GE Fanuc Intelligent Platforms
Programmable Control Products

VersaMax®

Micro PLC

MicroMotion Modules, GFK-2471

December 2007

Warnings, Cautions, and Notes as Used in this Publication

Warning

Warning notices are used in this publication to emphasize that hazardous voltages, currents, temperatures, or other conditions that could cause personal injury exist in this equipment or may be associated with its use.

In situations where inattention could cause either personal injury or damage to equipment, a Warning notice is used.

Caution

Caution notices are used where equipment might be damaged if care is not taken.

Note

Notes merely call attention to information that is especially significant to understanding and operating the equipment.

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Field Control	Motion Mate	Series 90	VersaPro
GEnet	PACSystems	Series Five	VuMaster
	Proficy	Series One	Workmaster

Contents

Chapter 1 Introduction

This manual describes the specifications, installation, and operation of the VersaMax Micro PLC's MicroMotion Modules, IC200UMM002 and IC200UMM102.

Chapter 1 lists general, functional, and I/O specifications, and gives an overview of the module.

Chapter 2: Installation, gives basic information for installing and wiring MicroMotion Modules. For VersaMax Micro PLC installation instructions, please refer to the *VersaMax Micro PLC User's Manual,* GFK-1645.

Chapter 3: Memory and Port Option Modules, describes the use of a Port Option module and/or a Memory Pack module with a MicroMotion Module. A communications module is required for communications with a host controller.

Chapter 4: Operation, describes the operating modes of the MicroMotion Module.

Chapter 5: Using the MicroMotion Setup Tool, describes the MicroMotion Setup Tool, and explains how to use it to set up, monitor, and control a MicroMotion Module.

Chapter 6: Configuring a MicroMotion Expansion Module, describes the steps to configure a MicroMotion Module when it is used as an expansion module in a VersaMax Micro PLC system.

Chapter 7: MicroMotion in a VersaMax PLC System, describes the data that can be used to transfer status and control data between a MicroMotion Module and the Micro PLC.

Chapter 8: MicroMotion in a Host Controller System, describes the details of data exchange between the MicroMotion Module and a host controller.

Chapter 9: Data Formats for MODBUS Communications, defines the MicroMotion Module data that can be read or written using MODBUS RTU communications.

Chapter 10: Error Codes, defines the error codes associated with Axis Errors and System Errors.

Appendix A: Floating Point Data, provides reference information about the format and use of floating point data.

Appendix B: Common Parameters, lists the MicroMotion Modules' 58 words of Common Parameter data.

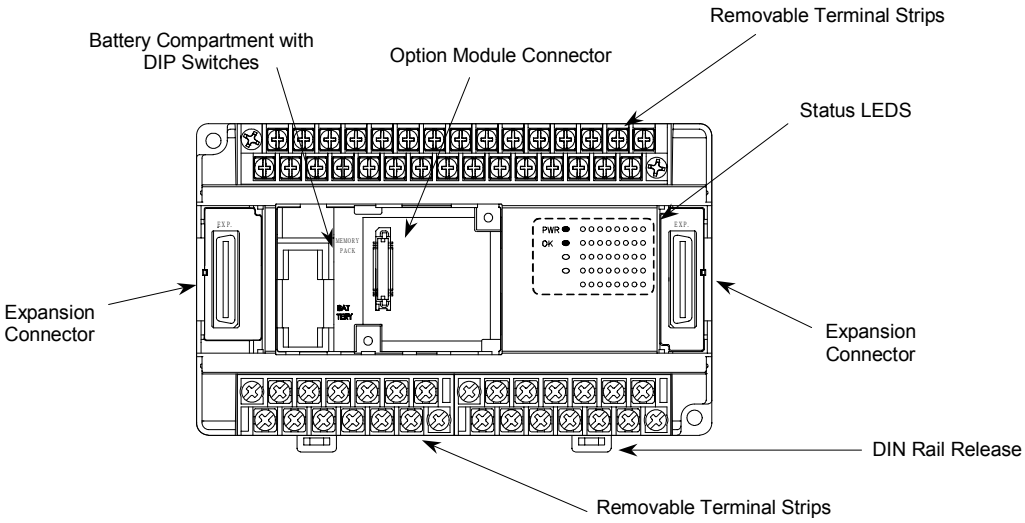
Module Description

VersaMax MicroMotion Modules provide independent motion control in a VersaMax Micro PLC or host controller system. Modules can be DIN-rail or panel-mounted. Two models are available:

- IC200UMM002: MicroMotion Module, 24VDC
- IC200UMM102: MicroMotion Module, 110/220VAC

Both are standard,VersaMax Micro PLC modules, with removable protective doors and hinged terminal covers and connector covers.

The diagram below shows the accessible components of the module with the protective doors removed, and the hinged terminal covers and connector covers open.



MicroMotion Module Features

VersaMax MicroMotion Modules provide:

- Two independent axes
- All I/O needed for motion control
- Ability to store up to 256 profiles independent of controller
- Profiles can be executed individually or continuously
- No motion programming required in PLC
- Motion setup tool integrated into Proficy Machine Edition.
- Servo or Stepper Control
- Speed Range: 1 to 2Mhz pulses per second
- Move types: Absolute/Incremental moves, blended and Jog moves
- Position rollover: Linear, rotary mode
- Positioning units: Pulse, µm, inch, degree, free-form
- Acceleration and deceleration: Linear, S-curve
- Dwell time: 0 to 32,768 ms (1 ms units)
- Acc/Dec rate: 1 to 50,000,000 (pulse/s^2, µm/s^2, inch/s^2, degree/s^2, Free form/s^2)
- Backlash Compensation: 0 to 65,535 (pulses, µm, inch, degree, Free-form)
- Range: +2,147,483,647 to –2,147,483,648 pulses
- Pulse output method: Line driver output
- Pulse output type: (1) Pulse and direction (2) CW/CCW
- Homing function: Free homing, low-speed homing, high-speed homing 1 (OFF edge), high-speed homing 2 (marker stop)
- Manual (JOG) operation: Manual input signal or pulse output by command
- Feedrate override function: 1 to 100% (Speed scale rate)

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Specifications

General Specifications

Item	Specifications	
Power supply type	**AC**	**DC**
Power voltage	100/110/120 V AC (50/60 Hz), 200/220/240 V AC (50/60 Hz)	24VDC
Power voltage fluctuation range	85 to 264 V AC wide range	19.2 to 30V DC
Allowable momentary power failure	85 to 100 V AC: for a momentary power failure of less than 10ms, operation continues 100 to 264 V AC: for a momentary power failure of less than 20ms, operation continues. See “Adding an Emergency Stop Circuit” in chapter 2.	A momentary power failure of less than 10ms, operation continues
Operating ambient temperature	0 to 55 ºC (Storage ambient temperature –10 to 75 ºC)	
Operating ambient humidity	5 to 95 % RH (no condensation) (Storage ambient humidity 5 to 95 % RH (no condensation)	
Vibration resistance	Conforms to JIS C 0911	
Noise resistance	- Noise voltage 1500 Vpp Noise pulse 100 ns, 1 micro sec - Static noise: 3000 V at metal exposed area	
Insulation resistance	20 MΩ or more between the AC external terminal and the protection earth (PE) terminal (based on 500V DC mega)	
Dielectric withstand voltage	1500 VAC for 1 minute between the AC terminal and the protection earth (PE) terminal	500 VDC
Grounding	Class D dedicated grounding (grounded by a power supply module)	
Environment used	No corrosive gases and no excessive dirt	
Structure	Attached on an open wall	
Cooling	Natural air cooling	
Anti-electric shock protection	I type device	
	Open device	

Functional Specifications

Item		Specifications
Number of axes		2
Maximum speed		2M pulses per second
Positioning system	Move type	(1) Absolute + Incremental method (2) Incremental method
	Position rollover	Linear, rotatary
	Positioning instruction units	Pulse, μm, inch, degree, Free-form
	Speed instruction range	1 to 2M pulses per second [note 1]
	Acceleration and deceleration	Liner Acc/Dec, S-shaped Acc/Dec
	Dwell time	0 to 32,768 ms (1 ms units)
	Acc/Dec rate	1 to 50,000,000 (pulse/s^2, μm/s^2, inch/s^2, degree/s^2, free form/s^2) [note 2]
	Backlash revision	0 to 65,535 (pulses, μm, inch, degree, Free-form)
	Range	+2,147,483,647 to – 2,147,483,648 pulses
	Pulse output type	(1) Pulse train [CW / CCW] (2) Clock + direction signal [CK/direction]
	Pulse output method	Line driver output
Positioning data	Number of moving profiles	256 (non-volatility)
	Setting method	Sequence program from PLC and personal computer
Operation mode		Auto operation, manual operation
Homing function		Free homing, low-speed homing, high-speed homing (OFF edge), high-speed homing (marker stop)
Manual (JOG) operation		Pulse output by manual input signal or command
Auto operation		Pulse output according to profile data registered with a sequence table.
Feedrate override function		1 to 100% (Speed scale rate, 1% unit)
I/O assignment		8 input words, 8 output words

Note 1: The minimum velocity units depend on the maximum speed set up in the Common Parameters.

Note 2: The range for acceleration and deceleration depends on the maximum speed set up in the Common Parameters.

I/O Specifications

Item			Specifications
Pulse output	Pulse signal (CW/CCW) Pulse + Direction signal (PLS/SIGN)		Line driver
	High level voltage at Power ON		2.4 V or more
	Low level voltage at Power OFF		0.4 V or less
Pulse input	High level voltage at Power ON		2.4 V or more
	Low level voltage at Power OFF		0.4 V or less
Control input	Input voltage		20.4 to 28.8 V DC
	Input impedance		Approx. 5.6 kΩ
	Input electric current		Approx. 4.3 mA (24 V DC)
	Operating voltage	Minimum ON voltage	15 V
		Minimum OFF voltage	5 V
	Input lag	ON to OFF	1ms or less
		OFF to ON	1ms or less
	Polarity		None
	Insulate method		Photocoupler

Operating Modes of a MicroMotion Module

VersaMax MicroMotion Modules can perform the following motion operations (see chapter 4):

- ***Homing mode***: establishes a Home Position for an axis, and writes the home position data to the axis position. The Home Position can be established using:
  - *Free Homing*: which sets the Home Position data to the current axis output position without moving the axis.
  - *Low-speed Homing*: which moves the axis at the Final Home Velocity to the On edge of the Home Position Limit Switch and stops at On edge of Home position, then writes the home position data to the current axis output position.
  - *High-Speed Homing (Off Edge)*: which moves the axis at the Find Home Velocity to the On Edge of the Home Position Limit Switch, then changes direction and moves with Final Home Velocity to the Off edge of the Home Position Limit Switch. The axis then moves toward the On edge of the Home Position Limit Switch with fixed velocity and stops at On edge of the Home switch and writes the Home Position data to the current axis output position.
  - *High-Speed Homing (Marker Pulse)*: which moves the axis at the Find Home Velocity to the On Edge of the Home Position Limit Switch, then changes direction and moves with final Home Velocity to the Off edge of the Home Position Limit Switch. The axis then moves toward the On edge of the first marker input after the Home Position Limit Switch goes On with fixed velocity and stops at On edge of the first marker input and then writes the home position data to the current axis output position.

- ***Manual mode***: controls axis movement using external input signals or commands from the controller. An axis can perform the following operations in Manual mode:
  - *Inching:* The axis outputs a pulse for specified distance in either clockwise or counter-clockwise direction.
  - *Jogging* : The axis outputs a continuous pulse until a Stop input or Stop command is received.

  By default, the axis's pulse output for inching or jogging moves is controlled by commands from the VersaMax Micro PLC or host controller. Alternatively, Manual mode can be controlled by external input signals to the MicroMotion module. Manual mode operation by external input signals must be enabled and disabled by the CPU or host.
- ***Automatic mode***: controls axis movement using position (profile) data that has been set up in advance. Complex positioning operations can be performed by combining multiple profiles in a Sequence Table.
  - A sequence table can be stored in the MicroMotion module (using the MicroMotion setup tool or on command from the PLC CPU or host controller.

Expansion or Standalone Operation

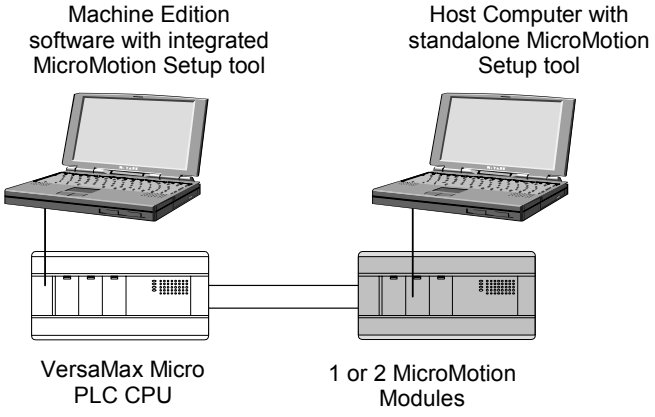
A VersaMax MicroMotion Module can operate as an expansion module in a VersaMax Micro PLC system, or in Standalone mode controlled by a host using MODBUS RTU commands. The MicroMotion Module provides the motion features described on the previous page in either Expansion module operation or Standalone operation.

Expansion Operation in a VersaMax Micro PLC

A VersaMax Micro PLC system can include up to two MicroMotion Modules, which operate as expansion modules controlled by the PLC CPU. The VersaMax Micro PLC CPU must be version 3.81 or later.

The system can also include optional host devices, monitoring the operation of MicroMotion Modules. A host computer communicates with the module using MODBUS RTU protocol. The host computer connects to the MicroMotion Module via one of the Port Option Modules described in chapter 3.

Programming and configuration for the Micro PLC are done using the Proficy Machine Edition software. An integrated MicroMotion Setup and Monitoring tool can be used for developing and monitoring motion operations. A host computer can also use the same MicroMotion Setup and Monitoring tool in standalone mode.

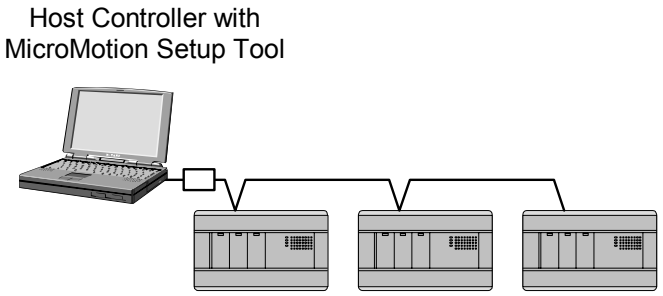


In addition to the monitoring and control provided by the user interface in the MicroMotion Setup Tool, motion operations can be set up, controlled, and monitored by the application program in the Micro PLC CPU using the module's assigned input and output status data as described in chapter 7. The host controller can also monitor and control motion operations using MODBUS RTU commands as described in chapters 8 and 9.

Standalone Operation

When used as in standalone mode, the MicroMotion Module is not part of a VersaMax Micro PLC system. A host computer must be used for monitoring and control. The host computer communicates with the module using MODBUS RTU protocol over an RS232 or RS485 serial line. The host computer connects to the MicroMotion Module via one of the Port Option Modules described in chapter 3.

Standalone operation is selected by setting by DIP switch 2 on the MicroMotion Module.



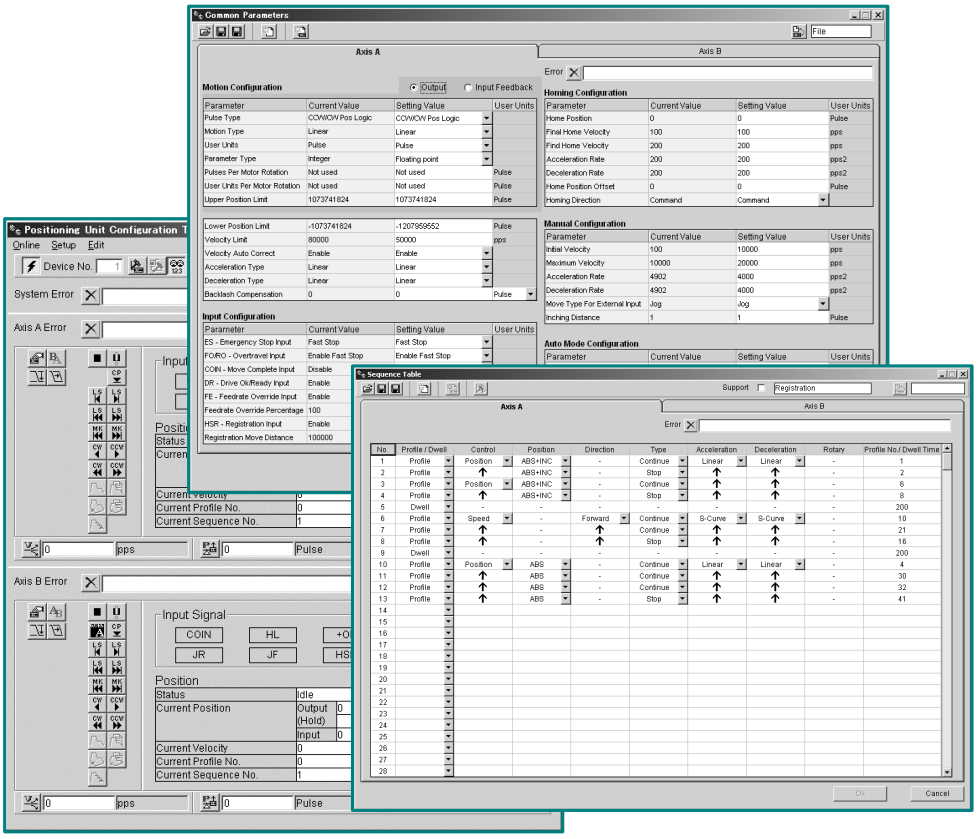
The MicroMotion Setup and Monitoring tool in the host controller can be used for developing and monitoring motion operations. In addition to the monitoring and control provided by the user interface in the MicroMotion Setup Tool, motion operations can be set up, controlled, and monitored by the application program in the host controller using MODBUS RTU commands as described in chapters 8 and 9. With the MicroMotion module connected using an RS232 or RS485 serial communications module, acting as a MODBUS Slave, any device having MODBUS RTU Master can be used as host controller. With the MicroMotion Module connected using an Ethernet Option Module, acting as Modbus TCP/IP Server, any device having MODBUS TCP/IP Client functionality can be used as the host controller.

MicroMotion Setup Tool

The MicroMotion Setup Tool provides an easy-to-use interface for setting up the motion parameters of a MicroMotion Module. In addition, the host controller or VersaMax Micro PLC CPU can use the MicroMotion Setup Tool to monitor and execute motion operations in real time.

The MicroMotion Setup tool is integrated into Proficy Machine Edition version 5.7 SIM 3 or later.

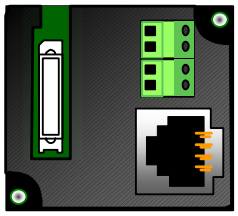
See chapter 5 for information about using the MicroMotion Setup Tool.



Port and Memory Pack Option Modules

- RS232 Port Option Module IC200USB001
- RS485 Port Option Module IC200USB002
- Memory Pack Module, IC200UMB001
- Ethernet Option Module IC200UEM001
- USB Option Module IC200UUB001

One Port Option module (IC200UEM001, IC200USB001or IC200USB002 or IC200UUB001) and/or Memory Pack module (IC200UMB001) can be installed on the front of a MicroMotion Module. A communications module is required for communications with a host controller.



The VersaMax Micro PLC Memory Pack Module, IC200UMB001, can be used to store and update data in a MicroMotion Module in either expansion operation or standalone operation.

See chapter 3 for information about the port and memory option modules.

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Chapter 2 Installation

This chapter describes the procedures for installing a VersaMax MicroMotion Module.

- Preinstallation check
- Agency Approvals, Standards, and General Specifications
- Installation Guidelines
- Installing a MicroMotion Module on a DIN Rail or Panel
- Connecting a MicroMotion Module to a Micro PLC
- System Wiring Guidelines
- I/O Installation and Wiring
- Terminal Assignments
- DIP Switch Settings
- Starting Up the Module

For information about installing other VersaMax Micro PLC equipment, please refer to the *VersaMax Nano and Micro PLCs Manual*, GFK-1645.

Preinstallation Check

Carefully inspect all shipping containers for damage during shipping. If any part of the system is damaged, notify the delivery service immediately. The damaged shipping container should be saved as evidence for inspection by the delivery service. As the consignee, it is your responsibility to register a claim with the delivery service for damage incurred during shipment. However, GE Fanuc will fully cooperate with you, should such action be necessary. After unpacking the equipment, record all serial numbers. Serial numbers are required if you should need to contact Product Service during the warranty period of the equipment. All shipping containers and all packing material should be saved should it be necessary to transport or ship any part of the system.

Keep MicroMotion Modules in their boxes during storage and transport.

2

Agency Approvals, Standards, and General Specifications

The VersaMax Micro PLC products supplied by GE Fanuc are global products designed and manufactured for use throughout the world. They should be installed and used in conformance with product-specific guidelines as well as the following agency approvals, standards and general specifications:

Agency Approvals		**Comments**
Industrial Control Equipment [Safety]	UL508, CSA C22.2 No 142-M1987	Certification by Underwriters Laboratories for Revision B and later models
Hazardous Locations [Safety] Class I, Div II, A, B, C, D	UL1604 CSA C22.2 No 142-M1987	Certification by Underwriters Laboratories for Revision B and later models
European EMC & LVD Directives	CE Mark	All models

Environmental		**Conditions**
Vibration	IEC68-2-6, JISC0911	1G @57-500Hz, 0.15mm p-p @10-57Hz
Shock	IEC68-2-27, JISC0912	15G, 11ms
Operating Temperature		0deg C to 55deg C [ambient]
Storage Temperature		–10deg C to +75deg C
Humidity		5% to 95%, non-condensing
Enclosure Protection	IEC529	Enclosure per IP54; protection from dust & splashing water
Isolation: Dielectric Withstand	UL508, UL840, IEC664	1.5KV for modules rated from 51V to 250V

Immunity and Emissions, Relevant Standards, and Level Passed

Description	***Standards***	***Specifications***
Electrostatic Discharge	EN 61000-4-2	± 4.0 kV (Contact); ± 8.0 kV (Air)
RF Susceptibility	EN 61000-4-3	10 V/m (unmodulated), 80-1000 MHz, 80% AM, 1 kHz sine wave
RF Susceptibility from Digital Radio Telephones	ENV 50204	10 V/m (unmodulated), 900±5Mhz, 100% AM (200 Hz square wave, 50% duty cycle)
Fast Transient	EN 61000-4-4	± 2.2 kV (PS); ± 1.1 kV (I/O)
Voltage Surge	EN 61000-4-5	± 2.2 kV, common mode (PS) ± 1.1 kV, differential (PS)
Conducted RF	EN 61000-4-6	10 V_{rms}, 0.15-80 MHz, 80% AM, 1 kHz sine wave (PS, I/O)
Voltage Dip Voltage Interrupt Voltage Variation	EN 61000-4-11	30% Nom., 10 ms >95% Nom., 10ms 20% Nom. 10 sec.
Radiated Emissions	EN 55011*	30 dBμV/m, 30 – 230 MHz (measured @ 30m) 37 dBμV/m, 230 – 1000 MHz (measured @ 30m)
Conducted Emissions	EN 55011*	79/66 dBμV, 0.15 – 0.5 MHz 73/60 dBμV, 0.5 – 30 MHz

* EN 55011 limits are equivalent to limits specified in EN 55022, CISPR 11, CISPR 22, and 47 CFR 15.

Installation Guidelines

This equipment is intended for use in typical industrial environments that utilize anti-static materials such as concrete or wood flooring. If the equipment is used in an environment that contains static material such as carpets, personnel should discharge themselves by touching a safely-grounded surface before accessing the equipment.

CE Mark Installation Requirement

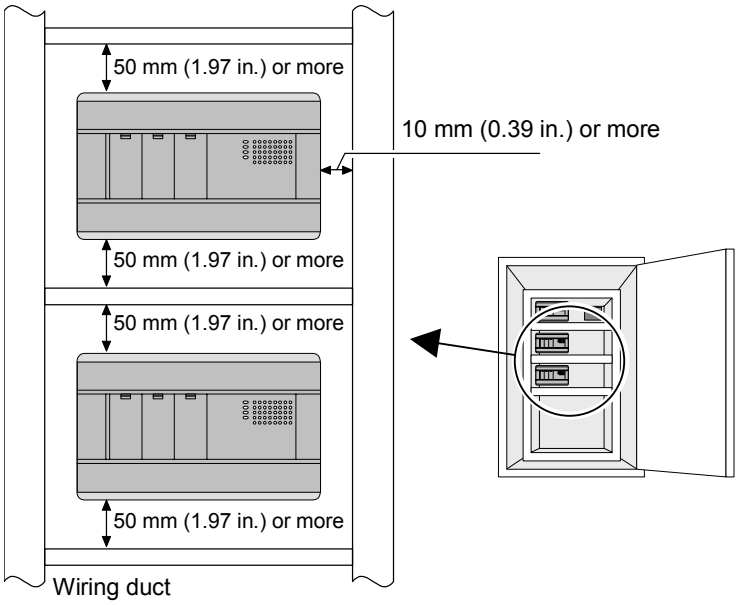
For compliance to the Low Voltage Directive, VersaMax MicroMotion Modules are considered 'open equipment' (i.e. live electrical parts may be accessible to users) and must be installed in an enclosure. IEC 1131-2:1991 (sect. 4.2, item 2) states: "Open equipment is not required to meet IP2x requirement…. Opening of the enclosure shall only be possible by means of a key or tool." The module should be installed in a location that meets the specifications listed on the previous page.

UL Requirements for Class I Div 2 Installations

- Equipment labeled with reference to Class 1 Div. 2 Groups A, B, C & D, hazardous locations is suitable for use in Class 1, Division 2, Groups A, B, C, D or non-hazardous locations only.
- Equipment labeled with reference to Class 1 Zone 2 Groups A, B, C & D, hazardous locations is suitable for use in Class 1, Zone 2, Groups A, B, C, D or non-hazardous locations only.
- Warning - explosion hazard - substitution of components may impair suitability for Class 1, Division 2.
- Warning - explosion hazard - do not disconnect equipment unless power has been switched off or the area is known to be non-hazardous.

Additional Environmental Guidelines

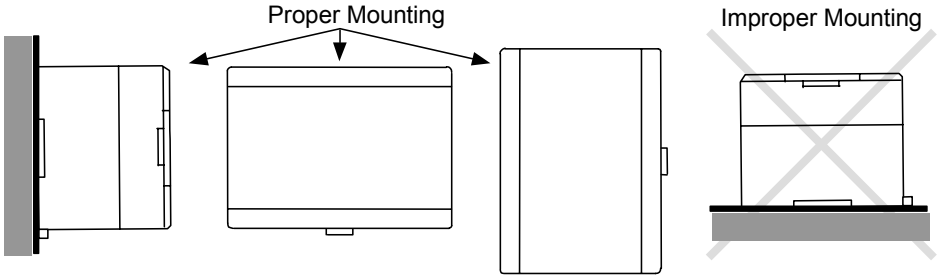
- The temperature must not change so rapidly that condensation could form on or inside the unit.
- There should be no combustible, corrosive or flammable gases.
- The environment should not have excessive dust, salty air, or conductive materials (iron powder, etc.) that could cause internal shorts.
- The module should not be installed where it will be exposed to direct sunlight.
- The module should not be exposed to water, oil or chemicals.
- Provide adequate ventilation space. Recommended minimum space allowances are approximately: (50 mm (1.97 in. or more) at top and bottom, 10mm (0.39 in. or more to the left and right).



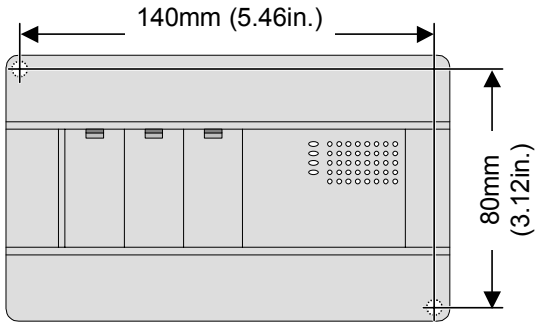
- The module should not be installed above equipment that generates a large amount of heat.
- If the ambient temperature exceeds 55°C, provide a ventilation fan or air conditioner.
- The equipment should not be installed within 300mm (11.81 in.) of any high voltage (more than 1000V) or high current (more than 1A) line.
- For ease of maintenance and safety, locate the module as far away from high voltage equipment and power generation equipment as possible.
- Take appropriate measures when installing systems in locations:
  - subject to static electricity or other forms of noise.
  - subject to strong electromagnetic fields.
  - close to power supplies.

Installing a MicroMotion Module on a DIN Rail or Panel

A VersaMax MicroMotion Module can be mounted on a 35mm DIN rail, or mounted on a metal panel using screws. The equipment must be mounted on a vertical surface. Do not mount it on a horizontal surface.



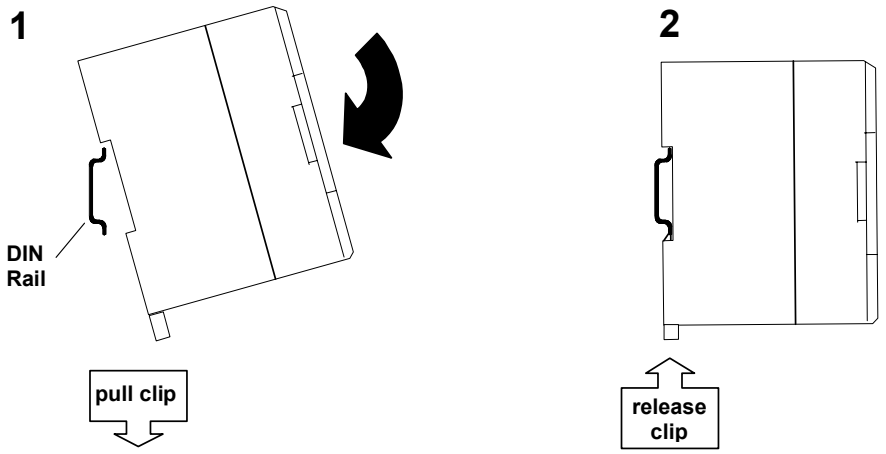
Mounting Dimensions



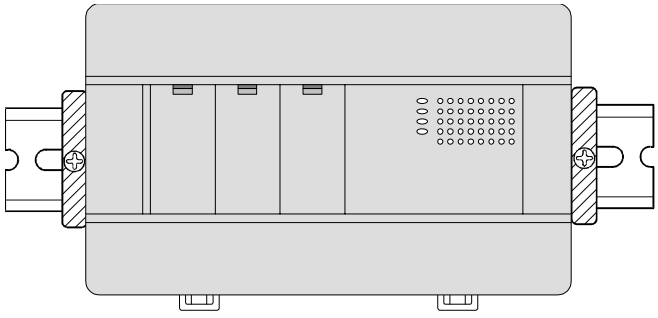
Mounting a Module on a DIN Rail

The DIN rail must be electrically grounded to provide EMC protection as described on the next page. DIN rails compliant with DIN EN50032 are preferred. For vibration resistance, the DIN rail should be installed on a panel using screws spaced approximately 5.24cm (6 inches) apart.

Modules mount on a 35 mm DIN rail as shown below. Using a small flat screwdriver or similar tool, pull out the retaining clip on the bottom of the unit. Press the unit back and release the retaining clip. Be sure the clip is holding the unit securely.

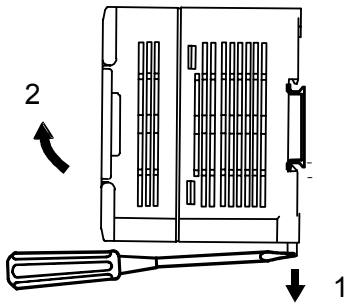


Secure the module by installing DIN rail brackets from both sides. (The module may shift on the DIN rail if it is not secured with mounting brackets.)



Removing a Module from a DIN Rail

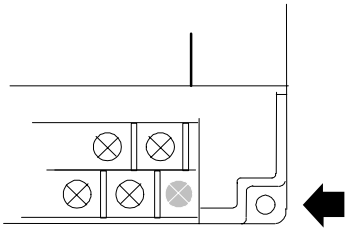
Pull down the retaining clips on the bottom of the module then pull it away from the DIN rail.



Panel-Mounting

For greatest resistance to mechanical vibration and shock, a MicroMotion Module should be installed on a metal panel.

Following the dimensions shown previously in this chapter or using the module itself as a template, mark the location of the module's panel-mount holes on the panel. Drill the hole in the panel. Install the module using 65x70 M4 (#8-32) screws at least 20mm (0.79 in.) long in the panel-mount holes.



1.1 to 1.4Nm (10 to 12 in/lbs) of torque should be applied to M4 (#8-32) steel screws threaded into material containing internal threads and having a minimum thickness of 2.4mm (0.093in).

Grounding the Metal Panel or DIN Rail

To prevent the risk of electric shock, the metal panel on which the module is installed must be properly grounded to protective earth.

Connect the ground wire to the metal panel using a star washer. Where connections are made to a painted panel, the paint should be removed so clean, bare metal is exposed.

Connect the metal plate, duct, pipe, door and side board etc. to protective earth.

Connecting a MicroMotion Module to a Micro PLC

Up to two MicroMotion Modules can be used as expansion units connected in series to a Micro PLC.

Caution

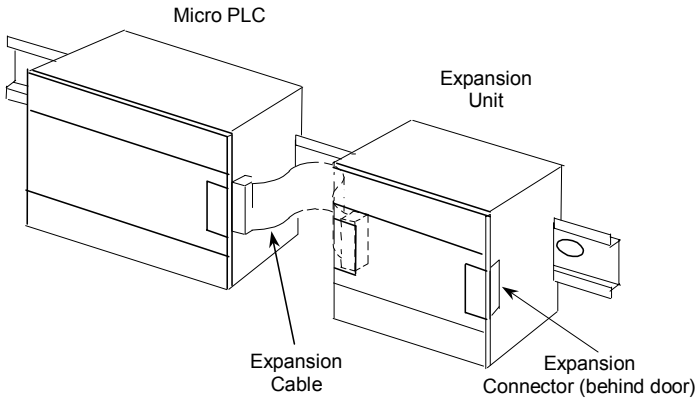
Power down the Micro PLC before connecting any expansion unit. Connecting an expansion unit with the Micro PLC powered up will damage the unit.

NOTE

The Micro PLC and expansion unit(s) should be wired to a common power source and powered up together. If an attached expansion unit is left unpowered, the Micro PLC may not power up properly.

The Expansion Cable

Ribbon cables are available in 0.1-meter (IC200CBL501), 0.5 meter (IC200CBL505), and 1 meter (IC200CBL510) lengths. The maximum total overall length for all units is 2 meters. The ribbon cable has keyed connectors to prevent incorrect installation. Powering up the system with the cable improperly installed can damage the MicroMotion Module. Do not substitute a different cable. Connect expansion units as shown below.



The Micro PLC and MicroMotion Module(s) must be connected in the same orientation. Connecting any expansion unit “upside down” will damage the DC input circuit when the system is powered up.

After installing the ribbon cable on a module, close the hinged door on the module.

System Wiring Guidelines

In addition to the following wiring suggestions, we strongly urge that you follow all wiring and safety codes that apply to your area or to your type of equipment. Failure to do so could lead to personal injury or death, property damage or destruction, or both.

Four types of wiring may be encountered in a typical factory installation:

- Power wiring – the plant power distribution, and high power loads such as high horsepower motors. These circuits may be rated from tens to thousands of KVA at 220 VAC or higher.
- Control wiring – usually either low voltage DC or 120 VAC of limited energy rating. Examples are wiring to start/stop switches, contactor coils, and machine limit switches. This is generally the interface level of discrete I/O.
- Analog wiring – transducer outputs and analog control voltages. This is the interface level to I/O analog blocks.
- Communications and signal wiring – the communications network that ties everything together, including computer LANs, MAP, and field busses.

These four types of wiring should be separated as much as possible to reduce the hazards from insulation failure, miss-wiring, and interaction (noise) between signals. A typical control system may require some mixing of the latter three types of wiring, particularly in cramped areas inside motor control centers and on control panels.

Wiring which is external to equipment and in cable trays should be separated following National Electrical Code practices.

Safety Measures

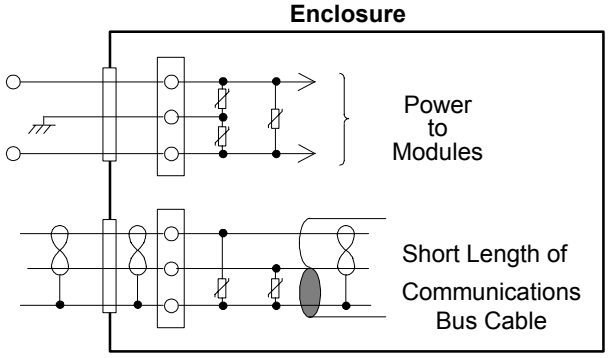
Appropriate emergency stop circuitry, interlock circuitry and similar safety measures should be added to the system in accordance with accepted practices.

Appropriate safety measures should be included in the design of the overall system to ensure safety in the event of incorrect, missing or abnormal signals caused by broken signal lines, momentary power interruptions or other causes.

Installing Additional Suppression

External MOV suppression can be installed at the power line input of a system enclosure (see below). The axial-leaded ZA series of MOVs from Harris is often used. The MOV should be able to handle most line transients. Measurement of actual transients may be required in extreme cases to decide what MOV is best.

Ideally, MOVs should be used at each cabinet in the system for maximum protection. The following illustration shows suppression on both power lines and a communications bus entering an enclosure.



Periodic Inspection and Replacement of MOVs

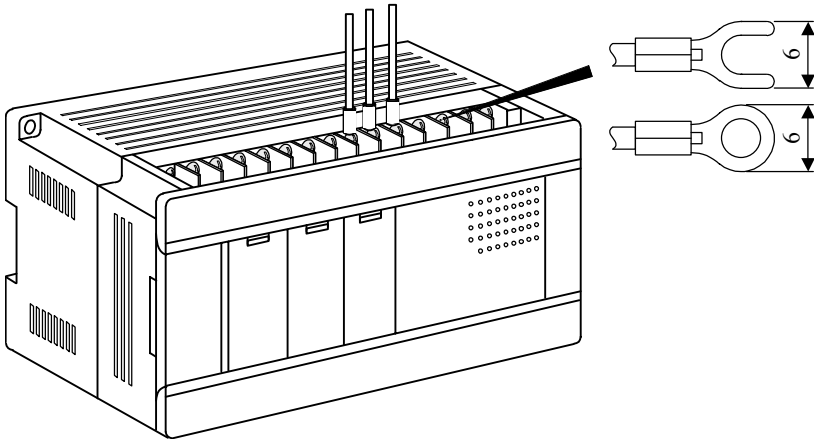
MOVs do a good job of absorbing transients on communications, control, and power lines, provided the total energy of those transients does not exceed the rating of the device. However, if the energy of the transient exceeds the rating of the device, the MOV may be either damaged or destroyed. *This failure may not be visibly or electrically evident.* MOVs should be regularly inspected for signs of damage to assure continued protection against transients. For some applications, periodic replacement of critical MOVs is recommended, even if they do not show signs of damage.

I/O Installation and Wiring

Follow the procedures below when routing and connecting field wiring.

- Turn off power to the module before connecting field wiring.
- All low-level signal wires should be run separately from other field wiring.
- All channels must be fed from the same phase for AC power lines.
- Install AC power cables and data lines in separate cable trays or bunches from DC field wiring.
- Field wiring should not be routed close to any device that could be a potential source of electrical interference.
- Route the signal and data lines as close as possible to grounded surfaces such as cabinet elements, metal bars and cabinets panels.
- If severe noise problems are present, additional power supply filtering or an isolation transformer may be required.
- Ensure that proper grounding procedures are followed to minimize potential safety hazards to personnel.
- Label all wires to and from field devices.
- Do not attempt to disassemble, repair or modify any part of the module.
- Do not pull on cables or bend cables beyond their natural limit. The lines may break.
- Always use the power supply voltage listed in the module specifications. Using other voltages may damage the equipment.
- Use shielded cable for analog inputs and outputs, and connect shields to a functional earth ground.
- Use twisted-pair cable or cable in metal duct for pulse input/output connections when using a MicroMotion Module with pulse input/output frequencies greater than 500kpps in a noisy environment.

Wiring Connections



Use copper conductors rated for 75 °C (167 °F) for all wiring.

- When using wiring terminals, be sure to tighten screws adequately, so the wiring terminals will not become loose. The suggested torque for terminal connections is 0.6Nm.
- When using a crimp-type connector, use one with an outer diameter of 6mm (0.24in.) or less.
- Do not use more than two crimp-type connectors on the same module terminal.

Alternatively, each module screw can accept:

- One wire, size AWG14 to AWG22 (2.1 to 0.36 mm^2) or:
- Two wires, size AWG16 to AWG22 (1.3 to 0.36 mm^2)

Warning

You should calculate the maximum current for each wire and observe proper wiring practices. Failure to do so could cause injury to personnel or damage to equipment.

- Each terminal can accept solid or stranded wires, but the wires into any given terminal must be of the same type and size.

Caution

When connecting stranded conductors, ensure that there are no projecting strands of wire. These could cause a short circuit, thereby damaging equipment or causing it to malfunction.

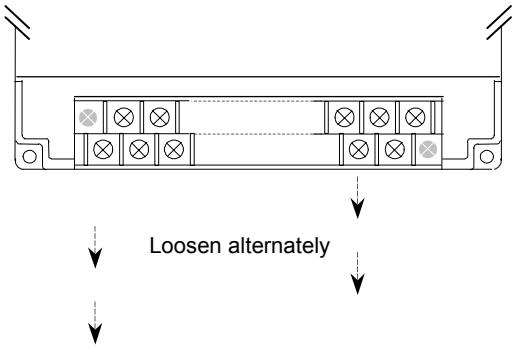
Removable Wiring Terminals

The terminal block assemblies of a MicroMotion Module can be removed to perform wiring.

Caution

Do not insert or remove a terminal assembly with power applied to the module OR TO FIELD DEVICES. Injury to personnel and damage to the equipment may result. Potentially dangerous voltages from field devices may be present on the screw terminals even though power to the module is turned off. Care must be taken any time you handle the removable terminal assembly or any wires connected to it

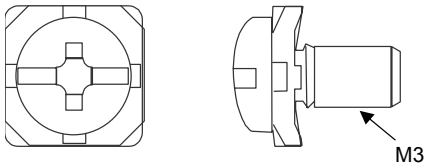
A new MicroMotion Module is shipped with its terminal block assemblies firmly installed. To remove a terminal assembly, use a small Phillips or flat screwdriver to alternately loosen the two captive retaining screws. Hold the terminal assembly; when the screws have been backed out of the holes, the terminal assembly is completely detached from the module.



When re-installing terminal assemblies, be sure to place each one in the correct location to avoid miss-wiring the module. The terminal assemblies are not keyed or labeled.

Terminal Screws

Should any of the terminal screws be lost or damaged, they can be replaced with M3 x 0.6mm pitch screws of the type shown below.



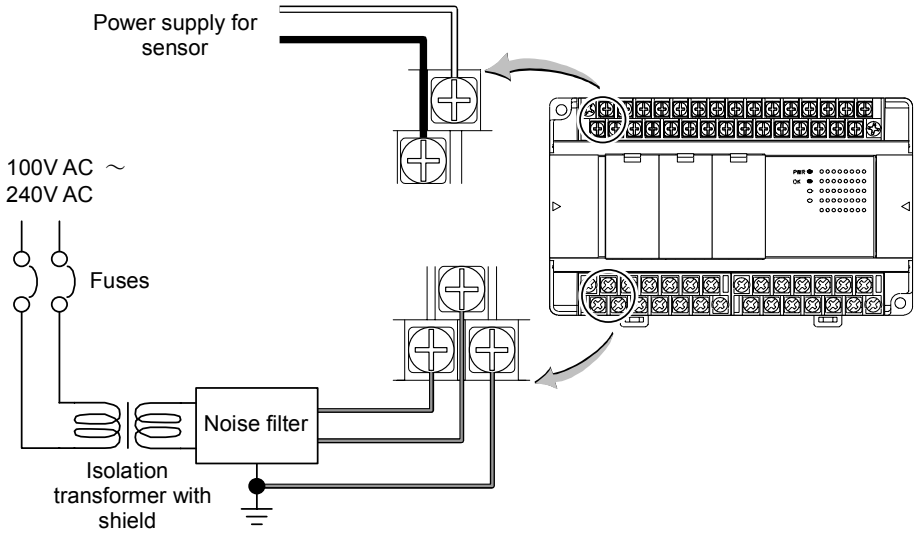
Power Wiring

- For power supply wiring, use a cable of 2mm^2 (0.0031in^2) or more to prevent a voltage drop from occurring.
- The function ground terminal (PE terminal) should use a cable of 2mm^2 (0.0031in^2) or more and Class D grounding (100Ω or less). The length of ground cable should not exceed 20m (65.62ft.).

Warning

The MicroMotion Module must be grounded to minimize electrical shock hazard. Failure to do so could result in injury to personnel.

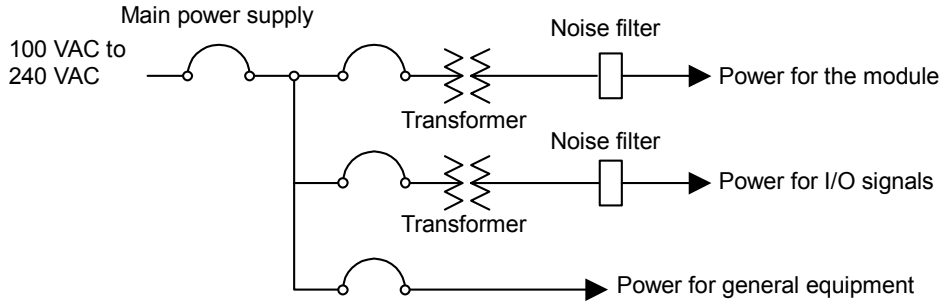
- Avoid joint grounding with equipment that can generate noise.
- If the MicroMotion Module is used as a VersaMax Micro PLC expansion module. It must use the same power supply system as the PLC CPU.
- For module IC200UMM102, connect a noise filter to the power cable.



Separation of the Power Supply

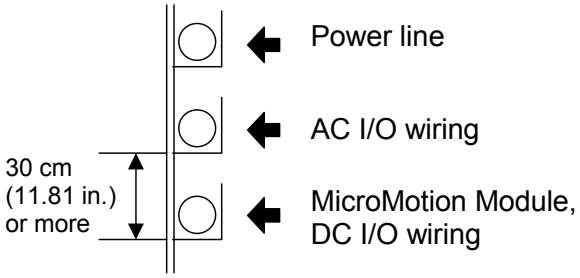
The power for the MicroMotion Module, the I/O signals, and the other equipment should be separated as much as possible.

When these power supplies are supplied from one main power source, separate the wiring with a transformer or similar device, so that each power supply is a separate system. For example:



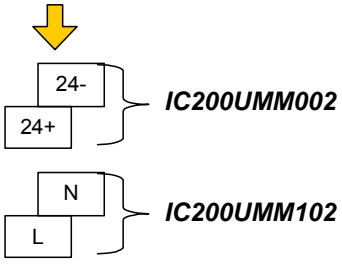
Caution

Be sure to separate the signal wiring of the MicroMotion Module from the power line and the wiring of AC I/O modules as shown below.

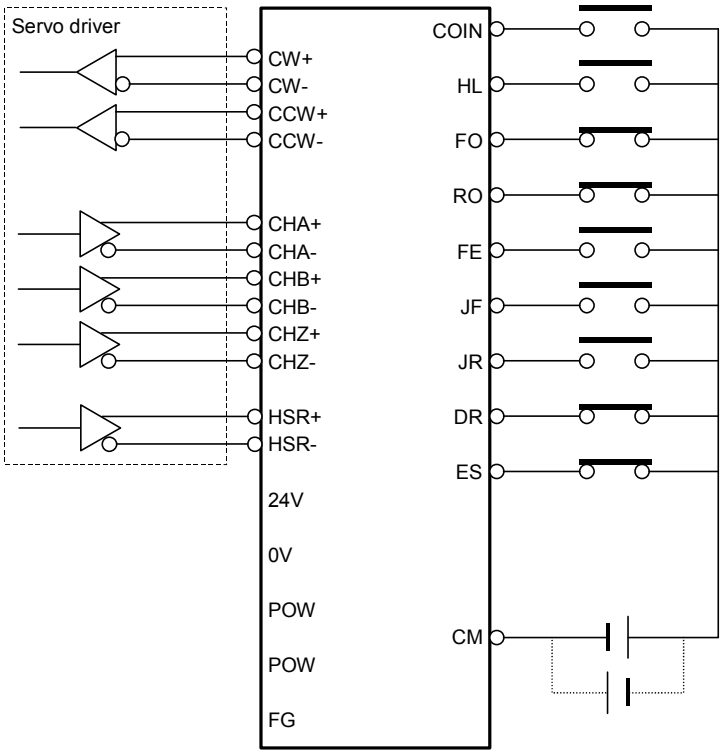


Terminal Assignments

	24V	NC	NC	CW1+	CCW1+	CH1A+	CH1B+	CH1Z+	HSR1+	HL1	RO1	JF1	DR1	COM1	MA1B
0V	NC	NC	CW1-	CCW1-	CH1A-	CH1B-	CH1Z-	HSR1-	COIN1	FO1	FE1	JR1	ES1	MA1A	
	POW	NC	CW2-	CCW2-	CH2A-	CH2B-	CH2Z-	HSR2-	COIN2	FO2	FE2	JR2	ES2	MA2A	NC
POW	FG	NC	CW2+	CCW2+	CH2A+	CH2B+	CH2Z+	HSR2+	HL2	RO2	JF2	DR2	COM2	MA2B	



I/O Signal Wiring

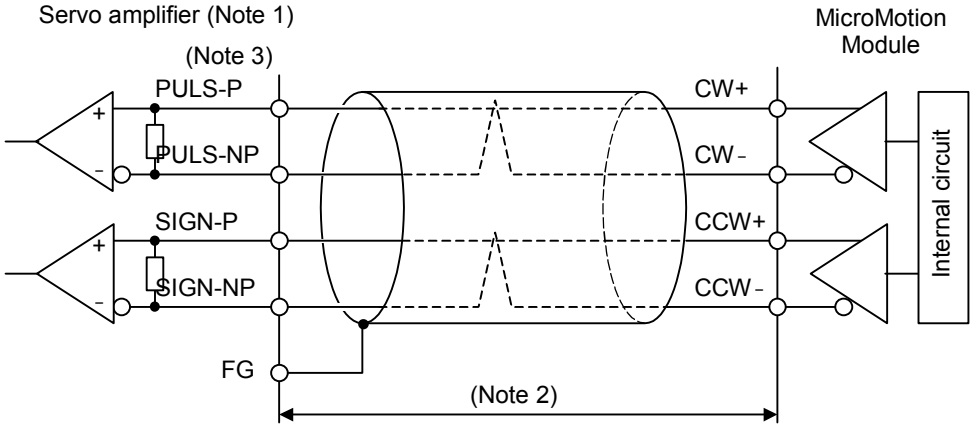


I/O Signals

Axis A	Axis B	Type	Details
CW1+ (PLSP)	CW2+ (PLSP)	Output	Line driver
CW1- (PLSN)	CW2- (PLSN)		
CCW1+ (SIGP)	CCW2+ (SIGP)		
CCW1- (SIGN)	CCW2- (SIGN)		
CH1A+	CH2A+	Input	Counter phase A
CH1A-	CH2A-		
CH1B+	CH2B+		Counter phase B
CH1B-	CH2B-		
CH1Z+	CH2Z+		Counter phase Z
CH1Z-	CH2Z-		
HSR1+	HSR2+		Registered distance shift trigger input
HSR1-	HSR2-		
HL1	HL2		Home position limit input
COIN1	COIN2		Positioning completion input
FO1	FO2		CCW direction limit input
RO1	RO2		CW direction limit input
JF1	JF2		CCW direction manual operation input
JR1	JR2		CW direction manual operation input
FE1	FE2		Speed change input
DR1	DR2		Operation OK/Ready input
ES1	ES2		Emergency stop input
COM1	COM2	Common	Common
MA1A	MA2A	Input	Not used, reserved
MA1B	MA2B		Not used, reserved

Output Wiring to a Servo Amplifier

Example wiring between the module and a servo amplifier is shown below.



Note 1: In general, shielded cables should be grounded only on the receiving terminal side (input side). However, it may be better to leave both sides open, or to ground on the sending terminal side or on both sides, depending on the noise environment and the ground conditions.

Note 2: If the output wiring cable is long, the output pulse wave is weakened. As a result, the servo amplifier may not receive signals properly when the output frequency is high. Keep the cable length as short as possible. Depending on the cable type and the load on the servo amplifier, cables of 5m (16.40ft.) or less are recommended.

