OPTIMATE SERIES
MODEL 440 TERMINAL

Opti Mate

KM440 Display Panel

Applications
- Machine control
- Process control
- Security systems
- HVAC
- Plant monitoring/control
- PLC applications
- Microprocessor applications

The KM440 Display Panel is a low cost/high performance man/machine interface with a broad range of display capabilities. The panel includes a 4 line by 20 character LCD display with the capability to display text messages, BCD, BCD Double, Binary and Floating-Point numbers.

OM-WINEDIT configuration software allows you to predefine up to 160 messages. These messages can be later selected for display by your PLC program to display status and variable data.

The KM440 Display Panel is part of Optimation's **OptiMate**® series. Each OptiMate panel is designed to connect to most PLCs with a single cable connection.

When used with a PLC, operation is transparent to the user. Terminal functions tie directly into your PLC ladder logic program. The KM440 takes care of the rest.

Features
- 4 line x 20 character LCD
- Text Message display
- Floating point, BCD, BCD Double and Binary data display
- PLC compatible
- RS232 communications
- Stand alone operation capable

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Configuration Options

PLC Stand Alone

OptiMate panels plug directly into most PLCs. A simple cable connection allows you to interface and control the OptiMate panel via PLC data registers and ladder logic.

The KM440 Display Terminal uses a bank of PLC registers. Complete operator interface is performed with 12 PLC registers for display message selection and data display. The KM440 continuously accesses these PLC registers and performs operations under ladder logic control on a real-time basis.

PLCs are slave devices on their standard communications ports. This means that a panel attached to the standard port must control the transfer of information by reading and writing the PLC registers. OptiMate panels will perform these communications for most major PLC protocols. Configuration for particular PLC protocols and interconnect cabling is covered in the following pages.
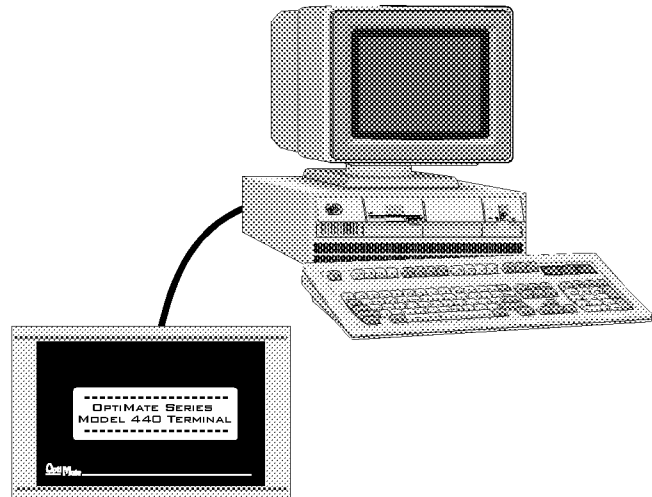
Microprocessor-Based Systems

OptiMate 400 Series modules can interface directly to most computers or microcontrollers. The modules communicate over RS232 serial communications. All that is required to interface OptiMate modules is an RS232 serial port and the ability to send and receive Hex numbers. The OptiMate Hex communications protocol, detailed in this document, allows the user to display messages and display data of various types.

Since the OptiMate 400 Series panels can only communicate on RS232, only 1 panel can be interfaced on each serial communications port.

In a microprocessor-based system, the host microprocessor is the system master. The OptiMate modules are slave devices that respond to commands from the host. In the case of the KM440, these commands are requests that update messages and numbers, and display message data.

Use with a PLC

Memory Mapping

Memory mapping is a technique that "maps" the memory of an OptiMate panel into the registers of the programmable controller. By knowing where the data of a specific OptiMate panel is mapped, this data can be moved, changed or monitored using ladder logic.

The term PLC register is used for describing the area of memory within the programmable controller that can be used for data storage. PLC registers are sometimes known as data registers or internal registers.

MSB   LSB

16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

PLC Register

The KM440 Display Panel uses a bank of 12 contiguous PLC registers. The register set definition is shown in the table below.

KM440 Panel PLC Register Map	
PLC Register	Register Function
M+0 (first register of bank)	Top line message selection
M+1	Second line message selection
M+2	Third line message selection
M+3	Bottom Line message selection
M+4	Top line data
M+5	Top line data 2 (for long BCD and floating point)
M+6	Second line data
M+7	Second line data 2 (for long BCD and floating point)
M+8	Third line data
M+9	Third line data 2 (for long BCD and floating point)
M+10	Bottom line data
M+11	Bottom line data 2 (for long BCD and floating point)

Register Definition

The following describes the function of the registers shown in the table.

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

- **Register M+2** - When a number from 1-160 is placed in this register, the predefined message associated with that number will be displayed on the third line of the LCD display.

- **Register M+3** - When a number from 1-160 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+4** - Numeric data associated with top line display (described in more detail in following paragraphs)

- **Register M+5** - Top line, for long BCD and floating-point data only (described in more detail in following paragraphs).

- **Register M+6** - Numeric data associated with second line of display.

- **Register M+7** - Second line, for long BCD and floating-point data only.

- **Register M+8** - Numeric data associated with the third line of display.

- **Register M+9** -Third line, for long BCD and floating-point data only.

- **Register M+10** - Numeric data associated with bottom line of display.

- **Register M+11** - Bottom line, for long BCD and floating-point data only.

Operational Overview

Displaying Messages on the LCD Display

Through the OM-WINEDIT configuration software, up to 160 predefined messages can be entered and stored in the KM440. 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, second, third, or bottom line. The messages entered via the configuration editor are numbered 1 through 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 .." , message #22 as "white fleeced lamb", message #25 as "Everywhere Mary went", and message #26 as "the lamb went also". If we wanted to put these four messages on the top, second, third and bottom lines of the display respectively, we would simply need to put the number 16 in register M, the number 22 in register M+1, the number 25 in register M+2 and the number 26 in register M+3.

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

Placing Numeric Data in the Display

Certain predefined messages may incorporate a numeric data field. One numeric field per line is allowed. Messages that contain data are entered through the configuration editor with a caret symbol "^" as a place holder for each numeric digit.

An example of the use of numeric data is the message "#Widgets sold: ^^^^". Assume that this is message # 36 entered through the configuration editor. Also assume that a total of 465 widgets have been sold today. To display the current number of widgets sold on the second line of the display, you would place `36` in register M+1 and `465` in register M+6. The second line of the display would then read "#Widgets sold: 465".

Displaying Data with a Decimal Point

The KM440 panel allows you to display fixed-point numbers.

Fixed-point numbers 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 use an actual decimal point is for display to the operator. An example of a fixed-point number is a program that uses temperature as a control variable. Within the program, all temperatures are scaled in tenths of a degree. The values are integer. A temperature of 73.5 degrees would be 735 in a data register. For the convenience of the operator, you would want the display to include the decimal.

Fixed-point numbers are handled by simply placing a decimal point or period in the message field during configuration. In other words, the message "Temperature : ^^^.^" would be entered during configuration (say message 47). If 47 were placed in register M and the value 735 in register M+4, the display would read "Temperature : 73.5" on the top line.

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 format), or 0 to 9999 (in BCD format). For these types of numbers, register M+4 is used for numeric value for the top line, register M+6 is used for the second line, register M+8 is used for the third line, and register M+10 is used for the bottom line.

Displaying "Double" Numbers

The KM440 will handle larger numeric numbers. If you select the option "BCD double" when the display message is being defined, your display will handle numbers between 0 and 99,999,999. The KM440 will use data in the register pair M+4 and M+5 for the top line. Likewise, M+6 and M+7 are used for the second line, M+8 and M+9 are used for the third line and M+10 and M+11 are used for the bottom line. The data must be in BCD format.

