

## **SECTION 4: DUAL DIFFERENTIAL SYSTEMS WITH 2 SEPARATE COLLECTOR ARRAYS FOR SOLAR HEATING POOL/HOT TUB, POOL/SPA, POOL/GREENHOUSE ETC.**

Model C35-1S-2S-3T provides two differential control channels plus a delay timer function to interlock the pool sweep pump. As shipped from the factory circuit board jumpers J1 and J2 are not installed: Output 1 and Output 2 differential channels are completely independent. The pool sweep interlock is operated by output 1 only. This configuration is ideal where the C35 is used to control two (2) independent, separate solar systems (ie. two separate collector arrays, each connected to a separate storage).

The illustrations in this section are for a typical Pool/hot tub system with two collector arrays. Other combinations (pool/spa, pool/greenhouse etc.) may be selected or your system plumbing may vary from that shown in Figure 4-1 but control operation remains the same.

### **POOL SOLAR COLLECTION**

If the pool sweep interlock function is to be used, it is important that Output 1 differential channel be used for pool collection. Solar collection to the pool is controlled by Output 1. When there is sufficient heat at the pool collectors Output 1 turns ON, operating the solar valve to divert pool loop water through the collector.

Collection starts (Output 1 ON) when the "collector/pool" temperature differential increases to the "TURN ON" threshold. Collection stops when the "collector/pool" differential temperature decreases to the "TURN OFF" threshold or when the pool temperature rises to the "TEMPERATURE ADJUST" setpoint.

### **HOT TUB SOLAR COLLECTION**

Solar collection to the hot tub (or other storage) is controlled by Output 2. When there is sufficient heat at the hot tub collector array, Output 2 turns ON to operate the hot tub solar pump.

Collection starts when the "aux collector/aux storage" differential temperature reaches the "TURN ON" threshold. Collection stops when the "aux collector/aux storage" temperature difference decreases to the "TURN OFF" threshold or if the hot tub temperature rises to the "TEMPERATURE ADJUST" setpoint.

### **DIFFERENTIAL TEMPERATURE THRESHOLDS**

The C35-1S-2S-3T is shipped from the factory with 4°F ON and 1.5°F OFF differential thresholds for both Output 1 and Output 2 channels. These thresholds may be field modified to 8°F ON and 3°F OFF. See section 9, Installation, and also the operation label on the C35 cover.

### **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 pool collector freeze sensor locations, Output 1 turns ON to circulate warmer pool water through the pool collection system to prevent the pool collector from freezing. Output 2 differential channel Recirculate Freeze Protection operates identical to the Output 1 differential channel.

## **RECIRCULATE FREEZE THRESHOLDS**

The collector and collector system plumbing are sensed both by a thermistor sensor and a freeze snap switch (for backup). The C35 starts recirculate freeze protection (Output turns ON) when the thermistor sensor temperature drops to 40°F and stops freeze protection (Output OFF) when the sensor temperature rises to 45°F.

One or more Model GC-1 freeze snap switches are wired in series with the thermistor sensor (Model SB, ST, SC, SW) and its contacts open to start recirculate freeze protection when the snap switch temperature drops to 44°F. Freeze protection stops when the snap switch temperature rises to 54°F.

## **POOL SWEEP INTERLOCK**

At the start of pool solar collection, air in the open loop pool collection system may cause some pool sweep pumps to become airborne. The Pool Sweep Interlock prevents this by disabling the pool sweep pump for approximately the first six (6) minutes of pool solar collection (after Output 1 turns ON). Hot tub solar collection (Output 2) does not cycle the pool sweep interlock.

## **MODE SWITCHES**

### **"AUTO"**

This is the normal operating mode for both the pool and hot tub differential temperature channels. In this mode, solar collection, recirculate freeze protection (if enabled) and the pool sweep interlock operate automatically.

### **"PRIORITY" DO NOT SELECT THE PRIORITY MODE.**

This mode is used only for dual differential systems having ONE (1) collector array to heat both storages. (See Section 5)

### **"OUT"**

This is a test mode to check pump and/or valve operation. In this mode, the output is turned OFF regardless of the differential temperature or "Temperature Adjust" thresholds. Recirculate freeze protection (if enabled) operates automatically in this mode.

**CAUTION: ALWAYS DISCONNECT AC POWER AT THE PANELBOARD BEFORE SERVICING ANY PART OF SYSTEM**

### **"ON"**

This is another test mode to check pump and/or valve operation. In this mode the output is forced ON regardless of differential temperature, "Temperature Adjust" or recirculate freeze thresholds. The Output 1 mode switch cycles the six (6) minute pool sweep interlock when the "ON" mode is selected.