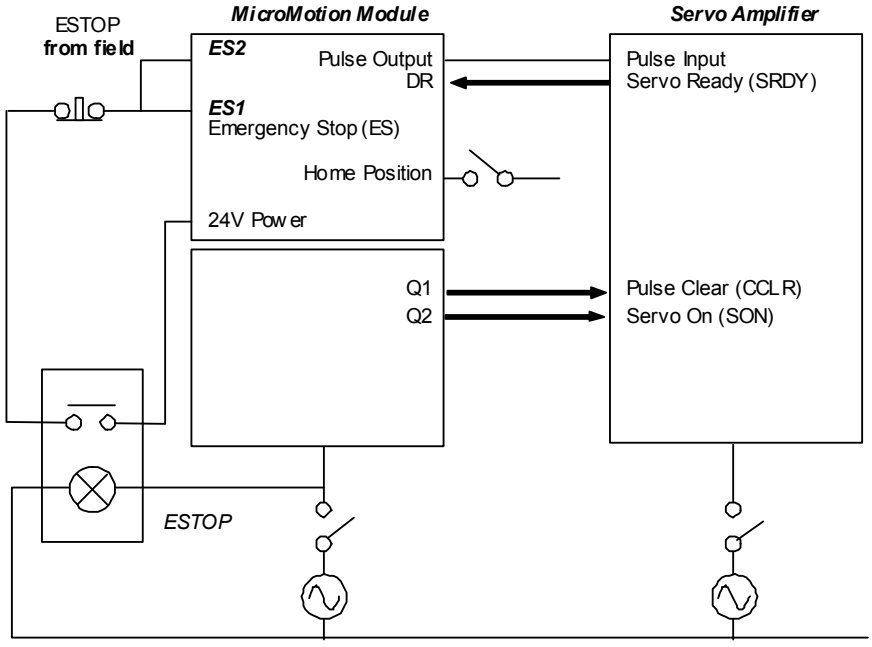
Note 3: Signal names depend on the type of the servo amplifier being used. Check the servo amplifier specifications before connecting it to the MicroMotion Module.

Adding an Emergency Stop Circuit

The DC-powered MicroMotion Module, IC200UMM002, requires at least 20ms to react when power is removed. The AC-powered MicroMotion Module, IC200UMM102, requires at least 1.1 second to react when power is removed. If power is removed for shorter periods of time, motion continues as though no power down condition had occurred.

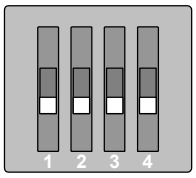
If the application requires motion to stop immediately on removal of power to the MicroMotion Module, connect a contactor/relay (EStop) to the power supply input of the MicroMotion Module. Use the normally-open contact of this contactor/relay to drive the Emergency Stop Input of the MicroMotion Module. When power is applied to this contactor, the Emergency Stop input of the MicroMotion Module is high, so Emergency stop is not active. When power is removed, the relay is deactivated and the module's Emergency Stop input goes Off. The length of time required for motion to then stop would depend on the deactivation time of the contactor/relay and on the module's setup parameter for Emergency Stop (Fast or Decelerated). In this type of installation, power tp the servo amplifier must also be removed when the power to the motion controller is removed.

NOTE: When the MicroMotion Module is used in a VersaMax PLC System, the PLC CPU and MicroMotion Module must share the same power source.



DIP Switch Settings

The DIP switches located behind the removable door on the front of a MicroMotion Module are factory-set to OFF (down position) as shown below.



These switches can be set as described below. Chapter 3 gives additional details about the use of switch 3 to control data exchange with a Memory Pack module.

Switch	***Description***
1	*Communication Speed* ON Set using MicroMotion Module setup software/CPU/controller. OFF 57.6 kbps / 8 bits – EVEN parity – 1 Stop bit.
2	*Standalone or Expansion Module Operation* ON Standalone mode (not as expansion unit to Micro PLC). OFF Controlled by a Micro PLC. (Be sure this switch is turned off before connecting to a Micro PLC.)
3	*Memory Pack Module Operation* ON Writes parameters from the Memory Pack module into the backup memory of the MicroMotion Module. OFF When the power supply is on, the MicroMotion Module starts without reading a parameter from the Memory Pack module. *If parameters already stored to the MicroMotion Module should be maintained, this switch should be turned off while installing Memory Pack module on the MicroMotion Module.* If this switch is off, parameters will not be read from the Memory Pack module into the backup memory of the MicroMotion Module.
4	(Used by the system) Do not turn on. (Starts in boot mode.)

Starting Up the Module

Before applying power to the MicroMotion Module:

- Be sure all mounting screws, terminal screws, cables and other items are properly tightened and secured.

Warning

Be sure the protective covers are installed over terminals when power is applied to the unit. The covers protect against accidental shock hazard that could cause severe or fatal injury.

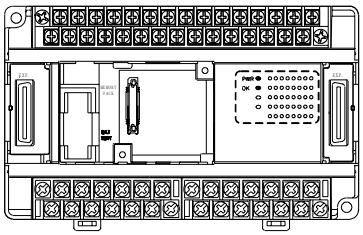
- Double-check all wiring. Faulty wiring may result in damage the module.
- Do not turn on the power supply to a broken module.
- If the MicroMotion Module is part of a VersaMax Micro PLC system, be sure that all expansion units connected to the Micro PLC are wired to the same power source and that the PLC and expansion units will power up together. If an attached expansion unit is left unpowered, the Micro PLC may not power up properly.

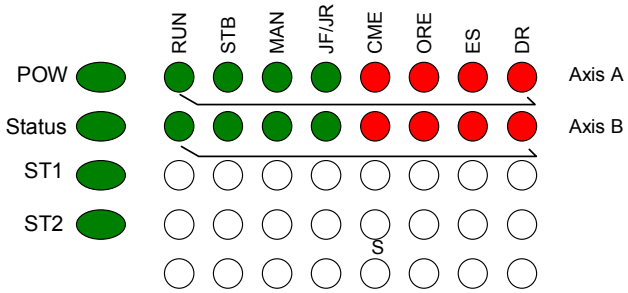
Normal Powerup Sequence

Apply the required power to the power inputs and observe the module LEDs. See the LED descriptions that follow.

LEDs on the MicroMotion Module

LEDs on the MicroMotion Module display the status of the module and its inputs and outputs.





LED	*Color*	*Description*
POW	Green	ON indicates the presence of power supply to the module.
Status OK	Green	ON when there is no error in the module.
ST1	Green	ON when there is no software error in the MicroMotion Module. This LED turns off if an error occurs in the system, axis A, or axis B.
ST2	Green	ON while various settings are being stored in backup memory. If power is turned off while this LED is ON, the parameters may not be stored correctly.
RUN	Green	ON when the axis (A or B) is operating, and outputting a pulse. The RUN LED is OFF during a Dwell in Auto mode.
STB	Green	ON when the axis (A or B) is standing by.
MAN	Green	ON when the axis (A or B) is being operated manually (external input mode). Turns OFF if the manual operation is cancelled.
JF / JR	Green	ON when either Jog Forward or Jog Reverse is ON on the axis (A or B). Turns OFF when both Jog Forward and Jog Reverse are OFF.
CME	Red	OFF if a command error occurs on the axis (A or B). Turns OFF if the command is performed without error or if error clear operation is performed.
ORE	Red	Indicates the status of overrun inputs Forward Overtravel and Reverse Overtravel on the axis (A or B). ON when either Forward Overtravel or Reverse Overtravel is OFF. OFF when Forward Overtravel and Reverse Overtravel are both ON. The overrun status may be retained in the module even if the ORE LED is off.
ES	Red	Indicates whether there is an emergency stop (ES) on the axis (A or B). ON when the Emergency Stop input is OFF. OFF when the Emergency Stop input is ON. The error must be cleared to restart operation of the MicroMotion Module.
DR	Red	Indicates the status of Drive OK/Ready input (COIN) on the axis (A or B). ON when the Drive OK/Ready input is OFF. This LED is turned OFF if the Drive OK/Ready input turns ON. The error must be cleared to restart the MicroMotion Module.
S	Green	Indicates Module is operating in Standalone mode.

Chapter 3 Memory and Port Option Modules

This chapter describes use of VersaMax Micro PLC port and memory option modules with a MicroMotion Module:

- Port Option Modules
  - Port Modules Description
  - Port Module Installation
- Memory Pack Module
  - Memory Pack Description
  - Memory Pack Installation
  - Reading Data from the Memory Pack at Startup
  - MicroMotion Module DIP Switch Setting for a Memory Pack
  - Write Protect Switch on the Memory Pack
  - Reading Data from the Memory Pack at Startup
  - Writing Data from the MicroMotion Module to the Memory Pack

3

Port Option Modules for MODBUS Communications

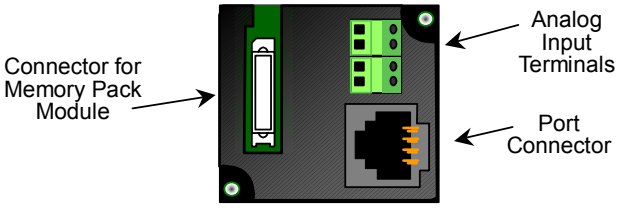
- RS232 Port Option Module IC200USB001
- RS485 Port Option Module IC200USB002
- Ethernet Option Module IC200UEM001
- USB Option Module IC200UUB001

Port Modules Description

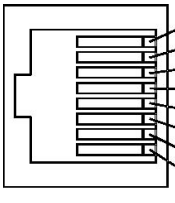
One Port Option module (USB001, USB002, UUB001, or UEM001) and/or a Memory Pack module (UMB001) can be installed on the front of a MicroMotion Module. A communications module is required for communications with a host controller.

RS232 and RS485 Option Modules

The RS232, RS485, and Ethernet Option Modules have a built-in connector for two analog inputs that is not used in MicroMotion Module applications.



For the RS232 and RS485 modules, pin assignments for the port connector are:



RS232

8	SG	Signal Ground
7	VCC	5VDC Output
6	10V	10VDC Output
5	NC	-
4	SD	Sent Data
3	RD	Received Data
2	NC	-
1	RS	Request to Send

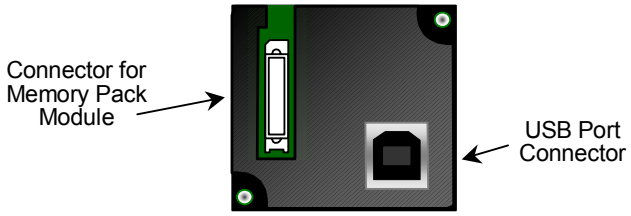
RS422/485

8	SG	Signal Ground
7	VCC	5VDC Output
6	NC	Not used
5	TX(+)	Send Data +
4	TX (-)	Send Data -
3	RX (-)	Received Data -
2	RX (+)	Received Data +
1	RT	Terminal Resistor

An external device can obtain power from the 5VDC output pin if it requires 200mA or less at 5VDC.

USB / RS232 Conversion Option Module

Option Module IC200UUB001 can be used to provide a USB Port.

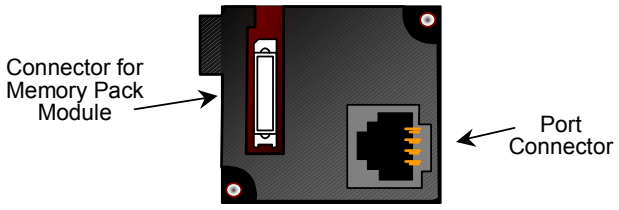


Characteristics of the USB port are:

Connector	Straight B type
USB version	2.0
Power	Self power
Baud Rates Supported	4800 through 19200 only. Do not configure other baud rates for Port 2 when using the USB Conversion Option Module.

Ethernet Option Module

Ethernet Module IC200UEM001 can be used to provide an Ethernet Port.



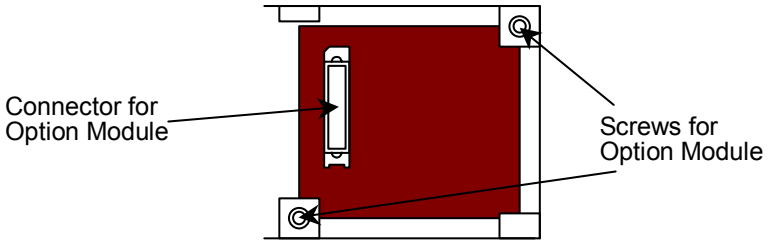
If the Ethernet Option Module is used with a MicroMotion Module, only the MODBUS TCP/IP Server capability is available. Communications drivers must be downloaded from GEFanuc.com. Refer to the datasheet for the Ethernet Option Module, GFK-2436, for more information.

Port Mode	RTU
Port Type	Slave
Data Rate	38400
Flow Control	None
Parity	Odd
Station Address	xxx

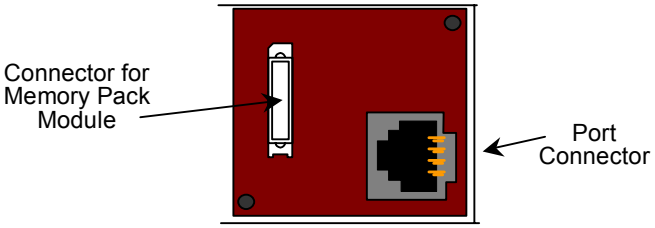
Port Module Installation

Power to the MicroMotion Module MUST BE TURNED OFF when installing or removing Option Modules.

1. Access the option connector on the front of the MicroMotion Module.
2. If a Port Option Module is being installed, orient the connector on the Port Option Module with the connector in the MicroMotion Module. Be careful to avoid contact with the exposed components in the module.



3. Press the Port Option Module downward until it clicks into place.
4. Install the screws provided with the Port Option Module into the corners as shown above.



Memory Pack Module

The VersaMax Micro PLC Memory Pack Module, IC200UMB001, can be used to store and update data in a MicroMotion Module in either a host controller system or VersaMax Micro PLC.

Memory Pack Description

The Memory Pack plugs directly onto the MicroMotion Module. Power for the Memory Pack comes from the connector.

When a Memory Pack is installed on the MicroMotion Module, the MicroMotion Module can read / write some or all of its motion setup data to the Memory Pack. After the data is stored on the Memory Pack, the data can be copied to one or more other MicroMotion Modules, with no additional setup needed.

Memory Pack Features

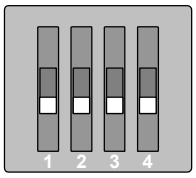
- Store 128kB of data.
- Read the data at power up.
- Write the data on command

Memory Pack Installation

1. Power to the MicroMotion Module MUST BE TURNED OFF when installing or removing Option Modules.
2. If a Memory Pack Module is being installed, orient the connector on the back of the Memory Pack with the connector on the MicroMotion Module or Port Option Module. Press the Memory Pack downward until it clicks into place.
3. Install the protective cover(s). If only the Memory Pack is used, both covers may be installed. If a port module is used, the righthand cover is not installed and the port connector remains accessible.

MicroMotion Module DIP Switch Setting for a Memory Pack

The DIP switches located behind the removable door on the front of a MicroMotion Module are factory-set to OFF (down position) as shown below.

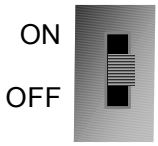


Switch 3 must be set to On to enable use of the Memory Pack for reading data in the MicroMotion module.

- If switch 3 is set to On, the Memory Pack can be used to write (or overwrite) parameters in the backup memory of the MicroMotion Module.
- If switch 3 is set to Off, parameters will not be read from the Memory Pack into the backup memory of the MicroMotion Module. When the MicroMotion Module is powered up, it will start without reading parameters from the Memory Pack.

If parameters already stored to the MicroMotion Module should be maintained, this switch should be turned off while installing Memory Option Module on the MicroMotion Module.

Write Protect Switch on the Memory Pack



When the Write Protect switch on the Memory Pack is in the On position, it prevents writing data to the Memory Pack.

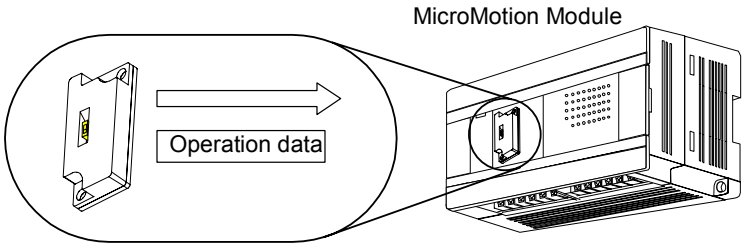
Caution

If the Write Protect switch is in On, it prevents writing data to the Memory Pack by the Motion module however no error message is generated and there is no indication that the data has not been written. This should be considered before setting the Write Protect switch.

Reading Data from the Memory Pack at Startup

The Memory Pack can be installed and removed only when power to the MicroMotion Module is Off. Do not install and remove the Memory Pack during operation.

When the MicroMotion Module is powered up, if DIP Switch 3 is set to the On position, the MicroMotion Module checks for the presence of a Memory Pack. If a Memory Pack is connected to the port 2, the MicroMotion Module automatically reads all the data (Common Parameters, Profiles, Sequence Table) in the Memory Pack.The MicroMotion Module stores the data in its internal backup memory. The MicroMotion Module will use the data copied from the Memory Pack at the next powerup, even if the Memory Pack has been removed while power was turned off.



The ST2 LED keeps blinking while the data is being transferred from the Memory Pack. Wait until the ST2 LED stops blinking to do any further operations.

If the DIP Switch 3 is On and the Write Protect switch on the Memory Pack is either On or Off, the data from the Memory Pack will be written to the MicroMotion Module at power up.

Writing Data from the MicroMotion Module to the Memory Pack

To copy the operating data stored in the MicroMotion Module into the Memory Pack, turn power off and install the Memory Pack. Be sure to turn off DIP switch 3 on the MicroMotion Module. Otherwise, the operating data stored in the Memory Pack would overwrite the operating data stored in the MicroMotion Module. Turn on the power supply.

The MicroMotion Setup Tool provides a user interface to format, initialize, and write data to a Memory Pack from a computer (see chapter 5). For a MicroMotion Module that is installed as an expansion module in a VersaMax Micro PLC system, the PLC CPU can initiate a write to a Memory Pack using commands F0 to F8 in the module's Control Output data. For a MicroMotion Module that is operating in standalone mode, the host controller can initiate a write to a Memory Pack by setting respective output coils 400 to 415.

Power to the MicroMotion Module must remain On during the backup, or the data will be lost. The ST2 LED on the front of the MicroMotion Module indicates whether the data is backed up to the module's internal memory and to the Memory Pack.

Chapter 4 Motion Operations

This chapter describes the operating modes of the MicroMotion Module:

- ***Homing mode***: establishes a Home Position for an axis, and writes the Home position data to axis output position data.
- ***Manual mode***: controls axis movement using external input signals or commands from the controller.
- ***Automatic mode***: controls axis movement using stored profiles and sequence data.

The easiest way to set up or change motion parameters is to use the MicroMotion setup tool. Motion parameters can also be written from the VersaMax Micro PLC CPU or host controller. For more information about setting up parameters, profiles, and the sequence table, please see:

Chapter 5: Using the MicroMotion Setup Tool explains how to use the MicroMotion Setup Tool to define module parameters, profiles, and the sequence table, and to how to monitor motion operations.

Chapter 7: MicroMotion in a VersaMax Micro PLC System explains how to read and write data using the module's assigned VersaMax PLC Input Status references and Output Control references.

Chapter 8: MicroMotion in a Host Controller System describes the details of data exchange between the MicroMotion Module and a host controller.

Chapter 9: Data Formats for MODBUS Communications defines the MicroMotion Module data that can be read or written using MODBUS RTU communications.

Homing Mode

Homing mode is used to establish a Home Position for an axis.

Homing Mode Parameters

The Homing mode parameters are: (Refer chapter 5 for details of these parameters)

Home Position (Common Parameter 22): the current position when homing is completed. When the homing is completed, the current axis position becomes the Home Position.

Final Home Velocity (Common Parameter 9): the lower-speed Final Home Velocity.

Find Home Velocity (Common Parameter 8): the maximum velocity for high-speed Homing moves.

Acceleration Rate (Common Parameter 10): the rate to accelerate to the high-speed Find Home Velocity.

Deceleration Rate (Common Parameter 11): the rate to decelerate from the high-speed Find Home Velocity.

Home Position Offset (Common Parameter 23): an exact adjustment distance to move the axis when the homing is completed.

Homing Direction (Bit 8 of Common Parameter 1): used for rotary motion, the Homing Direction determines whether the direction will commanded, or automatically-calculated based on the shortest distance.

Homing Operations

The Home Position can be established using:

- *Free Homing*: which sets the Home Position data to the current axis output position without moving the axis.
- *Low-speed Homing*: which moves the axis at the Final Home Velocity to the On edge of the Home Position Limit Switch and stops at On edge of Home position, then writes the home position data to the current axis output position.
- *High-Speed Homing (Off Edge)*: which moves the axis at the Find Home Velocity to the On Edge of the Home Position Limit Switch, then changes direction and moves with Final Home Velocity to the Off edge of the Home Position Limit Switch. The axis then moves toward the On edge of the Home Position Limit Switch with fixed velocity and stops at On edge of the Home switch and writes the Home Position data to the current axis output position.
- *High-Speed Homing (Marker Pulse)*: which moves the axis at the Find Home Velocity to the On Edge of the Home Position Limit Switch, then changes direction and moves with final Home Velocity to the Off edge of the Home Position Limit Switch. The axis then moves toward the On edge of the first marker input after the Home Position Limit Switch goes On with fixed velocity and stops at On edge of the first marker input and then writes the home position data to the current axis output position.

Details are given on the following pages.

Controlling Homing Mode

The VersaMax Micro PLC CPU or host controls the execution of Homing mode operations. Using the MicroMotion Setup Tool, place the tool online to a MicroMotion Module. Select Monitor Motion Module option and initiate a homing operation (see chapter 5), or:

- If the MicroMotion Module is part of a VersaMax Micro PLC system, the CPU can use the following commands in the module's Control Output Data to initate Homing (see chapter 7):

Command	*Operation*
10	Perform Free Homing
11	Perform Low-speed Homing (CCW direction)
12	Perform Low-speed Homing (CW direction)
13	Perform High-speed Homing Off Edge (CCW direction)
14	Perform High-speed Homing Off Edge (CW direction)
15	Perform High-speed Homing Marker Pulse (CCW direction)
16	Perform High-speed Homing Marker Pulse (CW direction)

- If the MicroMotion Module has a host controller, the host can set the following MODBUS coils to initiate Homing (see chapters 8 and 9):

Coil	*Operation*
300	Perform Free Homing on Axis A
301	Perform Low-speed Homing (CCW direction) on Axis A
302	Perform Low-speed Homing (CW direction) on Axis A
303	Perform High-speed Homing (OFF Edge / CCW direction) on Axis A
304	Perform High-speed Homing (OFF Edge / CW direction) on Axis A
305	Perform High-speed Homing (Marker / CCW direction) on Axis A
306	Perform High-speed Homing (Marker/CW direction) on Axis A
310	Perform Free Homing on Axis B
311	Perform Low-speed Homing (CCW direction) on Axis B
312	Perform Low-speed Homing (CW direction) on Axis B
313	Perform High-speed Homing (OFF Edge / CCW direction) on Axis B
314	Perform High-speed Homing (OFF Edge / CW direction) on Axis B
315	Perform High-speed Homing (Marker / CCW direction) on Axis B
316	Perform High-speed Homing (Marker / CW direction) on Axis B

General Information about Homing

If the axis is already operating (the Run bit is On), homing cannot be performed. Attempting to perform homing on an operating axis causes an error.

During Low-Speed or High-Speed Homing, other commands that can be executed during Run mode can be executed. However, commands to change velocity, the registration input, and feedrate override are not accepted.

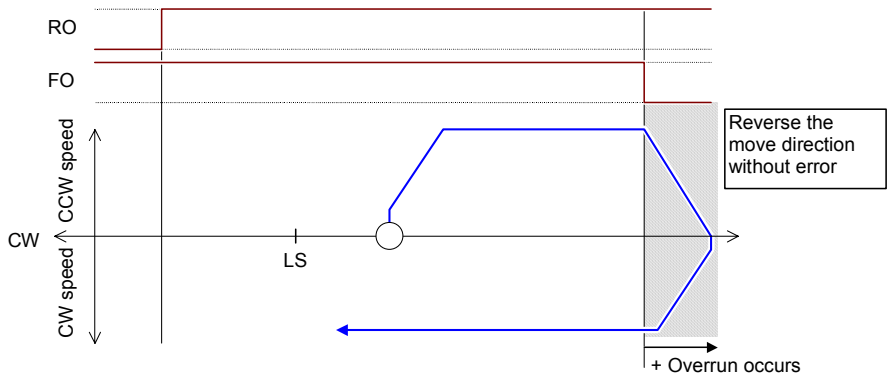
Effect of External Inputs during Homing

1. ***If an overrun already exists*** (the Forward Overrun (FO) or Reverse Overrun (RO) input for the axis is On) Free Homing cannot be started. For Low-Speed Homing and High-Speed Homing, motion can be started in the opposite direction.
2. ***If the Emergency Stop (ES) input goes Off*** in Free Homing, an error occurs. Low-Speed or High-Speed Homing cannot be performed if the Emergency Stop (ES) input is Off. The ES input must be turned On and the error cleared. If the Emergency Stop (ES) input goes Off during Low-Speed or High-Speed Homing, a fast or normal stop occurs.
3. ***If the Drive OK/Ready (DR) input for the axis is Off***, Free Homing cannot be performed. If DR goes Off during Low-Speed or High-Speed Homing, a fast stop occurs.
4. Free Homing cannot be performed if the Move Complete (COIN) input for the axis is Off.

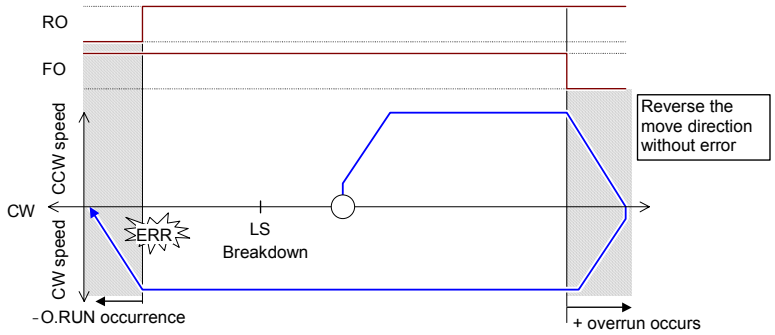
5. ***If an overrun occurs*** during Free Homing, (FO / RO input goes Off), an error occurs.

   For Low-Speed or High-Speed Homing, motion stops temporarily. No error occurs. Motion resumes in the opposite direction. If the RO or FO input goes Off again while moving in the opposite direction, an error occurs.

   If Low-Speed or High-Speed Homing is performed in a direction that moves *away from* the Limit Switch, an Overrun occurs and the direction is reversed.

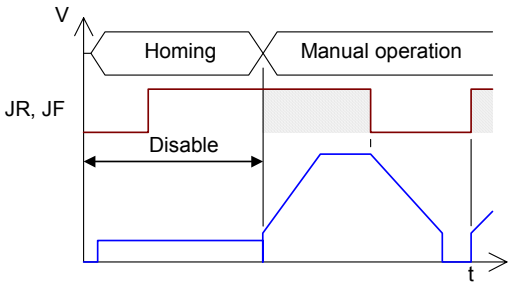


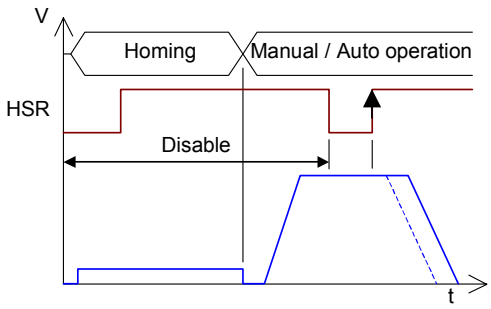
   If the Limit Switch is not able to turn On after the first overrun, motion past the Limit Switch position causes a second overrun, which generates an error as shown below, and motion stops.

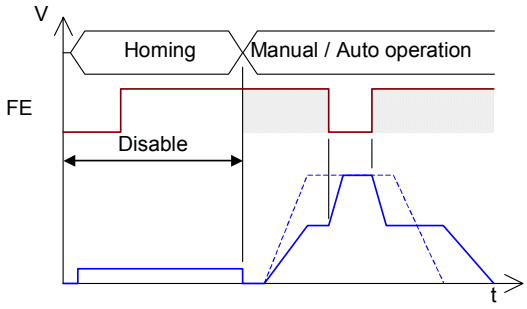


The Overrun (FO / RO) and Emergency Stop (ES) inputs can stop the pulse output. Whether these inputs cause a normal stop or a fast stop depends on their Common Parameter setting. If the move velocity is slow, a fast stop is always used.

6. ***The Jog Reverse (JR), Jog Forward (JF) and High-Speed Registration (HSR)*** inputs are disabled during Low-Speed or High-Speed Homing.

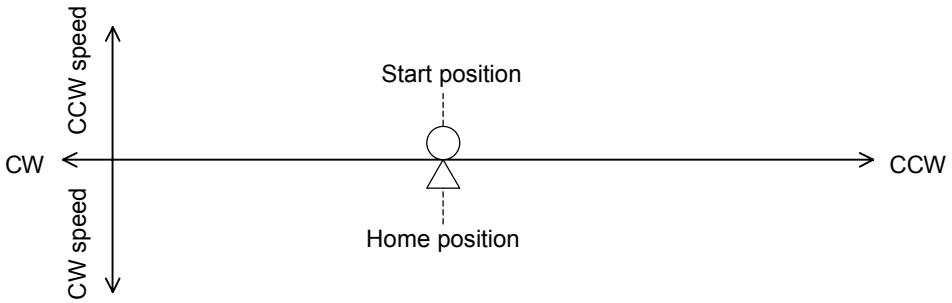






Free Homing

Free Homing must be performed while the axis is stopped. In Free Homing, the operation is complete when the the Home Position data is written into current axis output position

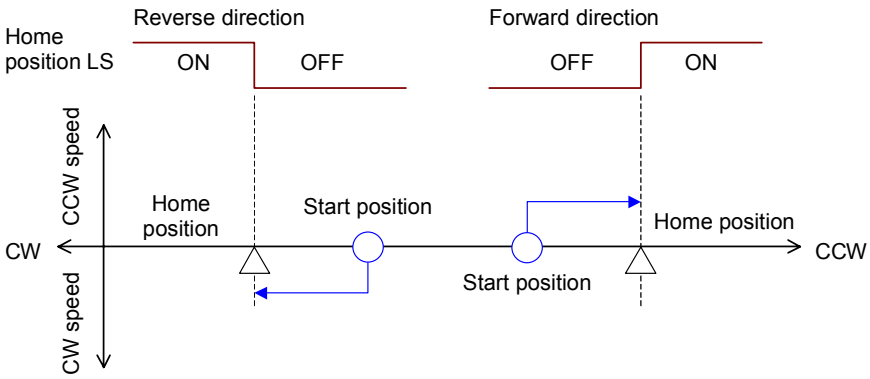


Low-speed Homing

In Low-Speed Homing, the axis moves in the commanded direction at the Final Home Velocity to a position where the Home Position Limit Switch turns On. Axis motion in Low-Speed Homing depends on whether the Home Position Limit Switch is On or Off when Homing starts.

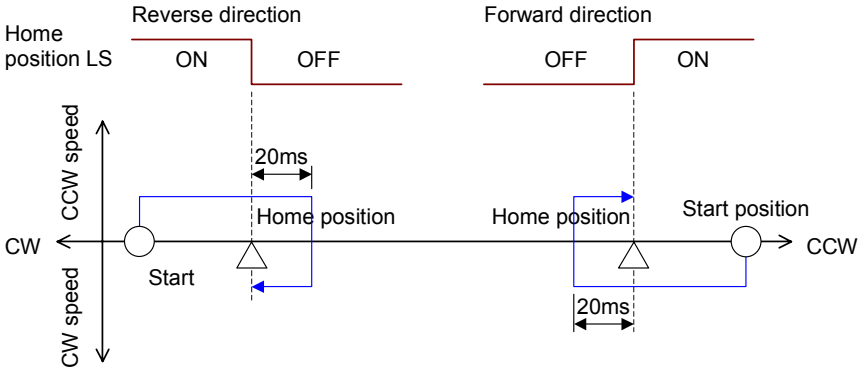
Low-Speed Homing when Home Position Limit Switch is Off

If the Home Position Limit Switch is Off at the start of Low-Speed Homing, the axis moves in the commanded direction to the On edge of the Home Position Limit Switch. The axis stops, and the current axis position becomes the Home Position. Homing is then complete.



Low-Speed Homing when Home Position Limit Switch is On

If the Home Position Limit Switch is On at the start of Low-Speed Homing, the axis moves in the commanded direction until it passes the Home Position Limit Switch position, turning Off the Home Position switch. The axis continues for 20ms beyond the Off edge of the Home Position switch and stops. The axis then starts moving in the reverse direction to the On edge of the Home Position Limit Switch. The axis stops and the Home Position becomes the current axis output position. Homing is complete.



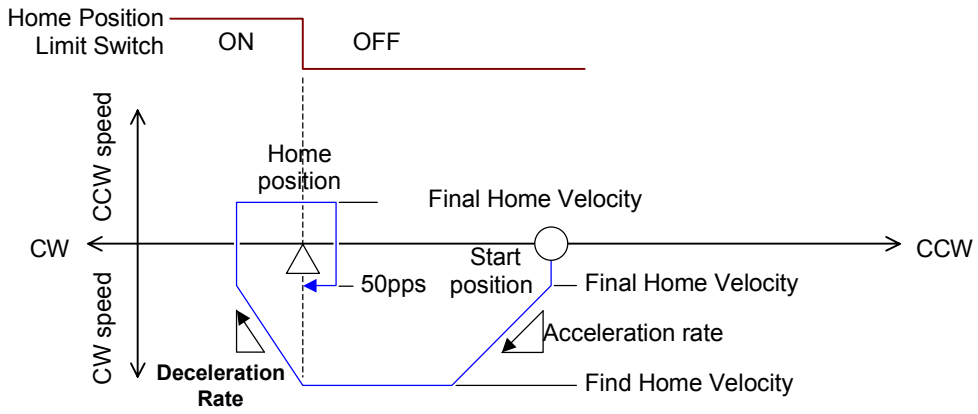
High-Speed Homing [Off-Edge]

In High-Speed Homing [Off Edge], the axis moves in the commanded direction at the Final Home Velocity to a position where the Home Position Limit Switch turns On.

Axis motion in High-Speed Homing [Off Edge] depends on whether the Home Position Limit Switch is On or Off when homing starts.

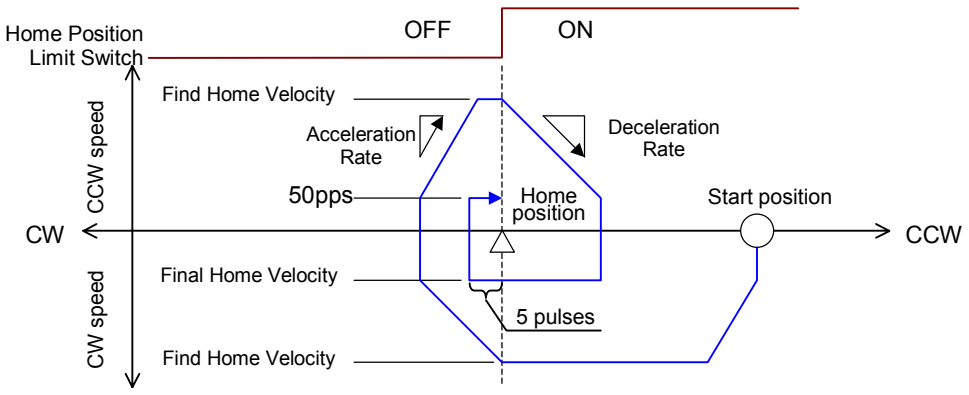
If the Home Position Limit Switch was Off at the start of High-Speed Homing [Off Edge]

- Motion starts in the commanded direction at the Final Home Velocity.
- The axis accelerates to the Find Home Velocity, and stops while slowing down at the On edge of the Home Position Limit Switch.
- The axis reverses direction and moves to the Off edge of the Home Position Limit Switch, at the Final Home Velocity.
- The axis stops 5 pulses from the Off edge of the Home Position Limit Switch.
- The axis reverses direction again and continues at a velocity of 50pps.
- The axis stops at the On edge of the Home Position Limit Switch. The Home Position becomes the current axis ouptut position and Homing is complete.



If the Home Position Limit Switch was On at the start of High-Speed Homing [Off Edge]:

- Motion starts in the commanded direction at the Final Home Velocity.
- The axis accelerates to the Find Home Velocity, and stops while slowing down at the Off edge of the Home Position Limit Switch.
- The axis reverses direction and accelerates from the Final Home Velocity to the Find Home Velocity.
- The axis moves at the Find Home Velocity to the On edge of the Home Position Limit Switch, then stops while slowing down.
- The axis reverses direction again and moves to the Off edge of the Home Position Limit Switch.
- The axis moves 5 pulses from the Off edge of the Home Position Limit Switch and stops.
- The axis reverses direction again and moves at 50pps to the On edge of the Home Position Limit Switch.
- The Home Position becomes the current axis output position and homing is complete.



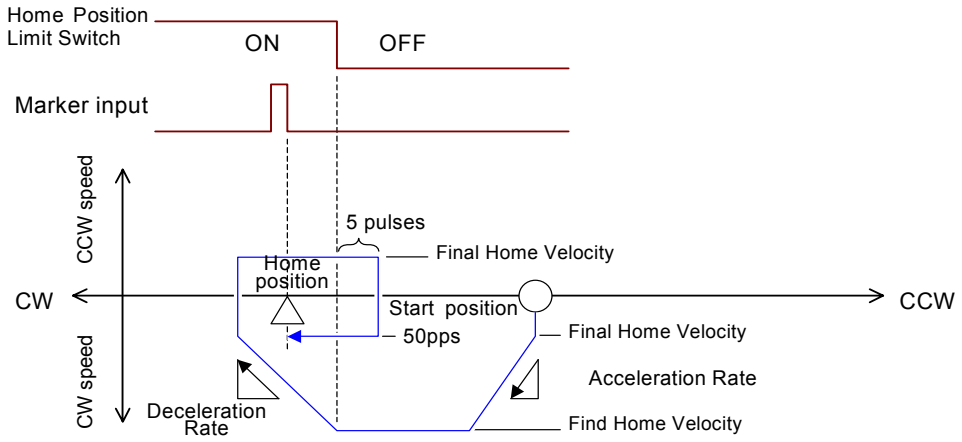
High-Speed Homing [Marker]

In High-Speed Homing [Marker], the axis moves in the commanded direction at the Final Home Velocity to the first marker input past the Home Position Limit Switch.

Axis motion in High-Speed Homing [Marker] depends on whether the Home Position Limit Switch is On or Off when homing starts.

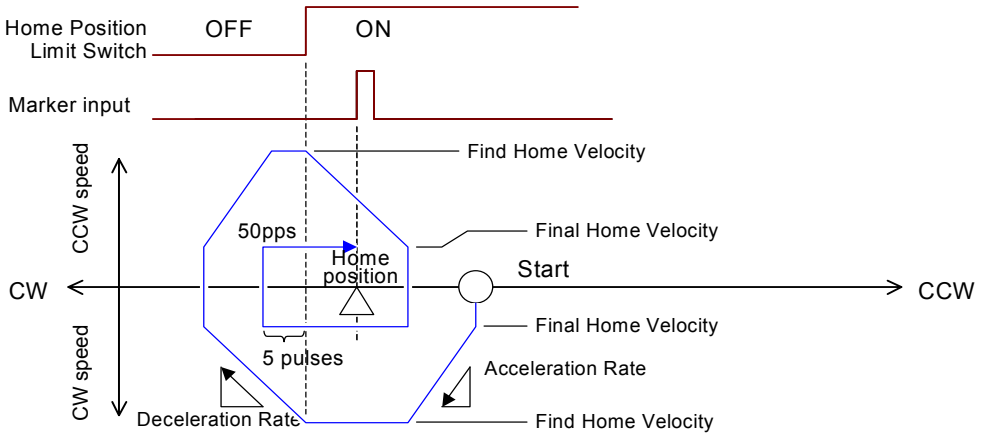
If the Home Position Limit Switch was Off at the start of High-Speed Homing [Marker]

- Motion starts in the commanded direction at the Final Home Velocity.
- The axis accelerates to the Final Home Velocity, and stops while slowing down at the On edge of the Home Positoin Limit Switch.
- The axis reverses direction and moves to the Off edge of the Home Position Limit Switch, at the Final Home Velocity.
- The axis stops 5 pulses past the Off edge of the Home Position Limit Switch.
- The axis reverses direction again, and continues at a velocity of 50pps.
- The axis stops at the On edge of the first marker input after the Home Position Limit Switch turns On. The Home Position becomes the current axis output position and Homing is complete.



If the Home Position Limit Switch was On at the start of High-Speed Homing [Marker Pulse]:

- Motion starts in the commanded direction at the Final Home Velocity.
- The axis accelerates to the Find Home Velocity, and stops while slowing down at the Off edge of the Home Position Limit Switch.
- The axis reverses direction and accelerates from the Final Home Velocity to the Find Home Velocity.
- The axis moves at the Find Home Velocity to the On edge of the Home Position Limit Switch, then stops while slowing down.
- The axis reverses direction again and moves at the Final Home Velocity to the Off edge of the Home Position Limit Switch.
- The axis moves 5 pulses from the Off edge of the Home Position Limit Switch and stops.
- The axis reverses direction again and moves at 50pps to the On edge of the first marker input after the Home Position Limit Switch turns On.
- The Home position data is written to the current axis output position and homing is complete.



Manual Mode

An axis can perform the following operations in Manual mode:

- *Inching* The axis outputs a pulse for specified distance in either clockwise or counter-clockwise direction.
- *Jogging* The axis outputs a continuous pulse until a Stop input or Stop command is received.

Manual Mode Parameters

The Manual mode parameters are: (Refer chapter 5 for details of these parameters)

Initial Velocity (Common Parameter 13): the initial velocity for the axis when the Jog Forward (JF) or Jog Reverse (JR) input is on, in User Units per second.

Maximum Velocity (Common Parameter 12): the greatest velocity for the pulse output when the Jog Forward (JF) or Jog Reverse (JR) input is on, in User Units per second.

Acceleration Rate (Common Parameter 14): the acceleration rate for Manual operation, in (User Units per second)^2.

Deceleration Rate (Common Parameter 15): the deceleration rate for Manual operation, in (User Units per second)^2.

Move Type for External Input (Bit 12 & 13 of Common Parameter 2): the type of Manual operation to be performed while the Jog Forward (JF) or Jog Reverse (JR) input is on: jog, inching, or inching plus jog.

Inching Distance (Common Parameter 16): Specify the distance for the inching operation when the Jog Forward or Jog Reverse input is turned on in Manual mode. Distance is in User Units.

Manual mode parameters can be set using the MicroMotion setup tool, or set by command from the VersaMax Micro PLC CPU or host controller.

Controlling Manual Mode

By default, the axis's pulse output for inching or jogging moves is controlled by commands from the VersaMax Micro PLC or host controller. Alternatively, Manual mode can be controlled by external input signals to the MicroMotion module.

Manual mode operation by external input signals must be explicitly enabled by the CPU or host. Once the axis is operating in external input mode, the CPU or host can no longer control the axis. The CPU or host must cancel external input mode to be able to control the axis again.

Using the MicroMotion Setup Tool, place the tool online to a MicroMotion Module,. Select Monitor Module and initiate a Manual Mode operation (see chapter 5), or use the commands below for a CPU or host controller.

Controlling Manual Mode, VersaMax PLC CPU

If the MicroMotion Module is part of a VersaMax Micro PLC system, the CPU can use the following commands in the module's Control Output Data to enable or disable Manual mode control by external inputs (see chapter 7):

Command	Operation
23	Manual operation: Use external input mode
24	Manual operation: Cancel external input mode

If External Input mode is NOT enabled as described above, the VersaMax Micro PLC CPU can use the following commands in the module's Control Output Data to control the axis (axis selection is done in word 1 of the Control Output Data):

Command	Operation
40	Perform Jog (consecutive pulse output/CCW direction)
41	Perform Inching (designated distance pulse output/CCW direction)
42	Perform Jog (consecutive pulse output/CW direction)
43	Perform Inching (designated distance pulse output/CW direction)

Controlling Manual Mode, Host Controller

If the MicroMotion Module has a host controller, the host can set the following MODBUS coils to enable or disable Manual mode operation with external inputs (see chapters 8 and 9):

Coil	Operation
292	Set / cancel Manual (external input) mode on Axis A
293	Set / cancel Manual (external input) mode on Axis B

If External Input mode is NOT enabled as described above, the host controller can set the following MODBUS coils to control the axis:

Coil	Operation
360	Perform Jog (consecutive pulse output/CCW direction) on Axis A
361	Perform Inching (designated distance pulse output/CCW direction) on Axis A
362	Perform Jog (consecutive pulse output/CW direction) on Axis A
363	Perform Inching (designated distance pulse output/CW direction) on Axis A
370	Perform Jog (consecutive pulse output/CCW direction) on Axis B
371	Perform Inching (designated distance pulse output/CCW direction) on Axis B
372	Perform Jog (consecutive pulse output/CW direction) on Axis
373	Perform Inching (designated distance pulse output/CW direction) on Axis B

Manual Operation by CPU or Host Controller Commands

Manual operation can be controlled by a command instruction unless:

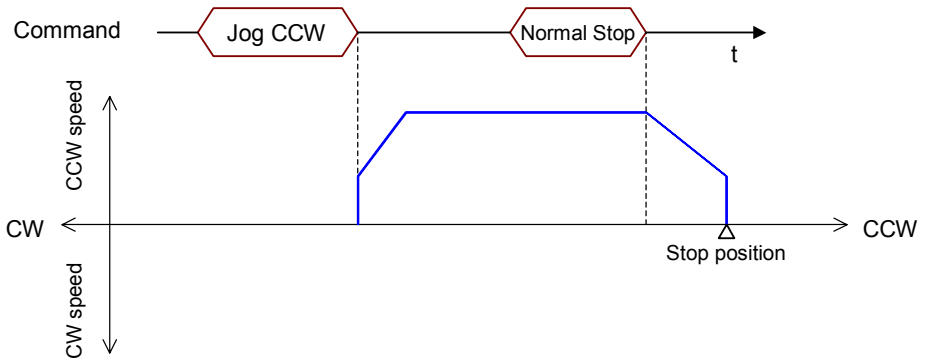
1. The axis is operating in external input mode. The CPU or host must cancel external input mode as described on the previous pages to control the axis again.
2. An overrun exists in the direction of movement.

Jogging Operation by Command

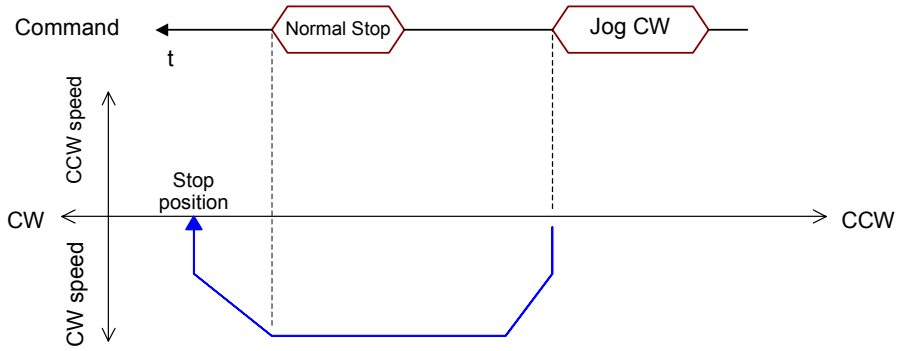
If the CPU or host writes the command for Jogging in the counter-clockwise direction, the axis outputs a forward pulse. If the command for Jogging in clockwise direction is given, the reverse pulse is output. If the Manual mode command for the opposite direction is given while Jogging is executing, the axis slows and stops.

When a Jog command is received, the axis accelerates at the Manual mode Acceleration more from the Initial Velocity to the Maximum Velocity. If the decelerated stop command or the stop command is received, the pulse slows to a stop at the Deceleration Rate or stops immediately, based on the command received.

Jog CCW by Command



Jog CW by Command



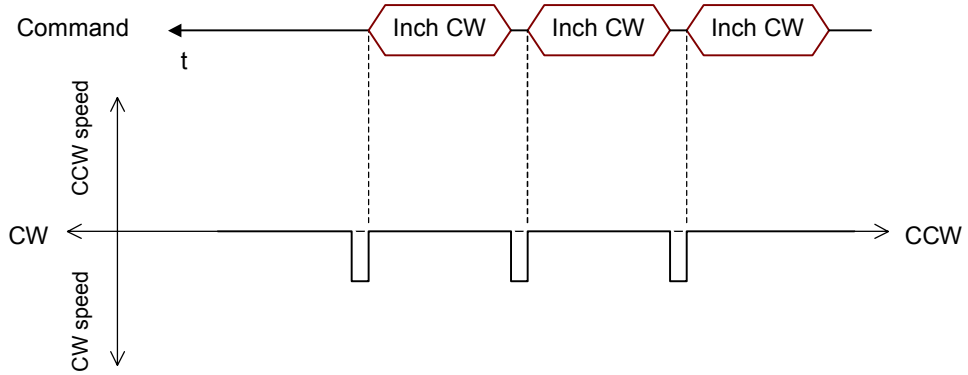
Inching Operation by Command

If the CPU or host writes the command for Inching in counter-clockwise direction, the axis outputs a forward pulse. If the command for Inching in clockwise direction is given, the reverse pulse is output. If the Manual mode command for the opposite direction is given while Inching is executing, the axis slows and stops.

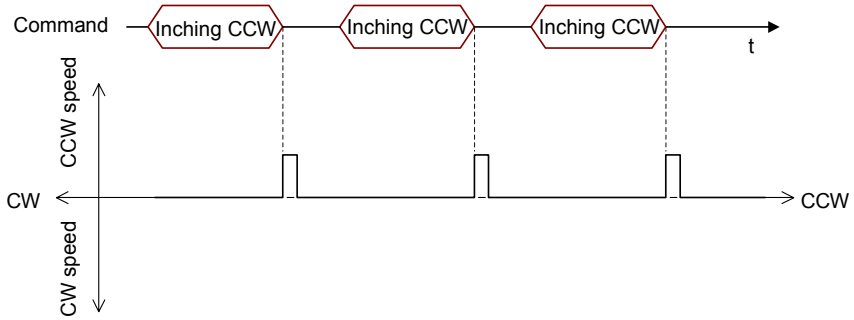
When the Inching command is received, the axis outputs a pulse for the Inching Distance specified by the common parameters, at the Manual mode Initial Velocity. No Stop command is needed.

If another inching command is received while the axis is moving, it is an error.

Inch CW by Command



Inch CCW by Command



Effect of External Inputs During Manual Operation by Command

The effects of external inputs during Manual Mode operation by command instructions are listed below.

Signal	*COIN*	*LS*	*FO*	*RO*	*FE*	*HSR*	*DR*	*ES*
On/Off State	ON/OFF	ON/OFF	OFF	OFF	ON	ON/OFF	OFF	OFF
Result	ERR	Disable	ERR	ERR	Valid	Valid	ERR	ERR

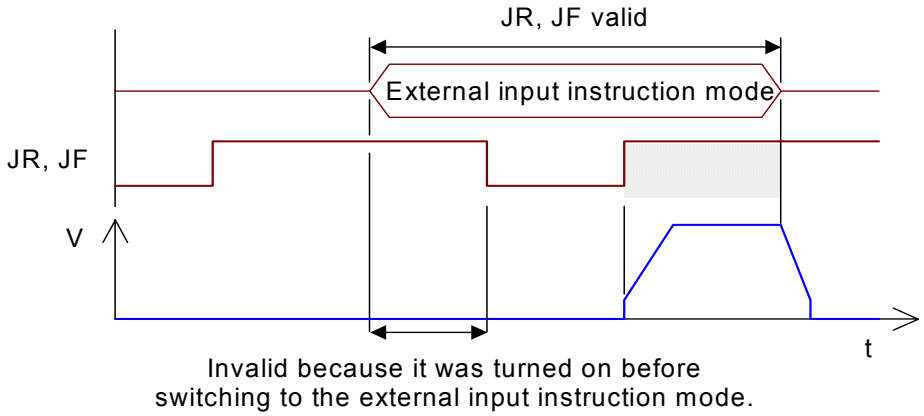
- The operation does not start if Emergency Stop (ES) is Off. The operation does not start until the error is cleared after turning On the input signal ES.
- If the Move Complete (COIN) and Drive OK/Ready (DR) inputs are enabled in the Common Parameters, both inputs must be turned On to start the manual operation. If COIN is Off at the start of the motion, an error is generated. Once the motion is in progress, the state of COIN is ignored.
- If the Overtravel inputs (FO and RO) are enabled in the Common Parameters, an emergency stop or decelerated stop occurs if the overtravel input turns Off during Manual mode.
- If the Drive OK/Ready (DR) input is enabled in the Common Parameters, an emergency stop occurs if DR turns Off during Manual mode.
- If the Emergency Stop (ES) input turns Off during Manual mode, a fast stop or normal stop (as set up) occurs.
- If the Feedrate Override (FE) input is enabled in the Common Parameters, if FE turns On during manual operation, the axis speed decelerates at the rate specified Deceleration Rate. If FE turns Off, the speed returns to its previous rate.
- If the Registration (HSR) input is enabled in the Common Parameters, turning HSR On during manual operation causes the fixed number of pulses to be output and stopped from the On position.

