Application Note - AN-104

3 Compressor Sequencer & Alternator

NOTICE

This application note is provided for use as a general example and a guide. Divelbiss assumes no responsibility, liability or warranty regarding this application, its use, functionality or reliability to meet application needs. User assumes all responsibility to ensure all safety precautions are taken when using this application note. This application must not be used alone in applications which would be hazardous to personnel in the event of a failure. Precautions must be taken by the user to provide mechanical and/or electrical safeguards external to this application and controllers shown.

Application Description

This application will control the start sequence of 3 compressors. Air pressure is monitored via three pressure switches. The low pressure switch identifies when air pressure has dropped to the level when one compressor is needed to increase the air pressure to normal levels. The ok pressure switch identifies when the pressure has reached the level where compressor operation is no longer required. The over pressure switch identifies an over pressure condition.

Compressor sequence is alternated to equalize the operation hours of each compressor as much as possible. The 'Lead' compressor is the compressor that will operate the next time air pressure drops and a compressor is required. The 'Lead' compressor is alternated between all three compressors (once each time pressure drops low and then rises to normal).

In the event a single compressor cannot meet the load demand (OK pressure not reached within 10 minutes), a second compressor is started to accomodate the load condition. After an additional 10 minutes without reaching the OK pressure, the third compressor is also started.

After 10 minutes with all three compressors started, if the pressure OK has not been reached, the alarm output will pulse on and off in two second intervals.

If at any time an over pressure is detected, all compressors will shut down and the alarm output will be on steady.

Equipment Used

Solves-it	
Controller P/N:	SI-100 or SI-200
Programming Software:	Divelbiss EZ LADDER
Digital I/O	On-Board
Application Program Filename:	AN-104_SI.dld
Programming Cable:	SI-PGM
Connection Diagram:	Figure 1

Harsh Environment Controller	
Controller P/N:	HEC-1000
Programming Software:	Divelbiss EZ LADDER
Digital I/O	On-Board
Application Program Filename:	AN-104_HEC.dld
Programming Cable:	HEC-910
Connection Diagram:	Figure 2

PCS	
Controller P/N:	PCS-100 (All Models)
Programming Software:	Divelbiss EZ LADDER
Digital I/O	Using ICM-HDIO-03P
Application Program Filename:	AN-104_PCS.dld
Programming Cable:	ICM-CA-34
Connection Diagram:	Figure 3

Enhanced Baby Bear	
Controller P/N:	ICM-EBB-100 (All Models)
Programming Software:	Divelbiss EZ LADDER
Digital I/O	On-Board
Application Program Filename:	AN-104_EBB.dld
Programming Cable:	ICM-CA-34
Connection Diagram:	Figure 4

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Input / Output Description

Low_PS : Real world input. Low Pressure Switch Normally closed. Indicates when pressure has fallen to when a compressor will be required. Input address: EBB-XXX = DI1.03, PCS-XXX = DI0.00, HEC-1000 = GPI0, SI-XXX = GPI0

Upper_PS : Real world input. Pressure OK Switch Normally open. Indicates when pressure has risen to when a compressor will no longer be required. Input address: EBB-XXX = DI1.04, PCS-XXX = DI0.01, HEC-1000 = GPI1, SI-XXX = GPI1

HI_PS : Real world input. High Pressure Switch Normally open. Indicates when pressure has risen too high and compressors should be shut down. Input address: EBB-XXX = DI1.05, PCS-XXX = DI0.02, HEC-1000 = GPI2, SI-XXX = GPI2

CMP1: Real world output. Compressor 1 Start Signal. Indicates for compressor 1 to start and operate. Output address: EBB-XXX = DO1.03, PCS-XXX = DO0.00, HEC-1000 = GPO0, SI-XXX = GPO0

CMP2: Real world output. Compressor 2 Start Signal. Indicates for compressor 2 to start and operate. Output address: EBB-XXX = DO1.04, PCS-XXX = DO0.01, HEC-1000 = GPO1, SI-XXX = GPO1

CMP3: Real world output. Compressor 3 Start Signal. Indicates for compressor 3 to start and operate. Output address: EBB-XXX = DO1.05, PCS-XXX = DO0.02, HEC-1000 = GPO2, SI-XXX = GPO2

ALARM: Real world output. Alarm Signal. Steady indicates over pressure, while pulsing indicates unable to satisfy load. Output address: EBB-XXX = DO1.06, PCS-XXX = DO0.03, HEC-1000 = GPO3, SI-XXX = GPO3

Program Variables

Low_PS: Boolean (Normally closed contact). Type: Input. Default value = 0. Description: Low Pressure Switch.

