The Ni-Wumpf System 1 Combination CPU / Driver board Manual

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Overview

Thirty years ago, I wrote the original manual for our System 1 CPU replacement – it worked out all right – nobody read it then, or the follow-up 20 years later. So, I'm fairly certain that I can plagiarize every word out of these original manuals without anyone being the wiser. And that's what I'm counting on now. It doesn't take a Masters in Computer Science to realize that there are a **lot** of different games in the pinball universe, and that the set of System 1 games from Gottlieb in 1977 - 1979, comprise only a very small niche in this universe. Unlike most though, I am one of those oh-so-fortunate few to have purchased my very first pinball game, "**Sinbad**", from this group. As such, I had always had a special interest in getting this game running just right. Originally, it came to me from a vendor, who quite fairly, described it as having a "memory problem" that he couldn't fix. It was nearly a year later that I knew enough about the architecture of the CPU to replace the 5101 chip, and finally see the game remember it's high score table. By that time, I had acquired three System 1 games, and it was getting increasingly more important that I know enough about these CPU's to keep the games running. Until finally, the "**Charlie's Angels**" that I had just purchased, arrived with a very seriously dead CPU. To top it off, the spare CPU's I had managed to scavenge for parts had no way of producing enough components to cobble up a working CPU, they were just that; parts. About 6 months after this, I was able to determine, in my infinite wisdom, that the part that was actually bad was an extremely odd-looking "spider" chip labeled 1752, and not much more. Research is not my strongest suite, so it took me a bit of time to discover that this was, in fact, a custom VLSI chip, and not available from any of the crack electronic components shoppes in my area. Not one to be daunted by this, I made my first call to the factory; Premier (who apparently was formed from Gottlieb). Did they have this chip? Oh yes, three left; $75 apiece. I have to admit, I was inches from my wallet and the purchase of these extremely rare pieces of silicon. But I deferred, and went back into the "*lab*" to see what I could do to part out these spare boards and get one working. This was 1990. In 1991, I no longer had any spare boards with a functional 1752 chip in it, and I knew enough to be able to identify a faulty 1753 chip in a big sort of hurry as well. It was plain then that unless something happened to rectify this situation, that there was not a big future for my dear-to-the-heart "**Sinbad**". Sooner of later, that chip would fail, and the game was DONE; forever; no resuscitation. By this time, I knew the full architecture of the CPU, and with the help of Steve Young and his wealth of background material, I knew exactly what those "spider" chips were, and why Rockwell designed a 4-bit distributed architecture CPU back then before the Z80 silicon, was widely available. And I also knew that Rockwell was perfectly willing to press these chips again for us, if we would front them fifty grand for a minimum lot order. Again I was close to reaching for my wallet, though how much good it would have DONE me is dubious when you consider my account might have had about six hundred dollars in it at the time. My eyes were opened to the end of an era in 1992, when I realized that no one was going to save these games and that the System 1 Gottlieb games were rapidly being consigned to the dump by wild-eyed operators with a nervous twitch in their grins, and a song in their hearts, madly whipping System 1 components and playfields against the far wall of the dumpster. Off and on I thought about what I could do to redesign this CPU, but hey, let's face it, I was never that hot a hardware techy, and the concept of a PIA was vague at best, with no idea of why you might actually *need* one. Had I not managed to pervert a very good friend of mine from high-school, to the hobby of collecting video games and pinball machines, (like I was), we'd all be waiting for someone, somewhere, who knew what they were doing, to develop this CPU sooner or later. Now, this was no easy task I can assure you, considering this friend of mine lived with his wife in a trailer! (How good a friend can you be, to convince someone that forcing a bunch of pinball games into a living space just big enough for Iguanas, is that next, very important, phase of life that everyone just <u>has</u> to go through...) As it turns out, this is one of those guys that finds it mildly interesting to force the functionality of a Cray supercomputer into one of those "gate array" thingies, and go out for pizza after it's DONE. Just right. He convinced me that designing such a CPU, was relatively sweatless; and his wife assured me that he would prove it. And so it began...

The one thing that was immediately raised to our attention when test-marketing the idea of a replacement CPU, was the interface cable between the CPU board and the driver board. On 85% of the System 1 games that I have restored, this connector has had to be repaired with new pins, and the contacts on the CPU board burnished to get a good surface. Most thought we should integrate the CPU and driver board, thus eliminating

this connector entirely. And it has taken me 30 years to do so. Now while, this combination would have been the ultimate replacement for the Gottlieb System 1 games, it really isn't something I would buy. Largely because of the cost of the board. I mean, all of those lamp driver transistors and Solenoid transistors bumping up the cost for a replacement CPU to a point where… it might not be worth restoring the game at all. Me? I just want to replace the part that's broken, whether that is the CPU, the driver board, the power supply, or the harness. It is really unlikely that ***all*** of these components are going to fail at the same time – though I have come to realize, after attending a number of pinball auctions, it is not ***un***likely to have every one of these boards missing in the head when you buy a bunch of games. Eh. You say potato, pahtado, whatever. I'm throwing in the towel, and putting this latest board out there.

Design

- History

This revision of the CPU, is now targeting what has plagued our supply issues over the past 5 years or so. Long after we produced the first CPU in 1995, the components that went into that board became obsolete. Z80s were no longer made, all keyboards that once used the 8279 chips for interfacing all those key switches went to the PS2 model, and then to USB, PALs went the FPGA or CPLD route, and through-hole technology as a whole turned to surface mount components. Amidst this upheaval in electronic architectures, how does one select what components to use, and hope to have a long life from that line of chips?

The answer is to look no further than your cell phone. We settled on the ARM chip for the main CPU this time, removed all of the PAL components entirely, and laid out TTL "fuses" at the edge of the logic to prevent damage from the displays, playfield and driver board back into the CPU. Finally, the inputs to the new board were bullet-proofed with LM339 comparator chips to prevent damage from voltage surges through the switches.

All of this went into the standalone CPU board, separately, on the driver board – we moved from transistors to FETs, far faster, more efficient, lower power, and while they are not generally as robust as their transistor counter parts, they have one towering advantage; you can still buy them. Similarly for the next generation driver board, we dropped the old discrete lamp transistors, and went to FETs, and FET arrays. A little risky in my consideration, but every modern pinball manufacturer has done the same so... Go with the flow, I say.

- Implementation...

The processor includes decode logic, memory, FLASH, and ALU all in one flat piece of silicon the size of your thumbnail. Very neat! Input and output is done directly from the CPU. It has an 8MHz crystal that steps up to a 72MHz internal clock. And just because it's a RISC ALU doesn't mean that complex instructions take a few dozen clock cycles to execute – much of the instructions have been CISC-ized – i.e. a multiply can clock through in one clock cycle – very, very fast. The default CPU currently comes with 128Kbytes of FLASH (program memory) storage, and 20Kbytes of SRAM storage. 16 System 1 games fit in there, with no challenges…

We still buffer the display outputs clock out through 74LS240 chips, which are nothing more that DATA buffer chips meant to buffer the 3 volt output levels from the ARM to the 5 volt output levels expected at the displays. Anything goes wrong with a display, and you need only replace the buffer chip – rather than the surface mount one. Unless you let this poor CPU cook while the displays short the hell out of it… Try not to do that.

