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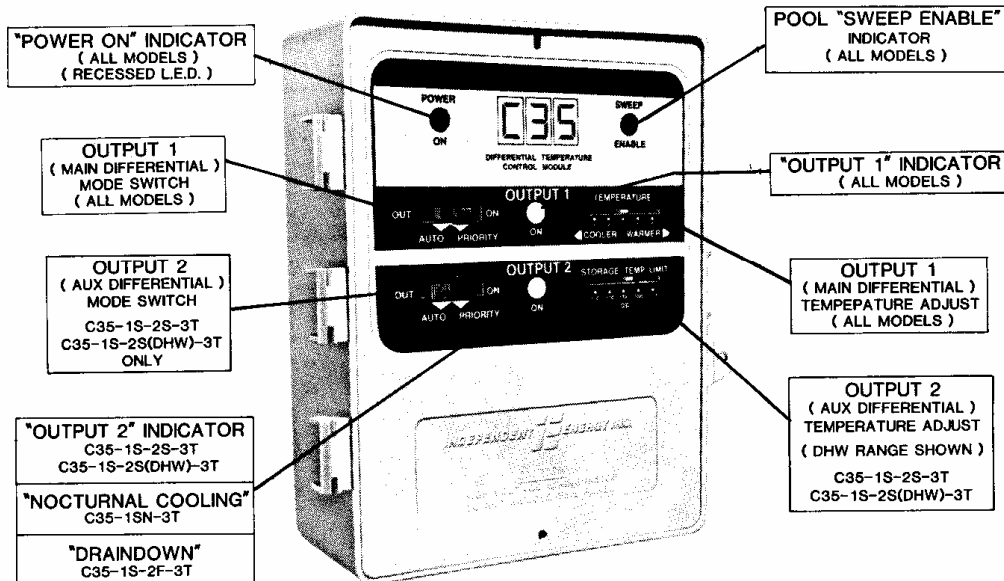
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SECTION 1: GENERAL DESCRIPTION

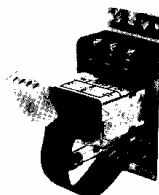
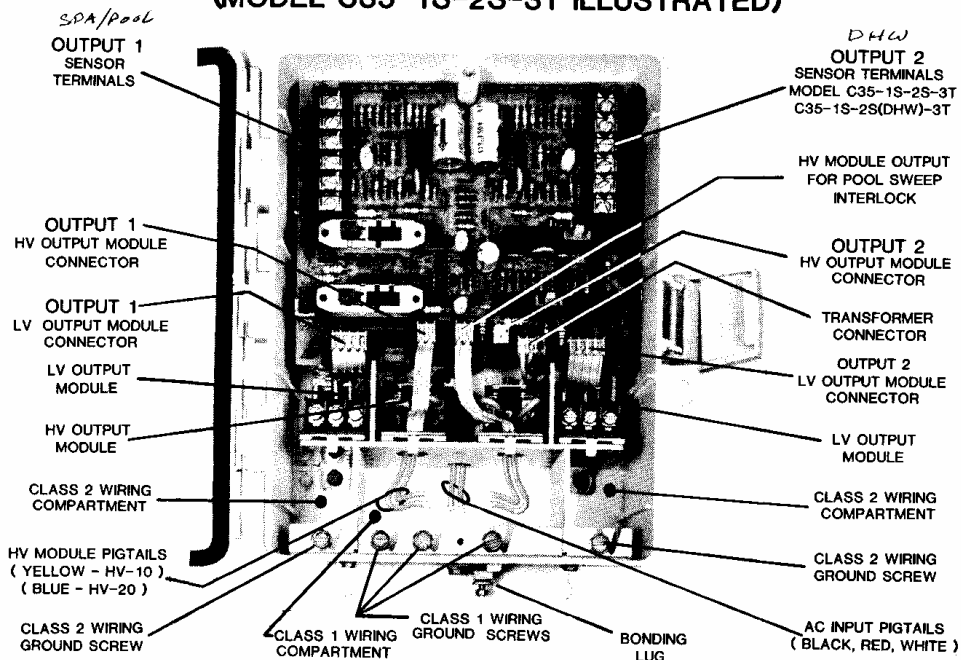
The Model C35 is a differential temperature control system designed for outdoor/indoor use with solar heated swimming pools, spas, hot tubs, etc. All models include Pool Sweep Interlock circuitry that may be field activated by plugging in an output module. Other standard features include field selectable Recirculate Freeze Protection and Differential Thresholds, and plug in output modules for valve, and/or pump, wiring. Dual differential models handle pool/spa, pool/hot tub, hot tub/DHW, DHW/solar greenhouse or other combination system applications. This Modular design approach includes field selectable options that enable the installer to "fine tune" his control requirements with a standard control, and without the extra labor and expense of installing multiple equipment enclosures. The end result, a control system that is easy to install, looks clean and simple, and offers the user more flexibility in controlling his solar system.

