Overview

GenPIC is a generic microcontroller utility PCB that can be used for a wide range of projects. The PCB will allow nearly any small appliance to be constructed requiring microcontroller control. The PCB measures 2.9" x 4.75".

The PCB is designed around the PIC18F66K80-I/PT microcontroller, or any of several other controllers that use the same pinout. This capable controller provides 64kb of ROM, 3.6kb of RAM, EEPROM, 12bit A/D running at up to 64MHz.
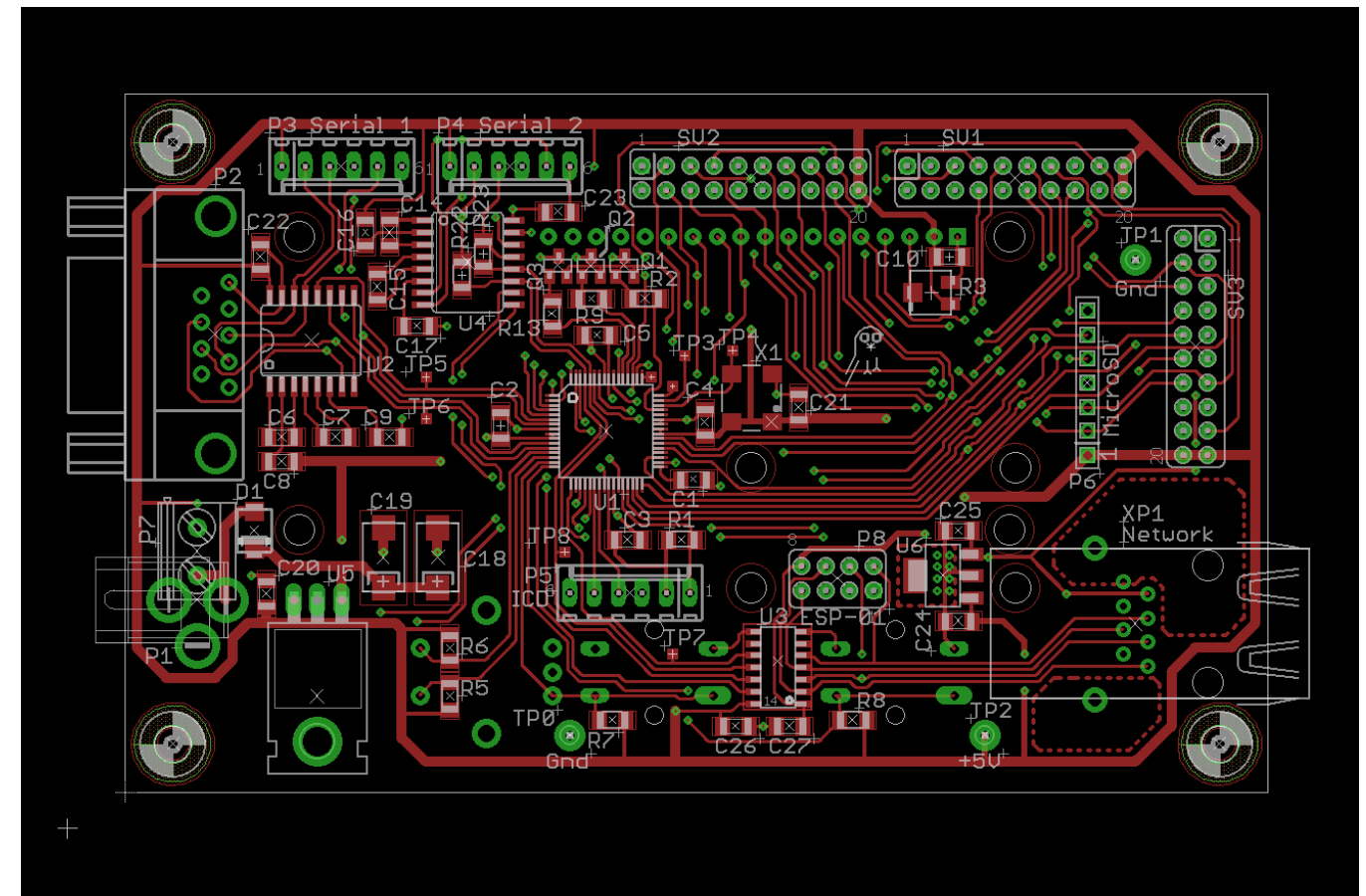
The PCB can be housed in an extruded aluminum case and support connections at either end of the case. A Hammond case 1455J1201 (5"x3"x1") will fit the PCB and allow construction of a neat assembly.

The PCB can also be set up in a front panel user interface configuration with an LCD display and either switches or a rotary encoder for input. A standard 2x16 LCD display such as a Newhaven NHD-0216 will fit directly on the PCB.

Communications is through either a pair of serial ports, one with a Dsub-9 on one end of the PCB. Or through a Lantronix XPort that allow direct to ethernet control of the device.

