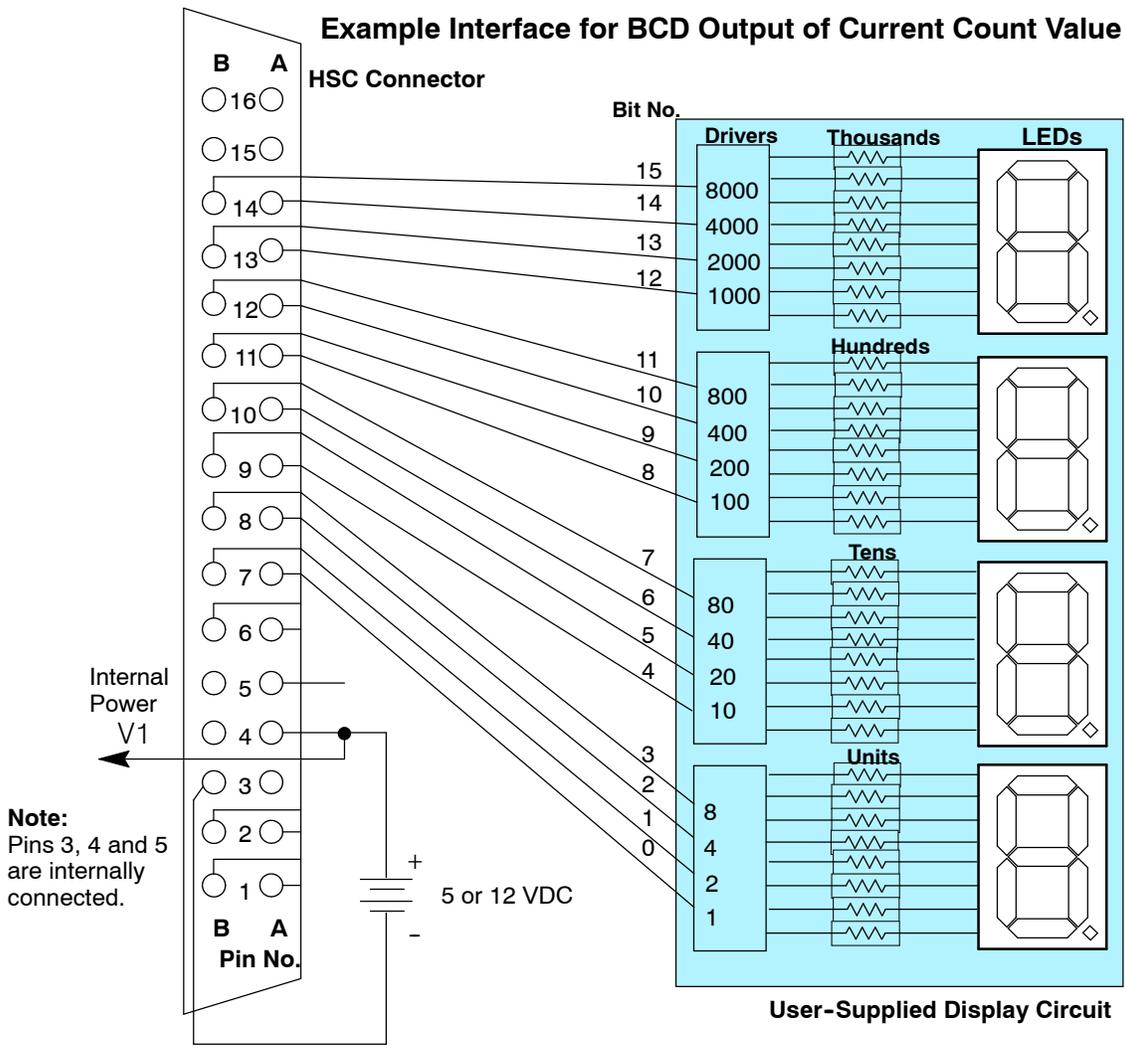
Reset Wiring Diagram



BCD Outputs

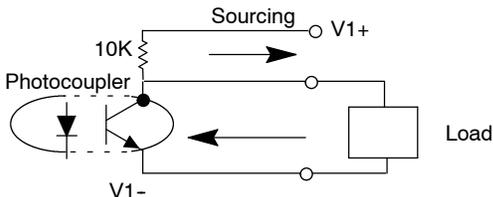
The CPU cannot read the current count directly, but there are 16 BCD outputs for driving a BCD display or connecting to a DC input module to read the current count into the CPU. The 16-connecting points (7A&B thru 14A&B) are attached to the BCD input of the drivers for visually displaying the BCD value or you can wire them to an input module. Such a configuration is completely optional, and requires that you supply the external devices. You determine the voltage level of these 16 points through your choice of an external power supply with the positive side connected to points 3A, 4A, 5A, and negative side connected to 3B, 4B, and 5B.

Example Interface for BCD Output of Current Count Value to LED Display

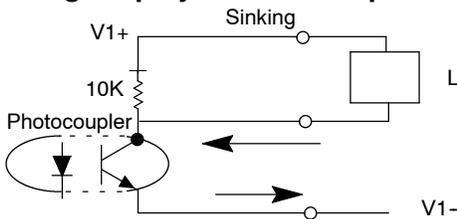


BCD Output Circuit (For Interfacing Display Device or Input Module)

