Model TVM-2A (VHF)
Model TVM-3A (UHF)
TV Frequency Monitor

Guide to Operations

2/02

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WARRANTY AND ASSISTANCE

All Belar products are warranted against defects in materials and workmanship. This warranty applies for one year from the date of delivery, FOB factory or, in the case of certain major components listed in the instruction manual, for the specified period. Belar will repair or replace products which prove to be defective during the warranty period provided that they are returned to Belar prepaid. No other warranty is expressed or implied. Belar is not liable for consequential damages.

For any assistance, contact your Belar Sales Representative or Customer Engineering Service at the Belar factory.

1 General Description

The Belar TVM-2A and the TVM-3A are digital TV frequency monitors designed expressly to measure TV visual carrier and aural carrier or aural intercarrier deviations. These units employ pulsed high-intensity red seven-segment LED displays for easy reading under high ambient light conditions. Since the TVM-2A and TVM-3A incorporate true frequency counter circuits that are multiplexed between aural and visual carriers, the aural and visual carrier frequencies may be measured independently. When one carrier is off, the monitor will display the remaining carrier frequency correctly while giving both an RF Level and an Off-Frequency alarm for the missing carrier. The monitor contains two digital displays, one for aural or intercarrier and one for visual with ± indicators to indicate deviations from correct channel frequency. The monitor also incorporates Off-Frequency alarm drivers that are inhibited so that three successive errors are required to signal an alarm to prevent false Off-Frequency alarms.

A 1 MHZ output is provided for frequency comparison.

The TVM-2A and TVM-3A will interface with the RFA-3 for off-air monitoring and remote control applications.

1-1 Features:

- Measures visual and aural carrier frequencies independently - no need to have one on to measure the other
- Push-button selection to measure aural carrier or aural intercarrier frequency
- True frequency counter circuits - instead of period comparators - give mathematically correct frequency readings
- Inhibited off-frequency alarm drivers to prevent false off-frequency alarms
- 1 MHZ output
- Interface with RFA-3 for off-air monitoring

Operating Modes:

Zero mode - unit self check

Operate mode - visual and aural, or, visual and intercarrier frequency measurement.

Direct - measures the carrier frequencies directly at the transmitter

RFA - measures the carrier frequencies off-air using an RFA-3 rf amplifier

1-2 Specifications:

TVM-2A ..... Channels 2-13
TVM-3A ..... Channels 14-83
Time Base ..... $\pm 5 \times 10^{-7}$, 0 to 30°C
$\pm 1 \times 10^{-6}$, 0 to 45°C
$\pm 1 \times 10^{-6}$, per year
Digital Readout ..... Separate 7-segment LED readout for visual and

	aural carrier or aural intercarrier deviations
Offset	Preset for ±10 kHz offsets, automatically adjusts for 0 offset on intercarrier
Off-Frequency Alarms	Either ±500 Hz or ±1000 Hz switch setable, inhibited for three successive errors
RF Level Alarm	Activates if one of the carriers is missing or too low for an accurate frequency measurement
Gate Time	2 seconds
Power Requirements	115 or 230 Vac, 50/60 Hz
Dimensions	3 ½"H x 11 1/4"D x 19"W (EIA rack mount)
Shipping Weight	12 lbs (5.4 kg)

2 Unpacking

2-1 Initial Inspection

Check the shipping carton for external damage. If the carton exhibits evidence of abuse in handling (holes, broken corners, etc.) ask the carrier's agent to be present when the unit is unpacked. Carefully unpack the unit to avoid damaging the equipment through use of careless procedures. Inspect all equipment for physical damage immediately after unpacking. Bent or broken parts, dents and scratches should be noted. If damage is found, refer to Paragraph 2-2 for the recommended claim procedure. Keep all packing material for proof of claim or for possible future use.

2-2 Claims

If the unit has been damaged, notify the carrier immediately. File a claim with the carrier or transportation company and advise Belar of such action to arrange the repair or replacement of the unit without waiting for a claim to be settled with the carrier.

2-3 Repacking for Shipment

If the unit is to be returned to Belar, attach a tag to it showing owner and owner's address. A description of the service required should be included on the tag. The original shipping carton and packaging materials should be used for reshipment. If they are not available or reusable, Belar can provide a replacement box and packaging at a nominal cost. Alternatively, the unit should be repackaged in the following manner:

a) Use a double-walled carton with a minimum test strength of 275 pounds.
b) Use heavy paper or sheets of cardboard to protect all surfaces.
c) Use at least 4 inches of tightly packed, industry approved, shock absorbing material such as extra firm polyurethane foam or rubberized hair. **Newspaper is not sufficient for cushioning material!**
d) Use heavy duty shipping tape to secure the outside of the carton.
e) Use large **FRAGILE** labels on each surface.
f) Return the unit, freight prepaid. Be sure to insure the unit for full value.

3 Installation and Setup

3-1 TVM-2A Operating Instructions

The following procedure should be followed when placing the unit into initial operation.

1. Switch the DIR-RFA switch on the rear panel to DIR for direct transmitter operation. Switch the DIR-RFA switch to RFA if operation with an RFA-3 off-air amplifier is intended. Set the 500-1000 switch to 1000 for the 1000 Hz off-frequency alarm function or to 500 for the 500 Hz off-frequency alarm.

2. Before applying power to the monitor, measure the incoming RF level of the visual and aural carriers with the internal diode by plugging an external microammeter into the red and black pin jacks (DC) on the rear panel and applying the RF to the LEVEL jack. Adjust the RF levels to the monitor to read a nominal 30 to 45 microamps as read on the external microammeter. After adjusting the RF levels, plug the aural cable into the aural jack A and plug the visual cable into the visual jack V.

   NOTE: Keep aural carrier level within 20 dB of visual carrier level so that the monitor will be able to count the intercarrier.

3. Before turning the unit on, adjust the line voltage selector switch, next to the fuse on the rear panel, to the line voltage that is to be applied to the unit. 115 volts should appear in the switch window for 115 volt line and 230 volts should appear in the window for 230 volt line.

   CAUTION: Do not apply 230 volts when the unit is switched to 115 volts.

   Install the appropriate fuse, ½ amp slow-blow for 115 volts or ¼ amp slow-blow for 230 volts. Apply power to the unit. Depress the DISPLAY PWR switch to turn the display on. Note that the DISPLAY PWR switch only turns the display indicators on and off; the unit remains on as long as the power is applied.

   CAUTION: Use the fuses specified here; otherwise the unit may be damaged.

4. Depress the ZERO switch on the front panel. After 2 timing periods, a 0.00 deviation should appear in the window for both the visual and aural frequency indication. In DIR mode the polarity signs should indicate a plus and should blink alternately every 2 seconds to indicate the unit is gating. In RFA mode the polarity signs should indicate a minus and should blink alternately every 4 seconds.

5. Depress the Operate (OPER) and release the Intercarrier (INT CAR) switches on the front panel. A count should appear in the window for both the visual and aural frequency deviations. The display units are in kHz deviation, +0.32 means +0.32 kHz or +320 Hertz.

6. Depress the INT CAR switch. The aural indication is the deviation of the 4.5 MHZ intercarrier. The INT CAR light will be on, indicating this mode.

7. The RF LEVEL light will come on if the RF level is insufficient for counting. The OFF FREQ light will come on if the RF LEVEL alarm is on for three or more successive counts. The display will be blank except for the polarity signs and decimal points. The RF LEVEL function appears on the rear panel terminal block, TB-1, as an NPN transistor open collector which goes to ground when the RF LEVEL light comes on. Terminal 3 is grounded and terminal 1 is the NPN collector. Note that if an inductive circuit such as a relay is used with the alarm transistor, the transistor must be protected from the counter EMF or reverse voltage with a diode or other means. Also note that the transistor current should be limited to 50 mA or less.

8. The OFF FREQ light will come on if the frequency deviation exceeds the off-frequency setting on the 500-1000 alarm switch on the rear panel. It requires 3 successive errors to trigger the alarm function. If the error exceeds 9.99 kHz for 3 successive counts, the OFF-FREQ light will come on and the display will blank out also. The polarity signs will remain blinking to demonstrate the unit is gating. The OFF FREQ function appears on the rear panel terminal block, TB-1, as an NPN transistor open collector which goes to ground when the OFF FREQ light comes on. Terminal 3 is ground and terminal 2 is the NPN collector. Note that if an inductive circuit is used with the alarm transistor, the transistor must be protected from the counter EMF or reverse voltage with a diode or other means. Also note that the transistor current should be limited to 50 mA or less.

9. If the INT CAR switch is released, the counter will count the visual carrier for 2 seconds (4 seconds in RFA mode) and will update the visual display, at which point the polarity sign of the VISUAL deviation will blink. Then the counter will count the aural carrier for 2 seconds (4 seconds in RFA mode) and will update the aural display. This sequence will repeat until the INT CAR switch is depressed.

   If the INT CAR switch is depressed, the counter will count the visual carrier as explained above and then will count the intercarrier for 2 seconds and will update the intercarrier deviation on the aural display. This sequence will repeat until the INT CAR switch is released.

   If the RF LEVEL lights up after the polarity sign of the VISUAL deviation blinks, this means that the aural carrier level is too low for the counter to count. If the RF LEVEL lights up after the polarity sign of the AURAL deviation blinks, this means that the visual carrier level is too low for the counter.

3-2 TVM-3 and TVM-3A Input Connections

The Belar TVM-3 and TVM-3A TV Frequency monitors are designed to work from either a composite visual-aural signal (DIRECT mode) or the IF outputs of a Belar RFA-3 TV RF Amplifier (RFA mode). Changes in internal connections are required to switch operation from the DIRECT to RFA mode, and vice versa. (In most cases, if the frequency monitor is shipped with an associated RFA-3, internal connections are initially set for operation with the RFA-3.)

The internal wiring changes involve changing the input connections to the A1 Signal Selector and Scaler card. For operation in the DIRECT mode, the A1 inputs are connected to the outputs of the A5 Mixer card by coaxial jumper cables. For operation in the RFA mode, the input connections to the A1 card are brought out to the monitor rear panel BNC jacks. The connections are as follows:

	"DIRECT"	"RFA"
A1 Input	A5 Output	Rear Panel Jack
pins 15 & 16 (ground)	to A5 pins 1 & 2 (ground)	to "A" (J3)
pins 8 & 7 (ground)	to A5 pins 4 & 3 (ground)	to "V" (J4)
pins 3 & 2 (ground)	to A5 pins 7 & 8 (ground)	to "LO" (J5)

In the "DIRECT" mode the A5 card input is connected to the "RF IN" BNC jack (J10) on the rear panel via coaxial cable.

Also note that the "DIR-RFA" switch on the rear panel of the unit must be set to the appropriate position for proper operation.

3-3 TVM-3A Operating Instructions

The following procedure should be followed for placing the unit into initial operation.

1. Switch the DIR-RFA switch on rear panel to DIR for direct transmitter operation. Switch the DIR-RFA switch to RFA if operation with an RFA-3 off-air amplifier is intended. Set the 500-1000 switch to 1000 for the 1000 Hz off-frequency alarm function or to 500 for the 500 Hz off-frequency alarm.

2. Before applying power to the monitor, measure the incoming RF level of the composite signal with the internal diode by plugging an external microammeter into the red and black pin jacks (DC) on the rear panel and applying the RF to the LEVEL jack. Adjust the RF level to the monitor to read a nominal 30 to 45 microamps as read on the external microammeter. After adjusting the RF level, plug the RF cable into the upper jack, RF IN.

3. Before turning the unit on, adjust the line voltage selector switch, next to the fuse on the rear panel, to the line voltage that is to be applied to the unit. 115 volts should appear in the switch window for 115 volt line and 230 volts should appear in the window for 230 volt line.

   CAUTION: Do not apply 230 volts when the unit is switched to 115 volts.

   Install the appropriate fuse, ½ amp slow-blow for 115 volts or ¼ amp slow-blow for 230 volts. Apply power to the unit. Depress the DISPLAY PWR switch to turn the display on. Note that the DISPLAY PWR switch only turns the display indicators on and off; the unit remains on as long as the power is applied.

CAUTION: Use fuses specified here; otherwise the unit may be damaged.

4. Depress the ZERO switch on the front panel. After 2 timing periods, a 0.00 deviation should appear in the window for both the visual and aural frequency indication. The polarity signs should indicate a plus and should blink alternately every 4 seconds to indicate the unit is gating.

5. Depress the Operate (OPER) and release the Intercarrier (INT CAR) switches on the front panel. A count should appear in the window for both the visual and aural frequency deviations. The display units are in kHz deviation. +0.32 means +0.32 kHz or +320 Hertz.

6. Depress the INT CAR switch. The aural indication is the deviation of the 4.5 MHZ intercarrier. The INT CAR light will be on, indicating this mode.

7. The RF LEVEL light will come on if the RF level is insufficient for counting. The OFF FREQ light will come on if the RF LEVEL alarm is on for three or more successive counts. The display will be blank except for the polarity signs and decimal point. The RF LEVEL function appears on the rear panel terminal block TB-1 as an NPN transistor open collector which goes to ground when the RF LEVEL light comes on. Terminal 3 is grounded and terminal 1 is the NPN collector. Note that if an inductive circuit such as a relay is used with the alarm transistor, the transistor must be protected from the counter EMF or reverse voltage with a diode or other means. Also note that the transistor current should be limited to 50 mA or less.

8. The OFF FREQ light will come on if the frequency deviation exceeds the off-frequency setting on the 500-1000 alarm switch on the rear panel. It requires 3 successive errors to trigger the alarm function. If the error exceeds 9.99 kHz for 3 successive counts, the OFF FREQ light will come on and the display will blank out also. The polarity signs will remain blinking to demonstrate the unit is gating. The OFF FREQ function appears on the rear panel terminal block TB-1 as an NPN transistor open collector which goes to ground when the OFF FREQ light comes on. Terminal 3 is ground and terminal 2 is the NPN collector. Note that if an inductive circuit is used on the alarm transistor, the transistor must be protected from the back EMF or reverse voltage with a diode or other means. Also note that the transistor current should be limited to 50 mA or less.

9. If the INT CAR switch is released, the counter will count the visual carrier for 2 seconds, the LO for 2 seconds, and update the visual display, at which point the polarity sign of the VISUAL deviation will blink. Then the counter will count the aural carrier for 2 seconds, the LO for 2 seconds, and will update the aural display. This sequence will repeat until the INT CAR switch is depressed.

   If the INT CAR switch is depressed, the counter will count the visual carrier as above and then will count the intercarrier for 2 seconds and will update the intercarrier deviation on the aural display. This sequence will repeat until the INT CAR switch is released.

   If the RF LEVEL lights up after the polarity sign of the VISUAL deviation blinks, this means that the aural carrier level is too low for the counter to count. If the RF LEVEL lights up after the polarity sign of the AURAL deviation blinks, this means that the visual carrier level is too low for the counter.

4 Detailed Circuit Description

4-1 Signal Selector and Scaler - A1 Card

Incoming signals are selected and conditioned by A1U1, A1U2 and A1U3. When logic "0" voltage (i.e., Approx. 0 volt) is applied to pin 4 of the A1 card, A1Q1 conducts and turns on A1U1A and A1U1B. The LO (Local Oscillator) input is thus driven into limiting and fed to the inputs of A1U4. Similarly, Visual Carrier (or Visual IF) and Aural Carrier (or Aural IF) are selected and driven into limiting when logic "0" voltages are applied to pin 6 and pin 19 causing A1U2A & B and A1U3A & B to turn on respectively. A1U4 ensures that output levels from A1U1B, A1U2B and A1U3B are ECL (Emitter Coupled Logic) compatible. The outputs from A1U4 are divided by 2 via AlU5, a high speed flip-flop device.

Intercarrier Deviation:

When the monitor is measuring intercarrier deviations (i.e., the INT CAR button is depressed*), logic "0" is applied to pin 6 and pin 19 of the A1 card simultaneously. Visual and Aural signals are thus selected and conditioned at the same time. A1U4 is used as a mixer in this operational mode. The mixed output is then passed through a lowpass filter composed of A1L1, A1C23 and A1C24. A logic "0" voltage is also applied to pin 14 of the A1 card at this time, causing A1Q6 to turn off. The filtered intercarrier output is then passed through A1Q5 and A1Q7 and fed to A1U5 to be divided by 2.

(*NOTE: The older TVM-2 & 3 monitors measure intercarrier deviation when the INT CAR button is released.)

For the TVM-2A, the divide-by-2 output from A1U5 is fed to A1U6 and is thus divided by 2 again. The scaled down signal (i.e., divide-by-4 for TVM-2A, divide-by-2 for TVM-3A) is fed to the main counter board. It is also level-shifted via A1Q8 to be used as the front panel RF LEVEL alarm driving signal, with an open-collector output to the rear panel remote alarm connector (TB-1 #1) through A1Q9. A1Q10 is used as a buffer stage for providing an open-collector output for the off-frequency (OFF FREQ) alarm to the rear panel remote alarm connector (TB-1 #2).

Self Check:

When the monitor is self checking (i.e., Zero button is depressed), a 3 MHZ signal is applied to pin 9 of the A1 card. This signal is fed to A1U4 through A1Q4, and is subsequently fed to A1U5.