## **"TEMPERATURE ADJUST" CONTROLS**

The "Temperature Adjust" controls set the Pool and hot tub maximum temperatures. The C35 control is shipped with a safe operating "Temperature Adjust" range of 65-104°F. Both "Temperature Adjust" controls operate identically.

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 solar collection begins, (Output 1 ON) then slowly move the "Temperature Adjust" control toward a cooler setting until output 1 just turns OFF. The pool temperature is now set for your comfort. Make note of the control setting for future reference.

The hot tub temperature may be adjusted by following the same procedure.

## **INDICATORS**

- "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 pump is disabled.
- "OUTPUT 1"** When illuminated, pool solar collection or pool collector recirculate freeze protection (if enabled) is in progress. The "Output 1" indicator also illuminates when the output 1 mode switch is in the "ON" mode.
- "OUTPUT 2"** When illuminated, hot tub solar collection or hot tub collector recirculate freeze protection is in progress. The "Output 2" indicator also illuminates when the Output 2 mode switch is in the "ON" mode.

## **MODE CHART FOR OUTPUT 1 AND OUTPUT 2 DIFFERENTIAL CHANNELS. (JUMPERS J1 AND J2 NOT INSTALLED)**

<b>C35 SWITCH POSITION</b>	<b>SOLAR COLLECTION</b>	<b>RECIRCULATE FREEZE</b>	<b>POOL SWEEP</b>
<b>OUT</b>	<b>DISABLED</b>	<b>AUTO</b>	<b>AUTO</b>
<b>AUTO</b>	<b>AUTO</b>	<b>AUTO</b>	<b>AUTO</b>
<b>ON</b>	<b>ON</b>	<b>ON</b>	<b>AUTO</b>

