

## HANSEN TECHNOLOGIES CORPORATION



Pulse Width Valve with  
Optional Close-Coupled Strainer

### Specifications, Applications, Service Instructions & Parts

#### Level Pulse Control System (LPS)

#### Pulse-Width Modulated Liquid Level Control for Refrigerants

ISO 9002

### INTRODUCTION

The Level Pulse Control System (LPS) is a pulse-width-modulating system that incorporates a sophisticated Auto-tune controller with a rugged, specially-designed, high-cycle, high-life pulse width valve. Using a 4–20 mA input signal from a customer-supplied level probe, the LPS modulates the flow of liquid to control liquid level, provide a uniform supply of makeup liquid, and, most importantly, minimize fluctuations in vessel pressure. The LPS is ideally suited for use with Hansen's Vari-Level (with MOD420) or Techni-Level (VLT) level probes.

### KEY FEATURES

- Stabilizes suction pressure and reduces unnecessary loading and unloading of compressors.
- Reduces pump disturbances and shutdowns due to cavitation.
- Has a reserve capacity for start-up and post-defrost fill.
- Valve dampens on closing to avoid inlet liquid shock to piping and other system components.
- Tight-seating shutoff.
- Incorporates an adjustable capacity setting to meet different system size or load requirements without orifice "swap out."
- Auto-tune controller adaptable to the operation of individual systems.

### APPLICATIONS

The Level Pulse Control System (LPS) is ideal for precisely modulating liquid refrigerant to feed recirculator packages, pump accumulators, receivers, intercoolers, and surge drums connected to flooded heat exchangers and process equipment. The LPS can be used to replace existing pressure-modulating valves, motorized ball valves, pneumatic-controlled valves, and single solenoid valves. The LPS is suitable for ammonia, R22, R134a, and other Hansen-approved refrigerants.

### MATERIAL SPECIFICATIONS

#### Pulse Width Valve

- Bodies: Ductile iron and cast steel
- Seats: Teflon
- Safe Working Pressure: 400 psig (27 bar)
- MOPD: 285 psi (19.4 bar)
- Refrigerant Temperature: –40F to +240F  
(–40°C to +115°C)

#### Controller

- Enclosure: Watertight, NEMA 4
- Power: 60VA
- Electrical: 24 to 28 VAC, 50/60 Hz
- Input, 4–20 mA loop, impedance: 100 Ohm
- Ambient temperature: –20F to +150F, 90% RH Max  
(–29°C to +65°C), 90% RH Max

## OPERATION

The Level Pulse Control System (LPS) modulates the flow of liquid into a vessel. This is done by monitoring the deviation from the level set point and opening or closing a unique, dampened, long-life solenoid valve during a repeating six second pulse width. The amount of time the valve is open during the pulse width is proportional to how far the liquid level is from the set point. If the liquid level is greatly below the set point, as for start-up or post-defrost fill, the valve may stay open for the entire six second pulse width. As the level approaches the set point, the valve is open a lesser amount of time until at the set point or above, the valve will not open during the pulse width. When the liquid level falls below the set point, the valve will again open.

## SIZING THE LPS

Select the appropriate pulse width valve (PWV) using Chart A: PWV Capacity Ranges to find the correct catalog number. For example: 225 ton full load ammonia accumulator feed requires the pulse width valve PWV3.

The liquid line to the inlet of the pulse width valve should be sized for a maximum liquid refrigerant velocity of 7 feet/second for ammonia or 5 feet/second for R22 at full load. This should minimize liquid velocity shock (liquid hammer) in the pipe. Refer to the Chart B for recommended inlet line sizes.

For liquid feed applications from medium-temperature to low-temperature vessels, the PWV capacity should be reduced for the lower pressure drop, such as for a flash cooler. The PWV should be positioned near the outlet of the medium-temperature vessel to minimize the possibility of flash gas at the inlet of the valve. The outlet line to the low-temperature vessel should be properly sized to take into account flash gas and liquid.

## SETTING THE PULSE WIDTH VALVE

Once the pulse width valve is installed in the line and the controller correctly wired, the pulse width valve can be easily set for optimal operation. Based on the system capacity and the selected PWV, determine the best setting (turns open) from Chart C.

For example: The correct model for a 225 ton ammonia accumulator feed system is PWV3, as described above. The correct setting for the PWV3 pulse width valve in this example is approximately 5 turns open (229 tons), as shown in Chart C.

