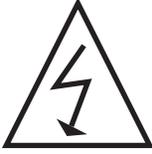


1.0 Safety Warnings



High Voltage!

The ACM-2 AC Current Monitor should be installed only by qualified technical personnel with knowledge of industrial electrical wiring and the requirements of the national and local electrical codes. An attempt to install this device by a person who is not technically qualified could result in a hazardous condition to the installer or other personnel, and/or damage to the ACM-2 or other equipment. Broadcast transmitters and associated equipment can operate at voltages that are potentially lethal. Please ensure that proper safety precautions have been made before installing this device.

Mounted on the output terminals of the current transformer is a metal-oxide varistor. It is a black disc about 5/8" inch in diameter with two wires. DO NOT under any circumstances operate the current transformer without the varistor connected. This could present a significant danger that might not be immediately apparent. If the varistor is disconnected, normal operation will occur as long as the current transformer output leads are connected to the load resistors on the ACM-2 PC board. However, if the load resistors become disconnected, the voltage at the output terminals of the current transformer will instantly rise to several thousand volts and will be quite dangerous. The function of the varistor is to provide a back-up load to the current transformer and limit the output voltage to a safe level in the event the ACM-2 PC board is disconnected.



WARNING!

The ACM-2 AC Current Monitor can, as can any individual monitoring system, fail suddenly and without warning. In cases where a dangerous or life-threatening condition could exist if the ACM-2 AC Current Monitor were to fail, the ACM-2 should not be used as the sole monitoring means. One or more redundant monitoring means should be used as necessary to achieve the reliability required by the application.

2.0 Introduction

The Sine Systems model ACM-2 AC Current Monitor allows monitoring of AC current by the RFC-1 remote control system. A common application is to verify the proper operation of obstruction lighting on communications towers. More generally, it may be used to telemeter the AC current consumption of any 115 or 230 volt device drawing from 1 to 70 amperes.

The ACM-2 AC Current Monitor package contains these items:

- AC Current Monitor PC board with mounting bracket
- AC Current Transformer
- Product Documentation

The user must supply any enclosures and/or junction boxes which may be required by national or local electrical codes.

3.0 Installation

The ACM-2 consists of a current transformer and a PC board that converts the output of the current transformer to a DC voltage. The current transformer should be mounted at a location that is convenient to the AC wiring to be monitored. The "hot" AC lead should be passed through the insulation tubing in the current transformer. The two terminals on the current transformer should be connected to terminal strip CURRENT XFMR on the ACM-2 PC board with a length of two-conductor wire (not supplied).

The ACM-2 PC board can be mounted in any dry location. Applicable national and local electrical codes should be followed in the installation and wiring of the current transformer. Under normal conditions, the output of the current transformer is low voltage AC (less than 20 volts rms). However, during lightning strikes or other transient voltage conditions, the voltage may be very high and appropriate precautions should be taken.