**DO NOT USE THE PRIORITY MODE FOR EITHER DIFFERENTIAL CHANNEL.  
SEE SECTION 5 FOR PRIORITY MODE USE.**

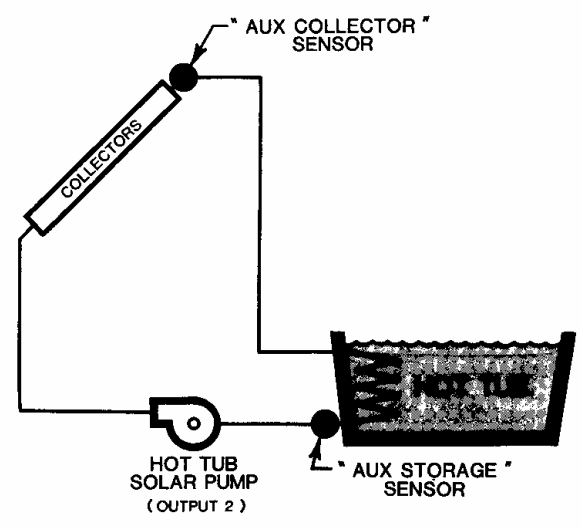
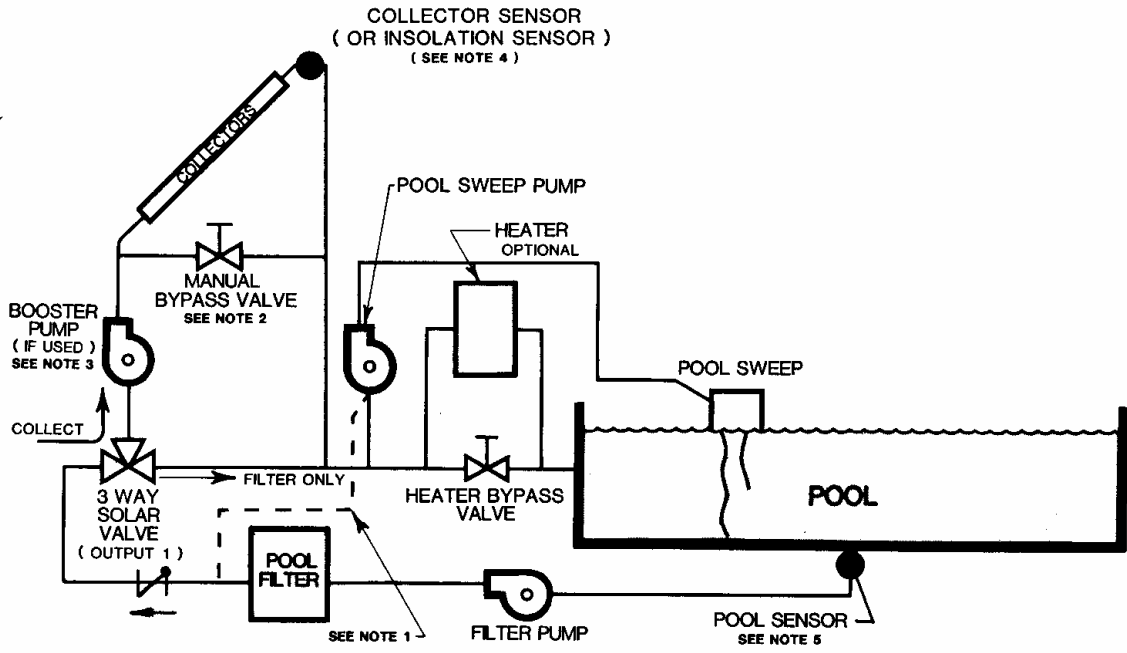
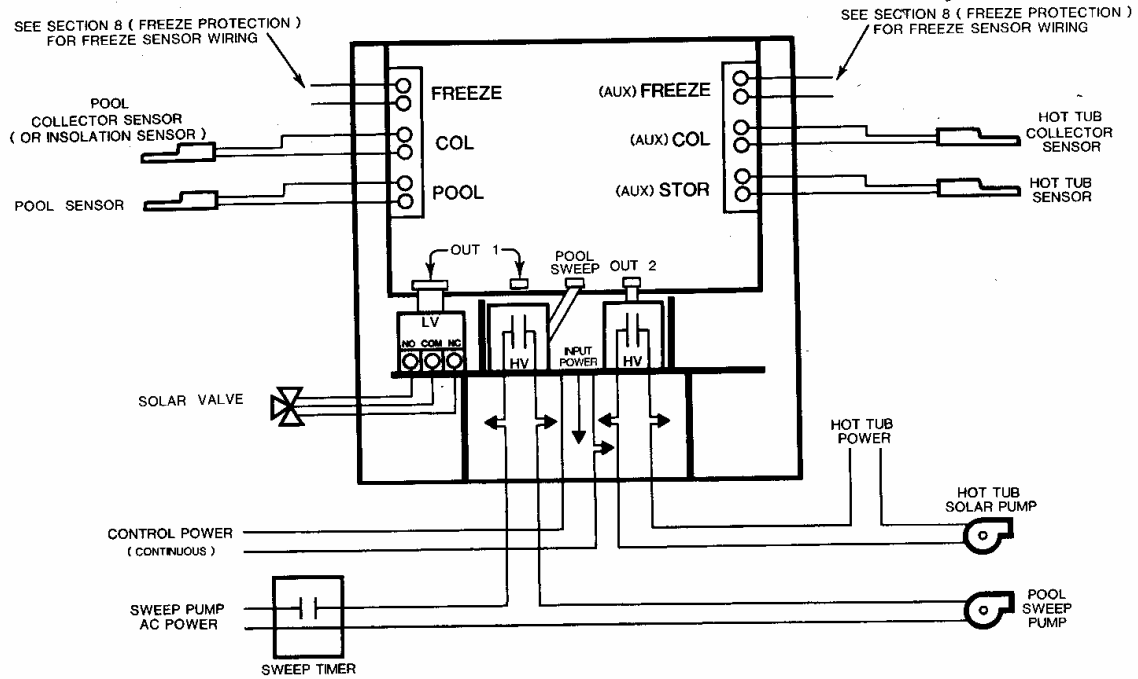
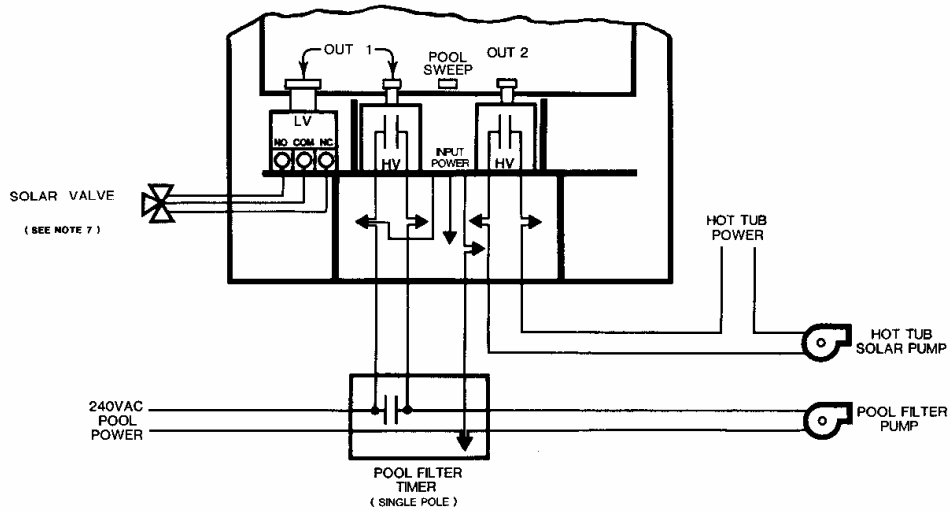


