SIEMENS

SIMATIC 505

TurboPlastic Module

User/Programmer Manual

Order Number: PPX:505–8117–3
Text Assembly Number: 2586546–0041
Third Edition

⚠ DANGER

DANGER indicates an imminently hazardous situation that, if not avoided, will result in death or serious injury.

DANGER is limited to the most extreme situations.

⚠ WARNING

WARNING indicates a potentially hazardous situation that, if not avoided, could result in death or serious injury, and/or property damage.

⚠ CAUTION

CAUTION indicates a potentially hazardous situation that, if not avoided, could result in minor or moderate injury, and/or damage to property.

CAUTION is also used for property-damage-only accidents.

MANUAL PUBLICATION HISTORY

SIMATIC 505 TurboPlastic Module User/Programmer Manual
Order Manual Number: PPX:505–8117–3

Refer to this history in all correspondence and/or discussion about this manual.

Event	Date	Description
Original Issue	05/91	Original Issue (2592530–0001)
Second Edition	07/93	Second Edition (2592530–0002)
Third Edition	07/98	Third Edition (2592530–0003)

LIST OF EFFECTIVE PAGES

Pages	Description	Pages	Description
Cover/Copyright	Third		
History/Effective Pages	Third		
iii — ix	Third		
1-1 — 1-12	Third		
2-1 — 2-33	Third		
3-1 — 3-20	Third		
4-1 — 4-7	Third		
5-1 — 5-24	Third		
A-1 — A-14	Third		
B-1 — B-5	Third		
C-1 — C-16	Third		
Index-1 — Index-5	Third		
Registration	Third		

Contents

Chapter 1 Overview

Chapter 2 Software Interface

Chapter 3 Installation and Startup

Chapter 4 Discrete Outputs

Chapter 5 Selected Functions

List of Figures

List of Tables

Chapter 1

Overview

1.1 Introduction

The SIMATIC® 505™ TurboPlastic Controller is a Series 505™ I/O module that is designed to provide closed loop control for the following functions on an injection molding machine:

- Clamp closing
- Injection
- Pack and hold
- Plasticate
- Clamp opening

Each function in the module runs as a 10-step profile within the module. Data for each of the profiles is downloaded from a programmable logic controller (PLC) V-memory. Process data is sent back to the PLC for system analysis. Normal I/O is used to handshake between the PLC and the module.

For each function there are two simultaneous operating loops available for control, both of which are updated in less than 2 milliseconds. Each loop may be run either in closed loop mode or in an open loop mode.

When the overlapping cycle mode is selected, both plasticate and clamp open profiles can be operated simultaneously.

The module has its own set of high-speed I/O consisting of five analog inputs, four analog outputs, and four discrete outputs.

The TurboPlastic module functions in any base of the SIMATIC 545 and SIMATIC 555 PLCs. For other controllers, contact your Siemens Energy & Automation, Inc. distributor or sales office. If you need assistance in contacting your U.S. distributor or sales office, call 1–800–964–4114.

References

Refer to the manuals listed below for instructions on installing, programming, and troubleshooting your System 505 controller.

- *SIMATIC 545/555/575 System Manual* (505–8201–x)
- *SIMATIC 545/555/575 Programming Reference Manual* (505–8204–x)

Agency Standards

Series 505 products have been developed with consideration of the draft standard of the International Electrotechnical Commission Committee proposed standard (IEC–65A/WG6) for programmable controllers (released as IEC 1131–2, Programmable Controllers, Part 2: Equipment Requirements and Tests, First Edition, 1992–09). The 575 controller system is designed to be compatible with ANSI/IEEE Std. 1014–1987. Contact Siemens Energy & Automation, Inc., for information about regulatory agency approvals that have been obtained on Series 505 units.

Agency approvals are the following:

- UL-listed (industrial control equipment)
- CSA-certified (process control equipment) or CUL (Canadian UL)
- FM (Class I, Div. 2, Group A, B, C, D Hazardous Locations)

European Community (CE) Approval

All Series 505 products carry the **CE Marking** (Low Voltage Directive 73/23/EEC and Electro-Magnetic Compatibility Directive 89/336/EEC). A declaration of conformity is included with each CPU.

Technical Assistance

For technical assistance, contact your Siemens Energy & Automation, Inc., distributor or sales office. If you need assistance in contacting your U.S. distributor or sales office, call 1–800–964–4114.

For additional technical assistance, call the Siemens Technical Services Group in Johnson City, Tennessee at 423–461–2552, or contact them by e-mail at **simatic.hotline@sea.siemens.com**. For technical assistance outside the United States, call 49-911-895-7000.

1.2 Who Should Read This Manual?

This manual is intended for use by technically-oriented persons who are completely familiar with the operation and programming of the SIMATIC 505 PLCs.

In addition, this manual is intended for use by experts in the field of injection molding who understand both the requirements and the correct application of the controls for injection molding, as well as the tuning of those controls. If problems are encountered that cannot be resolved by use of this manual, please contact your Siemens Energy & Automation, Inc. distributor or sales office. If you need assistance in contacting your U.S. distributor or sales office, call 1–800–964–4114.

⚠ **WARNING**

To minimize the risk of personal injury or property damage, the user is responsible for testing and otherwise assuring that operation of the TurboPlastic injection process control module is compatible with the target machine and that all the associated controls are properly programmed with adequate safety interlocks to protect both man and machine.

To the best of our knowledge, under the present state of semiconductor technology, solid-state programmable control devices can fail in an unsafe condition. This means that there is a possibility that certain types of malfunctions of these devices, unless proper safeguards are incorporated by the equipment manufacturer, could lead to sudden equipment startup. Such a startup could result in property damage and/or severe physical injury to the equipment operator.

If you or your company applies PLCs to equipment which requires an operator or attendant, you should be aware that this potential safety hazard exists and are advised to take appropriate precautions. Although the specific design steps depend on your particular application, the following precautions generally apply to installation of solid-state programmable control devices.

In addition, they conform to the guidelines for installation of PLCs as recommended in the NEMA ICS 3–304 Programmable Control Standards.

⚠ **CAUTION**

ICS 3–304.81 Safety Recommendations
Consideration should be given to the use of an emergency stop function which is independent of the PLC.

⚠ WARNING

Where the operator is exposed to the machinery, such as in loading or unloading a machine tool, or where the machine cycles automatically, consideration should be given to the use of an electromechanical override or other redundant means, independent of the PLC, for starting and interrupting the cycle.

If provision for changing programs while the equipment is in operation is required, consideration should be given to the use of locks or other means of assuring that such changes can be made only by authorized personnel.

These recommendations are intended as safeguards against the failure of critical components and the effects of such failure or the inadvertent errors that may be introduced if programs are changed while the equipment is in operation.*

Siemens recommends providing a means of disconnecting power from the output loads when the machine is not operating or when it is necessary for the operator to reach into the machine. Power must be removed by a non-semiconductor switch or hard-wired relay contact placed to interrupt power to the output load. It is not sufficient to rely solely on the PLC system for this function. (See Figure 1-1.)

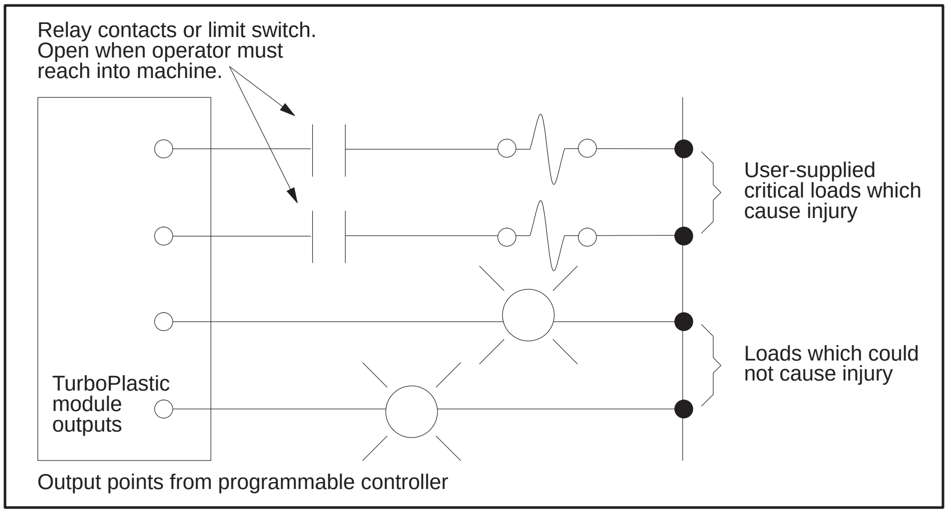


Figure 1-1 Operator Safety Switch Shutoff

---

*This section is reproduced by permission of the National Electrical Manufacturers Association from NEMA ICS 3–304, PLC Standard.

1.3 List of Terms

Closed Loop Mode	The mode in which the module reads a feedback signal value and uses that value to modify the output signal to achieve the desired result.
Boundary Conditions	Those conditions that must be present (such as maximum time reached or maximum position attained) at the time the module changes profiles or makes the transition to the next profile.
Cavity	The vacant area inside the mold that is filled with plastic to form or shape the part. Molds can contain multiple cavities to make more than one part per machine cycle.
Cure Timer	A time value used to delay the start of the clamp open profile until the molded part in the cavity has cooled and solidified sufficiently.
Direct Acting Clamp	A clamp that has a hydraulic cylinder connected directly to the clamp moving platen.
Hot Runner	A mold that has heated passages to avoid forming a sprue between shots.
Open Loop Mode	The mode in which the module performs open loop or fixed output manual control instead of reading a feedback signal and adjusting the output signal on that basis.
Overlapping Cycles	A mode of operation that allows the plasticate cycle to continue operating during clamp open and part removal cycles.
PID	PID, as used in this manual, refers to any closed loop control algorithm with the following three tuning parameters: proportional, integral, and derivative. Response of PID algorithms in the TurboPlastic module may be somewhat different from the usual or normal PID algorithm, due to the demanding performance requirements of many molding machines.
Runner	A passage in a mold that allows plastic to flow to the cavities.
Sprue	The unwanted plastic that solidifies in the runners along with the part being molded.
Toggle Clamp	A clamp having a mechanical stiff-leg operator system which the hydraulic cylinder moves to open and to close the clamp.

1.4 Module Functional Diagrams

The TurboPlastic module closed loop control is shown in Figure 1-2.

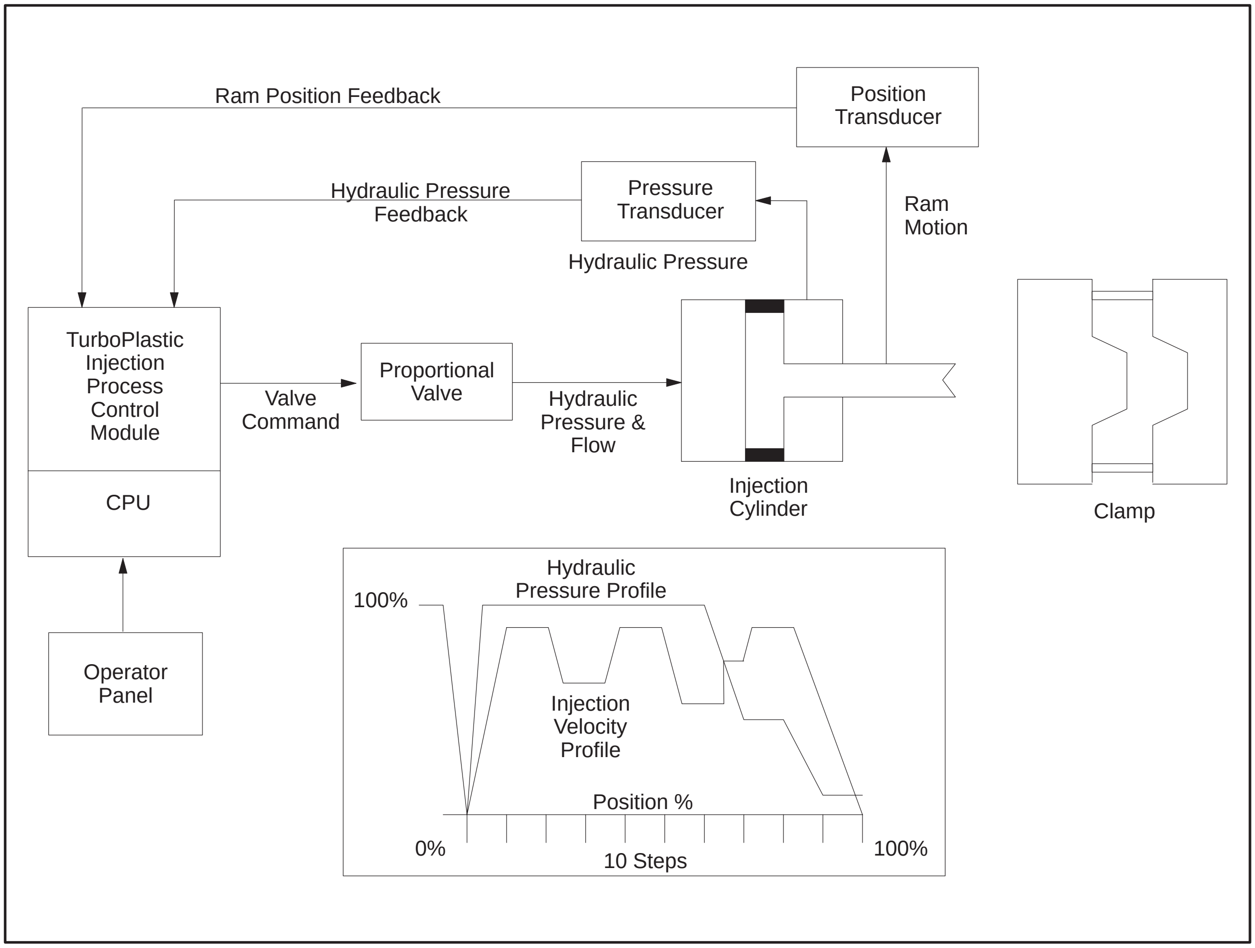


Figure 1-2 TurboPlastic Module Closed Loop Control

1.5 Machine Control Diagrams

The module inputs and outputs are shown in Figure 1-3.

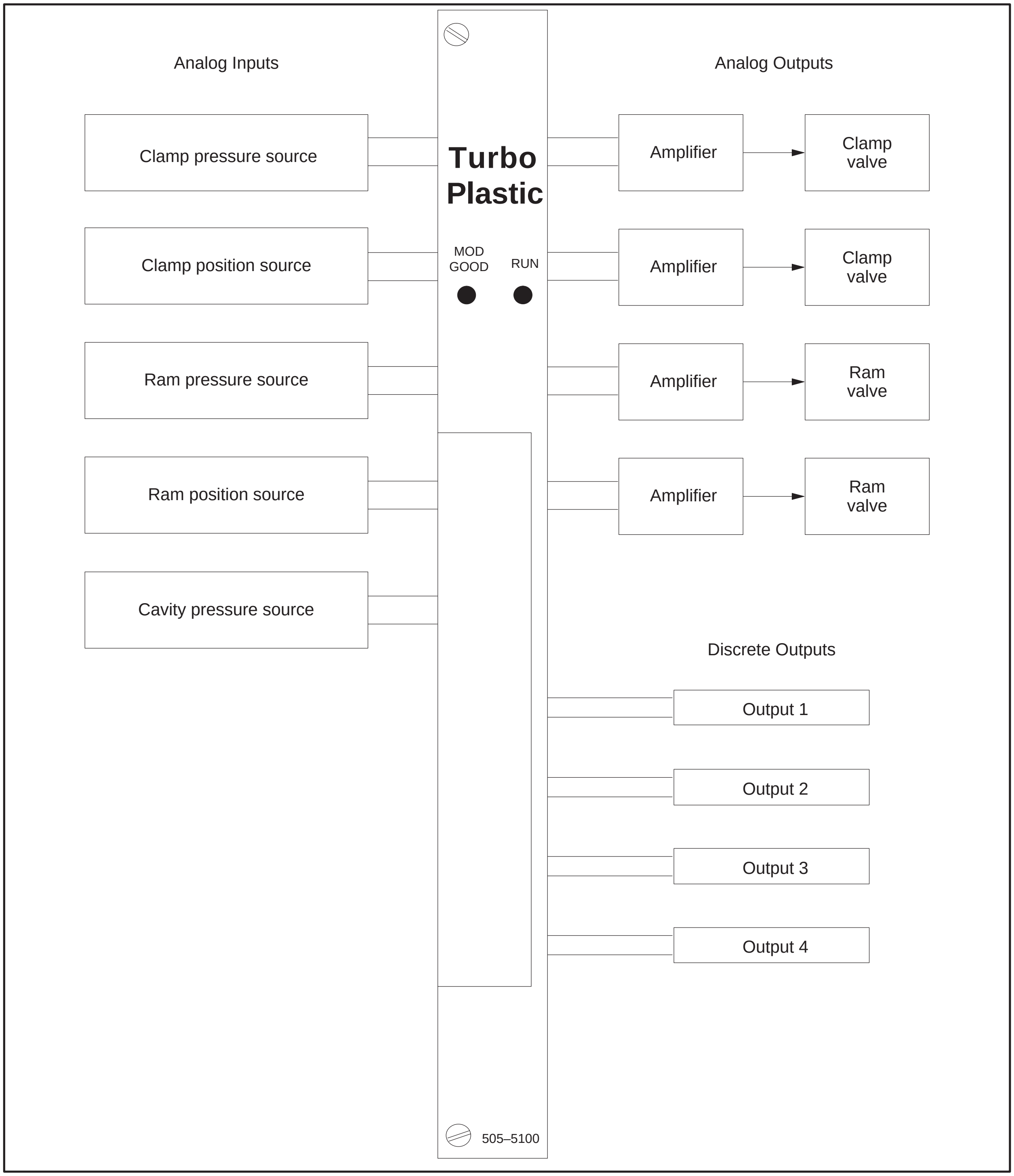


Figure 1-3 Module Inputs and Outputs

The plastic injection molding machine control points are shown in Figure 1-4.

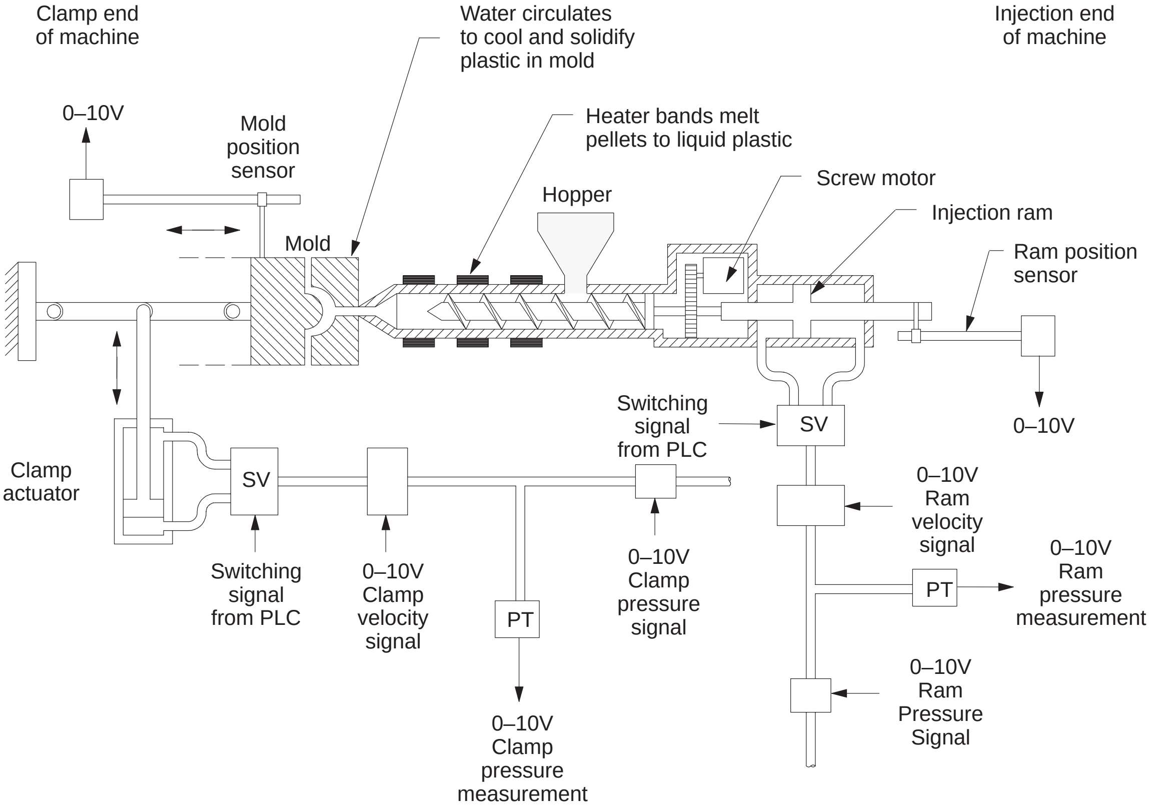


Figure 1-4 Plastic Injection Molding Machine Control Points

NOTE: This valve arrangement is only one of many that are supported by the TurboPlastic module. See the machine configuration section for others.

The TurboPlastic injection molding cycle is shown in Figure 1-5.

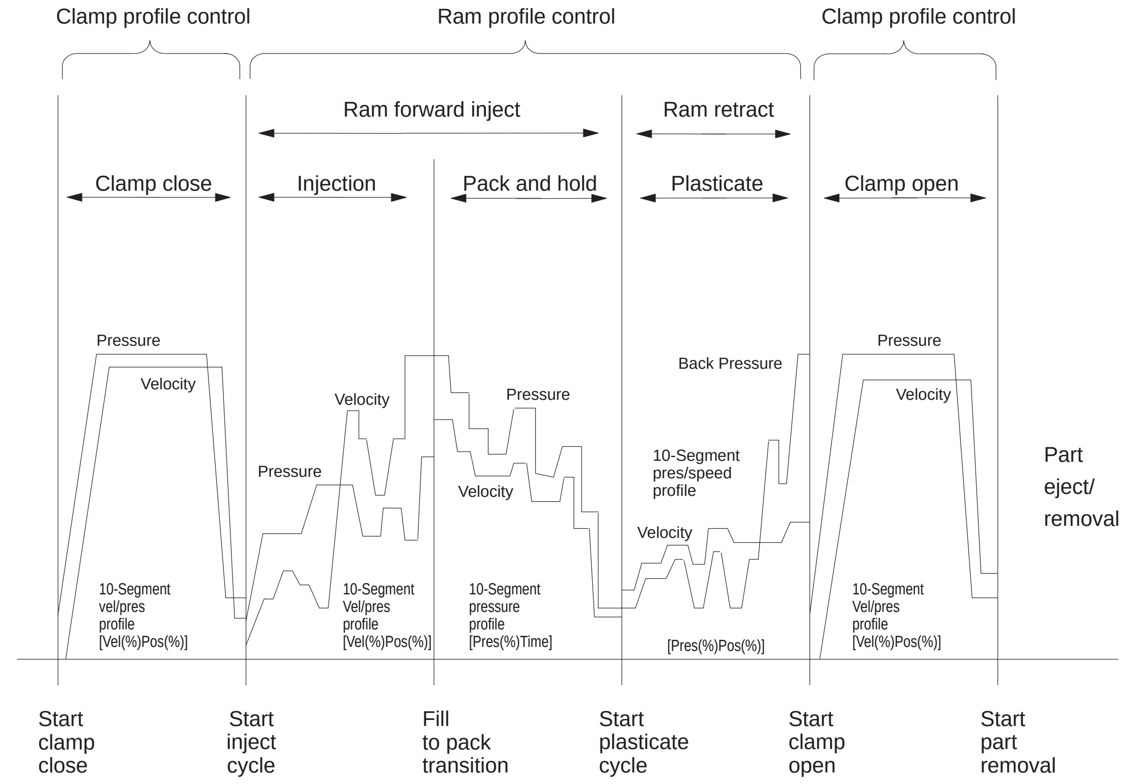


Figure 1-5 TurboPlastic Injection Molding Cycle

1.6 Analog Performance Specifications

Four high-speed analog outputs

- Clamp hydraulic flow
- Clamp hydraulic pressure
- Injection ram hydraulic flow
- Injection ram hydraulic pressure
- Voltage ranges: 0 to +10 V, or 0 to –10 V; 0 to +5 V, or 0 to –5 V
- 12-bit resolution, 0.25% accuracy
- 5 mA output current

Five high-speed analog inputs

- Clamp position
- Clamp hydraulic pressure
- Ram position
- Ram hydraulic pressure
- Cavity pressure
- Voltage range: 0 to +10 V; 0 to +5 V
- 12-bit resolution, 0.1% accuracy
- Differential inputs with ±25 VDC, ACpk common mode input range, 60 db 60 Hz rejection and 400 kΩ common-mode/800 kΩ differential input impedance typical

Outputs and inputs synchronized to loop processing

User programmable from less than 2 ms to 32.767 ms

Uses 400 V-memory locations for profile data to/from PLC making all data available to other modules, operator interfaces, and network devices

PLC control bits for:

- Cycle boundary (transitions)
- Profile error reporting

Block transfer via special function integrated circuit

Run/program and module good LED

Agency Approvals: U.L.®, CSA® listing

1.7 Environmental Specifications

Operating temperature
0°C to 60°C (32°F to 140°F)

Storage temperature
–40°C to 70°C (–40°F to 158°F)

Relative humidity
5% to 95% noncondensing

Vibration

- Sinusodial
  IEC 68–2–6, Test Fc;
  0.15 mm peak-to-peak, 10–57 Hz;
  1.0 g, 57–150 Hz

- Random
  NAVMAT P–9492 or IEC 68–2–34, Test
  Fdc with 0.04 G/Hz, 80–350 Hz and
  3db/octave rolloff 80–20 Hz and
  350–2 kHz, at 10 min/axis

Impact shock
IEC 68–2–27, Test Ea; Half Sine, 15 g, 11 ms

Electrostatic discharge
IEC 801, Part 2, Level 4 (15 kV)

Noise immunity (conducted)
IEC 801, Part 4, Level 3
MIL–STD–461B CS01, CS02, CS06 IEC
255–4, Appendix E EEC 4517/79 Com
(78) 766 Final, Part 4 IEEE 472,
2.5 kV

Noise immunity (radiated)
IEC 801, Part 3, Level 3
MIL–STD–461B RS01, RS02

Agency Approvals: U.L., CSA listing

Chapter 2

Software Interface

2.1 Module Functions

The TurboPlastic module is a table-driven controller that operates on an algorithm and requires no programming or setup. A choice of algorithms is provided, and many flexibilities are available in addition to the actual profile capability. These flexibilities can be accessed by storing appropriate values in a table. The module uses eight normal I/O words for handshaking, start-stop instructions, and status feedback. One of these words tells the module where in V-memory to look for its parameter table, and another tells it where in V-memory to place any results. Since the TurboPlastic module relies on the PLC for non-volatile storage of parametric data, a battery is not needed.

2.1.1 Operator Interface

An operator interface can be used to enter the various parameters into V-memory. If the process never changes, then these entries can be made with a programming package like SoftShop™ or TISOFT™; however, a third-party terminal allows operator adjustments as required. Data also may be downloaded from a TIWAY™ network or other intelligent module to the PLC for use by the module.

2.1.2 Module Operation

This module can be instructed to run an entire machine cycle without intervention from the PLC. The PLC needs only a start command to begin each new machine cycle. When it is necessary that the PLC perform an operation among any of the five functions, the module can be directed to run one or more functions, to notify the PLC of completion to that point, and to wait for further direction. Although a 10-step profile is provided for each of the five functions, a zero can be entered in any step to cause that function to terminate at that step. On power-up, any cycle instructions left over from a previous run are cleared.

When instructed to begin a set of functions, the module reads the data table and controls on that data until the cycle is complete. Only the Run/Stop function is monitored and acted upon by the module while running a cycle.

2.1.3 Status Feedback

Status feedback is constantly provided to the PLC by the module in the form of cycle status, indicating exactly which cycle and step is being performed.

- Actual input and output control values
- An indication whether or not the module is able to control within specified deviation limits
- Current deviation levels

2.1.4
Module Integrity Indicators

There are two LEDs on the front panel of the module:

- **MOD GOOD** indicates overall module integrity.
- **RUN** (Pgm/Run) indicates that the module is in run mode and the following conditions are met:

  – WY7 contains value 1121

  – No error status bits set in WX3.9

  – PLC output disable = not disable

2.2 Normal I/O Interface

The normal I/O interface is used for handshaking and status reporting between the PLC and the TurboPlastic module.

The TurboPlastic module is mapped as a four-word-in, four-word-out, special function I/O module with assignments as illustrated in Figure 2-1.

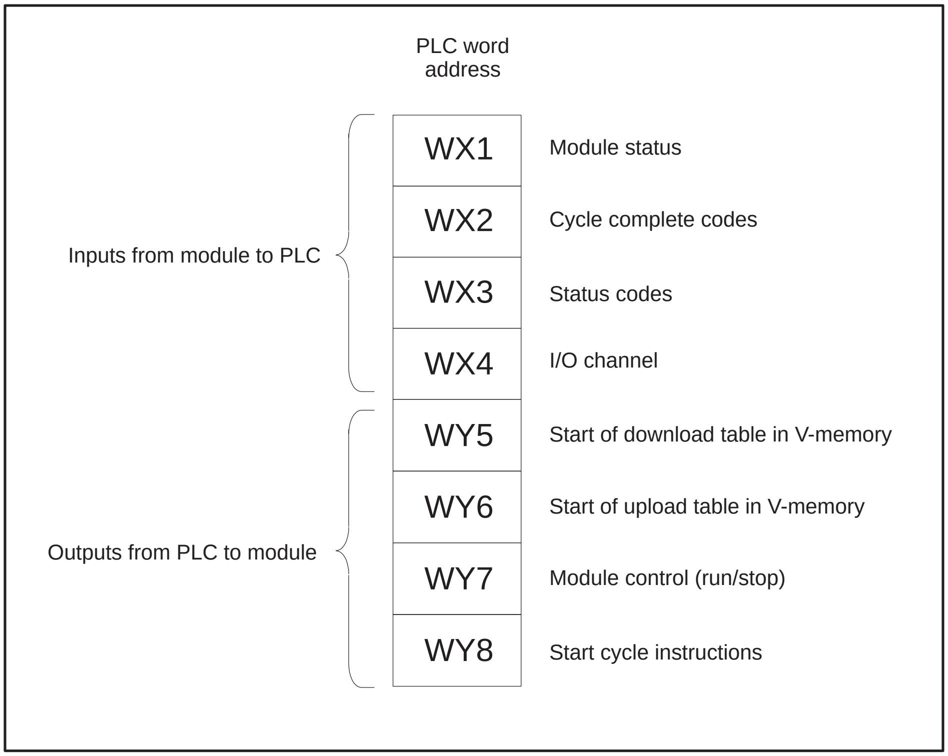


Figure 2-1 Module I/O Assignments

2.3 PLC Input Words: Module Data → PLC

2.3.1 WX1 = Module Cycle Status

The module-cycle-status word continuously reports both the profile and the step that the module is currently executing to the PLC. See Table 2-1. For example, WX1 = 305 means the module is currently executing Step 5 of Pack and Hold.

Table 2-1 WX1 = Module Cycle Status

Function Code (integer)	Function	
0	Module initialized or not in run mode	
101	Step 1	Clamp close profile
↓	↓	↓
110	Step 10	Clamp close profile
111	Clamp closure complete	
201	Step 1	Injection profile
↓	↓	↓
210	Step 10	Injection profile
211	Injection complete	
301	Step 1	Pack and hold profile
↓	↓	↓
310	Step 10	Pack and hold profile
311	Pack and hold complete	
401	Step 1	Plasticate profile
↓	↓	↓
410	Step 10	Plasticate profile
411	Plasticate complete	
501	Step 1	Clamp open profile
↓	↓	↓
510	Step 10	Clamp open profile
511	Clamp open complete	
*10101	Step 1	Plasticate and clamp open profiles (overlapping cycles on)
↓	↓	↓
*11010	Step 10	Plasticate and clamp open profiles (overlapping cycles on)

2.3.2 WX2 = Cycle Complete Codes

The cycle-complete-code word immediately reports the completion of each cycle to the PLC. See Table 2-2. For example, WX2 = binary value 0000 0000 0001 0000 means that the Clamp Open profile just completed.