Remove the seal cap from the capacity-adjusting stem and turn the stem fully closed (clockwise). Then, rotate the stem open (counterclockwise) the correct number of turns, in this case five. Replace the seal cap. The controller must now be set. Refer to the SETTING THE CONTROLLER section on page 3.

The level pulse system is designed to operate satisfactorily under varying load conditions. However, fine-tuning of the pulse width valve may

be desired in some cases, such as a sustained substantial load change. This is easy, since the valve has an adjustable orifice. Pump out is not required to change the setting of the Hansen pulse width valve. Simply remove the seal cap from the capacity-adjusting stem and change the setting as necessary, per Chart C below. Perform the Auto-tune cycle as described on the next page. It is important to perform the Auto-tune cycle whenever the capacity setting is substantially changed. Then, replace the seal cap and observe the system operation to verify that the adjustment was adequate.

## CHART A: PWV CAPACITY RANGES

Cat. No.	Capacity Ranges in Tons (kW)			
	Ammonia		R22	
PWV1	10 - 110	(35 - 387)	2.0 - 25	(7.0 - 88)
PWV2	15 - 185	(53 - 651)	3.0 - 40	(11 - 141)
PWV3	30 - 330	(106 - 1161)	6.0 - 70	(21 - 246)

Capacities are based on 75% pulse on time, +86F (+30°C) saturated liquid, a 50 psi (3.4 bar) pressure drop, and 0F (-17.8°C) evaporating temperature. For R134a capacities, multiply R22 capacity by .73 (accuracy within 8%).

## CHART B: RECOMMENDED PWV INLET LINE SIZE\*

Line Size	Maximum Capacity (Ammonia)	Maximum Capacity (R22)
3/4"	40 Tons (141 kW)	8.0 Tons (28 kW)
1"	80 Tons (281 kW)	15 Tons (53 kW)
1 1/4"	175 Tons (615 kW)	34 Tons (120 kW)
1 1/2"	270 Tons (950 kW)	51 Tons (179 kW)

This chart is adapted from ASHRAE standards. For R134a, multiply R22 capacity by .73 (accuracy within 8%).

\*For applications with a large pressure drop across the pulse width valve, attention must be paid to proper outlet line sizing to accommodate flash gas.

## CHART C: PWV SETTING BY CAPACITY IN TONS (kW)

Cat. No.	Turns Open (Ammonia)				
	2	3	4	5	6
PWV1	12 (42)	28 (98)	52 (183)	80 (281)	114 (401)
PWV2	17 (60)	35 (123)	68 (239)	125 (440)	188 (661)
PWV3	17 (60)	52 (183)	114 (401)	229 (805)	331 (1164)

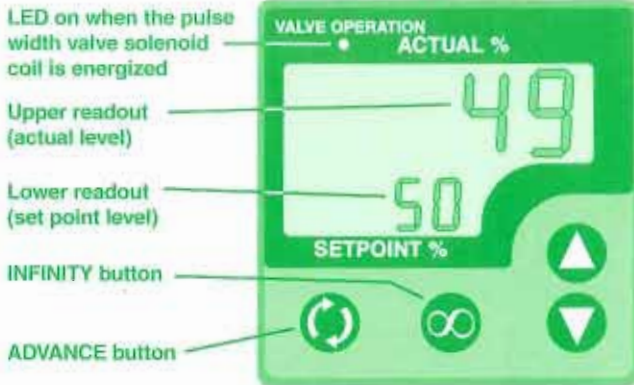
Cat. No.	Turns Open (R22)				
	2	3	4	5	6
PWV1	2.5 (8.8)	6.3 (22)	12 (42)	18 (63)	25 (88)
PWV2	3.8 (13)	7.5 (26)	15 (53)	28 (98)	42 (148)
PWV3	3.8 (13)	12 (42)	25 (88)	51 (179)	73 (257)

Capacities are based on 75% pulse on time, +86F (+30°C) saturated liquid, a 50 psi (3.4 bar) pressure drop, and 0F (-17.8°C) evaporating temperature.

## SETTING THE CONTROLLER

Apply power to the controller. The valve will operate to adjust the liquid level to the factory preset of 25%. To set the controller for a different level, use the UP ▲ or DOWN ▼ button until the desired set point level is displayed in the lower readout. This can be done while the valve is operating. The upper readout shows the actual level percentage in the level column.

With the pulse width valve properly adjusted to the correct "turns open" setting, allow the system to reach the desired actual liquid level. Then, proceed to the Auto-tune cycle, as described in the next section.



