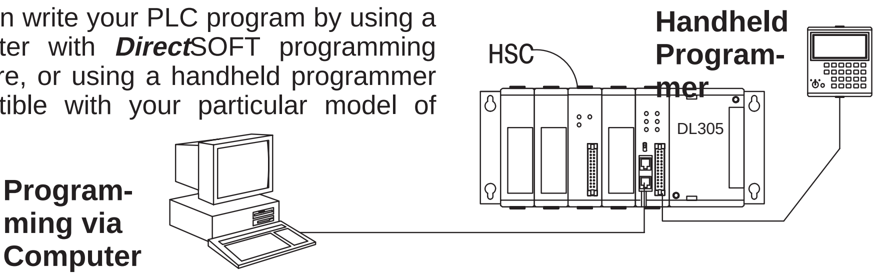
Writing the Program

How to Enter Your Program:

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

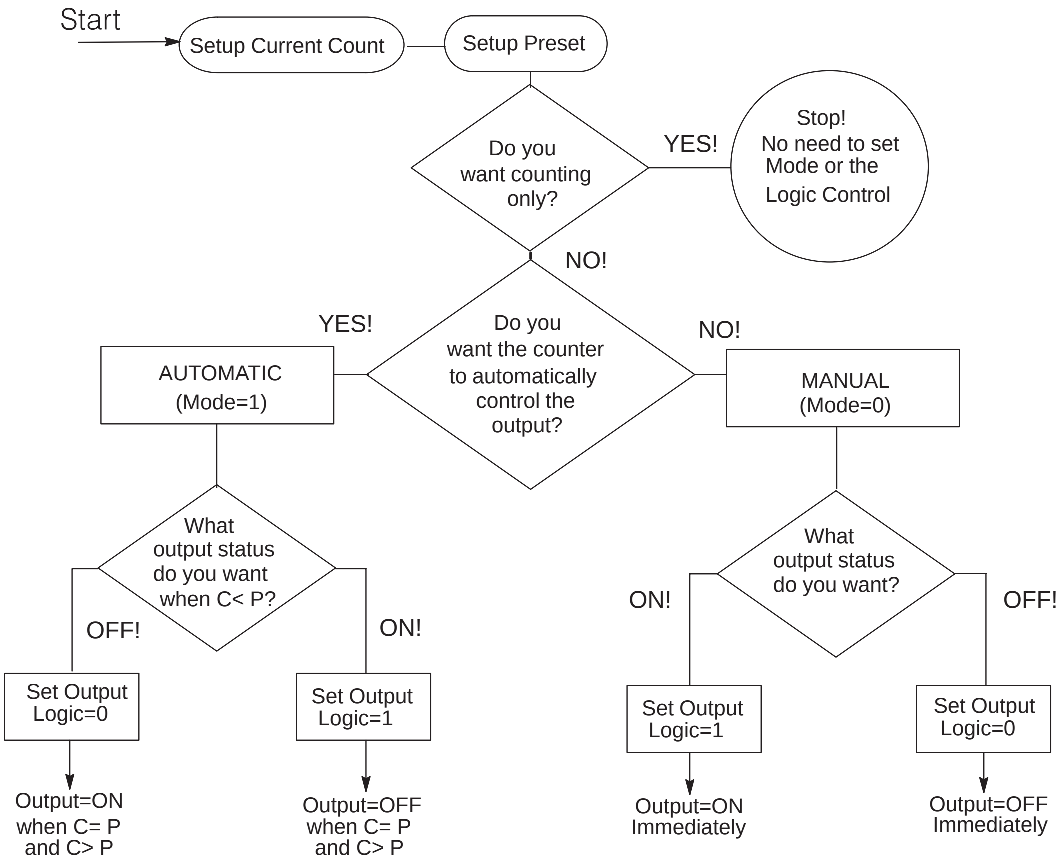


Setup Procedure

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


Start
Setup Current Count
Setup Preset
Do you want counting only?
YES!
Stop! No need to set Mode or the Logic Control
NO!
Do you want the counter to automatically control the output?
YES!
AUTOMATIC (Mode=1)
NO!
MANUAL (Mode=0)
What output status do you want when C< P?
OFF!
ON!
Set Output Logic=0
Set Output Logic=1
Output=ON when C= P and C> P
Output=OFF when C= P and C> P
What output status do you want?
ON!
OFF!
Set Output Logic=1
Set Output Logic=0
Output=ON Immediately
Output=OFF Immediately