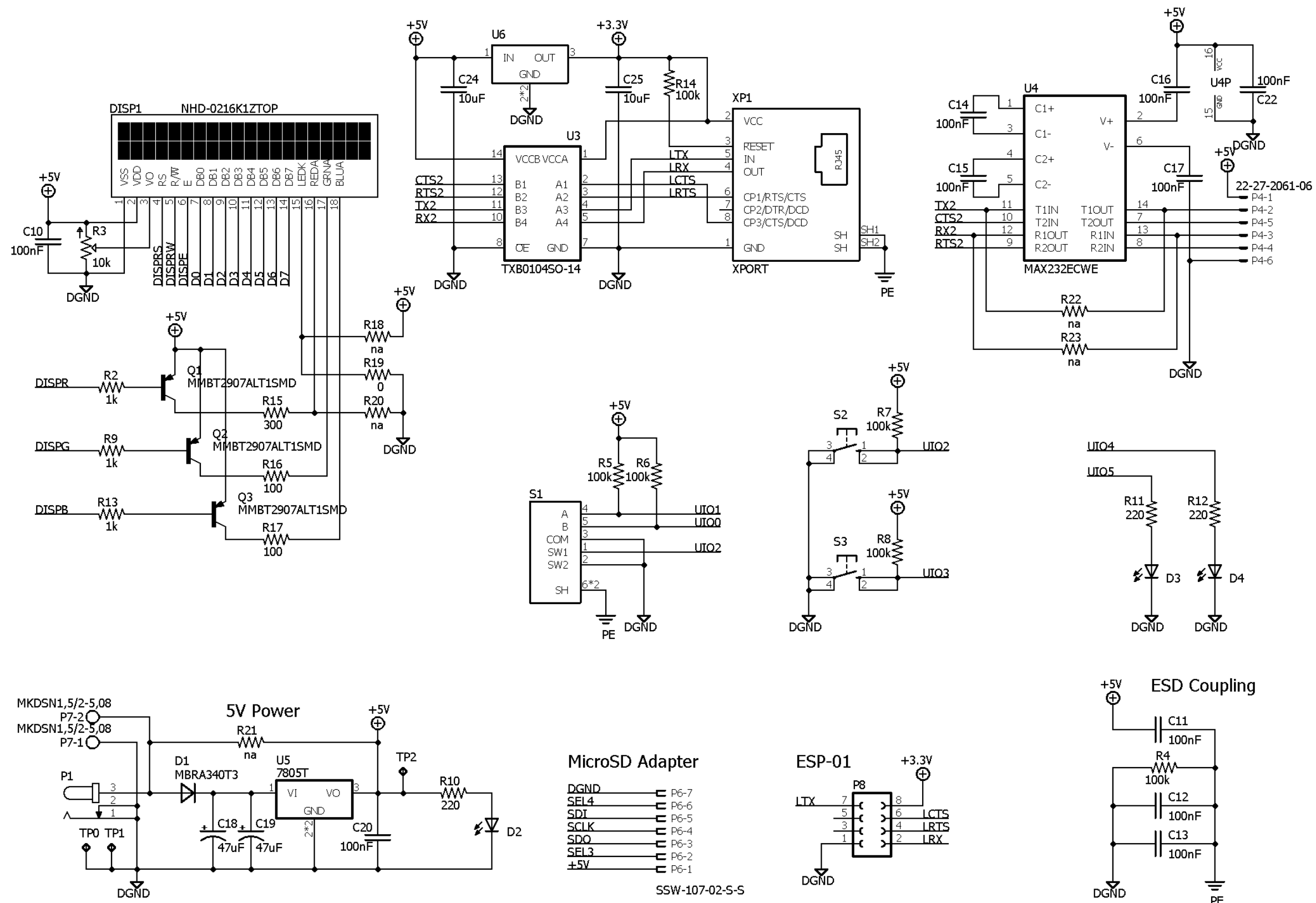A range of connectors and headers allow expansion of the PCB with a selection of I/O provided.
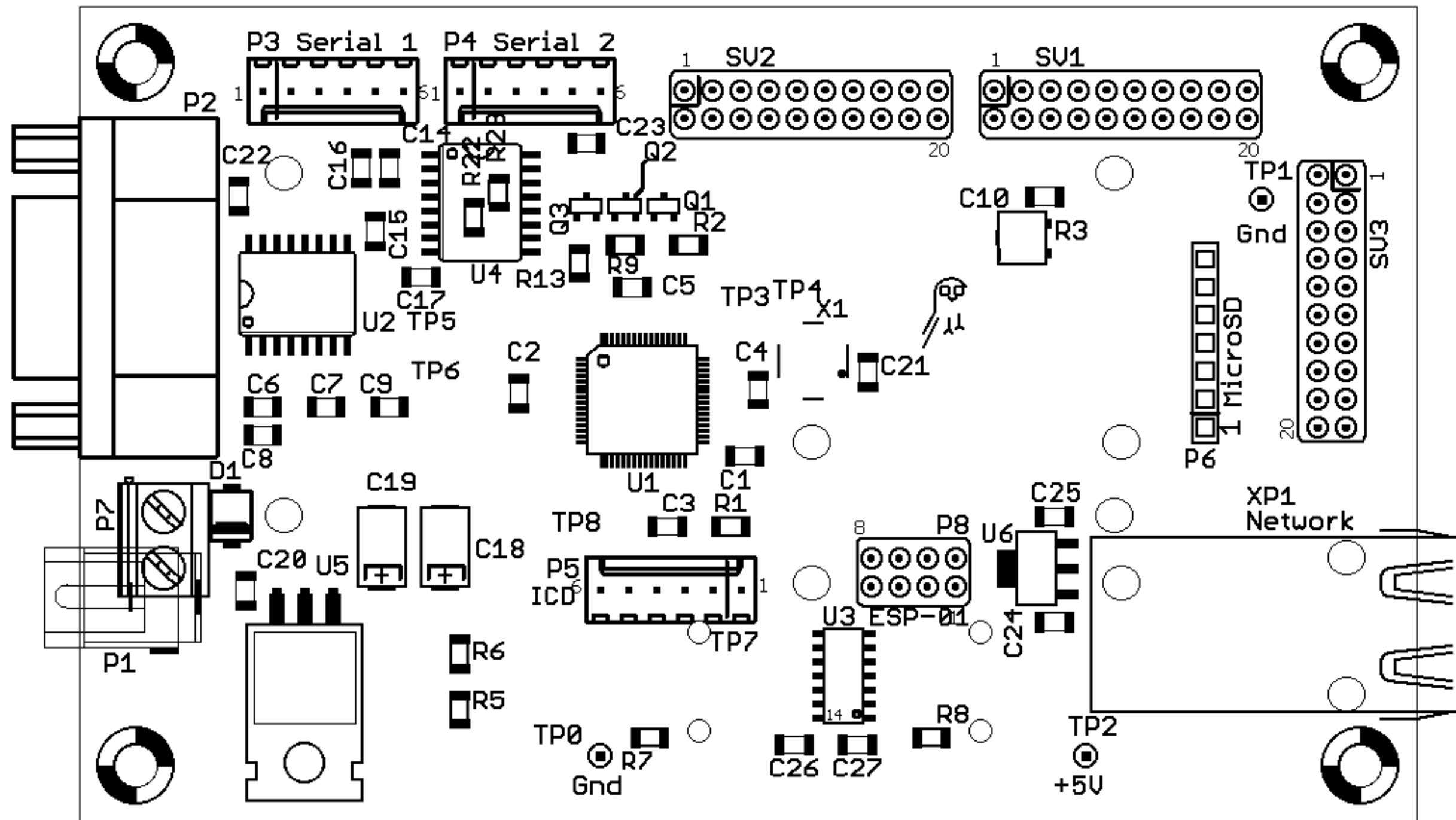
Appearance

