

Applying Ladder Logic

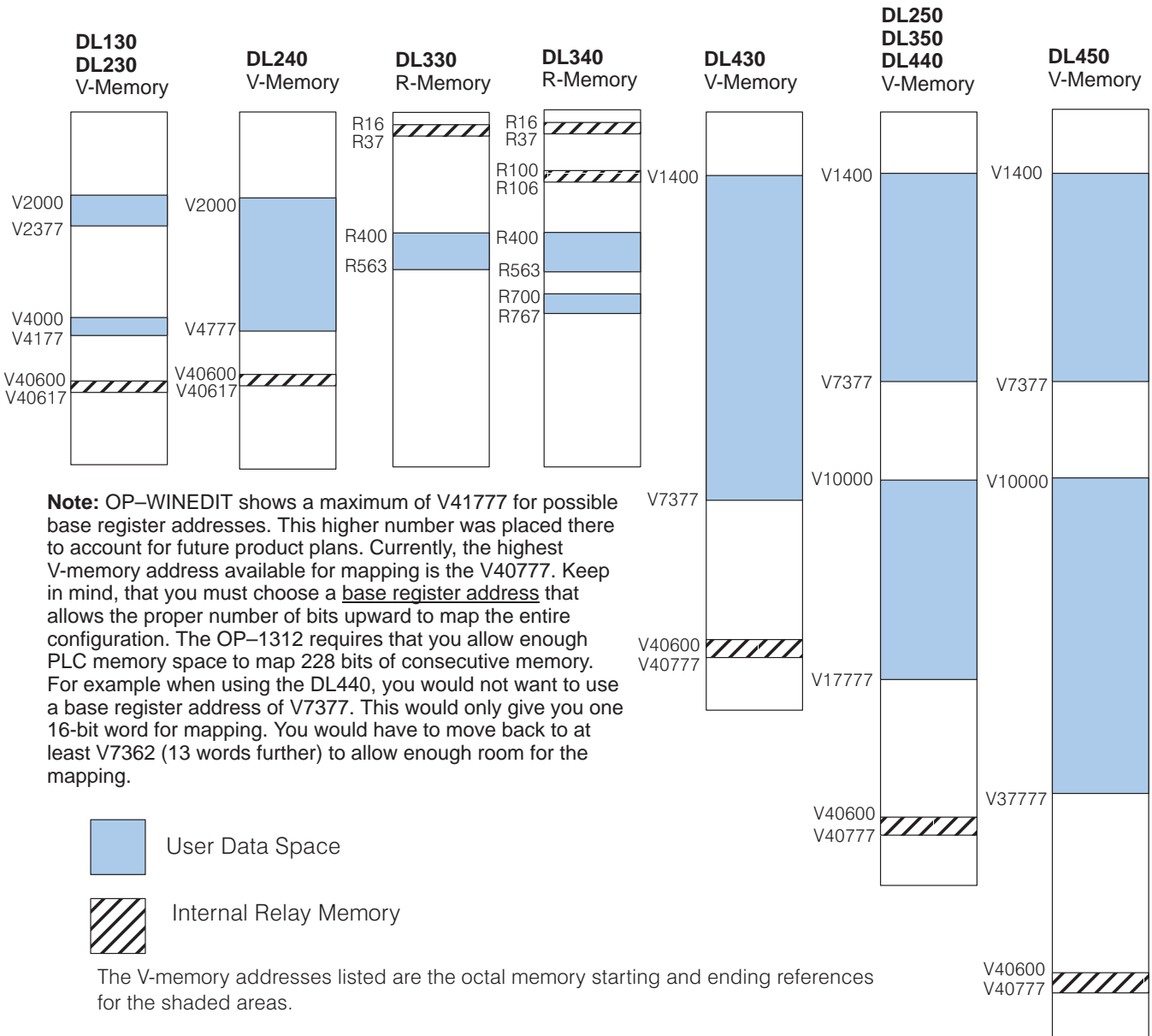
In This Chapter. . . .

- General Concepts
 - Using the Panel with PLC *Direct* PLC
 - Using the Panel with Allen-Bradley PLC
 - Bit Manipulation in the Force Flag Register
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General Concepts

