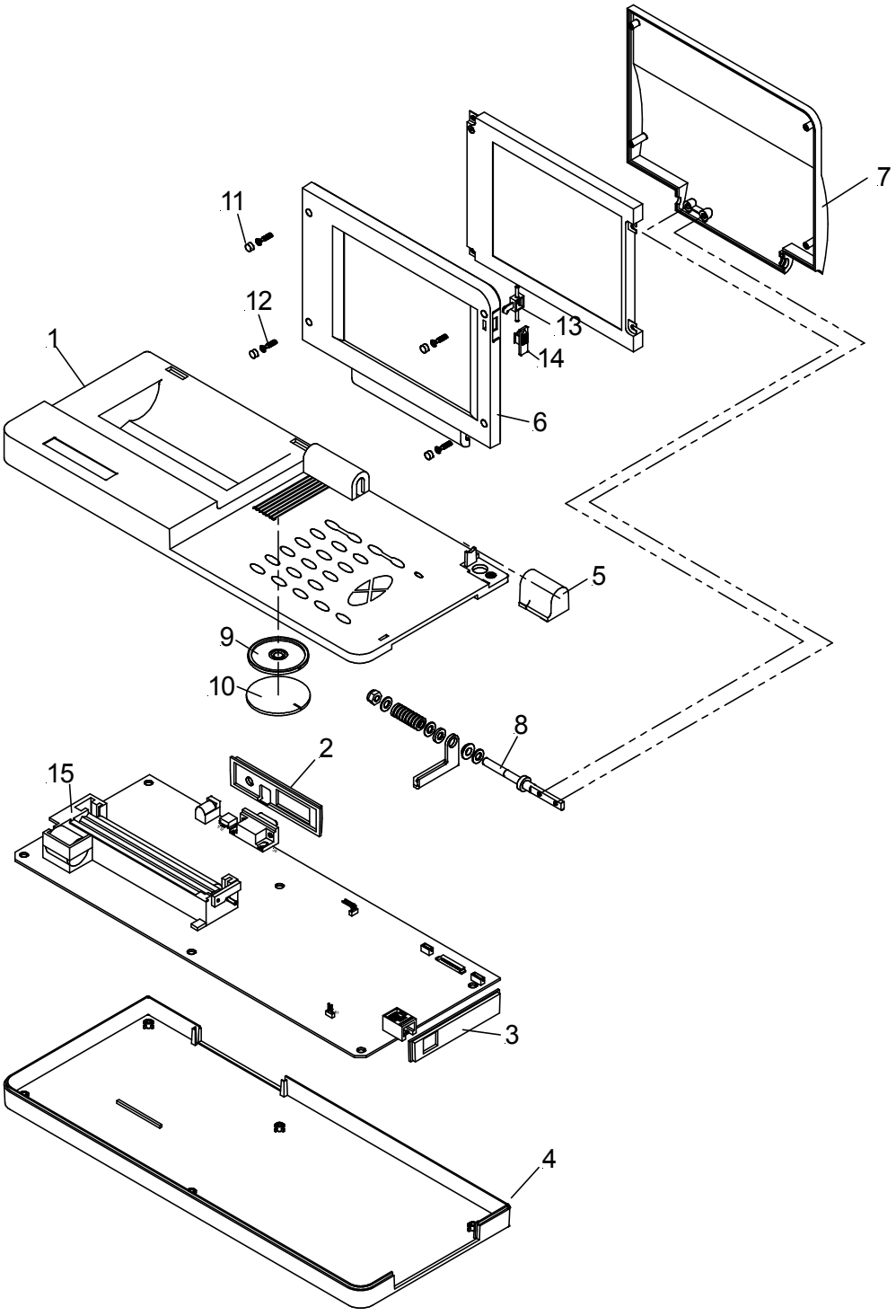
Super Spiro MK2 Service Manual

078-50 Issue. 1.0 September 2005

Micro Medical

Contents

Exploded Isometric View

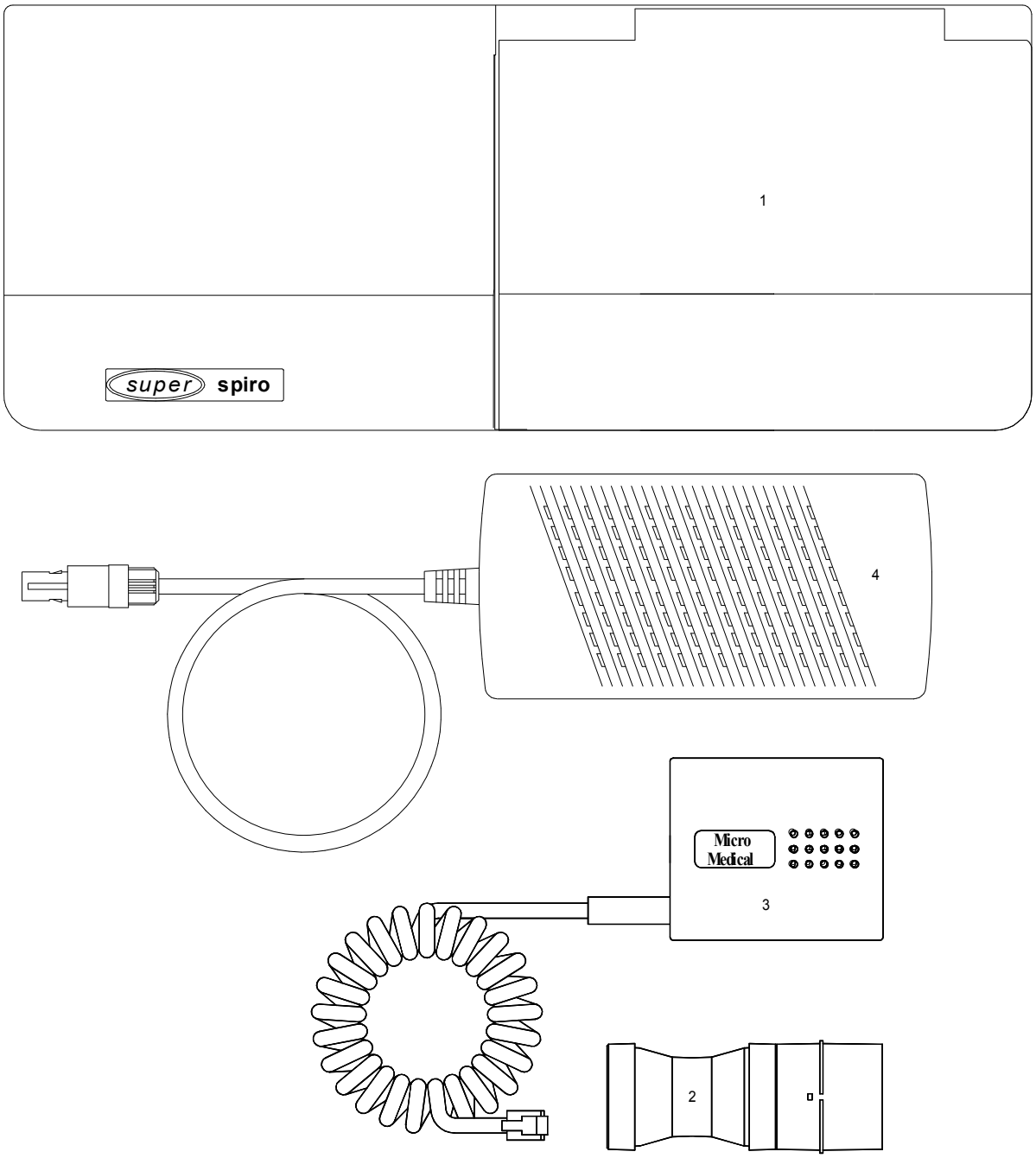


Parts List

ITEM No.	DESCRIPTION	MICRO MEDICAL PT No.
1	TOP MOULDING	MIM-078-22
2	BACK PANEL	MIM-078-34
3	SIDE PANEL	MIM-078-35
4	BOTTOM MOULDING	MIM-056-12
5	HINGE BLOCK	MIM-056-22
6	DISPLAY FRONT	MIM-056-13
7	DISPLAY BACK	MIM-056-14
8	DISPLAY HINGE ASSEMBLY	
9	SPEAKER	SPK-KDM-40016
10	SPEAKER COVER	MIM-056-21
11	SCREW COVER	
12	CSK SELF TAPPING SCREW 8mm LONG	
13	DISPLAY LATCH	MIM-056-23
14	DISPLAY LATCH BUTTON	
15	PRINTER MECHANISM	

