PERMA PURE

INSTRUCTION MANUAL

BALDWIN™ - Series

CLASSIC THERMO-ELECTRIC COOLERS

Model 5210

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A: SPECIFICATIONS

Physical Description

Single Channel System
2 x 10" Heat Exchangers connected in series only
1 Passive (cooled to ambient), 1 Active (cooled to 4°C) Heat Exchangers
LCD temperature display

Operating Specifications

Sample Gas Flow Range	3-8 LPM 6.4-17 SCFH
Average Inlet Dew Point at Rated Flow	175°F @ 43% H_2O 79°C
Maximum Cooling Rate	440 BTU/Hr 464kJ/Hr
Dimensions	14.55 x 11.12 x 10.57 in. HWD 37.0 x 28.2 x 26.8 cm
Weight	27 lbs 12.0 kg
Maximum Inlet Sample Temperature	400°F (205°C) SS, Glass Impingers 280°F (138°C) Kynar Impinger
Maximum Inlet Pressure	45 psig 3 bar / 2250 mmHg
Maximum Heat Exchanger Pressure Drop	<+1 in. H_2O
Ambient Temperature Range	33-104°F 0.6-40°C
Outlet Sample Gas Dew Point	41°F 5°C
Inlet Tubing Connection	⅜ in. FPT
Outlet Tubing Connection	¼ in. FPT
Drain Tubing Connection	⅜ in. FPT
Thermoelectric Elements	40 mm
Voltage	110 (220 optional) VAC 50/60 Hz
Power Supply	250W
Cooling Down Time	Less than 3 minutes

B: LIMITED WARRANTY

Perma Pure LLC
WARRANTY and DISCLAIMERS

Perma Pure (Seller) warrants that product supplied hereunder shall, at the time of delivery to Buyer, conform to the published specifications of Seller and be free from defects in material and workmanship under normal use and service. Seller's sole obligation and liability under this warranty is limited to the repair or replacement at its factory, at Seller's option, of any such product which proves defective within one year after the date of original shipment from seller's factory (or for a normal usable lifetime if the product is a disposable or expendable item) and is found to be defective in material or workmanship by Seller's inspection.

Buyer agrees that (1) any technical advice, information, suggestions, or recommendations given to Buyer by Seller or any representative of Seller with respect to the product or the suitability or desirability of the product for an particular use or application are based solely on the general knowledge of Seller, are intended for information guidance only, and do not constitute any representation or warranty by Seller that the product shall in fact be suitable or desirable for any particular use or application; (2) Buyer takes sole responsibility for the use and applications to which the product is put and Buyer shall conduct all testing and analysis necessary to validate the use and application to which Buyer puts the product for which Buyer may recommend the use or application of the product by others; and (3) the characteristics, specifications, and/or properties of the product may be affected by the processing, treatment, handling, and/or manufacturing of the product by Buyer or others and Seller takes no responsibility for he nature or consequence of such operations or as to the suitability of the product for the purposes intended to be used by Buyer or others after being subjected to such operations.

SELLER MAKES NO OTHER WARRANTY, EXPRESS OR IMPLIED, OF THE PRODUCT SUPPLIED HEREUNDER, INCLUDING, WITHOUT LIMITATION, IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR PARTICULAR PURPOSE, AND ALL SUCH WARRANTIES ARE HEREBY EXPRESSLY EXCLUDED. SELLER SHALL HAVE NO LIABILITY FOR LOSS OF PROFITS, OR SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES UNDER ANY CIRCUMSTANCES OR LEGAL THEORY, WHETHER BASED ON NEGLIGENCE, BREACH OF WARRANTY, STRICT LIABILITY, TORT, CONTRACT, OR OTHERWISE. SELLER SHALL IN NO EVENT BE LIABLE IN RESPECT OF THIS ORDER AND OR PRODUCT DELIVERED ON ACCOUNT OF THIS ORDER FOR ANY AMOUNT GREATER THAN THAT PAID TO SELLER ON ACCOUNT OF THIS ORDER.

C: PRINCIPLE OF OPERATION

Thank you for purchasing the Perma Pure Baldwin™ Classic Model 5210 Thermo-Electric Cooler. Perma Pure's Baldwin Classic Series Thermo-Electric Coolers are specifically designed for high ambient temperature & high water volume applications. Each model in our Classic Series features an oversized heat sink and high performance thermoelectric devices for high heat removal capacity. Heat sinks used in Baldwin Classic Thermo-Electric Coolers are made out of high heat transfer extruded aluminum with large 3/4" thick end plates. Each model also incorporates a special controller specifically designed to run at high ambient temperatures.

The process of sampling combustion product stack gas or exhaust from internal combustion engines requires a method to remove the moisture from the sample, without removing the gas components of interest. The Baldwin Classic Thermo-Electric Cooler is an ideal way to decrease the dew point of combustion gases to a repeatable, stable, constant low dewpoint. The Baldwin-Series cooler prevents water condensation in sample pre-filters, sample pumps, and gas analyzers. For gas analyzers where water vapor is an interferent, a stable, repeatable dewpoint becomes a part of the gas analyzer performance specification. Baldwin-Series coolers provide this constant low water concentration, resulting in an accurate component gas measurement.

All Baldwin-Series coolers use thermo-electric elements (Peltiers) to cool the sample gas to the desired dew point temperature. A Classic Thermo-Electric Cooler is best illustrated as a small heat pump with no moving parts. The Peltiers operate on direct current and may be used for heating or cooling by reversing the direction of current flow. This is achieved by moving heat from one side of the module to the other with current flow and the laws of thermodynamics. A typical single stage Peltier (Figure 1) consists of two ceramic plates with p- and n-type semiconductor material (bismuth telluride) between the plates. The elements of semiconductor material are connected electrically in series and thermally in parallel.

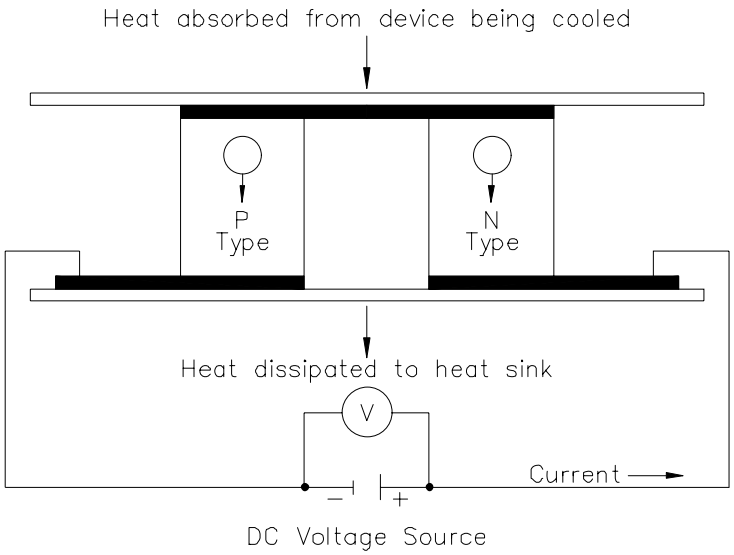

Figure 1: Thermo-electric element (Peltier)

When a positive DC voltage is applied to the n-type thermo-electric element, electrons pass from the p- to the n-type thermo-electric element and the cold side temperature will decrease as heat is absorbed. The heat absorption (cooling) is proportional to the current and the number of thermo-electric couples. This heat is transferred to the hot side of the Peltier element where it is dissipated into the heat sink and surrounding environment.

Baldwin™-Series Classic Thermo-Electric Coolers remove the moisture from the sample gas by cooling the gas as it passes through a laminar impinger (heat exchanger). A diagram showing the gas flow path through an impinger is shown in the Appendix. The heat exchanger, made of 316L stainless steel, Durinert® (a corrosion-resistant inert coating over 316L stainless steel), PVDF (Kynar), or glass, is mounted within a thermally insulated heat transfer block bored to receive the heat exchanger without a mechanical lock. This assembly allows the easy removal of any heat exchanger simply by slipping it out of the cooling block by hand. The heat transfer block cools the heat exchanger through the heat pumping action of the peltier element. The heat transfer block is on the cold side of the thermo-electric element and the heat sink is on the hot side of the thermo-electric element. The heat from the heat transfer block is pumped to the heat sink where it is then dissipated into the air by the heat sink fan. See Figure 2. The desired temperature is maintained by a closed loop control system, which is implemented through an analog proportional controller. The controller uses a type K thermocouple in the heat transfer block located very close to the cold side of the peltier element as the input sensor.

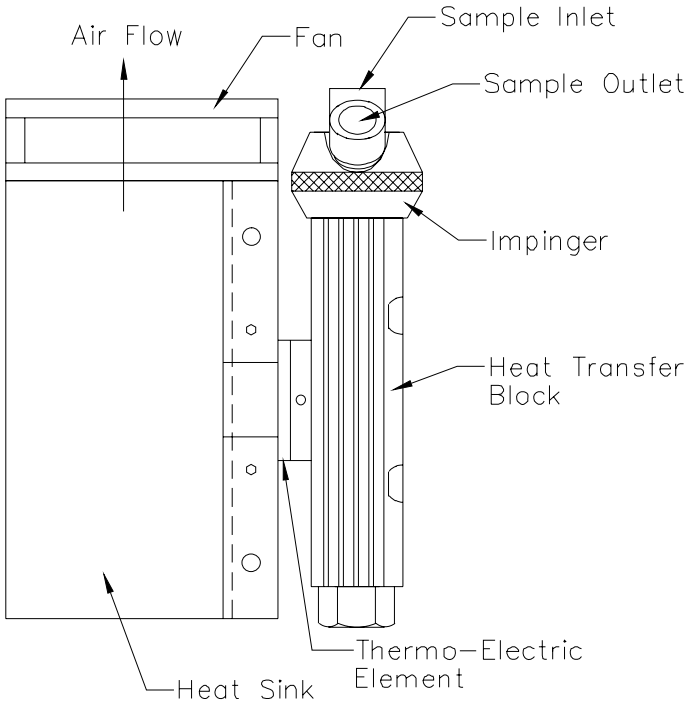

Figure 2: Heat Exchanger, Impinger and Heat Sink Assembly

The sample gas is passed to the Classic Thermo-Electric Cooler via the heated filter sample probe and heated sample line. The Classic Thermo-Electric Cooler lowers the sample dew point to 5°C (41°F). As the gas cools and the moisture vapor condenses, the condensate exits the heat exchanger through the bottom drain connection. Particulate matter passing through the sample cooler is removed by an optional pre-filter, located downstream from the cooler along with an optional water slip sensor. The conditioned sample gas can then be directed to the gas analyzers.

D: INSTALLATION

The Classic Model 5210 Thermo-Electric Sample Cooler should be installed away from heat sources in a well vented area of an instrument rack or enclosure. *REMEMBER, the Classic Model 5210 can only control to 71°F. DIFFERENTIAL from ambient temperature.* Thus, at an output temperature control of 41°F., the maximum ambient temperature is 104°F., above which cooling control is lost. When this differential is exceeded, the controller will go into full power consumption mode, with the cooling capacity floating in relation to the ambient temperature above 104°F. No damage will occur to the cooler, however, the output dew point will also float in relation to the ambient temperature. The more stable the ambient temperature environment around the Classic Model 5210, the better the output dew point stability.

Sample tubing connections to the Classic Model 5210 depend on the heat exchanger material of construction. A cooler with stainless steel heat exchangers uses a stainless steel inlet fitting on the Channel 1 heat exchanger. All other inlets and outlets are Kynar® standard compression type tube fittings with Teflon® ferrules. PVDF (Kynar®) heat exchangers use all Kynar® standard compression type tube fittings with Teflon® ferrules. Perma Pure cannot warrantee against damage to the Peltier elements or heat exchangers if our supplied Kynar® tube fittings are not used.

The inlet and outlet tubing for all metal or Kynar® heat exchangers is 1/4" NPT; the user should always use the compression type fittings provided for that purpose by the factory. The inlet of the Channel 1 heat exchanger uses a 3/8” tube x ¼” MNPT, fitting to mate with most standard 3/8” sample lines.

The condensate drain connections are Kynar® elbows or straight, 3/8” MNPT x 1/4” barbed tube fittings. An automatic condensate drain, Model 3KPB-003 dual-head peristaltic drain pump is recommended for water removal. This pump uses size 17 tubing.

CAUTION: Do no reduce the size of the condensate tubing since doing so restricts water flow resulting in water slip (moisture carryover) in the sample.

CAUTION: If using a stainless steel sample line, place 2 inches of Teflon® tubing in between the exchanger inlet fitting and the heated line. This prevents the sample cooler from heat sinking the incoming heated line, which adds undue load to the cooler.

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E: START-UP PROCEDURE

Plug in the power cord to a properly grounded main circuit. The Ready Green LED will come on within 3 minutes, indicating the ready temperature (10°C) has been achieved and the gas sample flow can begin. After approximately 3 minutes, the set-point of +5°C (41°F) will be achieved. The SLIP Green LED is always on unless, (1) moisture is detected by the water slip sensor, (2) the cooler was ordered without a relay board, or (3) there is a malfunction (e.g., shorted water slip sensor leads or a bad relay board).

The Baldwin™-Series Classic Model 5210 Thermo-Electric Cooler is virtually maintenance free. However, in the event of electrical problems, refer to the troubleshooting guide in this manual. All voltages can be read at the PCB terminal strip. Any deviations from the correct voltages indicate a problem.

