



**QUARTERLY NEWSLETTER
PUBLISHED BY
GALIL MOTION CONTROL**

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“ The mission of Galil’s experienced Applications Department is to provide prompt and accurate technical assistance to help OEMs successfully deliver their products to market. ”

GALIL SUPPORT TEAM



SERVO TRENDS

OCTOBER 2009, VOL. 24 NO. 4



PVT mode added to Galil’s DMC-40x0 Accelera Controller

PVT Mode Added to Accelera Controllers

Galil has recently added the PVT (Position-Velocity-Time) mode of motion to its Accelera controllers. In the PVT mode, the user can specify an ending velocity in addition to a delta position and delta time. This allows for much smoother motion while moving through specified points as compared to the existing CM Contour Mode which only specifies the delta time and position. The PVT mode uses a 3rd order polynomial to interpolate between position points. This results in no discontinuities in velocity and creates smooth motion.

The new PVT mode is a standard feature for Galil’s Accelera controllers: the DMC-40x0 (Firmware Revision 1.0c) Ethernet controller and DMC-18x6 (Firmware Revision 1.0d) PCI controller. It is available as an option for other controllers.

For more information on the new PVT mode, please read the technical article in this issue of ServoTrends, or download the Accelera Command reference at <http://www.galilmc.com/support/manuals.php> ■

RIO-4712x Pocket PLC Now Reads Position Sensors

The RIO-47122 Pocket PLC now accepts inputs from two position sensors such as quadrature encoders, SSI encoders and BiSS encoders. The new RIO options are listed on page 2. Additional position channels and I/O options are available upon request. ➤(cont. pg 2)



RIO-4712x Pocket PLC

Quadrature Encoders

Allows use of two encoders
(Channels A+,A-, B+,B-, Index+, Index-)
Part Number: RIO-4712x-QUAD

SSI Encoders

Allows use of two (2) SSI encoders
Part Number: RIO-4712x-SSI

BiSS Encoders

Allows use of two (2) BiSS encoders
Part Number: RIO-4712x-BISS

The new RIO encoder option accepts the position sensor signals at frequencies up to 10 MHz allowing for high speed counting. The Galil command TP (Tell Position) and DP (Define Position) are used to read and define the position, respectively.

The charge for the position feedback option is \$75 in single quantity and \$35 in quantities of 100.

Other features of the RIO include analog and digital I/O, Ethernet and RS232 ports, RISC processor for fast I/O handling, PID process control loops, timers, data logging, ability to send email alerts, Power-over-Ethernet, and more. Custom options are also available.

Please consult Galil at 1-800-377-6329 or see <http://www.galilmc.com/products/rio-47xxx.php> for more information. ■



Read Position Sensors with New Option for RIO Pocket PLC



Galil Adds PVT Mode for Smooth Motion

By Jason Rhodewalt, Application Engineer

Galil recently enhanced the firmware of the DMC-40x0 and DMC-18x6 Accelera controllers by adding in true PVT (Position-Velocity-Time) functionality. In the PVT mode, the user can specify an ending velocity in addition to a delta position and delta time. This allows for much smoother motion while moving through specified points as compared to the existing Contour Mode (CM) which only specifies the delta time and position.

In the Contour Mode, linear interpolation is used between the position points resulting in constant velocity and infinite acceleration between points. This can lead to “ticking” during motion as the velocity instantly changes between contour points. The PVT mode uses a 3rd order polynomial to interpolate between position points as opposed to linear interpolation. This results in no discontinuities in velocity and creates smooth motion.

Figures 1 and 2 below show the velocity profiles between contour and PVT mode, given the same position end points and delta time.