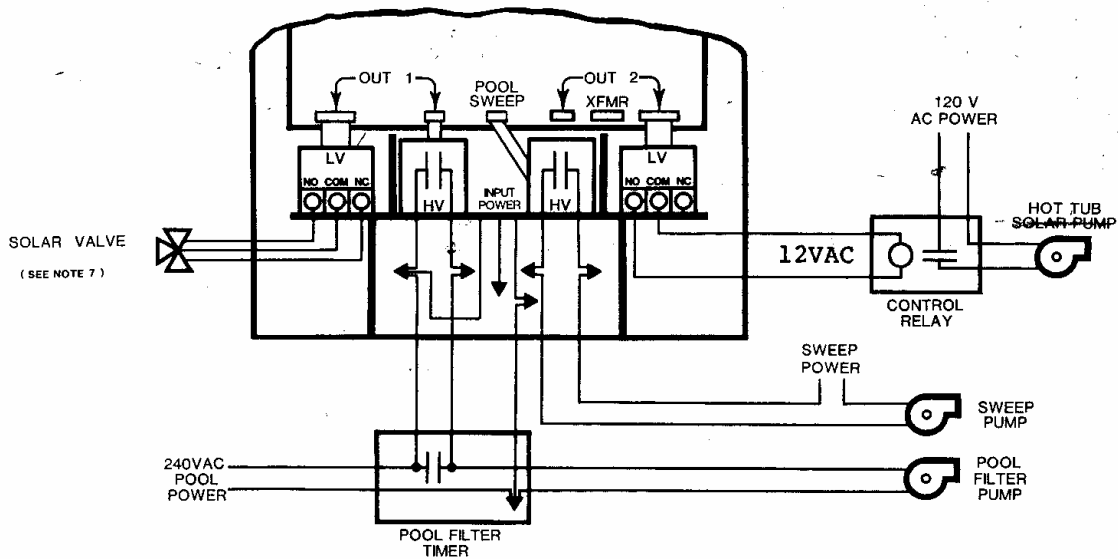
FIGURE 4-1, PLUMBING SCHEMATIC, POOL/HOT TUB SYSTEM WITH TWO COLLECTOR ARRAYS.



**FIGURE 4-2, ELECTRICAL SCHEMATIC, POOL/HOT TUB SYSTEM, DAYTIME FILTERING/COLLECTION.**



**FIGURE 4-3, ELECTRICAL SCHEMATIC, NIGHT TIME FILTERING WITH TIMER OR SYSTEMS WITH RECIRCULATE FREEZE PROTECTION.**



**FIGURE 4-4, ELECTRICAL SCHEMATIC, NIGHT TIME FILTERING OR RECIRCULATE FREEZE PROTECTION WITH POOL SWEEP INTERLOCK USED.**

**APPLICATION NOTES**

1. Typical pool sweep plumbing is as shown in Figure 4-1. 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. Bypass valve at collector loop may be used to throttle collection flow rate and provide gravity drainback freeze protection.
3. If a booster pump is used, pump is operated by Output 1.
4. Insolation sensor should be located near and at the same angle as the collector array to achieve same exposure.
5. Pool sensor may be located in filter pump suction line or at pump itself. The Hot Tub sensor may be located at the hot tub or on plumbing close to hot tub.
6. If Recirculate Freeze Protection is selected it must override the pool system timer. Wire as shown in Figure 4-3 or 4-4 and refer to Section 8, 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 valves instead of, or in addition to motorized valves. Ensure that the C35 maximum output rating is not exceeded.