Table 2-2 WX2 = Cycle Complete Codes

(16-Bit Word) Bit 1(MSB) Bit 16(LSB)	Cycle Complete Code
`[.... .... .... ...1]`	Clamp closure complete
`[.... .... .... ..1.]`	Injection complete
`[.... .... .... .1..]`	Pack and hold complete
`[.... .... .... 1...]`	Plasticate cycle complete
`[.... .... ...1 ....]`	Clamp opening complete
`[.... .... ..1. ....]`	Overlapping cycle complete
`[xxxx xxxx xx.. ....]`	Reserved

NOTE: See real-time process status words (V12–V16 in upload table) for bits that indicate type of completion.

2.3.3 WX3 = Status Codes

The status-code word continuously reports status and error information to the PLC. All error bits are checked prior to starting a cycle. See Table 2-3. For example, WX3 = binary value 1100 0000 0000 0000 indicates that the module is in the run mode and is running a profile. The I/O mapping and scaling feature allows a larger selection of devices to be interfaced to a module. Download table locations 257 through 283 specify required parameters. WX3 bit 9 has been defined to denote if any of these parameters are invalid. If bits 1 through 8 of WY8 are set, and any entries are invalid, the module exits RUN mode.

Table 2-3 WX3 = Status Codes

(16-Bit Word) Bit 1(MSB) Bit 16(LSB)	Cycle Complete Code
`[.... .... .... ...1]`	Illegal V-memory pointer in WY5 or WY6 (pointers are out of bounds)
`[.... .... .... ..1.]`	Illegal V-memory pointer in WY5 or WY6 (pointers overlap)
`[.... .... .... .1..]`	Clamp closure profile data error *
`[.... .... .... 1...]`	Injection profile data error *
`[.... .... ...1 ....]`	Pack and hold profile data error *
`[.... .... ..1. ....]`	Plasticate profile data error *
`[.... .... .1.. ....]`	Clamp opening profile data error *
`[.... xxxx 1... ....]`	Error bit for mapping and scaling
`[..00 .... .... ....]`	Output configuration 1
`[..01 .... .... ....]`	Output configuration 2
`[..10 .... .... ....]`	Output configuration 3
`[..11 .... .... ....]`	Reserved
`[.1.. .... .... ....]`	Defaults to 1 (reserved)
`[1... .... .... ....]`	Profile execution in progress

* Data is out of bounds or data is out of sequence (for active profiles only).

NOTE: To clear any of the above errors, force the first 5 bits of word WY8 to zero, then enter a new run command.

2.3.4
Data Validation

The module validates the following data from normal I/O and the upload table within certain limits before a cycle starts; an error code is returned to WX3 if any discrepancy is found (see section 2.3.3 for bit codes).

- There is an illegal V-memory pointer in WY5 or WY6. For example:

  — WY5 = 1 and WY6 = 100 indicates pointer overlap.

  — WY5 = 0 indicates pointer out of bounds (pointer < 1).

  — WY6 = 39789 indicates pointer out of bounds (pointer ≥ 32767).

- There is a profile data error in clamp closing, injection, or pack and hold profiles because values are not in decreasing order or value ≥ 32767.

- There is a profile data error in plasticate or clamp opening profiles because values are not in increasing order or value ≥ 32767.

2.3.5
WX4 = Reports Selected Channel Value

WX4 reports the selected channel value to allow faster updates to the PLC. Download table location 256 selects the channel that WX4 reports. Valid values in download table location 256 are 1 through 9. The default value is 3 (See Table 2-4).

Table 2-4 Download Table for WX4

Location	Description
256	Channel number (valid: 1, 2, 3, 4, 5, 6, 7, 8, 9; any other value = 3)

2.4 PLC Output Words: PLC Data → Module

2.4.1
WY5 = Pointer to V-memory

WY5 contains the V-memory start location for the profile download of the data table to the module. For example, WY5 = 101 means download table begins at V-101.

- Zero is not a valid value.
- Max value = PC V-memory max—300 or 65315 max.

2.4.2
WY6 = Pointer to V-memory

WY6 contains the V-memory start location for the upload of the process variable data table to the PLC. For example, WY6 = 400 means the upload table begins at V-400.

- Zero is not a valid value.
- Max value = PC V-memory max—100 or 65440 max.

2.4.3
WY7 = Module Mode Control

WY7 contains the module mode control value as follows:

- An integer value of 1121 in WY7 = run and enable special function (SF) transfers. All other values = disable run mode and lock out SF transfers.
- An integer value of 5000 in WY7 = the software revision display command that forces WX1 to display the current software revision (Rev.) number.

2.4.4
WY8 = Start Cycle

A transition from zero to a non-zero value in WY8 is required to execute a profile. A transition from a non-zero to a zero value is required to reset an error condition and to set up to start another cycle.

For example, the binary value 1111 1000 0000 0000 in WY8 tells the module to run a complete cycle with everything in closed loop mode. The module looks only at the first 5 bits of the WY8 word for the start, stop, and reset functions. Therefore, only the first 5 bits need to be zero to stop or reset this cycle.

PLC Output Words: PLC Data → Module (continued)

A non-zero value in WY8 implies the functions identified in Table 2-5.

Table 2-5 Cycle Initiation Codes and Mode Select

(16-Bit Word) Bit 1(MSB) Bit 16(LSB)	Cycle Initiation Codes and Mode Select
[1... ....]	Clamp close
[.1.. ....]	Inject
[..1. ....]	Pack and hold
[...1 ....]	Plasticate
[.... 1... ....]	Clamp open
[.... .1.. ....]	Overlapping cycles
Clamp Close Setpoints:	
[.... ..1. ....]	Open loop velocity
[.... ...1 ....]	Open loop pressure
Inject Setpoints:	
[.... .... 1... ....]	Open loop velocity
[.... .... .1.. ....]	Open loop pressure
Pack and Hold Setpoints:	
[.... .... ..1. ....]	Open loop ram velocity
[.... ....1 ....]	Open loop hydraulic pressure
Plasticate Setpoints:	
[.... .... 1...]	Open ram velocity
[.... .... .1..]	Open loop hydraulic pressure (back pressure)
Clamp Open Setpoints:	
[.... ....1.]	Open loop velocity
[.... ....1]	Open loop pressure

2.5 Block Transfer I/O Interface

In order to provide control, the module reads 300 V-memory locations from the PLC and writes up to 100 V-memory locations to the PLC. See Figure 2-2.

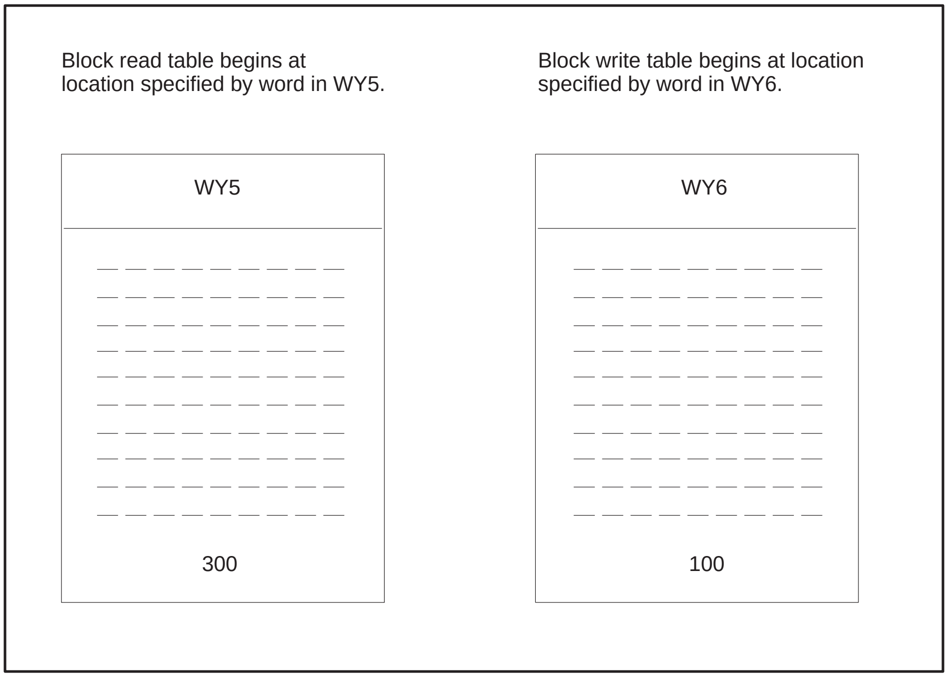


Figure 2-2 Block Transfer I/O Assignments

2.6 Block Read Data: PLC → Module

The module performs a block read of 300 consecutive V-memory locations starting at the V-memory location specified by WY5. See Figure 2-3. Table 2-8 contains all the information necessary for the module to perform a complete machine cycle, if so instructed.

Profile data consists of 5 sets of 44 values, followed by 5 hold values. The 44-value sets correspond to the 5 machine functions.

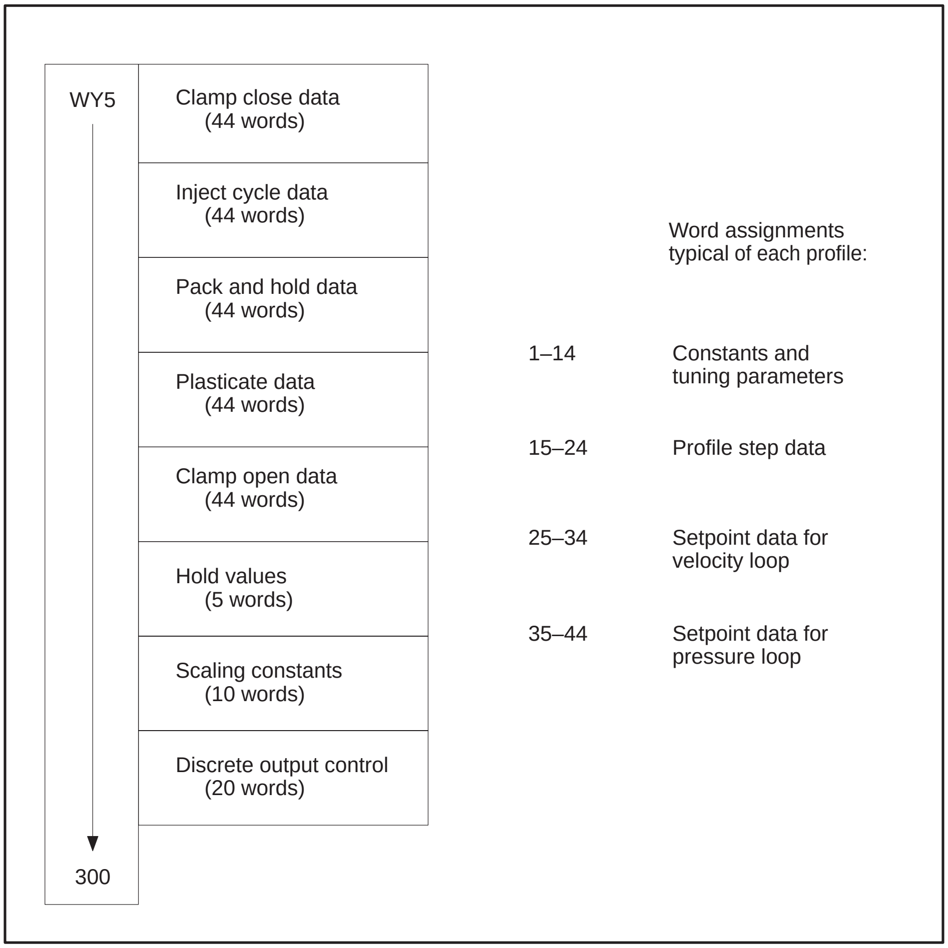


Figure 2-3 V-Memory Block Read

2.6.1 Definitions of Constants 1–14

The constants (V-memory locations 1–14 of each of the five profiles) are defined in the following paragraphs.

2.6.2 Constant 1

Constant 1 contains the module sample rate for this profile: 0–32767 in PLC = 0–32.767 ms. The normal value is 5000 or 5 ms; the minimum value is 1500 or 1.5 ms.

2.6.3 Constant 2

For all profiles except pack and hold, constant 2 contains the maximum profile time to transition: 0–32766 in PLC = 0–327660 ms or 327.66 seconds. For example, 325 = 3250 ms or 3.25 seconds. Note that 32767 = infinite time.

For pack and hold profile, constant 2 contains the minimum position of the injection ram to transition (end): 0–32000 in PLC = 0–10 V input. For example, 16000 = 5 V or 50 percent of scale.

2.6.4 Constant 3

For clamp close profile, constant 3 contains the lock-over velocity value (one of three lock-over variables stored in constants 3, 4, 5). The lock-over velocity provides a clamp lock-over feature for toggle machines by producing an additional burst of hydraulic flow and/or pressure for a specific amount of time at the end of the clamp close profile to force the toggle mechanism over center.

If the lock-over time (constant 5) is not zero, the lock-over velocity feature will be activated, providing hydraulic flow and pressure for a specified time after completion of the clamp close profile, whether by position: 0–32000 in PLC = 0–10 V output. For example, 8000 = 2.5 V or 25 percent of scale.

For injection and pack and hold profiles, constant 3 contains the maximum pressure value required to transfer from this profile. To disable constant 3, load 32767 or you can inhibit pressure transfer at different steps by using constant 10 Bits 14 –16. For plasticate profile, constant 3 contains the cure timer value.

You can specify a pressure threshhold before you enter a clamp open profile. Download table 179 (clamp open constant 3) specifies a value for comparison to channel 4. If a current channel 4 value is equal to or less than the value at download table 179, a clamp open profile is started.

2.6.5 Constant 4

For clamp close profile, constant 4 contains the lock-over pressure value used in the clamp lock-over feature: 0–32000 in PLC = 0–10 V output (see constant 3).

For inject and pack and hold profiles, constant 4 contains the maximum cavity pressure to transition value. For plasticate profile, constant 4 contains the cushion position value.

You can specify a time delay before you enter a clamp open profile. Download table location 180 (clamp open constant 4) specifies a time in milliseconds. If a millisecond time delay equal to the value at download table 180 has been accomplished, a clamp open profile is started.

2.6.6 Constant 5

For clamp close profile, constant 5 contains the lock-over time value used in the clamp lock-over feature. 0–32767 in PLC = 327670 ms.

For inject and pack and hold profiles, constant 5 contains the cavity fill pressure setpoint. The reaching of the cavity fill pressure setpoint starts time accumulating in real-time process variable location 30. For plasticate profile, constant 5 contains the cushion correction value.

2.6.7 Constant 6

Constant 6 contains the velocity scaling factor for the target machine. The velocity scaling factor is the maximum number of counts the input from the linear sensor can change in 1 ms: 0–32000 in PLC = 0–32000 counts/ms.

$$VSF \quad = \quad \frac{travel(counts) * speed(in/sec)}{1000\ ms/sec * stroke(in)}$$

For example, speed = 5 in/sec, stroke = 6 in, fully retracted position = 31500 counts, full forward position = 2050 counts

$$VSF \quad = \quad \frac{[31500 - 2050] * 5]}{1000 * 6} \quad = \quad 24.54 \approx 25\ \ counts/ms$$

2.6.8 Constant 7

Constant 7 contains the velocity loop gain value. Gain constant for PID calculation: 0–32767 in PLC = 0–3.2767 %/%. For example, 600 = gain of 0.06 %/%.

2.6.9 Constant 8

Constant 8 contains the velocity loop rate (derivative) value. Rate constant for PID calculation: 0–32767 in PLC = 0–327.67 ms. For example, 30000 = 300 ms rate factor.

2.6.10
Constant 9

Constant 9 contains the velocity loop reset (integral) value. Reset constant for PID calculation: 0–32767 in PLC = 0–327.67 ms. For example, 20000 = 200 ms reset factor.

NOTE: The larger the reset value ⇒ the smaller the reaction time on the PID calculation.

2.6.11
Constant 10

Constant 10 contains the velocity/pressure operation bit values. Values stored in constant 10 determine velocity and pressure algorithms for PID calculations. A zero in this word accepts the default selection as follows:

- Standard PID algorithm for both velocity and pressure loop calculation
- No filtering on input
- 0 to +10 V outputs
- No inhibit on pressure transfer

If changes to the default selection are required, the bit assignments for constant 10 are described below.

Bits 1–2
Velocity Algorithm

Velocity Byte 1 8	Pressure Byte 9 16	Description
`[00.. ....]`	`[.... ....]`	Select standard PID algorithm for velocity (default)
`[01.. ....]`	`[.... ....]`	Select dynamic PID algorithm for velocity calculation
`[10.. ....]`	`[.... ....]`	Reserved
`[11.. ....]`	`[.... ....]`	Reserved

Bits 3–4
Filters

Velocity Byte 1 8	Pressure Byte 9 16	Description
`[..00 ....]`	`[.... ....]`	Select no filter for velocity calculation (default)
`[..01 ....]`	`[.... ....]`	Select filter on position for velocity calculation
`[..10 ....]`	`[.... ....]`	Select filter on range for velocity calculation

Block Read Data: PLC → Module (continued)

Constant 10 (continued)

Bit 5
Flow Output Voltage Polarity

Velocity Byte 1 8	Pressure Byte 9 16	Description
[.... 0...]	[.... ....]	Select 0 to +10 V output range for flow command during profile*
[.... 1...]	[.... ....]	Select 0 to –10 V output range for flow command during profile*

NOTE: For machine configuration 3 in Ram control mode (injection, pack hold, and plasticate profiles), bit 5 selects the output range for output (flow/pressure) command.

Bit 6 (Plasticate only)
Auto Cushion Control

Velocity Byte 1 8	Pressure Byte 9 16	Description
[.... .0..]	[.... ....]	Auto cushion control off
[.... .1..]	[.... ....]	Auto cushion control on

Bit 7 (Pack and hold only)
Velocity Transfer

Velocity Byte 1 8	Pressure Byte 9 16	Description
[.... ..0.]	[.... ....]	Velocity transfer off
[.... ..1.]	[.... ....]	Velocity transfer on. This bit overrides velocity mode set for pack and hold in WY8 and runs pack and hold velocity in open loop using the final velocity output from inject as the setpoint. This provides a bumpless transition for velocity. *(Not functional in machine configuration 3.)*

Bit 8 (Open loop mode only)
Velocity Ramping

Velocity Byte 1 8	Pressure Byte 9 16	Description
[.... ...0]	[.... ....]	Select no velocity ramping
[.... ...1]	[.... ....]	Select velocity ramping**

* See download table word 225 for hold values.
** Ramping functions only in open loop mode.

Constant 10 (continued)

Bits 9–10
Pressure Algorithm

Velocity Byte	Pressure Byte	Description
1 8	9 16	
[.... ....]	[00.. ....]	Select standard PID algorithm for pressure calculation (default)
[.... ....]	[01.. ....]	Select dynamic PID algorithm for pressure calculation
[.... ....]	[10.. ....]	Reserved
[.... ....]	[11.. ....]	Reserved

Bit 11 (Open loop mode only)
Pressure Ramping

Velocity Byte	Pressure Byte	Description
1 8	9 16	
[.... ....]	[..0. ....]	Select no pressure ramping
[.... ....]	[..1. ....]	Select pressure ramping*

Bit 12
Output Range

Velocity Byte	Pressure Byte	Description
1 8	9 16	
[.... ....]	[...0 ....]	Selects a PID output range between 0 and +32000 (Output polarity depends on voltage selection bits.)
[.... ....]	[...1 ....]	Currently, this selects a range that is not useful. It should not be used. A future release may use this selection to interface with multifeature valves.

Bit 13
Pressure Output Voltage Polarity

Velocity Byte	Pressure Byte	Description
1 8	9 16	
[.... ....]	[.... 0...]	Select 0 to +10 V output range for pressure command during profile.**
[.... ....]	[.... 1...]	Select 0 to –10 V output range for pressure command during profile.**

NOTE: For machine configuration 3 in Ram control mode, the module uses bit 5 to select output range for output (flow/pressure) command.

---

*Ramping functions only in open loop mode.
**See download table word 225 for hold values.

Block Read Data: PLC → Module (continued)

Constant 10 (continued)

Bits 14–16 (inject and pack and hold profiles only)
Pressure Transition Inhibit

Velocity Byte 1 8	Pressure Byte 9 16	Description Permits transition on pressure during steps:
`[.... ....]`	`[.... .000]`	1 through 10
`[.... ....]`	`[.... .001]`	2 through 10
`[.... ....]`	`[.... .010]`	3 through 10
`[.... ....]`	`[.... .011]`	4 through 10
`[.... ....]`	`[.... .100]`	5 through 10
`[.... ....]`	`[.... .101]`	6 through 10
`[.... ....]`	`[.... .110]`	7 through 10
`[.... ....]`	`[.... .111]`	8 through 10

2.6.12
Constant 11

Constant 11 contains the pressure loop gain value. Gain constant for PID calculation: 0–32767 in PLC = 0–3.2767 %/%.
For example, 10,000 = gain of 1.

2.6.13
Constant 12

Constant 12 contains the pressure loop rate (derivative) value. Rate constant for PID calculation: 0–32767 in PLC = 0–327.67 ms.
For example, 2500 = rate of 25 ms.

2.6.14
Constant 13

Constant 13 contains the Pressure loop reset (integral) value. Reset constant for PID calculation: 0–32676 in PLC = 0–327.67 ms.
For example, 300 = reset of 3 ms.

NOTE: The larger the reset value ⇒ the smaller the reaction time on the PID calculation.

2.6.15
Constant 14

Constant 14 contains the velocity/pressure data acquisition bit values. The values stored in constant 14 bits determine velocity filter constants. A zero in this word accepts the default selection as follows:

- Velocity filter time constant of zero if velocity filter selected by bits 3 and 4 of word 10
- Pressure setpoint not forced into the bias term
- No reverse acting for velocity or pressure loop

Constant 14 (continued)

If changes to the default selection are required, the bit assignments are described below:

Bits 1–3

1 16	**Description**
`[xxx. .... .... ....]`	(Reserved for future use)

Bits 4–7

Velocity Filter Constants **1 16**	**Description**
`[...0 000. .... ....]`	Filter constant = 0.0
`[...0 001. .... ....]`	Filter constant = 0.1
`[...0 010. .... ....]`	Filter constant = 0.2
`[...0 011. .... ....]`	Filter constant = 0.3
↓	↓
`[...1 111. .... ....]`	Filter constant = 1.5

Bit 8

Bias Option Bit **1 16**	
`[.... ...0 .... ....]`	Pressure setpoint is not forced into the bias term. The bias term is initialized to 16000
`[.... ...1 .... ....]`	Pressure setpoint is forced into the bias term whenever there is a change in setpoint. A setpoint goes through a scale conversion prior to copy to the bias term. The formula for conversion is:

$$New\ bias = (New\ setpoint + 32000) / 2$$

NOTE: Bit 8 is used only in Ram closed-loop, pressure PID, standard algorithm, and machine configuration 3.

Block Read Data: PLC → Module (continued)

Constant 14 (continued)

Bit 9
Reverse Acting for Velocity Loop

1 **16**	
`[.... .... 0... ....]`	No reverse acting
`[.... .... 1... ....]`	Reverse acting

Bit 10
Reverse Acting for Pressure Loop

1 **16**	
`[.... .... .0.. ....]`	No reverse acting
`[.... .... .1.. ....]`	Reverse acting

Bits 11–16

1 **16**	
`[.... .... ..xx xxxx]`	Reserved

Table 2-6 contains the step data entry format and Table 2-7 contains the pack and hold step data entry format.

Table 2-6 Step Data Entry Format*

	Position	**Velocity**	**Pressure**	
Current/Starting Position	28,000			
Step 1	20,000	16,000	8,000	These values are in effect until Step 1 position is reached
Step 2	16,000	8,000	4,000	The values are in effect until Step 2 position is reached

*All profiles except Pack and Hold

Table 2-7 Pack and Hold Step Data Entry Format

	Cumulative Time	**Velocity**	**Pressure**	
Current/Starting Time (elapsed)	0			
Step 1	300	16,000	8,000	(Step 1 = 3 s)
Step 2*	500	12,000	6,000	(Step 2 = 2 s)

*Time for Step 2 = 500 – 300 = 200 or 2 s)

Table 2-8 contains information on the download table memory map.

Table 2-8 Download Table Memory Map

Clamp Closing Profile Data			
	Location	**Description**	**Range**
Constants			
WY5	1	Module sample rate	0—32.767 ms
	2	Max profile time	0—327.66 seconds (327.67 = ∞)
	3	Lock-over velocity	0—32000
	4	Lock-over pressure	0—32000
	5	Lock-over time**	0—327.67 seconds
	6	Velocity scaling factor	0—32000 counts/ms
	7	K1 (Velocity loop gain)	0—3.2767 %/%
	8	K2 (Velocity loop rate)	0—327.67 ms
	9	K3 (Velocity loop reset)	0—327.67 ms
	10	Velocity/pressure operation bits	(16 bits) 0 = default
	11	K1 (Pressure loop gain)	0—3.2767 %/%
	12	K2 (Pressure loop rate)	0—327.67 ms
	13	K3 (Pressure loop reset)	0—327.67 ms
	14	Velocity/pressure data acquisition bits	(16 bits) 0 = default
Clamp Position Profile Step Data*			
	15	Step 1 position	0—32000
	16	Step 2 position	0—32000
	17	Step 3 position	0—32000
	↓	↓	↓
	23	Step 9 position	0—32000
	24	Step 10 position	0—32000
Clamp Velocity Setpoint Data			
	25	Step 1 velocity	0—32000
	26	Step 2 velocity	0—32000
	27	Step 3 velocity	0—32000
	↓	↓	↓
	33	Step 9 velocity	0—32000
	34	Step 10 velocity	0—32000

* Data for Steps 15–24 must be zero or decrease monotonically. If zero, the cycle is terminated. (This profile expects the voltage input from the linear positions when the clamp is open to be larger than when the clamp is closed.)

** Lock-over feature will not activate if maximum profile time is exceeded or if an emergency stop occurs.

Block Read Data: PLC → Module (continued)

Table 2-8 Download Table Memory Map (continued)

Injection Profile Data			
	Location	**Description**	**Range**
Hydraulic Pressure Setpoint Data			
	35	Step 1 pressure	0—32000
	36	Step 2 pressure	0—32000
	37	Step 3 pressure	0—32000
	↓	↓	↓
	43	Step 9 pressure	0—32000
	44	Step 10 pressure	0—32000
Constants			
WY5+44	45	Module sample rate	0—32.767 ms
	46	Max profile time	0—327.66 seconds (327.67 = ∞)
	47	Max pressure to transition	0—32000 max (32767 = disable)
	48	Max cavity pressure to transition	0—32000 (32767 = disable)
	49	Cavity fill pressure setpoint	0—32000
	50	Velocity scaling factor	0—32000 counts/ms
	51	K1 (Velocity loop gain)	0—3.2767 %/%
	52	K2 (Velocity loop rate)	0—327.67 ms
	53	K3 (Velocity loop reset)	0—327.67 ms
	54	Velocity/pressure operation bits	(16 bits) 0 = default
	55	K1 (Pressure loop gain)	0—3.2767 %/%
	56	K2 (Pressure loop rate)	0—327.67 ms
	57	K3 (Pressure loop reset)	0—327.67 ms
	58	Velocity/pressure data acquisition bits	(16 bits) 0 = default
Ram Position Profile Step Data*			
	59	Step 1 position	0—32000
	60	Step 2 position	0—32000
	61	Step 3 position	0—32000
	↓	↓	↓
	67	Step 9 position	0—32000
	68	Step 10 position	0—32000
Ram Velocity Setpoint Data			
	69	Step 1 velocity	0—32000
	70	Step 2 velocity	0—32000
	71	Step 3 velocity	0—32000
	↓	↓	↓
	77	Step 9 velocity	0—32000
	78	Step 10 velocity	0—32000

* Data for Steps 59–68 must be zero or decrease monotonically. If zero, the cycle is terminated. (This profile expects the voltage input from the linear positioner when the ram is fully retracted to be larger than when it is forward.)

Table 2-8 Download Table Memory Map (continued)

Pack and Hold Profile Data			
	Location	Description	Range
Ram Hydraulic Pressure Setpoint Data			
	79	Step 1 pressure	0—32000
	80	Step 2 pressure	0—32000
	81	Step 3 pressure	0—32000
	↓	↓	↓
	87	Step 9 pressure	0—32000
	88	Step 10 pressure	0—32000
Constants			
WY5+88	89	Module sample rate	0—32.767 ms
	90	Profile minimum end position	0—32000 (32767 = disable)
	91	Max pressure to transition	0—32000 (32767 = disable)
	92	Max cavity pressure to transfer	0—32000 (32767 = disable)
	93	Cavity fill pressure setpoint	0—32000
	94	Velocity scaling factor	0—32000 counts/ms
	95	K1 (Velocity loop gain)	0—3.2767 %/%
	96	K2 (Velocity loop rate)	0—327.67 ms
	97	K3 (Velocity loop reset)	0—327.67 ms
	98	Velocity/pressure operation bits	(16 bits) 0 = default
	99	K1 (Pressure loop gain)	0—3.2767 %/%
	100	K2 (Pressure loop rate)	0—327.67 ms
	101	K3 (Pressure loop reset)	0—327.67 ms
	102	Velocity/pressure data acquisition bits	(16 bits) 0 = default
Pack Time Profile Step Data*			
	103	Step 1 time	0—327.67 seconds
	104	Step 2 time	0—327.67 seconds
	105	Step 3 time	0—327.67 seconds
	↓	↓	↓
	111	Step 9 time	0—327.67 seconds
	112	Step 10 time	0—327.67 seconds
Ram Velocity Setpoint Data			
	113	Step 1 velocity	0—32000
	114	Step 2 velocity	0—32000
	115	Step 3 velocity	0—32000
	↓	↓	↓
	121	Step 9 velocity	0—32000
	122	Step 10 velocity	0—32000

* Data for Steps 103–112 must be zero or increase monotonically. If zero, the cycle is terminated.

Table 2-8 Download Table Memory Map (continued)

Plasticate Profile Data			
	Location	**Description**	**Range**
Ram Hydraulic Pressure Setpoint Data			
	123	Step 1 pressure	0—32000
	124	Step 2 pressure	0—32000
	125	Step 3 pressure	0—32000
	↓	↓	↓
	131	Step 9 pressure	0—32000
	132	Step 10 pressure	0—32000
Constants			
WY5+132	133	Module sample rate	0—32.767 ms
	134	Max profile time	0—327.66 seconds (327.67 = ∞)
	135	Cure timer	0—327.66 seconds
	136	Cushion value	0—32000
	137	Cushion correction	0—320%
	138	Velocity scaling factor	0—32000 counts/ms
	139	K1 (Velocity loop gain)	0—3.2767 %/%
	140	K2 (Velocity loop rate)	0—327.67 ms
	141	K3 (Velocity loop reset)	0—327.67 ms
	142	Velocity/pressure operation bits	(16 bits) 0 = default
	143	K1 (Pressure loop gain)	0—3.2767 %/%
	144	K2 (Pressure loop rate)	0—327.67 ms
	145	K3 (Pressure loop reset)	0—327.67 ms
	146	Velocity/pressure data acquisition bits	(16 bits) 0 = default
Plasticate Profile Step Data*			
	147	Step 1 position	0—32000
	148	Step 2 position	0—32000
	149	Step 3 position	0—32000
	↓	↓	↓
	155	Step 9 position	0—32000
	156	Step 10 position	0—32000
Ram Velocity Setpoint Data			
	157	Step 1 velocity	0—32000
	158	Step 2 velocity	0—32000
	159	Step 3 velocity	0—32000
	↓	↓	↓
	165	Step 9 velocity	0—32000
	166	Step 10 velocity	0—32000

* Data for Steps 147–156 must be zero or increase monotonically. If zero, the cycle is terminated. (This profile expects the voltage input from the linear positioner at the beginning of the profile when the ram is forward to be smaller than at the end of the cycle when the ram is retracted.)

