

# ON TARGET

Gottlieb

TECHNICAL NEWSLETTER VOLUME 3, ISSUE 8 OCT./NOV./DEC. 1982

## SOUND/SPEECH, CIRCUIT ANALYSIS

### POWER SOURCES

Four input voltages are required for the Sound Speech Board. +30V DC for the LM379 Amplifier, +12V DC for the DAC'S, SC01A voice chip and LM741'S, -12V DC also goes to the DAC'S and LM741'S, and +5V DC is used for the 6502 CPU, 6532 RIOT and all TTL. +30V DC, +12V DC and -12V DC are supplied to the A6J1 edge connector by the A7 auxiliary power supply. The +5V DC originates at the A2 power supply.

### POWER UP

Upon applying power, the reset signal (Pin 40 6502, Pin 34 6532) is held low for at least 30ms. At this time, the processor is in a disabled state. This eliminates power on transience problems and allows time for the clock to stabilize. When the reset line goes high, the CPU is initialized internally through software to control orderly start-up.

Crystal Y1 is oscillating at 3.579 MHZ. Immediately it is squared up by U25, then divided by four by U2 74LS74, which makes the system operating speed 894 KHZ.

### SOUND SPEECH BOARD ENABLING

Sound enables S1, S2...\*S32 (high at A6J1 connector), are inverted by U16 (74LS04), then input at ports PA0-PA5 of U15 respectively. At the same time, S1-S8 are norred at U17 (74LS30). When one of these four inputs goes low, PA7 of U15 (an edge detecting input) sees a low to high transition. When this transition occurs, the TRQ line goes low and the CPU reads ports PA0-PA5. The state of these ports (1'S or 0'S) determines which memory locations will be accessed.

Ports PBO-PB5 of U15 are used as inputs for SBI, the operator adjustable switch pack.

### \* NOTE:

Sound 16 and Sound 32 may be enabled by lamp driver transistors. An LM393 dual comparator is used to insure a TTL low at U16 (74LS04) when enabled.

### DATA ROUTING

Instructions for sound and speech are stored in the EPROMS U5 and U6 and transferred to the CPU at the start of the instruction cycle. A chip enable signal, CE Pin 18, enables either EPROM for specific addresses.

Addressing is decoded and routed to the board hardware through U4 (74LS138), 3 to 8 line decoder, device select. G1 enable on U4 is tied high and G2A and G2B are tied low. Particular devices are selected according to the binary condition of AB12(A), AB13(B), and AB14(C). At least one device or area is being selected at all times. See Figures 1 and 2.

