

Technical Brief:

## Using the RMC Discrete I/O Command Mode



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### Abstract

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The RMC-DI/O is capable of sophisticated motion control using small and inexpensive Programmable Controllers with simple discrete I/O. An RMC with a DI/O communication interface is capable of three discrete I/O interfaces: Command Mode, Input to Event Mode, and Parallel Position Mode. Of these three communication modes, Command Mode is the most flexible; it allows changing parameters and retrieving positions, speeds, errors and other status information from the motion controller using simple discrete I/O.

This technical brief will compare the three discrete I/O interfaces of the RMC100 series product-line, describe implementing Command Mode, and finally provide a sample application using Command Mode.

## D/I/O Communication Mode Comparison

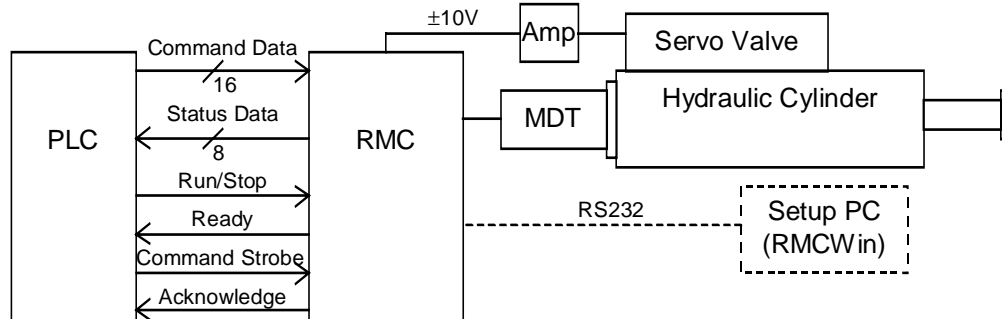
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The following chart lists the advantages and disadvantages of each communication mode. Each word or phrase in bold print appears in RMCWin's online help index.

<u>Interface Mode</u>	<u>Advantages</u>	<u>Disadvantages</u>
<b>Command Mode</b>	<ul style="list-style-type: none"><li>• Any RMC command can be issued</li><li>• Any status information can be retrieved (including <b>Actual Position, Actual Speed, Drive, Error Bits</b>, and other <b>Status Bits</b>)</li></ul>	<ul style="list-style-type: none"><li>• Requires a PLC</li><li>• Requires 2 PLC scans per command</li><li>• Gives commands to only one axis per command cycle</li></ul>
<b>Parallel Event Mode</b>	<ul style="list-style-type: none"><li>• Up to four axes may be commanded at once</li><li>• PLC or thumb-wheel switches may be used</li><li>• Allows use of Event Control feature</li></ul>	<ul style="list-style-type: none"><li>• Requires parallel inputs</li><li>• Returns only a <b>Halted Bit</b>—indicating an error has occurred—and an <b>In Position Bit</b> per axis</li><li>• Sequence must be pre-programmed in Event Control</li></ul>
<b>Input to Event Mode</b>	<ul style="list-style-type: none"><li>• Does not require a PLC</li><li>• Multiple axes may be given commands from a single input</li></ul>	<ul style="list-style-type: none"><li>• Returns only a <b>Halted Bit</b>—indicating an error has occurred—and an <b>In Position Bit</b> per axis</li><li>• Issues only <b>Start Event</b> commands</li></ul>
<b>Parallel Position Mode</b>	<ul style="list-style-type: none"><li>• Any position can be moved to in a single PLC scan</li><li>• Any open loop drive can be triggered in a single PLC scan</li><li>• Multiple profiles can be selected for any move</li></ul>	<ul style="list-style-type: none"><li>• Requires a PLC</li><li>• Returns only a <b>Halted Bit</b>—indicating an error has occurred—and an <b>In Position Bit</b> per axis</li><li>• Issues only <b>Go</b> and <b>Open Loop</b> commands</li><li>• Gives commands to only one axis per scan</li></ul>

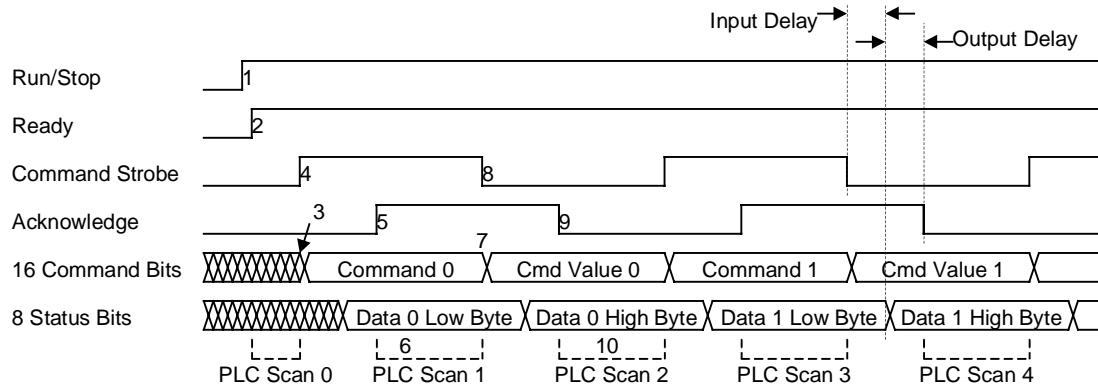
## Implementation

The following diagram shows the electrical control connections of a single-axis hydraulic system using RMC-DI/O in Command Mode (the PC and its RS232 cable are needed only during setup):



This document discusses only the connections between the Programmable Controller and the RMC. For details on the transducer and drive wiring, look up **Wiring Notes** in the RMCWin index.