F: LED SUMMARY

The Classic Model 5210 has a single-channel, digital operating temperature front panel indicator, and three LED status displays for each active channel (2 green, 1 red per channel). These indicators are arranged vertically on the front of the cooler on their respective sides. The “Ready” Green LED’s come on when the ready set-point temperature is reached for each channel. The “Slip” Green LED’s light up immediately upon power-on, indicating that the water slip relay is not actuated, this is the expected normal condition. The channel 1 “Slip” LED is connected to the water slip sensor, which is normally dry on start up. If the “Slip” Green LED goes out, this indicates water is “slipping” past the heat exchanger. The relay then shuts off the sample pump so that water is not allowed to reach the analyzers, preventing damage to the analytical instruments. Steps need to be taken at this time to determine the cause of the moisture and correct the situation. The “Failure” red LED’s come on if the thermocouple or an electronic controller component has failed.

READY LED On = Relay Set Point Temperature is Reached (+10°C)
SLIP LED On = Safe Operating Condition
SLIP LED Off = Water Slip Sensor Alarm (Unsafe Operating Condition)
Red LED On = Thermocouple or electronic Failure Alarm

When the Green LED's are lit, the Classic Model 5210 is operating at proper cooling block temperature, producing a stable, repeatable dewpoint, sample effluent. If either Green LED fails to light, it can indicate several problems. The first and most obvious is overload. Check the incoming sample gas temperature, moisture content, and flowrate through the heat exchangers to be sure all conditions are within published specifications. Overload requires more cooling power from the Classic Model 5210 than is available. If all conditions are correct, then the problem is an electrical malfunction, which can be traced using the troubleshooting guidelines in this manual.

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G: SET POINTS

Both the operating control temperature and ready relay set points are adjusted by 10 turn potentiometers located on the control board. Using a digital voltmeter (DVM), attach the black lead to P1 for ground reference point and attach the red lead to Test Points 1, 2 or 3 located just above terminal TB1 where the control thermocouple terminates. TP1 is the thermocouple zero/span adjustment test points, and should not be adjusted by the user. TP3 is the ready relay set point temperature (Set Point #3), and TP2 is the control set point temperature (Set Point #2). To adjust either set point, open the cooler front door, attach the DVM, and adjust the labeled potentiometer on the control card.

NOTE: These set point potentiometers are factory set and sealed for proper cooler operation. Please consult the factory before making any changes to these set point adjustments.

SET POINT #2 is factory adjusted to 5°C (.500VDC).
SET POINT #3 is factory adjusted to 10°C (1.00VDC).

H: RELAY BOARD

A: Computer Status Alarms

Wire computer status alarms to TB2, Terminals 1 through 3 for the Water Slip Alarms status and TB2, terminals 4 through 6 for the Ready/Slip alarm status.

B: Sample Pump Control-Water Slip Only

1. Jumper hot, neutral, and ground from the power supply line terminals to TB8 on the relay board.
2. Wire the sample pump power leads to TB2, terminals 6 (Hot), 7 (Neutral), and 8 (Ground).

C: Sample Pump Control-Water Slip plus Ready/Slip/Power Fail Safe Start

1. Wire TB2 and TB8 as in step B2 above.
2. Wire a jumper on TB1 from terminal 3 to terminal 4, and wire another jumper on TB9 from terminal 1 to terminal 2.
3. Wire sample pump hot wire to TB9 terminal 5.
4. Wire Water Slip Sensor to TB2 terminals 7 and 8.

Sample pump is now in series with Water Slip Sensor and the Ready/Slip/power failure relay, which will only allow the sample pump to start if both conditions are true, i.e. no water slip, and safe operating temperature of the sampling system.

I: "NEW JERSEY" THERMOCOUPLE OPTION

Some air quality management districts (e.g., those in New Jersey and Southern California) require temperature measurement of the gas stream at the outlet of the last heat exchanger on the cooler. Perma Pure offers a 1/32-inch diameter hypodermic-style type K thermocouple that can be inserted into a special heat exchanger (i.e., it has a small port for insertion of the thermocouple) so the actual sample dew point temperature can be measured. This is sometimes referred to as the New Jersey thermocouple outlet temperature option.

The Classic Model 5210 has two 10" heat exchangers which are operated in series (single-stream). The second heat exchanger will have a New Jersey thermocouple to sense the temperature inside the heat exchanger (upgrade option: 4C-NJ/K-10). In the part number, the "NJ" identifies the upgrade for a NJ type thermocouple. The "K" identifies the thermocouple itself as a type "K" thermocouple. The "-10" is the height of the heat exchangers.

In addition, Perma Pure offers an optional temperature transmitter board for signal or voltage temperature output. This board has one input and two outputs per channel. The input is for the type K thermocouple. The first output is an analog voltage output that can be configured for either 0-2.5vdc or 0-10vdc for a 0°C (32°F) to 25°C (77°F) temperature range. The second output is a 4-20mA for the same temperature range.

Classic Model 5210 New Jersey Thermocouple Option

Part No.	Description
4C-NJ/K-10	Heat exchanger upgrade to include NJ thermocouple port
3CXS-004	Heat exchanger, 10" SS w/ NJ thermocouple port
3CXD-004	Heat exchanger, 10" Durinert® w/ NJ thermocouple port
3CXK-004	Heat exchanger, 10" Kynar® w/ NJ thermocouple port
3CCB-012	Temperature transmitter board, single stream
3KTC-001	Thermocouple, Type K, replacement kit

J: TROUBLESHOOTING

Symptom	*Check*	*Action*
No LED(s) and no fan.	AC power input. DC 3A fuse (F1) on control Bd. AC 15A fuse on power supply. Check for +15VDC at P1 & P11 of control bd.	Ensure that AC power is connected. Replace fuse as necessary. Replace fuse as necessary. If low reading, remove wires from P1 & P11, measure at power supply and replace supply if voltage still is low.
LED(s) on and no fan.	Wire harness at P10 on control board over to P1 on relay boards. Relay Board for +12VDC at TB7 pins 1&2 and 3&4.	 If loose then reseat connectors. If no voltage or low reading, replace relay board.
F1 on control board keeps blowing.	Replace fuse (3A) and disconnect P10 cable going to relay board.	If fuse does not blow, replace relay board.
Impinger remains at ambient temperature.	Peltier current draw. Should be above 6 amps.	Replace Peltier element.
Thermocouple failure LED is on.	Thermocouple connection TB1.	Ensure proper connection. Try a good thermocouple in place of old one Replace thermocouple.
Impinger frozen and cooler indicates ambient temperature.	Thermocouple placement in heat exchanger block. Peltier current draw (>6A) for both elements on that channel.	Ensure proper placement. Replace bad peltier
Impinger does not reach set temperature, but is below ready temperature.	System loading. Calibration and set temperature adjustment.	Ensure system loading is not exceeding cooler capacity. Adjust as necessary.
Impinger temperature cycles up and down.	Peltier connections on control board. Ferrite bead on thermocouple going into terminal TB1.	Ensure a firm connection on flag connectors on control board. Ensure system loading is not exceeding cooler capacity. Wrap a Ferrite bead around thermocouple wires
Ready LED does not come on when impinger is below 7°C.	Ready temperature adjustment.	Adjust as necessary.
Water carryover in system.	Impinger temperature. Should be below 6°C.	Ensure system loading is not exceeding cooler capacity.
Slip LED does not come on *(alarm relay/water slip option installed)*.	Water carryover in system. Water slip sensor connections.	Ensure system loading is not exceeding cooler capacity. Ensure that all water slip sensor connections are made. Disconnect sensor at base of unit, Clean tip of sensor. Replace alarm relay/water slip board.
Pump does not start. Ready and slip LED(s) are on *(alarm relay/water slip option installed)*.	Pump electrical connections.	Ensure proper connections. Replace board.

For further service assistance, contact:

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Tel: 732-244-0010
Fax: 732-244-8140
Email: info@permapure.com
or your local representative

K: SPARE PARTS

Classic Model 5210

Part No.	Description
3CCB-010*	Control Board: Single Channel
2FAN-005	Fan: Muffin, 4” x 1”, 12 VDC
2FAN-004	Fan: Muffin, 4” x 1½”, 12 VDC
3CXD-003	Heat Exchanger: 10" Durinert®
3CXG-006	Heat Exchanger: 10” Glass, threaded w/ fittings
3CXK-003	Heat Exchanger: 10” Kynar
3CXS-003	Heat Exchanger: 10” Stainless Steel
3KPE-004*	Peltier Element Kit, 40 mm
1PSD-008*	Power Supply: 250 W, 15 VDC
3CCB-004*	Relay Board: Single Channel
1TTC-001	Thermocouple: Temperature, Control, Type K, 24”

* Recommended Spares

Sample Conditioning Systems w/ Classic Model 5210 Thermo-Electric Cooler

Model C1 (Models 4S-5210-9BC1, 4S-5210-9EC1)

Part No.	Description
3KFA-001	Filter Assembly, Sample in-line, 2-micron
3FHG-001	Filter Bowl, Glass
3FEC-002**	Filter Element: Ceramic, 2-micron
3KPB-003	Peristaltic Pump: Dual, Kit, 115V Complete w/ Enclosure
2PBM-003	Peristaltic Pump: Head Only, Standard
2PBM-001	Peristaltic Pump: Motor Only, 115V AC 60 Hz
2PBT-002PK*	Peristaltic Pump: Tubing, Norprene, Size 17 (10 feet)
3KPA-001*	Sample Pump: Assembly, Single Head w/ Check Valve, 115V
2PAS-008	Sample Pump: Single Head, Mini-Dia-Vac, 115V (bare)
2PAM-001*	Sample Pump: Repair Kit, Single
3CWS-001	Water Slip Sensor (Hastelloy/SS Pins)
3KCW-002	Water Slip Sensor (SS Pins) w/ Holder Assembly

* Recommended Spares **Consumables

Model CD (Models 4S-5210-9BCD, 4S-5210-9ECD)

Part No.	Description
3KFA-001	Filter Assembly, Sample in-line, 2-micron
3FHG-001	Filter Bowl, Glass
3FEC-002**	Filter Element: Ceramic, 2-micron
3KPB-003	Peristaltic Pump: Dual, Kit, 115V Complete w/ Enclosure
2PBM-003	Peristaltic Pump: Head Only, Standard
2PBM-001	Peristaltic Pump: Motor Only, 115V AC 60 Hz
2PBT-002PK*	Peristaltic Pump: Tubing, Norprene, Size 17 (10 feet)
3KPA-002*	Sample Pump: Assembly, Dual Head w/ Check Valve, 115V
2PAD-006	Sample Pump: Dual Head, Mini-Dia-Vac, 115V (bare)
2PAM-002*	Sample Pump: Repair Kit, Dual
3CWS-001	Water Slip Sensor (Hastelloy/SS Pins)
3KCW-002	Water Slip Sensor (SS Pins) w/ Holder Assembly

* Recommended Spares **Consumables

APPENDIX A: CLASSIC MODEL 5210

BALDWIN™ - Series

THERMO-ELECTRIC COOLERS

Classic Model 5210

Perma Pure's Baldwin™ Classic Series Model 5210 Thermo-Electric Coolers is specifically designed for high ambient temperature & high water volume applications. The Model 5210 features an oversized heat sink and high performance thermoelectric devices for high heat removal capacity. Heat sinks used in the Baldwin-Series Thermo-Electric Coolers are made out of high heat transfer extruded aluminum with large 3/4" thick end plates. The Model 5210 incorporates a special controller specifically designed to run at high ambient temperatures up to 110°F (43°C).

Physical Description

Single Stream System
2 x 10" Heat Exchangers connected in series only
1 Passive (cooled to ambient), 1 Active (cooled to 4°C) Heat Exchangers
LCD temperature display

Operating Specifications

Sample Gas Flow Range	3-8 LPM 6.4-17 SCFH
Average Inlet Dew Point at Rated Flow	175°F @ 43% H_2O 79°C
Dimensions	14.55 x 11.12 x 10.57 in. HWD 37.0 x 28.2 x 26.8 cm
Weight	27 lbs 12.0 kg
Maximum Inlet Sample Temperature	400°F (205°C) SS, Glass Impingers 280°F (138°C) Kynar Impinger
Maximum Inlet Pressure	45 psig 3 bar / 2250 mmHg
Maximum Heat Exchanger Pressure Drop	<+1 in. H_2O
Ambient Temperature Range	33-104°F 0.6-40°C
Outlet Sample Gas Dew Point	41°F 5°C
Inlet Tubing Connection	⅜ in. FNPT
Outlet Tubing Connection	¼ in. FNPT
Drain Tubing Connection	⅜ in. FNPT
Thermoelectric Elements	40 mm
Voltage	110 (220 optional) VAC 50/60 Hz
Power Supply	250W
Cooling Down Time	Less than 3 minutes

