C & C ASSOCIATES

troubleshooting guides

ELECTRONIC TROUBLESHOOTING THE CANON A-1

I. CIRCUIT DESCRIPTION

Power Circuit

The positive battery terminal is connected by a red (or sometimes orange) wire to the printed circuit switch-plate, located below the wind lever at the back of the camera. When the main switch **SW-7**, is set to "A," power is carried by the black wire to the magnet **MG-3** then along the flex to the emitter of transistor, **TR**. **TR**'s base is connected to switch **SW-1**, under the release button. When the release button is pressed halfway, **TR** turns on, connecting battery current to the metering circuit. The current from the collector of **TR** is designated **E1**.

As **E1** powers up the **Input-IC**, a controlled voltage, **KVC**, is produced at pin 6. **KVC** is used by the other ICs and circuits throughout the metering system.

The negative battery terminal is connected to the camera chassis. The flex circuit is grounded through the screw near the ASA pattern at the back of the camera.

Battery requirement: one 6 volt #544 silver oxide, lithium, or alkaline manganese battery.

Metering Circuit

When the release button is pressed halfway, powering the circuits, the photodiode/op-amp inside **OPT-IC** generates a current proportional to subject brightness (BV). (A transistor in the op-amp feedback compresses the output voltage producing a linear change with BV over a wide range of light conditions.) The **OPT-IC** is identical in function to PX-1 in the Canon AE-1. A second op-amp, **A6**, inside **Input-IC**, is the basis of a temperature compensation and level adjustment circuit for **OPT-IC**.

The output from pin 8, **OPT-IC** passes through a thermistor, then to pin 7, **Input-IC** — the input of op-amp **A5**. **A5**'s gain is externally adjusted by VR Gain, the low light level adjustment. **A5**'s output is a voltage which varies with light. This is the last analog signal in the metering circuit. The rest of the operations are digital.

The next step is to convert **A5**'s BV voltage into a digital signal. A-1 does the conversion with a dual ramp integrator, part of **Input-IC**. Voltage from **A5** is first sent to an electronic switch (analog switch) which has a constant voltage as a second input. The integrator is an op-amp with a capacitor **(C.AD)** in the feedback circuit. **C.AD** connects to pins 3 and 4 of Input-IC so that anyone interested can watch the integration process by connecting an oscilloscope to the negative side of **C.AD** at pin 3.

Here's what happens. The electronic switch is controlled by the clock (a train of pulses which is the camera's time base) so that first the BV voltage, then the constant voltage is connected to the integrator input. Switching takes place every 10ms and the timing is precise. The integrator is referenced so that BV voltage causes its output voltage to rise and the constant voltage (set below the reference) causes it to fall.

When BV voltage is switched to the integrator, its output voltage rises to begin the "up" side of the ramp. How high the output voltage rises depends upon the BV, since integration time is constant. When the reference voltage is switched to the input, the output voltage begins to fall. On this "down" side of the ramp, the constant input voltage causes a steady rate of fall from the voltage peak reached by BV integration. Therefore, the time required to bring the integrator's output voltage back to zero will increase and decrease with subject brightness. The analog BV voltage is thus expressed as a time interval, the first step toward conversion to a digital signal.

A binary counter inside **Input-IC** counts clock pulses generated by Oscillator-Interface IC. The counting starts when the integrator voltage begins the "down" ramp and ends when the voltage returns to reference. (A comparator connected to the integrator's output switches the counter off.) The binary number in the counter, when it stops, is the digital code for BV. Remember, since the slope of the down ramp is always constant, the time it takes the voltage to fall is related to the BV analog voltage. The fall time is also the counting time, so the binary count is an expression of BV.

The binary number is processed by a multiplexer inside **Input-IC**, so that it becomes a series of high and low voltages (1's and 0's) appearing at regular intervals on pin 13, **Input-IC**. (A multiplexer is like an electronic rotary selector switch. It connects first one, then another signal to a common terminal until each has had a turn. Then the cycle starts again.)

The binary code for BV is sent out of **Input-IC**, along a line called **"I-Bus"**, as a series of high and low voltages. Each series is a group of 8 bits (1's and 0's) called a binary word. One word lasts for 0.24ms and the last bit is an "end" signal. The **I-Bus** carries the binary word to pin 16, **CPU-IC** where it is stored in a memory and updated every 20ms.

When a dedicated flash is connected to the camera, or the battery check button is pressed, the binary word changes to become that function and the BV is ignored.

Now let's leave the BV count in the CPU memory and consider the other factors which make up the exposure.

The A-1 is a program camera which can operate in manual, aperture priority, shutter priority, full program, or flash-controlled mode. The circuits required to create this amount of flexibility would be frightfully complicated, except that the CPU controls all functions. Exposure information, such as ASA, BV, and minimum lens aperture, is given to the CPU along with the operating mode selected. The CPU then calculates an exposure value (Ev) based on that information, much the same as a photographer would using a hand-held light meter. The difference is the language. A series of binary codes instead of words and numbers (or voltages as in other electronic cameras) is used for communication.

We have seen the source of the BV code. The other binary codes originate in the decoder/driver IC **(D/D)**. A trigger generator (another multiplexer) distributes a series of low voltage signals (binary 0's) along five lines. The lines connect to a diode array which lives between the **ASA Code Generator** and the prism. This array connects the trigger generator to sets of logic switches which make up the **ASA, T/A, AVO,** and self-timer code generators. They all operate from the same trigger generator and the diodes keep the switches from crossing signals with one another.

Consider how the ASA code is generated. The ASA wiper is not sweeping a variable resistor as in cameras such as the AE-1. Instead, there is a pattern of switch contacts, each row connected to one line from the trigger source. As the ASA dial is turned, the wiper fingers touch or miss the contacts in the pattern. At any given ASA setting there will be fingers which connect the common to a pattern contact and others which do not. As the trigger generator sweeps a series of "lows" through the pattern, those fingers in contact will connect a binary low (0) to the common. Fingers not touching a contact will maintain a binary "high" (1) at the common. The ASA common then becomes the source of a code which is a unique series of binary highs and lows at each setting — the binary word.

The ASA common is connected to pin 6, **CPU-IC**. A spectator standing anywhere along the track between the ASA common and **CPU-IC** could watch, with the aid of an oscilloscope, the binary words passing by at regular intervals. Turning the ASA dial changes the configuration of the binary word, telling the arithmetic logic unit **(ALU)** inside **CPU-IC** which ASA was selected.

At the same time, the shutter speed and aperture **(T/A)**, **AVO**, and self-timer information is sent to **CPU-IC** as binary codes generated in the same manner as the ASA code. All the information processing is coordinated by a special series of pulses called **SYNC**. The sync code is an 8-bit word of 7 highs and 1 low generated by the decoder/driver.

One note before we go inside **CPU-IC**. The brush-type code generators produce a special signal called the "gray" code. It is similar to a pure binary number, except that each count changes only one bit at a time. The gray code is used to minimize errors and simplify pattern designs. CPU converts the gray code to a pure binary number before processing.

Exposure Control

The **ALU** inside **CPU-IC** is an 8-bit microprocessor which calculates Ev by adding and subtracting the information gathered from the function code generators. The standard formula is $2^{Ev} = \frac{BV \cdot ASA}{K}$. Log conversions enable the formula to be solved by simple arithmetic after all the numbers are converted to pure binary. However, the resulting Ev is also a binary number, which isn't too useful for setting shutter speeds and f-stops. Let's see how the A-1 manages the problem.

Assume the operator has selected program mode. The program specifies a single shutter speed/aperture combination for each Ev. In binary terms, an Ev is a binary code corresponding to a number or count. The program directs the ALU to use a portion of the count for the aperture value (AV) and the balance for the shutter speed (TV). The two counts are then moved to another part of CPU called a sequence controller.

The sequence controller keeps track of which AV and TV were selected and when those values have been reached. It instructs the **OSC/Interface-IC** by way of simple high and low voltage signals when to operate the magnets which control the aperture and shutter. The question is, how the sequence controller knows when the diaphragm has closed to the correct opening and the shutter has timed out.

The aperture control lever in the breech is connected to a wiper on the side of the mirror box. As the lens diaphragm begins to close, this wiper moves down a segmented switch pattern **(S.AVE)**. The pattern is connected to the sequence controller through pin **12, CPU-IC**. Each time the wiper crosses a pattern mark, a logic low is transmitted to the CPU. Each pulse is counted and a binary number results. When the count from the **S.AVE** equals the AV number from the CPU, the sequence controller signals the **OSC/Interface-IC** to release the aperture magnet, **MG-1**, and the diaphragm is blocked from further closing.

Shutter speed timing is less complicated because the clock pulse train, **CLK**, is available for a time base. The clock frequency is divided by a 20-stage counter so that speeds to 30 seconds can be timed. Remember, a timing capacitor is not required, just a counter. When the binary count reaches the number for TV, the sequence controller signals the **OSC/Interface-IC** to release **MG-3** and the closing curtain runs. The entire shutter timing process will be described in greater detail later.

Exposure control for other modes does not differ a great deal from program. Information about BV, ASA, AVO, and T/A is gathered the same way. The **ALU** calculates an Ev number, but the program is not applied. Instead there is a given value for either time or aperture. The value for the remaining function is the difference between the Ev and the given. The aperture and shutter time numbers are fed to the sequence controller and from there the process is identical to the program mode.

Operating mode selection is conveyed to CPU as part of the T/A code. The mode switch operates independently from the **T/A switch**, although they are on the same plate. Time and aperture share the same code generator, which simplifies the task for the **ALU**. (For example, the switch position is the same for both TV 1/125 and AV f-11).

Release Circuit

There is an automatic battery check built into the release sequence of the A-1. Pressing the release button a full stroke closes switch **SW-2** which grounds pin 19, **CPU-IC** through a diode. The sequence controller signals **OSC/Interface-IC** to turn on magnets **MG-1** and **MG-3** — placing a load on the battery. The battery voltage is then compared to a reference voltage for 12ms. **MG-2**, the release magnet, is turned on only if the battery voltage holds above the reference. **MG-2** is a combination magnet operated by the discharge of a capacitor, the same as all other A-Series Canon cameras.