Super Spiro mk2 - System Overview (Fig. 1)

The Micro Medical Super Spiro is a data recording spirometer consisting of a microcomputer unit (1) incorporating a 1/4VGA colour LCD display, data entry keypad, RS232 serial interface, USB interface and all associated circuitry. It is supplied with a digital volume transducer (2), disposable mouthpieces, transducer holder (3) and mains adapter (4). The Super Spiro is powered by a universal mains adapter (4).
When testing a subject the transducer is inserted into the holder which is plugged into the microcomputer unit. The digital volume transducer is used to measure the subjects expired flow and volume in accordance with the operating manual.

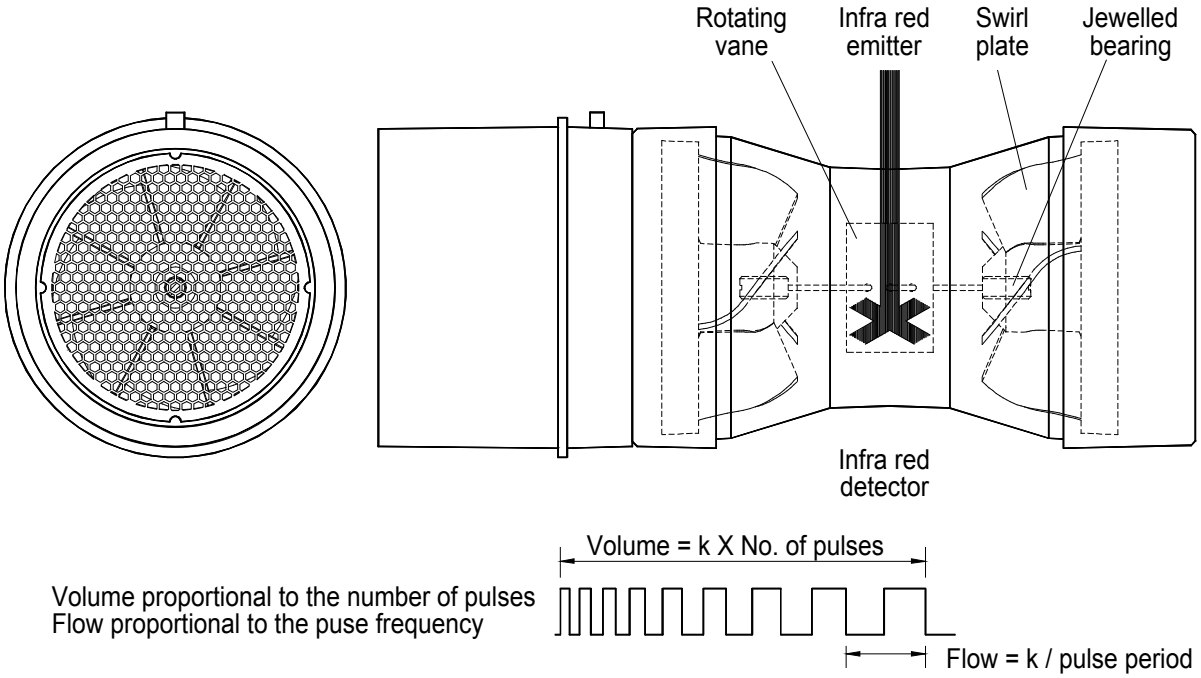


Transducer (Fig. 2)

The Micro Medical digital volume transducer consists of an acrylic tube with a vane positioned between two swirl plates. The low inertia vane is attached to a stainless steel pivot, which is free to rotate on two jewelled bearings mounted at the centre of the swirl plates. As air is passed through the transducer the swirl plates create a vortex, which causes the vane to rotate in a direction dependant upon the direction of airflow. The number of rotations is proportional to the volume of air passed through the transducer and the frequency of rotation is proportional to the flow rate. The transducer housing consists of a main body that contains a pair of light emitting diodes (LED's) and phototransistors. The transducer is fixed to the mouthpiece holder which pushes into the main body and is captured by an "O" ring seal. The LED's produce infra red beams which are interrupted by the vane twice per revolution. This interruption is sensed by the phototransistors. The output from the collector of each phototransistor will be a square wave with a phase difference between the two of + or - 90 degrees depending upon the direction of flow.

There is no routine maintenance required for the transducer other than cleaning according to the instructions in the operating manual.

Micro Medical Digital Volume Transducer



Disassembling the Super Spiro mk2 for Repairs

Main Unit

1. Disconnect all mains power supplies
2. Remove paper roll and paper roll housing cover, and put to one side

	**We recommend that you use a Philip Number Zero screwdriver for the following instruction.**

3. Place the Super Spiro mk2 face down to remove the six screws (Item 19) in the lower moulding, and put the screws to one side.
4. Turn the unit face up before easing the upper and lower mouldings apart.
5. Reconnect mains power supply
6. The Super Spiro mk2 is now ready for fault finding.

Reassembling the Superspiro after repairs

Main unit

1. Disconnect all mains power supplies
2. Position the top moulding over the bottom moulding and ensure that they both mate correctly.
3. Place the Super Spiro mk2 face down and insert the six screws.
4. Turn the unit face up and connect the mains supply.
5. Turn the unit and offer up the paper roll as explained in the operating manual.
6. Replace the paper cover.
7. The Super Spiro mk2 is now ready for operation.

Display console

1. Reconnect the 2 connectors on item 4 to the plugs on the display ensuring correct polarity.
2. Position the display over the locating pillars on the display back panel (item 8).
3. Position the display front panel (item 7) over the display.
4. Secure the display using 4 screws (item 16)
5. Replace the 4 screw covers (item 15).

Circuit Description, (see 078-01)

The Super Spiro mk2 board was designed primarily to interface with the Micro Medical Spirometer turbine, but the interface was kept open ended so that other modules, for example, airways resistance by the interrupter method (Rint) can be attached. A 9 pin 'D' type connector was designed in to allow 'customer special' modules to be attached and the unit is also USB compatible.
Provision was given to add a mezzanine board for customer special interface circuitry to be connected.

Microprocessor circuit (Drawing 078-02)

The Super Spiro mk2 is controlled by Renesas (formally Hitachi) HD64F2319 micro controller (uC) U2. It has in built 512 KByte flash memory and 8 KByte of RAM. The flash memory is used for boot loader and kernel, whilst the internal RAM is used as a stack only. The uC clock speed is set at 24.567 MHz by crystal X1. This clock divides properly for 115K baud rate for serial port. Although the USB is the primary interface port, the serial port is used for downloading the boot loader and initial board testing.

Since the uC internal RAM is not sufficient, an external 1 MByte RAM (U3) is used for running the modules and data manipulation. U5 is a fairly large flash memory utilised as a flash Disk. It stores various modules and data as files. The modules are loaded in RAM before executing. The data like spirometry records, patient information ect. Are saved as database files. U6 controls read/write signals to U5. The reset controller U1, controls the reset line to the uC and the rest of the system. If the supply voltage falls below 3.1 V, it reset the uC. The uC can hold itself in ON position, despite the user trying to switch itself off using TR1. This is necessary to prevent the system switching off whilst the uC is writing data to the flash disk. Similarly, it can turn itself off using TR2 for battery saving.

J3 is the connector to display backlight, with power and backlight on/off control using TR4. LK1 is shorted to download the boot loader for the first time. There after, it is not normally used, except to load the new updated version of the boot loader.