Manual Mode Operation Controlled by External Inputs

ManualMode operation by external inputs must be explicitly enabled or disabled by command from the PLC CPU or host controller as described earlier in this section.

In this mode, if the Jog Forward (JF) and Jog Reverse (JR) module inputs are connected and enabled in the Common Parameters, the JF and JR input signals will control movement of the axis.

Jog Forward (JF) and Jog Reverse (JR) are edge-sensitive, so they must go On *after* the switch to external input mode has been made. If JF and JR were already On when the PLC or controller sent the command to switch to external input mode, they must be turned On again after switching.



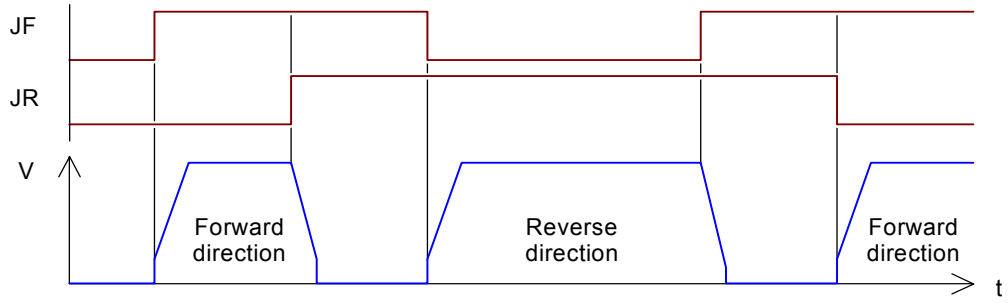
The Run bit must be Off to begin Manual Mode operation.

Operation in External Input Mode

External input instruction mode has three motions, which are set up in the axis the common parameters: Jogging, Inching, and Inching + Jog.

If the external input Jog Forward (JF) for the axis goes On, the forward pulse is output. If the external input Jog Reverse (JR) for a channel goes On, the reverse pulse is output.

The pulse stops while slowing down if both Jog Forward (JF) and Jog Reverse (JR) go On. After the pulse output stops completely, turning either input Off causes the pulse in the direction of the output that remains On. If either input is turned Off before its pulse output stops, the pulse is output according to the next external input that turns On.



Jogging Operation with External Inputs

In Jogging mode, the pulse begins at the Initial Velocity and accelerates at the Acceleration Rate to the Maximum Velocity.

Until a Stop command is given, turning the manual inputs JF and JR Off and On provides continuous operation as shown above. Motion continues is repeated until one of the following occurs:

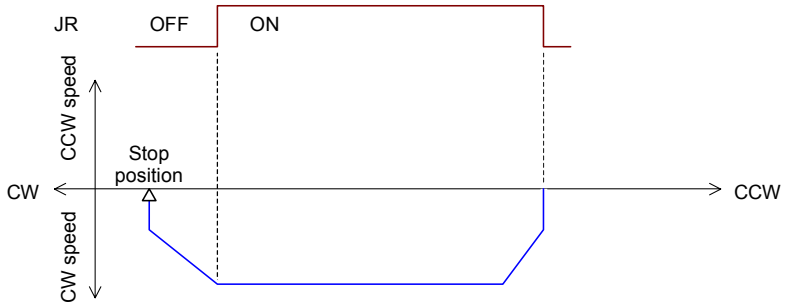
A. the external input instruction mode is cancelled.

B. the Stop command or Decelerated stop command is given.

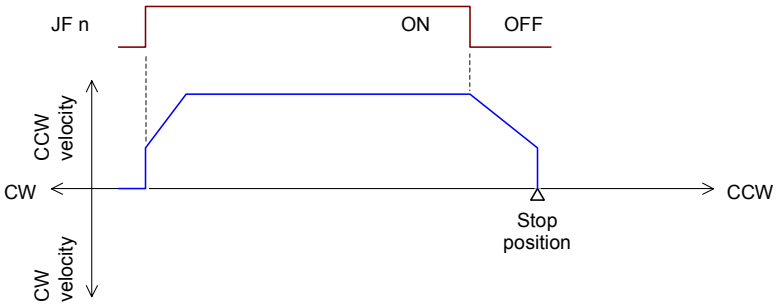
C. the external Emergency Stop (ES) input turns Off.

If an error occurs, the operation stops and the external input instruction mode is canceled.

Jog Reverse by JR Input

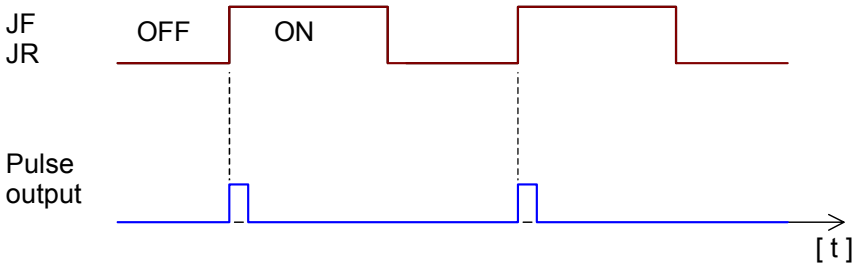


Jog Forward by JF Input



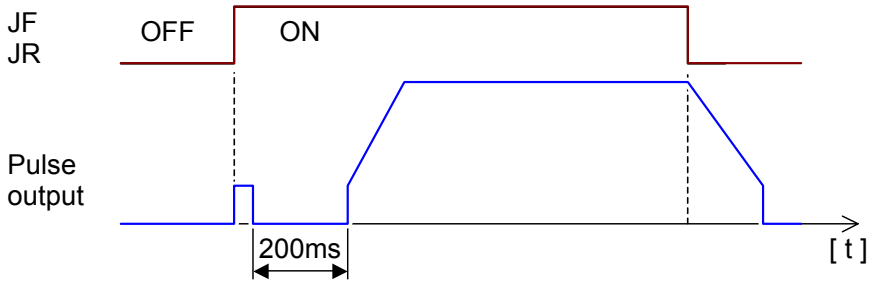
Inching Operation

In Inching mode, pulses are output at the On edge of external inputs Jog Forward (JF) and Jog Reverse (JR). The number of pulses that are output is set up in the Inching Distance common parameter.



Combined Inching and Jogging Operation

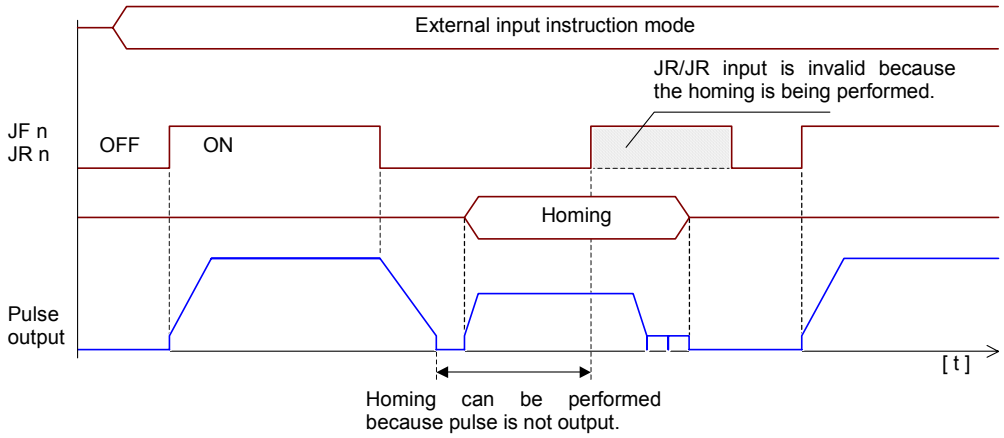
When Inching and Jogging are combined, turning On external input Jog Forward (JF) or Jog Reverse (JR) starts the inching operation. When the external input is On for 200ms or more after the inching operation is completed, the jog is started.



Executing Commands During External Inputs Manual Mode

Commands that can be executed during Run mode (Run bit is On) can be executed while the module is operating in Manual mode using the external JF and JR inputs.

Homing can be performed if the pulse is not being output (the Jog Forward and Jog Reverse inputs must both be Off). If either Jog Forward or Jog Reverse goes On during homing, it is ignored. Turn the JR/JF signal On again after homing is completed.

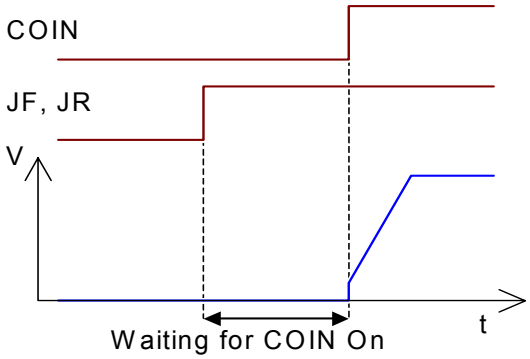


Effect of External Inputs During Manual Operation by External Inputs

The effects of external inputs that have been enabled in the axis setup on Manual Mode operations are described below.

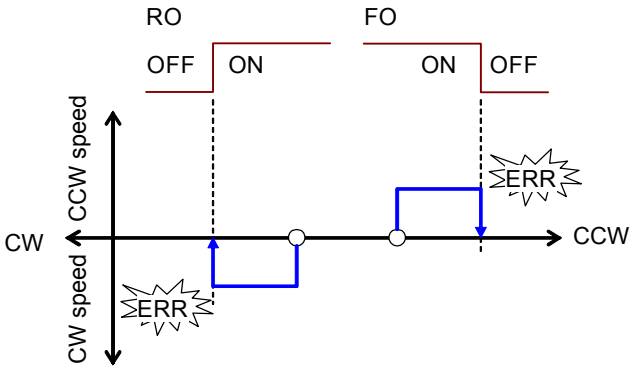
Signal	*COIN*	*LS*	*FO*	*RO*	*FE*	*HSR*	*DR*	*ES*
On/Off State	ON/OFF	ON/OFF	OFF	OFF	ON	ON/OFF	OFF	OFF
Result	ERR	Disable	ERR	ERR	Valid	Valid	ERR	ERR

- Manual Mode operation will not start unless the Move Complete (COIN) input and the Drive OK/Ready (DR) input are On.

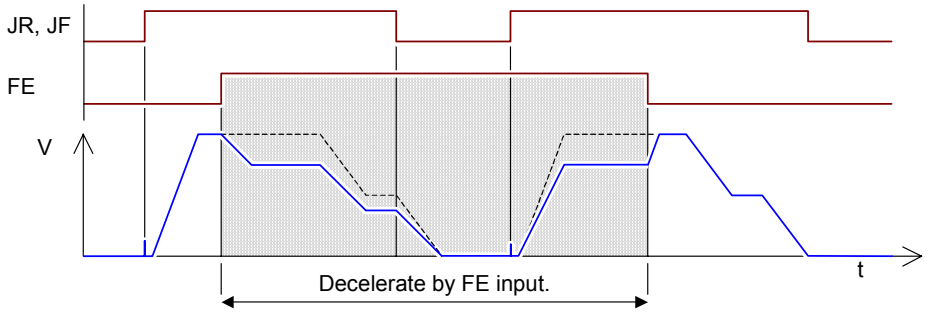


If COIN is Off at the start of the motion, an error is generated. Once the motion is in progress, the state of COIN is ignored.

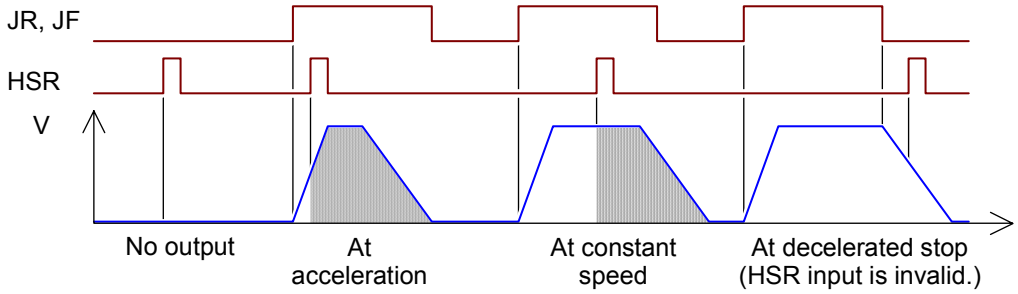
- A fast or normal stop occurs if the overrun input goes Off.



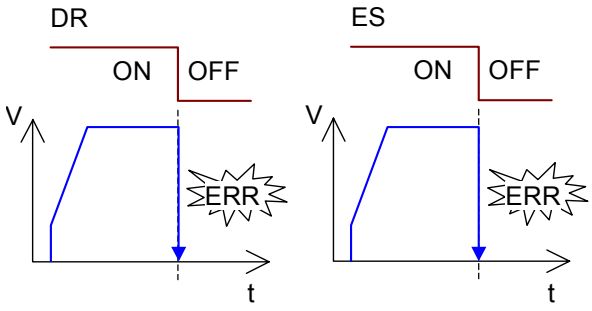
- An emergency stop occurs if Drive OK/Ready (DR) goes Off. See below.
- If FE goes On, speed slows at the Deceleration Rate. If FE goes Off, the speed returns to its previous rate. If the Feedrate Override (FE) input is On before the operation starts, the operation uses a velocity after feedrate as a fixed speed



- If the Registration (HSR) input goes On, the fixed number of pulses is output and stopped from the On position. External input instruction mode is not ended if it is stopped by HSR.



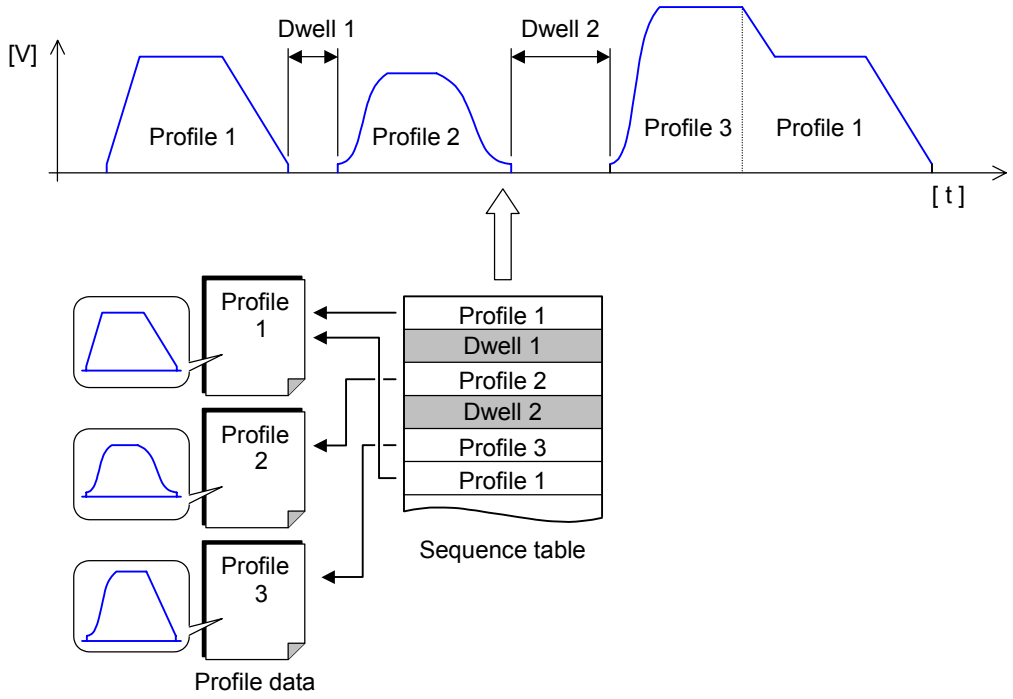
- If the Emergency Stop (ES) input goes On, a fast stop or normal stop (as set up in the Common Parameters) occurs. The input signal ES must be turned Off and the error must be cleared. The PLC CPU or host controller must then command the module to use the external JF and JR inputs again, as described earlier in this section.



Auto Mode

In Auto Mode, operations are performed using position (profile) data that has been set up in advance.

Complex positioning operations can be performed by combining multiple profiles in a Sequence Table.



Auto Mode Parameters

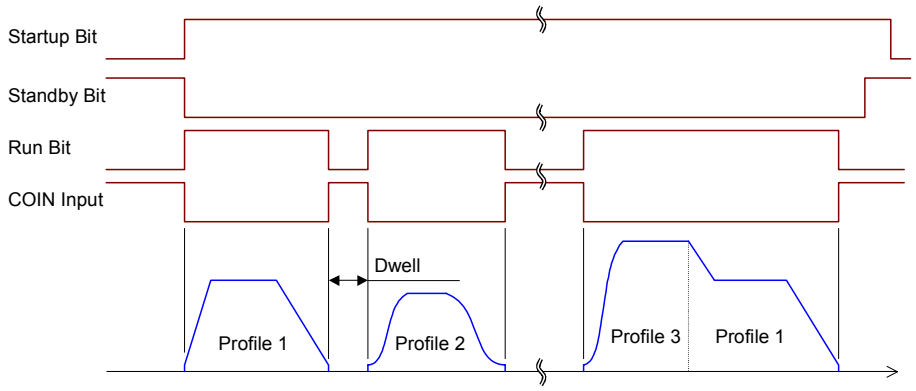
The Auto mode parameters are: (Refer chapter 5 for details of these parameters)

Initial Velocity (Common Parameter 7): the initial velocity for the auto mode operation.

Executing a Sequence Table

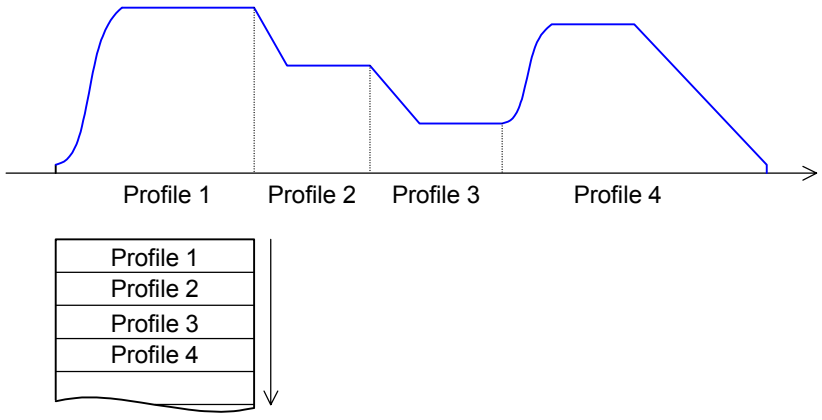
Execution of a sequence table can be started in two different ways:

1. A sequence table can be stored in the MicroMotion module (using the MicroMotion setup tool or on command from the PLC CPU or host controller. The sequence table will automatically begin executing when the MicroMotion Module starts up.



2. Alternatively, sequence table data can be written to the MicroMotion Module by the PLC CPU or host. The CPU or host might store data for multiple sequence tables, and can modify the profile parameters as appropriate.

   When the CPU or host supplies sequence table data and commands the module to execute the supplied sequence table (see next page), the supplied sequence table data will take precedence over a sequence table that is already stored in the module. Execution of the sequence table itself is the same.



Controlling Execution of a Sequence Table

Using the MicroMotion Setup Tool, place the tool online to a MicroMotion Module, select Monitor Module and initiate a Auto Mode operation (see chapter 5), or use the commands below for a CPU or host controller.

If the MicroMotion Module is part of a VersaMax Micro PLC system, the PLC CPU can control execution of a sequence table using the following commands in the module's Control Output data. (See chapter 7).

Command	Operation	Command Data Length
30	Perform single cycle at startup, using the sequence table stored (registered) in the module.	0
31	Perform single cycle of the sequence table data supplied with the command.	Sequence table +1
32	Perform multiple cycles at startup, using the sequence table stored (registered) in the module.	0
33	Perform multiple cycles of the sequence table data supplied with the command.	Sequence table +1
17	Fast Stop	0
18	Normal (decelerated) stop	0

If the MicroMotion Module has a host controller, the host can control execution of the sequence table by setting the following bits in the module's coils table. The host also writes the content of the sequence table data to the module's Holding Registers 500 to 1500. (See chapters 8 and 9).

Coil	Operation
340	Perform single cycle of stored (registered) sequence table on Axis A
341	Perform multiple cycles of stored (registered) sequence table on Axis A
342	Perform single cycle of supplied sequence table on Axis A
343	Perform multiple cycles of supplied sequence table on Axis A
344	Perform single cycle of stored (registered) sequence table on Axis B
345	Perform multiple cycles of stored (registered) sequence table on Axis B
346	Perform single cycle of supplied sequence table on Axis B
347	Perform multiple cycles of suppled sequence table on Axis B
240	Stop Axis A immedlately (Fast Stop)
241	Stop Axis B immediately (Fast Stop)
244	Normal (decelerated) stop on Axis A
245	Normal (decelerated) stop on Axis B

Single Cycle of a Sequence Table

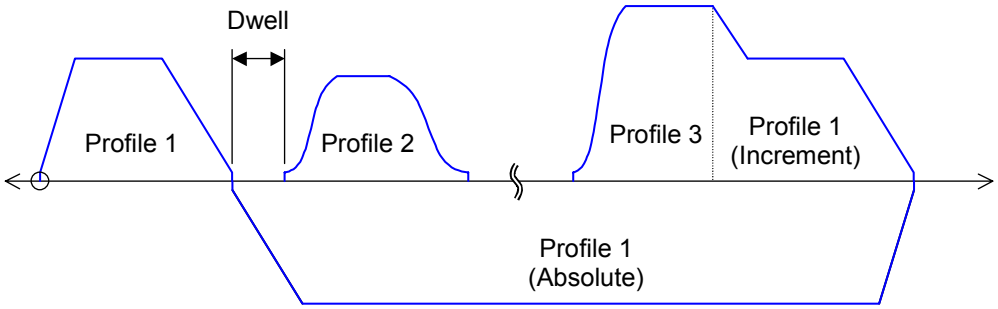
If the CPU or host commands the MicroMotion Module to perform a single cycle of a stored (registered) sequence table, the cycle (sequence table) is executed once.

If the CPU or host commands the MicroMotion Module to perform a single cycle of a supplied (specified) sequence table, the sequence table data changes to the specified data and the sequence table executes once.

Multiple Cycles of a Sequence Table

If the CPU or host commands the MicroMotion Module to perform multiple cycles of a stored (registered) sequence table, repeated execution of the table begins at startup.

If the CPU or host commands the MicroMotion Module to perform multiple cycles of a supplied (specified) sequence table, the sequence table data changes to the specified data and the sequence table executes repeatedly.



When multiple cycles are commanded, the CPU or host stops execution of the sequence table by sending a stop command. Multiple-cycle execution is also stopped by an emergency stop, overrun, or similar event.

Note that executing multiple cycles of the sequence table is NOT the same as continuous execution of profiles within the sequence table (which is described later in this section). If the sequence table will be executed repeatedly, the last profile in the sequence must have its Cycle Type set to Stop, not to Continue.

Parameters of Profiles in a Sequence Table

Each profile defined for Auto Mode has four parameters: Acceleration Rate, Deceleration Rate, Velocity, and Target Position.

When a profile is added to the sequence table, it is assigned additional parameters:

- *Control*: Positioning or Speed. In the sequence table, profiles that control positioning must be separated from profiles that control speed by Dwells.
- *Position*: For a positioning profile only: Absolute or absolute + incremental positioning
- *Direction*: for a speed profile only: Forward or Reverse direction
- *Cycle Type*: Stop (at the profile's Target Position), or continue to the next profile, changing speed.
- *Acceleration Type*: linear or S-curve.
- *Deceleration Type*: linear or S-curve.
- *Direction of Rotation*: specified direction or shortest direction for a rotary move.

The parameters of a profile are easily defined using the MicroMotion setup tool, which can also monitor execution of the profile in Run mode. Profile parameters can also be written to the module by the VersaMax Micro PLC CPU (see chapter 7) or host controller (see chapters 8 and 9).

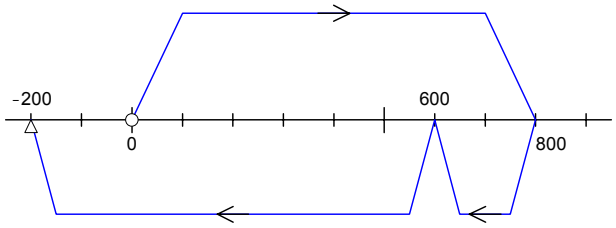
Control: Positioning

If the profile is set up for position control, the move to the target point combines the profile data parameters (Acceleration Rate, Deceleration Rate, and Velocity). In addition, profiles set up for Position Control have their Move Type parameter set to Absolute or Absolute + Incremental positioning.

Absolute Target Positioning for Linear Moves

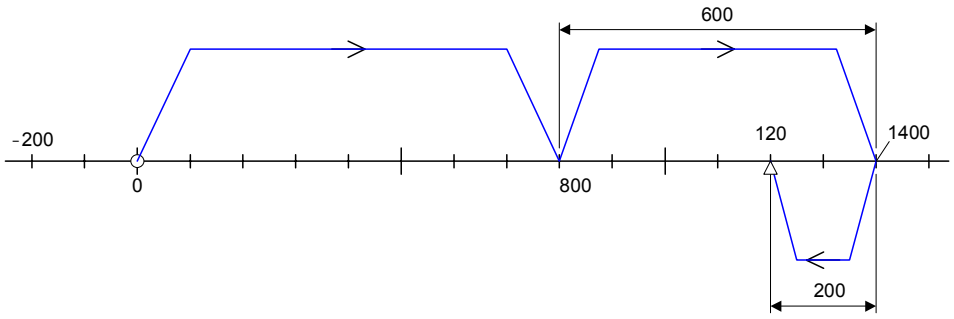
In absolute positioning, the values specified in the profle represent absolute target positions in relation to the 0 starting position. In the example below, the first move is from the starting position of 0 to the absolute position of +800. The second move is back to the absolute position of +600. The third move is to the final position of –200.

Profile	Target Position
1	800
2	600
3	-200



Absolute + Incremental Target Positioning for Linear Moves

In incremental positioning, the signed values specified in the profile represent the length and direction of each move in relation to the 0 starting position. The first move is always the same for either Absolute or Absolute + Incremental positioning. Using the same data as the first example, the first move below is from the starting position of 0 to the target position of +800. The second move is 600 in the positive direction, to the incremental position of 1400. The third move is 200 in the negative direction, to the final position of +1200.



Absolute Positioning for Rotary Moves

Rotary moves have a maximum length equivalent to 4,294,967,295 pulses. When switching from a linear move to a rotary move or from a rotary move to a linear move, the current position becomes 0.

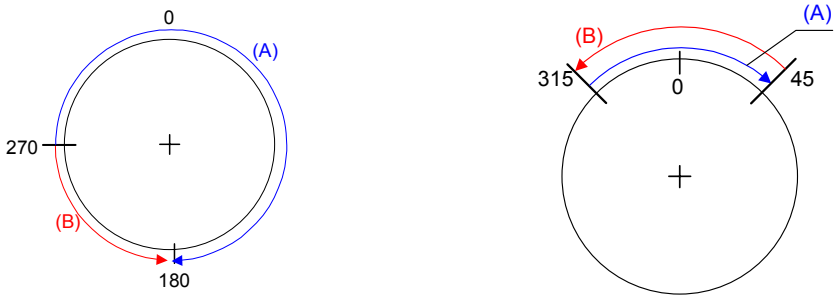
When the Position Type of a profile is set to Absolute, rotation may be specified from 0 to a configurable upper limit. The rotary direction is set up in the sequence table.

In the example illustrated below left, the current position is 270 degrees, the Target Position is 180 degrees and the Upper Position Limit is 360 degrees. If clockwise direction is specified, rotation occurs in the (A) direction. In the same example, if counter-clockwise direction is specified, rotation occurs as specified in the (B) direction. If shortest direction is specified, rotation would also occur in the (B) direction for this example.

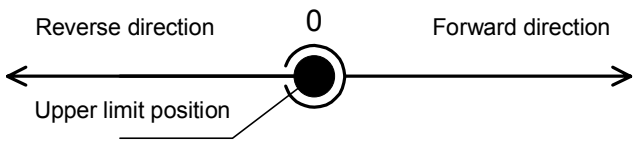
Incremental Target Positioning for Rotary Moves

As in absolute positioning, the range of axis movement is 0 to the Upper Position Limit. If the Target Position exceeds the Upper Position Limit, the current position is an angle from 0. When moving in the CCW direction, the current position is an angle from 0 if the target position is below 0 after incrementing. As illustrated below right, if the current position is 315 degrees and the Target Position is +90 degrees and the Upper Position Limit is 360 degrees; the axis rotates clockwise (A) to 45 degrees. If the current position is 45 degrees and the Target Position is -90 degrees; the axis rotates counterclockwise (B) to 315 degrees.

Absolute ***Incremental***



In Absolute + Incremental Positioning, if the Upper Position Limit is 0, the current position of the axis will never reach the Upper Position Limit.



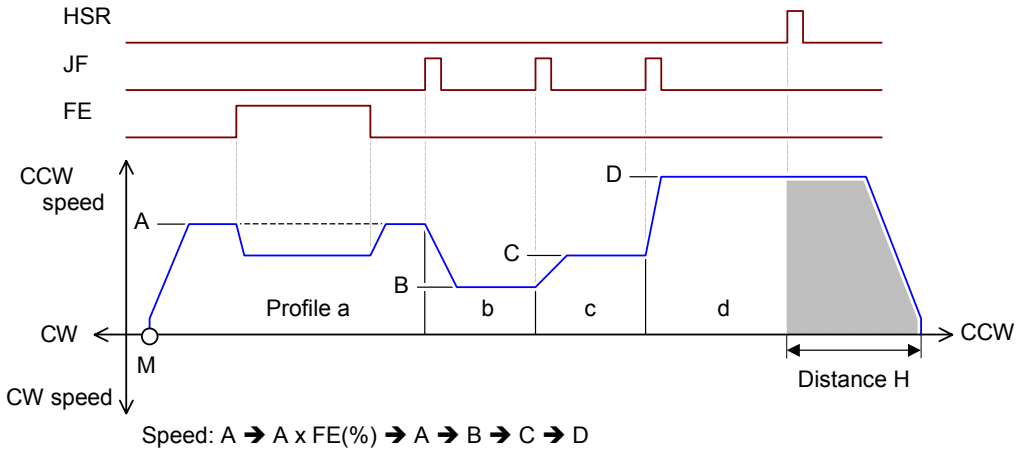
Moves in the shortest direction are not possible.

Control: Speed

If a profile is set up for Speed control, the move to the target point also combines the profile data parameters (Acceleration Rate, Deceleration Rate, and Velocity) for moving. In addition, a direction is specified for the axis motion.

If the Feedrate Override (FE) input is enabled in the axis setup, FE can be used to decrease the Velocity.

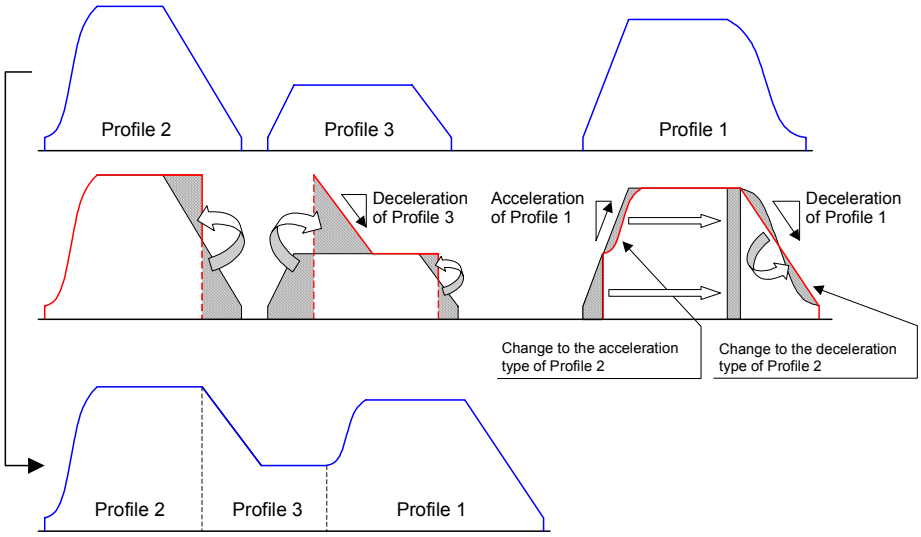
The Jog Forward (JF) input is an external input that is normally used in Manual mode. In Auto Mode, the input JF is used to switch profile data (speed control). Because the Jog Forward (JF) input or the Jog command can be used switch the sequence table, it is possible to switch the sequence of speeds when combining sets of profile data. In addition, if the Registration (HSR) input is enabled in the axis setup, it can be used to trigger the positioning control.



Speed: A ➔ A x FE(%) ➔ A ➔ B ➔ C ➔ D

Continuous Profiles in a Sequence Table

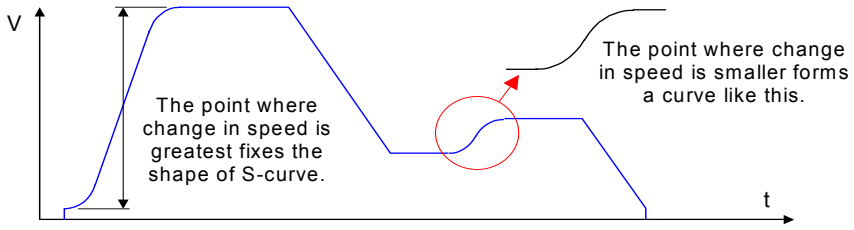
Each profile in a sequence table is set up with a Cycle Type of either Continue or Stop. If the Cycle Type is set to Stop, the axis stops at that profile's target position. If the Cycle Type is set to Continue, motion continues between profiles with only changes in speed, and no Dwells. Within a sequence table, an axis can execute up to 100 continuous profiles.



Because position control and speed control must be separated by Dwells, position control and speed control cannot be used together in the same continuous operation. In addition, rotary direction cannot be changed during a continuous operation.

All profiles of a continuous operation start with an acceleration or deceleration (if there is a change of speed between profiles), followed by motion at the Velocity (constant speed) of that profile. The final profile of a continuous operation also includes a final deceleration to stop.

The Acceleration Type and Deceleration Type (linear or S-curve) of the first profile in a continuous operation are used for all subsequent profiles in the operation. Acceleration Type and Deceleration Type cannot be changed during a continuous operation. If the Acceleration or Deceleration Type is S-curve, the MicroMotion Module determines the shape of the curve by the point of which a change in speed is greatest. (If the change in speed is small, the ideal shape of an S-curve cannot be formed).



Conditions that Prevent Automatic Operation

To switch into Auto Mode, the MicroMotion Module must be in standby mode (the module's STBY bit is on). Switching to Auto Mode when the STBY bit is Off causes a command error.

External Inputs During Auto Mode

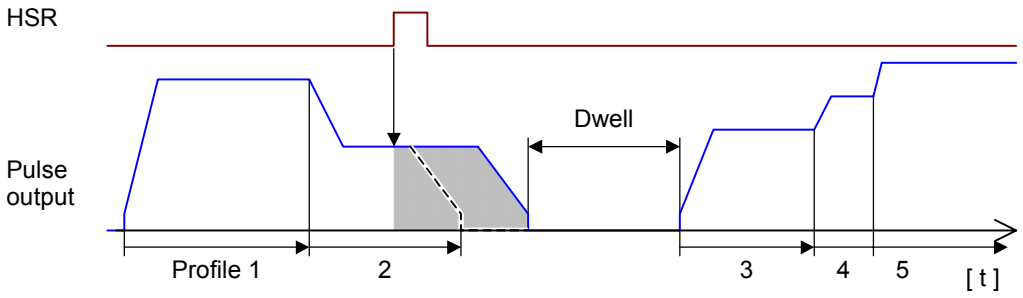
The effects of external inputs during Auto Mode are listed below.

Signal	*COIN*	*LS*	*FO*	*RO*	*JF*	*JR*	*FE*	*HSR*	*DR*	*ES*
On/Off State	ON/OFF	ON/OFF	OFF	OFF	ON	ON	ON	ON/OFF	OFF	OFF
Result	ERR	Disable	ERR	ERR	Valid	Disable	Valid	Valid	ERR	ERR

When the Overrun FO / RO input is Off, the axis stops.

In Auto Mode, the Jog Forward (JF) input is used as a switch input for the next profile in a continuous operation by speed control. (It is not used for positioning control.)

If the Registration (HSR) input goes On, the axis moves the Registration Move Distance then stops. Operation resumes at the start of the next profile.



If the Feedrate Override (FE) input goes On, the axis velocity decreases at the Feedrate Override Percentage. If FE goes Off, motion returns to the former speed.

If the Drive OK/Ready (DR) input goes Off, motion stops immediately. (Normal stop is not possible.)

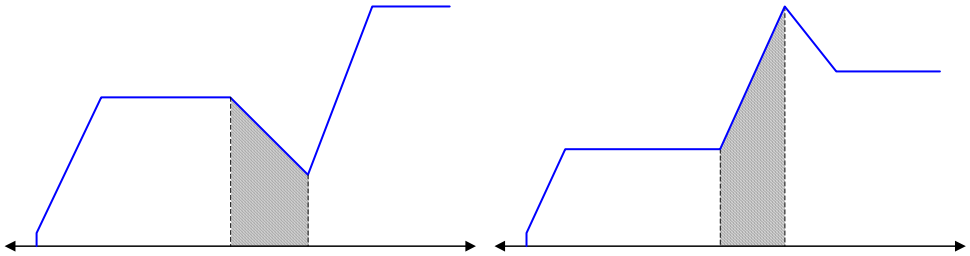
When the ES input goes off, a fast or normal stop occurs (depending on the axis setup for Emergency Stop.)

Commands During Automatic Operation

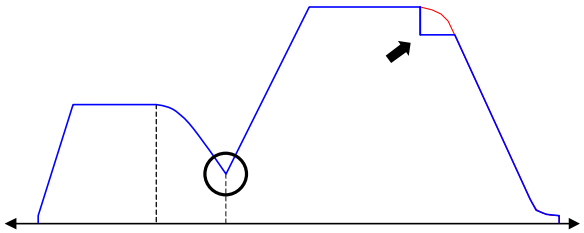
Commands that can be executed during Run mode (the Run bit is On) can be executed during Auto Mode.

Considerations for Using Auto Mode

If the move distance specified by the profile's Target Position is small and if the profile has a small Deceleration Rate, in Continuous operation, the axis can transition to the next profile before reaching the target velocity (left below). Similarly, if the move distance and Acceleration Rate specified in the profile are small, the axis can also transition to the next profile before reaching the target velocity (right below).



If the profile transitions directly from deceleration to acceleration, the velocity may drop suddenly.



If this happens, either:

A. adjust the profile so that acceleration occurs at a steady rate.

B. In the common parameters, select Linear as the Deceleration Type for the axis.

Chapter 5 Using the MicroMotion Setup Tool

The MicroMotion Setup Tool provides an easy-to-use interface for setting up the motion parameters of a MicroMotion Module, and for monitoring and executing motion operations in real time. The MicroMotion Setup tool is integrated into Proficy Machine Edition version 5.7 SIM 3 or later.

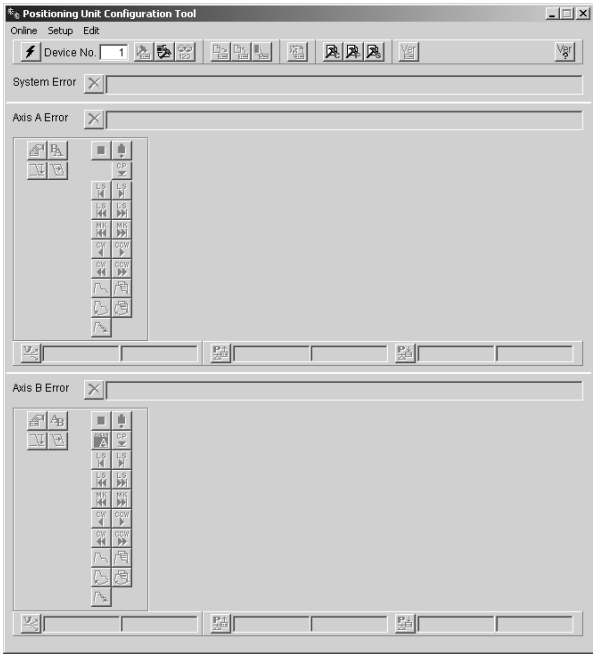
Chapter 6 explains how to launch the MicroMotion Setup Tool within the Proficy Machine Edition software.

This chapter explains how to use the MicroMotion Setup Tool to set up, monitor, and control a MicroMotion Module.

- Main Window of the Setup Tool
  - Operating Online or Offline
  - Monitoring a MicroMotion Module
  - Reading and Writing Parameter Data
  - Initializing Motion Module Parameters
  - Setting Up Communications Parameters
- Setting UpCommon Parameters
  - Motion Parameters
  - Input Configuration
  - Homing Configuration
  - Manual Mode Configuration
  - Auto Mode Configuration
- Setting Up Profiles for Auto Mode
- Setting Up a Sequence Table

Main Window of the Setup Tool

When the setup tool is first opened, the Main Window appears.



Accessing Basic Setup Tool Functions

From the Main Window of the Setup Tool, use the pulldown menus or buttons to select the basic Setup Tool functions:

Online or Offline operation to communicate with a MicroMotion Module for setup, monitoring, and motion control.

Monitor Motion Module to view motion data from a connected module in real time.

Read from File to read setup data from a file in the computer.

Write to File to save setup data to a file in the computer.

Write to Flash to write setup data to an installed Memory Pack.

Initialize Motion Module to set all motion parameters in the module to their default values.

Communications Parameters to set up communications for PC / Motion module.

The Main Menu is also the access point for the setup windows for Common Parameters, Profiles, and the Sequence table.

The same functions are available from the taskbar buttons:

	Online/Offline: Start or stop communication with a MicroMotion Module.
Device No. 1	In Offline mode, enter the station number of the MicroMotion Module to connect.
	Change the communication parameters of the MicroMotion Module.
	Change the communication parameters of Configuration tool.
	Enable/Disable Monitor Mode for the Setup Tool.
	Read from File: Read parameters from CSV file to the MicroMotion Module.
	Write to File: Save parameters from the MicroMotion Module to a file.
	Write to Flash: 0pen a window to communicate with a Memory Pack.
	Initialize parameters in the MicroMotion Module (reset parameters to their defaults).
	Open the Common Parameters window.
	Open the Profiles window.
	Open the Sequence Table window.
Ver	Display the firmware version of the MicroMotion Module.
Ver	Display the Version of the MicroMotion Tool

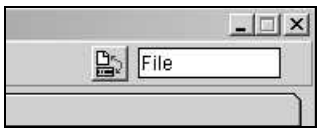
Operating Online or Offline

When the MicroMotion Setup Tool is connected to a MicroMotion Module, the tool can be either online or offline to the module.

From the Main Window, select Online/Offline or click the Online button to put the Setup Tool in Online or Offline mode.

Source of Data Displayed by the Setup Tool

In the Common Parameters, Profiles, and Sequence Table windows, the source of the current data (Device or File) is displayed in the upper right corner.

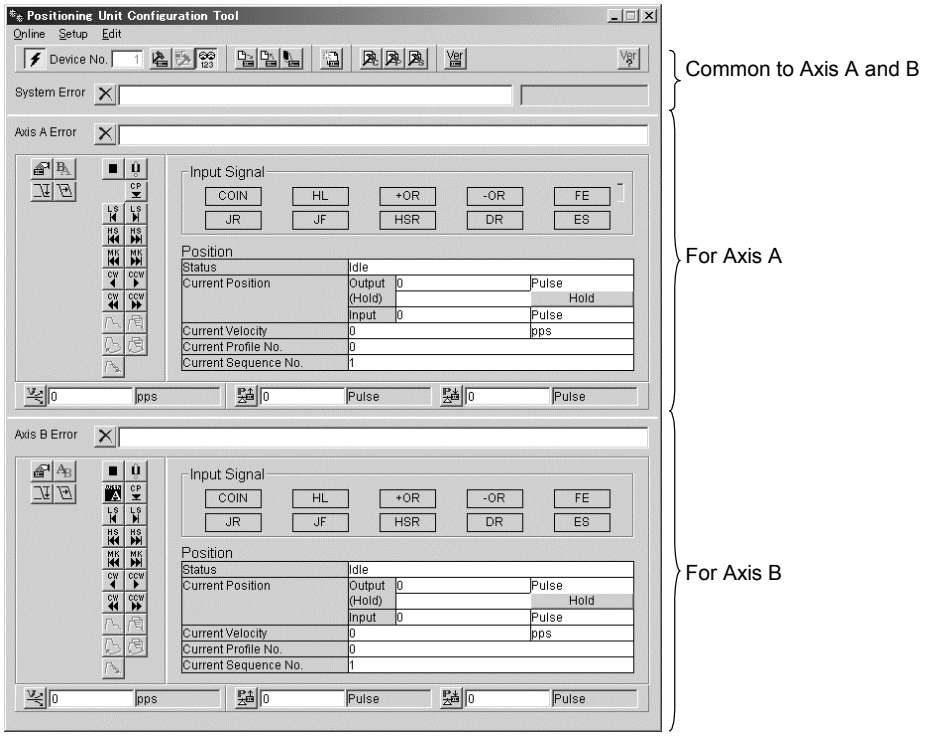


	Offline Mode	***Online Mode***
File	Data being displayed is from the CSV file in the computer.	
Device	Does not appear in Offline Mode.	Data in the MicroMotion Module Holding Registers (not yet being used for operation.
	Data being displayed is from the Setup Tool; no CSV file is open.	Operating data of the MicroMotion Module.

Monitoring a MicroMotion Module

When the MicroMotion Setup Tool is connected to a MicroMotion Module, the tool can monitor the On/Off states of module inputs, and monitor or control motion operations.

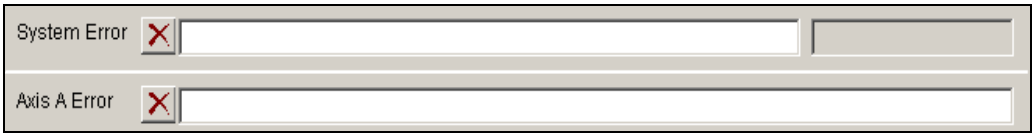
In the Main Window, select Monitor Motion Module or click on the Monitor Motion Module button to put the Setup Tool in Monitor mode.



The Axis A and Axis B monitoring areas appear when the Setup Tool is in Online mode.

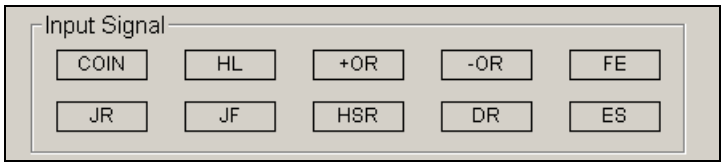
Display and Clear Axis Errors

In Online mode, the Setup Tool displays any System Errors and Axis Errors. Click X to clear an error. See chapter 11 for error definitions.



Monitor External Inputs

During operation, with communications established between the MicroMotion Module and the Setup Tool software and in monitor mode, the Setup Tool shows the states of the module's external inputs.



External Input	*ON (1)*	*OFF (0)*
Positioning Complete (COIN)	Green COIN	Colorless
Home Position Limit (HL)	Green HL	Colorless
Forward Overtravel (FO)	Colorless	Red +OR
Reverse Overtravel (RO)	Colorless	Red -OR
Feedrate Override (FE)	Green FE	Colorless
Jog Forward (JF)	Green JF	Colorless
Jog Reverse (JR)	Green JR	Colorless
High-Speed Registration (HSR)	Green HSR	Colorless
Drive OK/Ready (DR)	Colorless	Red DR
Emergency Stop (ES)	Colorless	Red ES

Monitor Axis Position

In the Position monitoring area of the Monitor window, the Status field displays the status of the current axis motion. For example:

Status	Auto (Position) / Dwell / FE move

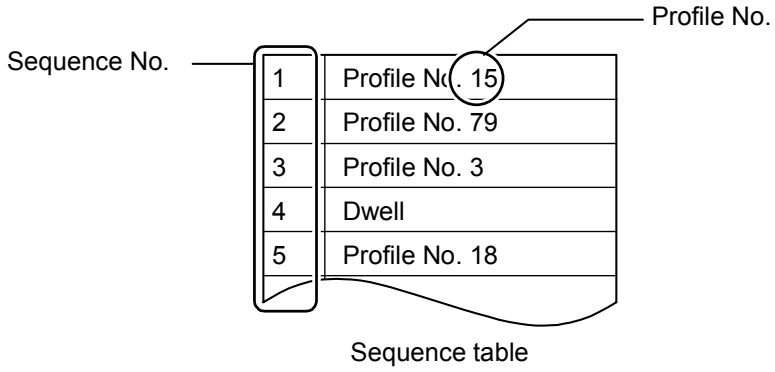
Status	Manual (Ex. Input) / Jog forward

The Current Position fields show the current commanded output pulse position (click on Hold to capture the current position, which will be displayed in the row adjacent to the “Hold”), and the input feedback pulse from the encoder.

Position			
Status	Idle		
Current Position	Output	0	Pulse
	(Hold)		Hold
	Input	0	Pulse
Current Velocity	0		pps
Current Profile No.	0		
Current Sequence No.	1		

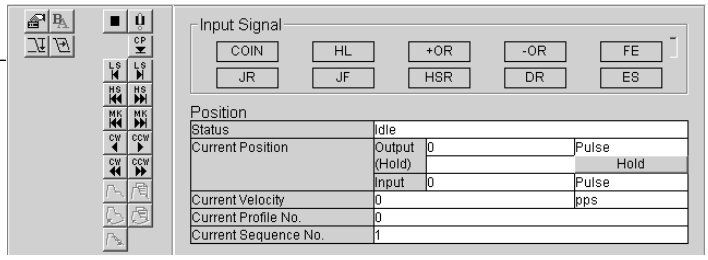
The Position monitoring area also displays:

- The current velocity
- The profile currently being executed. The profile is represented by the number from 0 to 255 that was assigned on the Profiles setup window of the MicroMotion setup tool. See the illustration below.
- The item in the Sequence Table that is currently being executed..



Control Motion Operations

When Monitor Module is enabled, additional control buttons become available for each axis. See chapter 4 for a description of the MicroMotion Module operations these buttons can control.



	Set/Cancel Manual Mode using external inputs.
	Switch the Feedrate Override function to run/cancel. (Decelerate the velocity being output up to the specified percent). The On state of the external input FE has priority.
	Shift a distance specified by common parameters. Click the icon to stop during manual operation and auto operation (speed control).
	Decelerate and stop the output pulse.
	Stop the output pulse immediately.
	Control both axis A and axis B when executing the same operation on both axes. (Displayed inB Axis area)
	Perform Free Homing: change the current position to the Home Position specified in the Common Parameters.
	Perform Low-Speed Homing in CW direction.
	Perform Low-Speed Homing in CCW direction.
	Perform High-Speed Homing (Off edge) in CW direction. Stop at Off edge of limit switch.
	Perform High-Speed Homing (Off Edge) in CCW direction. Stop at Off edge of limit switch.
	Perform High-Speed Homing (Marker) in CW direction. Stop at On edge of marker input after llimit switch turns on.
	Perform High-Speed Homing (Marker) in CCW direction. Stop at ON edge of marker input after limit switch turns on.
	Perform Inching CW, distance specified by common parameters.
	Perform Inching CCW, distance specified by common parameters.
	Jog in CW direction. Continue until this icon is clicked again or the icon for Stop/Emergency stop (see above) is clicked.
	Jog in CCW direction. Continue until this icon is clicked again or the icon for Stop/Emergency stop is clicked.
	Execute the Sequence Table stored in the module once.
	Execute the Sequence Table stored in the module. At the end, return to the first profile and start again.
	Execute the specified Sequence Table once.
	Execute the specified Sequence Table. At the end, return to the first profile and start again.
	Switch to next profile data by clicking this icon in Auto Mode (speed control).

Control the Output Pulse

The bottom of each axis monitoring area shows the current pulse rate, output pulse position and input feedback pulse position. These can be controlled by clicking on the buttons:

	Change the speed being output.
	Change the position of the current output pulse.
	Change the position of the current input pulse.

Read and Writing Parameter Data

Parameters saved a file on the computer can be stored to a MicroMotion Module and parameters previously stored to a MicroMotion Module can be saved to the file on the computer.

