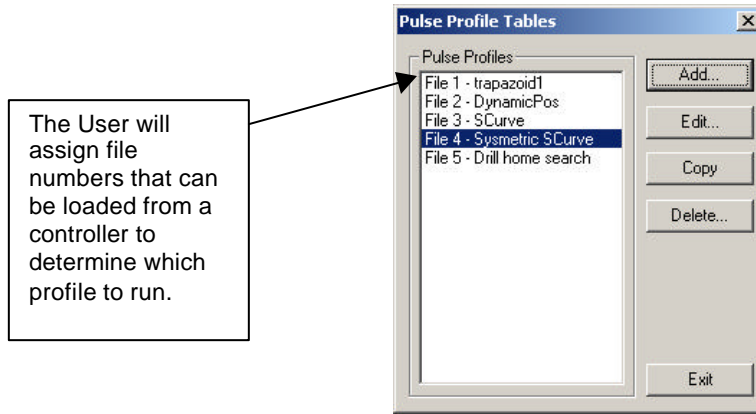


## Pulse Output Commands

Pulse Outputs can be generated by the command interface described below. The CTRIO Workbench utility can create up to **255** Pulse Profiles (File Number 1-255). The User will assign file numbers in the Workbench utility from 1 to 255 in the order that Preset Tables or Pulse Profiles are created. A given file number will represent either a Preset Table for Discrete Outputs or a Pulse Profile.



Per the configuration written by the CTRIO Workbench, either of the two Pulse Output Channels can output Pulses and Direction, or Up Pulses and Down Pulses.

(Pulse Output Control Offsets are always listed in the order of Outputs 0/1, Outputs 2/3)

CONTROL BIT to CTRIO	BIT OFFSETs	VMemory Offsets from Output Start (PLC in Octal)	READ as:
Enable Output	32, 48	26.0, 27.0	Level
Output Direction (1=CCW)	33, 49	26.1, 27.1	Level
Load and Seek New Dynamic Position	34, 50	26.2, 27.2	Rising Edge
Process Command	39, 55	26.7, 27.7	Rising Edge

STATUS BIT from CTRIO	BIT OFFSETs	VMemory Offsets from Input Start (PLC in Octal)
Pulse Active	32, 48	22.0, 23.0
Pulse Error by CTRIO	33, 49	22.1, 23.1
New Dynamic Position Loaded	34, 50	22.2, 23.2
Command Error	38, 54	22.6, 23.6
Command Complete	39, 55	22.7, 23.7

WORD CONTROL to CTRIO	WORD OFFSETs	VMemory Offsets from Output Start (PLC in Octal)
COMMAND CODE	0, 6	10, 16
WORD PARAMETER 1	1, 7	11, 17
WORD PARAMETER 2	2, 8	12, 20

DWORD CONTROL to CTRIO	WORD OFFSETs	VMemory Offsets from Output Start (PLC)
DWORD PARAMETER 1	0, 2	0, 4

COMMAND to CTRIO	CODE	WORD PARAMETER 1	WORD PARAMETER 2	DWORD PARAMETER 3
Load Profile from ROM	1	Trapezoid or S-Curve File Number	-	-
Load Profile from ROM	1	Dynamic Positioning File Number	-	New Position
Pulse Output at Velocity	5	Run Frequency (20-25000 Hz)	Duty Cycle (0 to 99)*	Number of Pulses
Pulse Output to Limit	6	Run Frequency (20-25000 Hz)	Edge & Duty Cycle (0 to 99)*	-
Pulse Output to Position	7	Run Frequency (20-25000 Hz)	Compare Function & Duty Cycle (0 to 99)*	Desired Input Function Value

\* A Duty Cycle value of 0 will also generate 50%.