Negative Logic



Positive Logic



I/O Specifications

Input Specifications	Count Input	Reset Input
Minimum Input Pulse Width	25 μ s	100 μ s
Signal Direction	Falling Edge	ON
Power Source Voltage	12 VDC 10%	12 VDC 10%
ON Current	10–25 mA	10–25 mA
OFF Current	3 mA max.	3 mA max.
ON Voltage	7 V min.	7 V min.
OFF Voltage	3 V max.	3 V max.

BCD Output Specifications	5 V \pm 5%	12V \pm 10%
Current Consumption	10 mA max.	25 mA max.
Ripple	1% max.	3% max.
Output Current (source) (6.0 V)	0.1 mA	0.4 mA

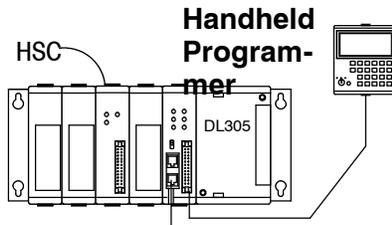
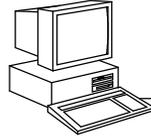
External Output Specifications	Rating
Output Type	NPN Open Collector
Output Voltage	5–24 VDC
Output Current	0.3 A
Leakage Current	0.05 mA max.

Writing the Program

How to Enter Your Program:

You can write your PLC program by using a computer with *DirectSOFT* programming software, or using a handheld programmer compatible with your particular model of CPU.