## **SECTION 5: DUAL DIFFERENTIAL SYSTEMS WITH ONE COMMON COLLECTOR ARRAY**

Model C35-1S-2S-3T provides two differential control channels plus a delay timer function to interlock the pool sweep pump. As shipped from the factory circuit board jumpers J1 and J2 are not installed: Output 1 and Output 2 differential channels are completely independent. The pool sweep interlock is operated by output 1 only. This configuration is ideal where the C35 is used to control two (2) independent, separate solar systems (ie. two separate collector arrays, each connected to a separate storage).

For systems that have only ONE (1) collector array to solar heat both storages the C35 is modified by installing Jumpers J1 and J2 on the C35 circuit board. These jumpers and an operation label overlay are shipped with the model C35-1S-2S-3T control. Installing the jumpers change the C35 collection and pool sweep interlock logic as follows:

**J1**        Either differential channel (eg. pool or spa) turns on output 1 to operate solar valve (see Figure 5-1).

**J2**        Pool sweep pump is disabled when Output 2 is ON.

This section describes operation of the C35-1S-2S-3T control and its use with dual differential systems that have one (1) common collector array to solar heat two (2) storages. Typical applications include POOL/SPA, POOL/HOT TUB or other similar combination systems. The illustrations in this section are for a typical POOL/SPA combination system. Your system configuration may not be identical to this example system but control operation is the same.

### **POOL SOLAR COLLECTION** (see Figure 5-1)

If the pool sweep interlock function is to be used, it is important that Output 1 differential channel be used for pool collection.

Solar collection to the pool is controlled by Output 1. When there is sufficient heat at the pool collectors Output 1 turns ON, operating the solar valve to divert pool loop water through the collector.

Collection starts (Output 1 ON) when the "collector/pool" temperature differential increases to the "TURN ON" threshold. Collection stops when the "collector/pool" differential temperature decreases to the "TURN OFF" threshold or when the pool temperature rises to the "TEMPERATURE ADJUST" setpoint.

Pool solar collection is inhibited when Spa solar collection is in progress (Valves V2 and V3 are positioned for Spa solar collection).

### **SPA SOLAR COLLECTION**

Solar collection to the spa (or other storage) is controlled by Output 1 and Output 2. Collection starts when the "aux collector"/"aux storage" differential temperature reaches the "TURN ON" threshold. Collection stops when the "aux collector"/"aux storage" temperature difference decreases to the "TURN OFF" threshold or if the SPA temperature rises to the "TEMPERATURE ADJUST" setpoint.

### **DIFFERENTIAL TEMPERATURE THRESHOLDS**

The C35-1S-2S-3T is shipped from the factory with 4°F ON and 1.5°F OFF differential thresholds for both Output 1 and Output 2 channels. These thresholds may be field modified to 8°F ON and 3°F OFF. See section 9, Installation, and also the operation label on the C35 cover.

### **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.

For combination solar systems with ONE collector array for TWO storages use the MAIN (Pool) differential channel for recirculate freeze protection. Leave the AUX (spa) differential channel freeze protection disabled, do **NOT** remove "AUX FREEZE" jumper on the AUX differential channel sensor terminal block.

When near freezing temperatures are reached at any of the freeze sensor locations, Output 1 turns ON to circulate warmer pool water through the collector array to prevent collector freezing. If the spa (Output 2) mode switch is in the "ON" position, spa water is used for recirculate freeze protection.

The collector and collector plumbing system temperatures are sensed both by a thermistor (Model SB, SC, ST, SW) sensor and one or more Freeze Snap switches (Model GC-1) for backup). The C35 starts freeze protection (Output 1 ON) when the thermistor sensor temperature drops to 40°F and stops freeze protection (Output 1 OFF) when the sensor temperature rises to 45°F.

The freeze snap switch(es) is wired in series with the thermistor type sensor and its contacts open to start recirculate freeze protection when the snap switch temperature drops to 44°F. Freeze protection is stopped when the snap switch temperature rises to 54°F.

### **POOL SWEEP INTERLOCK**

At the start of pool solar collection, air in the open loop pool collection system may cause some pool sweep pumps to become airborne. The Pool Sweep Interlock prevents this by disabling the pool sweep pump for approximately the first six (6) minutes of pool solar collection. Hot tub solar collection does not cycle the pool sweep interlock.

Additionally, (with J2 installed) the pool sweep pump is disabled ("SWEEP ENABLE" indicator OFF) whenever Output 2 is ON. This prevents the pool sweep pump from pumping spa water into the pool when valves V2 and V3 are positioned for solar collection to the spa.

### **MODE SWITCHES**

The following description of operating modes is identical for both the pool and spa (main and aux) differential channels.

#### **"AUTO"**

This is the normal operating mode for both differential channels. Collection, Recirculate freeze protection (if enabled) and the pool sweep interlock operate automatically.



