700 SERIES 'TPC' TRIPLEX PUMP CONTROLLER INSTRUCTION MANUAL

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* U.L. APPLIES TO OPTIONAL ENCLOSURE

INTRODUCTION:

The Sigma 700 Series Triplex Pump Controller is a state of the art microprocessor based, user configurable instrument for the monitoring and control of three (3) constant speed or (3) variable speed driven pumps.

The 700 TPC Series performs all of the functions found in a full size control panel.

- Displays process value in alpha and numeric format
- Displays pump run status
- Allows full user selection of all system variables
- Monitors critical alarms (motor overtemperature, etc.)
- Monitors non-critical alarms (seal leak, etc.)
- Monitors hand off auto selection switch position
- Monitors pump (VFD) 'run' feedback
- Provides relay outputs for pump control, level alarm, and general alarm.
- Provides 4/20MA output for VFD speed setting, proportional control, or retransmission.
- Continuous sensor monitor with general alarm output
- Visual alarms, 6 front of panel LED's provide alarm and status information
- Allows simulation of level to exercise pumps or verify operation
- Provides PID control and calculated flow (user selectable).
- Available in ¼ DIN panel mount or Nema 4X enclosures (optional)
- Calculates discharge flow (wet well applications)

ORDERING INFORMATION:

- 1/4 DIN Case   Sigma 700 Series TPC
- Wall Mount Nema 4X   Sigma 700 Series-TPC-N4X

SPECIFICATIONS:

- ANALOG INPUT (1 ea.)
  Analog, 4/20MA isolated with common negative, +-0.1% accuracy.

- DIGITAL INPUTS (8 ea.)
  Digital 10-30V DC (Grounding)

- ANALOG OUTPUT: (1 ea.)
  Analog, with common negative 4/20MA.

- RELAY OUTPUTS: (4 ea.)
  SPDT, Form 'C' 5A Relay

- DISPLAY:
  LCD, 2 line Alphanumeric, Backlit.

- ALARM RESET/SILENCE INPUT

- **LOOP POWER:**
  24VDC regulated output, 100MA max. (With 110VAC option).

- **3 USER KEYS:**
  Up, Down, Enter

- **ACCURACY:**
  0.1% of calibrated span

- **LOCKOUT:**
  User password, user configurable

- **INPUT IMPEDANCE:**
  Voltage 100K, current 100 OHMS

- **POWER:**
  24VDC, (110VAC optional)

- **ENVIRONMENTAL:**
  Operating, 0-65° C
  Storage, -40° -80° C
  R.H., 0-90% non condensing

- **ENCLOSURE:**
  ¼ DIN, ABS plastic 96 X 96 X 110MM or Nema 4X wall mount, with clear viewing window

- **FRONT PANEL:**
  Gasketed Nema 4X

- **ACCESS: (DIN CASE)**
  Chassis & boards remove from front of case. (DIN enclosure only) No tools required

- **TERMINAL STRIP:**
  (24) Removable for ease of wiring 28 – 16 AWG

- **CONNECTIONS:**
  Removable screw terminal blocks 28 – 16 AWG wire. (27 with 110VAC option)

- **CONTROL OUTPUTS:**
  4 relay outputs, user programmable, SPDT Form 'C' relays 5 AMP.

- CPU Activity Monitor

- **PROGRAMMING:**
  Menu based, all parameters and setpoints are user configurable via menu prompts and user keys. The preconfigured screens and 'pull down' sub menus with English prompts assure rapid setup and commissioning.

- 1 YEAR WARRANTY

- OPTIONS:
  2 option cards available, 1 with 8 DI / DO's and 1 AI / AO, 1 with 4 G / byte data logger and 2 thermocouple inputs.

- MODBUS® Master/Slave
  Network allows multiple units to be connected together for distributed applications or remote monitoring SCADA applications.

- EXPANSION CARDS:
  Significant expansion is possible via additional control boards and 'MODBUS®' networking.