In the Main window of the Setup Tool, all parameters (Common Parameters, Profile data, Sequeunce Table) can be selected or saved. In the Common Parameters window, the Common Parameters can be selected or saved. In the Profiles window, Profile data can be selected or saved. In the Sequence Table window, Sequence Table data can be written or saved.

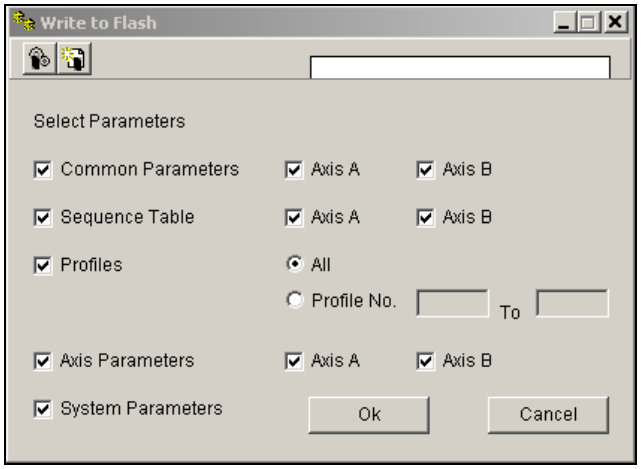
Saving and Storing Data from the Main Setup Window

From the Main Window:

- select Write to File to save the parameters as a CSV file in the computer.
- select Write to Flash to save the parameters to an installed Memory Pack.

Specify the parameters to be written, and click OK.

When writing the Common Parameters, Sequence Table, or Profile Data to the MicroMotion Module or to a file, if the operation is cancelled before it is finished, some parameters may be written or saved. Clicking Cancel does not undo the operation.



To save parameters to a CSV file, select the filename and location for the file.

Saving Parameters to a MicroMotion Module

When writing parameters directly to a connected MicroMotion Module, the Common Parameters, Profile data, and Sequence Table data are saved to the module's backup memory. When axis parameters (such as setting Manual Mode to operate using external inputs) are written to the module, a confirmation prompt appears to verify the write. Click OK to save the parameters to the module, or Cancel.

Writing Data to a Memory Pack Module

When Write to Flash is selected, the buttons at the top of the window can be used to format the Memory Pack for use with the MicroMotion Module, and to Initialize the Memory Pack with the default values of the MicroMotion Module parameters.

	Memory board format	Format a memory board for the MicroMotion Module. All value of each parameter is cleared and set to zero.
	Memory board initialization	Initialize a memory board, and set all value of each parameter to an initial value.

When the Memory Pack has been formatted, the Common Parameters, Profile data, Sequence Table, axis parameters, and system parameters can be written from the MicroMotion Module to the Memory Pack.

Select parameters to be stored to flash as shown previously, and click OK.

See chapter 2 for information about writing parameters from a Memory Pack to the MicroMotion Module.

Initializing Motion Module Parameters

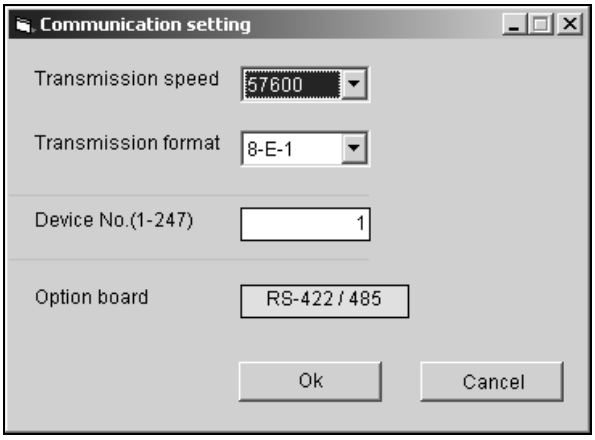
If the setup tool is connected to a MicroMotion Module, selecting Initialize sets all parameters in the module to their defaults.

- When Initialize is selected from the Main window, all parameters (Common Parameters, Profile data, Sequence Table), are set back to their defaults.
- When Initialize is selected from the Common Parameters window, only Common Parameters of the respective displayed axis are initialized.
- When Initialize is selected from the Profiles window, only Profile data is initialized
- When Initialize is selected from the Sequence Table window, only the sequence table is initialized.

When Initialize Module Parameters is selected, a confirmation prompt appears.

Setting Up Serial Communications Parameters for the Module

If the MicroMotion Module will communicate with a host via an installed Serial Communications option module (see chapter 3), its communications parameters must be compatible with the host. To set up the communications parameters, select PLC Comm Parameters from the Main Window.



The window displays the type of Serial Communications option module that is installed on Port 2 of the MicroMotion Module.

When DIP switch 1 is turned On, the MicroMotion Module communicates with the parameters that have been entered using the Setup Tool, or on command from the CPU or host. When switch 1 is turned Off, the MicroMotion Module uses default settings 57600, 8-E-1, Node ID 1.

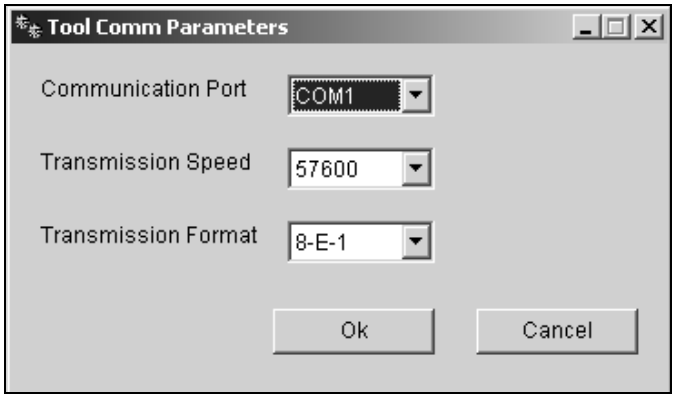
If you do not know the setting of the Device No. and the Transmission speed, you can verify each parameter if DIP switch 1 is turned On.

Setting Up Communications Parameters for the Setup Tool

To configure the parameters that will be used by the MicroMotion module to communicate with the computer that is running the Setup Tool software, select Setup>Tool Comm Parameters:

- **Communications Port** on the host or programmer can be: COM1/2/3/4/5/6/7/8/9/10
- **Transmission Speed** can be: 9600, 19200, 57600, or 115200
- **Transmission Format** can be: (always 8 bits) odd, none or even parity, 1 or 2 stop bits.

In the Tool Communication Parameters window, set up the port, baud rate, and transmission format (bits – parity – stop bits):



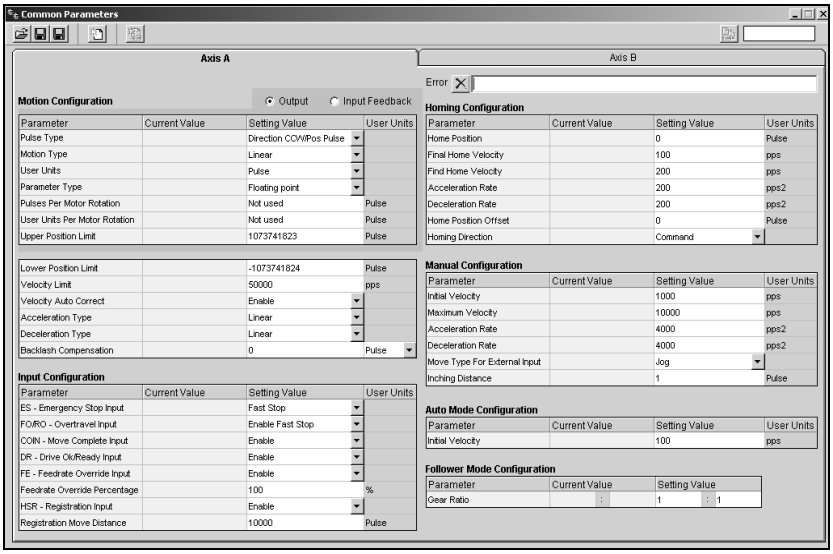
Setting Up Common Parameters

To configure the module's Common Parameters, select Common Parameters from the Main Window. See appendix B for a complete list of the Common Parameters.

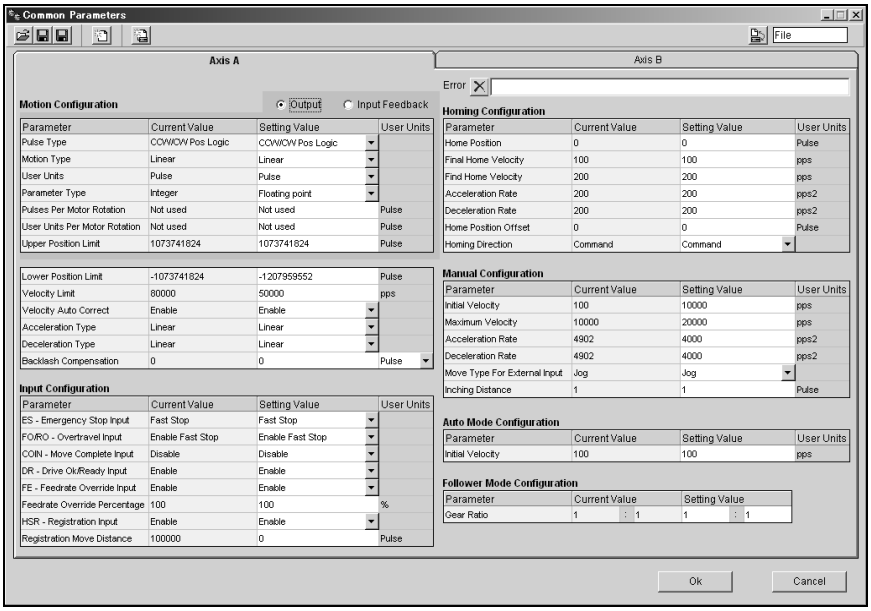
The Common Parameters window opens. If the setup tool is not communicating with a McroMotion Module, only the setting values are displayed as shown below. Initially, default values are supplied for each parameter. If a previously-saved setup file (.CSV) is open, the parameters from the file are displayed, and the word **File** appears in the field in the upper righthand corner of the window.

If the setup tool is communicating with a MicroMotion Module, the parameter settings from the module are displayed, and the word **Device** appears in the field in the upper righthand corner of the window.

There is a Common Parameters tab for Axis A and for Axis B.

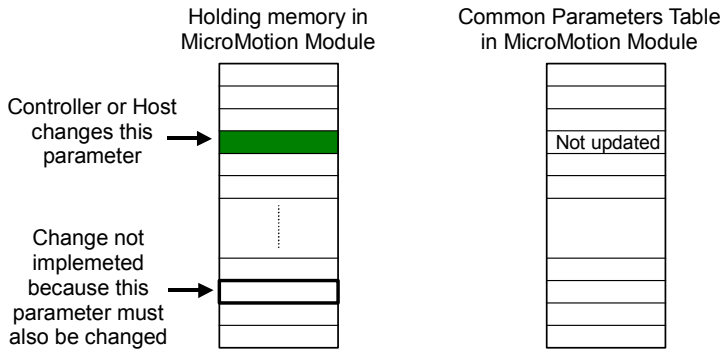


If the setup tool is communicating with a MicroMotion module, the current values are also displayed:

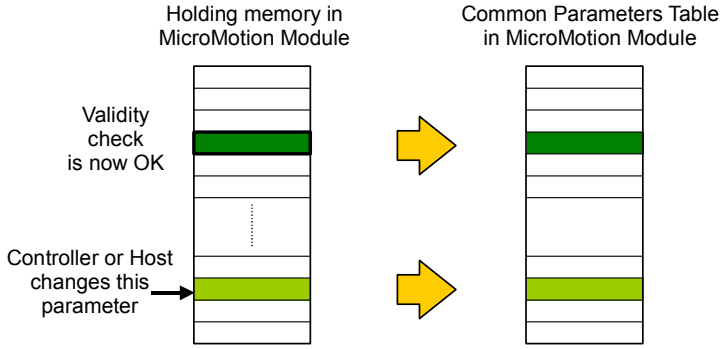


Changing the Common Parameters in Online Mode

If an individual Common Parameter is changed when the Setup Tool is Online to the module, related parameters may also need to be changed before the MicroMotion Module will accept the original change. If another parameter must also be changed, the MicroMotion Module stores the first changed parameter in its holding memory (but does not use it). To update the parameters entered in the tool to the Motion Module Click OK button in the lower righthand corner.



After the additional parameter change, the module again checks the validity of the change. If the subsequent parameter change makes the first parameter change valid, the module accepts both changed parameters and will use them. This procedure needs to be continued until there is no error.



If setting up a Common Parameter fails, the operation cannot be executed until the error is cleared and a correct parameter is supplied.

Changing Common Parameters when the User Units are Pulses

The priority for changing Common Parameters is summarized below.

1. Change the Parameter Type (Floating Point / Integer).
2. Changing parameters related to velocity.
   - If the Velocity Limit will be changed to the lower value than the Initial Velocity and/or Maximum Velocity of Manual Mode or the Initial velocity of Auto Mode, change those parameters to a lower speed *before* changing the Velocity Limit.
   - If the Maximum Velocity of Manual Mode will be changed to a lower value than the Initial Velocity of Manual Mode, change the Initial Velocity to a lower speed *before* changing the Maximum Velocity.
   - If the Find Home Velocity of Homing Mode will be changed to a lower value that the Final Home Velocity, change the Final Home Velocity to a lower speed *before* changing the Find Home Velocity.
3. Changing parameters related to position:
   - If the absolute value of the Upper Position Limit will be changed to a lower value than the current Inching Distance for Manual Mode, Backlash Compensation, Home Position Offset, or Registration Move Distance, change those parameters to a lower value *before* changing the absolute value of the Upper/Lower Position Limit.
   - If the Upper Position Limit will be changed to a lower value than the current combined Home Position plus Home Offset values, change those parameters to a combined lower value *before* changing the Upper Position Limit.
   - If the Lower Position Limit will be changed to a higher value than the current combined Home Position plus Home Offset values, change those parameters to a combined higher value *before* changing the Lower Position Limit.
   - The Upper Position Limit cannot be set above 2,147,483,647 and the Lower Position Limit cannot be set below –2,147,483,648 for Integer.
   - The Upper Position Limit cannot be set above 2,147,483,583 and the Lower Position Limit cannot be set below -2,147,483,583 for Floating Point.

Changing Input Feedback Parameters

When changing the items above for output pulses, be sure to change related parameters for Input Feedback pulses.

1. Change the Parameter Type (Floating Point / Integer) 1.
2. Change parameters related to velocity.
3. Change parameters related to position.

Changing Common Parameters when the User Units are NOT Pulses

The priority for changing Common Parameters is summarized below.

1. Change the Parameter Type (Floating Point / Integer).
2. Change the Pulses per Motor Rotation
3. Change the User Units per Motor Rotation. The settable Velocity Limit and Upper an Lower Position Limits are based on the values for Pulses per Rotation and User Units per Rotation.

   Velocity Limit = 2Mpps × User Units per pulse

   Upper Position Limit = 2,147,483,647 / Number of pulses per user unit (Pulses per Motor Rotation / User Units per Motor Rotation)

   Lower limit position = -2,147,483,648 / Number of pulses per user unit (Pulses per Motor Rotation / User Units per Motor Rotation)

   The Upper Position Limit cannot be set above 2,147,483,647 and the Lower Position Limit cannot be set below –2,147,483,648 for Integer.

   The Upper Position Limit cannot be set above 2,147,483,583 and the Lower Position Limit cannot be set below -2,147,483,583 for Floating Point.

4. Changing parameters related to velocity:
   - If the Velocity Limit will be changed to a lower value than the Initial Velocity and/or Maximum Velocity of Manual Mode, or the Initial Velocity of Auto Mode, change those parameters to a lower speed *before* changing the Velocity Limit
   - If the Maximum Velocity of Manual Mode will be changed to a lower value than the Initial Velocity of Manual Mode, change the Initial Velocity to a lower speed *before* changing the Maximum Velocity.
   - If the Find Home Velocity of Homing Mode will be changed to a lower value that the Final Home Velocity, change the Final Home Velocity to a lower speed *before* changing the Find Home Velocity. Homing velocity does not depend on the Velocity Limit.
5. Changing parameters related to position.
   - Change the Upper Position Limit to a lower value than the value found above.
   - Change the Lower Position Limit to a higher value than the value found above.
   - If the absolute value of the Upper Position Limit will be changed to a lower value than the current Inching Distance for Manual Mode, Backlash Compensation, Home Position Offset, or Registration Move Distance, change

those parameters to a lower value *before* changing the absolute value of the Upper/Lower Position Limit.

- If the Upper Position Limit will be changed to a lower value than the current combined Home Position plus Home Offset values, change those parameters to a combined lower value before changing the Upper Position Limit.
- If the Lower Position Limit will be changed to a higher value than the current combined Home Position plus Home Offset values, change those parameters to a combined higher value before changing the Lower Position Limit.

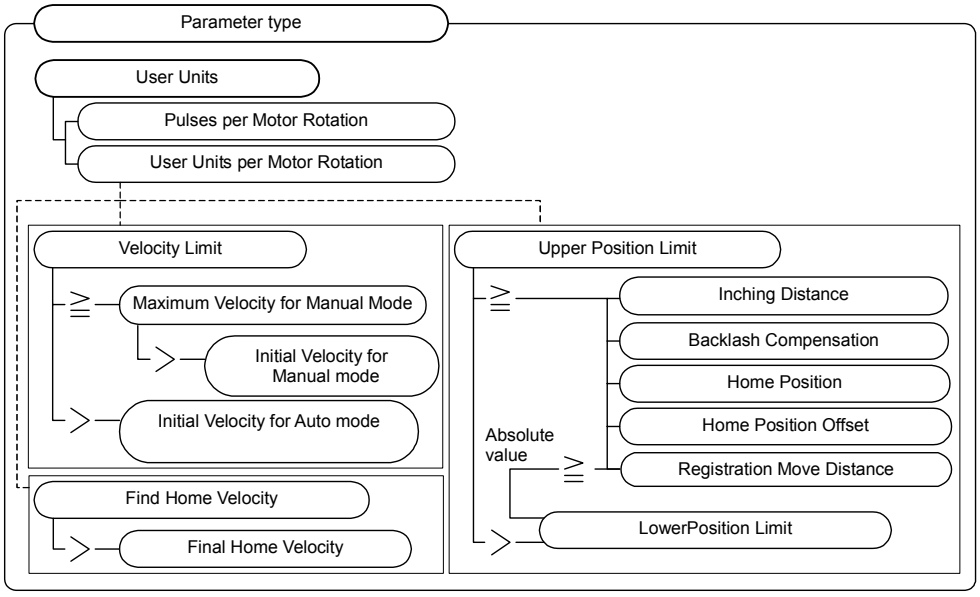
6. Change the User Units

Changing Input Feedback Parameters

When changing the items above, be sure to change related parameters for Input Feedback pulses.

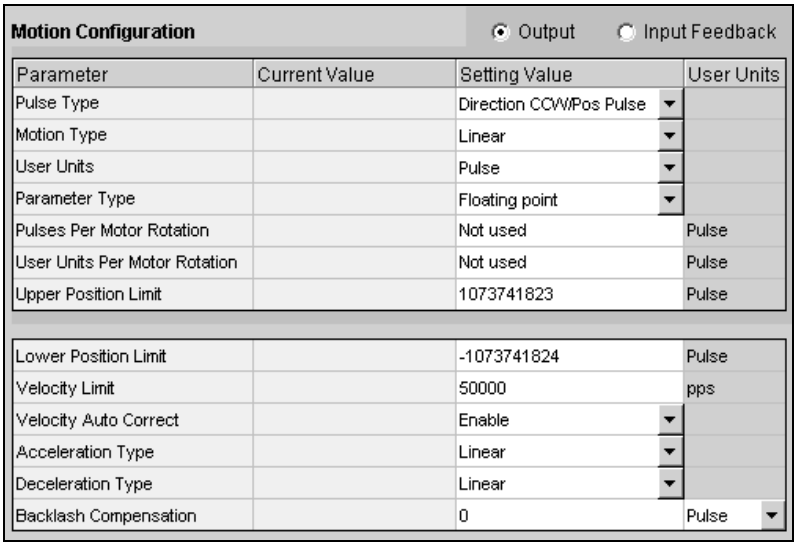
1. Change the Parameter Type (Floating Point / Integer).
2. Change the Pulses per Motor Rotation
3. Change the User Units per Motor Rotation
4. Change the Upper Position Limit
5. Change the User Units
6. Change the Registration Move Distance.

The diagram below illustrates the dependencies among the Common Parameters.



Motion Parameters

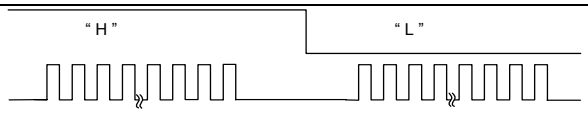
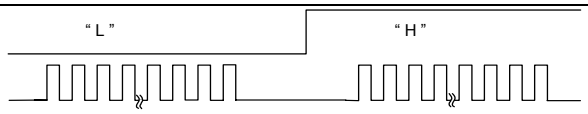
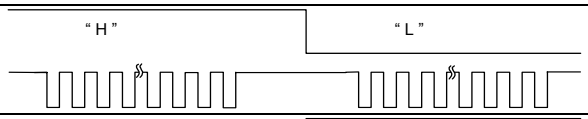
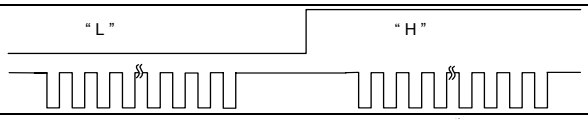
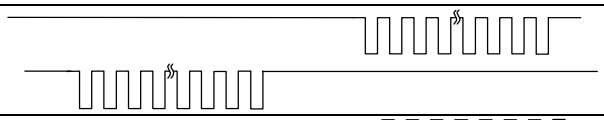
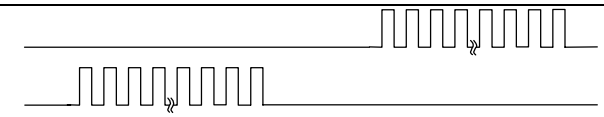
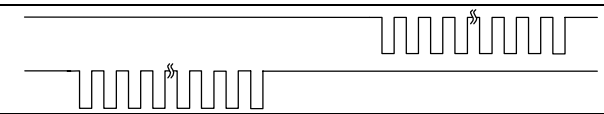
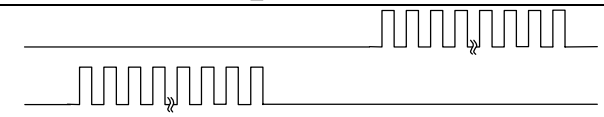
Set up the basic motion parameters for the axis. The default settings are shown below.



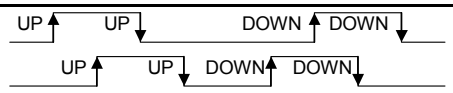
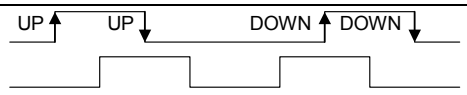
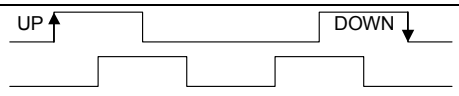
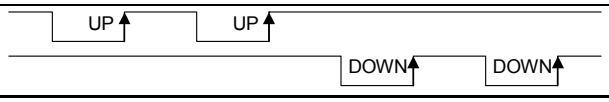
Output or Input: Select Output or Input Feedback for the axis.

Pulse Type: The setting for Pulse Type defines the basic operation for the axis. If the axis is set up for Output operation, match its pulse and direction type to the servo being controlled. If the axis is set up for Input Feedback, match its operation to the feedback from the encoder:

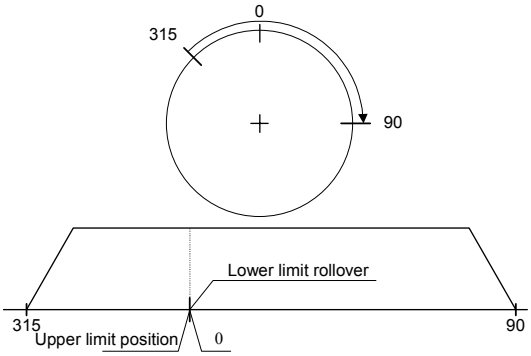
Output Pulse Type

Method	*Output signal*	*Forward (CCW)* *Reverse (CW)*
Direction signal clock output	Direction signal (CCW) Clock (CW)	
	Direction signal (CCW) Clock (CW)	
	Direction signal (CCW) Clock (CW)	
	Direction signal (CCW) Clock (CW)	
CW / CCW pulse output	CW CCW	
	CW CCW	
	CCW CW	
	CCW CW	

Input Feedback Pulse Type

X 4	
X 2	
X 1	
UP/DOWN Signal	

Motion Type: Select linear or rotary movement for the axis..



In Rotary mode, the range of movement is between 0 and a configurable limit. If the move reaches the upper limit position, it returns to 0 degree by rotating in the forward direction. If the move reaches 0, it returns to the upper limit position by rotating in the reverse direction. Motion does not stop at the upper and lower limit position. For example, if the number of Pulses per Motor Rotation is 32,768, the axis can rotate 131,072 times before stopping (4,294,967,295 ÷ 32,768 = 131,072)

The maximum distance for one rotary operation is equivalent to 4,294,967,295 pulses. If the number of output pulses reaches 4,294,967,295, motion stops suddenly. When motion stops, the pulse count is cleared to 0, and the axis can move the equivalent of 4,294,967,295 pulses again.

When switching from linear to rotary mode or from rotary to linear mode, the current position becomes 0.

User Units: Specify units of motion for the axis: Pulse, Free Form, MicroMeter, Inch, or Degree. Select “Free Form” to enter custom units of up to 8 characters. Free Form units can be assigned to suit the application. For example, if Pulses per Rotation of 16,384 should correspond to User Units per Rotation of 200 mm, the units should be assigned as Free Form.

Units	***Range***
Pulse	Integer : +2,147,483,647 to -2,147,483,648 Floating point : +2,147,483,583 to -2,147,483,583
Free Form	The setting range changes depending on a user-set value.
µm	Integer : +214,748,364.7 to -214,748,364.8 (0.1 µm) Floating point : +214,748,358.3 to −214,748,358.3
inch	Integer : +21,474.83647 to -21,474.83648 (0.00001 inch) Floating point : +21,474.83583 to −21,474.83583
degree	Integer : +21,474.83647 to -21,474.83648 (0.00001 degree) Floating point : +21,474.83583 to −21,474.83583

Parameter Type: Select floating point or integer units.

If floating point is selected, several axis parameters including velocity, acceleration, deceleration, and position limits are specified in double-word floating point. Because range errors can occur if the parameters and scaling are not correctly matched, the parameter type should be determined before designing the system. See Appendix A for information about floating point data.

Pulses per Motor Rotation (Common Parameter 4): If the User Units are not configured to be pulses, enter the number of output pulses that corresponds to one rotation of the motor.The MicroMotion Module uses this parameter and the User Units per Motor Rotation to scale outputs. Default is 2000 (hex 44FA0000).

Parameter Type	*Range*	*Length*
Floating point	10 to 65,535	Double word
Integer	10 to 65,535	Double Word

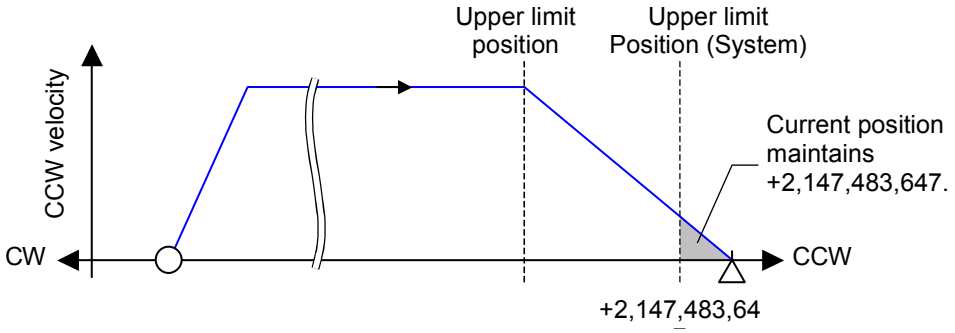
User Units per Motor Rotation (Common Parameter 5): If the User Units are not pulses, enter the number of selected Units (free form, micrometers, inches, degrees) that corresponds to one rotation of the motor. Default is 2000. This is a double-word floating point or integer value.

Units	*Valid range*
µm	+1 to +2,147,483,583(Floating Point) +2,147,483,647(Integer) (× 0.1)
inch	+1 to +2,147,483,583(Floating Point) +2,147,483,647(Integer) (× 0. 00001)
Free-form	+1 to +2,147,483,583(Floating Point) +2,147,483,647(Integer)
degree	+1 to +2,147,483,583(Floating Point) +2,147,483,647(Integer) (× 0. 00001)

Note: When using Free-form User Units, the initial velocity may be the high speed if the User Units per Motor Rotation parameter is set to a smaller value. In that case, the User Units per Motor Rotation should be changed. For example: the Initial Velocity is 2000pps and the Pulses per Motor Rotation is set to 2000, the User Units per Motor Rotation is set to 1 cm, and the Initial Velocity is set to 1 cm/s. If the Initial Velocity 2000pps is too high, the User Units per Motor Rotation should be changed to 10 mm or to 10000µm.

Upper Position Limit (Common Parameter 20): Enter the Upper Position Limit in the selected units to be used for overtravel monitoring. This is a double-word floating point or integer value in the range +2,147,483,583 to -2,147,483,583 (Floating Point) and +2,147,483,647 to -2,147,483,648 (Integer). All types of User Units are equivalent to pulses. Default is +1,073,741,823.

During Auto Mode operation, if the value of the target position data exceeds this limit in the forward direction, a position error occurs, and the move is not done. Correcting the position data and restarting the move cancels the error.



During Manual Mode operation when the Motion Type is Linear, if the target position exceeds this limit in the forward direction, the position error causes the axis to slow to a stop.

During Homing Mode, motion continues in opposite direction after it reaches this value, and continues until the Home Switch is detected or the axis reaches the opposite position limit. If the Home Switch is detected, normal homing operation takes place. If the axis reaches the opposite position limit, motion stops with position limit error.

In rotary operation in Manual or Homing Mode, if the target position exceeds this value in the forward direction, the value rolls over to the minimum position limit and motion continues.

Lower Position Limit (Common Parameter 21): Enter the lower position limit in the selected Units, for overtravel monitoring. See the above description of Upper Position Limit. This is a double-word floating point or integer value in the range +2,147,483,583 to -2,147,483,583 (Floating Point) and +2,147,483,647 to -2,147,483,648 (Integer). All units are equivalent to pulses. Default is -1,073,741,824.

Velocity Limit (Common Parameter 6): Set the maximum velocity as the maximum number of pulses, micrometers, inches, degrees, or free-form units per second. Default is 50000. This is a double-word floating point or integer value.

Velocity Auto Correct: By default, Velocity Auto Correct is disabled. If Auto Correct is set to enable, the axis velocity will be corrected automatically to a value that is within the configured limits. If Velocity Auto Correct is set to disable, the velocity will not be corrected and an error will be reported if the value is not within the configured limits.

When Velocity Auto Correct is enabled, the range of the Maximum Velocity determines the resolution of the minimum units. Velocity ranges and resolutions of their minimum units are shown in the following table. Velocity is adjusted using these resolutions in Manual Mode and Auto Mode. The velocity correction in Homing Mode is based on the Find Home Velocity.

Range of Maximum Velocity [pulse/s]	***Minimum Units***			
	Pulses /s	µm [µm/s] *	Inch [Inch/s] *	Degree [degree/s] *
1 to 5,000	1 pps	61.04	0.000244	0.02
5,001 to 50,000	10 pps	610.35	0.002441	0.22
50,001 to 500,000	100 pps	6103.52	0.024414	2.20
500,001 to 2,000,000	1000 pps	61035.2	0.24414	22.0

* The Pulses per Motor Rotation is 16384 and the User Units per Motor Rotation are 100,000µm, 4 inch, and 360 degrees.

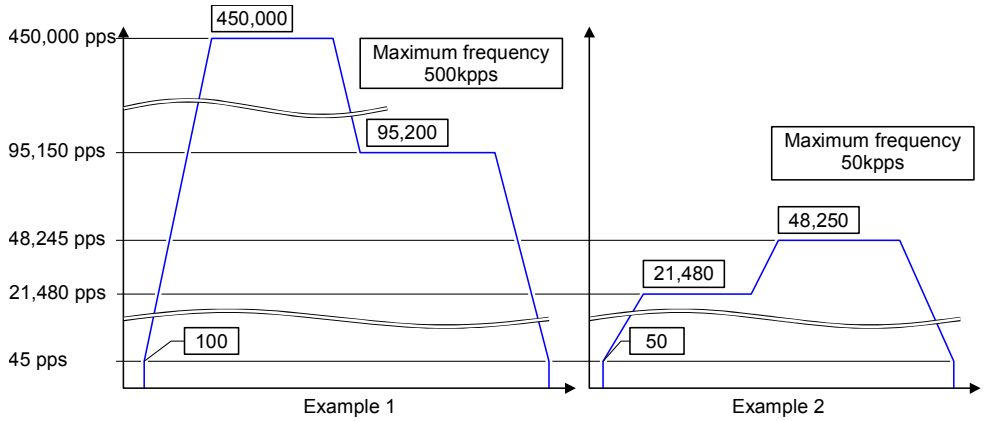
If acceleration and deceleration exceed the Upper Position Limit of each range, they are set to the Upper Position Limit value. If they fall below the lower limit value of each range, they will be set to the Lower Position Limit value.

If Velocity Auto Correct is enabled, the acceleration and deceleration for Homing Mode are adjusted depending on the Find Home Velocity.

Maximum acceleration and deceleration (pps conversion) = 500 x Maximum velocity (pps conversion)

Minimum acceleration and deceleration (pps conversion) = 0.0625 x Maximum velocity (pps conversion).

When the maximum velocity is less than 1000pps in pulse conversion, the acceleration / deceleration is a maximum of 500122pps^2 (pulse conversion).

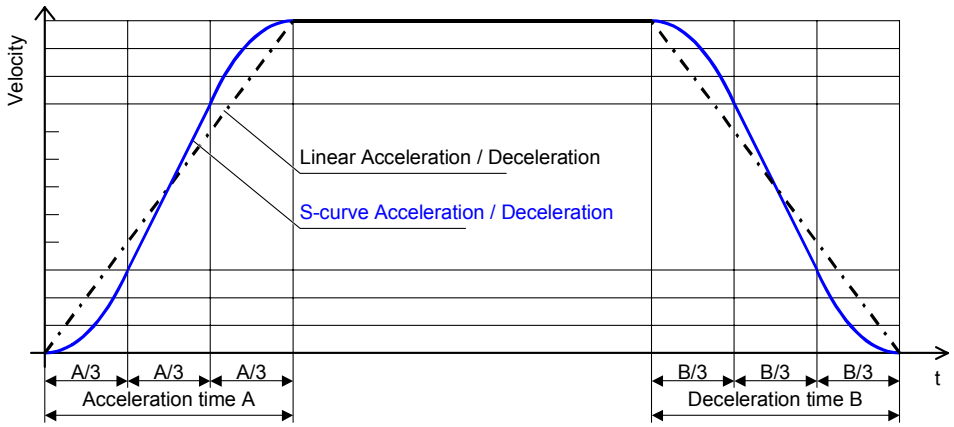


In example 1, the velocity units are 100 pps because the Velocity Limit is 500k pps (see the table on the previous page). Therefore, 95,150 pps would be adjusted to 95,200pps and 45 pps would be adjusted to 100 pps.

In example 2, the velocity units are 10 pps because the Velocity Limit is 50k pps (see the table on the previous page). Therefore, 48,245 pps would be adjusted to 48,250 pps. 21,480 pps would remain unchanged, and 45 pps would be adjusted to 50 pps.

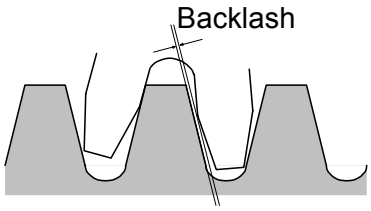
As mentioned, the pulse may be output at a different velocity than the set velocity depending on the Velocity Limit. If more precise speed control is required, the Velocity Limit can be lowered.

Acceleration Type: Set the acceleration type for high-speed homing to Linear or S-Curve.

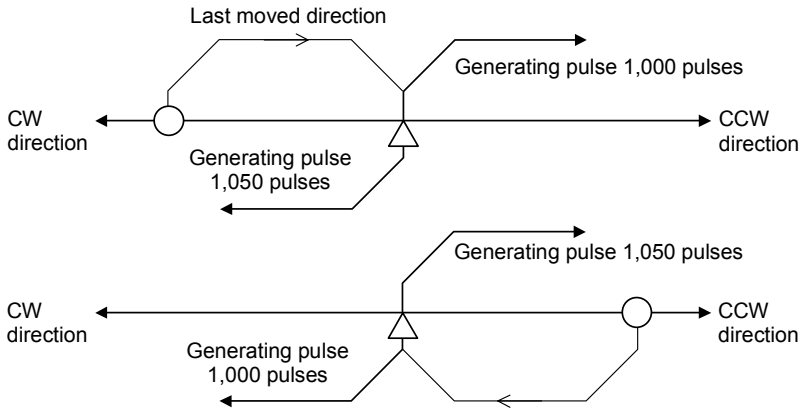


Deceleration Type: Set the deceleration for high-speed homing to Linear or S-Curve.

Backlash Compensation (Common Parameter 17): Specify the backlash compensation for the axis, in pulses or the selected user units. Backlash Compensation should be set to pulses if the number of User Units per Motor Rotation is large. Default is 0. This is a double-word floating point or integer value. If a value is specified, backlash compensation will be performed during Manual or Auto Mode whenever the rotating direction of the motor changes.



For example, if the target position data is 1,000 pulses / -1,000 pulse, and the Backlash Compensation is 50:



In Homing Mode, the result of Backlash Compensation depends on the travel direction and the type of homing being performed.

	Travel in CW direction	***Travel in CCW direction***
Free homing	-Travel distance	Travel distance
CW low speed homing	-Travel distance	Travel distance + backlash
CCW low speed homing	-Travel distance - backlash	Travel distance
CW high speed homing	-Travel distance	Travel distance + backlash
CCW high speed homing	-Travel distance - backlash	Travel distance

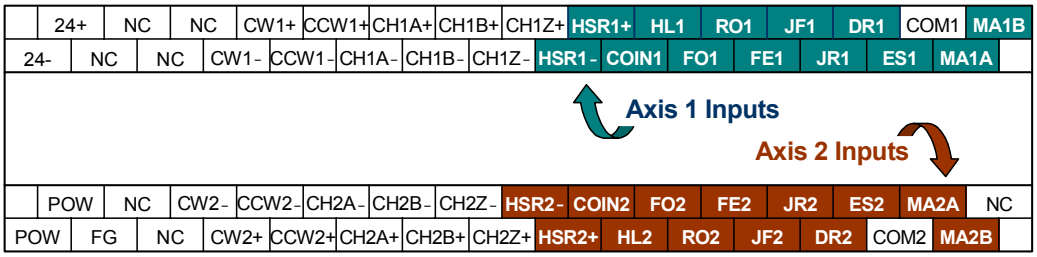
Input Configuration

Operation of most external Inputs is established on the Input Configuration area of the Common Parameters setup screen.

Input Configuration

Parameter	Current Value	Setting Value	User Units
ES - Emergency Stop Input		Fast Stop	
FO/RO - Overtravel Input		Enable Fast Stop	
COIN - Move Complete Input		Enable	
DR - Drive Ok/Ready Input		Enable	
FE - Feedrate Override Input		Enable	
Feedrate Override Percentage		100	%
HSR - Registration Input		Enable	
Registration Move Distance		10000	Pulse

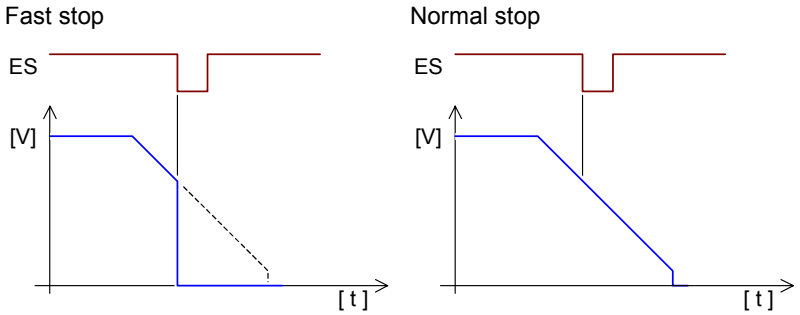
These external inputs correspond to input terminals on the MicroMotion module.



ES - Emergency Stop Input: By default, when the Emergency Stop input goes On, pulses on the axis stop immediately (Fast Stop). This can be changed to Normal Stop, which will stop the pulse at the configured Deceleration Rate. The Emergency Stop input cannot be disabled.

If the Emergency Stop input signal goes Off, the axis pulse stops regardless of the status of the MicroMotion Module.

If the axis is already decelerating when the Emergency Stop input goes off, it will either stop immediately (left below), or continue decelerating at the same rate (right).

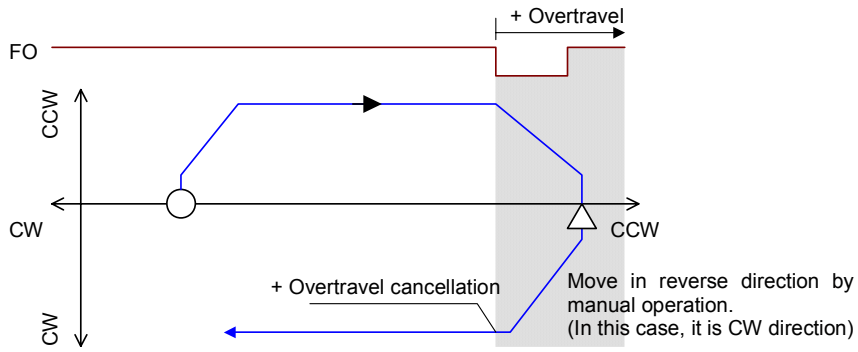


An error is generated when the Emergency Stop input goes off.

FO/RO - Overtravel Input: Determines what happens if the Forward Overtravel or Reverse Overtravel axis input goes off. By default, a forward or reverse overtravel will cause the axis to stop immediately (Enable Fast Stop). This can be changed to Enable Normal Stop. If the FO and RO inputs are not used for the axis, set this parameter to Disabled.

Restarting Operation After an Overtravel Occurs

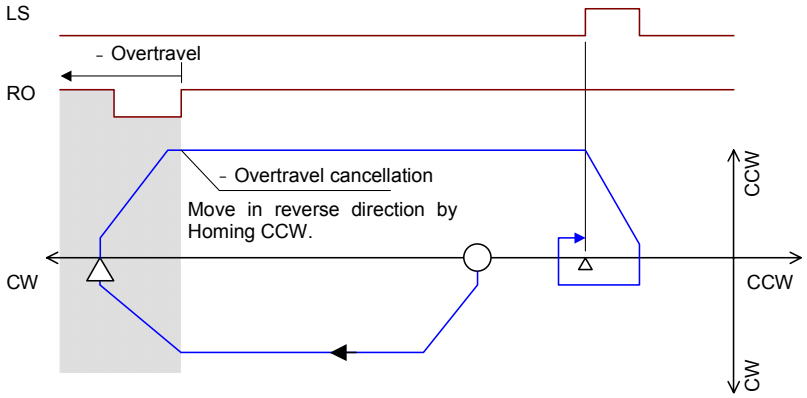
After an overtravel occurs, the axis cannot be moved in the same direction because an error exists. Motion can be restarted in the reverse direction with a Manual Jog or Homing operation.



If an Overtravel input has been turned Off by the overtravel move, it remains Off until motion reverses back past the overtravel on positon.

If the Overtravel is cancelled by the Manual Jog operation, the Standby (STBY) bit does not turn On. Because an Auto Mode operation can be performed only when the Standby bit is On, the error must be cleared and the Homing operation must be completed after the overtravel. Free Homing cannot be done when an overtravel exists.

Restarting Operation by Homing in the Reverse Direction

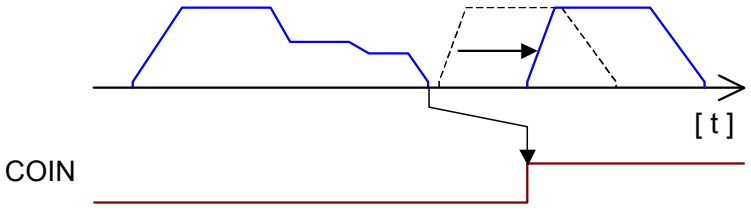


COIN – Move Complete Input: The Move Complete (COIN) input goes On when the axis has completed its positioning. Use of this input defaults to enabled. If the axis COIN input terminals will not be used, set this to disable.

If Move Complete is enabled, the Move Complete input must be On before axis motion can start.

When the axis is in Homing or Manual (Jog) mode, an operation is not complete until the Move Complete input (COIN) input goes On.

In Auto Mode, because the next profile data is run when the Move Complete input is on, the operation is not completed unless the Move Complete input turns On.

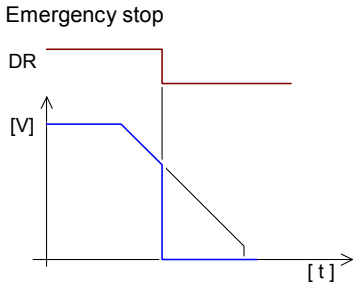


If a stop occurs because of an external input or Stop command, the MicroMotion Module completes the Stop processing before turning On the Move Complete input. The application logic in the CPU or host should check the Move Complete (COIN) input status. If the operation is restarted while the Move Complete input is still Off, an error occurs and the operation does not start.

DR - Drive OK/Ready Input: The Drive OK/Ready (DR) input can be used to monitor the status of an external device controlled by the axis. If the input terminal will not be used, set this to disable.

When the Drive OK/Ready input is enabled, the axis pulse output does not start until the Drive OK/Ready input turns On. If the Drive OK/Ready input turns Off during pulse output, the pulse output stops.

The normal status of the Drive OK/Ready input is On. If the Drive OK/Ready input is Off, it is an error, and an Emergency Stop occurs. A Decelerated Stop is not possible.



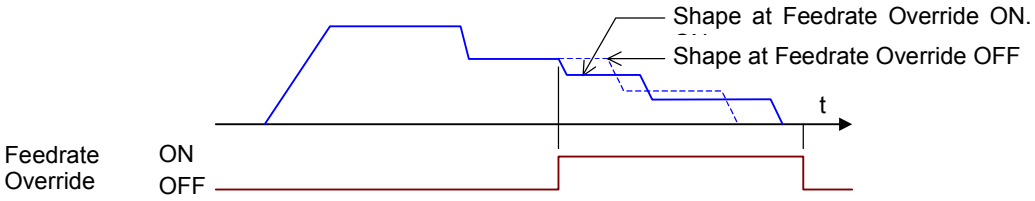
FE - Feedrate Override Input: If Feedrate Override (FE) input is enabled, when the Feedrate Override input is On, the axis will decelerate at the selected Feedrate Override Percentage (below). If the FE input terminals will not be used, set this to disable. The Feedrate Override function can be also be performed by a command from the Micro PLC or host controller.

The Feedrate Override input is level-sensitive. The Feedrate Override function can be validated during stop.

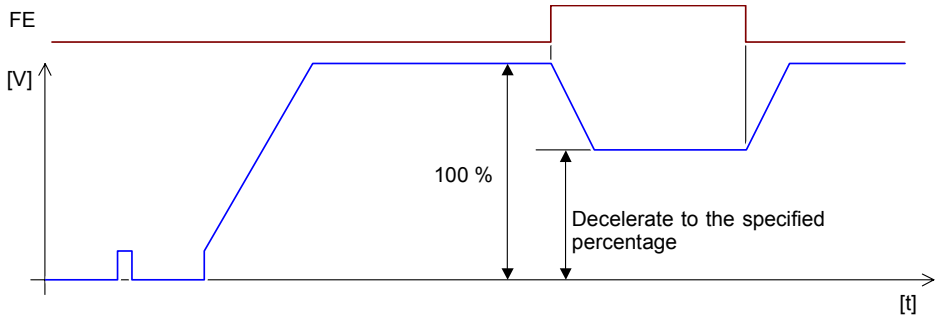
If an operation is started while Feedrate Override function is in effect, it is output at the speed decelerated to the percentage rate specified in the axis setup.

The Feedrate Override function is not used in Homing Mode, which operates at a fixed speed. Feedrate Override is also invalid during a Decelerated Stop.

Feedrate Override can be used in Manual or Auto Mode to decelerate the axis to the selected rate.

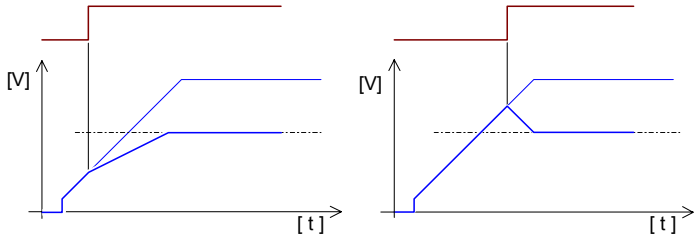


If Feedrate Override is turned Off before the end of the operation, the speed returns to its former rate.

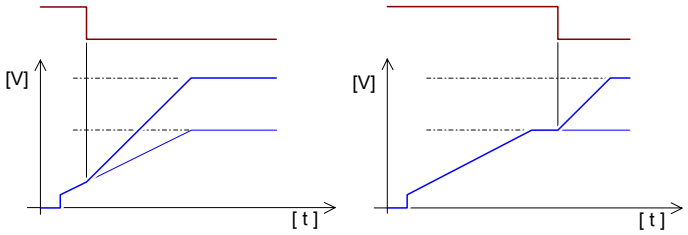


The rate of deceleration used for Feedrate Override can be specified from 1% to 100%, but the pulse will not slow down below the initial velocity, even if a slower speed is specified.

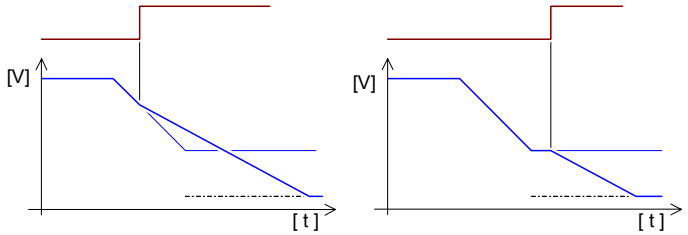
FE Input ON when Accelerating



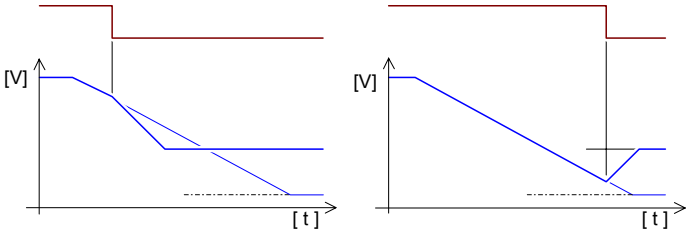
FE Input OFF when Accelerating during Feedrate Override



FE Input ON when Decelerating



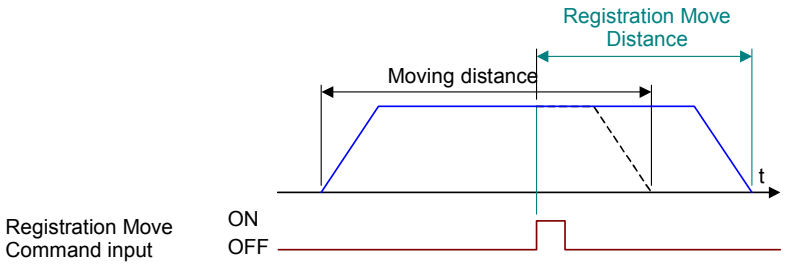
FE Input OFF when Decelerating During Feedrate Override



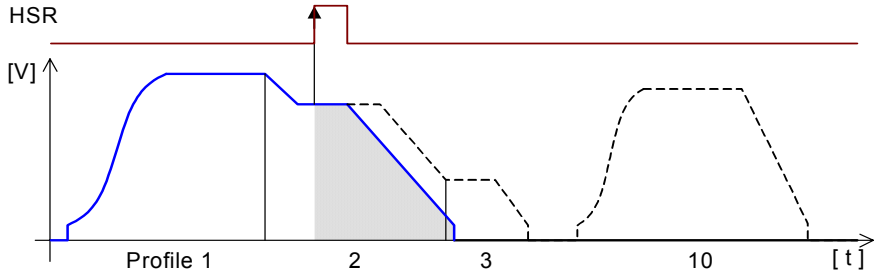
Feedrate Override Percentage (Common Parameter 18): If the Feedrate Override (FE) input is enabled (above), specify a constant percentage by which to decelerate the pulse rate when the external FE input turns On. This defaults to 100%, which causes the pulse to stop immediately. The pulse will not slow down below the initial velocity, even if a slower speed is specified.