Upper_PS: Boolean (Normally open contact). Type: Input. Default value = 0. Description: Upper OK Pressure Switch

HI_PS: Boolean (Normally open contact). Type: Input. Default value = 0. Description: High Pressure Switch.

CMP1: Boolean (Direct Coil). Type: Output. Default value = 0. Description: Compressor 1 Start Signal

CMP2: Boolean (Direct Coil). Type: Output. Default value = 0. Description: Compressor 2 Start Signal

CMP3: Boolean (Direct Coil). Type: Output. Default value = 0. Description: Compressor 3 Start Signal

PSI_Lo: Boolean. Type: Internal. Default value = 0. Description: PSI Low Point Detected.

PSI_Ok: Boolean. Type: Internal. Default value = 0. Description: PSI OK Point Detected.

PSI_Over: Boolean. Type: Internal. Default value = 0. Description: PSI too High Point Detected.

Cmp_Start: Boolean. Type: Internal. Default value = 0. Description: Start Compressor Flag.

Stg1Enable: Boolean. Type: Internal. Default value = 0. Description: Compressor Enable Flag for Stage 1 (1 Compressor).

Stg2Enable: Boolean. Type: Internal. Default value = 0. Description: Compressor Enable Flag for Stage 2 (2 Compressors).

Stg3Enable: Boolean. Type: Internal. Default value = 0. Description: Compressor Enable Flag for Stage 3 (3 Compressors).

CMP1Lead: Boolean. Type: Internal. Default value = 0. Description: Compressor # 1 Lead Flag.

CMP2Lead: Boolean. Type: Internal. Default value = 0. Description: Compressor # 2 Lead Flag.

CMP3Lead: Boolean. Type: Internal. Default value = 0. Description: Compressor # 3 Lead Flag.

PU_Reset: Boolean. Type: Internal. Default value = 0. Description: Used to Pulse ALARM output.

PU_Reset2: Boolean. Type: Internal. Default value = 0. Description: Used to Pulse ALARM output.

Time_Alarm: Boolean. Type: Internal. Default value = 0. Description: Flag to identify when load not met after timeout.

CmpNum: Integer. Type: Internal. Default value = 1. Description: Lead Compressor Number for next time compressor needed.

One: Integer. Type: Internal. Default value = 1. Description: # 1 used for comparisons.

Two: Integer. Type: Internal. Default value = 2. Description: # 2 used for comparisons.

Three: Integer. Type: Internal. Default value = 3. Description: # 3 used for comparisons.

Four: Integer. Type: Internal. Default value = 4. Description: # 4 used for comparisons.

DelayTime: Type: Timer. Default value = 10 Minutes. Description: Delay time between adding compressor stages.

Alarm_Elap: Type: Timer. Default value = none. Description: Holds the elapsed time for the Alarm Timer.

Stg2Elap: Type: Timer. Default value = none. Description: Holds the elapsed time for the Stage 2 Timer.

Stg3Elap: Type: Timer. Default value = none. Description: Holds the elapsed time for the Stage 3 Timer.

TwoSec: Type: Timer. Default value = 2 Seconds. Description: Time Delay for the Alarm Pulsing Timers.

Pulse_Elap: Type: Timer. Default value = none. Description: Holds the elapsed time for the PULSTIM Timer.

Pulse2_Elap: Type: Timer. Default value = none. Description: Holds the elapsed time for the PULSTIM2 Timer.

Program Description

Rungs 5-7: Monitors the pressure switches and update coils based on pressure conditions.

Rungs 9-10: If conditions are met, compressor starting is called for.

Rungs 12-14: When a compressor cycle is stopped, the lead compressor is incremented. When incremented to 4, the lead compressor is automatically reset to 1.

Rungs 16-17: Stage 2 Timing. If timer reaches 10 minutes, the Stage 2 requirement is met and a second compressor is called for.

Rungs 18-19: Stage 2 Timing. If timer reaches 10 minutes, the Stage 2 requirement is met and a third compressor is called for.

Rungs 20-21: Alarm Timing. If timer reaches 10 minutes, the Alarm requirement is met and the alarm to warn that all compressors have been operating, but the OK pressure cannot be reached is activated.

Rungs 23-25: Identifies if Compressor 1 is lead compressor.

Rungs 26-28: Identifies if Compressor 2 is lead compressor.

Rungs 29-31: Identifies if Compressor 3 is lead compressor.

Rungs 33-35: Based on Lead Compressor and Stage conditions, start compressor 1 signal is controlled.

Rungs 36-38: Based on Lead Compressor and Stage conditions, start compressor 2 signal is controlled.

Rungs 39-41: Based on Lead Compressor and Stage conditions, start compressor 3 signal is controlled.

Rungs 43-44: Based on conditions, the ALARM output is controlled.