Shutter Timing

As the mirror reaches the end of its rise, the first curtain latch is released and the count switch, **SW-4**, is opened. It might seem that counting for shutter timing should begin at the moment **SW-4** breaks contact, since the digital code for shutter speed is already set. However, there has to be a provision to compensate for variations in curtain positions and other mechanical irregularities which happen during assembly.

The compensation is provided by an adjustable delay using a capacitor and variable resistor, (**VR-1000**). Before the first curtain moves, the capacitor and pin 19, **OSC/Interface-IC** are shorted to ground through **SW-4**. **E1** voltage is connected o the capacitor through **VR-1000**, but no charging can take place while **SW-4** is closed. When **SW-4** opens, the capacitor begins to charge until a specific voltage is reached which triggers the timing count inside **OSC/Interface-IC**. The delay while the capacitor charges can be adjusted using **VR-1000** and is used to set the curtain spacing at 1/1000 second.

Shutter magnet, **MG-3**, releases the closing curtain when the time count reaches the count from the **ALU**. If the clock frequency is within specification and curtain spacing is correctly adjusted, all shutter speeds will be within tolerance.

Readout

The exposure calculation in the **ALU** is converted into another binary code called the binary coded decimal or BCD. BCD codes use 4-bit words, each representing one decimal number between zero and nine. Large decimal numbers, such as 1000, are very cumbersome when expressed as pure binary. By expressing each digit of the decimal number as a single 4-bit word, the word length is shortened and data manipulation is less of a problem.

Exposure information in the form of BCDs is transmitted to the **D/D-IC** from the **CPU-IC** along a line called the **O-Bus**.

The viewfinder display is an elaborate seven segment LED system which indicates shutter speed, aperture, and mode. Normally, the decoders and drivers to operate such a display would fill half the camera. To avoid this, a dynamic system is used. The dynamic method uses a multiplexer to feed the **D/D** so that only one segment is lighted at a time. Each LED segment is lit for 15 microseconds every 240 microseconds. The afterimage in the viewer's eye gives the impression that all segments are lit together. With this system only one decoder/driver is needed, with a considerable savings of power and space.

Flash Dedication

Pins 11 and 12, **Input-IC** are connected to the flash dedication pins in the accessory shoe. When a flash is installed, the **I-Bus** code from **Input-IC** is altered to instruct **CPU-IC** to override other aperture and shutter speed information. The TV code is set to 1/60 second and the AV is set to the number indicated by the flash.

II. EQUIPMENT AND GENERAL INFORMATION

A. Tools and equipment needed to carry out the testing procedures in this guide:

- Grounded soldering iron
- 1000 ohm test probe
- Zero ohm test probe
- Power supply
- DVM
- Oscilloscope
- Logic probe (optional)

B. Power consumption:

All measurements taken on typical camera using 5.80v supply:

Metering system with or without display 29ma
Shutter open 39ma
Battery check............................ 60ma
Self-timer peak with **LED** 36ma
Main switch off, battery drain less than 1 microamp

C. Typical coil resistance:

MG-1, aperture .... 325 ohms
MG-2, release .... 97 ohms
MG-3, shutter .... 195 ohms

D. Preparation for Troubleshooting:

All tests and measurements in this guide can be made with only the top and bottom cover removed. However, before removing the top cover, test the camera's operation in each mode to narrow the possible trouble area.

Most oscilloscope tests of binary codes and other wave forms can easily be made using the **SYNC** signal to trigger the sweep. (See the table of oscilloscope traces for specific settings and test points.) For convenience, solder a small piece of wire to the **SYNC** test point(**TP-2**). If a dual-trace scope is used, connect channel 1 to the **SYNC**, then set the trigger mode to channel 1. For measurements, use the channel 2 probe and display only channel 2. If a single-trace scope is used, set the trigger mode to "external" and connect the **SYNC** to the external trigger input.

If an oscilloscope is not available, a logic probe can be used to establish the presence of most logic signals. Results are best if a 3-volt power supply, such as 2 AA batteries, is used to power the logic probe. Connect the negative side to a strap lug to establish a common ground between the camera and probe.

The logic signals will appear as simultaneous "high" and "low" on the probe, but the relative intensity will vary with signal changes.

The logic signals used in the A-1's circuits are "active low." That is, zero volts is the logic "1," and the presence of voltage is no signal, or "0."

If the depth of field preview switch is pushed, and the lens set back to "auto," the shutter will not release and "EEEE EE" will appear in the viewfinder. To reset, remove the lens and push up on the aperture control lever, or set the double exposure lever to wind the shutter a second time.

III. IC CHECKS

A. OPT-IC

Pins 1 and **2** connect to the null adjustment resistors. Typical voltage is 0.06v.

Pin 3 is ground.

Pin 4 is **E1** in. The voltage should be near **B+** with **SW-1** closed.

Pin 5 connects to the input of **A-6** at pin 19, **Input-IC**. It is also connected to **KVC** through the center variable, which is the BV level adjustment. Typical voltage is 1.25v.

Pin 6 connects to the output of **A-6** at pin 18, **Input-IC**. Typical voltage is 0.60v.

Pin 8 is the BV voltage output. Typical voltage is 0.95v to 1.20v, which will change 18mv per Ev.

B. INPUT-IC

NOTE: These pin numbers and some pin functions do not agree with the Canon service manual or the SPT Journal Sept.-Oct., 1981. We have confidence in our data. Pay attention to the orientation of this IC as indicated on the schematic.

Pins 1 and **2** connect to the null adjustment resistors for the dual ramp A/D converter op-amp. Typical voltage is 0.03v.

Pin 3 is the output of the dual ramp A/D converter op-amp and is the cathode of **C.AD.** The scope trace is illustrated.

Pin 4 is the input to the dual ramp A/D converter and connects to the anode of **C.AD.** Typical voltage is 1.2v.

Pin 5 is **E1** in.

Pin 6 is the source of **KVC**. With **SW-1** closed, **KVC** should be 1.625v, +/— 0.080v.

Pin 7 is the input to op-amp **A-5** from the **OPT-IC**. Typical voltage is 0.95v to 1.20v which will change 10mv per Ev.

Pin 8 is the output of op-amp **A-5** connecting to the **Gain VR**. Typical voltage is constant 1.23v. Use a scope to check for stepped square wave form which varies with BV.

Pin 9 is the output of **VC** voltage, the same as for the **CCC**. Typical voltage is 1.219v, +/— 0.035v.

Pin 10 is the end tab, which is ground.

Pin 11 is the AV input from the left-side dedication pin on the flash shoe. To check the operation, start **CCC** current flowing by grounding the **CCC** contact (right-side dedication pin) through a 1000 ohm probe. The display should show 1/60, f-8. Next, while maintaining the **CCC** ground, short the left and right dedication contacts together. The display should show 1/60, f-4.5.

Pin 12 is the input from the **CCC** dedication contact. Voltage should equal **VC**. Operational check is the same as for pin 11.

Pin 13 is **I-BUS** signal out. See scope traces.

Pin 14 is **CLK** signal in.

Pin 15 is **SYNC** signal in.

Pin 16 is an internal connection to the voltage divider for the low voltage interlock comparator. Typical voltage is 2.0v.

Pin 17 connects to the battery check switch. Should be **E1** at all times except when check switch is operated. Grounding pin 17 should produce battery check.

Pins 18 and **19** connect to pins 6 and 5, **OPT-IC**. They are the output and input of **A-6**.

C. CPU-IC

Pin 1 is the latch signal to the **OSC/Interface-IC** to hold the circuits on during long exposures. Typical voltage is 2.0v before release and zero during the exposure.

Pin 2 is the count start signal input from the **OSC/Interface-IC**. The voltage should fall to near zero when the count switch, **SW-4**, opens.

Pin 3 is the **MG-1** signal output to pin 5, **OSC/Interface-IC**. The voltage should pulse to near zero during release. The pulse will be longer for smaller apertures.

Pin 4 is bias voltage input from the **OSC/Interface-IC**. Typical voltage is 3.5v to 4.0v.

Pin 5 is the output to the **OSC/Interface-IC** for **MG-2** and **MG-3** signal. Typical voltage is 2.0v to 2.5v before release and near zero during release.

Pins 6, 7, 8, and **9** are the inputs of the digital codes for **ASA, T/A**, Timer, and **AVO**. See scope traces.

Pin 10 is the **O-BUS** output of the display signal to the **D/D-IC**.

Pin 11 is ground.

Pin 12 is the count pulse input from the **S.AVE.** To test the input: remove the lens, wind the shutter, and set the preview switch. Press the release button one-half stroke, then observe the voltage at pin 12 as the aperture lever is moved down. There should be a series of near zero voltage pulses as the **S.AVE** wiper is moved down.

Pin 13 is the input from the **S.AVE** "set" switch. The voltage should go to near zero when the wind stroke is completed and the AE unit is charged. NOTE: If the low signal is not present, the error signal will appear in the viewfinder and the camera will not release in "auto" mode.

Pin 14 is the **SYNC** signal in.

Pin 15 is the **CLK** signal in.

Pin 16 is the **I-BUS** input from the **Input-IC**.

Pin 17 is **KVC** in.

Pin 18 is the input from the display switch, **SW-3**. Grounding this pin should turn off display.

Pin 19 is the release signal input from **SW-2**. Grounding pin 19 should start the release cycle.

Pin 20 is the input from **SW-5** which signals the shutter cycle is complete. When the pin 20 input is grounded, the latch is released and **E1** goes to zero.

Pin 21 is the input from the exposure memory switch, **SW-6**. When pin 21 is grounded, the Ev is locked, even if the **T/A** value is changed.

Pin 22 is the output signal to the **OSC/Interface-IC** which operates the BC and Timer LED. Typical voltage is 2.0v to 2.5v, dropping to zero while the LED lights.

D. OSC/Interface-IC

Pin 1 is the output signal to **MG-2**, the release magnet. The voltage should pulse low for release. Use a scope or logic probe to observe the short pulse.