Perma Pure LLC
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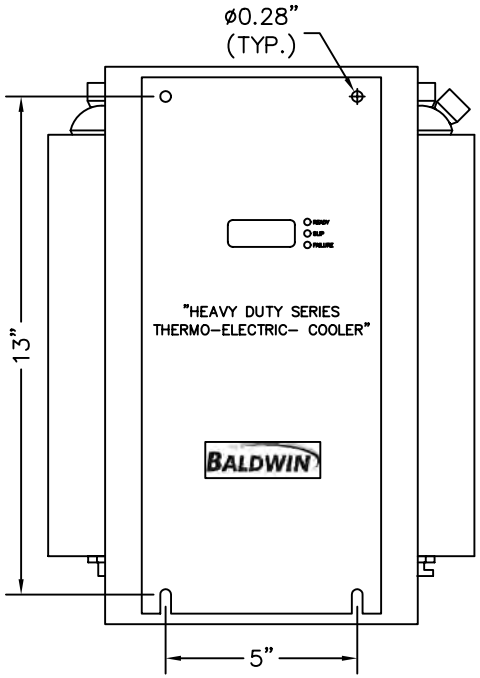
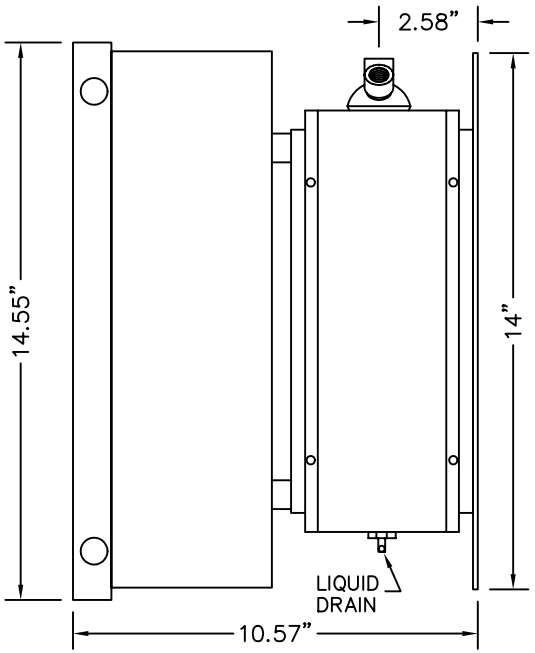
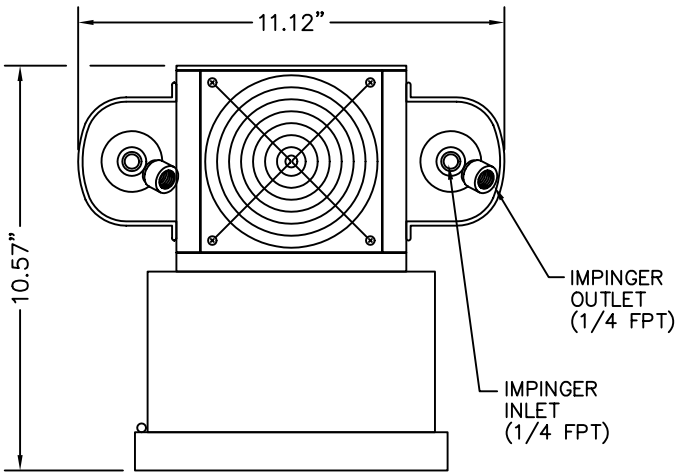
REVN	DATE	DESCRIPTION	DRAWN	APPROVED
0	00/00/00	INITIAL DRAWING	JO	



FRONT VIEW



RIGHT SIDE VIEW



TOP VIEW

ITEM	QTY	DESCRIPTION	MANUF.
USED FOR:		MODEL NUMBER:	
		DESCRIPTION:	

UNLESS OTHERWISE SPECIFIED
TOLERANCE DECIMALS
1 PLACE = ±.02
2 PLACE = ±.02
3 PLACE = ±.010
SURFACE FINISHES 125
ANGLES = ±5°
HOLES = +.003/-.001
BALDWIN
www.baldwinUSA.com

DRAWN BY: JO DATE: 05/12/02
APP'D: DATE

BALDWIN, INC.

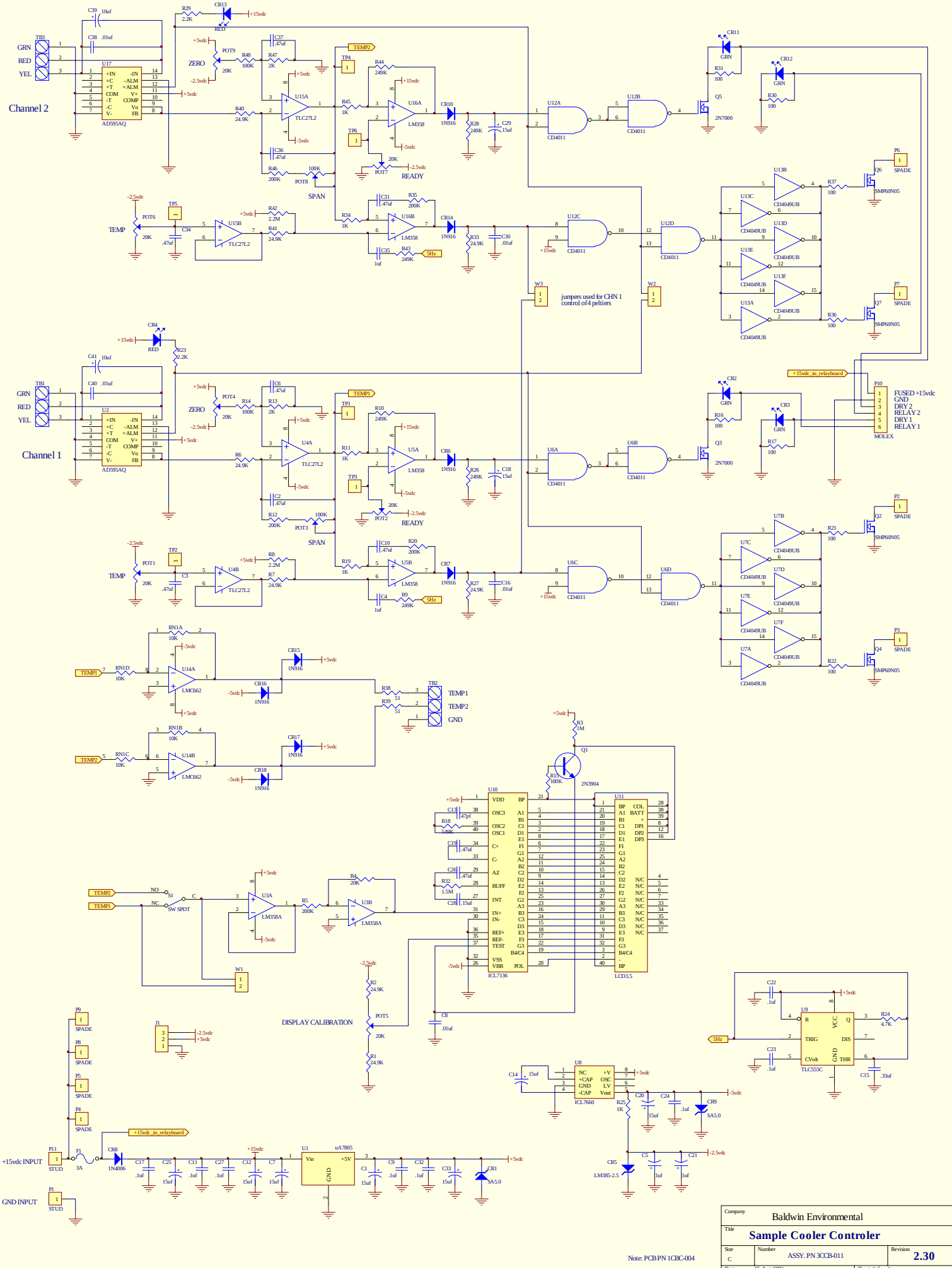
MATERIAL: AS NOTED
FINISH: AS NOTED

DESIGN DIMENSIONS ARE IN INCHES
( ) DENOTES MILLIMETER EQUIVALENTS WHEN USED

PART DESCRIPTION: MODEL 5210 SAMPLE COOLER ARRANGEMENT DRAWING

SIZE	SCALE:	DRAWING/PART NO.:
A	NTS	MODEL 5210

CAD DIR: S:\S&M\DWGS\T.E. COOL-HEAVY SERIES | SHEET 1 OF 1


Channel 2
Channel 1
AD595AQ
TLC27L2
LM358
CD4011
2N7000
SMP60N05
ZERO
SPAN
TEMP
READY
jumpers used for CHN 1
control of 4 peltiers
FUSED +15vdc
GND
DRY 2
RELAY 2
DRY 1
RELAY 1
MOLEX
TEMP1
TEMP2
GND
LMC662
SW SPDT
DISPLAY CALIBRATION
ICL7136
LCD3.5
ICL7660
TLC555C
LM385-2.5
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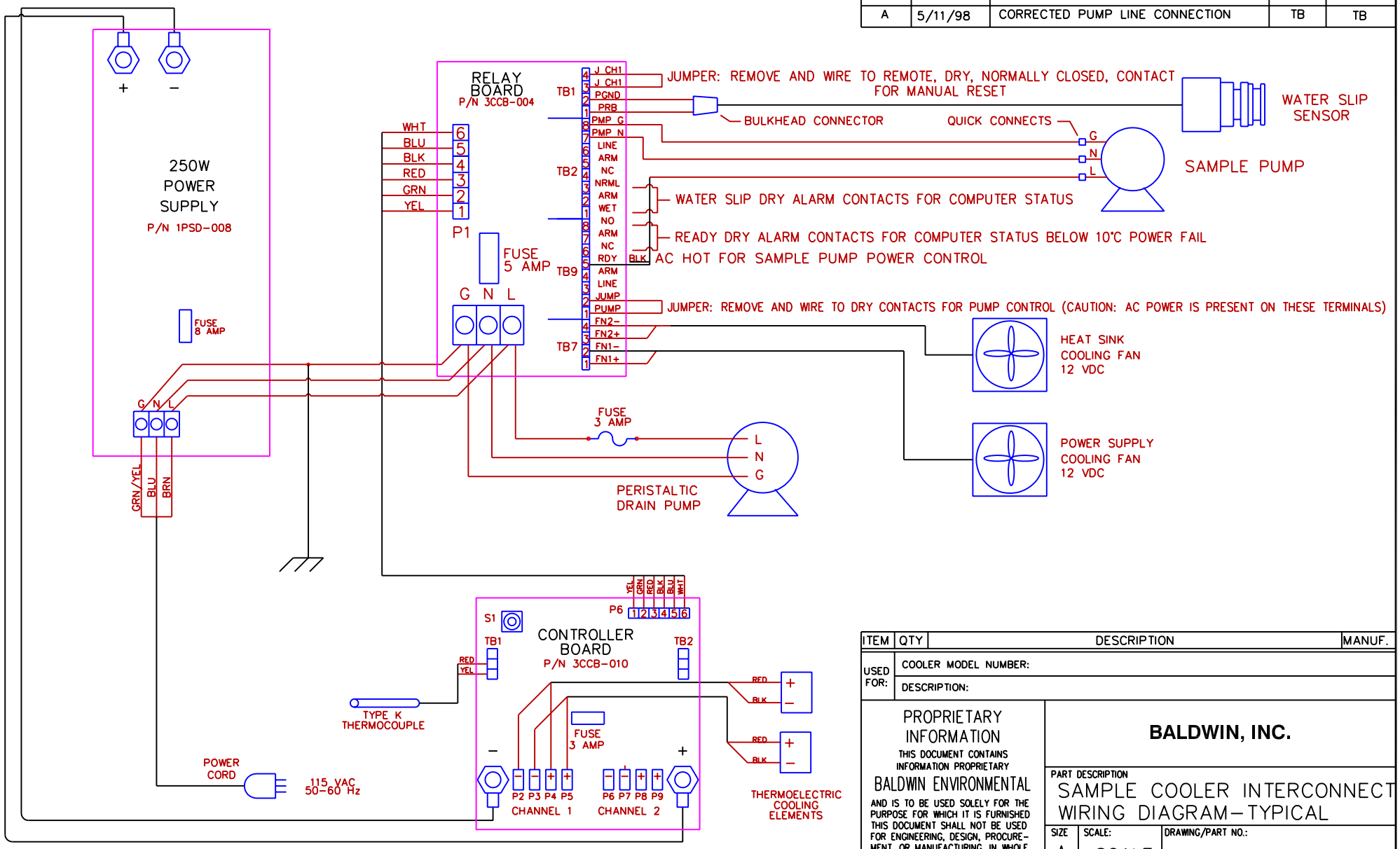


ITEM	QTY	DESCRIPTION	MANUF.
USED FOR:	COOLER MODEL NUMBER:		
	DESCRIPTION:		

PROPRIETARY INFORMATION

THIS DOCUMENT CONTAINS INFORMATION PROPRIETARY BALDWIN ENVIRONMENTAL AND IS TO BE USED SOLELY FOR THE PURPOSE FOR WHICH IT IS FURNISHED THIS DOCUMENT SHALL NOT BE USED FOR ENGINEERING, DESIGN, PROCUREMENT, OR MANUFACTURING, IN WHOLE OR IN PART.

