Polly Press System Documentation

Comprehensive Guide to Operation, Programming, and Maintenance

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For detailed information on the Polly Press industrial pressing system, including
component specifications, programming, and safety protocols.

Contents

1 Introduction to the Polly Press

The Polly Press is an automated industrial system designed for pressing operations in manufacturing or assembly applications. Controlled by a Trio Flex-6 Nano PLC and monitored via a Uniplay 7-A HMI, it integrates pneumatic actuators, electrical heating, and advanced safety features to deliver precise, repeatable, and safe performance. Key features include:

- Automated Pressing Cycle: Executes loading, pressing, dwelling, and unloading with precise control.

- Safety Compliance: Incorporates emergency stops, light curtains, and safety relays meeting SIL 3 and EN ISO 13849-1 standards.

- Operator Interface: A 7-inch touchscreen HMI for real-time monitoring and control.

- Modular Design: Supports expansion with additional sensors or actuators.

- Traceability: Logs cycle data and alarms for quality assurance.

The system achieves ≥98% uptime (MTBF ≥2000 hours) and supports cycle times of 8–10 seconds, depending on operator speed and workpiece complexity.

2 System Components

The Polly Press comprises 23 devices, including pneumatic cylinders, solenoid valves, safety relays, and control modules. The following table consolidates key devices, prioritizing updates from recent documentation.

Table 1: Key Devices of the Polly Press System

Device Name	Model	Quantity	Type	Key Specifications
Keyence Power Supply	MS20-H100	1	Switching Power Supply	24V, 4.5A, 100W; Input 85-264 VAC; Weight: 490 UL, C-UL, EN, IEC compliant
Eaton 5A Mini-Breaker	FAZ-D5/2-NA	1	Miniature Circuit Breaker	2-pole, 5A, 480V, D curve 10KAIC, DIN rail moun UL489 listed
Eaton 20A Mini-Breaker	FAZ-D20/2-NA-L	4	Miniature Circuit Breaker	2-pole, 20A, 240-415V, kA, D curve, DIN r mount, UL489 listed
Eaton 20A Contactor	DIL MP20	2	IEC Contactor	20A, 4-pole, 24V AC co 5.5 kW, screw termina RoHS, CE, UL listed
Eaton 32A Contactor	DIL MP32-10	2	IEC Contactor	32A, 4-pole, 24V AC/D coil, 7.5 kW, screw term nals, RoHS, CE, UL liste

