

Understanding the Features

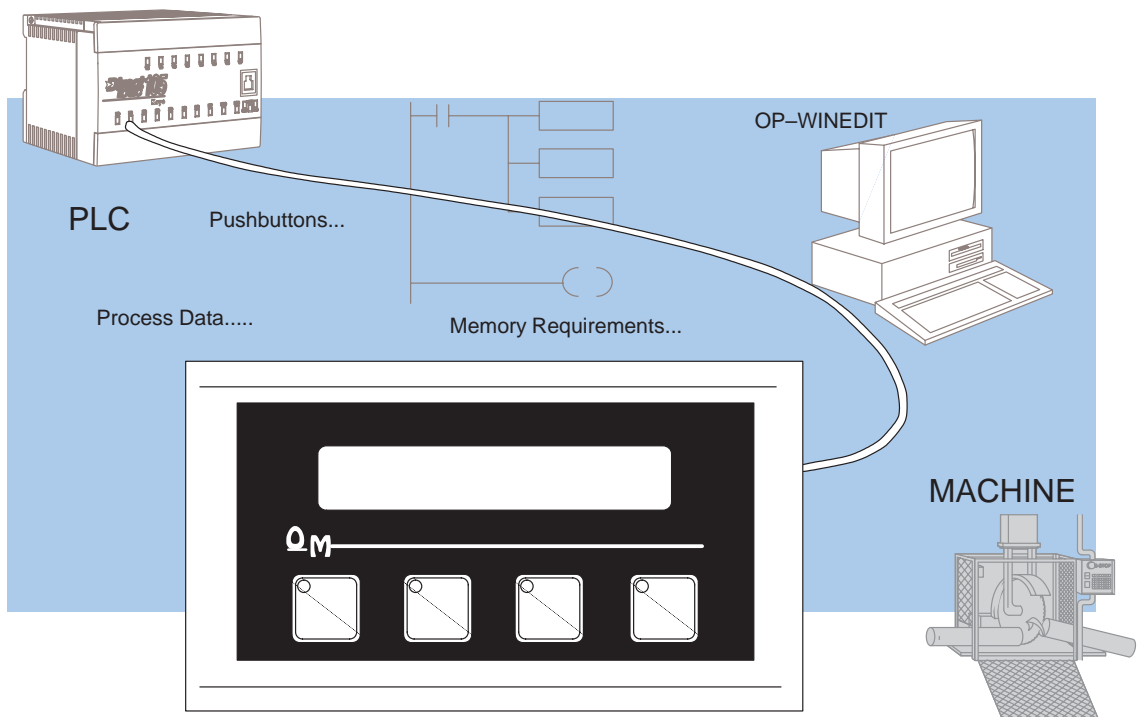
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 - Pushbuttons
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Learning the Features

In this section, the subject of how to use the OP-420 features is described. The details for using pushbuttons and messages are covered. We recommend that you study this chapter before attempting to configure and use the OP-panel. As you proceed through this chapter, relate the topics discussed with how your operator panel may be implemented. The concepts discussed in this chapter are applicable to all PLCs.

- Message Operations
- Memory Mapping Process
- Using the Pushbuttons



Status Register

Status Register Overview

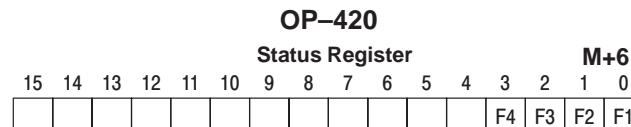
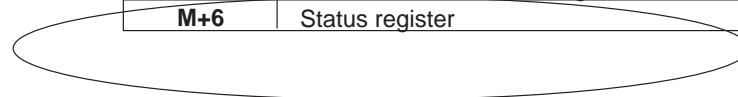
The OP400 panels communicate to the PLC through user defined PLC data registers. The starting or “Base” register is assigned during panel configuration and automatically occupies seven consecutive 16-bit data registers. In this manual the registers are identified as M+0, M+1, M+2, thru M+6. Status register M+6 contains bit-of-word information to monitor individual OP-panel functions and features. Shown in the figure below, base register M+6 **must have** bit level access by the user control program. That means the Status **word** register memory (OP-panel Base register) must be mapped to a user memory bit register. This bit register is referred to as Internal Control Relays such as C0, C1, etc.

Bit Level Access

The Status bits are monitored and manipulated by the PLC ladder logic. For discrete operations such as pushbuttons, register M+6 bits are accessed by the PLC control program. The figure below shows the fixed definition of the Status register bits. These bits are labeled F1 (pushbutton 1) thru F4 (pushbutton 4). The bits and associated labels are described on the following page. First examine the figure below to begin understanding the OP-panel registers and functions. You must structure your ladder logic program to coordinate OP-panel functions asynchronously. This means the operations are triggered successively – not by a clock, but by the completion of an operation.