Table 2-8 Download Table Memory Map (continued)

Clamp Opening Profile Data			
	Location	**Description**	**Range**
Ram Back Pressure Setpoint Data			
	167	Step 1 pressure	0—32000
	168	Step 2 pressure	0—32000
	169	Step 3 pressure	0—32000
	↓	↓	↓
	175	Step 9 pressure	0—32000
	176	Step 10 pressure	0—32000
Constants			
WY5+176	177	Module sample rate	0—32.767 ms
	178	Max profile time	0—327.66 seconds (327.67 = ∞)
	179	Clamp open pressure threshold in counts	0—32766 (32767 = disabled)
	180	Clamp open time delay in milliseconds	0 = disabled
	181	(Future use)	
	182	Velocity scaling factor	0—32000 counts/ms
	183	K1 (Velocity loop gain)	0—3.2767 %/%
	184	K2 (Velocity loop rate)	0—327.67 ms
	185	K3 (Velocity loop reset)	0—327.67 ms
	186	Velocity/pressure operation bits	(16 bits) 0 = default
	187	K1 (Pressure loop gain)	0—3.2767 %/%
	188	K2 (Pressure loop rate)	0—327.67 ms
	189	K3 (Pressure loop reset)	0—327.67 ms
	190	Velocity/pressure data acquisition bits	(16 bits) 0 = default
Clamp Open Profile Step Data*			
	191	Step 1 position	0—32000
	192	Step 2 position	0—32000
	193	Step 3 position	0—32000
	↓	↓	↓
	199	Step 9 position	0—32000
	200	Step 10 position	0—32000
Clamp Velocity Setpoint Data			
	201	Step 1 velocity	0—32000
	202	Step 2 velocity	0—32000
	203	Step 3 velocity	0—32000
	↓	↓	↓
	209	Step 9 velocity	0—32000
	210	Step 10 velocity	0—32000

* Data for Steps 191–200 must be zero or increase monotonically. If zero, the cycle is terminated. (This profile expects the voltage input from the linear positioner when the clamp is closed to be smaller than when it is open.)

Block Read Data: PLC → Module (continued)

Table 2-8 Download Table Memory Map (continued)

Hold Values			
	Location	**Description**	**Range**
Hydraulic Pressure Setpoint Data			
	211	Step 1 pressure	0—32000
	212	Step 2 pressure	0—32000
	213	Step 3 pressure	0—32000
	↓	↓	↓
	219	Step 9 pressure	0—32000
	220	Step 10 pressure	0—32000
WY5+220	221	Channel 1 output	0—32000
	222	Channel 2 output	0—32000
	223	Channel 5 output	0—32000
	224	Channel 6 output	0—32000
	225*	Output directional bits and discrete outputs	(16 bits)

* See Download Table, Constant 10, for operation during profiles and Chapter 4 for discrete output data.

Hold value locations 221–225 contain the values that are output to each channel during any portion of the cycle when the loop for this output does not control the profile. These hold values are output to all channels, including those channels not used in some configurations.

While the module is in the idle mode (not controlling a profile), the hold values are constantly read in and are passed through to the output. However, when a profile cycle is initiated, the values are read in at the beginning of the cycle along with the rest of the table, and are not updated again until the profile (or consecutive profiles) is completed or stopped and the cycle is complete.

The three main functions for these values are

- To maintain clamp tonnage during inject and pack and hold on a direct-acting or toggle-ram machine.
- To drive outputs when the same proportional valve that is used for inject is switched to drive the screw, die height, etc.
- To provide a bias for valves that have a dead-band.

Output directional bits in word 225 apply only during the time the hold values are active. Directional bits during profile execution are taken from constant 10 of each profile.

2.6.16 Description of Word 225

Word 225 determines the output polarity during hold mode as follows.

Bit 1

1 Word 225 16	**Description**
`[0... .... .... ....]`	Channel 1 output 0 to +10 V
`[1... .... .... ....]`	Channel 1 output 0 to –10 V

Bit 2

1 Word 225 16	
`[.0.. .... .... ....]`	Channel 2 output 0 to +10 V
`[.1.. .... .... ....]`	Channel 2 output 0 to –10 V

Bit 3

1 Word 225 16	
`[..0. .... .... ....]`	Channel 5 output 0 to +10 V
`[..1. .... .... ....]`	Channel 5 output 0 to –10 V

Bit 4

1 Word 225 16	
`[...0 .... .... ....]`	Channel 6 output 0 to +10 V
`[...1 .... .... ....]`	Channel 6 output 0 to –10 V

Bits 5-12 (future use)

1 Word 225 16	
`[.... xxxx xxxx ....]`	Reserved
Bits 13-16	See discrete outputs, Chapter 4

Table 2-8 Download Table Memory Map (continued)

Scaling Constants and Discrete Outputs			
	Location	**Description**	**Range**
WY5+225	226	Clamp close positive scale (future)	0—32000
	227	Clamp close negative scale (future	0—32000
	228	Injection positive scale	0—32000
	229	Injection negative scale	0—32000
	230	Pack and hold positive scale	0—32000
	231	Pack and hold negative scale	0—32000
	232	Plasticate positive scale	0—32000
	233	Plasticate negative scale	0—32000
	234	Clamp open positive scale (future)	0—32000
	235	Clamp open negative scale (future)	0—32000
	236 ↓ 255	Discrete outputs, see Chapter 4	
	284 ↓ 300	Reserved	

The features above are applicable only to Machine Configuration 3 in injection, pack and hold, and plasticate profiles, and work only on the pressure loop mode. A zero value in any of these locations defaults to one. For example, if the injection pressure loop calculates an output value of 32000, but V228 = 10, then the actual output is 32000/10 = 3200 or 1 volt.

Table 2-8 Download Table Memory Map (continued)

Update to a PLC Program			
	Location	**Description**	**Range**
WX4	256	Channel number	1—9 (default value = 3)

The value in download table location 256 is the same as the associated value in the upload table, except it is potentially updated at a faster rate.

Table 2-8 Download Table Memory Map (continued)

I/O Mapping and Scaling		
Location	**Description**	**Valid**
Upload table entry 4: channel 1 (output)		
257	Physical channel number	1, 2, 5, 6
258	Minimum scale value	0—32000
259	Maximum scale value	0—32000
Upload table entry 6: channel 2 (output)		
260	Physical channel number	1, 2, 5, 6
261	Minimum scale value	0—32000
262	Maximum scale value	0—32000
Upload table entry 34: channel 3 (input)		
263	Physical channel number	3, 4, 7, 8, 9
264	Minimum scale value	0—32000
265	Maximum scale value	0—32000
Upload table entry 5: channel 4 (input)		
266	Physical channel number	3, 4, 7, 8, 9
267	Minimum scale value	0—32000
268	Maximum scale value	0—32000
Upload table entry 9: channel 5 (output)		
269	Physical channel number	1, 2, 5, 6
270	Minimum scale value	0—32000
271	Maximum scale value	0—32000
Upload table entry 11: channel 6 (output)		
272	Physical channel number	1, 2, 5, 6
273	Minimum scale value	0—32000
274	Maximum scale value	0—32000
Upload table entry 7: channel 7 (input)		
275	Physical channel number	3, 4, 7, 8, 9
276	Minimum scale value	0—32000
277	Maximum scale value	0—32000
Upload table entry 10: channel 8 (input)		
278	Physical channel number	3, 4, 7, 8, 9
279	Minimum scale value	0—32000
280	Maximum scale value	0—32000
Upload table entry 2: channel 9 (input)		
281	Physical channel number	3, 4, 7, 8, 9
282	Minimum scale value	0—32000
283	Maximum scale value	0—32000

2.7 Block Write Data: Module → PLC

The module performs a block write of 100 consecutive V-memory locations starting at the V-memory location specified by WY6. See Figure 2-4.

Table 2-9 lists real-time variables and process values. The values in this table are updated in V-memory every PLC scan.

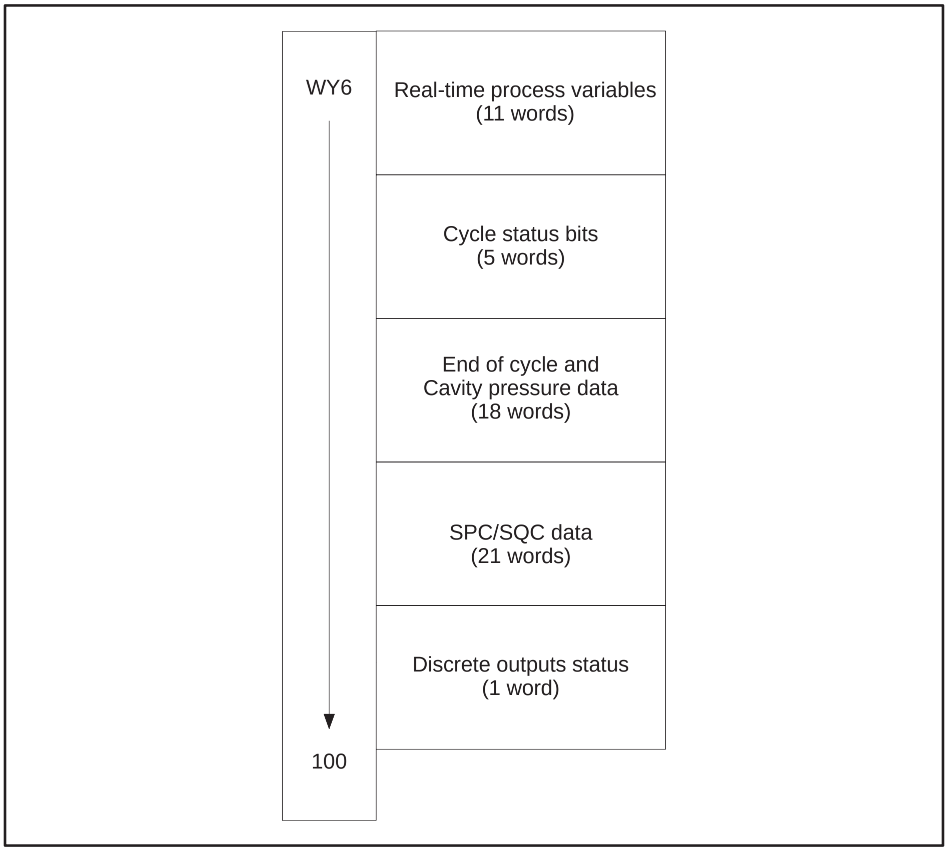


Figure 2-4 V-Memory Block Write

Table 2-9 Upload Table Memory Map

Real-time Process Variables, Cycle Status, SPC/SQC Data, Discrete Status			
	Location	**Description**	**Range**
(WY6)	1*	Actual loop calculation time	0—32767 microseconds
	2	Clamp position feedback (CH9)	0—32000
	3	Clamp velocity calculated by module	│
	4	Clamp hydraulic flow output (CH1)	│
	5	Clamp hydraulic pressure feedback (CH4)	│
	6	Clamp pressure output signal (CH2)	│
	7	Ram position feedback (CH7)	│
	8	Ram velocity calculated by module	│
	9	Ram hydraulic flow output (CH5)	│
	10	Ram hydraulic pressure feedback (CH8)	↓
	11	Ram hydraulic pressure output (CH6)	0—32000
	12	Clamp close status bits	16 bits
	13	Inject status bits	│
	14	Pack and hold status bits	│
	15	Plasticate status bits	↓
	16	Clamp open status bits	16 bits
	17	Inject final ram position	0—32000
	18	Inject final calculated velocity	│
	19	Inject final ram pressure	↓
	20	Inject final cavity pressure	0—32000
	21	Accumulated inject profile time	0—655.35 seconds
	22	Pack and hold final ram position	0—32000
	23	Pack and hold final calculated velocity	│
	24	Pack and hold final ram pressure	↓
	25	Pack and hold final cavity pressure	0—32000
	26	Accumulated pack and hold profile time	0—655.35 seconds
	27	Accumulated clamp close profile time	│
	28	Accumulated plasticate profile time	↓
	29	Accumulated clamp open profile time	0—655.35 seconds

* This value is updated only when profile is running. During other times the old value is left in place until next profile.

Block Write Data: Module → PLC (continued)

Table 2-9 Upload Table Memory Map (continued)

Real-time Process Variables, Cycle Status, SPC/SQC Data, Discrete Status			
	Location	Description	Range
(WY6+29)	30	Accumulated inject fill time	0—655.35 seconds
	31	Accumulated pack and hold time	0—655.35 seconds
	32	Peak inject cavity pressure	0—32000
	33	Peak pack and hold cavity pressure	↓
	34	Cavity pressure feedback (CH3)	0—32000
	35	Profile indicator for SPC/SQC	100, 200, 300, 400, or 500 (integer)**
	36	Step 1 average of 10 velocity inputs*	0—32000
	37	│	│
	38	│	│
	39	│	│
	40	│	│
	41	│	│
	42	│	│
	43	│	│
	44	↓	↓
	45	Step 10 average of 10 velocity inputs	0—32000
	46	Step 1 average of 10 pressure inputs*	0—32000
	47	│	│
	48	│	│
	49	│	│
	50	│	│
	51	│	│
	52	│	│
	53	│	│
	54	↓	↓
	55	Step 10 average of 10 pressure inputs	0—32000
	56	Discrete outputs, see Chapter 4	
	57	Adjusted Cushion Value	0—32000
	58	Plasticate Adjusted Cushion Value	0—32000
	59	Future Use	
	↓	↓	
	100	Future use	

* The value contained in each of these words is an average of the ten most recent values read in. Values are updated only at the end of the cycle.

** 100 = clamp close; 200 = inject; 300 = pack and hold; 400 = plasticate; 500 = clamp open. Clamp open will not be reported in overlap mode.

2.7.1
Real-time Process Status Bits for Words 12–16

Bit 1

1 16	**Description**
`[1... .... .... ....]`	End of profile at step #10

Bit 2

1 16	**Description**
`[.1.. .... .... ....]`	End of profile before Step 10 due to 0 value in next step

Bit 3

1 16	**Description**
`[..1. .... .... ....]`	Max time exceeded except for Pack and Hold—then min position reached

Bit 4

1 16	**Description**
`[...1 .... .... ....]`	Max pressure exceeded

Bit 5

1 16	**Description**
`[.... 1... .... ....]`	Max cavity pressure exceeded

Bit 6

1 16	**Description**
`[.... .1.. .... ....]`	Fill pressure reached

Bit 7

1 16	**Description**
`[.... ..1. .... ....]`	Cure time reached

Bits 8–15 Reserved

Bit 16

1 16	**Description**
`[.... .... .... ...1]`	Emergency stop caused by forcing 0 into word WY8 or WY7≠1121

Chapter 3

Installation and Startup

3.1 Machine Configurations

The first step in preparation for use of the TurboPlastic module is to determine the machine control and valve configuration. Figure 3-1, Figure 3-2, and Figure 3-3 show diagrams of the three most common configurations. Although some differences will be noted between the examples and actual machine configurations, one of the three examples should be functionally appropriate. Table 3-1 contains the injection, pack and hold, and plasticate profiles for output configuration 3. Refer to Table 3-2 for the necessary switch settings.

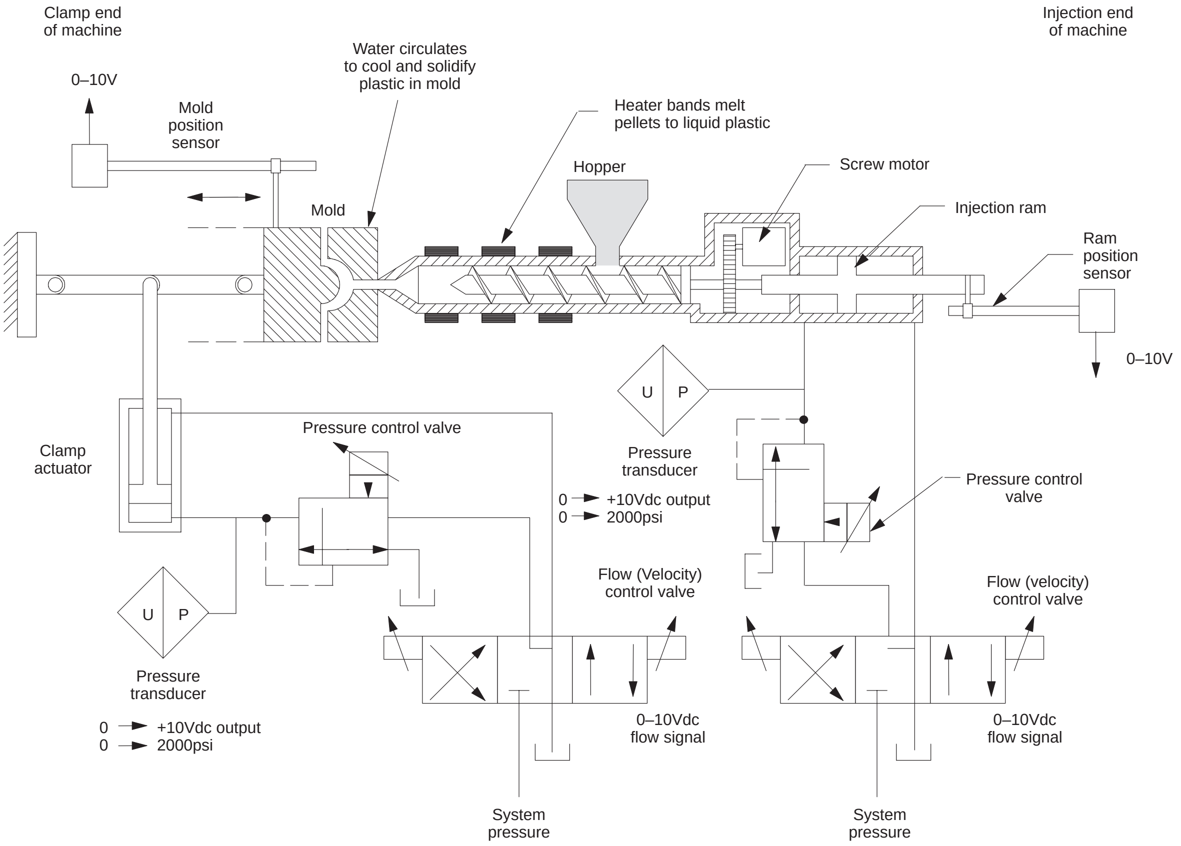


Figure 3-1 Plastic Injection Molding Machine Control Points, Machine Configuration 1

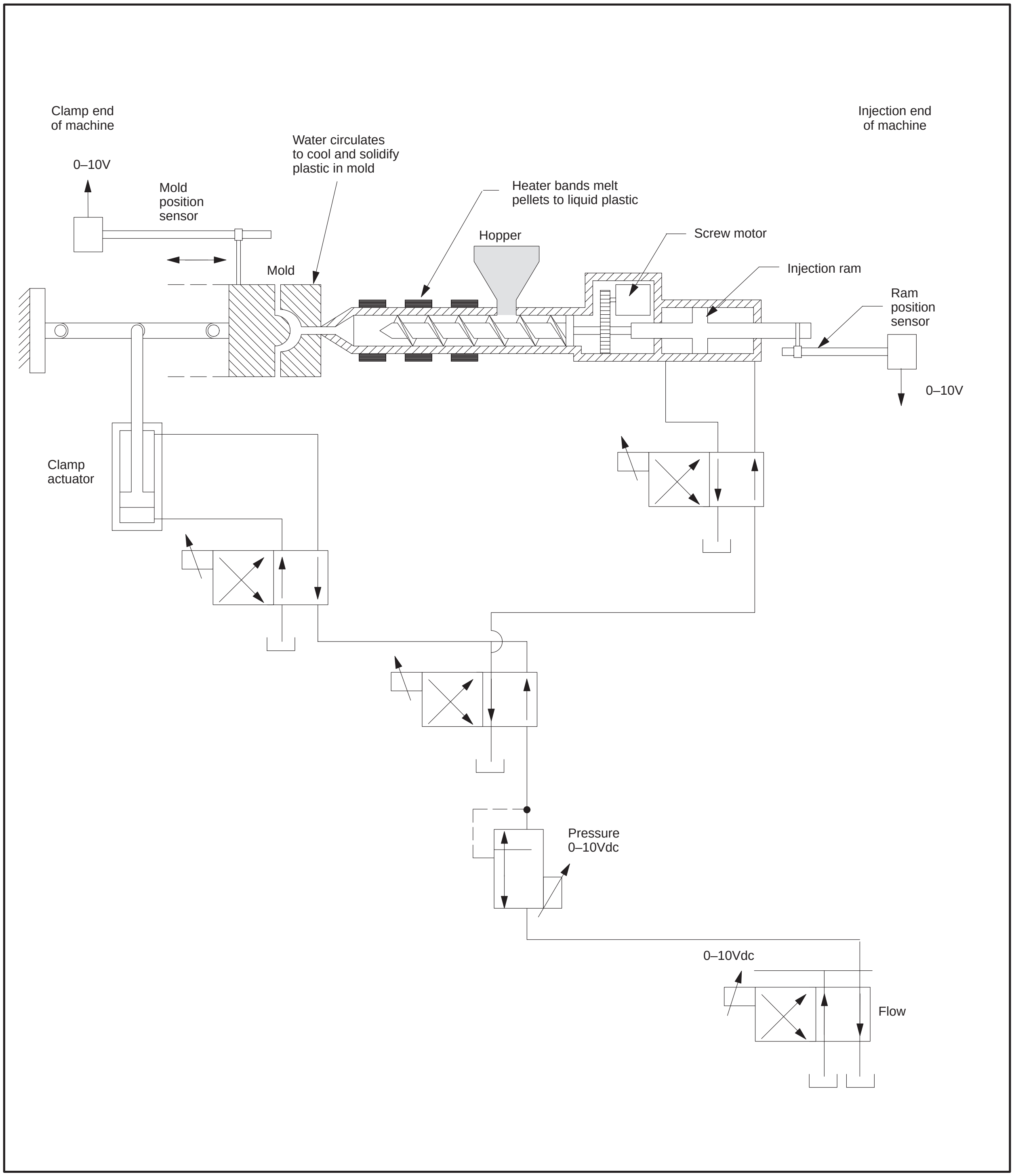


Figure 3-2 Plastic Injection Molding Machine Control Points, Machine Configuration 2

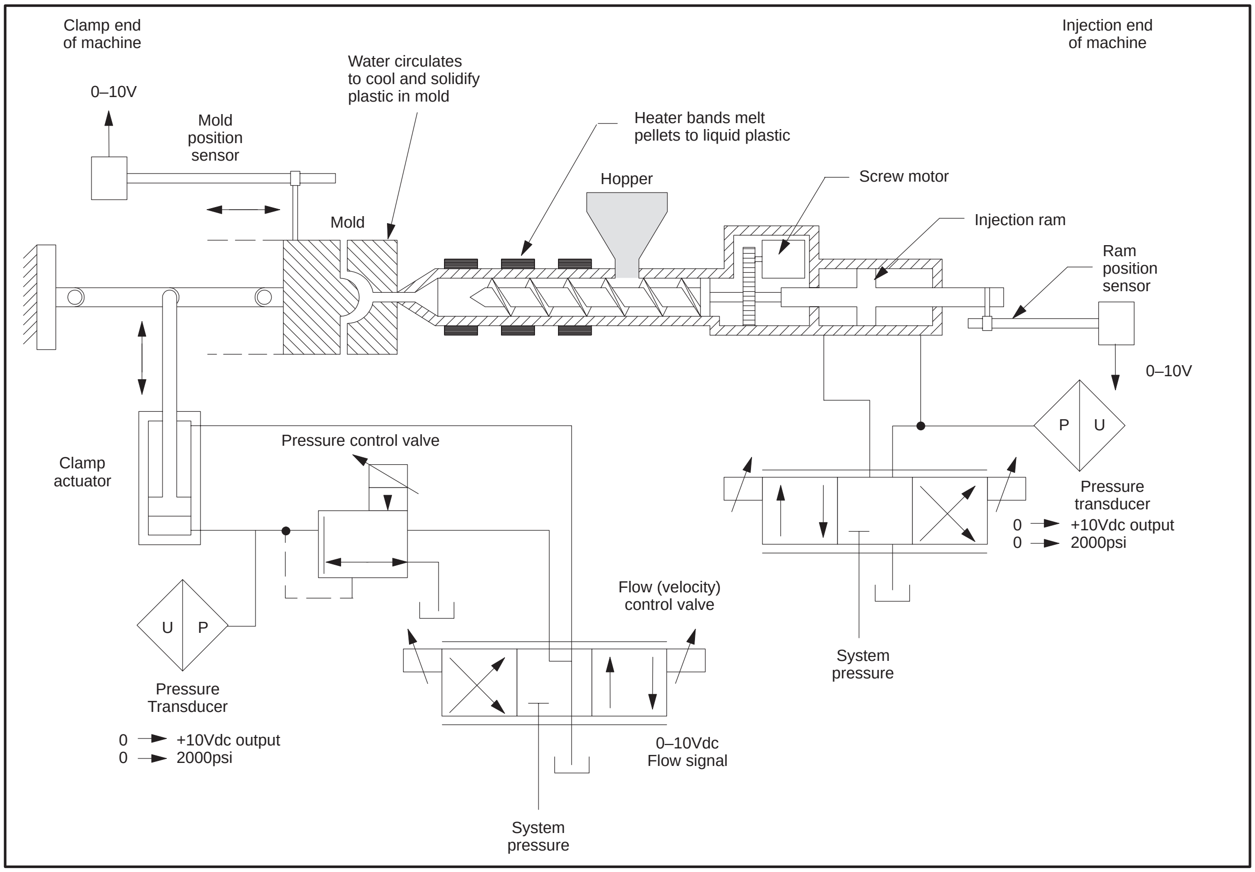


Figure 3-3 Plastic Injection Molding Machine Control Points, Machine Configuration 3

Table 3-1 Injection, Pack and Hold, and Plasticate Profiles for Output Configuration 3

Velocity Calculation	Pressure Calculation	Resultant Operation for Output Configuration 3 Only
Open loop	Open loop	Open loop ram velocity setpoint
Open loop	Closed loop	Closed loop hydraulic pressure output
Closed loop	Open loop	Closed loop hydraulic flow output
Closed loop for inject and pack and hold profiles	Closed loop for inject and pack and hold profiles	If hydraulic pressure < pressure setpoint, then closed loop output flow; if pressure > pressure setpoint, then closed loop output pressure
Closed loop for plasticate profile	Closed loop for plasticate profile	If current step pressure setpoint ≥ 32000, then closed flow profile is executed for the step; otherwise, a closed loop pressure profile is executed
Note: See input/output configurations, Table 3-2.		

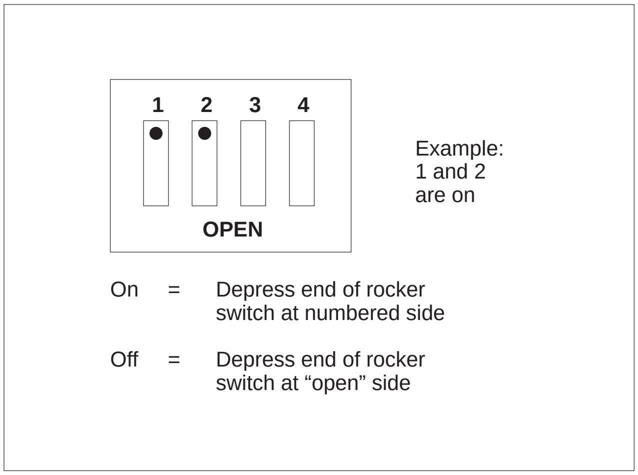
3.2 Input/Output Configuration Switch Settings

Table 3-2 TurboPlastic Module Input/Output Configuration

Channel Number	Input/Output Configurations		
	#1 SW1–1 = On SW1–2 = On	**#2 SW1–1 = Off SW1–2 = On**	**#3 SW1–1 = On SW1–2 = Off**
1	Clamp flow	Clamp/ram flow	Camp flow
2	Clamp pressure	Clamp/ram pressure	Clamp pressure
3	Cavity pressure	Cavity pressure	Cavity pressure
4	Clamp hydraulic pressure	Clamp hydraulic pressure	Clamp hydraulic pressure
5	Ram flow	Not used	Ram flow/pressure
6	Ram pressure	Not used	Not used
7	Ram position	Ram position	Ram position
8	Ram hydraulic pressure	Ram hydraulic pressure	Ram hydraulic pressure
9	Clamp position	Clamp position	Clamp position

SW1 is the dipswitch located near the bottom edge of the module circuit board. See Figure 3-4 and Figure 3-5.

Open=Off Closed=On



Example:
1 and 2
are on

On = Depress end of rocker switch at numbered side

Off = Depress end of rocker switch at “open” side

Figure 3-4 Dipswitch SW1

3.3 Input/Output Voltage Range Setup

Implementation of the bipolar input option is entirely in the hardware and is transparent to the firmware except for the application results. There are three jumpers that are located in the lower middle of the module board that control this option. Switch the jumpers up or down as a block (all up or all down) to select an option. The jumper label numbers on the board are J21, J20, and J22. In the default factory setting, J21, J20, and J22 are switched down. To select the bipolar input option, switch all the jumpers to the up position. Figure 3-5 shows the jumper/switch locator.

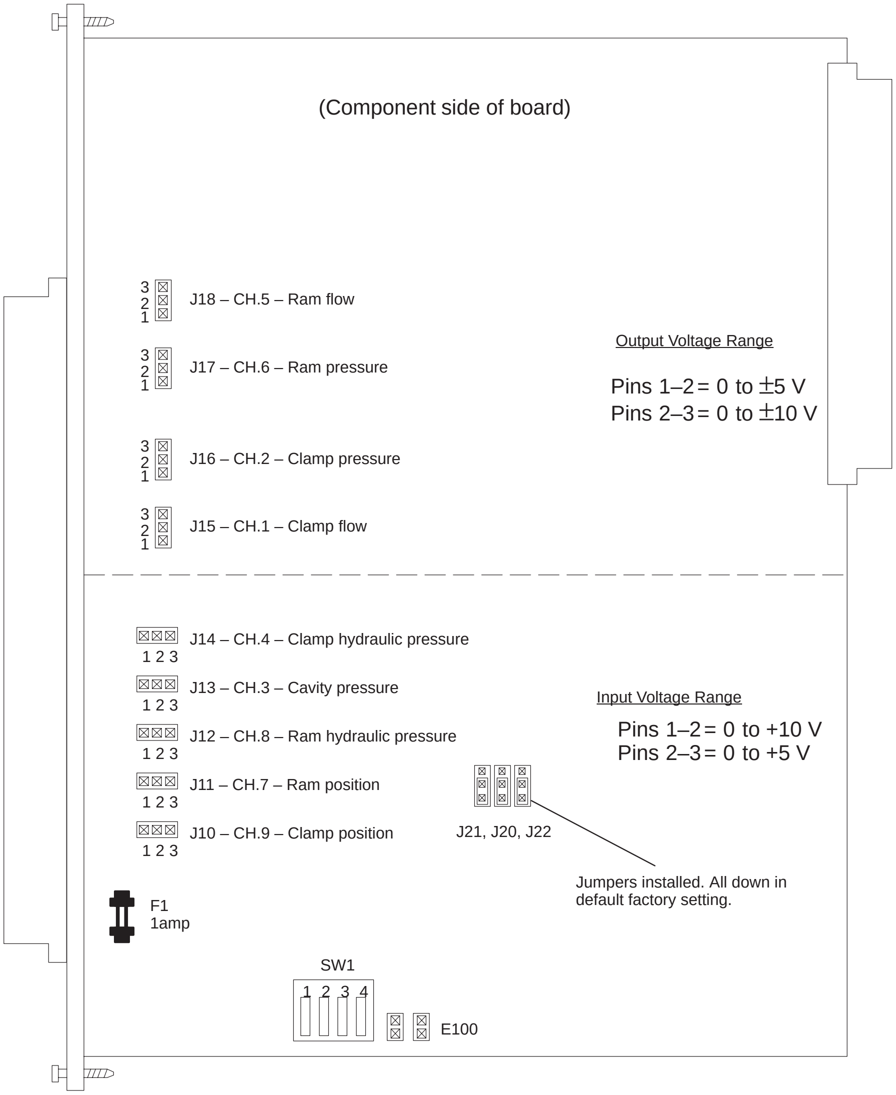


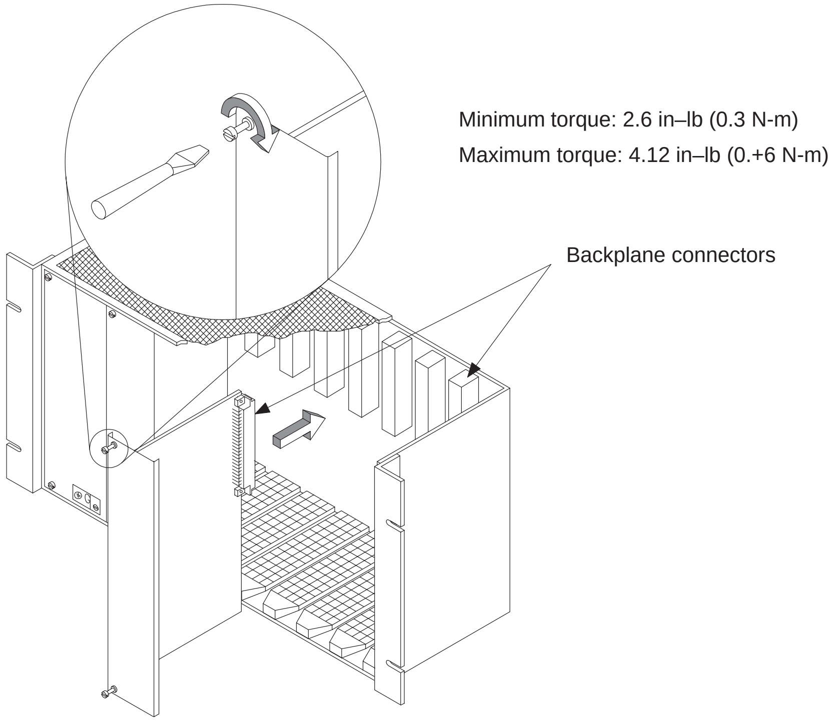
Figure 3-5 Jumper/Switch Locator

3.4 Installing the Module

Insert the module in any slot of a base using a 545 or 555 controller when the power is off. See Figure 3-6. Power consumption for the purpose of power budgeting on the base is 7 watts.