FEATURES:

- Microprocessor Based
- Alpha Numeric LCD display (backlit)
- 3 Function Keys
- Isolated 24VDC Sensor Power (with 110VAC option)
- 4/20MA, Programmable input
- 1 Analog Input
- 1 Analog Outputs
- 8 Digital Inputs
- 4 Form 'C' Relay Outputs
- Fully User Programmable in English
- 2 Ea. RS485 Ports (Programming and SCADA) MODBUS® Master/Slave.
- CPU Activity Monitor

OPTIONAL I/O CARD

Adds:
- 1 ea. 4/20MA input and output
- 8 ea. Programmable digital inputs/outputs
- Digital barometer
- Bubbler pressure sensor
- Data Logger

WIRING DETAIL

- Inputs, see Dwg # 10-298
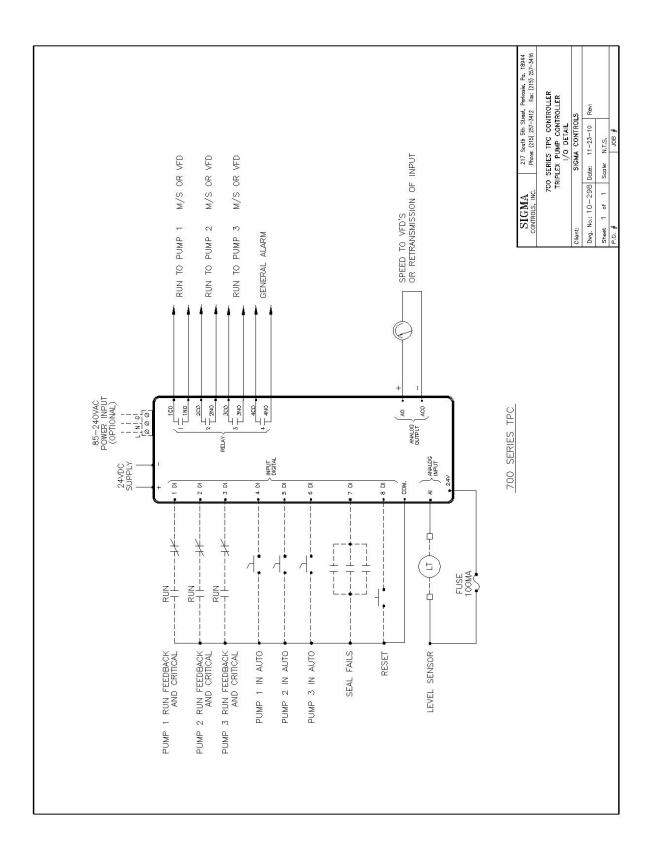- Outputs, see Dwg # 10-298

CAUTION

All electrical wiring must be in accordance with all local state and national codes that apply.
Do not exceed the rated current of the D.C. power supply (100MA) or the form 'C' relay outputs (5A/240VAC resistive).

WARNING

Hazardous voltages are present within the enclosure. Installation or service should only be carried out by trained personnel.

7

85-240VAC POWER INPUT (OPTIONAL)

L N G

24VDC SUPPLY

RELAY

1CO 1NO 2CO 2NO 3CO 3NO 4CO 4NO

RUN TO PUMP 1 — M/S OR VFD
RUN TO PUMP 2 — M/S OR VFD
RUN TO PUMP 3 — M/S OR VFD
GENERAL ALARM

INPUT DIGITAL

1 DI 2 DI 3 DI 4 DI 5 DI 6 DI 7 DI 8 DI COM.

ANALOG INPUT

AI 24V

ANALOG OUTPUT

AO ACO

SPEED TO VFD'S OR RETRANSMISSION OF INPUT

700 SERIES TPC

RUN RUN RUN

PUMP 1 RUN FEEDBACK AND CRITICAL
PUMP 2 RUN FEEDBACK AND CRITICAL
PUMP 3 RUN FEEDBACK AND CRITICAL
PUMP 1 IN AUTO
PUMP 2 IN AUTO
PUMP 3 IN AUTO
SEAL FAILS
RESET