STANDARD FEATURES ARE:

- * UL listed for use with pools, spas and hot tubs.
- * Designed for safety first.
- * Easy to install and service.
- * Field selectable differential thresholds.
- * Field addable output modules for pump and/or valve control.
- * Field activated pool sweep interlock.
- * User selectable priority storage heating (dual output models only).
- * Field selectable input voltage. 120 or 240 Vac.
- * 12 Vac outputs standard.
- * Field selectable Recirculate Freeze Protection.
- * Nocturnal cooling (factory option, Model C35-1SN-3T).
- * Bright L.E.D. indicators enhance readability in sunlight.
- * Easy to use slide controls.
- * Rugged and attractive raintight enclosure.
- * "ON" and "OUT" output test modes.
- * Draindown Freeze Protection (Model C35-1S-2F-3T).



(MODEL C35-1S-2S-3T ILLUSTRATED)



LV
12 VAC output
module - Allows
C35 to operate 2-
wire solenoid
valves or 3-wire
motorized valves.



HV-10
115/230V output
module rated
1/2HP, 9.8 amps
@ 115V
rated 3/4HP, 6.9
amps @ 230V

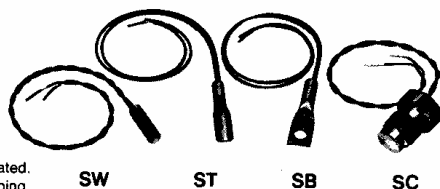


HV-20
115/230V output
module rate 1/2HP
9.8 amps @
115VAC
rated 1.5HP, 10
amps @ 230VAC

OUTPUT MODULES

STANDARD SENSORS -
THERMISTOR TYPE

Type: Thermistor, 10K ohm
@ 77°F.
Operating Temperature
Range: -40°F to 400°F.
Accuracy: ±0.5°F (32°F,
212°F).
Leads: 18 AWG stranded, Teflon insulated.
Case Material: 5/16" dia. copper tubing.
SC type is brass.
Interchangeability: All IE thermistor sensors
are interchangeable.
SW: Well Type.
ST-½: Strap on for ½" & ¾" tubing.
ST-1: Strap on for 1" tubing.
SB: Bolt on for flat surfaces.



SC-½: Screw in for ½" NPT.
SC-¼: Screw in for ¼" NPT.
SX: Sensor minus housing.
Note: Sensors not suitable for direct immersion.
Protect sensors and sensor connections
from direct contact with rain.

GC-1 "SNAP SWITCH" SENSOR.
UL AND CSA LISTED. BUILT TO
MILITARY STANDARDS.



INS-1 INSULATION SENSOR -
Simulates collector temperature for unglazed
swimming pool panels.



Operating Range, Accuracy, Leads: Same as
standard sensors.
Case Material: Aluminum.

MODEL VARIATIONS AND APPLICATION

Refer to the following sections of this manual for operation and application of the C35.