When placing a "BCD double" number in the display registers, the first register numerically in the sequence of two registers (M+4, M+6, M+8 or M+10) will contain the 4 least significant digits of the number. The second register in the sequence (M+5, M+7, M+9 or M+11) contains the data for the 4 most significant digits of the "BCD double" number.

If the data displayed on the third line of the panel is 46378345, the third line data registers will contain the following: (shown in BCD/Hex format)

BCD Double Data	PLC Register
M+8	8345
M+9	4637

Displaying Floating-Point Numbers

The KM440 has the capability to display Floating-Point (or Real) numbers if you select the option "Floating Point" when the display message is being defined in the OM-WINEDIT software.

Floating-point numbers can only be used with CPUs that support the IEEE 32-bit floating point number format. The floating-point numbers are stored in the IEEE 32-bit floating point format within the PLC. They always occupy 2 16-bit register locations regardless of the size of the number. Refer to the PLC manufacturer's programming documentation 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 KM440 will be able to display any number within that range. The panel always uses the format ±X.XXE±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 3 significant digits. The KM440 does not "round" the numbers up or down, instead it truncates the remaining digits so you always see the true number. The two examples in the table below show the data contained in the PLC registers and the value displayed on the panel in its format. Notice how the data is truncated, not rounded.

PLC Registers	KM440 Display
12301.789	+1.23E+04
123.96783	+1.23E+02

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 9 caret symbols "^" as a place holder for each of the 9 floating-point number symbols. Next, select the "Floating Point" option for the data format.

```
Temperature: 73.5
#Widgets sold: 465
Double: 46378345
Float Pt # +6.32E+02
```

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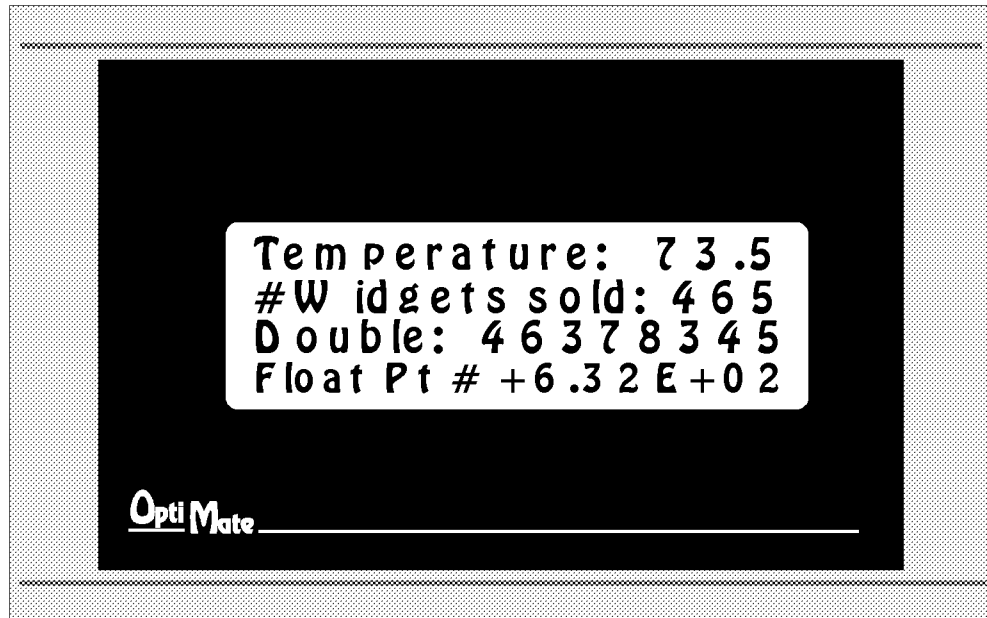
Suppose you wanted to configure message #58 to display a floating-point number. In the OM-WINEDIT software you would select KM440 as module type. Then to configure message #58 simply select it with the mouse and type in a message in the following manner "Float Pt # ^^^^^^^^^^" . Also, select floating point as the message format. To display a number, simply move it into either the top, second, third or bottom line data registers and load the appropriate message number into the corresponding top, second, third or bottom line message selection register. If the number 632.15 is to be displayed in message #58 on the bottom line, it will be displayed as the following: "Float Pt # +6.32E+02".

Configuration

Configuration of the KM440 Terminal is performed via an IBM PC-compatible computer with the Windows operating system. Optimation supplies the OM-WINEDIT software that will allow you to select module configuration and PLC protocol definition.

> Note : When configuring the KM440, always remember to use the programming cable that connects the panel to an IBM PC compatible computer. Always insert the programming cable into the panel to place it into configuration mode. When you are finished downloading, wait a few seconds before removing the programming cable. This will return the panel to PLC run mode.

Configuration of the KM440 begins selecting the proper PLC protocol information. Next, the block of PLC registers to be used must be defined. Then each of the messages used by the PLC program must be defined.

Message definition is very straightforward and easily accomplished. All that is necessary is the following sequence.
- Select the message number to enter.
- Type the message. Up to 20 characters are allowed. Any unused characters will be filled with blanks. One numeric field per message may be defined with caret `^` characters. One decimal point or colon may be placed within the field.
- If the message contains a numeric data field, the data format must also be selected.

Examples of Use with a Keyence PLC

Register Usage

The OptiMate OM-WINEDIT software allows you to configure a module to use a block of registers at a starting value that you define. For a Keyence PLC the recommended memory to use is the general purpose data memory starting at DM0000. Any block of registers within the data word range can be used as long as the block does not conflict with anything that may be using registers in the data memory area.

The PLC registers in the block used by the KM440 panel are used for numeric information. As such they are ideally suited for the general purpose data memory registers DM0000-DM0699.

Displaying Messages on the LCD Display

The examples on the following pages use a KM440 connected to a Keyence PLC. The KM440 is configured for a base address of DM0000.

Messages of various types can be configured via OM-WINEDIT and downloaded to the KM440. The message definitions shown in the figure below will be used in all of the examples that follow. **Also, assume that message #140 consists of all blanks "   ".**


```
OM440 Configuration                                                    [x]
Edit  Help

Panel:                          PLC Base                              Close
                                Register
                                Address: DM0000
                                                              Write to Panel
   OptiMate

Configure Messages:                                              Delete Msg
Msg Text                    Action    Decimal   Format    Range   Clear List

  1: "Parts Left: ^^^^^  ":   Display   Fixed     BIN
  2: "Product Rate ^^^.^ ":   Display   Fixed     BCD
  3: "Tank Level ^^^^    ":   Display   Fixed     BCD
  4: "Good Parts: ^^^^   ":   Display   Fixed     BCD
  5: "Reject Parts ^^^^  ":   Display   Fixed     BCD
  6: "Double: ^^^^^^^^   ":   Display   Fixed     BCD Double
  7: "Part/HrAvg ^^^^^^^^^^":  Display   Fixed     Floating Point
  8: "Process Step 1    ":
  9:
 10:
 11:
 12:
 13:
```

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Displaying BCD Numbers on the LCD Display