## CTRIO QuickStart Guide

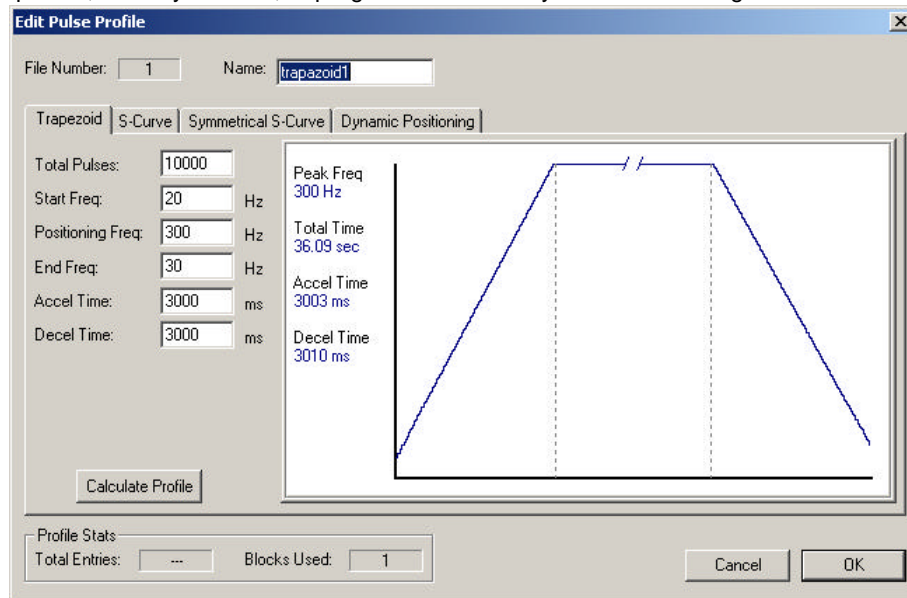
Fields above separated by a "&" indicate a Code where each byte has a different definition, (High byte & Low byte). For example, to enter the Pulse Output to Limit command, set the high byte of the Word Parameter 2 to the Edge you wish to terminate the Output Pulses (see definition following), and set the low byte to the desired Duty Cycle.

In order to process a command, first the program must load the **Command Code** and Required DWord, Word, and Bit Parameters. Then the program should drive the Process Command bit to a 1 and look for the CTRIO to acknowledge the command with the Command Complete bit. Finally the program should remove the Process Command bit and set the Enable Output bit when appropriate. If the Command Error bit is received, the CTRIO was unable to process the command due to an illegal value in either the Command Code or Parameter fields.

DWord and Word values for Pulse Outputs are considered unsigned integers.

## Pulse Output Profiles

Loading a Profile is the easiest method for pulse output motion control (Command Code = 0001). All the characteristics of acceleration, run frequency, and total pulse count are entered in the CTRIO Workbench Pulse Profile entry window. The profile can be a Trapezoid, Velocity S-curve, or program controlled Dynamic Positioning.



## Status Registers (STATUS BIT from CTRIO)

Name	PLC Example 1: V2000 as Base Input Address	PLC Example 2: V40600 as Base Input Address	Value
Output Enabled	V2022.0	V40622.0 or C440	ON when Enable Output is ON
Position Loaded	V2022.1	V40622.1 or C441	Used for Dynamic Positioning
Output Active	V2022.4	V40622.4 or C444	ON when Output is Pulsing
Output Stalled	V2022.5	V40622.5 or C445	CTRIO Output Fault Should Never be ON
Command Error	V2022.6	V40622.6 or C446	ON if Command or Parameters are Invalid
Command Complete	V2022.7	V40622.7 or C447	On if module receives Process Command

## Control Registers (From Controller to CTRIO)

Name	PLC Example 1: V2030 as Base Output Address	PLC Example 2: V40650 as Base Output Address	# Format
Command Code	V2040	V40660	Decimal
Parameter 1	V2041	V40661	Decimal
Parameter 2	V2042	V40662	Decimal
Parameter 3	V2031 / V2030	V40651-50	Signed Decimal
Enable Output	V2056.0	V40676.0 or C1740	Discrete
Goto Position	V2056.1	V40676.1 or C1741	Discrete
Direction	V2056.4	V40676.4 or C1744	Discrete
Process Command	V2056.7	V40676.7 or C1747	Discrete

## Trapezoid or S-Curve profiles

For pre-defined Trapezoid or S-Curve profiles, the program needs to prepare the Load Table command by selecting **Command Code = 1** and setting Word Parameter 1 to the File number of the profile (*example: File 1 Trapezoid1*). Then the program can set the Process Command bit and watch for the Command Complete bit. Then the program should clear the Process Command bit and set the Direction bit and finally the Enable Output bit to start the output pulses. Clearing the Enable Output bit will always suspend pulsing and reset any profile in progress to its beginning. Once complete, the profile remains loaded and can be restarted by clearing the Enable Output, changing the Direction bit (if desired), and again setting the Enable Output.