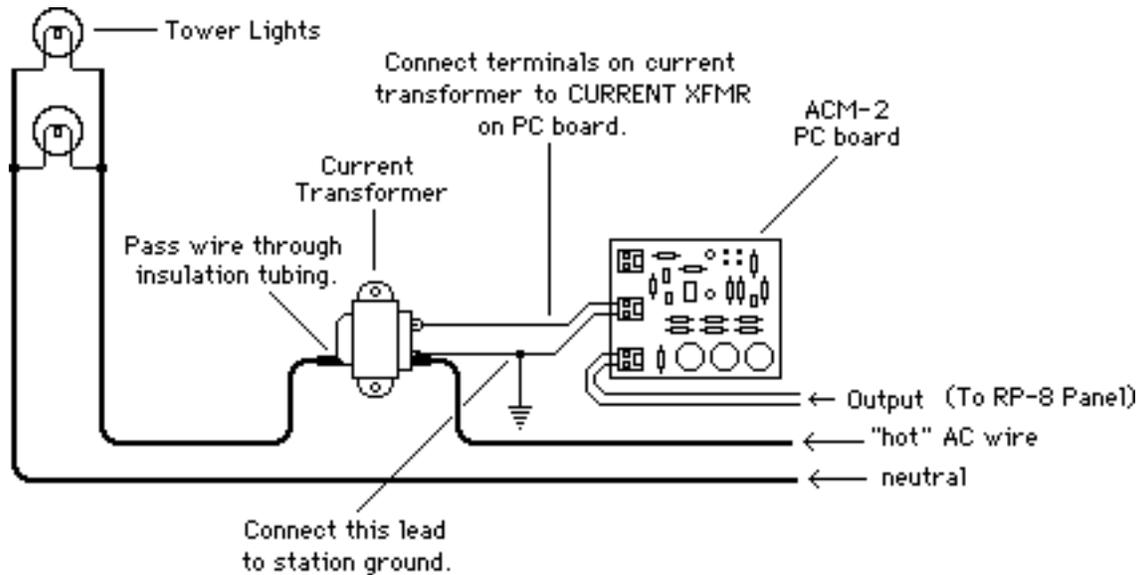


Figure 3.1; ACM-2 Installation Diagram

The DC output terminals (OUTPUT) on the ACM-2 PC board should connect to the telemetry terminals on the RP-8 panel. If the ACM-2 is connected to monitor the lights on a communications tower or other application susceptible to very high voltage transients, it is highly recommended that an SP-8 Surge Protector be used with the RP-8 panel. If an SP-8 is not used, two varistors should be installed at the telemetry terminals on the RP-8 panel to which the ACM-2 is connected. One lead of one varistor should connect to the "+" telemetry terminal and one lead of the other varistor should connect to the "-" telemetry terminal. The remaining two leads should connect to the metal rack in which the RP-8 panel is mounted. The varistor leads should be as short as possible. Two varistors are supplied with the ACM-2 for this purpose.

As factory wired, the ACM-2 PC board is set up to monitor a tower lighting circuit. The DC conversion circuit will "smooth out" the voltage generated by the lighting current to a nearly constant value, even if flashing beacons are used. Because of this, it is easy to monitor with a voice-reporting telemetry system like the RFC-1. Also, because the monitored voltage is an analog value, very small changes in lighting current can be observed. A 1% change in current can easily be resolved. In most cases this is sufficient to detect the failure of a single bulb in the lighting system.

The ACM-2 has a long integration time-constant which requires about two minutes to reach a final value. This is a desirable characteristic for monitoring lighting systems with flashing beacons.

Note that the current transformer has two holes that wires may be passed through. If the tower lighting circuit is powered by both legs of a 240 volt circuit, the other hole may contain the additional leg. Passing the wires through the holes from the same side of the current transformer to the other will cause the output of the ACM-2 to be proportional to the sum of the currents in each leg (assuming the legs are 180° out of phase). A piece of insulating tubing should be added to the wire passing through the second hole.

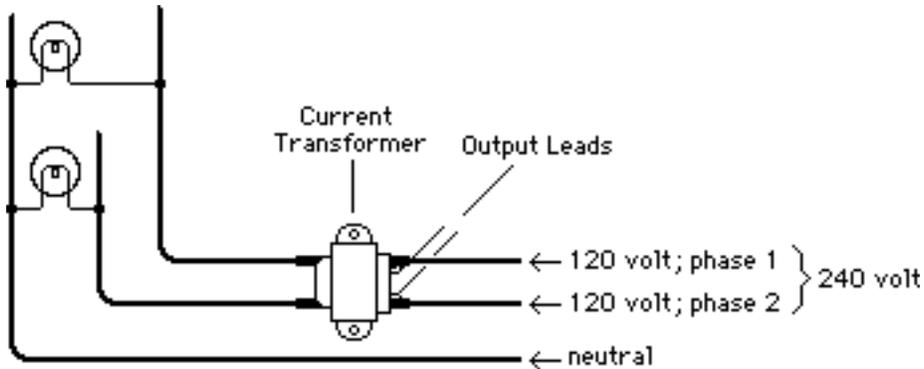


Figure 3.2; ACM-2 Current transformer wiring in 240 volt systems

For load circuits powered by two legs of a 208 volt 3 phase “Y” service, the same technique may be used, however, the output of the ACM-2 will not be proportional to the arithmetic sum of the currents in each leg. This is because the current in the sampled conductors is 120° out of phase and not 180° as above. For many applications, this is not important.