OP-420 Panel PLC Register Map

PLC Register	Register Function
M+0	Top line message selection
M+1	Bottom line message selection
M+2	Top line data
M+3	Top line data 2 (for long BCD and floating point numbers)
M+4	Bottom line data
M+5	Bottom line data 2 (for long BCD and floating point numbers)
M+6	Status register



Register Definition The following describes the function of each of the registers shown in the table.

- **Register M+0** – When a number from 1 to 160 is placed in this register, the predefined message associated with that number will be displayed on the **top** line of the LCD display.
- **Register M+1** – When a number from 1 to 160 is placed in this register, the predefined message associated with that number will be displayed on the **bottom** line of the LCD display.

- **Register M+2** – This contains numeric data associated with the **top** line display (this is described in more detail later).
- **Register M+3** – This is used for long BCD and floating point data only.
- **Register M+4** – This contains numeric data associated with the **bottom** line display (this is described in more detail later).
- **Register M+5** – This is used for long BCD and floating point data only.
- **Register M+6** – This is the status register. Bits 0 thru 3 monitor the status of pushbuttons F1 thru F4. These bits are set to 1 when the pushbuttons are active.

Messages

Displaying Messages on the LCD Screen

Through the OP-WINEDIT software, up to 160 predefined messages can be entered and stored in the OP-420. These messages are 20 characters long and can include a field for the display of numeric data.

Any predefined message can be displayed on either the top or bottom line. The messages entered during configuration are numbered 1 thru 160. To display a particular predefined message on the display, simply place that message's number in the message selection register.

For example, let's assume that we have defined message #16 as "Mary had a little" and message #22 as "white fleeced lamb". If we wanted to put these two lines on the top and bottom lines respectively, we would simply need to put the number 16 in register M+0 and 22 in register M+1.

If any number other than 1 thru 160 is placed in a message selection register, the associated line will not change.

Example Message:

Mary had a little
white fleeced lamb

To display message #16 here,
place 16 in register M+0.

To display message #22 here,
place 22 in register M+1.

There are two types of messages which may be displayed on this panel, **Static** and **Dynamic** messages.

Static Messages

Static messages are text displays which have *no* embedded data. The static messages may be displayed when an event or condition becomes true. You enter the messages during configuration.

Example Static Message:

SYSTEM RUNNING

Dynamic Messages

Dynamic messages are text messages which include embedded data. These messages are used to present the operator with important PLC data. This data is information which helps the operator closely monitor and control the machine or process.

Example Dynamic Message:

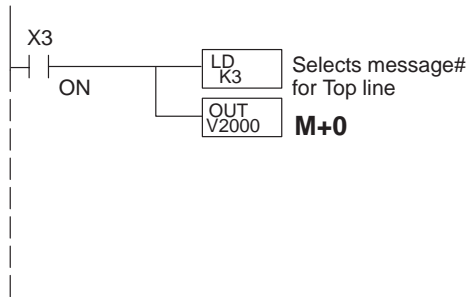
Zone1 Temp.: ^^^

Data Value update from PLC register

Displaying Messages

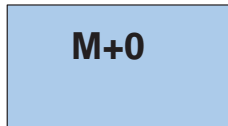
The logic required to display the configured message is quite simple. Simply put the message number (1-160) in memory location **M+0** for the top line message or **M+1** for the bottom line message. The figure below demonstrates an example of a Static message with the panel configured for a starting address of V2000.

Static Message Operation

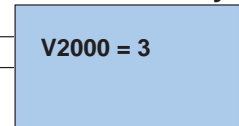


In this example, if the PLC's input signal X3 is ON, the 16 bit integer (K3) value is placed in Word register V2000 (M+0), selecting message #3 to be displayed on the top line.

OP-Panel Register



Example PLC User Memory



Message # request

Static Display

Description

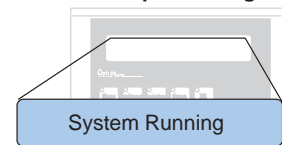
All supported CPUs use the first OP-panel register for displaying a top line static message.

Your ladder logic program must sequence the message being displayed by placing an integer value (1-160) in register M+0. For bottom line static messages use register M+1 for message selection. The OP-panel operating system automatically updates the latest top and bottom line messages according to values placed in the highlighted registers.