HSR - High-Speed Registration Input: If High-Speed Registration (HSR) is enabled, when the High-Speed Registration input turns On during Manual or Auto Mode, the axis outputs the specified number of pulses (below), then stops. If the input terminal will not be used, set this to disable. The number of pulses that will be output is set up in the Registration Move Distance parameter.

- In Manual Mode, when the High-Speed Registration input turns On, the module outputs the specified number of pulses from the present position, then stops. The move distance is extended whenever the High-Speed Registration input turns On.



- In Auto Mode, when the High-Speed Registration input turns On, the module outputs the specified number of pulses from the present position, then stops without starting the next profile. The CPU or host controller can restart Auto Mode operation after the axis stops.



No HSR: Profile 1➔2 ➔3 ➔Dwell ➔ 10

Including HSR: Profile 1➔2 (Registered distance movement)➔STOP

Registration Move Distance (Common Parameter 24): Specify the number of pulses from the axis should output when the High-Speed Registration input (above) turns on. Defaults to 10,000. This is a double-word floating point or integer value in the range 0 to +2,147,483,583.

Homing Configuration

Homing Configuration

Parameter	Current Value	Setting Value	User Units
Home Position		0	Pulse
Final Home Velocity		100	pps
Find Home Velocity		200	pps
Acceleration Rate		200	pps2
Deceleration Rate		200	pps2
Home Position Offset		0	Pulse
Homing Direction		Command	

Home Position: Specify the Home Position to be used for Homing. Measurement is in the configured User Units, with all units equivalent to pulses. When the homing is completed, the current data is rewritten to this data. This is a double-word floating point or integer value in the range +2,147,483,583 to –2,147,483,583 (Floating Point) and +2,147,483,647 to -2,147,483,648 (Integer). Default is 0.

Final Home Velocity: Set up the Final Home Velocity in User Units per second. It must be less than the Find Home Velocity. Default is 100. This is a double-word floating point or integer value.

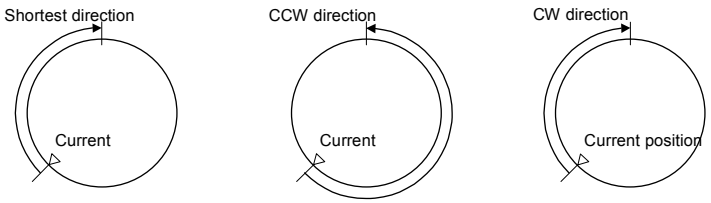
Find Home Velocity: Set up the Find Home Velocity, in User Units per second. It must be more than the Final Home Velocity. Default is 200. This is a double-word floating point or integer value.

Acceleration Rate: Set the acceleration rate for homing, in (User Units per second)^2. Default is 200. This is a double-word floating point or integer value.

Deceleration Rate: Set the deceleration rate for homing, in (User Units per second)^2. Default is 200. This is a double-word floating point or integer value.

Home Position Offset: Set the exact adjustment distance when the homing is completed, in the configured User Units. If this value is a positive number, positioning will start in the forward direction. If this value is negative, positioning will start in the reverse direction. All units are equivalent to pulses. Default is 0. This is a double-word floating point or integer value in the range +2,147,483,583 to –2,147,483,583 (Floating Point) and +2,147,483,647 to -2,147,483,648 (Integer).

Homing Direction: If the Motion Type for the axis has been set to Rotary in the Motion Configuration window, this setting determines whether the direction will commanded, or automatically-calculated based on the shortest distance direction. When the current position is 180° and an overrun occurs, homing is performed in the specified direction.



Manual Mode Configuration

Manual Configuration

Parameter	Current Value	Setting Value	User Units
Initial Velocity		1000	pps
Maximum Velocity		10000	pps
Acceleration Rate		4000	pps2
Deceleration Rate		4000	pps2
Move Type For External Input		Jog	
Inching Distance		1	Pulse

Initial Velocity: Set up the initial velocity for the axis when the Jog Forward (JF) or Jog Reverse (JR) input is On, in User Units per second. Default is 1000. This is a double-word floating point or integer value.

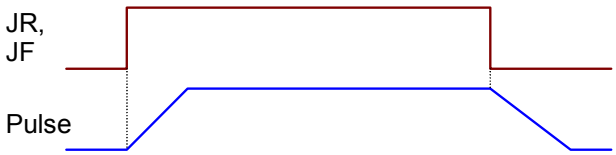
Maximum Velocity: Set up the greatest velocity for the pulse output when the Jog Forward (JF) or Jog Reverse (JR) input is On, in User Units per second. Default is 10000. This is a double-word floating point or integer value.

Acceleration Rate: Set the Acceleration Rate for Manual Mode, in (User Units per second)^2. Default is 4000. This is a double-word floating point or integer value.

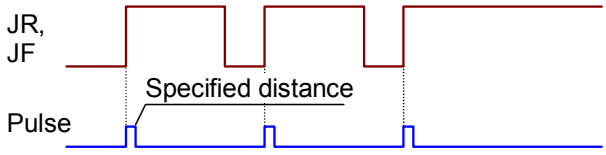
Deceleration Rate: Set the deceleration rate for Manual operation, in (User Units per second)^2. Default is 4000. This is a double-word floating point or integer value

Move Type for External Input: Choose the type of Manual operation to be performed while the Jog Forward (JF) or Jog Reverse (JR) input is On: jog, inching, or inching plus jog.

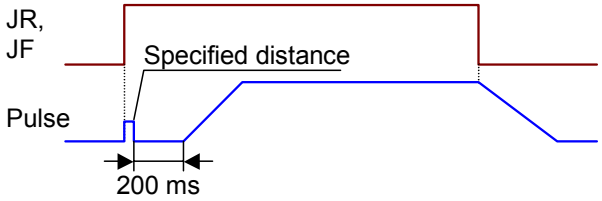
In Jog mode, if the Jog Forward or Jog Reverse input is turned on, a pulse is output at the Initial Velocity that has been set up for Manual Mode. The pulse accelerates at the Manual Mode Acceleration Rate until it reaches the Maximum Velocity. When the Jog Forward or Jog Reverse input is turned off, the pulse decelerates at the Deceleration Rate and stops.



In Inching mode, if the Jog Forward or Jog Reverse input is on, a pulse that corresponds to distance that user set is output at the Initial Velocity that has been set up for Manual Mode.



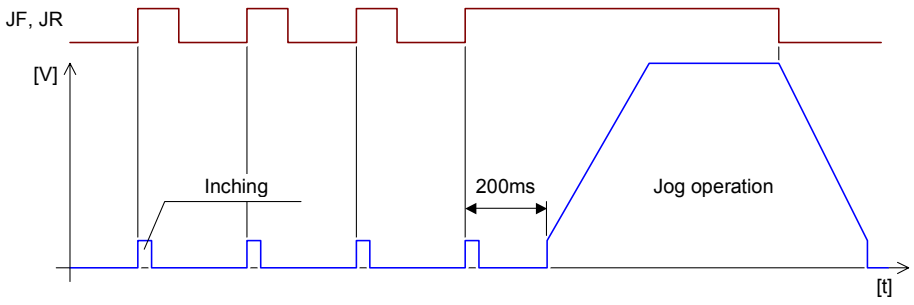
In Inching plus Jog mode, if the Jog Forward or Jog Reverse input is On, a pulse is output at the Initial Velocity that has been set up for Manual Mode. If Jog Forward or Jog Reverse remains on after 200ms, the pulse accelerates to the configured initial velocity at the configured acceleration rate. If the Jog Forward or Jog Reverse input is turned off, the pulse decelerates to the initial velocity at the specified deceleration rate, and stops.



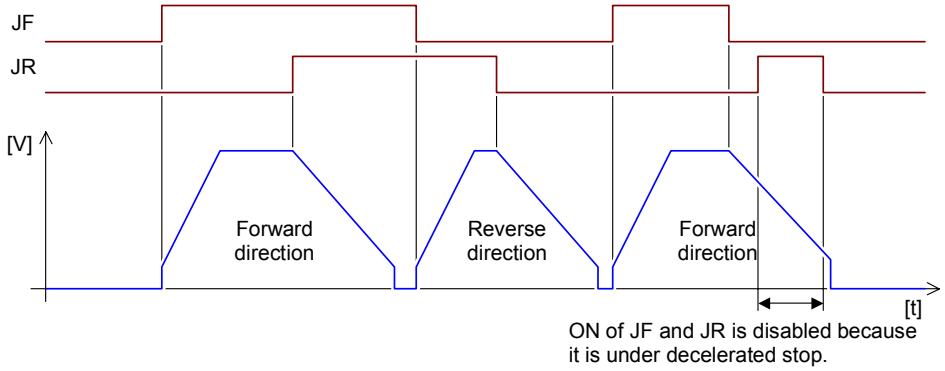
The Jog Forward and Jog Reverse Inputs

The Jog Forward (JF) and Jog Reverse (JR) inputs are used in Manual Mode. Jog Forward is also used during Auto Mode to move between profiles in a sequence table. Jog Forward and Jog Reverse have no effect in other modes of operation.

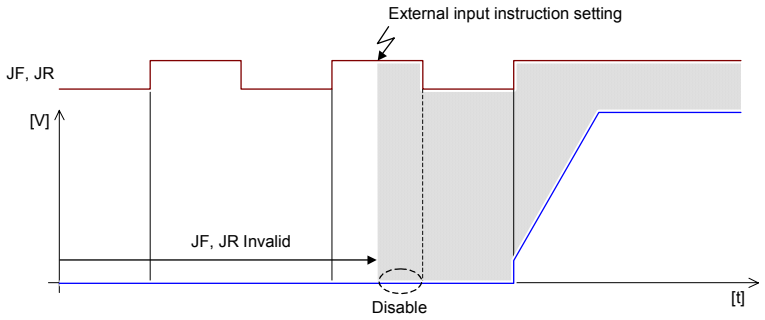
If the Jog Reverse input turns on while Jog Forward is On, or if Jog Forward turns On while Jog Reverse is on, the axis slows to a stop. If the Jog Forward or Jog Reverse input is turned On during deceleration, the input is not valid.



If Jog Forward or Jog Reverse is turned Off before the pulse output stops, the pulse output is restarted according to the input that is On after the pulse stops.



The Jog Forward and Jog Reverse inputs are level-sensitive. However, if the MicroMotion Module switches to Manual Mode from a different mode, the pulse is not output unless Jog Forward or Jog Reverse is turned Off once.



Inching Distance: Specify the distance for the inching operation when the Jog Forward or Jog Reverse input is turned On in Manual Mode. Distance is in User Units. Default is 1. This is a double-word floating point or integer value.

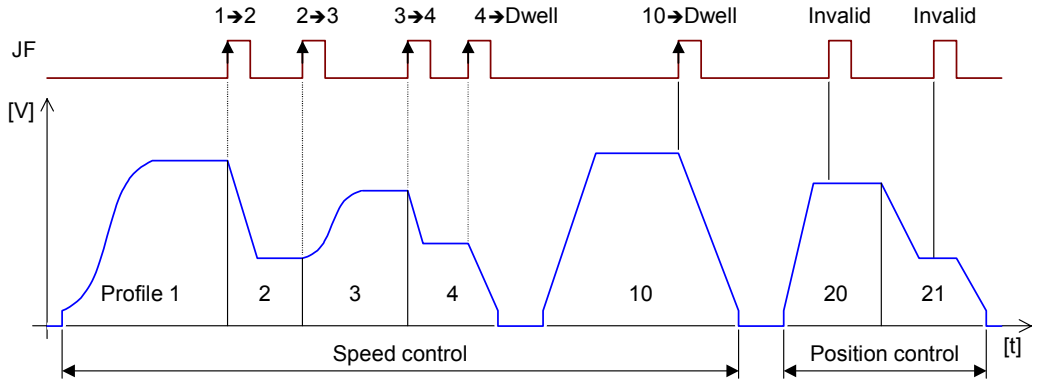
Auto Mode Configuration

Auto Mode Configuration			
Parameter	Current Value	Setting Value	User Units
Initial Velocity		100	pps

Initial Velocity: Set up the initial velocity for Auto Mode, in User Units per second. Default is 100. This is a double-word floating point or integer value.

Jog Forward Input in Automatic Operating Mode

In speed-controlled Automatic Operation Mode, the On edge of the Jog Forward input advances from one profile in a sequence table to the next profile, as shown below.

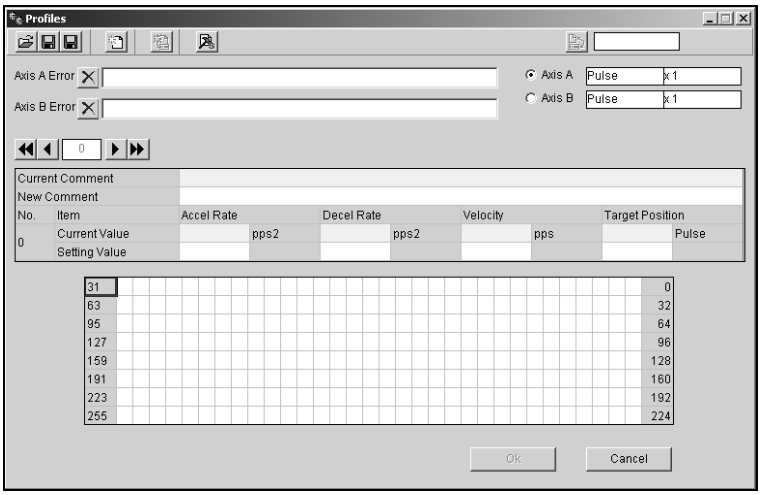


Setting Up Profiles for Auto Mode

In Auto Mode, operations are performed using position (profile) data that has been set up in advance.

Defining Profiles in Offline or Online Mode

Up to 256 profiles can be defined for a MicroMotion Module. Profile data is stored in the module's backup memory. Profiles can be edited in both online and offline mode. When the programmer is communicating with the MicroMotion Module, the parameters in the module are changed. If the programmer is not communicating with the MicroMotion Module, parameters are set locally, and can be saved as a CSV file.



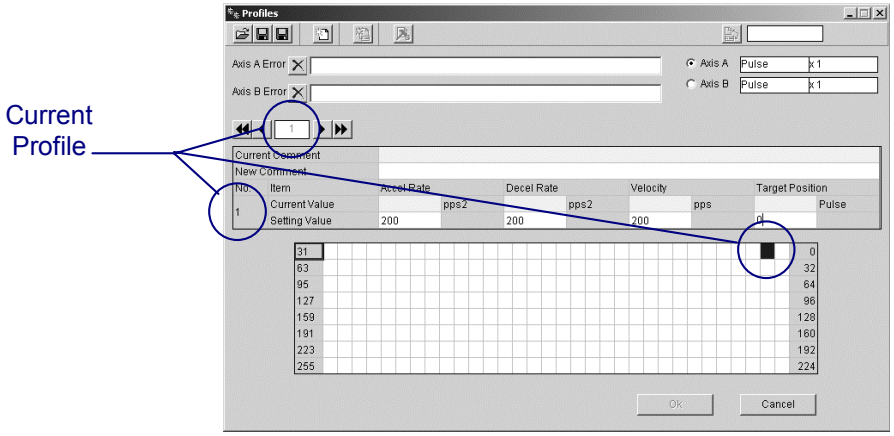
From this screen:

- Open an existing Profile.
- Save Profile data to a file.
- Save Profile data to a specific filename.
- Clear the Profile data in the programmer.
- Initialize the Profile data in the connected MicroMotion Module.
- Open the Sequence table.

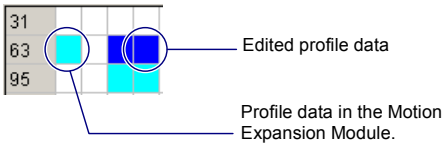
Profile Numbers

Up to 256 profiles (0 – 255) can be defined. Use the left or right arrows to select a profile:

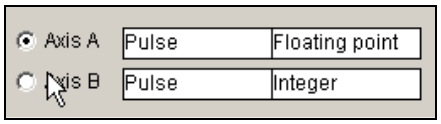
The current profile is indicated in the settings area and shown graphically on the screen.



In the graphic display, edited profile numbers are represented in dark blue. Profiles saved in the Motion Expansion Module memory are represented in cyan.



Axis Pulse Type Settings



The output User Units and input feedback Pulse Type assigned to each axis are shown in the upper right of the screen. Profile data can be used for both axes. If the User Units and magnification are not same for both axes, the meaning of the profile data will also not be the same.

Two axes can refer to the same profile table. Do not use the same profile data for Axis A and Axis B if they have different Upper Position Limit parameters. At the start of Auto Mode, the module may need to correct acceleration, deceleration and velocity based on the Upper Velocity Limit common parameter. After that, the MicroMotion Module performs the positioning control using the corrected profile data. If both axes are set up with different Upper Position Limits but share the same profiles, the corrected parameter may change to an unexpected value when the correction is made.

Profile Data Settings

For the fields in the Profiles window, existing values for the profile are shown in the upper fields. New values can be entered below. After entering a new value, click on OK.

Current Comment									
New Comment									
No.	Item	Accel Rate		Decel Rate		Velocity		Target Position	
0	Current Value		pps2		pps2		pps		Pulse
	Setting Value								

Comment: Any text. This text can be used to add a profile to the sequence table.

Acceleration Rate: The acceleration currently being set is displayed in the upper section.

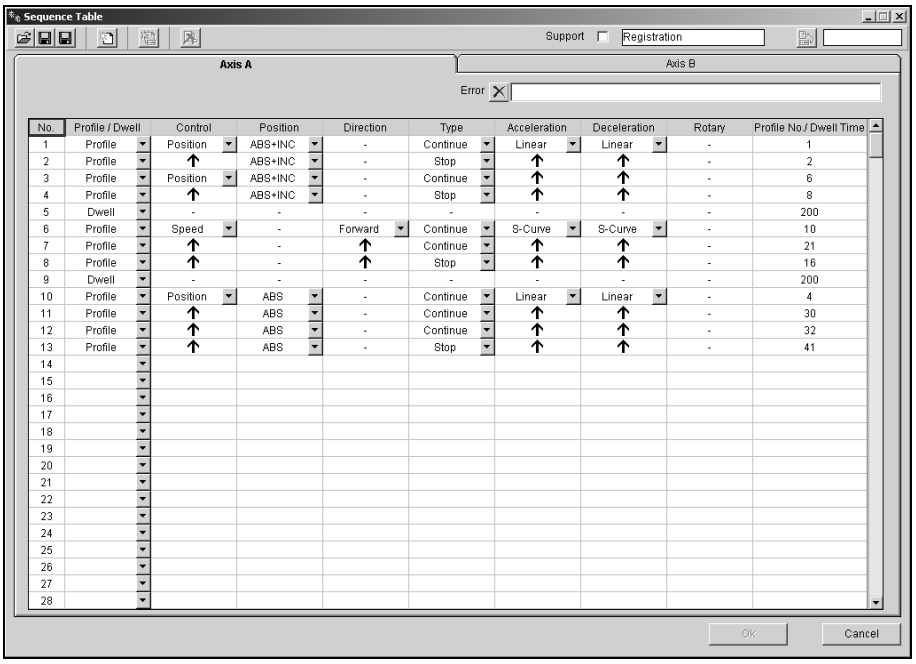
Deceleration Rate: The deceleration currently being set is displayed in the upper section.

Velocity: The maximum velocity currently being set is displayed in the upper section.

Target Position: The target position currently being set is displayed in the upper section.

Setting Up a Sequence Table

The Sequence Table window of the Setup Tool is shown below.



No.	Profile / Dwell	Control	Position	Direction	Type	Acceleration	Deceleration	Rotary	Profile No./ Dwell Time
1	Profile	Position	ABS+INC	-	Continue	Linear	Linear	-	1
2	Profile	↑	ABS+INC	-	Stop	↑	↑	-	2
3	Profile	Position	ABS+INC	-	Continue	↑	↑	-	6
4	Profile	↑	ABS+INC	-	Stop	↑	↑	-	8
5	Dwell	-	-	-	-	-	-	-	200
6	Profile	Speed	-	Forward	Continue	S-Curve	S-Curve	-	10
7	Profile	↑	-	↑	Continue	↑	↑	-	21
8	Profile	↑	-	↑	Stop	↑	↑	-	16
9	Dwell	-	-	-	-	-	-	-	200
10	Profile	Position	ABS	-	Continue	Linear	Linear	-	4
11	Profile	↑	ABS	-	Continue	↑	↑	-	30
12	Profile	↑	ABS	-	Continue	↑	↑	-	32
13	Profile	↑	ABS	-	Stop	↑	↑	-	41
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									

From this screen:

Open a saved Sequence Table.

Save a Sequence Table to a file.

Save a Sequence Table with a specific filename.

Clear the current Sequence Table window.

Initialize the Sequence Table in the connected MicroMotion Module.

Open the Profile data window.

If Support is checked, the profile No. can be selected by its descriptive name (comment field).

Sequence Table Settings

In Auto Mode, the MicroMotion Module executes the Profiles in a Sequence Table order starting with the lowest number. The Sequence Table can have up to 499 lines.

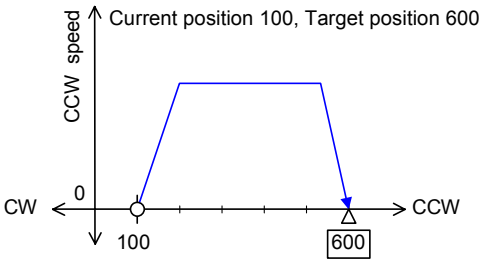
No.	Profile / Dwell	Control	Position	Direction	Type	Acceleration	Deceleration	Rotary	Profile No./ Dwell Time
1	Profile	Position	ABS+INC	-	Continue	Linear	Linear	-	1
2	Profile	↑	ABS+INC	-	Stop	↑	↑	-	2
3	Profile	Position	ABS+INC	-	Continue	↑	↑	-	6
4	Profile	↑	ABS+INC	-	Stop	↑	↑	-	8
5	Dwell	-	-	-	-	-	-	-	200
6	Profile	Speed	-	Forward	Continue	S-Curve	S-Curve	-	10
7	Profile	↑	-	↑	Continue	↑	↑	-	21
8	Profile	↑	-	↑	Stop	↑	↑	-	16
9	Dwell	-	-	-	-	-	-	-	200
10	Profile	Position	ABS	-	Continue	Linear	Linear	-	4
11	Profile	↑	ABS	-	Continue	↑	↑	-	30
12	Profile	↑	ABS	-	Continue	↑	↑	-	32
13	Profile	↑	ABS	-	Stop	↑	↑	-	41
14									

Profile/Dwell: For each line in the table, specify Profile or Dwell data.

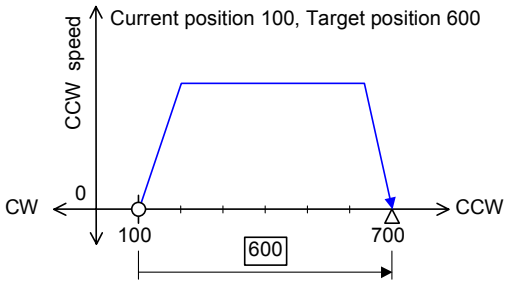
Control: For each Profile, select Position or Speed control.

Position: For Position control, select either either Absolute or Absolute + Incremental positioning.

Absolute (ABS) Positioning

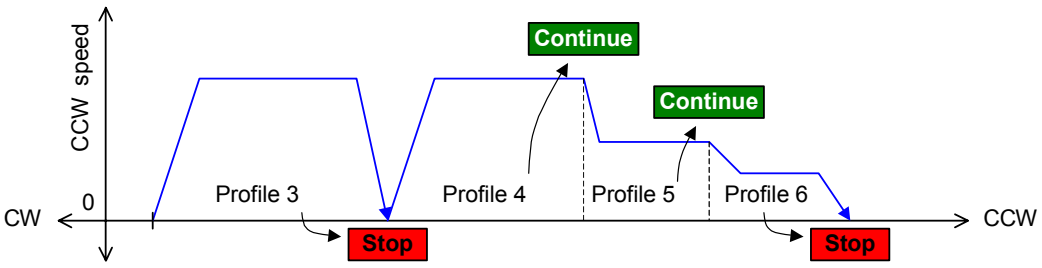


Absolute + Incremental (ABS + INC) Positioning

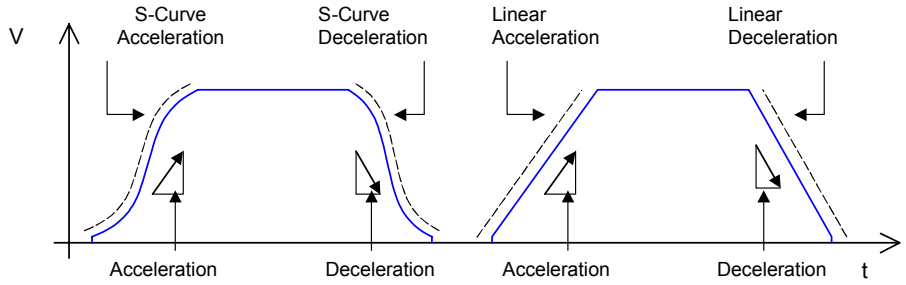


Direction: For Speed control, select either Forward or Reverse rotation.

Type: For Position control, the move can Continue to the next profile or Stop, as shown below. When Continue is selected, the next profile in the sequence will use the same Control, Acceleration, and Deceleration as the current profile. The MicroMotion Module can execute to 100 continuous profiles.

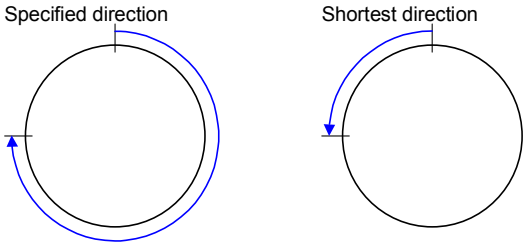


Acceleration: Set the Acceleration type to Linear or S-Curve.

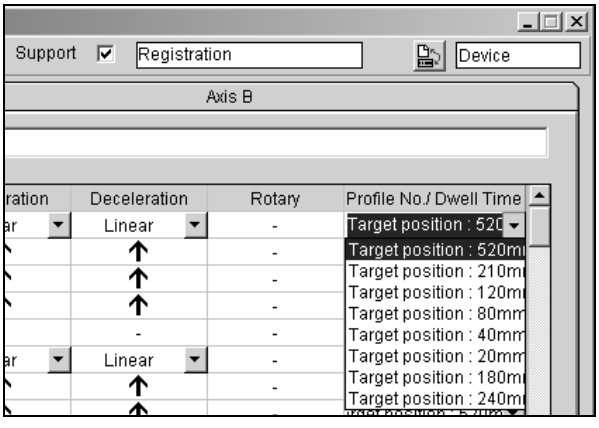


Deceleration: Set the Deceleration type to Linear or S-Curve.

Rotary: If the axis is set up in the Common Parameters to have its Motion Type: Rotary, and in the Sequence Table, Control is set to Position and Position is set to ABS, rotation can be in the shortest direction or in the designated direction.



Profile No./Dwell Time: For each Profile in the Sequence Table, specify the Profile Number to be executed. If Support is checked and Profile is selected, select the name of the profile (from the profile's Comment field). The names listed are those that have previously been saved, or stored to the module.



If Dwell is selected (Support is not checked), enter a Dwell time between 1 and 32,768[ms].

Chapter 6 Configuring a MicroMotion Expansion Module

This chapter explains how to use Proficy Machine Edition to configure a MicroMotion Module and to access the MicroMotion Setup Tool. These steps are required for a MicroMotion Module in a VersaMax Micro PLC system, or in a host controller system.

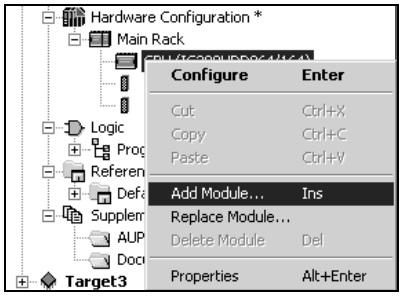
Support for MicroMotion Modules and for the MicroMotion Setup Tool requires Proficy Machine Edition version 5.7 SIM 3.

- MicroMotion Module Locations
- Module Configuration Using Machine Edition
  - Configure the Motion I/O Settings
  - Configure the Wiring Information
- Open the MicroMotion Setup Tool

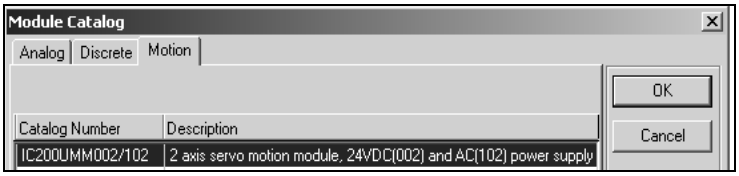
Module Configuration Using Machine Edition

For a VersaMax Micro PLC or host controller system, the MicroMotion Module must be present in the Proficy Machine Edition hardware configuration as an entry point to accessing the MicroMotion Setup Tool.

1. In Machine Edition, create a VersaMax Micro PLC target.
2. In the hardware configuration of that target, right-click on the CPU icon in the Main Rack, and replace the default CPU with a Micro-20/40/64 PLC CPU.
3. Right-click on the CPU icon and select Add Module.

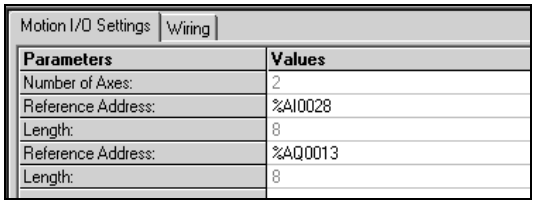


4. In the Module Catalog, click on the Motion tab. Select the IC200UMM002/102 module:



Configure the Motion I/O Settings for a VersaMax CPU

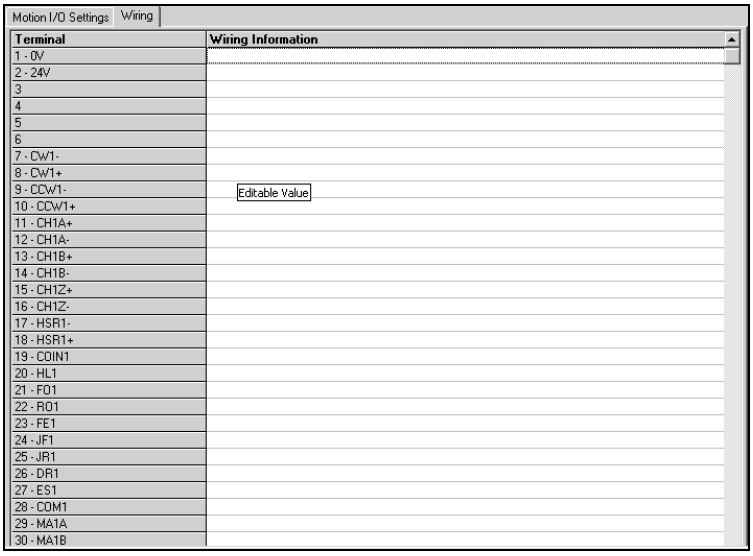
If the MicroMotion Module is being used as an expansion module in a VersaMax Micro PLC system, set up its CPU addressing. On the Motion I/O Settings tab, select the CPU reference address locations for the MicroMotion module's input and output data. The lengths are fixed, at 8 words / 128 bits each. The next available reference addresses appear by default, but can be changed.



These reference locations will be used for all data exchanged between the module and the PLC CPU. See chapter 7 for details.

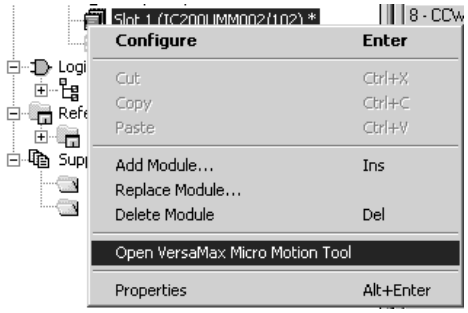
Configure the Wiring Information

On the Wiring tab, enter any descriptive information for the module's external inputs.



Open the MicroMotion Setup Tool

After configuring the module, right-click on the module icon and select Open VersaMax Micro Motion Tool:



The MicroMotion setup tool is used to configure the motion parameters and to monitor and control module operations. See chapter 5 for information.

Chapter 7 MicroMotion in a VersaMax PLC CPU System

The VersaMax PLC CPU CPU can read and write data and control motion operations using the module's assigned Output Control Data and Input Status Data, which is described in this chapter.

- MicroMotion Module Data
  - Output Control Data
  - Input Status Data
- Commands
  - Writing Operation Data to a MicroMotion Module
  - Operating Instructions, Commands 00 to 43
  - Set Motion Data, Commands 50 to 9F
  - Read Operating Data, Commands A0 to AF
  - Read Common Parameters, profile data and sequence table, Commands B0 to E8
  - Memory Pack Write, Commands F0 to F8
- Controlling Communications
  - Writing 7 Words or Less to a MicroMotion Module
  - Writing 8 Words or More to a MicroMotion Module
  - Reading 4 Words or Less from a MicroMotion Module
  - Reading 5 Words or More from a MicroMotion Module

MicroMotion Module Data

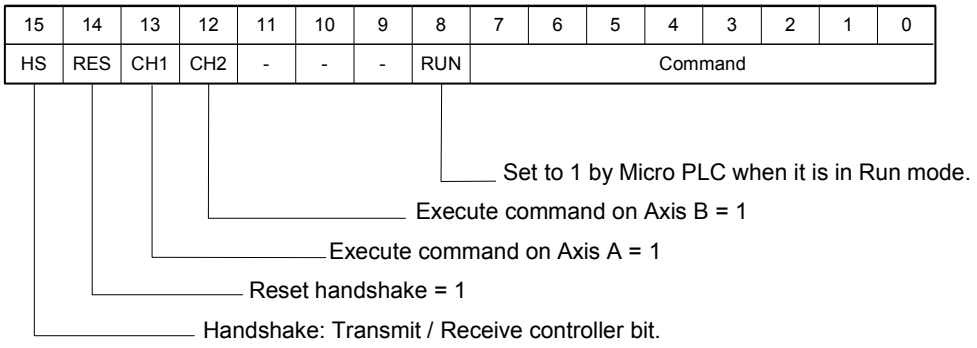
All data exchange between a MicroMotion Module and the VersaMax PLC CPU takes place using the eight words of input data and eight words of output data that are assigned when the module is configured using Proficy Machine Edition. The VersaMax PLC CPU CPU writes the output data to the module and refreshes the input data from the module during each scan of the I/O.

The application can use the output data to send commands to the module, and use the input data to read status and operating data from the module.

Although a MicroMotion Module only uses eight input words and eight output words in the CPU, more than eight words of data can be read or written over multiple I/O scans.

Output Control Data

The first word of the Output Control data starts with the output handshaking bit, which is used to control communications. Word 1 contains a command number, and can specify either axis or both to receive the command. Word 1 is also used to enable or disable the module's pulse output:



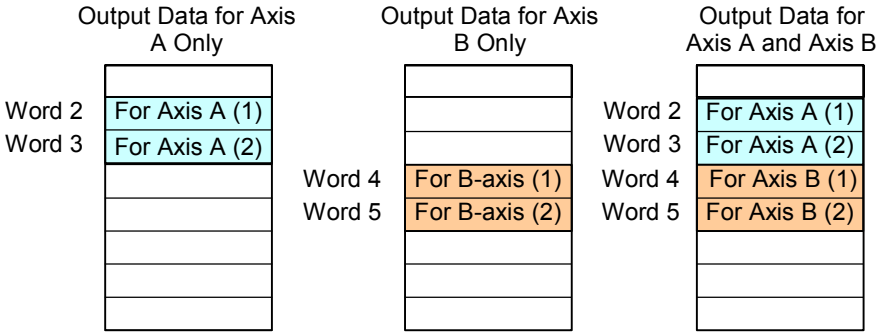
HS	Handshake bit. The application program in the PLC CPU needs to set or reset this bit to transmit data to or receive data from a MicroMotion Module.
RES	Reset handshake. The application program in the PLC CPU needs to set this bit to initialize a handshake. (Initialized when changing from 1 to 0.)
RUN	This bit enables or disables the MicroMotion Module's pulse output. The Run bit is controlled by the PLC CPU. The CPU sets this bit based on the operating mode of the CPU. It is set to 1 while the PLC CPU is running. It is set to 0 if CPU is in Stop mode, to stop the pulse output of MicroMotion Module.

Output Control Data Words 2 to 8

Words 2 to 8 of the module's Output Control Data is used for the command content. The data in words 2 to 8 depends on the command that is being sent, as shown in the command descriptions in this chapter.

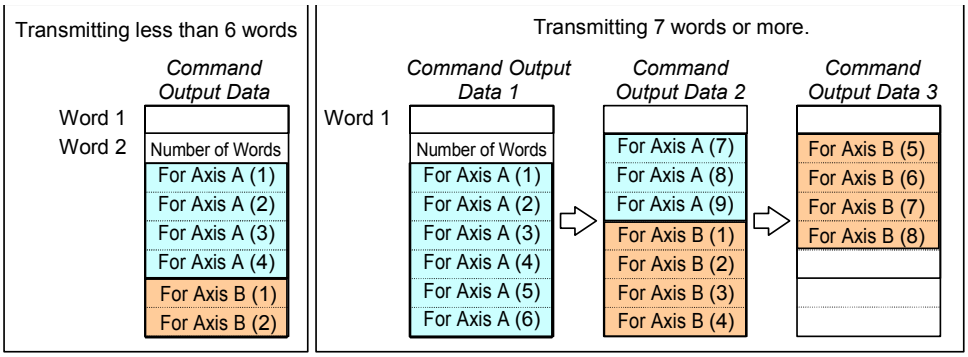
Output Control Data Format 1

The Output Control Data should use this format to send commands to a MicroMotion Module if the parameters to be written are two words or less for specified axis. In Output Control Data format 1, the data for Axis A is in words 2 and 3, and the data for Axis B is in words 4 and 5.

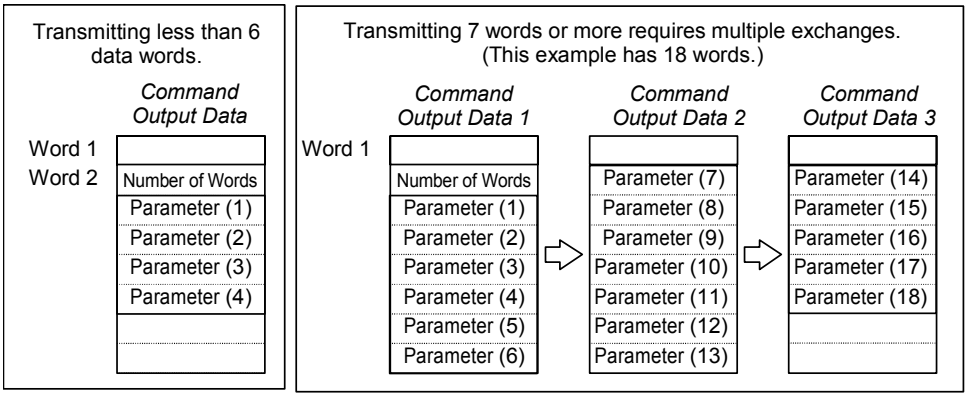


Output Control Data Format 2

The Output Control Data should use this format to send commands to a Micro Motion Module if the parameters to be written are three words or more for the specified axis (as shown below).



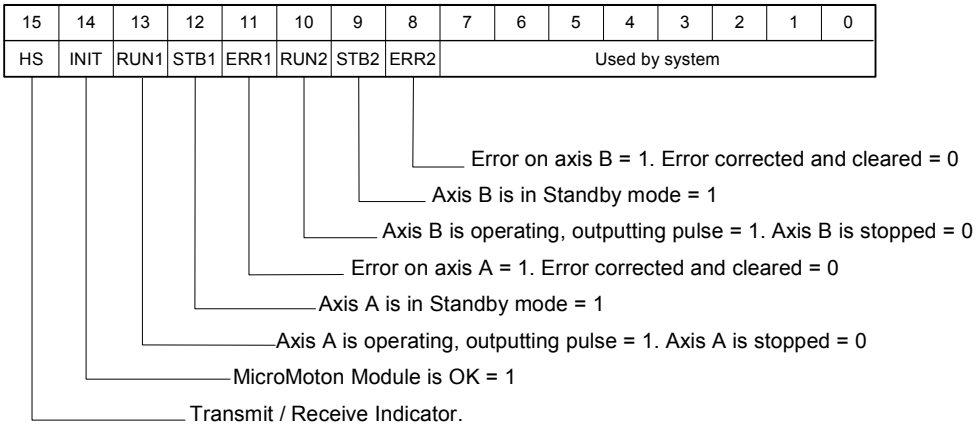
Output control data for transmitting of parameters for which no axis is specified is shown below. Data is set in order from word 2. The number of words is specified in word 2 of the first handshake.



Input Status Data

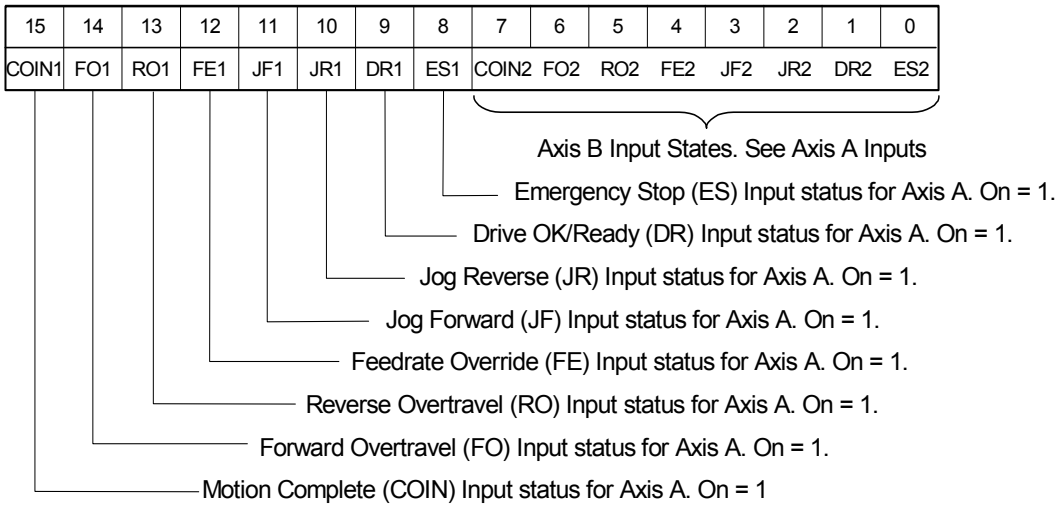
The VersaMax PLC CPU CPU reads the module's eight words of input data automatically during the scan.

Input Status Data Word 1: Handshaking and Axis Status



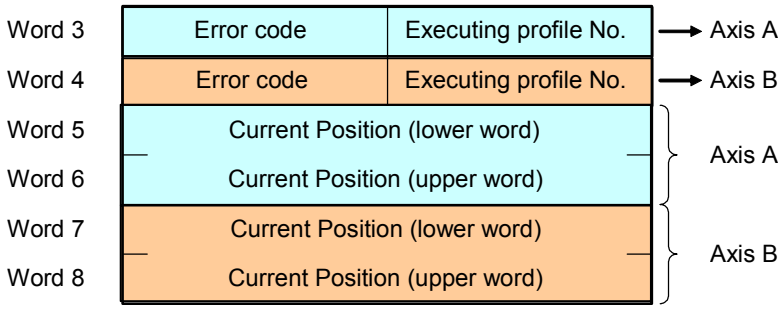
HS	The handshake bit is used when transmitting and receiving data between the PLC CPU and the MicroMotion Module. This bit mirrors the state of the corresponding handshake bit in the Output Control Data. The PLC CPU sets the handshake bit in the module's Output Control Data to 1 when to indicate the presence of a new command in the Output Control Data. When the CPU sets the output handshake bit to 1, the module sets the handshake bit in its Input Status Data to 1. When the CPU sets the output handshake bit to 0, the module then sets the input handshake bit to 0.
ERR	Bit 11 and Bit 8 are the axis error bits for axis A and axis B respectively. Even if the external signal of FO, RO, DR and ES in word 2 (see below) returns to a proper state, the error must be explicitly cleared by command from the PLC CPU.

Input Status Data Word 2: External Input States



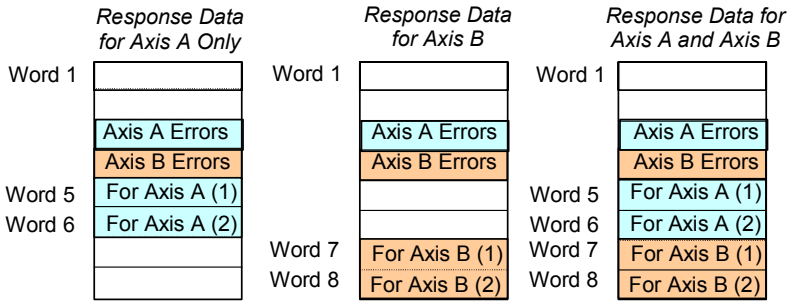
Input Status Words 3 to 8: Status Data Formats

Words 3 to 8 of the module's Input Status data are used to read module status information and parameters that have been stored to the MicroMotion Module. The contents displayed by these words can be changed by a command sent by the PLC CPU. By default, words 3 to 8 of the MicroMotion Module's Input Status Data contain the data shown below.



Response Data (Input Status Data), Format 1

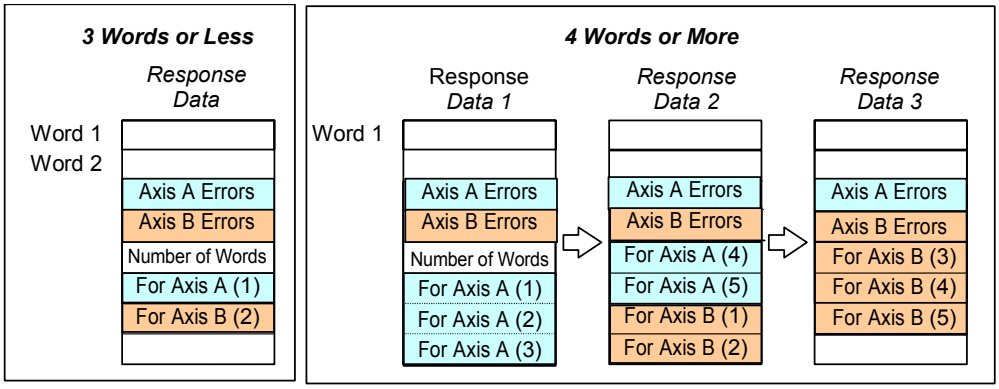
The Input Status Data response from the MicroMotion module to the commands initiated by PLC CPU for specified axis where the parameters to be read are 2 words or less is as shown below. Data for Axis A is in words 5 and 6 and data for Axis B is in words 7 and 8. The error data for both axes is always supplied.



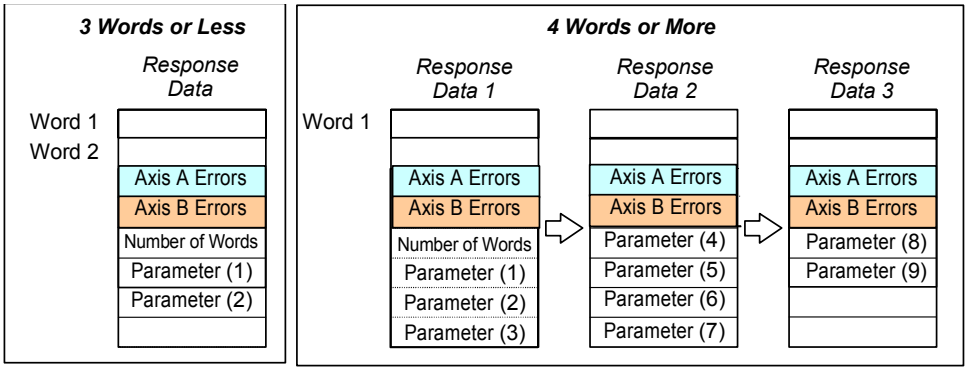
Response Data (Input Status Data), Format 2

The Input Status Data response from MicroMotion Module to the commands initiated by the PLC CPU for specified axis where the parameters to be read are 3 words or more is as shown below.

In Input Status Data responses to read data from Axis A and Axis B at the same time, data for Axis B is followed by Axis A.



Input Status Data response to commands for reading parameters for which no axis is specified is shown below. Data is set in order from word 5. The number of words is specified in word 5 of the first handshake.



Commands

The tables in this section list commands that can be sent from the VersaMax PLC CPU CPU to a MicroMotion Module using the module's Output Control data.

The number of data words listed in the tables that follow refers to the data being read or written only; it does not include the length of the command itself or of extra data that may be required for transmission.

If several handshakes are needed when transmitting data, the number of transmitting words must be set into the beginning of the transmitting data. Similarly, when several handshakes are needed for the response, the number of receiving words is specified in the beginning of the response.

For some commands, if the instruction is sent to both axes, the axes can start simultaneously. For commands that cannot be executed by both axes simultaneously, Axis A will start first if the instruction is sent to both axes.

Writing Operation Data to a MicroMotion Module

When writing data to the module, parameters should be set in the following sequence:

1. Common parameters.
2. Profile data, which set up specific individual profiles for use in Auto mode.
3. Sequence Table data.

The MicroMotion Module checks parameters for validity, and flags an error if an incorrect parameter is detected. See chapter 10 for information about error codes. Common parameters, profile data, and sequence table data must be written to a MicroMotion Module when the module is stopped. If this data is written to the module during operation, it is not used or stored by the module.

Storing Data in the Module's Backup Memory

When writing parameters directly to a connected MicroMotion Module, the Common Parameters, Profile data, and Sequence Table data are saved to the module's backup memory. When axis parameters (such as setting Manual Mode to operate using external inputs) are written to the module, command 9E (hex) must be used to command the module to store the parameters to its backup memory.

If the MicroMotion Module loses power while data is being stored, some data is lost. Parameters that have already been stored will be restored properly when power is turned on. Parameters that have not yet been stored up are set to an indefinite value.

The ST2 LED on the MicroMotion Module shows the status of the backup operation.

Operating Instructions, Commands 00 to 43

Command (hex)	Command description	Data, Words		Axis Specification	Comments
		Write	Read		
00	Not used	0	6	--	
01 *	Clear all errors (System & Axis)	0	0		
02 *	Clear System errors	0	0		
03 *	Clear axis error	0	0	A / B / AB	
10	Free Homing	0	0		
11	Low speed Homing, (CCW direction)	0	0		A and B can start at same time
12	Low speed homing, (CW direction)	0	0		
13	High speed Homing, Off Edge (CCW)	0	0		
14	High speed Homing, Off Edge ((CW)	0	0		
15	High speed Homing, Marker Pulse (CCW)	0	0		
16	High speed Homing, Marker Pulse (CW)	0	0		
17 *	Stop	0	0		
18 *	Normal (decelerated) stop	0	0		
19 *	Execute Feedrate Override	0	0		
1A *	Cancel Feedrate Override	0	0		
1B *	Register distance move	0	0		
1C	Switch speed control profile	0	0		
1D *	Change velocity	2 per axis	0		Output Control Data Format 1
1E	Write Current position (pulse output)		0		
1F	Write Current position (pulse input)		0		
20*	Read Current position, latch	0	2 per axis		Input Status Data Format 1
21, 22	Reserved			A / B	
23	Manual operation: Use external input instruction mode	0	0	A / B / AB	
24	Manual operation: Cancel external input instruction mode	0	0		
30	Auto mode: Single cycle of the sequence table stored in the module.	0	0		A and B can start at same time
31	Auto mode: Single cycle of the sequence table data supplied in the command.	Sequence table +1	0	A / B	Output Control Data Format 2
32	Auto mode: Continuous cycles of the sequence table stored in the module.	0	0	A / B / AB	A and B can start at same time
33	Auto mode: Continuous cycles of the sequence table data supplied in command.	Sequence table +1	0	A / B	Output Control Data Format 2
40	Manual Jog operation (consecutive pulse output/CCW direction)	0	0	A / B / AB	A and B can start at same time
41	Manual Inching (designated distance pulse output/CCW direction)	0	0		
42	Manual Jog operation (consecutive pulse output/CW direction)	0	0		
43	Manual Inching (designated distance pulse output/CW direction)	0	0		

* Command can execute during operation. Other commands are not processed because of error (command execution is impossible, error code 60 hexadecimal).

Write Motion Data, Commands 50 to 9F

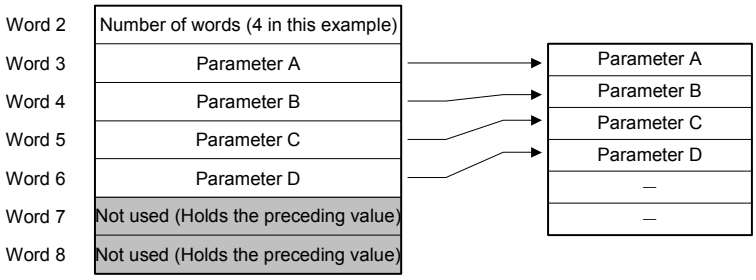
Write commands 50 to 9F are used to initialize (reset) or write parameters, profiles, and sequence data to a MicroMotion Module. These can be written or edited using the MicroMotion setup tool that is provided as part of the Machine Edition software. However, the PLC CPU CPU can also write all of the parameters. An axis must be stopped to write parameters to that axis.