⚠ WARNING **To minimize potential shock, turn off power to the I/O base and to any modules installed in the base before inserting or removing a module or installing a terminal block. Failure to do so may result in potential injury to personnel or damage to equipment.**

Make field connections to the front connector on the module with twisted shielded pair cable following standard grounding practices for instrumentation wiring (see Sections 3.5 and 3.6). Keep cable lengths between input sensors and the TurboPlastic module to a minimum. It is recommended that the length does not exceed 35 feet. The connectors accept wire of size #16 to #24 AWG.



Minimum torque: 2.6 in–lb (0.3 N-m)

Maximum torque: 4.12 in–lb (0.+6 N-m)

Figure 3-6 Inserting the Module into the Base

3.5 Power Supply and Grounding Recommendations

Because of the high-speed update of the TurboPlastic module, the amount of movement of the ram and/or platen between module samples is very small, even on fast machines. This means that very small changes in the analog input signal must be accurately detected in order to perform smooth closed loop control.

Special differential input stages have been installed in the module which provide extremely high common mode noise rejection, provided neither side of the DC circuit is grounded.

It is imperative that electrical noise, both direct and induced, on the two position inputs be kept below 0.05 mV. Use the following minimum guidelines.

- Provide a separate, highly-filtered power supply for the position input channels. This supply should be capable of furnishing 0 to +10 VDC at ±0.005% regulation and 0.250 mV ripple or better.

NOTE: Do not ground either the positive or negative side of the DC circuit.

- Run twisted shielded wiring throughout the positioning system starting from the power supply terminals. Then run all wiring in separate metallic conduit or flex that has been properly grounded with minimal exposed lengths at connection.
- Ground all shields at the module or amplifier input end as shown in Figure 3-7.

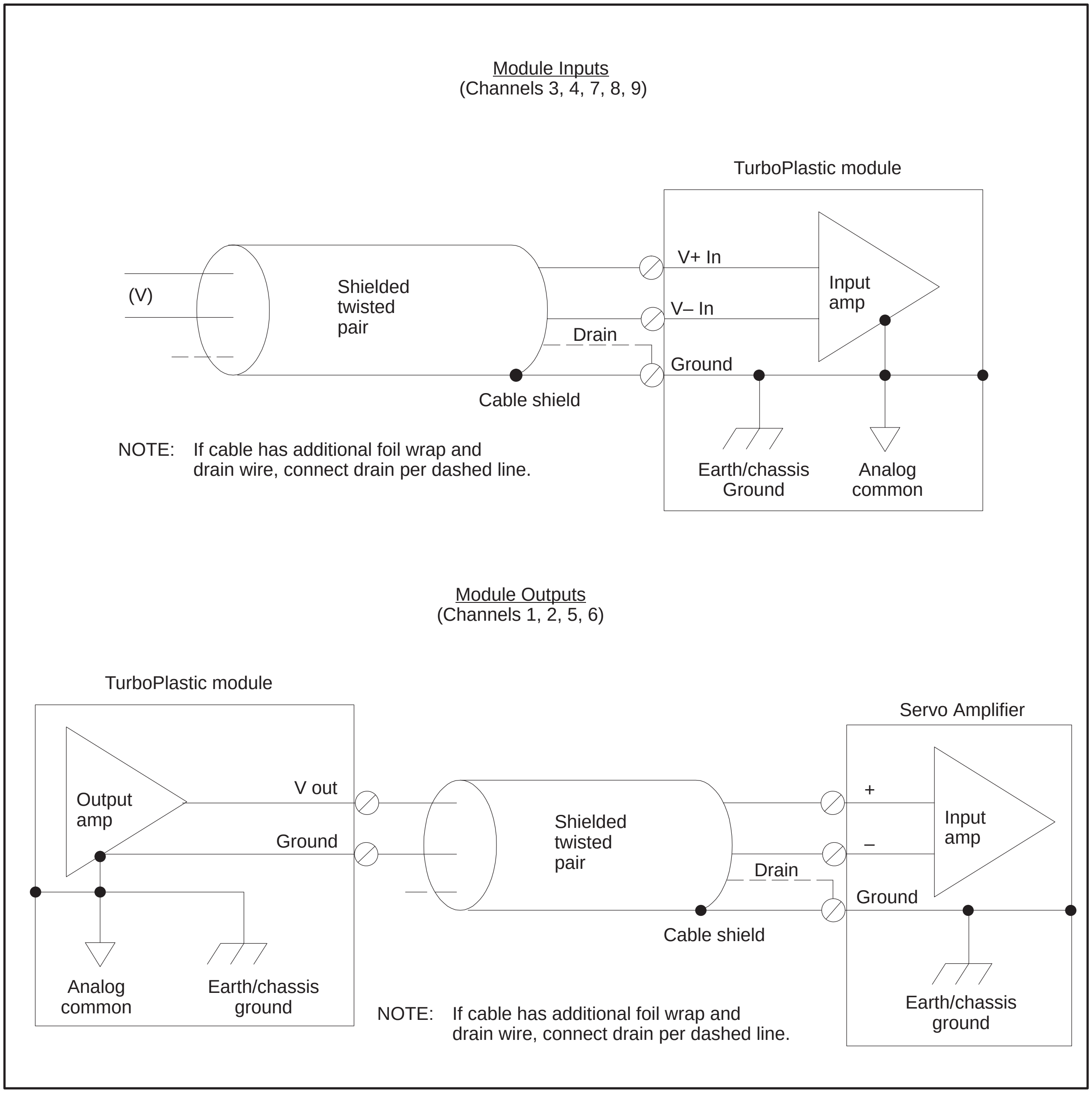
3.5.1
Testing the System

Generate a few lines of ladder logic to compare and then store the highest and lowest position values output to the PLC with the ram stopped. Variation of these position readings should not exceed 16 counts over a five-minute period.

Since changes to wiring and other parts of the system may increase the noise level to the module inputs, the ladder logic for the above test should be left in place for use later in troubleshooting. To make periodic testing of the system easier, you can create a screen on the operator interface to activate the test. A sample RLL program is listed in Appendix B.

3.6 Cable Connections and Grounding

Use twisted shielded cable routed away from high voltage circuits and routed away from electrically noisy areas.



NOTE: If cable has additional foil wrap and drain wire, connect drain per dashed line.

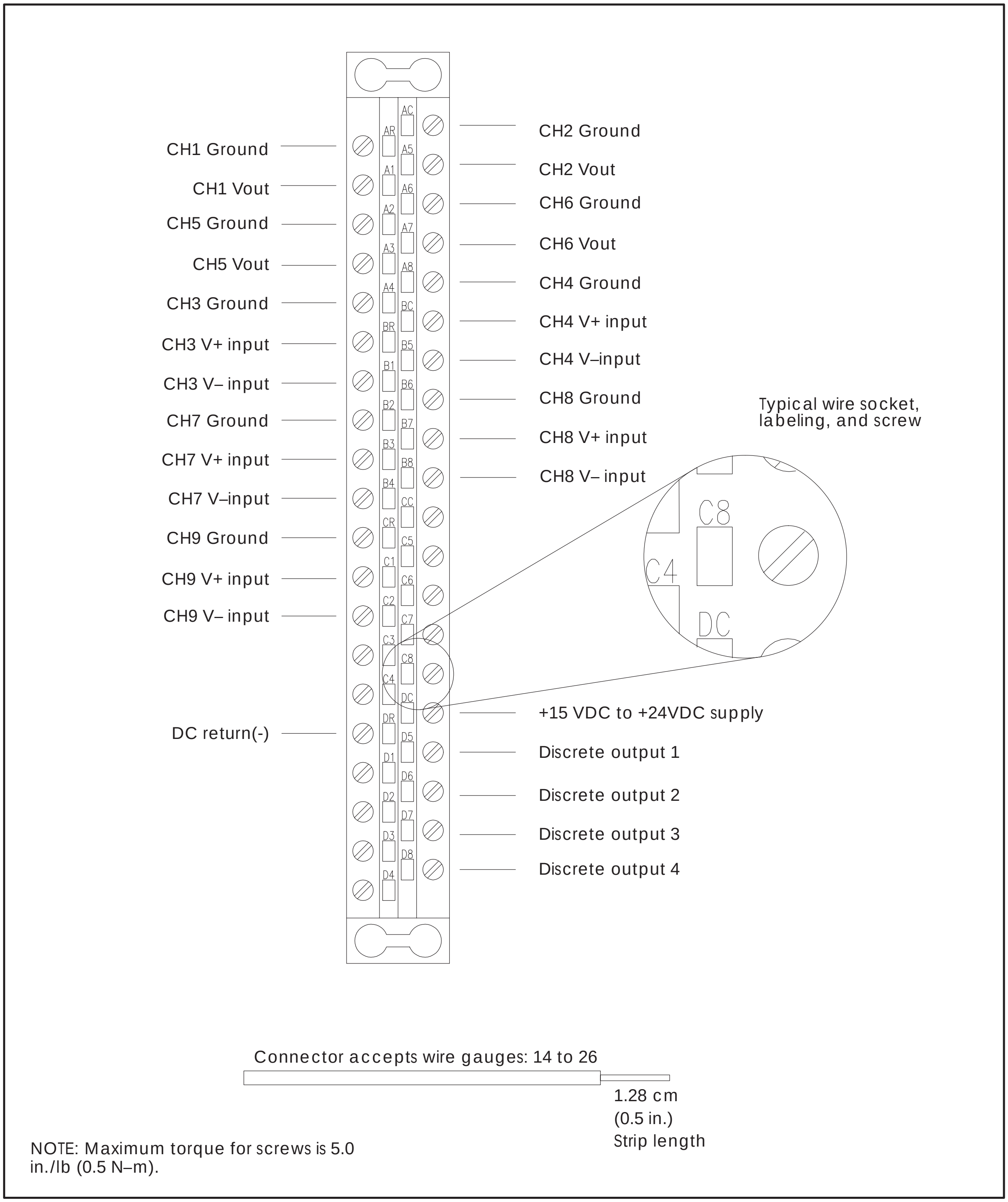
NOTE: If cable has additional foil wrap and drain wire, connect drain per dashed line.

Figure 3-7 Module Input/Output Wiring

3.7 Connector Pinouts

Table 3-3 Connector Pinout Table

Channel		Signal		Connector	Voltage Range
Number	**Function**	**In/Out**	**Function**	**Terminal**	**Jumper**
1	Clamp flow	Out	V Out Ground	A1 AR	J15
2	Clamp pressure	Out	V Out Ground	A5 AC	J16
3	Cavity pressure	In	V+ Input V– Input Ground	BR B1 A4	J13
4	Clamp hydraulic pressure	In	V+ Input V– Input Ground	BC B5 A8	J14
5	Ram flow	Out	V Out Ground	A3 A2	J18
6	Ram pressure	Out	V Out Ground	A7 A6	J17
7	Ram position	In	V+ Input V– Input Ground	B3 B4 B2	J11
8	Ram hydraulic pressure	In	V+ Input V– Input Ground	B7 B8 B6	J12
9	Clamp position	In	V+ Input V– Input Ground	C1 C2 CR	J10



NOTE: Maximum torque for screws is 5.0 in./lb (0.5 N–m).

Figure 3-8 Connector Pinout Diagram

3.8 Startup Values and Examples

Read this entire section before attempting to energize the module. If you are using any of the discrete output circuits, also read Chapter 4 before energizing the module.

The module reads in and validates the entire 300-word download table before executing any profile. Therefore, ensure (1) there are no incorrect values in any of the profiles; and (2) that the pertinent locations in the V-memory download table are filled in with appropriate values.

⚠ **CAUTION**

TISOFT may be used to enter table values during start-up, but to avoid mis-operation, LDC boxes in RLL should be used to load constants (even if the value entered is zero) to ensure that erroneous values are not present.

⚠ **CAUTION**

Before proceeding, ensure that the following tasks are completed:
— Input/output configuration set with SW1
— Input/output voltage ranges set with Jumpers J10–J18
— Connector attached to front of module and secured with screws
— Module seated in mounting base and secured with screws
— Power supply and signal wiring connected and accuracy verified

The following example provides a suggested set of startup values for the normal I/O and download table, with some explanation of their functions. This example assumes the following:

- Both clamp and inject functions are controlled by the module.
- The TurboPlastic module is located in the first slot in the base.
- The download table starts at V-memory location 1.
- The upload table starts at V-memory location 301.

Suggested values for normal I/O locations:

WY5	→	1	Start of download table—300 values
WY6	→	301	Start of upload table—100 values
WY7	→	1121	Sets module in run mode—run light on
WY8	→	0	Must be toggled back to zero or any value that has its first 5 bits = zero to allow another start cycle
WY8	→	16384	Runs inject in closed loop mode only.

With the PLC configured for a 4WX/4WY, SF module in Slot #1 with the above values loaded; the **MODULE GOOD** and **RUN** LEDs on the module front panel should be lighted.

NOTE: If LEDs blink, refer to Table 3-4. Should any fail codes occur (except for the factory test jumper), the module should not be used.

Table 3-4 Module Fail Codes

Number of Blinks		Error/Failure Condition
Module Good LED	**Pgm/Run LED**	
C**	0	Illegal machine configuration
0	1	Analog/digital conversion
0	2	Timer failure
0	3	Internal RAM failure (not used)
0	4	External RAM (LSB and MSB)
0	5	External RAM (LSB)
0	6	External RAM (MSB)
0	7	SFIC RAM
0	8	ROM checksum failure
0	9	Digital/analog conversion
0	10	Analog/digital conversion
1*	1	Factory test jumper

* Both LEDs blink if factory test jumper is in place. To correct, remove shorting block from two pins labeled E100 located near bottom edge of circuit board (see Figure 3-5).

** Module good LED blinks continuously.

NOTE: When implementing RLL to enter a zero followed by a Start Cycle command to WY8, note that a delay equivalent to one PLC scan time is required between consecutive commands for communications overhead. This delay is often provided by the number of interlocks employed. To avoid mis-operation, use a timer or interlock to ensure this delay is always present. An interlock can be provided by having RLL check WX1 for a zero value before sending a start cycle command.

The module expects the linear positioners feeding the position information to its input channels to read zero or near-zero volts when the clamp is closed and the ram is forward. When the clamp is open and the ram is retracted, a reading of ≈10 V is expected (32000-count in the PLC V-memory). Suggested (unscaled) values are contained in Table 3-5.

Startup Values and Examples (continued)

Table 3-5 Download Table

Location		Value	Description of Function
Clamp Close Profile			
V1	→	5000	Sets module scan to 5 ms during close
V2	→	300	Sets low pressure close at 3 seconds
V3	→	0	Lock over velocity
V4	→	0	Lock over pressure
V5	→	0	Lock over time not used
V6	→	30	Velocity scaling factor = 30 counts/ms
V7	→	50	Velocity loop gain
V8	→	0	Velocity loop rate
V8	→	0	Velocity loop rate
V9	→	0	Velocity loop reset
V10	→	0	Velocity/pressure operation = default
V11	→	50	Pressure loop gain
V12	→	0	Pressure loop rate
V13	→	0	Pressure loop reset
V14	→	0	Velocity/pressure data acquisition = default
V15	→	16000	Any number approximately half open
V16	→	3000	Any number slightly greater than fully closed position
V17–V24	→	0	Other steps to be filled in later
V25	→	8000	Velocity = 1/4 speed
V26	→	4000	Velocity = 1/8 speed
V27–V34	→	0	Other steps to be filled in later
V35	→	8000	Pressure = 1/4 of maximum
V36	→	4000	Pressure = 1/8 of maximum
V37–V44	→	0	Other steps to be filled in later

Note: The two steps shown for each profile can be from Step 1 to 10.

Table 3-5 Download Table (continued)

Location		Value	Description of Function
Inject Profile			
V45	→	5000	Sets module scan to 5 ms during inject
V46	→	32767	Sets max profile time to infinity
V47	→	32000	Sets inject transition pressure to maximum
V48	→	32000	Sets cavity transition pressure to maximum if equipped
V49	→	0	Not used
V50	→	30	Velocity scaling factor = 30 counts/ms
V51	→	50	Velocity loop gain
V52	→	0	Velocity loop rate
V53	→	0	Velocity loop reset)
V54	→	0	Velocity/pressure operation = default
V55	→	50	Pressure loop gain
V56	→	0	Pressure loop rate
V57	→	0	Pressure loop reset
V58	→	0	Velocity/pressure data acquisition = default
V59	→	16000	Any number approximately half of shot size
V60	→	3000	Any number slightly greater than end of fill position
V61–V68	→	0	Other steps to be filled in later
V69	→	8000	Velocity = 1/4 speed
V70	→	4000	Velocity = 1/8 speed
V71–V78	→	0	Other steps to be filled in later
V79	→	8000	Pressure = 1/4 of maximum
V80	→	8000	Pressure = 1/4 of maximum
V81–V88	→	0	Other steps to be filled in later
Note: The two steps shown for each profile can be from Step 1 to 10.			

Table 3-5 Download Table (continued)

Location		Value	Description of Function
Pack and Hold Profile			
V89	→	5000	Sets module scan to 5 ms during pack and hold
V90	→	0	Sets minimum profile position to end of stroke
V91	→	32000	Sets hold transition pressure to maximum
V92	→	32000	Sets cavity transition pressure to maximum if equipped
V93	→	0	Not used
V94	→	30	Velocity scaling factor = 30 counts/ms
V95	→	50	Velocity loop gain
V96	→	0	Velocity loop rate
V97	→	0	Velocity loop reset
V98	→	0	Velocity/pressure operation = default
V99	→	50	Pressure loop gain
V100	→	0	Pressure loop rate
V101	→	0	Pressure loop reset
V102	→	0	Velocity/pressure data acquisition = default
V103	→	200	Time for first pack and hold step = 2 seconds
V104	→	500	Time for second pack and hold step = 3 seconds Note accumulation
V105–V112	→	0	Other steps to be filled in later
V113	→	100	Set small velocity to open flow valve
V114	→	100	Set small velocity to open flow valve
V115–V122	→	0	Other steps to be filled in later
V123	→	8000	Pressure = 1/4 of maximum
V124	→	2000	Pressure = 1/8 of maximum
V125–V132	→	0	Other steps to be filled in later

Note: The two steps shown for each profile can be from Step 1 to 10.

Table 3-5 Download Table (continued)

Location		Value	Description of Function
Plasticate Profile			
V133	→	5000	Sets module scan to 5 ms during plasticate
V134	→	32767	Sets max profile time to infinity
V135	→	32767	Sets cure timer to infinity if so equipped
V136	→	0	Not used
V137	→	0	Not used
V138	→	30	Velocity scaling factor = 30 counts/ms
V139	→	50	Velocity loop gain
V140	→	0	Velocity loop rate
V141	→	0	Velocity loop reset
V142	→	0	Velocity/pressure operation = default
V143	→	50	Pressure loop gain
V144	→	0	Pressure loop rate
V145	→	0	Pressure loop reset
V146	→	0	Velocity/pressure data acquisition = default
V147	→	16000	Any number approximately half of shot size
V148	→	25000	Any number to accomplish shot size
V149–V156	→	0	Other steps to be filled in later
V157	→	500	Set small velocity to open flow valve
V158	→	500	Set small velocity to open flow valve
V157–166	→	0	Other steps to be filled in later
V167	→	500	Back pressure = near 0psi
V168	→	900	Back pressure = near 0psi
V169–V176	→	0	Other steps to be filled in later

Note: The two steps shown for each profile can be from Step 1 to 10.

Startup Values and Examples (continued)

Table 3-5 Download Table (continued)

Location		Value	Description of Function
Clamp Open Profile			
V177	→	5000	Sets module scan to 5 ms during open
V178	→	300	Sets opening time to 3 seconds maximum
V179	→	0	Not used
V180	→	0	Not used
V181	→	0	Not used
V182	→	30	Velocity scaling factor = 30 counts/ms
V183	→	50	Velocity loop gain
V184	→	0	Velocity loop rate
V185	→	0	Velocity loop reset
V186	→	0	Velocity/pressure operation = default
V187	→	50	Pressure loop gain
V188	→	0	Pressure loop rate
V189	→	0	Pressure loop reset
V190	→	0	Velocity/pressure data acquisition = default
V191	→	1600	Any number approximately half open
V192	→	2500	Any number fully open position
V193–V200	→	0	Other steps to be filled in later
V201	→	8000	Velocity = 1/4 speed
V202	→	4000	Velocity = 1/8 speed
V203–V210	→	0	
V211	→	8000	Pressure = 1/4 of maximum
V212	→	4000	Pressure = 1/8 of maximum
V213–V220	→	0	Other steps to be filled in later

Note: The two steps shown for each profile can be from Step 1 to 10.

Hold values are output to the respective channels whenever those channels are not actively controlled in a profile. Hold values are usually zero for toggle machines, as shown in Table 3-5.

Table 3-5 Download Table (continued)

Location		Value	Description of Function
Hold Values			
V221	→	0	Channel 1 output
V222	→	0	Channel 2 output
V223	→	0	Channel 5 output
V224	→	0	Channel 6 output
V225	→	0	Sets all outputs to 0 to +10 V during hold mode—see constant 10 in each profile for output range during profile execution

Several status words are provided to monitor the process operation, determine if the cycle is complete, how it completed, or if something is wrong. To take advantage of this information, display these words on your operator interface and/or build a status table in TISOFT to monitor locations. See Table 3-6.

Table 3-6 Status Words

Location		Description		Location		Description		Location		Description	
WX1	→	Step number	(D)	V301	→	Scan time	(D)	**V312	→	Close complete	(B)
WX2	→	Completes	(B)	V302	→	Clamp position	(D)	**V313	→	Injection complete	(B)
*WX3	→	Errors	(B)	V303	→	Clamp velocity	(D)	**V314	→	Pack complete	(B)
WX4	→	I/O channel	(D)	V304	→	Clamp flow	(D)	**V315	→	Plasticate complete	(B)
WY5	→	Download table	(D)	V305	→	Clamp pressure	(D)	**V316	→	Open complete	(B)
WY6	→	Upload table	(D)	V306	→	Clamp pressure	(D)				
WY7	→	Run/Stop	(D)	V307	→	Ram position	(D)				
WY8	→	Start Cycle	(B)	V308	→	Ram velocity	(D)				
				V309	→	Ram flow	(D)				
				V310	→	Ram pressure	(D)				
				V311	→	Ram pressure	(D)				

(D) = decimal display (B) = binary display

* Be sure to check bits 3 and 4 of word WX3 for correct setting of dipswitches for your machine configuration before attempting to run. See Table 3-2 for setting details. It is recommended that a check for correct configuration is provided in RLL that alarms if an incorrectly configured module is ever inserted into the base.

** Values in V312–V316 remain intact until the next time the same type profile is completed at which time they are overwritten.

Chapter 4

Discrete Outputs

4.1 Description

The module includes four fast-response discrete outputs. The outputs are updated by the module, thus avoiding delays caused by PLC scan rates. This provides you with a means to control auxiliary processes or functions without the additional cost and space requirements of a separate module.

The discrete output circuits are of the sourcing configuration, acting as a switch to supply voltage/current (from a user-provided power supply) to the application load. The outputs cannot be used in a sinking configuration, which provides a current path from the negative side of the load to ground. See examples in Figure 4-1.

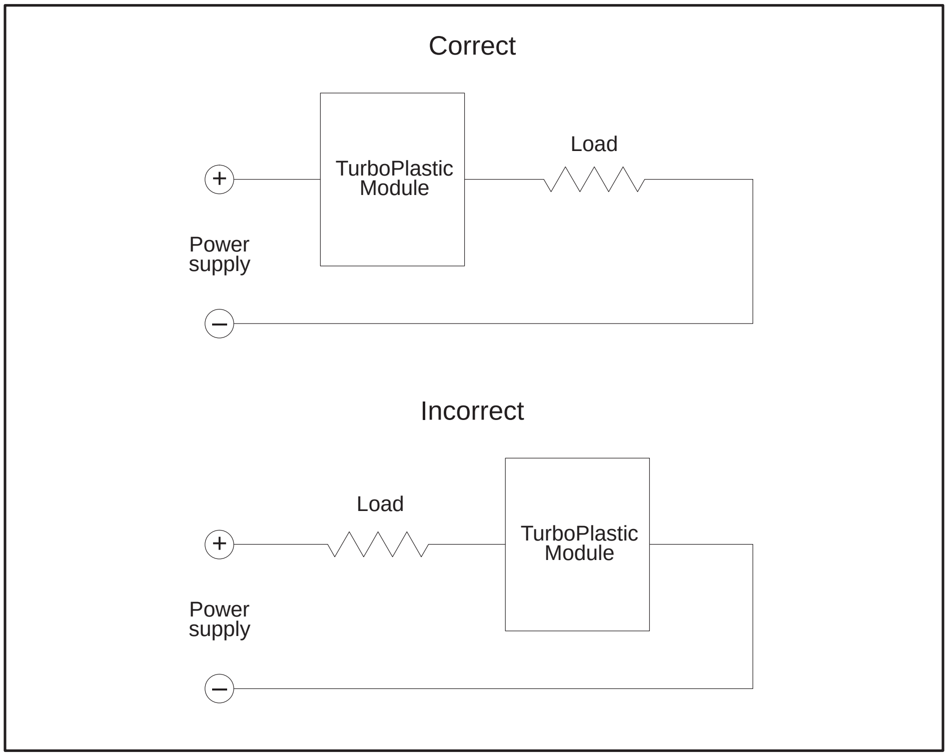


Figure 4-1 Discrete Output Circuits

NOTE: Before attempting to use the discrete outputs, refer to the specifications in Section 4.2 for important rating information.

4.2 Specifications

Discrete Output Specifications

Item	Value
Total output current (all outputs on)	0.90 A (40°C) 0.75 A (60°C)
Maximum current per output	0.50 A (40°C) 0.40 A (60°C)
Rated voltage	15 to 24 VDC
Operating voltage range	12 to 30 VDC
Temporary overload	2.0 A for 1 ms
Maximum on-state voltage drop	0.5 VDC
Maximum off-state leakage current	0.2 mA
Kickback protection	diode
Maximum delay time through module (with 5 mA minimum load)	1 ms on to off 1 ms off to on
Type of outputs	non-latching, unprotected
Output fuse rating	1amp, 125 V, normal blow, 5x20 mm

4.3 Discrete Output Control

4.3.1
Download Table Words 236–255

Control of each discrete output is done in ten steps. These ten steps correspond with the analog ten-step profile. Each profile is assigned a 16-bit word for each discrete output. See Figure 4-2.

Bit 6 is the enable/disable bit for each word. A value of 1 in bit 6 enables the discrete output in that profile and a value of 0 in bit 6 disables it. A discrete output cannot be turned on unless bit 6 of its control word is set to 1. Bits 7–16 represent steps 10 through 1, respectively. A value of 1 in any of bits 7–16 turns on that discrete output during the corresponding step of that profile. A value of 0 in any of the bits 7–16 turns off that discrete output during the corresponding step of that profile. Table 4-1 lists the download table memory map.

As shown in Figure 4-2, clamp close profile word 236, discrete output 1 is on in steps 1 to 4, off in steps 5 to 8, and on in steps 9 and 10.

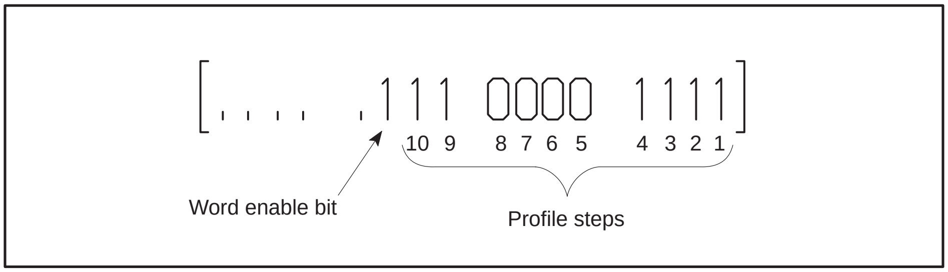


Figure 4-2 Sample Discrete Output Control Values

Table 4-1 Download Table Memory Map

Location	Profile	Discrete Output	Location	Profile	Discrete Output
236	Clamp close	1	248	Plasticate	1
237		2	249		2
238		3	250		3
239		4	251		4
240	Inject	1	252	Clamp open	1
241		2	253		2
242		3	254		3
243		4	255		4
244	Pack and hold	1			
245		2			
246		3			
247		4			

4.4 Discrete Output Hold Values

4.4.1
Download Table Word 225

Bits 13 to 16 of word 225 determine the state of the discrete outputs in idle mode. When the bit is set to 1, the discrete output will be on until the beginning of the next profile. The appropriate word in the next profile keeps the output on or instructs it to turn off. A bit set to zero turns the output off during idle mode.

Bit 16 Discrete output 1

1 16	Description
[.... ....0]	off
[.... ....1]	on

Bit 15 Discrete output 2

1 16	Description
[.... ....0.]	off
[.... ....1.]	on

Bit 14 Discrete output 3

1 16	Description
[.... .... .0..]	off
[.... .... .1..]	on

Bit 13 Discrete output 4

1 16	Description
[.... .... 0...]	off
[.... .... 1...]	on

4.5 Discrete Output Status

4.5.1 Upload Table Word 56

Bits 13 to 16 of word 56 report the status of the discrete outputs to the PLC. The module does not have LEDs to indicate output conditions, so these bits are provided to permit monitoring by the user.

⚠ CAUTION

Bits 13–16 indicate commands sent to the logic side of the module only; they provide no indication of the status of the output on the user's side of the module. LEDs or other indicators should be used if it is critical to monitor the status of the outputs on the load side of the module.

Bit 16 Discrete output 1

1 16	**Description**
`[.... .... .... ...0]`	Discrete output off
`[.... .... .... ...1]`	Discrete output on

Bit 15 Discrete output 2

1 16	**Description**
`[.... .... .... ..0.]`	Discrete output off
`[.... .... .... ..1.]`	Discrete output on

Bit 14 Discrete output 3

1 16	**Description**
`[.... .... .... .0..]`	Discrete output off
`[.... .... .... .1..]`	Discrete output on

Bit 13 Discrete output 4

1 16	**Description**
`[.... .... .... 0...]`	Discrete output off
`[.... .... .... 1...]`	Discrete output on

4.6 Module Connections

4.6.1 Discrete Connectors

Table 4-2 contains the discrete output connector pinout table.

Table 4-2 Discrete Output Connector Pinout Table

Function	Connector Terminal
Output 1550	D5
Output 2	D6
Output 3	D7
Output 4	D8
DC supply (+)*	DC
DC return (–)	DR

* See Figure 3-5 for fuse location. See Figure 3-8 for connector pinout diagram.

4.6.2 Functional Wiring

Figure 4-3 shows the functional wiring diagram.