4-2 Crystal, Counter and Logic - A2 Card

Time Base and Control Logic:

The 3 MHZ clock signal from crystal oscillator A2Y1, or the later clock oscillator board, is divided by 3 in A2IC8. This 1 MHZ signal is further divided by 1000 in A2IC9, A2IC2 and A2IC3. The 1 kHz clock signal, after passing through a gate, A2IC22, and an inverter, A2IC11F, is divided by 4000 in A2IC4, A2IC5, A2IC13 and A2IC12 to generate a time period of 2 seconds. At the end of the 2 second period, the not Q output of the last divide-by-2 stage, pin 8 of A2IC12B, changes from a logic "1" (i.e., Approx. 3.5 volts) to a logic "0" (i.e.,

approx. 0 volt). This logic "0" thus closes the gate A2IC22 and prevents the time counters A2IC4, A3IC5, A2IC13 and A2IC12 from counting. Shortly after, the Q output of a flip-flop, pin 9 of A2IC24B, is set to logic "1" which enables the gates in A2IC21, A2IC22 and A2IC23. These gates, together with gates in A2IC10 and A2IC11, decode the output stages in A2IC9 and generate control signals for transferring the content from the frequency counters to the latches, resetting the time counter, resetting the frequency counter, presetting the frequency counter, and setting the counting direction for the frequency counters. The flip-flops in A2IC14 are used to generate the input signal selection frequency. Output signals from these flip-flops are decoded by gates in A2IC15, A2IC16, A2IC17, A2IC27 and A2IC28, and used as control signals to the A1 card. The output of a flip-flop (pin 12 of A2IC24) is set to logic "1" at the end of 1 ms following the 2 second time period, thus reopening the gate for the time counters (A2IC22) and the gate for the frequency counters (A2IC31). Gates in A2IC18 are used to generate bounce free signals for the front panel switches S4, (i.e., ZERO, OPER and INT CAR). Gates in A2IC26 are used to generate bounce free signals for the rear panel switch S3, (i.e., DIR/RFA).

Frequency Deviation Counter:

The prescaled RF signal from the A1 card is fed to the gate in A2IC31. For the TVM-2A, this signal is divided by 5 in A2IC38 and A2IC39. For the TVM-3A, the prescaled Visual IF is divided by 10 in A2IC38 and A2IC39; whereas the prescaled LO bypasses this divider via the gates in A2IC20 and A2IC29. A2IC19 is used to eliminate erroneous triggering due to switching signal sources (i.e., from IF to LO). The output from this divider (divide-by-5 for TVM-2A, divide-by-10 for TVM-3A) is then divided by 10 in A2IC42. The output from A2IC42 is, after passing through a series of steering gates (A2IC36, A2IC37), fed to an up-down counter chain consisting of A2IC44, A2IC48 and A2IC56. This counter chain changes its counting direction every 10,000 pulses, (i.e., when all the counters in this counter chain are in "0" state). Gates in A2IC47, A2IC55, A2IC51, A2IC34 and flip-flops in A2IC43 are used to detect the all "0" state and change the counting direction. Gates in A2IC11, A2IC15, A2IC25, A2IC34, A2IC49, A2IC50, A2IC53, A2IC54 are used to generate appropriate preset numbers for the counter chain. Since A2IC42 is a BCD coded up-counter (i.e., counter changes it state from 0 to 9 in ascending order), gates in A2IC41, A2IC32, A2IC33 and A2IC46, binary adder A2IC40 and latches A2IC45 are used to derive the appropriate deviation as well as the effect to the following UP/DOWN counter chain.

4-3 Display Section - A3A Card

All display circuitry for the TVM-2A/3A is located on the A3A Card. For the following description, refer to the A3A and Chassis schematic diagrams.

The transfer signal (pin 6 of A3A Card) and the Visual/Aural select signal (pin 5 of A3A card) are decoded and buffered in A3AIC11 and IC17 to provide control signals to the latches for Visual deviation (A3AIC4, IC5, IC6) and Aural/Intercarrier deviation (A3AIC1, IC2, IC3). The control signals are also used to latch the Count Direction (pin 17 of A3A Card) and the 9.99 kHz Alarm status (pin 16 of A3A Card) in A3AIC18 for Visual or IC25 for Aural/Intercarrier data. The same control signals are used to trigger the monostable multivibrators in A3AIC24 which blink the associated display polarity sign at the completion of that count cycle and to clock the divide-by-3 off-frequency counter for Visual (A3AIC7) or Aural/Intercarrier (A3AIC16) frequency alarm functions as well as the off-frequency status latches in A3AIC26.

The off-frequency status is obtained from the 100's and 1000's digits of the input data plus the 9.99 kHz

alarm status and setting of the 500-1000 Hz switch at the time of the data transfer. The series of gates in A3AIC10, IC9, IC8 decode the input data to obtain a single status signal at pin 11 of A3AIC8D which is latched in the Visual or Aural/Intercarrier half of A3AIC26. A zero on the latch input indicates no alarm and the inverted output 1 resets the V or A divide-by-3 counter. This completes the data input functions.

The remainder of the A3A Card is devoted to converting the data in the various latches into display form. The network of A3AC13, R23, R24 and gates A3AIC22F and IC17D form an oscillator set to run at approximately 5 kHz. This signal is fed to the clock input of the counter in A3AIC20 which is arranged as a one-of-four selector. These four selector outputs are used for the display multiplex control signals. The gates in A3AIC13 and IC21 buffer and invert the multiplex control signals to be applied to the output enable pins of the deviation digit latches and the display anode drive transistors. One digit of each side is driven at the same time and the selects are staggered such that the sign digit of one side and the 100's digit of the other side are enabled together. The four bit data from the enabled latch outputs (A3AIC1 thru IC6) is decoded into segment data by A3AIC15 for Visual or IC12 for the Aural/Intercarrier side and then each segment drive signal is inverted and current boosted by a transistor in A3AIC23 or IC19. The combination of latch output enable and digit anode drive lights each digit and the fast sequencing produces the complete Visual and Aural/Intercarrier display.

4-4 Power Supply - A4A Card

All three power supply voltages for the TVM-2A/3A are derived from one common power transformer with three separate secondary windings. All DC operating voltages are derived from full wave bridge rectifiers driving IC regulated outputs. Refer to the A4A and chassis schematic diagrams.

The -5 volt and +12 volt supplies rely on fixed voltage IC regulators mounted on the chassis. The -5 volts is driven by the 9 vac winding connected to pins 9 and 13 of the A4A Card, full wave rectified by A4ACR8 thru CR11, filtered by A4AC9 and supplies the regulator from pin 15 of the A4A Card. The regulated -5 volts returns to the A4A Card on pin 16 for bypass and distribution to the A1 Card. The supply current runs about 300 mA to power the ECL logic.

The +12 volt supply is very similar. The 15 vac winding is connected to pins 10 and 14 of the A4A Card, rectified by A4ACR4 thru CR7, filtered by A4AC6 and supplies the regulator from pin 11. The regulated +12 volts returns to the A4A Card on pin 12 for bypass, distribution to the A5 Card in a TVM-3A and to supply voltage for the control functions of the +5 volt supply. The supply current runs less than 50 mA in a TVM-2A and less than 100 mA in a TVM-3A.

The +5 volt supply system is very different due to the high current requirements for the logic and display sections and the need to keep power dissipation in the unit to a minimum. The supply is logically divided into two sections, a power section and a control section. This divided arrangement was developed to provide stable regulation with less than two volts drop between supply input and regulated output in order to minimize power dissipation in the high current supply. It should be noted that due to the interconnection of the two supplies, failure of the +12 volt supply will shut down the +5 volt output.

The power section has a 5 amp 7 vac secondary winding feeding the chassis mounted bridge rectifier CR1 and filter capacitor C1 to supply the collector of the regulating pass transistor Q1 mount on the rear chassis panel. The control section is located on the power supply card A4A and obtains supply voltage from the +12 volt source

to supply the adjustable voltage divider network A4AR6, R7 and VR1. VR1 sets the crowbar overvoltage protection level. The 12 volt source also supplies the IC regulator A4AU1 on pin 11. U1 generates a highly accurate +7 volt reference, which is present on pin 6 of U1, and is divided down to +5 volts by adjustable voltage divider A4AR2, R4 and potentiometer R3. The adjusted +5 volt reference from R3 is fed back to A4AU1 at pin 5. A sample of the main +5 volt output from the circuit is also fed back to U1 at pin 3, and compared to the +5 volt reference voltage by an internal comparator. The output from U1 at pin 10 is automatically adjusted by the comparator so that the fed back output sample is always equal to the +5 volt reference. The output of U1 pin 10 is protected from high current by A4AR12 and is current boosted by pass transistor A4AQ1.

The emitter of A4AQ1 drives the base of the chassis mounted high current pass transistor Q1. The high current +5 volt supply from the emitter of Q1 enters the A4A Card on pin 37 for sampling and distribution. A sample of the output current, which is indicated by the voltage drop across A4AR5, is fed back to A4AU1 at pin 2. When the voltage drop across R5 reaches 0.7 volts (i.e., 4.7 A output), U1 will prohibit any further current increase by causing a progressive decrease in output voltage. The +5 volt supply current runs about 1.5 amps under normal conditions.

A sample of the regulated output is also applied, through A4AR8, to the emitter of A4AQ2. The crowbar overvoltage reference from A4AR7 is applied to the base of Q2. If, for any reason the output of the power supply exceeds 6 volts, the base-emitter junction of A4AQ2 will be forward biased, and will cause A4ACR3 to be triggered through A4ACR2. When CR3 is triggered, the chassis mounted transistor Q2 is turned on (through pin 19 of the A4A Card), and shorts the +5 volt output to ground, thereby blowing chassis mounted fuse F2 and disabling the unit.

4-5 Mixer - A5 Card

Mixer card A5 consists of an oscillator, cavity, and an intermediate frequency filter and amplifier.

The oscillator section is a crystal-controlled modified Colpitts design (A5Q1). The output of the oscillator is fed to terminal 7 through a resistive pad consisting of A5R5 and A5R6, for processing by the Signal Selector card A1. The oscillator is also fed to amplifier A5Q2, whose output is then applied to the LO input of the cavity.

The cavity, A1, is divided into the multiplier and the mixer sections. The incoming LO is applied to diode CR2 which is selected for its step recovery properties. The cavity is then tuned by L4 and C3 to resonate at a frequency of ten times the incoming LO frequency. This frequency (which is 44 MHZ above the center frequency of the TV channel) is applied to the mixer section via a coupling loop.

Composite RF is applied to the input terminal of the mixer section of the cavity. It is then fed to the cathode of the mixer diode CR1. The mixer section of the cavity is tuned by L5 and C2 to resonate at the incoming LO frequency. This mixing results in an inverted intermediate frequency of 41.25 MHZ for the aural channel and 45.75 MHZ for the visual channel. The intermediate frequency filter is comprised of coil A5L5's top half and A5L6 which are a double-tuned circuit. These circuits are tuned to the aural frequency of 41.25 MHZ. The signal is then amplified by Q3 to a nominal output level of 0 dBm. The visual intermediate frequency filter is comprised of A5L5's lower half and A5L8, another double-tuned circuit. These circuits are tuned to a frequency of 45.75 MHZ. This signal is then amplified by A5Q4 to a nominal output level of 0 dBm. The visual and aural signals are then fed to the Signal Selector card A1.

5 Diagrams, Schematics and Parts Lists

Replaceable Parts. This page contains information for ordering replaceable parts for the monitor. The parts lists that follow show the parts in alphanumeric order by reference designation and provide a description of the part with the Belar part number.

Ordering Information. To order a replacement part from Belar, address the order or inquiry to Belar and supply the following information:

a. Model number and serial number of unit.
b. Description of part, *including the reference designation and location.*

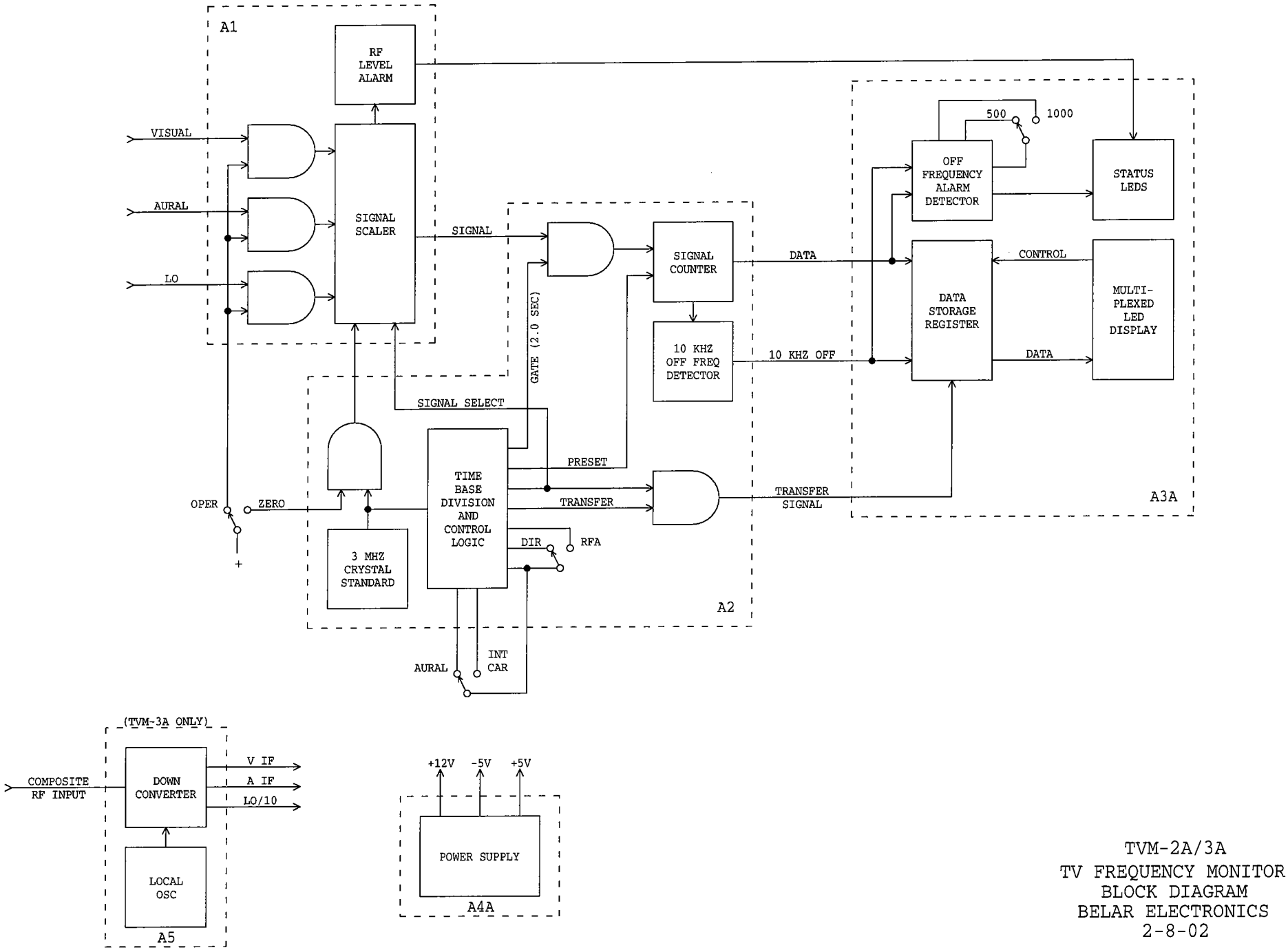
Orders may also be taken over the telephone. Parts orders can be put on your VISA, MasterCard, or American Express card, or we can ship them COD.

REFERENCE DESIGNATORS

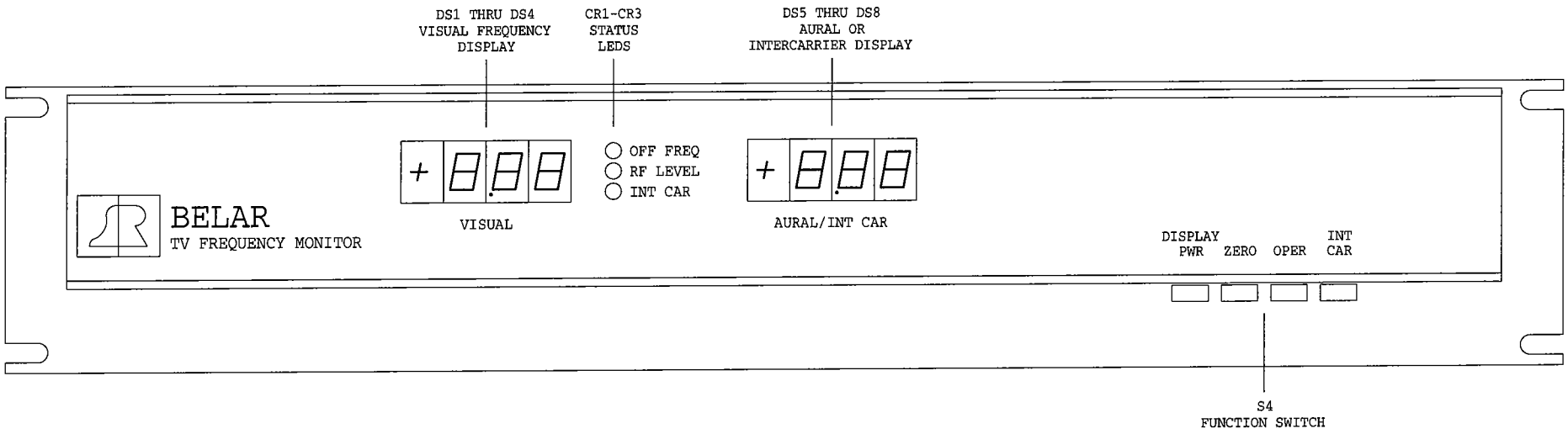
A	= assembly	J	= jack	S	= switch
BR	= diode bridge	L	= inductor	T	= transformer
C	= capacitor	M	= meter	TB	= terminal block
CR	= diode or LED	P	= plug	U	= integrated circuit
DS	= display or lamp	Q	= transistor	W	= cable
F	= fuse	R	= resistor	X	= socket
FL	= filter	RL	= relay	Y	= crystal
HDR	= header connector	RN	= resistor network		