Rungs 46-49: Timers to pulse the ALARM output for OK pressure not reached alarm.

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Connection Diagrams

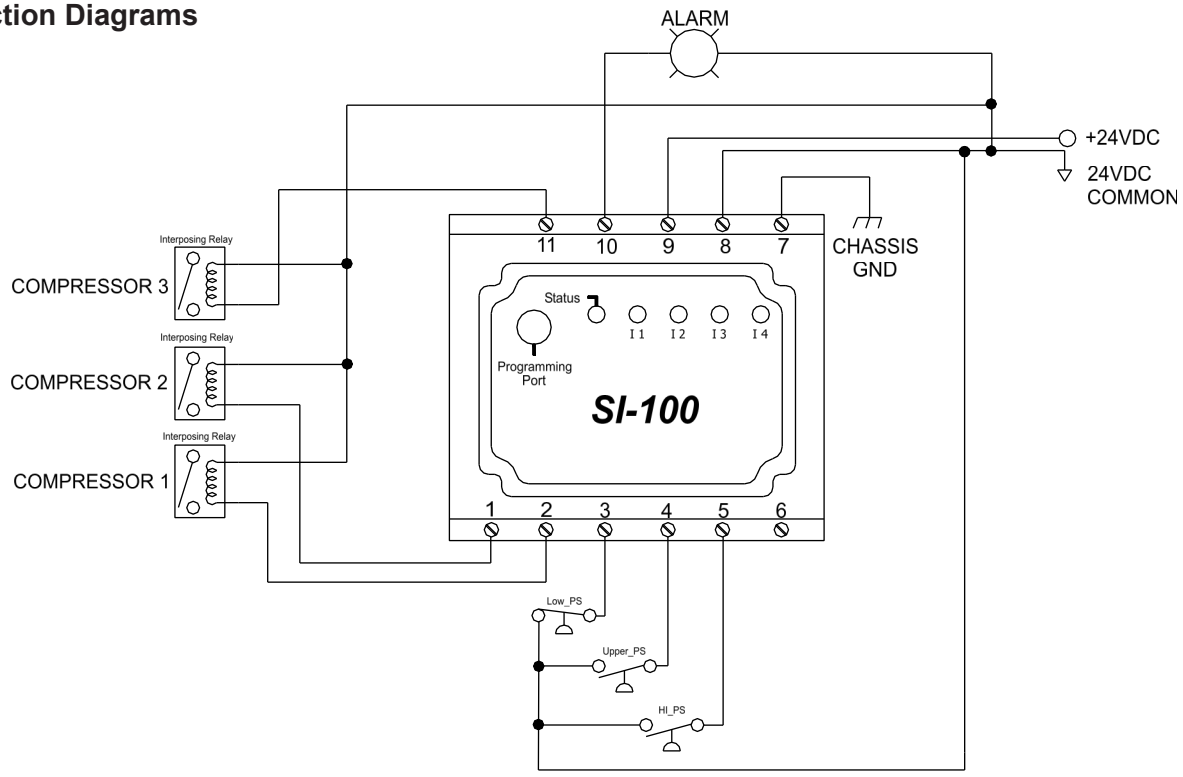

FIGURE 1 - SOLVES-IT CONNECTIONS

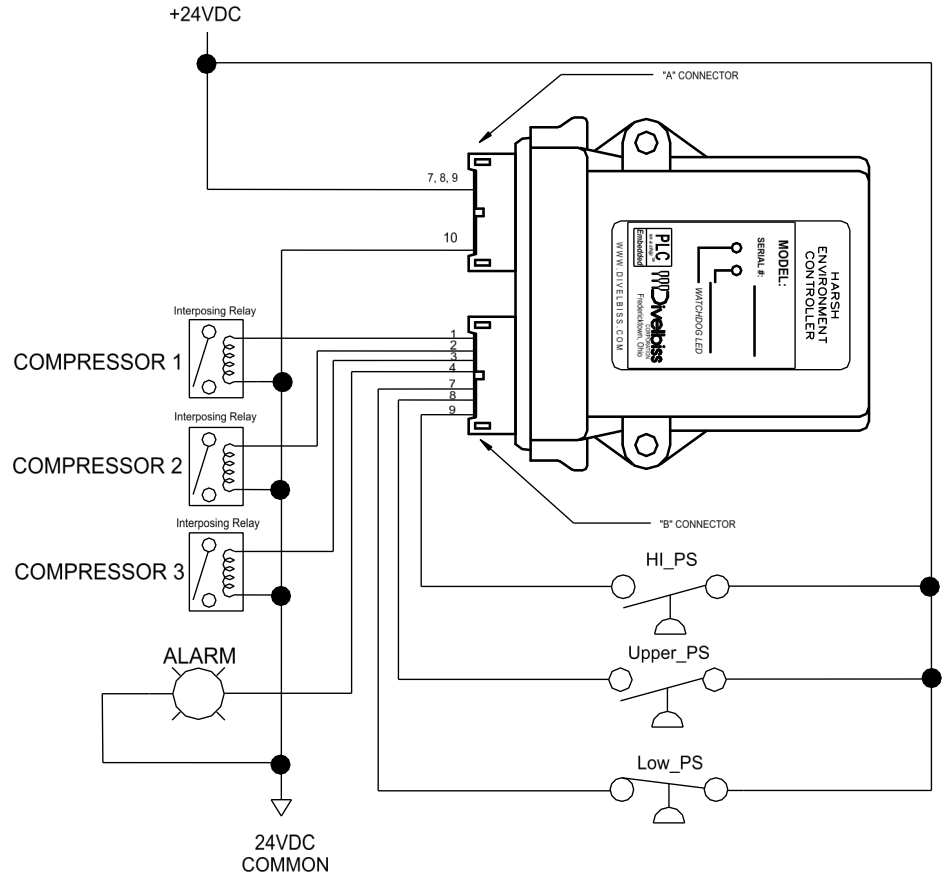