Setting Up the Counters

Programming Conventions

As mentioned earlier, you can use either a handheld programmer or ***Direct***SOFT to enter your ladder logic. The examples we will be giving in this section of the manual are specific to ***Direct***SOFT. 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:

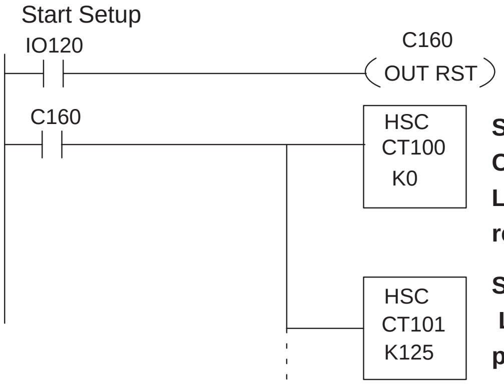
- **Instructions –** You will not be using the normal counter box when setting up the HSC. While in ***Direct***SOFT, if you use hot key **F7** and examine the list of boxes available, you will find that one of them is called **HSC**. This is the box that you use in your ladder logic for setting up the 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 ***Direct***SOFT) 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.



Setup One–Shot

Setup Current Count
Load 0 into current count counter

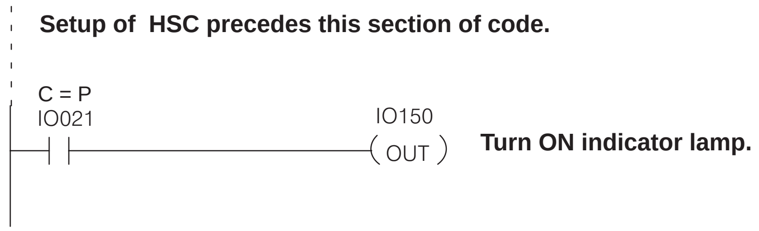
Setup Preset
Load 125 into preset counter

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 indicataor lamp when C = P for an HSC in Slot2.



What Happens After the Counter Reaches the Upper Limit?

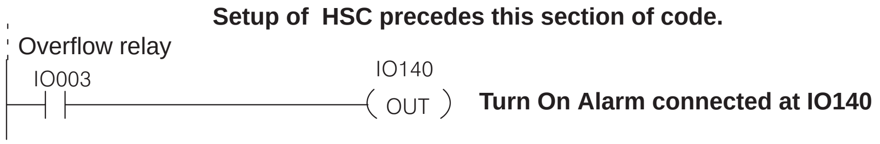
The upper limit for the counter is 9999. If your ladder logic has been written so that the counter continues to count past C=P and eventually reach a current count of 9999, the counter will stop counting pulses when it reaches the upper limit. It does not wrap around to zero. It is instead in an “overflow”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


Setup of HSC precedes this section of code.
Overflow relay
IO003
IO140
OUT
Turn On Alarm connected at IO140

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 thant preset (C < P), then you will want to set Output1 Mode = 1 and set Output1 Logic Control = 1.