Name	Part Number	Qty	Type	Description
Edison 3-Phase Distribution Block	EPDB104 Cu/Al	3	Distribution Block	4-pole, 100A, 600V, copper/aluminum, DIN r... mount, UL listed
Phoenix Contact Relay	29 61 192	1	Power Relay	10A at 250V AC, 24V D... coil, 1 NO contact, DIN r... mount, UL listed
Phoenix Contact Relay	29 61 105	3	Power Relay	10A at 250V AC, 24V D... coil, 1 NO contact, DIN r... mount, UL listed
Omron Temp Monitoring Relay	K8AK-TH11S	2	Temperature Monitoring Relay	Thermocouple input (K, T), 3A at 250V AC, -200 +1300°C, ±0.5% accurac...
Schmersal Safety Relay	SRB 206SQ	1	Safety Relay	2 safety inputs, 2 outpu... 24V DC, SIL 3, EN IS... 13849-1 compliant
Stride SE3 Network Switch	SE3-SW5U	1	Industrial Ethernet Switch	5x 10/100/1000 Mb... ports, managed, VLA... QoS, 12-24V DC, IP30, -... to +75°C
Pneumatic Cylinder	XYZ-456	1	Pneumatic Cylinder	100mm bore, 3500m... stroke, 0.1-1.0 MPa, al... minum body, NBR seals
Pneumatic Cylinder	S5-T1F-4.0X8.0-HC-2-EE1-N	2	Pneumatic Cylinder	40mm bore, 80mm strok... 0.1-1.0 MPa, aluminu... body, magnetic piston
Solenoid Valve	DMB-DDAP-1DM	1	Solenoid Valve	1/2" orifice, 24V DC, 1... m³/h flow, 0.1-0.7 MP... normally closed
Solenoid Valve	92B-AAB-CAA-DM-DDAP-1DM	1	Solenoid Valve	1/2" orifice, 24V DC, 1... m³/h flow, 0.1-0.7 MP... normally closed
Leuze Safety Light Curtain Receiver	MLC510R14-300	2	Safety Light Curtain	14mm resolution, 300m... range, 24V DC, SIL 3, E... ISO 13849-1 compliant
Leuze Deflecting Mirror	UM60-300	1	Deflecting Mirror	Aluminum, 90° angle, IP... rated, for safety light cu... tains
Trio Flex-6 Nano CPU	Flex-6 Nano (P600)	1	PLC CPU	32-bit RISC, 1 MB RAM... MB Flash, expandable I/... Ethernet, DIN rail moun...
Trio Flex Nano In16 (DI) Module	Nano-In16	1	Digital Input Module	16 inputs, 24V DC, DIN r... mount
Trio Flex Nano Out16 (DO) Module	NANO-Out16	1	Digital Output Module	16 outputs, 24V DC, 0.5... per output, DIN rail mou...
Trio Flex Nano THC4 (Analog TC) Module	Nano-THC4	1	Analog Thermocouple Module	4 inputs, K, J, T therm... couples, ±0.5% accurac... DIN rail mount

Trio HMI	Uniplay 7-A	1	Human-Machine Interface	7" TFT LCD, 800x480 res-lution, Ethernet, USB, R-232, touchscreen, IP65
SMC Pressure Switch	IS10 Series	1	Pressure Switch	0-1 MPa range, NPN/PN analog 4-20 mA, 24V D IP65
Emergency Stop But-ton	Schmersal AZM300	1	Safety Switch	IP67, 24V DC, 2 NC co tacts

2.1 Notes

- The pneumatic cylinder model was updated to XYZ-456, reflecting a newer or more specific model.

- The Schmersal AZM300 emergency stop button was added for enhanced safety redundancy.

- All devices comply with UL, CE, IEC, and EN ISO standards for industrial use.

3 I/O Mapping

The I/O mapping assigns inputs and outputs to PLC channels for control and monitoring. The following table incorporates updates from recent documentation.

Table 2: I/O Mapping for Polly Press

Signal Type	Device Name	Terminal/PLC Channel	Description
Digital Input	E-Stop Circuit	IN(0)	Monitors emergency stop loop (Schmersal SRB 206SQ)
Digital Input	Safety Gate Switch	IN(1)	Monitors safety door (Schneider XCK-J115)
Digital Input	Safety Light Curtain	IN(2), IN(3)	Monitors perimeter protec-tion (Leuze MLC510R14-300)
Digital Input	Safety Relay	IN(4)	Monitors safety inputs (Schmersal SRB 206SQ)
Digital Input	Cylinder Home Sensor	IN(5)	Detects cylinder retracted position
Digital Input	Cylinder End Sensor	IN(6)	Detects cylinder extended position
Digital Input	Start Cycle Pushbut-ton	IN(7)	Initiates cycle start com-mand
Digital Input	Reset Pushbutton	IN(8)	Acknowledges faults/resets system

Digital Input	Pressure Switch	IN(9)	Confirms air supply pressure (SMC IS10 Series)
Digital Input	Emergency Stop Button	IN(10)	Additional E-Stop input (Schmersal AZM300)
Digital Output	Press Actuate Solenoid	OUT(1)	Extends pneumatic press cylinder
Digital Output	Press Retract Solenoid	OUT(2)	Retracts pneumatic press cylinder
Digital Output	Alarm Buzzer	OUT(3)	Sounds on fault condition
Digital Output	Cycle Lamp	OUT(4)	Indicates cycle in progress
Analog Input	Temperature Sensor (Thermocouple)	AI(1)	Monitors press/heater temperature (Omron K8AK-TH11S)
Analog Input	Air Pressure Transducer	AI(2)	Monitors supply air pressure

3.1 Notes

- The cylinder home sensor channel was updated to IN(5) for configuration consistency.