Now, in the past, output to the driver board for the lamps, was performed by 7416's to buffer the DATA lines, and a demultiplexor / latch to select one of the nine lamp latches on the driver board, from the "address" lines requested. Internally, that is still the case. While the inter-board harness is gone, damage to the FETs will still threaten the CPU. The solenoid pulse is still latched in a 74374, and uses the same 7416's to drive the solenoid lines. Again, as in the older CPU, the solenoid output lines are augmented with zener diode protection, to shunt voltage feedback from faulty driver components, and protect the processor from further damage. Damage from failed driver components *should* therefore be restricted to replacing these zener diodes.

Installation Caveats

The System 1 combination board was designed to be installed in the position in the head where the driver board once installed. And this brings up changes in several areas; mounting, cabling, and position. The first, and easiest topic to address, is that of cabling. The installer will immediately notice that the connectors on the CPU (figure 1) are located at different positions than those on the original CPU. Because each connector is slotted exclusively for the cable going onto it, it is felt to be impossible to get the wrong cable on the wrong connector. But for those in need of clarification...

The CPU is oriented so that the component side faces out. The long side of the board will have all four connectors for the driver board (J2, J3, J4, and J5) on the bottom, as well as the front door connector on the very left (J6), leaving the left side with two connectors for power (J1), and the playfield switches (J7). On the top of the board are now the two connectors going to the displays (A1-J2, and A1-J3). The board is a bit larger than the original driver board, but uses the same mounting holes. If the power supply option is purchased, it should be installed on the main CPU last, allowing the operator to install the cabling w/out interference from the power supply daughter board.

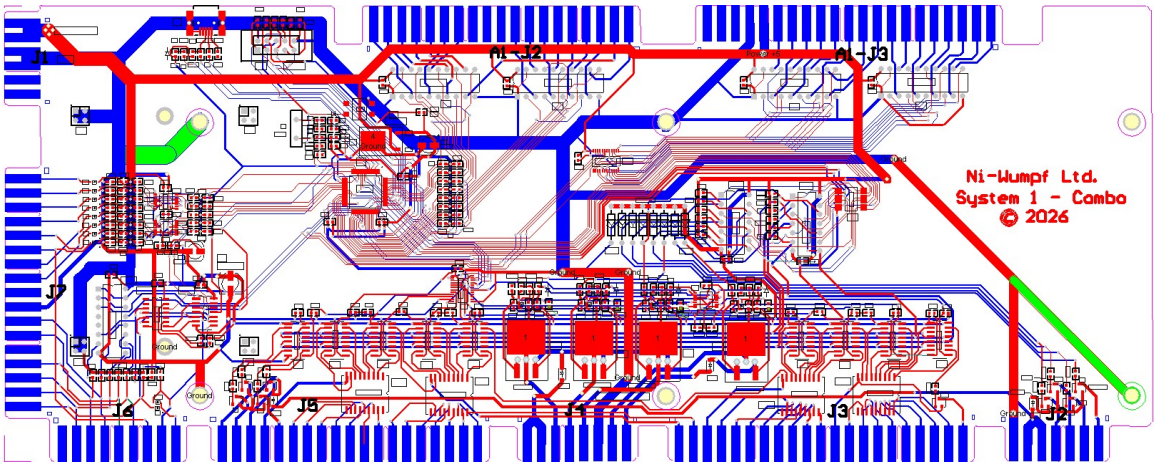


Figure 1 - Ni-Wumpf replacement CPU showing connector designation.

- Optional Power Supply

In the event that the Ni-Wumpf power supply is to be installed, J1 on the CPU board is not used, power is fed directly from the optional power supply to the CPU board. This daughter board module mounts to the main CPU assembly on the left side via 4 small 4-pin electrical connectors at each corner, and two nylon standoffs to hold the 2 boards together. If used, the power cable from the bottom board (A2J1) is connected directly to the lower A2P1 connector – it is critical that this cable be installed in the right direction when it has no pin alignment features. Fortunately, it will should connect *easily* in one direction with the A2P2 connector nylon guard preventing inversion of the cable. If you find yourself trying to force it on the power supply – you have it upside down. The display cable A2J3 is then installed on the A2P3 connector.

-WARNING-
-WARNING-
-WARNING-

Before *the game is powered up with the new CPU there are several guidelines that must be followed to prevent the board from suffering damage.*

- Do not install/remove any cables from the CPU when the game is powered up.
- Do not remove the optional power supply module while the game is powered up.

Displays; a bad display will destroy the new CPU just as readily as it did the old CPU. However, on the new CPU, the display driver chips are simple 74LS240 chips and are more easily obtained than the old 7448's are, (though *those* are hard enough to come by in themselves). Please be sure that all of the displays to be used are checked out before you power up the board. This can be a difficult procedure, especially because checking out an unknown display, means possibly frying the test CPU if it is bad. Fortunately, there are not

that many bad displays that fall into this category. To err on the side of safety is the best approach, and this means not to use a display whose functionality is questionable. If you have no option, and bad displays, grab yourself a supply of 74LS240 chips, socket each of these components on your Ni-Wumpf CPU, and watch the output on these displays carefully for brightly lit display segments/digits, or no output at all while you are trying to determine if your display is OK. If you see these symptoms, power down the game immediately, and remove that display. It is likely that the driver chip may have been damaged, but unlikely that the damage worked through to the CPU.

Switches, the connectors; J6 and J7 are just as likely to be corroded as J5, and the pins, just as brittle. While these connectors cannot seriously damage the CPU because of their condition, it is imperative that they be checked and repaired to attain proper game operation. Shorted wiring (switch matrix wiring) *can* damage the CPU. With an untested game, examine the bottom of the playfield carefully to be sure that no switch wiring is shorted to; bulb sockets, solenoid brackets, and the metal of the front door. Such shorts can damage the strobe matrix chip.

Power up!

On power-up, the system will reset and start its first section of code, which is to blink the LED on the board once. Because RAM, program memory, decode logic and the like are all part of the main processor chip, as long as that LED blinks – self-test is over. Thereafter the system configures its I/O sections, and the CPU then reads its NVRAM to determine which game is to be loaded for operation. The board comes from the factory set *without* any game to use, and will immediately jump into the section of code that requires the user to select a game to install the board into. If the board has already been targeted to a different game, the operator will have to enter self-test mode via the front door button, and advance to the last menu entry in the list; "GAME". Once the game start button is depressed in that menu, the CPU will begin listing all possible game names for each of the Gottlieb tables. The game name is displayed in the player 3 and 4 displays, and hitting the "game start" button advances the selection. Continue pressing the start button until the game name shown is the one desired, and press the test button to exit game select menu. Once DONE (the next top menu item) is selected, this value is written to NVRAM, and the game should be power-cycled (or hit the reset button on the CPU) to load the new game's parameters into memory. The board can be retargeted for a different game at any time by going into the Game Test menu, and repeating this process to change the game value.