The following example shows a couple of messages being displayed on the LCD display as long as 1800 is active. The second line uses BCD message #4. The data for the second line data field is coming from DM0200. The bottom line is text message #8. The top and third lines use data display message #140, which has been configured as a blank text message.

```
1800    #00140   DM0000
─┤├──────┤ LDA ├──┤ STA ├──   Select message
                              140 to top line

        #00004   DM0001
        ─┤ LDA ├──┤ STA ├──   Select message 4
                              to second line

        #00140   DM0002
        ─┤ LDA ├──┤ STA ├──   Select message
                              140 to third
                              line
        #00008   DM0003
        ─┤ LDA ├──┤ STA ├──   Select
                              message 8
                              to bottom
        DM0200   DM0006       line
        ─┤ LDA ├──┤ STA ├──   Put data
                              from DM0200
                              into top line
                              data field
```

```
Good Parts: 2 3 5
Process Step 1

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```

DM0000	Top line message selection
DM0001	Second line message selection
DM0002	Third line message selection
DM0003	Bottom line message selection
DM0004	Top line data
DM0005	Top line data 2 (for long BCD & floating point)
DM0006	Second line data
DM0007	Second line data 2 (for long BCD & floating point)
DM0008	Third line data
DM0009	Third line data 2 (for long BCD & floating point)
DM0010	Bottom line data
DM0011	Bottom line data 2 (for long BCD & floating point)

Displaying Binary Numbers

The example shown on the right is similar to the last example. The primary difference is that it uses a Binary number in the top line display. The top line uses data display message #1, which has been configured as a Binary display message. The data for the top line data field is coming from DM0325. The third line is text message #8. The second and bottom lines use message #140 which has been configured as a blank text message.

```
Parts Left:   56432
Process Step 1
```

1801	#00001 ⟨LDA⟩	DM0000 ⟨STA⟩	Select message 1 for top line
	#00140 ⟨LDA⟩	DM0001 ⟨STA⟩	Select message 140 to second line
	#00008 ⟨LDA⟩	DM0002 ⟨STA⟩	Select message 8 to third line
	#00140 ⟨LDA⟩	DM0003 ⟨STA⟩	Select message 140 to bottom line
	DM0325 ⟨LDA⟩	DM0004 ⟨STA⟩	Put data from DM0325 into top line data field
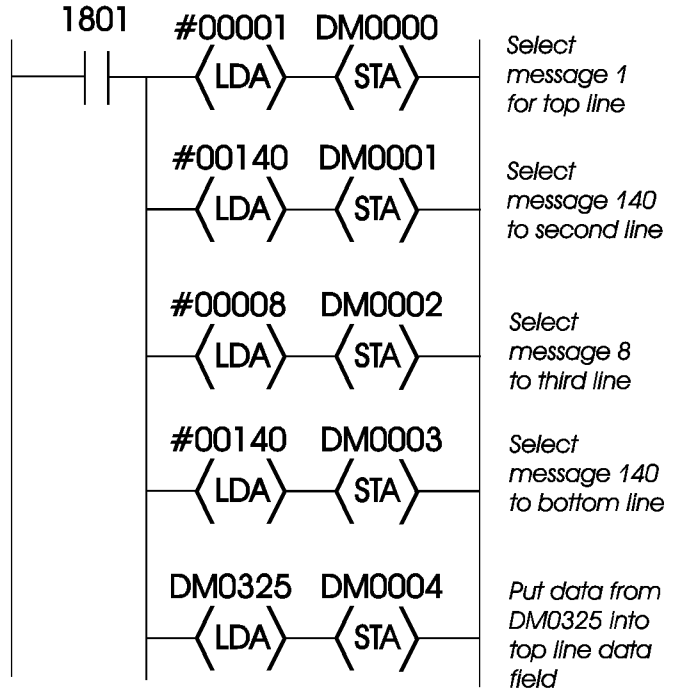
Displaying BCD Double Numbers

Keyence PLCs do not have a means of easily handling BCD double numbers, however, the KM440 has the capability to display them. For the panel to display BCD double numbers, the number has to be in the proper format within the PLC registers. The following paragraph describes the process in more detail.

The example shown on the right places a BCD double number on the bottom line of the display. The bottom line uses data display message #6, which has been configured as a BCD double display message. The data for the bottom line data field is coming from DM0250 and DM0251. The top line is text message #8. The second line displays BCD message #3. The data for second line BCD message comes from register DM0275. The third line uses message #140 which has been configured as a blank text message.

```
Process Step 1
Tank Level: 1935

Double: 64197324
```

1802	#00008 ⟨LDA⟩	DM0000 ⟨STA⟩	Select message 8 for top line
	#00003 ⟨LDA⟩	DM0001 ⟨STA⟩	Select message 3 to second line
	#00140 ⟨LDA⟩	DM0002 ⟨STA⟩	Select message 140 to third line
	#00006 ⟨LDA⟩	DM0003 ⟨STA⟩	Select message 6 to bottom line
	DM0275 ⟨LDA⟩	DM0006 ⟨STA⟩	Put data from DM0275 into top line data field
	DM0250 ⟨LDA⟩	DM0010 ⟨STA⟩	Put BCD double data from DM00250 and DM00251 into bottom line data field
	DM0251 ⟨LDA⟩	DM0011 ⟨STA⟩	
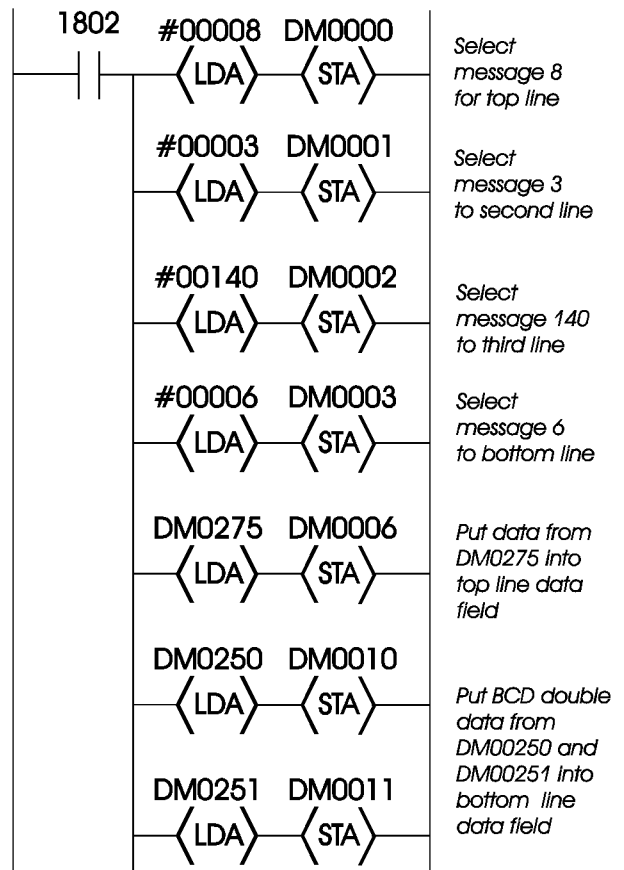
Displaying Floating-Point Numbers

The example shown on the right is similar to the previous example. The primary difference is that it uses a floating-point number in the third line display message. The third line uses data display message #7, which has been configured as a floating-point display message. Since the data is a floating-point number, it uses two consecutive 16-bit registers containing data in the IEEE 32-bit floating point format. The two registers have to be looked at together, not individually, for you to be able to make any sense of the data. In this example, the data is loaded from DM0175 and DM0176 to the third line display registers DM0008 and DM0009. The top and bottom lines use message #140 which has been configured as a blank text message. The second line uses message #8, a text message.

1803	#00140 DM0000 ⟨LDA⟩ ⟨STA⟩	Select message 140 for top line
	#00008 DM0001 ⟨LDA⟩ ⟨STA⟩	Select message 8 to second line
	#00007 DM0002 ⟨LDA⟩ ⟨STA⟩	Select message 7 to third line
	#00140 DM0003 ⟨LDA⟩ ⟨STA⟩	Select message 140 to bottom line
	DM0175 DM0008 ⟨LDA⟩ ⟨STA⟩	Put IEEE 32-bit floating point data from DM0175 and DM0176 into third line data field
	DM0176 DM0009 ⟨LDA⟩ ⟨STA⟩	