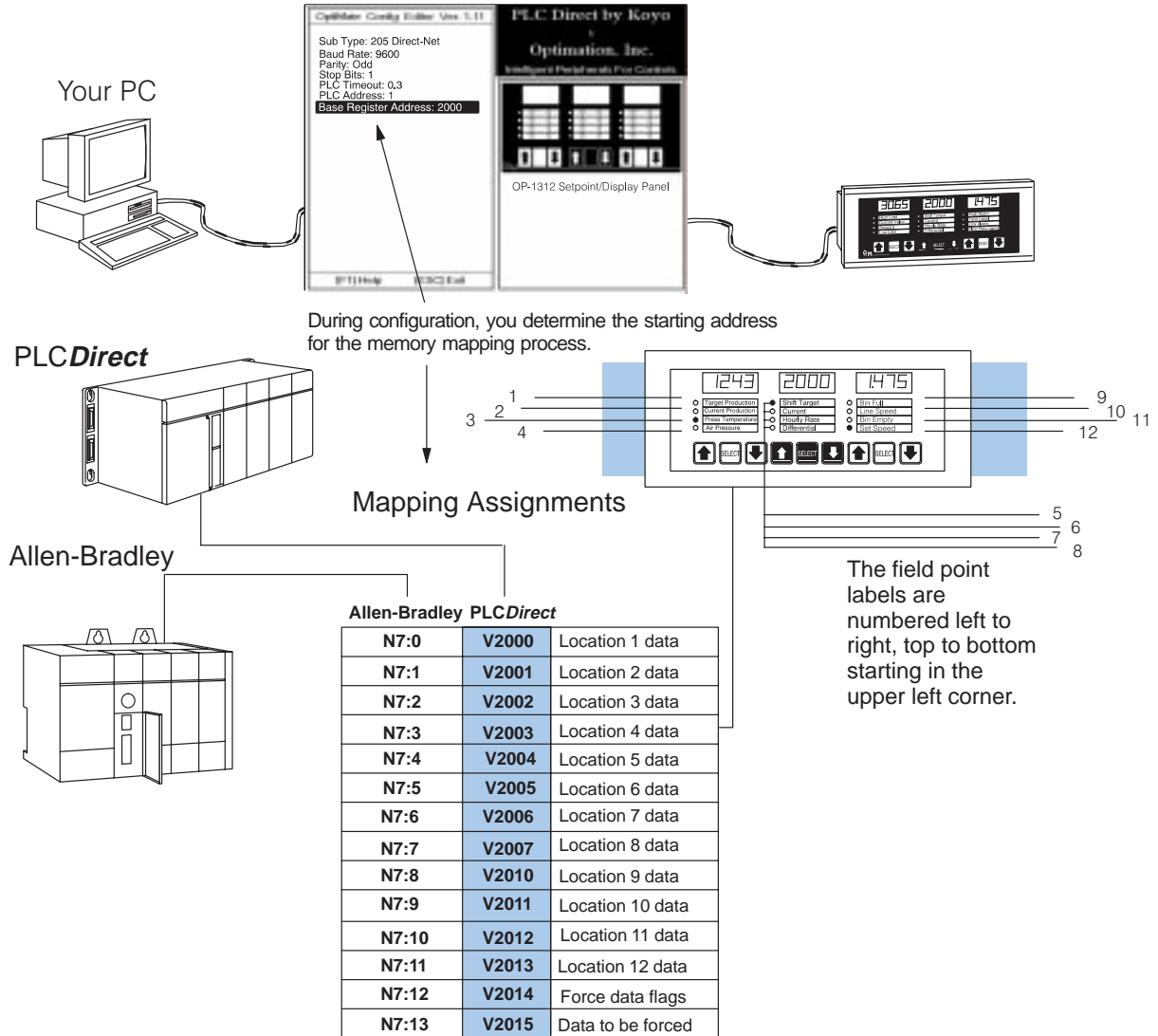
Base Register Addresses for PLC Direct Memory

During initial configuration, you are asked to indicate a base register address. Below are charts showing the valid memory ranges that you can use for base register addresses when using a PLC *Direct* programmable controller. The base register address is the starting point for the consecutive memory locations that will be mapped to the panel's memory. The process of mapping is explained on the next page. Although technically the memory reserved for internal relays of the PLC is available for the base register address, it is usually not practical to use it.



Memory Mapping

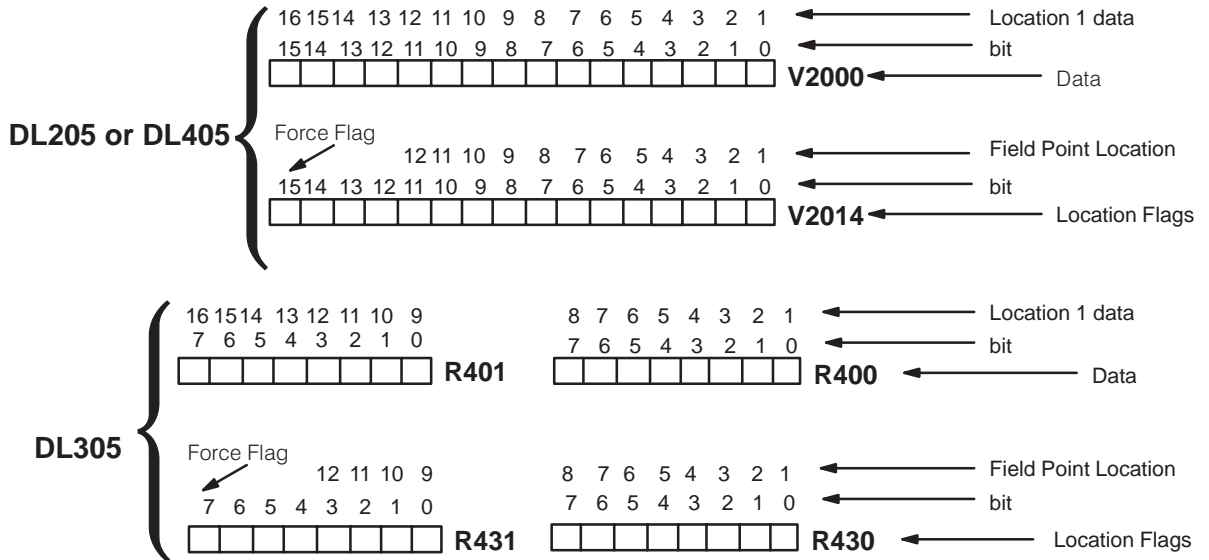
The OP-1312 uses memory mapping in order to link itself to a PLC. Memory mapping is a technique that maps the memory of the OP-1312 into the memory of the PLC. During initial configuration, you indicate where in the PLC memory you want to start the mapping process. By knowing where the data of the specific panel is mapped, this data can be moved, changed or monitored using ladder logic. In the examples below, we have used a base register address of V2000 for PLC *Direct* and N7:0 as the Allen-Bradley base register address.



