ON TARGET
Gottlieb
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TROUBLESHOOTING GOTTLIEB DISPLAYS

The physical appearance of a game can really make or break a game. The player appeal will be greatly enhanced by an attractive lightbox, playfield and displays. Defective displays can throw off the balance of the image that a prospective player gets from a game. Playing a game with defective displays can really frustrate and confuse a player. Naturally, that player will probably not return to challenge the game.

Following is a brief theory of operation of the displays, along with troubleshooting information. Presenting the knowledge and theory first will allow you to more fully understand the troubleshooting and problem solving aspect of displays. The better understanding you have of troubleshooting procedures, the less that game will be down and the better the earning potential, see Figure 1.

The theory of operation of a fluorescent digit display tube is similar to the vacuum tube theory. The filament acts as the cathode. When the filament is charged with electricity and heated, electrons are emitted. If a more positive voltage is applied to the anode and grid at this time, electrons emitted from the filament are drawn into the anode through the grid. These electrons striking the anode will excite the fluorescent substance on the anode and emit light. If the anode and grid voltages are dropped to zero or negative, no electrons will be drawn to the anode and no light will be emitted.

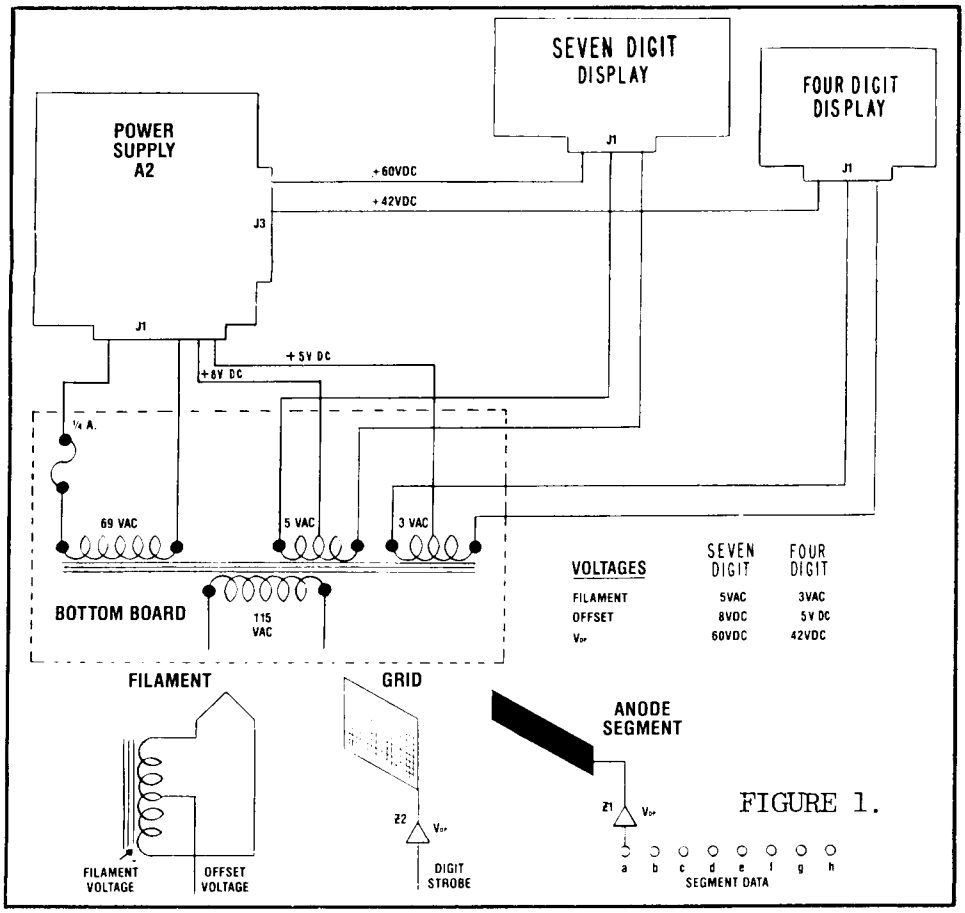

FIGURE 1.

The filament, which acts as a direct heated cathode, works on AC power. The constant variation of the AC voltage provides uniform brightness across the face of the display and also assures that the filament wire will not get overheated and break or wear at any point. To cut off the flow of electrons to the grid and anode, a negative voltage (in reference to the filament) must be applied to the grid or anode. Since the filament AC voltage swings negative every half-cycle, just grounding the grid would still allow electrons to flow every half-cycle. For this reason, a low +DC vol-

TROUBLESHOOTING GOTTLIEB DISPLAYS (CONT.)

tage is applied to the filament in addition to the AC voltage. On the negative half-cycle the filament will still have a positive potential above the grounded grid or anode. This is the purpose of the offset voltages for the displays.