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+5V

R1
100k

P5-1
P5-2
P5-3
P5-4
P5-5
P5-6
22-27-2061-06

PGD
PGC

DGND

U1   PIC18F66K80   +5V

AN0   29 RA0/CVREF/AN0/ULPWU   VDD1 10
AN1   30 RA1/AN1/C1INC   VDD2 25
AN2   31 RA2/AN2/VREF-/C2INC   VDD3 41
AN3   32 RA3/AN3/VREF+   VDD4 57
AN4   34 RA5/AN4/HLVDIN/T1CKI/SS   AVDD1 40
                                        AVDD2

UIO0   13 RB0/AN10/FLT0/INT0
UIO1   14 RB1/AN8/CTDIN/INT1   MCLR/RE3 28
UIO2   15 RB2/CANTX/CTED1/INT2
UIO3   16 RB3/CANRX/CTED2/INT3   RE0/AN5/RD   37 SEL3
       20 RB4/AN9/CTPLS/KBI0   RE1/AN6/C1OUT/WR 38 SEL4
UIO4   21 RB5/T0CK1/T3CK1/CCP5/KBI1 RE2/AN7/C2OUT/CS 39 SEL5
UIO5   22 RB6/PGC/KBI2   RE4/CANRX   27 CTS2
       23 RB7/PGD/T3G/KBI3   RE5/CANTX   24 RTS2
                                        RE6/RX2/DT2 60 RX2
RC0   48 RC0/SOSCO/SCLKI   RE7/TX2/CK2 61 TX2
RC1   49 RC1/SOSCI
SEL2   50 RC2/T1G/CCP2   RF0/MDMIN   17 DISPRS
SCLK   51 RC3/REFO/SCL/SCK   RF1   19 DISPRW
SDI   62 RC4/SDA/SDI   RF2/MDCIN1   35 DISPE
SDO   63 RC5/SDO   RF3   36
SEL0   64 RC6/CCP3   RF4/MDCIN2   45 DISPR
SEL1   1   RC7/CCP4   RF5   52 DISPG
                                        RF6/MDMOUT   53 DISPB
D0   54 RD0/C1INA/PSP0   RF7
D1   55 RD1/C1INB/PSP1
D2   58 RD2/C2INA/PSP2   RG0/RX1/DT1 6   RX
D3   59 RD3/C2INB/CTMUI/PSP3   RG1/CANTX2   7   CTS
D4   2   RD4/ECCP1/P1A/PSP4   RG2/T3CKI   8   RTS
D5   3   RD5/P1B/PSP5   RG3/T1X/CK1 12 TX
D6   4   RD6/P1C/PSP6   RG4/T0CK1   18
D7   5   RD7/P1D/PSP7