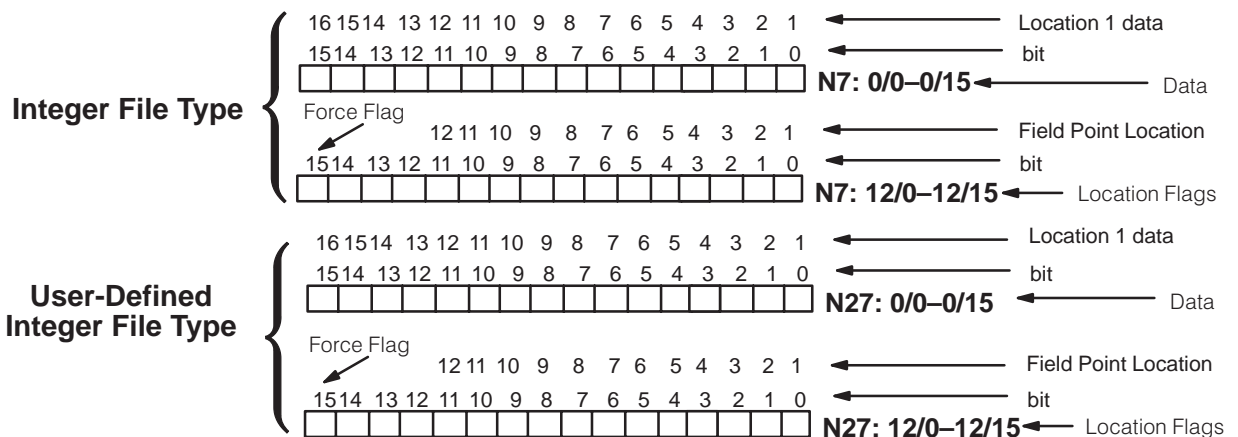
Addressing Conventions

Before we jump into ladder logic programming, let's take a moment to review and compare the addressing conventions used by PLC *Direct* and Allen-Bradley. Notice that the addressing of Allen-Bradley is **decimal**, but it is **octal** for PLC *Direct*.

PLCDirect Memory—A typical address within a PLCDirect programmable controller is Vxxxx (such as V2000 for the DL205 or DL405 families) or Rxxx (such as R400 for the DL305 family). The V-memory in the DL205 and DL405 is divided into 16-bit boundaries, and the R-memory in the DL305 is divided into 8-bit boundaries. Refer to your individual User Manuals for complete memory information. Using these addresses, we have shown for illustration only the Location 1 data memory allocation and the register(s) that hold the field point location flags when using the force setpoint option. Don't worry about understanding exactly how the data and flag registers are used. We'll show you that on next page.

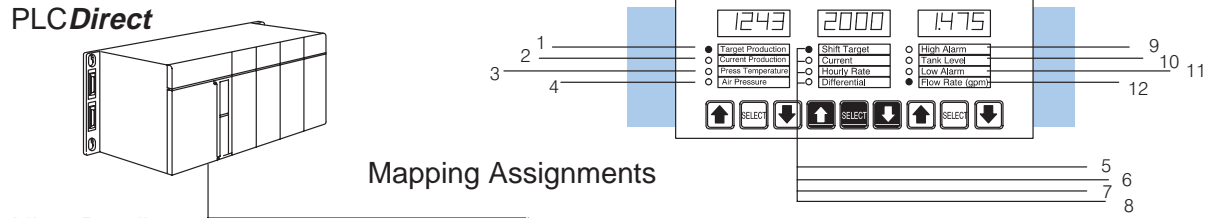


Allen-Bradley Memory—A typical address for Allen-Bradley might be N7:0/0 or N27:0/0. The OP-1312 will allow you to define your starting address for mapping purposes using either Allen-Bradley's integer (N7) file type or user-defined integer file types (N9–N255). *If you plan to use an integer file between N9 and N255, you must define these in the Allen-Bradley memory map before configuring the panel.* Below we have shown you how 16-bit integer files could be used to map the Location 1 data and the register that holds the field point location flags when using the force setpoint option. Don't worry about understanding exactly how the data and flag registers are used. We'll show you that next page.



Force Setpoint Registers

The OP-1312 has the capability to “force” a setpoint via ladder logic. If you plan to use this function, you must enable the option during configuration. Below is a complete memory map showing how memory is mapped when using a base register address of V2000 (PLC*Direct*) or N7:0 (Allen-Bradley). Notice that the Forcing Option uses the last two 16-bit words. In the case of the DL305, this would be the last four words, since it uses 8-bit words.



Allen-Bradley

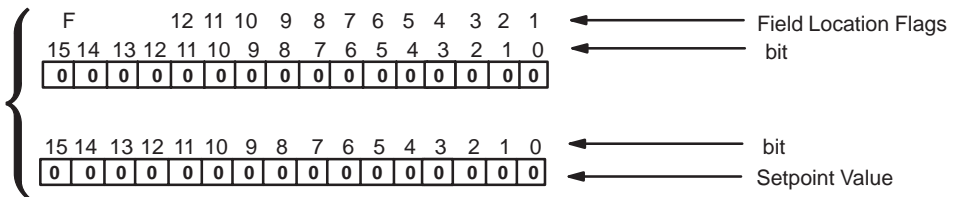
Mapping Assignments

Allen-Bradley PLC*Direct*

N7:0	V2000	Location 1 data
N7:1	V2001	Location 2 data
N7:2	V2002	Location 3 data
N7:3	V2003	Location 4 data
N7:4	V2004	Location 5 data
N7:5	V2005	Location 6 data
N7:6	V2006	Location 7 data
N7:7	V2007	Location 8 data
N7:8	V2010	Location 9 data
N7:9	V2011	Location 10 data
N7:10	V2012	Location 11 data
N7:11	V2013	Location 12 data
N7:12	V2014	Force data flags
N7:13	V2015	Data to be forced