FIGURE 2 - HEC-1000 CONNECTIONS

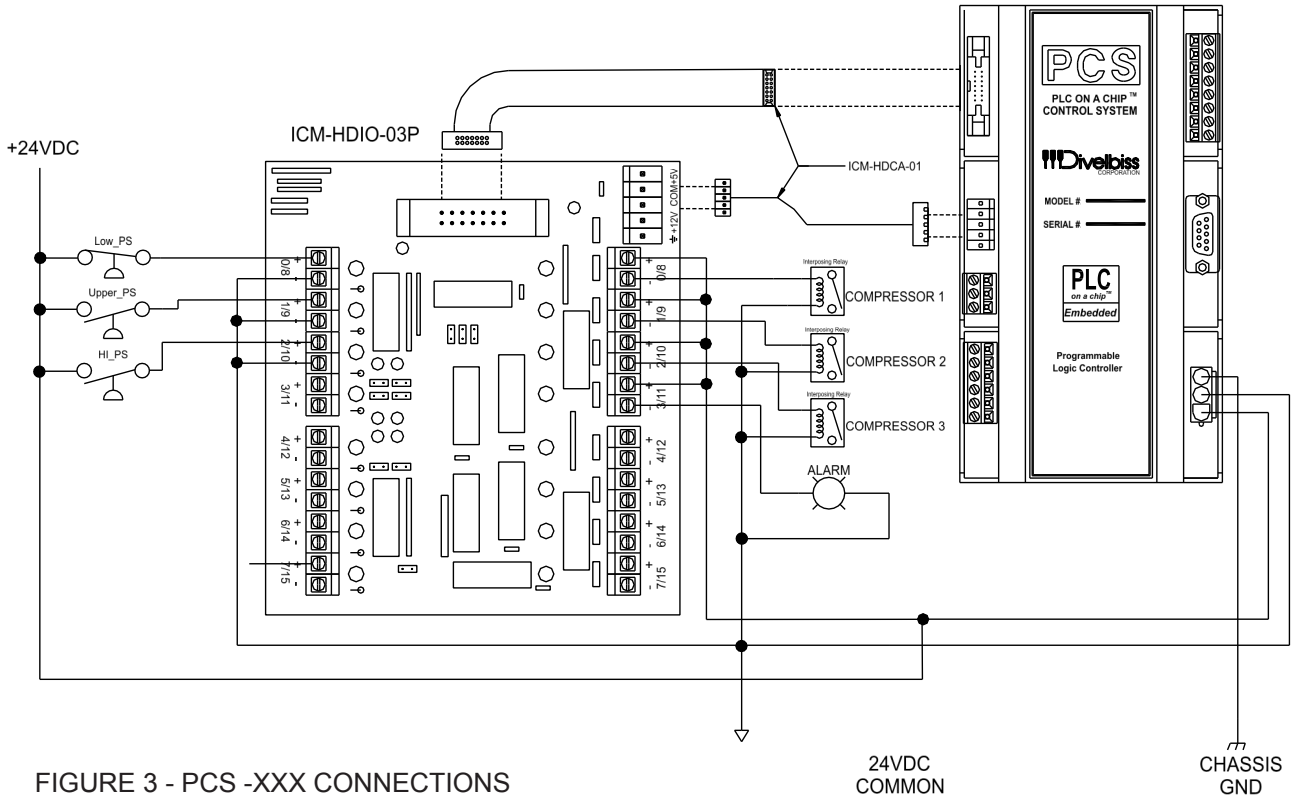

FIGURE 3 - PCS -XXX CONNECTIONS

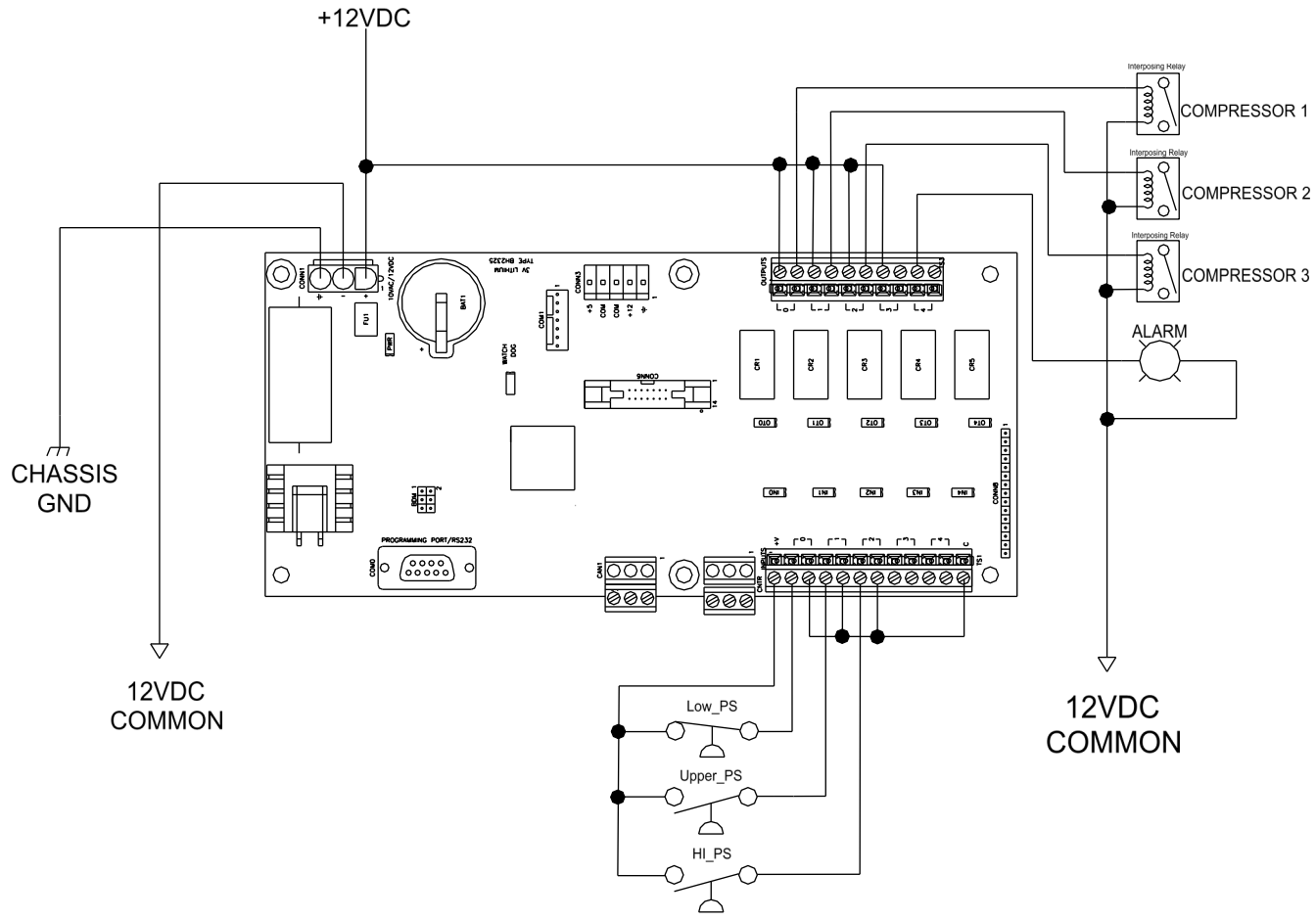

