ON TARGET
Gottlieb
TECHNICAL NEWSLETTER VOLUME 3, ISSUE 2 FEBRUARY 1982

SWITCH MATRIX (PART TWO)

TROUBLE SHOOTING
THE SWITCH MATRIX

In the last issue, the function of the matrix isolation diode was discussed at length. Dependent on how a diode fails, several different symptoms will appear.

If a diode internally opens, the effect will only be isolated to that particular switch. Closing the switch will have no effect (See Figure 1). Test #18 will not display a matrix number.

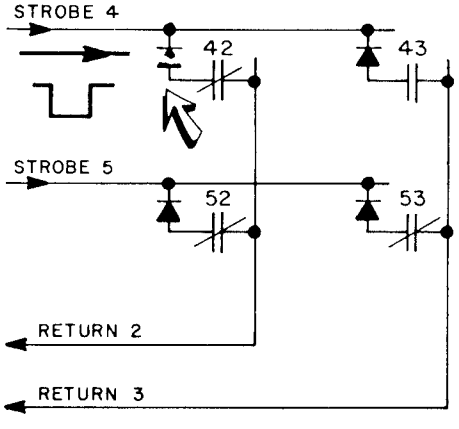

Figure 1

If a diode shorts, the effect becomes more dramatic. Figure 2 demonstrates that we lose our switch isolation, and that the return lines may detect false signals. This will cause the game

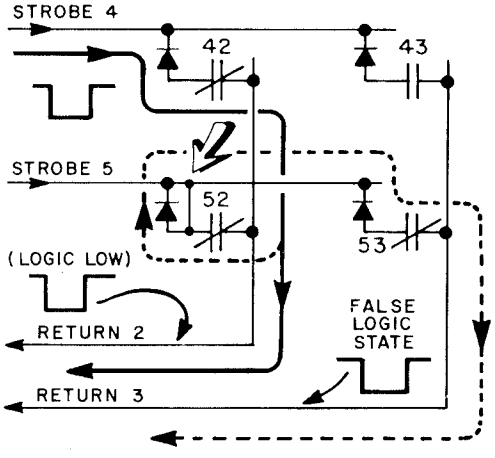

Figure 2

to malfunction and may lead the technician to believe that a bad control board or power supply is the cause. Note in Figure 3 that a reversed diode may generate the same problem as a shorted diode.

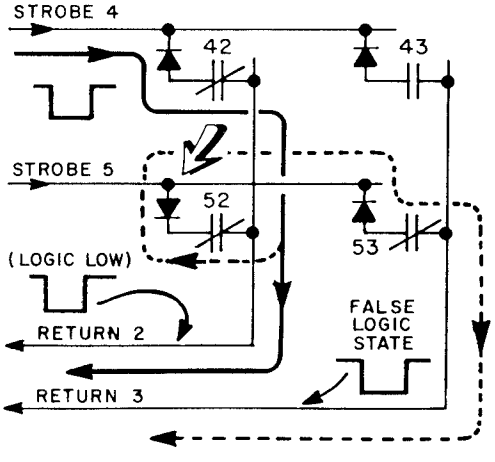

Figure 3

Diodes can be checked by first unplugging A1J5 and A1J6 from the control board. Be sure the game power is off before unplugging the connectors. And then performing a continuity test on each of the diodes until the defective diode has been found (See Figure 4).

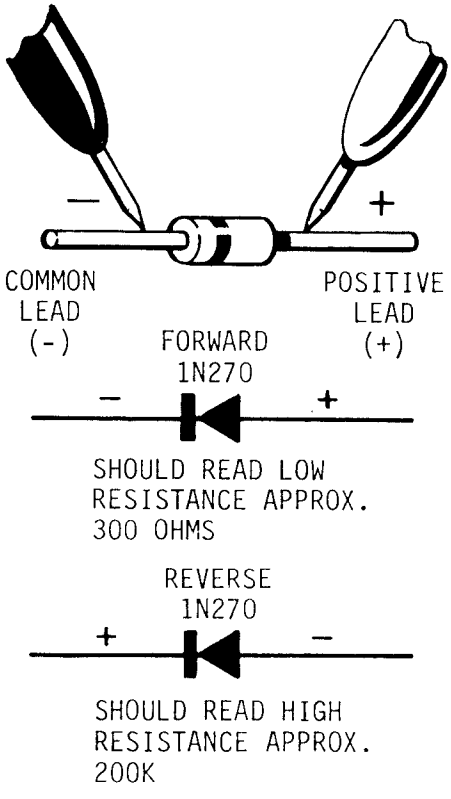

Figure 4

This is necessary as the control system will not respond correctly if a particular strobe line or return line is either open or shorted (to ground or to one another). Switches common to a bad strobe or return will all be affected. (Refer to the game manual switch matrix diagram.)