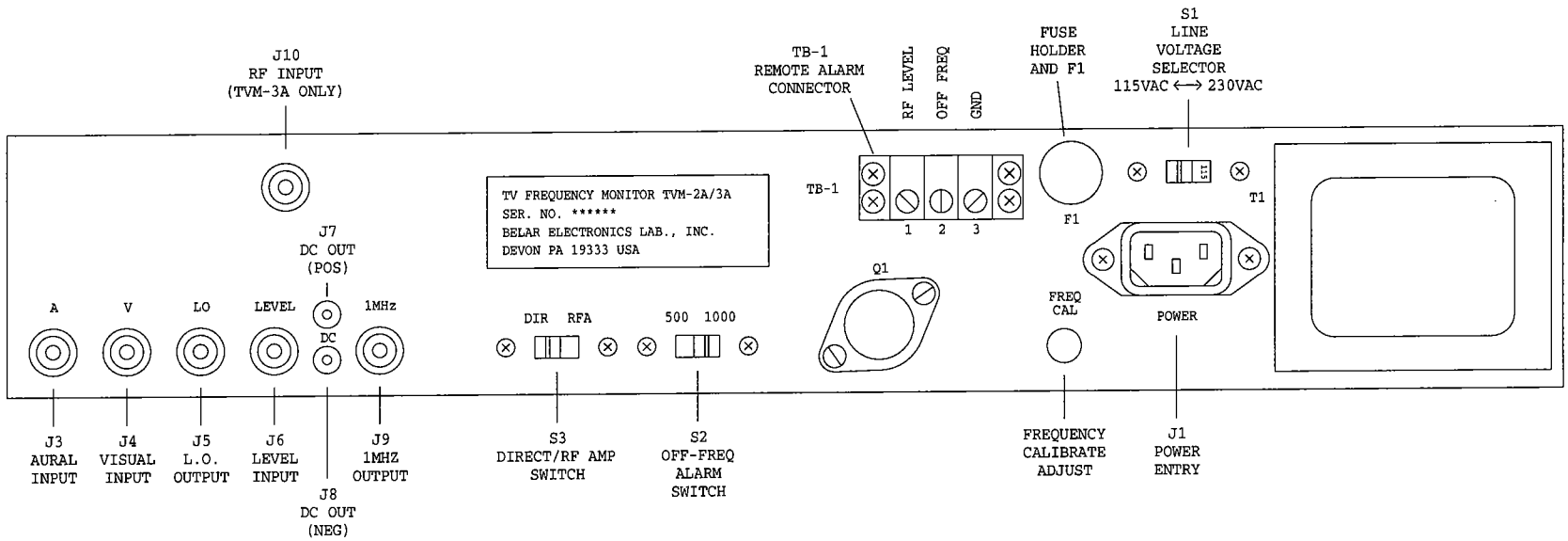
ABBREVIATIONS

ADC	= analog-to-digital converter	pF	= picofarads
BCD	= binary coded decimal	PIV	= peak inverse voltage
CER	= ceramic	POLY	= polystyrene
COMP	= composition	PORC	= porcelain
CONN	= connector	POT	= potentiometer
DAC	= digital-to-analog converter	SEMICON	= semiconductor
DPM	= digital panel meter	SI	= silicon
ELEC	= electrolytic	TANT	= tantalum
GE	= germanium	μF	= microfarads
IC	= integrated circuit	V	= volt
k	= kilo = 1,000	VAR	= variable
M	= meg = 1,000,000	VDCW	= dc working volts
MOD	= modulation	W	= watts
MY	= Mylar	WW	= wirewound
PC	= printed circuit		



TVM-2A/3A
TV FREQUENCY MONITOR
BLOCK DIAGRAM
BELAR ELECTRONICS
2-8-02



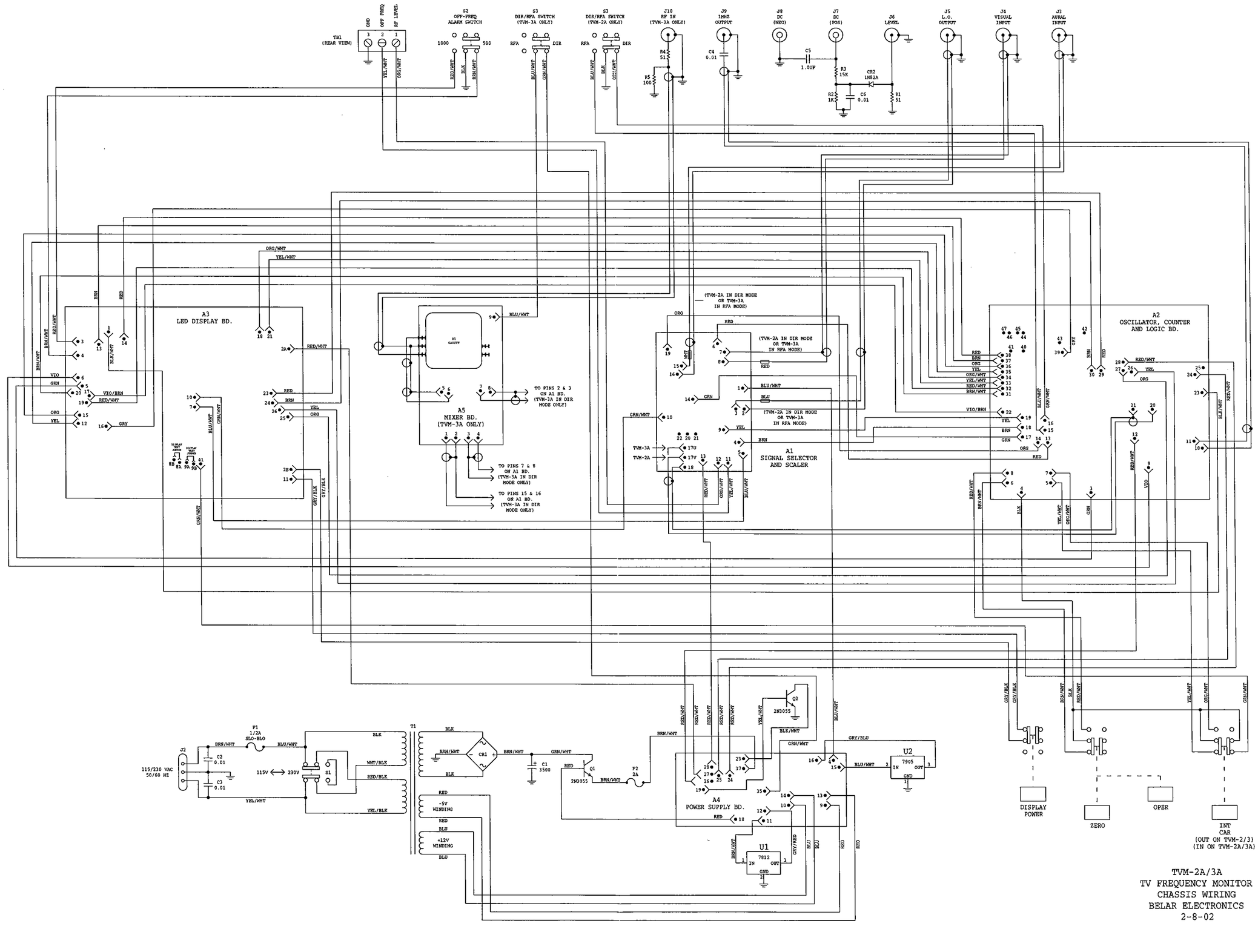


TVM-2A/3A FRONT & REAR VIEW
BELAR ELECTRONICS

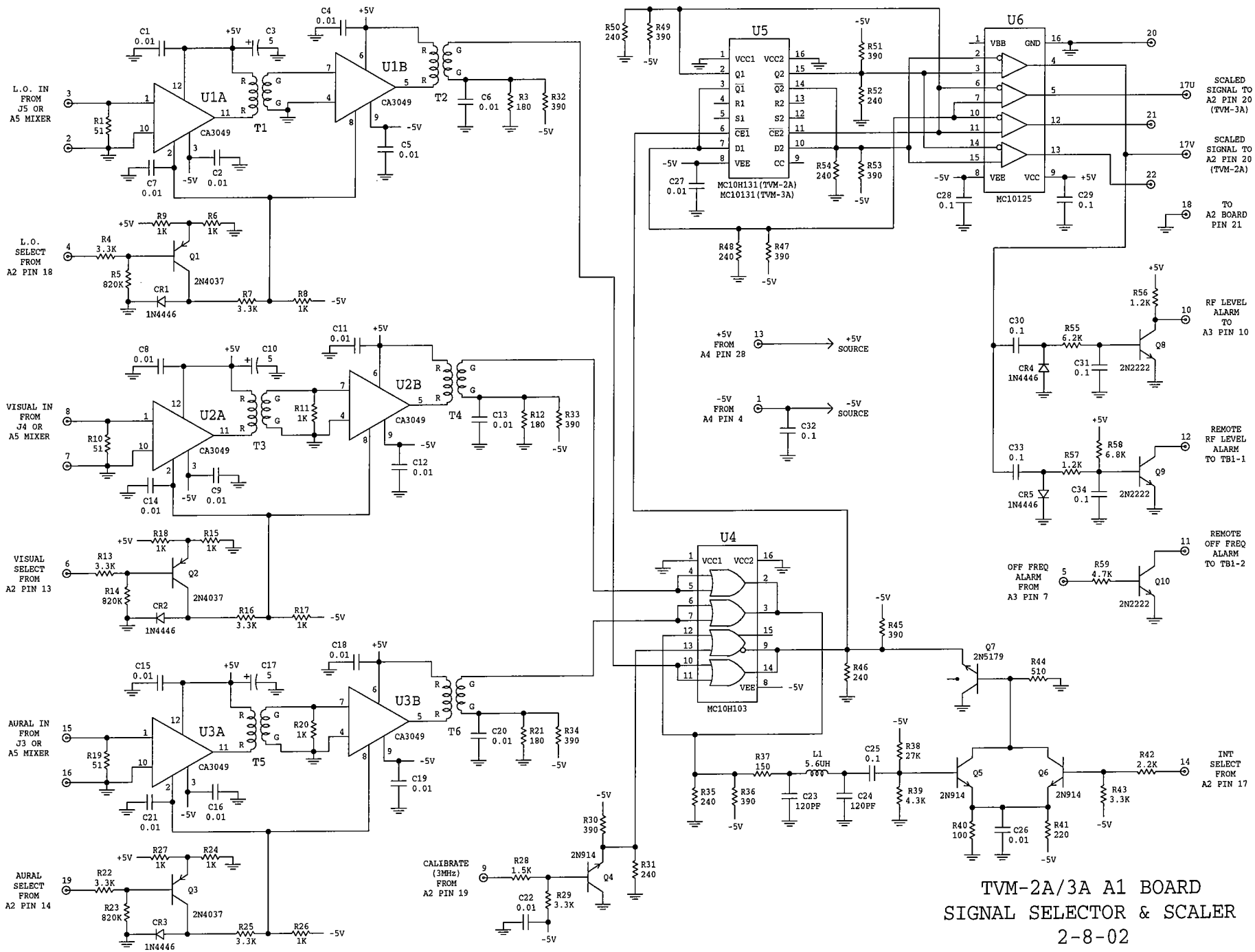
TVM-2A/3A PARTS LISTS

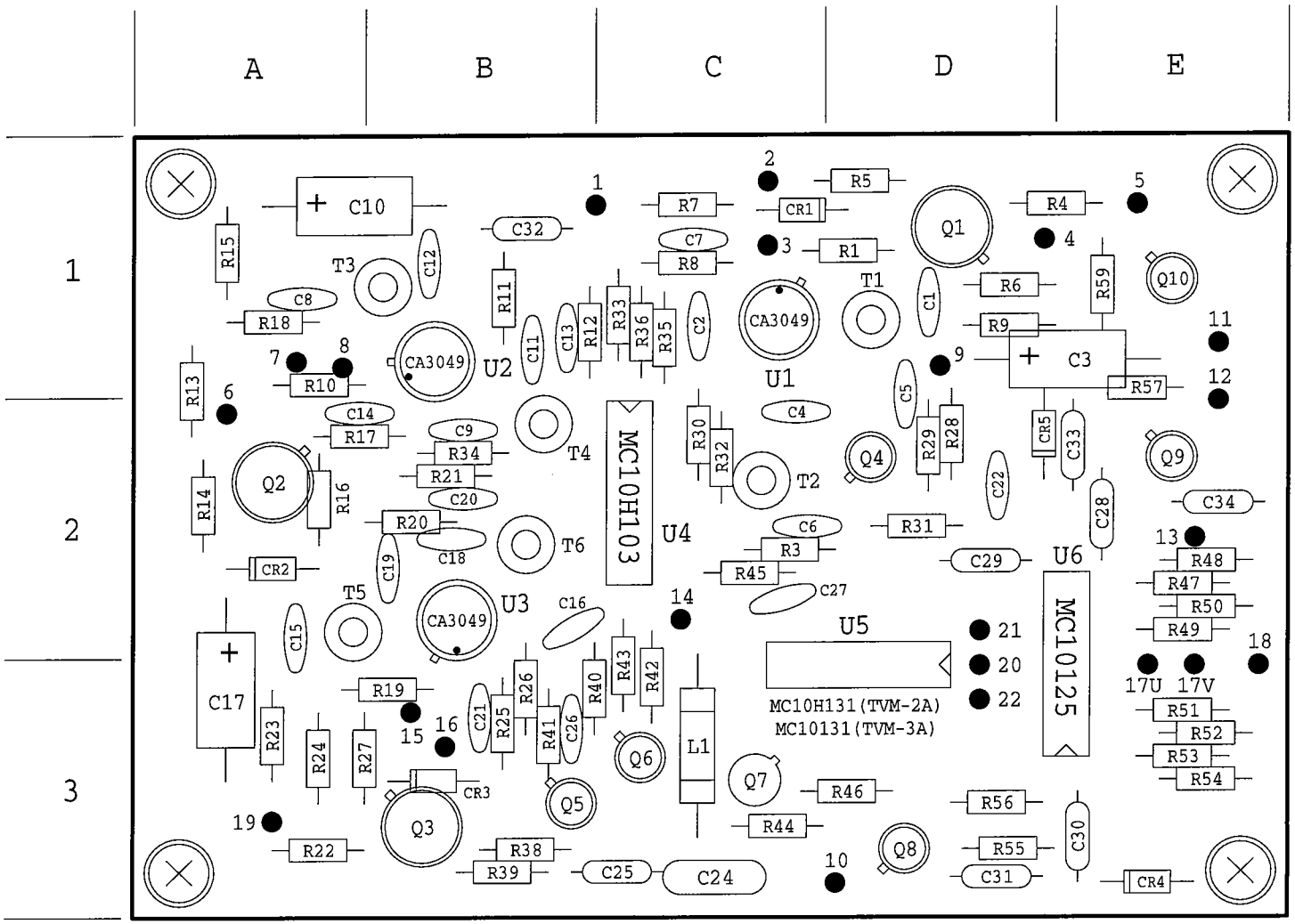
MAIN CHASSIS

Reference Designation	Description	Part Number
C1	C: FIXED ELEC 3500uF 40V	0180-0026
C2,C3	C: FIXED CERAMIC 0.01uF 2kV	0151-0010
C4	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C5	C: FIXED CERAMIC 1.0uF 50V	0151-0008
C6	C: FIXED CERAMIC 0.01uF 100V	0151-0003
CR1	DIODE: BRIDGE	1900-0021
CR2	DIODE: 1N82AG (ECG-112)	1900-0019
F1	FUSE: MDL 1/2A slo-blo	2110-0005
F2	FUSE: AGC 2A	2110-0006
XF1	FUSEHOLDER:	2110-0003
XF2	FUSE CLIP:	2110-0010
J2	JACK: POWER	0360-0010
J3 thru J6	JACK: BNC	0360-0005
J7	SOCKET: PIN, RED	0360-0009
J8	SOCKET: PIN, BLK	0360-0008
J9	JACK: BNC	0360-0005
J10	JACK: BNC (TVM-3A only)	0360-0005
Q1,Q2	TRANSISTOR: 2N3055	1850-0021
XQ1,XQ2	SOCKET: TRANSISTOR TO-3	1200-0007
R1	R: METAL FILM 51 2% 1/2W	0771-5102
R2	R: METAL FILM 1k 2% 1/4W	0751-1022
R3	R: METAL FILM 15k 2% 1/2W	0771-1532
R4	R: METAL FILM 51 2% 1/2W	0771-5102
R5	R: METAL FILM 100 2% 1/2W	0771-1012
S1	SWITCH: SLIDE 115/230V SELECTOR	3102-0002
S2,S3	SWITCH: SLIDE	3102-0001
S4	SWITCH: PUSHBUTTON (4 BUTTON)	3101-0012
T1	TRANSFORMER: POWER	9100-0015
TB1	TERMINAL BLOCK: 3 SCREW	0360-0001
U1	IC: 7812CK	1826-0030
U2	IC: 7905CK	1826-0032
XU1,XU2	SOCKET: TRANSISTOR TO-3	1200-0007
--	LINE CORD	8120-0002



TVM-2A/3A
TV FREQUENCY MONITOR
CHASSIS WIRING
BELAR ELECTRONICS
2-8-02


L.O. IN FROM J5 OR A5 MIXER
L.O. SELECT FROM A2 PIN 18
VISUAL IN FROM J4 OR A5 MIXER
VISUAL SELECT FROM A2 PIN 13
AURAL IN FROM J3 OR A5 MIXER
AURAL SELECT FROM A2 PIN 14
CALIBRATE (3MHz) FROM A2 PIN 19
+5V FROM A4 PIN 28
-5V FROM A4 PIN 4
+5V SOURCE
-5V SOURCE
OFF FREQ ALARM FROM A3 PIN 7
SCALED SIGNAL TO A2 PIN 20 (TVM-3A)
SCALED SIGNAL TO A2 PIN 20 (TVM-2A)
TO A2 BOARD PIN 21
RF LEVEL ALARM TO A3 PIN 10
REMOTE RF LEVEL ALARM TO TB1-1
REMOTE OFF FREQ ALARM TO TB1-2
INT SELECT FROM A2 PIN 17
U1A
U1B
U2A
U2B
U3A
U3B
CA3049
T1
T2
T3
T4
T5
T6
U4
MC10H103
U5
MC10H131(TVM-2A)
MC10131(TVM-3A)
U6
MC10125
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
Q9
Q10
2N4037
2N2222
2N914
2N5179
CR1
CR2
CR3
CR4
CR5
1N4446
TVM-2A/3A A1 BOARD
SIGNAL SELECTOR & SCALER
2-8-02