Command (hex)	*Command description*	*Data, Length in Words*	*Axis*	*Format*
50	Initialize all parameters	0	--	
51	Initialize common parameters	0	A / B / AB	
52	Clear all data profiles	0	--	
53	Clear specific data profiles	1	--	Output Control Data Format 2
54	Clear sequence table	0	A / B / AB	
Common Parameters				
60	Set all Common Parameters	58 per axis	A / B / AB	Output Control Data Format 2
61	Set Common Parameters for outputs (description follows)	1 per axis		Output Control Data Format 1
62	Set Common Parameters for input feedback (description follows)			
63	Set Common Parameters for external inputs (description follows)			
64	Set Pulses per Motor Rotation [output]	2 per axis		
65	Set User Units per Motor Rotation [output]			
66	Set Velocity Limit			
67	Set Initial Velocity for Auto mode			
68	Set Find Home Velocity for homing			
69	Set Final Home Velocity for homing			
6A	Set homing Acceleration Rate			
6B	Set homing Deceleration Rate			
6C	Set Maximum Velocity for Manual mode			
6D	Set Initial Velocity for Manual mode			
6E	Set Acceleration Rate for Manual mode			
6F	Set Deceleration Rate for Manual mode			
70	Set Inching Distance for Manual mode			
71	Set Backlash Compensation			
72	Set Feedrate Override Percentage	1 per axis		
73	Reserved	2 per axis		
74	Set Upper Position Limit [output]			
75	Set Lower Position Limit [output]			
76	Set Home Position for homing			
77	Set Home Position Offset for homing			
78	Set Registration Move Distance			
79	Set Pulses per Motor Rotation [input feeback]			
7A	Set User Units per Motor Rotation [input feedback]			
7B	Set Upper Position Limit [input feedback]			

Command (hex)	*Command description*	*Data, Length in Words*	*Axis*	*Format*
7C	Set User Units [input feedback]	4 per axis		Output Control Data Format 2
7D	Set User Units [output pulse]			
90	Set profile data (description follows)	9 per profile	--	
91	Set one profile (description follows)	9		
92	Set Acceleration Rate for one profile	3		
93	Set Deceleration Rate for one profile	3		
94	Set Velocity for one profile	3		
95	Set Target Position for one profile	3		
98	Write Sequence table (description follows)	Sequence table length +1	A / B	
9E	Axis information backup	0	A / B / AB	
9F	Set communication parameters	2	--	Output Control Data Format 2

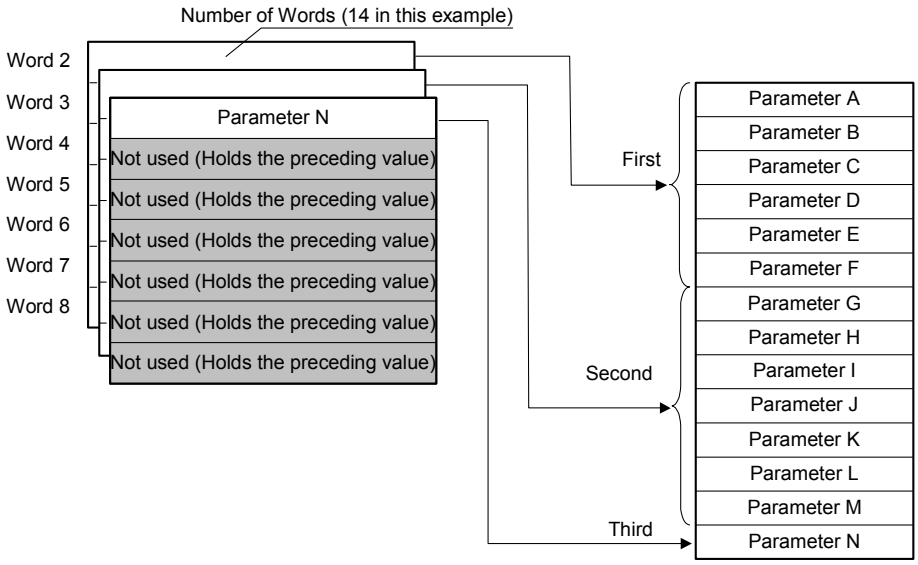
Writing Up to Six Parameter Words

If the data length is up to six words, the parameters are sent together, starting with the number of words in Output Control data word 2.



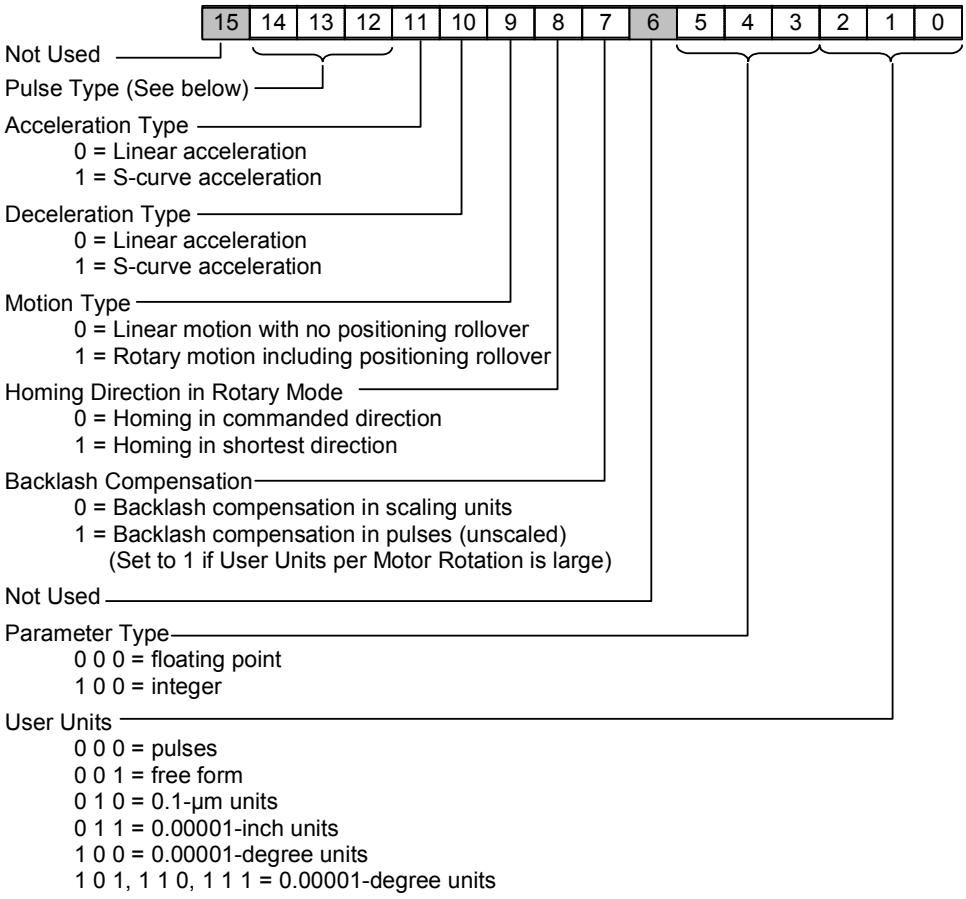
Writing Seven or More Parameter Words

If more than six words of data are sent, multiple transfers are needed. Word 2 contains the data length. In the example below, three writes of Output Control Data are needed to send a total of 14 data words to the MicroMotion Module. The first set of data includes the data length in word 2, followed by six words of data. The second set of data includes seven words of data. The third set includes the final data word being sent to the module. The module ignores the values in the unused words at the end of the data set.



Command 61: Write Common Parameter 1

Command 61 writes Common Parameter 1 data. This word defaults to 0.



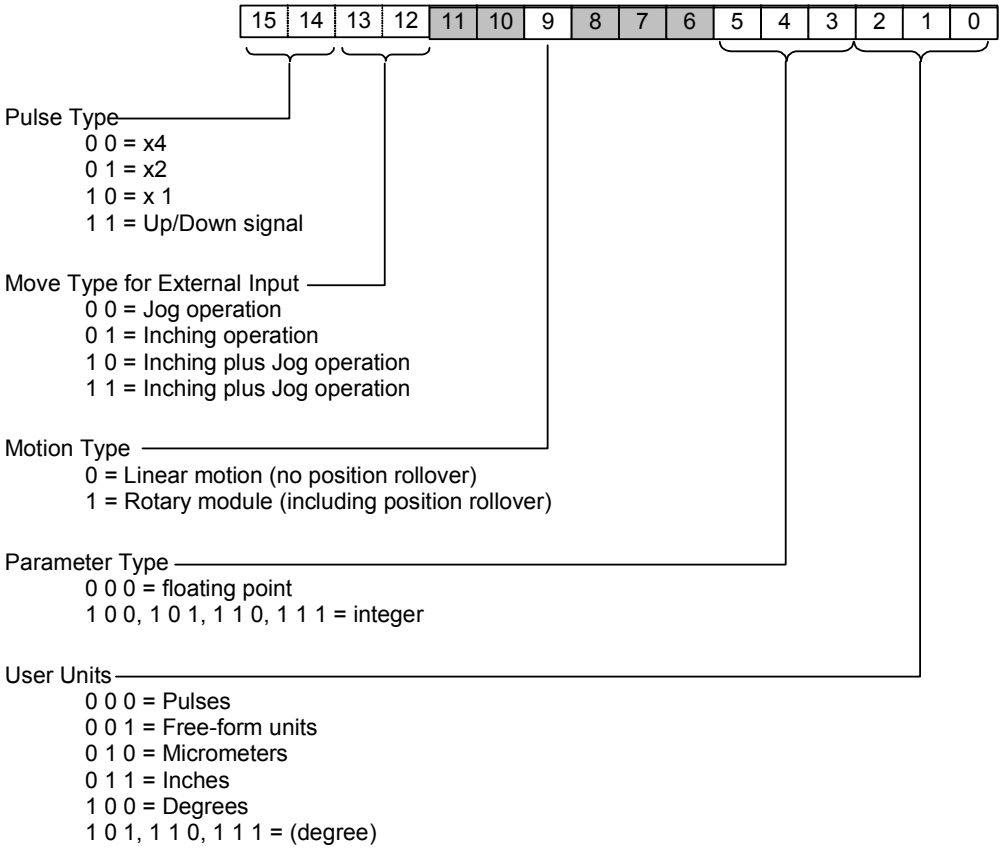
Pulse Type (word 1, bit 14 to bit 12)

The value in bits 12 to 14 sets up the pulse output type and the logic of pulse output. Bit 15 is not used. Match the Pulse Type to the pulse input method of servo controller.

Bit 14	Bit 13	Bit 12	Pulse Output Method				
0	0	0	Direction signal	L=CW	H=CCW	Active High	
0	0	1		H=CW	L=CCW		
0	1	0		L=CW	H=CCW	Active Low	
0	1	1		H=CW	L=CCW		
1	0	0	CW pulse	Active High		CCW pulse	Active High
1	0	1		Active Low			Active Low
1	1	0	CCW pulse	Active High		CW pulse	Active High
1	1	1		Active Low			Active Low

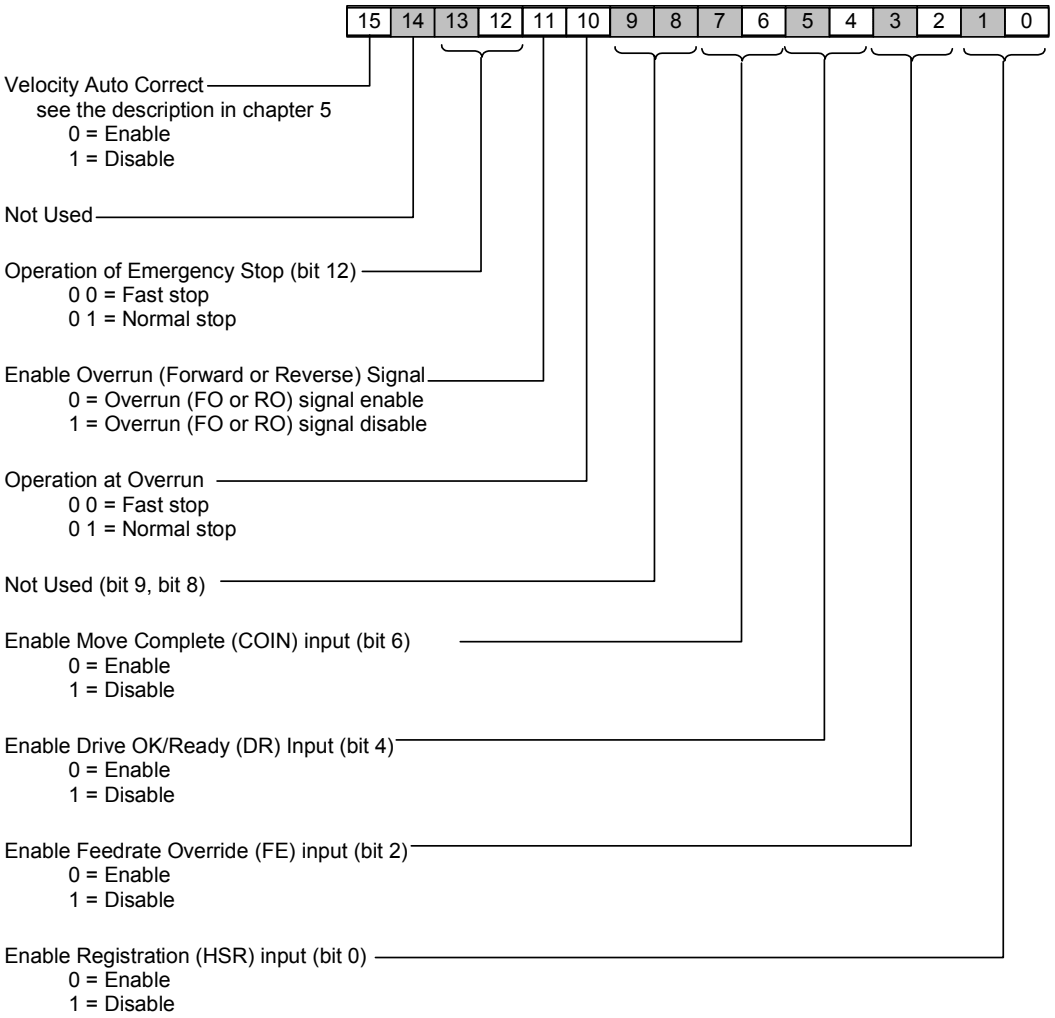
Command 62: Write Common Parameter 2

Command 62 writes common parameter 2 data. This word defaults to 0.



Command 63: Common Parameter 3

Command 63 writes common parameter 3 data which sets up the operation of most external inputs. External inputs that will not be used should be set to Disable.



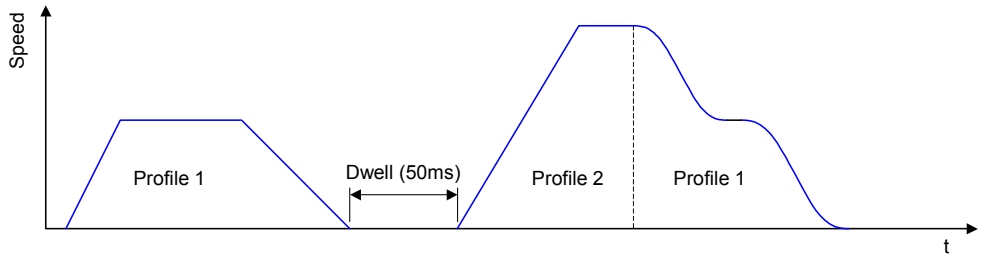
Command 90, Command 91: Set Profile Data

Up to 256 profiles can be defined for a MicroMotion Module. Profile data is stored in the module's backup memory. Each profile has four parameters: acceleration, deceleration, velocity, and target position.

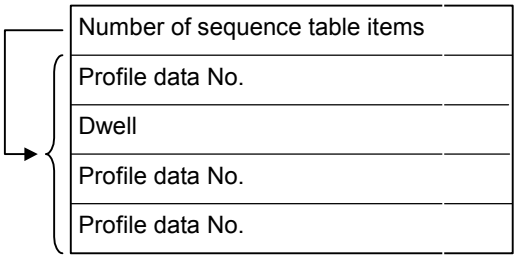
Word	Profile Parameter
1	Acceleration rate (lower) [Pulse /s^2, µm/s^2, inch/s^2, degree/s^2, free form/s^2]
2	Acceleration rate (upper)
3	Deceleration rate (lower) [Pulse/s^2, µm/s^2, inch/s^2, degree/s^2, freeform/s^2]
4	Deceleration rate (upper)
5	Velocity (lower) [Pulse/s, µm/s, inch/s, degree/s, freeform/s]
6	Velocity (lower)
7	Target position data (lower) [Pulse, µm, inch, degree, freeform]
8	Target position data (upper)

Command 98: Write Sequence Table

A Sequence Table consists of up to 499 items of Profile data and Dwells. An example Sequence Table is shown below.



In this example, the Sequence Table defines a Profile, a Dwell, then two additional profiles. The first item in the table specifies the number of items that follow.

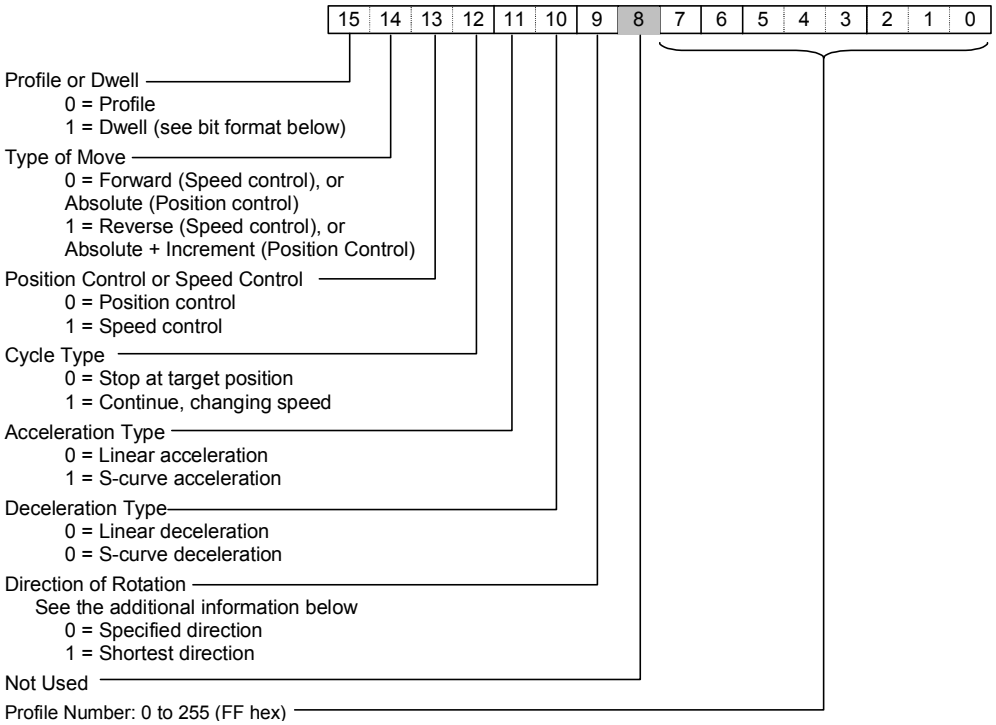


In the Sequence Table, each profile or dwell is represented as a number, which is the hexadecimal value equivalent to the bits in the profile or dwell. The format of the bits in the profile or dwell is shown on the next page.

	b15	b14	b13	b12	b11	b10	b9	b8	b7 b0	Value (hex)
Number of sequence table items									4 (0 4 hex)	0004
Profile data No.1	0	0	0	0	0	0	0	0	1 (0 1 hex)	0001
Dwell (50ms)	1								5 0 (3 2 hex)	8032
Profile data No.2	0	0	0	1	0	1	0	0	2 (0 2 hex)	1402
Profile data No.1	0	1	0	0	0	1	0	0	1 (0 1 hex)	4401

Format of a Profile in the Sequence Table

Each profile in the Sequence Table has the following parameters.



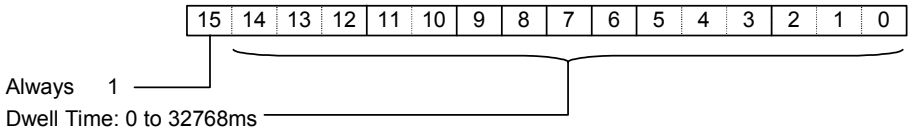
Type of Move (bit 14): For Position control, this bit selects Absolute or Absolute + Incremental positioning. For Speed control, this bit selects Forward or Reverse.

Cycle Type (bit 12): For Position control, the move can Continue to the next profile or Stop. When Continue is selected, the next profile in the sequence will use the same Control, Acceleration, and Deceleration as the current profile.

Direction of Rotation (bit 9): The setting for Direction of Rotation is effective only when the axis performs position control by an absolute value on the rotary motion.

Format of a Dwell in the Sequence Table

For a profile, bit 15 must be 1.The data for a dwell consists of the length of time for the dwell to continue.



Read Operating Data, Commands A0 to AF

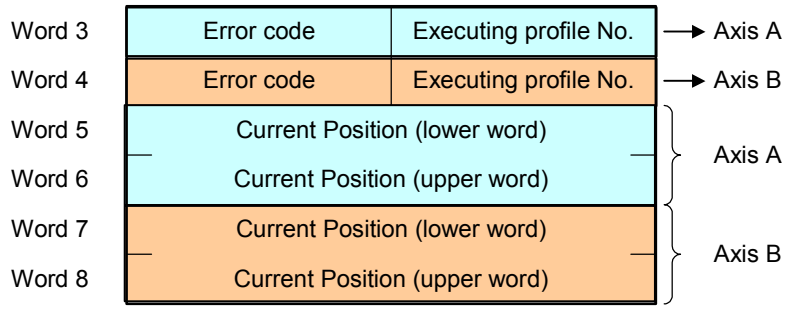
The PLC CPU can use the following commands to read operating data from a MicroMotion Module. All read commands can be executed during operation. The MicroMotion returns the requested information in words 5 to 8 of its Input Status Data. Words 1 to 4 always have the same data format, which is shown earlier in this chapter.

Read Commands A0 through A9 (see below) specify the data formats to be used.

Command (hex)	*Command Description*	*Data, Words to Read*	*Axis Specification*
A0	Return Current Axis Position (default)	4	A / B / AB
A1	Return Current Velocity	4	
A2	Return Currently-executing Profile in Auto mode	4	
A3	Return Axis Status	4	
A4	Return System Errors	4	--
A5	Return Communications Status	4	
A6	Return Axis A Position and Velocity	4	
A7	Return Axis B Position and Velocity	4	
A8	Return Axis A Output Position and Input Feedback Position	4	
A9	Return Axis B Output Position and Input Feedback Position	4	
AE	Error indication	4	
AF	Software version indication	2	

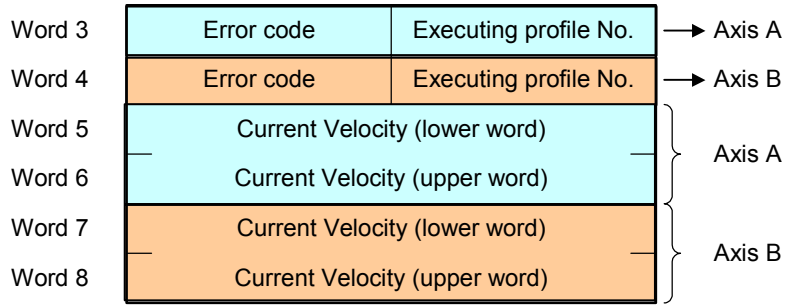
Command A0, Return Current Axis Position and Profile No. in Auto Mode

This is the default format for words 3 to 8 of the module's Input Status Data at startup. The PLC CPU CPU can also send command A0 to the module to return to the axis position data format.



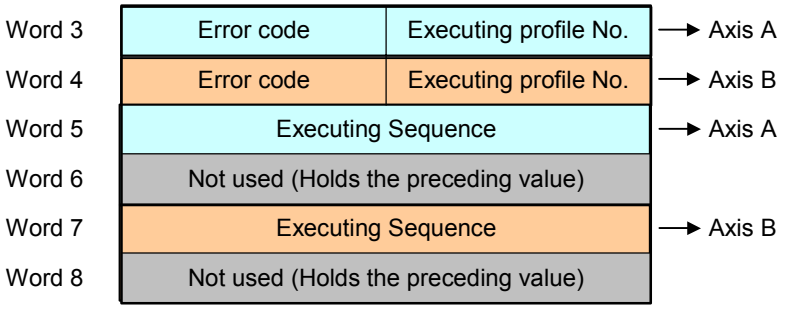
Command A1, Return Current Velocity and Profile no. in Auto mode

The PLC CPU CPU can use command A1 to request the current velocity, error code, and executing profile of axis A and B in words 3 to 8 of module's Input Status data.



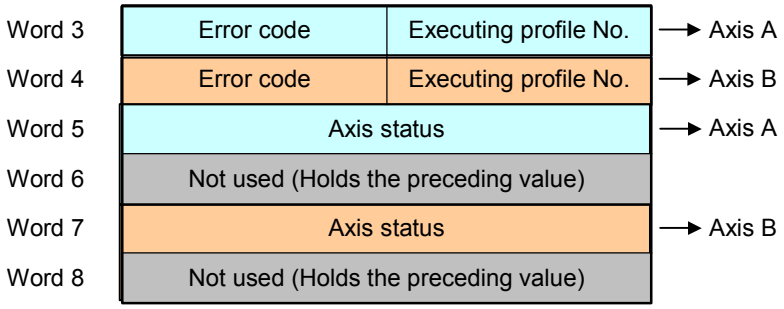
Command A2, Return Currently-executing Profile in Auto Mode

The PLC CPU CPU can use command A2 to request the executing profile, error code, and executing sequence of axis A and B in words 3 to 8 of module's Input Status data.

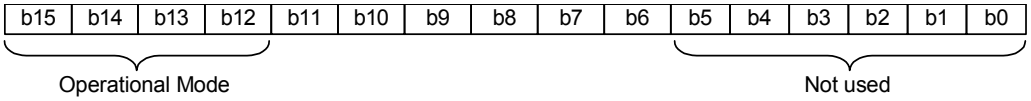


Command A3, Return Axis Status

The PLC CPU CPU can use command A3 to request the executing profile, error code, and status of axis A and B in words 3 to 8 of module's Input Status data.



In this format, words 5 and 7 contain the axis status data described below.



Bits	***Type***	***Description***	
15 - 12	Operational Mode (hex value)	0	Idling status (not operating in any operating mode)
		1	Performing Free Homing
		2	Performing low-speed homing (forward direction)
		3	Performing low-speed homing (reverse direction)
		4	Performing High-Speed Homing [Off Edge] (forward direction)
		5	Performing High-Speed Homing [Off Edge] (reverse direction)
		6	Performing High-Speed Homing [Marker] (forward direction)
		7	Performing High-Speed Homing [Marker] (reverse direction)
		8	Manual operation (stopped) [External input instruction mode]
		9	Manual operation (operating) [External input instruction mode]
		A	Manual operation (controlled by command)
		B	Auto mode (positioning control)
		C	Auto mode (speed control)
11	O.RUN	1 = axis has overrun error. 0 = no overrun or the overrun is cancelled.	
10	Dwell	In Auto mode, 1 = Dwell.	
9	HSR	In Auto mode or Manual mode, this is 1 while the positioning by the registration input .	
8	FE	In Auto or Manual mode, 1 = speed is controlled by the Feedrate Overwrite input .	
7	JF	In Manual mode, 1 = while rotating in forward direction by the external input or command.	
6	JR	In Manual mode, 1 = rotating in reverse direction by the external input or command.	

Command A4, Return System Errors

The PLC CPU CPU can use command A4 to request two system errors in words 3 and 4 of module's Input Status data. See chapter 10 for a list of system errors.

Word 3	System error [1]
Word 4	System error [2]
Word 5	Not used (Holds the preceding value)
Word 6	Not used (Holds the preceding value)
Word 7	Not used (Holds the preceding value)
Word 8	not used (Holds the preceding value)

Command A5, Return Communications Status

The PLC CPU CPU can use command A5 to request the executing profile and error code both axes and the module's serial communications information in words 3 to 8 of the Input Status data. See chapter 10 for a list of system errors.

Word 3	Error code	Executing profile No.	→ Axis A
Word 4	Error code	Executing profile No.	→ Axis B
Word 5	Communication used currently I/F		Common
Word 6	Current transmission speed, transmission format		
Word 7	Device No.		
Word 8	Not used (Holds the preceding value)		

Command A6, Return Axis A Position and Velocity

The PLC CPU CPU can use command A6 to request the executing profile number and error code of both axes, and the current position and velocity of Axis A in words 3 to 8 of the module's Input Status Data.

Word 3	Error code	Executing profile No.	→ Axis A
Word 4	Error code	Executing profile No.	→ Axis B
Word 5	Axis A Current Position (lower word)		
Word 6	Axis A Current Position (upper word)		
Word 7	Axis A Current Velocity (lower word)		
Word 8	Axis A Current Velocity (upper word)		

Command A7, Return Axis B Position and Velocity

The PLC CPU CPU can use command A7 to request the executing profile number and error code of both axes, and the current position and velocity of Axis B in words 3 to 8 of the module's Input Status Data.

Word 3	Error code	Executing profile No.	→ Axis A
Word 4	Error code	Executing profile No.	→ Axis B
Word 5	Axis B Current Position (lower word)		
Word 6	Axis B Current Position (upper word)		
Word 7	Axis B Current Velocity (lower word)		
Word 8	Axis B Current Velocity (upper word)		

Command A8, Return Axis A Output Position and Input Feedback Position

The PLC CPU CPU can use command A8 to request the executing profile number and error code of both axes, and the current output position and feedback position for Axis A in words 3 to 8 of the module's Input Status Data.

Word 3	Error code	Executing profile No.	→ Axis A
Word 4	Error code	Executing profile No.	→ Axis B
Word 5	Axis A Current Position [Input pulse] (lower word)		
Word 6	Axis A Current Position [Input pulse] (upper word)		
Word 7	Axis A Current Position [Output pulse] (lower)		
Word 8	Axis A Current Position [Output pulse] (upper)		

Command A9, Return Axis B Output Position and Input Feedback Position

The PLC CPU CPU can use command A9 to request the executing profile number and error code of both axes, and the current output position and feedback position for Axis B in words 3 to 8 of the module's Input Status Data.

Word 3	Error code	Executing profile No.	→ Axis A
Word 4	Error code	Executing profile No.	→ Axis B
Word 5	Axis B Axis B Current Position [Input pulse] (lower		
Word 6	Axis B Current Position [Input pulse] (upper word)		
Word 7	Axis B Current Position [Output pulse] (lower)		
Word 8	Axis B Current Position [Output pulse] (upper)		

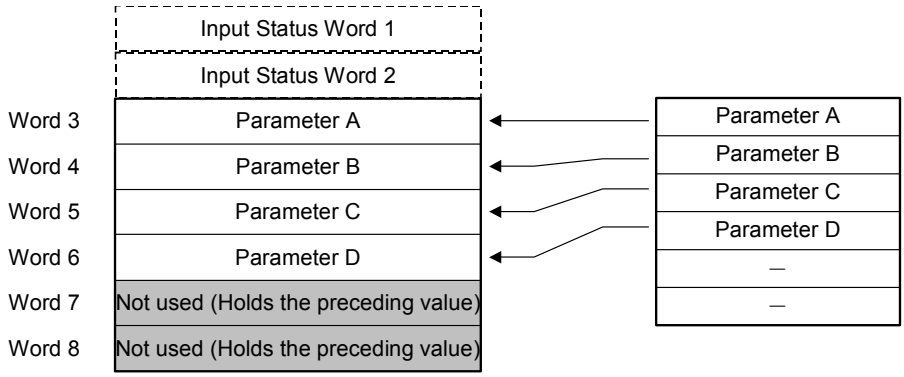
Read Common Parameters, Commands B0 to E8

The PLC CPU can use the following commands to request parameter data in words 5 to 8 of the module's Input Status Data. Words 1 to 4of the Input Status Data always have the same format, described earlier in this chapter. All read commands can be executed during operation.

Command (hex)	*Command description*	*Data, Words to Read*	*Axis Specification*
B0	All parameters	58 per axis	A / B / AB
B1	Common Parameters for outputs (see previous description of command 61)	1 per axis	
B2	Common Parameters for input feedback (see previous description of command 62)		
B3	Common Parameters for external inputs (see previous description of command 63)		
B4	Pulses per Motor Rotation	2 per axis	
B5	User Units per Motor Rotation		
B6	Velocity Limit		
B7	Initial Velocity for Auto mode		
B8	Find Home Velocity for homing		
B9	Final Home Velocity for homing		
BA	Homing Acceleration Rate		
BB	Homing Deceleration Rate		
BC	Maximum Velocity for Manual mode		
BD	Initial Velocity for Manual mode		
BE	Acceleration Rate for Manual mode		
BF	Deceleration Rate for Manual mode		
C0	Inching Distance for Manual mode		
C1	Backlash Compensation		
C2	Feedrate Override	1 per axis	
C3	Gear Ratio in Follower mode	2 per axis	
C4	Upper Position Limit		
C5	Lower Position Limit		
C6	Home Position for homing		
C7	Home Position Offset for homing		
C8	Registration Move Distance		
C9	Pulses per Motor Rotation [input feedback]	2 per axis	A / B / AB
CA	User Units per Motor Rotation [input feedback]	2 per axis	A / B / AB
CB	Upper Position Limit [input feedback]	2 per axis	A / B / AB
CC	User Units [input feedback]	4 per axis	A / B / AB
CD	User Units [output pulse]	4 per axis	A / B / AB
E0	Read all profile data	9 per Profile	Unnecessary
E1	Read specific profile	9	
E8	Read Sequence Tables	Number of sequence tables	A / B

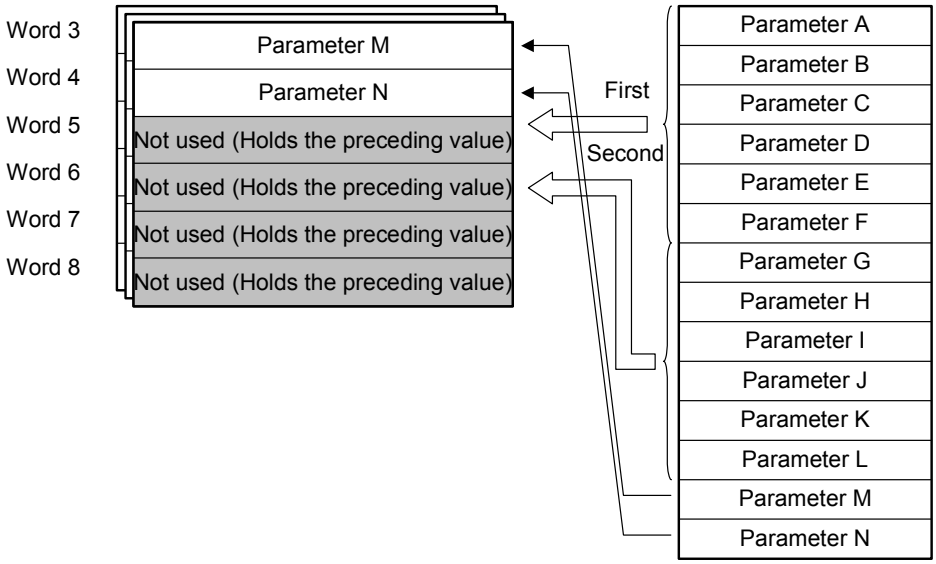
Reading Less than Six Parameter Words

If the PLC CPU CPU command requests six or less parameter words the module returns the requested parameters in order starting in Word 3. Words 1 and 2 have the same status data described previously. Words 3 to 8 contain the parameter data.



Reading Seven or More Parameter Words

If the PLC CPU CPU command requests seven or more parameter words (for example, command B0, Read All Parameters), the module returns a set of parameters whenever the PLC CPU CPU sets the handshaking bit in the Control Output data to 1. In the example below, parameters A to F are returned in the first set of eight words. Parameters G to L are returned in the second set of eight words. Parameters M and N are returned in the third set of eight words.



Memory Pack Write, Commands F0 to F8

If a Memory Pack is installed on the MicroMotion Module, data can be written to the Memory Pack on command. If the MicroMotion Module loses power while writing to the Memory Pack, the operating data in the Memory Pack is deleted.

The MicroMotion Setup Tool provides a user interface to format, initialize, and write data to a Memory Pack from a computer (see chapter 5). The application program in the PLC CPU CPU can also command the MicroMotion Module to format, initialize, and write data to a Memory Pack using the commands listed below.

Command (hex)	*Command description*	*Data, Words*		*Axis Specifi-cation*	*Comments*
		Write	*Read*		
F0	Format Memory Pack	0	0	--	
F1	Initialize Memory Pack: set Common Parameters, Profiles, and Sequence Table to their default values.	0	0		
F2	Write All to Memory Pack; Common Parameters, Profiles, Sequence Table	0	0		
F3	Write Common Parameters to Memory Pack	0	0	A / B / AB	
F4	Write All Profiles to Memory Pack	0	0	--	
F5	Write All Profiles to Memory Pack (same as F4)	1	0		Output Control data format 2
F6	Write Sequence Table to Memory Pack	0	0	A / B / AB	
F7	Write System Parameters to Memory Pack	0	0	--	
F8	Write Axis Operation Data to Memory Pack	0	0	A / B / AB	

Cautions

Do not install or remove a Memory Pack while power to the MicroMotion Module is On. The module may be damaged. Make sure to power is Off before installing or removing a Memory Pack.

Do not turn off power to the MicroMotion Module while writing data to a Memory Pack. Data may become corrupted. Make sure that the data write operation is finished before turning off power to the MicroMotion Module.

Controlling Communications

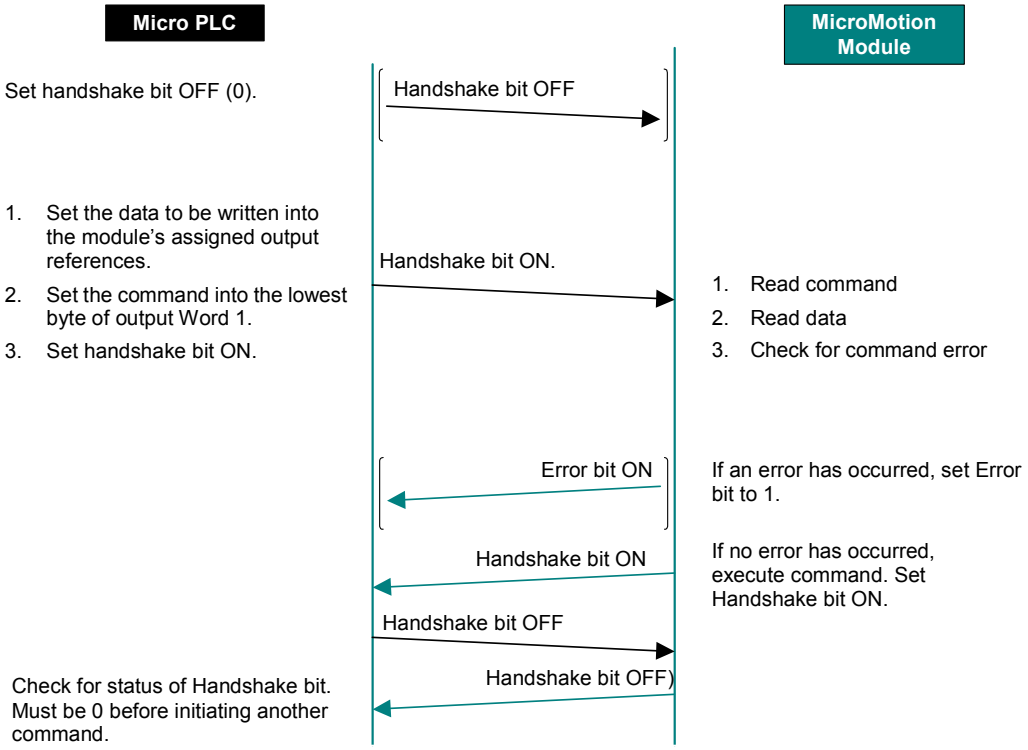
As explained earlier in this chapter, communications between a MicroMotion Module and VersaMax PLC CPU CPU are accomplished using the module's eight assigned input and eight assigned output reference address words in the PLC CPU. The input words are used for the module's Input Status Data. The output words are used for the module's Output Control Data. The most significant bit of first words of Input Status Data and Output Control Data act as handshaking bits. By monitoring and setting these handshaking bits, the application program in the VersaMax CPU can control data read and write operations.

The diagrams on the following pages show the handshaking interaction between the PLC CPU CPU and a MicroMotion module for reading and writing data in single exchanges or multiple exchanges.

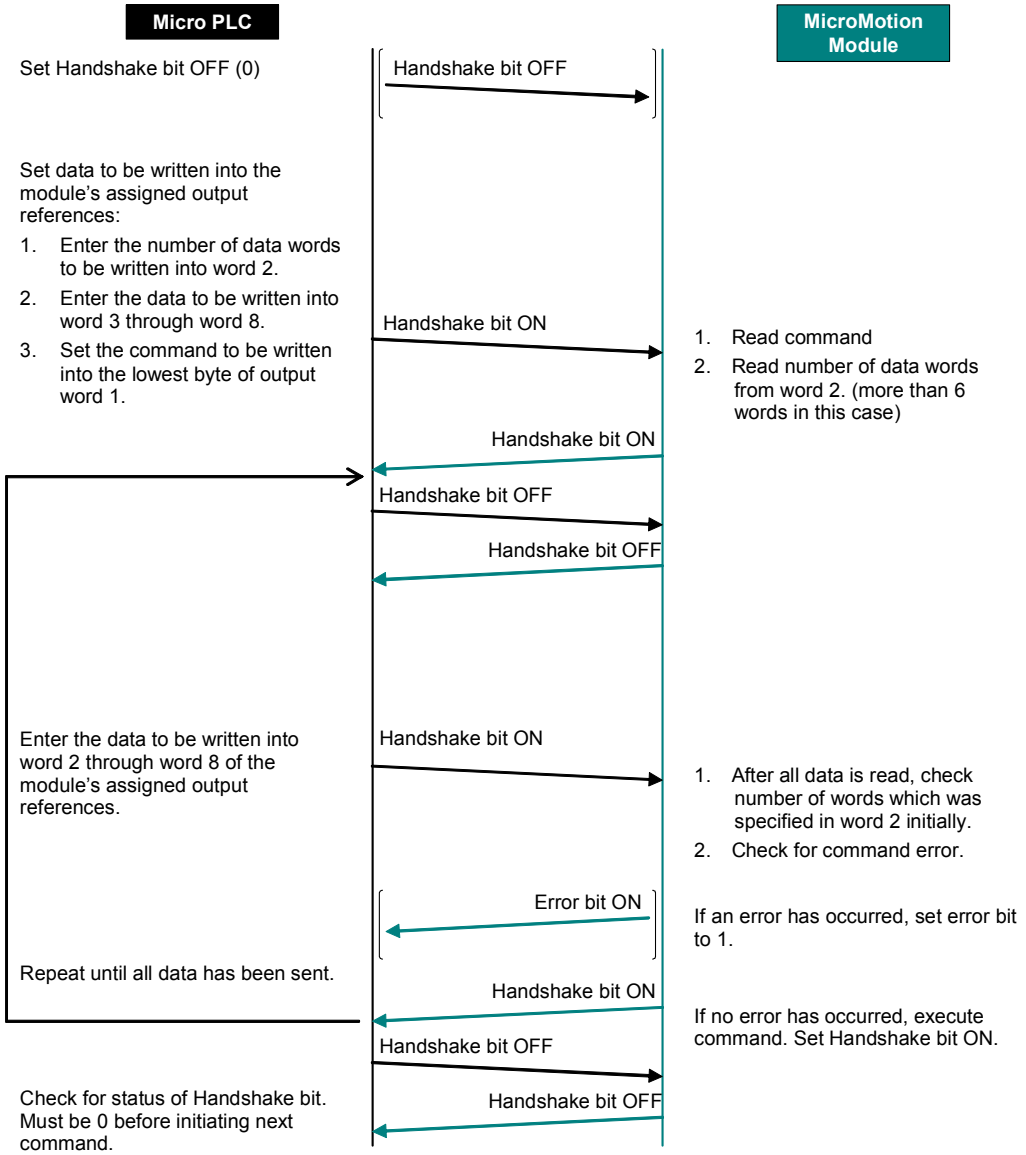
To execute a command to the MicroMotion Module:

1. Place the data for the command (if needed) in the module's configured output data CPU references.
2. In Word 1 of the output data:
   - Select the axis on which the command will be executed by setting the bit 13 for Axis A or bit 12 for Axis B..
   - Enter the command number in bits 0-7, in hexadecimal format. Commands are listed earlier in this chapter.
   - Finally, set the Handshake Bit (bit 15) to 1.
3. Check the module's Input Status Data. When the handshake bit (HS of the Input Status Data) has been set to 1 by the module, the application program in PLC CPU should clear the corresponding handshake bit in the Output Control Data to 0 to stop sending the control data.
4. When sending more than 7 words to the module, multiple commands must be used as described in this section.

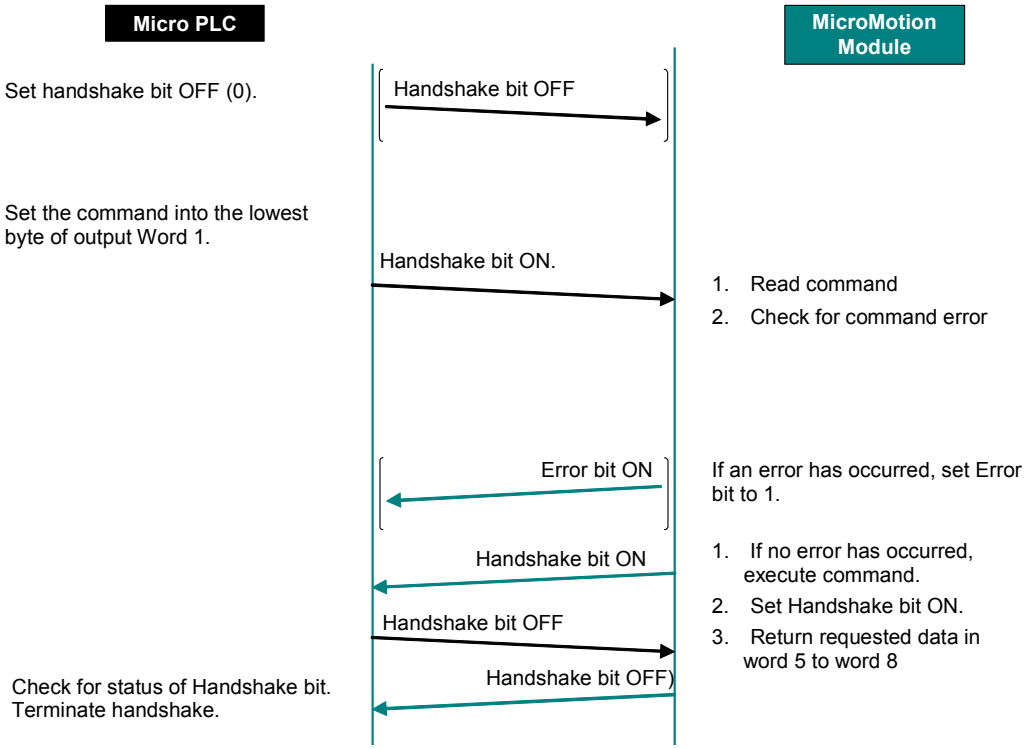
Writing 7 Words or Less to a MicroMotion Module



Writing 8 Words or More to a MicroMotion Module

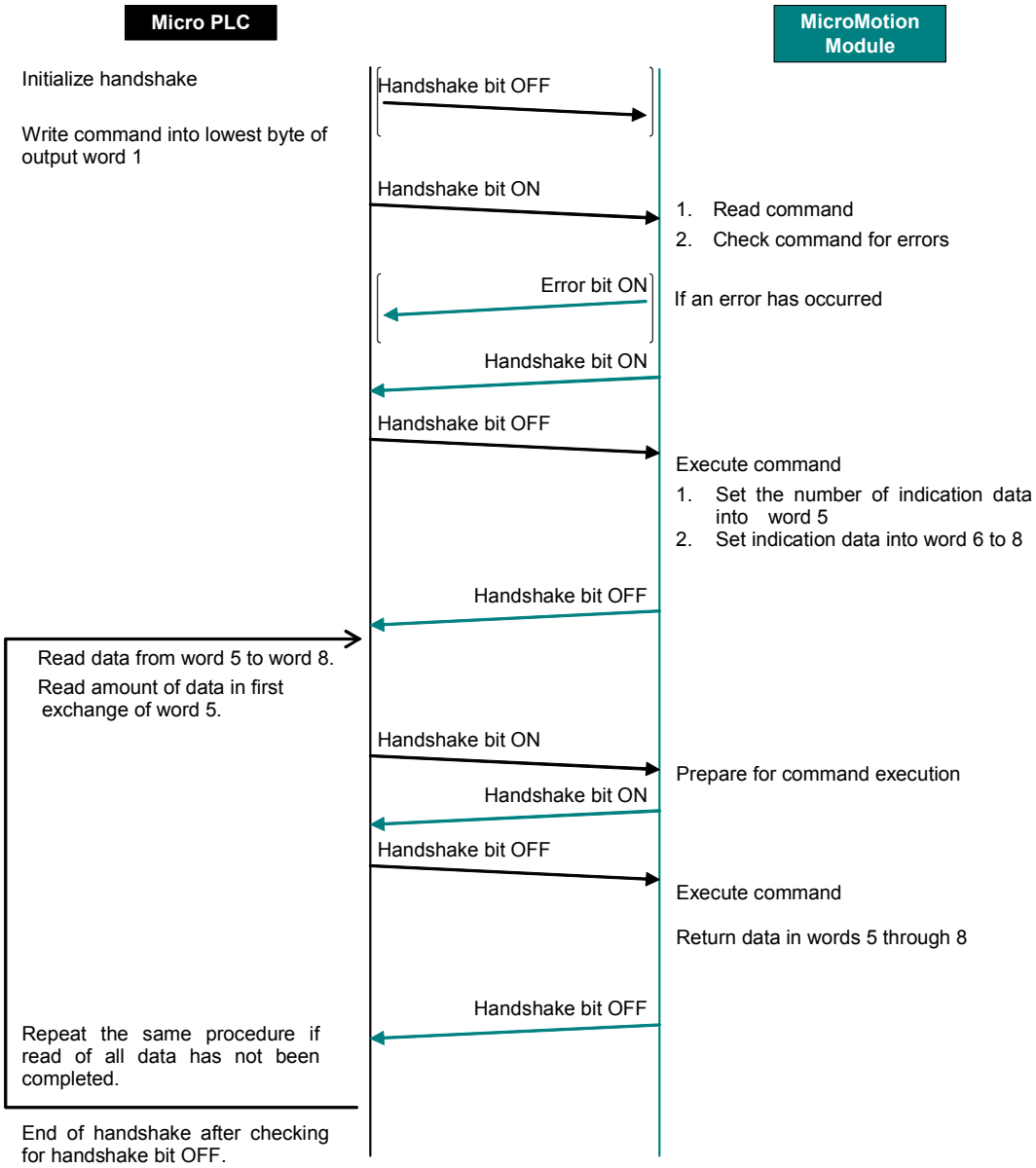


Reading 4 Words or Less from a MicroMotion Module



The read data is held while the handshake bit in the Output Control Data is On. If the handshake bit in the Output Control Data goes Off, data update is restarted using the same data format as before the Read command was executed.

Reading 5 Words or More from a MicroMotion Module



Chapter 8 MicroMotion in a Host Controller System

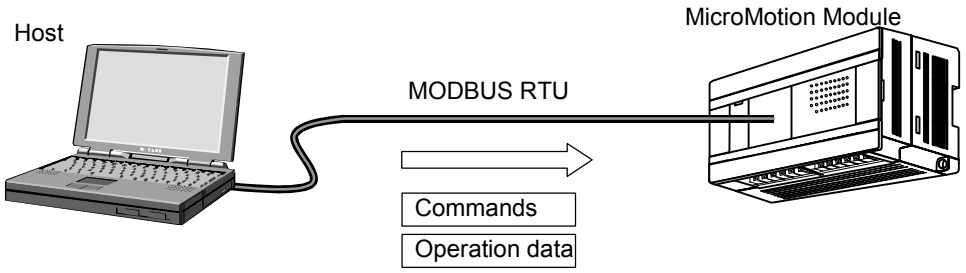
This chapter describes the details of data exchange between the MicroMotion Module and a host controller.

