Technical Brief:

Using the RMC Discrete I/O Parallel Event Mode

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Abstract

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 four discrete I/O interfaces: Command Mode, Input to Event Mode, Parallel Position Mode, and Parallel Event Mode. Of these communication modes, Parallel Event mode is the best fit when the motion can be pre-programmed using the RMC's Event Control feature and parallel inputs can be provided to the RMC—such as through a PLC or thumb-wheel switch.

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

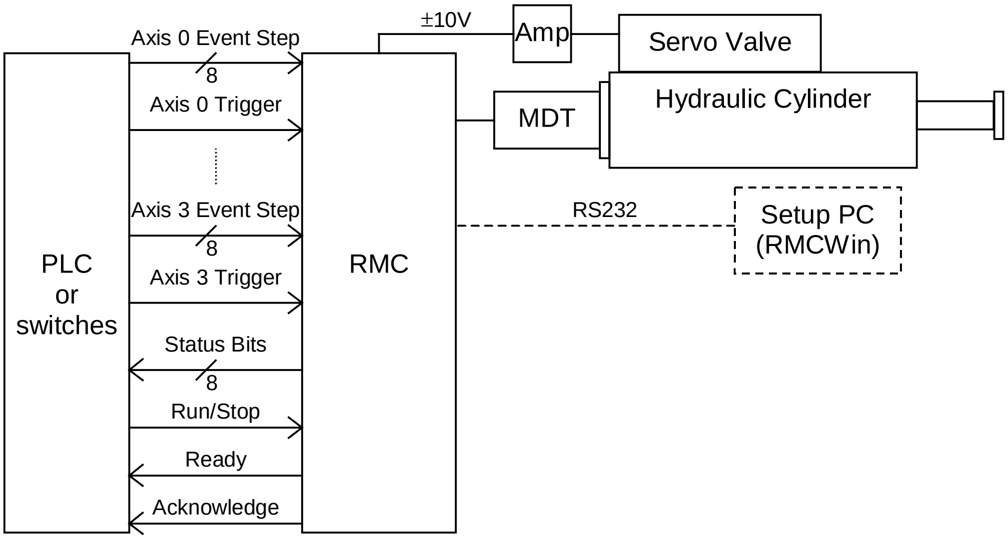
DI/O Communication Mode Comparison

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.

Interface Mode	Advantages	Disadvantages
Parallel Event Mode	• Up to four axes may be commanded at once • PLC or thumb-wheel switches may be used • Allows use of Event Control feature	• Requires parallel inputs • Returns only a **Halted Bit**—indicating an error has occurred—and an **In Position Bit** per axis • Sequence must be pre-programmed in Event Control
Parallel Position Mode	• Any position can be moved to in a single PLC scan • Any open loop drive can be triggered in a single PLC scan • Multiple profiles can be selected for any move	• Requires a PLC • Returns only a **Halted Bit**—indicating an error has occurred—and an **In Position Bit** per axis • Issues only **Go** and **Open Loop** commands • Gives commands to only one axis per scan • Is limited in number of speed/acceleration profiles
Command Mode	• Any RMC command can be issued • Any status information can be retrieved (including **Actual Position**, **Actual Speed**, **Drive**, **Error Bits**, and other **Status Bits**)	• Requires a PLC • Requires 2 PLC scans per command • Gives commands to only one axis per command cycle
Input to Event Mode	• Does not require a PLC • Multiple axes may be given commands from a single input • Allows use of Event Control feature	• Returns only a **Halted Bit**—indicating an error has occurred—and an **In Position Bit** per axis • Issues only **Start Event** commands

Implementation

The following diagram shows the electrical control connections of a single-axis hydraulic system using RMC-DI/O in Parallel Event 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 following points describe the operation of Parallel Event mode:

- Parallel Event mode uses the following digital inputs and outputs. The following table is intended to match input and output number with the names associated with each. Their uses will be described below.

CPU DI/O:

Input 0	Run/Stop
Input 1	Unused
Output 0	Ready
Output 1	Acknowledge

Communication DI/O:

Inputs 0-7	Axis 0 Event Step
Inputs 8-15	Axis 1 Event Step
Input 16	Axis 0 Trigger
Input 17	Axis 1 Trigger
Outputs 0-7	Status Bits

Sensor DI/O (required only if more than two axes are used):

Inputs 0-7	Axis 2 Event Step
Inputs 8-15	Axis 3 Event Step
Input 16	Axis 2 Trigger
Input 17	Axis 3 Trigger
Outputs 0-7	Unused