FIGURE 4 - ICM-EBB-XXX CONNECTIONS

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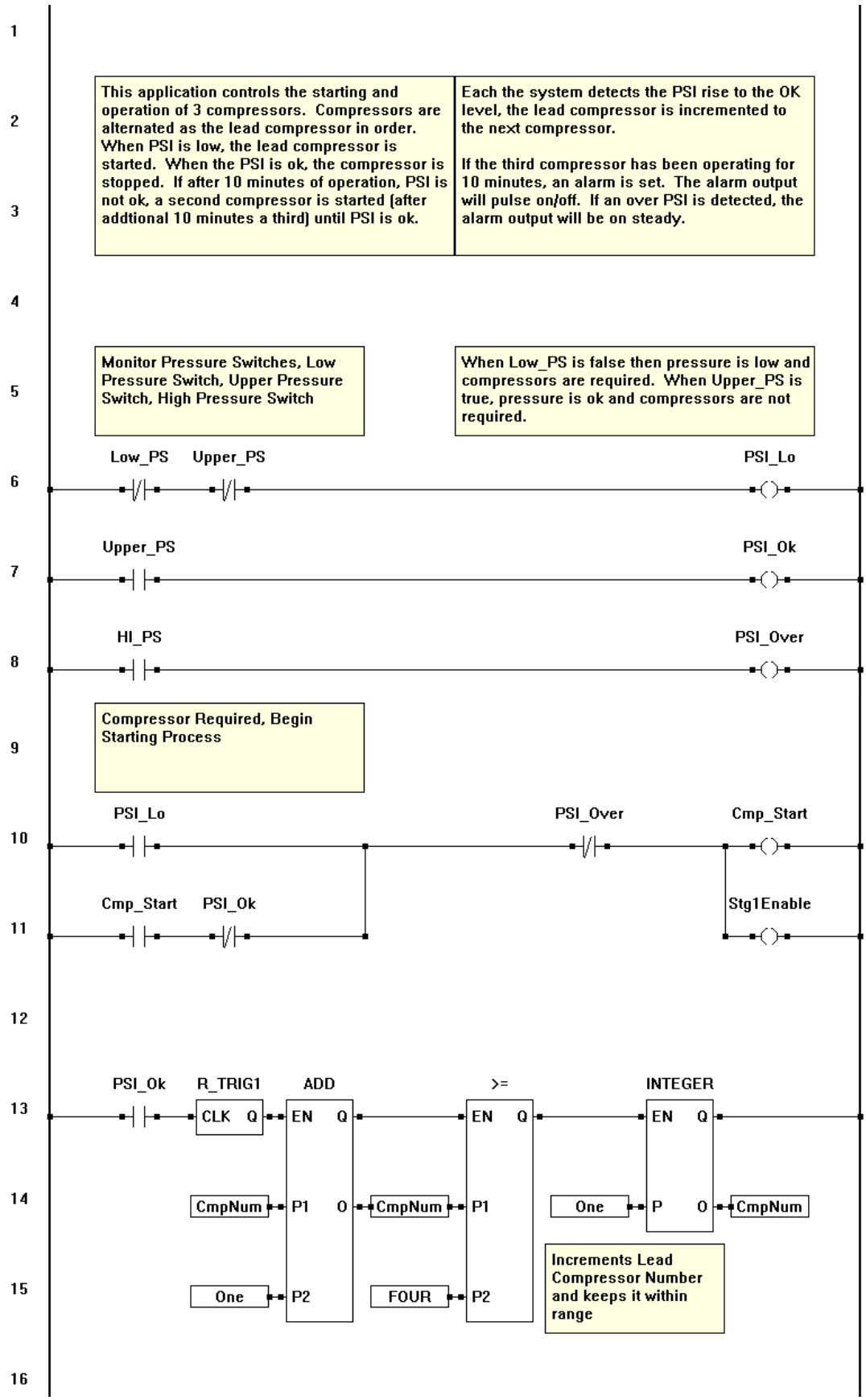
Ladder Diagram