**"PRIORITY"**

This mode allows the homeowner to place priority heating on either the pool or spa ("Main" or "Aux") differential channels. To use this mode, select "Priority" on the desired differential channel and "Auto" on the non-priority channel. Solar collection for the non-priority ("Auto") channel is inhibited until the "Priority" channel storage is heated to the "Temperature Adjust" setpoint. **DO NOT** select "PRIORITY" mode on both channels simultaneously. The "Priority" mode should only be used for dual differential systems that solar heat both storages from one (1) common collector array.

**"ON"**

This mode is a test mode to check pump and/or valve TURN ON operation. The output turns ON regardless of the differential temperature, high limit, or freeze thresholds.

The "Aux" ("Spa") channel mode switch "ON" position allows the homeowner to force Spa solar heating only. When in the ON mode, the spa can be continuously heated by backup heat and/or solar. When the Spa channel mode switch is switched to the "ON" position for this purpose, the Pool channel mode switch must be switched to the "OUT" position.

**"OUT"**

This is a test mode to check valve and/or pump TURN OFF operation. In this mode, solar collection to the applicable storage is disabled. Recirculate freeze protection (if enabled) or the "Aux" Collector/Spa differential output will operate Output 1 even when the "Main" (Pool) channel is in the "Out" mode.

**CAUTION: ALWAYS DISCONNECT AC POWER AT THE PANELBOARD BEFORE ATTEMPTING TO SERVICE ANY PART OF SYSTEM.**

**INDICATORS**

- |                       |   |
|-----------------------|---|
| <b>"POWER ON"</b>     | Illuminates when AC power is applied to the C35.  |
| <b>"SWEEP ENABLE"</b> | When illuminated, the pool sweep pump operates normally. When off, the pool sweep is disabled.  |
| <b>"OUTPUT 1"</b>     | The "OUTPUT 1" indicator illuminates during solar collection to the pool or spa or if Recirculate Freeze Protection (if enabled) is in progress. The indicator also illuminates when the "ON" mode is selected for the pool differential channel. |
| <b>"OUTPUT 2"</b>     | Illuminates during Spa solar collection or when the Spa channel mode switch is in the "ON" mode.  |

MODE CHART FOR MODEL C35-1S-2S-3T CONTROL. (JUMPERS J1 AND J2 INSTALLED)

NORMAL OPERATING MODES

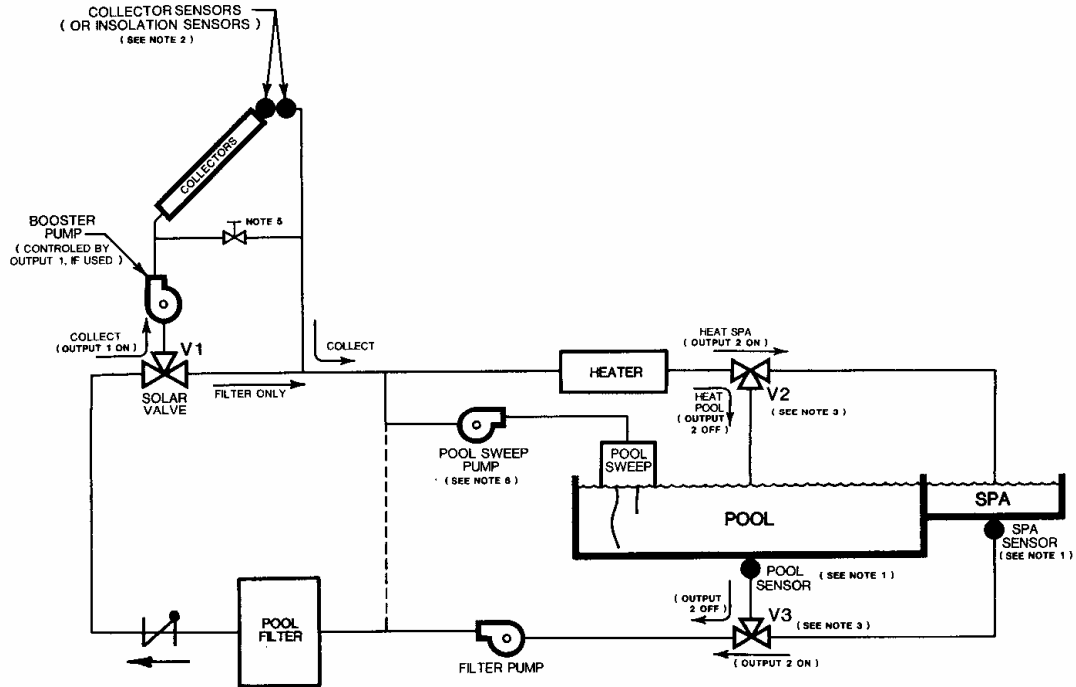
MODE	SWITCH POSITION		SOLAR COLLECTION		FREEZE PROT. (OUTPUT 1) (IF ENABLED)	POOL SWEEP
	OUTPUT 1	OUTPUT 2	OUTPUT 1 (POOL)	OUTPUT 2 (SPA)		
1	OUT	OUT	OFF	OFF	AUTO	AUTO
2	AUTO	OUT	AUTO	OFF	AUTO	AUTO
3	AUTO	AUTO	AUTO	AUTO	AUTO	AUTO
4	PRIORITY	AUTO	AUTO	AUTO *	AUTO	AUTO
5	AUTO	PRIORITY	AUTO *	AUTO	AUTO	AUTO
6	OUT	AUTO	OFF	AUTO	AUTO	AUTO
7	OUT	ON	OFF	<del>AUTO</del> ON	AUTO	OFF