Figure 1: Velocity Profile in Contour Mode

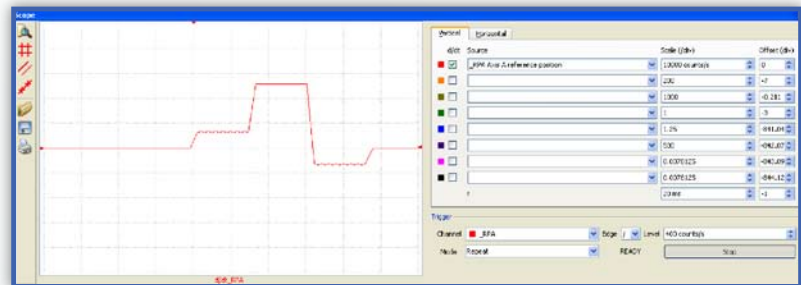
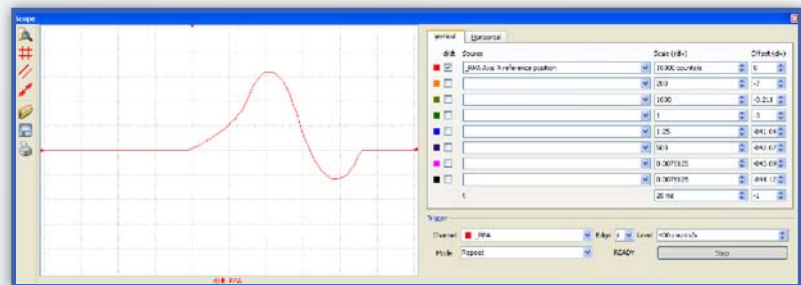


Figure 2: Velocity Profile in PVT Mode



In the example above, it is important to note that even though the velocity and position profile between points are different, the ending positions for each segment are the same between contour mode and PVT mode. ➤(cont. pg 3)

This means that in systems where end points are critical, but path between points are not, PVT mode can easily replace contour mode for smoother motion. Galil has also developed a software program that can help convert existing contour programs to PVT programs. Please consult a Galil Applications Engineer for details.

Galil's implementation of PVT mode includes two new commands; PV and BT. The PV command follows the format PV_n=p,v,t where n is the axis, p is the relative position, v is the velocity to achieve at the end of the segment, and t is the delta time. Each axis on the controller has a 255 segment buffer for PVT points. The BT command is used to coordinate the start of PVT mode across multiple axes. For full command details please refer to the DMC-40x0 Command Reference.

Example: Consider a two-axis stage for moving a silicon wafer along a specific path for cleaning. In this application it is critical that the wafer be at certain points at specific times, but the path between points is not critical. No jerky motion is allowed as it may displace the wafer. This system is a good candidate for PVT motion.

The required points for the stage are below in **Table 1**. Notice each segment is required to take 512ms, except the last one which must complete in 200ms.

Table 1: Stage Requirements

Distance (encoder counts)		Time (ms)	
X Axis	Y Axis	X Axis	Y Axis
5000	5000	512	512
5000	-5000	512	512
0	5000	512	512
5000	0	200	200

Given the data in **Table 1**, the user must now select velocities for each PVT segment. Since the first two segments in the X axis are the same, it is reasonable to select a non-zero value for the ending velocity of segment one. At the end of each of the subsequent segments, the X axis needs to stop so we set the velocities to zero. Note that these are ending velocities; the velocity between points will be non-zero and will follow a second order polynomial path.

The Y axis changes direction at the end of each segment and as a result we will choose to set the ending velocities to zero.

By combining the data from **Table 1** and **Table 2** we can form a DMC program that will follow our profile. The DMC program can be seen in **Figure 3**. Graphing out the full X vs. Y profile in **Figure 4** we can see that each end point specified is achieved in the allotted time. **Figure 5** shows the X axis velocity (in red) along with the Y axis velocity (in orange). Both velocity profiles are much smoother than a similar profile constructed in contour mode.

Table 2: Ending Velocities

Velocity At End Point (counts/second)	
X Axis	Y Axis
15000	0
0	0
0	0
0	0

Figure 3: DMC Program

```

0 PUA=5000,15000,512
1 PUA=5000,0,512
2 PUA=0,0,512
3 PUA=5000,0,200
4 PUA=0,0,0
5 PUB=5000,0,512
6 PUB=-5000,0,512
7 PUB=5000,0,512
8 PUB=0,0,200
9 PUB=0,0,0
10 BTAB
11 EN
12
    
```