(continued on p. 2)

SWITCH MATRIX (PART TWO)

(continued from p. 1)

SWITCH MATRIX
RELATED RROBLEMS

At times, isolating a particular game problem may not be a simple task. The problem may be mechanical, electronic or both. It may be power supply problems or the worst of any problem, intermittent. The secret to any good troubleshooting is to observe the symptoms and ascertain what could possibly cause such symptoms.

The proper functioning of the switch matrix is vital for correct game operation. It's both mechanical and electronic in nature. The playfield switches are mechanical and need proper mechanical adjustment while their contacts are wired directly to the control board inputs of the game micro computer. The "garbage in - garbage out" saying really applies here. If our system has bad information inputted into it (malfunctioning switch matrix), it will output bad information. The electronic control board may be falsely implicated as the cause of the problem, while a misadjusted switch or broken matrix wire may be the true cause. Remember, always check the mechanical parts of a game before you start pulling electronic boards! Plug connections, broken wires, binds in playboard mechanical devices, relay contact and game switch adjustments, and solenoid plunger alignment should be considered where applicable.

Now let's examine certain functions on a Gottlieb System 80 pinball game.

If a matrix switch is closed and remains closed, the program will only recognize that switch once. For example, if a switch closes, scores 5,000 points and gives bonus multiplier, and then remains closed, it will not score 5,000 points and add bonus multiplier until it is opened and again closed. The only exceptions to this are hole ball kickers and the outhole kicker. These kickers will constantly kick and score. If this problem exists on a game, check for a closed matrix switch.

It's very important to note that intermittent problems may be the result of contact gap on a switch resulting in closure due to vibration on the playfield. A good example of this is when player 1 jumps to player 2, or ball 1 jumps to ball 2. Here the outhole switch is too closely gapped and closes when a drop target bank resets, a pop bumper is struck, or a flipper is actuated. (Many times, points are scored just by energizing the flipper.)

Checking the Switch Matrix

To make a thorough check of the switch matrix, use the game manual, the game self/test function, and an ohm meter. The game manual explains the switch test (#18) and lists all scoring and feature related assignments for all of the matrix switches.

Self/test step #18 is the switch test. It's a two-fold test that not only insures that switches are open but allows the operator to check that each switch will actually close and register as a true switch closure.

The game manual instructs the technician on how to enter the self/test. Step #18 will be shown in the credit display. The ball-in-play display will indicate switch status. If all matrix switches are open a 99 will be displayed. Remove the ball(s) from the ball return track for this test. If any switch is closed, the corresponding switch matrix number will be displayed. (Remember, the matrix number assignments are found in the manual.) If more than one switch is closed, the matrix numbers will be sequentially displayed.

If all switches are open, test the actual switch closure of each switch. Close any matrix switches and its assigned matrix number will be displayed.

Next Month:

System 80A and the new 7 digit display:
Schematic (7 digit display) and the new control board options will be discussed.

Given below is a transistor and diode substitution list. This list can be used to order either exact replacement parts or permissable substitutes.