Controller Face

## AUTO-TUNE CYCLE

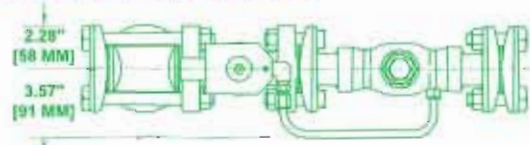
The Auto-tune cycle is used by the controller to "learn" the characteristics of the individual system. Auto-tune is a calibration process that permits the controller to perform optimally in maintaining a stable liquid level. The system should be at nominal full load with no coils in defrost and the liquid should be at the desired level when performing Auto-tune.

Depress the ADVANCE button once. The **pb 1** prompt is displayed in the lower readout. If the value in the upper readout is 0, use the UP ▲ button to change the setting to any value other than 0. Depress the ADVANCE button again to display the **Aut** prompt in the lower readout. Press the UP ▲ button once to change the upper readout from **OFF** to **Auto**. Press the INFINITY button to return to the normal display and begin the Auto-tune cycle.

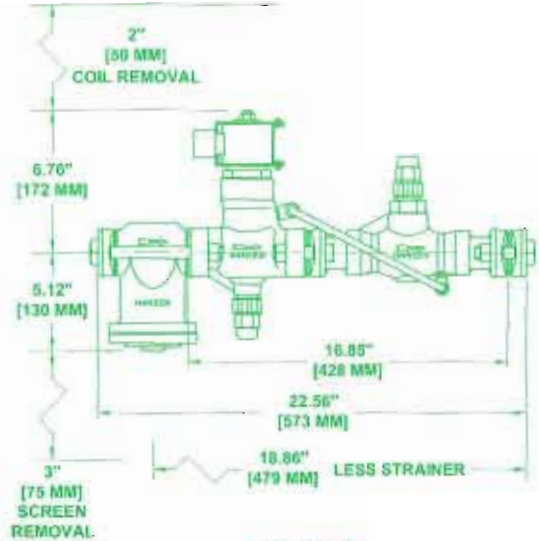
During the Auto-tune cycle, the upper readout alternates between the actual liquid level percentage and the **tune** prompt. During the tuning cycle, there may be a wide downward swing in liquid level in the vessel. This is normal. The level will return to the level set point on completion of the Auto-tune cycle. Auto-tune typically takes one to two minutes, but may take longer depending on the system.

After the Auto-tune cycle is complete, the controller automatically returns to the normal operation mode, as indicated when the upper readout stops alternating to the **tune** prompt and displays only the actual liquid level. The Level Pulse Control System is now calibrated and in the normal operation mode.