Keypad Circuit (Drawing 078-12)

The keypad is connected as 4 X 4 matrix. The software can determine which key is pressed by driving a pattern to one side of the matrix and reading the result. The pattern switches on one row and the corresponding result specifies which column the pressed key belongs to. Diode arrays D1 and D2 are required to control the matrix.

There are six dedicated keys for display contrast, sound volume paper feed and On/Off. These keys directly control the hardware and are not software driven. LED1 indicates if the battery charger is connected.

The keypad circuit is a separate board which holds the actual keys. It connects to the main board via connector J1.

RTC and Keypad Interface (Drawing 078-05)

J7 connects the keypad board to the main board. U21 is use for generating interrupt if any key is pressed.

U22 is an RS232 interface chip, converting logic (3V3) Rx and Tx line to RS232 level signals. It has in built step up and power inverter, generating +- 6V6. It requires capacitors C57 – C60 to do this conversion. J6 is 9 pin D type RS232 connector. It has standard pin outs except for pin 4 which has 3V3 power. This could be useful in the future to supply power to an interface board.

U24 is a Phillips Real Time Clock (RTC) device. It keeps the current time and date. When the unit is switched off, it is powered from the rechargeable battery. It draws very little current, and therefore can stay on for years without draining the battery significantly.

U25 is a temperature sensor, located on one corner of the board. It measures current ambient temperature for inspiratory calculations.

U23 is 32 byte EEPOM to store system parameters. Most of the system parameters can be stored in the flash disk, but some parameters like the calibration values, serial number etc. are best stored here. If the flash disk is formatted, these parameters are not lost.

Printer Driver Circuit (Drawing 078-06)

The in built thermal printer is controlled by a separate micro controller U26. The uC is a Renesas H3687 Tiny series with 56 Kbyte internal flash and 512 bytes of RAM. The uC controls the thermal printer heads and drives the motor to turn the paper. U27 is a high power motor controller. The interface from main uC is via logic level RS232. Since this uC requires 5V supply, the interface signals are converted from 3V3 to 5V by U28. The software to this uC can be upgraded by turning on TR10 and resetting the uC. This puts the uC in boot mode and software can be programmed in the internal flash via the serial port.

VR1 resistance value is read by the uC to control the switch on printer head time. This enables lighter/darker dots on the paper. This is set during production and is not available to the user.

Power Supply (Drawing 078-03)

The Super Spiro mk2 requires various power supply for different devices. On top of this, it should work from the internal rechargeable battery or from mains power converter (9 V) and should recharge the battery.

If the mains power is connected, the battery output is switched off by TR5. All the power to the system is from the mains power module, except the on/off controller. At the same time, the battery is charged by power controller U9, which ensures that steady 9V is applied to the battery.

When the mains power module is not connected, then the battery supplies all of the power to the system. It also powers the on/off JK flip flop, which turns on TR6 when on/off key is pressed, and turns off when the key is pressed again. U43 is a rail to rail comparator which ensures that the unit can not be turned on when the battery voltage falls below a minimum level. The minimum level is set to ensure that there is always some battery power available to run the real time clock and enough to start the unit.

The battery voltage/ mains output (unregulated) is available as VPRINT for printer motor driver device. The rest of the outputs are regulated by SPIC converters LT1613. The main output is 3V3 marked as VCC. This is converted by U10 and powers the main uC and most of other devices. U8 converts to 2V5 which is required by the display driver (FPGA), and U7 converts to stable 9V required by the backlight and the printer. U14 is a low dropout voltage regulator supplying 5V to the printer controller.

Sensor Interface (Drawing 078-04)

J5 is a 6 pin RJ422 multi purpose connector. Its primary function is to connect to spirometry turbine, but it also used for interfacing with Rint head. The power to the interface is via pin 4, which has either continuous 9V from the mains module if connected or 9V from the regulator but can be switched on when required. This allows the Rint head internal battery to be charged if connected to the mains, or 9V is controlled under battery operation. Pins 2 and 3 of the connector are turbine outputs or are shared with SPI bus for Rint or other interfaces. U15 and U16 are Schmitt trigger which ensures that the turbine pulses are clean. U13 is a latch which remembers the signal of pin 3 when pin 2 is triggered. These determine if the flow is inwards or outwards.

In the main uC, the SPI port and the RS232 port are shared on the same I/O pins. The output in RS232 mode also drives the internal printer or can be used for programming the printer uC. The selection is done by analogue switches U17 – U20.

Display Driver (Drawing 078-07)

The STN 0.25 VGA colour display is entirely controlled by Altera EP1K10 FPGA. Normally, the FPGA code is loaded via a serial EEPROM, but in this case, the uC loads the code on start-up. The code file is loaded in the flash disk. The advantage of this method is that it allows code to be upgraded in the field. The STN display can only generate 8 colours by mixing RGB pixels, but other shades can be generated by time multiplexing the RGB colours. For this reason the lighter shades may generate some interference patterns.

The display pixel information is held in 128 KByte RAM. Two display pages (A & B) are adopted, and the software can select either to display page A or B or mix them together as A & B, A | B etc. Page B can be horizontally and vertically scrolled by simply writing the offsets. This allows display to be scrolled during spirometry tidal breathing test. Furthermore, the controller has a facility to flash parts of display with programmable on/off time period and allow programmable background colours.

U33 generates 27 V (VEE) required for the display. This voltage can be adjusted by varying the digital variable resistor U34. Modifying the value of the resistor changes the contrast of the display.

U31 is a touch screen controller, which detects if the stylus is pressed on the display and sends an interrupt to uC. The uC then reads the A/D conversion of the touch screen X-Y resistance value to determine the position of the stylus.

Since the display controller generates high frequency signals, care should be taken to ensure that the cable from connector J9 to the display is properly shielded.

Sounder Circuit (Drawing 078-08)

uC generates a known frequency which is sent to the audio speaker via an audio amplifier/ driver (U37). This method allows various musical sound to be played through the speaker. The audio frequency is passed through digital potential divider (U35) to adjust its amplitude which acts as volume control. The fixed up/down key varies the potential divider. When any key is pressed, the U36 mutes the sound to avoid clicking noise. The uC and also mute the sound using VOL_OFF I/O line.

USB Driver (Drawing 078-09)

Super Spiro Mk2 has facility to act as a host USB controller or as a slave USB port. The host facility is required to drive the USB printers, and in the slave mode, it communicates with the PC to either send the data or in case of Spida, perform live spirometry tests. Cypress SL811HST device (U39) is used as a USB controller, running at 12 MHz for version 1.1 full speed. Resistor R79 is switched on in the slave mode to inform the host that it is full speed, whilst in host mode, R62 is switched on to load the D+ line via 15K resistor.

U40 is a 5V voltage regulator, supplying power to USB slave device. This regulator will only be switched on if the host is not connected and the software activates the USB PWR+ line. Pin 4 of J12 is logic low if connected to the host.

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Fault Analysis

The following analysis is only a guideline and should be carried out in a logical sequence. If the fault is still apparent after the following suggestions then the unit should be fault found using the circuit descriptions and circuit diagrams provided.