```
Process Step 1
Part/HrAvg +1.68E+05
```

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Note: Keyence PLCs do not have a means of easily handling floating-point numbers, however, the KM440 has the capability to display them. For the panel to display floating-point numbers, the number has to be in the IEEE 32-bit floating-point format within the PLC registers.
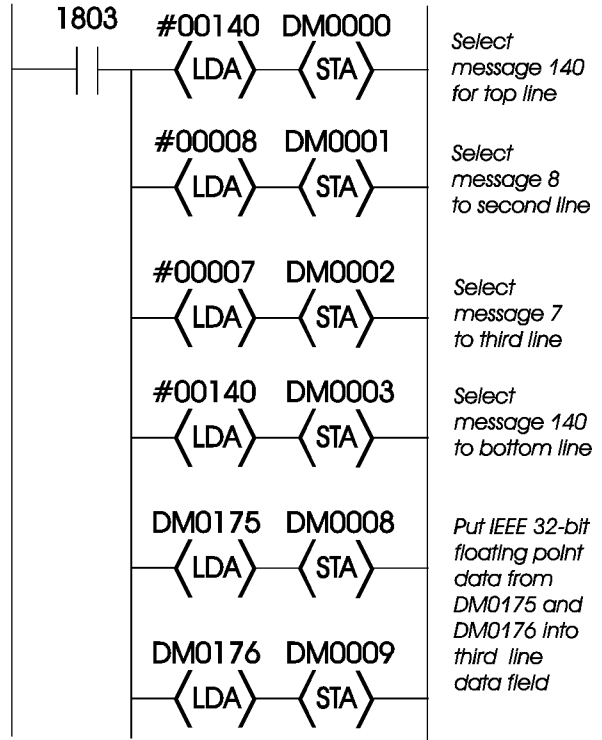
Examples of Use with a Modicon PLC

Register Usage

The OptiMate OM-WINEDIT software allows you to configure the KM440 to use a block of 12 contiguous registers at a starting value that you define. For a Modicon PLC the recommended memory to use is the **4x** memory area. Any block of registers between 40020 and 40617 can be used as long as the block does not conflict with anything that may be already using registers in the KM440's planned memory area.

Configuring Messages for the KM440

The figure below shows an example of a group of messages that can be displayed by the KM440. The use of these messages will be explained in more detail on the following pages. Also, assume that the base register address is 40020, as shown below.

```
OM440 Configuration                                                    [X]

Edit   Help

Panel:                      PLC Base
                            Register                              Close
                            Address:  40020

   OptiMate                                                     Write to Panel

Configure Messages:
                                                                 Delete Msg
Msg Text                    Action    Decimal    Format    Range  Clear List

   1: "Parts Left: ^^^^^   ":    Display    Fixed    BIN
   2: "Product Rate ^^^.^  ":    Display    Fixed    BCD
   3: "Tank Level ^^^^     ":    Display    Fixed    BCD
   4: "Good Parts: ^^^^    ":    Display    Fixed    BCD
   5: "Reject Parts ^^^^   ":    Display    Fixed    BCD
   6: "Double: ^^^^^^^^    ":    Display    Fixed    BCD Double
   7: "Part/HrAvg ^^^^^^^^^^":   Display    Fixed    Floating Point
   8: "Process Step 1     ":
   9:
  10:
  11:
  12:
  13:
```

Displaying BCD Numbers on the LCD Display

Messages of various types can be configured via OM-WINEDIT and downloaded to the KM640. The message definitions shown on the previous page will be used in all of the examples that follow. **Also assume that message #140 consists of all blank characters, "   ".**

The example below shows a couple of messages being displayed on the LCD display as long as 00300 is active. The second line uses BCD message #4. The data for the second line data field is coming from register 40256. The bottom line displays text message #8. The top and third lines display message #140, which has been configured as a blank text message.


```
00300
  | |        #0140
             #0000      Put
             ADD        message 140
             40020      on top line

             #0004
             #0000      Put
             ADD        message 4
             40021      on 2nd line

             #0140      Put
             #0000      message 140
             ADD        on 3rd line
             40022

             #0008      Put
             #0000      message 8
             ADD        on bottom
             40023      line

             40256      Copy data
             40026      from 40256
             BLKM       into 2nd line
             1          data field
```
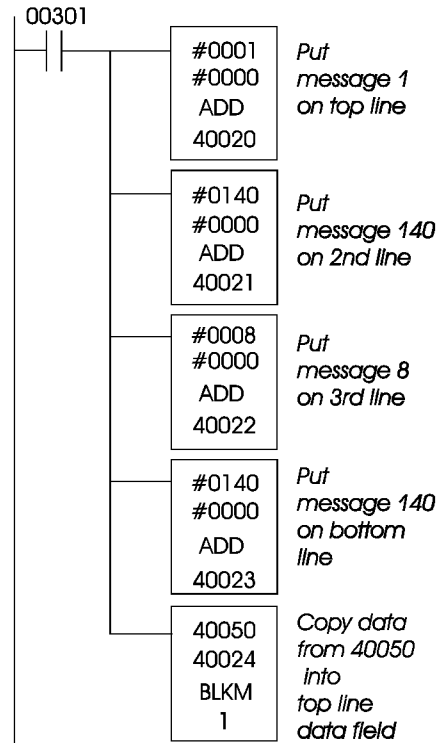
Good Parts: 2 3 5
Process Step 1

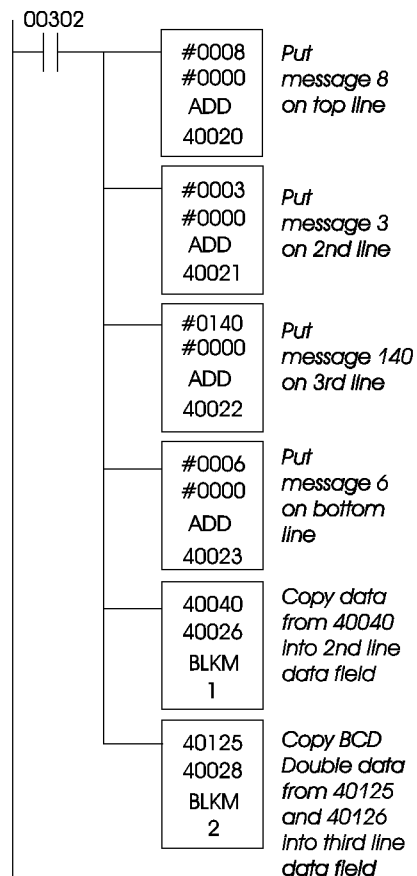| Reg	Description
40020	Top line message selection
40021	Second line message selection
40022	Third line message selection
40023	Bottom line message selection
40024	Top line data
40025	Top line data 2 (for long BCD & floating point)
40026	Second line data
40027	Second line data 2 (for long BCD & floating point)
40028	Third line data
40029	Third line data 2 (for long BCD & floating point)
40030	Bottom line data
40031	Bottom line data 2 (for long BCD & floating point)

Displaying Binary Numbers

The example shown on the right is similar to the last example. The primary difference is that it uses a Binary number in the top line display. The top line displays data display message #1, which has been configured as a Binary display message. The data for the top line data field is copied from register 40050 to the top line display register (M+4) 40024. The third line displays text message #8. The second and bottom lines display message #140, which has been configured as a blank text message.