Once configured, the CPU will power-up, and display the System 1 platform code revision ("P-REV") in the player 1 and 2 displays, and the specific game code revision ("G-REV") in the player 3 and 4 displays for a few seconds before finally going into idle mode for use.

The Test Menu

The diagnostic routines for the CPU board are organized under four separate sub-menus, and one game selection menu within the test routine entry. When you first press the test switch inside the game's front door, you should see the displays blank, and the player 1 display show the word **DATA** in rough alphanumerics. (I don't want to hear any hassles about how "well" the 8-segment displays in the game display letters, so just keep that off the complaints category!) The **SETUP** menu is used to customize the operation of the game outside of the factory defaults. The **DATA** menu is that used for gathering and resetting bookkeeping statistics for all of the games played since the game was last reset to the factory defaults. Values in the book keeping section of the game can be zeroed (by pressing the game start button, and the game test button simultaneously), but otherwise cannot be modified. Pressing the test switch again will offer the operator the chance to enter the **HARDWR** sub-menu, used for testing the operational condition of the various components of the game. The **OPTIOn** menu, like the original CPU, gives you the chance to set and modify different award/credit option settings for the game. When the test switch is pressed yet again, the game will give the operator the chance to exit the test mode; **DONE**, and resume game play. To enter into any of the sub-menus displayed in the player 1 display, *press the replay button* on the front door. This will select the option shown, whether it is a menu, or the **DONE** command.

When a sub-menu has been selected in the player 1 display, the player 2 display will begin to display the fields available for that sub-menu, while the player 3 display will show the value of that field. To advance the field displayed in the player 2 display, depress the test button. To increment/cycle the value displayed, repeatedly press the replay button. To zero this value press the test button and the replay button simultaneously. (In this case "simultaneously" means to be pressed as closely spaced in time as can be expected. The easiest method to accomplish this is to press and hold the replay button, then depress the test button, and then quickly release both.) Selecting the **DONE** field in a sub-menu, will return the user to the main menu, clearing the player 2 and 3 displays. To advance onto the next field, after modification, depress the test button once again.

- SETUP

The setup menu configures the scoring and high score settings. The following fields are available for modification:

Field	**Description**	**Possible Values**
NUMBER BALLS	Number of balls per game.	Normally 3 or **5**, but not limited.
FIRST THRESH	First scoring threshold for player to achieve a credit	Any value from 10,000 to 990,000 must be less than other thresholds. Factory default = **120,000**
SECOnD THRESH	Second scoring threshold	Should be greater than the 1st threshold If less than this value, or "0", thresholding is ended. Factory default = **180,000**
THIRD THRESH	Second scoring threshold	Should be greater than the 2nd threshold If less than this value, or "0", thresholding is ended. Factory default = **280,000**
HIGH SCORE	Highest score to date preset	Any value from 10,000 to 990,000 This value is updated at the end of the game if exceeded by any player. Factory default = **320,000**
AUTO PERCEn	Automatically adjusts the threshold values up / down based on the average game score in order to achieve the set percentage of games that would award the first threshold	**0** (disabled) – 30 percent
BALL SAVE	The amount of time, in seconds, that the game will grant the player a "mulligan" for that ball	**0** (disabled) – 40 seconds
ENABLE 4 HSTD	Maintain four different high scores to date, or only one.	**0** - disabled; 1 – enabled
SHOW HSTD	Show the high score to date(s) at game idle.	0 - disabled; **1** – enabled
ENABLE MILIOn	Allow the game to maintain and display scores > 999.990 points. If enabled, the scores "scroll across the display. If disabled, a score that exceeds 999,990 rolls over to "0", and any HSTD is lost.	**0** - disabled; 1 – enabled
TOTAL TILTS	Number of plumb-bob tilts detected in a period of time before the game tilts the ball	0 – 5; a setting of '0' will end the game immediately. Factory default = **3**.
IDLE ANIMAT	Enable/disable idle mode animation of playfield lamps	0 - disabled; **1** – enabled

	between games.	
FAST BONUS	Speeds up scoring the bonus at end of ball.	**0** - disabled; 1 – enabled
SKILL SHOT[1]	Enables the skill shot at the beginning of each ball for a bonus value of 10,000.	**0** - disabled; 1 – enabled

Table 1 – Setup menu settings

- DATA

In the bookkeeping sub-menu, the following fields are available for review:

Field	Description
TOTAL CREDS	number of credits coined into the game
GAME STARTS	number of games started
COInS LEFT	number of coins through left chute
COInS RIGHT	number of coins through right chute
TOTAL REPLAS	number of replays awarded
NUMBER SLAMS	number of slam tilts detected
NUMBER EBALLS	number of free balls awarded
NUMBER TILTS	number of normal tilts detected

Table 2 - Bookkeeping fields and their meaning

Fields in the book keeping section can be zeroed as described above. Zeroing some of these values may impact the auto-percentaging algorithm. Bookkeeping information is completely reset when the selection is made to restore factory settings (see below).

[1] Countdown has no skill shot.

- HARDWR

In the hardware testing sub-menu, the CPU tests the operation of the displays, the lamps, the coils, and the switches. While exercising the lamp and the display test, any switch closure on the playfield will interrupt the running test, and terminate it.

DISPS - Selecting the display test will begin the first half of the display test, which is to count from 0 to 'z' repetitively in every display digit for all of the displays. If you depress the replay switch again during this test you will toggle the test from this mode into the segment select mode, which shows a marching digit across each of the display digits counting from 0 to 'z' repetitively.

LITES - Selecting the lamp test will continuously pulse the lamps on and off for around three minutes before timing out.

COILS - Selecting the coil test will cycle through all of the system coils available, including the special coil assignments used in such games as Count Down and Close Encounters. While the coils are pulsing, the corresponding coil number will be displayed in the player three display. Table 3 will detail the coil assignment numbers. Please note that not all games use coils 6, 7, and 8. Consult your game specific manual for the game being tested to determine the coil assignment number to the actual playfield solenoid. This exercise will repeat also for about three minutes before timing out. Because the sound subsystem was originally a set of chimes, the chime and sound boards are tested through this selection (coil 3 – 5).

SWITCH - In this test, the CPU scans the playfield for any newly detected switch closures and reports the switch assignment in the player 3 display. One second after the last switch is detected, the display will return to show a "0" in the display, indicating that the CPU is scanning for newly detected closures. If two or more switches are depressed at once, the CPU will display them, but you will only be able to see the last switch indication in the display.[2] Be aware that this test cannot determine if any switches have been stuck closed since before the test began, as it can only detect newly activated switches. Depressing the game start again during this test will toggle the switch closure mode of this test, where the CPU will display all of the switches detected that are "closed" on the game (eg if the ball is in the ball trough, it will display '15', in the player 3 display).

InIT E – Selecting this function restores factory defaults to the EEPROM. The CPU will flash the displays when it is DONE resetting the audits, high-scores, and features.