1. No solar collection to pool or spa.
2. Solar collection to pool only.
3. Solar collection to pool and spa without priority heating.
4. Solar collection to pool and spa with priority heating of pool.
5. Solar collection to pool and spa with priority heating of spa.
6. Solar heating of spa only.
7. Backup and Solar heating of spa.

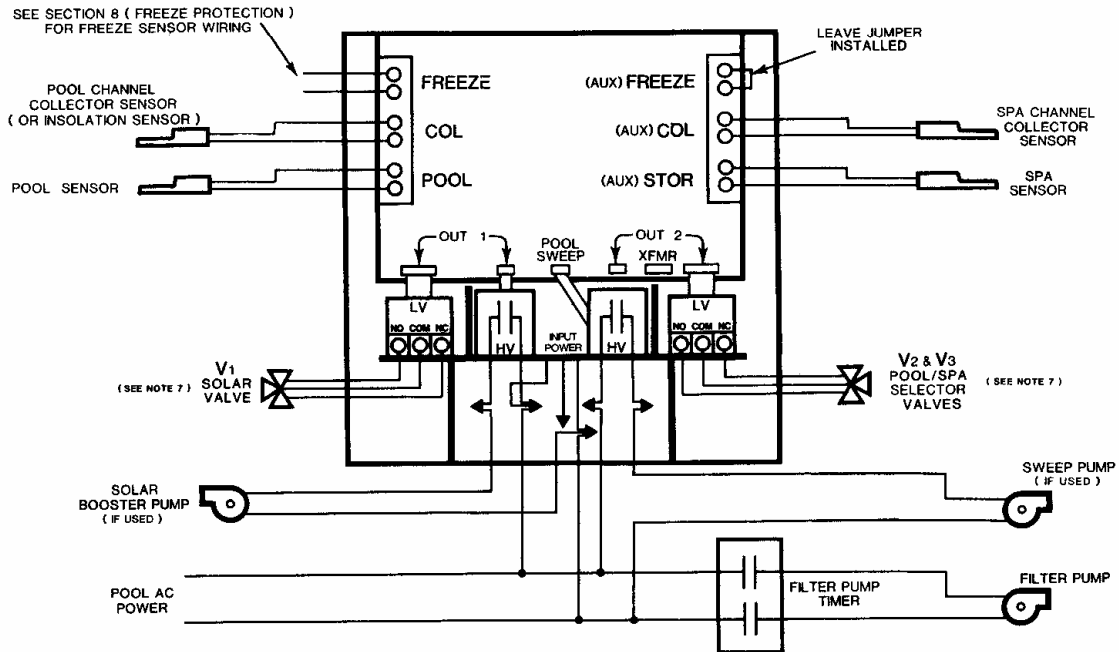
\* Differential temperature channel marked with asterisk will not turn ON until the "Priority" channel storage is heated to the "Temp. Adjust" setpoint.