IMPORTANT

The application notes or suggestions for installation of Independent Energy Inc. products, hereby submitted, are illustrative only and must not be followed in effecting any actual installation without engineering or technical advice from properly licensed personnel. No warranty or representation, expressed or implied, as to the suitability of the installation design and/or methods illustrated, or as to the freedom of such an installation from infringement of patent rights of others, is given.

YOUR SYSTEM	C35 MODEL USED	OPERATION SECTION
SINGLE DIFFERENTIAL SYSTEMS for solar heated pools, spas, hot tubs, etc.	C35-1S-3T	3
SINGLE DIFFERENTIAL SYSTEMS with NOCTURNAL COOLING function provided.	C35-1SN-3T	3
DUAL DIFFERENTIAL SYSTEMS with 2 separate collector arrays for solar heating pool/spa, pool/hot tub, pool/ greenhouse, etc.	C35-1S-2S-3T	4
DUAL DIFFERENTIAL SYSTEMS with ONE common collector array to solar heat <u>two</u> storages. (e.g. Pool/spa, pool/hot tub, etc.)	C35-1S-2S-3T (field modified collection logic)	5
DUAL DIFFERENTIAL SYSTEMS 2nd output differential used for solar heating of DHW tank or space heating storage system.	C35-1S-2S(DHW)-3T	6
SINGLE DIFFERENTIAL SYSTEMS with Draindown Freeze Protection.	C35-1S-2F-3T	7

SECTION 2: SPECIFICATIONS

MECHANICAL

Enclosure Type: Raintight high impact plastic enclosure with hinged gasket sealed door and single snap action latch. Padlock tab provided.

Overall size: 10.8"L X 8.5"W X 4.12"D (see figure 2-1)

Weight: 4.5 \pm 0.5 lbs. (depending on model)

Conduit Entries: Five, 1/2" knockouts, (3-CLASS I, 2-CLASS II.)

Mounting: Vertical only, 4 external keyhole slots.

ENVIRONMENTAL

Storage temperature: -40 to 150°F (-40 to 65°C)

Operating Temperature: 32 to 113°F (0-45°C) ambient with direct sun exposure.

Exposure to Weather: Mounted vertical, door closed, no water entry permitted. Weep hole at bottom of enclosure provided for drain of internal condensation. Enclosure resistant to ultraviolet radiation.

ELECTRICAL/OPERATIONAL

Controls & Indicators: See Operation (Section 3 ,4, 5, 6, or 7 as applicable) for description.

Input Power: 120 or 240 VAC \pm 10%, 60 HZ (field selectable)
(Consult factory for 50HZ operation)

Circuit Power Consumption: 6 watts max, valves off

Valve Output Ratings:
combined output power
for output 1 and 2. 12 Vac, 20 VA continuous.
12 Vac, 40 VA intermittent duty with 10% duty
cycle. 1 Minute ON time maximum.

Pump Output Ratings:
(up to 2 HV modules may
be installed) HV-10 = 1/2HP, 9.8A, @ 120 VAC.
3/4HP, 6.9A, @ 240 VAC.
HV-20 = 1/2HP, 9.8A, @ 120 VAC.
1-1/2HP, 10A, @ 240 VAC.

Differential Temperature
Thresholds, Outputs 1 and 2 4° ON, 1.5° OFF; \pm 1° F as shipped.
Field Programmable to: 8° ON, 3° OFF; \pm 1° F.

Output 2
(C35-1S-2S(DEW)-3T ONLY: 8°F ON, 3°F OFF; ±1°F.
Field programmable to: 20±4°F ON, 5±2° OFF.

"Temperature Adjust" Range: 65 ±5°F to 103 ±1.5°F
Output 2 C35-1S-2S(DEW)-3T: 110 to 225°F(OUT); Setpoints: ±10°F

"Temperature Adjust" Deadband: 4 ±1°F.

Pool Sweep Interlock Timer: Pool sweep interrupted for 6 ± 2 minutes after
Output 1 turns ON (collection, recirculation,
nocturnal cooling, mode switch to ON etc.)