CLK   46 OSC1/CLKIN/RA7   VSS1
CLKOUT 47 OSC2/CLKOUT/RA6   VSS2 26
                                        VSS3 43
       33 VDDCORE/VCAP   VSS4 56
                                        AVSS 42

C1
10uF

DGND   DGND

+5V
SV1
SCLK 17   19   20   18 SEL2
SDI   15   16   SEL1
SDO   13   14   SEL0
AN0   11   12   AN1
D6   9   10   D7
D4   7   8   D5
D2   5   6   D3
D0   3   4   D1
      1   2
DGND

+5V
SV2
SCLK 17   19   20   18 SEL5
SDI   15   16   SEL4
SDO   13   14   SEL3
AN2   11   12   AN3
D6   9   10   D7
D4   7   8   D5
D2   5   6   D3
D0   3   4   D1
      1   2
DGND

+3.3V
SV3
SCLK 17   19   20   18 SEL5
SDI   15   16   SEL4
SDO   13   14   SEL3
      11   12   AN4
      9   10   AN3
      7   8   AN2
      5   6   AN1
      3   4   AN0
      1   2
DGND

+5V
C8
100nF

+5V
22-27-2061-06

C23   U2P
100nF

U2
C6   C1+   V+   2   P3-1
100nF   P3-2
          C1-   6   P3-3
C7   C2+   V-   P3-4
100nF   P3-5
          C2-   C9   P3-6
                           100nF

T1IN   11   T1OUT 14   CP2-1
T2IN   10   T2OUT 7   CP2-2
R1OUT 12   R1IN   13   CP2-3
R2OUT 9   R2IN   8   CP2-4
                          CP2-5
MAX232ECWE   CP2-6
                          CP2-7
                          CP2-8
                          CP2-9
                          CP2SH

DGND   DGND   PE

CLKOUT TP3
CLK   TP4
RX   TP5
TX   TP6
RX2   TP7
TX2   TP8
RC0   TP9
RC1   TP10

+5V   +3.3V

C2   C3   C4   C5   C26   C27   C28   C21
100nF 100nF 100nF 100nF 100nF 100nF 100nF 100nF

DGND

+5V

X1
VCC   OUT   CLK
EN   GND
16MHz

DGND

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DISP1   NHD-0216K1ZTOP

+5V
C10
100nF
R3
10k
DGND

VSS VDD VO RS R/W̄ E DB0 DB1 DB2 DB3 DB4 DB5 DB6 DB7 LEDK REDA GRNA BLUA
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

DISPRS DISPRW DISPE D0 D1 D2 D3 D4 D5 D6 D7

+5V
U6
IN   OUT
GND
2*2
C24
10uF
DGND
+3.3V
C25
10uF
R14
100k

U3
VCCB VCCA
14   1
CTS2 13 B1 A1 2
RTS2 12 B2 A2 3
TX2   11 B3 A3 4
RX2   10 B4 A4 5
      8 OE GND 7
DGND
TXB0104SO-14

XP1
2 VCC
3 RESET
5 IN
4 OUT
   LTX
   LRX
   LCTS
   LRTS
6 CP1/RTS/CTS
7 CP2/DTR/DCD
8 CP3/CTS/DCD
1 GND   SH1
        SH2
XPORT
RJ45
DGND
PE

+5V
C16
100nF
U4P
VCC 16
GND 15
C22
100nF
DGND
+5V
22-27-2061-06

C14
100nF
1
3
C15
100nF
4
5

U4
C1+
C1-
C2+
C2-
TX2 11 T1IN T1OUT 14 P4-1 / P4-2
CTS2 10 T2IN T2OUT 7   P4-5
RX2 12 R1OUT R1IN   13 P4-3
RTS2 9   R2OUT R2IN   P4-4 / P4-6
V+ 2
V- 6
C17
100nF
MAX232ECWE

R22
na
R23
na
DGND

+5V
R18 na
R19 0
R20 na
DGND

DISPR R2 1k   Q1 MMBT2907ALT1SMD
R15 300
DISPG R9 1k   Q2 MMBT2907ALT1SMD
R16 100
DISPB R13 1k   Q3 MMBT2907ALT1SMD
R17 100
+5V

+5V
R5 100k R6 100k
S1
4 A
5 B
3 COM
1 SW1
2 SW2
   SH
6*2
PE
UIO1
UIO0
UIO2
DGND

+5V
S2
3
4 1
R7 100k
UIO2
+5V
S3
3
4 1
R8 100k
UIO3
DGND

UIO4
UIO5
R11 220
R12 220
D3
D4
DGND   DGND

MKDSN1,5/2-5,08
P7-2
MKDSN1,5/2-5,08
P7-1

5V Power
R21 na
+5V
TP2

D1 MBRA340T3
P1
3
2
1
TP0 TP1
DGND
U5 7805T
VI VO
GND
2*2
C18 47uF C19 47uF C20 100nF
R10 220
D2

MicroSD Adapter
DGND   P6-7
SEL4   P6-6
SDI   P6-5
SCLK   P6-4
SDO   P6-3
SEL3   P6-2
+5V   P6-1
SSW-107-02-S-S