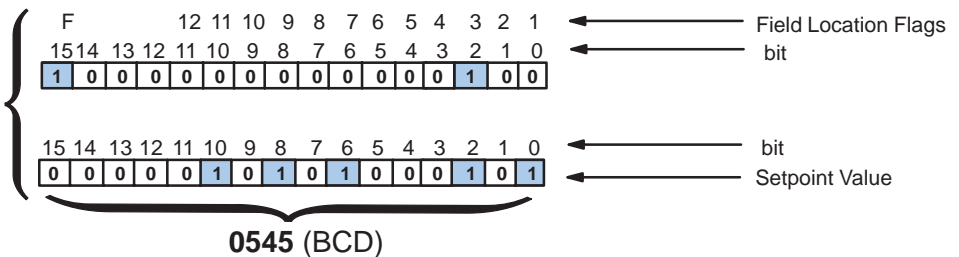
How the Memory is Used- The first 16-bits mapped for forcing are used to set the force option flag **F** (Bit 15) and the individual flags representing the memory locations you want forced (Bits 0 to 11). Bits 12, 13 and 14 are consumed but not used. The second set of 16-bits are used to hold the data that is being forced. This is the setpoint value.

Force Function Registers



Example- The force registers shown below are setup for forcing Location 3 to the value 545 when using a PLC that uses a BCD number handling system. This is the way the PLC*Direct* and compatibles operate. Allen-Bradley weights each bit in binary not BCD, so the bits that are set would vary accordingly. This will become clearer when we examine actual ladder logic examples later.

Force Function Registers



Using the Panel with PLCDirect

Writing Display Data to the PLC Memory

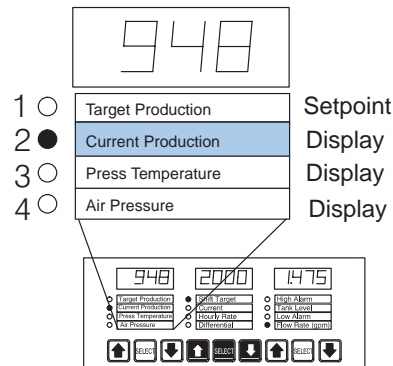
In this example, assume we have entered a setpoint (**Target Production**) manually by using the **Select Key** to move to the Target Production Label and then the **Arrow Keys** to enter the value. Since Target Production has been linked by configuration to the PLC memory, this value is stored in **V2000** or **R400/R401** depending on which PLC you are using. Assume you entered the value 1700. Now we want to count production items and display the current count with our panel. To do this, we have a PLC counter that is being triggered by outputs from a photoelectric eye at the end of the production line. We are using either **Counter Zero (CT0)** for the DL205 or DL405 or **Counter 600 (CT600)** for the DL305. If you are using the DL205 or DL405, then the current count (**Current Production**) for CT0 is automatically stored in **V1000**. If you are using the DL305, the current count (**Current Production**) for CT600 is stored automatically in **R600/R601**. We are also using the value in V2000 or R400/R401 for the preset of our counter – this will be the value 1700. To display the current production rate on the panel, we need to remap either V1000 or R600 to the memory assigned to Label 2 in the diagram. Once we do this, the panel will display the data via the LED window corresponding to Location 2 (See Memory Map). Although we are writing data via a counter in this example, the data could be written from any source i.e. from timers, encoder pulses, PID variables, etc. As long as you can get the data into the mapped field point locations, it can be read by the panel.

Example Details: During configuration, we set our first four labels to be one Setpoint and three Displays. We entered our setpoint in from the panel arrow keys as 1700. This value is stored in Location 1 of the PLC's memory. This is the preset of our counter.

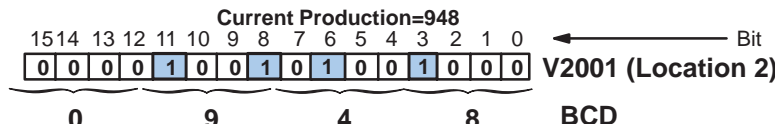
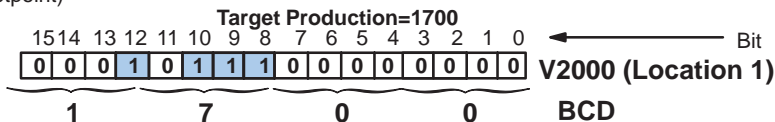
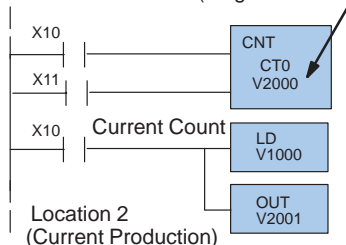
We are using the ladder logic to write the current count to Location 2 of the PLC's memory that is reserved for the OP-1312. In this example, the LED window is reporting Label 2 (the indicator LED is glowing). Because the panel is linked to the PLC memory, we are able to see the label's corresponding data as it is being written to the PLC memory.