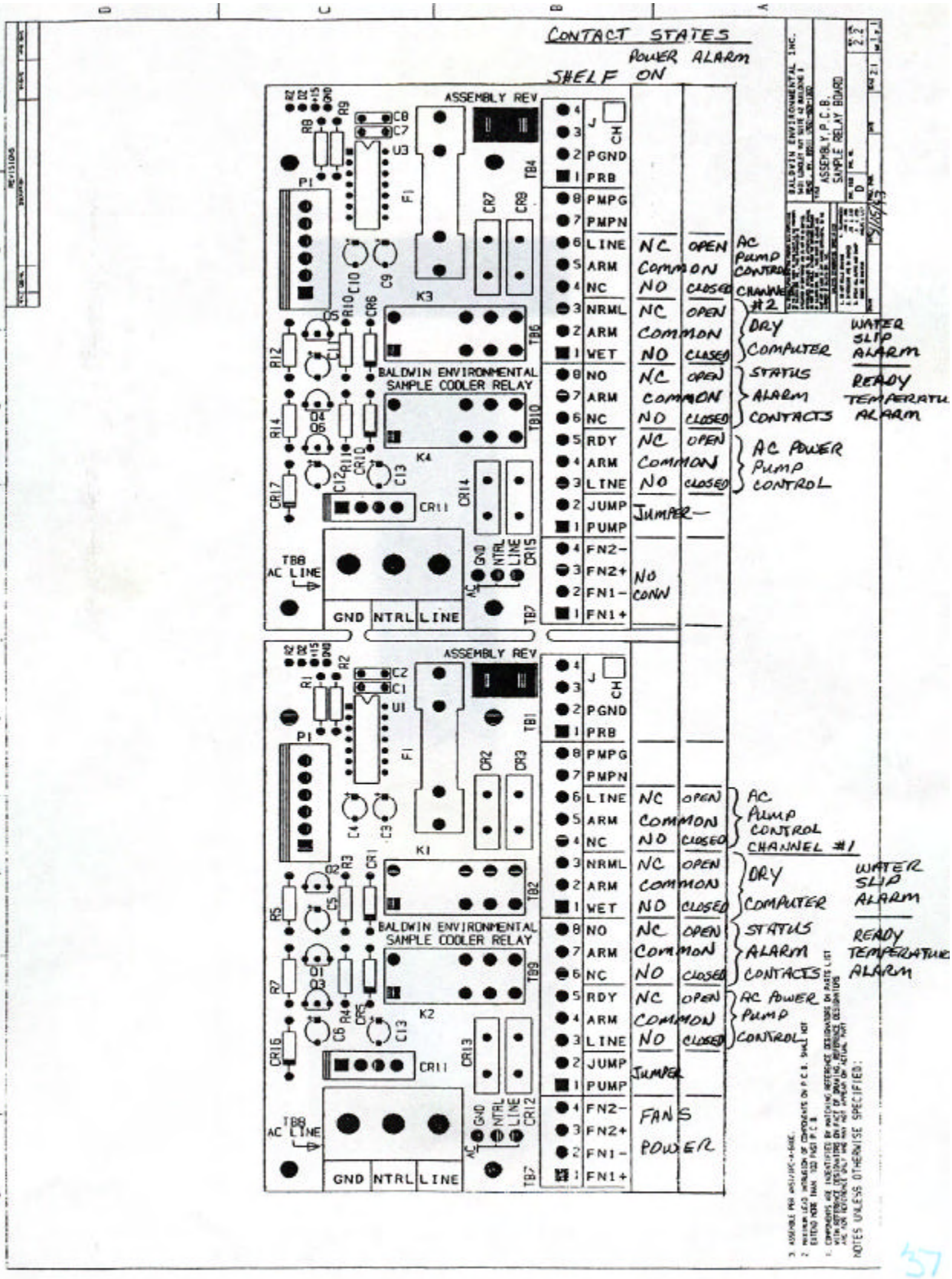
BALDWIN ENVIRONMENTAL

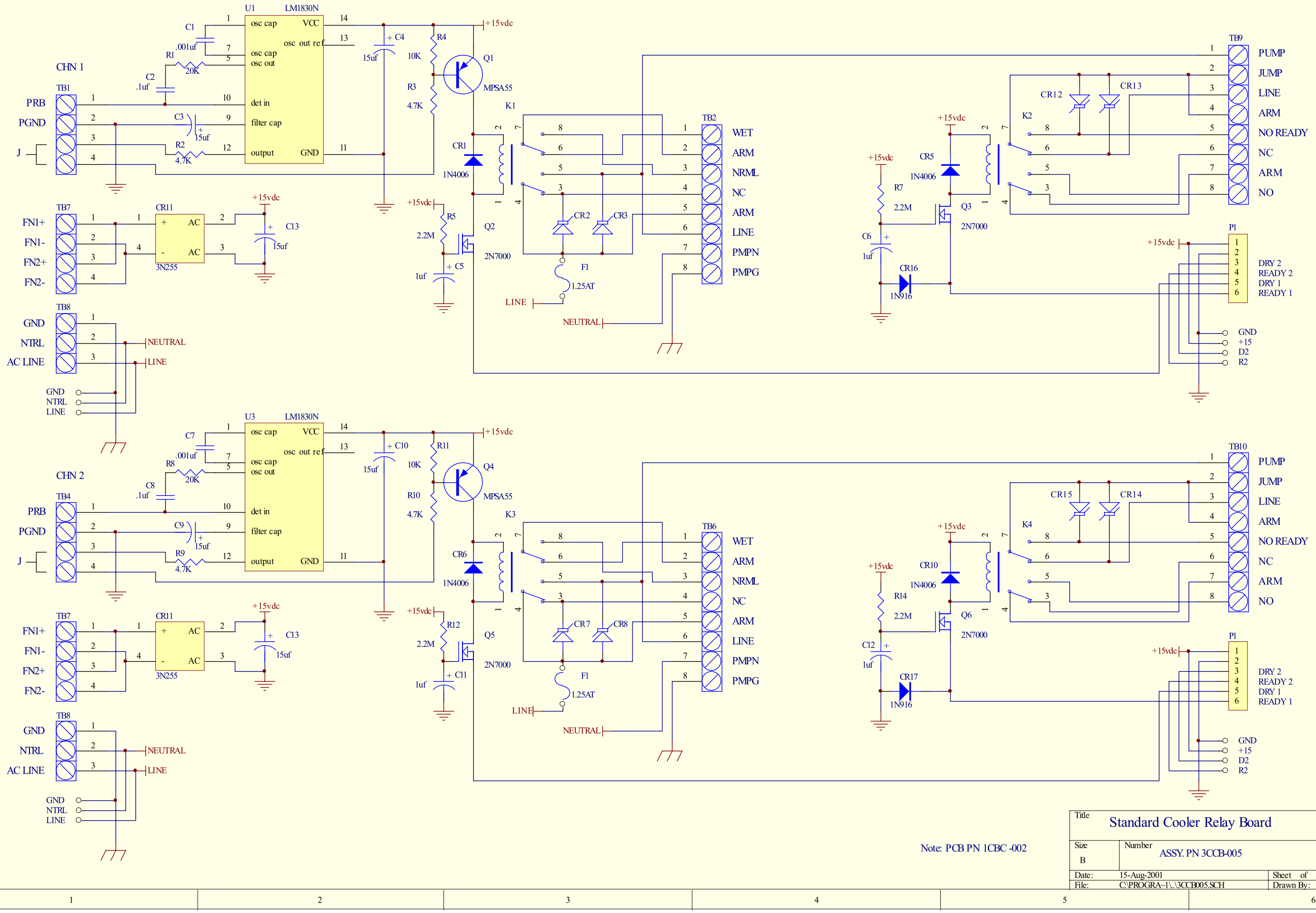
BALDWIN, INC.

PART DESCRIPTION
SAMPLE COOLER INTERCONNECT WIRING DIAGRAM–TYPICAL

SIZE	SCALE:	DRAWING/PART NO.:
A	SCALE	1DC1C2Pa

CAD DIR: S:\DRAW\ SHEET


CONTACT STATES
POWER ALARM
SHELF ON
ASSEMBLY REV
BALDWIN ENVIRONMENTAL
SAMPLE COOLER RELAY
GND NTRL LINE
AC LINE
J CH
PGND
PRB
PMPG
PMPN
LINE NC OPEN
ARM COMMON
NC NO CLOSED
AC PUMP CONTROL CHANNEL #2
NRML NC OPEN
ARM COMMON
WET NO CLOSED
DRY COMPUTER
WATER SLIP ALARM
NO NC OPEN
ARM COMMON
NC NO CLOSED
STATUS ALARM CONTACTS
READY TEMPERATURE ALARM
RDY NC OPEN
ARM COMMON
LINE NO CLOSED
AC POWER PUMP CONTROL
JUMPER
PUMP
FN2-
FN2+
FN1-
FN1+
NO CONN
FANS POWER
ASSEMBLY, P.C.B.
SAMPLE RELAY BOARD
BALDWIN ENVIRONMENTAL INC.
NOTES UNLESS OTHERWISE SPECIFIED:


U1 LM1830N
osc cap
VCC
osc out ref
osc cap
osc out
det in
filter cap
output
GND
CHN 1
PRB
PGND
J
TB1
C1 .001uf
R1 20K
C2 .1uf
C3 15uf
R2 4.7K
+ C4 15uf
R4 10K
R3 4.7K
Q1 MPSA55
+15vdc
K1
CR1 1N4006
Q2 2N7000
R5 2.2M
+ C5 1uf
CR2
CR3
F1 1.25AT
LINE
NEUTRAL
TB2
WET
ARM
NRML
NC
ARM
LINE
PMPN
PMPG
TB7
FN1+
FN1-
FN2+
FN2-
CR11
AC
AC
3N255
C13 15uf
TB8
GND
NTRL
AC LINE
GND
NTRL
LINE
U3 LM1830N
CHN 2
C7 .001uf
R8 20K
C8 .1uf
C9 15uf
R9 4.7K
+ C10 15uf
R11 10K
R10 4.7K
Q4 MPSA55
K3
CR6 1N4006
Q5 2N7000
R12 2.2M
+ C11 1uf
CR7
CR8
F1 1.25AT
TB6
WET
ARM
NRML
NC
ARM
LINE
PMPN
PMPG
TB4
TB9
PUMP
JUMP
LINE
ARM
NO READY
NC
ARM
NO
K2
CR12
CR13
CR5 1N4006
R7 2.2M
Q3 2N7000
C6 1uf
CR16 1N916
TB10
PUMP
JUMP
LINE
ARM
NO READY
NC
ARM
NO
K4
CR15
CR14
CR10 1N4006
R14 2.2M
Q6 2N7000
C12 1uf
CR17 1N916
P1
DRY 2
READY 2
DRY 1
READY 1
GND
+15
D2
R2
Note: PCB PN 1CBC -002
Title
Standard Cooler Relay Board
Size B
Number ASSY. PN 3CCB-005
Revision REV2.02
Date: 15-Aug-2001
Sheet of
File: C:\PROGRA~1\..\3CCB005.SCH
Drawn By:

APPENDIX B: SAMPLE CONDITIONING SYSTEM

REVN	DATE	DESCRIPTION	DRAWN	APPROVED
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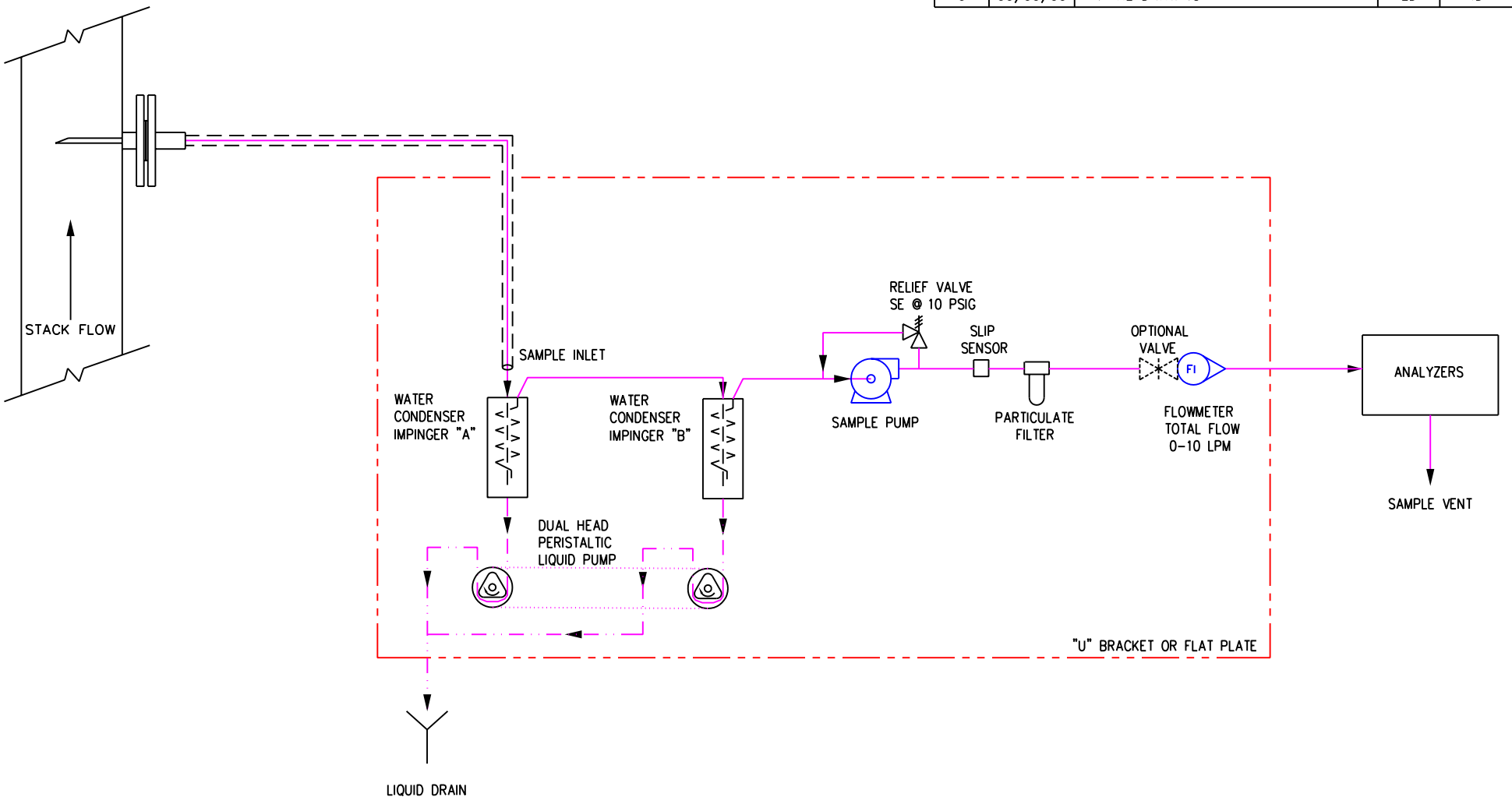

NOTES:

1. ALL COMPONENTS WETTED BY SAMPLE AND CALIBRATION GASES SHALL BE STAINLESS STEEL, BOROSILICATE GLASS, TEFLON OR VITON.
2. TOTAL FLOW SHALL BE RATED CAPACITY OF SAMPLE CHILLER.

