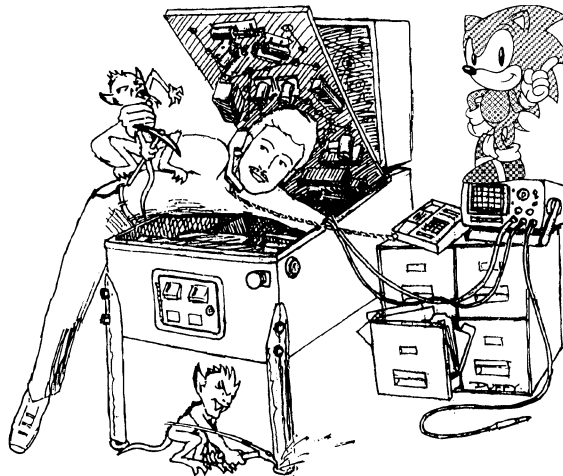# Service Bulletin № 80

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TO: Parts & Service Managers

DATE: December 21, 1995

SUBJ: **Theory of Operation: Apollo 13 Playfield Magnet Interface
        and 7-Segment Display Board (520-5130-06)**

We would like to introduce a feature on Apollo 13 which grabs the ball off a ramp and orbits it around the moon dropping it into the under playfield Trough Assembly.

Digitally this board consists of output ports that reside at three dedicated address locations.- These locations are determined both by pinout choices (at the I/O Board) and by hardware decoding on both CPU/Sound and I/O Boards.

A CPU write operation to Hex address $3601 clears the outputs of latch **U2** (74LS273) (The /CLR line goes low, and all outputs of **U2** go low.) A write to address $3600 brings the /CLR line high, and enables data output from latch **U2**. The actual data bits present during these two write operations are ignored.
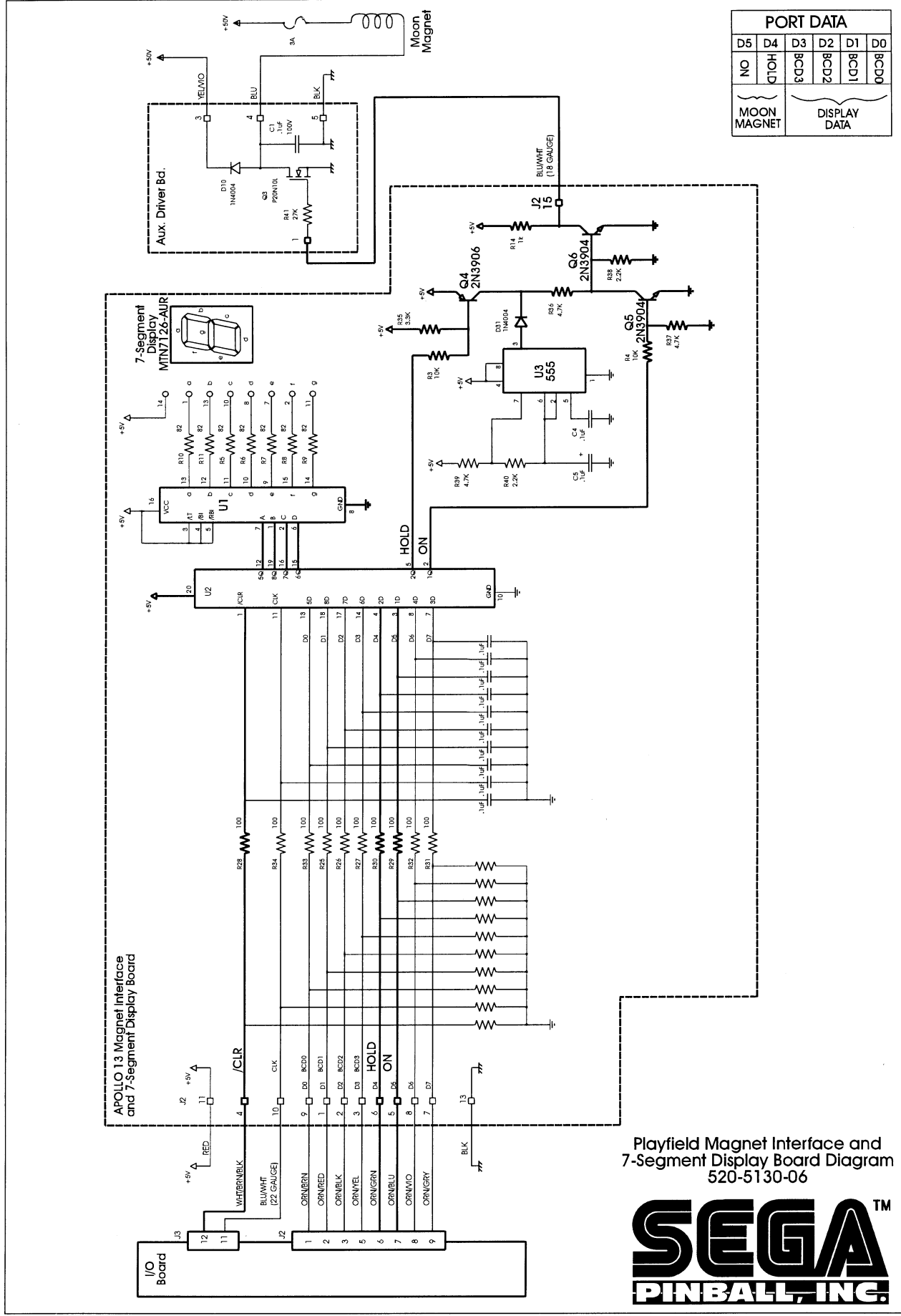
A write to address $3500 can then take place, with the data bits present being latched into the outputs of **U2**. Bits D0 thru D3 are latched to generate the Binary-Coded-Decimal (BCD) digit which is visible via decoder/driver **U1** and the 7-Segment LED display.