- Parameters and tables used by the RMC are configured using the RMCWin software and stored in the RMC **FLASH memory**.
- All axes are initialized by raising the **Run/Stop** (CPU input 0) line on the RMC, and all axes are immediately stopped by the falling of the **Run/Stop** line on the RMC. Therefore, an emergency-stop button often controls the **Run/Stop** input.
- The **Ready** (CPU output 0) line matches the **Run/Stop** input line to give feedback to the controlling system that the RMC is ready to take commands.
- When the **Run/Stop** line is set, the **Trigger** inputs for all axes are monitored. When the **Trigger** switches state (either from on to off or vice versa), then all nine inputs for the axis (**Trigger** plus **Event Step**) are monitored; if they remain stable for a user-configured duration (between 2 and 20 milliseconds) a new command is issued to the RMC.
- When a command is received, the Event Step number given in binary on that axis's eight **Event Step** inputs is read and the axis begins an event sequence with that event step.
- Each time the **Run/Stop** or a new command is executed on one or more axes, the **Acknowledge** (CPU output 0) line toggles.

  It is important to wait for the **Acknowledge** line to toggle before using the **Status Bits**; otherwise, the bits may reflect the status of a previous move. For example, suppose the **In Position** bit is set from a previously completed move. If the **Acknowledge** line has not toggled before the PLC uses the **In Position** bit, the newly commanded move will look as though it completed immediately.
- The eight **Status** (DI/O outputs 0-7) outputs are used for the following:

DI/O Output #	2-4 Axis RMC's	5-8 Axis RMC's
0	Axis 0 In Position	Axis 0 In Position
1	Axis 1 In Position	Axis 1 In Position
2	Axis 2 In Position	Axis 2 In Position
3	Axis 3 In Position	Axis 3 In Position
4	Axis 0 Stop on Error	Axis 4 In Position
5	Axis 1 Stop on Error	Axis 5 In Position
6	Axis 2 Stop on Error	Axis 6 In Position
7	Axis 3 Stop on Error	Axis 7 In Position

  Using the RMCWin software, these outputs may be marked to be user-controlled instead of being used for the above default assignments. User-controlled outputs are set and cleared from the **Event Step table**.

The following general steps must be taken to set up a system using Parallel Event mode:

1. **Design the System**

   Designing the system begins with selecting the appropriate method of communication. First, decide whether one of the RMC's field bus solutions fits your application, and if you decide to use digital I/O, then decide which of the communication modes fits your application.

If you decide to use digital I/O using Parallel Event mode, then you must design the wiring of the system and the event step table.

2. **Program the Event Step Table**

   Programming the Event Step table is described in the RMCWin online help. The event step table will hold the majority of the controlling logic. Be sure to save your Event Step table both in the RMC FLASH memory, and also on disk from RMCWin.

3. **Configure the RMC Communication**

   The following steps are required to configure the Communication DI/O from RMCWin:

   - Connect the serial port to the module being configured.
   - On the **Tools** menu, click **Module configuration**.
   - In the **Slots** list, select the **Communication DI/O** item, and then click **Slot options**.
   - In the **DI/O mode** list, click **Parallel Event** 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.
   - Click **Mode options**.
   - In the **Input Filter** box, enter the number of milliseconds you wish to have the RMC wait for the inputs to settle. You may need to change this more than once if you are not sure how long you should delay. If you don't need the speed, it may be wise to be conservative and select 20ms.
   - If desired, you may select to control any of the outputs by selecting the appropriate **User-controlled outputs** check boxes.
   - 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.

4. **Wire, Test, and Tune the System**

   Wiring and testing should follow your design. Tuning the system is described in the RMCWin online help. Be sure to save your tuning parameters both in the RMC FLASH memory, and also on disk from RMCWin.

Sample Application

The customer needs a single axis to move between two positions. The user will select one of ten different positions to which the cylinder will extend and then retract back to a home position. The home position will be defined at 0”. The ten extend positions are required by different products that may be produced and are known ahead of time (half-inch steps between 4” and 9.5”). The user wishes to use a thumb-wheel to select the set (sequence) and a button to initiate the motion.

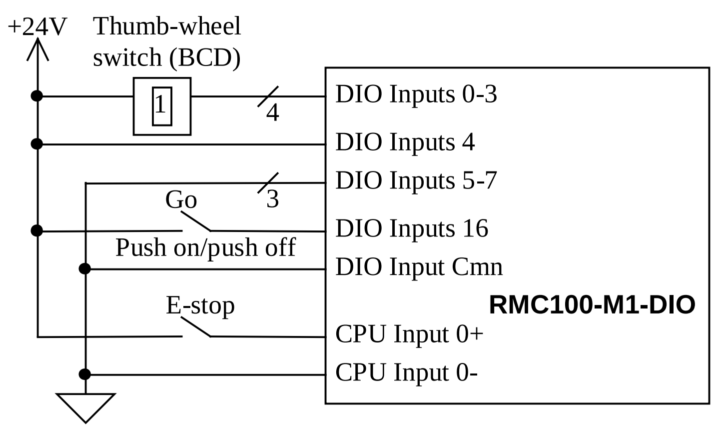
We will assume that the customer decided 5 inches per second was the maximum safe extension speed, and that 10 inches per second was the maximum safe retracting speed.