ITEM	QTY	DESCRIPTION	MANUF.
USED FOR:		MODEL NUMBER: M325, 5210	
		DESCRIPTION:	

UNLESS OTHERWISE SPECIFIED
TOLERANCE DECIMALS
1 PLACE = ±.02
2 PLACE = ±.02
3 PLACE = ±.010
SURFACE FINISHES 125
ANGLES = ±5°
HOLES = +.003/-.001
BALDWIN
www.baldwinUSA.com

DRAWN BY: MES DATE
APP'D: DATE
MATERIAL
FINISH
DESIGN DIMENSIONS ARE IN INCHES
( ) DENOTES MILLIMETER EQUIVALENTS WHEN USED

BALDWIN, INC.

PART DESCRIPTION
PASSIVE/ACTIVE SAMPLE CONDITIONING SYSTEM FLOW DIA.

SIZE	SCALE:	DRAWING/PART NO.:
A	NTS	PASSIVE/ACTIVE

CAD DIR: S:\S&M\DWGS\SAM. COND. SYSTEM\DWG | SHEET 1 OF 1

REVN	DATE	DESCRIPTION	DRAWN	APPROVED
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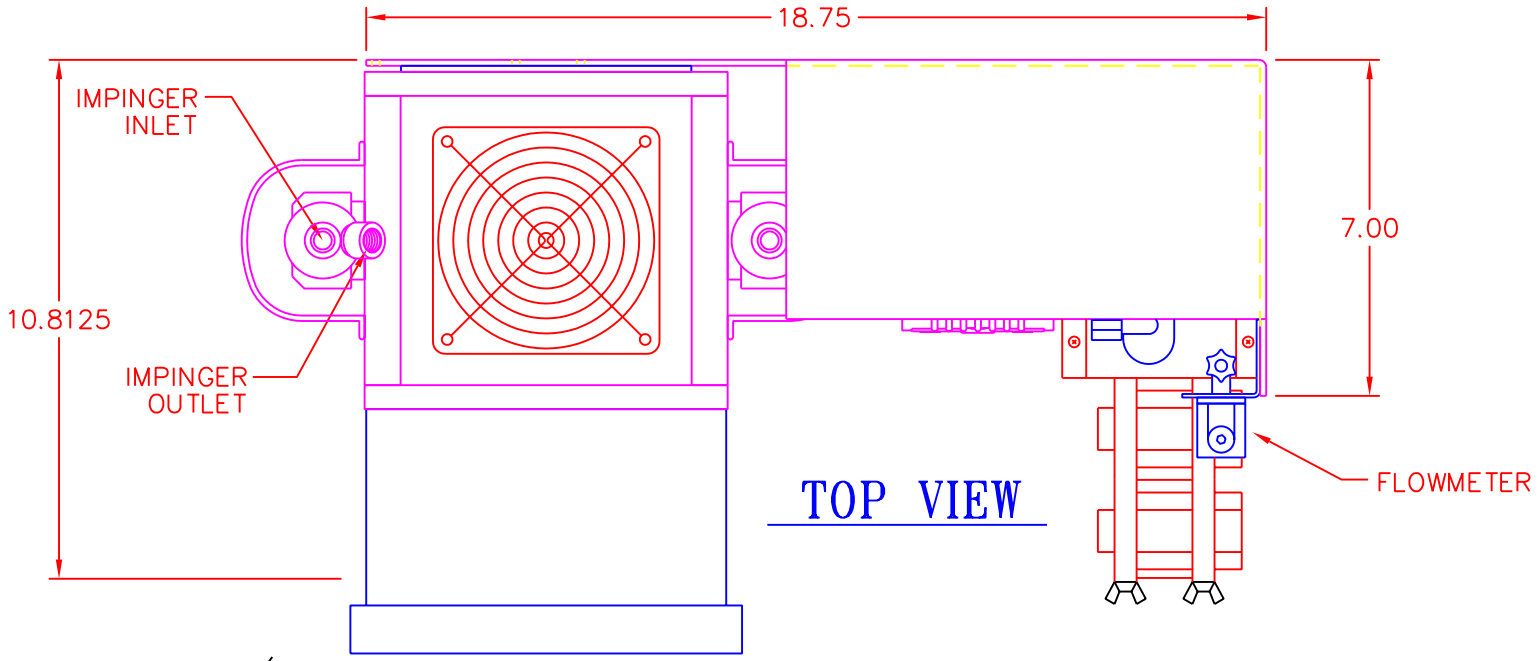
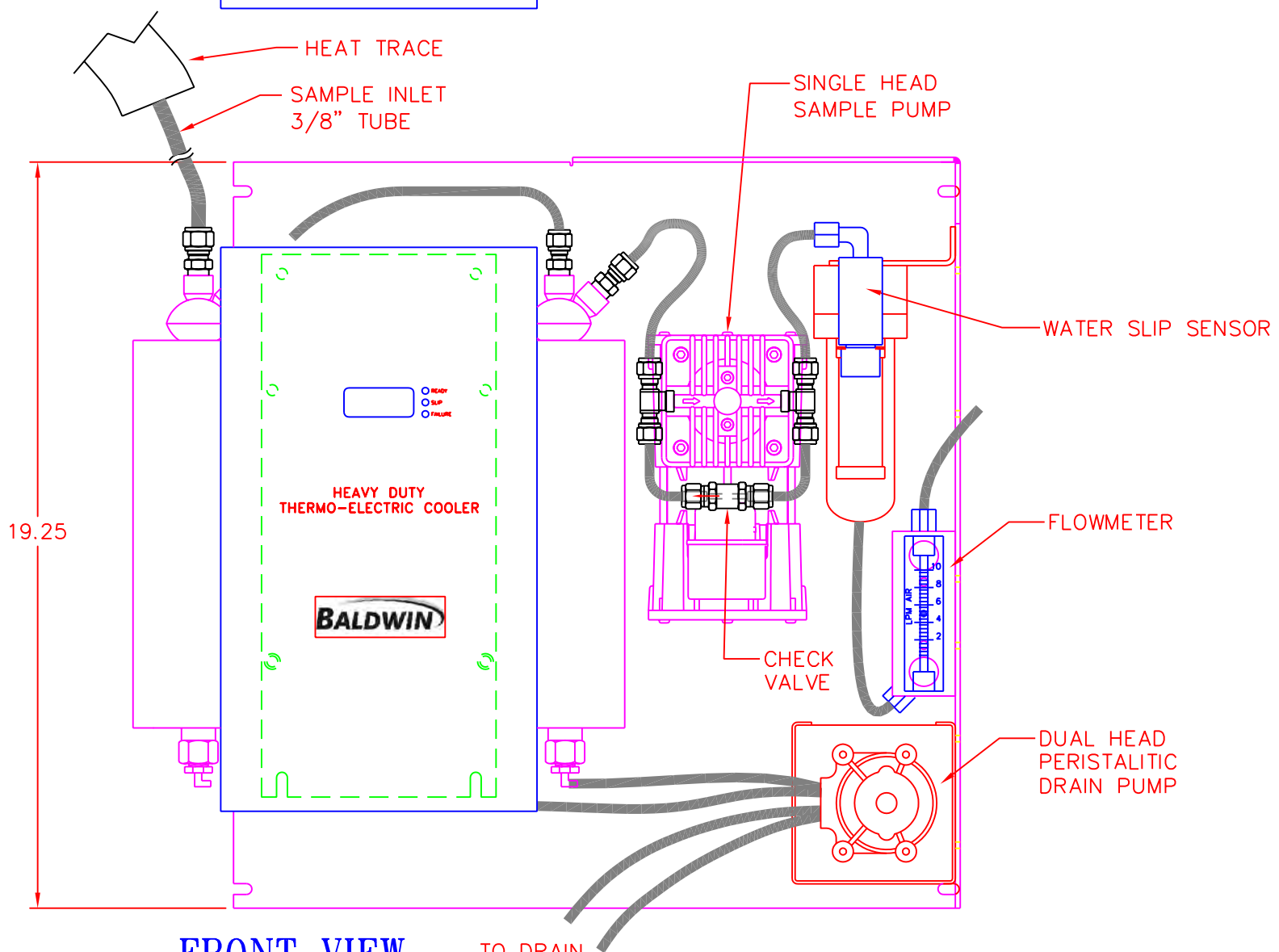
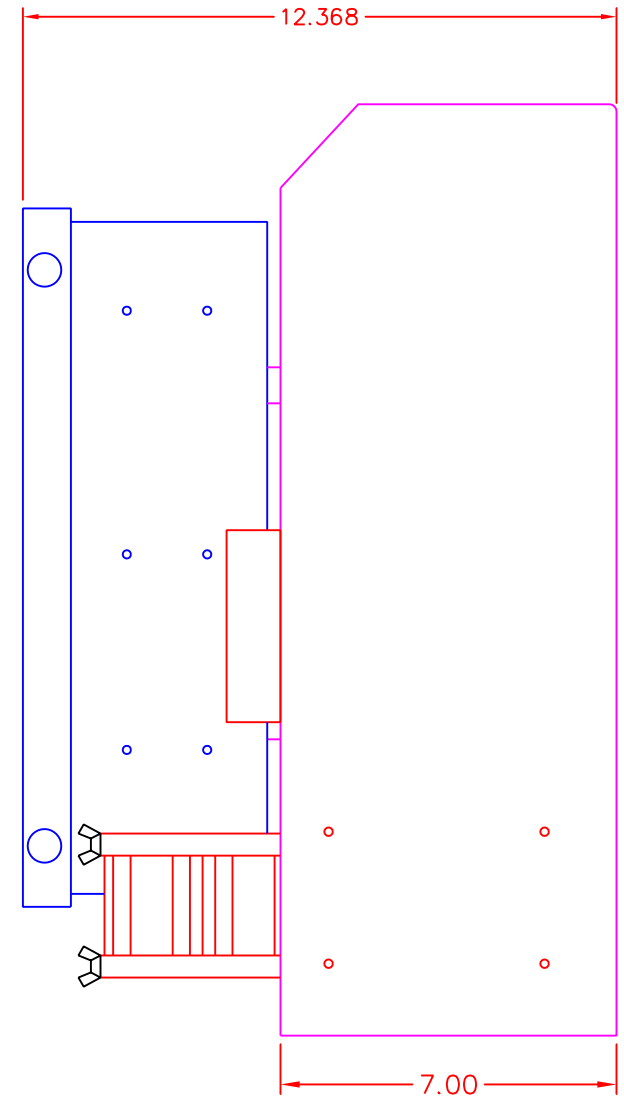


TOP VIEW



FRONT VIEW



RIGHT SIDE VIEW

ITEM	QTY	DESCRIPTION	MANUF.
USED FOR:		MODEL NUMBER:	
		DESCRIPTION:	

UNLESS OTHERWISE SPECIFIED	
TOLERANCE DECIMALS	SURFACE FINISHES 125
1 PLACE = ±.02	
2 PLACE = ±.02	
3 PLACE = ±.010	
ANGLES = ±5°	
HOLES = +.003/-.001	
BALDWIN	
www.baldwinUSA.com	

DRAWN BY: RAW	DATE 04/21/04
APP'D:	DATE
MATERIAL	
FINISH	
DESIGN DIMENSIONS ARE IN INCHES	
( ) DENOTES MILLIMETER EQUIVALENTS WHEN USED	

BALDWIN, INC.