Programming via Computer

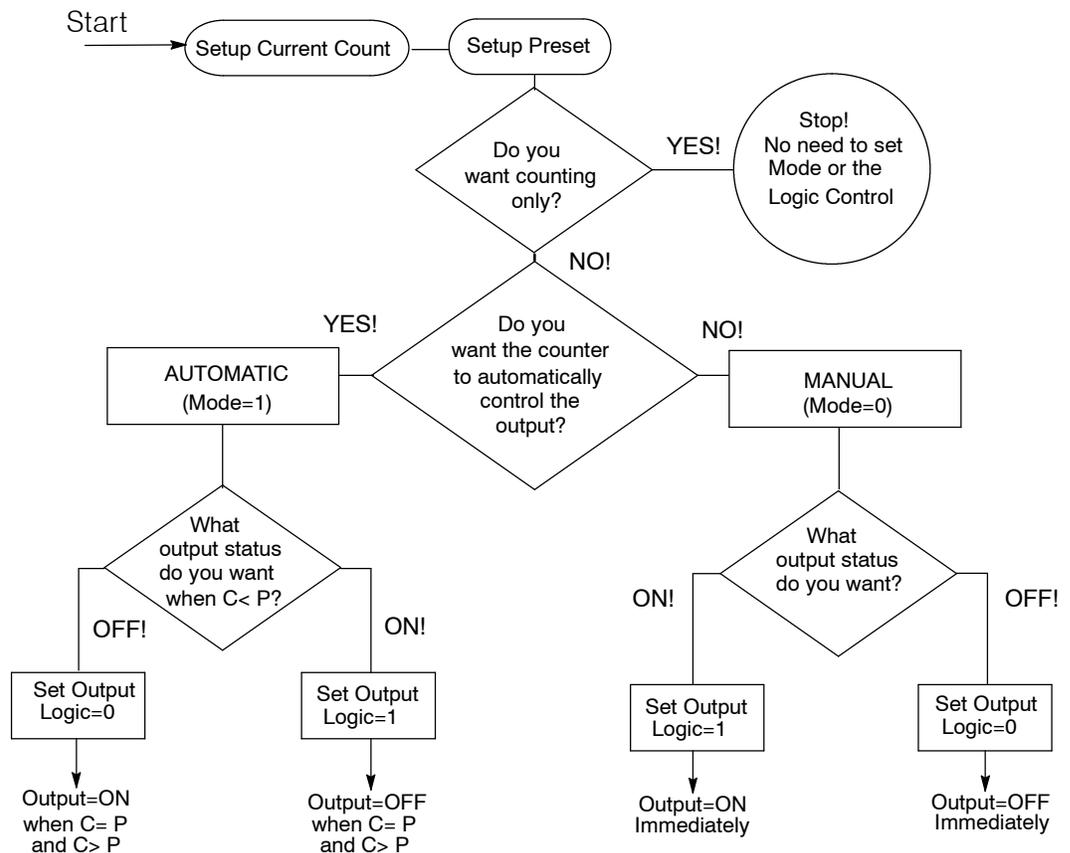


Setup Procedure

The HSC must be set up with your ladder logic in a specified manner. If you are using the counters only (and not the external outputs), then you only have to worry about setting up the counters:

- **Setup the Counters** - Your logic must setup a current count value (C) and a preset value (P) in the same scan cycle. The order of execution must be current count first and preset second. The values used for either C or P can be any integer between 0 and 9999. A value must be entered—there are no default values.
- **Setup the Outputs (Optional)** - If you plan to use the external outputs, you must setup something called **Output Mode** and **Output Logic Control** for each of the two outputs. These two settings will ultimately control the logic status (OFF or ON) and the method for triggering each output.

Flow Diagram of SetupLogic



Setting Up the Counters

Programming Conventions

As mentioned earlier, you can use either a handheld programmer or *DirectSOFT* to enter your ladder logic. The examples we will be giving in this section of the manual are specific to *DirectSOFT*. We will, however, where necessary point out some subtle differences for the handheld programmer. When setting up your counters, you will be using the following conventions:

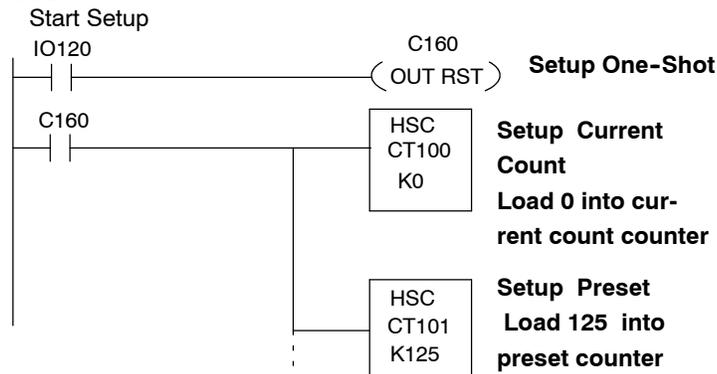
- **Instructions** - You will not be using the normal counter box when setting up the HSC. While in *DirectSOFT*, if you use hot key **F7** and examine the list of boxes available, you will find that one of them is called **HSC**. This is the box that you use in your ladder logic for setting up the HSC. If you are using the handheld programmer for the DL305, you will use the conventional **CNT** key (followed by the appropriate counter number) in order to do the setup.
- **Registers or Constants** - In order to setup the current count and preset in your counters, you can either enter constant values directly (i.e. K125) or you can point to any user-register (i.e. R400) where the values are stored. This is entirely up to you. We have used the direct reference with a constant in all of our examples.
- **Activating the Setup** - the counter begins counting pulses as soon as the CPU enters the RUN mode and the setup logic is scanned. You can use any type of permissive contact to trigger the setup logic. The setup logic only has to be scanned one time to setup the preset and the current count starting point. Therefore, it is important to trigger the setup logic with a one-shot. (See the example below as to how this is done.) If you don't use a one-shot, the current count and preset setup will be executed as long as the permissive contact is on. (It will look like the counter isn't working properly, but in reality your program is simply loading a current count on every scan!)