There are six separate voltages that should be checked when you are troubleshooting displays. The voltages are generated with a combination of the bottom board and A2 power supply board. The anode voltages are regulated +DC supplied from the power supply board. The high voltage section of the A2 board has a 60V AC input that is rectified and regulated by the Q1 and Q2 circuitry to produce +60V DC. The zener diode CR6 provides the +42V DC output from the +60V DC. The +60V DC output is the high voltage supply for the anode segments and digit grids on the 7-digit display. The +42V DC is the high voltage supply for the 4-digit status display.

The 7-digit display filament offset voltage is +8V DC generated by the +12V DC input to the A2 power supply board by zener diode CR7 and R10. The 4-digit display filament offset voltage is +5V DC, which is the same as the logic supply voltage. The +8V DC is applied to the center tap of the 5V AC winding on the small transformer. The +5V DC is applied to the center tap of the 3V AC winding on the small transformer. The two pairs of AC offset voltages then go up to the displays in the lightbox via connector A12J4.

The configuration of our display signal wiring is as follows:

	Group	Player Display
Segments:	A	1st and 2nd player
	B	3rd and 4th player
	C	Status (and Bonus if present)
Digits:	D1 through D6 and D16	1st and 3rd player (and Bonus if present)
	D7 through D12 and D13	2nd and 4th player
	D13 through D16	Status

The display control signals originate at the A1 control board and are wired directly to the displays. There are 16 digit control lines and three groups of 8 segment lines that are common wired to three groups of displays. The common wiring is actually a combination of cross wiring between digits, segments, and displays.

The digit lines are always sequentially strobed, so only one line at a time will be high. The processor will fill each segment group with the data or blanking information that is necessary for each digit.

For instance, if there is a first and second player up, then the "B" segment group will always be filled with blanking information. So when the digits are strobed for the 3rd and 4th player, the segments will be low, and the display will be blank. If 1st player only is up, then the processor will fill the "A" group with blanking information when the digits D7 through D13 are high. The microprocessor scans each digit 61 times a second so displayed data will look constant to the eye.

Most problems that will develop in displays will be shared by two or more displays because of the signal configuration. A segment-related problem would be shared by the 1st and 2nd player displays or 3rd and 4th player displays. Digit problems will be shared by player displays 1 and 3 or 2 and 4. When checking display problems, remember that one bad display can make others appear bad because of the common wiring. Disconnect one display at a time and observe what happens to the other displays.
CAUTION: Do not plug or unplug displays with the power on. Damage to the control board will result.

If the problem can be determined to be on the display board itself, it may be possible to fix the display board, saving the expense of purchasing a whole new display.

The voltages can be easily checked on the display board to determine what component may be bad. The +60V DC can be checked by placing your meter leads across the 1 mfd filter capacitor or across pins 9 and 10 of the UDN6118 buffer chip. The 5V AC filament voltage can be checked on the fluores-

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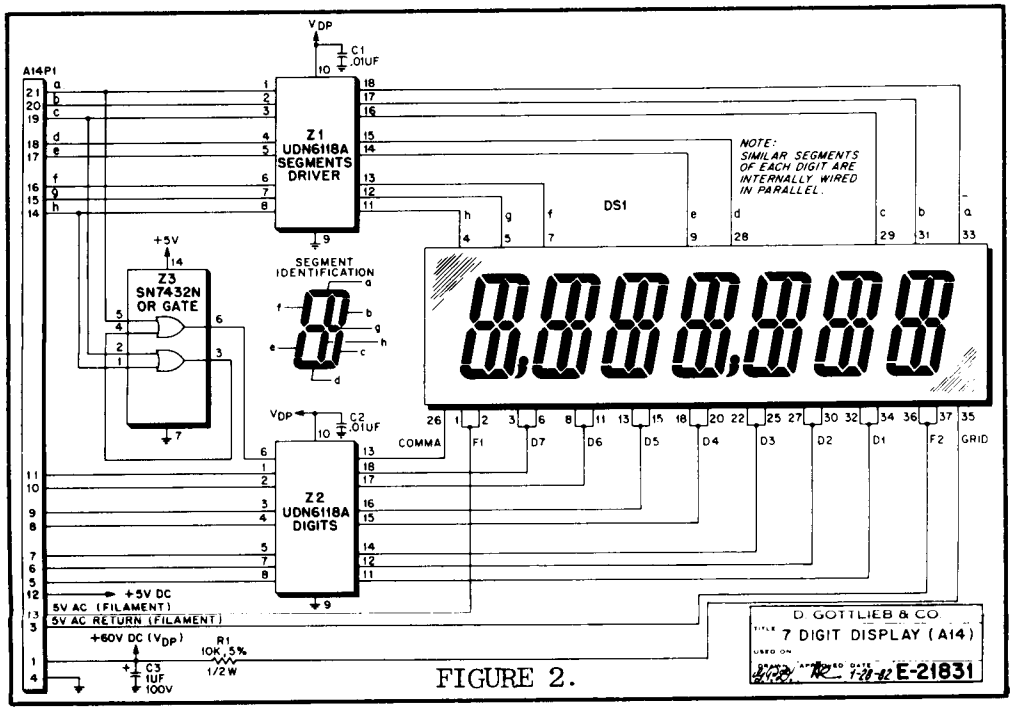