Easy step examples are given for PLCs with CTRIO I/O data mapped in the word and CR bit areas of CPU Memory:

### Easy Steps to Run a Trapezoid or S-Curve Profile on CTRIO Y0 & Y1

Steps	Name	Example 1 Mapped I/O		Example 2 Mapped I/O		Action
		PLC Control Outputs Base Addr = V2030	PLC Status Inputs Base Addr = V2000	PLC Control Outputs Base Addr = V40650 (C1200)	PLC Status Inputs Base Address = V40600 (C0)	
1	Command Code	V2040		V40660		Set to 1 (Load Stored Profile)
2	Parameter 1	V2041		V40661		File # of stored profile, User determines
3	Process Command	V2056.7		V40676.7 or C1747		Turn ON until Command Complete Status Bit is Returned (see step 4)
4	Command Status		V2022.7		V40622.7 or C447	When ON, Profile is now Loaded Clear Process Command Bit (step 3)
5	Set Direction	V2056.4		V40676.1 or C1741		Set ON or OFF for Direction of Rotation
6	Enable Output	V2056.0		V40676.0 or C1740		Turn ON to Start Pulses
7	Enable Status		V2022.0		V40622.0 or C440	When ON, module is confirming Enable Output
8	Output Status		V2022.4		V40622.4 or C444	When ON, module is Pulsing, OFF with Enable Status ON = Profile has completed
9	Disable Output	V2056.0		V40676.0 or C1740		Turn OFF when Pulse Status is OFF AND Enable Status is ON

*To Re-launch a Loaded Profile, simply repeat Steps 5-9*

## Dynamic Positioning

For Dynamic Positioning, only the motion limits of Min Frequency, Max Frequency, and Max Acceleration come from the CTRIO Workbench Profile. After loading a Dynamic Position Profile per the above paragraph, setting the Enable Output causes the CTRIO module to assume a position of 0 pulses. The program should write the next target position in DWord Parameter 3, and set the Load/Seek Position bit. This will cause the CTRIO to set both the *Pulses Active* and the *New Position Loaded* bit and begin output pulses (with the proper direction setting) to achieve the new position.

The program can monitor the state of the *Pulses Active* bit and the *New Position Loaded* bit to determine when the new position has been attained. The *New Position Loaded* status bit will always follow the state of the *Load/Seek New Position* control bit. This status bit should be used to signal the program that the CTRIO has received the new state of the control bit.

Position Loaded Status Bit V40622.1 or C441	Pulses Active Status Bit V40622.0 or C440	CTRIO Dynamic Position Pulse Output State
0	0	Idle
1	1	Go To Position Acknowledged, Pulsing
0	1	Still Pulsing, Go To Position Control Bit is OFF
1	0	Go To Position Acknowledged, Position Attained

## CTRIO QuickStart Guide

After the *GoTo Position* is acknowledged, the program can load the next position into the DWord Parameter 3. When *Pulses Active Status* goes to 0, then setting the GoTo Position control bit will again start the output toward the new position. The CTRIO moves to the new position relative to its previous position as long as the Enable Output control bit remains set. Clearing the Enable Output bit will disable output pulsing and reset the current position to 0.

### Easy Steps to Dynamic Positioning on CTRIO Y0 and Y1

Steps	Name	Example 1 Mapped I/O		Example 2 Mapped I/O		Action
		PLC Control Outputs Base Addr = V2030	PLC Status Inputs Base Addr = V2000	PLC Control Outputs Base Addr = V40650 (C1200)	PLC Status Inputs Base Address = V40600 (C0)	
1	Command Code	V2040		V40660		Set to 1 (Load Stored Profile)
2	Parameter 1	V2041		V40661		File # Containing VMin, VMax, and Accel
3	Process Command	V2056.7		V40676.7 or C1747		Turn ON until Command Complete Status Bit is Returned (see step 4)
4	Command Status		V2022.7		V40622.7 or C447	When ON, Profile is now Loaded Clear Process Command Bit (step 3)
5	Enable Output	V2056.0		V40676.0 or C1740		Turn ON to assume 0 position Turn OFF to disable pulses and zero pos.
6	Enable Status		V2022.7		V40622.7 or C447	When ON, Pulses are Now Enabled And Last Position is Retained
7	Parameter 3	V2031/V2030		V40662/V40661		Target position: User defined (DWord)
8	Go To Position	V2056.1		V40676.1 or C1741		Starts Pulses with direction to obtain the new position relative to previous position
9	Position Loaded Status		V2022.1		V40622.1 or C441	When ON, Go To Position is Acknowledged
	Output Active Status		V2022.4		V40622.4 or C444	When ON, module is Pulsing, OFF with Position Loaded Status ON = New Position Move has completed
10	Go To Position	V2056.1		V40676.1 or C1741		Turn OFF to be ready to load a new position