Top Line Static Message

Register	Value	Function
M+0	3	Top line message selection
M+1		Bottom line message selection
M+2		Top line data
M+3		Top line data 2
M+4		Bottom line data
M+5		Bottom line data 2
M+6		Status register

Example Message #3



Dynamic Message Operation

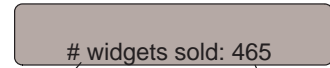
You may program message numbers 1–160 to be used as dynamic messages. One numeric field per line is allowed. Dynamic messages may be displayed on either the top or bottom display lines. The maximum number of digits which may be displayed is five if binary data format is used, four if BCD is used, and eight if BCD double is used. The figure below demonstrates the OP–WINEDIT screens for programming a dynamic message.

Enter the message text and place the caret (^) symbol(s) depending on the number of digits you would like to display. The value range which may be displayed is 0–65,535 integer, 0–9999 BCD or 0–99999999 BCDD. Choose binary, BCD, or BCD double format and fixed point decimal placement.

For dynamic messages which require fixed decimal point placement within the value, you must use the OP–WINEDIT to perform parameter placement type. For fixed position decimal points you must enter the decimal directly into the message text, such as Zone1 Temp = ^.^.^.

For example, let's say message #36 is "# widgets sold: ^^^". Let's also say that 465 widgets have been sold today. To display the current number of widgets sold on the bottom line of the display, you would place 36 in register M+1 and 465 in register M+4. The bottom line would then display: "# widgets sold: 465".

Example Message #36:



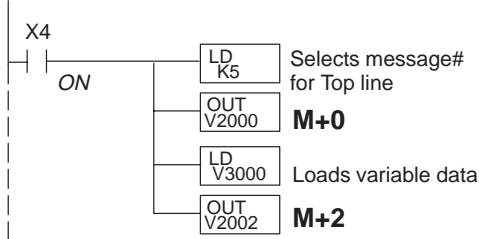
Place 36 in register M+1; message is "# widgets sold: ^^^".

To display this, 465 must be in register M+4.

Examples of dynamic messages. Notice the caret (^) symbols, which is where data will be when the message is displayed.

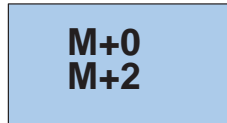


Dynamic Message Top Line

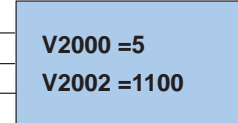


In this example, if the PLC's input signal X4 is ON, the 16 bit integer (K5) value is placed in Word register V2000 (M+0) selecting message #5 to be displayed on the top line. The data value in register V3000 (let's say 1100) is moved into V2002 (M+2), which is embedded in the top line message. The top line data value will update as long as X4 is enabled (ON).

OP-Panel Register



Example PLC User Memory



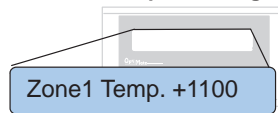
Message # requested
Top line message data

Remember, your ladder logic program must select the message being displayed by placing an integer value between 1 and 160 (message #) in register M+0. The embedded data for the top line message is controlled by loading a 16 bit value into register M+2.

Top Line Dynamic Message

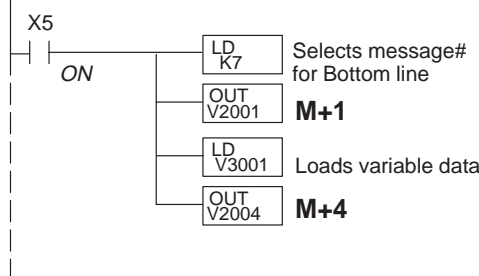
Register	Value	Function
M+0	5	Top line message selection
M+1		Bottom line message selection
M+2	1100	Top line data
M+3		Top line data 2
M+4		Bottom line data
M+5		Bottom line data 2
M+6		Status register

Example Message #5



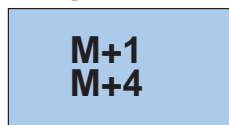
The highlighted registers M+0 and M+2 in this figure result in displaying this top-line dynamic message.

Dynamic Message Bottom Line

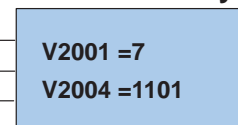


In this example, if the PLC's X5 input signal is ON, the 16 bit integer (K7) value is placed in Word register V2001 (M+1) requesting message #7 to be displayed on the bottom line. The data value in register V3001 (let's say 1101) is moved into V2004 (M+2), which is embedded in the bottom line message. The bottom line data value will update as long as X5 is enabled (ON).

OP-Panel Register

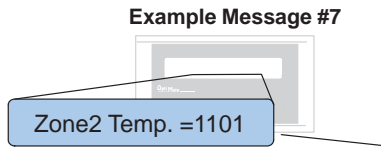


Example PLC User Memory



Message # requested
Bottom line data message

Remember, your ladder logic program must select the bottom line message being displayed by placing an integer value between 1 and 160 (message #) in register M+1.