Example Memory Mapping
DL205/405 DL305

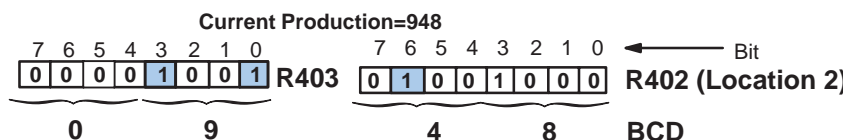
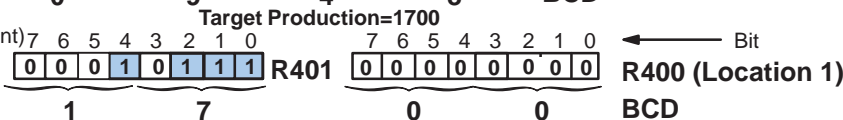
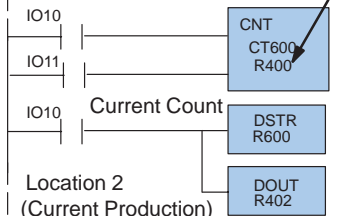
V2000	R400/R401	Location 1 data
V2001	R402/R403	Location 2 data
V2002	R404/R405	Location 3 data
V2003	R406/R407	Location 4 data
V2004	R410/R411	Location 5 data
V2005	R412/R413	Location 6 data
V2006	R414/R415	Location 7 data
V2007	R416/R417	Location 8 data
V2010	R420/R421	Location 9 data
V2011	R422/R423	Location 10 data
V2012	R424/R425	Location 11 data
V2013	R426/R427	Location 12 data
V2014	R430/R431	Force data flags
V2015	R432/R433	Data to be forced



DL205 or DL405 (Target Production Setpoint)



DL305 (Target Production Setpoint)



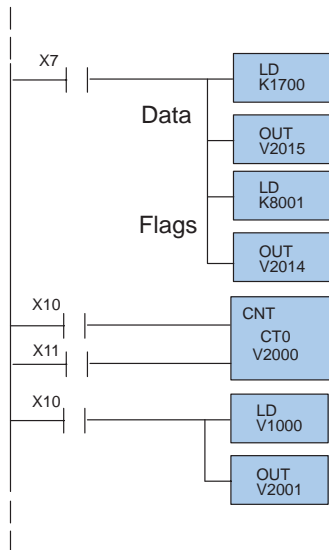
Applying Ladder Logic

Forcing Setpoint Data to the PLC Memory for the DL205/DL405

As mentioned, you can write a setpoint value to your PLC memory using the arrow keys on the panel. There are times, however, when you might want to write the data to a setpoint location via your ladder logic. When you write the setpoint using your ladder logic, it is called “**Forcing the Setpoint**”.

The example shown is the same as the one shown earlier except instead of entering the setpoint via the arrow keys of the panel, we have chosen to let our ladder logic **force** the value. Forcing can be used to initiate a setpoint (as we have done here) or it can be used to change a setpoint. Notice the order in which you enter the ladder logic information for the force flag register and force data register. You have to first set the data, then you set your location flag or flags, along with the force flag (F). Although this example, shows only one of the location flags set (Location 1), you can set any number of flags simultaneously. If you set several flags, keep in mind that the same data will be forced to all of the flagged locations.

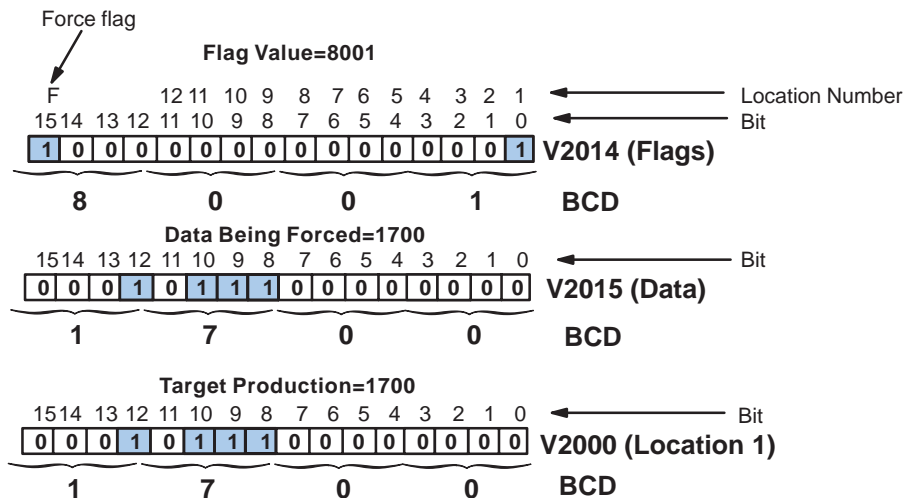
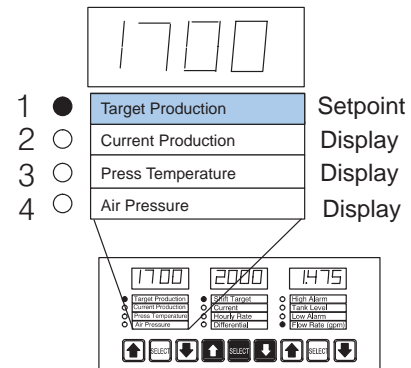
DL205 or DL405



Example Memory Mapping

DL205/405

V2000	Location 1 data
V2001	Location 2 data
V2002	Location 3 data
V2003	Location 4 data
V2004	Location 5 data
V2005	Location 6 data
V2006	Location 7 data
V2007	Location 8 data
V2010	Location 9 data
V2011	Location 10 data
V2012	Location 11 data
V2013	Location 12 data
V2014	Force data flags
V2015	Data to be forced



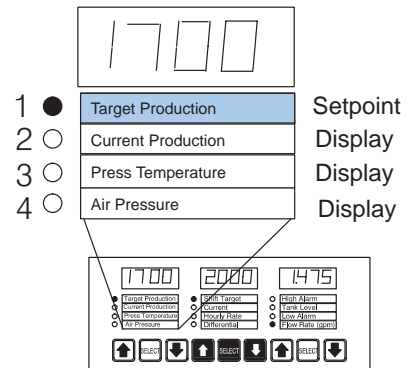
Forcing Setpoint Data to the PLC Memory for the DL305

Forcing the setpoint for the DL305 is very similar to how it is done for the DL205 and DL405. The primary difference is that you are dealing with 8-bit words rather than 16-bit. In the example below, we are writing the value 1700 to Location 1 (R400/R401). We are then using that value as the preset for our counter C600. R600/R601 is the register that automatically stores the current count for the C600 counter. We are remapping the current count to R402/R403 so that it can be read by the panel.