Preset and Current Count

Shown below is a table with the counter numbers that you will enter either in your HSC box (when using *DirectSOFT*) or following your CTR command when using the handheld programmer. Notice that the counter used depends on the module location in the base.

Counter Setup	Slot 0 Cntr	Slot 1 Cntr	Slot 2 Cntr	Slot 3 Cntr
Current Count	CT100	CT102	CT104	CT106
Preset	CT101	CT103	CT105	CT107

Example: The following ladder logic initializes an HSC in Slot 0 with a preset value of 125 and a current count of 0. Notice the OUT RST instruction. In the DL305 instruction set, the OUT RST is a one-shot, similar to the PD (positive differential) instruction of the DL205 and DL405 families.

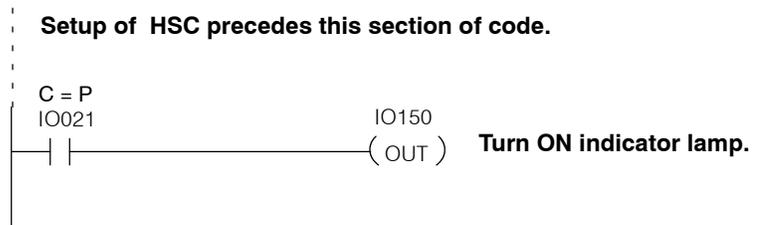


Relationship Between Preset and Current Count

The relationship between current count and preset will change as your program runs and the HSC continues to count pulses. You can monitor the status of **C<P**, **C=P**, and **C>P** by checking certain I/O points. Each of the three flags have I/O points assigned to them for storing the status of each. The addresses associated with these points changes according to which slot you have used for the HSC. You can use the I/O points for these flags to trigger events inside your RLL program.

Counter Status	Slot 0	Slot 1	Slot 2	Slot 3
C > P	IO000	IO010	IO020	IO030
C = P	IO001	IO011	IO021	IO031
C < P	IO002	IO012	IO022	IO032

Example: The following ladder logic will turn ON an indicator lamp when C = P for an HSC in Slot 2.



What Happens After the Counter Reaches the Upper Limit?

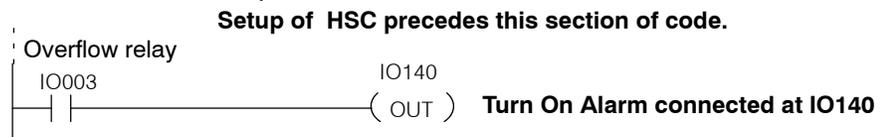
The upper limit for the counter is 9999. If your ladder logic has been written so that the counter continues to count past C=P and eventually reach a current count of 9999, the counter will stop counting pulses when it reaches the upper limit. It does not wrap around to zero. It is instead in an “overflow” status.

Overflow

The I/O point assigned to the Overflow function (current count greater than 9999 range) of the HSC can also be monitored by your RLL to either report the status or trigger an event. The address associated with the I/O point changes according to HSC slot position and is shown in the following table:

Counter Overflow	Slot 0	Slot 1	Slot 2	Slot 3
Count > 9999	IO003	IO013	IO023	IO033

Example: The following ladder logic will sound an alarm if the current count exceeds 9999. This example assumes the HSC is in Slot 0.



Setting Up the Outputs

How to Control The Outputs:

You use your ladder logic to select the way that the HSC outputs operate. You will use your logic to turn ON or OFF certain internal I/O points that control what are called **Output Mode** and **Output Logic Control**. By controlling the mode and logic for Outputs1 and 2, we are able to determine when the outputs turn ON or OFF. The flow diagram shown below explains the thought process for setting the mode and logic control to determine the status of the outputs. For example, if you choose to operate OUTPUT1 in the automatic mode, and you want to have the output ON when current count is less than preset ($C < P$), then you will want to set Output1 Mode = 1 and set Output1 Logic Control = 1.