*To Seek the Next Position, simply repeat Steps 7-10*

### Pulse Output at Velocity

For motion control directly from the CPU/controller program, use the Pulse Output at Velocity command (Command = 0005). The Number of Pulses can be set to "FFFFFFF" in Hex for unlimited pulse counts. Leaving the Duty Cycle set to 0 achieves the default (50%), otherwise it can be set in 1% increments by writing this value from 1 to 99 decimal. After this command is processed, the Run Frequency and Duty Cycle fields can be adjusted by direct access.

In order to change directions from Pulse Output in "Velocity" mode, the Enable Output bit must first be cleared (which stops the Pulse Outputs). Then after the new direction bit is written, the Enable Output bit can be set to resume pulsing.

Steps: **PLC Address V40650 and module channel 1 is used for the CTRIO base output address for all examples in this Doc.**

*Easy Steps to Run Velocity Control on CTRIO Y0 & Y1*

Steps	Name	Example 1 I/O Mapping		Example 2 I/O Mapping		Action
		PLC Control Outputs Base Addr = V2030	PLC Status Inputs Base Addr = V2000	PLC Control Outputs Base Addr = V40650 (C1200)	PLC Status Inputs Base Address = V40600 (C0)	
1	Command Code	V2040		V40660		Set to 5 (Pulse at Velocity)
2	Parameter 1	V2041		V40661		Set Initial Run Frequency (20-25000 Hz)
3	Parameter 2	V2042		V40662		Duty Cycle (1-99) (Can leave 0 for 50%)
4	Parameter 3	V2031/V2030		V40662/V40661		Number of Pulses (DWord) Set to FFFF FFFF for No Limit
5	Set Direction	V2056.4		V40676.1 or C1741		Set ON or OFF for Direction of Rotation
3	Process Command	V2056.7		V40676.7 or C1747		Turn ON until Command Complete Status Bit is Returned (see step 4)
4	Command Status		V2022.7		V40622.7 or C447	When ON, Command has been accepted Clear Process Command Bit (step 3)
6	Enable Output	V2056.0		V40676.0 or C1740		Turn ON to Start Pulses
7	Disable Output	V2056.0		V40676.0 or C1740		Turn OFF to Stop Pulses

*While Velocity Control is running, Run Frequency (Step 2) and Duty Cycle (Step 3) may be actively adjusted simply by writing the variable.*

**Pulse Output to Input Limit**

The Pulse Output to Limit (Command = 6) is very similar to Pulse Output at Velocity. It can be used for Home Search routines where a relatively low frequency is used to seek a CTRIO discrete input. The CTRIO input must be assigned for Limit by the CTRIO Workbench utility.

As with Pulse Output at Velocity, set Word Parameter 1 to the desired frequency, Word Parameter 2 Low Byte to the Duty Cycle, and the High Byte to the Edge to Seek.

The Edge to Seek field reads Word Parameter 2 bits 13 and 12 to determine the edge(s) on which to terminate Output Pulses, and bits 9 and 8 to determine which CTRIO Input terminal to use.

Edge(s)	Bits 15..12
Rising	0000, 0 Hex
Falling	0001, 1 Hex
Both	0010, 2 Hex

CTRIO Input	Bits 11..8
Ch1 C	0000, 0 Hex
Ch1 D	0001, 1 Hex
Ch2 C	0010, 2 Hex
Ch2 D	0011, 3 Hex

Example 1: To run to a Rising Edge Limit on Channel 1's C Input at 50% Duty Cycle, use Word Parameter 2 = 0000 Hex. (Duty Cycle = 00 also creates 50% duty)

Example 2: To run to a Falling Edge Limit on Channel 2's C Input at 20% Duty Cycle, use Word Parameter 2 = 1214 Hex.

*Easy Steps to Run Velocity on CTRIO Y0 & Y1 until Discrete Input Limit*

Note: Discrete Input must be Configured for this Function by CTRIO Workbench or else a Command Error will occur.