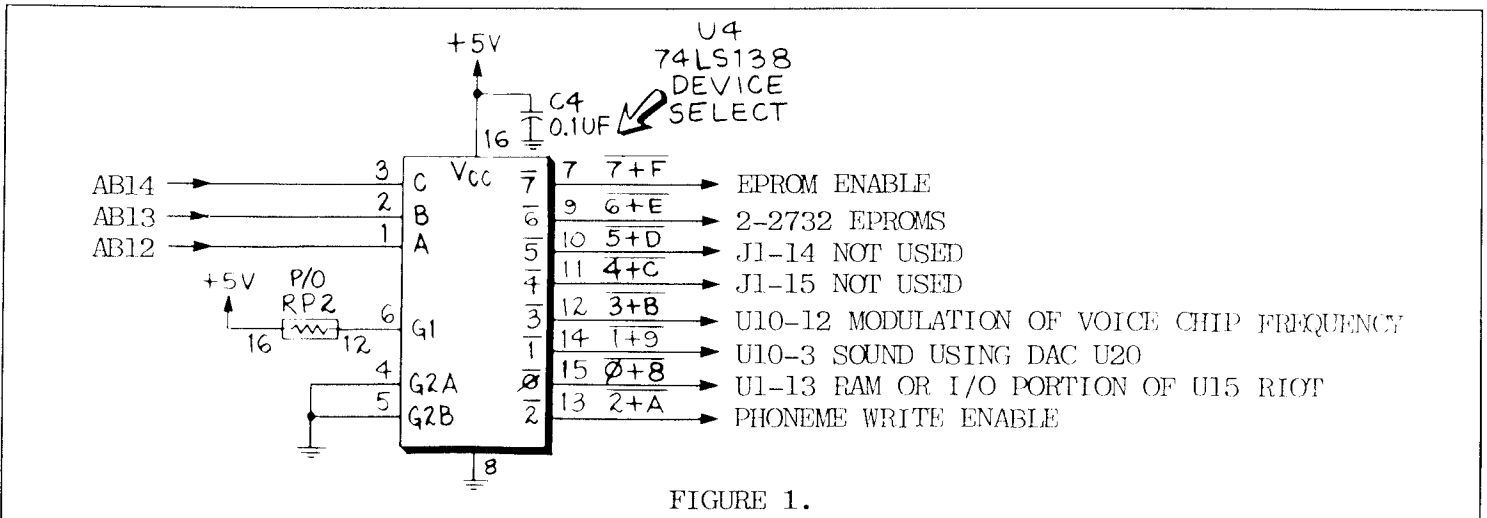


FIGURE 1.

# SOUND/SPEECH, CIRCUIT ANALYSIS (Cont.)

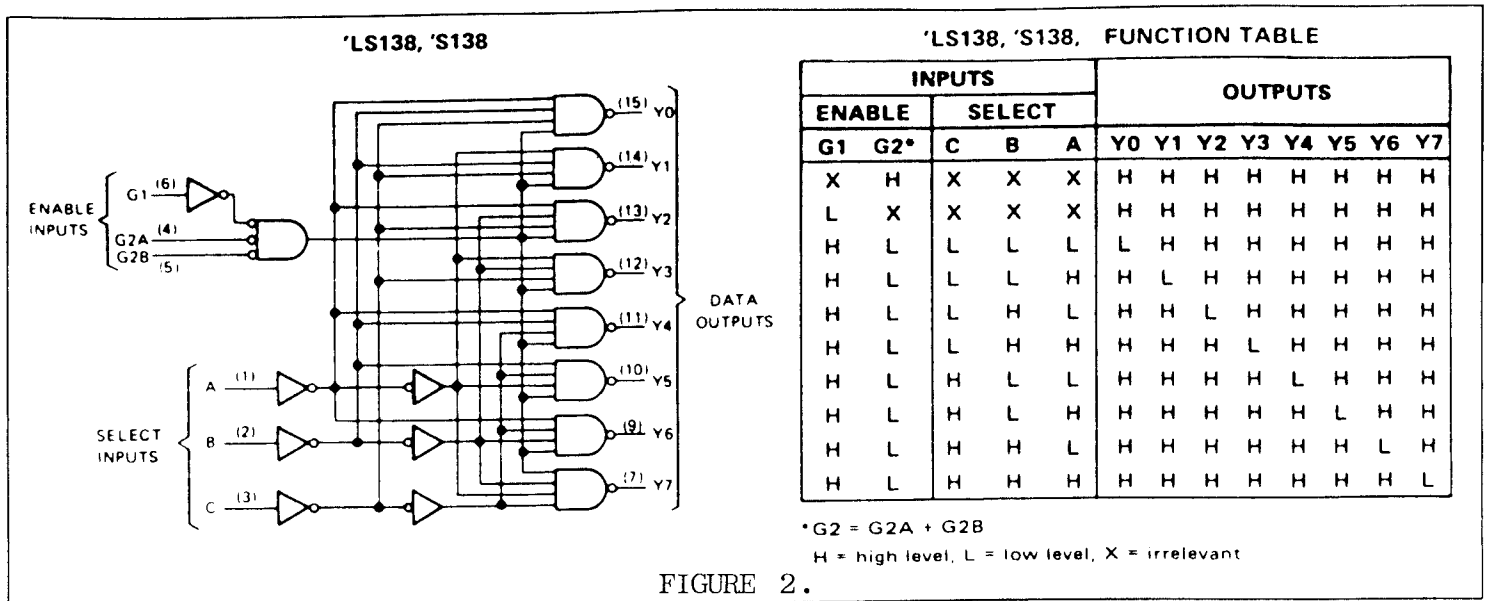


FIGURE 2.