When the unit is turned on there is no display present

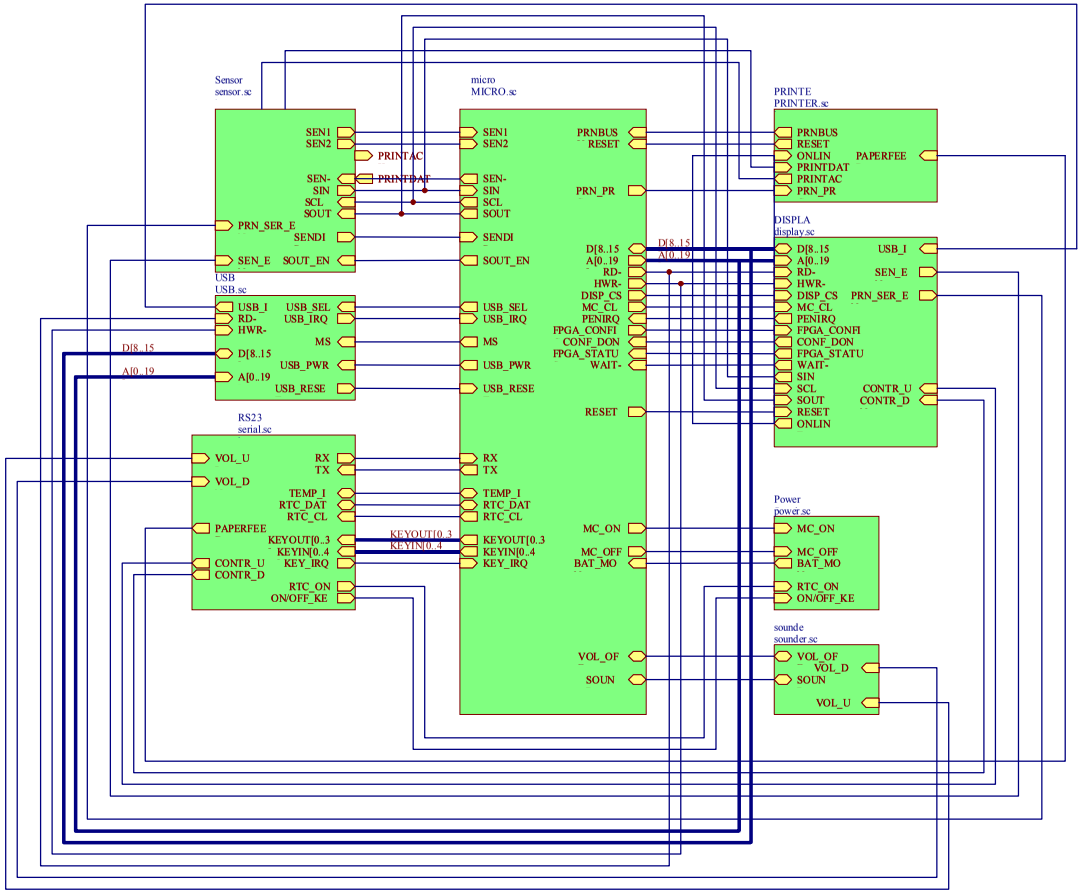
-Ensure charger is turned on at the mains.

FVC readings are low

-Remove turbine from transducer housing. Taking the turbine, move it slowly through the air and check that the vane is not sticking.