PART DESCRIPTION
MODEL 4S-5210-9EC1
SAMPLE CONDITIONING SYSTEM

SIZE	SCALE:	DRAWING/PART NO.:
B	1/4	4S-5210-9EC1

CAD DIR: S:\S&M\DWGS\SAM. CON. SYSTEM\DWG | SHEET 1 OF 1

REVN	DATE	DESCRIPTION	DRAWN	APPROVED
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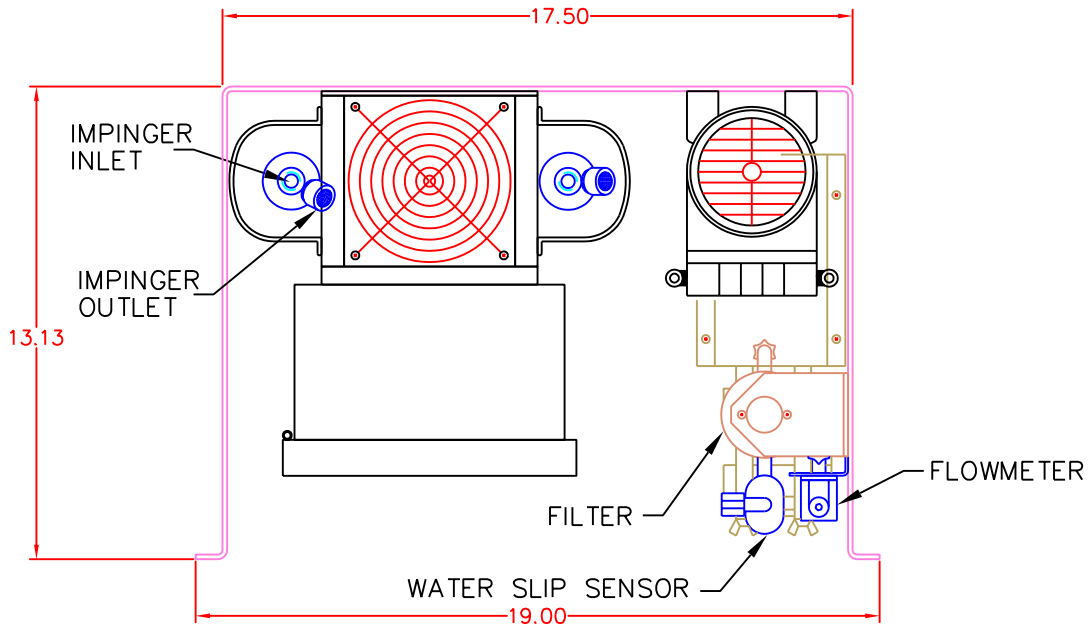
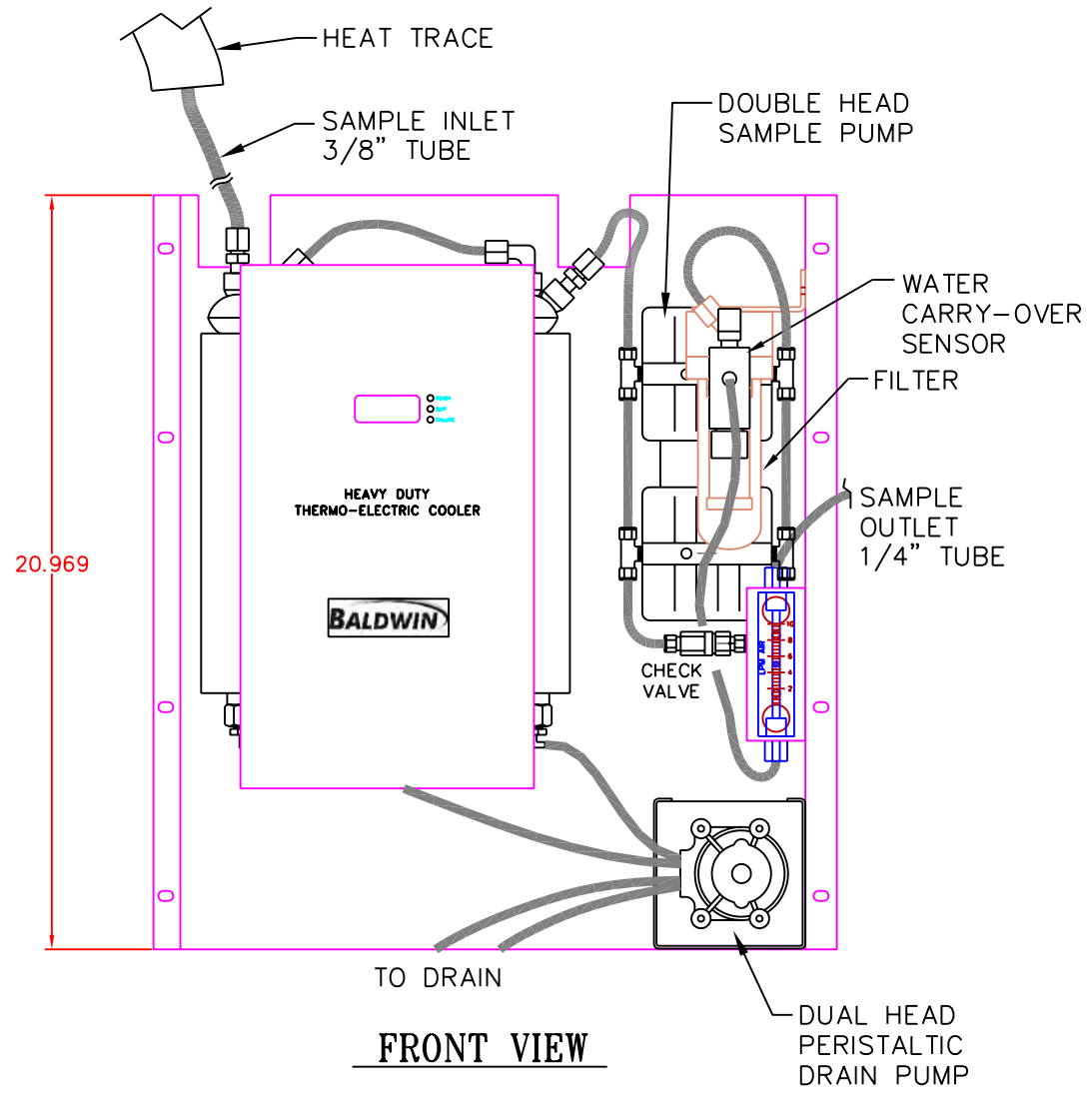
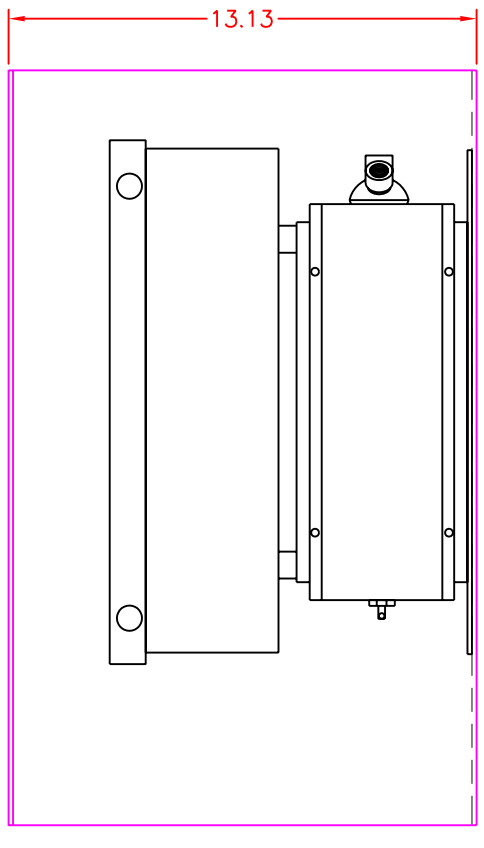


TOP VIEW



FRONT VIEW



RIGHT SIDE VIEW

ITEM	QTY	DESCRIPTION	MANUF.
USED FOR:		MODEL NUMBER:	
		DESCRIPTION:	

UNLESS OTHERWISE SPECIFIED
TOLERANCE DECIMALS
1 PLACE = ±.02
2 PLACE = ±.02
3 PLACE = ±.010
SURFACE FINISHES 125
ANGLES = ±5°
HOLES = +.003/-.001

BALDWIN
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DRAWN BY: RAW DATE 04/21/04
APP'D: DATE
MATERIAL
FINISH

DESIGN DIMENSIONS ARE IN INCHES
( ) DENOTES MILLIMETER EQUIVALENTS WHEN USED

BALDWIN, INC.

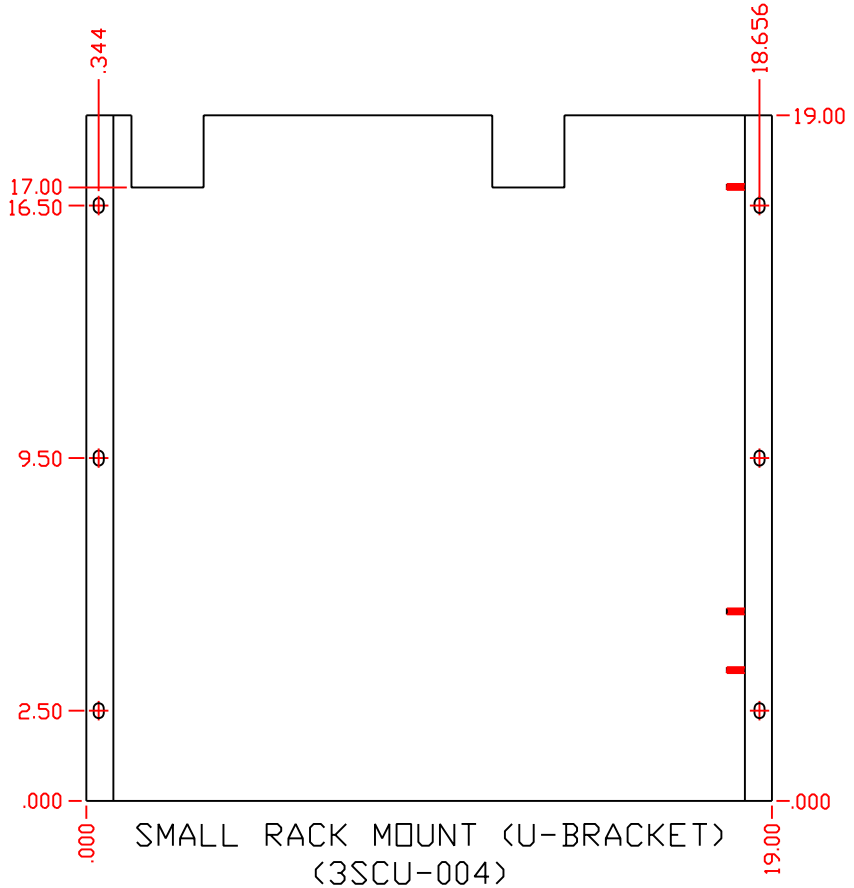
PART DESCRIPTION
MODEL 4S-5210-9BCD
SAMPLE CONDITIONING SYSTEM

SIZE	SCALE:	DRAWING/PART NO.:
B	1/8	4S-5210-9BCD

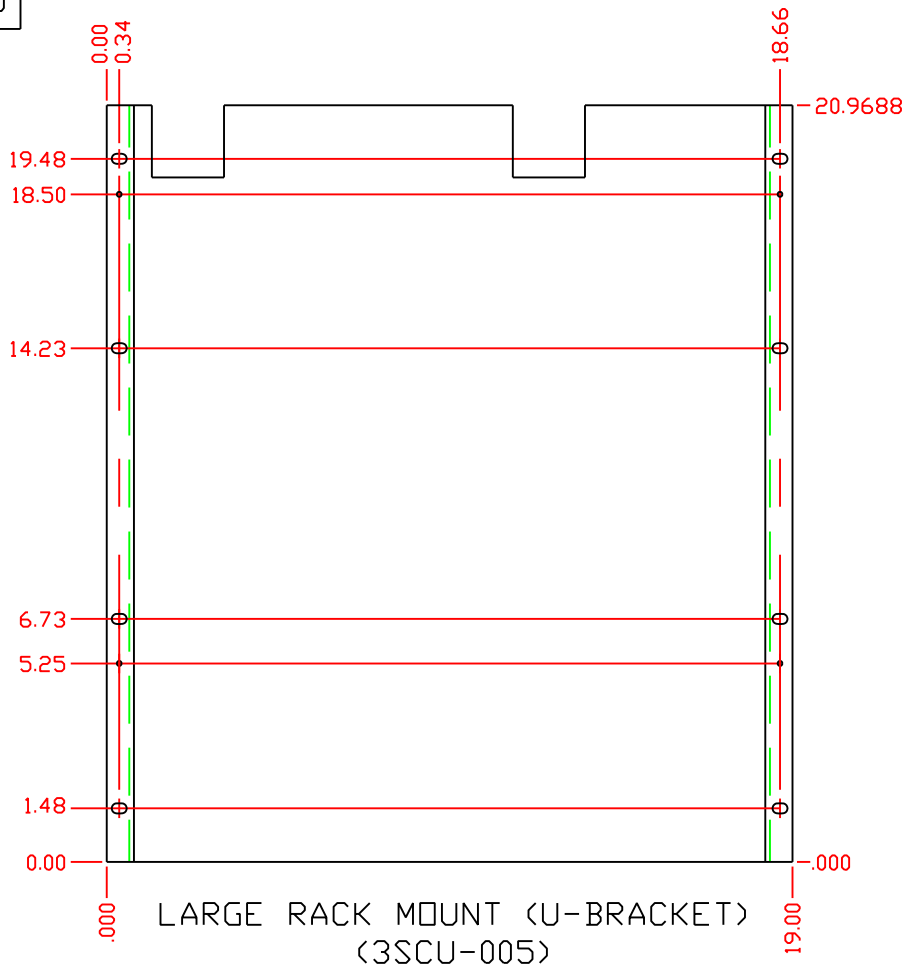
CAD DIR: S:\S&M\DWGS\SAM. COND. SYSTEM\DWG | SHEET 1 OF 1

BRACKET	MODEL C	MODEL C1	MODEL CD	MODEL CD2	MODEL 5
SMALL	M115	M325	M425	M425	
LARGE		5210, 8210	5210, 8210	8210	545, 10410

REVN	DATE	DESCRIPTION	DRAWN	APPROVED
0	00/00/00	INITIAL DRAWING	JO	



SMALL RACK MOUNT (U-BRACKET)
(3SCU-004)



LARGE RACK MOUNT (U-BRACKET)
(3SCU-005)

ITEM	QTY	DESCRIPTION	MANUF.
USED FOR:		MODEL NUMBER:	
		DESCRIPTION:	

UNLESS OTHERWISE SPECIFIED
TOLERANCE DECIMALS
1 PLACE = ±.02
2 PLACE = ±.02
3 PLACE = ±.010
SURFACE FINISHES 125
ANGLES = ±5°
HOLES = +.003/-.001
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BALDWIN, INC.
AND IS TO BE USED SOLELY FOR THE PURPOSE FOR WHICH IT IS FURNISHED THIS DOCUMENT SHALL NOT BE USED FOR ENGINEERING, DESIGN, PROCUREMENT, OR MANUFACTURING, IN WHOLE OR IN PART.
BALDWIN, INC.

DRAWN BY: JO DATE: 06/19/02
APP'D: DATE
MATERIAL: AS NOTED
FINISH: AS NOTED
DESIGN DIMENSIONS ARE IN INCHES
( ) DENOTES MILLIMETER EQUIVALENTS WHEN USED

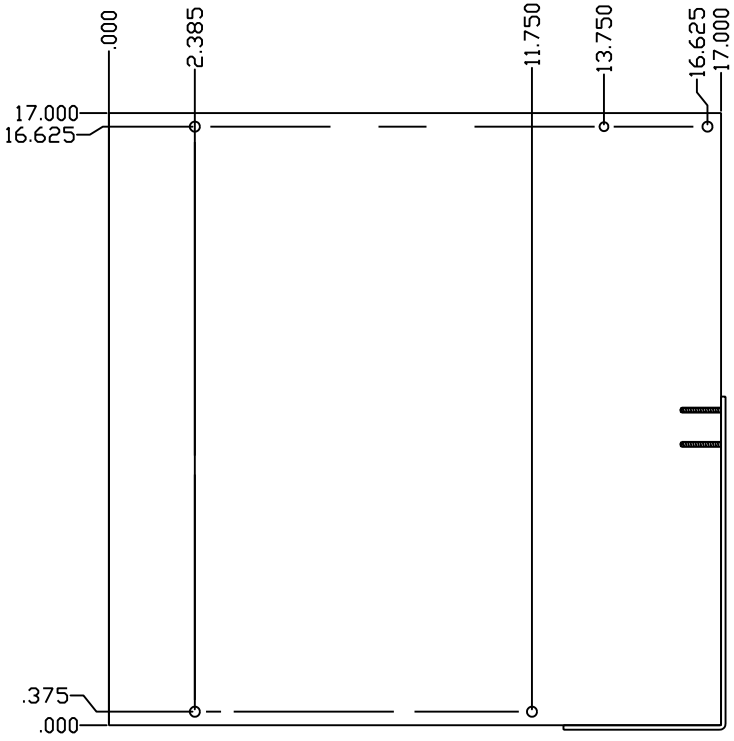
BALDWIN, INC.