Sound and speech are divided into two operating sections. To create sound, \$1000 is placed on the address bus. The combination of address \$1000 and the  $\overline{1+9}$  signal, enable the U7 and U8 latches. Data on the "D" inputs (6 inputs high) are then transferred to the "Q" outputs. This transfer process occurs whenever a new value is to be sent to the DAC. U20 is an 8-bit DAC with 8 input lines. Information from U7 and U8 is immediately transformed to a proportional output current through U20. All lines at a binary "1" condition would equal maximum current; all other combinations would produce a linearly proportional current. U22 is used as a current-to-voltage converter.

R13 is a 10K trimpot used for amplitude range adjustment. Pin 6 of U22 is the signal output and leads to R15, a 10K volume control pot which is used in conjunction with R16 to mix and balance the voice and sound. From there, the signal goes to Pin 9 of U23, a LM379 audio amplifier that provides 6 watts of power into an 8 ohm load.

## SPEECH SYNTHESIS

U14 SC01A is a phoneme synthesizer capable of reproducing a single phoneme (basic unit of speech) on commands. 64 phonemes are able to be produced by setting P0-P5 to the proper phoneme code and then applying a strobe signal. A string of consecutive phonemes creates speech. Two latches, U11 and U18, the U19 DAC, Q1 and Q2, and U21 analog inverter comprise a software controlled variable clock signal to the SC01A. R6 is a 10K trimpot used for frequency adjustment.

As the clock frequency to Pins 15 and 16 of the SC01A changes, the frequency of the currently produced phoneme also changes, resulting in a variance in the base speech frequency. Sound effects may also be produced with the SC01A by changing the clock frequency. The SC01A will automatically signal the CPU that it has processed the current phoneme and needs immediate attention by toggling the  $\overline{A/R}$  line Pin 8.

When a high to low transition occurs on this line ( $\overline{A/R}$ ),

the SC01A is informing the CPU that phoneme data has been received. What the CPU actually senses is a low to high transition because of the inversion of the signal through the Q3 transistor. This indicates timing out of old phoneme data and is concurrent with a request for new phoneme data.

At this point, new data is sent out from the CPU through U13 level shift. Each of the data lines DB0-DB5 are pulled up by RPl because the phoneme data must be at a +5V DC level for the SC01A to operate properly. This is also true for the strobe signal (S) and (L1) and (L2) inputs of the SC01A.

Latching of the phoneme data occurs on the rising edge of the (S) strobe signal (Pin 7 of the SC01A).  $\overline{2+A}$  and the R/ $\overline{W}$  signal are combined together at Pins 5 and 6 of U10B 74LS02. This signal is buffered by U12 and anded with the Phase 1 clock and the clock output of U25E-10. The result is that all three inputs must be high for a high output (refer to Figure 3.). When any input is low, the output will be low.