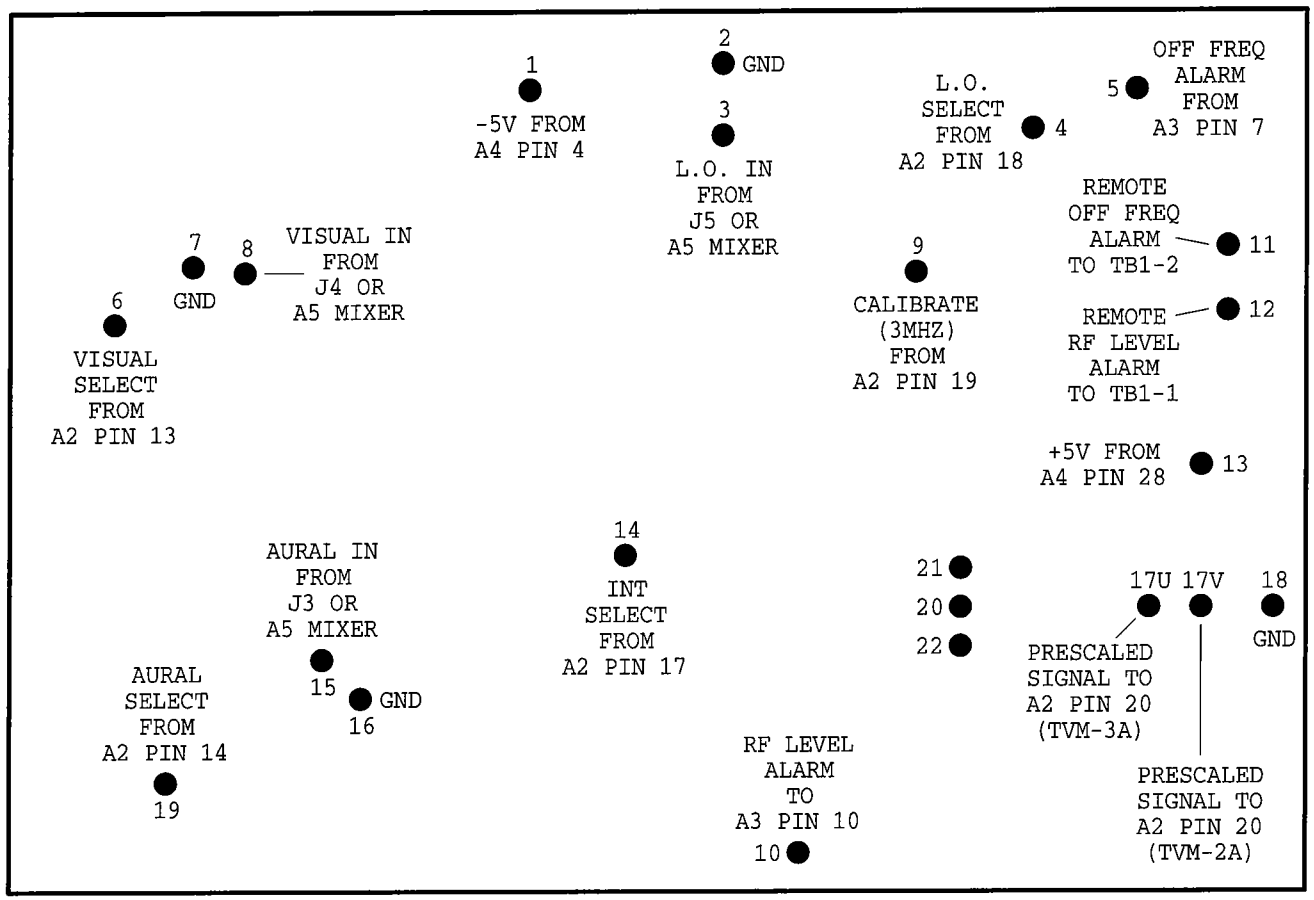


TVM-2A/3A A1 BOARD
COMPONENT LAYOUT
BELAR ELECTRONICS

TVM-2A/3A A1 BOARD
PART LOCATIONS

Desig/Loc		Desig/Loc		Desig/Loc		Desig/Loc		Desig/Loc		Desig/Loc	
C1	D1	C27	C2	Q10	E1	R25	B3	R51	E3	pins	
C2	C1	C28	E2			R26	B3	R52	E3	1	B1
C3	E1	C29	D2	R1	D1	R27	A3	R53	E3	2	C1
C4	C2	C30	E3	R2	--	R28	D2	R54	E3	3	C1
C5	D1	C31	D3	R3	C2	R29	D2	R55	D3	4	D1
C6	C2	C32	B1	R4	D1	R30	C2	R56	D3	5	E1
C7	C1	C33	E2	R5	D1	R31	D2	R57	E1	6	A2
C8	A1	C34	E2	R6	D1	R32	C2	R58	E2*	7	A1
C9	B2			R7	C1	R33	C1	R59	E1	8	A1
C10	A1	CR1	C1	R8	C1	R34	B2			9	D1
C11	B1	CR2	A2	R9	D1	R35	C1	T1	D1	10	D3
C12	B1	CR3	B3	R10	A1	R36	C1	T2	C2	11	E1
C13	B1	CR4	E3	R11	B1	R37	C2*	T3	B1	12	E2
C14	A2	CR5	D2	R12	B1	R38	B3	T4	B2	13	E2
C15	A2			R13	A1	R39	B3	T5	A2	14	C2
C16	B2	L1	C3	R14	A2	R40	B3	T6	B2	15	B3
C17	A3			R15	A1	R41	B3			16	B3
C18	B2	Q1	D1	R16	A2	R42	C3	U1	C1	17U	E3
C19	B2	Q2	A2	R17	A2	R43	C3	U2	B1	17V	E3
C20	B2	Q3	B3	R18	A1	R44	C3	U3	B2	18	E3
C21	B3	Q4	D2	R19	B3	R45	C2	U4	C2	19	A3
C22	D2	Q5	B3	R20	B2	R46	D3	U5	D3	20	D3
C23	C3*	Q6	C3	R21	B2	R47	E2	U6	E3	21	D2
C24	C3	Q7	C3	R22	A3	R48	E2			22	D3
C25	C3	Q8	D3	R23	A3	R49	E2				
C26	B3	Q9	E2	R24	A3	R50	E2				

*note: these locations are on bottom of pc board.



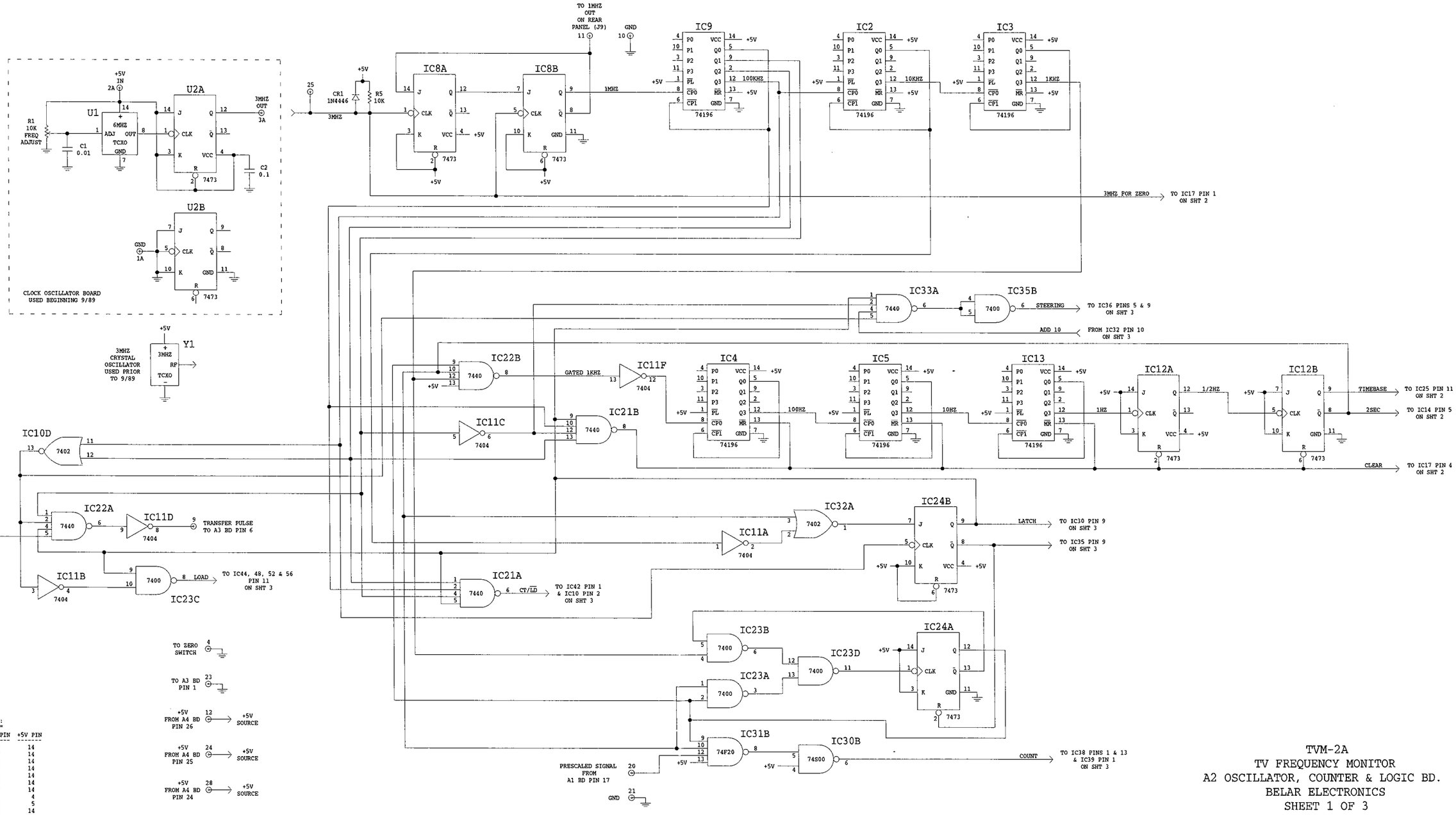
TVM-2A/3A A1 BOARD
CONNECTIONS
BELAR ELECTRONICS

A1 BOARD TVM-2A/3A

Reference Designation	Description	Part Number
C1,C2	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C3	C: FIXED ELEC 5uF 25V	0180-0007
C4 thru C9	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C10	C: FIXED ELEC 5uF 25V	0180-0007
C11 thru C16	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C17	C: FIXED ELEC 5uF 25V	0180-0007
C18 thru C22	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C23,C24	C: FIXED MICA 120pF 5% (C23 is on pcb bottom)	0140-1215
C25	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C26,C27	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C28 thru C34	C: FIXED CERAMIC 0.1uF 50V	0151-0006
CR1 thru CR5	DIODE: 1N4446	1900-0002
L1	INDUCTOR: 5.6 uH	9140-0004
Q1 thru Q3	TRANSISTOR: 2N4037	1850-0011
Q4 thru Q6	TRANSISTOR: 2N914	1850-0006
Q7	TRANSISTOR: 2N5179	1850-0023
Q8 thru Q10	TRANSISTOR: 2N2222 (Q8 thru Q10 alternate part is 2N914)	1850-0020
R1	R: METAL FILM 51 2% 1/4W	0751-5102
R2	not used	
R3	R: METAL FILM 180 2% 1/4W	0751-1812
R4	R: METAL FILM 3.3k 2% 1/4W	0751-3322
R5	R: METAL FILM 820k 2% 1/4W	0751-8242
R6	R: METAL FILM 1k 2% 1/4W	0751-1022
R7	R: METAL FILM 3.3k 2% 1/4W	0751-3322
R8,R9	R: METAL FILM 1k 2% 1/4W	0751-1022
R10	R: METAL FILM 51 2% 1/4W	0751-5102
R11	R: METAL FILM 1k 2% 1/4W	0751-1022
R12	R: METAL FILM 180 2% 1/4W (R12 is factory select, nominal value shown)	0751-1812
R13	R: METAL FILM 3.3k 2% 1/4W	0751-3322
R14	R: METAL FILM 820k 2% 1/4W	0751-8242
R15	R: METAL FILM 1k 2% 1/4W	0751-1022
R16	R: METAL FILM 3.3k 2% 1/4W	0751-3322
R17,R18	R: METAL FILM 1k 2% 1/4W	0751-1022
R19	R: METAL FILM 51 2% 1/4W	0751-5102
R20	R: METAL FILM 1k 2% 1/4W	0751-1022
R21	R: METAL FILM 180 2% 1/4W (R21 is factory select, nominal value shown)	0751-1812
R22	R: METAL FILM 3.3k 2% 1/4W	0751-3322
R23	R: METAL FILM 820k 2% 1/4W	0751-8242
R24	R: METAL FILM 1k 2% 1/4W	0751-1022
R25	R: METAL FILM 3.3k 2% 1/4W	0751-3322
R26,R27	R: METAL FILM 1k 2% 1/4W	0751-1022
R28	R: METAL FILM 1.5k 2% 1/4W	0751-1522

A1 BOARD TVM-2A/3A cont.

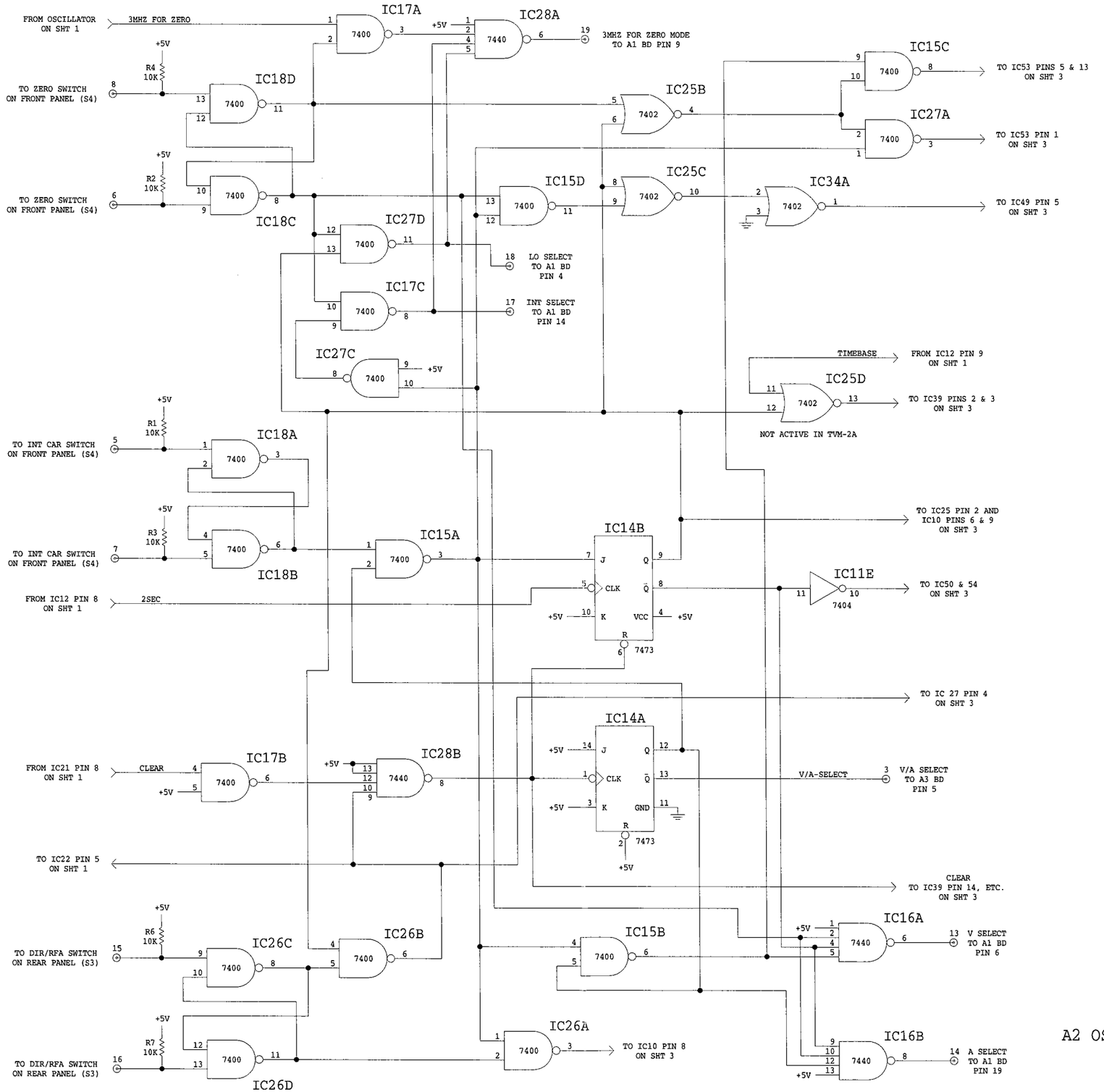
Reference Designation	Description	Part Number
R29	R: METAL FILM 3.3k 2% 1/4W	0751-3322
R30	R: METAL FILM 390 2% 1/4W	0751-3912
R31	R: METAL FILM 240 2% 1/4W	0751-2412
R32 thru R34	R: METAL FILM 390 2% 1/4W	0751-3912
R35	R: METAL FILM 240 2% 1/4W	0751-2412
R36	R: METAL FILM 390 2% 1/4W	0751-3912
R37	R: METAL FILM 150 2% 1/4W (R37 is on pcb bottom)	0751-1512
R38	R: METAL FILM 27k 2% 1/4W	0751-2732
R39	R: METAL FILM 4.3k 2% 1/4W	0751-4322
R40	R: METAL FILM 100 2% 1/4W	0751-1012
R41	R: METAL FILM 220 2% 1/4W	0751-2212
R42	R: METAL FILM 2.2k 2% 1/4W	0751-2222
R43	R: METAL FILM 3.3k 2% 1/4W	0751-3322
R44	R: METAL FILM 510 2% 1/4W	0751-5112
R45	R: METAL FILM 390 2% 1/4W	0751-3912
R46	R: METAL FILM 240 2% 1/4W	0751-2412
R47	R: METAL FILM 390 2% 1/4W	0751-3912
R48	R: METAL FILM 240 2% 1/4W	0751-2412
R49	R: METAL FILM 390 2% 1/4W	0751-3912
R50	R: METAL FILM 240 2% 1/4W	0751-2412
R51	R: METAL FILM 390 2% 1/4W	0751-3912
R52	R: METAL FILM 240 2% 1/4W	0751-2412
R53	R: METAL FILM 390 2% 1/4W	0751-3912
R54	R: METAL FILM 240 2% 1/4W	0751-2412
R55	R: METAL FILM 6.2k 2% 1/4W	0751-6222
R56,R57	R: METAL FILM 1.2k 2% 1/4W	0751-1222
R58	R: METAL FILM 6.8k 2% 1/4W (R58 is on pcb bottom)	0751-6822
R59	R: METAL FILM 4.7k 2% 1/4W	0751-4722
T1,T3,T5	TRANSFORMER: RF	Belar
T2,T4,T6	TRANSFORMER: RF	Belar
U1 thru U3	IC: CA3049T	1820-0010
U4	IC: MC10H103	1826-0035
U5	IC: MC10H131 (TVM-2A) MC10131 (TVM-3A)	
U6	IC: MC10125	1826-0036