The unit does not record any blows

-Inspect transducer housing connector for damage.
-Check that transducer housing lead is properly connected to the RJ11 socket.
-Remove turbine from transducer housing. Taking the turbine, move it slowly through the air and check that the vane is not sticking.
-Blow into transducer housing and move transducer head cable around to check for breaks in the cable.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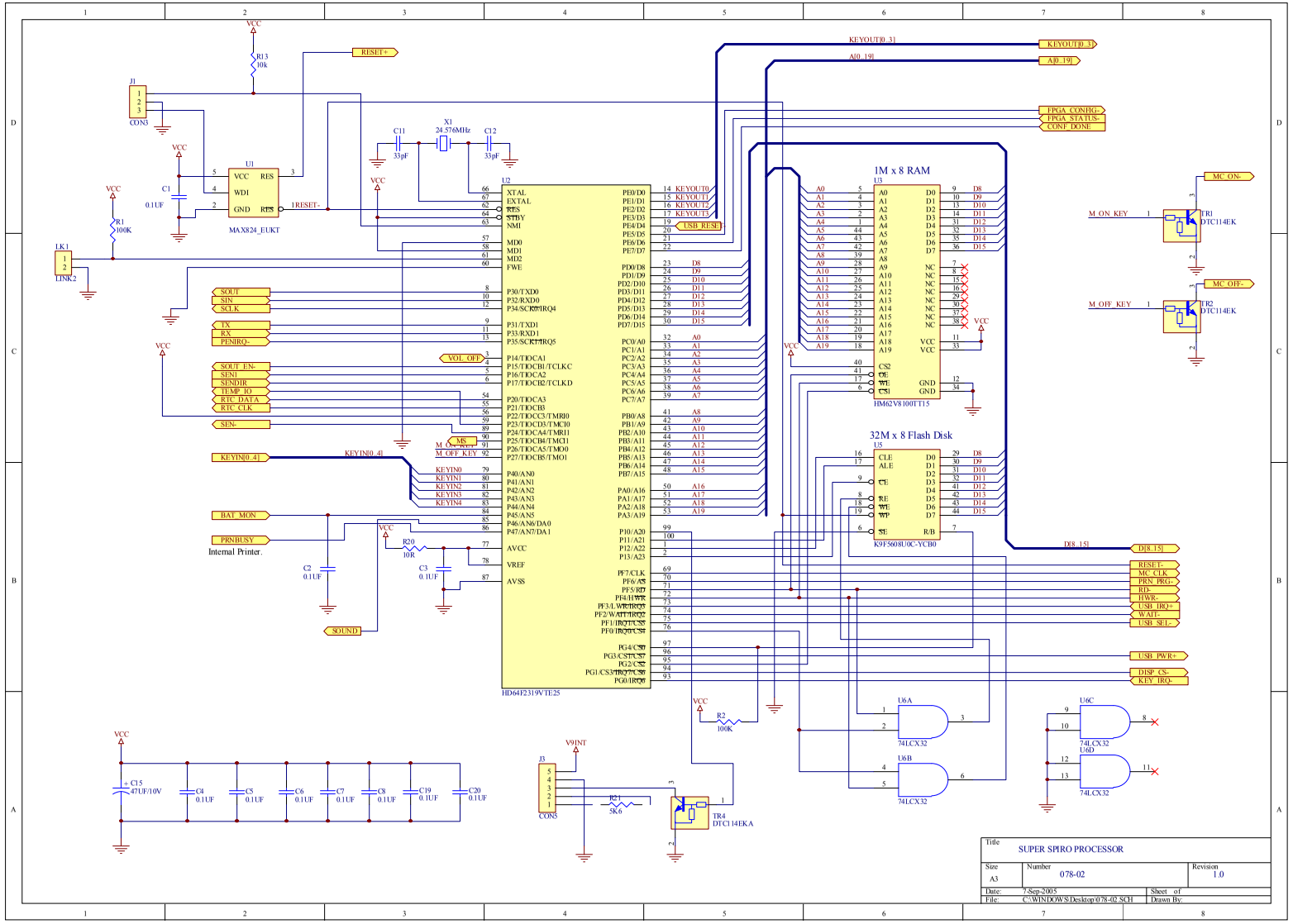
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Revision 1.0
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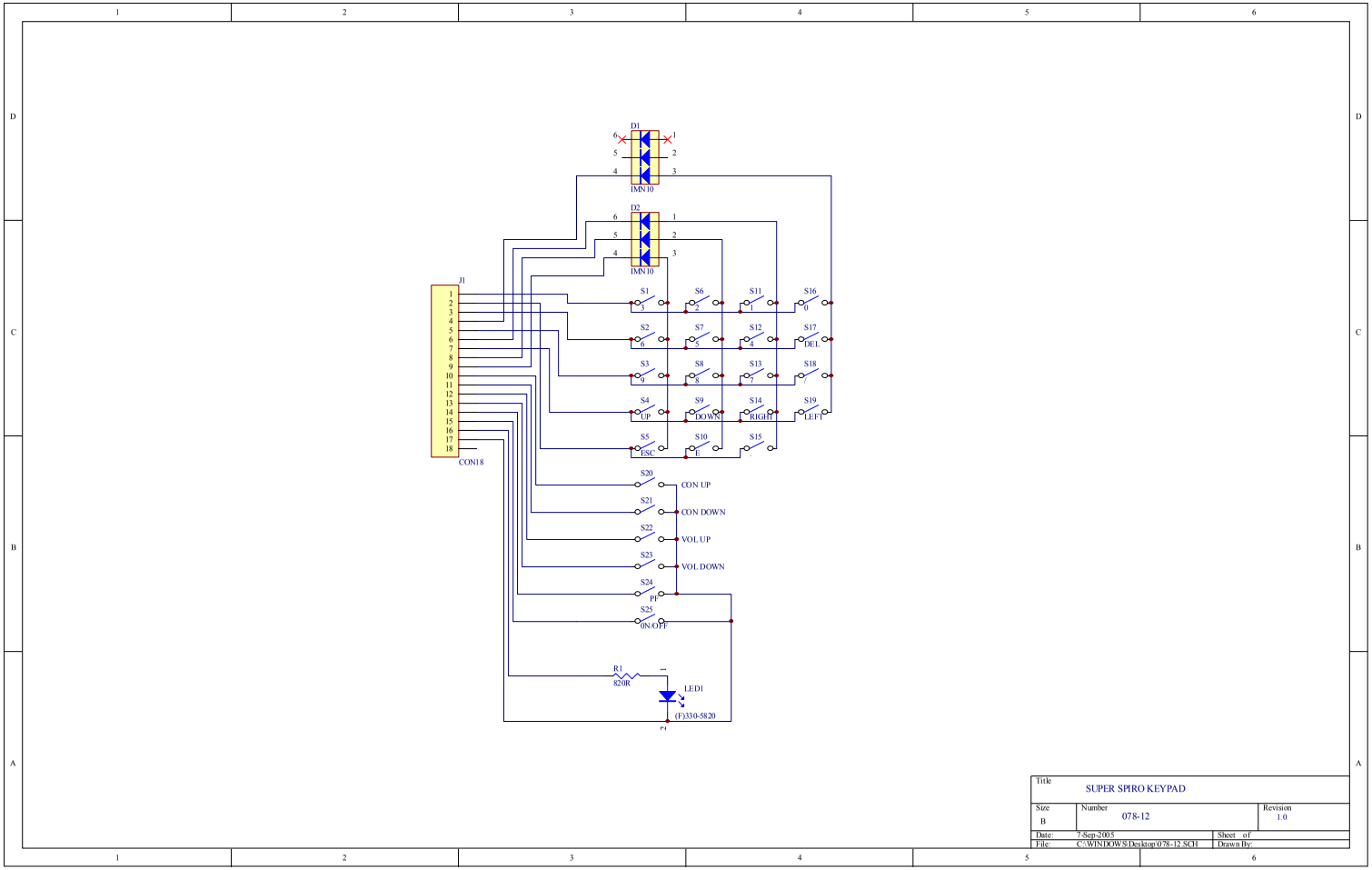
Internal Printer.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S9
DOWN
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E
S11
S12
S13
S14
RIGHT
S15
S16
S17
DEL
S18
S19
LEFT
S20
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PH
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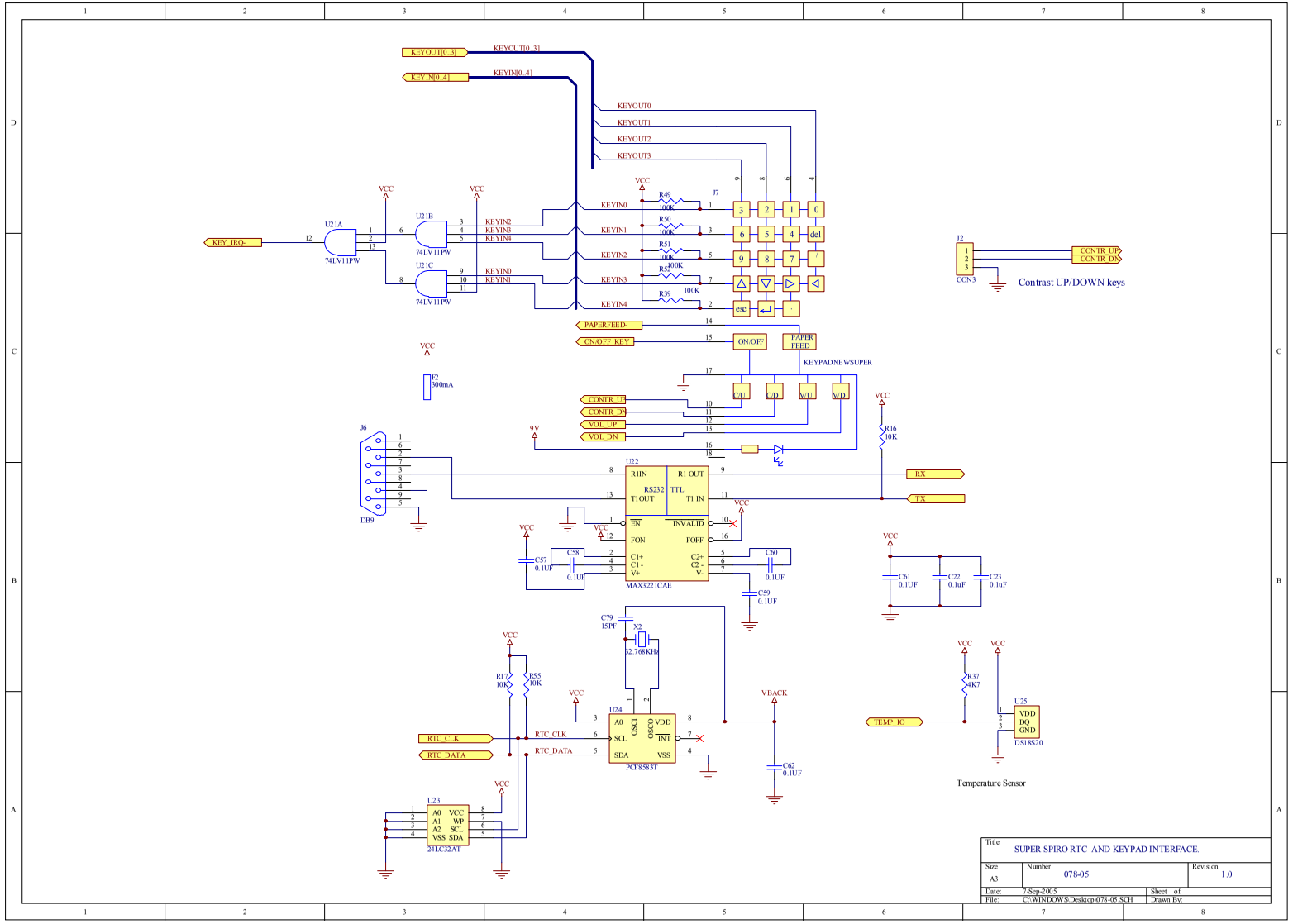