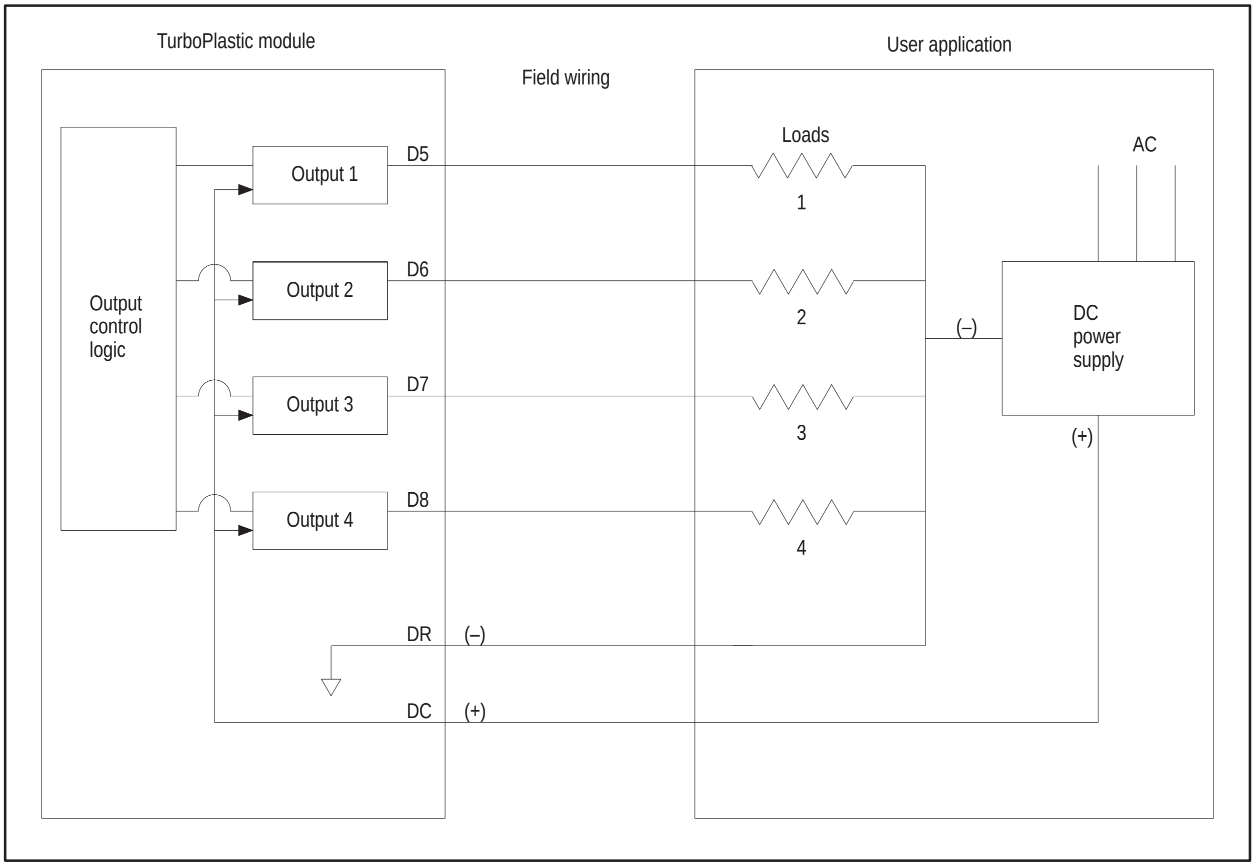


Figure 4-3 Functional Wiring Diagram

Chapter 5

Selected Functions

5.1 Overlapping Cycle

The overlapping cycle functionality of the TurboPlastic module provides the capability to perform plasticate during the clamp open profile, and part removal in addition to the normal plasticate profile.

The feature is activated by setting bit numbers 4, 5, and 6 of word WY8 to 1 which enables plasticate, clamp open, and overlapping cycles.

When bit number 6 of word WY8 is set, a cure timer* determines when the clamp opening cycle begins. (A cure timer determines the completion of the plasticate cycle in the non-overlapping mode.) The cure timer is located at position number 135 in the download table, which is the third value in the plasticate portion of the table.

If the appropriate bits are set, and the cure timer is set to a value that is less than the time required for plasticate to complete, then the clamp opens and overlap occurs. If the cure timer is set to a value greater than the time required to complete plasticate, then the clamp is held closed until the cure timer expires, and no overlap occurs. Even though the cure timer has expired and clamp close has completed, the plasticate cycle continues to run if required to do so by the plasticate profile.

During execution, instructions are read from the PLC and status information is reported back to the PLC. Exceptions to the normal (sequential) operation are described in paragraphs 5.1.1 and 5.1.2.

5.1.1 Module Sample Rate

The sample rate for the nonconcurrent portions of operation for both the plasticate and clamp close profiles is determined by the values of Word #1 in their respective download tables. However, during the overlapping portions of the cycle, the sample rates are added together, thereby increasing the module scan time to a value equal to the combined values.

Example:

Plasticate sample rate (V133) = 5000 or 5 ms
Clamp open sample rate (V177) = 3000 or 3 ms

Module scan time during plasticate only = 5 ms
Module scan time during plasticate and clamp = 8 ms
Module scan time during clamp open only = 3 ms

* See List of Terms in Chapter 1 for description of cure time.

5.1.2
Step Numbers

Each profile can be programmed with as few as one or as many as ten steps. Word WX1, module cycle status, is continuously updated with the profile number and step number within that profile. See Table 2-1 for WX1 details.

- Step numbers, while the plasticate cycle is running by itself, are reported as 401, 402, 403, etc., as in normal operation.
- Step numbers, while the clamp opening cycle is running by itself, are reported as 501, 502, 503, etc., as in normal operation.
- While the plasticate and clamp open profiles are running simultaneously (overlapping cycles), step numbers are reported in the format **1xxyy**, where **1** indicates the overlapping operation, **xx** indicates the plasticate step being run, and **yy** indicates the clamp open step being run.

For example, WX1 = 10305 indicates overlapping operation with plasticate profile in step 3 and clamp closing profile in step 5.

5.2 PID Algorithms

The TurboPlastic module provides two distinct user-selectable PID algorithms that give different control responses (see PID, Section 1.3). Algorithm selection depends on the machine controlled by the user and the response desired.

5.2.1 Standard PID Algorithm

The standard PID algorithm is one of several offered in the 505 series of controllers, except that when a change of set point is requested, this new setpoint value is immediately output. This provides an instantaneous or “step” change in the output to the new setpoint value. PID control then takes place about the setpoint value. In one case, you can select set point output as an option; see constant 14, bit 8, page 2-19.

The basic equation for the standard PID algorithm is as follows:

$$\begin{array}{rcll}
k_c & = & gain & input\ from\ V\ memory\ table \\
t_d & = & rate & \text{″} \\
t_i & = & reset & \text{″} \\
t_s & = & scantime & \text{″} \\
vsf & = & velocity\ scaling\ factor & \text{″} \\
setpoint & = & setpoint\ from\ table & \text{″} \\
prev\ pos & = & previous\ position & input\ from\ a/d \\
curr\ pos & = & current\ position & \text{″}
\end{array}$$

Calculate integral constant term:

$$k_i = \frac{1000 \ * \ gain \ * \ scantime}{reset}$$

Calculate derivative constant term:

$$k_d = \frac{gain \ * \ rate}{scantime \ * \ 1000}$$

Calculate process variable:

$$PV\ new = \frac{[prev\ pos - curr\ pos] \ * \ 32000}{vsf}$$

Calculate new error term:

$$curr\ err = setpoint - PV\ new$$

Calculate new bias term:

$$trial\ m_x = k_i \ * \ curr\ err + setpoint$$

$$trial\ m_n = \frac{k_c \ * \ curr\ err}{1000} - k_d \ * \ (PV\ new - PV\ old) + trial\ m_x$$

Calculate new output value:

$$new\ output = trial\ m_n$$

5.2.2 Standard PID Algorithm Trace

Figure 5-1 shows the trace of a typical response for the standard PID algorithm.

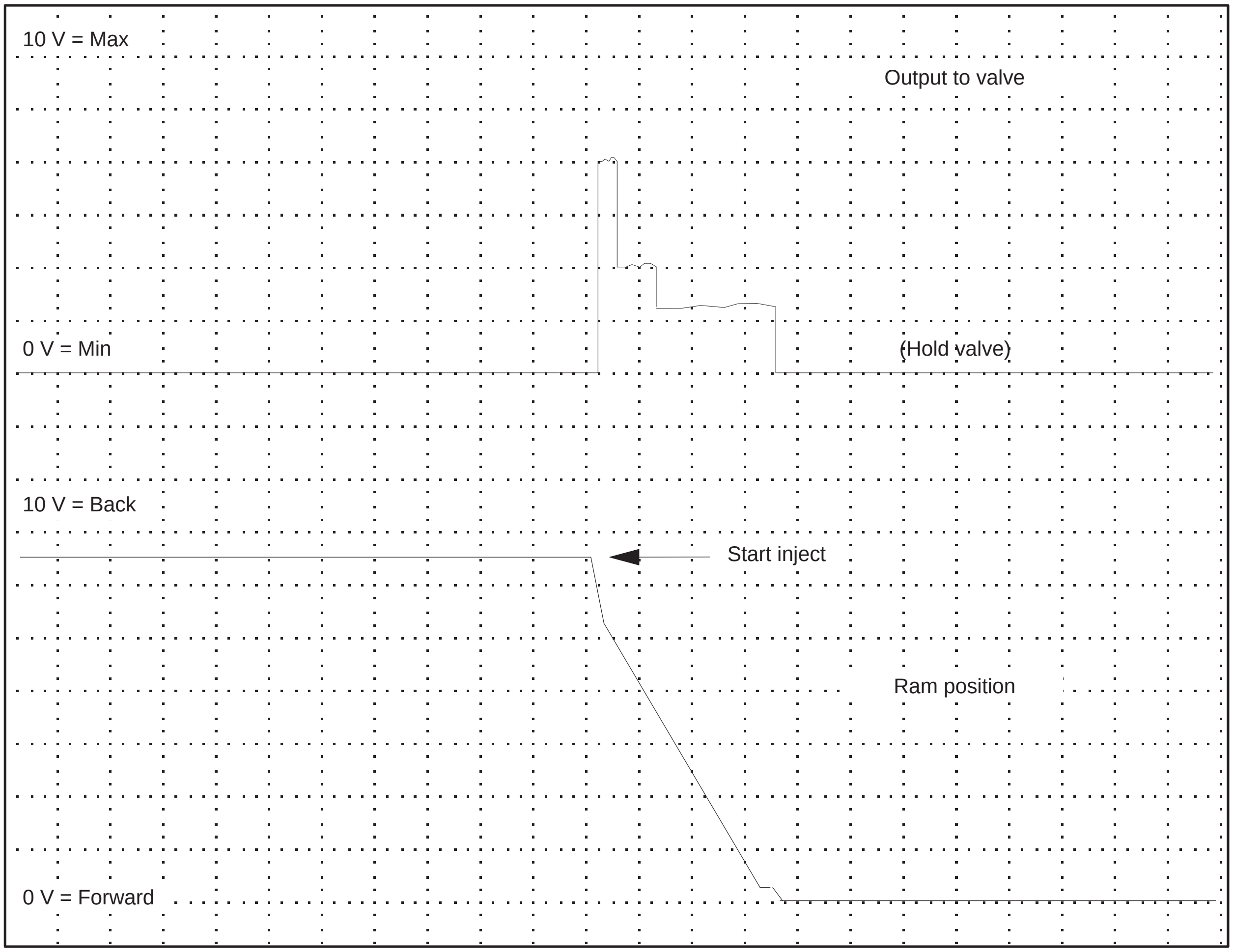


Figure 5-1 Standard Velocity PID Algorithm

5.2.3 Dynamic PID Algorithm

The dynamic PID algorithm is a variation of the implementation suggested for use with the DSP chip applications. As is suggested by its name, this algorithm is faster-reacting and consequently does not require that the setpoint be forced into the output upon change.

The basic equation for the dynamic PID algorithm is as follows:

$$\begin{array}{rcll}
k_c & = & gain & \text{input from V memory table} \\
t_d & = & rate & \quad '' \\
t_i & = & reset & \quad '' \\
t_s & = & scantime & \quad '' \\
vsf & = & \text{velocity scaling factor} & \quad '' \\
setpoint & = & \text{setpoint from table} & \quad '' \\
prev\ \ pos & = & \text{previous position} & \text{input from } a/d \\
curr\ \ pos & = & \text{current position} & \quad ''
\end{array}$$

Calculate integral constant term:

$$k_i = \frac{1000 \ * \ gain \ * \ scantime}{reset}$$

Calculate derivative constant term:

$$k_d = \frac{gain \ * \ rate}{scantime \ * \ 1000}$$

Calculate process variable:

$$PV\ \ new = \frac{[prev\ pos - curr\ pos] \ * \ 32000}{vsf}$$

Calculate new error term:

$$curr\ err = setpoint - PV\ \ new$$

Calculate new bias term:

$$trial\ \ m_x = k_i \ * \ curr\ \ err + prev\ \ output$$

Calculate new output value:

$$trial\ \ m_n = \frac{k_c \ * \ curr\ \ err}{1000} - k_d \ * \ (PV\ \ new - PV\ \ old) + trial\ \ m_x$$

$$new\ \ output = trial\ \ m_n$$

5.2.4 Dynamic PID Algorithm Trace

Figure 5-2 shows the trace of a typical response for the dynamic PID algorithm.

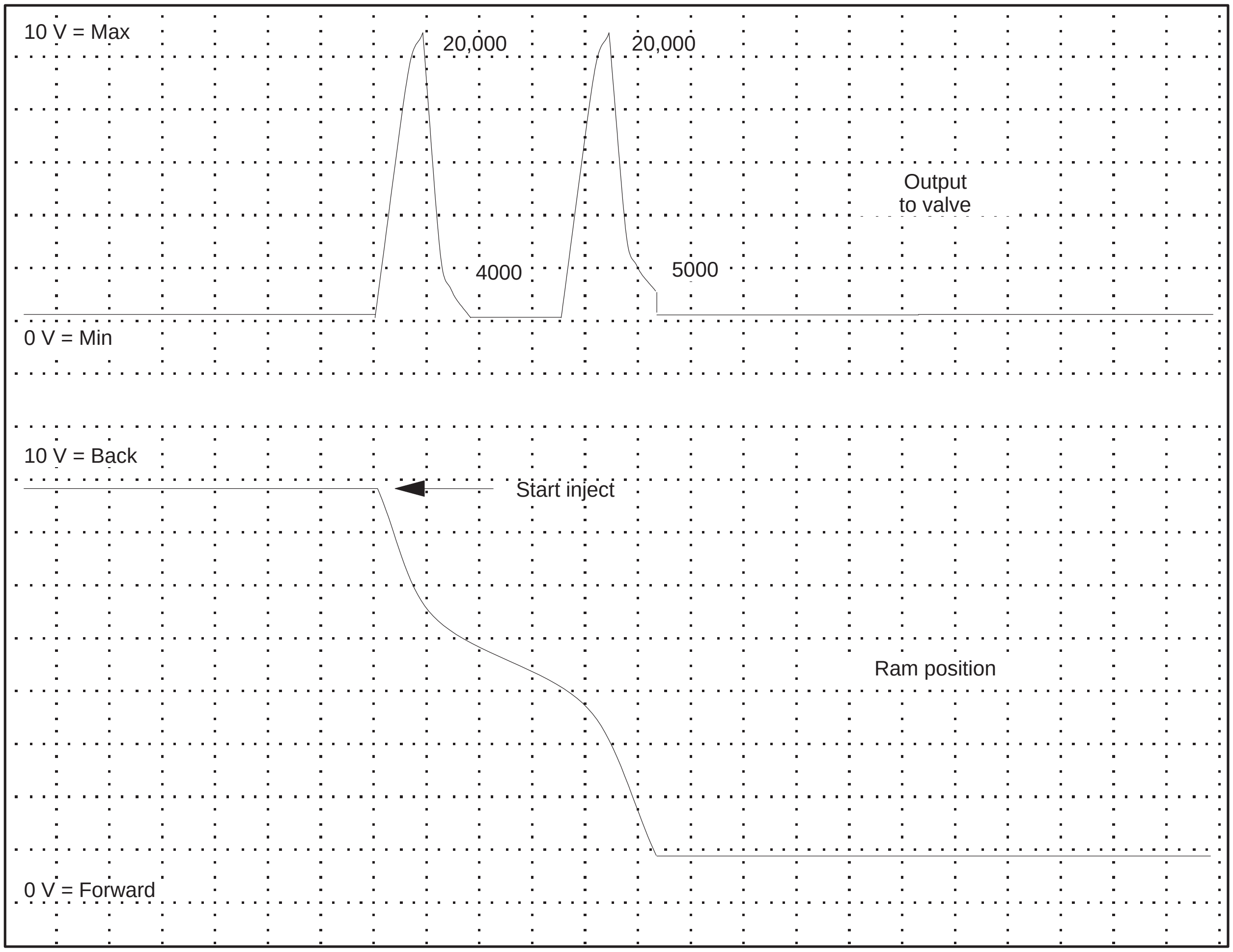


Figure 5-2 Dynamic Velocity PID Algorithm

5.3 Software Filters

The TurboPlastic module provides several distinct user-selectable software filters to allow operation in spite of noisy input signals. These filters are provided for use when ambient noise is slightly above normal and when random spikes on the input might occur. These filters are not effective for noise levels substantially above recommended levels.

5.3.1
Filter on Range

A ranging filter is provided for use when random spikes may be present on the input. This filter computes the difference between the current position reading and the last position reading and compares this value to the velocity scaling factor (VSF) that has been entered for the profile.

- If the difference is less than the VSF, the value is used as read.
- If the difference is greater than the VSF, the value is accumulated into an averaging register, and another reading is requested from the analog input.

This process is repeated until a valid reading is obtained or the maximum number of 10 reads has been reached. At that time the average is used in the velocity calculation and the module continues its normal scan operation.

Since the TurboPlastic module can complete an analog input read in about 25 microseconds, a number of reads can be allowed in the same scan without substantially affecting the over-all module performance.

5.3.2
Filter on Position

A filter on position* is provided for cases where low levels of harmonics are present. While this filter has its constants specifically chosen for 60 Hz harmonic rejection, it does work with many other harmonics as well.

The formula for this first order filter and an example with values follows:

$$\textit{new input} = \textit{filter constant}\ (\textit{read input} - \textit{previous input}) + \textit{previous input}$$

$$\begin{aligned} \textit{new input} &= 1(200 - 100) + 100 \\ &= 1(100) + 100 \\ &= 100 + 100 = \underline{200} \end{aligned}$$

A smaller filter constant gives more damping of input and more effective filtering. The example below illustrates the effect of a smaller filter constant on new input value.

$$\begin{aligned} \textit{new input} &= 0.1(200 - 100) + 100 \\ &= 0.1(100) + 100 \\ &= 10 + 100 = \underline{110} \end{aligned}$$

---

*See Constant 14, bits 4–7 on page 2-19.

5.4 Ramping Function

The TurboPlastic module provides a ramping function for both velocity and pressure control functions during open loop operation of all profiles. The ramping function is activated by setting appropriate bits in Constant 10 in the download table of each profile.

In normal open loop operation, the setpoints are output as step changes for both pressure and velocity. With the ramping function activated instead of the step function output, the output varies on a slope or ramp that increases or decreases proportionally from the starting position to the position in the next step in the profile table. Figure 5-3 shows the open loop output without ramping and Figure 5-4 shows the open loop output with ramping.

5.4.1 Velocity Ramp Example

Clamp Close Profile Table

	Position	**Velocity**	**Pressure**
Current	6 in		
Step 1	5 in	3 ips	1200 psi
Step 2	4 in	8 ips	1800 psi
Step 3	3 in	2 ips	1200 psi
Step 4	2 in	6 ips	1500 psi
Step 5	1 in	6 ips	1500 psi
Step 6	0 in	1 ips	600 psi

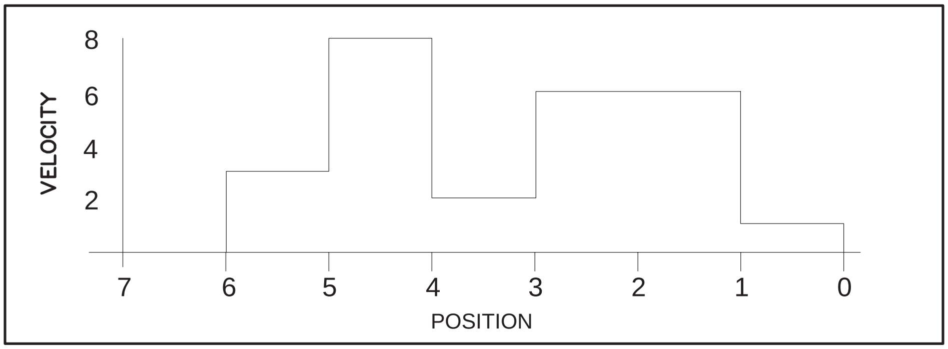


Figure 5-3 Open Loop Output without Ramping

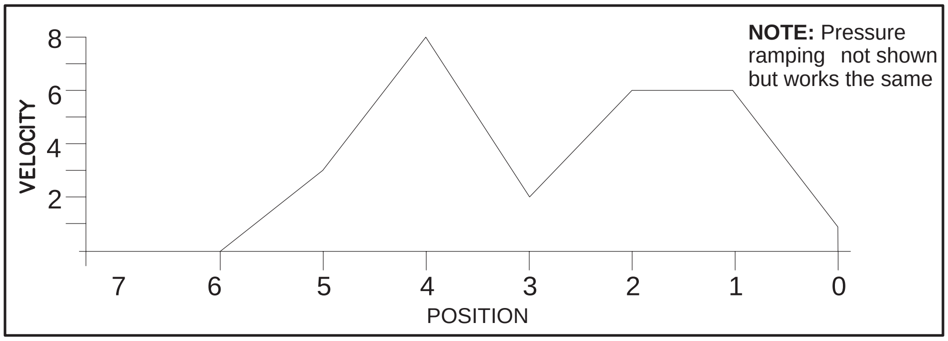


Figure 5-4 Open Loop Output with Ramping

5.5 Cavity Pressure

The cavity pressure function reads the pressure of the plastic material as it fills the mold cavities.

5.5.1 Cavity Pressure Sensor

A pressure sensor must be installed in one of the mold cavities and wired to the appropriate TurboPlastic module channel to provide the input signal value. You can observe the cavity pressure value at any time by monitoring variable 34 in the upload table.

5.5.2 Cavity Fill Time

You can use cavity pressure to determine the length of time to fill a cavity. The cavity-fill time is defined as the time it takes for the cavity pressure to reach the cavity-fill pressure setpoint entered into the download table. Since the fill pressure may be reached in either inject or pack-and-hold, depending on how the profiles are programmed, the capability to make this measurement is provided for both profiles. The cavity-fill pressure setpoint for inject is table variable 49, and for pack is 93 in the download table. When this value is entered, the length of time to fill a cavity during inject can then be read from the upload table variable 30, and during pack-and-hold from variable 31 in the upload table.

5.5.3 Peak Cavity Pressure

Also available for both inject and pack-and-hold is the peak cavity pressure that occurred during the profile, and the cavity reading at the end of each of the profiles. These can be read from variables 32 and 20, in the upload table, respectively, for inject, and variables 33 and 25, respectively, for pack-and-hold. Both of these values are useful in determining where to set the transition and fill pressure setpoints.

NOTE: A spill or surge in the system could enter as a peak value in these locations if it is a greater value than the current value.

Bits are provided to determine whether the maximum cavity pressure to transition is causing a profile to complete. By testing for bit 5 in words 13 and 14 of the upload table at the completion of a profile, you can determine if the inject (word 13) or pack-and-hold (word 14) profiles completed on cavity pressure. These bits stay in place until the next time that profile is completed.

You can use the cavity pressure to end both the inject and pack-and-hold cycles. The maximum cavity pressure to transition for inject is entered into download table variable 48, and for pack-and-hold variable 91. To disable this function in either profile, enter the value 32767 into the table.

5.6 Cushion Control

Cushion control is an attempt to maintain a consistent end-of-inject position. Its goal is to eliminate rejects due to short shots.

The cushion control loop retains an actual screw position at the end of injection profile and compares it with the required value (location V136 in the download table). Any deviation is then added to or subtracted from the shot-size setpoint. (i.e., the last step of the plasticate profile) on the next shot. As long as the cushion control bit is enabled (bit 6 of constant 10 is set to 1), the cushion control process keeps track of the deviation from one cycle to the next. To start out with a new deviation or to disable the cushion control feature, set the cushion control bit to 0.

The cushion control loop also includes the following features:

- Correction gain (location V137 in the download table) — allows the control loop to make corrections as a percentage of the deviation. This allows making corrections in incremental steps rather than in one large step. Correction gain resolution is from 0.01% to 320%.
- Cushion values report — allows data collection for various applications, such as safety checking for leaky ring, checking for lack of material, SPC/SQC, etc. Cushion values are found in the Upload table in location V57 for the adjusted cushion value and V58 for the adjusted last step of plasticate profile position step-data.

5.7 SPC/SQC

5.7.1 Data Collected by All Profiles

SPC/SQC profile data is concentrated from memory locations (WY6)+V35 to (WY6)+V55 of the Upload table:

V35	Profile ID
V36 – V45	Velocity Input Average data
V46 – V55	Pressure Input Average data

NOTE: These locations are updated at the end of a profile after it has completely executed. If you need to retain this data for later use, you must copy it to another location before the next profile execution completes.

All profiles collect the following types of data at the end of a profile after execution.

NOTE: *For Overlap mode (executing Plasticate profile and Clamp Open profile in the same machine cycle):* Because of the restriction in available memory, the module updates only plasticate SPC/SQC data and does not update for Clamp Open profile.

- **Profile ID.** This location identifies the type of profile collecting data:

  100 = Clamp Close profile
  200 = Injection profile
  300 = Pack and Hold profile
  400 = Plasticate profile
  500 = Clamp Open profile

- **Velocity Input Average.** These 10 locations correspond to a profile step data. (For example: if reporting data for a Clamp Close profile, location 36 is the average velocity input for clamp close step 1 position data.)

  Averaging of each location is based on a 10-sliding-window value method. For example, if the module took 20 position readings during a step and turned them into velocities, the average velocity will be calculated (at the transition of the step to the next) by using only the last 10 values. If the number of calculated velocities is less than 10, the module uses the actual number of calculated velocities for calculating the average.

- **Pressure Input Average.** These 10 locations correspond to a profile step data. (For example: if reporting data for a Clamp Close profile, location 36 is the average pressure input for clamp close step 1 position data.)

  Averaging of each location is based on a 10-sliding-window value method. For example, if the module took 20 pressure readings during a step, the average pressure will be calculated (at the transition of the step to the next) by using only the last 10 values. If the number of pressure readings is less than 10, the module uses the actual number of readings for calculating the average.

5.7.2
Additional Data Collected by Injection and Pack/Hold Profiles

For Injection and Pack/Hold profiles, the module collects additional data at the end of a profile:

- For Injection Profile:

V17	Inject final ram position
V18	Inject final calculated velocity
V19	Inject final ram pressure
V20	Inject final cavity pressure

- For Pack/Hold Profile:

V22	Pack/Hold final ram position
V23	Pack/Hold final calculated velocity
V24	Pack/Hold final ram pressure
V25	Pack/Hold final cavity pressure

5.8 Scaling Constants

With machine configuration #3, a single valve controls flow and pressure. At different intervals in the profile, control is switched between flow and pressure; because of the valve design, there is more gain during pressure control mode than during flow control mode.

Constants are provided in the Download table to allow you to reduce a pressure output. These constants are stored in (WY5)+V226 to (WY5)+V235. There are three restrictions for using these constants:

- Use only with machine configuration #3.
- Use only in Injection, Pack-and-Hold, Plasticate profiles.
- Use only on pressure outputs.

For example, if the injection pressure loop calculates an output value of 32000 and (WY5)+V228 = 10, the actual output equals 3200.

5.9 Reverse Acting

The Reverse Acting option is available only in closed-loop mode for velocity loop and pressure loop. You select this option with bits 9 and 10 of constant #14:

Bit 9	Velocity Loop 0 = No Reverse Action 1 = Reverse Acting
Bit 10	Pressure Loop 0 = No Reverse Acting 1 = Reverse Acting

For example: with Reverse Acting selected, the module performs the following calculation:

Actual Output = 32000 – PID loop output

If loop output = 32000, then reverse acting output = 0.

If loop output = 0, then reverse acting output = 32000.

5.10 End-of-Profile Conditions

5.10.1 Checking End-of-Profile Condition

Different conditions cause profiles to terminate execution. You can determine the condition when the profile terminated by checking the following:

- WX2
- (WY6)+ V12 *for* Clamp Close status bits
  V13 *for* Inject status bits
  V14 *for* Pack and Hold status bits
  V15 *for* Plasticate status bits
  V16 *for* Clamp Open status bits

Table 5-1 shows the types of conditions causing termination for the different profiles.

Table 5-1 Locations for Conditions Causing Profile Termination

Profile	Conditions Causing Termination of Profile					
	Max Time	**Min Position**	**Time**	**Position**	**Pressure**	**Emergency**
Clamp Close (WY6)+V12	(WY5)+V2			(WY5)+V15 to (WY5)+V24		WY8 = 0 *or* WY7 ≠ 1121
Inject (WY6)+V13	(WY5)+V46			(WY5)+V59 to (WY5)+V68	(WY5)+V47 and (WY5)+V48	WY8 = 0 *or* WY7 ≠ 1121
Pack/Hold (WY6)+V14		(WY5)+V90	(WY5)+V103 to (WY5)+V112		(WY5)+V91 and (WY5)+V92	WY8 = 0 *or* WY7 ≠ 1121
Plasticate (WY6)+V15	(WY5)+V134			(WY5)+V147 to (WY5)+V156		WY8 = 0 *or* WY7 ≠ 1121
Clamp Open (WY6)+V16	(WY5)+V178			(WY5)+V191 to (WY5)+V200		WY8 = 0 *or* WY7 ≠ 1121
To disable transition conditions:	To disable transition conditions, load 32767 in location identified in Table 2-9	To disable transition conditions, load 32767 in location identified in Table 2-9	Not Applicable	Not Applicable	To disable transition conditions, load 32767 in location identified in Table 2-9	Not Applicable

5.10.2
Clamp Close Profile

The following conditions cause termination of the Clamp Close profile:

- **Maximum Time:** the profile execution time exceeds the maximum profile time. Check location (WY5)+V2.
- **Position:** either the profile step position data encounters a zero value in one of the steps, or it goes past the last step position data (past step #10). Check locations (WY5)+V15 to (WY5)+V24.
- **Emergency Exit:** indicated by WY8=0 or WY7≠1121.

NOTE: Lock-over velocity and pressure values are output if the profile was completed on position and if lock-over time has a timer value greater than 0. (A zero value means there is no lock-over time.) Lock-over feature will not activate if maximum profile time is exceeded or if an emergency exit occurs.

5.10.3
Injection Profile

The following conditions cause termination of the Injection profile:

- **Maximum Time:** the profile execution time exceeds the maximum profile time. Check location (WY5)+V46.
- **Position:** either the profile step position data encounters a zero value in one of the steps, or it goes past the last step position data (past step #10). Check locations (WY5)+V59 to (WY5)+V68.
- **Pressure:** either the pressure input exceeds the maximum pressure-to-transition value, or the cavity pressure input exceeds the maximum cavity-pressure-to-transition value. Check locations (WY5)+V47 and (WY5)+V48.
- **Emergency Exit:** indicated by WY8=0 or WY7≠1121.

5.10.4 Pack and Hold Profile

The following conditions cause termination of the Pack and Hold profile:

- **Time:** either the profile step time encounters a zero value in one of its steps, or it goes past the last step time data (past step #10). Check locations (WY5)+V103 to (WY5)+V112.
- **Minimum Position:** the position input is smaller than the profile minimum end position. Check location (WY5)+V90.
- **Pressure:** either the pressure input exceeds the maximum pressure-to-transition value, or the cavity pressure input exceeds the maximum cavity-pressure-to-transition value. Check locations (WY5)+V91 and (WY5)+V92.
- **Emergency Exit:** indicated by WY8=0 or WY7≠1121.

5.10.5 Plasticate Profile

The following conditions cause termination of the Plasticate profile:

- **Maximum Time:** the profile execution time exceeds the maximum profile time. Check location (WY5)+V134.
- **Position:** either the profile step position data encounters a zero value in one of the steps, or it goes past the last step position data (past step #10). Check locations (WY5)+V147 to (WY5)+V156.
- **Emergency Exit:** indicated by WY8=0 or WY7≠1121.

NOTE: If cure time is loaded with a timer value greater than 0, the profile completion bit in WX2 will not be on (for maximum time and position conditions) until the cure time has expired. In this case, to detect plasticate profile completion condition before cure time expires, check V15 completion status bit on upload table.

If the auto-cushion feature has been selected, the last position profile step data could vary, depending on how much cushion is needed.