Flow Diagram of SetupLogic

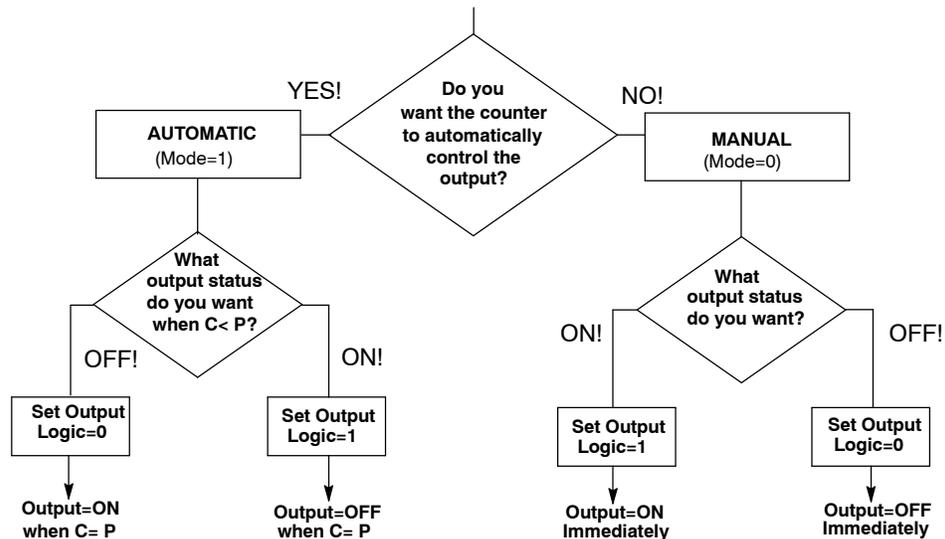


Table 1
Status of Mode and Logic Controls in the Automatic Mode

It may be also useful to look at the relationship between the Output Mode and Output Logic control and the external outputs for $C < P$ and $C = P$ using a table.

Output 1 Mode	Output 1 Logic Control	Output 1 $C < P$	Output 1 $C = P$
1	0	OFF	ON
1	1	ON	OFF
Output 2 Mode	Output 2 Logic Control	Output 2 $C < P$	Output 2 $C = P$
1	0	OFF	ON
1	1	ON	OFF

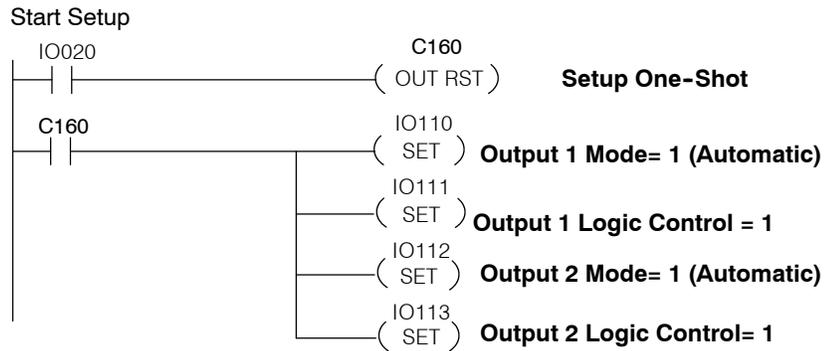
NOTE: When in the Automatic Mode (Output Mode = 1), the output will assume the state determined by the output logic control as soon as the CPU is placed into the Run Mode.

Setting Mode and Output Logic Control

The table shown below will help you determine the appropriate internal I/O points for selecting the Mode and Output Logic Control associated with the two outputs of the HSC. Remember the HSC can go into Slots 0, 1, 2 or 3. The numbers associated with the I/O points change depending on which slot you have selected.