PART DESCRIPTION
SAMPLE CONDITIONER RACK MOUNT MOUNTING DIMENSIONS

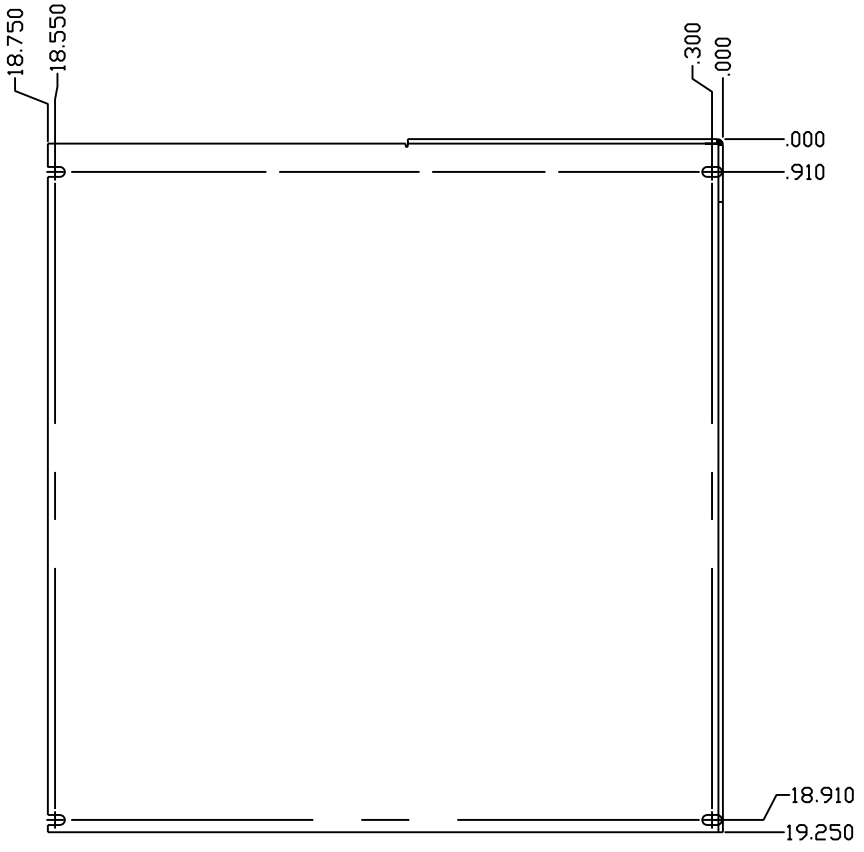
SIZE	SCALE:	DRAWING/PART NO.:
A	3/16	RACK MOUNT

CAD DIR: S:\S&M\DWG\S_C-SYSTEMS\WALL MOUNT | SHEET 1 OF 1

REVN	DATE	DESCRIPTION	DRAWN	APPROVED
0	00/00/00	INITIAL DRAWING	JO	



SMALL WALL MOUNT (FLAT PLATE)
(3SCP-002)



LARGE WALL MOUNT (FLAT PLATE)
(3SCP-001)

BRACKET	MODEL C	MODEL C1	MODEL CD	MODEL CD2	MODEL 5
SMALL	M115	M325	M425	M425	
LARGE		5210, 8210	5210, 8210	8210	545, 10410

ITEM	QTY	DESCRIPTION	MANUF.
USED FOR:		MODEL NUMBER:	
		DESCRIPTION:	

UNLESS OTHERWISE SPECIFIED
TOLERANCE DECIMALS
1 PLACE = ±.02
2 PLACE = ±.02
3 PLACE = ±.010
SURFACE FINISHES 125
ANGLES = ±5°
HOLES = +.003/-.001
BALDWIN
www.baldwinUSA.com

DRAWN BY: JO DATE: 06/19/02
APP'D: DATE:
MATERIAL: AS NOTED
FINISH: AS NOTED
DESIGN DIMENSIONS ARE IN INCHES
( ) DENOTES MILLIMETER EQUIVALENTS WHEN USED

BALDWIN, INC.

PART DESCRIPTION: SAMPLE CONDITIONER WALL MOUNT MOUNTING DIMENSIONS

SIZE	SCALE:	DRAWING/PART NO.:
A	3/16	WALL MOUNT

CAD DIR: S:\S&M\DWG\S_C-SYSTEMS\WALL MOUNT | SHEET 1 OF 1

AIR DIMENSIONS INCORPORATED

1371 West Newport Center Dr., Suite 101, Deerfield Beach, FL 33442 - Phone 954-428-7333 or 800-423-6464 Fax 954-360-0987
http://www.airdimensions.com e-mail address -Info@AirDimensions.com

MINI DIA-VAC®

MAINTENANCE AND DISASSEMBLY INSTRUCTIONS

A. General Operations Characteristics

1. Normal motor coil temperatures may be 160 - 180 degrees F. Winding insulation is Class B. Please note the two fans are different, so before removing the fans, note which side they belong on.

2. To check pumping efficiency, employ suitably damped gauges connected so as to dead-end either pressure or vacuum.
NOTE: Check each separately, One or the other port must be open during this test.
Use 0-60 PSI pressure gauge and 0-30 inch hg. vacuum gauge, (or mercury manometer).
Maximum pressure should be at least 33 PSIG for the .160 eccentric.
Maximum vacuum should be 21 inches Hg when using the .160 eccentric.

3. Match electrical power to motor

4. Do not start pump and motor with load of pressure or vacuum on pump head.

5. Pumps are intended for gaseous operation, eliminate liquids entering pump.

6. Nominal running amps for Mini Dia-Vac® at 115/230 volts are 1.7/0.8

B. Maintenance Procedures

1. Motor oiling - No oiling or other lubrication addition is necessary at all. All bearings are pre-lubricated and shielded from external contamination.

2. Diaphragm Replacement (also see Maintenance Procedure Below):

a. Standard EPDM (part 4302 or kit 11309) - Operating life can be five years or more under conditions of light pressure or vacuum loads and infrequent operation. Over 20 PSI and constant operation may require 3 month diaphragm inspection procedure. High ambient conditions over 100 degrees F may also decrease diaphragm life.

b. Teflon coated EPDM (part 4301 or kit 11305) - Satisfactory operation can be attained for periods of 12 months or more under conditions of light pressure of vacuum loads.

c. Viton/Nomex (part 4303 or kit 11307) - same as b above.

Where critical processes may involve the pumping of corrosive or toxic gas media, it is recommended that a monthly check of the diaphragm be part of a scheduled maintenance procedure.

Air Dimensions Inc. will supply recommendations on the choice of diaphragm material and or pump head construction on request.

*Diaphragms require close precision tolerance, therefore only ADI diaphragms should be used as replacements.

C. Disassembly of Head Section and Service Diaphragm

1. Remove head section by unscrewing the four large bolts. A flat-bladed screw driver may be needed to gently pry the head free of the service diaphragm. **If you have Teflon coating on the heads use caution not to scratch the surface.

2. The valve body can then be removed by unscrewing the two smaller screws (also accessible on the top of the head section). This part may be freed by gently tapping on these two screws after they have been loosened about three or four turns. When the valve body is removed, check all internal surfaces for any accumulation of dirt. The two valve discs can be wiped clean and replaced as long as they appear unaffected by usage. The valve gasket can be easily removed and should be inspected. As a matter of good practice, the valve discs and valve gasket should be replaced during any routine maintenance check of the head section. A once a year routine procedure is recommended.

3. The service diaphragm is secured by the single screw in its center. Remove this screw with a 5/32" Allen wrench. The diaphragm and its clamping plate should be easily lifted off. Some slight adherence to the metal may occur if the diaphragm has been in use for a long period.

4. When replacing the service diaphragm, a Teflon washer (part# 23001) should be inserted under the head of the diaphragm cap screw. This is added insurance against small gas leaks through screw heads and may be essential in vacuum applications where outside air contamination cannot be tolerated. After tightening the screw, the excess Teflon should be trimmed away.

NOTE: When replacing the service diaphragm, be sure the four projecting studs of the base casting are properly located in the four outer holes provided in the diaphragm before the part is clamped in place. Be sure the diaphragm plate is firmly replaced with its center screw.

D. Disassembly and Replacement of the Connecting Rod

1. Remove head section and service diaphragm as described in (C) above. When this is done and the front screen has been removed, the connecting rod assembly may be taken out (refer to exploded view drawing). Gently pry up and remove the connecting rod cap (part# 3301) which is held in place by the diaphragm screw.

2. Loosen but do not remove the counterweight screw. This is accessible from the top of the pump base casting and will require a 5/32" hex allen wrench. The connecting rod eccentric assembly, including counterweight and fan, will then slide of the motor shaft.

3. When replacing the eccentric assembly, be careful to align the flat section on the motor shaft with the counterweight screw. The eccentric assembly should be aligned so the fan is on the outer side from the motor. Slide this assembly as far onto the motor shaft as it will go before tightening the counterweight screw onto the flat of the motor.

NOTE: After prolonged use, the eccentric assembly may freeze up on the motor shaft. A wheel puller may be needed to free the part. When replacing the eccentric assembly, the motor shaft should be lightly coated with a graphite or MDS based lubricant.

E. Related Torque Values

1. Head bolts - 110 inch pounds.
2. Valve body screws and Diaphragm plate screws - 70 inch pounds

1. Single Pump Head Loading

Note: *Use only MASTERFLEX Precision Tubing with MASTERFLEX Pumps to insure optimum performance. Use of other tubing may void applicable warranties.*

Contents: One pump head, one 15 in (38 cm) length of silicone tubing, one mounting hardware package, manual and tubing loading key.

Supplied tubing loading key required for assembly.

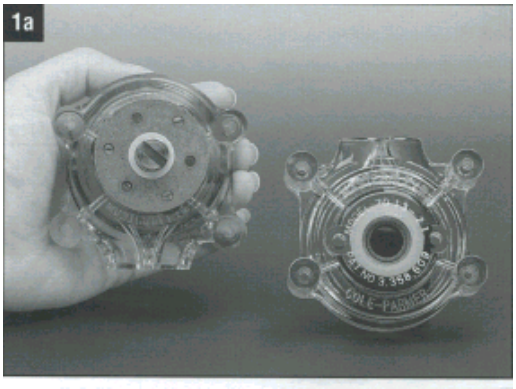
a) Separate the end bells (the pump head halves). Hold the end bell containing the rotor as shown with the tubing retainer grooves facing down.

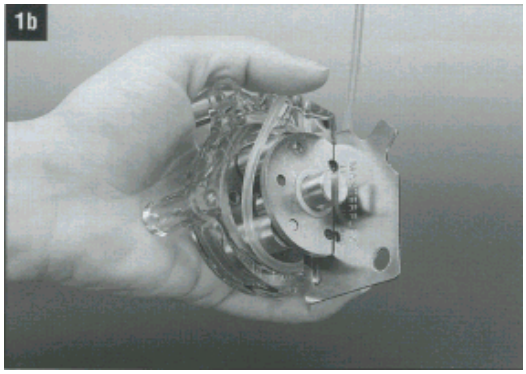
b) Place tubing in the right groove and against the first two rollers. Hold tubing with thumb. Near groove, insert smaller prong of loading key between the top of the rotor and tubing. Push key in as far as possible.

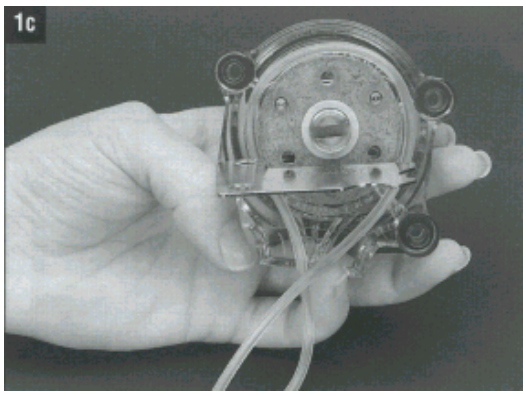
c) Push down and turn key counterclockwise (ccw) completely around the rotor. The key will push the tubing uniformly into the end bell assembly. Hold the second end of tubing. Remove key.

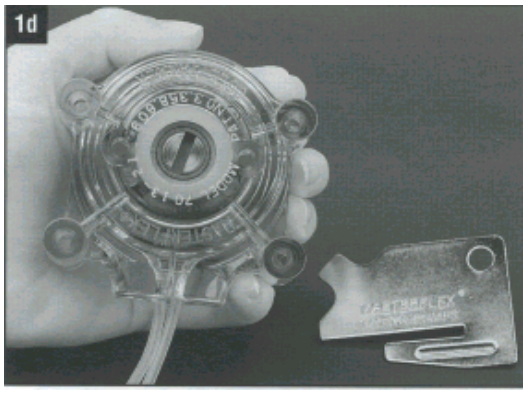
d) Position the other end bell on top and press the end bells together. Be careful not to pinch the tubing. If end bells do not snap tightly together, reload tubing. If necessary, turn key in slot on rotor shaft to adjust tubing (as in Step e).