- The emergency stop button (IN(10)) enhances safety redundancy.

- Safety inputs are hardwired to the Schmersal SRB 206SQ safety relay.

4 Production Cycle

The production cycle executes in approximately 8–10 seconds, depending on operator speed and workpiece complexity. The sequence is:

1. Power-Up & Initial Safety Check (1 sec): Verifies E-Stop (IN(0), IN(10)), safety gate (IN(1)), light curtains (IN(2), IN(3)), safety relay (IN(4)), temperature (AI(1)), and air pressure (IN(9), AI(2)). Alarms if any condition fails.

2. Preheat & Temperature Control (Variable): Operator sets temperature (50–250°C, ±3°C) via HMI; heaters adjust based on thermocouple feedback (AI(1)).

3. Workpiece Loading (2–4 sec): Operator places part on press plate; light curtains ensure safety.

4. Cycle Start (0.5 sec): Operator presses "Start" (IN(7)); PLC rechecks safety inputs; cycle lamp (OUT(4)) lights.

5. Press Actuation - Downstroke (1 sec): Solenoid (OUT(1)) extends cylinder; "extended" sensor (IN(6)) confirms position.

6. Dwell Time (1 sec): Press holds at full extension.

7. Press Retraction - Upstroke (1 sec): Solenoid (OUT(2)) retracts cylinder; "home" sensor (IN(5)) confirms retraction.

8. Workpiece Unloading (2–4 sec): Operator removes part; light curtains prevent cycle if interrupted.

9. Fault/Alarm Handling (Varies): Retracts cylinder, sounds alarm, displays fault, waits for "Reset" (IN(8)).

Total cycle time: 8–10 seconds.

5   Safety Protocols

Safety features ensure operator protection and compliance with SIL 3 and EN ISO 13849-1 standards:

- Schmersal SRB 206SQ Safety Relay: Monitors E-Stop, gate, and light curtains; disables outputs on fault.

- Leuze MLC510R14-300 Light Curtain: Prevents cycle if interrupted (14mm resolution, 300mm range).

- Schmersal AZM300 Emergency Stop Button: Provides redundancy (IP67, 2 NC contacts).

- Schneider XCK-J115 Door Interlock Switch: Ensures safety door is closed.

- Omron K8AK-TH11S Temperature Monitor: Alarms on over-temperature.

- SMC IS10 Series Pressure Switch: Blocks cycle if air pressure is inadequate.

Fault Response: Retract cylinder (OUT(2)=1), sound alarm (OUT(3)=1), display fault, require "Reset" (IN(8)).