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KEYIN3
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KEYOUT2
KEYOUT3
R89 100K
R50 100K
R51 100K
R52 100K
R39 100K
J7
PAPERFEED-
ON/OFF_KEY
ON/OFF
PAPER FEED
KEYPADNEWSUPER
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CONTR_DN
CON3
Contrast UP/DOWN keys
F2 300mA
J6
DB9
CONTR_UP
CONTR_DN
VOL_UP
VOL_DN
9V
U22
MAX3221CAE
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R1 OUT
RS232
TTL
T1OUT
T1 IN
EN
INVALID
FON
FOFF
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C2+
C1 -
C2 -
V+
V-
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TX
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OSCI
OSCO
VDD
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RTC_CLK
RTC_DATA
R17 10K
R55 10K
VBACK
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A1
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VCC
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R37 4K7
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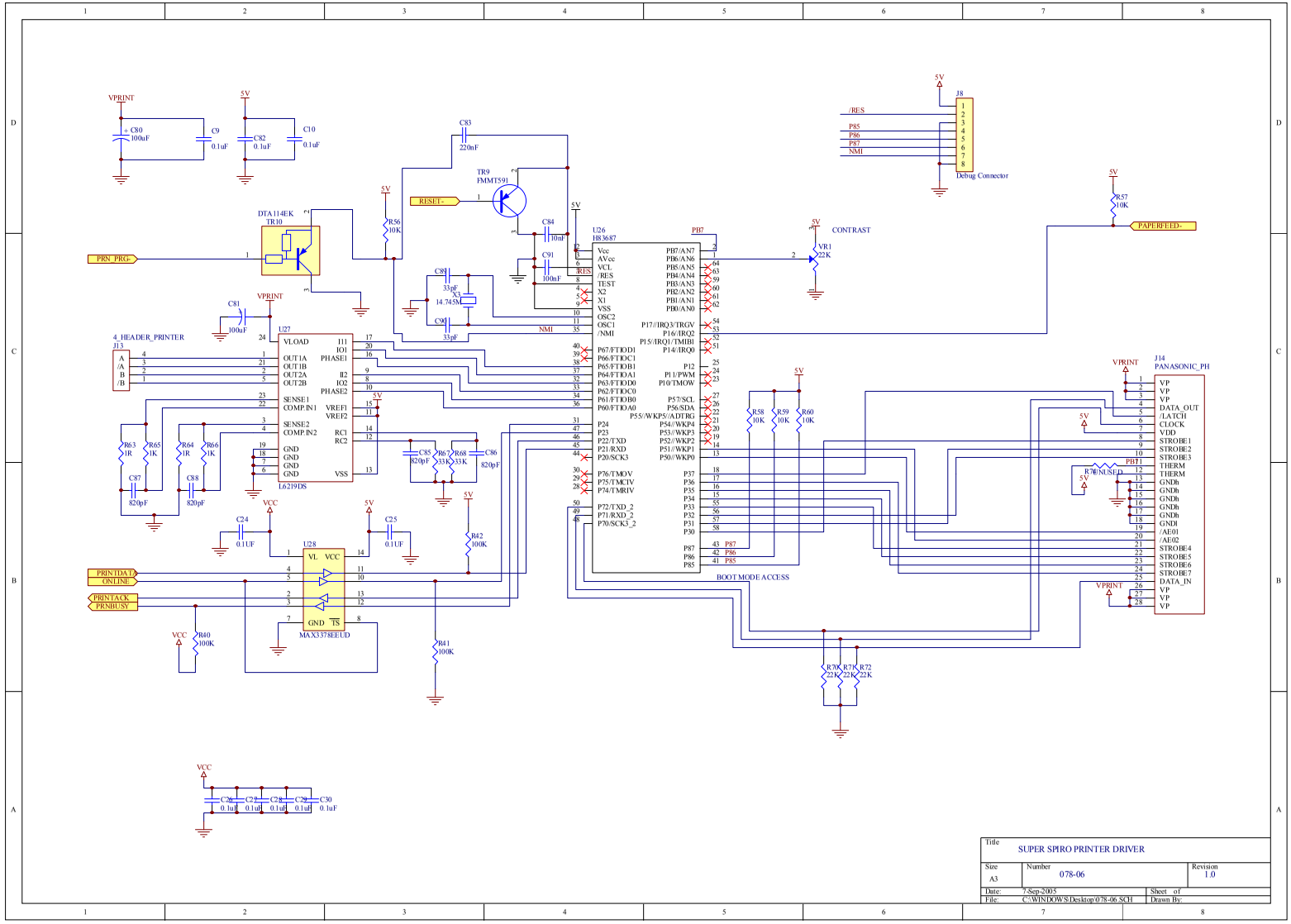