Pin 2 is the output to the shutter magnet, **MG-3**. The voltage will drop to near zero from **E1** to latch **MG-3**.

Pin 3 is the **MG-2, MG-3** input signal from the **CPU-IC**. Use a scope to observe the operation. There will be a low followed by a 5ms positive gate signal to release **MG-2**.

Pin 4 is the bias out to the **CPU-IC**. Typical 3.5v to 4.0v

Pin 5 is the **MG-1** signal input from the **CPU-IC**. Use a scope or logic probe to observe the low pulse. If a scope is used, the length of the pulse will increase for smaller apertures.

Pin 6 is the count start output signal to the **CPU-IC**. The pulse should go low to signal that **SW-4** has opened. Ground pin 19 or the green wire from the A/T flex to delay the timing and latch the shutter open.

Pin 7 is the input signal from the **CPU-IC** to operate the latch. To test the operation, ground pin 7 with a zero ohm probe, then press the release button one-half stroke. Allow the release button to return, the display should remain on.

Pin 8 is the **LED** control signal in from the **CPU-IC**. Press the release button one-half stroke, then ground pin 8 with a 1000 ohm probe. The **LED** should light.

Pin 9 is the connection to the clock frequency **(CLK)** adjusting resistor.

Pin 10 is the end tab and is ground.

Pin 11 connects to the resistor which controls the current to the magnets. Typical voltage is 0.28v.

Pin 12 is the connection to the battery check oscillator capacitor. Pulse height is about 1.5v. Frequency should be about 5 Hz for battery check at a 6.0v supply.

Pin 13 is the latch output. The voltage should stay near zero during a long exposure, even if the release button is let up.

Pin 14 is **KVC** in.

Pin 15 is **CLK** out. Look for about 32,000 Hz with a scope.

Pin 16 is **E1** in.

Pin 17 is the output to the **LED**.

Pin 18 is the output to **MG-1**. The voltage will be near **E1** until release, then a short low pulse to operate the magnet.

Pin 19 is the input from the count switch, **SW-4** and the count start delay. Voltage should go from low to high at release. Grounding pin 20 should latch the shutter open.

E. **Decoder/Driver-IC.**

The **D/D-IC** is not readily accessible, so the best method is to check the inputs and outputs at the flex connection near the ASA pattern. There are 12 pads, and most are accessible even with the connector bar in place. From left (ASA side) to right (prism side), here are the connections.

1. The **O-BUS** signal input from pin 10, **CPU-IC**.

3. The clock signal input.

4. **KVC** input.

5. **E1** input.

6. Ground.

7 through **11.** Output signal to the diode array. A series of low voltages.

12. The **SYNC** output.

IV. **Relating scope traces to problems**

CLK: The **CLK** signal controls all other camera functions including the release and display. The **CLK** signal is generated inside the **OSC/Int IC.**

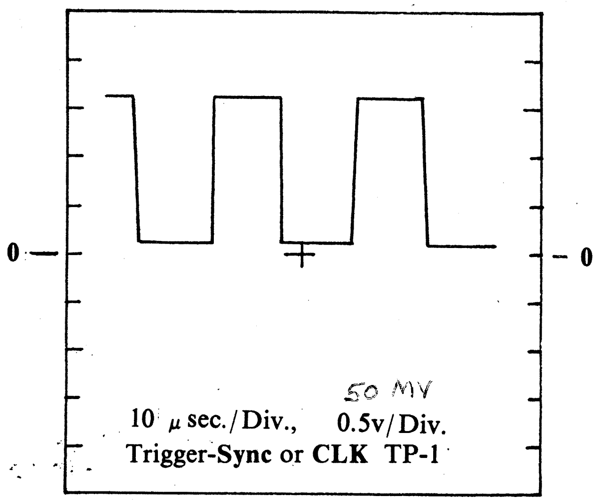
SYNC: The **SYNC** signal is developed by the **D/D IC** from the **CLK** signal. As with the **CLK** signal, there is no operation without **SYNC.**

I-BUS: The **I-BUS** signal tells the **CPU,** by means of binary codes, of the subject brightness, flash mode operation, and battery check. The signal is generated by the **INPUT IC.**

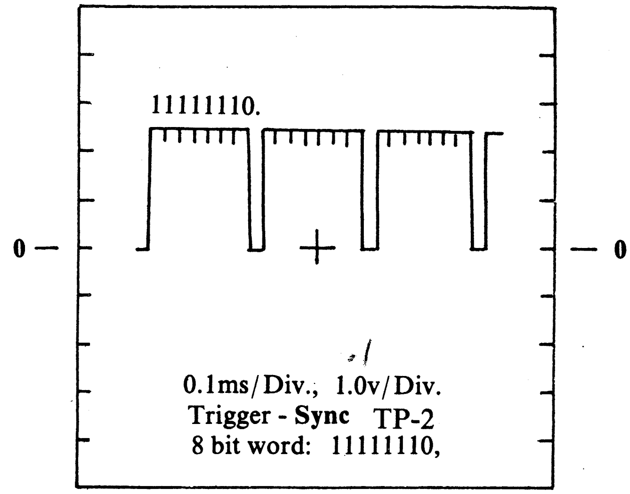
C.AD The **C.AD:** signal is the rise and fall of voltage on the cathode of capacitor **C.AD.** The "AD" stands for analog to digital conversion. If the **C.AD** signal is not correct, the **INPUT IC** or the capacitor may be at fault. If the flash mode and battery check are normal, the capacitor is the most likely cause.

AVO, ASA, T/A: These signals are binary codes which indicate aperature, time, and ASA. The **D/D IC** generates the basic signal which is distributed to each code generator (wiper) through the diode array. The codes thus generated are sent to the **CPU** to tell it what is happening outside. If one of the codes is not present or correct, check that particular flex, flex connector, or wiper. If all signals are incorrect, the D/D flex connector, **D/D IC** soldering, or diode array may be at fault. An open diode in the diode array can also cause one code to be incorrect.

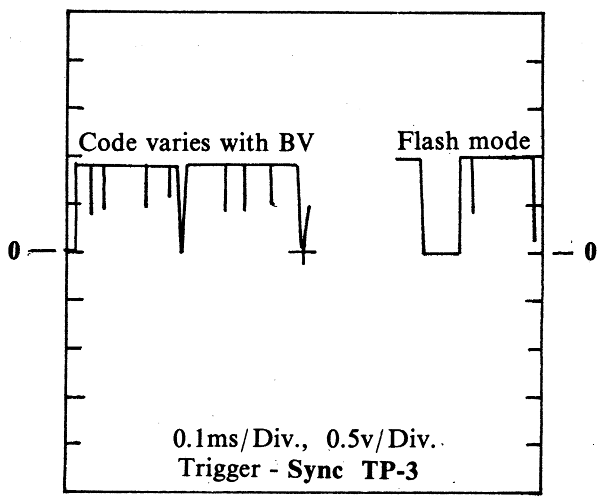
O-BUS: The **O-BUS** signal carries display information in binary code from the **CPU IC** to the **D/D IC.** If the signal is incorrect, the problem is a short to ground or **E1** in the transmission line, or IC malfunction.



CLK

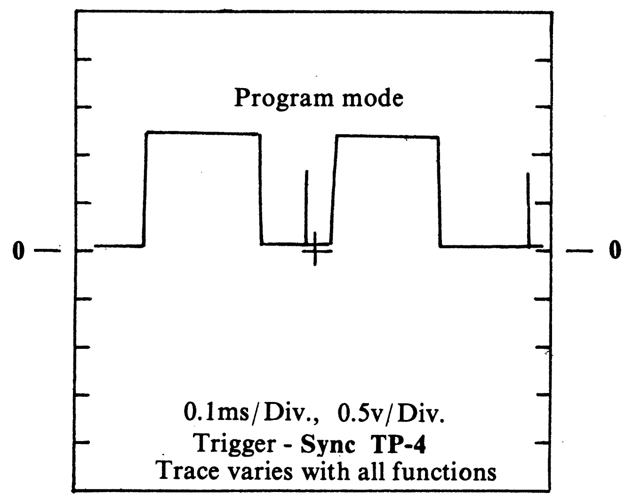


SYNC

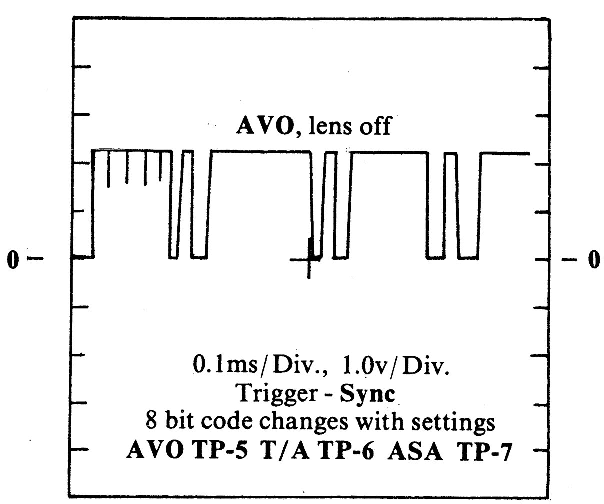


I-BUS

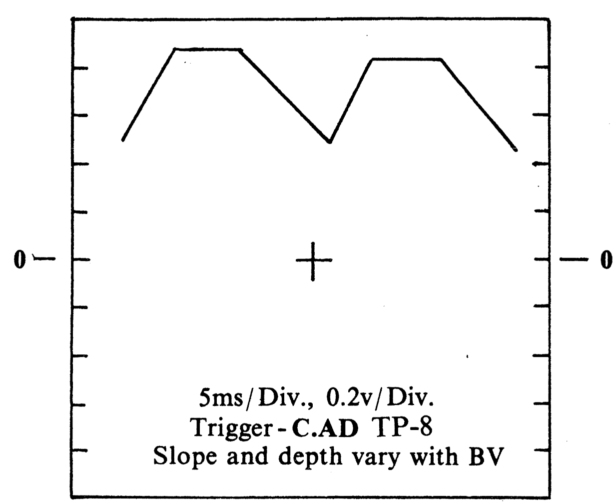
AVO - MAX APERTURE PIN



O-BUS



AVO, T/A, ASA



C.AD

V. TROUBLESHOOTING FLOW CHART INDEX

Camera Symptom	Flow Chart
No viewfinder display No shutter release	1A
Batteries drain quickly	1B
Display indication low Overexposure in "Auto" Manual operation normal	2A
Display indication high Underexposes in "Auto" Manual operation normal	2B
Shutter will not release Display indication normal Battery check normal	3A
Spontaneous shutter release	3B
Shutter will not release, "auto" Display indicates error Manual functions normal	3C
Diaphragm closes too far Display indication normal Shutter operation normal	4A
Diaphragm stays open or over Display indication normal Shutter operation normal	4B
Shutter speeds fast or run through Display indication normal Aperture operation normal	5A
Shutter speeds slow or open Display indication normal Aperature operation normal	5B
Display indications abnormal Other functions normal	6A
Flash dedication incorrect Other functions normal	7A