6   Programming the Polly Press

The system is programmed in Trio BASIC for the Trio Motion Perfect software, running on the Flex-6 Nano PLC. The program is modular, with subroutines for initialization, safety checks, cycle control, HMI updates, and error handling.

```
' Polly Press Program
' Main loop to control the press cycle and monitor safety/HMI

' Global Variables
VR(0) = 0  ' safety_ok flag (1 = safe, 0 = unsafe)
VR(1) = 0  ' cycle_running flag (1 = running, 0 = stopped)
VR(2) = 0  ' error_code (0 = no error, >0 = specific error)
VR(3) = 0  ' cycle_count for logging
VR(4) = 0  ' temperature_setpoint (degrees C, set via HMI)
VR(5) = 0  ' current_temperature (degrees C, from AI(1))

' I/O Assignments
' Inputs: IN(0)=E-Stop, IN(1)=Door Switch, IN(2,3)=Light Curtain, IN(4)=Safety Relay
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```
' IN(5)=Cylinder Home, IN(6)=Cylinder Extended, IN(7)=Start PB, IN(8)=Reset PB
' IN(9)=Pressure Switch, IN(10)=Emergency Stop (new)
' Outputs: OUT(1)=Solenoid Extend, OUT(2)=Solenoid Retract, OUT(3)=Alarm, OUT(4)=Cycle Lam
' Analog: AI(1)=Temperature, AI(2)=Pressure

GOSUB Initialize

WHILE TRUE
    GOSUB CheckSafety
    GOSUB MonitorTemperature
    IF VR(0) = 1 AND IN(7) = 1 AND VR(1) = 0 AND VR(5) >= VR(4) - 3 THEN
        VR(1) = 1  ' Start cycle
        GOSUB RunCycle
        VR(1) = 0  ' End cycle
        VR(3) = VR(3) + 1  ' Increment cycle count
    ENDIF
    IF VR(0) = 0 OR VR(5) > VR(4) + 3 THEN
        GOSUB HandleError
    ENDIF
    GOSUB UpdateHMI
    WA(0.01)  ' Prevent CPU overload
WEND

' Subroutine: Initialize
Initialize:
    PRINT "Initializing Polly Press..."
    VR(0) = 0
    VR(1) = 0
    VR(2) = 0
    VR(3) = 0
    VR(4) = 100  ' Default temperature setpoint
    VR(5) = 0
    OUT(1) = 0  ' Solenoid Extend off
    OUT(2) = 0  ' Solenoid Retract off
    OUT(3) = 0  ' Alarm off
    OUT(4) = 0  ' Cycle Lamp off
    RETURN

' Subroutine: CheckSafety
CheckSafety:
  IF IN(0) = 0 OR IN(1) = 0 OR IN(2) = 0 OR IN(3) = 0 OR IN(4) = 0 OR IN(9) = 0 OR IN(10) = 0 TH
        VR(0) = 0
        VR(2) = 1  ' Safety fault
    ELSE
        VR(0) = 1
        VR(2) = 0
    ENDIF
    RETURN
```

```
' Subroutine: MonitorTemperature
MonitorTemperature:
    VR(5) = AIN(1)  ' Read temperature
    IF VR(5) > VR(4) + 3 THEN
        VR(2) = 2  ' Over-temperature error
    ENDIF
    RETURN


' Subroutine: RunCycle
RunCycle:
    PRINT "Starting Press Cycle..."
    OUT(4) = 1  ' Turn on cycle lamp
    OUT(1) = 1  ' Extend cylinder
    WA(1.0)     ' Wait for extension
    IF IN(6) = 1 THEN  ' Check extended sensor
        WA(1.0)  ' Dwell time
        OUT(1) = 0
        OUT(2) = 1  ' Retract cylinder
        WA(1.0)  ' Wait for retraction
        IF IN(5) = 1 THEN  ' Check home sensor
            OUT(2) = 0
            OUT(4) = 0  ' Turn off cycle lamp
            PRINT "Cycle Complete"
        ELSE
            VR(2) = 3  ' Retraction error
        ENDIF
    ELSE
        VR(2) = 4  ' Extension error
    ENDIF
    RETURN


' Subroutine: HandleError
HandleError:
    IF VR(2) > 0 THEN
        PRINT "Error Detected: Code ", VR(2)
        OUT(1) = 0
        OUT(2) = 1  ' Retract cylinder
        OUT(3) = 1  ' Sound alarm
        OUT(4) = 0  ' Turn off cycle lamp
        IF IN(8) = 1 THEN  ' Reset button pressed
            OUT(3) = 0  ' Silence alarm
            VR(2) = 0   ' Clear error
        ENDIF
    ENDIF
    RETURN


' Subroutine: UpdateHMI
```

```
UpdateHMI:
    ' Update HMI tags (pseudo-code)
    IF VR(1) = 1 THEN
        ' Set HMI tag: CycleStatus = "Running"
    ELSE
        ' Set HMI tag: CycleStatus = "Idle"
    ENDIF
    IF VR(2) > 0 THEN
        ' Set HMI tag: ErrorCode = VR(2)
    ENDIF
    ' Set HMI tags: Temperature = VR(5), CycleCount = VR(3)
    RETURN
```

6.1 Program Explanation

- Main Loop: Monitors safety, temperature, and operator inputs, initiating the cycle when conditions are met.