TRANSISTOR AND DIODE SUBSTITUTION GUIDE

PART NUMBER	GOTTLIEB XO NO.	SYLVANIA SUBS. ECG	RCA SUBS. SK	GEN. ELEC. SUBS. GE	INT. RECT. SUBS. IR/WEP	MOTOROLA SUBS. HEP	RADIO SHACK SUBS. MISC.	POLARITY (TYPE)	RATED I_C (A)	RATED V_{CEO} (V)	RATED V_{CBO} (V)	RATED P_T TOTAL POWER DISSIPATION (W)	RATED h_{FE} MIN.-MAX.	
PMD 10K40	XO 315					2N6057		NPN	12	40	40	150	1K-20K	
PMD 10K60	XO 311					2N6057		NPN	12	60	60	150	1K-20K	
PMD 12K40	XO 308							NPN	8.0	40	40	100	1K-20K	
T1P 31B	XO 641	184				S5000		NPN	3	80	80	16	10-50	
T1P 31C	XO 307					S5004		NPN	3	100	100	16	10-50	
T1P 105	XO 319							PNP	8	60	60	32	1K-20K	
T1P 115	XO 312							PNP	2	60	60	20	1000-	
T1P 640	XO 322	245						NPN	10	60	60	100	1000-	
2SC 945	XO 316	199	3124	20		S0015		NPN	100M	50	60		200	
2SA 1015	XO 317							NPN	5.0	50	50		70	
MPS A13	XO 304	172		64	~~TR69~~ S9100	S9100		NPN	100M	30	30	625M	10K-	
MPS A43	XO 305					S0005		NPN	30M	200	200	625M	50-200	
MPS U45	XO 306	272						NPN	2.0	40	50	10	4K-12K	
MPS A70	XO 309	159	3114	65	TR20/717	S0019		PNP	5M	40	30	350M	40-400	
MPS 6534	XO 318	159	3114	21	TR20/717	S0019		PNP	100M	40	40	350M	90-270	
2N 2222A	XO 320			20		S3001		NPN	150M	40	75	0.5	100-300	
2N 2907A	XO 321	159	3114	67	TR20/717	S0013		PNP	150M	60	60	0.4	100-300	
2N 3055	XO 301	130	3027	14	TR59/247	S7004		NPN	15	70	100	65	20-70	
2N 3416	XO 302	123A	3124	210	TR21/735	S0015		NPN	500M	50	50	360M	75	
2N 4400	XO 313	123A	3122	20	TR21/735	S0015		NPN	600M	40	60	350M	20	
2N 5550	XO 314	194	3045		TR78/	S0005		NPN	10M	140	160	625M	60-250	
2N 5875	XO 310						2N6229	PNP	10	60	60	86	20-100	
2N 6043	XO 303	261	3180			S9102		NPN	8.0	60	60	2.2	1K-20K	

Z = ZENER
* = GERMANIUM

DIODES AND ZENERS

PART NO.	XO NO.	PIV (V)	I_O (A)	(W)	TOLERANCE
1N 270	XO 265	100V	200M		*
1N 703	XO 251	3.5V	250M	0.5 W	13%
1N 3445	XO 266	8.2V	2M	1.0 W	10% Z
1N 4002	XO 253	100V	1.0		
1N 4004	XO 254	400V	1.0		
1N 4148	XO 261	75V	10M		
1N 4720	XO 260	100V	3.0		
1N 4734A	XO 255	5.6V	45M	1.0 W	5% Z
1N 4738A	XO 256	8.2V	31M	1.0 W	5% Z
1N 4742A	XO 257	12V	21M	1.0 W	5% Z

PART NO.	XO NO.	PIV (V)	I_O (A)	(W)	TOLERANCE
1N 4743A	XO 262	13V	19M	1.0 W	5% Z
1N 4746A	XO 258	18V	14M	1.0 W	5% Z
1N 4751A	XO 271	30V	8.5M	1.0 W	5% Z
1N 4753	XO 259	36V	7M	1.0 W	10% Z
1N 4759A	XO 267	62V	4M	1.0 W	5% Z
1N 5225B	XO 269	3V	20M	0.5 W	5% Z
1N 5401	XO 263	100V	3.0		

HAUNTED HOUSE

FLASHBACK

Many Gottlieb pinball games made in the mid-1930s had a feature used by no other manufacturer: a clock set into the lightbox. The clock was electric, run off the game's batteries or its "battery eliminator" (a transformer and rectifier). The clock movement was made by Hammond and was called by Gottlieb the "Playtime Clock".

Notice

The Pinball/Video Service Hotlines are now the same. Call 800-323-9121, in Illinois 800-942-1620 from 8:00 a.m. to 4:30 p.m. CST for any Gottlieb pinball or video game assistance.

MAILING LIST: Get ON TARGET every month by sending your name and mailing address to:

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