Recirculate Freeze Thresholds ON @ 40 ±2°F.
Output 1 & 2 using collector OFF @ 45 ±2°F.
or separate freeze sensors:

Draindown Freeze Thresholds: Drains @ 44 ±4°F
(C35-1S-2F-3T only) Refills @ 65 ±8°F

Sensor Accuracy:
Thermistor Types: ±1/2°F
Freeze Snap Switch (GC-1): Opens @ 44 ±4°F, Closes @ 54 ±5°F

Bonding/Grounding: 1 ground screw for each conduit entry. Bonding
lug for 8 AWG wire provided outside enclosure.

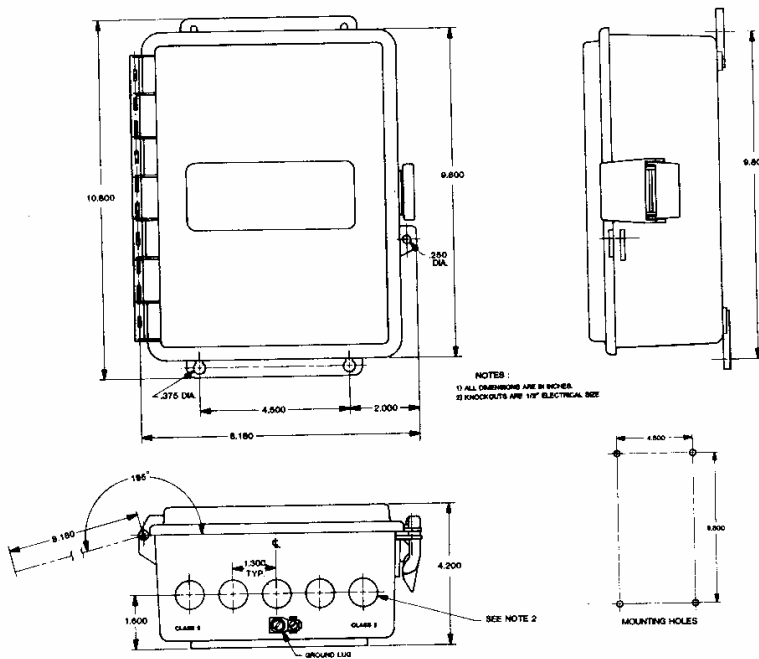


FIGURE 2-1, CONTROL DIMENSIONS

SECTION 3: OPERATION, MODELS C35-1S-3T AND C35-1SN-3T

This operation section covers **SINGLE DIFFERENTIAL SYSTEMS** for solar heated Pools, Spas, Hot Tubs etc. (see Section 1, General Description, for other system applications.)

A typical solar heated pool plumbing system is shown in figure 3-1. This system has an open loop collection system and pool water is circulated through the collectors during solar collection (direct solar heating). Your system plumbing may vary from this configuration but control operation remains basically the same.

SOLAR COLLECTION

When there is sufficient heat at the collector panels, normal pool loop flow is diverted through the collector array to heat pool water.

Collection starts (Output 1 ON) when the collector/pool temperature difference increases to the "TURN ON" threshold

Collection stops when the temperature difference decreases to the "TURN OFF" threshold or when the Pool temperature rises to the "Temperature Adjust" setpoint. The C35 is shipped with 4°F ON and 1.5°F OFF thresholds. These thresholds may be field modified to 8°F ON and 3°F OFF. See Section 9, Installation.

RECIRCULATE FREEZE PROTECTION (if enabled)

WARNING: Recirculate Freeze Protection may be enabled on the C35 at the time of installation. To provide adequate protection, it is important that recirculate freeze protection only be "installed" by qualified personnel who have thoroughly read Section 8, Freeze Protection.

When near freezing temperatures are reached at any of the freeze sensor locations, Output 1 turns "ON" to circulate warmer pool water through the collection system to prevent collector freezing.