VI. TROUBLESHOOTING

1. Power Circuit Malfunctions

A. External Observations: No viewfinder display.
No shutter release.

- Be sure battery contacts are clean, then check for **B+** at **TP-9**.
  - NO → Red wire is off of the positive battery contact.
  - OK ↓
- Check for **B+** at the red wire on **MG-3**. Be sure the main switch is on.
  - NO → Main switch is not connecting or the black wire to **MG-3** is open.
  - OK ↓
- check for **B+** at pin 17, **Input IC** and the emitter of **TR**.
  - NO → Flex is open between red wire near **MG-2** and emitter of **TR**.
  - OK ↓
- Press the release button one-half stroke, then check for **E1** (nearly **B+**) at **MG-1** wire, **MG-2**, or any IC pin designated **E1**.
  - NO → Use 1000 ohm probe to ground **TR's** base. If **E1** appears, check **SW-1 under the release button and the flex from TR** to **SW-1.**
  - OK ↓
- Check flex circuit pressure connections.
  - OK ↓
- Check for **CLK** and **SYNC** signals.
  - NO → No **CLK,** check **OSC/INT IC.** No **SYNC,** check **D/D IC.**

B. External Observations:

Batteries drain if main switch is left on.

Connect DVM micro ammeter in series with the battery. Turn on the main switch and observe current.

→ Less than 2 micro-amps is normal.

↓ more than 2 micro-amps

Check voltage on **MG-2** terminals or other **E1** connections. Is it more than a few millivolts?

→ NO: Desolder the black wire from **MG-3** where it connects to the main flex near **MG-2.** If current leak stops, **OSC/INT IC** may be leaking. **MG-3** connects to pin 2, **OSC/INT.**

↓ Yes

One by one, desolder the connections to:
- Preview switch (blue wire)
- Battery check (orange)
- **SW-1 & SW-2** (flex)

observe the current.
If current stops, clean the switch insulators.

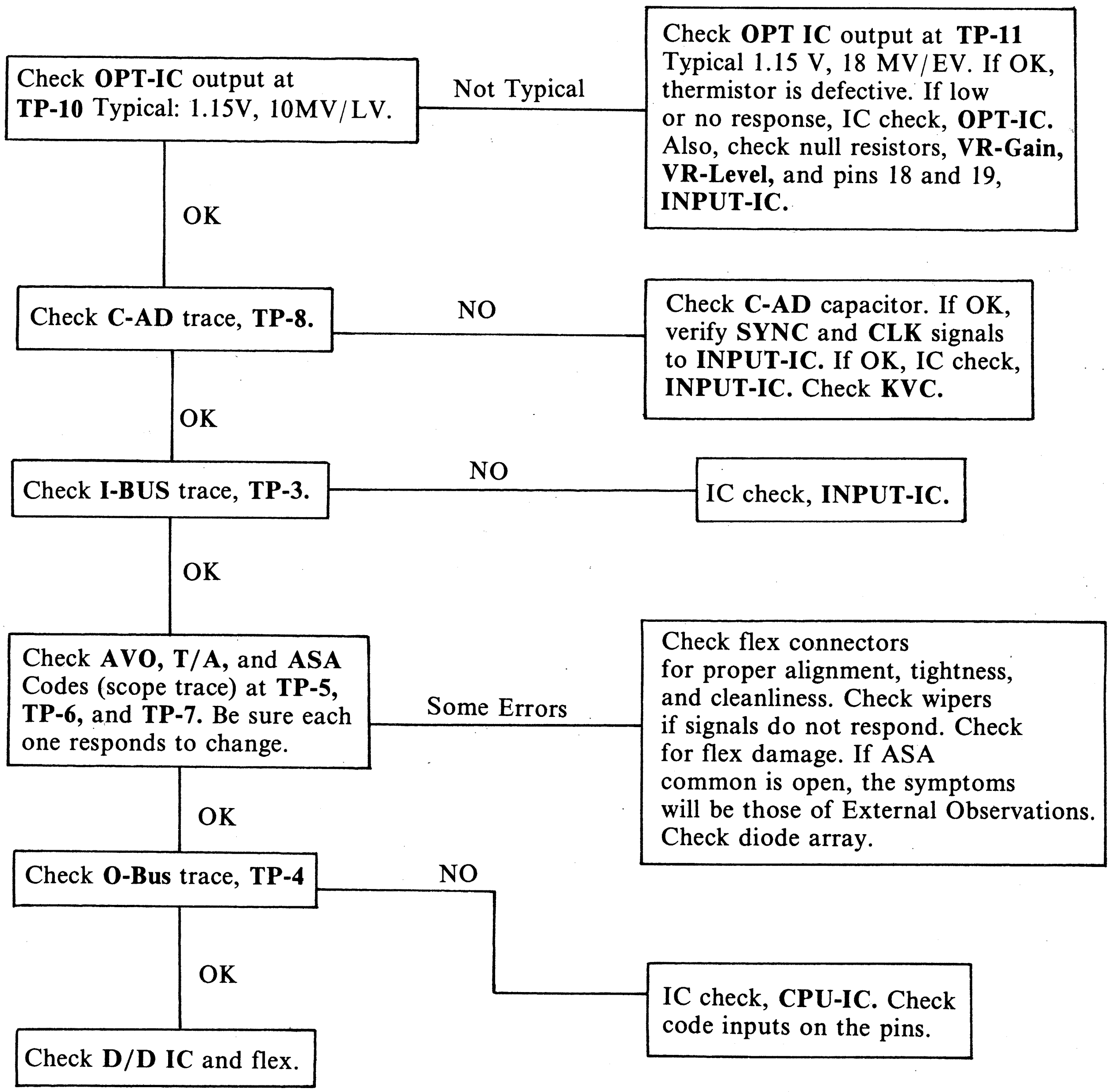
→ Recheck current leak with top cover removed to check for top cover shorts.

↓

If current continues, TR may be leaking or there is a high resistance short to ground between the base of **TR** and **SW-1.**

2. Metering Circuit Malfunctions

A. External Observations:
Display exposure reading is low or flashing.
Auto speeds slow, auto aperture open.
Manual speeds and aperture OK.



B. External Observations:
Display exposure reading is high.
Auto speeds fast, auto aperture stops down.
Manual speeds and aperture OK

Follow the flow chart for "A. External Observations."

3. Release Malfunctions

A. External Observations:

Display reading is normal.
Battery check is OK.
Shutter will not release.

Note: If camera fails to release, it will remain "latched" electrically until the battery check button is pressed to reset the circuits. Be sure to reset each time the release button is pressed a full stroke and the shutter does not release.