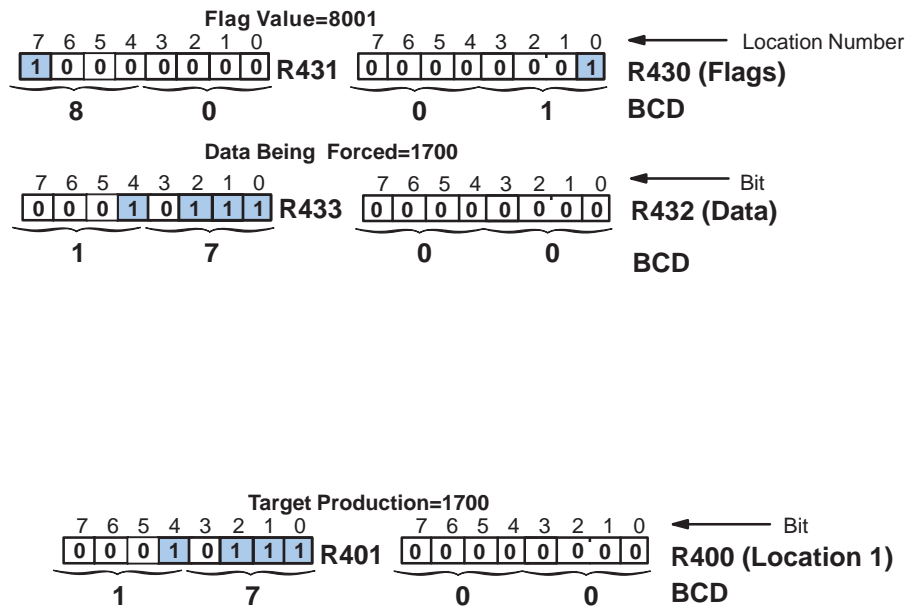
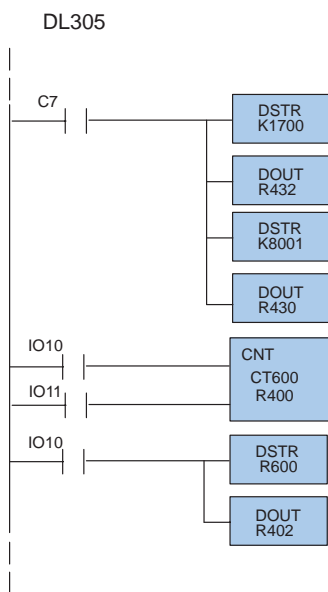
Below we are using the forcing function to initiate the preset of a counter. It could, however, be a preset or setpoint for anything, i.e. motor speed, target pulse count, temperature level, drill depth, etc. Notice the order in which you enter the ladder logic information for the force flag register and force data register. You have to first set the data, then you set your location flag or flags, along with the force flag (F). Although this example, shows only one of the location flags set (Location 1), you can set any number of flags simultaneously. If you set several flags, keep in mind that the same data will be forced to all of the flagged locations.

Example Memory Mapping

DL305	
R400/R401	Location 1 data
R402/R403	Location 2 data
R404/R405	Location 3 data
R406/R407	Location 4 data
R410/R411	Location 5 data
R412/R413	Location 6 data
R414/R415	Location 7 data
R416/R417	Location 8 data
R420/R421	Location 9 data
R422/R423	Location 10 data
R424/R425	Location 11 data
R426/R427	Location 12 data
R430/R431	Force data flags
R432/R433	Data to be forced



Applying Ladder Logic

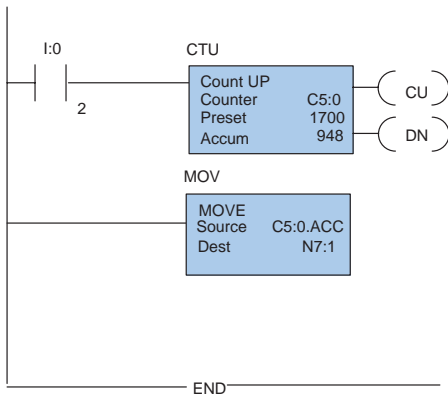


Using the Panel with an Allen-Bradley PLC

Writing Display Data to the PLC Memory

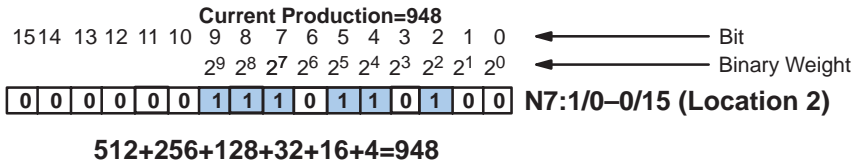
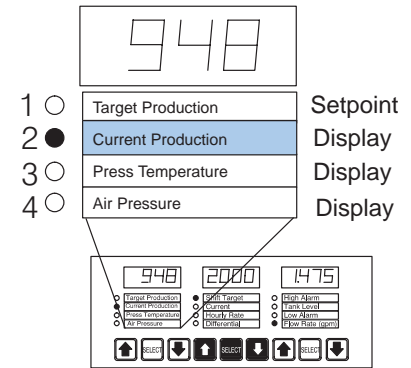
In order for the OP-1312 to display meaningful data from the configured field points, the PLC's ladder logic must write the data to the field points. In the example below we are using a counter that is being triggered by outputs from an electric eye. The electric eye is counting production items. The input to the counter is shown as I:0/2. The counter is C5:0 and we have entered a setpoint of 1700 via the arrow keys of the panel. The current count is held in the counter's accumulator. We are taking the accumulated count and moving it to N7:1 which is the configured link to the Current Production display (Label 2). Notice that Allen-Bradley deals with its registers in binary—not BCD. For this reason, during configuration you should make sure that you indicate Binary when setting up for Allen-Bradley.