FIGURE 2.

cent display tube by placing the meter across pins 1 and 37 on the tube. The +8V DC filament offset voltage should be checked from either one of the pins 1 or 37 to the negative side of the 1 mfd capacitor or any ground. The 4-digit display voltages are checked using the same procedures.

The display board components can be checked individually using just a meter. All components should have standard readings that can be checked to verify their integrity. On the fluorescent display tube itself, there should be infinite continuity readings between all segment, digit, and filament pins. Make all measurements on the pins of the tube using the display schematic from the game manual, see Figure 2. Some of the pins are not connected to anything and the digits have two pins each. There are other minor variations between 4-digit, 6-digit, and 7-digit tubes. There should be continuity readings between the two filament pins and also between the individual two digit pins, but again, not to each other.

The two main IC chips on the board are high voltage, Darlington output buffers, UDN6118A. These IC's isolate the high voltage segment anode and digit grid lines from the low level signal source. To check them with a meter, first disconnect the plug from the display. Then put your ground lead on pin 9 of the UDN6118 chip. From pin 9 to pin 10, V_{DD} source reference, there should be infinite or very high resistance. Then checking pin 9 to all the input pins, 1 through 8, there should be a resistance of from 30K to 45K ohms. From the ground, pin 9, to the output pins, 10 through 18, there should be a high impedance reading of from 110K to 130K ohms. The readings should be the same if the meter leads are reversed.

On the 7-digit and 4-digit display boards there is a 7432 quad OR gate that is used to generate the comma on the 7-digit display and the "1" on the 4-digit display. Continuity readings on this chip would give indications of forward and reverse bias voltage drop. With the ground lead on pin 7 (ground), there should be a high resistance or impedance reading to all pins, except to the tube connected outputs, pins 3 and 6. Placing the positive lead on pin 7 will give readings of 25K to 30K ohms, showing forward bias, on all pins.

The large filter capacitors on the +60V DC input line can be checked for continuity by placing the positive lead on the negative side of the capacitor and the negative lead on the positive side. There should be a reading of 25K to 30K ohms and infinity in the reverse direction.

Please note that all these readings may vary, depending on the type of meter you are using. These readings will greatly differ if you are using an old meter or an analog meter. If your measurements differ greatly, or if in doubt, verify your readings by checking against a good display.

The glass tube can also break down internally or burn out over the years. The fluorescent display tube can be replaced, saving money over the cost of the whole display board. First unsolder all the display tube pins from the display P.C. board. Then carefully insert a

TROUBLESHOOTING GOTTLIEB DISPLAYS (CONT.)

utility knife between the P.C. board and the top of the display tube. The glue should be sliced or loosened and then pried up. We do not recommend prying the glass off, as the P.C. can crack or the glass could shatter in your hand. We also recommend using some work gloves to protect your hands in case the glass shatters or the knife slips.

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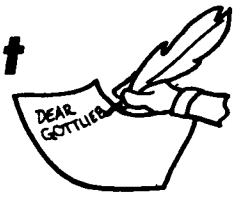

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FLASHBACK

At midnight, April 30, 1942, Gottlieb officially converted to war production. For the duration, Gottlieb made small metal parts mostly for parachute harnesses and aerial bombs. Not until November 1945 was pinball game production resumed, with STAGE DOOR CANTEEN.

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FIXIN' IT BY PHONE

When you call our toll-free numbers for technical assistance, we usually can solve your problem. At times though, two or more calls are necessary to communicate enough information for us to accurately pinpoint the problem. What happens is that time is lost, and patience wears thin. You want to be able to troubleshoot that game fast and as accurately as possible. Next time you need our assistance, follow these simple suggestions before you call: write down exactly what the symptoms are and when they occur. Check and record voltage levels at their destination points. Use the self-test routine outlined in the game manual. Remember, a major cause for intermittent problems is switches; poor adjustment and dirty contacts will cause a myriad of problems. Toll-free lines are 800-323-9121 in the U.S., and in Illinois 800-942-1620, and are available from 8:00 am to 4:30 pm C.S.T.

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