Bottom Line Dynamic Message

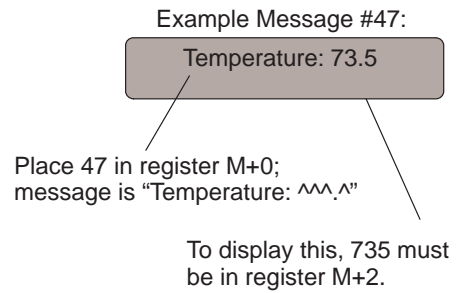
Register	Value	Function
M+0		Top line message selection
M+1	7	Bottom line message selection
M+2		Top line data
M+3		Top line data 2
M+4	1101	Bottom line data
M+5		Bottom line data 2
M+6		Status register

The highlighted registers shown in this figure results in displaying this bottom-line dynamic message.

Displaying Data With a Decimal Point

The OP-420 panel allows you to display fixed point numbers, which are numeric values that have a known decimal point placement and are simply handled as integer values within the PLC program. The only time you see an actual decimal point is on the LCD display. An example of a fixed point number is a program that uses temperature as a control variable, and within the program all temperatures are scaled in tenths of a degree. The values are integer, so a temperature of 73.5 degrees would be 735 in a data register. For the convenience of the operator, you would want the LCD display to include the decimal.

Fixed point numbers are handled by simply placing a decimal point or period in the message field during configuration. For example, let's say you want to display the message "Temperature: 73.5" on the top line, and the message is #47. Enter message #47 as "Temperature:^^.^" during configuration.

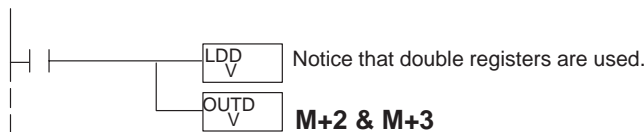


Displaying BCD and Binary Numbers

Normally, numeric values to be displayed are values contained in one 16-bit register. One 16-bit register will handle values between 0 and 65535 in binary form, or between 0 and 9999 in BCD form. For these type numbers, register M+2 is used for the numeric value for the top line and M+4 is used for the bottom line.

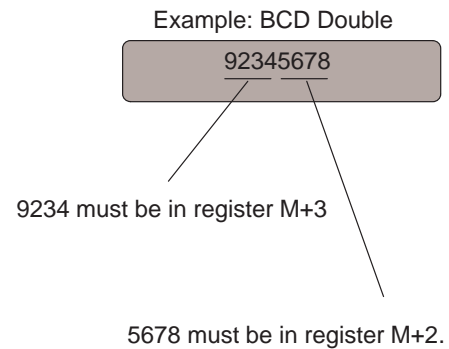
Displaying BCD Double Numbers

The OP-420 will handle large numeric numbers. If you select the option **BCD Double** when the display message is being defined, your display can handle numbers between 0 and 99,999,999. The panel will use data in the register pair M+2 and M+3 for the top line, and use M+4 and M+5 for the bottom line. The data must be in BCD.



When placing a BCD double number in the display registers, the first register numerically in the sequence of two registers (M+2 or M+4) will contain the four least significant digits of the number. The second register in the sequence (M+3 or M+5) contains the data for the four most significant digits of the BCD double number.

For example, to display the number 92345678 on the top line of the display, the top line data registers, M+2 and M+3, must contain 5678 and 9234 respectively.



Displaying Floating Point Numbers

The OP-420 has the capability to display Floating Point (or Real) numbers if you select the option **Float** when the display message is being defined in the OP-WINEDIT software.

Floating point numbers can only be used with the D2-250, D3-350, and D4-450 CPUs since they are the only compatible CPUs that support the IEEE 32-bit floating point number format, which is where the floating point numbers are stored. They always occupy two 16-bit register locations regardless of the size of the number. See the PLC User Manual for more information on the IEEE 32-bit floating point number format.

An IEEE 32-bit floating point number has a range of $-3.402823E+38$ to $+3.402823E+38$. The OP-420 will be able to display any number within that range. The panel always uses the format $\pm X.XXE\pm XX$ to display the numbers.

The panel does not have the ability to display all the significant digits of a floating point number, it only displays the first three significant digits. The OP-420 truncates the remaining digits so you always see the true number. The two examples below show the data contained in the PLC registers and the corresponding value displayed on the panel in its format. Notice how the data is truncated.

The configuration of a floating point number message is similar to any other message. First, you select the message number, then you type in the text using nine caret symbols (^) as a place holder for each of the nine floating point number symbols. Next, select the **Float** option for the data format.