IC POWER PINS:

IC TYPE	GND PIN	+5V PIN
7400	7	14
74S00	7	14
7402	7	14
7404	7	14
74P20	7	14
74LS20	7	14
7440	7	14
7473	11	4
7475	12	5
7486	7	14
74S112	8	16

TVM-2A
TV FREQUENCY MONITOR
A2 OSCILLATOR, COUNTER & LOGIC BD.
BELAR ELECTRONICS
SHEET 1 OF 3
2-8-02



IC POWER PINS:

IC TYPE	GND PIN	+5V PIN
7400	7	14
74S00	7	14
7402	7	14
7404	7	14
74F20	7	14
74LS20	7	14
7440	7	14
7473	11	4
7475	12	5
7486	7	14
74S112	8	16

TVM-2A
TV FREQUENCY MONITOR
A2 OSCILLATOR, COUNTER & LOGIC BD.
BELAR ELECTRONICS
SHEET 2 OF 3
2-8-02

FROM IC26 PIN 6 ON SHT 2

FROM IC24 PIN 8 ON SHT 1

IC35C 7400

IC35D 7400

IC27B 7400

IC30A 74S00

IC30D 74S00

IC43A 7473 — J, CLK, K, R, Q, $\overline{Q}$, VCC, GND — COUNT DIRECTION TO A3 BD PIN 17

IC39B 74S112 — J, K, $\overline{CLK}$, $\overline{S}$, $\overline{R}$, Q, $\overline{Q}$, GND

IC38A 74S112

IC38B 74S112

IC42 74196 — P0, P1, P2, P3, $\overline{PL}$, $\overline{CPD}$, $\overline{CPU}$, VCC, $\overline{Q0}$, $\overline{Q1}$, $\overline{Q2}$, $\overline{Q3}$, $\overline{PR}$, GND — CT/$\overline{LD}$

IC43B 7473

FROM IC28 PIN 8 ON SHT 2

FROM IC30 PIN 6 ON SHT 1

COUNT

IC17D 7400

IC31A 74F20

IC41A 7486

IC41C 7486

IC41B 7486

IC41D 7486

FROM IC21 PIN 6 ON SHT 1

CT/$\overline{LD}$

IC33B 7400

IC37B 7400

IC36C 7400

IC36A 7400

IC37D 7400

IC36B 7400

STEERING — FROM IC35 PIN 6 ON SHT 1

FROM IC25 PIN 13 ON SHT 1

IC39A 74S112

NOT ACTIVE IN TVM-2A

IC37A 7400

IC40 7483A — A0, A1, A2, A3, B0, B1, B2, B3, C4, C0, S0, S1, S2, S3, VCC, GND

30 A3 TO A3 BD PIN 24
29 B3 TO A3 BD PIN 23
27 C3 TO A3 BD PIN 25
26 D3 TO A3 BD PIN 26

IC34B 7402

IC32C 7402

IC32B 7402

IC32D 7402

TO IC33 PIN 4 ON SHT 1

IC46B 7402

IC45A 7475 — D1, D2, LE, $\overline{Q1}$, $\overline{Q2}$, Q1, Q2, VCC, GND

IC46C 7402

FROM IC34 PIN 1 ON SHT 2

FROM IC15 PIN 8 ON SHT 2

FROM IC27 PIN 3 ON SHT 2

FROM IC11 PIN 10 ON SHT 2

TO +5V (IC42 PIN 14) -10 OFFSET

TO IC34 PIN1 0 OFFSET

TO +5V (IC43 PIN 4) +10 OFFSET

TO IC34 PIN1 -10 OFFSET

TO +5V (IC43 PIN 14) 0 OFFSET

TO +5V (IC43 PIN 14) -10 OFFSET

IC30C 74S00

FROM IC24 PIN 9 ON SHT 1

LATCH

IC46D 7402

IC45B 7475 — D1, D2, LE, $\overline{Q1}$, $\overline{Q2}$, Q1, Q2, VCC, GND

IC46A 7402

IC25A 7402

IC35A 7400

NOT USED

FROM IC34 PIN 9 ON SHT 2

IC49D 7400

IC50D 7400

IC49C 7400

IC50C 7400

IC49B 7400

IC50A 7400

IC49A 7400

IC50B 7400

IC53B 7400

IC54D 7400

IC53A 7400

IC54C 7400

IC53D 7400

IC54A 7400

IC53C 7400

IC54B 7400

IC44 74192 — P0, P1, P2, P3, $\overline{PL}$, CU, CD, MR, VCC, $\overline{TCD}$, $\overline{TCU}$, GND, Q0, Q1, Q2, Q3

31 A2 TO A3 BD PIN 20
32 B2 TO A3 BD PIN 19
34 C2 TO A3 BD PIN 18
33 D2 TO A3 BD PIN 21

IC48 74192

37 A1 TO A3 BD PIN 13
38 B1 TO A3 BD PIN 14
36 C1 TO A3 BD PIN 15
35 D1 TO A3 BD PIN 12

IC52 74192

41
42
43
40

IC56 74192

46
47
45
44

FROM IC23 PIN 8 ON SHT 1

LOAD

IC47A 7402

IC47D 7402

IC47B 7402

IC47C 7402

IC55B 7402

IC55C 7402

IC55A 7402

IC55D 7402

9.99KHZ ALARM TO A3 BD PIN 16

IC51A 7440

IC51B 7440

IC34C 7402

IC34D 7402

FROM IC26 PIN 3 ON SHT 2

IC10C 7402

IC10B 7402

IC10A 7402

IC POWER PINS:

IC TYPE	GND PIN	+5V PIN
7400	7	14
74S00	7	14
7402	7	14
7404	7	14
74F20	7	14
74LS20	7	14
7440	7	14
7473	11	4
7475	12	5
7486	7	14
74S112	8	16

TVM-2A
TV FREQUENCY MONITOR
A2 OSCILLATOR, COUNTER & LOGIC BD.
BELAR ELECTRONICS
SHEET 3 OF 3
2-8-02

CLOCK OSCILLATOR BOARD
USED BEGINNING 9/89

U1
6MHZ
ADJ OUT
TCXO
GND

U2A
U2B
7473

R1 10K FREQ ADJUST
C1 0.01
C2 0.1
+5V IN 2A
3MHZ OUT 3A
GND 1A

Y1
3MHZ CRYSTAL OSCILLATOR USED PRIOR TO 9/89

CR1 1N4446
R5 10K
25
3MHZ
TO 1MHZ OUT ON REAR PANEL (J9) 11
GND 10

IC8A
IC8B
1MHZ

IC9
IC2
IC3
74196
100KHZ
10KHZ
1KHZ

3MHZ FOR ZERO → TO IC17 PIN 1 ON SHT 2
TO IC20 PIN 12 ON SHT 3

IC33A
7440
IC35B
7400
TO IC36 PINS 5 & 9 ON SHT 3
ADD 10 ← FROM IC32 PIN 10 ON SHT 3

IC22B
IC11F
7404
GATED 1KHZ
IC4
IC5
IC13
100HZ
10HZ
1HZ
IC12A
IC12B
1/2HZ
TIMEBASE → TO IC25 PIN 11 ON SHT 2 & IC29 PIN 1 ON SHT 3
2SEC → TO IC14 PIN 5 ON SHT 2
CLEAR → TO IC17 PIN 4 ON SHT 2 & IC19 PIN 1 ON SHT 3

IC11C
IC21B

IC10D
7402
TO IC20 PIN 13 ON SHT 3

IC22A
IC11D
TRANSFER PULSE TO A3 BD PIN 6
FROM IC14 PIN 8 ON SHT 2

IC11B
IC23C
LOAD → TO IC44, 48, 52 & 56 PIN 11 ON SHT 3

IC21A
CT/$\overline{LD}$ → TO IC42 PIN 1 & IC10 PIN 2 ON SHT 3

IC32A
IC11A
IC24B
LATCH → TO IC30 PIN 9 ON SHT 3
TO IC35 PIN 9 ON SHT 3

IC23B
IC23D
IC23A
IC24A

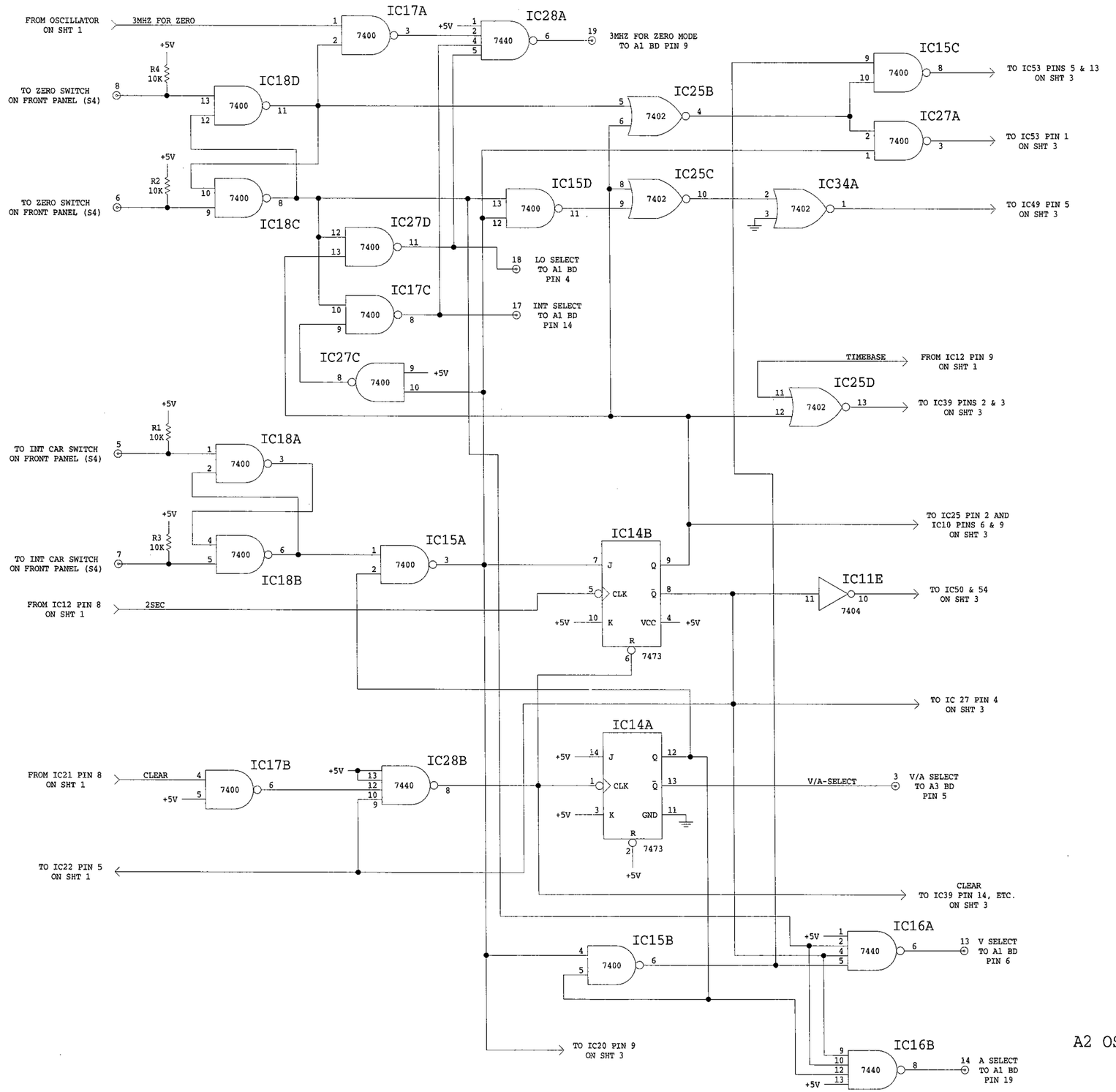
IC31B
74F20
IC30B
74S00
PRESCALED SIGNAL FROM A1 BD PIN 17 20
GND 21
FROM IC29 PIN 3 ON SHT 3
COUNT → TO IC39 PIN 1 & IC29 PIN 13 ON SHT 3

TO ZERO SWITCH 4
TO A3 BD PIN 1 23
+5V FROM A4 BD PIN 26 12 → +5V SOURCE
+5V FROM A4 BD PIN 25 24 → +5V SOURCE
+5V FROM A4 BD PIN 24 28 → +5V SOURCE

IC POWER PINS:

IC TYPE	GND PIN	+5V PIN
7400	7	14
74S00	7	14
7402	7	14
7404	7	14
74F20	7	14
74LS20	7	14
7440	7	14
7473	11	4
74HC73	11	4
7475	12	5
7486	7	14
74S112	8	16

TVM-3A
TV FREQUENCY MONITOR
A2 OSCILLATOR, COUNTER & LOGIC BD.
BELAR ELECTRONICS
SHEET 1 OF 3
2-8-02



IC POWER PINS:

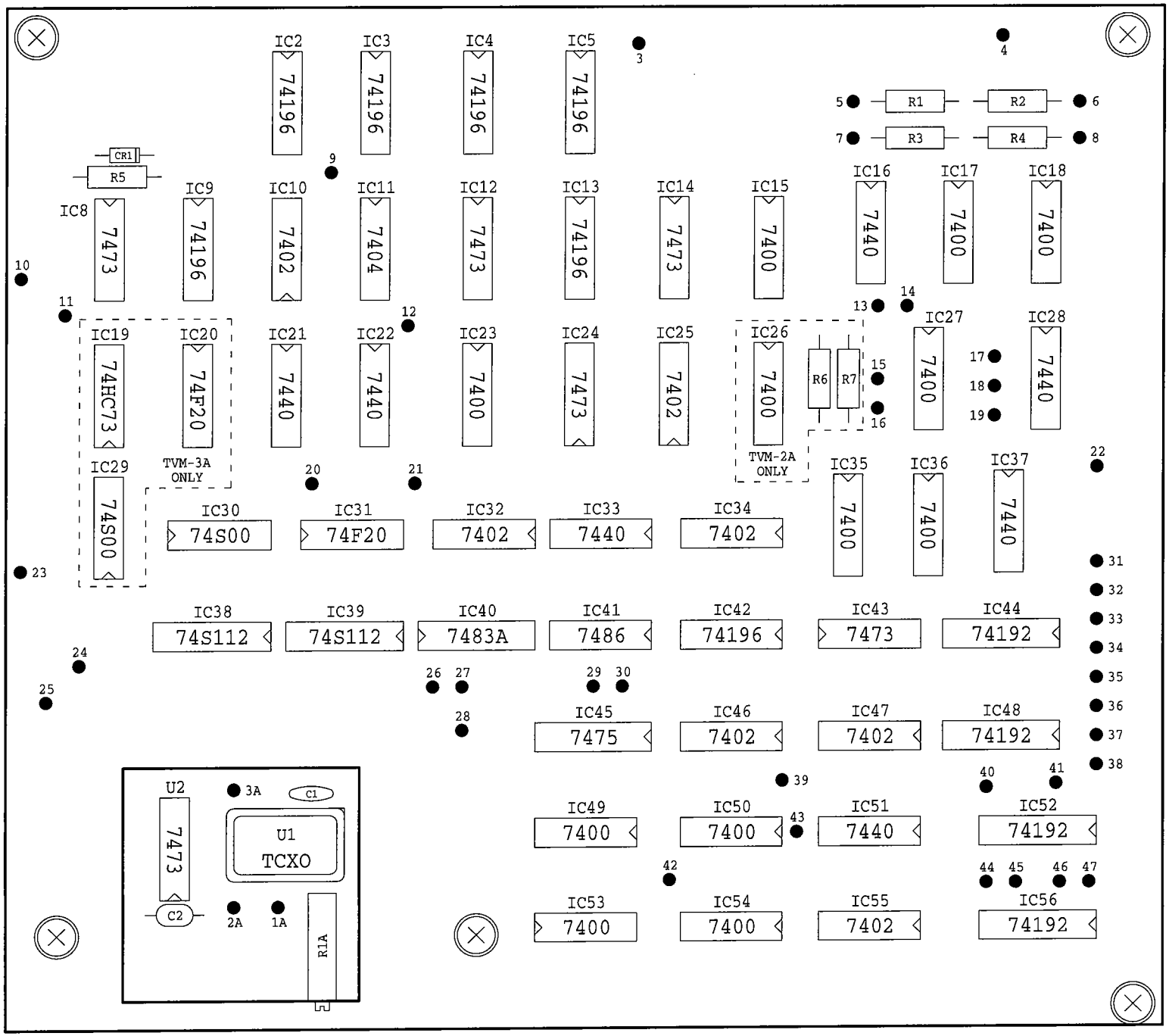
IC TYPE	GND PIN	+5V PIN
7400	7	14
74S00	7	14
7402	7	14
7404	7	14
74F20	7	14
74LS20	7	14
7440	7	14
7473	11	4
74HC73	11	4
7475	12	5
7486	7	14
74S112	8	16