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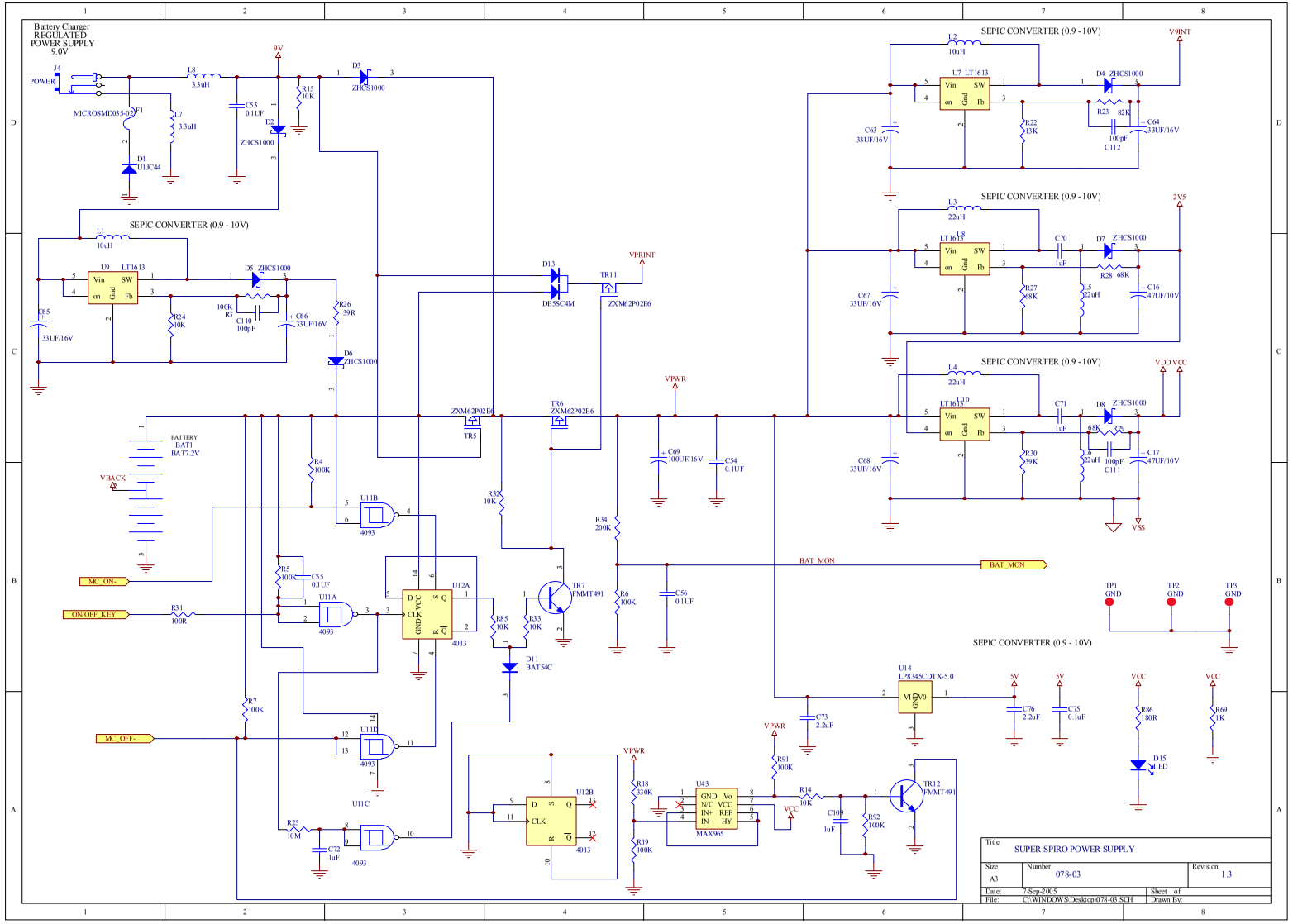
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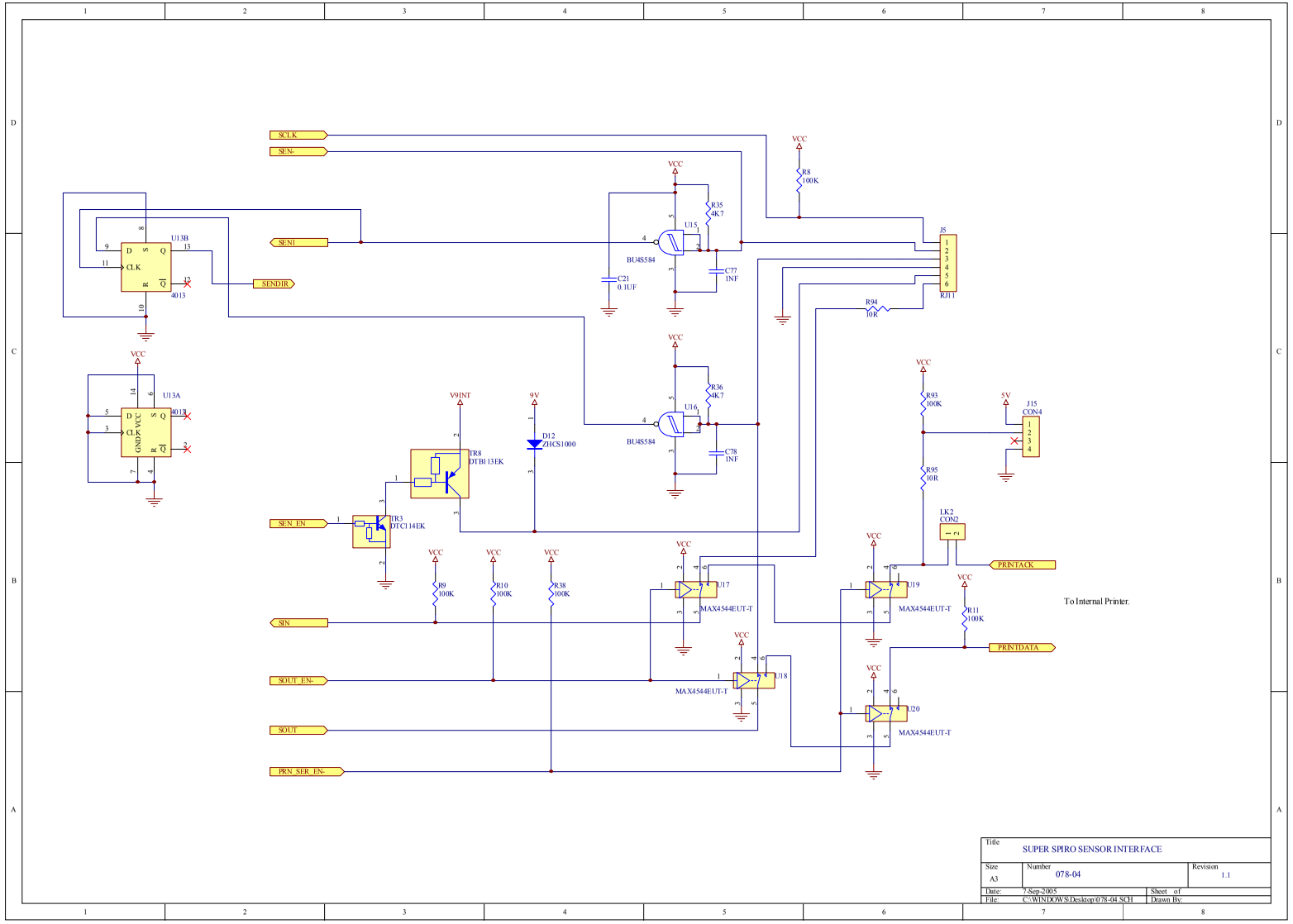
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C78
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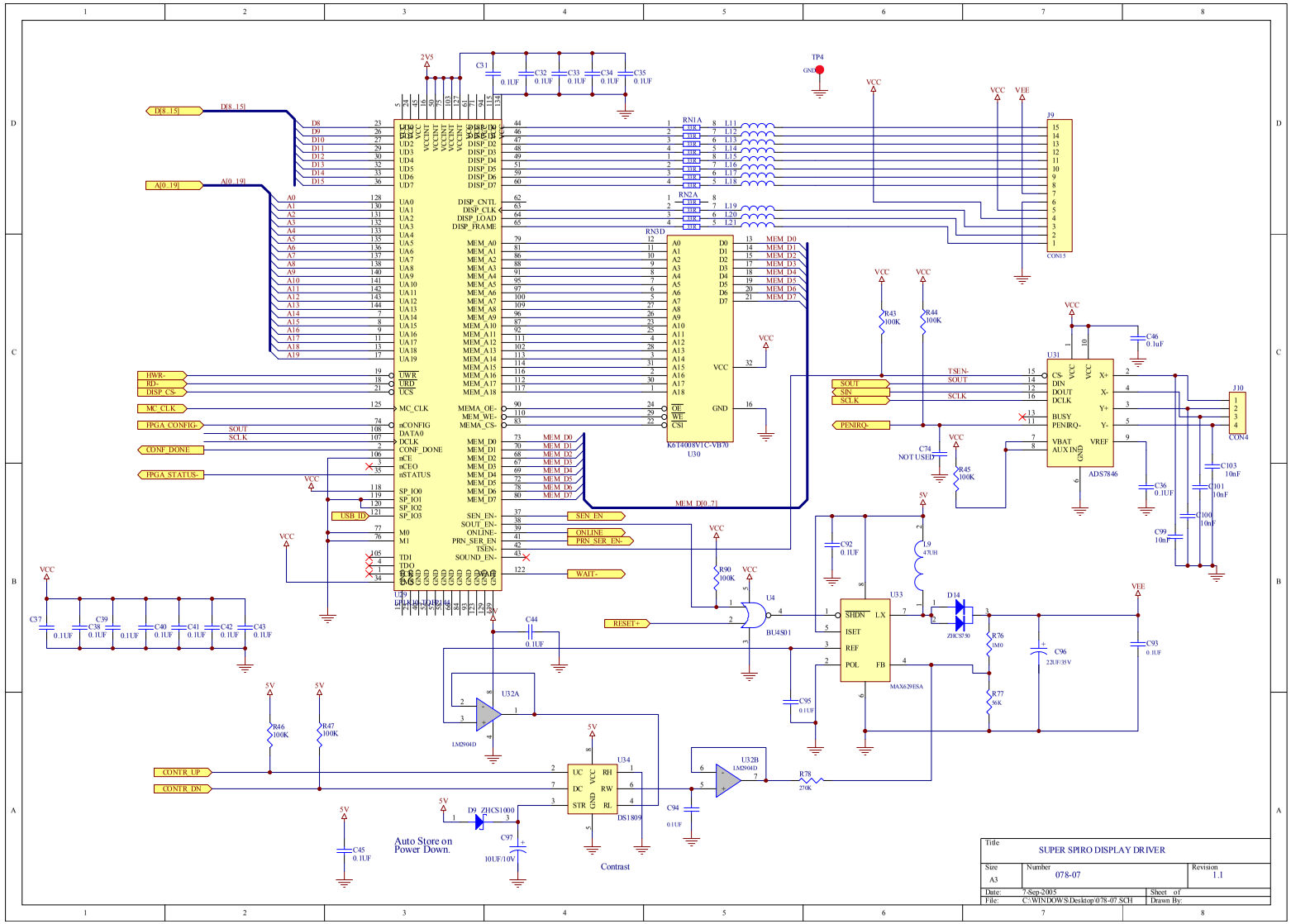
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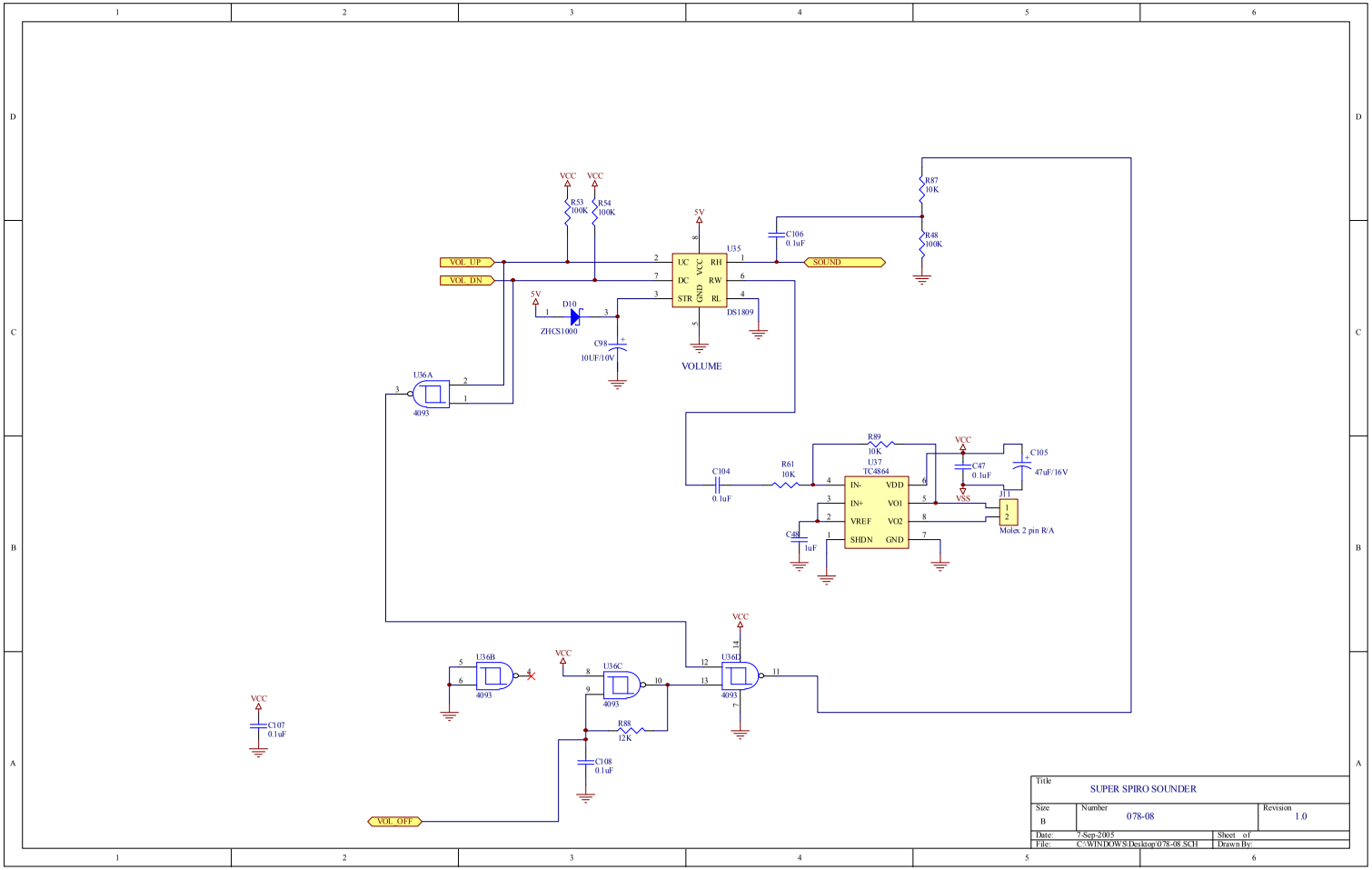
CON15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R48 100K
D10
ZHCS1000
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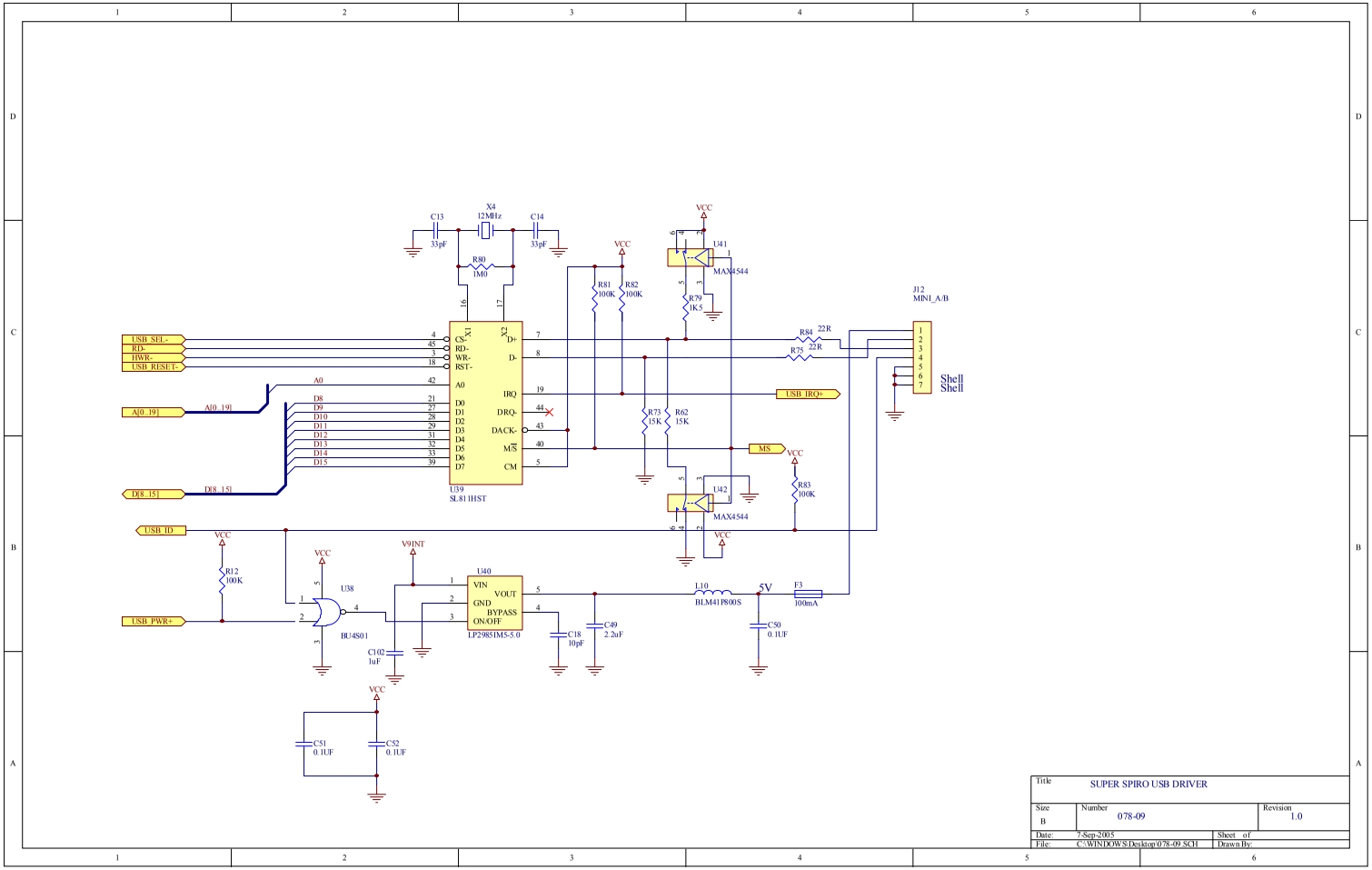
Drawn By:


X4
12MHz
C13
33pF
C14
33pF
R80
1M0
VCC
U41
MAX4544
R81
100K
R82
100K
R79
1K5
J12
MINI_A/B
R84
22R
R75
22R
USB_SEL-
RD-
HWR-
USB_RESET-
A0
A[0..19]
D8
D9
D10
D11
D12
D13
D14
D15
D[8..15]
U39
SL811HST
USB_IRQ+
R73
15K
R62
15K
MS
U42
MAX4544
R83
100K
USB_ID
R12
100K
USB_PWR+
U38
BU4S01
V9INT
U40
LP2985IM5-5.0
C102
1uF
C18
10pF
C49
2.2uF
L10
BLM41P800S
5V
F3
100mA
C50
0.1UF
C51
0.1UF
C52
0.1UF
Shell
Shell
Title
SUPER SPIRO USB DRIVER
Size
B
Number
078-09
Revision
1.0
Date:
7-Sep-2005
Sheet of
File:
C:\WINDOWS\Desktop\078-09.SCH
Drawn By: