5

Controlling the Outputs

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Introduction

The 4 Control Outputs

The HSC has four output signals:

- **CW**—a signal usually connected to the motor controller's input that has been programmed for clockwise motion.
- **CCW**—a signal usually connected to the motor controller's input that has been programmed for counter-clockwise motion.
- **OUT1**—a signal usually connected to the motor controller's input that has been programmed for deceleration.
- **OUT2**—a signal usually connected to the motor controller's input that has been programmed to brake.

All the Output Signals Look the Same

If you were to look at each of the above four signals with a VOM or an oscilloscope, they would all look the same. They are simply constant DC output signals whose voltage is directly dependent on the rating of the external power supply. What is important is the point in time in your RLL program that you turn them ON or OFF and how your motor controller (to which they are connected) is either hard-wired or programmed.

The 4 Y Output Relays for Turning ON Each Control Output

The HSC has four output relays for turning ON each of the HSC control outputs:

- **Ym+6**—turns ON CW.
- **Ym+4**—turns ON CCW.
- **Ym+7**—turns ON deceleration signal.
- **Ym+5**—turns ON brake signal.

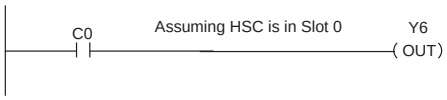
Using the Y Output Relays to Control the Outputs is Optional

You do not have to use the output relays shown above, but they are there if you need them. In the pages that follow, we will show you how to either invoke a program that will turn ON and OFF each of the control outputs in an ordered sequence **automatically**, or how to do it **manually** by using the 4 internal relays just described. Both ways require ladder logic, but they are very different in terms of flexibility. We will be explaining each method in great detail.

Manual Output Control

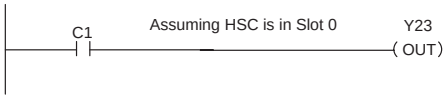
Using Ym+6 or Ym+23 to turn Direction Outputs ON or OFF.

Ym+4, Ym+5, Ym+6 and Ym+7 manually control the outputs CCW, OUT2, CW and OUT1 respectively. You can turn them ON at any time in your ladder logic, with the exception being that you cannot have CW and CCW on at the same time and you cannot be in Home Search or HSC RUN modes.For example, here is a rung of logic that would turn ON the CW output:



Turn ON the CW output signal.

Using the above method, you could turn OFF CW and CCW by using Ym+6 and Ym+4 respectively or you can turn off (reset) CW or CCW by turning ON Ym+23:



Turn OFF the CW or CCW output signal.

Automatic Output Control

Also Called HSC RUN

Automatic output control is also called, HSC RUN. It is simply a mode that allows the HSC to automatically control when each of the 4 outputs turn ON by looking at relative values of current count and preset. Upon entering HSC RUN, there is a built-in algorithm that determines whether CW or CCW turns ON. The algorithm also determines the sequence for turning the HSC outputs ON or OFF.

NOTE: When you invoke HSC RUN, the HSC looks at current count and preset **only when it enters** HSC RUN. At that time, it uses the relationship between these two variables to decide whether it should turn ON either CW or CCW. If you change the relationship during the course of your program, it will not take effect until you exit HSC RUN and then invoke HSC RUN again. Also, preset and decel values in shared memory (at the time HSC RUN is invoked) are used until HSC RUN is exited. *If new values are written during HSC RUN=ON, they will be ignored until you exit HSC RUN and re-enter again.*

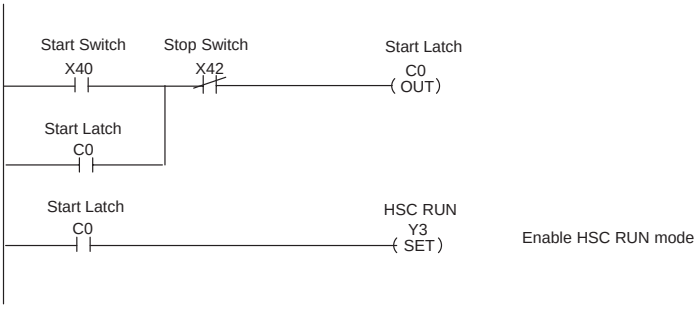
How Do You Invoke HSC RUN?

You have two ways in which you can invoke HSC RUN --**either externally or internally**.

- Externally, you turn ON the field device connected to the RUN terminals.
- Internally, you turn ON Ym+3.

Example of Using Ym+3 to Activate HSC RUN

Below is a short segment of ladder logic showing how to use Ym+3 to turn ON HSC RUN. We are again assuming that the HSC is located in Slot 0 of the base. Notice that we have included in our sample logic a start latch using an internal control relay of the DL405 CPU, combined with a start and a stop switch connected to the terminals of an I/O module:



Using the Direction Outputs

What is a Direction Output?

There are two direction outputs for the HSC: **CW** (clockwise) and **CCW** (counter-clockwise). The actual turning of a motor shaft in these two directions is controlled by the internal logic of the motor controller that you are using, not the HSC.

How the HSC Knows When to Turn ON CW or CCW

As mentioned earlier, if you have not invoked HSC RUN or Home Search, you can turn CW and CCW ON or OFF in your ladder logic at any time using either Ym+6 (CW) or Ym+4 (CCW).

You can, on the other hand, let the HSC automatically decide when to turn them ON or OFF by invoking HSC RUN. The HSC will decide if it should turn ON CW or CCW **based on the relationship between preset and current count at the time HSC RUN is entered**. The table below shows the relative states of CW and CCW based on current count and preset at time of entry:

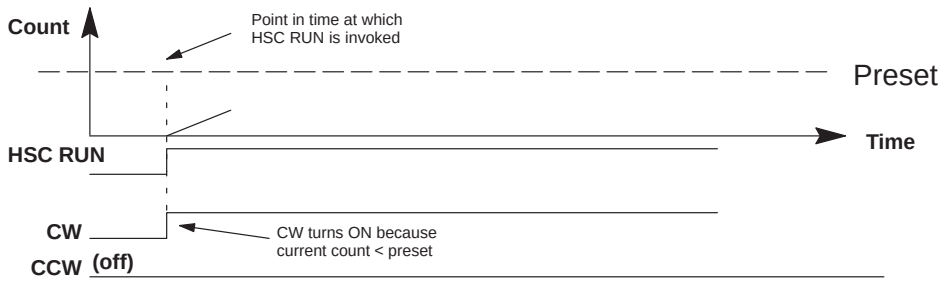
Relationship Upon Entering HSC RUN	CW	CCW
Current count is less than preset (cc<preset)	ON	OFF
Current count is equal to preset (cc=preset)	OFF	OFF
Current count is greater than preset (cc>preset)	OFF	ON

Timing Diagrams for HSC RUN

The following diagrams show you the timing relationships between HSC RUN and the direction outputs for the three possible scenarios of preset versus current count.

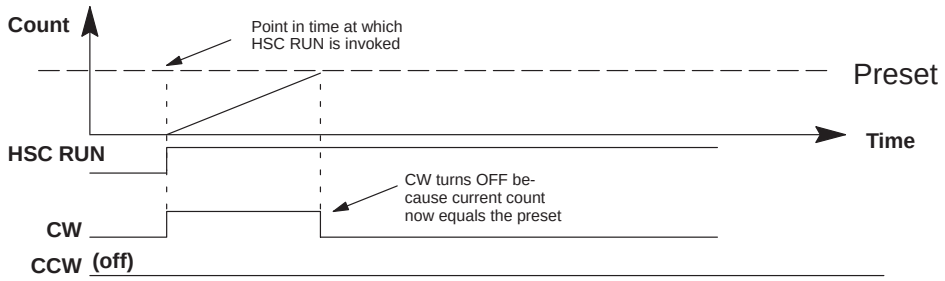
As you can see from the following diagram, the clockwise output (CW) turns on because the current count is less than the preset.

Current Count < Preset



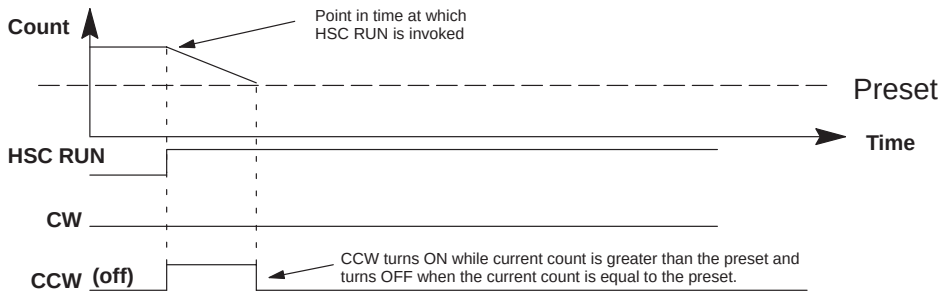
As the current count continues to approach the preset, the HSC will monitor the relationship between the current count and the preset. When the current count is equal to the preset, the HSC automatically turns off the clockwise output (CW).

Current Count = Preset



There may be occasions when you are counting down towards a preset. For example, you may have loaded a negative preset, or, you may have used an offset to change the current count so that it is above the preset. The following diagram shows how the HSC can also automatically control the counter clockwise (CCW) output.

Current Count > Preset



Using the Speed Outputs with the Direction Outputs

What are the Speed Outputs?

There are two speed outputs: OUT1 (deceleration) and OUT2 (brake). While ON, these two signals are constant DC signals. Their ability to decelerate or brake a motor is entirely dependent on the logic of the motor controller to which they are attached. The motor controller must do the speed changing. These signals merely initiate these functions in your controller.

2 Ways to Initiate OUT1 and OUT2

You can initiate OUT1 (decel) or OUT2 (brake) in either the HSC RUN mode, or invoke them in your ladder logic using the appropriate Y outputs. To use the manual method, you turn OUT1 ON by turning ON Ym+7. In a similar fashion, when you turn ON Ym+5, OUT2 will turn ON.