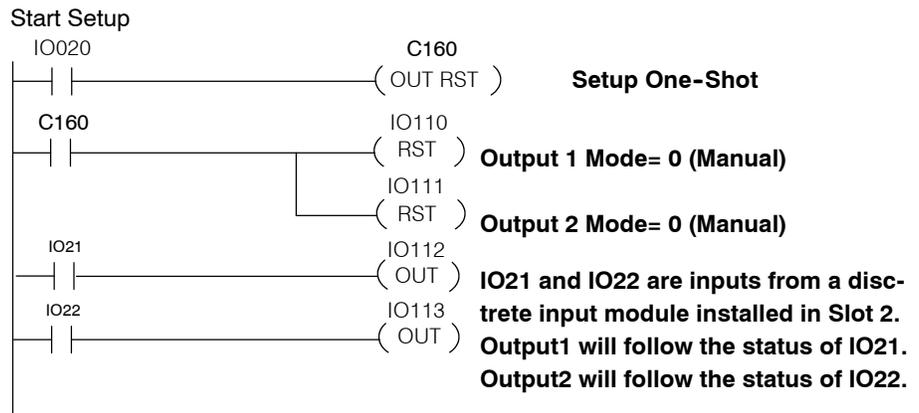
CPU Output Reference	Slot 0	Slot 1	Slot 2	Slot 3
Output 1 Mode	IO100	IO110	IO120	IO130
Output 1 Logic Control	IO101	IO111	IO121	IO131
Output 2 Mode	IO102	IO112	IO122	IO132
Output 2 Logic Control	IO103	IO113	IO123	IO133

Example: The following example shows how to set up an HSC installed in Slot 1 to automatically control the outputs. You want both outputs to be ON when the PLC is placed in RUN (C<P), but turn OFF when C=P. The table shows IO110–IO113 for Slot1. If we follow the flow chart, we see that we need to turn ON IO110–IO113, which selects the automatic mode for both outputs and the C=P operation to go from ON to OFF.



When using the automatic mode (as shown above), the state of Output 1 Logic Control and Output 2 Logic Control determines the state of Output1 and Output2 until C = P. So in the above example, both outputs will turn ON as soon as the PLC enters RUN mode. These outputs will remain ON until enough pulses have been counted for current count to equal preset (C = P).

The example below, uses the **RST** command to set the Mode to manual and it uses the **OUT** command to control the Logic Controls for the two outputs IO21 and IO22.