ESP-01
+3.3V
P8
LTX 7   8
     5   6 LCTS
     3   4 LRTS
     1   2 LRX
DGND

+5V   ESD Coupling
C11 100nF
R4 100k
C12 100nF
C13 100nF
DGND   PE

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P3 Serial 1
P4 Serial 2
SV2
SV1
1
1
20
20
P2
C22
C16
C14
C23
Q2
R22
R23
C10
R3
TP1
Gnd
SU3
1
C15
Q3
Q1
R2
C17
U4
R13
R9
C5
TP3 TP4
X1
MicroSD
U2 TP5
TP6
C2
C4
C21
C6 C7 C9
U1
C1
P6
20
C8
TP8
C3 R1
C25
XP1
Network
D1
C19
C18
8
P8
U6
P7
C20 U5
P5
ICD
1
U3 ESP-01
C24
P1
R6
R5
TP7
TP0
R7
14
R8
TP2
Gnd
C26 C27
+5V

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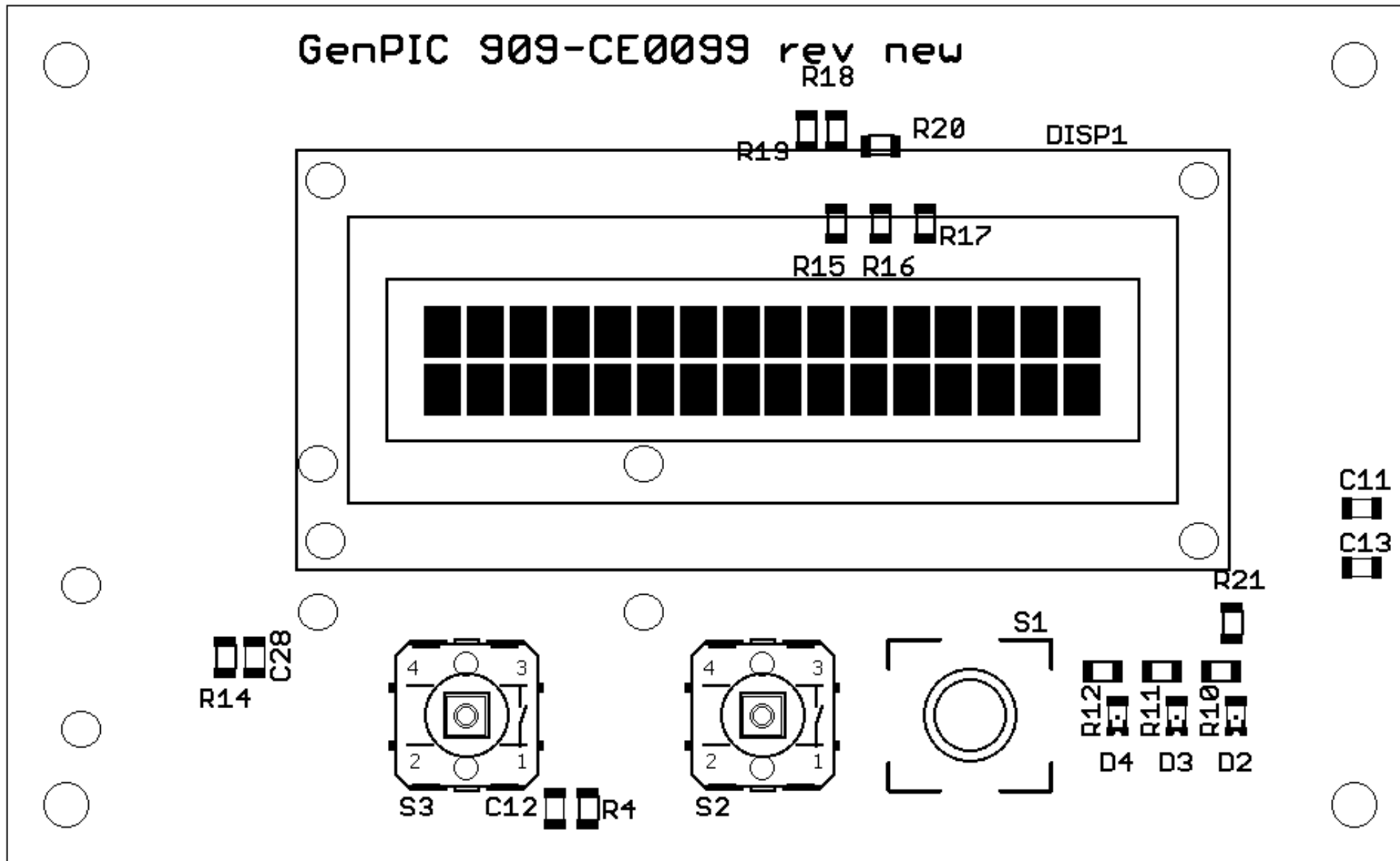
R18
R19 R20 DISP1
R15 R16 R17

C11
C13
R21

C28
R14

4 3
S3
2 1
C12 R4

4 3
S2
2 1

S1

R12 R11 R10
D4 D3 D2

General BOM

The BOM below is generic and must be tailored to the application. GenPIC presents any number of options in loading the PCB. There are some components that cannot be loaded if others are used. See the following pages of notes to understand the various options.