## INSTALLATION DIMENSIONS PULSE WIDTH VALVE

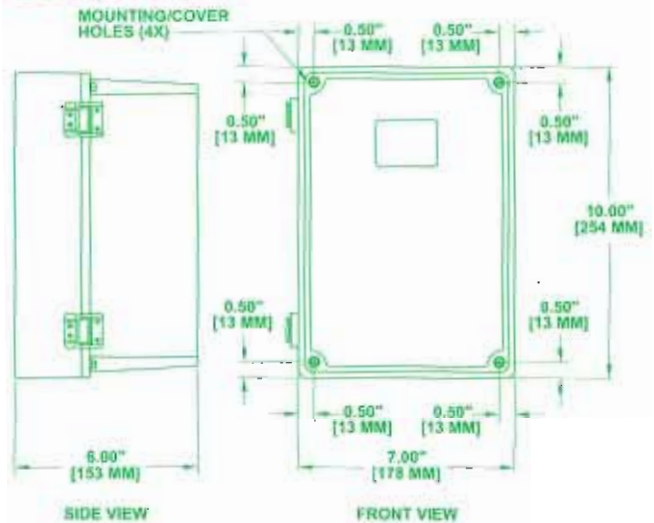


TOP VIEW

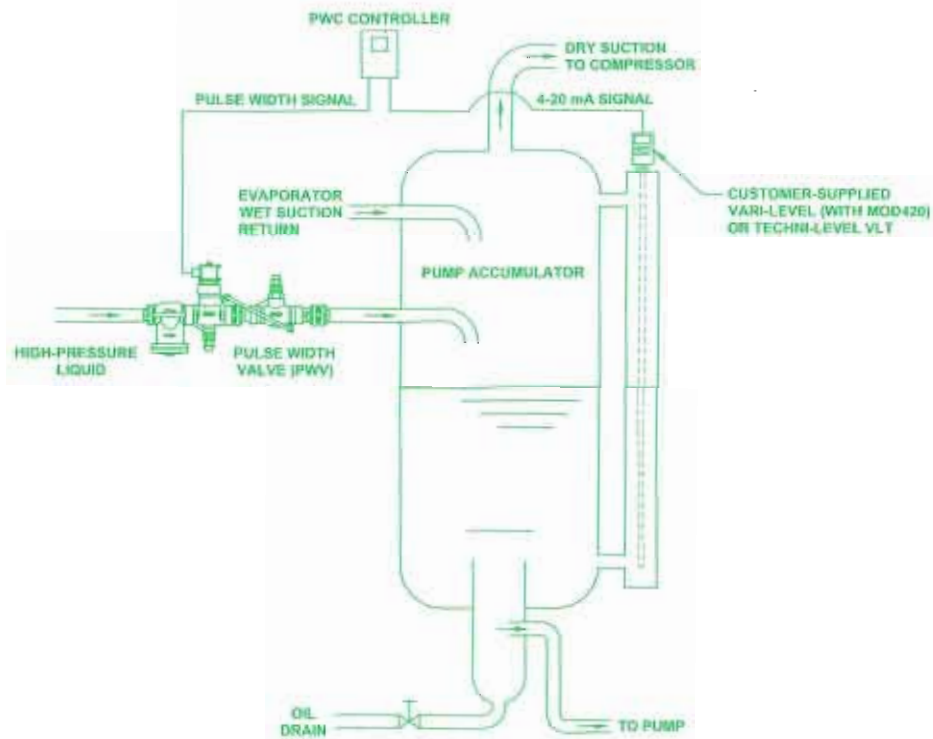


SIDE VIEW

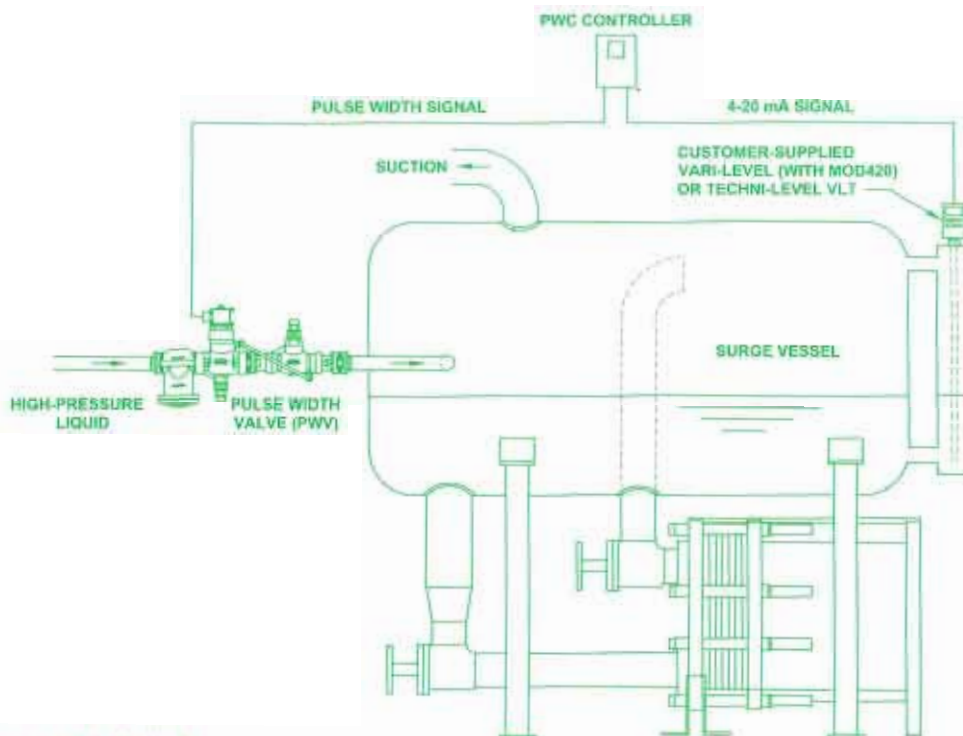
## CONTROLLER



## TYPICAL APPLICATIONS



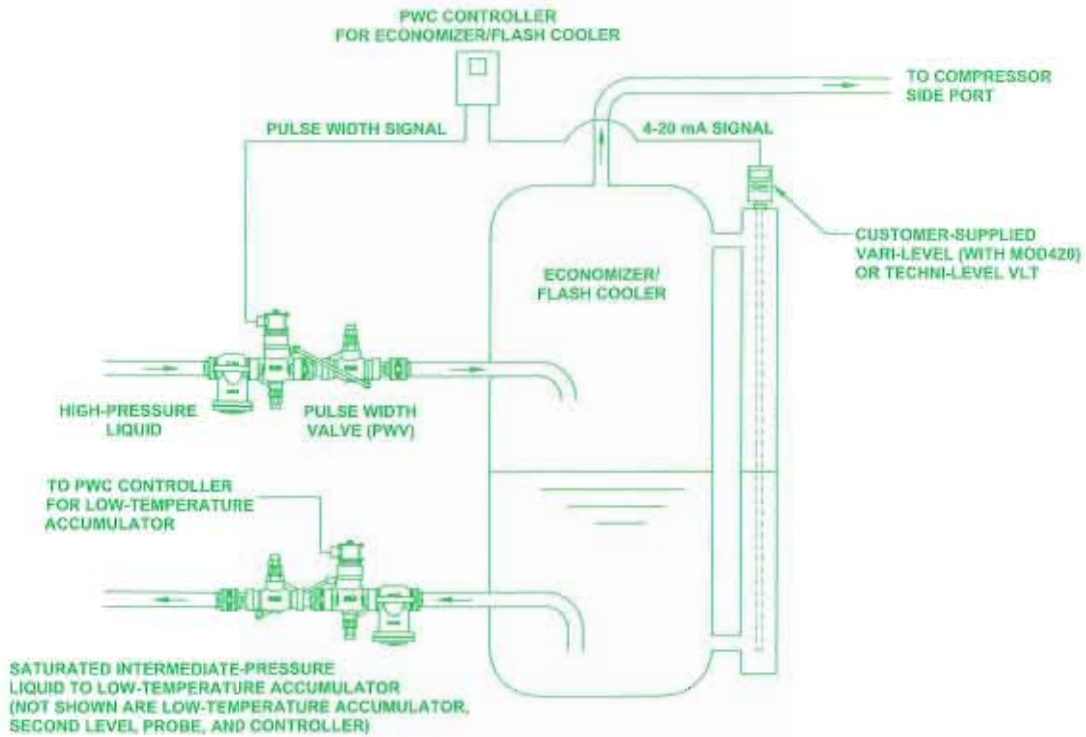