Example: Floating Point Numbers

PLC Registers	OP-420 Display
12301.789	+1.23E+04
123.96783	+1.23E+02

Let's say you wanted to configure message #58 to display a floating point number. In the OP-WINEDIT software, select OP-420 as the module type, and then select message #58 with the mouse. Type in the following message: "Float Pt ^^^^^^^" and select floating point as the message format.

To display a number simply move it into either the top or bottom line data registers and load the appropriate message number into the corresponding top or bottom line message selection register. For example, if you display the number 632.15 in message #58, it will be displayed as "Float Pt # +6.32E+02".

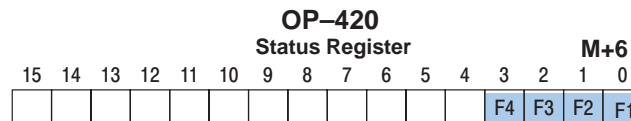
Pushbuttons

Pushbutton Operation

The OP-420 has four user-defined pushbuttons. Pushbuttons may be used to begin events or tasks within the PLC, such as start/stop control. This section describes concepts of how to monitor and control the pushbuttons on your OP-panel.

The OP-panel pushbutton inputs are monitored for ON/OFF conditions in your PLC ladder logic program. From a practical point of view we need to control and monitor the bits in the status register on an individual basis. The OP-420 pushbuttons are assigned to the *first four bits* of the **Status Register (M+6)**. Examine the highlighted status bits below which show each user definable pushbutton.

Register	Function
M+0	Top line message selection
M+1	Bottom line message selection
M+2	Top line data
M+3	Top line data 2
M+4	Bottom line data
M+5	Bottom line data 2
M+6	Status register



Pushbutton Example

The pushbutton example shown here is using **DirectLOGIC** PLC address references. The equivalent instructions for *other* PLC products supported are shown in Chapter 5 of this manual.



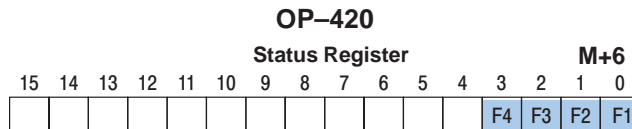
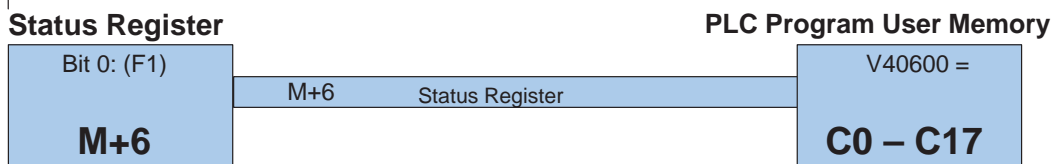
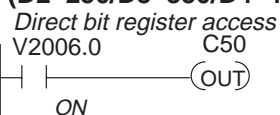
NOTE: In the following example we assume that the OP-panel is configured with a base register of **DirectLOGIC** address V2000. In this case, status register M+6 is V2006 which we will assume has been mapped to V40600, the **DirectLogic** internal control relay memory. Mapping details are discussed later in this chapter.



In this example, C0 represents the pushbutton No.1 (F1) via the mapping process. When pushbutton No.1 is pressed C0 is true and Coil C50 is energized.

Status Register (M+6) = V40600: C0 – C17

(D2-250/D3-350/D4-450 Only)



Pushbuttons Using Direct Access to Status Register Bits

The **DirectLogic** D2-250/D3-350/D4-450 CPUs and the Allen-Bradley SLC 5/03 and 5/04 support instructions which provide individual status bits access. This is called **Bit-of-Word** capability. For example, in the figure above, the ladder logic for the D2-250/D3-350/D4-450 monitors the first bit of the status word directly. Once again, our example assumes that we configured the OP-panel with a starting base address of V2000.

Pushbutton LEDs

There are LEDs located on each of the user defined pushbuttons. These LEDs indicate whether the pushbutton status condition is ON or OFF. You may choose the pushbutton type while configuring your OP-panel. There are two different operator controls, alternate or momentary, which will determine the LED response when the pushbuttons are pressed. In the case of an alternating configured pushbutton, the LED will change state each time the pushbutton is pressed. With momentary configured pushbuttons the LED is ON only as long as the pushbutton is being pressed.

Memory Mapping Process

Each OP-420 is assigned 112 bits of PLC user memory which will be used as the OP-panel database. The ladder logic program must access this assigned OP-panel memory. Let's take a closer look at this user memory and how it relates to the OP-panel features.