```
Parts Left:   56432

Process Step 1
```

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```
00301
──┤├──┬──────┬─────────────┐
      │ #0001│ Put
      │ #0000│ message 1
      │ ADD  │ on top line
      │ 40020│
      ├──────┤
      │ #0140│ Put
      │ #0000│ message 140
      │ ADD  │ on 2nd line
      │ 40021│
      ├──────┤
      │ #0008│ Put
      │ #0000│ message 8
      │ ADD  │ on 3rd line
      │ 40022│
      ├──────┤
      │ #0140│ Put
      │ #0000│ message 140
      │ ADD  │ on bottom
      │ 40023│ line
      ├──────┤
      │ 40050│ Copy data
      │ 40024│ from 40050
      │ BLKM │  into
      │  1   │ top line
      └──────┘ data field
```

Displaying BCD Double Numbers

Long BCD numbers (up to 8 digit) can be displayed by the KM440. This number format is a standard capability for some PLCs, however, Modicon PLCs do not have an easy means of handling BCD double numbers. If the number is in the proper format in the KM440's data registers, it can display the number. Due to the limitations of the Modicon PLCs, this capability will not be commonly implemented.
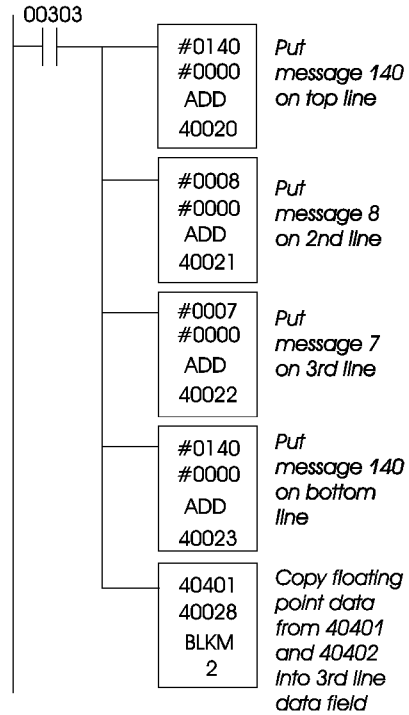
The example shown on the right shows a BCD double number displayed in the bottom line . The bottom line uses data display message #6, which has been configured as a BCD double display message. The data is copied from 40125 and 40126 to the bottom line data registers. The top line displays text message #8. The second line displays message #3. The data for the second line is copied from 40040 to the second line data register. The third line uses message #140 which has been configured as a blank text message.

```
Process Step 1
Tank Level: 1935

Double: 64197324
```

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```
00302
──┤├──┬──────┬─────────────┐
      │ #0008│ Put
      │ #0000│ message 8
      │ ADD  │ on top line
      │ 40020│
      ├──────┤
      │ #0003│ Put
      │ #0000│ message 3
      │ ADD  │ on 2nd line
      │ 40021│
      ├──────┤
      │ #0140│ Put
      │ #0000│ message 140
      │ ADD  │ on 3rd line
      │ 40022│
      ├──────┤
      │ #0006│ Put
      │ #0000│ message 6
      │ ADD  │ on bottom
      │ 40023│ line
      ├──────┤
      │ 40040│ Copy data
      │ 40026│ from 40040
      │ BLKM │ into 2nd line
      │  1   │ data field
      ├──────┤
      │ 40125│ Copy BCD
      │ 40028│ Double data
      │ BLKM │ from 40125
      │  2   │ and 40126
      └──────┘ into third line
               data field
```

Displaying Floating-Point Numbers

Modicon PLCs have a means of handling floating-point numbers and the KM440 has the capability to display them. For the panel to display floating-point numbers, the number has to be in the IEEE 32-bit floating-point format within the PLC registers. The following paragraph describes the process in more detail.

The example shown on the right gets its value from two PLC registers. The third line displays data display message #7, which has been configured as a floating-point display message. Since the data is a floating-point number, it uses two consecutive 16-bit registers containing data in the IEEE 32-bit floating-point format. The two registers have to be looked at together, not individually, for you to be able to make any sense of the data. In this example, the data is copied from 40401 and 40402 to the third line display registers 40028 and 40029. The top and bottom lines display message #140, which has been configured as a blank text message. The second line displays message #8, a text message.

```
00303
 ┤├──┬──┌──────┐
      │  │ #0140│   Put
      │  │ #0000│   message 140
      │  │ ADD  │   on top line
      │  │ 40020│
      │  └──────┘
      │  ┌──────┐
      │  │ #0008│   Put
      │  │ #0000│   message 8
      │  │ ADD  │   on 2nd line
      │  │ 40021│
      │  └──────┘
      │  ┌──────┐
      │  │ #0007│   Put
      │  │ #0000│   message 7
      │  │ ADD  │   on 3rd line
      │  │ 40022│
      │  └──────┘
      │  ┌──────┐
      │  │ #0140│   Put
      │  │ #0000│   message 140
      │  │ ADD  │   on bottom
      │  │ 40023│   line
      │  └──────┘
      │  ┌──────┐
      └──│ 40401│   Copy floating
         │ 40028│   point data
         │ BLKM │   from 40401
         │  2   │   and 40402
         └──────┘   into 3rd line
                    data field
```