Flow Diagram of SetupLogic

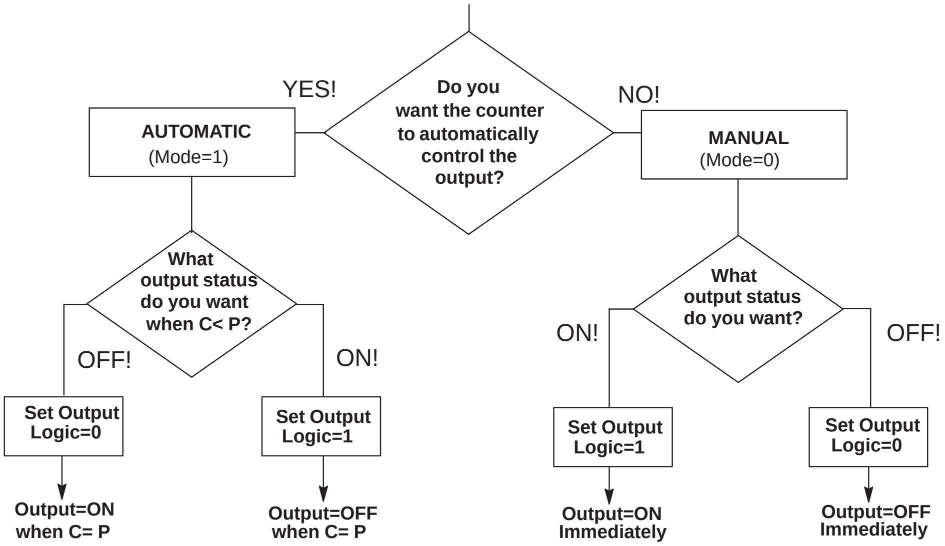


Table 1 Status of Mode and Logic Controls in the Automatic Mode

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

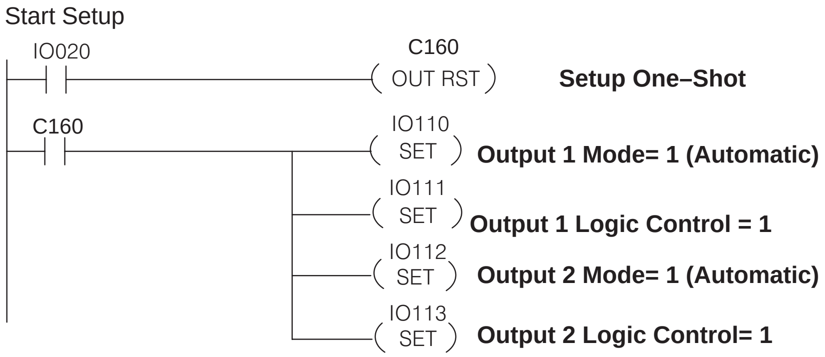
NOTE: When in the Automatic Mode (Output Mode = 1), the output will assume the state determined by the output logic control as soon as the CPU is placed into the Run Mode.

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.

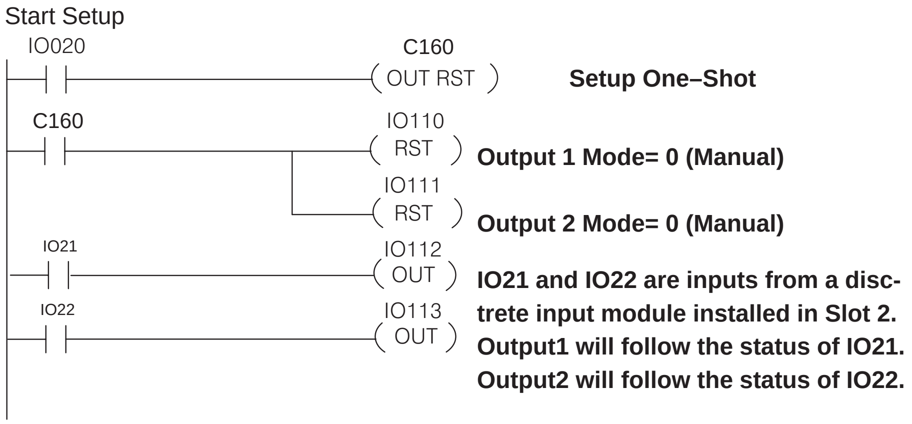
CPU Output Reference	Slot 0	Slot 1	Slot 2	Slot 3
Output 1 Mode	IO100	IO110	IO120	IO130
Output 1 Logic Control	IO101	IO111	IO121	IO131
Output 2 Mode	IO102	IO112	IO122	IO132
Output 2 Logic Control	IO103	IO113	IO123	IO133

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.


Start Setup
IO020
C160
OUT RST
Setup One–Shot
C160
IO110
SET
Output 1 Mode= 1 (Automatic)
IO111
SET
Output 1 Logic Control = 1
IO112
SET
Output 2 Mode= 1 (Automatic)
IO113
SET
Output 2 Logic Control= 1

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.


Start Setup
IO020
C160
OUT RST
Setup One–Shot
C160
IO110
RST
Output 1 Mode= 0 (Manual)
IO111
RST
Output 2 Mode= 0 (Manual)
IO21
IO112
OUT
IO22
IO113
OUT
IO21 and IO22 are inputs from a disc-
trete input module installed in Slot 2.
Output1 will follow the status of IO21.
Output2 will follow the status of IO22.