- Communications Parameters
- Writing Operation data to a MicroMotion Module
- MODBUS RTU Communications Overview
- MODBUS Data Types
- Using MODBUS Commands to Read and Write Data
- MODBUS Function Code Descriptions

MODBUS data formats for the MicroMotion Module are defined in chapter 9.

Communications Parameters

A host computer communicates with the MicroMotion Module using MODBUS RTU protocol over an RS232 or RS485 serial line. Connection requires one of the Port Option Modules that are described in chapter 1.



When the DIP switch 1 on the MicroMotion Module is Off (the default), the communication parameters are set to their defaults.

The following three parameters need to be set properly for MODBUS communications:

- Communication Speed: 115.2 k, 57.6k, 19.2k, and 9.6k bps. Default value is 57.6kbps.
- Transmission format: Default value is 8 bits, Even parity, and 1 stop bit.

8 bits, Even parity, 1 stop (8-E-1)
8 bits, Odd parity, 1 stop (8-O-1)
8 bits, No parity, 1 stop (8-N-1)
8 bits, No parity, 2 stop (8-N-2)

- Device Number: The range is 1 to 247. Default value is 1.

When communications parameters are set correctly, the MicroMotion Module automatically saves the settings after clicking OK.

Writing Operation Data to a MicroMotion Module

For most applications, operation data is written to a MicroMotion Module using the MicroMotion setup tool. See chapter 5 for instructions. Operation data can also be written to a MicroMotion Module by the host controller, using standard MODBUS RTU write commands as described in this chapter and in chapter 9. Parameters should be set in the following sequence:

1. Common parameters.
2. Profile data, which set up specific individual profiles for use in Auto mode.
3. Sequence Table data for Auto mode.

The MicroMotion module checks parameters for validity, and flags an error if an incorrect parameter is detected. See chapter 11 for information about error codes. Common parameters, profile data, and sequence table data must be written to a MicroMotion Module when the module is stopped. If this data is written to the module during operation, it is not used or stored by the module.

Backing Up Data in the MicroMotion Module

If the setup is completed normally, the MicroMotion Module automatically backs up setup data. The module can optionally back up other axis information parameters such as External Input mode by setting output coil 146 for Axis A and coil 147 for Axis B.

When doing a backup, if the MicroMotion Module loses power, some data is lost. Parameters that have already been backed up will be restored properly when power is turned on. Parameters that have not yet been backed up are set to an indefinite value.

If a Memory Option Module is installed on the MicroMotion Module, data can be written to the Memory Option Module on command. If the MicroMotion Module loses power while writing to the Memory Option Module, the operating data in the Memory Option Module can get corrupted.

The ST2 LED on the MicroMotion Module shows the status of the backup operation.

Type of Data		***Backup Operation***
Axis information	In Manual mode, control operation with external inputs.	Necessary to set Coil 146 ON for Axis A, Coil 147 ON for Axis B
Common parameters	(Axis A / Axis B)	Back up happens automatically
Sequence table	(Axis A / Axis B)	Back up happens automatically
Profile data	(Common)	Back up happens automatically
Communication settings	Transmission speed	Back up happens automatically
	Transmission format	Back up happens automatically
	Device No.	Back up happens automatically

MODBUS RTU Communications Overview

MODBUS protocol is a communication method of single master/multiple slave. MODBUS master transmits the request (query). The slave that receives the query processes the request, and responds.

MODBUS (RTU) Message Format

The format of a MODBUS RTU message is shown below.

Start	Device Address	Function Code	Data	CRC Check	End
Silent interval	8 bits	8 bits	n*8 bits	16 bits	Silent interval

MODBUS (RTU) begins with a silent interval of at least 3.5-letters and ends with a 3.5-letter silent interval. The other fields are 8-bit data.

Device Address

Each MODBUS slave has a unique Device Number address from 1 to 247. The MicroMotion Module slave processes a query transmitted to its Device Address number, then returns a response to the master.

Device Address number 0 is used to broadcast the same query to all slaves. When a slave receives a broadcast query it performs the requested function but does not return a response to the master.

MODBUS Function Codes

A VersaMax MicroMotion Module supports the following MODBUS Function Codes:

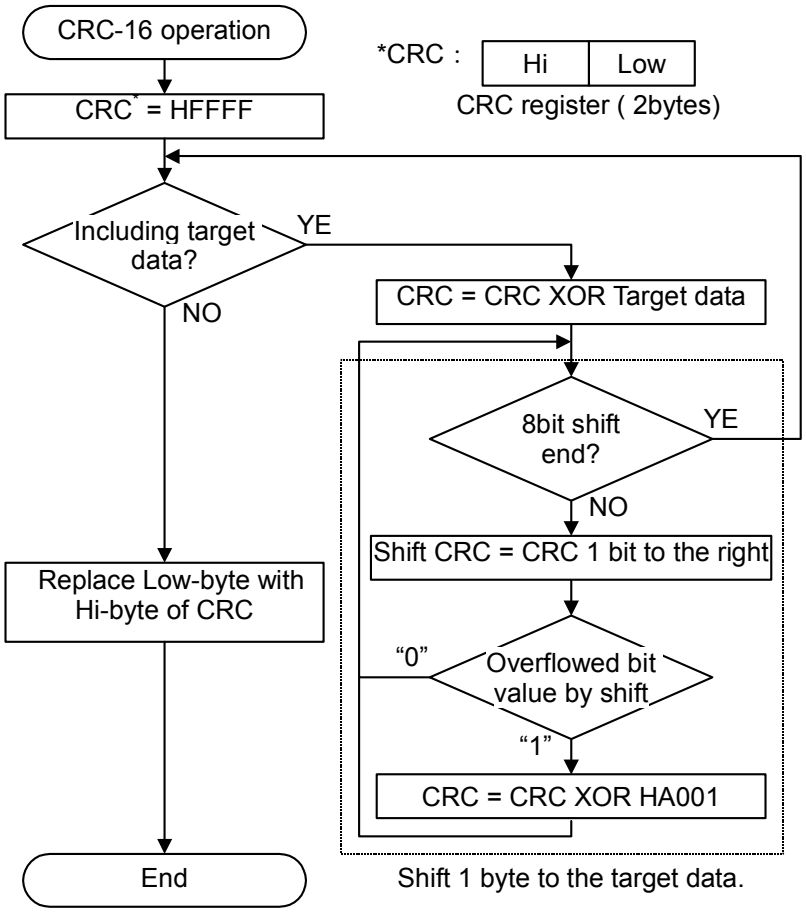
Function Code	Function	
	MODBUS Function	Use in the MicroMotion Module
01 (0x01)	Read Coil Status	Read Coil status (consecutive n points)
02 (0x02)	Read Input Status	Read Input status (consecutive n points)
03 (0x03)	Read Holding Registers	Read Holding register status (consecutive n points)
04 (0x04)	Read Input Registers	Read Input register status (consecutive n points)
05 (0x05)	Force Single Coil	Set Coil (1 point)
06 (0x06)	Preset Single Register	Set Holding register (1 point)
15 (0x0F)	Force Multiple Coils	Set Coil (consecutive n points)
16 (0x10)	Preset Multiple Registers	Set Holding register (consecutive n points)

Data

This part of the query is used to transmit parameters related to the function code. The field length is variable.

Error Check

The error check field of a MODBUS message uses Cyclic Redundancy Checking (CRC). CRC code is a 16-bit data created to any data length block of 8-bit unit, and uses a generative polynomial of CRC-16(X^16+X^15+X^2+1).



Exception Responses

When the master directs a query to a specific slave (not broadcast), the slave may:

1. Receive the query and perform the processing normally.The slave returns a normal response corresponding to function code specified by query.
2. Not receive the query (communication error, etc). The slave does not respond. A timeout error occurs at the master.
3. Receive the query but detect a parity/CRC error. The slave does not respond. A timeout error occurs at the master.
4. Receive the query but not be able to process it. The slave returns an exception response to the master. An exception response consists of the slave address, function code, and data field. The slave address is set in the slave address field the same as the normal response. The function code of query is set to function code and the MSB becomes 1. The master can detect the exception response by this. The data field contains an exception code that describes the error:

Exception Code	*Name*	*Meanings*
01	Wrong function	Slave does not support the requested function.
02	Wrong data address	Specified data address does not exist in the slave.
03	Wrong data	Specified data is not permitted.
04	Slave device trouble	Not supported by the MicroMotion Module.
05	Acknowledge	Not supported by the MicroMotion Module.
06	Slave device Busy	Module is still processing the previous query.

MODBUS Data Types

The VersaMax MicroMotion Module uses the following four MODBUS data types for setting, operating, status, and control data. Details of these data types showing the bits and registers that are used for MicroMotion Module data are given in chapter 9.

Coil Data

Coils are bit-type data that is used to exchange status information and commands with the MicroMotion Module. The MicroMotion Module uses Coil addresses 1 to 519.

Input Status Data

Input Status data is bit-type data that is used for status information about external inputs. Input Status data is read-only. The MicroMotion Module uses Input Status addresses 10001 to 10519.

Input Registers

Input Registers are word-type data that is used for status information about the MicroMotion Module. Input Registers contain the current parameter information. Input Registers are read-only. The MicroMotion Module uses Input Register addresses 30001 to 36999.

Holding Registers

Holding Registers are word-type data used for setup/parameter information. This data can be read or written. The MicroMotion Module uses Holding Register addresses 40001 to 46999.

Writing Parameters to a MicroMotion Module

The host writes a parameter to Holding Register in a MicroMotion Module using a MODBUS RTU Preset Single/Preset Multiple Register command. Note that when the host writes a value to the Holding Register in a MicroMotion Module, the value remains there until the host changes it (whether or not the value is correct).

Next, the host sends a Force Single Coil command to turn on (1) the coil that corresponds to that parameter.

The table below summarizes the associations between setting parameters, Holding Registers, and Coils.

Item		*Holding Registers*	*Setting Coils*	
Common parameter	A axis	100 - 157	205	Initialization of all parameters
			206	Initialize Common Parameters for Axis A to defaults
			220	Set Common Parameters for Axis A
	B axis	200 - 257	205	Initialization of all parameters
			207	Initialize Common Parameters for Axis B to defaults
			221	Set Common Parameters for Axis B
Sequence table	A axis	500 - 999	205	Initialization of all parameter
			212	Clear Sequence Table of Axis A
			226	Set Sequence Table for Axis A
	B axis	1500 - 1999	205	Initialization of all parameters
			213	Clear Sequence Table of Axis B
			227	Set Sequence Table for Axis B
Profile data		4520 - 6567	205	Initialization of all parameters
			210	Clear all profile data
			224	Set all Profile data
		4519, 4520 - 6567	211	Clear one profile *
			225	Set one Profile *
			* The profile to clear or set is specified in Holding Register 4519 and coil 211 or 225 is turned on.	
Transmission speed		4	141	
Device No.		5	142	

The module detects coils for setting parameters at the edge, and turns them off if the coil on is detected.

After detecting the set coil, the module checks the parameter in the corresponding Holding Register. If the parameter is correct, the module stores a copy of the parameter in the corresponding Input Register, which is the location used for the actual operating parameters. If the parameter is not correct, the module does not copy the value to the corresponding Input Register. In that case, the value in the Holding Register and the corresponding Input Register are not the same.

After writing a parameter to module and setting its associated coil, the host should check the error area of the Input Register table to see whether the coil is on. If an error has caused the coil to be off, the host can try turning on the coil again.

When changing individual parameters, the host should check for errors after each parameter change, and make corrections if necessary.

Some parameter changes may cause errors in the Sequence Table or Profile data. The host should also check those areas.

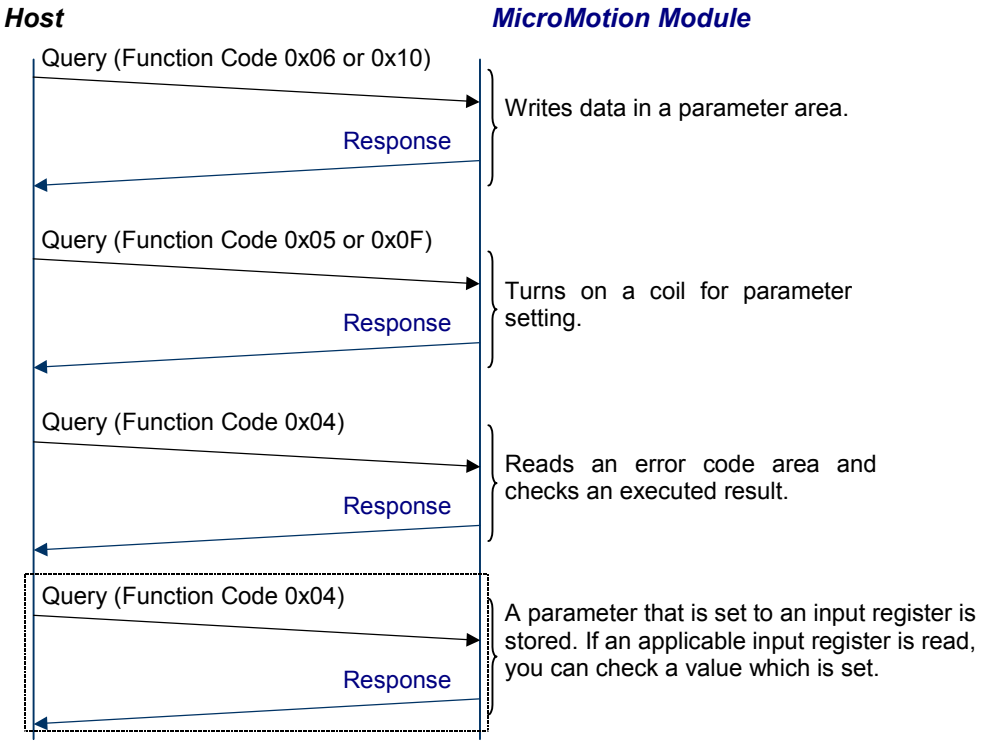
Using MODBUS Commands to Read and Write Data

The host uses the MODBUS commands described on the following pages to set up, start, stop, and monitor the MicroMotion Module.

Parameter Setup

A parameter is set up by writing the value to a Holding Register and setting the corresponding Coil bit to 1.

The sequence of setting a parameter using MODBUS commands is shown below.

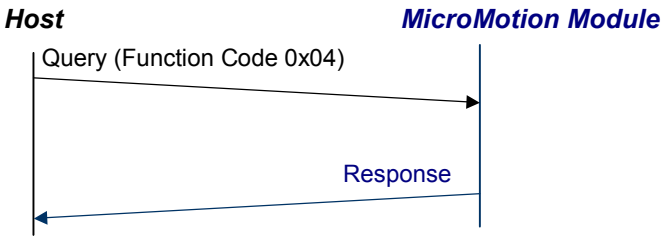


Function Codes:

0x04 … Read input registers
0x05 … Force single coil
0x06 … Force single register
0x0F … Force multiple coils
0x10 … Force multiple registers

Monitoring the MicroMotion Module

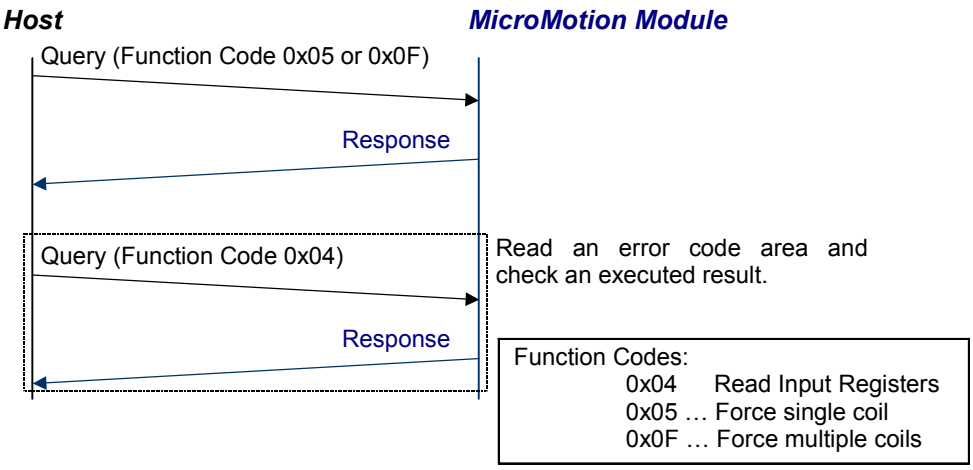
Operating information for the MicroMotion Module and the current parameter are assigned to a unique address of the Input Register. The host can read the information using Function Code 04.



Function Code: 0x04 … Read Input Registers

Start or Stop the Module

The host can start operation on an axis by setting a coil, or stop the operation by clearing the same coil.



Coils for requests like start operation or stop operation are turned off by the system. Coils that stop a manual operation are *not* turned off automatically; they must be turned off by the user.

MODBUS Function Code Descriptions

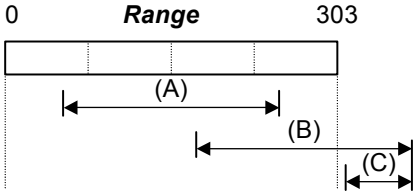
Function Code 0x01 (Read Coil Status)

This command reads the status of one or more coils in the MicroMotion Module. The read Coil Status command cannot be broadcast to multiple slaves.

Response

The module returns the status of all requested coils in the data field of the response. For each bit, 1 means the coil is ON and 0 means the coil is OFF. Each byte indicates the status of 8 points; unused bits are filled with zeros.

If the starting address and number of coils specified in the query result in some data being partly or completely out of range (B and C below), the module returns an Exception Response.



(A): Number of bits and address all within range.

(B): Partly out of range.

(C): Completely out of range.

Although the status of a coil that has no function assigned is off, the status when the coil is turned on with function code 0x05 and 0x0F is held. (The operation of the MicroMotion Module is not influenced.)

Example Query and Response

In this example, the host reads the coil status of addresses from 110 to 123 (14 points) from the MicroMotion Module assigned to Device Address number 03.

Query (hex)

Device address	0 3
MODBUS Function code	0 1
Coil starting address (upper)	0 0
Coil starting address (lower)	6 D
Number of coils (upper)	0 0
Number of coils (lower)	0 E
Error check	[CRC]

Response (hex)

Device address	0 3
MODBUS Function code	0 1
Number of data bytes	0 2
Coil data (upper)	C B
Coil data (lower)	0 A
Error check	[CRC]

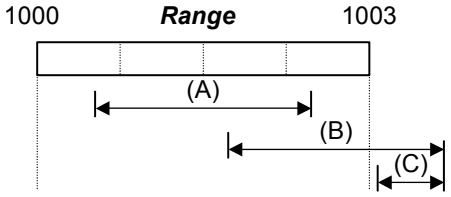
Function Code 0x02 (Read Input Status)

This command reads the status of one or more Input bits in the MicroMotion Module. The Read Input Status command cannot be broadcast to multiple slaves.

Response

The module returns the status of all requested Input Status bits in the data field of the response. For each bit, 1 means the coil is ON and 0 means the coil is OFF. Each byte indicates the status of 8 points; unused bits are filled with zeros.

If the starting address and number of bits specified in the query result in some data being partly or completely out of range (B and C below), the module returns an Exception Response.



(A): Number of bits and address all within range.

(B): Partly out of range.

(C): Completely out of range.

Example Query and Response

In this example, the host reads the input status of addresses from 12408 to 12415 (8 bits) from the MicroMotion Module assigned to Device Address number 05.

Query (hex)

Device address	0 5
MODBUS Function code	0 2
Input status starting address (upper)	0 9
Input status starting address (lower)	6 7
Number of input status bits (upper)	0 0
Number of input status bits (lower)	0 8
Error check	[CRC]

Response (hex)

Device address	0 5
MODBUS Function code	0 2
Number of data bytes	0 1
Input status data	C 5
Error check	[CRC]

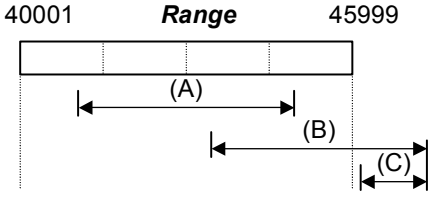
Function Code 0x03 (Read Holding Registers)

This command reads the status of one or more Holding Registers in the MicroMotion Module. The Read Holding Registers command cannot be broadcast to multiple slaves.

Response

The module returns the status of all requested Holding Registers in the data field of the response. The status of each register is stored in the Holding Register Data in order of upper byte then lower byte.

If the starting address and number of registers specified in the query result in some data being partly or completely out of range (B and C below), the module returns an Exception Response.



(A): Number of words and address all within range.

(B): Partly out of range.

(C): Completely out of range.

Holding Registers that are not currently being used are normally set to 0. If function code 0x06 or 0x10 writes data to an unassigned Holding Register, the module retains the value that is written. However, that does affect the operation of the module. Values in the Holding Registers do not control module operation until their corresponding coils are set to 1, as described previously.

Example Query and Response

In this example, the host reads the status of Holding Registers from 42001 to 42002 (2 words) from the MicroMotion Module assigned to Device Address number 10 decimal (0A hex).

Query (hex)

Device address	0 A
MODBUS Function code	0 3
Holding register starting address (upper)	0 7
Holding register starting address (lower)	D 0
Number of holding registers (upper)	0 0
Number of holding registers (lower)	0 2
Error check	[CRC]

Response (hex)

Device address	0 A
MODBUS Function code	0 3
Number of data bytes	0 4
Holding register data 1 (upper)	4 9
Holding register data 1 (lower)	2 A
Holding register data 2 (upper)	C 1
Holding register data 2 (lower)	F 5
Error check	[CRC]

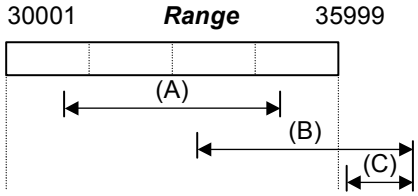
Function Code 0x04 (Read Input Registers)

This command reads the status of Input Registers in the MicroMotion Module. The Read Input Registers command cannot be broadcast to multiple slaves.

Response

The module returns the requested words from the Input Registers in the data field o the response. The status of each register is stored in the Input Registers in order of upper byte then lower byte. Unused Input Registers are set to 0.

If the specified starting address and number of registers in the query result in some data being partly or completely out of range (B and C below), the module returns an Exception Response.



(A): Number of words and address all within range.

(B): Partly out of range.

(C): Completely out of range.

Example Query and Response

In this example, the host reads the status of Input Registers from 30160 to 30161 (2 words) from the MicroMotion Module assigned to Device Address number 10 decimal (0A hex).

Query

Device address	0 A
MODBUS Function code	0 4
Input register starting address (upper)	0 0
Input register starting address (lower)	9 F
Number of input registers (upper)	0 0
Number of input registers (lower)	0 2
Error check	[CRC]

Response

Device address	0 A
MODBUS Function code	0 4
Number of data bytes	0 4
Input register data 1 (upper)	4 9
Input register data 1 (lower)	2 A
Input register data 2 (upper)	C 1
Input register data 2 (lower)	F 5
Error check	[CRC]

Function Code 0x05 (Force Single Coil)

This command writes to one coil in the MicroMotion Module. The Force Single Coil command can be sent to one slave or broadcast to all slaves. If it is broadcast, the same coil is written in each slave.

Response

The normal response to this query is the same as the query. When this command is broadcast, no response is returned.

If this command sets a coil that does not have an assigned function, the coil status changes to 1 but the operation of the MicroMotion Module is not influenced.

Example Query and Response

In this example, the host turns ON (sets to 1) coil 120 for the MicroMotion Module assigned to Device Address number 21 decimal (15 hex).

Query (hex)

Device address	1 5
MODBUS Function code	0 5
Coil starting address (upper)	0 0
Coilstarting address (lower)	7 7
Change data (upper)	F F
Change data (lower)	0 0
Error check	[CRC]

Response (hex)

Device address	1 5
MODBUS Function code	0 5
Coil starting address (upper)	0 0
Coil starting address (lower)	7 7
Change data (upper)	F F
Change data (lower)	0 0
Error check	[CRC]

Function Code 0x06 (Force Single Register)

This command writes to one Holding Register in the MicroMotion Module. The Force Single Register command can be sent to one slave or broadcast to all slaves. If it is broadcast, the same Holding Register is written in each slave.

Response

The normal response to this query is the same as the query. When this command is broadcast, no response is returned.

If this command sets a coil that does not have an assigned function, the coil status changes to 1 but the operation of the MicroMotion Module is not influenced.

Example Query and Response

In this example, the host writes the value 20 decimal (14 hex) into Holding Register 40001 in the MicroMotion Module assigned to Device Number address 27.

Query (hex)

Device address	1 B
MODBUS unction code	0 6
Register starting address (upper)	0 0
Register starting address (lower)	0 0
Change data (upper)	0 0
Change data (lower)	1 4
Error check	[CRC]

Response (hex)

Device address	1 B
MODBUS Function code	0 6
Register starting address (upper)	0 0
Register starting address (lower)	0 0
Change data (upper)	0 0
Change data (lower)	1 4
Error check	[CRC]

Function Code 0x0F (Force Multiple Coils)

This command writes to one or more coils in the MicroMotion Module. The Force Multiple Coils command can be sent to one slave or broadcast to all slaves. If it is broadcast, the same coils are written in each slave.

Data is written in 8-bit bytes. If the ending data in the query sent by the host is less than 8 bits, the ending bits are ignored.

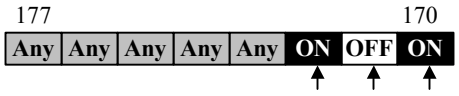
Response

The normal response to this query is the same as the query except for the number of bytes in the query and data area. When this command is broadcast, no response is returned.

If this command sets a coil that does not have an assigned function, the coil status changes to 1 but the operation of the MicroMotion Module is not influenced.

Example Query and Response

In this example, the host sets the status of coils 170 to 172 (3 points) in the MicroMotion Module assigned to Device Address number 31 decimal (1F hex) as follows:



Query (hex)

Device address	1 F
MODBUS Function code	0 F
Coil starting address (upper)	0 0
Coil starting address (lower)	A 9
Number of coils (upper)	0 0
Number of coils (lower)	0 3
Number of bytes	0 1
Change data	0 5
Error check	[CRC]

Response (hex)

Device address	1 F
MODBUS Function code	0 F
Coil starting address (upper)	0 0
Coil starting address (lower)	A 9
Number of coils (upper)	0 0
Number of coils (lower)	0 3
Error check	[CRC]

Function Code 0x10 (Force Multiple Registers)

This command writes to one or more Holding Registers in the MicroMotion Module. The Force Multiple Registers command can be sent to one slave or broadcast to all slaves. If it is broadcast, the same Holding Registers are rewritten in all slaves.

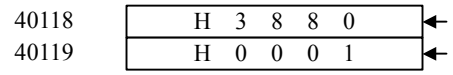
Response

The normal response to this query is the same as the query except for the data sections. When this command is broadcast, no response is returned.

If this command writes to a register that does not have an assigned function, the value is changed but the operation of the MicroMotion Module is not influenced.

Example Query and Response

The host writes to Holding Registers 40118 and 40119 (2 words) in the MicroMotion Module that is assigned to Device Address number 51 decimal (33 hex). The data to be written is:



Query (hex)

Device address	3 3
MODBUS Function code	1 0
Register starting address (upper)	0 0
Register starting address (lower)	7 5
Number of registers (upper)	0 0
Number of registers (lower)	0 2
Number of bytes	0 4
Change data 1 (upper)	3 8
Change data 1 (lower)	8 0
Change data 2 (upper)	0 0
Change data 2 (lower)	0 1
Error check	[CRC]

Response (hex)

Device address	3 3
MODBUS Function code	1 0
Register starting address (upper)	0 0
Register starting address (lower)	7 5
Number of registers (upper)	0 0
Number of registers (lower)	0 2
Error check	[CRC]

Chapter 9 Data Formats for MODBUS Communications

This chapter defines the MicroMotion Module data that can be read or written using MODBUS RTU communications. See chapter 8 for details of the MODBUS RTU commands that are used to read or write this data.

- MODBUS Coils Table Data for a MicroMotion Module
- Input Status Table Data for a MicroMotion Module
- Input Register Data for a MicroMotion Module
- Holding Register Data for a MicroMotion Module

MODBUS Coils Table Data for a MicroMotion Module

Coils are bit-type data that is used to exchange status information and commands with the MicroMotion Module. All data in the Coils table can be read and written. The MicroMotion Module uses Coil addresses 1 to 519, as defined on the following pages. Except as noted in the table, setting a bit to 1 enables the associated action.

Coils Table Address	***Name***	***When Detected***
1	Command bits. These bits correspond to the output command data that can be sent by a VersaMax Micro PLC CPU, as described in chapter 7.	-
2		-
3		-
4		-
5		-
6		-
7		-
8		-
(9 – 12)	Not used	-
13	Execute command on Axis B (Used by VersaMax Micro PLC CPU)	-
14	Execute command on Axis A (Used by VersaMax Micro PLC CPU)	-
15	Initialize handshake (Used by VersaMax Micro PLC CPU)	-
16	Transmit / receive indicator (Used by VersaMax Micro PLC CPU)	-
(17 - 140)	Not used	-
141	Change Transmission Speed	edge
142	Request to set Device Number	edge
143	Not used	-
144	Double word data sequence. 0 = lower/upper, 1 = upper/lower	level
145	Pulse output at CPU stop. 1 = continue pulse, 0 = stop pulse	edge
146	Save Axis A parameters	edge
147	Save Axis B parameters	edge
(148 - 199)	Not used	-
200	Clear system error	edge
201	Clear Axis A error	edge
202	Clear Axis B error	edge
(203 - 204)	Not used	-
205	Initialize all parameters.	edge
206	Initialize Common Parameters for Axis A to defaults	edge
207	Initialize Common Parameters for Axis B to defaults	edge
(208 - 209)	Not used	-
210	Clear all profile data	edge
211	Clear one profile	edge

Coils Table Address	Name	When Detected
212	Clear Registration Sequence Table of Axis A	edge
213	Clear Registration Sequence Table of Axis B	edge
(214 - 219)	Not used	-
220	Set Common Parameters for Axis A	edge
221	Set Common Parameters for Axis B	edge
(222 - 223)	Not used	-
224	Set all Profile data	edge
225	Set designated Profile data	edge
226	Set Registration Sequence Table for Axis A	edge
227	Set Registration Sequence Table for Axis B	edge
(228 - 239)	Not used	-
240	Stop Axis A immediately	edge
241	Stop Axis B immediately	edge
(242 - 243)	Not used	-
244	Decelerate and stop Axis A	edge
245	Decelerate and stop Axis B	edge
(246 - 247)	Not used	-
248	Feedrate Override on Axis A. Decelerate\Accelerate the pulse to the specified rate.	level
249	Feedrate Override on Axis B. Decelerate\Accelerate the pulse to the specified rate.	level
(250 - 251)	Not used	-
252	Move the registration distance on Axis A	edge
253	Move the registration distance on Axis B	edge
(254 - 255)	Not used	-
256	Change profile of Axis A in Auto mode (speed control)	edge
257	Change profile of Axis B in Auto mode (speed control)	edge
(258 - 259)	Not used	-
260	Change Pulse Speed on Axis A	edge
261	Change Pulse Speed on Axis B	edge
(262 - 263)	Not used	-
264	Change the current output position on Axis A by the value specified	edge
265	Change the current output position on Axis B by the value specified	edge
(266 - 267)	Not used	-
268	Read current position of Axis A, latching	edge
269	Read current position of Axis B, latching	edge
(270 - 271)	Not used	-
272	Change the current input position on Axis A by the value specified	edge
273	Change the current input position on Axis B by the value specified	edge

Coils Table Address	Name	When Detected
(274 - 279)	Not used	-
280	Reserved	
(281 - 282)	Not used	-
283	Reserved	
(284 - 291)	Not used	-
292	Set / cancel Manual (external input) mode on Axis A. Set = 1, cancel = 0.	level
293	Set / cancel Manual (external input) mode on Axis B. Set = 1, cancel = 0.	level
(294 - 299)	Not used	-
300	Free homing on Axis A	edge
301	Low speed homing (CCW direction) on Axis A	edge
302	Low speed homing (CW direction) on Axis A	edge
303	High speed homing (OFF Edge / CCW direction) on Axis A	edge
304	High speed homing (OFF Edge / CW direction) on Axis A	edge
305	High speed homing (Marker / CCW direction) on Axis A	edge
306	High speed homing (Marker/CW direction) on Axis A	edge
(307 - 309)	Not used	-
310	Free homing on Axis B	edge
311	Low speed homing (CCW direction) on Axis B	edge
312	Low speed homing (CW direction) on Axis B	edge
313	High speed homing (OFF Edge / CCW direction) on Axis B	edge
314	High speed homing (OFF Edge / CW direction) on Axis B	edge
315	High speed homing (Marker / CCW direction) on Axis B	edge
316	High speed homing (Marker / CW direction) on Axis B	edge
(307 - 339)	Not used	-
340	Single cycle operation of Registration (stored) sequence table on Axis A	edge
341	Consecutive cycle operation of Registration (stored) sequence table on Axis A	edge
342	Single cycle operation of Designation (supplied) sequence table on Axis A	edge
343	Consecutive cycle operation of Designation (supplied) sequence table on Axis A	edge
344	Single cycle operation of Registration (stored) sequence table on Axis B	edge
345	Consecutive cycle operation of Registration (stored) sequence table on Axis B	edge
346	Single cycle operation of Designation (supplied) sequence table on Axis B	edge

Coils Table Address	Name	When Detected
347	Consecutive cycle operation of Designation (supplied) sequence table on Axis B	edge
(348 - 359)	Not used	-
360	Perform manual (Jog) operation (consecutive pulse output/CCW direction) on Axis A	level
361	Perform manual (Inching) operation (designated pulse output/CCW direction) on Axis A	edge
362	Perform manual (Jog) operation (consecutive pulse output/CW direction) on Axis A	level
363	Perform manual (Inching) operation (designated pulse output/CW direction) on Axis A	edge
(364 - 369)	Not used	-
370	Perform manual (Jog) operation (consecutive pulse output/CCW direction) on Axis B	level
371	Perform manual (Inching) operation (designated pulse output/CCW direction) on Axis B	edge
372	Perform manual (Jog) operation (consecutive pulse output/CW direction) on Axis	level
373	Perform manual (Inching) operation (designated pulse output/CW direction) on Axis B	edge
(374 - 399)	Not used	-
400	Format Memory Pack module	edge
401	Save initial values of MicroMotion Module to Memory Pack module	edge
402	Save all parameters from MicroMotion Module to Memory Pack module	edge
403	Save Common Parameters for Axis A to Memory Pack module	edge
404	Save Common Parameters for Axis B to Memory Pack module	edge
(405 - 406)	Not used	-
407	Write all Profile data to Memory Pack module	edge
408	Write all Profile data to Memory Pack module (Same functionality as coil 407)	edge
409	Write registration Sequence Table for Axis A to Memory Pack module	edge
410	Write registration Sequence Table for Axis B to Memory Pack module	edge
(411 - 412)	Not used	-
413	Save communication setting and device number to Memory Pack module	edge
414	Write Axis A information to the Memory Pack module	edge
415	Write Axis B information to the Memory Pack module	edge

Input Status Table Data for a Micro Motion Module

Input Status data is bit-type data that is used for status information. Input Status data is read-only. The MicroMotion Module uses Input Status addresses 10001 to 10519.

Input Status Table Address	***Contents***
1	Used by the system
2	
3	
4	
5	
6	
7	
8	
9	Axis B error =1. Corrected and cleared = 0.
10	Axis B in Standby mode = 1.
11	Axis B operating, outputting pulse = 1. Axis B is stopped = 0.
12	Axis A error = 1. Corrected and cleared = 0.
13	Axis A in Standby mode = 1.
14	Axis A operating, outputting pulse = 1. Axis A is stopped = 0.
15	MicroMotion Module is OK = 1.
16	Transmit / receive bit, 1 = receiving instruction.
17	Axis B Emergency Stop input status. On = 1.
18	Axis B Drive OK/Ready input status. On = 1.
19	Axis B Jog Reverse input status. On = 1.
20	Axis B Jog Forward input status. On = 1.
21	Axis B Feedrate Override input status. On = 1.
22	Axis B Reverse Overtravel input status. On = 1.
23	Axis B Forward Overtravel input status. On = 1.
24	Axis B Move Complete input status. On = 1.
25	Axis A Emergency Stop input status. On = 1.
26	Axis A Drive OK/Ready input status. On = 1.
27	Axis A Jog Reverse input status. On = 1.
28	Axis A Jog Forward input status. On = 1.
29	Axis A Feedrate Override input status. On = 1.
30	Axis A Reverse Overtravel input status. On = 1.
31	Axis A Forward Overtravel input status. On = 1.
32	Axis A Move Complete input status. On = 1.

Input Status Table Address	*Contents*
(33 - 142)	Not used
143	MicroMotion Module standalone operation status 0 = Controlled by VersaMax Micro PLC 1 = Standalone mode
144	Double word data format 0 = Lower word/upper word format 1 = Upper word/lower word format
(145 - 149)	Not used
150	Common Parameters error status 0 = No errors, 1 = Error
151	Axis A error status: 0 = no error, 1 = error
152	Axis B error status: 0 = no error, 1 = error
(153 - 247)	Not used
248	Feedrate Override status on Axis A 0 = No feedrate override status 1 = feedrate status status
249	Feedrate Override status on Axis B 0 = No feedrate override status 1 = feedrate status status
(250 - 279)	Not used
280	Reserved
(281 - 282)	Not used
283	Reserved
(284 - 291)	Not used
292	Manual operation (external input) on Axis A 0 = no, 1 = yes
293	Manual operation (external input) on Axis B 0 = no, 1 = yes
(294 - 359)	Not used
360	Manual operation in CCW direction on Axis A: 0 = no, 1 = yes
(361)	Not used
362	Manual operation in CW direction on Axis A: 0 = no, 1 = yes
(363 - 369)	Not used
370	Manual operation in CCW direction on Axis B: 0 = no, 1 = yes
(371)	Not used
372	Manual operation in CW direction on Axis B: 0 = no, 1 = yes
(373 - 419)	Not used
420	Saving to backup memory: 0 = Save completed, 1 = Saving to backup
421	Writing to Memory Pack module 0 = Write completed, 1 = Saving to Memory Pack module
(422 -)	Not used

Input Register Data for a MicroMotion Module

Input Registers a are word-type data that is used for status information about the MicroMotion Module. Input Registers contain the current parameter information. Input Registers are read-only. The MicroMotion Module uses Input Register addresses 30001 to 36999.

For parameters related to speed, the system may correct the value. If so, the actual speed, which is set to the input register, may be different from the value set to the holding register.

Input Registers Address	***Name***
1	Software version [Lower]
2	Software version [Upper]
3	Communication interface: 0 = RS-422/485, 1= RS-232c/usb
4	Current communication speed and transmission format Upper byte: 0 = 115.2k, 1 = 57.6k, 2 = 19.2k, 3 = 9600 Lower byte: 0 = 8/E/1, 1 = 8/O/1, 2 = 8/N/1, 3 = 8/N/2
5	Current Device Number
(6)	Not used
7	DIP Switch status indication in lower 4 bits DIP Switch 1- bit 0, DIP Switch 2 – bit, DIP Switch 3 - bit 2, DIP Switch 4 - bit 3
8	System error [Lower]. See chapter 11.
9	System error [Upper]
10	Axis error. See chapter 11.
11	Axis A status [Lower]
12	Axis A status [Upper]
13	Current position of Axis A calculated from the output pulse. [Lower]
14	Current position of Axis A calculated from the output pulse. [Upper]
15	Current position of Axis A calculated from the input pulse [Lower]
16	Current position of Axis A calculated from the input pulse [Upper]
17	Current speed Axis A calculated from the output pulse [Lower]
18	Current speed Axis A calculated from the output pulse [Upper]
19	Currently-executing profile on Axis A in Auto mode.
20	Currently executing sequence table number on Axis A in Auto mode.
(21 - 24)	Not used
25	Axis B error. See chapter 11.
26	Axis B status [Lower]
27	Axis B status [Upper]
28	Current position of Axis B calculated from the output pulse. [Lower]

Input Registers Address	*Name*
29	Current position of Axis B calculated from the output pulse [Upper]
30	Current position of Axis B calculated from the input pulse [Lower]
31	Current position of Axis B calculated from the input pulse [Upper]
32	Current speed Axis B calculated from the output pulse [Lower]
33	Current speed Axis B calculated from the output pulse [Upper]
34	Currently-executing profile on Axis B in Auto mode.
35	Currently executing sequence table number on Axis B in Auto mode.
(36 - 79)	Not used
80	Current position of Axis A when the latch read coil is turned on. [Lower]
81	Current position of Axis A when the latch read coil is turned on. [Upper]
82	Current position of Axis B when the latch read coil is turned on. [Lower]
83	Current position of Axis B when the latch read coil is turned on. [Upper]
(84 - 99)	Not used
100	Common Parameters word 1 for Axis A
101	Common Parameters word 2 for Axis A
102	Common Parameters word 3 of Axis A
103	Output Pulses per Motor Rotation for Axis A [Lower]
104	Output Pulses per Motor Rotation for Axis A [Upper]
105	Output User Units per Motor Rotation for Axis A [Lower]
106	Output User Units per Motor Rotation for Axis A [Upper]
107	Velocity Limit for Axis A [Lower]
108	Velocity Limit for Axis A [Upper]
109	Initial Velocity of Axis A in Auto mode. [Lower]
110	Initial Velocity of Axis A in Auto mode. [Upper]
111	Find Home homing speed of Axis A [Lower]
112	Find Home homing speed of Axis A [Upper]
113	Final Home homing speed of Axis A [Lower]
114	Final Home homing speed of Axis A [Upper]
115	Homing: Acceleration Rate for Axis A [Lower]
116	Homing: Acceleration Rate for Axis A [[Upper]
117	Homing: Deceleration Rate for Axis A [Lower]
118	Homing: Deceleration Rate for Axis A [Upper]
119	Maximum Velocity for Axis A in manual mode [Lower]
120	Maximum Velocity for Axis A in manual mode [Upper]
121	Initial Velocity for Axis A in manual mode [Lower]
122	Initial Velocity for Axis A in manual mode [Upper]
123	Acceleration Rate for Axis A in manual mode [Lower]
124	Acceleration Rate for Axis A in manual mode [Upper]

Input Registers Address	Name
125	Deceleration Rate for Axis A in manual mode [Lower]
126	Deceleration Rate for Axis A in manual mode [Upper]
127	Inching Distance for Axis A in manual mode [Lower]
128	Inching Distance for Axis A in manual mode [[Upper]
129	Backlash Compensation for Axis A [Lower]
130	Backlash Compensation for Axis A [Upper]
131	Feedrate Override Percentage for Axis A
132	Reserved
133	Reserved
134	Upper Position Limit for Axis A [Lower]
135	Upper Position Limit for Axis A [Upper]
136	Lower Position Limit for Axis A [Lower]
137	Lower Position Limit for Axis A [Upper]
138	Home position data for Axis A in homing [Upper]
139	Home position data for Axis A in homing [lower]
140	Home Position Offset for Axis A [Lower]
141	Home Position Offset for Axis A [Upper]
142	Registration Move Distance for Axis A [Lower]
143	Registration Move Distance for Axis A [Upper]
144	Input Feedback Pulses per Motor Rotation for Axis A [Lower]
145	Input Feedback Pulses per Motor Rotation for Axis A [Upper]
146	Input Feedback User Units per Motor Rotation for Axis A [Lower]
147	Input Feedback User Units per Motor Rotation for Axis A [Upper]
148	Input feedback Upper Position Limit for Axis A [Lower]
149	Input feedback Upper Position Limit for Axis A [Upper]
150	Free-form User Units for Axis A [Output pulse]: 1st/2nd character
151	Free-form User Units for Axis A [Output pulse]: 3rd/4th character
152	Free-form User Units for Axis A [Output pulse]: 5th/6th character
153	Free-form User Units for Axis A [Output pulse]: 7th/8th character
154	Free-form User Units for Axis A [Input feedback]: 1st/2nd character
155	Free-form User Units for Axis A [Input feedback]: 3rd/4th character
156	Free-form User Units for Axis A [Input feedback]: 5th/6th character
157	Free-form User Units for Axis A [Input feedback]: 7th/8th character
(158 –189)	Not used
190	New velocity while Axis A is in motion [Lower]
191	New velocity while Axis A is in motion [Upper]
192	New current position of Axis A when not in motion [Output pulse/Lower]
193	New current position of Axis A when not in motion[Output pulse/Upper]

Input Registers Address	*Name*
194	New current position of Axis A when not in motion [Input pulse/Lower]
195	New current position of Axis A when not in motion [Input pulse/Upper]
(196 – 199)	Not used
200	Common Parameters word 1 for Axis B
201	Common Parameters word 2 for Axis B
202	Common Parameters word 3 for Axis B
203	Output Pulses per Motor Rotation for Axis B [Lower]
204	Output Pulses per Motor Rotation for Axis B [Upper]
205	Output User Units per Motor Rotation for Axis B [Lower]
206	Output User Units per Motor Rotation for Axis B [Upper]
207	Velocity Limit for Axis B [Lower]
208	Velocity Limit for Axis B [Upper]
209	Initial Velocity of Axis B in Auto mode. [Lower]
210	Initial Velocity of Axis B in Auto mode. [Upper]
211	Find Home homing speed of Axis B [Lower]
212	Find Home homing speed of Axis B [Upper]
213	Final Home homing speed of Axis B [Lower]
214	Final Home homing speed of Axis B [Upper]
215	Homing: Acceleration Rate for Axis B [Lower]
216	Homing: Acceleration Rate for Axis B [[Upper]
217	Homing: Deceleration Rate for Axis B [Lower]
218	Homing: Deceleration Rate for Axis B [Upper]
219	Maximum Velocity for Axis B in manual mode [Lower]
220	Maximum Velocity for Axis B in manual mode [Upper]
221	Initial Velocity for Axis B in manual mode [Lower]
222	Initial Velocity for Axis B in manual mode [Upper]
223	Acceleration Rate for Axis B in manual mode [Lower]
224	Acceleration Rate for Axis B in manual mode [Upper]
225	Deceleration Rate for Axis B in manual mode [Lower]
226	Deceleration Rate for Axis B in manual mode [Upper]
227	Inching Distance for Axis B in manual mode [Lower]
228	Inching Distance for Axis B in manual mode [[Upper]
229	Backlash Compensation for Axis B [Lower]
230	Backlash Compensation for Axis B [Upper]
231	Feedrate Override Percentage for Axis B
232	Reserved
233	Reserved
234	Upper Position Limit for Axis B [Lower]

Input Registers Address	Name
235	Upper Position Limit for Axis B [Upper]
236	Lower Position Limit for Axis B [Lower]
237	Lower Position Limit for Axis B [Upper]
238	Home Position data for Axis B in homing [Upper]
239	Home Position data for Axis B in homing [lower]
240	Home Position Offset for Axis B [Lower]
241	Home Position Offset for Axis B [Upper]
242	Registration Move Distance for Axis B [Lower]
243	Registration Move Distance for Axis B [Upper]
244	Input Feedback Pulses per Motor Rotation for Axis B [Lower]
245	Input Feedback Pulses per Motor Rotation for Axis B [Upper]
246	Input Feedback User Units per Motor Rotation for Axis B [Lower]
247	Input Feedback User Units per Motor Rotation for Axis B [Upper]
248	Input feedback Upper Position Limit for Axis B [Lower]
249	Input feedback Upper Position Limit for Axis B [Upper]
250	Free-form User Units for Axis B [Output pulse]: 1st/2nd character
251	Free-form User Units for Axis B [Output pulse]: 3rd/4th character
252	Free-form User Units for Axis B [Output pulse]: 5th/6th character
253	Free-form User Units for Axis B [Output pulse]: 7th/8th character
254	Free-form User Units for Axis B [Input feedback]: 1st/2nd character
155	Free-form User Units for Axis B [Input feedback]: 3rd/4th character
256	Free-form User Units for Axis B [Input feedback]: 5th/6th character
257	Free-form User Units for Axis B [Input feedback]: 7th/8th character
258 – 289	Not used
290	New velocity while Axis B is in motion [Lower]
291	New velocity while Axis B is in motion [Upper]
292	New current position of Axis B when not in motion [Output pulse/Lower]
293	New current position of Axis B when not in motion[Output pulse/Upper]
294	New current position of Axis B when not in motion [Input pulse/Lower]
295	New current position of Axis B when not in motion [Input pulse/Upper]
(296 - 499)	Not used
500	Number of elements in the registration sequence table of Axis A.
501	Registration Sequence Table 1 for Axis A
…	…
999	Registration Sequence Table 499 for Axis A
1000	Number of table elements in the Designation Sequence table for Axis A
1001	Designation Sequence 1 for Axis A
…	…

Input Registers Address	*Name*
1499	Designation Sequence 499 for Axis A
1500	Number of elements in the registration sequence table of Axis B.
1501	Registration Sequence Table 1 for Axis B
…	…
1999	Registration Sequence Table 499 for Axis B
2000	Number of table elements in the designation Sequence table for Axis B
2001	Designation Sequence 1 for Axis B
…	…
2499	Designation Sequence 499 for Axis B
(2500 - 4499)	Not used
4500	Profiles registered in the MicroMotion Module [1 - 16]
…	
4515	Profiles registered in the MicroMotion Module [241 - 256]
(4516 - 4519)	Not used
4520	Profile 1 Acceleration Rate [Lower]
4521	Profile 1 Acceleration Rate [Upper]
4522	Profile 1 Deceleration Rate [Lower]
4523	Profile 1 Deceleration Rate [Upper]
4524	Profile 1 Velocity [Lower]
4525	Profile 1 Velocity [Upper]
4526	Profile 1 Target Position [Lower]
4527	Profile 1 Target Position [Upper]
…	…
6560	Profile 256 Acceleration Rate [Lower]
6561	Profile 256 Acceleration Rate [Upper]
6562	Profile 256 Deceleration Rate [Lower]
6563	Profile 256 Deceleration Rate [Upper]
6564	Profile 256 Velocity [Lower]
6565	Profile 256 Velocity [Upper]
6566	Profile 256 Target Position [Lower]
6567	Profile 256 Target Position [Upper]
(6568 -)	Not used

Holding Registers Data for a MicroMotion Module

Parameters of the MicroMotion Module are written to the MODBUS Holding Registers This does not affect the operation of the MicroMotion Module, however. If the coil for parameter setting is turned on, the parameters are copied to the Coils table, where they are used by the module. The following table shows how parameters in the Holding Registers correspond to equivalent parameters in the module's Coils table. Details of specific Holding Register assignments are shown on subsequent pages.

Data in the Holding Registers

Holding Registers are word-type data used for setup/parameter information. See chapter 8 for parameter data formats. This data can be read or written. The MicroMotion Module uses Holding Register addresses 40001 to 46999.