SLC 5/03 or 5/04



Example Memory Mapping

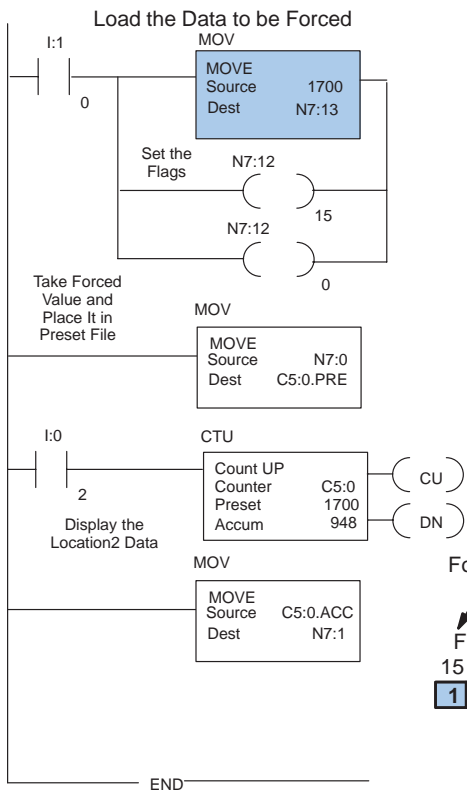
N7:0/0-0/15	Location 1 data
N7:1/0-1/15	Location 2 data
N7:2/0-2/15	Location 3 data
N7:3/0-3/15	Location 4 data
N7:4/0-4/15	Location 5 data
N7:5/0-5/15	Location 6 data
N7:6/0-6/15	Location 7 data
N7:7/0-7/15	Location 8 data
N7:8/0-8/15	Location 9 data
N7:9/0-9/15	Location 10 data
N7:10/0-10/15	Location 11 data
N7:11/0-11/15	Location 12 data
N7:12/0-12/15	Force data flags
N7:13/0-0/15	Data to be forced



Forcing Setpoint Data to the PLC Memory

As mentioned, you can write a setpoint value to your PLC memory using the arrow keys on the panel. There are times, however, when you might want to write the data to a setpoint location via your ladder logic. When you write the setpoint using your ladder logic, it is called **“Forcing the Setpoint”**. Below we are using this function to initiate the preset of a counter. It could, however, be a preset or setpoint for anything, i.e. motor speed, target pulse count, temperature level, drill depth, etc.

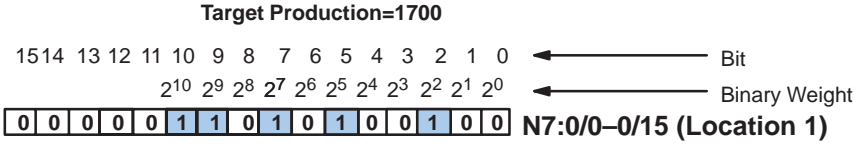
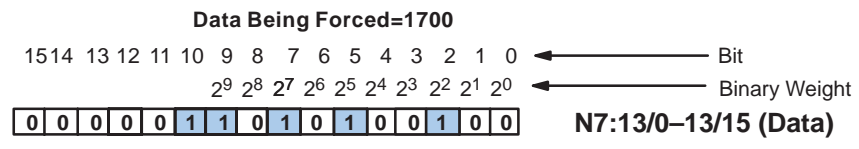
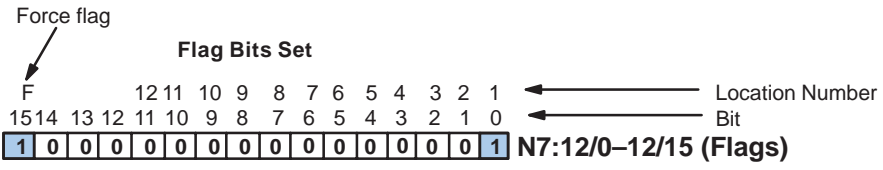
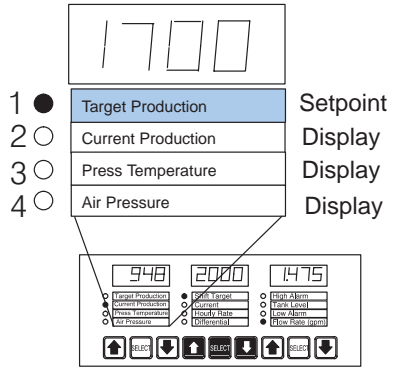
The example shown is the same as the one on the previous page except instead of entering the setpoint via the arrow keys of the panel, we have chosen to let our ladder logic **force** the value. Forcing can be used to initiate a setpoint (as we have done here) or it can be used to change a setpoint. Notice the order in which you enter the ladder logic information for the force flag register and force data register. You have to first set the data, then you set your location flag or flags, along with the force flag (F). Although this example, shows only one of the location flags set (Location 1), you can set any number of flags simultaneously. If you set several flags, keep in mind that the same data will be forced to all of the flagged locations.