```
Process Step 1
Part/HrAvg+1.68E+05
```

OptiMate

Use in a Microprocessor-Based System

OptiMate 400 Series modules can interface a microprocessor-based controller over a serial link. This link will be RS232. The microprocessor acts as the master. It can write data to the panel or read data from the panel.

The KM440 uses the OptiMate Hex protocol for fast and easy communications. The OptiMate Hex protocol is defined in subsequent pages.

Module Address

In a microprocessor system, each panel must have its own unique address. You define this address (between 0 and 30) using the configuration editor. For the OptiMate 400 Series line of modules, the module address is normally 0. The panel will respond to the host only if it is properly addressed.

Communications Protocol

To use an OptiMate panel as a slave device in a microprocessor-based system, the panel must be configured for the OptiMate Hex protocol. The other options that must be set are module address, baud rate, parity and number of stop bits. If parity is set to even or odd, only one stop bit is allowed. Once selected, it must be downloaded to the panel.

Computer-Based Operation

The KM440 protocol for computer-based operations is OptiMate Hex protocol.

All of the basic functionality described for PLC operation is also available to computer or microprocessor-based applications.

The following is a synopsis of the KM440 operation as it relates to computer-based applications. In certain cases, more detail is provided under the same topic for PLC operation. The details of messages involved are covered in the protocol documentation which follows.

Displaying Messages on the LCD Display

Under computer-based operation, the KM440 can be instructed to display predefined messages. Selection of a predefined message simply requires transmitting the proper command (0xA1), the message number, the appropriate line, and initial display data. The data must be in hexadecimal.

To display messages using the "Send data display message", the message text and data must be sent along with the command to send the message (0xA6), the line number, displayed data type and initial display data. The message text should be sent in the ASCII hexadecimal equivalent. The other commands and the data must be sent in hexadecimal.

Placing Numeric Data in the Display

Any message containing caret `^` place holders will allow either the display of numeric data or numeric data entry.

Numeric data for the numeric data field can be transmitted by the host computer. This is done by transmitting the proper command (0xA7), the line number, and the data in a message field. For this message type, all data is transmitted in the hexadecimal format.

KM440 OptiMate Hex Protocol

General format

STX   Module function ftn_data   checksum
address

Where STX   = 0x02
Module address   = 0 to 30
function   = 0xA1 ; Select predefined message display
                      0xA6 ; Send display message
                      0xA7 ; Send data for data display message
                      0xA9 ; Display status request
ftn_data   = data specific to the function
checksum   = 8 bit sum of all characters after address until checksum

Note : Spaces are shown for readability only. There are no spaces between message fields.
0xXX denotes a hex number.

Select Predefined Message

STX   Module 0xA1 line mesg_no data   checksum
Address

where line   = top (0x00), second (0x01), third (0x02) or bottom (0x03) line
mesg_no   = number of the predefined (through the configuration editor) message
               (1 - 160, hex integer, i.e. 33 = 0x21)
data   = 4 bytes. The format depends on the message type selected
     > For an integer type data message, the first two bytes are not used (send as 0's). The
       Third byte is the high 8 bits of the 16 bit integer data. The fourth byte is the low 8 bits.
     > For BCD data type message, the data is sent MSByte through LSByte. For a long BCD
       Data type message, all 4 bytes (8 digits) are used. For a regular BCD message, only
       the last two bytes are used.
     > For floating point data format, data sent in IEEE 32-bit floating point format, MSB first.
     - Used as display data for numeric data display message.
     - Ignored for all other message types.

response
ACK   *if message received and processed OK*
or
NAK   *if any errors in message*

where   ACK   = 0x06
           NAK   = 0x15

Send data display message

STX   Module 0xA6 line_type text data   checksum
Address

where line_type = line number and data type
        bits 0,1 = line number
               Top line   = 0x00
               Second line = 0x01
               Third line   = 0x02
               Bottom line = 0x03
        bits 2,3 =unused
        bits 4,5 = data type
               Binary (integer) = 0x00
               BCD   = 0x01
               BCD Double   = 0x02
               Floating Point = 0x03
        bits 6,7 =unused
text   = 20 characters of ASCII text: message including caret characters for numeric display
       Data placeholders.
     Example: STX 0x02 0xA6 0x23 BCD Double ^^^^^^^   0x43 0x62 0x78 0x59
       0x??(checksum)
     will display "BCD Double 43627859 " on the bottom line of the display.
data   = 4 bytes. The format depends on the message type selected
     > For an integer type data message, the first two bytes are not used (send as 0's). The
       Third byte is the high 8 bits of the 16 bit integer data. The fourth byte is the low 8 bits.
     > For BCD data type message, the data is sent MSByte through LSByte. For a long BCD
       Data type message, all 4 bytes (8 digits) are used. For a regular BCD message, only
       the last two bytes are used, the first two bytes are not used (send as 0's).
     > For floating point data format, data sent in IEEE 32-bit floating point format, MSB first.

response
ACK   *if message received and processed OK*
or

NAK   *if any errors in message*

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Send data for data display message
> STX   Module   0xA7   line   data   checksum
>   Address
>   where line   = top (0x00), second (0x01), third (0x02) or bottom (0x03) line
>   data   = 4 bytes. The format depends on the message type selected
>   > For an integer type data message, the first two bytes are not used (send as 0's). The
>   Third byte is the high 8 bits of the 16 bit integer data. The fourth byte is the low 8 bits.
>   > For BCD data type message, the data is sent MSByte through LSByte. For a long BCD
>   Data type message, all 4 bytes (8 digits) are used. For a regular BCD message, only
>   the last two bytes are used.
>   > For floating point data format, data sent in IEEE 32-bit floating point format, MSB first.

response
ACK   *if message received and processed OK*
 or
NAK   *if any errors in message*

Display status request
> STX   Module   0xA9   checksum
>   Address

response
STX top_line_msg line2_msg line3_msg bot_line_msg   checksum   *if message received and processed OK*
            where top_line_msg = last predefined message selected for top line
                        line2_msg   = last predefined message selected for second line
                        line3_msg   = last predefined message selected for third line
                        bot_line_msg = last predefined message selected for bottom line
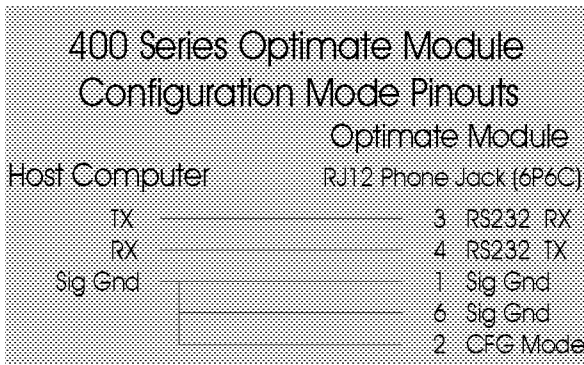
 or
NAK   *if any errors in message*

Set Up and Interconnect

Connection to the System

OptiMate modules are designed for communications connection to system devices. The module can be connected to a computer or PLC over the serial port (RS232).

Connection to a Computer for Configuration

Connection of a 400 Series OptiMate module to a computer for configuration can be accomplished over an RS232 link. RS232 is limited to one OptiMate module to a computer serial port. See the figure below for 400 Series OptiMate module configuration mode pinouts.

```
400 Series Optimate Module
Configuration Mode Pinouts
                          Optimate Module
Host Computer        RJ12 Phone Jack (6P6C)
       TX ————————————————— 3  RS232 RX
       RX ————————————————— 4  RS232 TX
   Sig Gnd ——┬—————————————— 1  Sig Gnd
             └—————————————— 6  Sig Gnd
             ┌—————————————— 2  CFG Mode
```

Refer to manufacturer's documentation for computer serial link connector pinouts.

Configuration cables are available for connection to IBM PC-AT compatible ports.

Run Mode Connection to a Computer or PLC

Connection of a 400 Series OptiMate module to a computer or PLC can be accomplished over an RS232 link. RS232 is limited to one OptiMate module to one computer serial port. Since PLCs are slave devices, the RS232 link for a PLC is limited to one OptiMate module. See the figure on the right for 400 Series OptiMate Module run mode pinouts.

Refer to manufacturer's documentation for PLC or computer serial link connector pinouts.

Standard cables are available for connection to several different PLCs as well as to IBM PC-AT compatible ports.

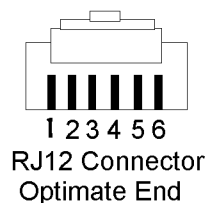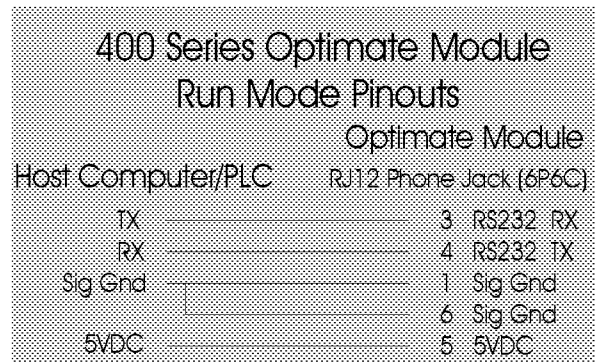The figure on the right shows the RJ12 connector pinouts for connection to an OptiMate 400 series module.

Power

The KM440 Setpoint/Display Panel will operate only on a DC voltage of *5VDC*. Steady state current is listed on the specification page.

The KM440 panel can draw power from its communications cable if the host device has a 5VDC connection on its comm port.

The KM440 panel can be powered from a 5VDC adapter for panel configuration or connection to PLCs or microprocessor-based devices that do not have a 5VDC connection in their communication ports. A description of the DC power connector is listed on the specification page.

> **Note:** Only use an Optimation approved 5VDC power supply or equivalent that contains a center negative DC power jack.

There is a very brief (0.1 - 1 millisecond) power on surge up to 0.44amps. This is typical of nearly any type of electronic equipment and is due to the initial charging of power capacitors. This surge is not normally a problem for a commercial power supply.