OP Base Register Memory Definition

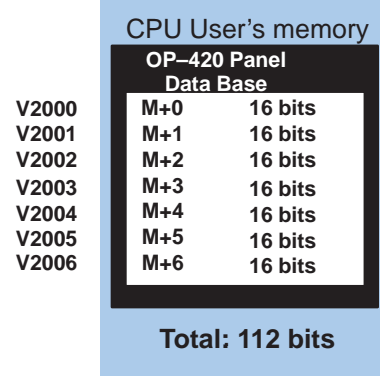
As discussed earlier, regardless of which PLC product you are using the base registers address M+0 through M+6 are formatted the same. In this manual, when the terms M+0 through M+6 are used, this identifies which base register(s) are affected for the topic being covered.

Base Address Manual Reference	Function Description
M+0 =	Top line message selection
M+1 =	Bottom line message selection
M+2 =	Top line data
M+3 =	Top line data 2
M+4 =	Bottom line data
M+5 =	Bottom line data 2
M+6 =	Status register

Operator Panel Base Memory

PLC user memory is assigned to each panel with the OP-WINEDIT configuration software. For new OP-panels and add-on applications the programmer must define seven 16 bit registers for PLC interface. Below is a figure showing memory layout for *Direct*LOGIC DL105, DL205, DL405 PLC's and uses V2000-V2006 for the OP-420 panel. See the next page for other PLC product memory usage examples.

You must reserve 112 bits (seven 16-bit registers or fourteen 8-bit registers) which are used to process data between the panel and your PLC. You must configure the **Base** register for the OP-panel. This base register address is stored in the OP-panel memory.



OP-Panel User Memory

Let's examine the different address conventions for PLC *Direct* and Allen-Bradley. For example, the PLC *Direct* address references are **octal**, and the Allen-Bradley is **decimal**. The *Direct*LOGIC DL105/DL205/D3-350/DL405 OP-panel address uses V-memory registers which are 16-bit registers. The DL305 family uses reference assignments with 8-bit registers. This means that the DL305 will require fourteen 8 bit registers for data handling. The Allen-Bradley memory is defined with a reference which (**Nx**) represents the memory area, and (**:n**) which defines the word within the memory area. Please refer to the appropriate CPU User manual for the PLC product you are using.

*Direct*LOGIC DL105/DL205/D3-350/DL405

Example Address		Function
V2000	M+0	Top line message selection (#1 to #160)
V2001	M+1	Bottom line message selection (#1 to #160)
V2002	M+2	Top line data
V2003	M+3	Top line data 2
V2004	M+4	Bottom line data
V2005	M+5	Bottom line data 2
V2006	M+6	Status register

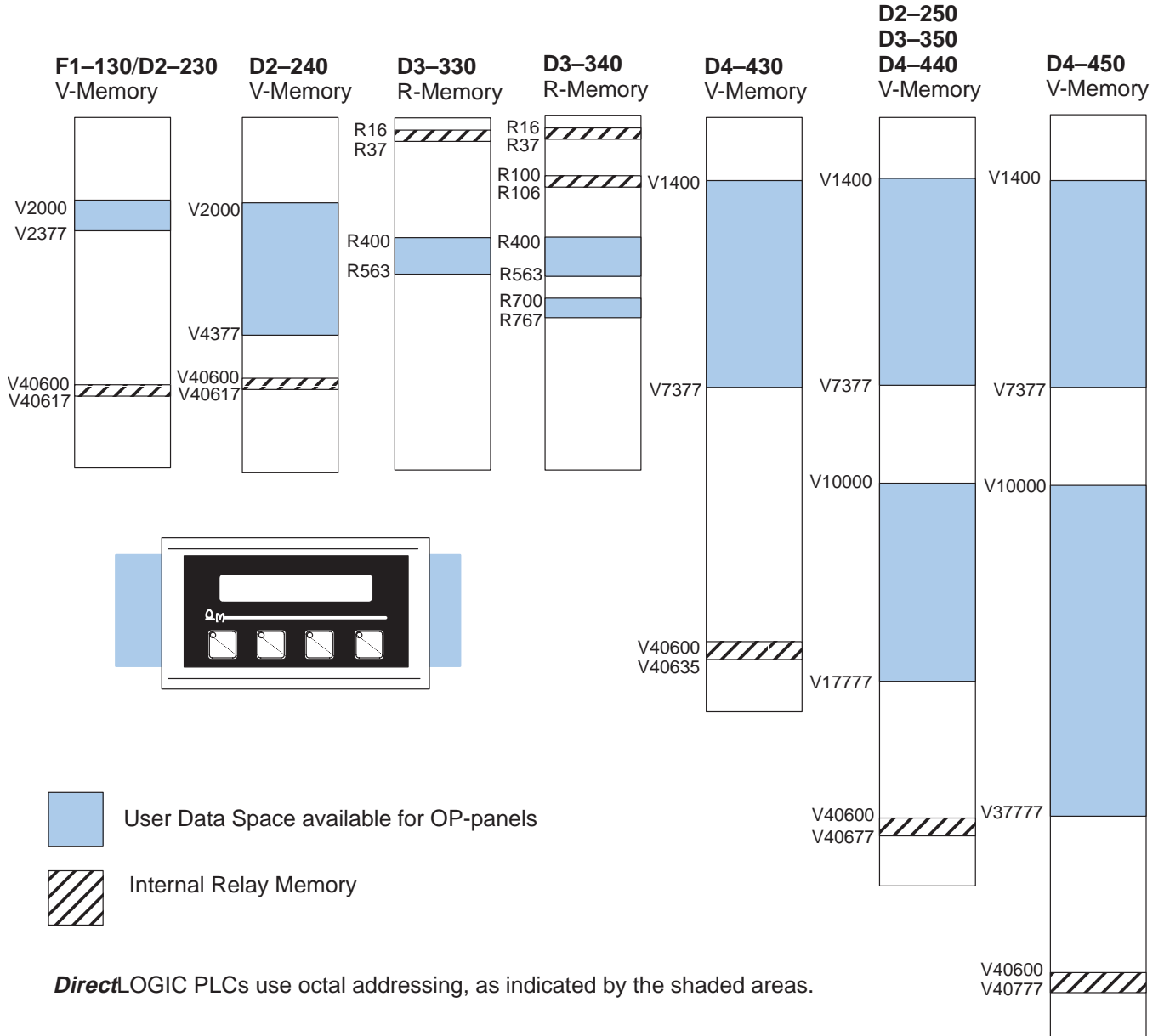
*Direct*LOGIC DL305 (DL340 only)