Figure 4: X vs. Y Graph of Commanded Position

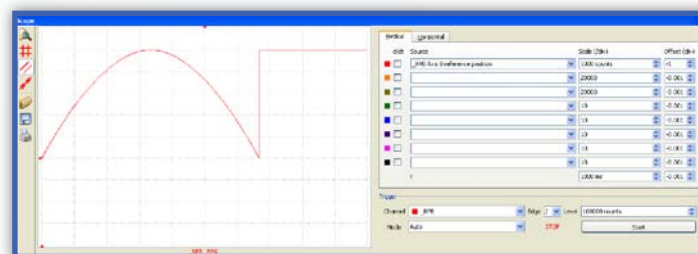
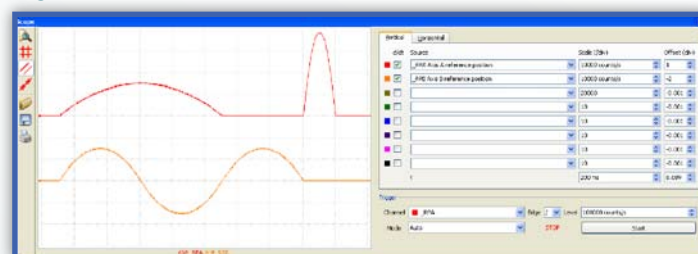


Figure 5: X and Y Velocities vs. Time



By taking advantage of Galil's new PVT mode of motion the system engineer has the ability to profile much smoother motion. The main drawback of contour mode, namely the discontinuity in velocities, is solved by switching to PVT mode. Both new and existing designs would both see a direct benefit from implementing the PVT mode of motion. If you have questions about PVT mode, or your application, please contact a Galil Applications Engineer at 1-800-377-6329 or download the Accelera Command reference at <http://www.galilmc.com/support/manuals.php> ■



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With over 500,000 controllers installed worldwide, Galil is the leading supplier of motion controllers. Galil's legacy of innovation began in 1983 with the introduction of the first microprocessor-based servo motion controller. Today, Galil continues its leadership by offering the most powerful, cost-effective and easy-to-use controllers to accommodate all your motion and I/O needs.

Galil offers a broad array of motion controllers in a variety of formats: single and multi-axis, card-level and box-level, bus-based and stand-alone. Galil's Ethernet/RS232 and PCI controllers are available in an Econo version for lowest cost and Accelera version for ultra high-speed performance. Plug-in, multi-axis drives for steppers and servos save space, cost and wiring. For intelligent I/O control, the RIO Pocket PLC is compact, low-cost and packed with analog and digital I/O.

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ACCELERA CONTROLLERS AND DRIVES

DMC-40x0 Ethernet/RS232
DMC-18x6 PCI

ECONO CONTROLLERS AND DRIVES

DMC-21x3 Ethernet/RS232
DMC-18x2 PCI

SINGLE-AXIS CONTROLLERS AND DRIVES

DMC-1415 Ethernet/RS232
CDS-3310 Ethernet/RS232

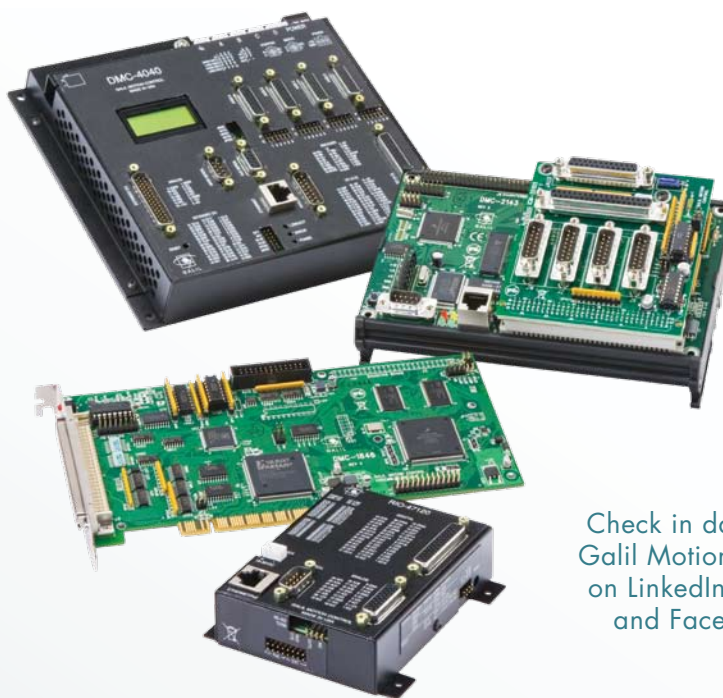
POCKET PLC I/O CONTROLLER

RIO-47xxx Ethernet/RS232

SOFTWARE TOOLS

GalilTools. Servo Tuning and analysis software

Ladder Interface. Converts Ladder program into DMC code for RIO Pocket PLC.



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