Item	Qty	Description	Part# / Mfg
PCB	1	GenPIC PCB	909-CE0098 / Keck
C1	1	10uF 16V ceramic capacitor 1206	CL31A106KOHNNNE / Samsung
C2-C9,C11-C17, C20-C28	25	0.1uF 50V ceramic capacitor 1206	C1206C104K5RAC7867 / Kemet
C18, C19	2	47uF 25V tantalum capacitor 7343	T495D476K025ATE250 / Kemet
D1	1	1A rectifier diode	S1A / Fairchild
D2	1	Green LED 1206	LTST-C150GKT / Lite-On
D3	1	Yellow LED 1206	LTST-C150KSKT / Lite-On
D4	1	Red LED 1206	LTST-C150CKT / Lite-On
DISP1	1	16x2 LCD display	NHD-0216K1Z-NSW-BBW-L / Newhaven
DISP1 (alt)	1	16x2 LCD display	NHD-0216K1Z-NS(RGB)-FBW / Newhaven
P1	1	5.5x2.5mm DC jack	PJ-202B / CUI
P2	1	Dsub 9 conductor female	A-DF 09 A/KG-T2S / Assmann
P3-P5	3	Locking header, 6 conductor 0.1"	0022232061 / Molex
P6	1	Header, 6 conductor 0.1"	PPPC071LFBN-RC / Sullins
P6	1	MicroSD Module	DEV-13743 / SparkFun
P7	1	Terminal block 5.08mm	1729128 / Phoenix
P8	1	2x4 position header, 0.1"	PPPC042LFBN-RC / Sullins
P8	1	WiFi Module	ESP-01 / Espressif
Q1-Q3	3	PNP transistor SOT-23	MMBT2907ALT1G / OnSemi
R1,R4-8,R14,R20	7	100k resistor 1206	RC1206FR-07100KL / Yageo
R2,R9,R13	3	1k resistor 1206	RC1206FR-071KL / Yageo
R3	1	10k potentiometer 3mm	ST32ETB103 / Copal
R10-12	3	220ohm resistor 1206	RC1206FR-07220RL / Yageo
R15	1	300ohm resistor 1206	RC1206FR-07300RL / Yageo
R16-17	2	100ohm resistor 1206	RC1206FR-07100RL / Yageo
R18-20,R21-23	6	0ohm jumper 1206	RC1206JR-070RL / Yageo
S1	1	Rotary encoder with switch	EVE-JBBF2020B / Panasonic
S2,S3	2	Pushbutton switch 12mm	B3F-4055 / Omrom
S2,S3	2	Switch cap	B32-1610 / Omrom
SV1-3	3	2x10 position header, 0.1"	SFH11-PBPC-D10-ST-BK / Sullins

Item	Qty	Description	Part# / Mfg
U1	1	8bit microcontroller	PIC18F66K80-I/PT / Microchip
U2,U4	1	RS-232 Transceiver, SOIC16W	SP232ECT / Exar
U3	1	Level shift IC, SOIC14	TXB0104DR / TI
U5	1	5V linear regulator, TO-220	LM7805CT / Fairchild
U5 (alt)	1	3.3V linear regulator, TO-220	LM1086IT-3.3 / TI
U6	1	3.3V LDO regulator, SOT-223	AP2114H-3.3TRG1 / Diodes Inc
X1	1	16MHz crystal oscillator	CB3-3I-16M0000 / CTS
XP1	1	XPort terminal server	XP1001000-05R / Lantronix

Power and Power Connector

Two power connectors are provided in the P1/P7 location, only one of these connectors can be loaded as they occupy the same space. This allows a screw terminal block or a standard 5.5x2.5mm DC jack to power the board with 7-18Vdc when used with the U5 voltage regulator.

Alternately 5Vdc power could be supplied directly on Pins 1 and 6 of P3 or P4 if one of these serial ports is not used.

P1	1	5.5x2.5mm DC jack	PJ-202B / CUI
P7	1	Terminal block 5.08mm	1729128 / Phoenix

Regulator

A standard 7805 voltage regulator is provided at U5. This allows use of the assembly with 7 to 18Vdc power. Current usage depends on configuration.

As this is a linear regulator care must be taken to limit power dissipation. Depending on the loading of the GenPIC board and feature selection power consumption will go up. Power dissipation can be limited by reducing the supply voltage to 9Vdc or as low as 7Vdc.

Some heatsinking is provided by means of the copper ground plane. Additionally there should be room for a heatsink to be used with U5.

If direct 5.0Vdc power is to be provided with no regulator then R21 can be loaded with a jumper while U5, D1, C18, and C19 are omitted.