The collector and collector system plumbing temperatures are sensed both by a thermistor sensor and a freeze snap switch (for backup). The C35 starts Recirculate Freeze Protection (Output 1 ON) when the thermistor sensor temperature drops to 40°F and stops freeze protection (Output 1 OFF) when the sensor reaches 45°F. The freeze snap switch is wired in series with the freeze sensor and its contacts open to activate freeze protection when the snap switch temperature drops to 44°F. Freeze protection de-activates when the snap switch temperature rises to 55°F.

POOL SWEEP INTERLOCK (see figures 3-1 and 3-2)

At the start of solar collection, air in open loop systems may cause some pool sweep pumps to become airbound. The Pool Sweep Interlock prevents this by disabling the sweep pump for approximately the first six (6) minutes of solar collection while all air is being purged from this entire plumbing system.

NOCTURNAL COOLING (C35-1SN-3T only)

Nocturnal Cooling begins when the pool temperature is **above** the "Temperature Adjust" setpoint and when the collector sensor is 8°F **cooler** than the pool temperature.

Cooling continues until the collector sensor is only 3°F **cooler** than the pool temperature, or if the pool is cooled down to the adjusted setpoint.

MODE SWITCH

"AUTO" This is the normal operating mode for your system. Both auto positions identical, select either. In the Auto mode, solar collection, sweep interlock, nocturnal cooling (C35-1SN-3T only) and recirculate freeze protection (if enabled) operate automatically.

"OUT" This is a test mode to check valve and/or pump operation. In this mode, OUTPUT 1 is forced OFF to de-activate Solar collection and Nocturnal cooling (C35-1SN only). Recirculate Freeze Protection (if enabled) operates automatically. If the "OUT" mode is selected and Output 1 remains ON, Recirculate Freeze Protection (if enabled) is in progress.

CAUTION: ALWAYS DISCONNECT AC POWER AT PANELBOARD BEFORE SERVICING ANY PART OF CONTROL SYSTEM.

"ON" This is another test mode to check valve and/or pump operation. In this mode, OUTPUT 1 is forced ON regardless of differential temperature, Nocturnal Cooling or Recirculate Freeze thresholds. This mode also cycles the six (6) minute pool sweep interlock.

NOTE: When changing modes allow ample time (approximately 30 seconds) for motorized diverter valves to cycle completely. This will prevent motorized valves from becoming partially positioned.

"TEMPERATURE ADJUST"

The "Temperature Adjust" control sets the maximum pool temperature. Controls are shipped with a safe operating range of 65-104°F. The pool contains a large volume of water and it will respond slowly to temperature adjustments. One recommended adjustment procedure is to set the "Temperature Adjust" control to its warmest setting allowing the pool to be heated until a comfortable temperature is attained. At this point, wait until collection begins, (Output 1 ON) then slowly move the temperature control toward a cooler setting until the output just turns off. The pool temperature is now set for your comfort. Make note of the control setting for future reference.

INDICATORS

The C35 L.E.D. indicators are recessed to enhance readability in sunlight. The indicators operate as follows:

- "POWER ON":** Illuminates when AC power is applied to the C35.
- "SWEEP ENABLE":** When illuminated, the pool sweep pump operates normally. When off, the pool sweep is disabled.

"OUTPUT 1": Is ON when either solar collection, recirculate freeze protection (if enabled) or nocturnal cooling (C35-1SN-3T only) is in progress.

"NOCTURNAL COOLING": (Model C35-1SN-3T only) When ON, Nocturnal Cooling is in progress. The "Output 1" indicator also illuminates in this mode.