[2] This test is critical in determining the contact capability for a switch. Should a switch be detected that generates more than one signal within approximately 50 milliseconds, a chime will sound and the displays will flash "CLEAn SWITCH" to indicate a dirty contact. While a dirty contact may not always fail this test, any time one does fail, it can be sure that it is in need of cleaning. Because the scan rate of the new CPU is so accelerated over that of the original CPU (100 times faster), it is possible that a game will play fine with an OEM CPU, yet show signs of multiple switch closures when operating under the new CPU. This test was designed to help isolate those switches so that the contacts may be cleaned. Bear in mind that the contacts are "gold" plated and should not be filed, but cleaned with a contact cleaner. If, after several attempts at cleaning, however, the switch still cannot pass this test, or shows multiple scoring for a single depression, it is definitely damaged already; feel free to file it, and as a last resort; replace it. Contact your local distributor for available switch replacements.

Coil Assignment	Coil
1	outhole
2	knocker
3	10's chime
4	100's chime
5	1,000's chime
6	<game specific>
7	<game specific>
8	<game specific>
L1	game over relay
L2	tilt relay
L3	lamp 17 aux. (if used)
L4	lamp 18 aux. (if used)

Table 3 - Coil assignments

- OPTIOn

If you consult the original game manual for the System 1 game, you will find that all of the parameters that were selectable via the DIP switches on that board are also selectable via this menu, with a few added fields. It was felt that some of the System 1 games would benefit from an add-a-ball ability, and so that option was added. It was later determined that the entire diagnostic set-up to the games had gotten just complex enough to justify an option to reset all of the EEPROM settings to the factory default.

Field	Description	Possible Values
LEFT COINS	Left coin counter multiplier.	(see table 5 for matrix)
RIGHT COINS	Right coin counter multiplier.	(see table 5 for matrix)
CHUTE MATCH	chute control	**0** - allow separate coin chute control 1 - set coin chute 2 control to be that of chute 1
CREDIT LIMIT	Maximum credits allowed.	0 - 15; **0 enables free play**
COIN SOUNDS	Play credit tune	0 - disabled; **1** - enabled
SHOW CREDS	Show credits	0 - disabled; **1** – enabled
SPECIL CREDIT	Special awards credit or extra ball	0 - disabled; **1** – enabled
SPECIL OVERRD[3]	Disable additional Specials and	**0** - disabled; 1 – enabled

[3] The code supplied with the Ni-Wumpf CPU is not always identical to the operation of the original Gottlieb code. In some cases, the changes were intentional, others are a result of modern circuitry, and still others are the result of too many Margaritas, low blood sugar, and a callous disregard for proper coding technique when operating a pinball machine. One of these intentional coding changes was a direct request from operators that have these games on location. This is the case of the "special" routine on several of the games. In *all* games where the prerequisite amount of unique combination of challenging shots have been achieved, the player is awarded with the chance to score a "special". On some of the tables, however, the game may then proceed to reset the lights, rollovers, and drop targets necessary to collect that special more than once in the course of one ball. With the original CPU however, while the "special" lamp may light yet another time, the game will *not* award a second special. One of the changes made to the code was to correct this operational "flaw", and enable the player to achieve as many "specials" on one ball as he is capable of scoring. However, when these games are used on location, this may result in unacceptable earnings loss. Therefore, to override this software "feature", setting the "SPECIL OVERRD" option setting will enable the alternate "special" award for all subsequent specials awarded.

In this mode, upon completion of a second "special" within a single ball playing time, the award is changed from the default of an extra game or ball, to one of adding the value set for SPECIL AWARD (factory default of 20,000 points) to the players score.

	award a point value for subsequent specials scored	
SPECIL AWARD	Point value for above Special Override	1,000 – 60,000 in increments of 1,000. Factory default = 20,000
SCORE SOUNDS	Play sounds when scoring	0 - disabled; **1 –** enabled
ENABLE MATCH	Match feature	0 - disabled; **1 –** enabled
EXBALL LIMIT	Maximum number of extra balls allowed per ball in play. This is the add-a-ball limit.	1 – 8; Factory default = **3**.
HSTD AWARD	Award for beating HSTD	0 - no award for beating high score to date. **1** - three replays awarded
EnABLE ADVnCE	Enable expert settings menu	**0** - disabled; 1 **–** enabled
USE nI SnDBRD[4]	Change sound outputs to format for use with the Ni-Wumpf sound board	**0** - disabled; 1 – enabled

Table 4 - Options settings and their descriptions

Setting	Description
0	one coin/credit
1	one coin / 2 credits
2	one coin / 3 credits
3	one coin / 4 credits
4	one coin / 5 credits
5	one coin / 6 credits
6	one coin / 7 credits
7	one coin / 8 credits
8	one coin / 9 credits
9	two coins/credit[5]
10	two coins / 2 credits[4]
11	two coins / 3 credits[4]
12	two coins / 4 credits[4]
13	two coins / 5 credits[4]
14	two coins / 3 credits[6]
15	three coins/credit[7]

Table 5 - Coin counter multiplier table

[4] Enabling the Ni-Wumpf sound board will disable sounds to the GTB sound board if mistakenly set. It should only be set when the new WAV sound board is installed in the game. Please refer to that manual for more information on its functionality.
[5] No credit(s) are given until the second coin is inserted.
[6] First coin gives one credit. Second coin gives two credits, unless a game has been started, in which case it acts as if it were the first coin of two and only gives one credit.
[7] No credit is given until the third coin is deposited.

- GAME

Continue pressing the start button while in the GAME menu until the game name shown is the one desired, and press the test button to exit game select menu.

Display Name	Game
nOT VALID	Setting the game to this forces the operator to enter a game setting at next power-up
CLEO PATRA	Cleopatra
SInBAD	Sinbad
JOKER POKER	Joker Poker
DRAGOn	Dragon
SOLAR RIDE	Solar Ride
COUnT DOWn	Countdown
CLOSE EnCnTR	Close Encounters
CHARLS AnGELS	Charlies Angels
PInBAL POOL	Pinball Pool
TOTEM	Totem
InCRDL HULK	Incredible Hulk
GEnIE	Genie
BUCK ROGERS	Buck Rogers
TORCH	Torch
ROLLER DISCO	Roller Disco
ASTERD AnnIE	Asteroid Annie and the Aliens

Table 6 – System 1 Games

Note: All settings in the game test menu are only saved once the operator navigates to the DONE menu item and exits the test menu.

- EXPERT

****CAUTION!!!** setting these fields may cause damage to your game!**

Specifically, setting the coil hold time to lock on a solenoid for a minute or two is likely to trigger a warning from Smokey the Bear that only ***you*** can prevent forest fires. These fields are for tweaks to your board that will adjust certain timing parameters in how points are scored, how switches are sampled, and how long solenoids are energized. It can be enabled by setting the "ADVNCE" option in the "OPTION" menu above.