LEVEL SENSOR

LT

FUSE 100MA

SIGMA CONTROLS, INC.
217 South 5th Street, Perkasie, Pa. 18944
Phone: (215) 257-3412   Fax: (215) 257-3416
700 SERIES TPC CONTROLLER
TRIPLEX PUMP CONTROLLER
I/O DETAIL
SIGMA CONTROLS
Client:
Dwg. No.: 10-298 Date: 11-23-10 Rev:
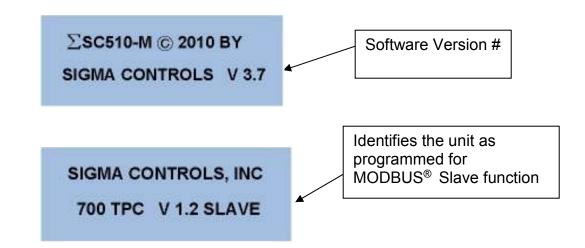Sheet 1 of 1 Scale: N.T.S.
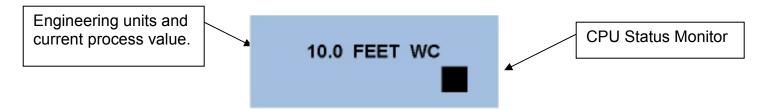P.O. #   JOB #

PROGRAMMING & SETUP

Review Screens

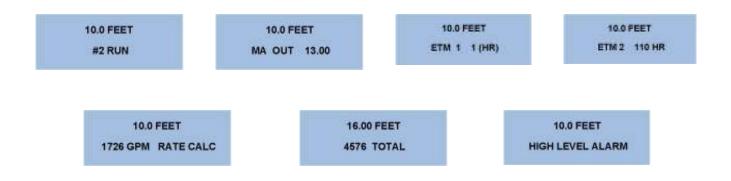The 700 Series TPC utilizes 'plain English' menu driven screens which are sequential and intuitive.

When the unit powers up, the startup screen will appear as follows:

ΣSC510-M © 2010 BY

SIGMA CONTROLS V 3.7

Software Version #

SIGMA CONTROLS, INC

700 TPC V 1.2 SLAVE

Identifies the unit as programmed for MODBUS® Slave function

After the initial screens have appeared, the unit will show the 'MAIN SCREEN'.

Engineering units and current process value.

10.0 FEET WC

CPU Status Monitor

NOTE: The lower line in the 'Main' screen can show multiple process related information. Press the ⬆⬇ buttons to scroll to the following information:

| 10.0 FEET |
| #2 RUN |

| 10.0 FEET |
| MA OUT 13.00 |

| 10.0 FEET |
| ETM 1 1 (HR) |

| 10.0 FEET |
| ETM 2 110 HR |

| 10.0 FEET |
| 1726 GPM   RATE CALC |

| 16.00 FEET |
| 4576 TOTAL |

| 10.0 FEET |
| HIGH LEVEL ALARM |

PROGRAMMING SCREENS
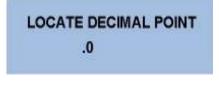
From the Main Menu, Press the ✸ button to access the Password Screen:

.

ENTER PASSWORD

0

Use the ⬆⬇ buttons to enter the preprogrammed password, then press ✸ to advance to the Menu Screens.
Use the ⬆⬇ buttons to advance to the 'Scaling' screen.

MENU SELECTION

SCALING

Enter the Scaling Menu by pressing the ✸ button and advance to:

LOCATE DECIMAL POINT

.0

Press the ⬆ button to select the number of decimal points desired: .0, .00, .000 or 0 (none), then press ✸ to advance to the Analog Input screen.
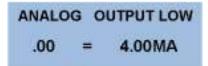
ANALOG   INPUT   LOW

.00   =   4.00MA

Use the ⬆⬇ buttons to select the process value that will be displayed when the input is 4.00MA. Example shows that .00 will be displayed at 4.00MA input. Press ✸ to advance to Analog Input High Screen.