Steps	Name	Example 1 I/O Mapping		Example 2 I/O Mapping		Action
		PLC Control Outputs Base Addr = V2030	PLC Status Inputs Base Addr = V2000	PLC Control Outputs Base Addr = V40650 (C1200)	PLC Status Inputs Base Address = V40600 (C0)	
1	Command Code	V2040		V40660		Set to 6 (Pulse at Velocity until Discrete Input Limit)
2	Parameter 1	V2041		V40661		Set Initial Run Frequency (20-25000 Hz)
3	Parameter 2	V2042		V40662		Select Discrete Input Edge in High Byte Low Byte is Duty Cycle (1-99) Example: Rising Input 1D at Duty = 45% Set This Parameter to 212D Hex
4	Set Direction	V2056.4		V40676.1 or C1741		Set ON or OFF for Direction of Rotation
5	Process Command	V2056.7		V40676.7 or C1747		Turn ON until Command Complete Status Bit is Returned (see step 4)
4	Command Status		V2022.7		V40622.7 or C447	When ON, Command has been accepted Clear Process Command Bit (step 3)
6	Enable Output	V2056.0		V40676.0 or C1740		Turn ON to Start Pulses
7	Output Active Status		V2022.4		V40622.4 or C444	ON While Pulsing OFF When Limit has Stopped Pulsing

*While Run Velocity to Limit is running, Run Frequency (Step 2) and Duty Cycle(Step 3) may be actively adjusted simply by writing the variable.*

**Pulse Output to Position**

The Pulse Output to Position command (Command = 7) allows Pulse Outputs that terminate when a specific Input Function Value is obtained. Set Word Parameter 1 to the desired Frequency (As with Velocity and Run to Limit). Set Word Parameter 2 Low Byte to the Duty Cycle and the High Byte to the Compare Function as defined below.

The Compare Function field defines either greater or less than any of the four CTRIO Input Function Values. The compare will take place against Input DWord Parameter 1 of the selected Function. The CTRIO reads command code bit 12 to determine if the compare is “greater than or equal” or “less than”. It reads bits 9 and 8 to determine the Input Function to use for comparison.

Comparison	Bits 15..12
Greater Than or Equal	0001, 1 Hex
Less Than	0000, 0 Hex

Input Function	Bits 11..8
Ch1 Fn1	0000, 0 Hex
Ch1 Fn 2	0001, 1 Hex
Ch2 Fn 1	0002, 2 Hex
Ch2 Fn 2	0003, 3 Hex

*Easy Steps to Run Velocity on CTRIO Y0 & Y1 until Function Input Value*

Steps	Name	Example 1 I/O Mapping		Example 2 I/O Mapping		Action
		PLC Control Outputs Base Addr = V2030	PLC Status Inputs Base Addr = V2000	PLC Control Outputs Base Addr = V40650 (C1200)	PLC Status Inputs Base Address = V40600 (C0)	
1	Command Code	V2040		V40660		Set to 6 (Pulse at Velocity until Discrete Input Limit)
2	Parameter 1	V2041		V40661		Set Initial Run Frequency (20-25000 Hz)
3	Parameter 2	V2042		V40662		Select Compare Function in High Byte Low Byte is Duty Cycle (1-99) Example: Until Greater than or Equal to Ch 2 Function 1 at Duty = 45% Set This Parameter to 2D Hex
4	Parameter 3	V2031/V2030		V40651/V40650		Function DWord Value for Comparison
5	Set Direction	V2056.4		V40676.1 or C1741		Set ON or OFF for Direction of Rotation
6	Process Command	V2056.7		V40676.7 or C1747		Turn ON until Command Complete Status Bit is Returned (see step 4)
7	Command Status		V2022.7		V40622.7 or C447	When ON, Command has been accepted Clear Process Command Bit (step 3)
8	Enable Output	V2056.0		V40676.0 or C1740		Turn ON to Start Pulses
9	Output Active Status		V2022.4		V40622.4 or C444	ON While Pulsing OFF When Limit has Stopped Pulsing

*While Run Velocity to Function Input Value is running, Run Frequency (Step 2) and Duty Cycle(Step 3) may be actively adjusted simply by writing the variable.*

Example: To run a Pulse Output at 30% duty until Ch2 Fn 1 is at 100,000, write 100,000 to DWord Parameter 3, set the desired Frequency in Word Parameter 1, set Word Parameter 2 to 12E Hex (Hex 1E = 30% Decimal), set the proper direction bit, then load and execute Command Code = 7, and finally set the Enable Output bit. The Output will Pulse until Ch2 Fn1's Input DWord Parameter 1 gets to 100,000.