Field	Description
SCORE LAG TM	This the time lag between scoring bonus values when counting down. Unlike the setting below, it affects the pause between subsequent bonuses scored after the multiplier has ticked off. The default value here is – 80 milliseconds.
BONUS LAG TM	This the time lag between scoring *multiple* bonus values when counting down (i.e. within a bonus multiplier), it also affects some of the multiple point scoring when the game would score 5000 points (for example), in a series of 1000 point increments. The default value here is – 75 milliseconds

COIL HOLD TM	Number of milliseconds to apply the coil voltage to a coil before subsequently disabling it. The default value is 200 milliseconds.
COIL LAG TM	Period of time in milliseconds to wait between activating the same coil again. Default – 200 milliseconds
LAMP ENA TM	Length of time to latch the data values into the lamp latch on the driver board. This setting can be extended to enable the CPU to work with some badly designed aftermarket driver boards, at the slight expense of game responsiveness. The default enable time is 15 milliseconds.
SWITCH STR TM	Speed by which the playfield switches are scanned. This also affects the display refresh rate. A faster strobe time enables better responsiveness to clean switches, but may cause the CPU to miss detecting dirty switches. The default value is 1000 microseconds.
SWITCH DUP TM	Maximum period of time during which a repeated switch detection will be discarded. By default any switch seen more than once within 60 milliseconds will be ignored.
TIME CALIBR	CPU clock calibration timer, when at this menu item, the High Game to Date lamp will flash in 100 millisecond intervals. Putting an oscilliscope to the output line should show a 100mSecond square wave.

Table 7 - Options settings and their descriptions

Troubleshooting

The CPU should normally blink *once* during power-up to indicate that it is operational. Following this single flash, it should immediately display the game revisions on the displays. No other LED diagnostics are available.

Symptom	Possible Cause
Switches do not register	If after entering the switch test, a switch is conclusively not being identified, the next logical step is to determine if there are other switches on the associated strobe line with that switch. If there are, this should indicate a problem with the switch strobe hardware specifically U14.
Lamps missing strobe column (1 of 9)	Verify operation of output at pins 4 – 11 and 18 of U9 during lamp test, if one or more of these pins is not cycling, this SMT chip may need to be replace. Getting a probe onto this really small chip is not that easy, it might be best to go right to the bottom edge connector to validate pulses. Plus, these pulses are *very* short (15 – 40 mSecs), your probe / 'scope will need to be set to this speed.
Lamp missing row (1 of 4)	Check appropriate inverter functionality for the associated gates in U10 or U11, if operation is correct the problem may be in driver board, or, as above in the harness to the driver board. Else, replace U10 / U11.
Display segment always high or missing in displays of bank A	Remove connection to each display and verify problem exists with a known good display in the player 1 position, if so, replace U5, if not, one display may be affecting the entire bank.
Display segment always high or missing in displays of bank B.	See above, using the player 2 position; replace U6.
Digit missing or showing overlapping segments with digits in bank (displaying all segments that other digits have showing)	Probe appropriate inverter operation on the buffers of U3 and U4 for the affected digit. If incorrect replace U3 / U4.
No solenoids will fire	Check for activity at Z9 – 11 during solenoid self-test (requires an oscilloscope)
Solenoid won't fire.	Check for shorts across ZD2 – ZD9, if none, check output pulse for solenoid at inverter outputs of U10 or U11 while in coil self-test, if pulse is absent, check input to corresponding driver gate to confirm proper operation from Z9. If incorrect replace Z9.
Solenoid always energized	Probe U10, U11 as above with game in idle mode, all outputs of the associated solenoid gates should be at a logic state '0'. If so, the problem exists in the driver board.
CPU crashes/sporadically resets	Generally, this is NOT a CPU problem, but rather an associated problem with the +5 voltage level. It is only

	now being seen with the replacement CPU, because the old CPU used CMOS logic (12v) that was much more immune to voltage spikes/drop-outs. The problem can normally be reproduced by causing the CPU to energize a solenoid, while simultaneously energizing a non-CPU controlled solenoid (such as a bumper). This will stress the power supply enough to drop-out the voltage regulator or surge the ground. Check that all solenoids are the correct part number and that the snubbing diodes across them are working. Check for good ground connections at the power supply header pins. Check that the solenoid drive transistors are not "leaking". Check the connector between the CPU and driver board for good connection. Check the power supply voltage regulator for a solid +5 volts.

Table 6 – Troubleshooting hints

Warranty

The ***Ni-Wumpf*** replacement System 1 CPU is warranted against manufacturing defects and premature component failure, known as infant mortality, for up to 90 days after the date of its purchase. For this reason, it may be prudent to keep a copy of the receipt for the board handy, in case the need should arrive to lend some credibility to your claims as to when it was actually purchased. In the unlikely event that a part should fail on the board within this time frame, simply package up the board, with a copy of your receipt, and return it to the factory address mentioned below, with some note of explanation as to why we are receiving this unexpected gift. Your CPU will be repaired or replaced and returned to you as quickly as possible.

Failure of the system within the warranty period due to abuse or incorrect installation is not covered by this warranty. The purpose of this warranty should be quite clear: We are willing to accept responsibility for manufacturing defects of the boards we are building, and feel that 90 days is a sufficient period to determine if such a defect may exist. We are not willing to accept the responsibility of others who may install this board into a game that may be broken enough to cause the CPU to fail.

- Repair

To determine the steps required to repair your CPU, it is best to gather the information necessary to get the board serviced, whether by yourself or the factory. First of all, be certain that the CPU is actually broken before calling it in for service, and the best way to ascertain this is to consult this manual in detail under the configuration and troubleshooting sections. Next, armed with the confidence that a smoking chip is indeed reason for repair, contact your distributor to determine what steps to take next. If you intend to do the repair yourself, he will be the person with the parts necessary to replace the chips you deem necessary. He will also be the person with the knowledge of what repair costs the factory will be charging if you wind up sending it in for repair (and in the case that the company address should change, he will know what the current address for ***Ni-Wumpf*** will be).

Repair of the ***Ni-Wumpf*** CPU is performed at the factory also, though there are a few options available for repair that may be exercised. Because the board design is relatively simple, it should be reasonable to undertake repair of the board yourself should you feel capable of doing so. There is only one chip that requires factory programming - all of the other components should be available from an electronics supplier if they are determined to be at fault. Now in the case of board repair being sent to the factory, return the board to our service address noted on our website with a note describing the problem. Repair costs should be paid in advance and may be estimated by contacting the factory beforehand.