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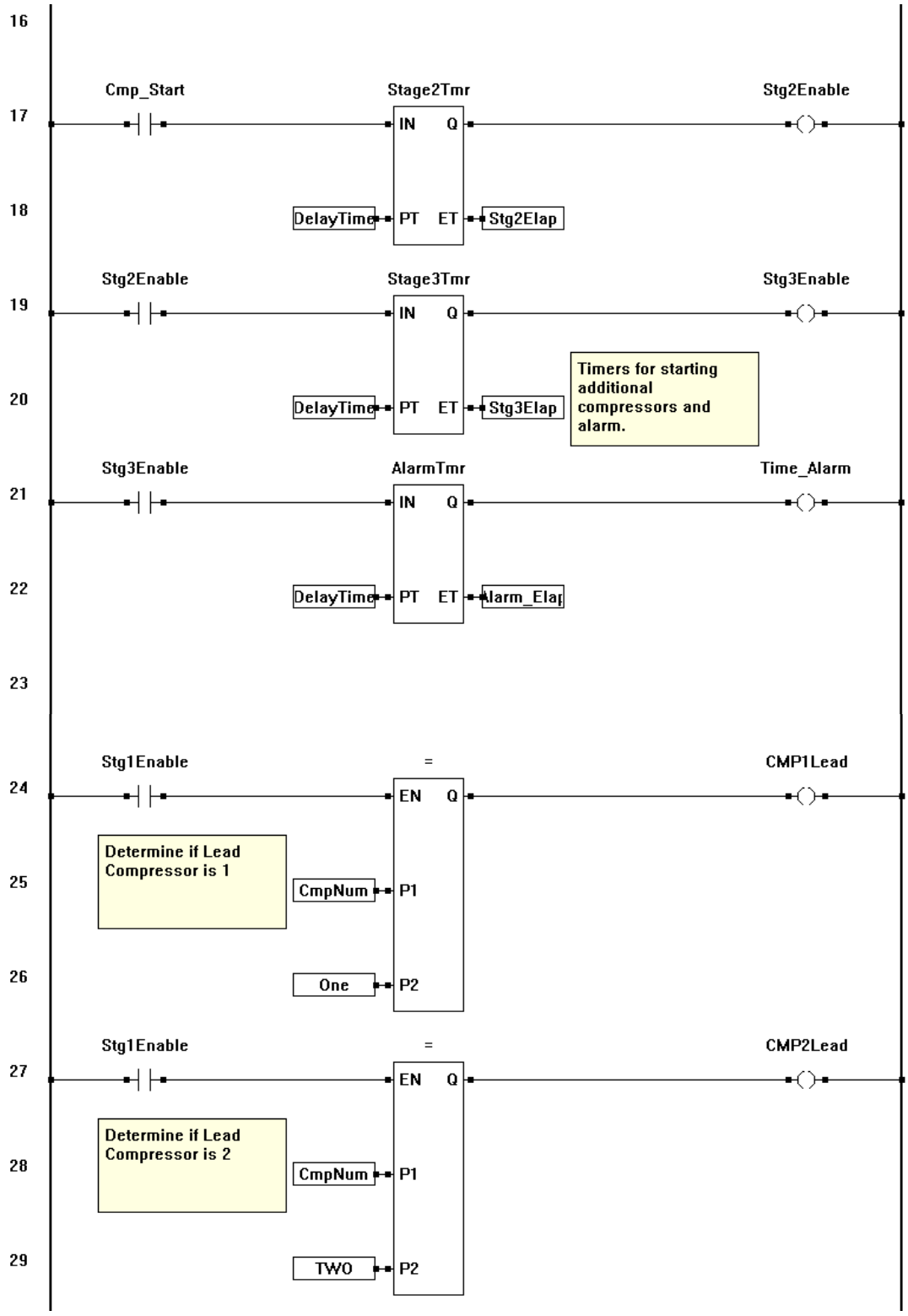

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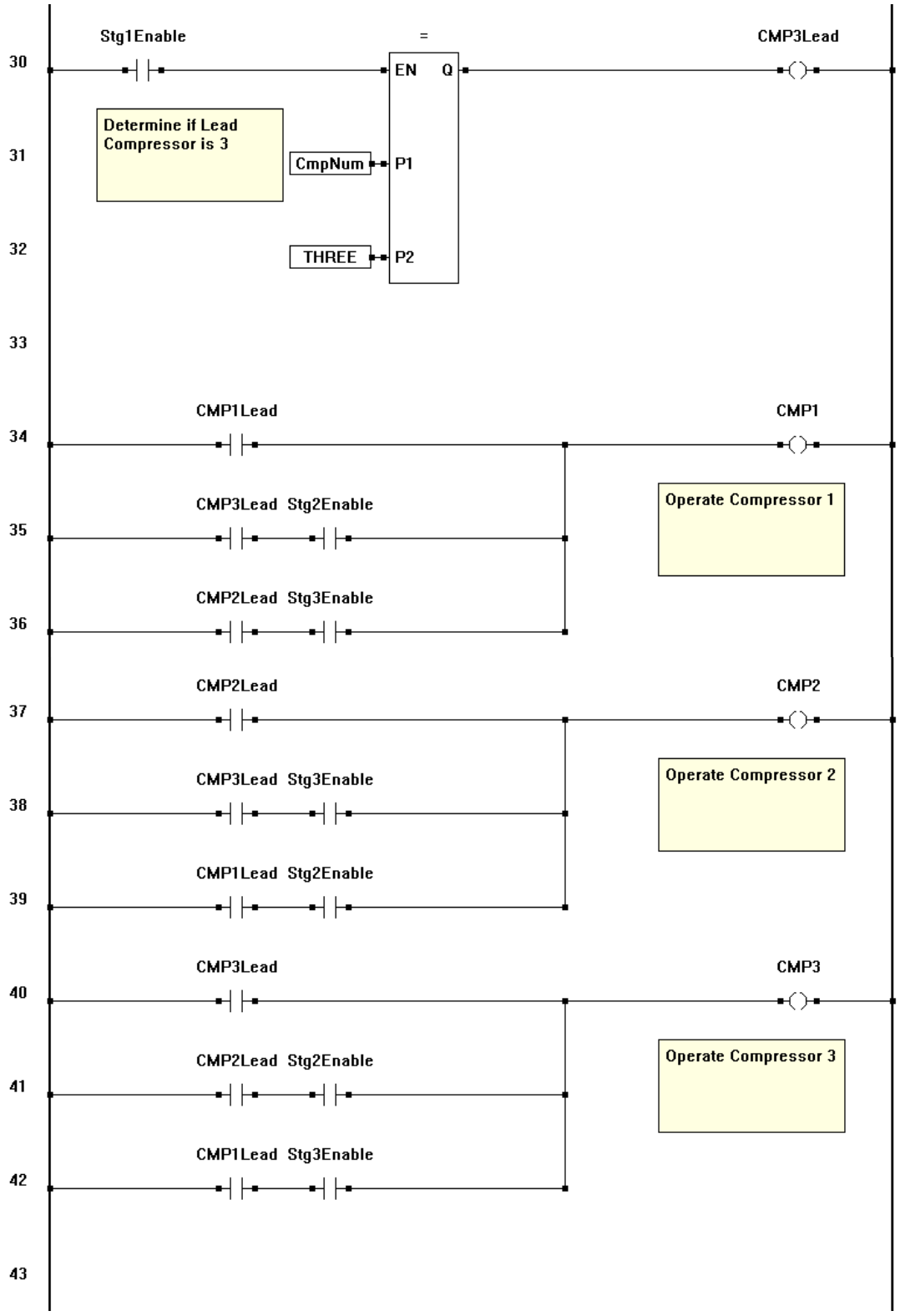