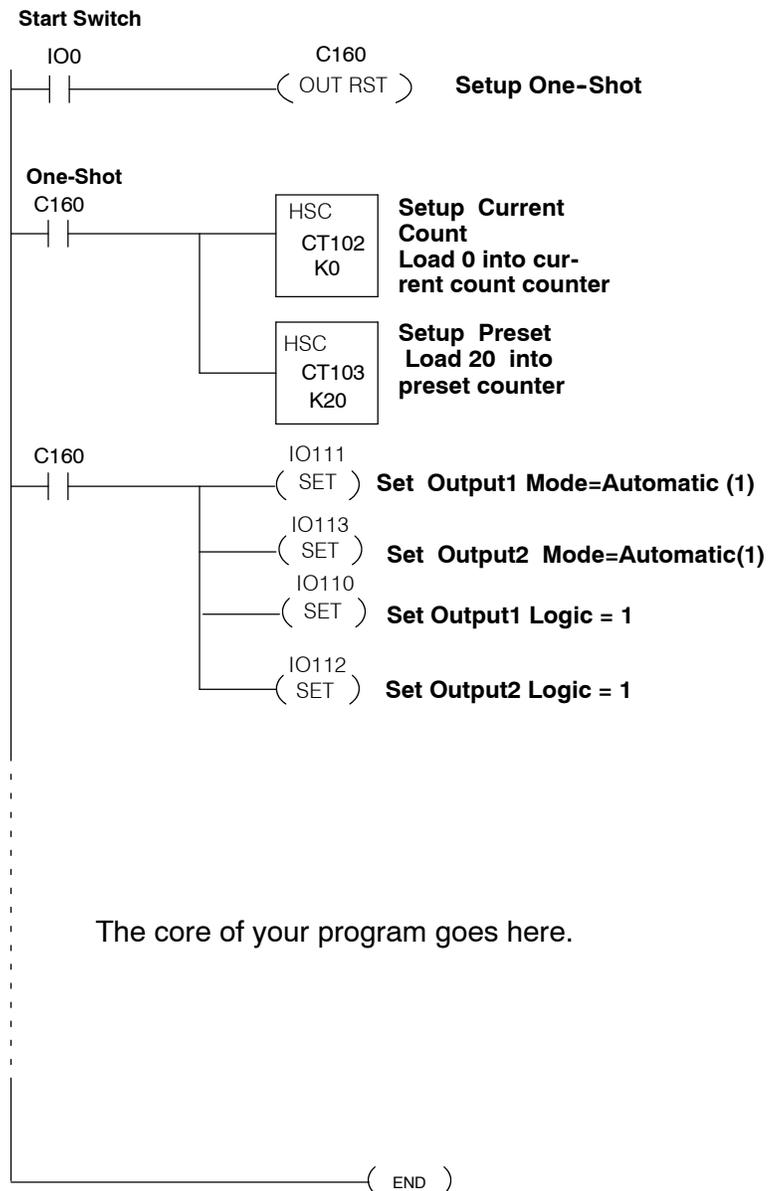


Example 1: Activating both Outputs Automatically

As you know from reading earlier pages, the HSC module can go in slots 0, 1, 2, or 3. In this program, we are assuming that the HSC module has been placed in Slot 1. This means that the counters (HSC boxes) in your program would be designated as CT102 and CT103 (See Page 16). The Output Mode and Output Logic control are assigned I/O points 110 through 113 (See Page 19).

We are using IO0 and C160 as a one-shot to start this setup. The one-shot enables the two HSC boxes, CT102 and CT103 for one scan. This initializes the preset value to 20 and the current count to 0.

C160 also turns ON IO111 and IO113, enabling the Automatic Mode for both outputs. This means when each output will turn ON or OFF is solely dependent on the current count and preset. When $C = P$, OUTPUT1 and OUTPUT2 will be activated. Whether this means either output turns ON or OFF, depends on how you have set the Output Logic Control in each case. Here you see that we have set the logic of both to 1. So, this means that the output will be ON when $C < P$ and turn OFF when $C = P$.