SLC 5/03 or 5/04

Example Memory Mapping

N7:0/0-0/15	Location 1 data
N7:1/0-1/15	Location 2 data
N7:2/0-2/15	Location 3 data
N7:3/0-3/15	Location 4 data
N7:4/0-4/15	Location 5 data
N7:5/0-5/15	Location 6 data
N7:6/0-6/15	Location 7 data
N7:7/0-7/15	Location 8 data
N7:8/0-8/15	Location 9 data
N7:9/0-9/15	Location 10 data
N7:10/0-10/15	Location 11 data
N7:11/0-11/15	Location 12 data
N7:12/0-12/15	Force data flags
N7:13/0-0/15	Data to be forced



Applying Ladder Logic

Bit Manipulation in the Force Flag Register

Controlling Individual Bits

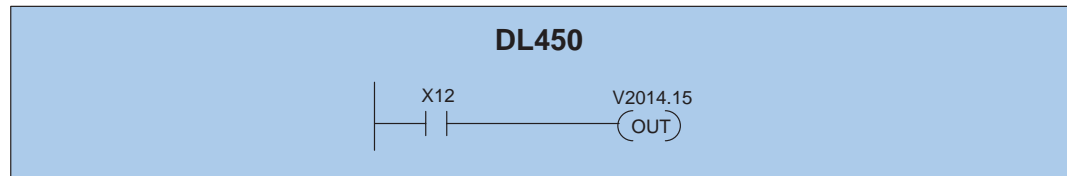
If you are using the Setpoint Forcing Option, then you may want to use alternative methods for setting the Force Flag Register. In the previous pages, we showed you how to set bits in the Force Flag Register by changing a complete memory word. In some cases, this involves figuring out BCD or binary numbers. You can, however, set these flags on an individual basis. Two methods for accomplishing this are discussed below:

- **Bit-of-Word**
- **Internal Relays**

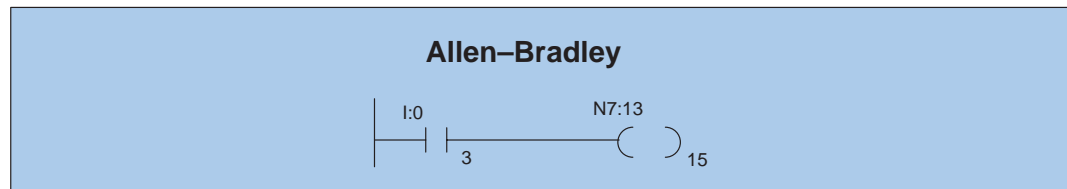
Which of these methods is best for you depends on the make and model of the PLC you are using. Let's look at each of these two methods and discuss their relative merits.

Bit-of-Word

The most direct way to address the individual bits with your ladder logic is to use "bit-of-word". This method is available to the DL450 (PLC *Direct*) and SLC 5/03 and 5/04 (Allen-Bradley). Below is a rung of logic that might be used with the DL450. For example, here is a rung of logic that sets the Force Flag (Bit 15) of a panel that had a base address of V2000 for its mapping. This would mean that the Force Flag Register starts at V2014. You could set the location flags the same way.

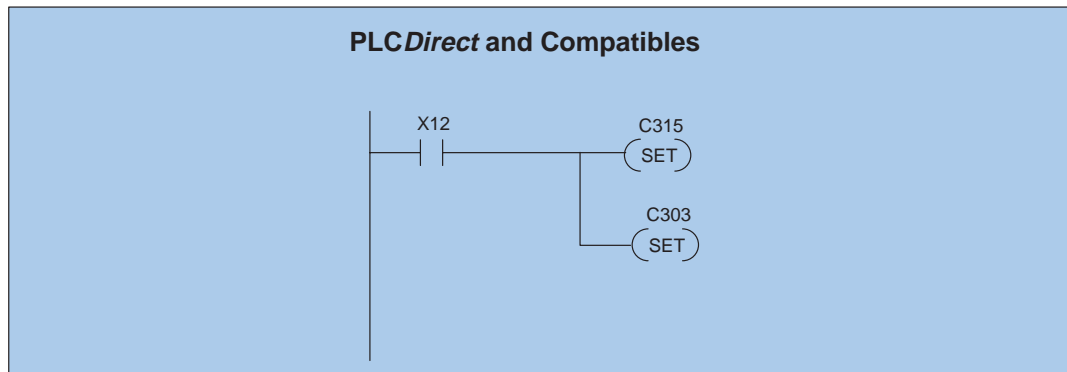


Here's the same thing for either an Allen-Bradley SLC5/03 or 5/04. This example assumes that the configuration started its mapping at N7:0. This would mean that N7:13 would become your Force Flag Register.



Internal Relays

This method is only available to **PLCDirect** programmable controllers. If you are already familiar with the DL205, DL305 and DL405 PLCs, then you know about internal relays. These relays, by PLC design, are mapped to certain bits in reserved memory areas. For example, the DL205 and DL405 have internal relays starting at V40600. They are designated as C0, C1, etc. Assume that you have mapped your panel into the PLC's memory starting with address V40600. The example below shows how relay X12 is used to set the 15th bit of the Force Flag Register (V40614 in this case). Bit 15 is the force flag, and in this case, it would correspond to C315. With the same rung of logic we have also set a Location bit. In this case, Bit 4 (Location 5/Label 5 of the PLC and Panel) corresponds to C303. *Look in your User Manual of your PLC to find out the number designation of the the individual relays and for the corresponding bits that become mapped to your panel. This is usually a table in the back of the manual.*



A better way to make use of internal relays is to use a process of “remapping”. With this technique you map your panel to user memory (such as V2000), and then map parts of your user memory only to those relays you actually need to use. In the example below, we have used SP1 to remap the Force Flag Register (V2014) to V40614 of the internal relays. Now when X12 sets the Bit 15 (C315), it is also setting the Bit 15 of V2014.