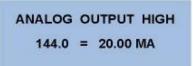ANALOG INPUT LOW

144.0 = 20.00 MA

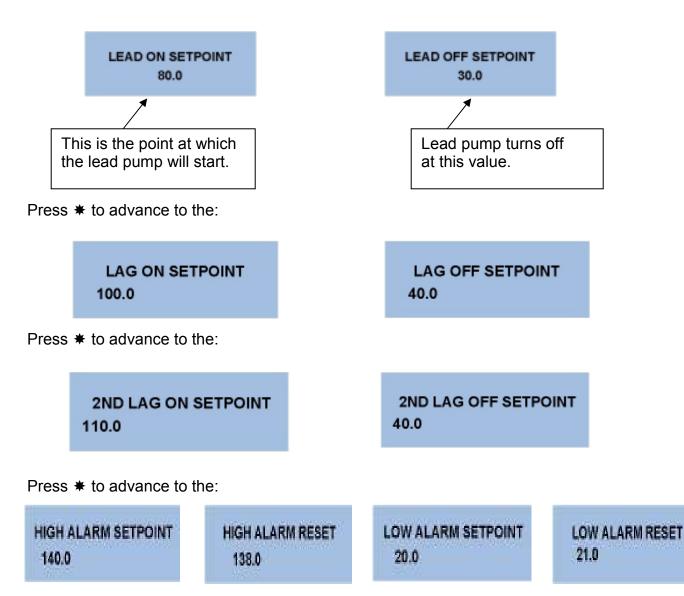Use the ⬆⬇ buttons as before to select a value to be displayed when the input is 20.00MA.

Press the ✹ button to advance to the Analog <u>Output</u> Low Screen.

> ANALOG   OUTPUT LOW
>
> .00   =   4.00MA

Use ⬆⬇ buttons to select a process value to output 4.00MA then ✹ to advance to the Analog <u>Output</u> High Screen and select the desired value.
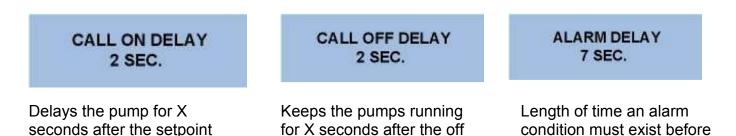
> ANALOG OUTPUT HIGH
>
> 144.0 = 20.00 MA

This completes the 'Scaling' section. Press ✹ to save any changed values and return to the 'Main Menu' Screen. As previously described, enter the MENU selection and select the 'SETPOINTS' menu, where process setpoints are entered. The first screen is the Lead On Setpoint selection.

> LEAD ON SETPOINT
> 80.0

> LEAD OFF SETPOINT
> 30.0

This is the point at which the lead pump will start.

Lead pump turns off at this value.

Press ✹ to advance to the:

> LAG ON SETPOINT
> 100.0

> LAG OFF SETPOINT
> 40.0

Press ✹ to advance to the:

> 2ND LAG ON SETPOINT
> 110.0

> 2ND LAG OFF SETPOINT
> 40.0

Press ✹ to advance to the:

> HIGH ALARM SETPOINT
> 140.0

> HIGH ALARM RESET
> 138.0

> LOW ALARM SETPOINT
> 20.0

> LOW ALARM RESET
> 21.0

**NOTE: High Alarm Reset value must be less than High Alarm Setpoint.
Low Alarm Reset value must be greater than Low Alarm Setpoint.**

Press ✴ to advance to System Timers:

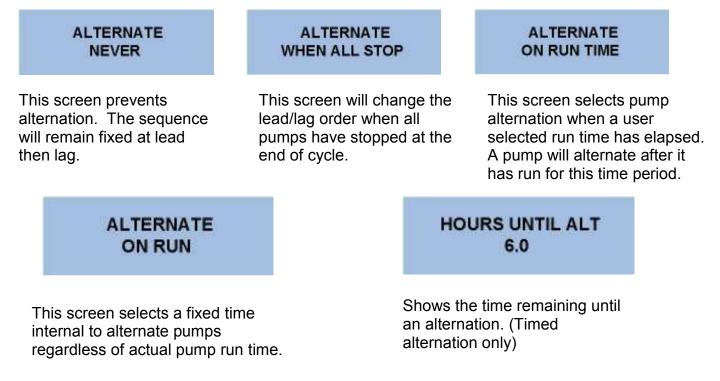|		
CALL ON DELAY 2 SEC.	CALL OFF DELAY 2 SEC.	ALARM DELAY 7 SEC.
Delays the pump for X seconds after the setpoint has been read out.	Keeps the pumps running for X seconds after the off setpoint has been reached.	Length of time an alarm condition must exist before being considered actual.

This is the end of the setpoints screen section. Press ✴ to save values and return to the main menu.
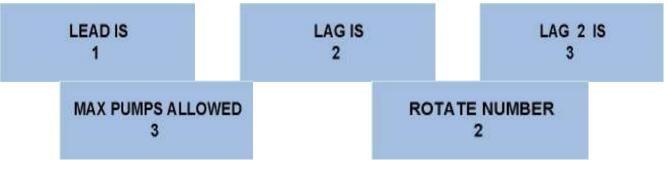
ALTERNATION

The alternation screens are provided to alternate the lead/lag sequence to equalize view. Several options are available as follows:

From the Main Menu, navigate to the Alternate Menu. Select Between the following options:

ALTERNATE NEVER	ALTERNATE WHEN ALL STOP	ALTERNATE ON RUN TIME
This screen prevents alternation. The sequence will remain fixed at lead then lag.	This screen will change the lead/lag order when all pumps have stopped at the end of cycle.	This screen selects pump alternation when a user selected run time has elapsed. A pump will alternate after it has run for this time period.

ALTERNATE ON RUN	HOURS UNTIL ALT 6.0
This screen selects a fixed time internal to alternate pumps regardless of actual pump run time.	Shows the time remaining until an alternation. (Timed alternation only)

Once the alternate selection has been made, scroll to pump sequence screen.

LEAD IS 1	LAG IS 2	LAG 2 IS 3

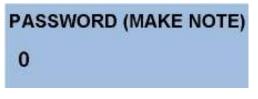| MAX PUMPS ALLOWED 3	ROTATE NUMBER 2

Max number of pumps to run   Number of pumps in alternation sequence

Select desired sequence and press ✷ to return to the main menu.

SETUP

Setup screen provides 'global' parameters, which affect overall performance and operation.

PASSWORD SCREEN

PASSWORD (MAKE NOTE)

0

Setting a password 'Locks' out unauthorized access to program items.
NOTE: Please make a note of the password value if changed. Access to the Menus will be unavailable without the correct password.

Press ✷ to move to the ETM (Elapsed Time Meter) screens for each pump. ETM's can be reset here by setting value to 0.

ETM 1 150	ETM 2 160	ETM 3 60

Press ✷ to select the desired ETM screen then ✷ to advance to the 'Input Filter' screen.

INPUT FILTER

1

NOTE: The input filter 'slows down' the process display and is of use in applications where the process is "noisy" such as monitoring the pressure on a pump discharge. Increasing the filter value will slow down the process display and stabilize pump action. Use caution, too large a filter number can cause potential ill effects. Increase filter number 1 unit at a time and observe results before increasing further.

Press ✴ to advance to the unit text screen.

UNIT TEXT
INCHES

The following engineering units are available:

Inches, Feet, Degrees C, Degrees F, PPM, NTU, MGD, Inch Hg. Blank, LPM, PSI, and GPM.
Select the desired units and press ✴ to advance to the PID function screen.