MODE CHART FOR C35-1S-3T AND C35-1SN-3T MODELS

C35 SWITCH POSITION	SOLAR COLLECTION	RECIRCULATE FREEZE	POOL SWEEP	NOCTURNAL COOLING C35-1SN-3T
OUT	DISABLED	AUTO	AUTO	DISABLED
AUTO	AUTO	AUTO	AUTO	AUTO
ON	ON	ON	AUTO	ON

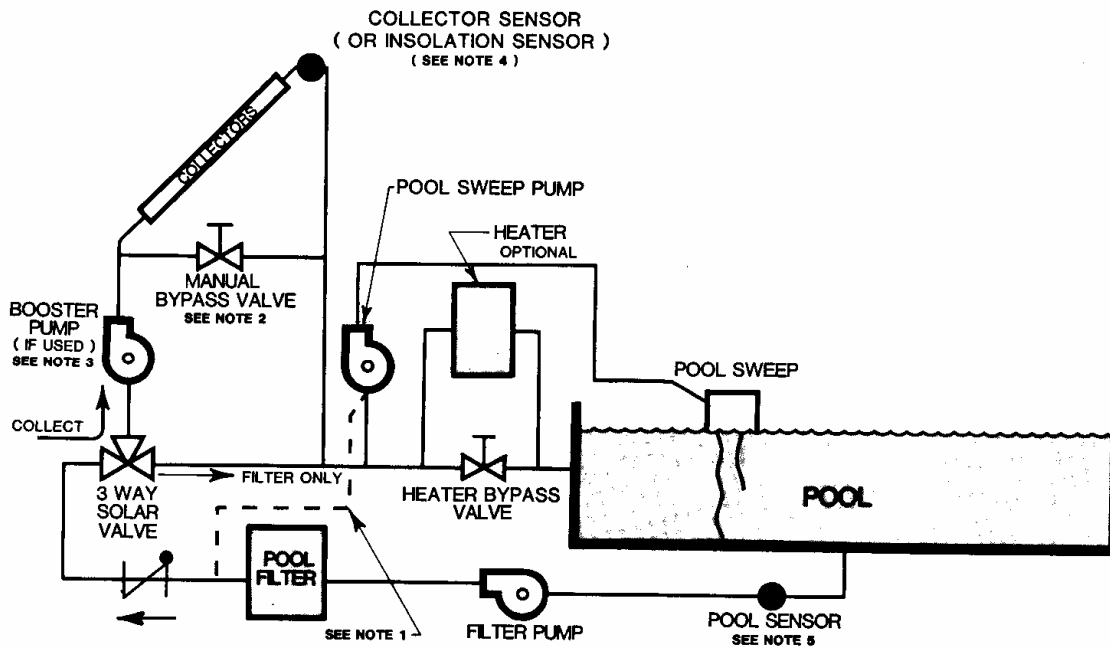


FIGURE 3-1, PLUMBING SCHEMATIC OPEN LOOP POOL SYSTEM

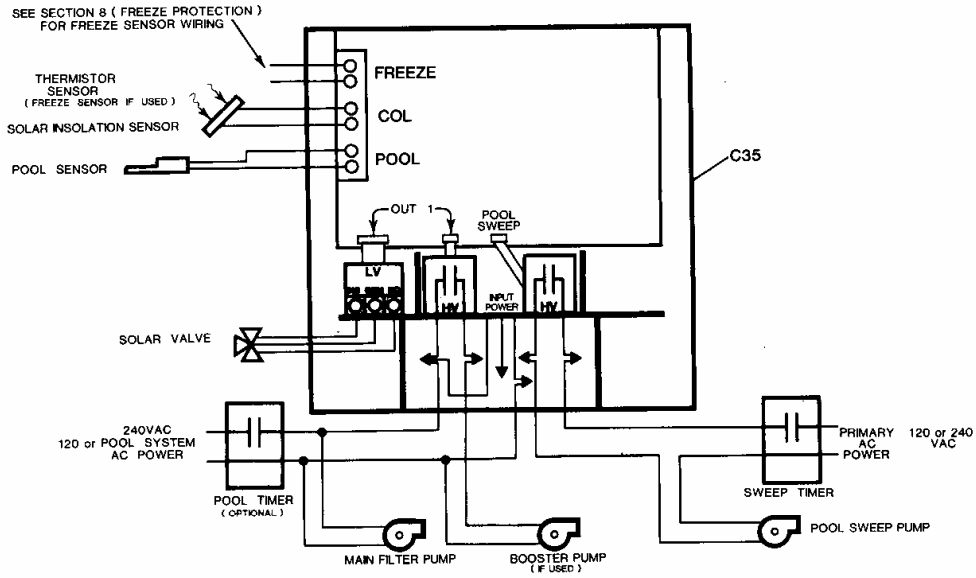


FIGURE 3-2, ELECTRICAL SCHEMATIC, DAYTIME FILTERING/COLLECTION WITH TIMER AND GRAVITY DRAINBACK FREEZE PROTECTION

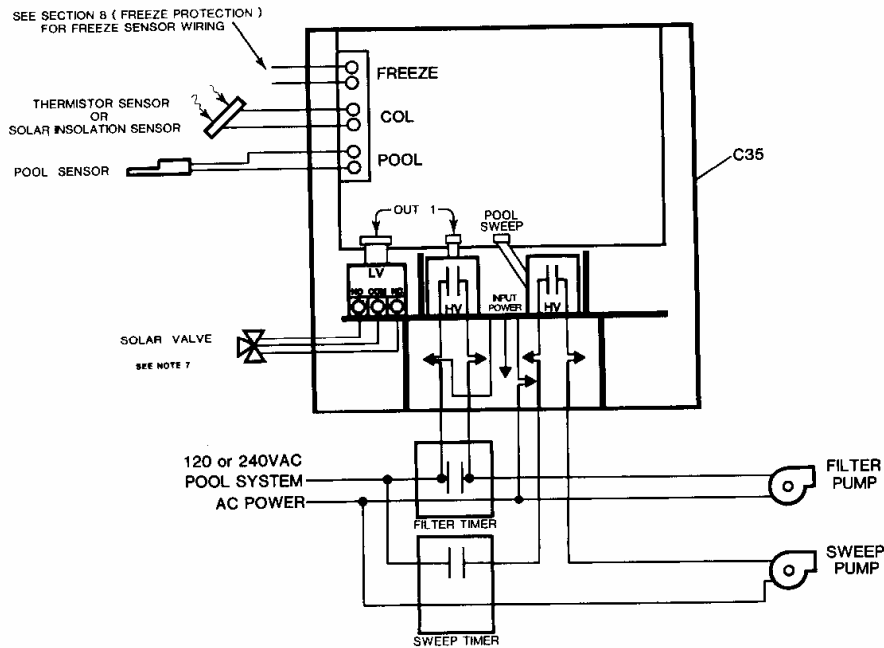


FIGURE 3-3, ELECTRICAL SCHEMATIC, NIGHT TIME POOL FILTERING WITH TIMER OR SYSTEMS WITH RECIRCULATE FREEZE PROTECTION AND/OR NOCTURNAL COOLING

APPLICATION NOTES:

1. Typical pool sweep plumbing is as shown. This may require the pool sweep interlock to prevent air pockets from the open collector loop entering sweep plumbing. If your system is plumbed per the dashed line, then the interlock may not be required.
2. Collector bypass valve may be used to throttle collector flow rate and provide for drainback freeze protection.
3. If booster pump is used, operate pump by output 1.
4. Insolation sensor should be located near and at the same angle as the collector array to achieve the same exposure.
5. Pool sensor may be located in filter pump return loop or at pump itself.
6. If Recirculate Freeze Protection is selected it must override the pool system timer. Wire as shown in Figure 3-3 and refer to Section 8, Freeze Protection. Note that the C35 is powered continuously and that the Output 1 HV module overrides the filter pump timer to provide proper Recirculate freeze protection.
7. Total combined Output 1 and Output 2 LV module output power must **NOT** exceed 20VA continuous, 40VA intermittent duty, 10% duty cycle, 1 Minute ON time maximum. LV module(s) may power one or more solenoid type valves instead of, or in addition to motorized valves. Ensure that the C35 electrical ratings are not exceeded.