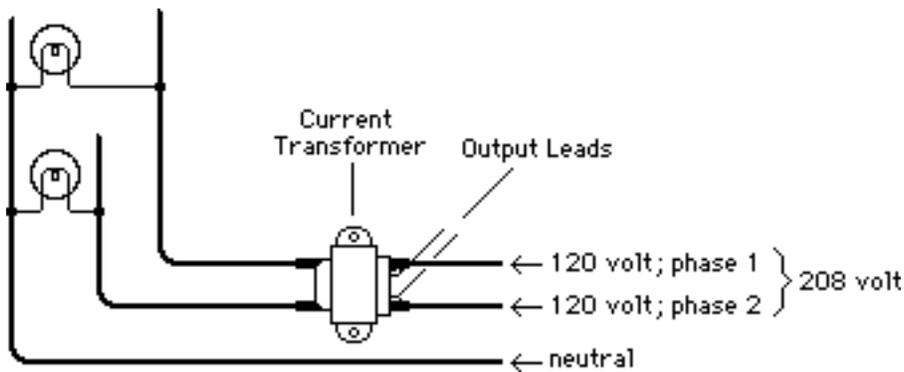


Figure 3.3; ACM-2 Current transformer wiring in 208 volt systems

As an example, assume that 10 amperes is flowing in both legs and the output of the ACM-2 is calibrated to 100%. If the current in one leg drops to zero amperes, the ACM-2 output will drop to 57% instead of 50%. This is not good enough for precise measurements but it is acceptable for approximate or “go/no go” measurements. If more precision is required, it may be practical to measure a number of known failure conditions in advance. It then becomes easy to correlate an unknown failure condition with previously observed ACM-2 output data.

3.1 Setting Current-Range Jumpers

The voltage at the output of the ACM-2 PC board is in the range of 1 to 4 volts DC. The input current range which produces this output is determined by the jumpers installed at locations A and B on the ACM-2 PC board. The following chart shows the jumper settings for ranges of current in the system to be monitored.

| AC Current | Jumper A | Jumper B |
|------------|-----------|-----------|
| 2-13 amps | out (cut) | out (cut) |
| 13-26 amps | in | out (cut) |
| 26-70 amps | in | in |

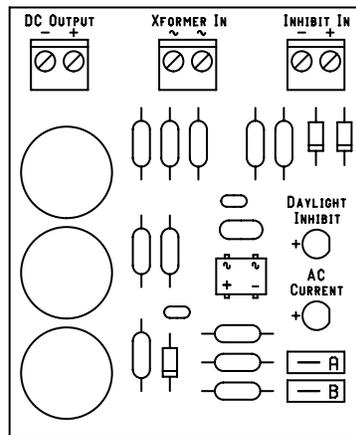


Figure 3.4; ACM-2 Current range jumpers (lower right corner)

As an example, suppose that a lighting system has two 620 watt bulbs in a flashing beacon and four 120 watt obstruction bulbs. This totals 1720 watts. We divide 1720 watts by 115 volts and get 14.9 amperes peak lighting current. Looking at the chart above we see that we need to leave jumper A intact and cut jumper B.

3.2 Daylight Alarm Inhibit

One way to inhibit tower light alarms during daylight hours with the RFC-1 Dial-Up Remote Control is to block the tower lights as a telemetry alarm source during the daylight hours using the internal clock and programming in the RFC-1. The ACM-2 alarm channel can be inhibited from causing an alarm from roughly 5:00 am to 8:00 pm each day. If the lights are not on from 8:00 pm to 5:00 am, an alarm will occur. This approach is effective but it is not necessarily the best solution to the problem.

Another way to monitor the tower lights only during dark hours is to automatically disable the ACM-2 telemetry during daylight with a photosensor circuit. The following circuit can accomplish this:

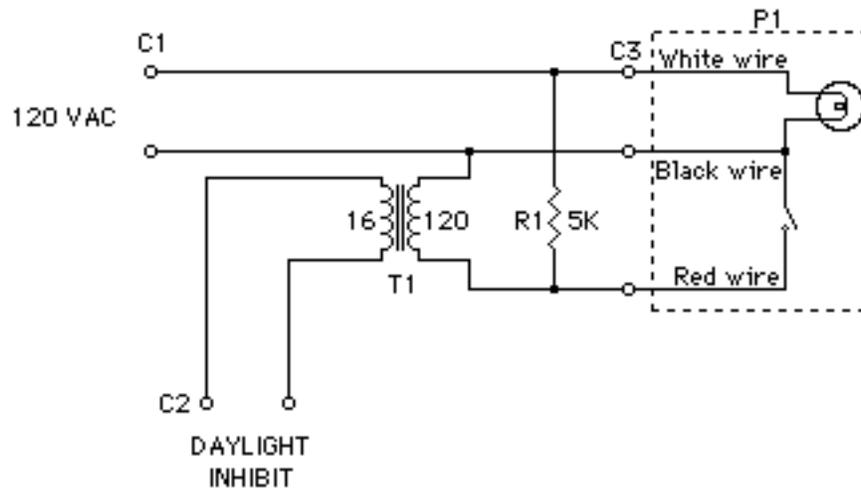


Figure 3.5; ACM-2 Daylight inhibit

The parts for this circuit are:

- P1 photo control sensor (Intermatic #K4221C available at most home improvement stores)
- R1 5K, 10 Watt wirewound enamel resistor
- T1 Power transformer, 120 volt/16 volt

4.0 Operation

With the current transformer and ACM-2 PC board installed and connected to the RP-8 panel, the AC circuit should be turned on. After waiting two minutes for the DC output voltage to stabilize, the telemetry may be calibrated with the potentiometer on the appropriate channel of the RP-8 panel. The reading may be calibrated to read directly in amperes if desired. For example 14.9 amperes could be calibrated to "1490." For tower lighting circuits, however, it is usually easier to calibrate the "normal" current, with all bulbs good, to something easy to remember, like "1000." In other words, normal lighting current is "1000" or "100.0%." If the reading drops to "0981" it means that the lighting current is 98.1% of normal.

When monitoring tower lighting current, the following points should be noted:

- Remember that if the reading is calibrated to "1000," a change of 10 units is only a 1% change in lighting current. Do not be alarmed at readings that "wander around" some as long as the percentage variation is within appropriate limits.
- The "normal" tower lighting current will rise and fall somewhat as the AC line voltage rises and falls throughout its daily cycle. If absolute precision is required, monitor the AC line voltage on a separate channel and compute the load resistance mathematically.
- If a flashing beacon is used, variations in duty-cycle (ratio of off-to-on) will show up as variations in lighting current. The ACM-2 is designed to minimize this effect but it still can happen to some degree. In particular, an intermittently "sticky" mechanical flasher might be responsible for erratic results. A flasher that fails in the "on" position will cause a very high reading and a flasher that fails in the "off" position will cause a very low reading.
- Tower lighting current can change seasonally, particularly if the tower is tall or if the AC run to the base of the tower is long. Due to the negative temperature coefficient of copper wire, it may be normal to notice a slightly higher lighting current in the cold winter months.
- The current change by the failure of one bulb can be predicted mathematically. For example, if a lighting system consists of two 620 watt and four 120 watt bulbs, a total of 1720 watts will be consumed if all bulbs are working. If one 120 watt bulb burns out, the power consumption is reduced to 1600 watts. This is a change of about 7%. Therefore, if the normal lighting current was calibrated to "1000," then the reading should drop to about 0930 (down 7%) with the failure of one 120 watt bulb.

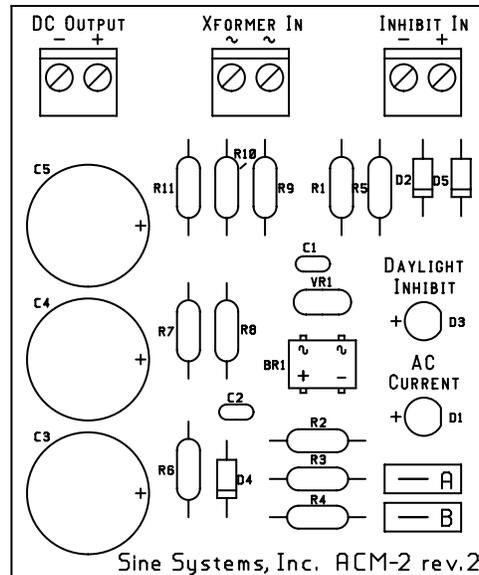


Figure 3.6; ACM-2 Component Locations

Parts List

| <u>Location</u> | <u>Description</u> |
|-----------------|--|
| BR1 | bridge rectifier, 1A 200V |
| C1, C2 | capacitor, monolythic ceramic, 0.1 μ F, 50 V |
| C3, C4, C5 | capacitor, aluminum electrolytic, 4700 μ F, 16 VDC |
| D1 | LED, green |
| D2 | LED, yellow |
| D2, D4, D5 | diode, 1N4005 |
| R1 | resistor, carbon film, 1/2 watt, 5%, 22 ohms |
| R3, 9, 11 | resistor, carbon film, 1/2 watt, 5%, 510 ohms |
| R2, R4 | resistor, carbon film, 1/2 watt, 5%, 220 ohms |
| R5 | resistor, carbon film, 1/2 watt, 5%, 330 ohms |
| R6, 7, 8 | resistor, carbon film, 1/2 watt, 5%, 1K ohms |
| R10 | resistor, carbon film, 1/2 watt, 5%, 3.3K ohms |
| T1 | current transformer, custom step down, open primary |
| VR1 | varistor, 11VAC |