Pump accumulator (recirculator)



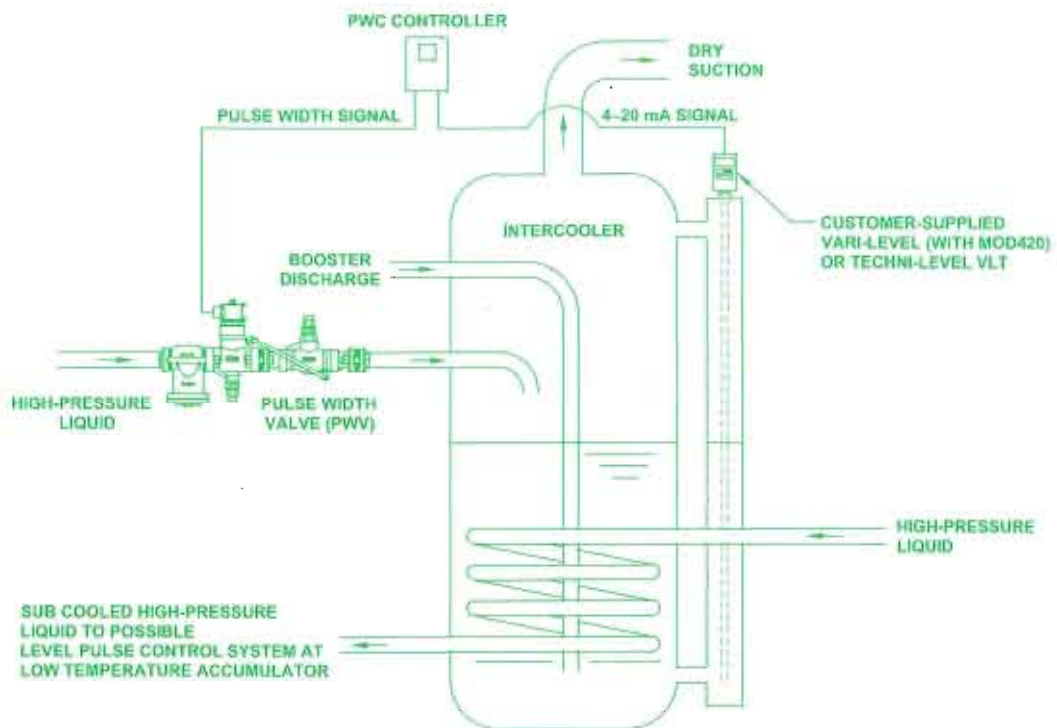
The drawings shown in this bulletin are of fictional refrigeration systems. These drawings should not be used for design or construction.