PID FUNCTION
PID OFF

Scroll to the PID screen. PID functions can be turned on or off in this item.
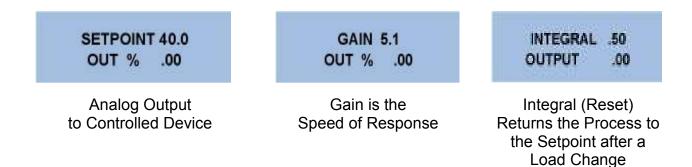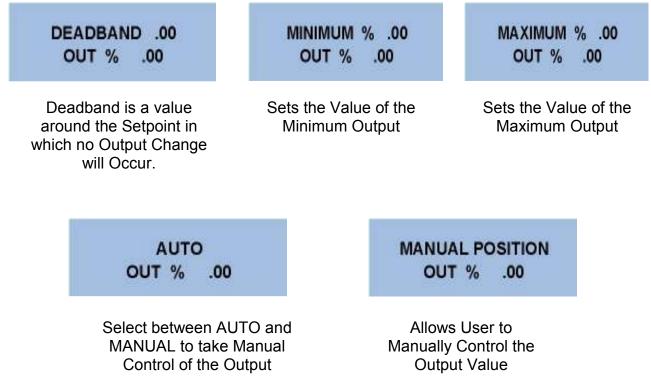
PID FUNCTION
PID ON

Use the ↑↓ buttons to move between PID, ON or Off.

NOTE: P.I.D. function provides proportional control of the output with a user-selected setpoint. It is used for the modulation of a valve or variable speed drive to maintain a constant process value, with process load changes.

It is strongly recommended that the user be familiar with this control method prior to using it in a 'live' application.

Scroll to PID settings, change values with ↑↓.

| SETPOINT 40.0 | GAIN 5.1 | INTEGRAL .50 |
| OUT %   .00 | OUT %   .00 | OUTPUT   .00 |

| Analog Output to Controlled Device | Gain is the Speed of Response | Integral (Reset) Returns the Process to the Setpoint after a Load Change |

```
DEADBAND  .00
OUT  %    .00
```

```
MINIMUM  %  .00
OUT  %    .00
```

```
MAXIMUM  %  .00
OUT  %    .00
```

Deadband is a value around the Setpoint in which no Output Change will Occur.

Sets the Value of the Minimum Output

Sets the Value of the Maximum Output

```
AUTO
OUT  %    .00
```

```
MANUAL POSITION
OUT  %    .00
```

Select between AUTO and MANUAL to take Manual Control of the Output

Allows User to Manually Control the Output Value

SETUP (continued)

FLOW CALCULATION

The calculation estimates the station flow rate by measuring the influent flow volume during the time the pumps are turned off. It is necessary to enter into the controller a value for gallons/inch, which requires the calculation of the area of the wet well. For example: Gallons per inch.

If the wet well is 10 FT X 10 FT, then the area is 10x10 = 100 SQ FT, multiply by 1" depth to get the volume of liquid in 1 inch of level.
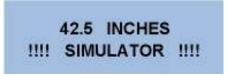
NOTE: Use same units for calculation

120" x 120" x 1" = 14,400 Cubic Inch
Factor: 1 Cubic Inch = .00043290 U.S. Gallons
Therefore, 14,400 CU IN = 14,400 x 0.0043290 Cubic Inch = 62.33
1" = 62.33 Gallons
Enter the value into the volume screen:

```
GALLONS PER INCH
62
```

SIMULATOR SCREEN

The simulator screen allows the user to simulate a changing process to test all system setpoints and functions.
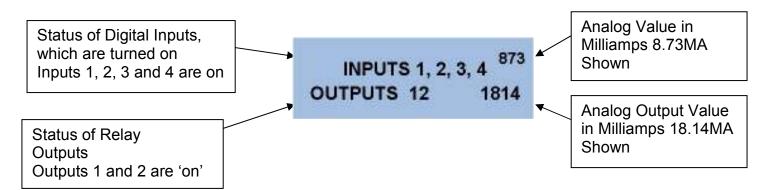From the main menu select the simulator screen, the current process value will be displayed.
Press the ↑↓ buttons to raise or lower the process value.

```
42.5  INCHES
!!!!  SIMULATOR  !!!!
```

Note: The screen will flash the word 'simulator' to remind the operator that the controller is in the simulate mode. If no buttons are pressed, the controller will return to the main menu in 30 seconds.