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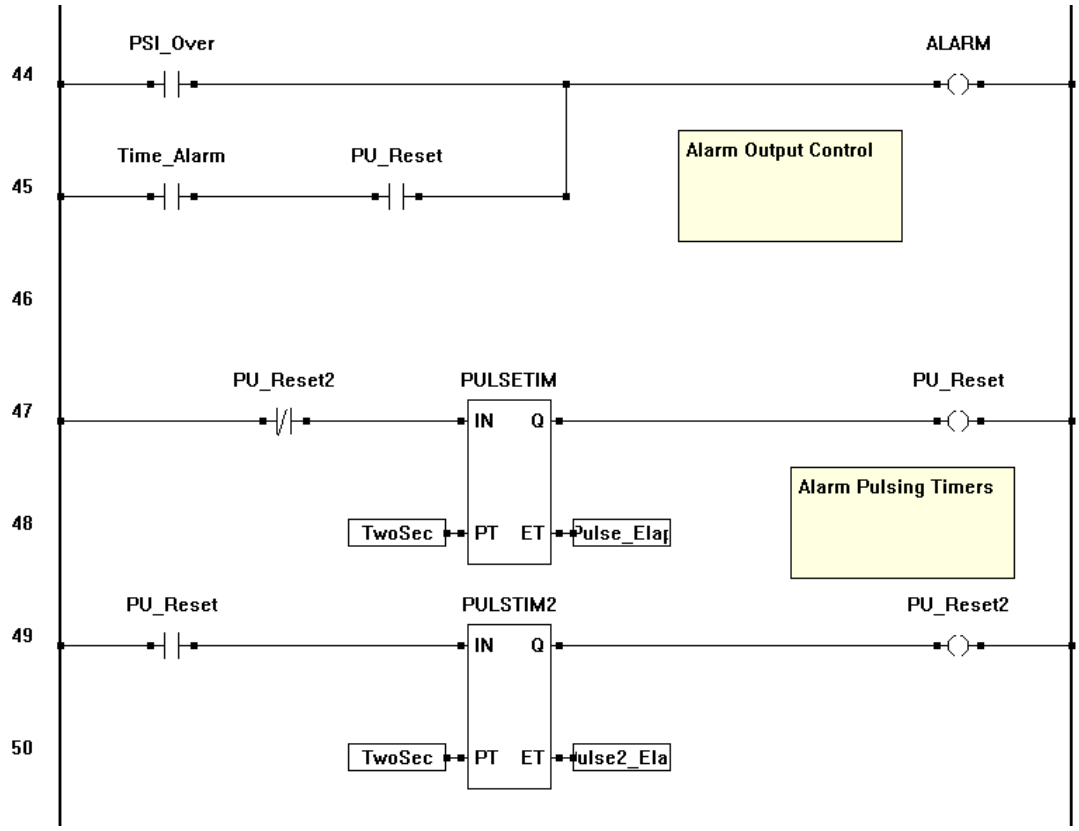

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