Holding Registers Address	Name
(1 - 3)	Not used
4	Set communication speed and transmission format Upper byte: 0 = 115.2k, 1 = 57.6k, 2 = 19.2k, 3 = 9600 Lower byte: 0 = 8/E/1, 1 = 8/O/1, 2 = 8/N/1, 3 = 8/N/2
5	Set Device Number for the MicroMotion Module
(6 - 99)	Not used
100	Set Common Parameters for outputs of Axis A (description follows).
101	Set Common Parameter for input feefback- of Axis A (description follows).
102	Set Common Parameter external inputs of Axis A (description follows).
103	Set Output Pulses per Motor Rotation for Axis A [Lower]
104	Set Output Pulses per Motor Rotation for Axis A [Upper]
105	Set Output User Units per Motor Rotation for Axis A [Lower]
106	Set Output User Units per Motor Rotation for Axis A [Upper]
107	Set Velocity Limit for Axis A [Lower]
108	Set Velocity Limit for Axis A [Upper]
109	Set Initial Velocity of Axis A in Auto mode. [Lower]
110	Set Initial Velocity of Axis A in Auto mode. [Upper]
111	Set Find Home homing speed of Axis A [Lower]
112	Set Find Home homing speed of Axis A [Upper]
113	Set Final Home homing speed of Axis A [Lower]
114	Set Final Home homing speed of Axis A [Upper]
115	Set Homing: Acceleration Rate for Axis A [Lower]
116	Set Homing: Acceleration Rate for Axis A [[Upper]
117	Set Homing: Deceleration Rate for Axis A [Lower]
118	Set Homing: Deceleration Rate for Axis A [Upper]

Holding Registers Address	Name
119	Set Maximum Velocity for Axis A in manual mode [Lower]
120	Set Maximum Velocity for Axis A in manual mode [Upper]
121	Set Initial Velocity for Axis A in manual mode [Lower]
122	Set Initial Velocity for Axis A in manual mode [Upper]
123	Set Acceleration Rate for Axis A in manual mode [Lower]
124	Set Acceleration Rate for Axis A in manual mode [Upper]
125	Set Deceleration Rate for Axis A in manual mode [Lower]
126	Set Deceleration Rate for Axis A in manual mode [Upper]
127	Set Inching Distance for Axis A in manual mode [Lower]
128	Set Inching Distance for Axis A in manual mode [[Upper]
129	Set Backlash Compensation for Axis A [Lower]
130	Set Backlash Compensation for Axis A [Upper]
131	Set Feedrate Override Percentage for Axis A
132	Reserved
133	Reserved
134	Set Upper Position Limit for Axis A [Lower]
135	Set Upper Position Limit for Axis A [Upper]
136	Set Lower Position Limit for Axis A [Lower]
137	Set Lower Position Limit for Axis A [Upper]
138	Set Home Position data for Axis A in homing [Upper]
139	Set Home Position data for Axis A in homing [lower]
140	Set Home Position Offset for Axis A [Lower]
141	Set Home Position Offset for Axis A [Upper]
142	Set Registration Move Distance for Axis A [Lower]
143	Set Registration Move Distance for Axis A [Upper]
144	Set Input Feedback Pulses per Motor Rotation for Axis A [Lower]
145	Set Input Feedback Pulses per Motor Rotation for Axis A [Upper]
146	Set Input Feedback User Units per Motor Rotation for Axis A [Lower]
147	Set Input Feedback User Units per Motor Rotation for Axis A [Upper]
148	Set Input feedback Upper Position Limit for Axis A [Lower]
149	Set Input feedback Upper Position Limit for Axis A [Upper]
150	Set Free-form User Units for Axis A [Output pulse]: 1st/2nd character
151	Set Free-form User Units for Axis A [Output pulse]: 3rd/4th character
152	Set Free-form User Units for Axis A [Output pulse]: 5th/6th character
153	Set Free-form User Units for Axis A [Output pulse]: 7th/8th character
154	Set Free-form User Units for Axis A [Input feedback]: 1st/2nd character
155	Set Free-form User Units for Axis A [Input feedback]: 3rd/4th character
156	Set Free-form User Units for Axis A [Input feedback]: 5th/6th character

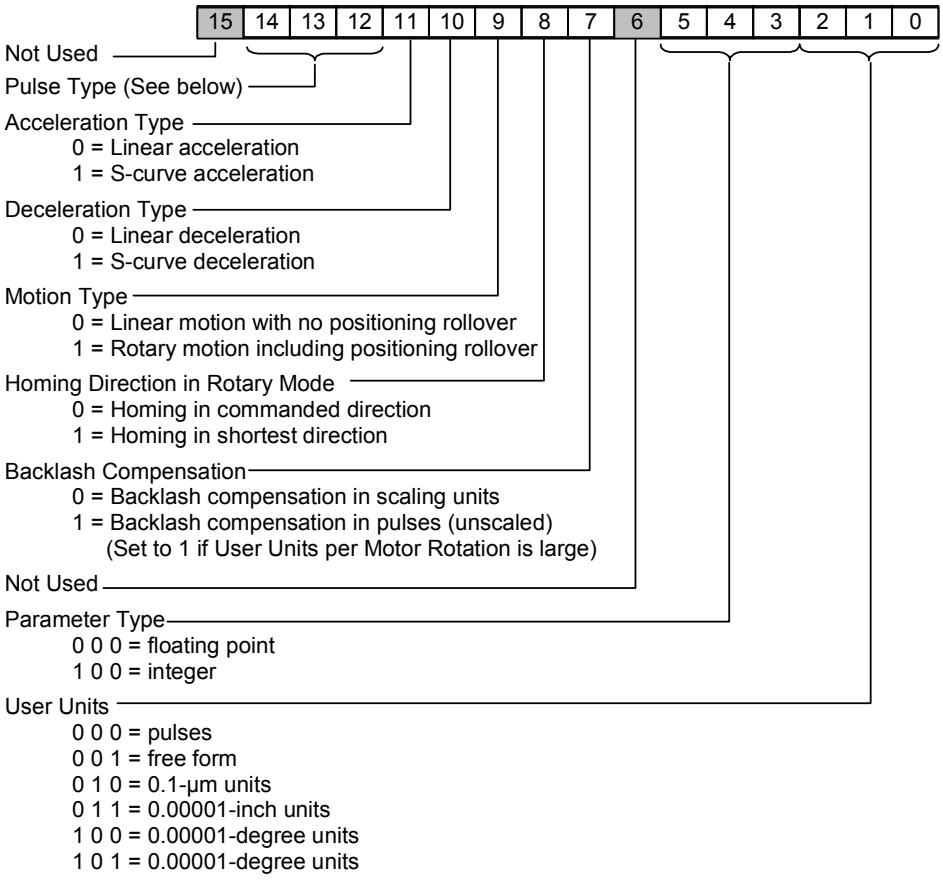
Holding Registers Address	Name
157	Set Free-form User Units for Axis A [Input feedback]: 7th/8th character
(158 –189)	Not used
190	New velocity while Axis A is in motion [Lower]
191	New velocity while Axis A is in motion [Upper]
192	New current position of Axis A when not in motion [Output pulse/Lower]
193	New current position of Axis A when not in motion[Output pulse/Upper]
194	New current position of Axis A when not in motion [Input pulse/Lower]
195	New current position of Axis A when not in motion [Input pulse/Upper]
(196 - 199)	Not used
200	Set Common Parameters for Outputs of Axis B (description follows).
201	Set Common Parameters for Input Feedback of Axis B (description follows).
202	Set Common Parameters for external inputs of Axis B (description follows).
203	Set Output Pulses per Motor Rotation for Axis B [Lower]
204	Set Output Pulses per Motor Rotation for Axis B [Upper]
205	Set Output User Units per Motor Rotation for Axis B [Lower]
206	Set Output User Units per Motor Rotation for Axis B [Upper]
207	Set Velocity Limit for Axis B [Lower]
208	Set Velocity Limit for Axis B [Upper]
209	Set Initial Velocity of Axis B in Auto mode. [Lower]
210	Set Initial Velocity of Axis B in Auto mode. [Upper]
211	Set Find Home homing speed of Axis B [Lower]
212	Set Find Home homing speed of Axis B [Upper]
213	Set Final Home homing speed of Axis B [Lower]
214	Set Final Home homing speed of Axis B [Upper]
215	Set Homing: Acceleration Rate for Axis B [Lower]
216	Set Homing: Acceleration Rate for Axis B [[Upper]
217	Set Homing: Deceleration Rate for Axis B [Lower]
218	Set Homing: Deceleration Rate for Axis B [Upper]
219	Set Maximum Velocity for Axis B in manual mode [Lower]
220	Set Maximum Velocity for Axis B in manual mode [Upper]
221	Set Initial Velocity for Axis B in manual mode [Lower]
222	Set Initial Velocity for Axis B in manual mode [Upper]
223	Set Acceleration Rate for Axis B in manual mode [Lower]
224	Set Acceleration Rate for Axis B in manual mode [Upper]
225	Set Deceleration Rate for Axis B in manual mode [Lower]
226	Set Deceleration Rate for Axis B in manual mode [Upper]
227	Set Inching Distance for Axis B in manual mode [Lower]
228	Set Inching Distance for Axis B in manual mode [[Upper]

Holding Registers Address	Name
229	Set Backlash Compensation for Axis B [Lower]
230	Set Backlash Compensation for Axis B [Upper]
231	Set Feedrate Override Percentage for Axis B
232	Reserved
233	Reserved
234	Set Upper Position Limit for Axis B [Lower]
235	Set Upper Position Limit for Axis B [Upper]
236	Set Lower Position Limit for Axis B [Lower]
237	Set Lower Position Limit for Axis B [Upper]
238	Set Home Position data for Axis B in homing [Upper]
239	Set Home Position data for Axis B in homing [lower]
240	Set Home Position Offset for Axis B [Lower]
241	Set Home Position Offset for Axis B [Upper]
242	Set Registration Move Distance for Axis B [Lower]
243	Set Registration Move Distance for Axis B [Upper]
244	Set Input Feedback Pulses per Motor Rotation for Axis B [Lower]
245	Set Input Feedback Pulses per Motor Rotation for Axis B [Upper]
246	Set Input Feedback User Units per Motor Rotation for Axis B [Lower]
247	Set Input Feedback User Units per Motor Rotation for Axis B [Upper]
248	Set Input feedback Upper Position Limit for Axis B [Lower]
249	Set Input feedback Upper Position Limit for Axis B [Upper]
250	Set Free-form User Units for Axis B [Output pulse]: 1st/2nd character
251	Set Free-form User Units for Axis B [Output pulse]: 3rd/4th character
252	Set Free-form User Units for Axis B [Output pulse]: 5th/6th character
253	Set Free-form User Units for Axis B [Output pulse]: 7th/8th character
254	Set Free-form User Units for Axis B [Input feedback]: 1st/2nd character
155	Set Free-form User Units for Axis B [Input feedback]: 3rd/4th character
256	Set Free-form User Units for Axis B [Input feedback]: 5th/6th character
257	Set Free-form User Units for Axis B [Input feedback]: 7th/8th character
258 – 289	Not used
290	New velocity while Axis B is in motion [Lower]
291	New velocity while Axis B is in motion [Upper]
292	New current position of Axis B when not in motion [Output pulse/Lower]
293	New current position of Axis B when not in motion[Output pulse/Upper]
294	New current position of Axis B when not in motion [Input pulse/Lower]
295	New current position of Axis B when not in motion [Input pulse/Upper]
(296 - 499)	Not used
500	Set Number of elements in the Registration sequence table of Axis A.

Holding Registers Address	Name
501	Set Registration Sequence Table 1 for Axis A (description follows)
…	…
999	Set Registration Sequence Table 499 for Axis A
1000	Set Number of table elements in the designation Sequence table for Axis A
1001	Set Designation Sequence 1 for Axis A
…	…
1499	Set Designation Sequence 499 for Axis A
1500	Set Number of elements in the registration sequence table of Axis B.
1501	Set Registration Sequence Table 1 for Axis B
…	…
1999	Set Registration Sequence Table 499 for Axis B
2000	Set Number of table elements in the designation Sequence table for Axis B
2001	Set Designation Sequence 1 for Axis B
…	…
2499	Set Designation Sequence 499 for Axis B
(2500 - 4499)	Not used
4519	Specify Profile data number to set
4520	Set Profile 1 Acceleration Rate [Lower]
4521	Set Profile 1 Acceleration Rate [Upper]
4522	Set Profile 1 Deceleration Rate [Lower]
4523	Set Profile 1 Deceleration Rate [Upper]
4524	Set Profile 1 Velocity [Lower]
4525	Set Profile 1 Velocity [Upper]
4526	Set Profile 1 Target Position [Lower]
4527	Set Profile 1 Target Position [Upper]
…	…
6560	Set Profile 256 Acceleration Rate [Lower]
6561	Set Profile 256 Acceleration Rate [Upper]
6562	Set Profile 256 Deceleration Rate [Lower]
6563	Set Profile 256 Deceleration Rate [Upper]
6564	Set Profile 256 Velocity [Lower]
6565	Set Profile 256 Velocity [Upper]
6566	Set Profile 256 Target Position [Lower]
6567	Set Profile 256 Target Position [Upper]
(6568 -)	Not used

Holding Registers 100, 200: Set Common Parameters for Outputs

The data in Holding Registers 100 and 200 writes Common Parameters for outputs. This word defaults to 0.



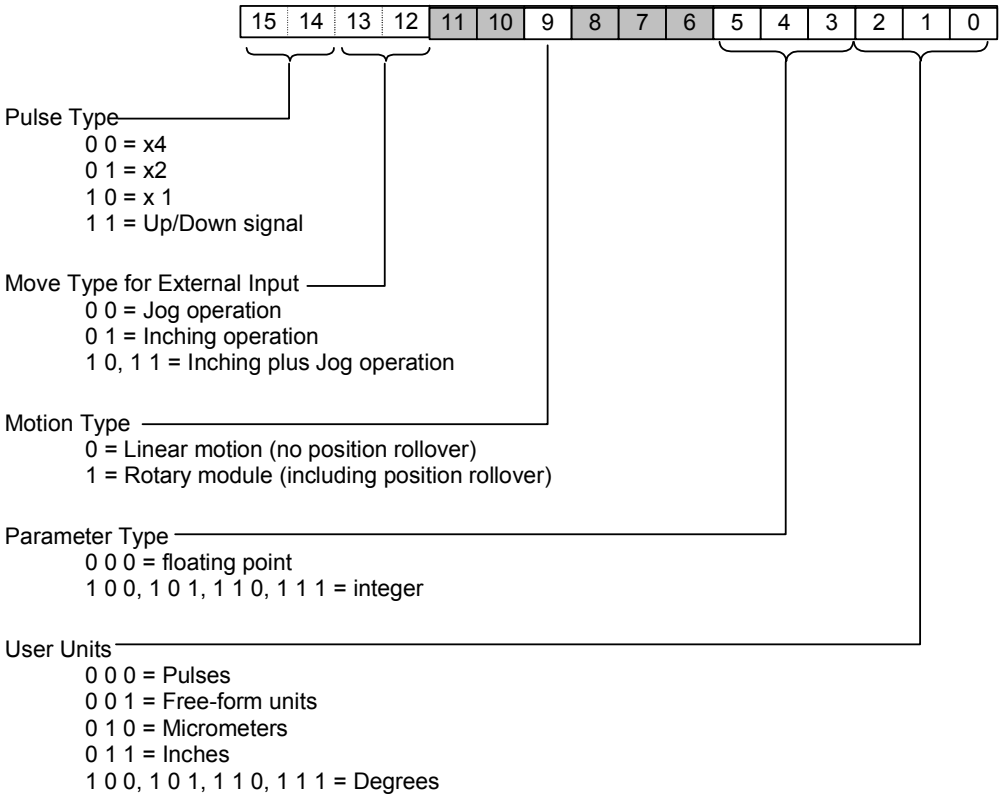
Pulse Type (word 1, bit 14 to bit 12)

The value in bits 12 to 14 sets up the pulse output type and the logic of pulse output. Bit 15 is not used. Match the Pulse Type to the pulse input method of servo controller.

Bit 14	*Bit 13*	*Bit 12*	*Pulse Output Method*				
0	0	0	Direction signal	L=CW	H=CCW	Active High	
0	0	1		H=CW	L=CCW		
0	1	0		L=CW	H=CCW	Active Low	
0	1	1		H=CW	L=CCW		
1	0	0	CW pulse	Active High		CCW pulse	Active High
1	0	1		Active Low			Active Low
1	1	0	CCW pulse	Active High		CW pulse	Active High
1	1	1		Active Low			Active Low

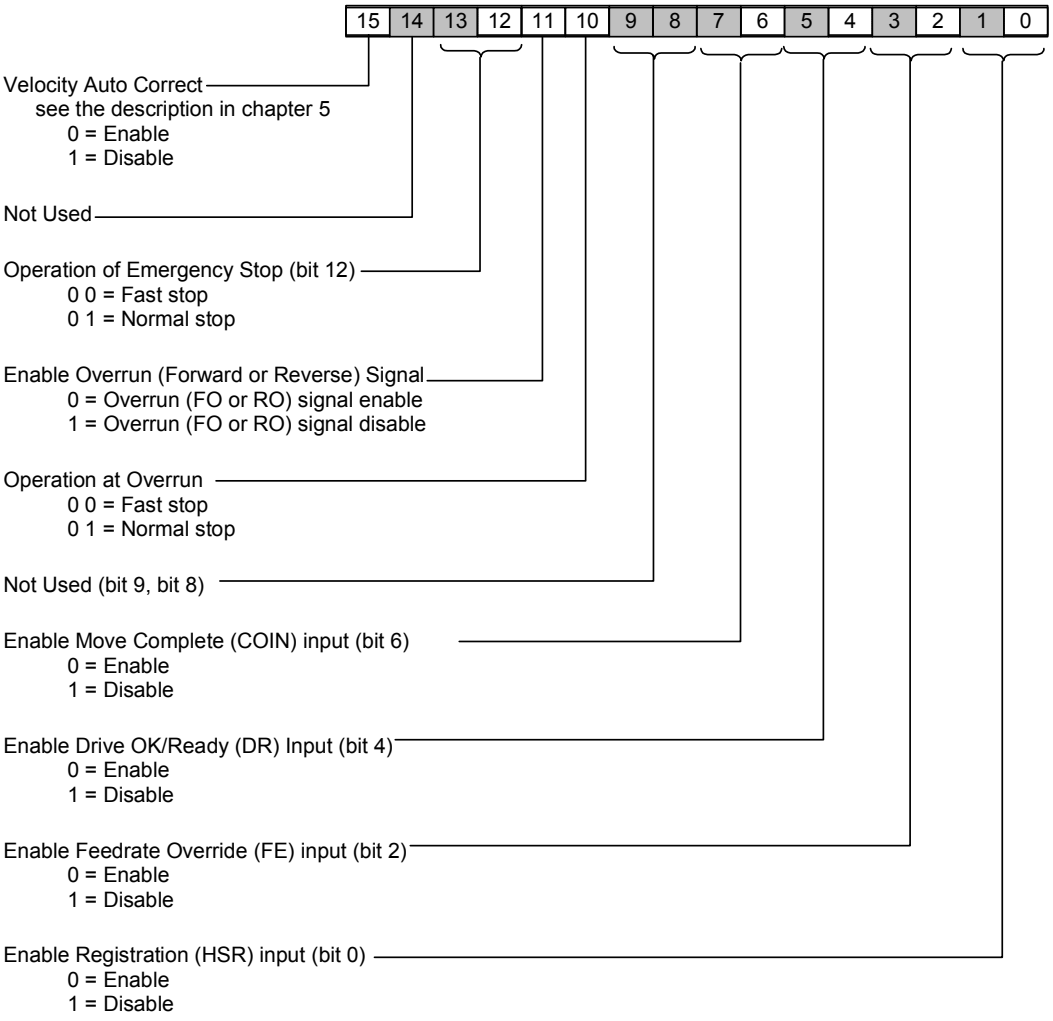
Holding Registers 101, 201: Set Common Parameters (Input Feedback)

The data in Holding Registers 101 and 201 sets up the input feedback parameters. This word defaults to 0.



Holding Registers 102, 202: Common Parameters for External Inputs

The data in Holding Registers 102 and 202 sets up the operation of most external inputs. External inputs that will not be used should be set to Disable.



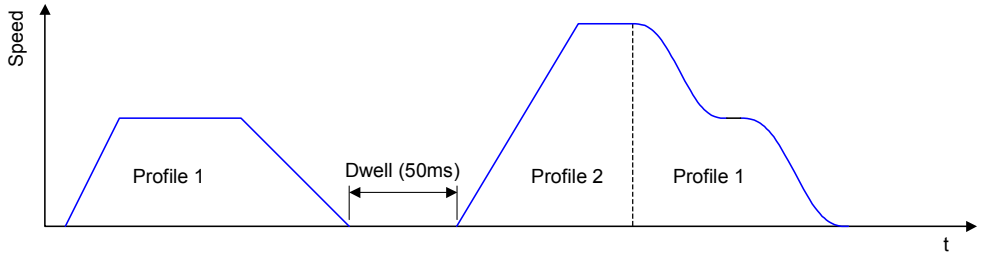
Holding Registers 500 - 2499: Write Sequence Table

The below table shows the registers assigned for the Registration and Designation sequence table data.

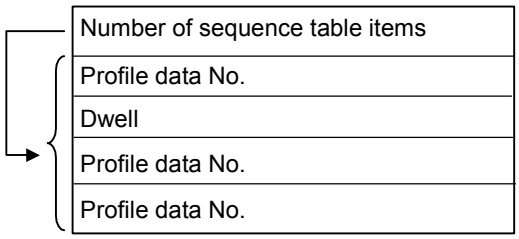
	Registration (Stored) Sequence Table	***Designation (Supplied) Sequence Table***
Axis A Registers	500 to 999	1000 to 1499
Axis B Registers	1500 to 1999	2000 to 2499

The first register will contain the number of sequences. For example if there are 10 sequences, registers 501 to 510 will contain the registration sequence data of Axis A and the registers 511 to 999 will contain zero. The value in the register 500 will be 10, which is the number of sequences.

A Sequence Table consists of up to 499 items of Profile data (including the operational information), and Dwells. An example Sequence Table is shown below.



The example Sequence Table defines a Profile, a Dwell, then two additional profiles. The first item in the table specifies the number of items that follow.

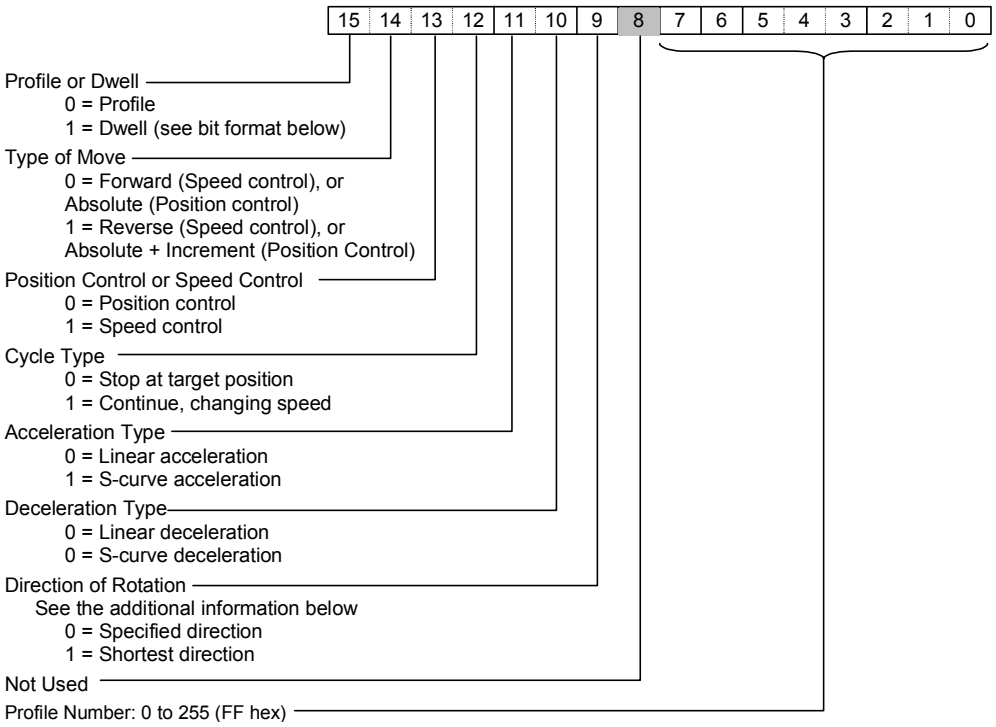


In the Sequence Table, each profile or dwell is represented as a number, which is the hexadecimal value equivalent to the bits in the profile or dwell. The format of the bits in the profile or dwell is shown on the next page.

bits	***15***	***14***	***13***	***12***	***11***	***10***	***9***	***8***	***7 -- 0***	***Value (hex)***
Number of items									4 (04 hex)	0004
Profile data 1	0	0	0	0	0	0	0	0	1 (01 hex)	0001
Dwell (50ms)	1								50 (32 hex)	8032
Profile data 2	0	0	0	1	0	1	0	0	2 (02 hex)	1402
Profile data 1	0	1	0	0	0	1	0	0	1 (01 hex)	4401

Format of a Profile in the Sequence Table

Each profile in the sequence table has the following parameters.



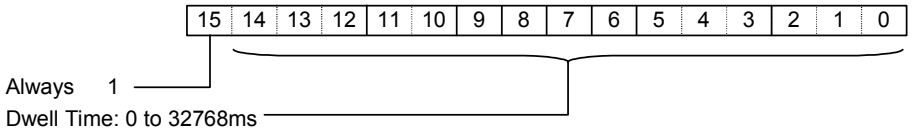
Type of Move (bit 14): For Position control, this bit selects Absolute or Absolute + Incremental positioning. For Speed control, this bit selects Forward or Reverse.

Cycle Type (bit 12): For Position control, the move can Continue to the next profile or Stop. When Continue is selected, the next profile in the sequence will use the same Control, Acceleration, and Deceleration as the current profile.

Direction of Rotation (bit 9): The setting for Direction of Rotation is effective only when the axis performs the position control by an absolute value on the rotary motion.

Format of a Dwell in the Sequence Table

For a profile, bit 15 must be 1.The data for a Dwell consists of the length of time for the dwell to continue.



Chapter 10 Error Codes

This section describes the error codes that may be reported by the MicroMotion Module.

- Types of Errors
  - Axis Errors
  - System Errors
- Error Codes for Axis Errors
- Error Codes for System Errors

Types of Errors

The MicroMotion detects errors on each axis, module errors, and communications errors. The MicroMotion Module indicates error codes in its Input Status Data, as described in chapter 8.

Axis Errors

An axis error is an error for an individual axis. Axis errors include incorrect parameters, or exceeding the specified distance or speed during operation.

Axis Error Levels

There are two axis error levels: warning and abnormal.

- If a warning axis error occurs, the operation is able to continue. If the error is an incorrect setting, the incorrect setting is ignored. The ST1 LED remains on.
- If an abnormal axis error occurs, the axis stops and the ST1 LED turns off. The ST1 LED lights again when the error condition has been corrected and the error has been cleared. (It is possible to return to the reverse direction if an overrun has occurred.) If the error is an incorrect setting, the incorrect setting is ignored.The module continues to use the current value.

System Errors

System errors include errors in the operation of the MicroMotion Module and communications errors. When a system error occurs, the ST1 LED is turned off according to the error level. (ST1 LED lights up when canceling the error factors and executing the operation for clearing the error.) But, when the failure level error occurs, STATUS LED is turned off.

System Error Levels

There are three system error levels: warning, abnormal, and failure.

- If a System warning occurs, the operation is able to continue. If the warning is because of an incorrect setting, the incorrect setting is ignored. The ST1 LED remains on.
- Abnormal errors occur when reading parameters from backup memory or from the Memory Option Module. The system will not operate until the parameter is set again. The ST1 LED is turned off
- Failure is the most serious error. Operation stops and the MicroMotion Module's Status LED is turned off.

Error Codes for Axis Errors

The following table lists the error codes for axis errors in numerical order.

Error (hex)	*When Detected*	*Description of Axis Error*	*Error Type*
10	Always	During operation, the Emergency Stop (ES) input turned off and the operation stopped. ES turned off during stop.	Abnormal
11		During operation/stop, FO input turned off and the operation stopped.	Abnormal
12		During operation/stop, RO input turned off and the operation stopped.	Abnormal
13	At operation start	Cannot start the operation because COIN input did not turn on.	Abnormal
14		Cannot start the operation because DR input did not turn on.	Abnormal
15	During operation	Operation stopped because DR input turned off during operation.	Abnormal
16		Operation stopped due to exceeding Upper Position Limit common parameter (+2,147,483,647 for Integer data type and 2,147,483,583 for Floating Point data type).	Abnormal
17		Operation stopped due to exceeding Lower Position Limit common parameter (–2,147,483,648 for Integer data type and 2,147,483,583 for Floating Point data type).	Abnormal
18	Always	Detected error in Common Parameter data during operation.	Abnormal
19		Detected error in Sequence Table data during operation.	Abnormal
1A		Detected error in Profile data during operation.	Abnormal
1F	At powerup	The power supply is turned off while the operation is stopped due to Emergency Stop input. * This error is saved in backup memory.	
20	Common parameter setup	Scales of initial velocity, upper limit velocity, acceleration, and deceleration are not correct.	Abnormal
21	Auto mode	Scales of initial velocity, upper limit velocity, acceleration, and deceleration are not correct. (Detected only when Velocity Auto Correct is disabled.)	Abnormal
28	Homing	FE input turned on or FE command was received during homing.	Warning
29		HSR input turned on or HSR command was received during homing.	Warning
30	Manual mode	During manual operation, the operation stopped because the Upper Position Limit was exceeded.	Abnormal
31		During manual operation, the operation stopped because the Lower Position Limit was exceeded.	Abnormal
38		Exceeded the Velocity Limit when changing speed in Auto Mode.	Warning
39		During operation on the external input instruction mode, the manual operation command is received.	Warning
3A		During operation on the external input instruction mode, invalid command was received.	Warning

Error (hex)	When Detected	Description of Axis Error	Error Type
40	Auto mode	During auto operation, if the next sequence block is performed, the operation stopped due exceeding the Upper Position Limit.	Abnormal
41		During auto operation, if the next sequence block is performed, the operation stopped due to exceeding the Lower Position LImit.	Abnormal
42		The command for the operation start is received before homing.	Abnormal
43		There is no specified profile data.	Abnormal
50	Reserved		
51			
48	In auto operation	Speed specified by speed change command exceeded the Maximum Velocity.	Warning
58	Reserved		
60	In command execution	The command that cannot be executed is received during operation. The control system command is received when the common parameter is not set properly.	Warning
61		The command is changed during handshake.	Warning
62		Command cannot be executed due to incorrect parameter or other reason.	Warning
63	Changing current position	Position Change command specifies position that exceeds the Upper Position Limit or Lower Position Limit.	Warning
6F	Undefined command execution	Undefined command executed.	Warning
80	Setting Common Parameters	Common parameter setup error (1) *Parameter Type other than floating point and integer is specified.*	Warning
81		Common parameter setup error (2) *The number of Pulses Per Motor Rotation that was specified (or calculated for other types of User Units) is out of range.*	Warning
82		Common parameter setup error (3) *Value of Pulses per Motor Rotation is less than 10 for Output Pulse*	Warning
83		Common parameter setup error (4) *The User Units Per Motor Rotation is out of the valid range.*	Warning
84		Common parameter setup error (5) *The User Units Per Motor Rotation specified as 0.*	Warning
85		Common parameter setup error (6) *The Velocity Limit is out of range.*	Warning
86		Common parameter setup error (7) *The Velocity Limit is specified to 0.*	Warning
87		Common parameter setup error (8) *Auto Mode Initial Velocity is specified as 0.*	Warning
88		Common parameter setup error (9) *Auto Mode Initial Velocity is higher than the Velocity Limit.*	Warning

Error (hex)	When Detected	Description of Axis Error	Error Type
89	Setting Common Parameters	Common parameter setup error (10) *Final Home Velocity is specified as 0.*	Warning
8A		Common parameter setup error (11) *Final Home Velocity is greater than the Velocity Limit*	Warning
8B		Common parameter setup error (12) *Values of Final Home Velocity and Find Home Velocity are inconsistent.*	Warning
8C		Common parameter setup error (13) *Find Home Velocity is specified as 0.*	Warning
8D		Common parameter setup error (14) *Find Home Velocity is out of range.*	Warning
8E		Common parameter setup error (15) *Acceleration Rate for homing is out of range.*	Warning
8F		Common parameter setup error (16) *Deceleration Rate for homing is out of range.*	Warning
90		Common parameter setup error (17) *Manual mode Maximum Velocity is specified as 0.*	Warning
91		Common parameter setup error (18) *Manual mode Maximum Velocity exceeds the Velocity Limit.*	Warning
92		Common parameter setup error (19) *Manual mode Initial Velocity is specified as 0.*	Warning
93		Common parameter setup error (20) *Manual mode Initial Velocity exceeds the Manual mode Maximum Velocity.*	Warning
94		Common parameter setup error (21) *Manual mode Initial Velocity and Maximum Velocity are inconsistent.*	Warning
95		Common parameter setup error (22) *Manual mode Acceleration Rate is out of range.*	Warning
96		Common parameter setup error (23) *Manual mode Deceleration Rate is out of a valid range.*	Warning
97		Common parameter setup error (24) *Inching Distance for Manual mode is out of range.*	Warning
98		Common parameter setup error (25) *Backlash Compensation is out of range.*	Warning
99		Common parameter setup error (26) *Feedrate Override Percentage exceeds 100%.*	Warning
9A		*Reserved.*	
9B		Common parameter setup error (28) *The Upper Position Limit data is out of range.*	Warning
9C		Common parameter setup error (29) *The Lower Position Limit data is out of range.*	Warning

Error (hex)	When Detected	Description of Axis Error	Error Type
9D	Setting Common Parameters	Common parameter setup error (30) *Upper Position Limit and Lower Position Limit values are inconsistent.*	Warning
9E		Common parameter setup error (31) *Home Position exceeds the Upper Position Limit.*	Warning
9F		Common parameter setup error (32) *Home Position exceeds the Lower Position Limit.*	Warning
A0		Common parameter setup error (33) *Home Position Offset is out of range.*	Warning
A1		Common parameter setup error (34) *Home Postion exceeds the Upper Position Limit by the Home Position Offset.*	Warning
A2		Common parameter setup error (35) *Home Position exceeds the Lower Position Limit by the Home Position Offset.*	Warning
A3		Common parameter setup error (36) *Registration Move Distance is out of range.*	Warning
A4		Common parameter setup error (37) *For input feedback, a Parameter Type other than floating point or integer is specified.*	Warning
A5		Common parameter setup error (38) *For input feedback, the Pulses Per Motion Rotation is out of range.*	Warning
A6		Common parameter setup error (39) *For input feedback, the Pulses Per Motion Rotation is less than 10.*	Warning
A7		Common parameter setup error (40) *For input feedback, the User Units per Motion Rotation is out of range.*	Warning
A8		Common parameter setup error (41) *For input feedback, the User Units per Motion Rotation is specified as 0.*	Warning
A9		Common parameter setup error (42) *For input feedback the Upper Position Limit is out of range.*	Warning
AA		Common parameter setup error (43) *Character code of the Free-form User Units is not ASCII.*	Warning

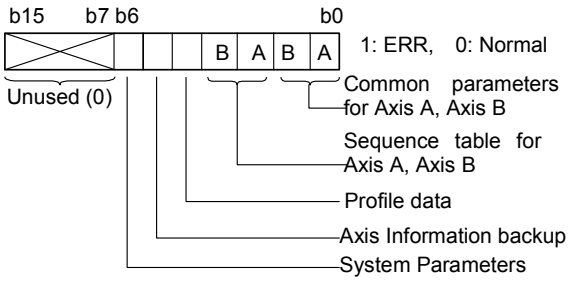
Error (hex)	When Detected	Description of Axis Error	Error Type
B0	Setting the Sequence Table	Sequence table setup error (1) *The number of profiles + dwells in the Sequence Table exceeds 499.*	Warning
B1		Sequence table setup error (2) *There is no profile data.*	Warning
B2		Sequence table setup error (3) *Profile with Control set to Position and Type set to Continue was followed immediately by profile with Control set to Speed.*	Warning
B3		Sequence table setup error (4) *Profile with Type set to Continue was followed immediately by a Dwell.*	Warning
B4		Sequence table setup error (5) *Profile with Control set to Speed, Direction set to either forward or reverse and Type set to Continuous was followed immediately by profile with Control set to Speed and Direction set to the opposite.*	Warning
B5		Sequence table setup error (6) *Last profile in the Sequence Table has its Type set to Continue.*	Warning
B6		Sequence table setup error (7) *Profile data is not compatible with change to the Common Parameters.*	Warning
B7		Sequence table setup error (8) *Data in the Sequence Table is not compatible with change to the Common Parameters.*	Warning
B8		Sequence table setup error (9) *101 or more profiles in the Sequence Table are set to continue.*	Warning
C0*	Setting the Profile Data	Profile data setup error (1) *Acceleration Rate for the profile is out of range.*	Warning
C1*		Profile data setup error (2) *Deceleration Rate for the profile is out of range.*	Warning
C2*		Profile data setup error (3) *Velocity specified for the profile exceeds the Common Parameter for Velocity Limit.*	Warning
C3*		Profile data setup error (4) *Velocity specified for the profile is below the Common Parameter for Initial Velocity.*	Warning
C4*		Profile data setup error (5) *Target Position for the profile exceeds the Common Parameter for Upper Position Limit.*	Warning
C5*		Profile data setup error (6) *Target Position for the profile is below the Common Parameter for Lower Position Limit.*	Warning
C6		Profile data setup error (7) *Incorrect profile number specified (not 0 – 255).*	Warning

* Only the profile data registered in the sequence table is checked. These Error codes will be generated while setting the sequence table.

Error Codes for System Errors

The following table lists the error codes for system errors in numerical order.

Error (hex)	When Detected	Description	Status LED	Operation	Error Level
E101	Powerup	Data of system RROM is not correct.	Off	Stop	Failure
E102		System RAM cannot read and write correctly.	Off	Stop	Failure
E103	Always	Address error interrupt and undefined command interrupt occurred in the module.	Off	Stop	Failure
E104		During operation, system ROM data error is detected.	Off	Stop	Failure
E105	Powerup	Dedicated processor does not start.	Off	Stop	Failure
E201	Always	▪ VersaMax Micro PLC stopped while MicroMotion Module was operating on an instruction from the Micro PLC. ▪ Micro PLC power supply is off. ▪ The expansion cable is not connected. When the MicroMotion Module is controlled by the VersaMax Micro PLC, the Status LED on the MicroMotion Module module is turned off if the Micro PLC is not operating or present. Monitoring starts after an instruction is received by the MicroMotion Module. If no instruction is received after the power is turned on, the status LED is turned off but no error code is reported.	Off	Stop	Abnormal
E202		The MicroMotion Module is connected to a VersaMax Micro PLC but its DIP switch is set for standalone. The Status LED is turned off.	Off	Stop	Abnormal

Error (hex)	When Detected	Description	Status LED	Operation	Error Level
E301	Powerup	Failed in reading axis parameters (common parameters, profile data, sequence table). Subcode contains additional information:  For error codes that do not have subcodes, the subcode data is 0000.	Off	Stop	Abnormal
E302		Failed in reading a system communication parameter. Subcode (see above) contains additional information.	Off	Stop	Abnormal
E303		Axis parameters (common parameters, profile data, sequence table) read from a Memory Option Module not correct. Subcode (see above) contains additional information.	Off	Stop	Abnormal
E304		A communication parameter read from a Memory Option Module is not correct.	Off	Stop	Abnormal
E401	Data Backup	Failed in backing up parameters. Subcode (see above) contains additional information.	On	Run	Warning
E402	Writing to Memory Module	Failed in writing parameters to Memory Option Module. Subcode (see above) contains additional information.	On	Run	Warning
E501	Command is received	Received a command from a VersaMax Micro PLC while set up for standalone operation.	On	Run	Warning
E502		If a previous command is writing a value into backup memory and another command is executed that does not write to backup memory (for example, a Jog command), this error may not occur. If both commands need to write to backup memory ,and the first command is not yet completed its writing process into backup memory,then only this error code will appear	On	Run	Warning
E503		Received another command while writing to Memory Option Module. If a command was received while writing to a Memory Option Module, this error may not occur.	On	Run	Warning
E504		Received an undefined command from a VersaMax Micro PLC.	On	Run	Warning

Error (hex)	When Detected	Description	Status LED	Operation	Error Level
E601	MODBUS Query received from host	Detected a parity error in query from a host.	On	Run	Warning
E602		Detected a framing error in query from a host.	On	Run	Warning
E603		Detected an overrun error in query from a host.	On	Run	Warning
E604		Detected a CRC error in query from a host.	On	Run	Warning
E801		Received an unsupported function. (Returned an exception response of wrong function.)	On	Run	Warning
E802		Received a query which accesses an address that does not exist. (Returned an exception response of wrong data address.)	On	Run	Warning
E803		Received data not acceptable. (Returned an exception response of wrong data.)	On	Run	Warning
E804		Received a query while the MicroMotion Module is out of order. (Returned an exception response of a slave device trouble.)	Off	Stop*	Warning
E806		Received another query while a process to the query is performed. (Returned an exception response of a slave device busy.)	On	Run	Warning

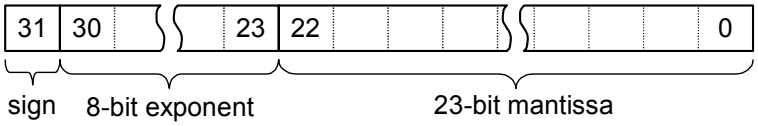
* If a query is transmitted when the MicroMotion Module has stopped operating due to an error, it returns a query response of slave device trouble.

Appendix A Floating Point Data

Floating point data in the MicroMotion module uses the single-precision floating-point (IEEE754) format.

Floating Point Data Format

Single-precision floating point is 32-bit data with the format shown below.



Bit 31 is the sign bit. 0 = Positive number, 1 = Negative number

Exponent	
Exponent part (E)	*Power-of two number (E')*
FF	Overflow value
FE	127
↓	↓
80	1
7F	0
7E	-1
↓	↓
01	-126
00	Handled as 0

Mantissa	
Mantissa part (M)	*Mantissa number (M')*
7FFFFF	$(1.11 - - - 11)_2$
7FFFFE	$(1.11 - - - 10)_2$
↓	↓
1	$(1.00 - - - 01)_2$
0	$(1.00 - - - 00)_2$

Floating point (F) data can be represented as the following mathematical expression, with: Sign (S), Exponent (E), and Mantissa (M).

$$(F) = (-1)S \times (1 + M \times 2\text{-}23) \times 2E\text{-}7FH = (-1)S \times M' \times 2E'$$

The range of values that can be represented in 32-bit floating point format is:

Hexadecimal		***Floating Point***	***Remarks***
Upper word	***Lower word***		
7F7F	FFFF	$+3.402823\ldots\times10^{38}$	Maximum value
0080	0000	$+1.175494\ldots\times10^{-38}$	Absolute value is the minimum positive number
↓		↓	Handled as 0
8080	0000	$-1.175494\ldots\times10^{-38}$	Absolute value is the minimum negative number
FF7F	FFFF	$-3.402823\ldots\times10^{38}$	Minimum value

Using Floating Point Data

The limited number of significant digits in 32-bit floating point format may result in differences between the result of a calculation and the true value. When the Parameter Type for an axis is set up as Floating Point, all of parameters for that axis (for example, position and velocity data) will be floating point format.

The following types of errors may occur when using floating point data:

Rounding off error	Because the operation result is represented in the number of significant digits, error occurs by deleting the lower digits with rounding down / rounding up/ rounding. *Example:* If decimal number 0.1 is converted to binary, it will be a repeating decimal. It is an approximation to 0.1 within the limited number of significant digits, but it is not the same as 0.1.
Large Underflow	When adding or subtracting numbers with a very large and a small value, the small value is not reflected to the calculation result. *Example:* When adding 1234 and 0.0056, the expected calculation result is 1234.0056. But the mantissa of the number is rounded down because the calculation is based on the number with large exponent bits.
Small Underflow	When subtracting two close numbers, the number of significant digits decreases, resulting in calculation error. *Example:* When subtracting 1.23789 from 1.23456, the number of significant digits before calculation is 6. But the number of significant digits of the calculation result is 3 because the calculation results is –0.00333.

Floating Point Accuracy of the MicroMotion Module

The MicroMotion Module converts floating point data to integer data. The module also converts position and velocity data into pulses. These and other data conversions and calculations can result in slight inaccuracies. For example if the Maximum Velocity for an axis is set to 100,000 pulses/second, the actual pulse is output at 100,000pps, but the current velocity indication reported back is 99,999pps.

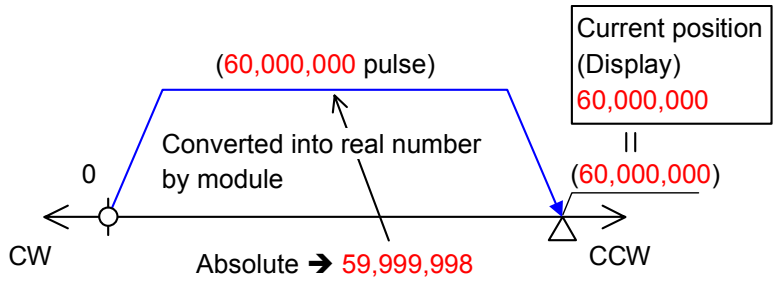
Position Errors in Auto Mode

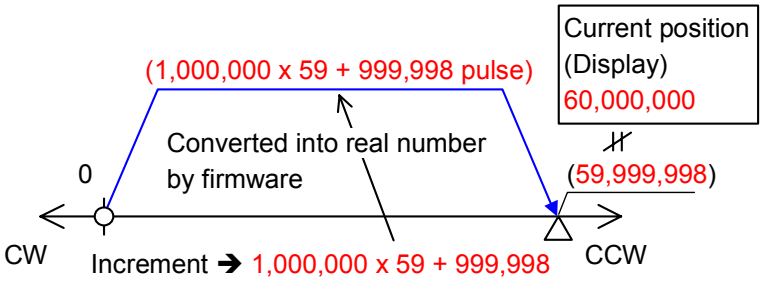
When using floating point format, if a long move distance is set for a profile in Auto mode and the absolute measurement is set up for the profile in the Sequence Table, the set position and the stop position may become mis-aligned.

Real Number	*Floating Point (hex)*	*Real Number (0.1 unit)*	*Floating Point (hex)*	*Real Number (0.00001 Unit)*	*Floating Point (hex)*
2147483647	4F000000	214748364.7	4D4CCCCD	21474.83647	46A7C5AC
…		…		…	
2147483584		214748360.1		21474.83497	
…	…	…	…	…	…
16999991	4B81B31B	1099999.3	498646FA	139.99993	430BFFFB
16999990		1099999.2		139.99992	
16999989	4B81B31A	1099999.1	498646F9	139.99991	430BFFFA
…	…	…	…	…	…
2	40000000	0.2	3E4CCCCD	0.00002	37A7C5AC
1	3F800000	0.1	3DCCCCCD	0.00001	3727C5AC
0	00000000	0	00000000	0	00000000
-1	BF800000	-0.1	BDCCCCCD	-0.00001	B727C5AC
-2	C0000000	-0.2	BE4CCCCD	-0.00002	B7A7C5AC
…		…	…	…	…
-16999990	CB81B31B	-1099999.1	C98646F9	-139.99991	C30BFFFA
-16999991	CB81B31C	-1099999.2	C98646FA	-139.99992	C30BFFFB
-16999992		-1099999.3		-139.99993	
…	…	…	…	…	…
-2147483584	CF000000	-214748360.1	CD4CCCCC	-21474.83497	C6A7C5AC
…		…		…	
-2147483648		-214748364.8		-21474.83648	

In Auto mode, there may be a difference in final position reached when the same target position is specified with absolute and increment positioning.

The examples below show the difference in operation resulting from floating point conversion with the target position set as absolute or incremental.





Floating point (Moved distance)				Real number (Output pulse)				Floating point (Position after moves)
59,999,998	=	H4C64E1C0	➔	60,000,000	➔	H4C64E1C0	=	60,000,000
59,999,999	=	H4C64E1C0	➔	60,000,000	➔	H4C64E1C0	=	60,000,000
60,000,000	=	H4C64E1C0	➔	60,000,000	➔	H4C64E1C0	=	60,000,000
60,000,001	=	H4C64E1C0	➔	60,000,000	➔	H4C64E1C0	=	60,000,000
60,000,002	=	H4C64E1C0	➔	60,000,000	➔	H4C64E1C0	=	60,000,000

The equivalent HEX value for different floating point numbers is same.

Absolute Move

Target position is 59,999,998 pulses (absolute). If this is represented in floating point format, it becomes 16#4C64E1C0. The MicroMotion Module converts this value to a real number, and outputs the pulses.

> Floating point : 59,999,998 (16#4C64E1C0) ➔(Convert into real number)➔
> Real number : 60,000,000 (Number of output pulses)

The module calculates the current position from the output number of pulses. This value is converted to floating point.

> Output pulse (Real number) 60,000,000➔(Convert into floating point)➔
> Current position (Display) 60,000,000

In this example, the number of output pulses increases by 2 pulses above the specified number.

> 59,999,998 (Number of specified output pulses) ≠ 60,000,000 (Number of actual output pulses & Current position display)

Incremental Move (Increments of 1,000,000)

> Floating point : 1,000,000 (H49742400) ➔(Convert into real number)➔
> Real number : 1,000,000 (Number of output pulses)

The module repeats this 59 times and outputs 999,998 pulses.

> Floating point : 999,998 (16#497423E0) ➔(Convert into real number)➔
> Real number : 999,998 (Number of output pulses)

The module calculates current position from the output number of pulses. This value is converted to floating point.

> Output pulse (Real number) 59,999,998➔(Convert into floating point)➔
> Current position (Display) 60,000,000

In this case, the current position is 2 pulses above the user specification and actual output pulses.

> 59.999.998 (Number of specified output pulses & Number of actual output pulses) ≠ 60,000,000 (Current position display)

Appendix B Common Parameters

The MicroMotion Module has 29 Common Parameters (58 words). Initially, each parameter is set to its default, as shown in the Setup Tool Common Parameters window (see chapter 5). The table below lists both parameters for the output pulse and [parameters for input feedback].

Parameter No.	Transmission word	MSB ← 15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0 → LSB
1	1	Pulse output, Acceleration and deceleration mode, Operating mode, Positioning specifying															
2	2	Pulse input, Inching operation															
3	3	External input/Pulse output Operational setting															
4	4	Number of pulses per rotation of motor (Lower) [Number of pulses]															
	5	Number of pulses per rotation of motor (Upper)															
5	6	Work travel of rotation of motor (lower) [µm, inch, degree, Free form / rotation]															
	7	Work travel of rotation of motor (Upper)															
6	8	Upper limit speed data (lower) [Auto/Manual control] [Pulse/s, µm/s, inch/s, degree/s, Free form/s]															
	9	Upper limit speed data (Upper)															
7	10	Initial velocity (Lower) [Auto operation] [Pulse/s, µm/s, inch/s, degree/s, Free form/s]															
	11	Initial velocity (Upper) [Auto operation]															
8	12	High-speed homing velocity (Lower) [Pulse/s, µm/s, inch/s, degree/s, Free form/s]															
	13	High-speed homing velocity (Upper)															
9	14	Low-speed homing velocity (lower)[Pulse/s, µm/s, inch/s, degree/s, Free form/s^2]															
	15	Low-speed homing velocity (Upper)															
10	16	Homing acceleration rate (Lower) [Pulse/s^2, µm/s^2, inch/s^2, degree/s^2, Free form/s^2]															
	17	Homing acceleration rate (Upper)															
11	18	Homing deceleration rate (Lower) [Pulse/s^2, µm/s^2, inch/s^2, degree/s^2, Free form/s^2]															
	19	Homing deceleration rate (Upper)															
12	20	Speed (Lower) [Manual operation] [Pulse/s, µm/s, inch/s, degree/s, Free form/s]															
	21	Speed (Upper) [Manual operation]															
13	22	Initial velocity (Lower) [Manual operation] [Pulse/s, µm/s, inch/s, degree/s, Free form/s]															
	23	Initial velocity (Upper) [Manual operation]															
14	24	Acceleration rate (Lower) [Manual operation] [Pulse/s^2, µm/s^2, inch/s^2, degree/s^2, Free form/s^2]															
	25	Acceleration rate (Upper) [Manual operation]															
15	26	Deceleration rate (Lower) [Manual operation] [Pulse/s^2, µm/s^2, inch/s^2, degree/s^2, Free form/s^2]															
	27	Deceleration rate (Upper) [Manual operation]															
16	28	Moving distance data for inching operation (Lower) [Number of pulses, µm, inch, degree, Free form]															
	29	Moving distance data for inching operation (Upper)															

Parameter No.	Transmission word	MSB ← 15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0 → LSB
17	30	Backlash (Lower) [Number of pulses, µm, inch, degree, Free form]															
	31	Backlash (Upper)															
18	32	Feedrate override [%]															
19	33	Reserved															
	34	Reserved															
20	35	Upper limit position data (Lower) [Number of pulses, µm, inch, degree Free form]															
	36	Upper limit position data (Upper)															
21	37	Lower limit position data (Lower) [Number o pulses, µm, inch, degree, Free form]															
	38	Lower limit position data (Upper)															
22	39	Home position data (Lower) [Number of pulses, µm, inch, degree, Free form]															
	40	Home position data (Upper)															
23	41	Homing off-set data (Lower) [Number of pulses, µm, inch, degree, Free form]															
	42	Homing off-set data (Upper)															
24	43	Extension moving distance data (Lower) [Number of pulses, µm, inch, degree, Free form]															
	44	Extension moving distance data (Upper)															
25	45	Number of pulses per rotation of motor [Input pulse] (Lower) [Number of pulses]															
	46	Number of pulses per rotation of motor [Input pulse] (Upper)															
26	47	Work travel per rotation of motor [Input pulse] (Lower) [µm, inch, degree, Free form / rotation]															
	48	Work travel per rotation of motor [Input pulse] (Upper)															
27	49	Upper limit position data [Input pulse] (Lower) [Number of pulses, µm, inch, degree, Free form/s^2]															
	50	Upper limit position data [Input pulse] (Upper)															
28	51	Registration unit (1^{st} character / 2^{nd} character) [ASCII code]															
	52	Registration unit (3^{rd} character / 4^{th} character) [ASCII code]															
	53	Registration unit (5^{th} character / 6^{th} character) [ASCII code]															
	54	Registration unit (7^{th} character / 8^{th} character) [ASCII code]															
29	55	Registration unit [Input pulse] (1^{st} character / 2^{nd} character) [ASCII code]															
	56	Registration unit [Input pulse] (3^{rd} character / 4^{th} character) [ASCII code]															
	57	Registration unit [Input pulse] (5^{th} character / 6^{th} character) [ASCII code]															
	58	Registration unit [Input pulse] (7^{th} character / 8^{th} character) [ASCII code]															

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