CHECK SW-4

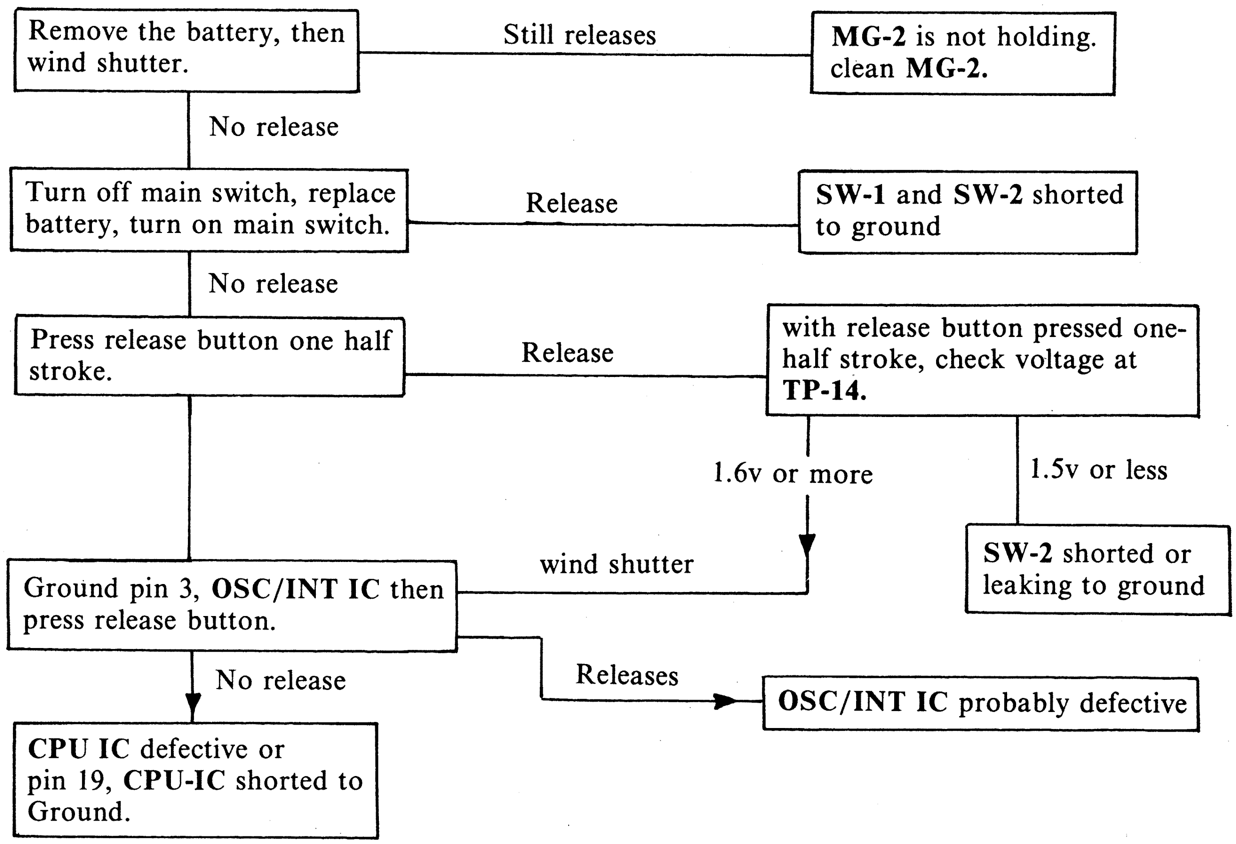
- Push the release arm of **MG-2** toward the front of the camera.
  - No release → Mechanical problem with the mirror box.
  - Release ↓
- Hold the release button one-half stroke, then check for **E-1** at **TP-13, MG-2.**
  - No or low → **MG-2** coil is open, poor solder connections to **MG-2,** or the flex is open from the collector of **TR** to **MG-2.**
  - OK ↓
- Hold the release button one-half stroke, then ground **TP-13**
  - No release → **MG-2** is sticking, has poor solder connections, or release arm pivots are binding. Check the storage capacitor for **MG-2,** located under the flex near **MG-2.**
  - Releases ↓
- Wind shutter, hold release button one-half stroke, then ground pin 1, **OSC/INT IC.**
  - No release → Flex open between Pin 1, **OSC/INT IC** and **TP-13**
  - Releases ↓
- Wind shutter, then press the release button full stroke. The circuits should latch on, indicated by the display turning off.
  - No Latch → Ground pin 19, **CPU IC** with release button pressed one-half stroke.
    - Latch or release → Diode **D-2** is open. Flex is open between **D-2** and **SW-2**. **SW-2** not making contact. Pin 19, **CPU-IC** should be low if release button is pressed.
    - No Latch or release → **IC Check, CPU IC**
  - Latch OK ↓
- While the circuit is latched, apply **B+** to pin 3, **OSC/INT IC** with a 1000 ohm probe.
  - No release → IC check, **OSC/INT IC**
  - Release ↓
- 1. Check connection from pin 5, **CPU IC** to pin 3 **OSC/INT IC.**
  2. IC check, **CPU IC.**

  Note: If CPU-IC checks OK, check **E1** voltage in latch condition. If **E1** falls below 4.5v, the release is blocked. If voltage is low with fresh battery, check for excessive current drain from magnets.

Release Malfunctions, (Cont)

B. External Observations

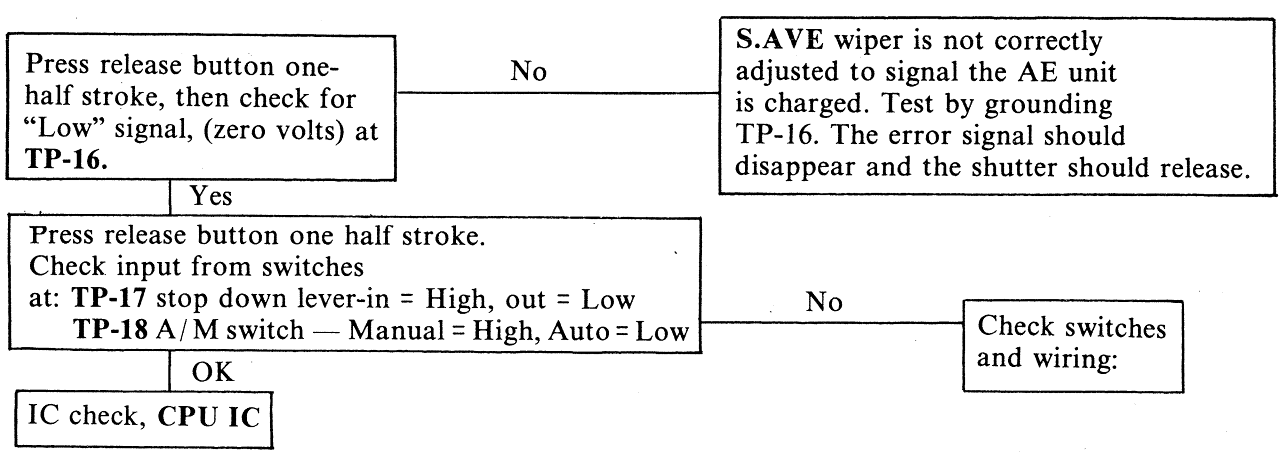
Spontaneous release or release with half stroke of release button. Other functions OK.



C. External Observations:

No release in "Auto" mode.
Error signal in viewfinder display
Manual functions OK

First be sure AE unit is charged by setting the multiple exposure lever and winding the shutter a second time.



4. Aperture Malfunctions:

A. External observations:

Diaphragm stops down to minimum or under-
exposed in "Auto"
Display is normal - agrees with dial reading in aperture priority mode
Other functions OK.

Set lens to "A" for all tests. Be sure there
is no "m" signal in viewfinder

Desolder the red wire to **MG-1** from the flex. Release shutter on slow speed and observe aperture

Stops down any amount → **MG-1** or blocking levers are sticking. Let camera sit with the shutter charged for several minutes to verify this test.

stays open

Resolder red wire from **MG-1**

Use logic probe or scope to Check signal at pin 5, **OSC/INT IC.** Voltage should fall from about 2v to zero, then return to 2v as mirror rises.

NO → IC check, **CPU IC**

OK

Use 1000 ohm probe to ground pin 5, **OSC/INT IC,** then release shutter. Hold the release button down and lift the probe away. Listen for the click of **MG-1's** release.

NO → If **MG-1** clicks only when the release button is let up, **OSC/INT IC** is probably defective or there is a short to ground in the wire from **MG-1** to pin 18, **OSC/INT IC.**

OK

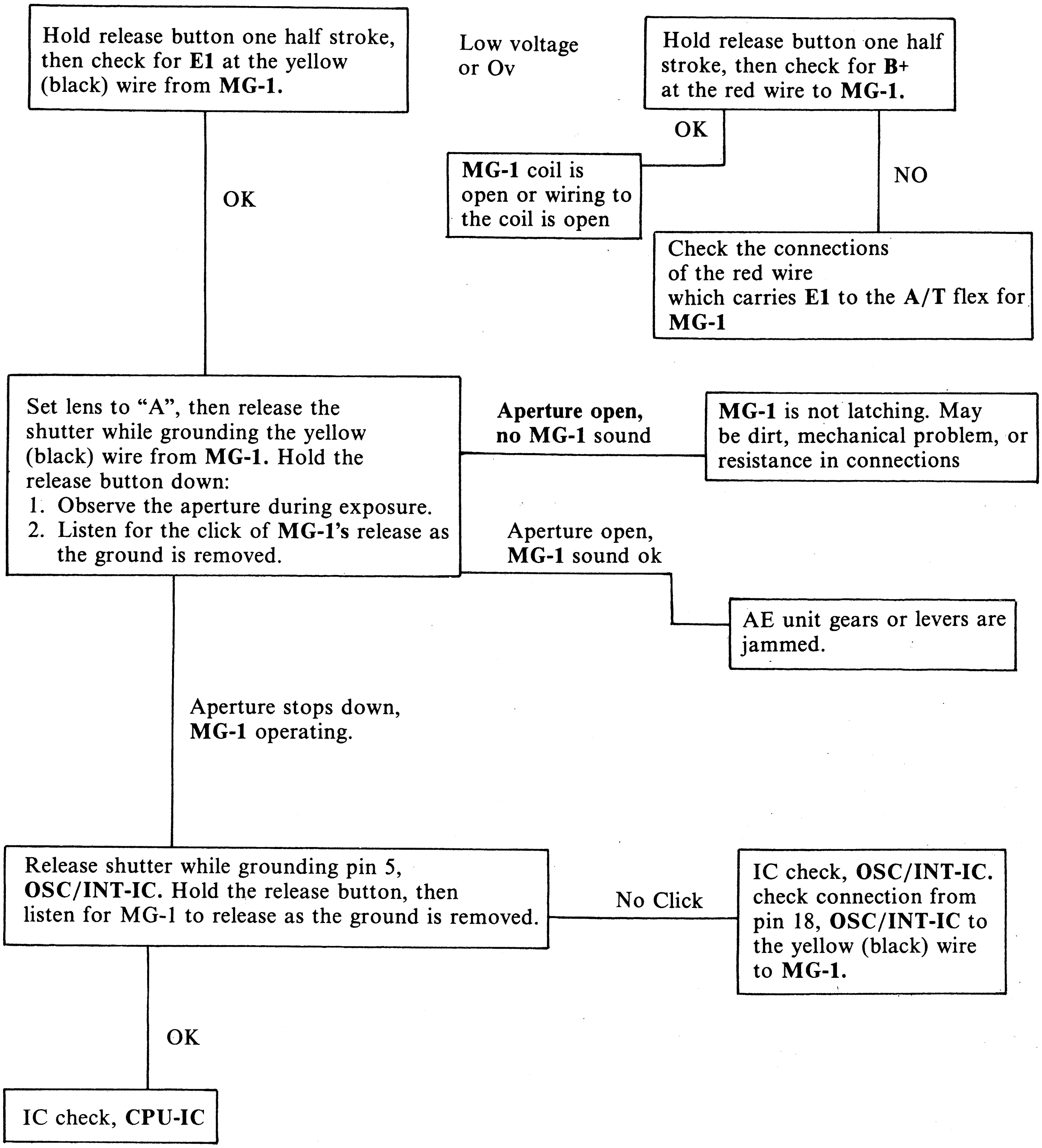
Check the output from the **S.AVE** wiper at **TP-15.** Remove the lens, wind shutter, and lock the stop-down lever in. As the aperture control lever is pushed down, there should be a series of "lows" at **TP-15.** If erratic or stays high, clean the **S.AVE** or check wiper.