5.10.6
Clamp Open Profile

The following conditions cause termination of the Clamp Open profile:

- **Maximum Time:** the profile execution time exceeds the maximum profile time. Check location (WY5)+V178.
- **Position:** either the profile step position data encounters a zero value in one of the steps, or it goes past the last step position data (past step #10). Check locations (WY5)+V191 to (WY5)+V200.
- **Emergency Exit:** indicated by WY8=0 or WY7≠1121.

5.11 Suggestions for Tuning Loops

These suggestions assume that you have some knowledge of PID terminology and are familiar with the operation of the TurboPlastic module. Use them as guidelines in tuning a loop, but understand that each application has its own characteristics.

Understanding of the PID loops available in the TurboPlastic module, as well as how the loops react, is helpful. There are two user-selectable loops in the TurboPlastic module. Either can be selected to control velocity and/or pressure loops. Since one algorithm is not superior to the other, experiment with both while adjusting the process. The different characteristics of the two algorithms may make one algorithm more suitable to the particular machine being run.

5.11.1
Standard PID Algorithm

The standard PID loop was modeled on the 505 system controller loop algorithm. Within this loop, the setpoint can be forced into the loop bias term each time there is a change in setpoint. Since the setpoint is output at the first loop calculation, the control on this loop is taken instantaneously around the setpoint, the PID algorithm reaction does not need to be quick. Gain and reset are almost always used in tuning this loop. This algorithm is used more frequently for controlling pressure loops.

5.11.2
Dynamic PID Algorithm

The dynamic PID loop was modeled on the TMS320C25 chip algorithm with some minor adaptations. Within this loop, the calculation starts by reading a new error term and calculating a new output. Each subsequent output is biased by the previous output. This is a quicker reaction loop than the standard algorithm, therefore, the setpoint is not forced into the equation in order to react to changes in the setpoint. Gain alone is used in most cases to tune this loop. This algorithm is used more frequently for controlling velocity loops.

5.11.3 Before Tuning Loops

Check the following items before tuning loops:

- Clamp and ram position inputs must be steady (not more than ±16 counts). If the counts exceed this range, the loop cannot be tuned correctly.
- Adjust zero and span of the valve amplifier cards.
- Have on hand a strip chart recorder (2 channels or more). Table 5-2 lists approximate initial values of the parameters to set up the loop.

Table 5-2 Initial Loop-tuning Parameter Values

Parameters		Standard	Dynamic
Velocity scaling factor	**(VSF)**	16–24	16–24
Loop Gain	**(P)**	500	500
Loop Rate	**(R)**	None	None
Loop Reset	**(I)**	20000	0

⚠ **CAUTION**

Rate is rarely needed for TurboPlastic applications since the process response is quick.

Reset is always needed in the standard algorithm since gain by itself produces a constant output.

5.11.4 Symptoms and Actions

Table 5-3 shows symptoms, probable causes, and some corrective actions.

Table 5-3 Tuning Loops

Symptom	Probable Cause	Remedy
Valve command does not follow the TurboPlastic output command	Incorrect zero span on amplifier card	Zero span the valve
	Velocity setpoint too high, causing output values to exceed flow capacity of valve	Lower the velocity setpoint
	Valve response too slow	Typical valve response should be 50 ms or faster
	Valve amplifier ramp function on	Turn off valve ramping function
Output causes excessive overshoot and undershoot	Too much gain and/or reset	Lower gain and/or reset
Output is uniformly straight and ignores all setpoints	VSF too large for process	Lower VSF
	Velocity setpoint too high	Lower velocity setpoint
	No VSF is entered	Enter a VSF
	Gain set too low	Increase gain
Output goes up/down sharply causing jerky motion	VSF too small for process	Increment VSF slowly (e.g., in steps of +2) until motion is smooth
	Not optimum algorithm	Try the other algorithm
	Too much noise on input	Run RLL noise test and eliminate noise source
	A loop rate has been entered	Delete loop rate
	Module scan time too short	Increase the module scan time to give better resolution on position
Loop response is not fast enough	Not enough gain and/or reset	Increase gain and/or reset
	Currently used algorithm not suitable for this process	Use the other algorithm and observe results

Appendix A

Sample Operator Interface Screens

The following pages show sample operator interface screens that can be used to input profile and other data to PLC memory for use by the TurboPlastic module.

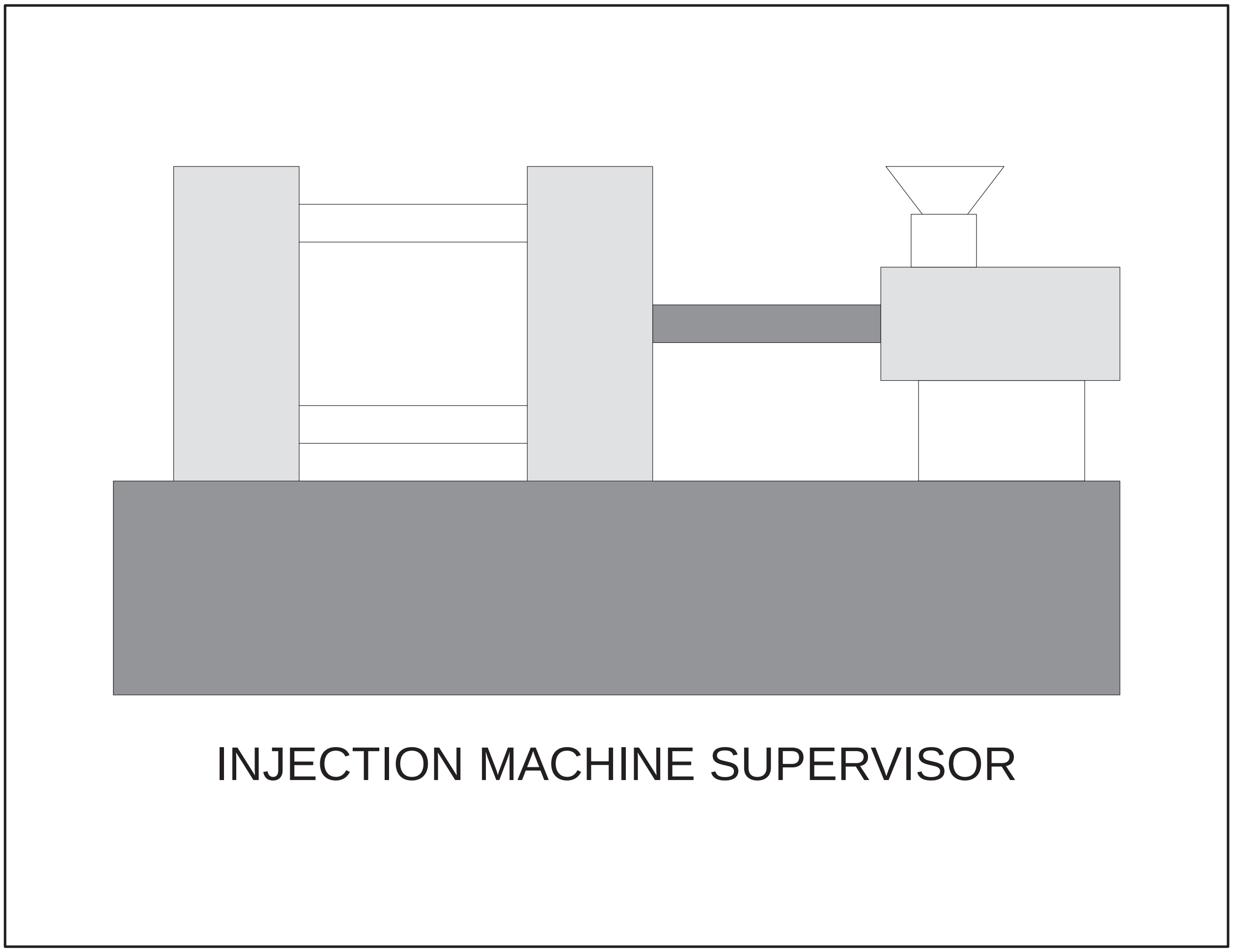


Figure A-1 Sample Injection Machine Supervisor Power-up Graphic

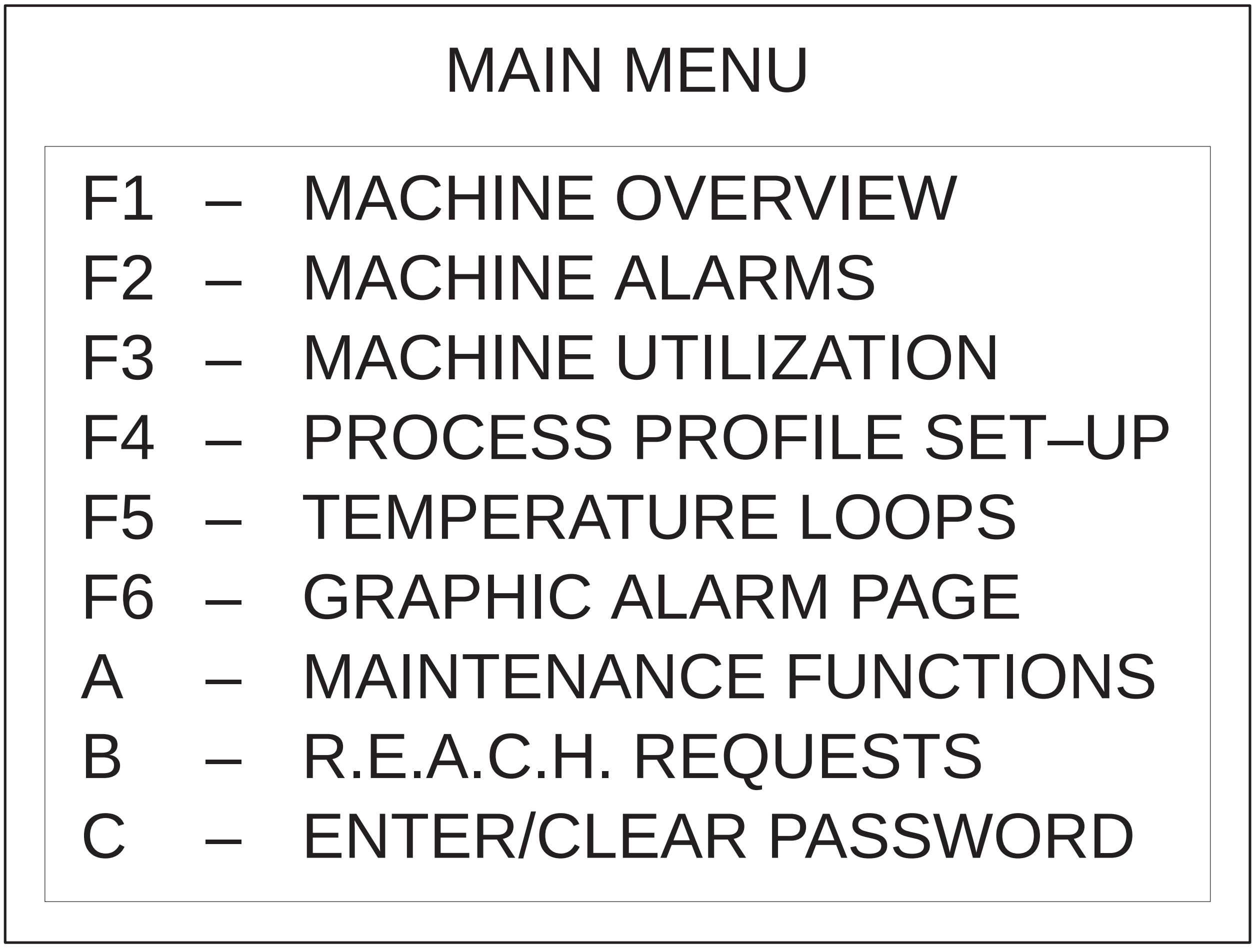
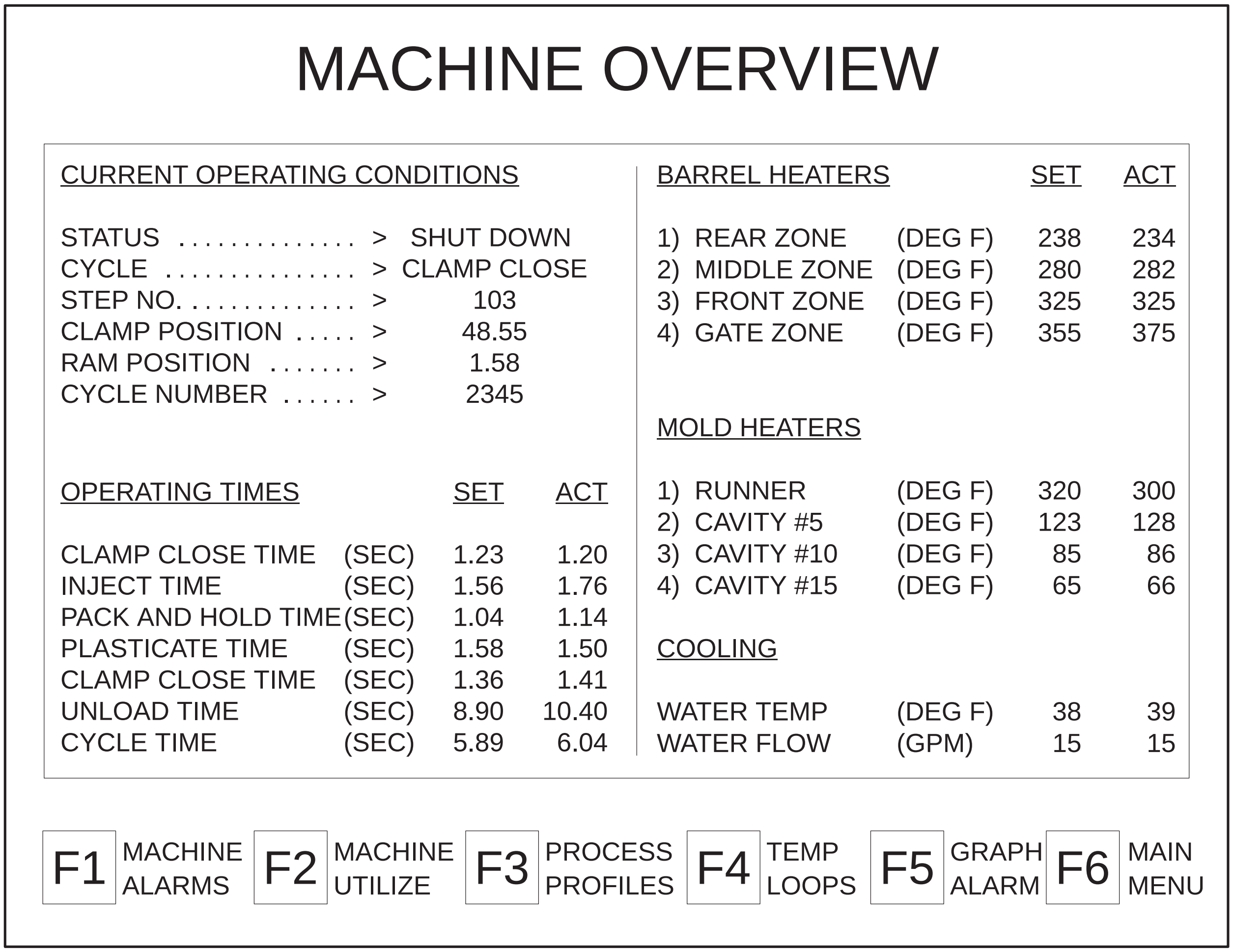


Figure A-2 Sample Main Menu



MACHINE OVERVIEW

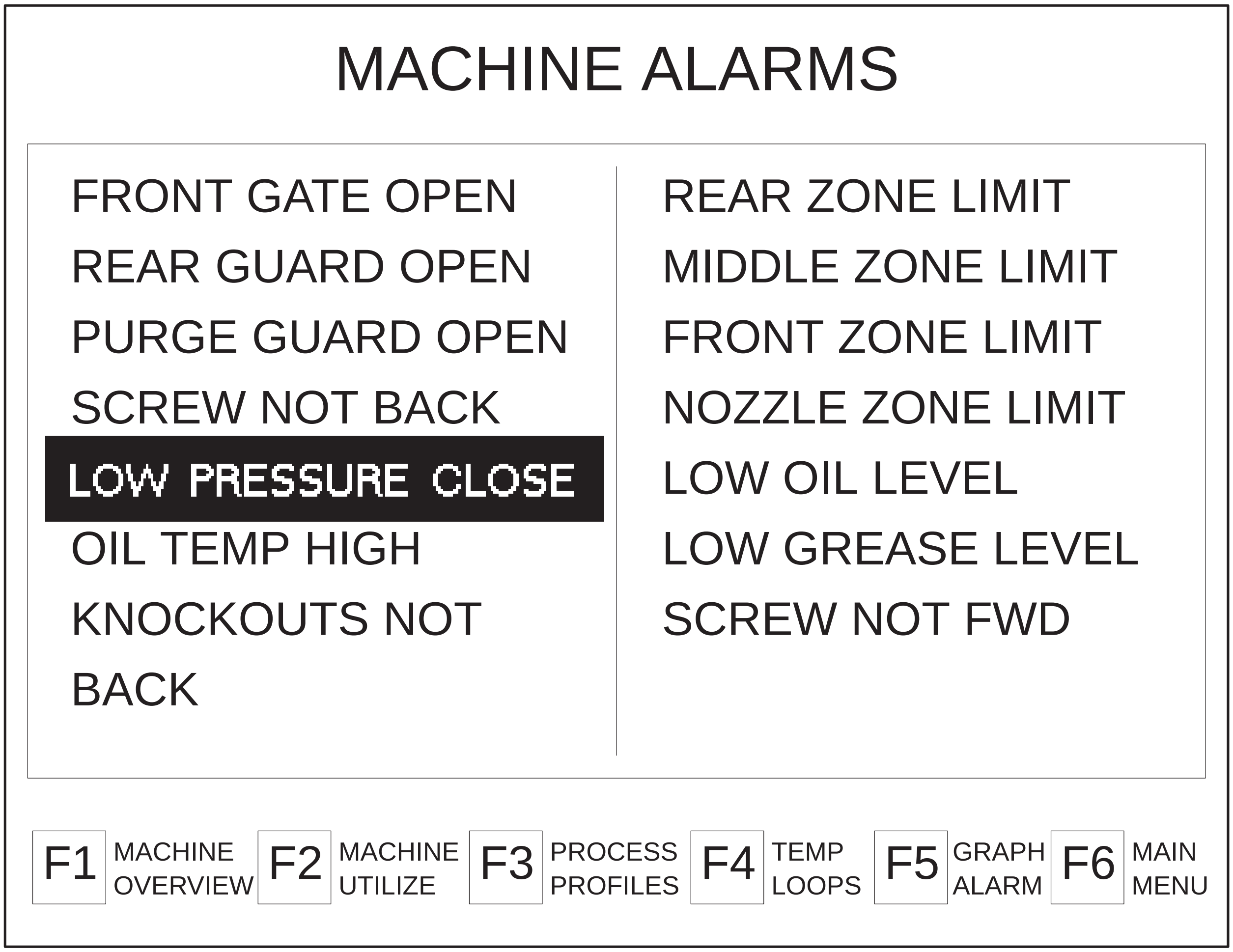
CURRENT OPERATING CONDITIONS

STATUS .... > SHUT DOWN
CYCLE .... > CLAMP CLOSE
STEP NO. .... > 103
CLAMP POSITION ..... > 48.55
RAM POSITION .... > 1.58
CYCLE NUMBER ...... > 2345

OPERATING TIMES		SET	ACT
CLAMP CLOSE TIME	(SEC)	1.23	1.20
INJECT TIME	(SEC)	1.56	1.76
PACK AND HOLD TIME	(SEC)	1.04	1.14
PLASTICATE TIME	(SEC)	1.58	1.50
CLAMP CLOSE TIME	(SEC)	1.36	1.41
UNLOAD TIME	(SEC)	8.90	10.40
CYCLE TIME	(SEC)	5.89	6.04

BARREL HEATERS		SET	ACT
1) REAR ZONE	(DEG F)	238	234
2) MIDDLE ZONE	(DEG F)	280	282
3) FRONT ZONE	(DEG F)	325	325
4) GATE ZONE	(DEG F)	355	375
MOLD HEATERS			
1) RUNNER	(DEG F)	320	300
2) CAVITY #5	(DEG F)	123	128
3) CAVITY #10	(DEG F)	85	86
4) CAVITY #15	(DEG F)	65	66
COOLING			
WATER TEMP	(DEG F)	38	39
WATER FLOW	(GPM)	15	15

Figure A-3 Machine Overview

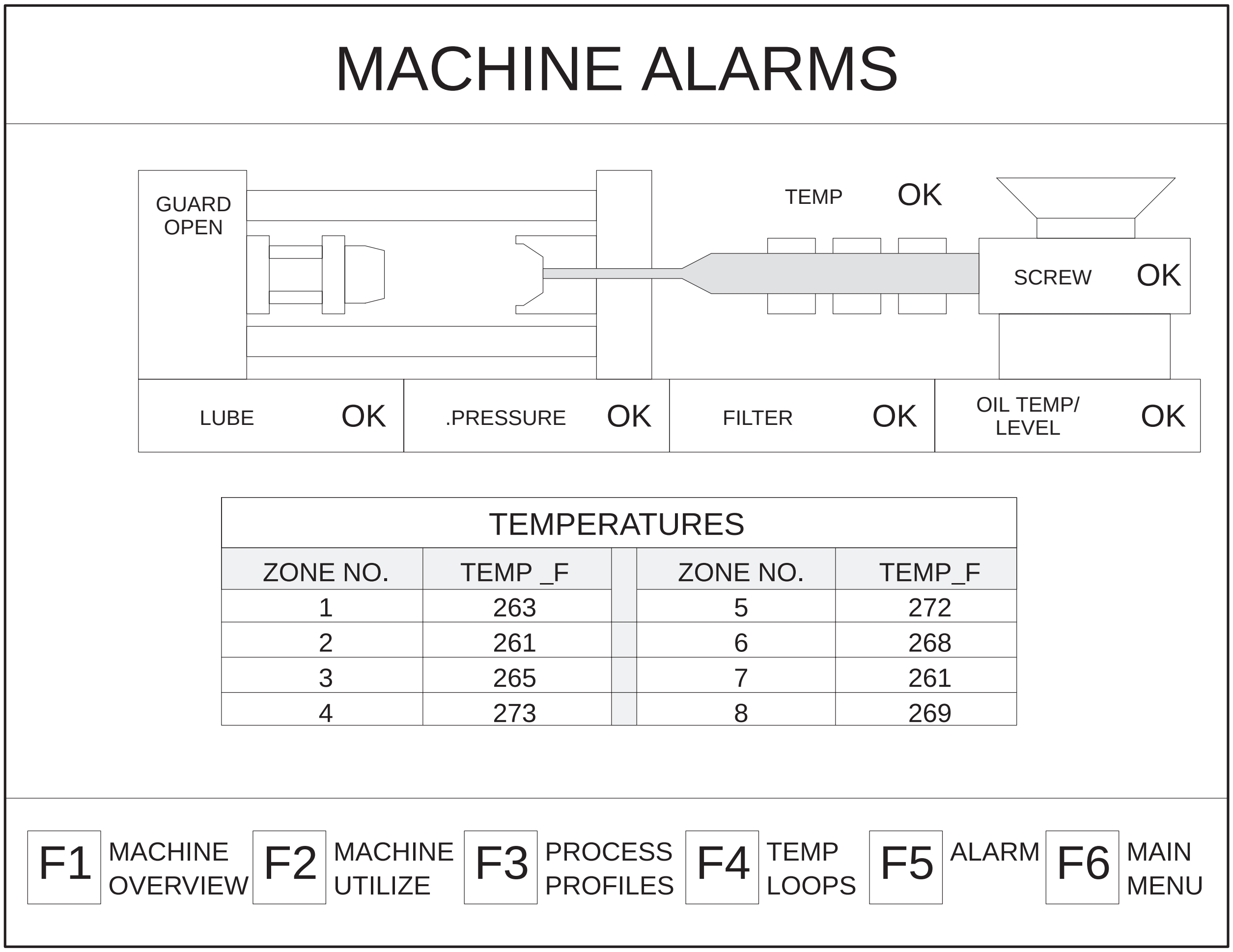


MACHINE ALARMS

FRONT GATE OPEN
REAR GUARD OPEN
PURGE GUARD OPEN
SCREW NOT BACK
LOW PRESSURE CLOSE
OIL TEMP HIGH
KNOCKOUTS NOT BACK

REAR ZONE LIMIT
MIDDLE ZONE LIMIT
FRONT ZONE LIMIT
NOZZLE ZONE LIMIT
LOW OIL LEVEL
LOW GREASE LEVEL
SCREW NOT FWD

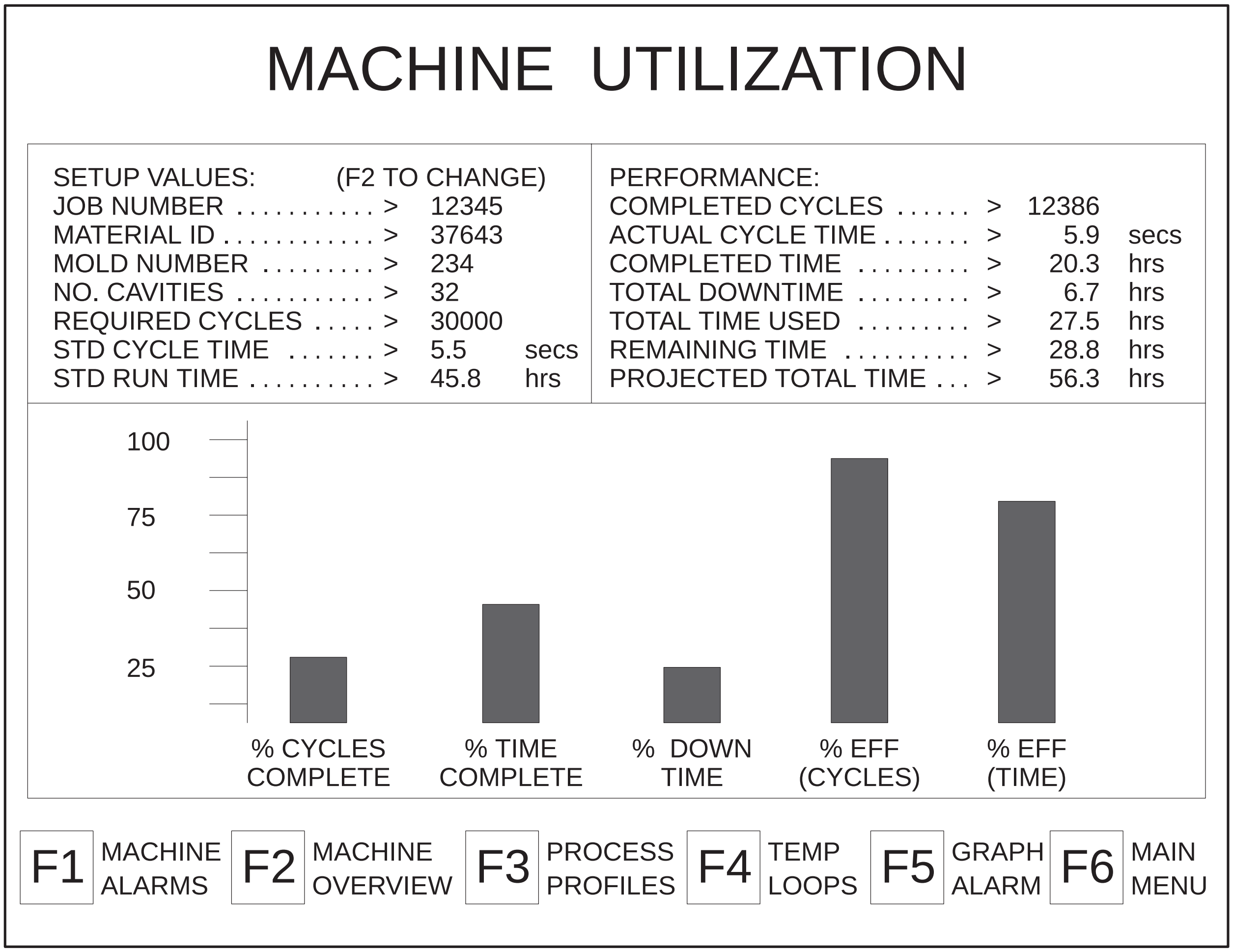
Figure A-4 Machine Alarms



TEMPERATURES

ZONE NO.	TEMP _F	ZONE NO.	TEMP_F
1	263	5	272
2	261	6	268
3	265	7	261
4	273	8	269

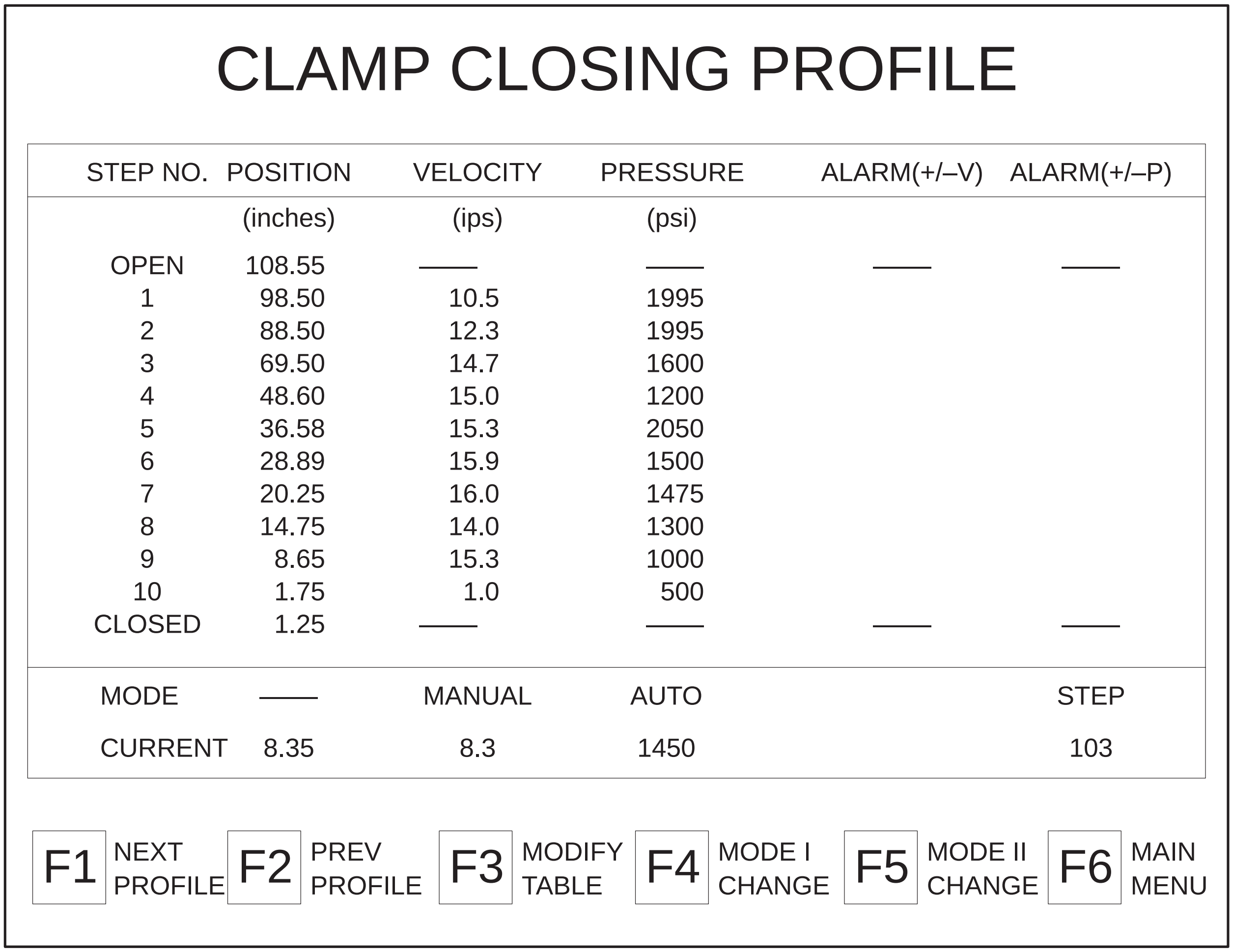
Figure A-5 Graphic Machine Alarms



MACHINE UTILIZATION

```
SETUP VALUES:          (F2 TO CHANGE)   PERFORMANCE:
JOB NUMBER . . . . . . . . . . . >   12345       COMPLETED CYCLES . . . . . .   >   12386
MATERIAL ID . . . . . . . . . . . . >   37643       ACTUAL CYCLE TIME . . . . . . .   >     5.9   secs
MOLD NUMBER . . . . . . . . . >   234         COMPLETED TIME . . . . . . . . .   >    20.3   hrs
NO. CAVITIES . . . . . . . . . . . >   32          TOTAL DOWNTIME . . . . . . . . .   >     6.7   hrs
REQUIRED CYCLES . . . . . >   30000       TOTAL TIME USED . . . . . . . . .   >    27.5   hrs
STD CYCLE TIME . . . . . . . >   5.5   secs  REMAINING TIME . . . . . . . . . .   >    28.8   hrs
STD RUN TIME . . . . . . . . . . >   45.8  hrs   PROJECTED TOTAL TIME . . .   >    56.3   hrs
```