Example Address		Function
R400/R401	M+0	Top line message selection (#1 to #160)
R402/R403	M+1	Bottom line message selection (#1 to #160)
R404/R405	M+2	Top line data
R406/R407	M+3	Top line data 2
R410/R411	M+4	Bottom line data
R412/R413	M+5	Bottom line data 2
R414/R415	M+6	Status register

Allen-Bradley SLC 500

Example Address		Function
N7:0	M+0	Top line message selection (#1 to #160)
N7:1	M+1	Bottom line message selection (#1 to #160)
N7:2	M+2	Top line data
N7:3	M+3	Top line data 2
N7:4	M+4	Bottom line data
N7:5	M+5	Bottom line data 2
N7:6	M+6	Status register

DirectLOGIC User Memory Overview



Understanding the Features

Mapping Operation

We explained earlier that the PLC and OP-panel must exchange data on a *bit-level* basis. For **Direct**LOGIC controllers, the OP-panel status register (M+6) must be mapped into internal control relays such as C0, C1, etc. This allows *direct access* to the Status bit register. You must execute mapping every CPU scan in order to update data between the OP-panel and PLC.

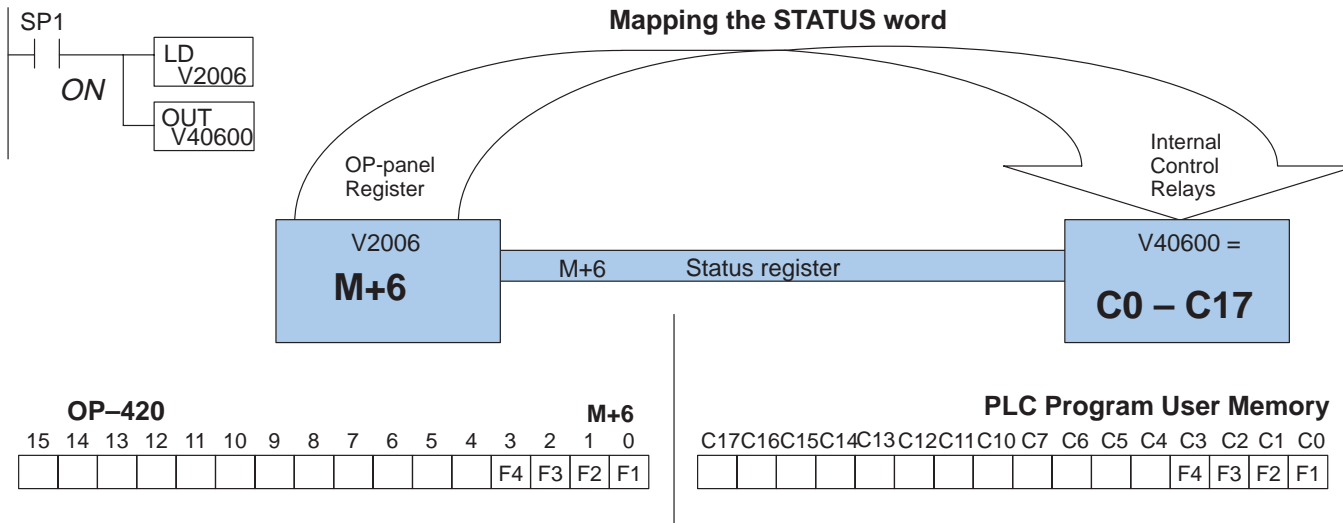
The following examples assume the OP-panel starting base-register (M+0) is assigned to word register V2000. For example, the DL105, DL205, D3-350, and DL405 CPUs have internal control relays starting at register V40600. They are designated as C0, C1, etc. Mapping updates status data (M+6) into base register V2006 each PLC scan.