Aperture Malfunctions (cont.)

B. External Obervations:

Aperture stays open or overexposes
Display is normal - agrees with dial indication
in aperture priority mode, other functions OK.

Be sure the diaphragm blades work freely

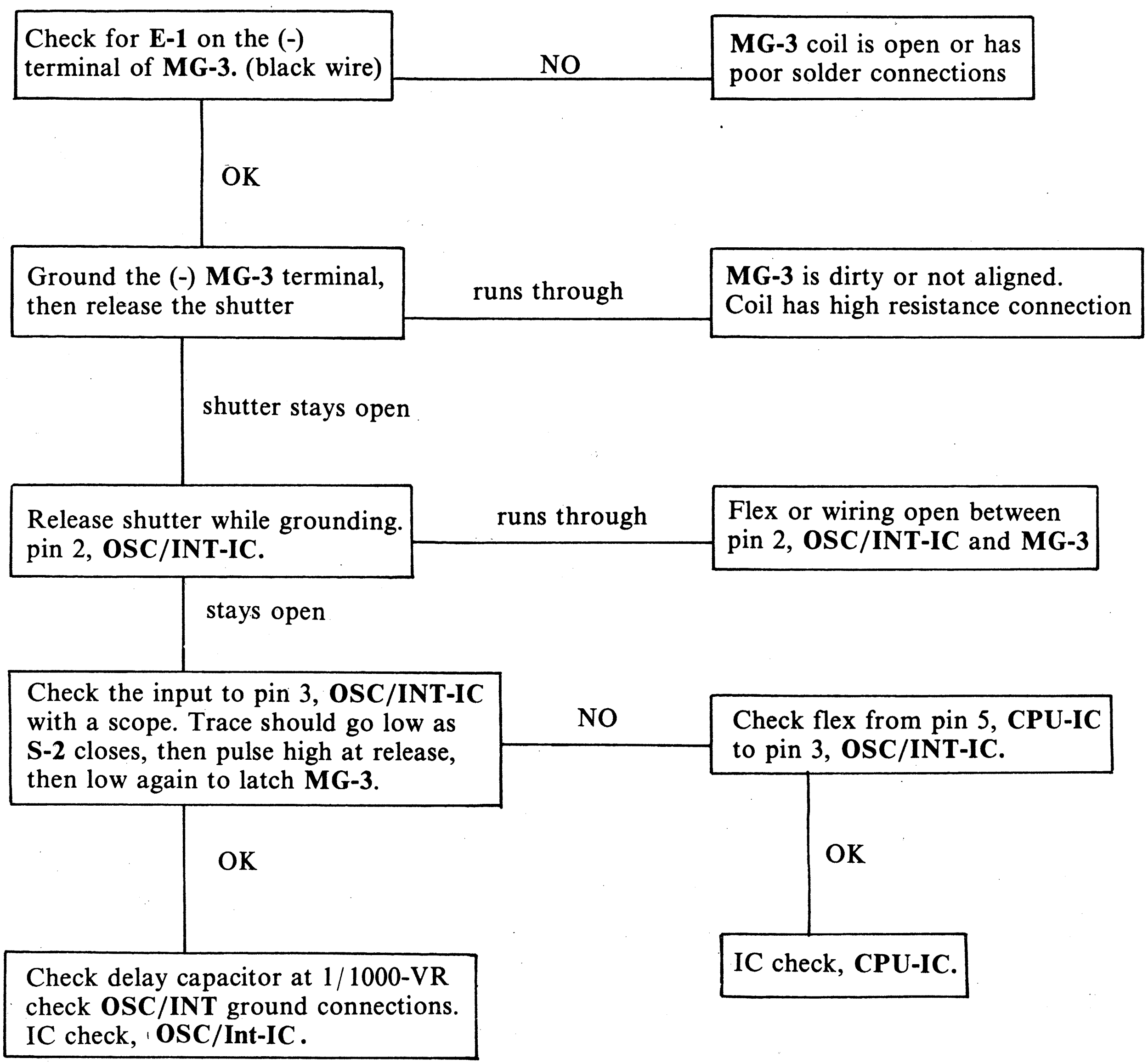


5. Shutter Malfunctions

A. External Observations:

Shutter fast or runs through without opening.
Aperture functions OK
Display OK - corresponds to speed dial indications

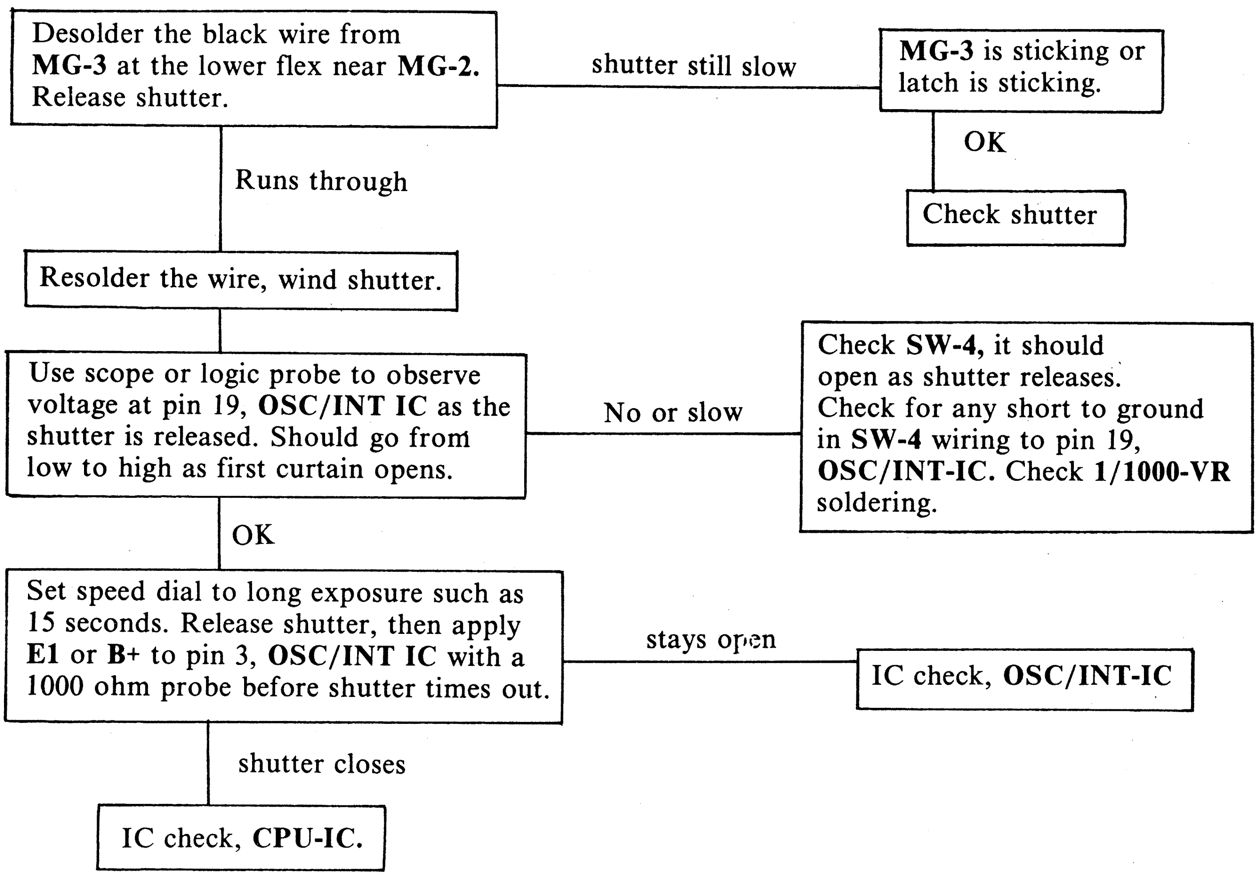
Be sure MG-3 is closed firmly and the second curtain is fully wound so that the latch held by **MG-3** is engaged



5. Shutter Malfunctions (cont.)

B. External Observations:

Shutter is slow or latches open
Aperture function is OK
Display OK. - corresponds to speed dial indication.



6. Display Malfunctions

A. External Observations:

Display does not correspond to aperture or time settings, or is erratic or dim.
Shutter speeds normal
Aperture normal.
Auto exposure OK.

1. Check the **O-Bus** signal from **CPU-IC** to **D/D IC.** If it is not correct, the **CPU-IC** is at fault or there is a short between pins or to ground.
2. If the **O-Bus** signal is correct, check the flex connection to the **D/D-IC.** Also, carefully check the D/D flex for cracks near the connection.
3. Check the **CLK, E1, KVC,** and ground inputs to the D/D flex.
4. Remove the D/D flex and check the solder connections to the **D/D IC.**