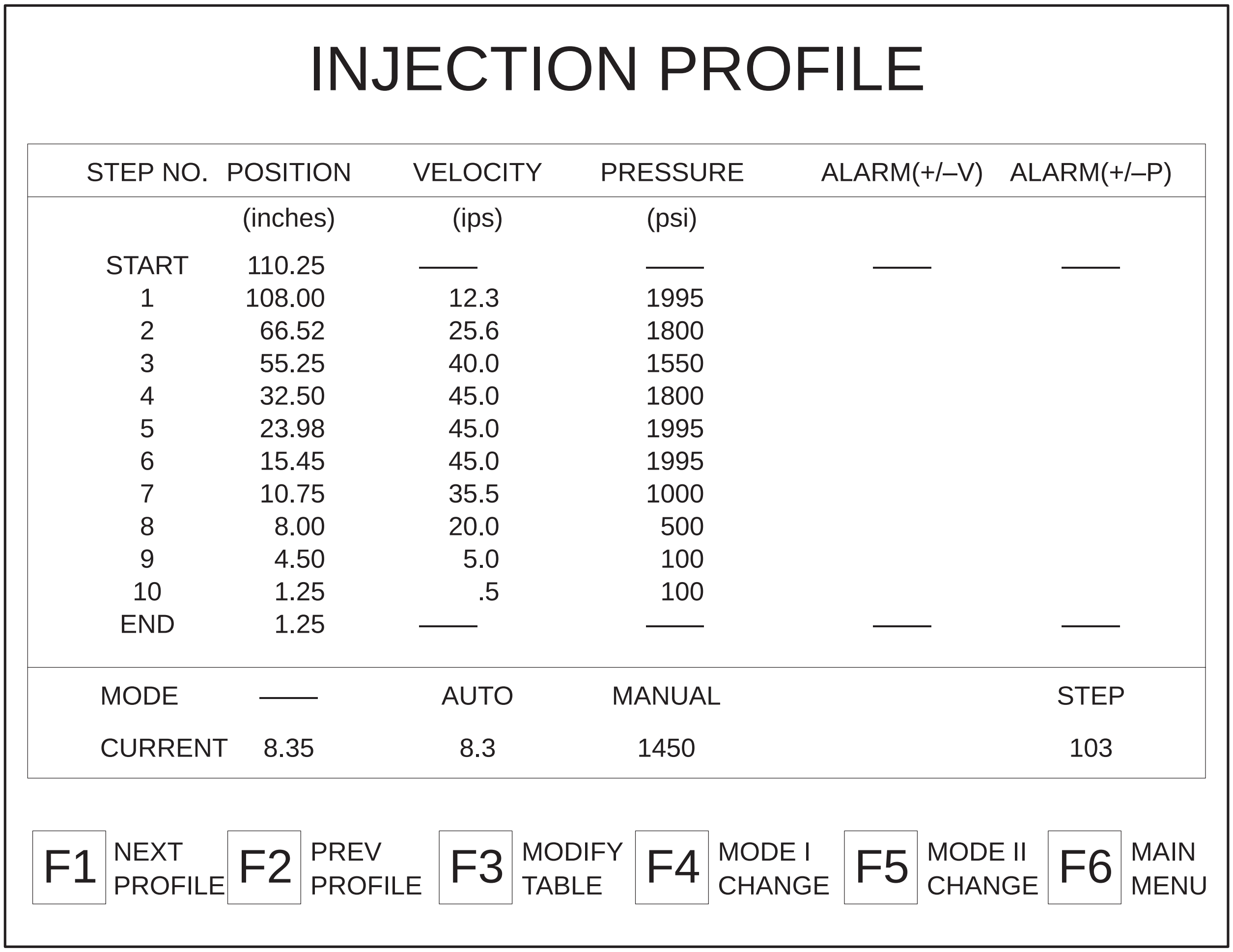
Figure A-6 Machine Utilization



CLAMP CLOSING PROFILE

STEP NO.	POSITION	VELOCITY	PRESSURE	ALARM(+/–V)	ALARM(+/–P)
	(inches)	(ips)	(psi)		
OPEN	108.55	——	——	——	——
1	98.50	10.5	1995		
2	88.50	12.3	1995		
3	69.50	14.7	1600		
4	48.60	15.0	1200		
5	36.58	15.3	2050		
6	28.89	15.9	1500		
7	20.25	16.0	1475		
8	14.75	14.0	1300		
9	8.65	15.3	1000		
10	1.75	1.0	500		
CLOSED	1.25	——	——	——	——
MODE	——	MANUAL	AUTO		STEP
CURRENT	8.35	8.3	1450		103

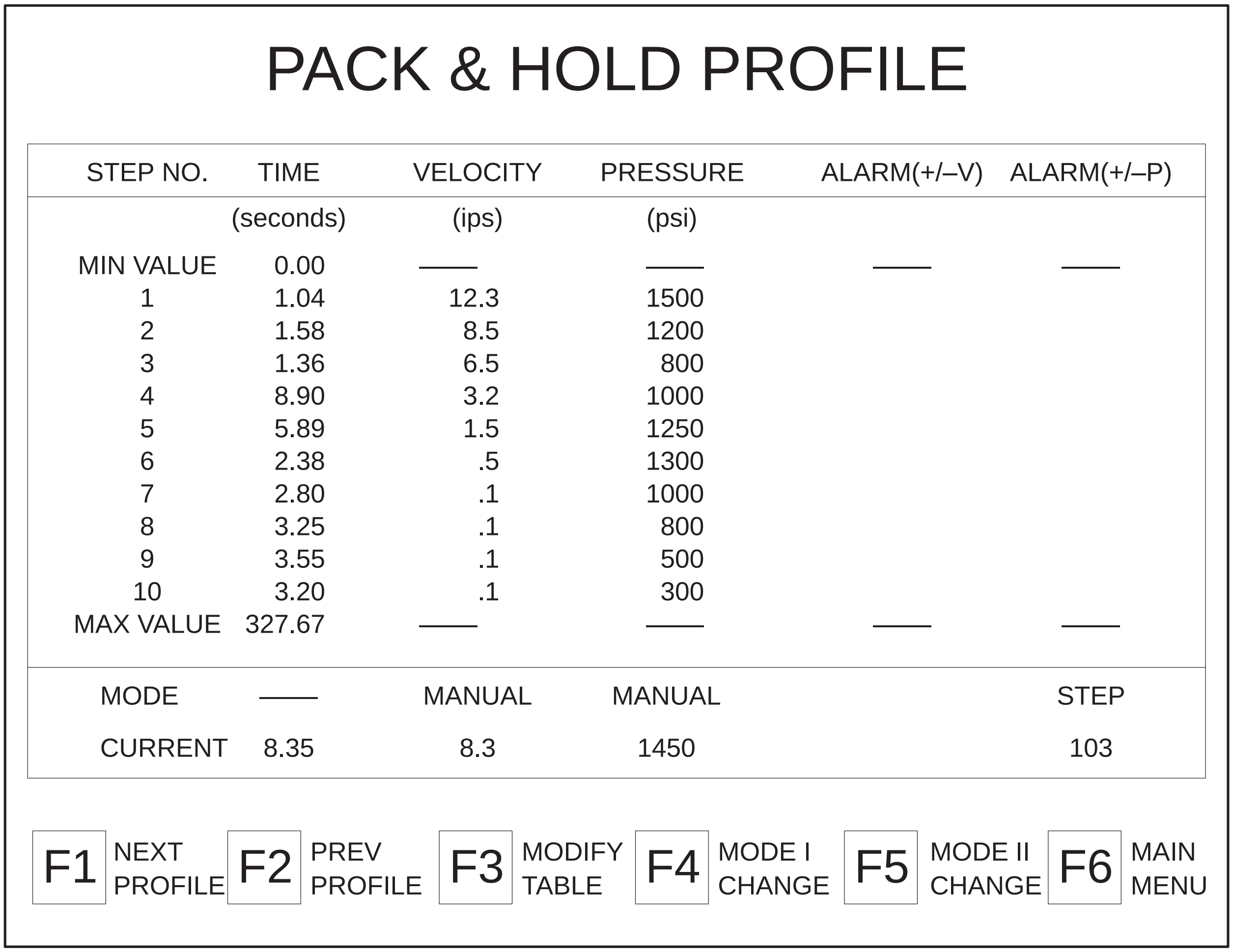
Figure A-7 Clamp Closing Profile



INJECTION PROFILE

STEP NO.	POSITION	VELOCITY	PRESSURE	ALARM(+/–V)	ALARM(+/–P)
	(inches)	(ips)	(psi)		
START	110.25	——	——	——	——
1	108.00	12.3	1995		
2	66.52	25.6	1800		
3	55.25	40.0	1550		
4	32.50	45.0	1800		
5	23.98	45.0	1995		
6	15.45	45.0	1995		
7	10.75	35.5	1000		
8	8.00	20.0	500		
9	4.50	5.0	100		
10	1.25	.5	100		
END	1.25	——	——	——	——
MODE	——	AUTO	MANUAL		STEP
CURRENT	8.35	8.3	1450		103

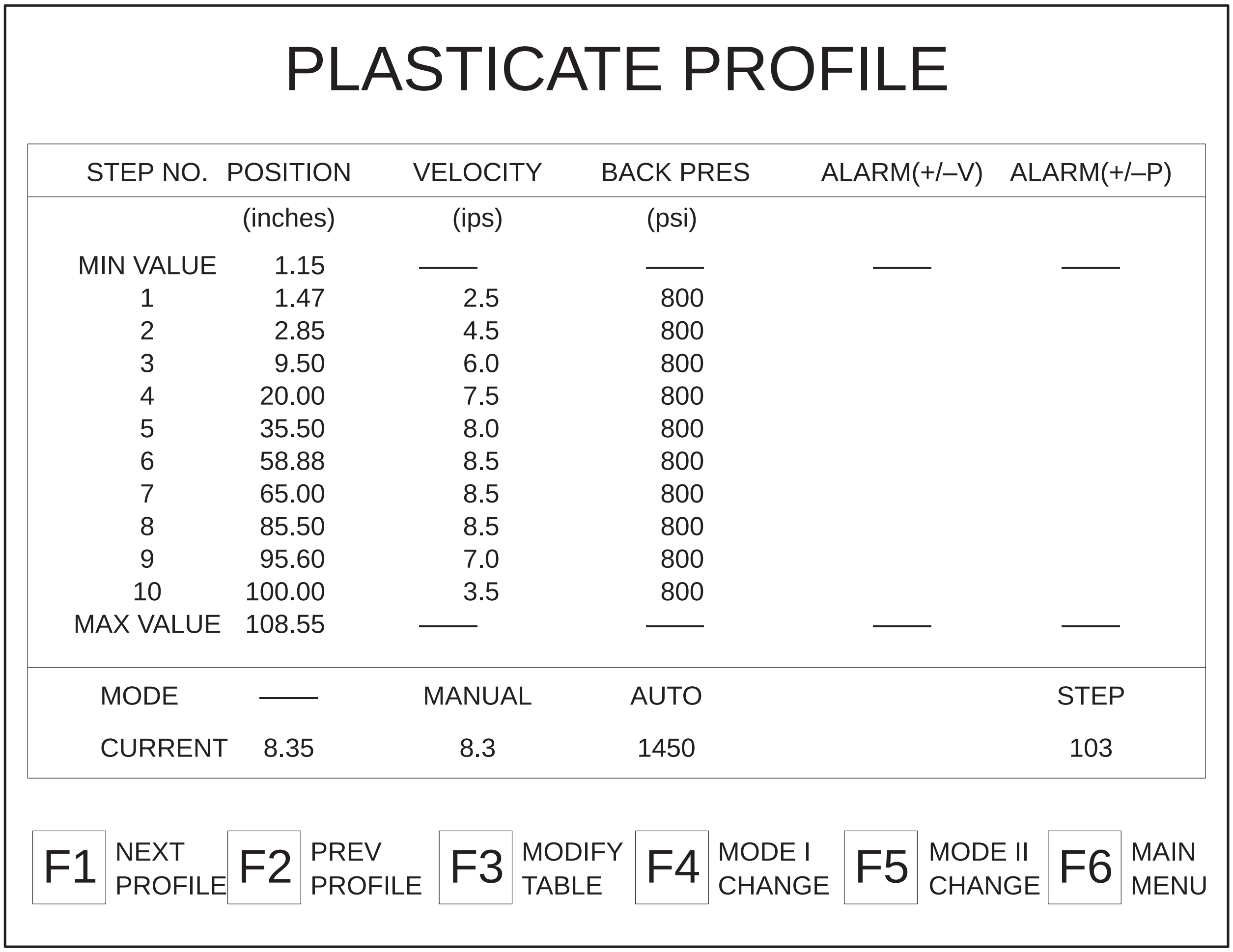
Figure A-8 Injection Profile



PACK & HOLD PROFILE

STEP NO.	TIME	VELOCITY	PRESSURE	ALARM(+/–V)	ALARM(+/–P)
	(seconds)	(ips)	(psi)		
MIN VALUE	0.00	——	——	——	——
1	1.04	12.3	1500		
2	1.58	8.5	1200		
3	1.36	6.5	800		
4	8.90	3.2	1000		
5	5.89	1.5	1250		
6	2.38	.5	1300		
7	2.80	.1	1000		
8	3.25	.1	800		
9	3.55	.1	500		
10	3.20	.1	300		
MAX VALUE	327.67	——	——	——	——
MODE	——	MANUAL	MANUAL		STEP
CURRENT	8.35	8.3	1450		103

Figure A-9 Pack and Hold Profile

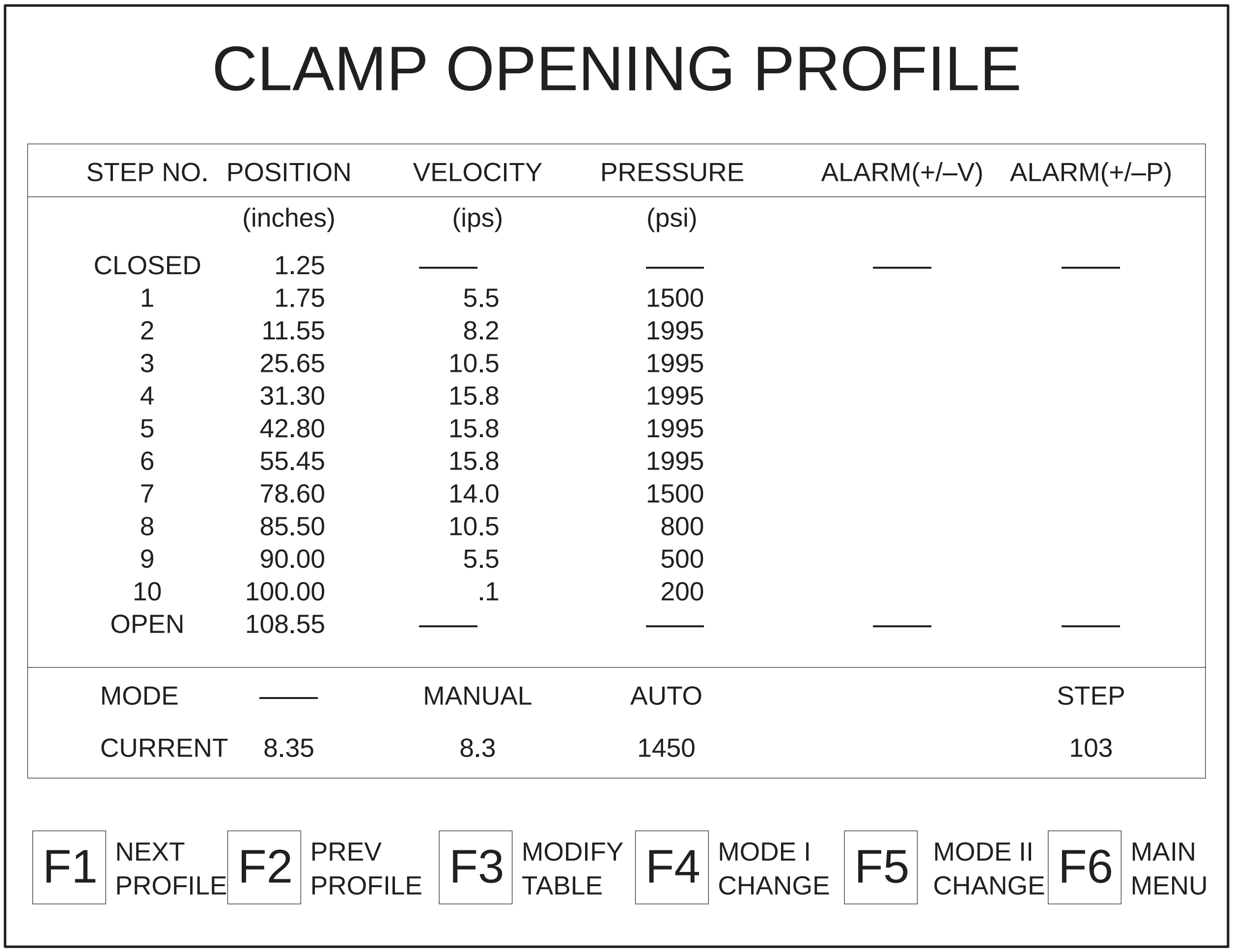


PLASTICATE PROFILE

STEP NO.	POSITION	VELOCITY	BACK PRES	ALARM(+/–V)	ALARM(+/–P)
	(inches)	(ips)	(psi)		
MIN VALUE	1.15	——	——	——	——
1	1.47	2.5	800		
2	2.85	4.5	800		
3	9.50	6.0	800		
4	20.00	7.5	800		
5	35.50	8.0	800		
6	58.88	8.5	800		
7	65.00	8.5	800		
8	85.50	8.5	800		
9	95.60	7.0	800		
10	100.00	3.5	800		
MAX VALUE	108.55	——	——	——	——
MODE	——	MANUAL	AUTO		STEP
CURRENT	8.35	8.3	1450		103

F1 NEXT PROFILE
F2 PREV PROFILE
F3 MODIFY TABLE
F4 MODE I CHANGE
F5 MODE II CHANGE
F6 MAIN MENU

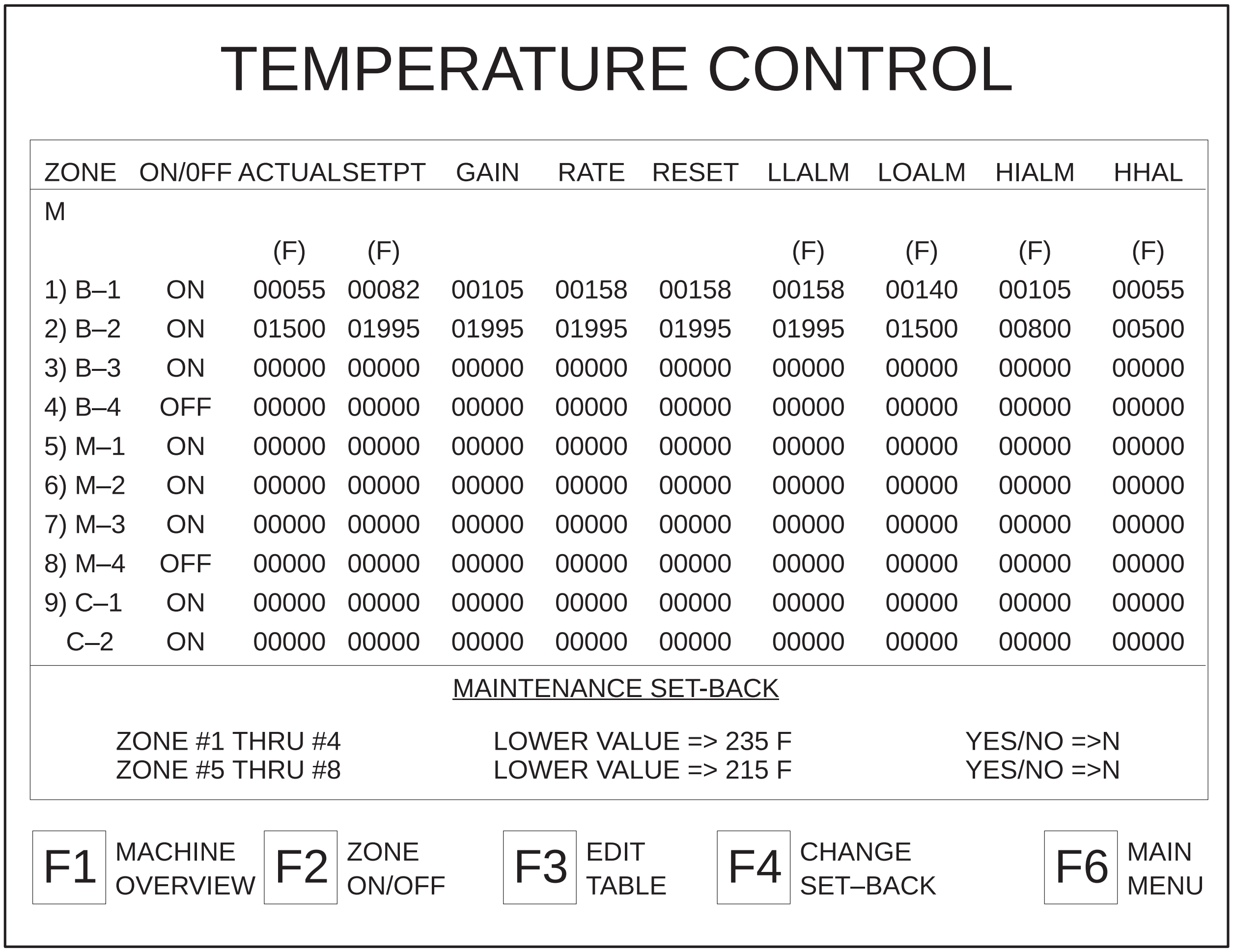
Figure A-10 Plasticate Profile



CLAMP OPENING PROFILE

STEP NO.	POSITION	VELOCITY	PRESSURE	ALARM(+/–V)	ALARM(+/–P)
	(inches)	(ips)	(psi)		
CLOSED	1.25	——	——	——	——
1	1.75	5.5	1500		
2	11.55	8.2	1995		
3	25.65	10.5	1995		
4	31.30	15.8	1995		
5	42.80	15.8	1995		
6	55.45	15.8	1995		
7	78.60	14.0	1500		
8	85.50	10.5	800		
9	90.00	5.5	500		
10	100.00	.1	200		
OPEN	108.55	——	——	——	——
MODE	——	MANUAL	AUTO		STEP
CURRENT	8.35	8.3	1450		103

Figure A-11 Clamp Opening Profile



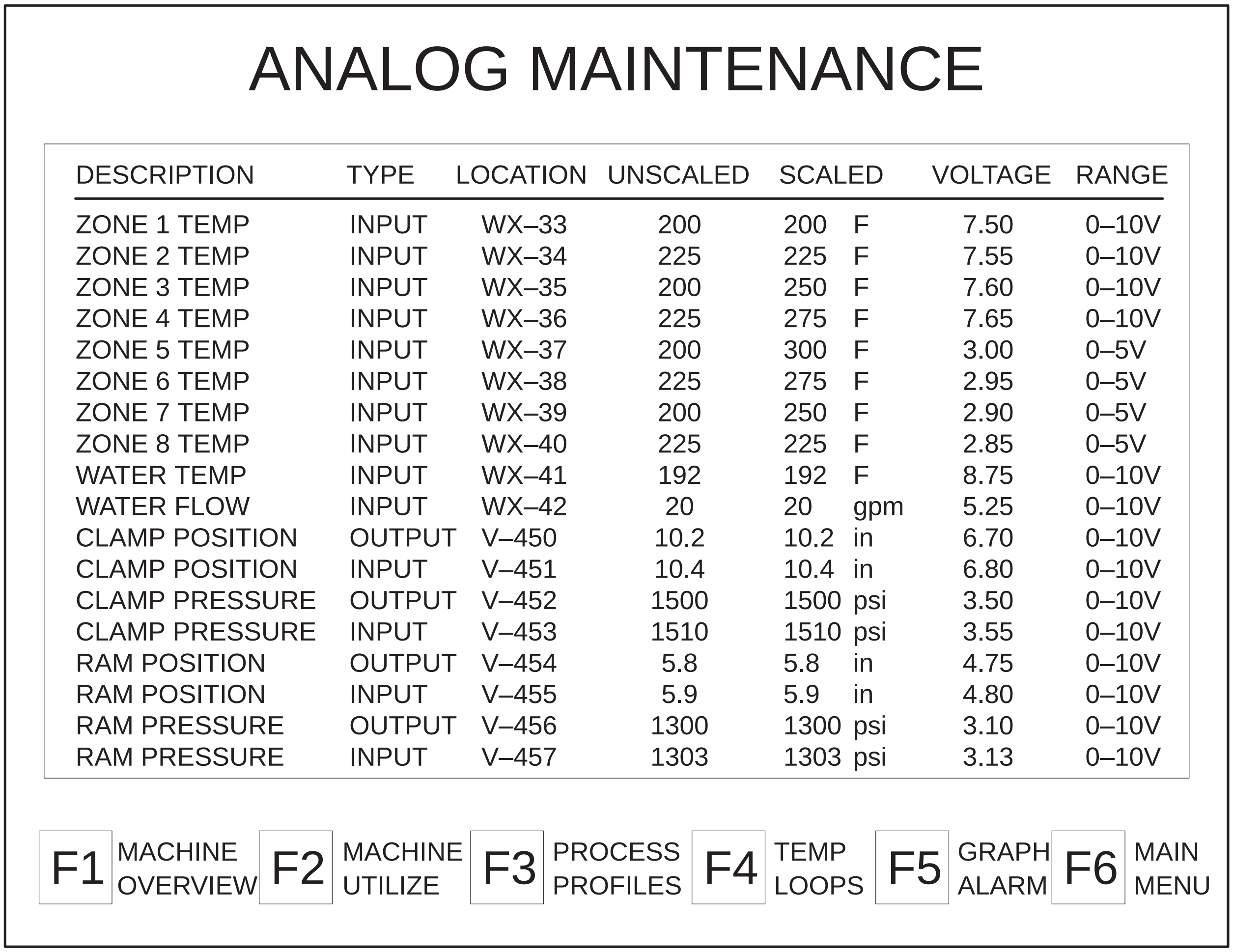
TEMPERATURE CONTROL

ZONE	ON/0FF	ACTUAL	SETPT	GAIN	RATE	RESET	LLALM	LOALM	HIALM	HHALM
		(F)	(F)				(F)	(F)	(F)	(F)
1) B–1	ON	00055	00082	00105	00158	00158	00158	00140	00105	00055
2) B–2	ON	01500	01995	01995	01995	01995	01995	01500	00800	00500
3) B–3	ON	00000	00000	00000	00000	00000	00000	00000	00000	00000
4) B–4	OFF	00000	00000	00000	00000	00000	00000	00000	00000	00000
5) M–1	ON	00000	00000	00000	00000	00000	00000	00000	00000	00000
6) M–2	ON	00000	00000	00000	00000	00000	00000	00000	00000	00000
7) M–3	ON	00000	00000	00000	00000	00000	00000	00000	00000	00000
8) M–4	OFF	00000	00000	00000	00000	00000	00000	00000	00000	00000
9) C–1	ON	00000	00000	00000	00000	00000	00000	00000	00000	00000
C–2	ON	00000	00000	00000	00000	00000	00000	00000	00000	00000

MAINTENANCE SET-BACK

ZONE #1 THRU #4 LOWER VALUE => 235 F YES/NO =>N
ZONE #5 THRU #8 LOWER VALUE => 215 F YES/NO =>N

Figure A-12 Temperature Control



ANALOG MAINTENANCE

DESCRIPTION	TYPE	LOCATION	UNSCALED	SCALED		VOLTAGE	RANGE
ZONE 1 TEMP	INPUT	WX–33	200	200	F	7.50	0–10V
ZONE 2 TEMP	INPUT	WX–34	225	225	F	7.55	0–10V
ZONE 3 TEMP	INPUT	WX–35	200	250	F	7.60	0–10V
ZONE 4 TEMP	INPUT	WX–36	225	275	F	7.65	0–10V
ZONE 5 TEMP	INPUT	WX–37	200	300	F	3.00	0–5V
ZONE 6 TEMP	INPUT	WX–38	225	275	F	2.95	0–5V
ZONE 7 TEMP	INPUT	WX–39	200	250	F	2.90	0–5V
ZONE 8 TEMP	INPUT	WX–40	225	225	F	2.85	0–5V
WATER TEMP	INPUT	WX–41	192	192	F	8.75	0–10V
WATER FLOW	INPUT	WX–42	20	20	gpm	5.25	0–10V
CLAMP POSITION	OUTPUT	V–450	10.2	10.2	in	6.70	0–10V
CLAMP POSITION	INPUT	V–451	10.4	10.4	in	6.80	0–10V
CLAMP PRESSURE	OUTPUT	V–452	1500	1500	psi	3.50	0–10V
CLAMP PRESSURE	INPUT	V–453	1510	1510	psi	3.55	0–10V
RAM POSITION	OUTPUT	V–454	5.8	5.8	in	4.75	0–10V
RAM POSITION	INPUT	V–455	5.9	5.9	in	4.80	0–10V
RAM PRESSURE	OUTPUT	V–456	1300	1300	psi	3.10	0–10V
RAM PRESSURE	INPUT	V–457	1303	1303	psi	3.13	0–10V