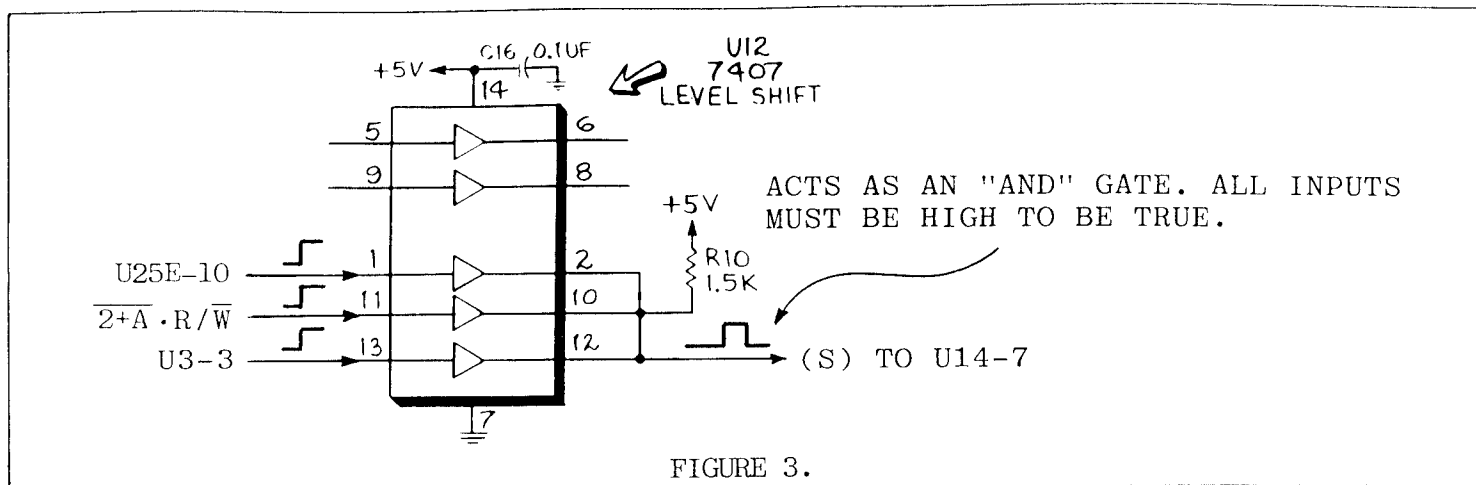


FIGURE 3.

This gating ensures correct timing of the (S) strobe signal.

When a change in pitch is desired, the "G" enable, Pin 13 of U9 goes high and data is

transferred to the U12 level shift where it is buffered and then sent to the L1 and L2 inputs of the SC01A.

SC01A signal outputs, Pins 20, 21, 22 are tied together and sent

to R16, 10K pot. As explained in the sound section, they are mixed with the sound output and amplified by U23 IM379 dual power amplifier and output on AGJ1 Pin 7.

## CAVEMAN

### TROUBLESHOOTING TIP

For proper initialization of Caveman pin-video game, communication must occur between the pinball section and the video section.

Problems that can happen are "No activity from the front door switches, bonus lights frozen on the playfield, or in some cases, how to play instructions appear in German on the screen."

Check for continuity between the A3J3 master driver connector and the A23J2 connector on the video card cage. Specifically, look at A23J2 Pin 10 (144 wire). This wire originates at A3J3 Pin 13 and carries a strobe signal (high to low pulse). This is necessary for initialization of the handshaking routine between the pinball and the video. Make sure the A23J2 connector is making connection to the pins on the I/O RAM board (A23). This plug can be reversed without damage to the system.

### FLASHBACK

In 1937 Gottlieb made TRADING POST, a turntable digger machine. This was the type of machine in which the player operated a crane or arm to catch merchandise from a moving turntable. Although these machines were popular for many years, TRADING POST was Gottlieb's only one. An unusual feature of this game was the random awarding of a replay. It was also an attractive-looking game; the turntable, arm and all exterior castings and fittings were chrome plated and the cabinet was bird's-eye maple with walnut trim.

### comment corner

Believe it! Gottlieb listens to you! D. Gottlieb is aware that operator experience and expertise can only help our efforts to produce a more reliable and serviceable product. ON TARGET will publish any letters of opinion if it will be beneficial to our readers. At times, letters sent to us may not appear in the upcoming issue. However, they may be included in future issues.



# CONDITION OF ARRIVAL REPORT

As part of our ongoing Quality Assurance Program, D. Gottlieb & Co. has begun a customer inspection feature for all new games. Beginning with the production of the pinball game "Punk" and the video game "Q\*Bert", a distributor or owner opening up a new Gottlieb game will find a self-adhesive tag affixed to the lightbox glass

or top glass. The tag is a Condition of Arrival Report that we would like our customers and distributors to fill out. Returning this postpaid mailer to us for every game will assist our Quality Control/Quality Assurance Departments in their procedures. This will ensure the most reliable product possible for our customers.

# FIXIN' IT BY PHONE

Starting October 2, 1982, it will be necessary for our Illinois customers using the toll-free hotline to dial a "1" before the "800" phone number, 1-800-942-1620; outside Illinois, 1-800-323-9121.

The Pinball/Video Service Hotlines are now the same. Call from 8:00 AM to 4:30 PM CST, for any Gottlieb Pinball or Video game assistance.

# ON TARGET

It is our task in the Technical Marketing Services to provide as much help and service to our customers as possible. Yet due to the expanded contents of the newsletter and the increased distribution time, we will start printing the "On Target" newsletter on a bi-monthly basis as of January 1983. This will assure that we can provide the most helpful, accurate information to our customers as we develop it.

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