Data bits D4 and D5 are latched into the outputs of **U2** to enable the moon magnet. When the magnet is turned off both Bits D4 and D5 are low which means the hold output of **U2** will be low turning **Q4** *ON* which supplies 5v DC to the collector of **Q5** and the base of **Q6**. The *ON* output of **U2** will be low turning **Q5** *OFF* which will turn **Q6** *ON* which brings the output at J2 pin 15 low leaving the magnet *OFF*.

When bit D5 goes high and D4 stays low (*ON* condition) **Q5** is switched on, turning off **Q6** and resulting in a high drive signal or voltage at J2 pin 15.

When bit D4 is high with D5 low (*HOLD* condition) **Q4** is turned off, **Q5** is turned off, and the (10% duty cycle) square wave output of **U3** is applied to **Q6**, resulting in a 10% drive signal at J2 pin 15.

The two different drive signals result in a powerful *GRAB* effect and milder *HOLD* action of the Moon Magnet similar to pull-in and hold power in our flipper coils.

PORT DATA

D5	D4	D3	D2	D1	D0
ON	HOLD	BCD3	BCD2	BCD1	BCD0
MOON MAGNET		DISPLAY DATA			

Moon Magnet

+50V

3A

Aux. Driver Bd.

YEL/WIO 3

BLU 4

C1 .1uF 100V

BLK 5

D10 1N4004

Q3 P20N10L

R41 27K

1

BLU/WHT (18 GAUGE)

J2 15

+5V

R14 1k

Q4 2N3906

Q6 2N3904

R38 2.2K

+5V

R35 3.3K

D31 1N4004

R36 4.7K

Q5 2N3904

R37 4.7K

R3 10K

U3 555

R4 10K

C4 .1uF

+5V

R39 4.7K

R40 2.2K

C5 .1uF

7-Segment Display MTN7126-AUR

+5V 14

R10 R11 R5 R6 R7 R8 R9

82

VCC AT /BI /RBI U1 A B C D GND

16 3 4 5 7 1 2 6 8

HOLD ON

5Q 8Q 7Q 6Q 2Q 1Q

U2 /CLR CLK 5D 8D 7D 6D 2D 1D 4D 3D GND

20 1 11 13 18 17 14 4 3 8 7 10

+5V

D0 D1 D2 D3 D4 D5 D6 D7

.1uF .1uF .1uF .1uF .1uF .1uF .1uF .1uF

R28 R34 R33 R25 R26 R27 R30 R29 R32 R31
100 100 100 100 100 100 100 100 100 100

APOLLO 13 Magnet Interface and 7-Segment Display Board

/CLR CLK D0 BCD0 D1 BCD1 D2 BCD2 D3 BCD3 D4 HOLD D5 ON D6 D7

J2 +5V 11

4 10 9 1 2 3 6 5 7 8

13 BLK

+5V RED

WHT/BRN/BLK

BLU/WHT (22 GAUGE)

ORN/BRN ORN/RED ORN/BLK ORN/YEL ORN/GRN ORN/BLU ORN/VIO ORN/GRY

J3 12 11 J2 1 2 3 5 6 7 8 9

I/O Board

Playfield Magnet Interface and
7-Segment Display Board Diagram
520-5130-06

SEGA Pinball, Inc. ™