Ni-Wumpf LTD.
www.ni-wumpf.com

Schematic Supplement for the
Ni-Wumpf System 1
Replacement CPU

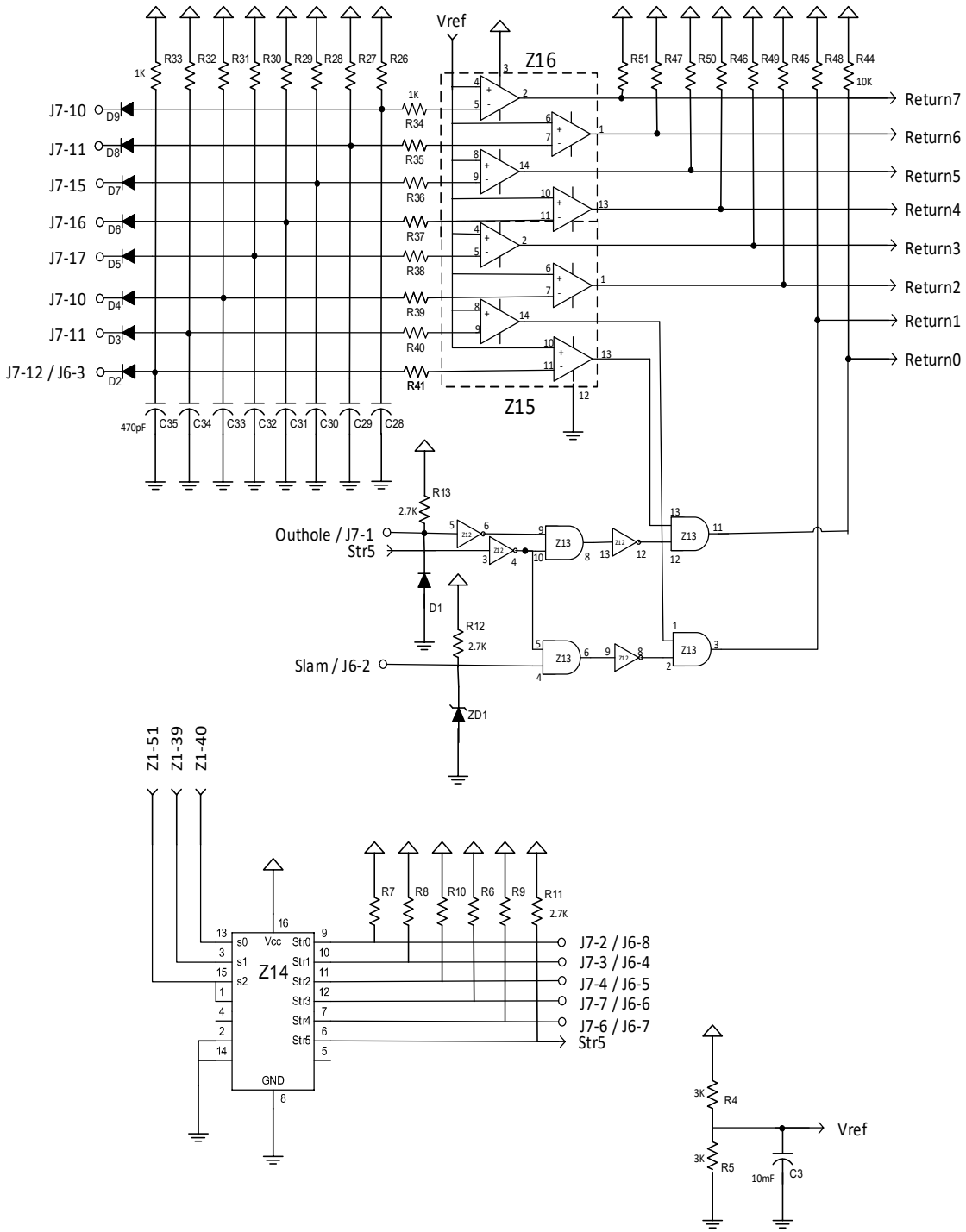


Fig. 2 - System 1 Switch strobes and returns

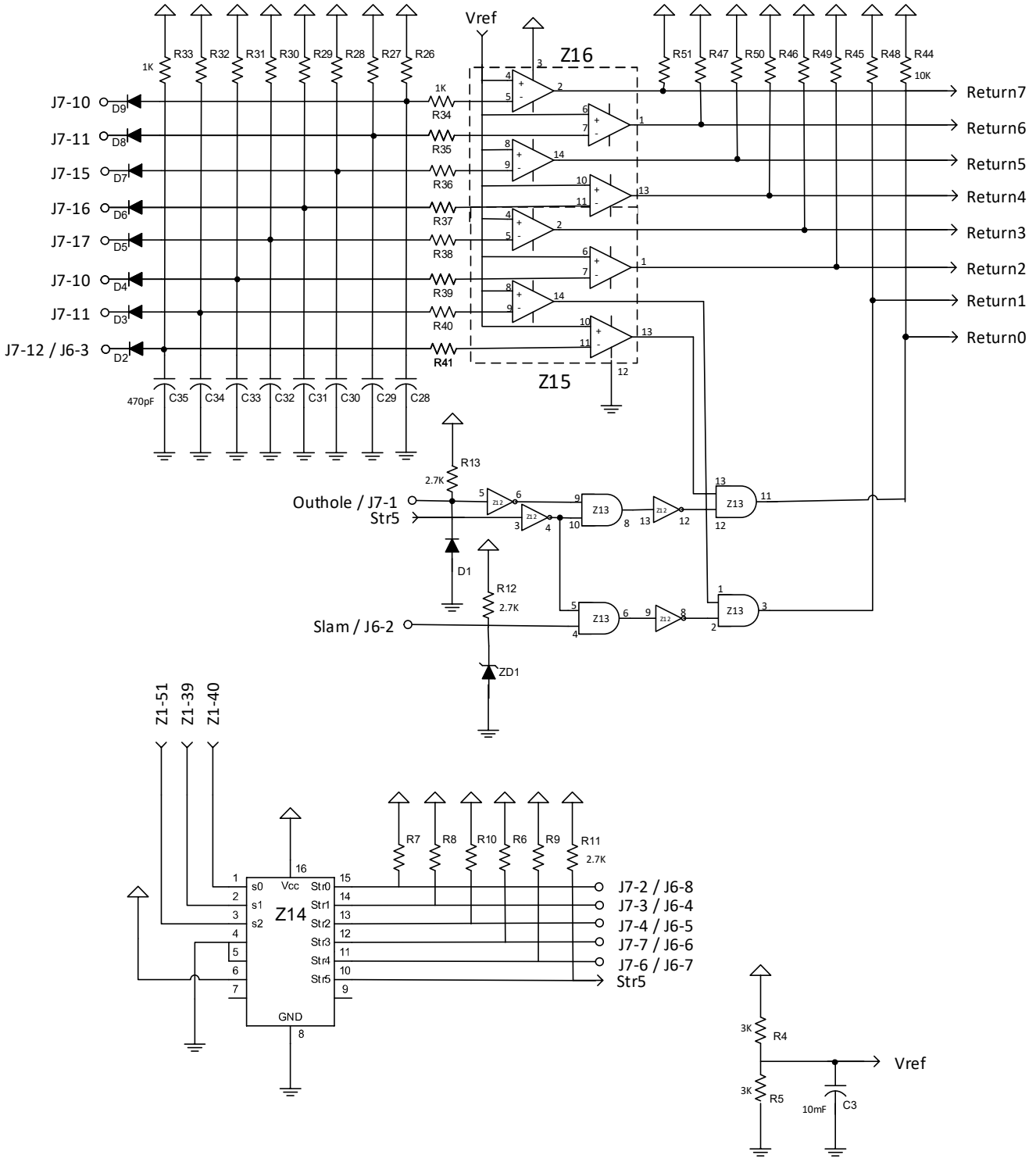


Fig. 2 (Rev M) - System 1 Switch strobes and returns

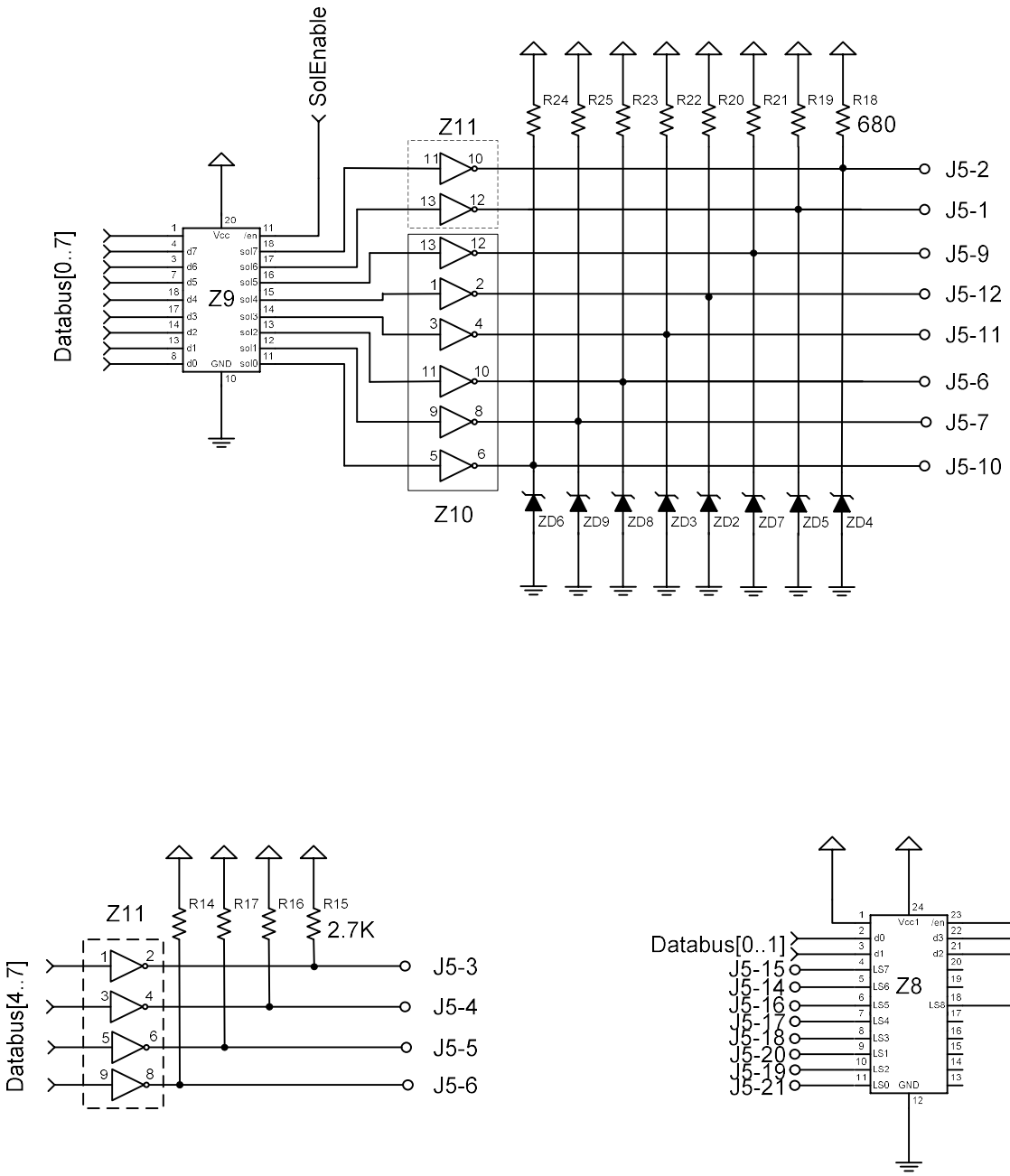


Fig. 3 - System 1 Lamps and Solenoids

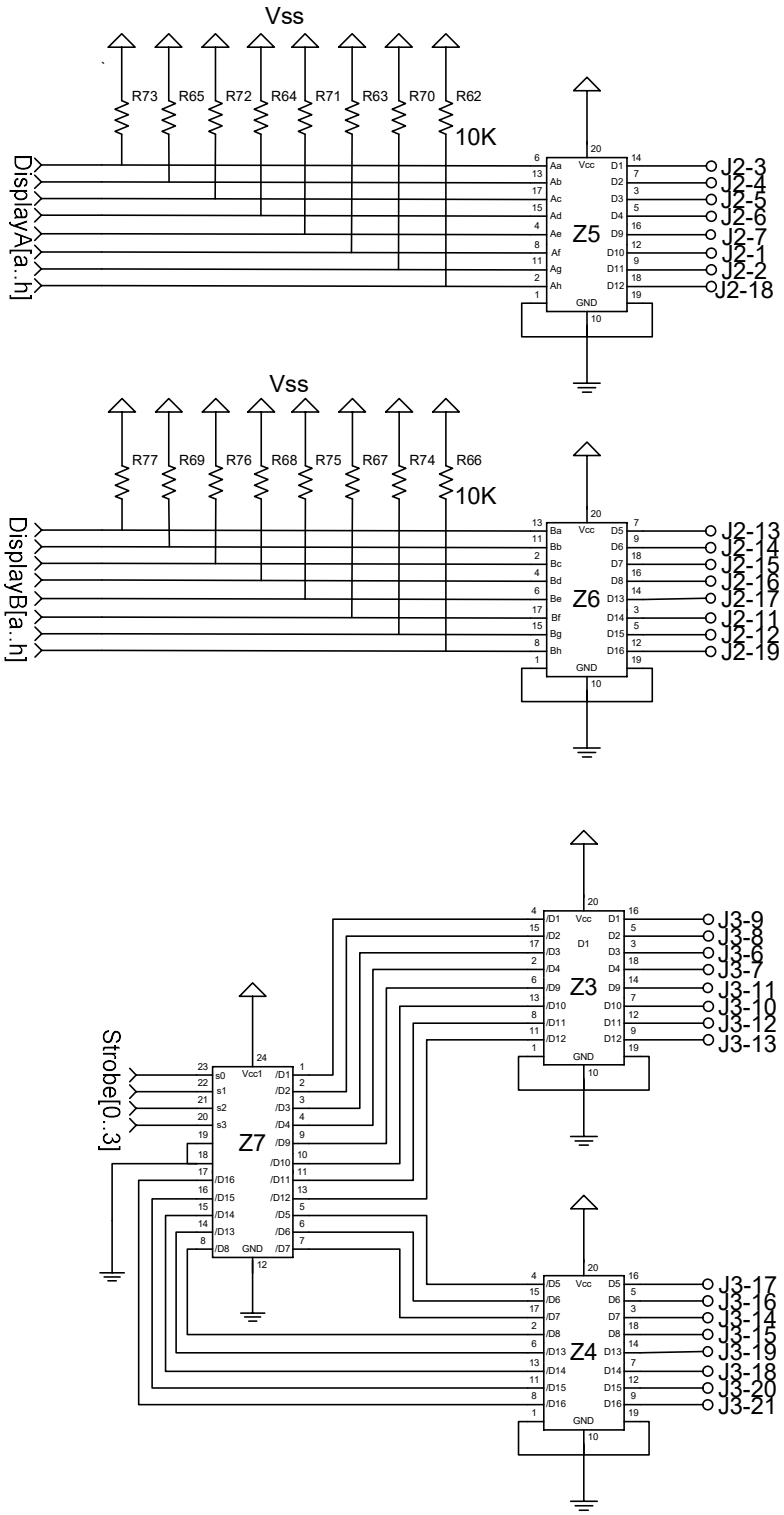


Fig. 4 - System 1 Display outputs

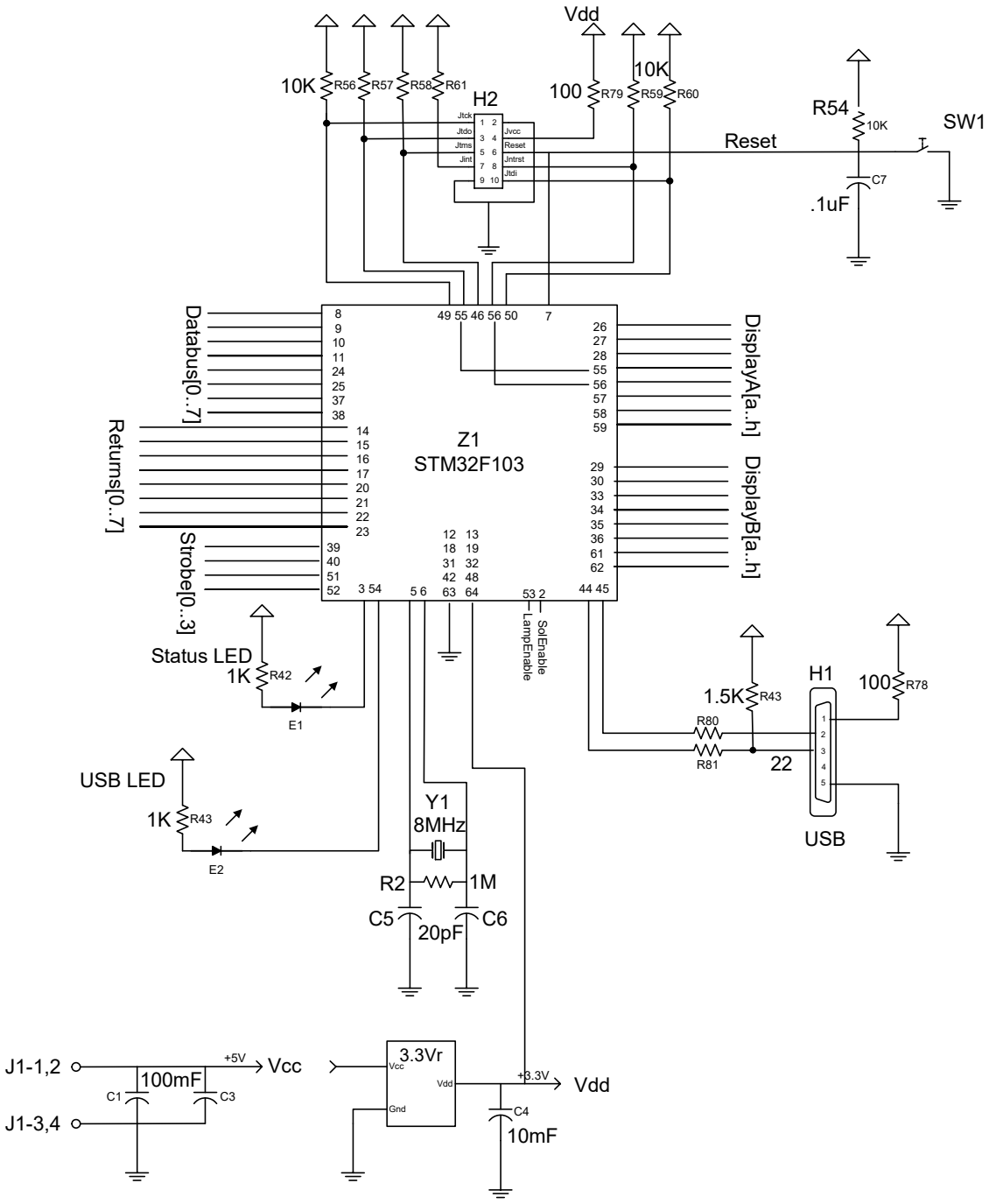


Fig. 5 - System 1 CPU

Part Designation	Quantity	Component	Description
Z1	1	ZTM32F103RBT6	STM Arm 32 bit microprocessor
Z3 – Z6	4	74LS240	Octal Inverter/Buffer driver with tri-state outputs.
Z7	1	74HCT154	4 to 16 signal demultiplexor