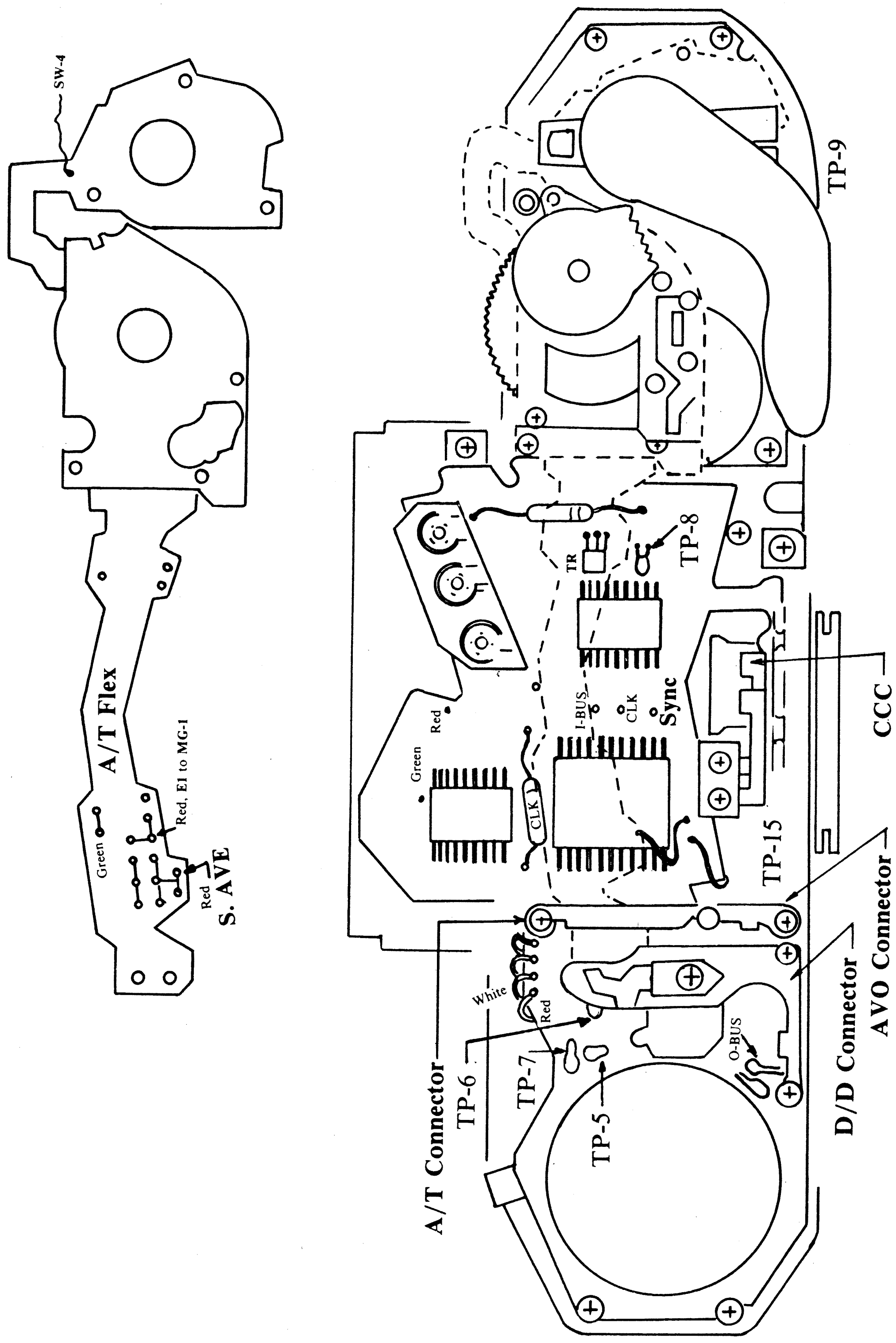
7. Flash Malfunctions

A. External observations:

Improper readout with dedicated flash.
Auto and manual functions OK.

Set lens to Auto, shutter speed to 1/125

1. Use 4700 ohm probe (or 1000 ohm probe) to ground the **CCC** contact. Display should indicate f-8, 1/60. If not, check connection to pin 12, **Input-IC** from the CCC contact. If the connection is good, check **Input-IC.**
2. With the probe in place on the **CCC** contacts, short the two dedication contacts together. Display should indicate f-4, 1/60, If not, check the connection to pin II, **Input-IC.**



Glossary

T/A. The digital code for time, aperture, and program mode.

AVO. The digital code for minimum aperture of the lens.

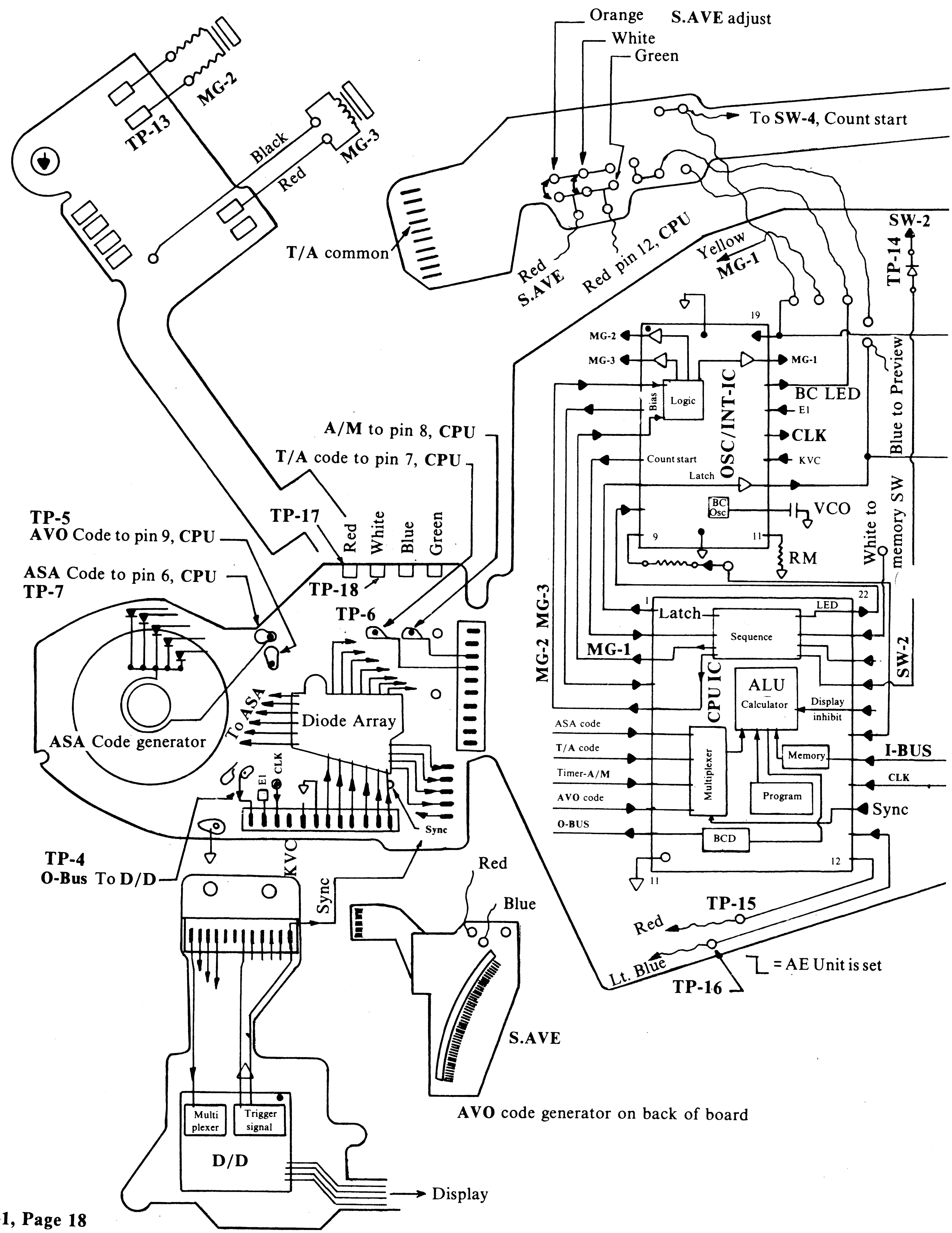
S.AVE Segmented aperture value electrode. It senses the aperture closing.

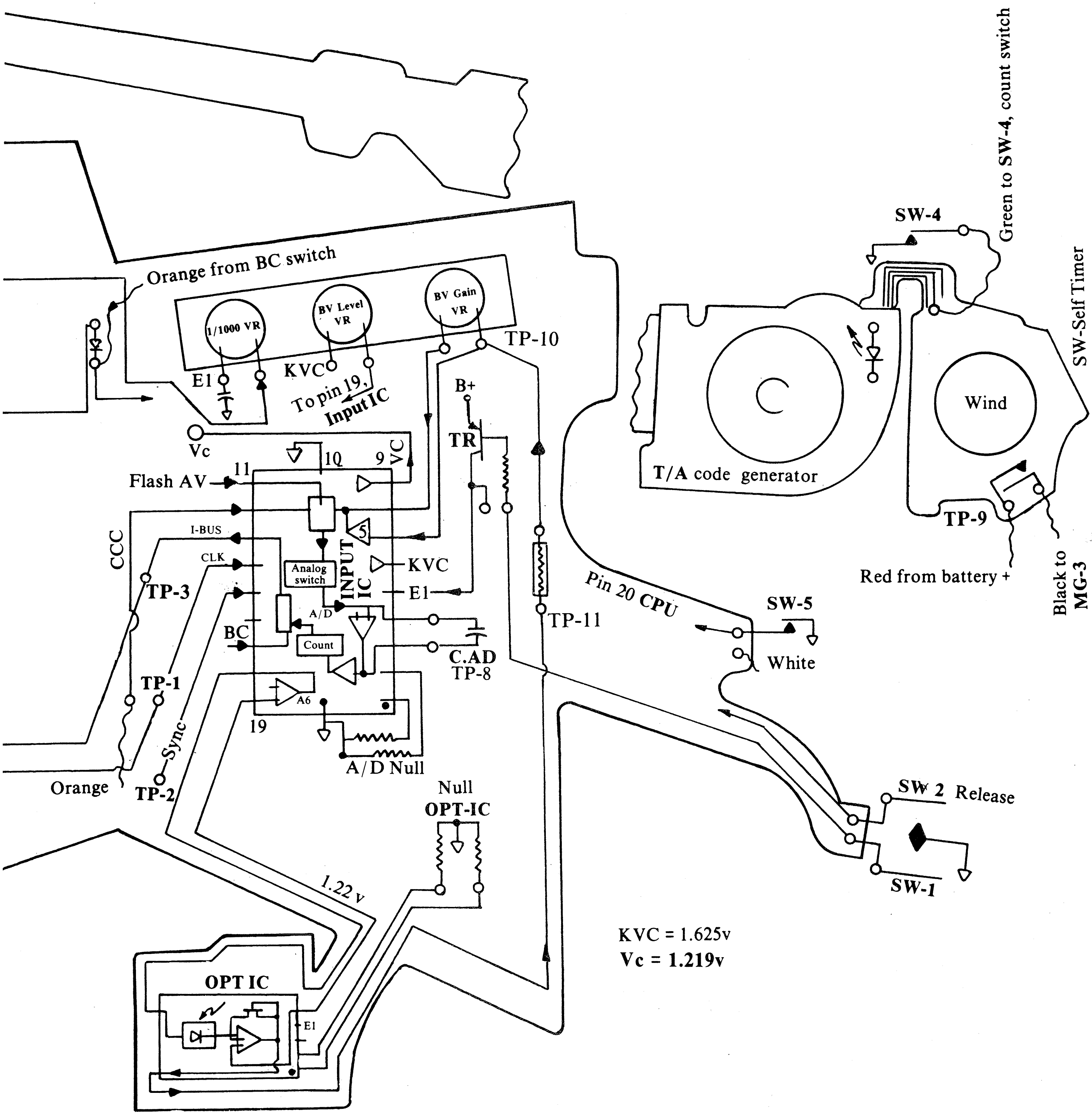
I-Bus. The digital code for the BV and flash mode signals from the Input IC to the CPU IC.