If a 3.3V environment is needed the PIC18F66K80 microcontroller can be run on 3.3V by replacing U5 with a 3.3V regulator. Care must be taken to insure all other components used in the configuration can also run at 3.3Vdc.

R21	1	0ohm jumper 1206	RC1206JR-070RL / Yageo
U5	1	5V linear regulator	LM7805CT / Fairchild
U5 (alt)	1	3.3V linear regulator	LM1086IT-3.3 / TI

Microcontroller

A capable PIC18F66K80 microcontroller is used for GenPIC. There are quite a few other microcontrollers in the Microchip catalog with pinouts close enough to be used, but few provide the dual serial ports needed for many of the GenPIC configurations.

While this microcontroller is probably complete overkill for most applications GenPIC will be used for, it is only $4 in single piece quantities.

U1	1	8bit microcontroller	PIC18F66K80-I/PT / Microchip

Oscillator

The X1 position allows a standard 5x7mm oscillator for the microcontroller. 16MHz is nominal and can be multiplied up to 4 times to 64MHz by an internal PLL in the microcontroller.

If frequency precision is not needed the PIC18F66K80 has an internal oscillator available, the X1 position can be left empty.

X1	1	16MHz crystal oscillator	CB3-3I-16M0000 / CTS

Serial Port #1

A standard RS-232 serial port is provided by serial port #1. This is a full implementation including RTS/CTS flow control if properly implemented in software. Level conversion from logic to RS-232 levels is provided by a standard ST232/MAX232 driver IC.

Two connectors are provided, P2, a female 9 pin DSub with a standard pinout and P3, a 6 pin locking header. Only one of these should be used in the configuration.

P2	1	Dsub 9 conductor female	A-DF 09 A/KG-T2S / Assmann
P3	1	Locking header, 6 conductor 0.1"	0022232061 / Molex
U2	1	RS-232 Transceiver	SP232ECT / Exar

Serial Port #2

A standard RS-232 serial port is provided by serial port #2. This is a full implementation including RTS/CTS flow control if properly implemented in software. Level conversion from logic to RS-232 levels is provided by a standard ST232/MAX232 driver IC.

A 6 pin locking header is provided for the port.

If logic level serial is required the transceiver IC can be omitted and jumpers loaded into the R22 and R23 positions. This precludes RTS/CTS but provides RX and TX.

Alternately a RS422 or other style of driver could be constructed on a daughterboard plugged into the P4 position via a header. +5V and Gnd are provided on the connector.

P4	1	Locking header, 6 conductor 0.1"	0022232061 / Molex
R22, R23	2	0ohm jumper 1206	RC1206JR-070RL / Yageo
U4	1	RS-232 Transceiver	SP232ECT / Exar

Micro SD Storage

If large amounts of data needs to be stored a micro SD card can be accommodated using a SparkFun breakout module connected at P6

P6	1	Header, 6 conductor 0.1"	PPPC071LFBN-RC / Sullins
P6	1	MicroSD Module	DEV-13743 / SparkFun

Ethernet

A direct ethernet connection can be provided by means of a Lantronix XPort terminal server. This uses serial port #2 on the microcontroller and precludes use of serial port #2, U4 must not be loaded.

The XPort is a 3.3V device, thus power is supplied by U6, a 3.3V regulator and U3 a logic level shift IC is used to convert the I/O lines.

U6	1	3.3V LDO regulator	AP2114H-3.3TRG1 / Diodes Inc
U3	1	Level shift IC	TXB0104DR / TI
XP1	1	XPort terminal server	XP1001000-05R / Lantronix

WiFi

A simple WiFi wireless connection is possible using an ESP-01 module with a ESP8266 WiFi controller. The ESP-01 uses an 8-pin header at P8 as well as serial port #2, the three volt regulator U6, and the logic shift IC U3. Use of the ESP-01 precludes use of the XPort or serial port #2, XP1 and U4 must not be loaded.

U6	1	3.3V LDO regulator	AP2114H-3.3TRG1 / Diodes Inc
U3	1	Level shift IC	TXB0104DR / TI
P8	1	2x4 position header	PPPC042LFBN-RC / Sullins
P8	1	WiFi Module	ESP-01 / Espressif

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Character Display

A standard 80x36mm 16x2 LCD character display can be loaded into position DISP1. This is a very generic display that uses the standard Hitachi HD44780 control protocol. If a larger display is to be used it can be connected to the same header, even if it will not fit on the PCB. Alternately the display could be connected to one of the service ports SVC1 or SVC2 that provide the needed I/O for a display.

The display is provided a full 8bit parallel bus allowing for easy control. SPI and 4bit displays could be driven from a service port.

The configuration of jumpers R18-20 allow several different backlight configurations to be accommodated. Alternately the Newhaven RGB displays could be controlled with transistors Q1-Q3 and resistors R15 to R20. Normally jumpers are used here for displays with built in backlight limiting resistors, if no onboard resistor is present a current limiting resistor can be installed here.