Using HSC RUN to Initiate OUT1

When using HSC RUN, OUT1 (decel) is a relative value that establishes two different points (relative to preset) at which OUT1 will turn ON. For example if your preset is 3000, and you have stored a deceleration value of 1000, the deceleration will start (OUT1=ON) when the count is at 2000 counts (counting UP to preset) **or** 4000 counts (counting DOWN to preset). The HSC derives these numbers by looking at the number you have stored in shared memory hex 0C, then adding and subtracting this value from the preset.

In Figure A at the top of the next page, we have illustrated how OUT1 is triggered when the current count equals 4000. It does this because 4000 is the point at which the current count is within 1000 pulses (decel value) from preset as we count DOWN toward preset (current count >preset). In Figure B, we show how OUT1 is triggered when the current count is at 2000, because in this second example we are approaching preset counting UP (current count < preset).

As you can see, when the current count **reaches** the threshold area (defined by your stored decel value), from either counting direction, the decel signal (OUT1) will turn ON and stay ON until it is reset. You can reset OUT1 either with Ym+0 (as we have done in our examples) or exiting and re-entering HSC RUN.

How OUT2 is Initiated in HSC RUN

When using HSC RUN, OUT2 (brake) will automatically turn ON **when the current count equals the preset value**.

In both Figure A and Figure B on next page, you see that OUT2 turns ON (and the direction output turns OFF) at the very moment that the current count equals 3000 (the stored preset value).

Monitoring Speed Output Status

Both OUT1 and OUT2 have flags that can be monitored to check the status. You can use these flags in ladder logic to trigger events.

Flag	Function
Xn+7	Will turn ON when OUT1 is ON and turn OFF when OUT1 is OFF.
Xn+5	Will turn ON when OUT2 is ON and turn OFF when OUT2 is OFF.

Figure A:

Example of Outputs when Decel=1000, Preset=3000, and Current Count > Preset

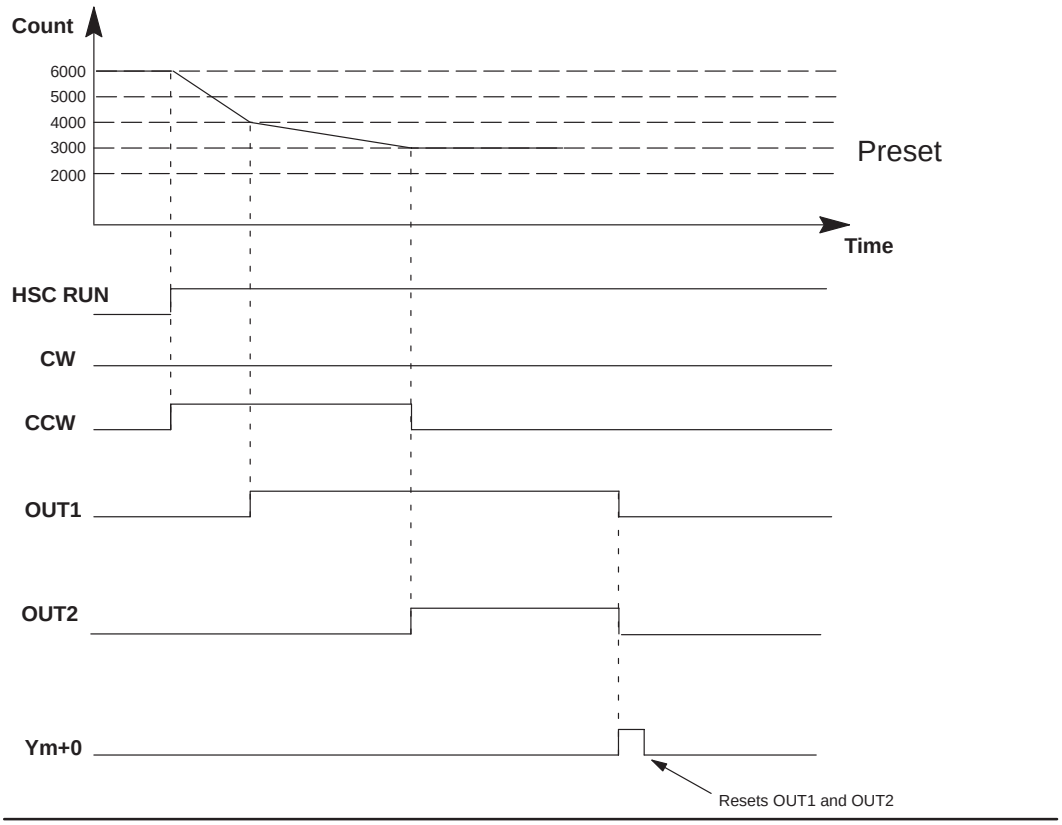


Figure B:

Example of Outputs when Decel=1000, Preset=3000, and Current Count < Preset