Plate and frame heat exchanger

## TYPICAL APPLICATIONS

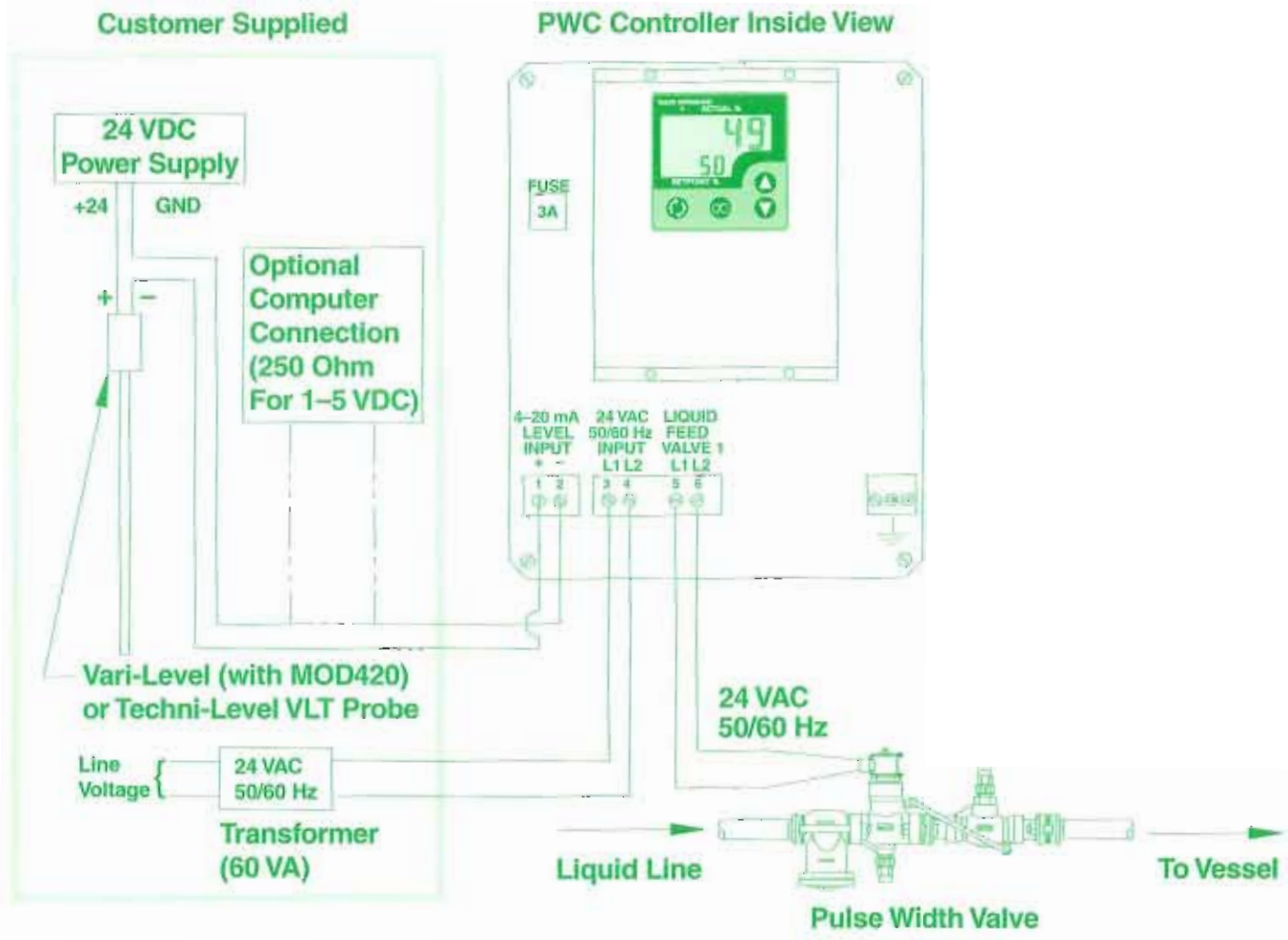


**Economizer/Flash Cooler**



**Intercooler**

## TYPICAL WIRING



### ELECTRICAL

The pulse width valve coil draws approximately 19 watts and will operate properly between 85% and 110% of rated voltage (24 VAC). The standard coil connection is a 1/2" fitting (NPSM) for conduit with 18" (450 mm) pigtail leads. Coils with DIN plug or junction box are available. Contact the factory. All coils are molded and have a standard zinc-plated, steel housing which meets NEMA 3R (rainproof) and NEMA 4 (splashproof, approximately IP65) requirements. The junction box is NEMA 1. The coil should only be energized while on solenoid tube, otherwise immediate coil burnout may occur. To avoid bending the solenoid tube, remove the coil from the valve before connecting any electrical conduit.