Z8	1	74HCT4514	4 to 16 signal demultiplexor with input latch
Z9	1	74HCT374	Octal Latch
Z10, Z11	2	7406	Open-collector hex Inverter / Buffer driver
Z12	1	74LS04	Hex inverter
Z13	1	74LS08	Quad 2-input AND gate
Z14	1	74LS156	1-of-8 Decoder / Demultiplexer
Z14 (rev. M)	1	74LS138	1-of-8 Decoder / Demultiplexer
Z15, Z16	2	LM339	Lo-Pwr Quad Voltage Comparator
V1	1	LF33CDT	1 amp 3.3Volt voltage regulator
SW1	1	SPST-NO	SPST switch
Y1	1	8MHZ 20pF	8.000 MHz crystal
C1, C2	2	100uF	16V 100uF Radial Aluminum Electrolytic Capacitor
C3, C4	2	10uF	16V 10uF Radial Aluminum Electrolytic Capacitor
C5, C6	2	20pF	20pF capacitor
C7	1	104uF	0.1mF capacitor
C8 – C27	20	103uF	0.01mF nominal bybass capacitor
C28 – C35	8	470pF	470pF capacitor
R2	1	1MOhm	1M 1/8W SMD resistor
R16, R17	2	3KOhm	3K 1/8W SMD resistor
R6, R54	2	100Ohm	100 1/8W SMD resistor
R1, R4, R5, R7 - R15, R20, R26, R52, R53, R60 - R77	34	10KOhm	10.0K 1/8W resistor
R18, R19, R21-R27, R78-R81	13	2.7KOhm	2.7K resistor
R44 - R51	8	680 Ohm	680 resistor
R3, R28 - R43, R58,	17	1KOhm	1.0K resistor
R59	1	2KOhm	2.0K resistor
R55,R56	2	22Ohm	22 Ohm 1/8W SMD resistor
R57	1	1.5KOhm	1.5k Ohm 1/8W SMD resistor
E1, E2	2	C171KRKT	Red LED
D1 - D9	10	BAS16	small signal diode
ZD1	1	MMBZ5231	5.1V zener diode (SMT)
ZD2 - ZD9	8	1N5231	5.1V Zener Diodes
H1	1	67503	AMP 5P type B USB connector
H2	1	6-1002	10 pin .100" low provile box header Male

Table 6 - Table of parts on the Ni-Wumpf CPU