DISP1	1	16x2 LCD character display	NHD-0216K1Z-NSW-BBW-L / Newhaven
DISP1 (alt)	1	16x2 LCD character display	NHD-0216K1Z-NS(RGB)-FBW / Newhaven
DISP1 (alt)	1	16x2 OLED character display	LOD-H01602DP/A-Y / Lumex

User Interface

A rotary encoder and two pushbutton switches allow a user interface to be constructed alongside the LCD display.

The rotary encoder S1 incorporates a pushbutton switch, as such it could be used without additional switches to allow a simple user interface that required values to be adjusted by means of a rotary knob. The encoder switch uses the same input line as S2, only one or the other may be installed.

S2 and S3 are located below the display, the two pushbutton switches would allow a user interface to be constructed.

Additionally two LED's, D3 and D4, are located near the switches to provide additional status indications. A third LED in the group, D2, simply indicates power status.

S1	1	Rotary encoder with switch	EVE-JBBF2020B / Panasonic
S2, S3	1	Pushbutton switch 12mm	B3F-4055 / Omrom
D2	1	Green LED 1206	LTST-C150GKT / Lite-On
D3	1	Yellow LED 1206	LTST-C150KSKT / Lite-On
D4	1	Red LED 1206	LTST-C150CKT / Lite-On

Service Ports

The service ports allow for a wide range of additional circuitry to be added.

SV1 and SV2 are identical in pinout, with different select lines for use a strobes and clocks. These provide the full eight bit wide data bus, the SPI bus, two analog inputs, and three select lines. +5V power and ground are also provided. A couple mounting holes are provided in the PCB for a standoff that can be used for securing a daughterboard connected to the service port.

SV3 is focused on analog use with eight lines that can be either analog inputs (AN0-AN7) or digital outputs from the microcontroller. The SPI bus is provided as well as both 5V and 3.3V power.
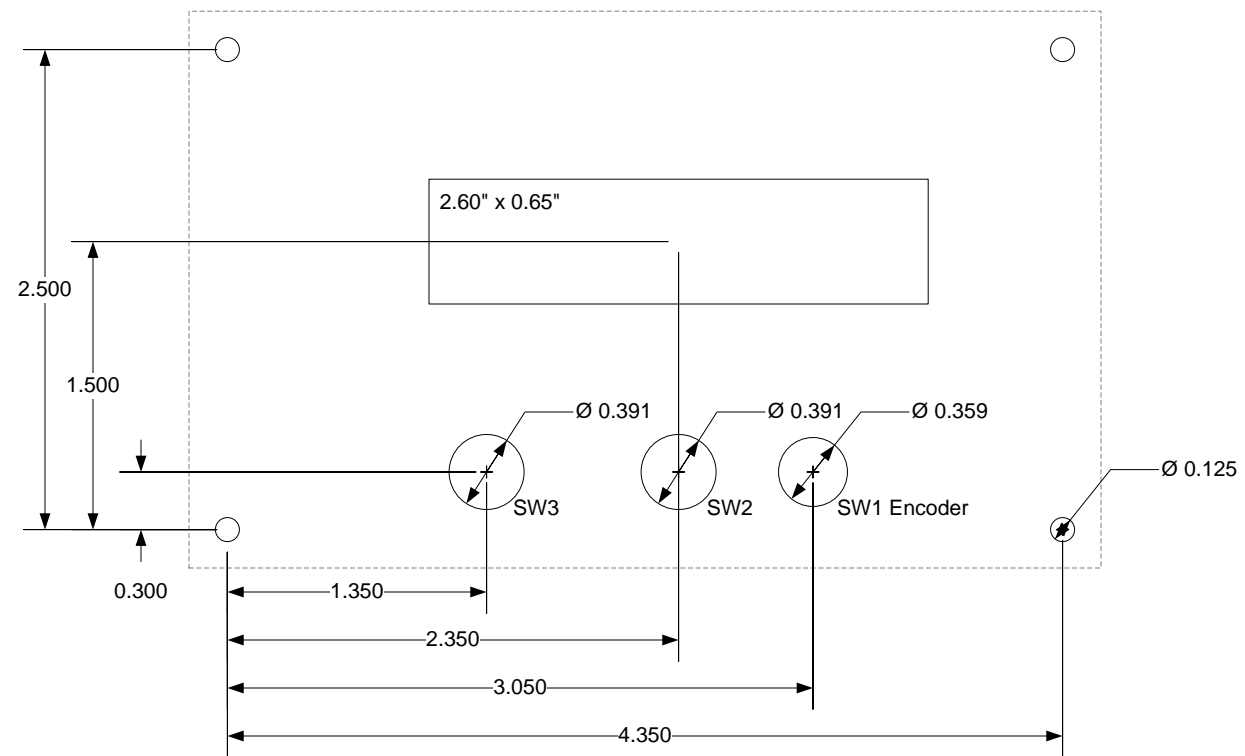
All of the service ports are connected using a 2x10 0.1" header, with the female header mounted to the GenPIC PCB.

SV1-3	3	2x10 position header, 0.1"	SFH11-PBPC-D10-ST-BK / Sullins

Panel Layout

If used in a panel mount situation the GenPIC allows for easy layout. All of the needed drilled holes are on even centers while the display is centered on the same grid with everything else.