```
400 Series Optimate Module
Run Mode Pinouts
                          Optimate Module
Host Computer/PLC    RJ12 Phone Jack (6P6C)
       TX ————————————————— 3  RS232 RX
       RX ————————————————— 4  RS232 TX
   Sig Gnd ——┬—————————————— 1  Sig Gnd
             └—————————————— 6  Sig Gnd
     5VDC ————————————————— 5  5VDC
```

```
   ┌─┐
┌──┴─┴──┐
│ ┃┃┃┃┃┃│
 1 2 3 4 5 6
RJ12 Connector
Optimate End
```

Configuration

Configuration Selections

OptiMate panels can be configured for the specific application by using the OM-WINEDIT Configuration Editor. The OM-WINEDIT Editor runs on any IBM PC compatible computer with Windows. It allows the user to select the exact functionality to meet application requirements.

For the KM440 module, the following are important configuration parameters. Further configuration details are covered in the OM-WINEDIT help screens.

Microprocessor-Based Systems

Decision	Selection
Single/Multi Module	Choose Single module even if the system will contain several modules. The Multi-module selection applies only to systems using a communications master. In computer-based systems, each module is configured independently.
Configuration starting point	First-time configuration, start with defaults for module. Subsequent configurations can utilize disk files you create.
PLC Type	Select OptiMate Hex
Address	Each module must have a unique address. Normally 0 for the KM440.
Protocol	Select appropriate baud rate, 8 data bits, #stop bits & parity. Note that if even or odd parity selected, only 1 stop bit is available.
Messages	Define messages as required for application

Single Module PLC-Based Systems

Decision	Selection
Single/ Multi Module	Choose single panel configuration
Configuration starting point	First-time configuration start with defaults for the panel. Subsequent configurations can utilize disk files you create
PLC Type	Select appropriate PLC type
Protocol	Select appropriate baud rate, # data bits, # stop bits & parity. Note that if 8 data bits and even or odd parity selected, only 1 stop bit is available
Messages	Define messages as required for application

Multi-Module PLC Applications (Uses OM-9001 Communications Master)

Not Applicable with the 400 Series Panels

Note: Configuration must be downloaded from an IBM PC compatible computer to each module. This is done over the serial link. When configuring the KM440, always remember to use the programming cable that connects the panel to an IBM PC compatible computer. Also, always insert the programming cable into the panel to place it into configuration mode. When you are finished downloading, wait a few seconds before removing the programming cable. This will return the panel to PLC run mode. Communication cables are available from Optimation.

Configuration using a Keyence PLC

The KM440 requires that certain parameters be set in order for it to communicate with a Keyence PLC. The parameters are PLC type, protocol, baud rate, parity, stop bits and base register address.

If you are using the KV10, KV16, KV24, KV40 or the KV80 PLCs the KM440 should always be set to the following:

KM440 Communication Parameters	
KV10, KV16, KV24, KV4, KV80, KV300, KV-L2	
Baud rate	9600
Parity	even
Stop Bits	1
Data Bits	8

Communications with a KV300 CPU can be accomplished by two means:
(1) direct connection to the communications port on the CPU
(2) connecting the panel to a KV-L2 Serial Interface Module

Note: If a KV-L2 Serial Interface Module is connected in the PLC system, you must use it to connect to the KM440. If you try to connect the panel to the KV300 CPU's communcations port, the panel will not communicate because the CPU will not recognize the protocol.

Direct Connection to the CPU
If you are connected to the KV300 through the CPU communications port, configure the KM440 with the parameters shown in the table above.
The KM440 uses the KV mode protocol to communicate with the PLC, therefore, the port that the panel is communicating with should be set for KV mode also.

Communications through the KV-L2
If you are using a KV-L2, the following dip switch paramenters apply:

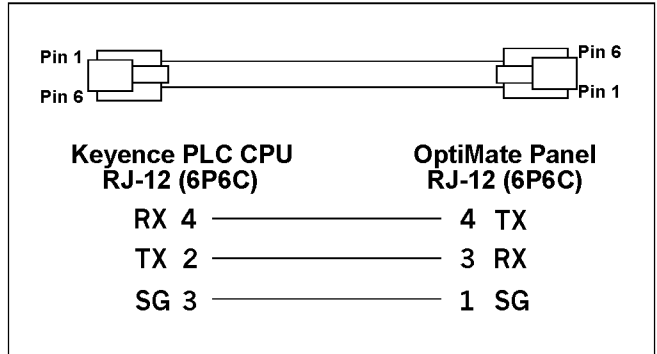| Port 1		Port 2	
A1	A2	A3	A3
OFF	OFF	OFF	OFF

The dip switch settings shown above are dependent on the port that the KM440 is connected to. If the panel is connected to Port 1, then switches A1 and A2 should be OFF. If you have another device on Port 2, then the switches for Port 2 should be set to the proper protocol for that device.
The KM440 uses the KV Mode protocol to communicate with Keyence PLCs. Regardless of the "B" dip switch settings, the port that the panel is connected to will automatically default to the communication parameters shown in the table above.
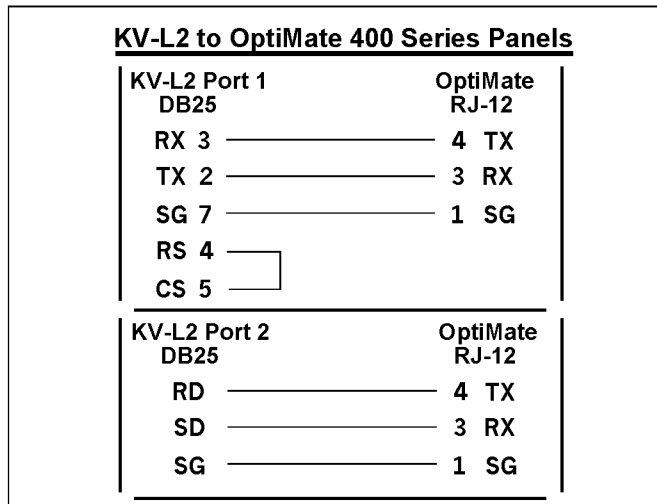Note: If using Port 2, ensure that the port switch is set for RS232.

Refer to the chapter on the KV-L2 Serial Interface Module in the Keyence User's Manual for more details.

The figure below shows the pinouts to connect a KM440 to a Keyence PLC CPU. This cable is available from Optimation.


```
Pin 1                                          Pin 6
Pin 6                                          Pin 1

  Keyence PLC CPU              OptiMate Panel
    RJ-12 (6P6C)                RJ-12 (6P6C)
      RX  4 ————————————————— 4  TX
      TX  2 ————————————————— 3  RX
      SG  3 ————————————————— 1  SG
```

The figure below shows the pinouts to connect a KM440 to a KV-L2 Serial Interface Module. The pinouts shown are for RS232.