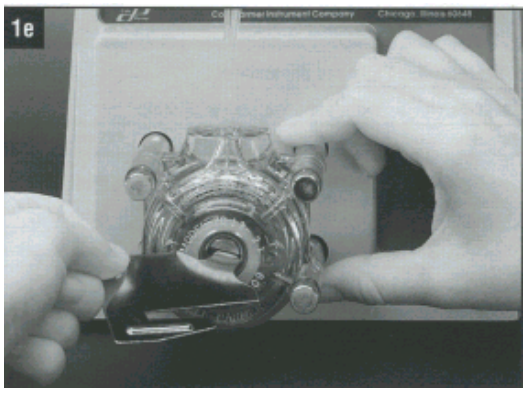
e) With key in slot on rotor shaft, turn key to align tang on rotor shaft with slot in motor drive shaft. Point tubing retainer grooves up. Shift the pump head slightly till it snaps on the alignment pins (if present). Secure with four provided screws. Tighten with fingers only.

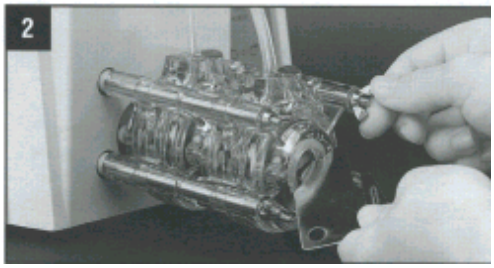












2. Multi-Channel Mounting

Flat bladed screwdriver required for mounting.

Tubing loading key required for mounting.

Note: Other special mounting hardware for multi-channel pumping. See " 3. Replacement Parts and Accessories".

a) Load the pump heads with tubing.

b) Install the four correct length-mounting screws in drive.

c) Slide the first pump head into the mounting screws.

d) Place key in slot on mounting shaft. Twist to align tang on rotor shaft with slot in motor drive shaft. Shift the pump housing around till it drops over the alignment pins (if present).

e) Repeat for each additional pump head, aligning pump head tang with slot on previously mounted pump head.

f) Slide the four flat washers onto screws and secure with the four wingnuts. Tighten with fingers only.

g) A support bracket is supplied with 3 and 4 channel mounting hardware for additional support. Mount over bottom two screws. Inert one of the three different adjustments screws depending upon drive height.

3. Replacement Parts and Accessories

A. End Bells (order two end bells for a complete head assembly).

Pump Head #	**PC Order number**	Pump Head #	**PC Order number**
07013-00, -20 07013-10, -21	**MN-07013-81** **MN-07013-91**	- 07013-50, -52	- **MN-07013-92**
07014-00, -20 07014-10, -21	**MN-07014-81** **MN-07014-91**	- 07014-50, -52	- **MN-07014-92**
07015-00, -20 07015-10, -21	**MN-07015-81** **MN-07015-91**	- 07015-50, -52	- **MN-07015-92**
07016-00, -20 07016-10, -21	**MN-07016-81** **MN-07016-91**	- 07016-50, -52	- **MN-07016-92**
07017-00, -20 07017-10, -21	**MN-07017-81** **MN-07017-91**	- 07017-50, -52	- **MN-07017-92**
07018-00, -20 07018-10, -21	**MN-07018-81** **MN-07018-91**	- 07018-50, -52	- **MN-07018-92**
07024-00, -20 07024-10, -21	**MN-07024-81** **MN-07024-91**	- 07024-50, -52	- **MN-07024-92**
07035-02, -20 07035-12, -21	**MN-07035-81** **MN-07035-91**	- -	- -

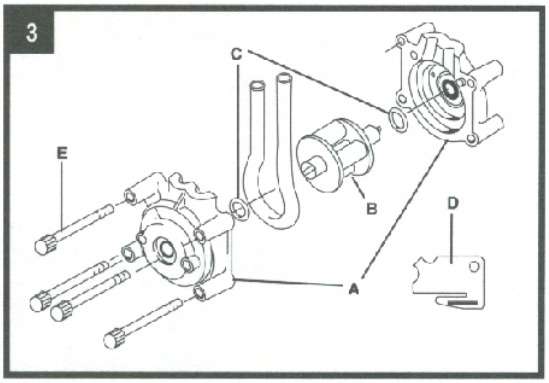
B. Rotor assemblies

Pump Head number	Pump Head suffix	**Order number**
07013, 07014, 07016 07018	-00 -10, -50 -20 -21, -52	**MN-07013-75** **MN-07013-76** **MN-07013-80** **MN-07013-95**
07015, 07024, 07035	-00, -02 -10, -50, -12 -20 -21, -52	**MN-07013-75** **MN-07013-76** **MN-07013-80** **MN-07013-90**

C. MN-07021-04 Thrust washers. Pack of 10.
D. MN-07013-90 Tubing loading key.
E. Mounting hardware for standard pump heads.

Set contains four #8-32 screws, four washers, and four wingnuts.

Number of heads To be mounted	**Cold- rolled steel Order number**	**Stainless steel Order number**
1	**MN-07013-02**	**MN-07013-04**
2	**MN-07013-03**	**MN-07013-05**
3	**MN-07013-03**	**MN-07013-08**
4	**MN-07013-07**	**MN-07013-09**



4. Specifications

	Thin wall*	Thick wall*
Maximum continuous discharge pressure-psi(bar):	20(1.4)	25(1.7)
Maximum intermittent discharge pressure-psi(bar):	35(2.4)	40(2.7)
Maximum vacuum:	660(510')m Hg	26(20')in Hg
Maximum suction lift:	8.8(6.7')m H2O	29(22')ft H2O
Number of rollers:	3	
Occlusion:	Standard fixed	
Maximum pump speed (rpm):	600	
Nominal torque load:	6.5 kg-cm(90 oz-in)	
Housing materials:	Polycarbonate (PC) all models, or Polyphenylene sulfide (PPS) all models except 07035	
Roller/rotor materials:	Cold rolled Stl (CRS) or Stainless Stl (SS)	
Operating temperature:	0 to 40° (32 to 104°F)	

*Thin wall: tubing 13, 14, 16, 17, 18 Thick wall: tubing 15, 24, 35
┼With tubing 17 & 18
╪ Use in this temperature range for continuous duty operation with no decrease in performance or product life. Pump heads will work outside this range with some possible reductions in performance or product life.

5. Warranty and Return Items

Warranty

Use only MASTERFLEX Precision Tubing with MASTERFLEX Pumps to insure optimum performance. Use of other tubing may void applicable warranties.

The manufacturer warrants this product to be free from any significant deviations from published specifications. If repair or adjustment is necessary within the warranty period, the problem will be corrected at no charge if it is not due to misuse or abuse on your part, as determined by the manufacturer. Repair costs outside the warranty period, or those resulting from product misuse or abuse, may be invoiced to you.
The warranty period for this product is noted on the Warranty Card.

Product Return

To limit charges and delays, contact the seller or manufacturer for authorization and shipping instructions before returning the product, either within or outside the warranty period. When returning the product, please state the reason for the return. For your protection, pack the product carefully and insure it against possible damage or loss. Any damages resulting from improper packaging are your responsibility.

Technical Assistance

If you have any questions about the use of this product, contact the manufacturer or authorized dealer.

CHART OF VOLUME PERCENT WATER CONCENTRATIONS
AT SATURATION FOR VARIOUS TEMPERATURES
AT STANDARD PRESSURE (ATMOSPHERIC PRESSURE)

DEGREES C	DEGREES F	VOLUME %	DEGREES C	DEGREES F	VOLUME %
+100	+ 212	100.00	+ 2	+ 36	0.696
+ 90	+ 194	69.20	+ 1	+ 34	0.649
+ 80	+ 176	46.70	0	+ 32	0.602
+ 75	+ 167	38.70	- 1	+ 30	0.555
+ 70	+ 158	30.70	- 2	+ 28	0.510
+ 65	+ 149	25.20	- 3	+ 27	0.469
+ 60	+ 140	19.70	- 4	+ 25	0.431
+ 55	+ 131	15.50	- 5	+ 23	0.396
+ 50	+ 122	12.20	- 6	+ 21	0.363
+ 45	+ 113	9.45	- 7	+ 19	0.333
+ 40	+ 104	7.25	- 8	+ 18	0.305
+ 35	+ 95	5.55	- 9	+ 16	0.281
+ 30	+ 86	4.19	- 10	+ 14	0.256
+ 29	+ 84	3.95	- 11	+ 12	0.234
+ 28	+ 82	3.73	- 12	+ 10	0.214
+ 27	+ 81	3.62	- 13	+ 9	0.196
+ 26	+ 79	3.32	- 14	+ 7	0.179
+ 25	+ 77	3.13	- 15	+ 5	0.163
+ 24	+ 75	2.94	- 16	+ 3	0.148
+ 23	+ 73	2.77	- 17	+ 1	0.135
+ 22	+ 72	2.61	- 18	0	0.123
+ 21	+ 70	2.46	- 19	- 2	0.112
+ 20	+ 68	3.31	- 20	- 4	0.102
+ 19	+ 66	2.17	- 22	- 8	0.084
+ 18	+ 64	2.04	- 24	- 11	0.069
+ 17	+ 63	1.91	- 26	- 15	0.057
+ 16	+ 61	1.79	- 28	- 18	0.046
+ 15	+ 59	1.68	- 30	- 22	0.038
+ 14	+ 57	1.58	- 32	- 26	0.031
+ 13	+ 55	1.48	- 34	- 30	0.025
+ 12	+ 54	1.38	- 36	- 34	0.019
+ 11	+ 52	1.29	- 38	- 37	0.016
+ 10	+ 50	1.21	- 40	- 40	0.013
+ 9	+ 48	1.13	- 42	- 44	0.011
+ 8	+ 46	1.06	- 44	- 47	0.008
+ 7	+ 45	0.988	- 46	- 51	0.006
+ 6	+ 43	0.922	- 48	- 54	0.005
+ 5	+ 41	0.861	- 50	- 58	0.004
+ 4	+ 39	0.803	- 52	- 62	0.003
+ 3	+ 37	0.751	- 54	- 65	0.002

MOISTURE CONVERSION TABLE

DEWPOINT		VAPOR PRESSURE (WATER/ICE in EQUALIBRIUM) mm MERCURY	PPM on VOLUME BASIS at 760 mm of Hg PRESSURE	RELATIVE HUMIDITY at 70 F	PPM on WEIGHT BASIS in AIR
F	C				
-110	-166	.0000010	.00132	.0000053	.00082
-108	-162	.0000018	.00237	.0000096	.0015
-106	-159	.0000028	.00368	.000015	.0023
-104	-155	.0000043	.00566	.000023	.0035
-102	-152	.0000065	.00855	.000035	.0053
-100	-148	.0000099	.0130	.000053	.0081
-98	-144	.000015	.0197	.000080	.012
-96	-141	.000022	.0289	.00012	.018
-94	-137	.000033	.0434	.00018	.027
-92	-134	.000048	.0632	.00026	.039
-90	-130	.00007	.0921	.00037	.057
-88	-126	.00010	.132	.00054	.082
-86	-123	.00014	.184	.00075	.11
-84	-119	.00020	.263	.00107	.16
-82	-116	.00029	.382	.00155	.24
-80	-112	.00040	.562	.00214	.33
-78	-108	.00056	.737	.00300	.46
-76	-105	.00077	1.01	.00410	.83
-74	-101	.00105	1.38	.00559	.86
-72	-98	.00143	1.88	.00762	1.17
-70	-94	.00194	2.55	.0104	1.58
-68	-90	.00261	3.43	.0140	2.13
-66	-87	.00349	4.59	.0187	2.84
-64	-83	.00464	6.11	.0248	3.79
-62	-80	.00614	8.08	.0328	5.01
-60	-76	.00808	10.6	.0430	6.59
-58	-72	.0106	13.9	.0565	8.63
-56	-69	.0138	18.2	.0735	11.3
-54	-65	.0178	23.4	.0948	14.5
-52	-62	.0230	30.3	.123	18.8
-50	-58	.0295	38.8	.157	24.1
-48	-54	.0378	49.7	.202	30.9
-46	-51	.0481	63.3	.257	39.3
-44	-47	.0609	80.0	.325	49.7
-42	-44	.0768	101	.410	62.7
-40	-40	.0966	127	.516	78.9
-38	-36	.1209	159	.644	98.6
-36	-33	.1507	198	.804	122.9
-34	-29	.1873	246	1.00	152
-32	-26	.2318	305	1.24	189
-30	-22	.2859	376	1.52	234
-28	-18	.351	462	1.88	287
-26	-15	.430	566	2.30	351
-24	-11	.526	692	2.81	430
-22	-8	.640	842	3.41	523
-20	-4	.776	1020	4.13	633
-18	0	.939	1240	5.00	770
-16	+3	1.132	1490	6.03	925
-14	+7	1.361	1790	7.25	1110
-12	+10	1.632	2150	8.69	1335
-10	+14	1.950	2570	10.4	1596
-8	+18	2.326	3060	12.4	1900
-6	+21	2.765	3640	14.7	2260
-4	+25	3.280	4230	17.5	2680
-2	+28	3.880	5100	20.7	3170
0	+32	4.579	6020	24.4	3640
+2	+36	5.294	6970	28.2	4330
+4	+39	6.101	8030	32.5	4990
+6	+43	7.013	9230	37.4	5730
+8	+46	8.045	10590	42.9	6580
+10	+50	9.029	12120	49.1	7530
+12	+54	10.52	13840	56.1	8600
+14	+57	11.99	15780	63.9	9800
+16	+61	13.63	17930	72.6	11140
+18	+64	15.48	20370	82.5	12650
+20	+68	17.54	23080	93.5	14330
+22	+71	19.827	26088		16699
+24	+75	33.377	29443		18847
+26	+79	25.209	33169		21232
+28	+8				