A power supply is required to operate the level probe. This is to be supplied by the customer and must have a 24 VDC regulated output and a minimum of 25 mA current output.

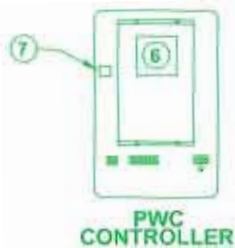
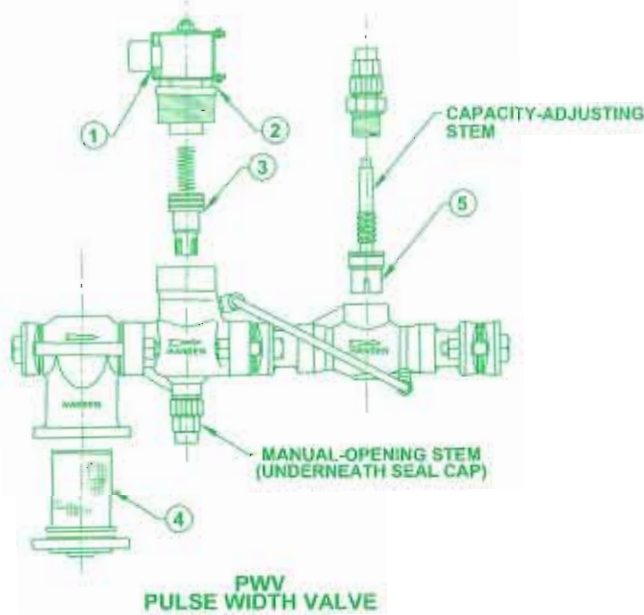
The controller requires 24VAC 50/60 Hz (60 VA) input. A transformer should be selected with this output and the appropriate AC line voltage input. The appropriate transformer can be purchased from Hansen if needed.

### OPTIONAL COMPUTER CONNECTION

If desired, the level pulse control system (LPS) can be connected to a computer for monitoring liquid level. Refer to the schematic above for wiring. For more information on using a Hansen level probe with a computer, refer to the appropriate Hansen technical bulletin (Vari-2 or P109).

If the LPS is connected to a computer and the computer goes down or power is lost at the computer, the LPS will continue to function normally in nearly all cases. Until corrective action is taken on the computer, information normally sampled by the computer will be unavailable. Once the computer problem is corrected, operation will return to normal. No additional steps normally need to be performed on the LPS.

## PARTS LIST



Item	Description	Catalog Number
1	<b>Solenoid Coil Kit, 24V, 1/2" Fitting</b> Above kit consists of: Bare Coil Coil Housing Assembly Kit Coil Washer Coil Nut	70-1058
2	<b>Solenoid Tube/Plunger Kit, PWV</b> Above kit consists of: Plunger Assembly with Seals Solenoid Tube Solenoid Tube Gasket Tube Screws Coil Washer Coil Nut	70-1072
3	<b>Piston Assembly Kit, PWV</b> Above kit consists of: Piston Assembly Closing Spring Upper Body O-ring Lower Body O-ring	70-1073
4	<b>Strainer Screen Kit</b> Above kit consists of: Screen Assembly Bottom Cover Gasket	78-1003
5	<b>Throttling Plug Kit, PWV1</b> <b>Throttling Plug Kit, PWV2</b> <b>Throttling Plug Kit, PWV3</b> Above kits consist of: Throttling Plug Ball Bearings Ball Retainer Bonnet O-ring	50-1079 50-1015 50-1016
6	Controller, 24VAC	77-0666
7	3 amp fuse	20-1698

## SERVICE CODES

The PWC controller automatically displays service codes when necessary. These codes are displayed on the controller digital readouts.

The most common codes are listed in the chart below. When the controller displays a service code, make note of the code and consult the chart. Perform the corrective action indicated and observe the operation of the controller to verify normal operation.

If the controller continues to display the service code or a service code appears that is not listed in the chart, turn power to the controller off, then on. If the service code continues to appear, contact the factory.