TEST AND ABNORMAL OPERATING MODES

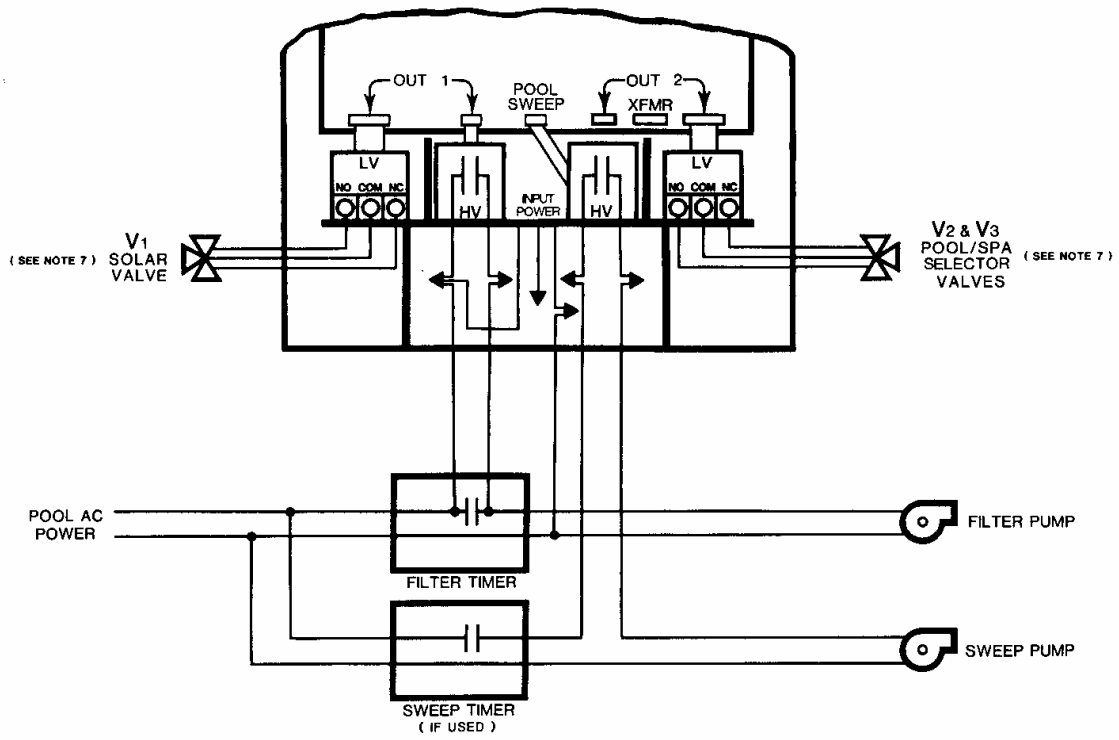
MODE	SWITCH POSITION		SOLAR COLLECTION		FREEZE PROT. (OUTPUT 1) (IF ENABLED)	POOL SWEEP
	OUTPUT 1	OUTPUT 2	OUTPUT 1 (POOL)	OUTPUT 2 (SPA)		
8	ON	OUT	ON	OFF	AUTO	AUTO
9	ON	ON	ON	ON	AUTO	OFF
10	ON	AUTO	ON	AUTO	AUTO	AUTO



**FIGURE 5-1, PLUMBING SCHEMATIC, OPEN LOOP POOL/SPA COMBINATION SYSTEM WITH ONE COLLECTOR**



**FIGURE 5-2: ELECTRICAL SCHEMATIC, POOL/SPA COMBINATION SYSTEM WITH DAYTIME FILTERING WITHOUT RECIRCULATE FREEZE PROTECTION**



**FIGURE 5-3, ELECTRICAL SCHEMATIC, POOL/SPA COMBINATION SYSTEM WITH NIGHT TIME FILTERING OR RECIRCULATE FREEZE PROTECTION.**

#### APPLICATION NOTES

1. The pool and spa sensors **MUST** be located at the pool and spa to accurately measure the water temperature.
2. Two collector sensors are required. The "Main" and "Aux" (Pool and Spa) collector sensors should be placed at the same location on the collector panels. If insolation sensors are used, mount them close to and at the same angle as the collector panels.
3. If two 3-WAY motorized valves are used for valves V2 and V3, ensure that they operate from the same starting position. Internal valve limit switches may cause two parallel wired valves to continuously cycle should the valves lose mechanical synchronization. When changing modes allow ample time for the valves to cycle completely before switching to a new mode.
4. If the pool and spa water levels are not equal, valves V2 and V3 must be positive sealing (posi-seal) type to prevent leakage.
5. Collector bypass valve may be used to throttle collector flow rate and provide gravity drainback freeze protection.
6. Typical pool sweep plumbing is as shown in Figure 5-1. 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.
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 output module(s) may power one or more solenoid type valves instead of, or in addition to motorized valves. Ensure that the C35 maximum output rating is not exceeded.