1. Design the System

The RMC controls based on the transducer or encoder counts received. However, counts rarely correspond to meaningful engineering units. Therefore, the RMC allows the user to convert counts into meaningful position units by using **Scale** and **Offset** parameters. Refer to RMCWin’s online documentation for details. In this application, the position units used will be thousandths of an inch. Therefore, speeds will be given in thousandths of an inch per second.

Because only one axis of MDT feedback is used, the smallest RMC module available—an **RMC100-M1-DI/O** module—will be used.

Using Parallel Event mode, the thumb-wheel can be used to trigger an event sequence and will select the starting event step number. The following wiring diagram is used:



Notice that the eight Event Step number bits are wired to hold the following values:

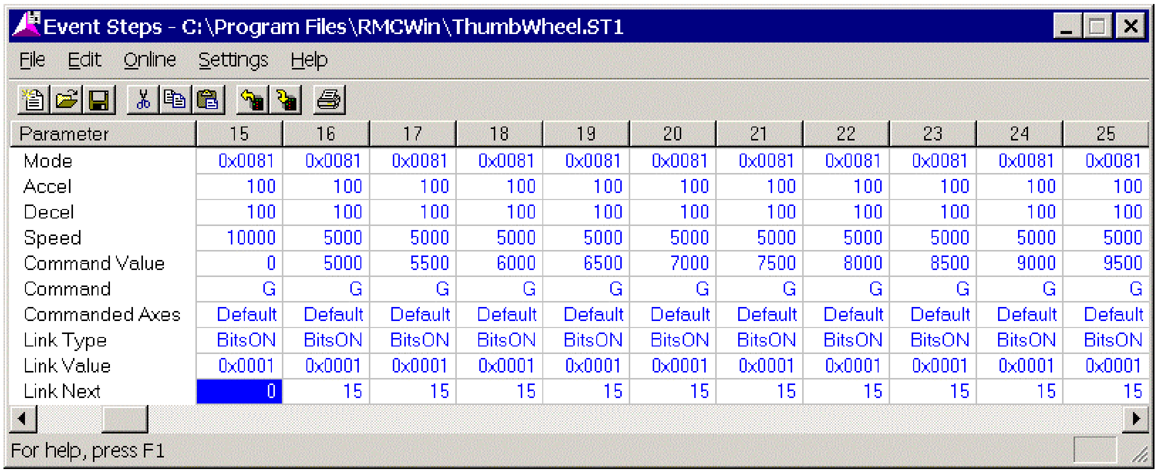
Bit #:	7	6	5	4	3	2	1	0
Value:	0	0	0	1	X	X	X	X

X = Set by thumb-switch

When this binary number is converted to decimal, the selectable step numbers range is 16-25. The reason bit 4 is tied high is to avoid using event step 0, without which the range would be 0-15. Event step 0 is used—by convention—as a step which does nothing.

2. Program the Event Step table

We will use the steps selected by the thumb-wheel (16-25) to perform the first move. Each of those ten steps will wait until the axis is in position, and then skip to step 15, which will retract back to the home position, and then return to step 0 when in position. The following screen shot demonstrates this table:



Parameter	15	16	17	18	19	20	21	22	23	24	25
Mode	0x0081	0x0081	0x0081	0x0081	0x0081	0x0081	0x0081	0x0081	0x0081	0x0081	0x0081
Accel	100	100	100	100	100	100	100	100	100	100	100
Decel	100	100	100	100	100	100	100	100	100	100	100
Speed	10000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000
Command Value	0	5000	5500	6000	6500	7000	7500	8000	8500	9000	9500
Command	G	G	G	G	G	G	G	G	G	G	G
Commanded Axes	Default	Default	Default	Default	Default	Default	Default	Default	Default	Default	Default
Link Type	BitsON	BitsON	BitsON	BitsON	BitsON	BitsON	BitsON	BitsON	BitsON	BitsON	BitsON
Link Value	0x0001	0x0001	0x0001	0x0001	0x0001	0x0001	0x0001	0x0001	0x0001	0x0001	0x0001
Link Next	0	15	15	15	15	15	15	15	15	15	15

This table must be downloaded to the module, and then stored in the RMC's FLASH memory.

3. Configure the RMC Communication

The steps required for this procedure are described in the **Implementation** section of this Technical Brief. You should not need to invert any inputs or outputs, nor should you need to select any additional user-controlled outputs.

4. Wire, Test, and Tune the System

The system should be wired as described in the design above. Test the functionality of the final system, and finally tune the system as described in the RMCWin online help.

Reference

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).