## CONTROLLER SERVICE CODES

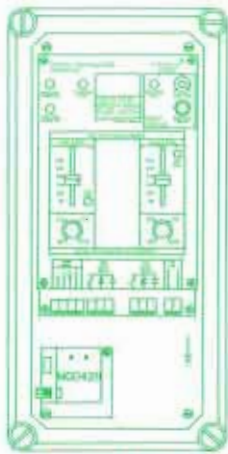
Code	Probable Cause	Action
Blank Readout	Power to the unit may be off, wiring broken, or incorrect input power.	Check switches, fuses, breakers, connectors, and other items to verify "on" position and operating condition. Verify correct input power.
0000 or 0001	The 4-20 mA probe or control loop may be improperly wired, reversed, shorted, or open.	Check the probe connections and wiring for proper installation and condition of connections and wiring.
0002 or 0003	Current in the 4-20 mA probe control loop may be too high.	Verify the probe output current for a 4-20 mA signal. Verify that the ambient temperature at the controller is within specifications.
0004 0005	The calibration data is corrupt.	Perform Auto-tune on the controller.

For other service codes, contact the factory.

## VARI-LEVEL® ADJUSTABLE LEVEL CONTROLS FOR REFRIGERANTS

The Hansen Vari-Level® consists of a level probe for a 3" or 4" pipe level column plus a solid-state control unit for ON-OFF of up to five individual, relay-operated level control points. Three commonly-used control points are a high alarm/cutout, operating level, and low alarm/cutout. Now available is the Vari-Level LB2LH, suitable for high and low alarm/cutout. A 4-20 mA output module, MOD420, is available for all Vari-Levels for use with the Hansen Level Pulse Control System.

A bright digital LED displays percent level in vessel. Each level control point is adjustable for height and operating differential with a built-in level simulator. The standard electrical input is 115V, 50/60Hz; 230V, 50/60Hz is available. Suitable for ammonia, R22, R134a and other Hansen-approved refrigerants.



LB2LH with MOD420



LP

## TECHNI-LEVEL® (VLT) LEVEL TRANSDUCER PROBES

These specially-designed level transducer probes with 4-20 mA isolated output are for refrigerant level control in computer-operated plants or connection to a Hansen Level Pulse Control System. All transducer electronics are compact and located on top of probe. Fifty feet (15 m) of two wire cable is included with the probe. The level column connection on the probe is 3/8" MPT. Suitable for ammonia, R22, R134a and other Hansen-approved refrigerants.



VLT

## ORDERING INFORMATION, PULSE WIDTH VALVE

Cat. No.	Size	Nominal Capacities in Tons (kW)	
		Ammonia	R22
PWV1	3/4"	10 - 110 (35 - 387)	2.0 - 25 (7.0 - 88)
PWV2	1"	15 - 185 (53 - 651)	3.0 - 40 (11 - 141)
PWV3	1 1/4"	30 - 330 (106 - 1161)	6.0 - 70 (21 - 246)
PWV5*	2"	110 - 750 (387 - 2638)	25 - 225 (88 - 791)

\*Available late 1998

For R134a, multiply R22 capacity by .73 (accuracy within 8%).

## CONTROLLER

Catalog Number	For Pulse Width Valve
PWC	PWV1 PWV2 PWV3
PWCA	PWV5

**TO ORDER:** Specify the catalog number of the controller and the valve, required nominal capacity (tons or kW), connection style and size (3/4", 1", 1 1/4" FPT or SW; 1 1/2" and 2" SW for PWV5), and recommended optional strainer. Weld neck flanges (up to 1 1/2"; 2" for PWV5) and ODS flanges (up to 1 3/8"; 2 1/8" for PWV5) are available at an extra cost. A 115V/24VAC or 230V/24VAC transformer is available. Specify if needed.

For widely-fluctuating loads of greater than 5 to 1 full load to low load, two pulse width valves with controllers in parallel, one level set point slightly higher than the other, are recommended. Contact the factory for more details.

## CAUTION

Hansen products are for refrigeration systems only. These instructions and related safety precautions must be read completely and understood before selecting, using, or servicing the product. Only knowledgeable, trained refrigeration technicians should install, operate, or service the products. Stated temperature and pressure limits should not be exceeded. Components should not be removed from the system unless the system has been evacuated to zero pressure. See also the Safety Precautions in the current List Price schedule and the Safety Precautions Sheet supplied with this product. Escaping refrigerant can cause injury, especially to the eyes and lungs.

## WARRANTY

Hansen electrical and electronic items are guaranteed against defective materials and workmanship for 90 days F.O.B. our plant. All other components are guaranteed for one year F.O.B. our plant. No consequential damages or field labor is included.

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