Mapping Example (DL105, DL205, D3-350, and DL405)

DL105, DL205, D3-350, and DL405

This figure demonstrates how the OP-panel status word is mapped to ladder program user memory for bit manipulation. In this figure, notice the sixteen bits in the status register are loaded into the Internal Control Relays C0-C17. These control relays are used within the ladder logic program for monitoring pushbuttons and coordinating data entry control.

SP1 (always ON) maps OP register V2006 to V40600:C0 -C17.



Mapping Example (D3-340)

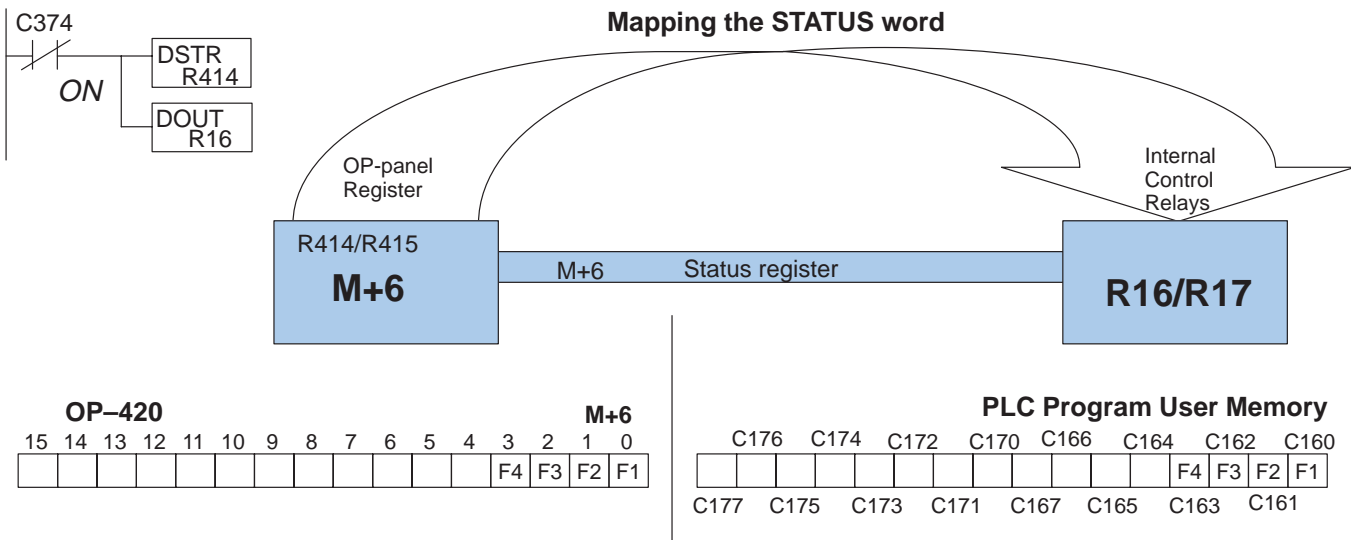
DL305 Family

Let's look at mapping the D3-340 CPU belonging to the DL305 family. Unlike the DL105, DL205, D3-350, and DL405 mapping examples, the DL305 uses 8-bit words. It therefore takes two 8-bit words for each mapped memory location because each mapped memory location needs sixteen consecutive bits. We will assume that R400 was used as the base register address and we want the mapping to start at R16 for the status register.

This figure demonstrates how the OP-panel status word is mapped to ladder program user memory for bit manipulation. In this figure, notice that the two 8-bit status registers (M+6) are loaded into the Internal Control Relays R16 – R17. These control relays are used within the ladder logic program for monitoring pushbuttons and coordinating data entry control.

Not C374 (always ON after first scan) maps OP register R414/R415 to R16/R17.

Note that DSTR and DOUT are 16-bit instructions.



Understanding the Features