Figure A-13 Analog Maintenance

Appendix B

Sample RLL and Logic Diagrams

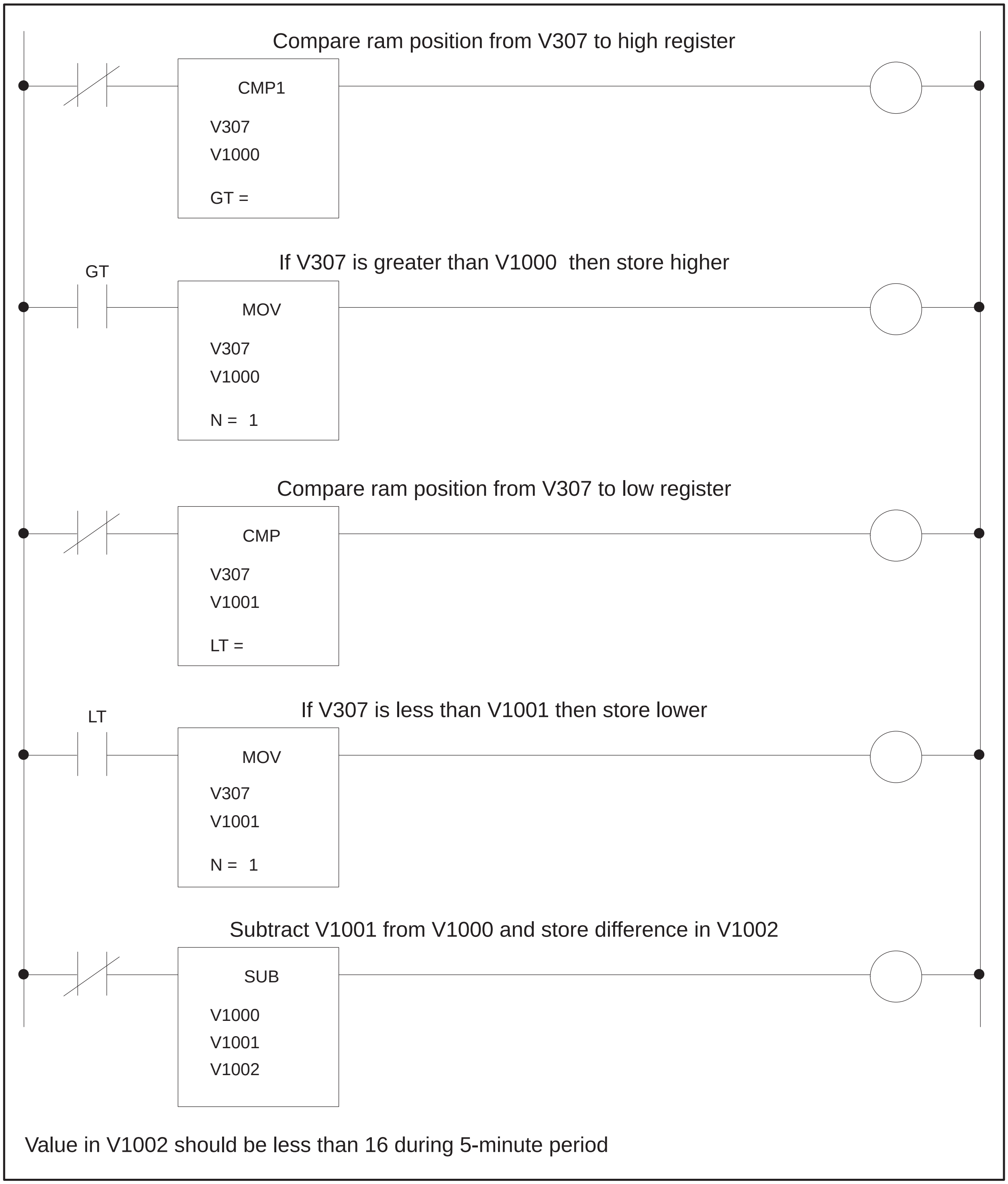


Figure B-1 Sample RLL for Noise Check

B.2 Ejector Logic Diagram

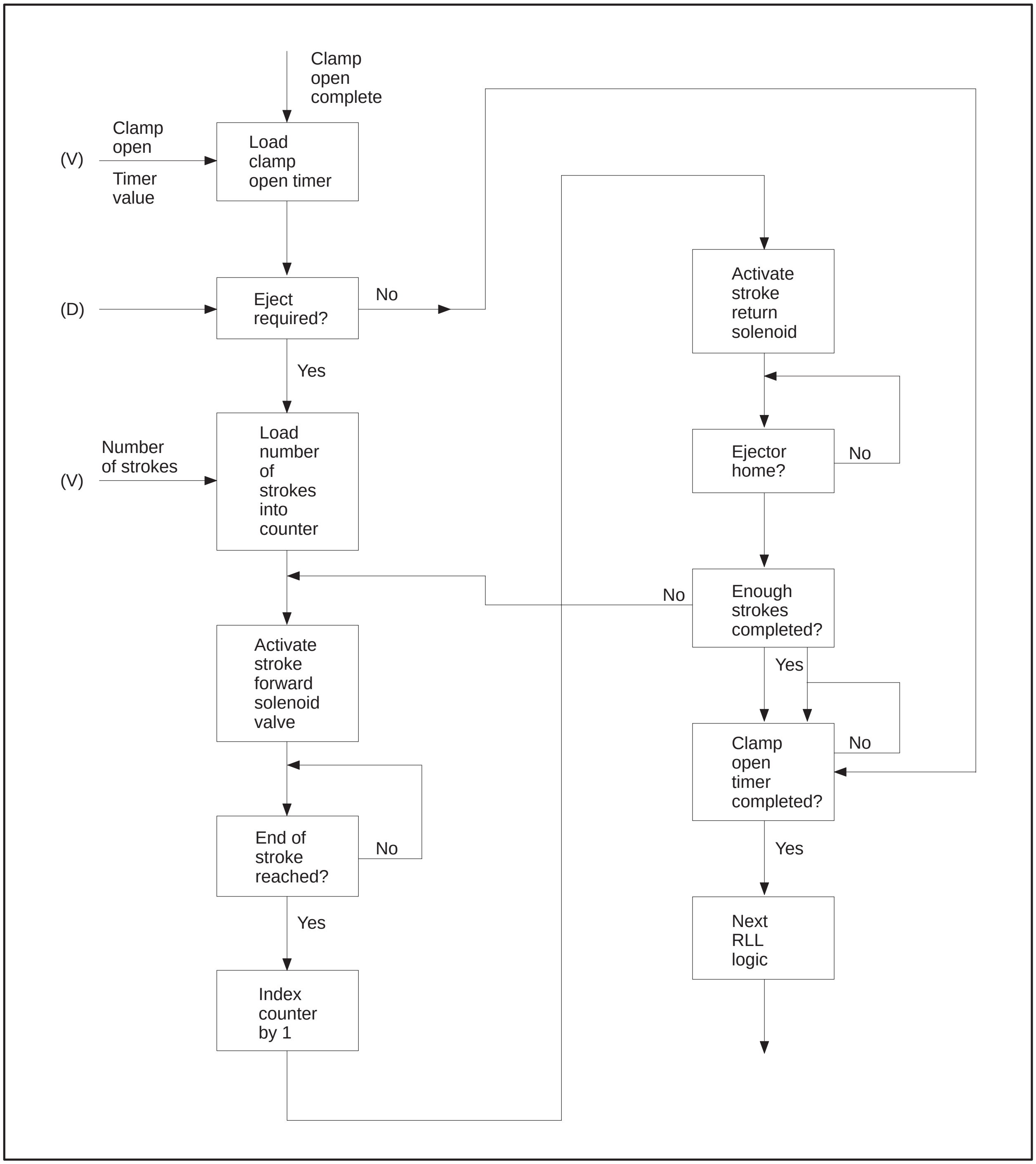


Figure B-2 Ejector Logic Diagram for RLL Implementation

B.3 Auto Cushion Control Logic Diagram

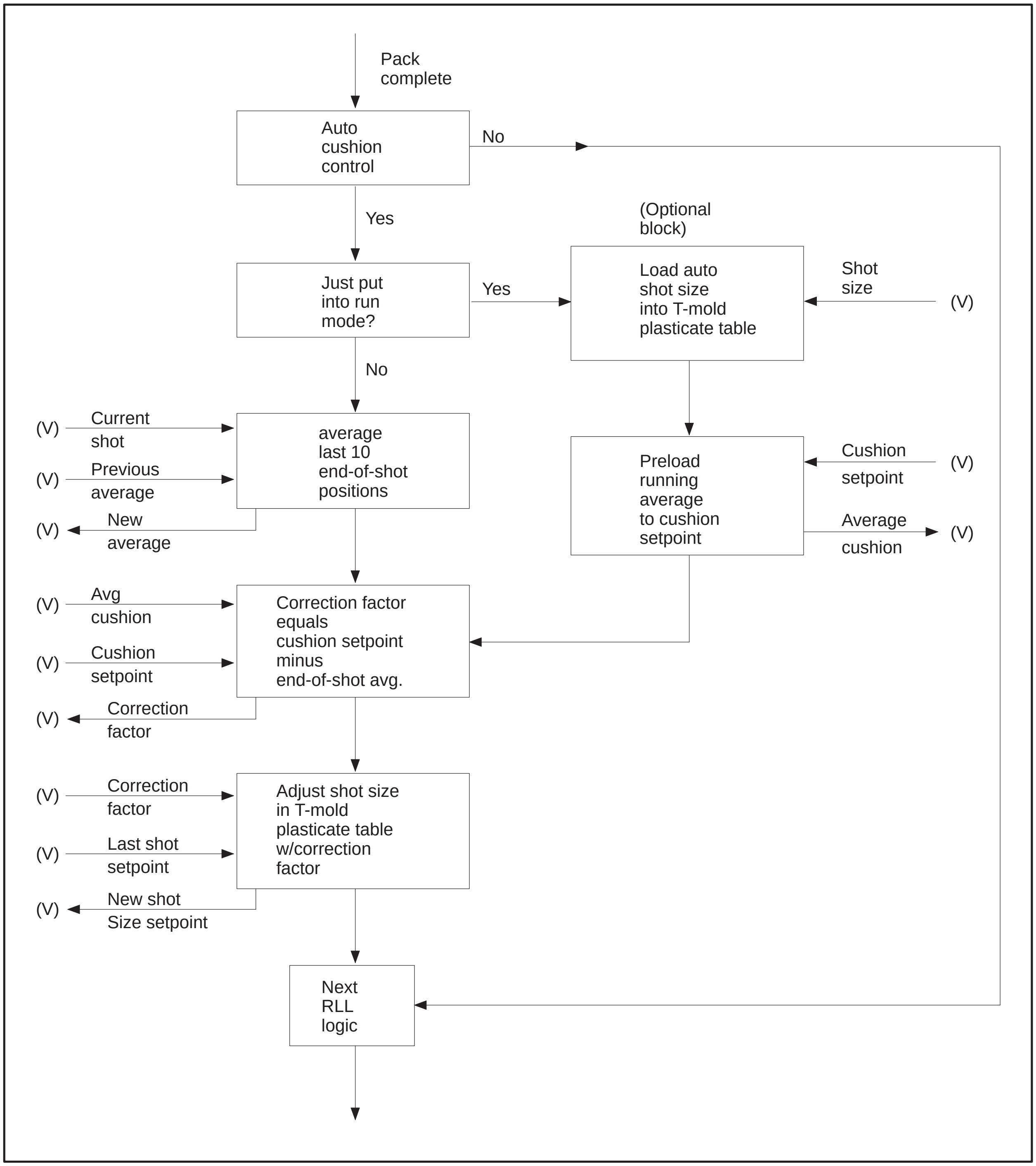


Figure B-3 Auto Cushion Control Logic Diagram for RLL Implementation

B.4 Decompression/Suck-Back Logic Diagram

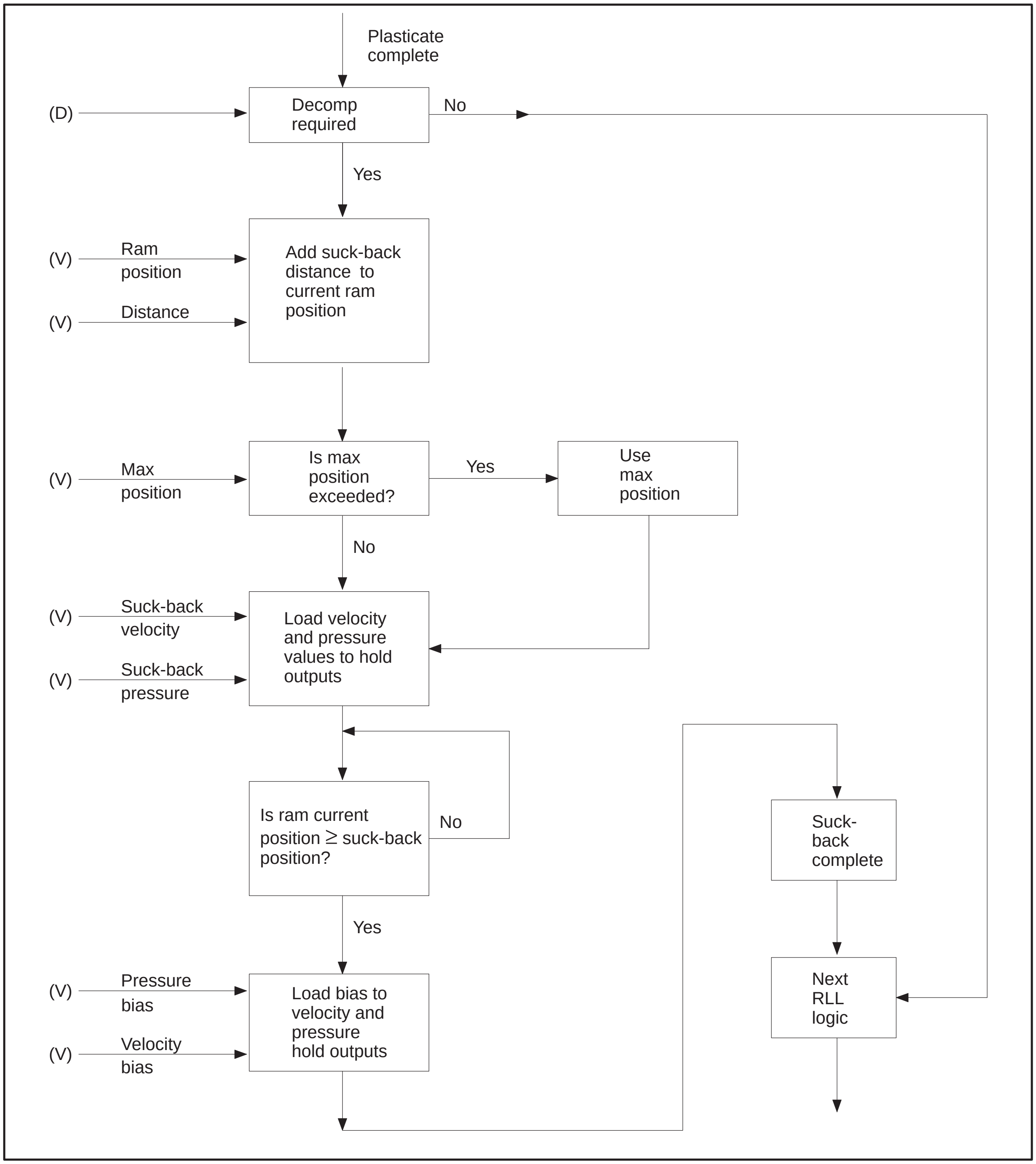


Figure B-4 Decompression/Suck-Back Logic Diagram for RLL Implementation

Appendix C

Process Variable and Profile Log Sheets

The master forms contained in this appendix may be *reproduced* as needed for use in recording application data.

Clamp Closing Profile Data Log

Process/Part::

Machine: **Mold:** **Date:**

Function	Address	Loc	Description	Set Value
Constants				
1 **(WY5)**		1	Module sample rate	
2		2	Max profile time	
3		3	Lock-over velocity	
4		4	Lock-over pressure	
5		5	Lock-over time	
6		6	Lock-over scaling factor	
7		7	K1 (velocity loop gain)	
8		8	K2 (velocity loop rate)	
9		9	K3 (velocity loop reset)	
10		10	Velocity/pressure operation bits	
	Bits 1–2		PID algorithm for velocity	
	Bits 3–4		Filter for velocity calculation	
	Bit 5		Voltage range for flow command	
	Bit 6		Not used this profile	
	Bit 7		Not used this profile	
	Bit 8		Velocity ramping	
	Bits 9–10		PID algorithm for pressure	
	Bit 11		Pressure ramping	
	Bit 12		Output range	
	Bit 13		Voltage range for pressure	
	Bits 14–16		Not used this profile	
11		11	K1 (pressure loop gain)	
12		12	K2 (pressure loop rate)	
13		13	K3 (pressure loop reset)	
14		14	Velocity/pressure data acquisition bits	
	Bits 1–3		SPC/SQC diagnostics	
	Bits 4–7		Velocity filter constants	
	Bit 8		Bias option	
	Bit 9		Reverse acting for velocity	
	Bit 10		Reverse acting for pressure	

Clamp Closing Profile Data Log

Process/Part::

Machine: **Mold:** **Date:**

Function	Address	Loc	Description	Set Value
Clamp Position Profile Step Data				
15		15	Step 1 position	
16		16	Step 2 position	
17		17	Step 3 position	
18		18	Step 4 position	
19		19	Step 5 position	
20		20	Step 6 position	
21		21	Step 7 position	
22		22	Step 8 position	
23		23	Step 9 position	
24		24	Step 10 position	
Clamp Velocity Setpoint Data				
25		25	Step 1 velocity	
26		26	Step 2 velocity	
27		27	Step 3 velocity	
28		28	Step 4 velocity	
29		29	Step 5 velocity	
30		30	Step 6 velocity	
31		31	Step 7 velocity	
32		32	Step 8 velocity	
33		33	Step 9 velocity	
34		34	Step 10 velocity	
Hydraulic Pressure Setpoint Data				
35		35	Step 1 pressure	
36		36	Step 2 pressure	
37		37	Step 3 pressure	
38		38	Step 4 pressure	
39		39	Step 5 pressure	
40		40	Step 6 pressure	
41		41	Step 7 pressure	
42		42	Step 8 pressure	
43		43	Step 9 pressure	
44		44	Step 10 pressure	

Injection Profile Data Log

Process/Part::

Machine: **Mold:** **Date:**

Function	**Address**	**Loc**	**Description**	**Set Value**
Constants				
1**(WY5+44)**		45	Module sample rate	
2		46	Max profile time	
3		47	Max pressure to transition	
4		48	Max cavity pressure to transition	
5		49	Cavity fill pressure setpoint	
6		50	Velocity scaling factor	
7		51	K1 (velocity loop gain)	
8		52	K2 (velocity loop rate)	
9		53	K3 (velocity loop reset)	
10		54	Velocity/pressure operation bits	
	Bits 1–2		PID algorithm for velocity	
	Bits 3–4		Filter for velocity calculation	
	Bit 5		Voltage range for flow command	
	Bit 6		Not used this profile	
	Bit 7		Not used this profile	
	Bit 8		Velocity ramping	
	Bits 9–10		PID algorithm for pressure	
	Bit 11		Pressure ramping	
	Bit 12		Output range	
	Bit 13		Voltage range for pressure	
	Bits 14–16		Not used this profile	
11		55	K1 (pressure loop gain)	
12		56	K2 (pressure loop rate)	
13		57	K3 (pressure loop reset)	
14		58	Velocity/pressure data acquisition bits	
	Bits 1–3		SPC/SQC diagnostics	
	Bits 4–7		Velocity filter constants	
	Bit 8		Bias option	
	Bit 9		Reverse acting for velocity	
	Bit 10		Reverse acting for pressure	

Injection Profile Data Log

Process/Part::

Machine: **Mold:** **Date:**

Function	Address	Loc	Description	Set Value
Pack Time Profile Step Data				
15		59	Step 1 position	
16		60	Step 2 position	
17		61	Step 3 position	
18		62	Step 4 position	
19		63	Step 5 position	
20		64	Step 6 position	
21		65	Step 7 position	
22		66	Step 8 position	
23		67	Step 9 position	
24		68	Step 10 position	
Ram Velocity Setpoint Data				
25		69	Step 1 velocity	
26		70	Step 2 velocity	
27		71	Step 3 velocity	
28		72	Step 4 velocity	
29		73	Step 5 velocity	
30		74	Step 6 velocity	
31		75	Step 7 velocity	
32		76	Step 8 velocity	
33		77	Step 9 velocity	
34		78	Step 10 velocity	
Ram Hydraulic Pressure Setpoint Data				
35		79	Step 1 pressure	
36		80	Step 2 pressure	
37		81	Step 3 pressure	
38		82	Step 4 pressure	
39		83	Step 5 pressure	
40		84	Step 6 pressure	
41		85	Step 7 pressure	
42		86	Step 8 pressure	
43		87	Step 9 pressure	
44		88	Step 10 pressure	

Pack and Hold Profile Data Log

Process/Part::

Machine: **Mold:** **Date:**

Function	**Address**	**Loc**	**Description**	**Set Value**
Constants				
1**(WY5+88)**		89	Module sample rate	
2		90	Profile end position	
3		91	Max pressure to transition	
4		92	Max cavity pressure to transfer	
5		93	Cavity fill pressure setpoint	
6		94	Velocity scaling factor	
7		95	K1 (velocity loop gain)	
8		96	K2 (velocity loop rate)	
9		97	K3 (velocity loop reset)	
10		98	Velocity/pressure operation bits	
	Bits 1–2		PID algorithm for velocity	
	Bits 3–4		Filter for velocity calculation	
	Bit 5		Voltage range for flow command	
	Bit 6		Not used this profile	
	Bit 7		Not used this profile	
	Bit 8		Velocity ramping	
	Bits 9–10		PID algorithm for pressure	
	Bit 11		Pressure ramping	
	Bit 12		Output range	
	Bit 13		Voltage range for pressure	
	Bits 14–16		Not used this profile	
11		99	K1 (pressure loop gain)	
12		100	K2 (pressure loop rate)	
13		101	K3 (pressure loop reset)	
14		102	Velocity/pressure data acquisition bits	
	Bits 1–3		SPC/SQC diagnostics	
	Bits 4–7		Velocity filter constants	
	Bit 8		Bias option	
	Bit 9		Reverse acting for velocity	
	Bit 10		Reverse acting for pressure	

Pack and Hold Profile Data Log

Process/Part::

Machine: **Mold:** **Date:**

Function	Address	Loc	Description	Set Value
Pack/Hold Time Profile Step Data				
15		103	Step 1 time	
16		104	Step 2 time	
17		105	Step 3 time	
18		106	Step 4 time	
19		107	Step 5 time	
20		108	Step 6 time	
21		109	Step 7 time	
22		110	Step 8 time	
23		111	Step 9 time	
24		112	Step 10 time	
Ram Velocity Setpoint Data				
25		113	Step 1 velocity	
26		114	Step 2 velocity	
27		115	Step 3 velocity	
28		116	Step 4 velocity	
29		117	Step 5 velocity	
30		118	Step 6 velocity	
31		119	Step 7 velocity	
32		120	Step 8 velocity	
33		121	Step 9 velocity	
34		122	Step 10 velocity	
Ram Hydraulic Pressure Setpoint Data				
35		123	Step 1 pressure	
36		124	Step 2 pressure	
37		125	Step 3 pressure	
38		126	Step 4 pressure	
39		127	Step 5 pressure	
40		128	Step 6 pressure	
41		129	Step 7 pressure	
42		130	Step 8 pressure	
43		131	Step 9 pressure	
44		132	Step 10 pressure	

Plasticate Profile Data Log

Process/Part::

Machine: **Mold:** **Date:**

Function	**Address**	**Loc**	**Description**	**Set Value**
Constants				
1**(WY5+132)**		133	Module sample rate	
2		134	Max profile time	
3		135	Cure timer	
4		136	Cushion value	
5		137	Cushion correction	
6		138	Velocity scaling factoror	
7		139	K1 (velocity loop gain)	
8		140	K2 (velocity loop rate)	
9		141	K3 (velocity loop reset)	
10		142	Velocity/pressure operation bits	
	Bits 1–2		PID algorithm for velocity	
	Bits 3–4		Filter for velocity calculation	
	Bit 5		Voltage range for flow command	
	Bit 6		Not used this profile	
	Bit 7		Not used this profile	
	Bit 8		Velocity ramping	
	Bits 9–10		PID algorithm for pressure	
	Bit 11		Pressure ramping	
	Bit 12		Output range	
	Bit 13		Voltage range for pressure	
	Bits 14–16		Not used this profile	
11		143	K1 (pressure loop gain)	
12		144	K2 (pressure loop rate)	
13		145	K3 (pressure loop reset)	
14		146	Velocity/pressure data acquisition bits	
	Bits 1–3		SPC/SQC diagnostics	
	Bits 4–7		Velocity filter constants	
	Bit 8		Bias option	
	Bit 9		Reverse acting for velocity	
	Bit 10		Reverse acting for pressure	

Plasticate Profile Data Log

Process/Part::

Machine: **Mold:** **Date:**

Function	Address	Loc	Description	Set Value
Plasticate Profile Step Data				
15		147	Step 1 position	
16		148	Step 2 position	
17		149	Step 3 position	
18		150	Step 4 position	
19		151	Step 5 position	
20		152	Step 6 position	
21		153	Step 7 position	
22		154	Step 8 position	
23		155	Step 9 position	
24		156	Step 10 position	
Ram Velocity Setpoint Data				
25		157	Step 1 velocity	
26		158	Step 2 velocity	
27		159	Step 3 velocity	
28		160	Step 4 velocity	
29		161	Step 5 velocity	
30		162	Step 6 velocity	
31		163	Step 7 velocity	
32		164	Step 8 velocity	
33		165	Step 9 velocity	
34		166	Step 10 velocity	
Ram Hydraulic Pressure Setpoint Data				
35		167	Step 1 pressure	
36		168	Step 2 pressure	
37		169	Step 3 pressure	
38		170	Step 4 pressure	
39		171	Step 5 pressure	
40		172	Step 6 pressure	
41		173	Step 7 pressure	
42		174	Step 8 pressure	
43		175	Step 9 pressure	
44		176	Step 10 pressure	

Clamp Opening Profile Data Log

Process/Part::

Machine: **Mold:** **Date:**

Function	Address	Loc	Description	Set Value
Constants				
1	**(WY5+176)**	177	Module sample rate	
2		178	Max profile time	
3		179	Future use	
4		180	Future use	
5		181	Future use	
6		182	Velocity scaling factoror	
7		183	K1 (velocity loop gain)	
8		184	K2 (velocity loop rate)	
9		185	K3 (velocity loop reset)	
10		186	Velocity/pressure operation bits	
	Bits 1–2		PID algorithm for velocity	
	Bits 3–4		Filter for velocity calculation	
	Bit 5		Voltage range for flow command	
	Bit 6		Not used this profile	
	Bit 7		Not used this profile	
	Bit 8		Velocity ramping	
	Bits 9–10		PID algorithm for pressure	
	Bit 11		Pressure ramping	
	Bit 12		Output range	
	Bit 13		Voltage range for pressure	
	Bits 14–16		Not used this profile	
11		187	K1 (pressure loop gain)	
12		188	K2 (pressure loop rate)	
13		189	K3 (pressure loop reset)	
14		190	Velocity/pressure data acquisition bits	
	Bits 1–3		SPC/SQC diagnostics	
	Bits 4–7		Velocity filter constants	
	Bit 8		Bias option	
	Bit 9		Reverse acting for velocity	
	Bit 10		Reverse acting for pressure	

Clamp Opening Profile Data Log

Process/Part::

Machine: **Mold:** **Date:**

Function	Address	Loc	Description	Set Value
Clamp Open Profile Step Data				
15		191	Step 1 position	
16		192	Step 2 position	
17		193	Step 3 position	
18		194	Step 4 position	
19		195	Step 5 position	
20		196	Step 6 position	
21		197	Step 7 position	
22		198	Step 8 position	
23		199	Step 9 position	
24		200	Step 10 position	
Clamp Velocity Setpoint Data				
25		201	Step 1 velocity	
26		202	Step 2 velocity	
27		203	Step 3 velocity	
28		204	Step 4 velocity	
29		205	Step 5 velocity	
30		206	Step 6 velocity	
31		207	Step 7 velocity	
32		208	Step 8 velocity	
33		209	Step 9 velocity	
34		210	Step 10 velocity	
Hydraulic Pressure Setpoint Data				
35		211	Step 1 pressure	
36		212	Step 2 pressure	
37		213	Step 3 pressure	
38		214	Step 4 pressure	
39		215	Step 5 pressure	
40		216	Step 6 pressure	
41		217	Step 7 pressure	
42		218	Step 8 pressure	
43		219	Step 9 pressure	
44		220	Step 10 pressure	

Hold Values Data Log

Process/Part::

Machine: **Mold:** **Date:**

Function	Address	Loc	Description	Set Value
WY5+220				
1		221	Channel 1 output	
2		222	Channel 2 output	
3		223	Channel 5 output	
4		224	Channel 6 output	
5		225	Output directional bits/discretes	
	Bit 1		Channel 1 output polarity	
	Bit 2		Channel 2 output polarity	
	Bit 3		Channel 5 output polarity	
	Bit 4		Channel 6 output polarity	
	Bit 16		Discrete output 1	
	Bit 15		Discrete output 2	
	Bit 14		Discrete output 3	
	Bit 13		Discrete output 4	

Scaling Constants Data Log

Process/Part::

Machine: **Mold:** **Date:**

Function	Address	Loc	Description	Set Value
WY5+225				
1		226	Clamp close positive scale	
2		227	Clamp close negative scale	
3		228	Injection positive scale	
4		229	Injection negative scale	
5		230	Pack and hold positive scale	
6		231	Pack and hold negative scale	
7		232	Plasticate positive scale	
8		233	Plasticate negative scale	
9		234	Clamp open positive scale	
10		235	Clamp open negative scale	

Discrete Output Data Log

Process/Part::

Machine: **Mold:** **Date:**

Function	Address	Loc	Description		Set Value
WY5+235					
1		236	Clamp close discrete	output 1	
2		237	|	output 2	
3		238	|	output 3	
4		239	↓	output 4	
5		240	Inject discrete	output 1	
6		241	|	output 2	
7		242	|	output 3	
8		243	↓	output 4	
9		244	Pack and hold discrete	output 1	
10		245	|	output 2	
11		246	|	output 3	
12		247	↓	output 4	
13		248	Plasticate discrete	output 1	
14		249	|	output 2	
15		250	|	output 3	
16		251	↓	output 4	
17		252	Clamp open discrete	output 1	
18		253	|	output 2	
19		254	|	output 3	
20		255	↓	output 4	

Upload Table Memory Map Data Log

Process/Part::

Machine: **Mold:** **Date:**

Function	Address	Loc	Description	Comments/Notes
WY6				
		1	Actual loop calculation time	
		2	Clamp position feedback	
		3	Clamp velocity calculated by module	
		4	Clamp hydraulic flow output	
		5	Clamp hydraulic pressure feedback	
		6	Clamp pressure output signal	
		7	Ram position feedback	
		8	Ram velocity calculated by module	
		9	Ram hydraulic flow output	
		10	Ram hydraulic pressure feedback	
		11	Ram hydraulic pressure output	
		12	Clamp close status bits	
		13	Inject status bits	
		14	Pack and hold status bits	
		15	Plasticate status bits	
		16	Clamp open status bits	
		17	Inject final ram position	
		18	Inject final calculated velocity	
		19	Inject final ram pressure	
		20	Inject final cavity pressure	
		21	Accumulated inject profile time	
		22	Pack and hold final ram position	
		23	Pack and hold final calculated velocity	
		24	Pack and hold final ram pressure	
		25	Pack and hold final cavity pressure	
		26	Accumulated pack and hold profile time	
		27	Accumulated clamp close profile time	
		28	Accumulated plasticate profile time	
		29	Accumulated clamp open profile time	
		30	Accumulated inject fill time	
		31	Accumulated pack and hold time	
		32	Peak inject cavity pressure	
		33	Peak pack and hold cavity pressure	
		34	Cavity pressure feedback	

Upload Table Memory Map Data Log

Process/Part::

Machine: **Mold:** **Date:**

Function	**Address**	**Loc**	**Description**	**Comments/Notes**
WY6+34				
35		35	Profile indicator for SPC/SQC	
36		36	Average of 10 velocity inputs	
37		37	Average of 10 velocity inputs	
38		38	Average of 10 velocity inputs	
39		39	Average of 10 velocity inputs	
40		40	Average of 10 velocity inputs	
41		41	Average of 10 velocity inputs	
42		42	Average of 10 velocity inputs	
43		43	Average of 10 velocity inputs	
44		44	Average of 10 velocity inputs	
45		45	Average of 10 velocity inputs	
46		46	Average of 10 pressure inputs	
47		47	Average of 10 pressure inputs	
48		48	Average of 10 pressure inputs	
49		49	Average of 10 pressure inputs	
50		50	Average of 10 pressure inputs	
51		51	Average of 10 pressure inputs	
52		52	Average of 10 pressure inputs	
53		53	Average of 10 pressure inputs	
54		54	Average of 10 pressure inputs	
55		55	Average of 10 pressure inputs	
56		56	Discrete output status bits	
	Bit 16		Discrete output 1	
	Bit 15		Discrete output 2	
	Bit 14		Discrete output 3	
	Bit 13		Discrete output 4	

Index

Customer Response

We would like to know what you think about our user manuals so that we can serve you better. How would you rate the quality of our manuals?

	Excellent	Good	Fair	Poor
Accuracy	_______	_______	_______	_______
Organization	_______	_______	_______	_______
Clarity	_______	_______	_______	_______
Completeness	_______	_______	_______	_______
Graphics	_______	_______	_______	_______
Examples	_______	_______	_______	_______
Overall design	_______	_______	_______	_______
Size	_______	_______	_______	_______
Index	_______	_______	_______	_______

Would you be interested in giving us more detailed comments about our manuals?

☐ **Yes!** Please send me a questionnaire.

☐ **No.** Thanks anyway.

Your Name: ____

Title: ____

Telephone Number: (_____)____

Company Name: ____

Company Address: ____

____

____

Manual Name: SIMATIC 505 TurboPlastic Module User/Programmer Manual **Edition:** Third

Text Assembly Number: 2586546-0041 **Date:** 07/98

Order Number: PPX:505–8117–3

FOLD

SIEMENS ENERGY & AUTOMATION INC
3000 BILL GARLAND ROAD
PO BOX 1255
JOHNSON CITY TN 37605–1255

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL

FIRST CLASS PERMIT NO.3 JOHNSON CITY, TN

POSTAGE WILL BE PAID BY ADDRESSEE

ATTN TECHNICAL COMMUNICATIONS M/S 519
SIEMENS ENERGY & AUTOMATION INC
PO BOX 1255
JOHNSON CITY TN 37605–1255

FOLD