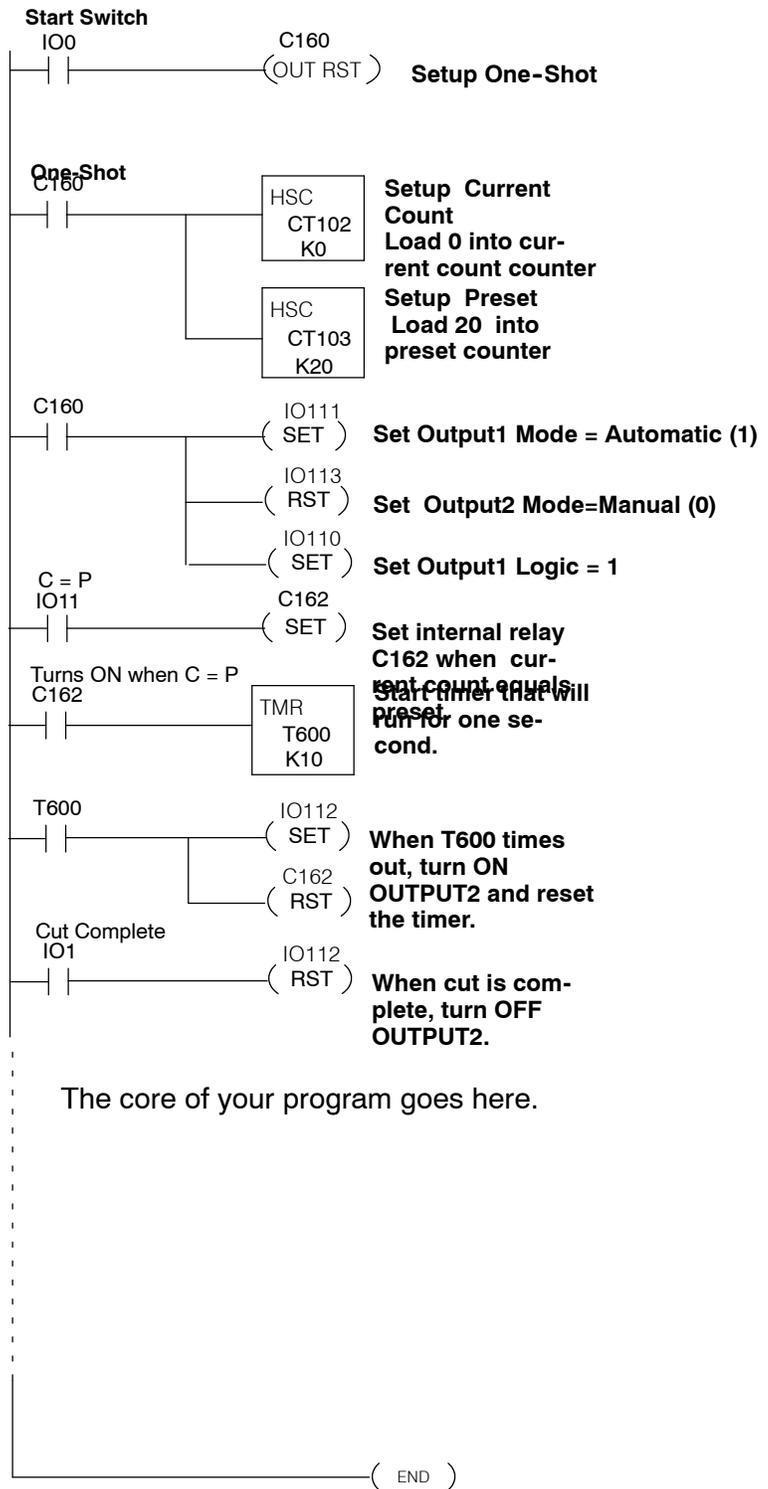


Example 2: Mixing Modes of Operation for Outputs

In this example, we are illustrating how you can use the manual and automatic modes for controlling outputs in the same program. We have decided to control OUTPUT1 automatically, and to control OUTPUT2 manually. This could be a cut-to-length application where OUTPUT1 advances a board toward a saw for a preset number of pulses recorded by the HSC. OUTPUT2 controls the cutting operation. We will assume the HSC module is in Slot 1.

When C = P, OUTPUT1 is turned OFF. At the same time, relay C162 turns on a timer (T600). When T600 times out, we turn ON OUTPUT2 by setting IO112. In our board cutting example, this could mean that a saw is activated by OUTPUT2. The point being made here is that manual control of an output or outputs operates independently from the status of preset and current count.

In the Manual Mode, the relationship of current count compared to preset does not automatically affect the output. In the example shown here, we have used an internal status flag relay IO11 (C=P) to start a timer. When the timer times out(1 second), we turn ON OUTPUT2 by setting IO112. This is done to insure the board has stopped moving before we start the cut.



Example 3: Changing Presets On the Fly

WARNING: The application shown below changes the counter's preset value while the program is executing. Under some conditions (explained in a moment), this causes OUTPUT1 and OUTPUT2 to turn ON for approximately 1 millisecond as soon as preset is changed. This condition occurs only if the external outputs are OFF when the change is initiated, and you are in the **automatic** mode of control. This could result in unsafe or unpredictable results if the field device connected to the outputs sees this momentary ON signal. To prevent this, include a segment in your ladder logic that switches the operating mode of the HSC to **manual** before the preset is changed. The example below illustrates how this is done.

In this example, we are illustrating how you can change the preset value "on the fly". This means you are changing the preset while the program is still running. Although we are only showing the logic for controlling OUTPUT1, the same method could be used to affect both outputs.

We have placed the HSC in Slot 1 for this example. It can, of course, go into any Slot 0 through 3. We will assume at the point in your program where this logic starts, the process has been running with a Preset that had been entered in earlier ladder logic not shown here. At the point this ladder logic is executed, the counter has already been counting pulses and comparing them against the previous Preset.

This part of the program uses an MCS and MCR instruction to load a new Current Count and Preset value. The logic between MCS and MCR will only execute when the MCS rung has power flow.

With this example, the process is started via IO002. When energized, C161 is latched in the ON state. C161 also enables the MCS. C161 resets IO111, putting the HSC in Manual Mode. The only other rung that executes during this first scan is the rung that causes C161 to turn ON C162.

On the second scan through the logic inside the MCS/MCR, since C162 is now ON, CT102 loads a new Current Count of 0 and CT103 writes a new Preset of 200. C162 will one-shot C165, which puts the HSC back into automatic mode and resets IO110. It also disables the MCS/MCR.