The RMC accepts commands of up to 32 bits and returns 16-bit data words. However, because it has only half that number of inputs and outputs, an extra input and output on the RMC are used to strobe half of the data at a time. The following timing chart and accompanying list of steps illustrate the sequencing of Command Mode:



This process begins assuming that **Run/Stop** and **Command Strobe** are set low by the PLC. In the steps below inputs and outputs are labeled as “CPU” or “DI/O”. These labels refer to the CPU and DI/O modules of the RMC product, and not of the PLC:

1. Raise the **Run/Stop** (CPU input 0) line on the RMC. This is done on startup of the PLC.
2. Wait for the **Ready** (CPU output 0) line on the RMC to go high in response to the **Run/Stop** line. This begins the first PLC scan.
3. Place the 16-bit Command on the RMC’s **Command Bits** (DI/O inputs 0-15).
4. Raise the **Command Strobe** (CPU input 1) line on the RMC. This ends the first PLC scan.

5. Wait for the **Acknowledge** (CPU output 1) line on the RMC to go high. This begins the next PLC scan.
6. Read the low byte of the data requested by the command from the **Status Bits** (DI/O outputs 0-7) on the RMC.
7. Place the 16-bit Command Value on the RMC's **Command Bits**.
8. Lower the **Command Strobe** on the RMC. Then ends the next PLC scan.
9. Wait for the **Acknowledge** line on the RMC to go low. This begins the next PLC scan.
10. Read the high byte of the data requested by the command from the **Status Bits** on the RMC.

The process then repeats from step 3 with the next command.

In the above timing chart, notice two time durations are marked: **Input Delay** and **Output Delay**. These intervals can be set using RMCWin to any value between zero and twenty milliseconds.

**Input Delay** indicates how long the RMC waits after seeing the **Command Strobe** toggle before reading the command data. Change this setting to account for the PLC outputs' and the RMC inputs' settling time.

**Output Delay** indicates how long the RMC waits after writing the requested data before toggling the **Acknowledge** line. Change this setting to account for the RMC outputs' and the PLC inputs' settling time.

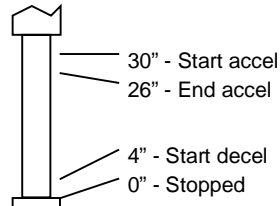
To configure Command mode, do the following:

- Connect the serial port to the module being configured.
- On the **Tools** menu, click **Module Configuration**.
- In the **Slots** list, click the **Communication DI/O** item, and then click **Slot options**.
- In the **DI/O mode** list, select **Command** mode.
- If you need to invert any inputs or outputs to match your hardware, select the appropriate check boxes in the **Invert inputs** and **Invert outputs** areas.
- If you wish to use the Communication DI/O counter feature, click either **Edge** or **Quadrature** under **Counter Type**. See **Using Counters** in the RMCWin online help for more details.
- Click **Mode options**.
- Enter the **Input delay** and **Output delay** parameters as described above.
- Click **OK**.
- Click **Update RMC**.
- The **Update Module Configuration** dialog box will be displayed to indicate the progress. If the module could not be reset manually, you may be prompted to reset the module yourself.

## Sample Application

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In this application, a single hydraulic cylinder will be moved over a 30 in stroke. It will extend at a rate of 5 in/sec and retract at a rate of 10 in/sec. At each end of the move, there will be a four-inch acceleration/deceleration zone:



The operator display will include the current actual position.

This application can easily be done using an **RMC100-M1-DI/O** module using Command Mode. The simplest way to implement this application is to begin by loading the profile table with the two motion profiles used:

The screenshot shows a window titled "Motion Profiles ...". It has a menu bar with "File", "Edit", "Online", and "Help". Below the menu bar is a toolbar with various icons. The main area contains a table with two columns labeled "0" and "1". The rows are "Parameter", "Mode", "Accel", "Decel", and "Speed".

Parameter	0	1
Mode	0x0002	0x0002
Accel	4000	4000
Decel	4000	4000
Speed	5000	10000

At the bottom of the window, there is a status bar that says "For help, press F1".

The '2' in the Mode field indicates that the acceleration and deceleration are given as distances. For details on the motion profile table, look up **Profiles** in the RMCWin online help.

This profile table and the tuning parameters can either be stored in the RMC's FLASH memory, or stored in the Programmable Controller and downloaded using the Set Parameter commands. We'll assume they are stored in the FLASH. See the **Set Profile** and **Set Parameter** topics in the RMCWin online help for details on setting these values from the Programmable Controller.

## Reference

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Throughout this technical note, references are made to RMCWin online help index entries. To obtain the RMCWin software package, contact Delta Computer System's web site ([www.deltacompsys.com](http://www.deltacompsys.com)).