DIAGNOSTIC SCREEN

The diagnostic screen is provided as an aid to troubleshooting. This screen provides the status of all digital inputs, relay outputs, and analog input and output.

Status of Digital Inputs, which are turned on Inputs 1, 2, 3 and 4 are on

Analog Value in Milliamps 8.73MA Shown

```
INPUTS 1, 2, 3, 4    873
OUTPUTS  12         1814
```

Status of Relay Outputs Outputs 1 and 2 are 'on'

Analog Output Value in Milliamps 18.14MA Shown

The diagnostic screen provides information about the current status of inputs and outputs and provides valuable information to aid in trouble shooting.

The screen shows the status of the 'RAW' analog input 1 and output 1 values. These raw values are approximately the input and output range in the selected input value; as shown, the input is 8.73MA and the output is 18.14MA. These raw values can provide help in determining if the 700 Series TPC is receiving the correct analog input.

The input/outputs are as follows:

<div align="center">

ANALOG

</div>

AI

Raw input from level sensor (4AI)

AO   #1 (AOI)

DIGITAL

DIGITAL INPUT

Pump 1 Run Feedback / Critical (NC)	1DI
Pump 2 Run Feedback / Critical (NC)	2DI
Pump 3 Run Feedback / Critical (NC)	3DI
Pump 1 HOA in Auto	4DI
Pump 2 HOA in Auto	5DI
Pump 3 HOA in Auto	6DI
Seal Fail	7DI
External Reset	8DI

DIGITAL OUTPUT

1	Relay 1 Run to Pump 1	RLY1
2	Relay 2 Run to Pump 2	RLY2
3	Level Alarm	RLY3
4	General Alarm	RLY4

NOTES ON ALARMS

General Alarm output is energized if any alarm in the system becomes active.

PUMP ALARMS

(1) Pump Fail, after a pump has been 'called' to run a digital input (normally from the auxiliary contact on the respective motor starter) it gives 'feedback' to the controller at 1DI, 2DI and 3DI. If the controller fails to see this input within the alarm timer setting it assumes the motor starter has failed to energize and it energizes the 'Pump Failed to Run' alarm, removes this pump from the sequence, and brings on the next available pump.

(2) Critical Alarm, the critical alarm inputs are in 'series' with the run feedback at DI1, 2 & 3, or normally closed inputs, usually from the pump motor thermostats or VFD faults. If the controller 'sees' either of these inputs go open, then the "pump fail" is brought up on the screen and the respective pump is shut down. The next pump is brought on.

(3) Seal Leak, All seal leak inputs are connected to a single digital input 7DI. When any of these are closed the non-critical alarm is activated. The pumps are not shut down, but the "seal fail alarm" appears on the screen.

(4) H.O.A. selectors, are monitored for their position at 4, 5, and 6 DI. If an HOA is not in the 'Auto' position, that pump will not be permitted to run.

5) External Reset button can be connected to 8DI. When activated, it will clear any active alarm. Alarms will be reset on the controller by pressing ↑↓ buttons simultaneously.

SERIES 700 TPC PROGRAMMING RECORD SHEET

Model Number: _____   **Serial Number:** _____

Vers: _____

Password: _____

- **Scale:**

    Locate Decimal Point _____

- **Input:**

    Analog Input Low: _____
    Analog Input High: _____

- **Output:**

    Analog Output Low: _____
    Analog Output High: _____

- **Settings:**

    Lead on _____
    Lead off _____
    Lag on _____
    Lag off _____
    2nd Lag on _____
    2nd Lag off _____
    High Alarm Setpoint:_____
    High Alarm Reset Point: _____
    Low Alarm Setpoint: _____
    Low Alarm Reset Point: _____
    Call On Delay: _____ Sec.
    Call Off Delay: _____ Sec.
    Alarm Time Delay: _____ Sec.