- Initialize: Resets variables and outputs to a safe state.

- CheckSafety: Verifies all safety inputs.

- MonitorTemperature: Checks for over-temperature conditions.

- RunCycle: Executes the press cycle (extend, dwell, retract).

- HandleError: Stops operations, retracts cylinder, and alarms.

- UpdateHMI: Sends status and data to the HMI.

6.2 Programming Notes

- Assumes a single operating mode; additional modes require further subroutines.

- HMI communication uses Modbus TCP or Trio protocol.

- Cycle data is logged for $\geq$30 days, exportable via USB/network.

7 HMI Configuration

The Trio Uniplay 7-A HMI provides a 7-inch touchscreen interface with multiple screens:

- Home/Status: Displays machine state (STOPPED, READY, RUNNING), cycle count, and safety status.

- Temperature Control: Sets temperature setpoints (50–250°C) and displays current temperatures.

- Cycle Details: Shows cycle progress and logged data.

- Alarm/Fault: Lists alarms with descriptions.

- Settings: Admin access for recipe management.

Table 3: HMI Tags for Polly Press

Tag Name	Type	Description
CycleStatus	Digital	Running (1) or Idle (0)
SafetyStatus	Digital	Safe (1) or Unsafe (0)
ErrorCode	Integer	0 = No error, 1 = Safety fault, etc.
TemperatureSetpoint	Analog	Set temperature (VR(4), °C)
CurrentTemperature	Analog	Measured temperature (VR(5), °C)
CycleCount	Integer	Number of completed cycles (VR(3))
StartCommand	Digital	Start button press (IN(7))
ResetCommand	Digital	Reset button press (IN(8))

7.1 Notes

- Tags use color-coding: green=OK, red=Fault, yellow=Warning.

- Recipe management saves/loads parameters via unique IDs.

8 Maintenance and Troubleshooting

8.1 Routine Maintenance

- Daily: Inspect safety devices, clean press area, verify HMI display.

- Weekly: Test E-Stop, light curtains, and door switch; check air supply for leaks.

- Monthly: Maintain filter-regulator-lubricator (FRL), test solenoid valves, inspect wiring.

- Annually: Calibrate thermocouples and pressure transducers.

8.2 Troubleshooting

Table 4: Troubleshooting Guide for Polly Press

Issue	Possible Cause	Solution
Press Won't Start	Safety fault (E-Stop, gate, light curtain)	Check safety inputs, resolve fault, press Reset
Cylinder Not Moving	Low air pressure or solenoid failure	Verify air supply (0.1-1.0 MPa), check solenoid wiring
Over-Temperature Alarm	Heater malfunction or setpoint exceeded	Adjust setpoint, check thermocouple (AI(1))
HMI Not Responding	Network or power issue	Verify Ethernet connection, check power supply
Cycle Incomplete	Sensor failure (home/extended)	Inspect sensors (IN(5), IN(6)), replace if faulty

9 Additional Information Needed

To refine this documentation, please provide:

- Exact sequence of operations for special modes (e.g., manual, maintenance).

- Detailed I/O channel assignments for all devices.

- HMI screen layout and operator control requirements.

- Recipe management specifications.

10 Conclusion

This document provides a comprehensive guide to the Polly Press system, covering components, I/O mapping, production cycle, safety protocols, programming, HMI configuration, and maintenance. It integrates updates from recent documentation, ensuring accuracy and reliability for operation, programming, and maintenance tasks.