O-Bus. The BCD digital code for the display from the CPU IC to the Decoder/Driver.

Sync. A repeating digital signal consisting of seven 1s and one 0. It coordinates all other digital code transmission.

CLK. The clock pulse train which is the time base for all events. The frequency is about 32 KHZ.


Orange
S.AVE adjust
White
Green
To SW-4, Count start
MG-2
TP-13
Black
MG-3
Red
T/A common
Red
S.AVE
Red pin 12, CPU
Yellow
MG-1
SW-2
TP-14
19
MG-2
MG-3
MG-1
Logic
Bias
OSC/INT-IC
BC LED
E1
CLK
KVC
Count start
Latch
Blue to Preview
BC Osc
VCO
9
11
RM
White to memory SW
A/M to pin 8, CPU
T/A code to pin 7, CPU
TP-5
AVO Code to pin 9, CPU
TP-17
Red
White
Blue
Green
ASA Code to pin 6, CPU
TP-7
TP-18
TP-6
To ASA
Diode Array
ASA Code generator
E1
CLK
Sync
MG-2 MG-3
1
Latch
Sequence
LED
22
MG-1
SW-2
CPU IC
ALU
Calculator
Display inhibit
ASA code
T/A code
Timer-A/M
AVO code
O-BUS
Multiplexer
Memory
Program
I-BUS
CLK
Sync
BCD
11
12
TP-4
O-Bus To D/D
KVC
Sync
Red
Blue
TP-15
Red
Lt. Blue
TP-16
= AE Unit is set
S.AVE
AVO code generator on back of board
Multi plexer
Trigger signal
D/D
Display



KVC = 1.625v
Vc = 1.219v

VII. LIST OF COMMONLY USED PARTS

Part Description	Part Number
Wind lever nut	CA1-0965
Wind lever	CF1-0269
Release button	CF1-0248
Release button cover	CA1-1121
Mode switch lever	CA1-0960
Rewind knob	CG9-0051
Rewind shaft	CA1-0981
ASA dial face	CS1-8153
ASA lock plate	CA1-0986
ASA dial	CF1-0252
ASA wiper	CF1-0251
Slide cover, A/T dial	CA1-0975
Slide, A/T dial	CA1-1062
A/T dial	CF1-0245
Timer switch lever	CA1-0932
ME switch lever	CA1-0930
Timer/Main switch	CF1-0239
Film door	CG1-0055
Tripod socket	CA1-4708
Right front leather	CA1-1079
Left front leather	CA1-1112
Top cover	CG9-0048
Bottom cover	CA1-0905
Battery cover	CF1-1489
Eyepiece lens	CF1-0255
Screen	CN1-5083
Wind shaft	CF1-0236
Film spool	CF1-1411
Film sprocket	CA1-4727
Upper wind plate	CG9-0063
Aperture magnet **MG-1**	CF1-1458
Shutter magnet **MG-3**	CF1-0492
Release magnet **MG-2**	CG1-0050
CPU-IC	CH4-0004
OSC/INT-IC	CH4-0006
INPUT-IC	CH4-0005
OPT-IC	CH4-0008
A/T flex unit	CY1-1049
Main flex unit	CG1-0051
D/D flex unit	CG1-0052
AE unit	CG1-0047
Top cover screw	X91-1736-360
Bottom cover screw	X91-1701-110

VIII. ADJUSTMENT PROCEDURE

1. Adjust the 1/1000 shutter speed:
Measure the speed with the lens off, then adjust using the **1/1000 VR.**

2. Check the clock frequency:
It should be 32 KHz, +/- 2 KHz. If a calibrated scope or frequency counter is not available, carefully check the shutter speed at 1 second. The clock frequency is adjusted by changing the value of the **CLK** resistor, located between the **CPU** and **OSC/Int ICs.**

3. Adjust the auto shutter speeds:
Set the mode to aperture priority, f=5.6 and the ASA to 100. Note the shutter speed indication in the viewfinder display at LVs 6, 9, and 15. Adjust the **BV Gain-VR** for linear response between LV-9 and LV-15. Adjust the **BV Level-VR** for 1/125 at LV-12. Measure the auto shutter speed at LV-12 to verify 1/125. If the shutter speed does not correspond to the indication, recheck the clock frequency or clean **MG-3.**

4. Check the auto aperture at LV-12 and ASA 100. The exposure can be decreased 1/8 Ev by moving the small orange wire, soldered to the **A/T Flex,** forward to a vacant land. Move both the white and orange wires to decrease the exposure by 1/4 Ev.

Most other adjustments are not normally necessary. Refer to the Canon A-1 manual for further information.

Batt check sw CG9-0061

I. EXTERNAL TESTS

Note: The Canon A-1's viewfinder is closely related to all exposure functions. You will be able to locate the source of many malfunctions from external observations.

1. With the main switch set to "A," press the battery test button. The LED should blink to indicate a strong battery. If there is no indication, check for about 60ma power consumption with test button pressed.

   A. Very low current would indicate power circuit problems.

   B. Current between 2ma and 30ma would indicate possible IC problems.

   C. Near normal current would indicate a poor connection to the LED.

2. With lens off, set 1/125, then press the release button one-half stroke and observe the display. The "M" and 125 should be lighted, also an f-number which should change with light and ASA. Point the camera to a dark area; a flashing "5.6" should appear. Slowly depress the maximum aperture sensing pin; the f-number should change in steps to "1.2," then "0."

3. Change to aperture priority mode; the f-number displayed should be "11" (if you haven't moved the dial) and the shutter speed number will change with light and ASA.

4. Install the lens and set it to "A." Ground the right side dedication contact through a 1000 ohm probe while holding the release button one-half stroke. The display should indicate "60 F 8.0." Release the shutter; the aperture should close to f-8 and the shutter speed should be 1/60.

5. If results of test 1 through 4 were normal, all ICs are working and any malfunction is probably due to poor adjustment or a mechanical problem. Here are some common causes of improper results from the tests.

   A. No display (be sure the white dot is showing) and no release could be a power circuit problem, no clock **(OSC/INT-IC)**, or defective **D/D IC**. Also, there may be poor connection of the pressures contacts to the **D/D** flex.

   B. No display but normal exposure is probably the **D/D** flex, pressure contacts, or possibly the **CPU-IC**.

   C. Partial display or garbage display with corresponding shutter and auto aperture behavior usually means dirty wipers on the speed dial or the **T/A** flex pressure connection. The mode switch contacts also can cause this problem. The sure test is flash mode. If the flash mode operation is correct, the problem is in the **T/A** system.

   D. Display and exposure malfunctions, including flash mode, suggest IC problems. Usually the **Input-IC** or **CPU-IC**.

   E. If the display does not respond to changes in light, but does with ASA, the problem is **Input-IC**, **OPT-IC**, **C.AD**, or related circuit.

   F. If the display indicates correct aperture but actual lens opening is different, the problem is usually **MG-1**, **S.AVE**, or possibly **OSC/INT IC**.

   G. If the display indicates correct shutter speed, but actual speed is different, **SW-4**, the delay, or **OSC/INT-IC** may be at fault.

6. "EEE EE" display in "A" mode usually means the AE unit on the mirror box is not set or out of adjustment. The same signal in "M" mode often means a defective **CPU-IC**.

7. Check self-timer operation. If it is not working, the cause is usually a dirty wiper or pressure contact.

II. TROUBLESHOOTING UPDATES

1. Many battery drain problems occur around the battery check switch. You may have to slightly loosen the screw holding the switch contact and insulators in addition to cleaning them.

2. If there is battery drain because low voltage is present at the **E-1** locations (for example pin 5, **Input IC**) even with **TR** off or disconnected, try lifting the flex pressure contacts and shifting the ASA board slightly.

3. If there is no digital signal present at test points for ASA, AVO, or T/A, first determine the voltage at each point. If the voltage is near zero, the **CPU-IC** is probably defective. If two volts or higher, the **D/D-IC** is probably defective.

4. When troubleshooting **OPT-IC** and **INPUT-IC** for high or low brightness voltage, be sure **KVC** is connected to pin 19, **INPUT-IC** through the **BV Level VR.**

If the camera does not release, make the following external observations to help narrow the problem:

1. If the display does not turn off when the release button is pressed, switch **SW-4** (Count Switch) may not be making contact when the shutter is set, or may not be connected to pin 19 **OSC/INT IC**.

2. If release is erratic and the display sometimes stays off (circuit latched) after the shutter runs, switch **SW-5** may be dirty or pin 20, **CPU** may not be soldered. **SW-5** is located at the front under the speed control code generator board. You can reach it with top cover in place by removing the speed dial guard and cover plate at the front.

III. CIRCUIT UPDATES AND CORRECTIONS

1. Early models of A-1 circuits did not operate magnets from the **E-1** source. Instead, magnets are connected to battery voltage through the Main Switch, **S-7**. When troubleshooting for battery drain, remember that transistor TR need not be on for voltage to appear at the magnets.