TVM-3A
TV FREQUENCY MONITOR
A2 OSCILLATOR, COUNTER & LOGIC BD.
BELAR ELECTRONICS
SHEET 2 OF 3
2-8-02

IC POWER PINS:

IC TYPE	GND PIN	+5V PIN
7400	7	14
74S00	7	14
7402	7	14
7404	7	14
74F20	7	14
74LS20	7	14
7440	7	14
7473	11	4
74HC73	11	4
7475	12	5
7486	7	14
749112	8	16

TVM-3A
TV FREQUENCY MONITOR
A2 OSCILLATOR, COUNTER & LOGIC BD.
BELAR ELECTRONICS
SHEET 3 OF 3
2-8-02

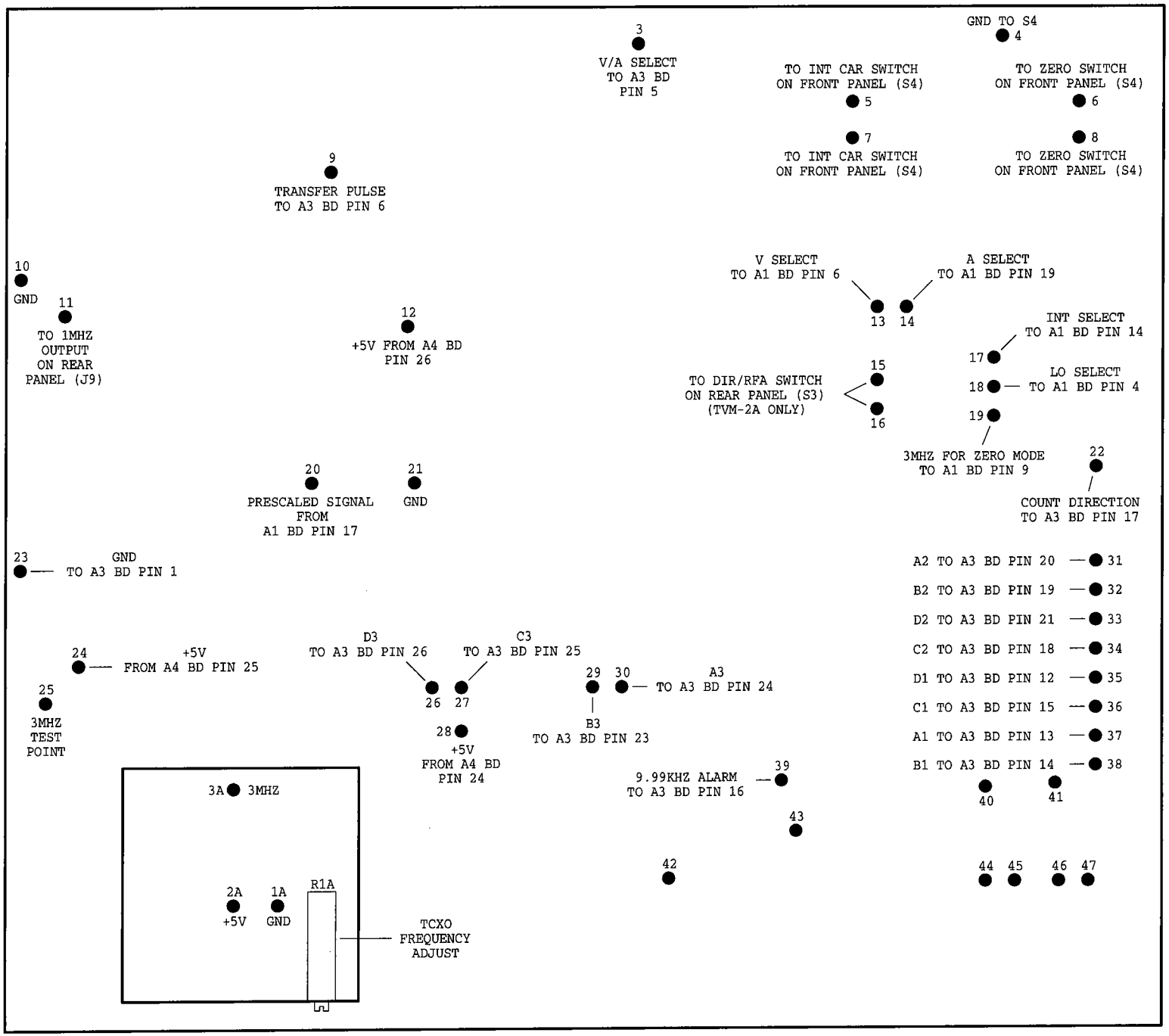


TVM-2A/3A A2 BOARD
COMPONENT LAYOUT
BELAR ELECTRONICS

TVM-2A/3A A3 BOARD Rev. A
PART LOCATIONS

Desig/Loc		Desig/Loc		Desig/Loc		Desig/Loc		Desig/Loc		Desig/Loc		Desig/Loc	
C1	I2	DS3	C9	IC22	F6	R6	A3	R34	H5	R62	C7	8A	E6
C2	I2	DS4	D9	IC23	D6	R7	A3	R35	E4	R63	C7	8B	E6
C3	H2	DS5	G9	IC24	C6	R8	A3	R36	E4	R64	C7	9A	E6
C4	G2	DS6	G9	IC25	B6	R9	A4	R37	E4	R65	C7	9B	E6
C5	G2	DS7	H9	IC26	B6	R10	A4	R38	E6	R66	C7	10	E4
C6	F2	DS8	H9			R11	A5	R39	E6	R67	C7	11	I7
C7	E2			Q1	I7	R12	A5	R40	E6	R68	C7	12	A5
C8	B2	IC1	I3	Q2	H7	R13	B4	R41	E6	R69	A9	13	B2
C9	H4	IC2	H3	Q3	G7	R14	B5	R42	D6	R70	B9	14	C2
C10	G4	IC3	G3	Q4	F7	R15	I4	R43	C5	R71	B9	15	A5
C11	F4	IC4	G3	Q5	F7	R16	I4	R44	F7	R72	D9	16	B5
C12	D4	IC5	F3	Q6	E7	R17	I4	R45	A7	R73	F9	17	A4
C13	C4	IC6	E3	Q7	E7	R18	H4	R46	I6	R74	F9	18	H1
C14	B4	IC7	D3	Q8	D7	R19	H4	R47	H7	R75	F9	19	A4
C15	G5	IC8	C3	Q9	D7	R20	F4	R48	F7	R76	I8	20	A4
C16	D6	IC9	C3	Q10	D7	R21	F4	R49	F7	R77	E8	21	H1
C17	C5	IC10	B3	Q11	B7	R22	D4	R50	D7	R78	E9	22	--
C18	C6	IC11	B3	Q12	B7	R23	C4	R51	D7	R79	E9	23	H4
C19	B6	IC12	H4	Q13	A7	R24	C4	R52	B7			24	H4
C20	B3*	IC13	G4			R25	F6	R53	B7	pins		25	I4
C21	B3*	IC14	F4	J1	E2	R26	E6	R54	E7	1	B1	26	I4
		IC15	D4	J2	D2	R27	E6	R55	H7	2A	I2	41	F6
CR1	E8	IC16	D4			R28	I5	R56	H7	2B	I7		
CR2	E9	IC17	B4	R1	H2	R29	I5	R57	H7	3	A2		
CR3	E9	IC18	B4	R2	H2	R30	I5	R58	G7	4	A2		
		IC19	H6	R3	C2	R31	I5	R59	G7	5	A3		
DS1	B9	IC20	G6	R4	B2	R32	I5	R60	G7	6	A3		
DS2	C9	IC21	G6	R5	A2	R33	H5	R61	G7	7	E4		

* C20 & C21 ARE ON BOTTOM OF PC BOARD



TVM-2A/3A A2 BOARD
CONNECTIONS
& ADJUSTMENTS
BELAR ELECTRONICS

A2 BOARD TVM-2A/3A

Reference Designation	Description	Part Number
CR1	DIODE: 1N4446	1900-0002
IC1	IC: not used	
IC2 THRU IC5	IC: 74196	1821-0020
IC6,IC7	IC: not used	
IC8	IC: 7473	1821-0010
IC9	IC: 74196	1821-0020
IC10	IC: 7402	1821-0002
IC11	IC: 7404	1821-0003
IC12	IC: 7473	1821-0010
IC13	IC: 74196	1821-0020
IC14	IC: 7473	1821-0010
IC15	IC: 7400	1821-0001
IC16	IC: 7440	1821-0009
IC17,IC18	IC: 7400	1821-0001
IC19	IC: 74HC73 (TVM-3A Only)	1822-0044
IC20	IC: 74F20 (TVM-3A Only)	1821-0034
IC21,IC22	IC: 7440	1821-0009
IC23	IC: 7400	1821-0001
IC24	IC: 7473	1821-0010
IC25	IC: 7402	1821-0002
IC26	IC: 7400 (TVM-2A Only)	1821-0001
IC27	IC: 7400	1821-0001
IC28	IC: 7440	1821-0009
IC29	IC: 74S00 (TVM-3A Only)	1821-0023
IC30	IC: 74S00	1821-0023
IC31	IC: 74F20	1821-0034
IC32	IC: 7402	1821-0002
IC33	IC: 7440	1821-0009
IC34	IC: 7402	1821-0002
IC35,IC36	IC: 7400	1821-0001
IC37	IC: 7440	1821-0009
IC38,IC39	IC: 74S112	1821-0026
IC40	IC: 7483A	1821-0012
IC41	IC: 7486	1821-0013
IC42	IC: 74196	1821-0020
IC43	IC: 7473	1821-0010
IC44	IC: 74192	1821-0019
IC45	IC: 7475	1821-0011
IC46,IC47	IC: 7402	1821-0002
IC48	IC: 74192	1821-0019
IC49,IC50	IC: 7400	1821-0001
IC51	IC: 7440	1821-0009
IC52	IC: 74192	1821-0019
IC53,IC54	IC: 7400	1821-0001
IC55	IC: 7402	1821-0002
IC56	IC: 74192	1821-0019

A2 BOARD TVM-2A/3A cont.

Reference Designation	Description	Part Number
R1 THRU R5	R: MF 10K 2% 1/2W	0771-1032
R6,R7	R: MF 10K 2% 1/2W (TVM-2A ONLY)	0771-1032
Y1*	CRYSTAL OSCILLATOR, 3 MHz	0410-0010

*NOTE: UNITS SHIPPED AFTER 9/89 HAVE THE CLOCK/OSCILLATOR BOARD IN PLACE OF Y1.

CLOCK/OSCILLATOR BOARD

C1	C: FC 0.01uF 100V	0151-0003
C2	C: FC 0.1uF 50V	0151-0006
R1	R: VAR COMP 10k, 10 TURN	2100-0018
U1	IC: TCXO 6MHz	0410-0011
U2	IC: 7473	1821-0010

VISUAL

AURAL

TRANSFER PULSE FROM A2 BOARD PIN 9

V/A SELECT FROM A2 BOARD PIN 1

COUNT DIRECTION FROM A2 BD PIN 22

9.99MHZ ALARM FROM A2 BD PIN 19

1800MHZ SELECT FROM OFF-FREQUENCY ALARM SWITCH ON REAR PANEL (S2)

900MHZ SELECT FROM OFF-FREQUENCY ALARM SWITCH ON REAR PANEL (S2)

A3 FROM A2 BD PIN 30
B3 FROM A2 BD PIN 29
C3 FROM A2 BD PIN 27
D3 FROM A2 BD PIN 26

A2 FROM A2 BD PIN 31
B2 FROM A2 BD PIN 32
C2 FROM A2 BD PIN 34
D2 FROM A2 BD PIN 33

A1 FROM A2 BD PIN 37
B1 FROM A2 BD PIN 38
C1 FROM A2 BD PIN 36
D1 FROM A2 BD PIN 35

DISPLAY TEST JUMPER

OFF FREQ ALARM TO A1 BD PIN 5

RF LEVEL ALARM FROM A1 BD PIN 10

FROM INT CAR PUSHBUTTON

DISPLAY POWER FROM S4

IC POWER PINS:

IC TYPE	GND PIN	+5V PIN
4001B	7	14
4011B	7	14
4012B	7	14
4013B	7	14
4049UB	8	1
4050B	8	1
4098B	8	16

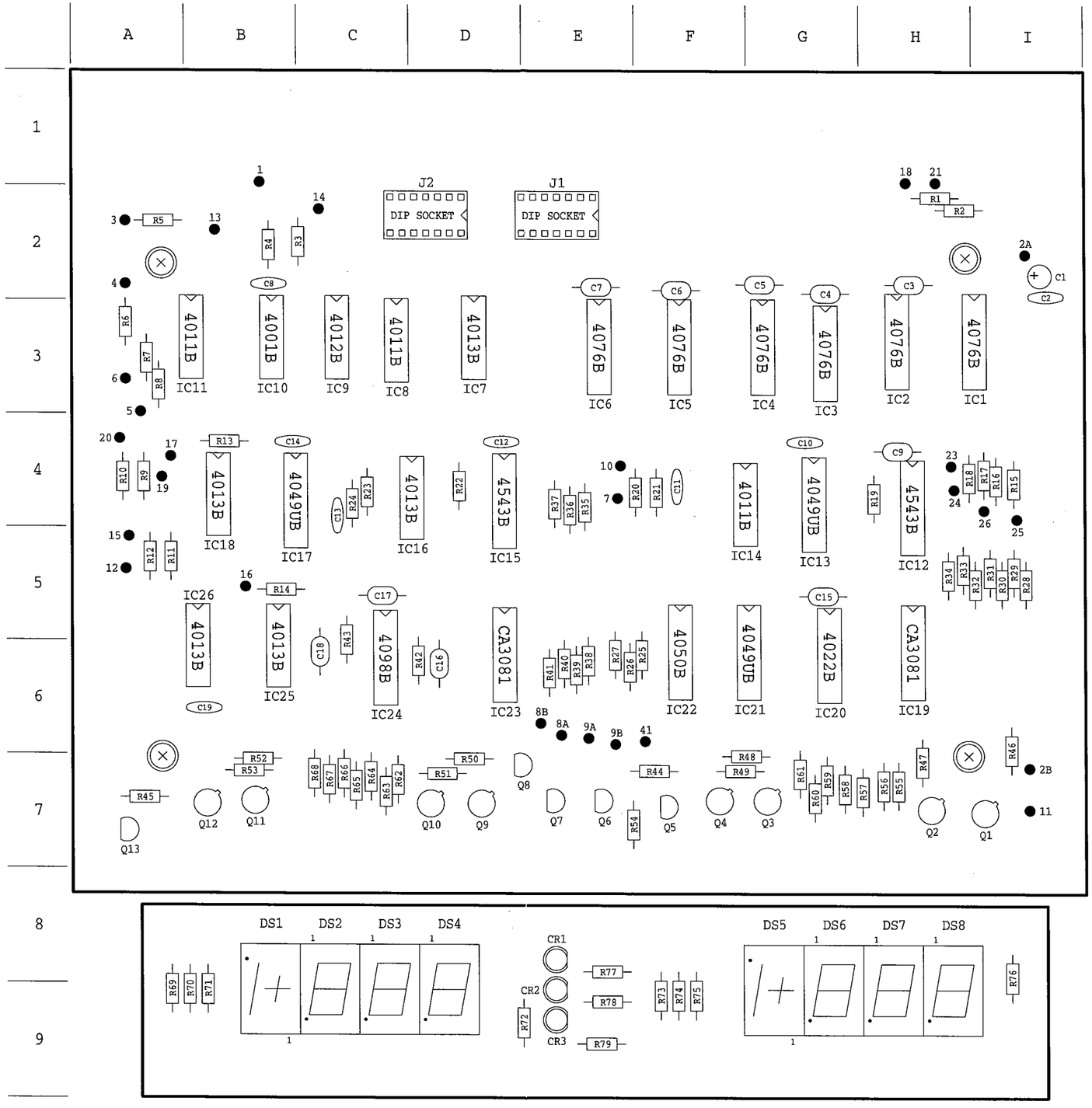
+5V TO DISPLAY POWER PUSHBUTTON (S4)

+5V FROM A4 POWER SUPPLY BOARD PIN 27

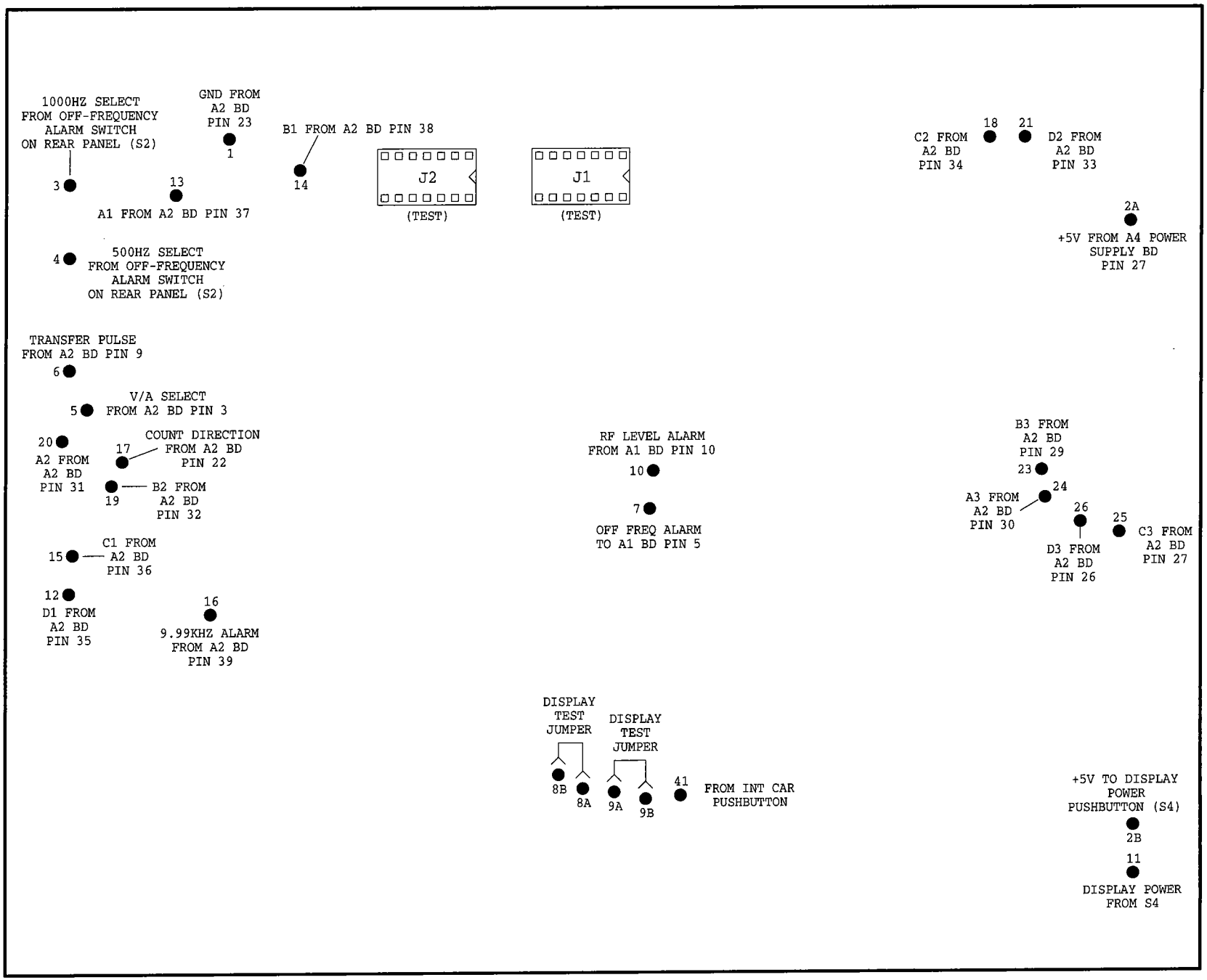
GND FROM A2 BD PIN 23

+5V SOURCE

TVM-2A/3A
TV FREQUENCY MONITOR
A3 BOARD DISPLAY BD.
REV. A
BELAR ELECTRONICS
2-8-02



TVM-2A/3A A3 BOARD
COMPONENT LAYOUT
BELAR ELECTRONICS



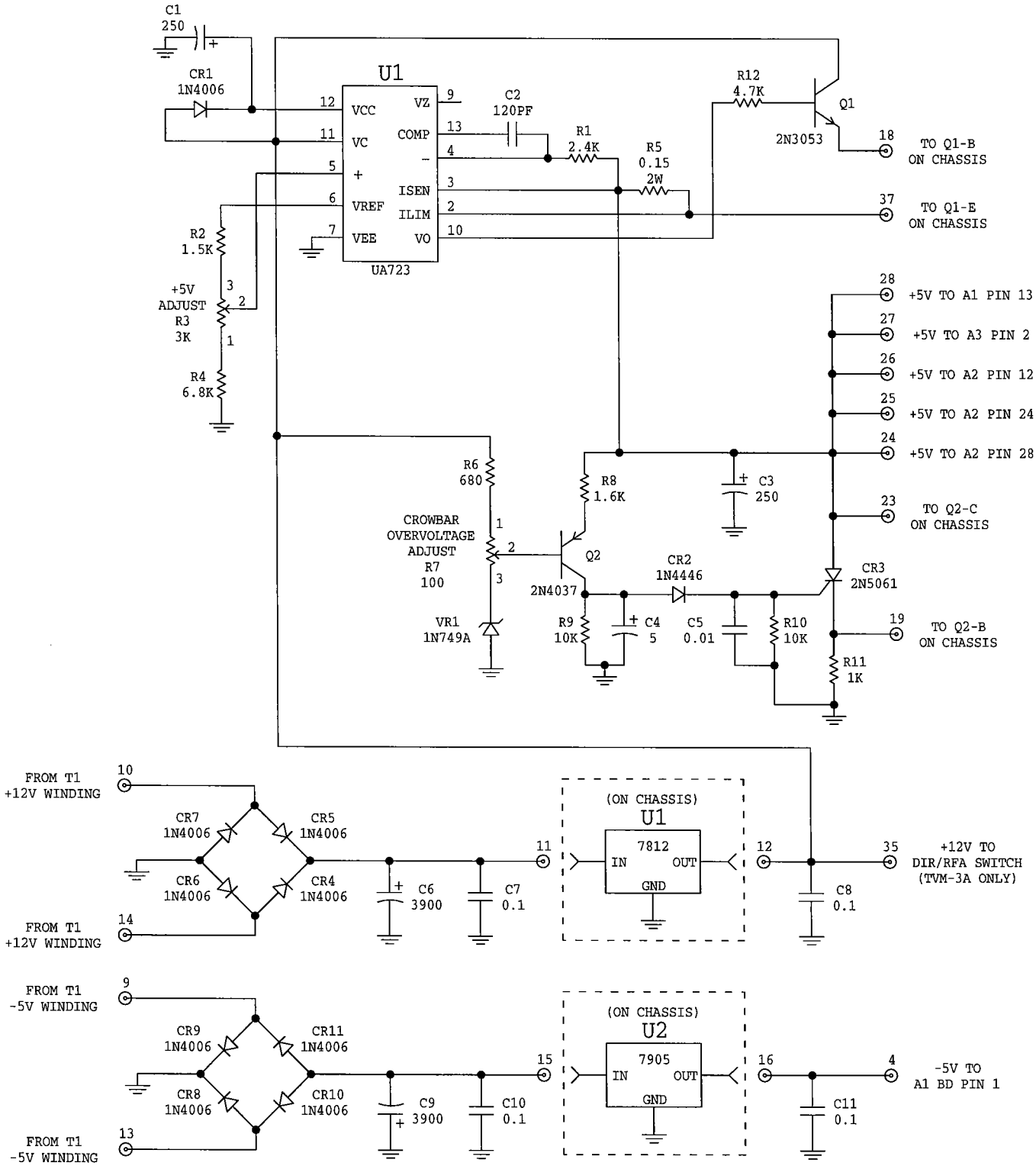
TVM-2A/3A A3 BOARD
CONNECTIONS
BELAR ELECTRONICS

A3 BOARD TVM-2A/3A, Rev. A

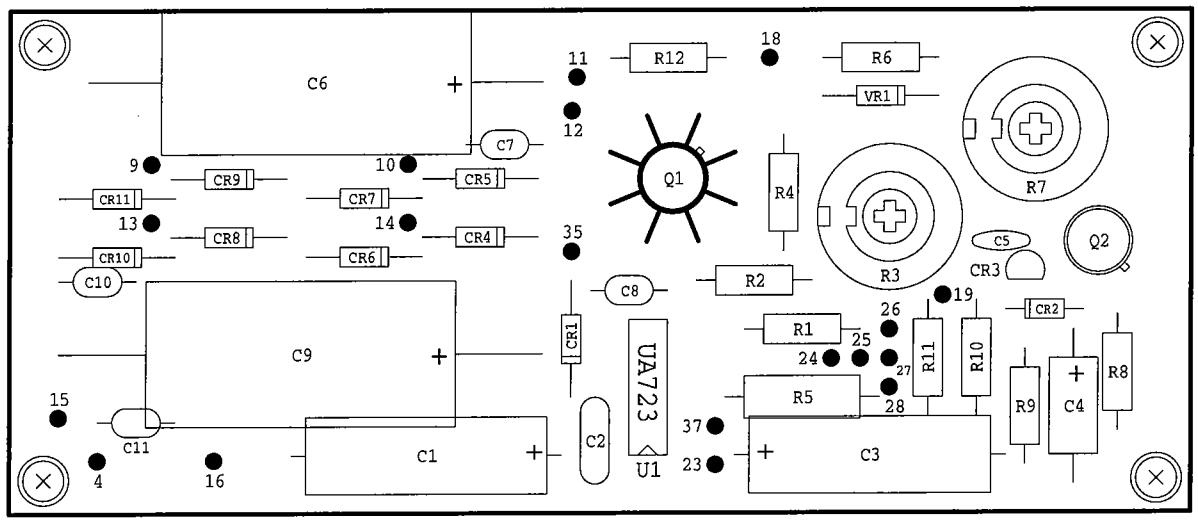
Reference Designation	Description	Part Number
C1	C: FIXED TANT 15uF 16V	0185-0003
C2	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C3 THRU C7	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C8	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C9	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C10 THRU C14	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C15	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C16	C: FIXED CERAMIC 1.0uF 50V	0151-0008
C17	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C18	C: FIXED CERAMIC 1.0uF 50V	0151-0008
C19	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C20,C21*	C: FIXED MICA 100pF 5% (* on pc bottom)	0140-1015
CR1,CR2	LED: RED MV5053	1910-0001
CR3	LED: YELLOW MV5353	1910-0002
DS1	DISPLAY: HP5082-7656	1930-0003
DS2 THRU DS4	DISPLAY: HP5082-7650	1930-0002
DS5	DISPLAY: HP5082-7656	1930-0003
DS6 THRU DS8	DISPLAY: HP5082-7650	1930-0002
IC1 THRU IC6	IC: 4076B	1822-0020
IC7	IC: 4013B	1822-0003
IC8	IC: 4011B	1822-0002
IC9	IC: 4012B	1822-0025
IC10	IC: 4001B	1822-0015
IC11	IC: 4011B	1822-0002
IC12	IC: 4543B	1822-0024
IC13	IC: 4049UB	1822-0005
IC14	IC: 4011B	1822-0002
IC15	IC: 4543B	1822-0024
IC16	IC: 4013B	1822-0003
IC17	IC: 4049UB	1822-0005
IC18	IC: 4013B	1822-0003
IC19	IC: CA3081	1826-0027
IC20	IC: 4022B	1822-0004
IC21	IC: 4049UB	1822-0005
IC22	IC: 4050B	1822-0006
IC23	IC: CA3081	1826-0027
IC24	IC: 4098B	1822-0021
IC25,IC26	IC: 4013B	1822-0003
J1,J2	SOCKET: IC 14 PIN	1200-0011
Q1 THRU Q4	TRANSISTOR: 2N2907A	1850-0027
Q5 THRU Q8	TRANSISTOR: 2N4401	1850-0028
Q9 THRU Q12	TRANSISTOR: 2N2907A	1850-0027
Q13	TRANSISTOR: 2N4401	1850-0028

A3 BOARD TVM-2A/3A, Rev. A, cont.

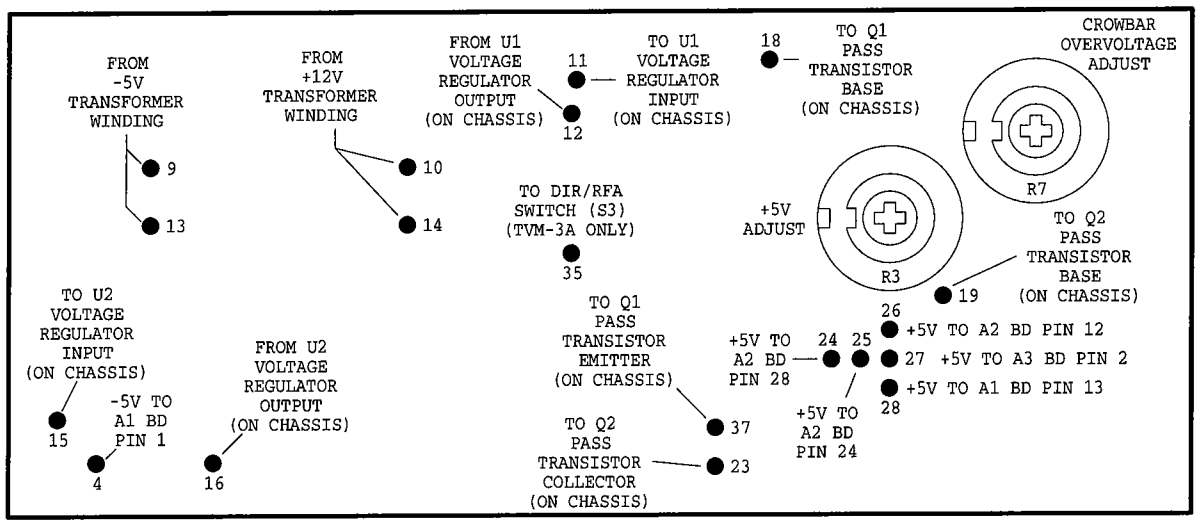
Reference Designation	Description	Part Number
R1 THRU R4	R: METAL FILM 2k 2% 1/4W	0751-2022
R5,R6	R: METAL FILM 10k 2% 1/4W	0751-1032
R7 THRU R18	R: METAL FILM 2k 2% 1/4W	0751-2022
R19,R20	R: METAL FILM 10k 2% 1/4W	0751-1032
R21	R: METAL FILM 56k 2% 1/4W	0751-5632
R22 THRU R24	R: METAL FILM 10k 2% 1/4W	0751-1032
R25 THRU R27	R: METAL FILM 5.6k 2% 1/4W	0751-5622
R28 THRU R41	R: METAL FILM 2.2k 2% 1/4W	0751-2222
R42,R43	R: METAL FILM 820k 2% 1/4W	0751-8242
R44,R45	R: METAL FILM 1k 2% 1/4W	0751-1022
R46 THRU R53	R: METAL FILM 560 2% 1/4W	0751-5612
R54	R: METAL FILM 10k 2% 1/4W	0751-1032
R55 THRU R76	R: METAL FILM 100 2% 1/4W	0751-1012
R77 THRU R79	R: METAL FILM 220 2% 1/4W	0751-2212



TVM-2A/3A
TV FREQUENCY MONITOR
A4 POWER SUPPLY BD.
REV. A
BELAR ELECTRONICS
2-8-02



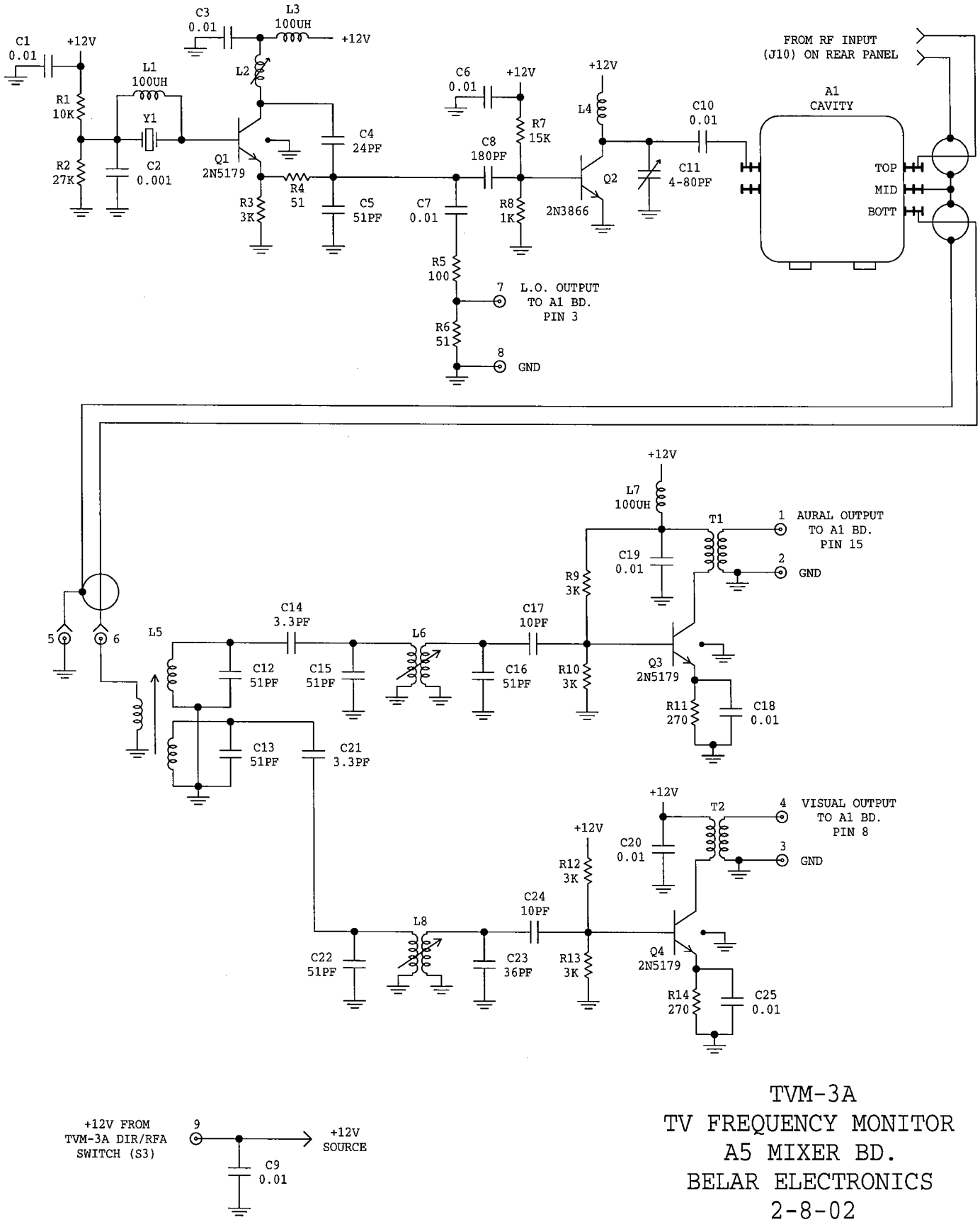
TVM-2A/3A A4 BOARD
COMPONENT LAYOUT
BELAR ELECTRONICS



TVM-2A/3A A4 BOARD
CONNECTIONS & ADJUSTMENTS
BELAR ELECTRONICS

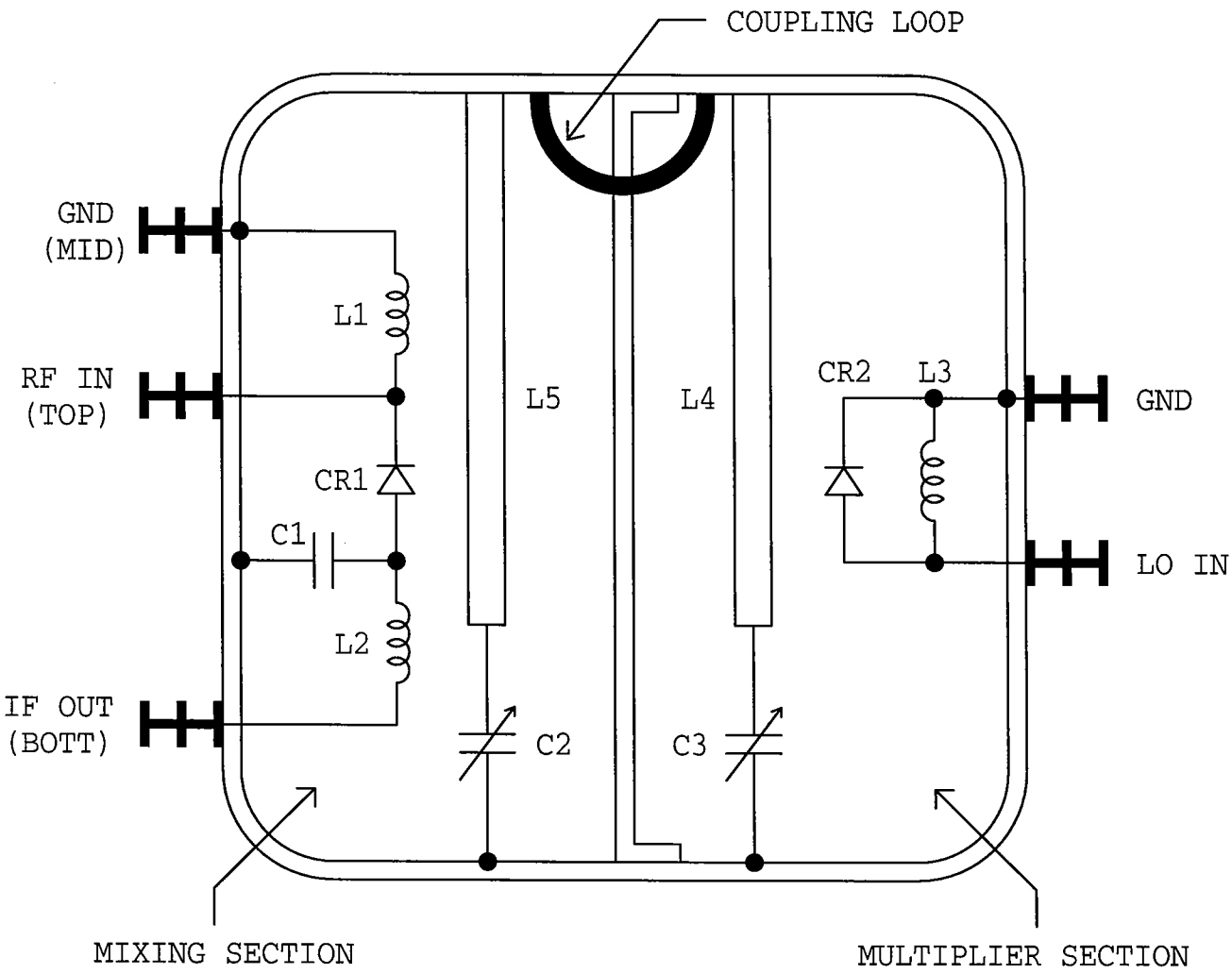
A4 BOARD TVM-2A/3A, Rev. A

Reference Designation	Description	Part Number
C1	C: FIXED ELEC 250uF 16V	0180-0008
C2	C: FIXED MICA 120pF 5%	0140-1215
C3	C: FIXED ELEC 250uF 16V	0180-0008
C4	C: FIXED ELEC 5uF 25V	0180-0007
C5	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C6	C: FIXED ELEC 3900uF 25V	0180-0035
C7,C8	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C9	C: FIXED ELEC 3900uF 25V	0180-0035
C10,C11	C: FIXED CERAMIC 0.1uF 50V	0151-0006
CR1	DIODE: 1N4006	1900-0016
CR2	DIODE: 1N4446	1900-0002
CR3	SCR: 2N5061	1850-0013
CR4 THRU CR11	DIODE: 1N4006	1900-0016
Q1	TRANSISTOR: 2N3053	1850-0008
Q2	TRANSISTOR: 2N4037	1850-0011
R1	*R: METAL FILM 1.6k 2% 1/2W	0771-1622
R2	R: METAL FILM 1.5k 2% 1/2W	0771-1522
R3	*R: VAR WW 1k 2W	2100-0012
R4	*R: METAL FILM 4.7k 2% 1/2W	0771-4722
R5	R: WW 0.15 OHM 5% 2W	0811-0017
R6	R: METAL FILM 680 2% 1/2W	0771-6812
R7	R: VAR WW 100 2W	2100-0013
R8	R: METAL FILM 1.6k 2% 1/2W	0771-1622
R9,R10	R: METAL FILM 10k 2% 1/2W	0771-1032
R11	R: METAL FILM 1k 2% 1/2W	0771-1022
R12	R: METAL FILM 4.7k 2% 1/2W	0771-4722
*Note: In TVM-2A units beginning serial number 701274 and TVM-3A units beginning serial number 801142 the following values are used;		
R1	R: METAL FILM 2.4k 2% 1/2W	0771-2422
R3	R: VAR WW 3k 2W	2100-0005
R4	R: METAL FILM 6.8k 2% 1/2W	0771-6822
U1	IC: UA723C	1820-0012
VR1	DIODE: 1N749A	1900-0018

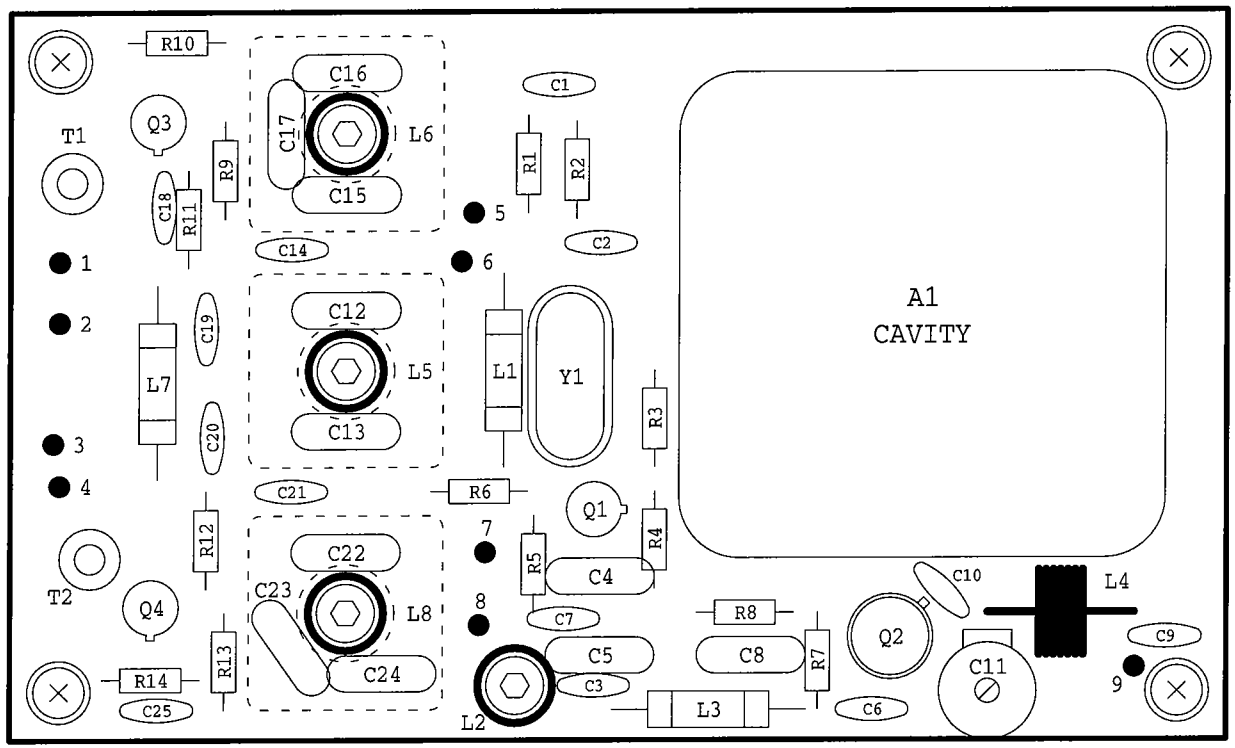


TVM-3A
TV FREQUENCY MONITOR
A5 MIXER BD.
BELAR ELECTRONICS
2-8-02

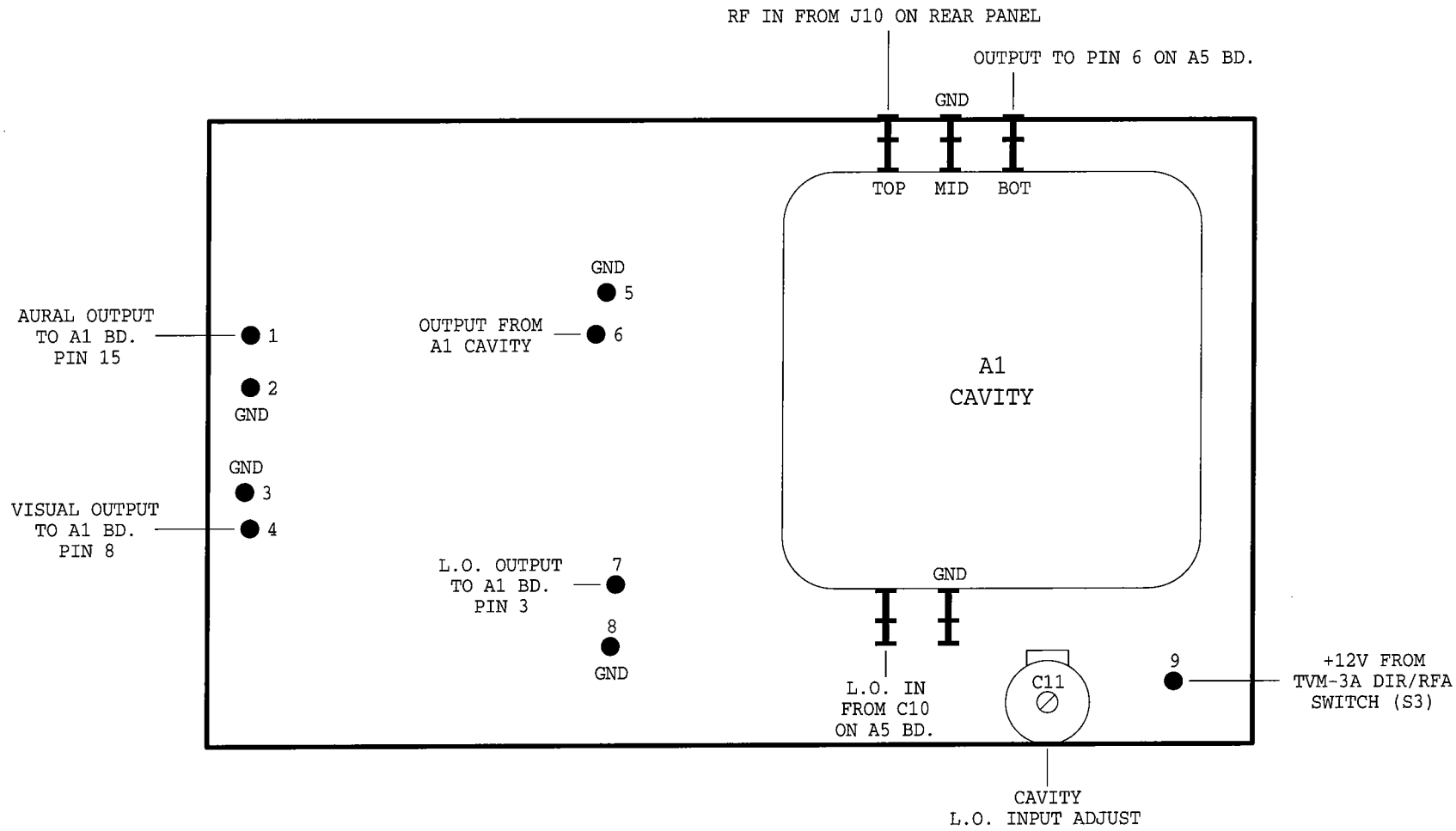
A1 CAVITY ASSEMBLY
(TVM-3A ONLY)
2-8-02



Reference Designation	Description	Part Number
C1	C: FIXED MICA 10pF 5%	0140-1005
C2,C3	C: VARIABLE CERAMIC 1-10pF	0121-0010
CR1	DIODE: 1N82 AG-F (ECG-112)	1900-0019
CR2	DIODE: 1N4446	1900-0002
L1	COIL: 3 TURNS #22 WIRE	Belar
L2	COIL: 12 TURNS #22 WIRE	Belar
L3	COIL: 8 TURNS #20 WIRE	Belar
L4,L5	COIL:	Belar



TVM-3A A5 BOARD
COMPONENT LAYOUT
BELAR ELECTRONICS



TVM-3A A5 BOARD
CONNECTIONS & ADJUSTMENTS
BELAR ELECTRONICS

A5 BOARD TVM-3A

Reference Designation	Description	Part Number
A1	CAVITY ASSEMBLY	Belar
C1	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C2	C: FIXED CERAMIC 0.001uF 1kV	0151-0002
C3	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C4	C: FIXED MICA 24pF 5%	0140-2405
C5	C: FIXED MICA 51pF 5%	0140-5105
C6,C7	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C8	C: FIXED MICA 180pF 5%	0140-1815
C9,C10	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C11	C: VAR MICA 4-80pF	0121-0004
C12,C13	C: FIXED MICA 51pF 5%	0140-5105
C14	C: FIXED CERAMIC 3.3pF 1kV	0151-0001
C15,C16	C: FIXED MICA 51pF 5%	0140-5105
C17	C: FIXED MICA 10pF 5%	0140-1005
C18 THRU C20	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C21	C: FIXED CERAMIC 3.3pF 1kV	0151-0001
C22	C: FIXED MICA 51pF 5%	0140-5105
C23	C: FIXED MICA 36pF 5%	0140-3605
C24	C: FIXED MICA 10pF 5%	0140-1005
C25	C: FIXED CERAMIC 0.01uF 100V	0151-0003
L1	INDUCTOR: 100uH	9140-0005
L2	INDUCTOR:	Belar
L3	INDUCTOR: 100uH	9140-0005
L4 THRU L6	INDUCTOR:	Belar
L7	INDUCTOR: 100uH	9140-0005
L8	INDUCTOR:	Belar
Q1	TRANSISTOR: 2N5179	1850-0023
Q2	TRANSISTOR: 2N3866	1850-0014
Q3,Q4	TRANSISTOR: 2N5179	1850-0023
R1	R: METAL FILM 10k 2% 1/4W	0751-1032
R2	R: METAL FILM 27k 2% 1/4W	0751-2732
R3	R: METAL FILM 3k 2% 1/4W	0751-3022
R4	R: METAL FILM 51 2% 1/4W	0751-5102
R5	R: METAL FILM 100 2% 1/4W	0751-1012
R6	R: METAL FILM 51 2% 1/4W	0751-5102
R7	R: METAL FILM 15k 2% 1/4W	0751-1532
R8	R: METAL FILM 1k 2% 1/4W	0751-1022
R9,R10	R: METAL FILM 3k 2% 1/4W	0751-3022
R11	R: METAL FILM 270 2% 1/4W	0751-2712
R12,R13	R: METAL FILM 3k 2% 1/4W	0751-3022
R14	R: METAL FILM 270 2% 1/4W	0751-2712
T1,T2	TRANSFORMER:	Belar
Y1	CRYSTAL: ORDER PER FREQUENCY	Belar
XY1	SOCKET: CRYSTAL	1200-0006