- **Alternation:**

    Never ☐
    When All Stop
    Alternate On Run Time ☐
    Run Time = _____
    Alternate On Time ☐
    Run Time = _____

- **Alternation:**

    Never: ☐
    On Run Times: ☐ _____Hrs.
    When All Stop: ☐ _____ Hrs.
    On Time: ☐ _____Hrs.
    Lead is: _____ Lag is: _____

- **Setup:**

    Password: _____
    Input Filter: _____
    Unit Text: _____

- **PID Function On/Off**

    Action: Reverse ☐   Direct ☐

- **PID Settings**

    Setpoint: _____
    Gain: _____
    Integral: _____
    Dead Band: _____

- **Flow Calc ON/Off**

    Gallons Per Inch: _____
    Lead Range: _____
    Lag Range: _____
    Lag 2 Range: _____

MAINTENANCE AND TROUBLE SHOOTING

The Series 700 TPC is a digital solid-state device, which requires no periodic maintenance.

Occasional physical checks of the unit should be carried out for physical and mechanical security of mounting, terminal blocks, and electrical wiring.

TROUBLE SHOOTING

- UNIT 'LOCKS UP' -- Recycle power to the unit by removing AC power, waiting 10 seconds and reconnecting power.

NOTE: **This should be done by using the user provided circuit breaker or fuse,
not by removing the power wires at the terminal block. Serious injury or death**

- DISPLAY REMAINS AT ZERO OR SHOWS NO CHANGE -- If the display remains at zero or shows no change but the process is changing, check for DC voltage on the loop. With 2 wire (4/20MA) instruments check with a DC voltmeter at the level instrument, by disconnecting the level instrument from its 2 wires and measuring across these 2 wires with a DC voltmeter for the presence of 24VDC.

Check the diagnostic screen for analog input value.

If DC voltage is present, reconnect the negative wire of the supply and insert a milliamp meter between the positive wires. The loop should provide a signal between 4 and 20 MA. If no current is present or current exceeds 20MA consult the level instrument supplier.

If DC voltage is not present check the user supplied power supply or if using the 700 DPC supply measure across terminals 24VDC and + and -. If no 24VDC is present consult factory. If 24VDC is present check field wiring between the 700 DPC and the field device and recheck 'SCALE' functions to ensure correct setup.

Sigma Controls, Inc.
PROCESS CONTROLS AND INSTRUMENTATION

WARRANTY

All Sigma Controls, Inc. products are warranted to be free from defective materials and workmanship for one (1) year from date of shipment. Sigma reserves the right to repair or replace at its option any product found to be defective. In no event shall Sigma Controls, Inc. be liable for any consequential, incidental, or special damages and the limit of its liability shall not exceed the purchase price of the supplied equipment.

*****IMPORTANT*****

SENSORS AND CABLE THAT HAVE BEEN USED IN WASTE WATER OR HAZARDOUS LIQUIDS MUST BE THOROUGHLY CLEANED BEFORE RETURNING. UNITS RETURNED UNCLEANED WILL BE CONSIDERED UNREPAIRABLE AND RETURNED TO SENDER OR DISCARDED. NOTE: DO NOT SUBMERGE UNITS FOR CLEANING WITH CABLE CUT OR REMOVED. THIS WILL ALLOW CLEANING FLUID TO ENTER HOUSING, DAMAGING ELECTRONICS AND VOIDING THE WARRANTY.

RETURN FOR REPAIR POLICY (WARRANTY/NON-WARRANTY REPAIR)

Return status can be determined upon factory inspection of returned equipment.

A completed Return Authorization form must accompany all items returned for repair.

Repairs will be evaluated as quickly as possible. Cost for non-warranty repairs will be provided before repairs are initiated and repairs will be completed only after approval by customer.

217 S. Fifth Street, Perkasie, PA 18944   PH: 215-257-3412   FAX: 215-257-3416