```
        KV-L2 to OptiMate 400 Series Panels
 KV-L2 Port 1                    OptiMate
   DB25                           RJ-12
     RX  3 ————————————————— 4  TX
     TX  2 ————————————————— 3  RX
     SG  7 ————————————————— 1  SG
     RS  4 ┐
     CS  5 ┘

 KV-L2 Port 2                    OptiMate
   DB25                           RJ-12
     RD    ————————————————— 4  TX
     SD    ————————————————— 3  RX
     SG    ————————————————— 1  SG
```

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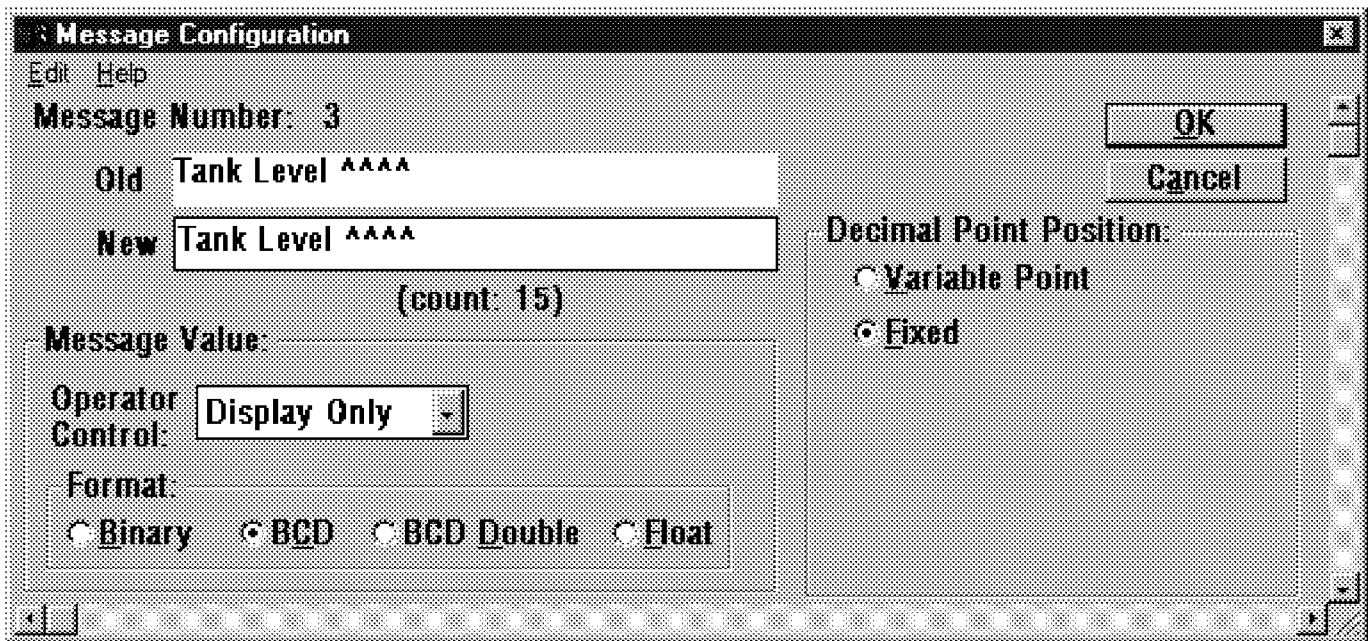   **www. optimate.com**

Creating Messages

The figure on right the illustrates the process of creating messages for your program to use. The first step involves simply using a message template to define, on paper, each of the messages. We suggest copying the template page and using it to define all of your messages.

The next step is to use the OM-WINEDIT configuration editor to enter the messages as defined. Remember to use carets wherever variable data is to be used. The OM-WINEDIT editor will guide you through other definable parameters, including data type, message type, etcetera, as shown below.

Message #	Text (20Characters Max.)																			
1	E	n	t	e	r		S	e	t	p	o	i	n	t	:		^	^	^	^
2	P	r	o	d	u	c	t		R	a	t	e	:		^	^	^	.	^	
3	S	h	i	f	t		T	a	r	g	e	t	:		^	^	^	.	^	

Example Message Definitions

Message Configuration

Edit Help

Message Number: 3

Old Tank Level ^^^^

New Tank Level ^^^^

(count: 15)

Message Value:

Operator Control: Display Only

Format:
○ Binary ◉ BCD ○ BCD Double ○ Float

Decimal Point Position:
○ Variable Point
◉ Fixed

OK

Cancel

Message Definition Template

Message #	Text (20Characters Max.)																			

Message Definition Template

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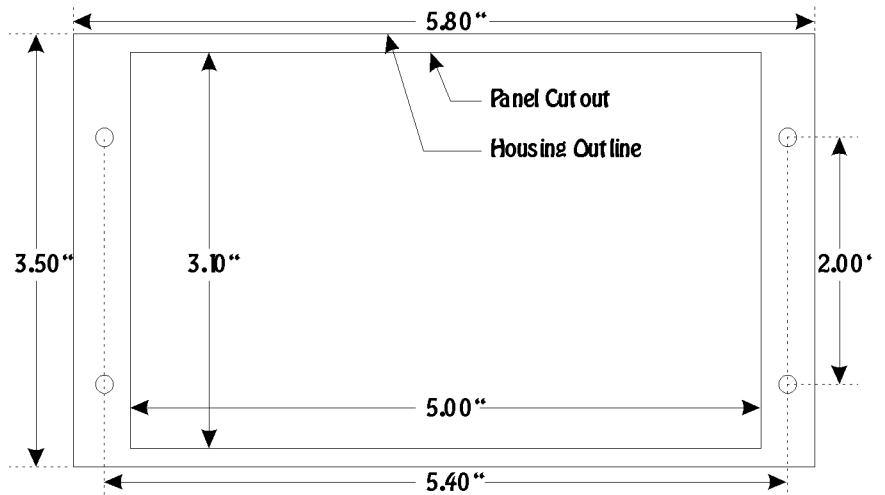Optimal Automation for Industry   **(256)883-3050**   **KM440**   **page-21**
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Specifications

Physical

- Recessed Mount Housing: 6.00"L x 3.50"H x 1.25"D
- Cutout size: 3.20"H x 5.10"L
- Panel Fasteners: Four, 6x32 threaded studs, shown at right (on ends, symmetrical about center line)
- Weight : 10 ounces
- Colors : Dark gray housing with dark gray panel.
- LCD Display: 4 line X 20 character STN with LED backlight
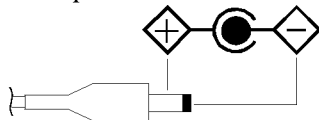 character size: 4.75mm high X 2.95mm wide

Electrical

- Power: 5VDC @ 0.75Watts
        150mA @ 5VDC
- Power On Surge (see figure below)
        0.44A for 1 millisecond max

Power on Surge
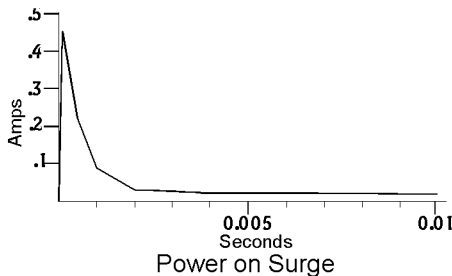
- Power connector :
    DC power plug, center negative (see figure below) DC power plug is necessary for panel configuration and for connection to PLCs that do not have a 5VDC connection in their communication ports.

    Always use an Optimation approved 5VDC power supply with a *center negative plug.*

Communications

- RS232
- 4800 to 19200 baud
- Compatible with major PLC protocols
- Microprocessor compatible OptiMate Hex protocol
- 6 pin RJ12 phone jack type connector

Panel Mounting Dimensions

Communications Failure Operation

Should the panel (when not selected for configuration) ever fail to communicate successfully for a period of 12 seconds, the LCD display will flash "Host Comm Fail !" on the second line.

Environmental

- Enclosure   - NEMA 4 (when properly installed)
- Temperature   - 0 to 50 C
- Humidity   - 95% Non-condensing

Message Types (160 user-defined messages available)

- General Text message
- Data display message (one data value per line)

Numeric Types & Values

- Integer
- Fixed Point
- BCD (Values between 0 & 9999; with appropriate decimal placement)
- BCD Double (Values between 0 & 99999999 with appropriate decimal placement)
- Binary (Values between 0 & 65535 with appropriate decimal placement)
- Floating Point (Values between -3.402823E+38 to +3.402823E+38 in the format of ±X.XXE±XX)

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