

PVK40

User's manual

Feature Rich Development and Educational Kit
for 40-pin Microchip PIC[®] microcontrollers

ASIX[®]

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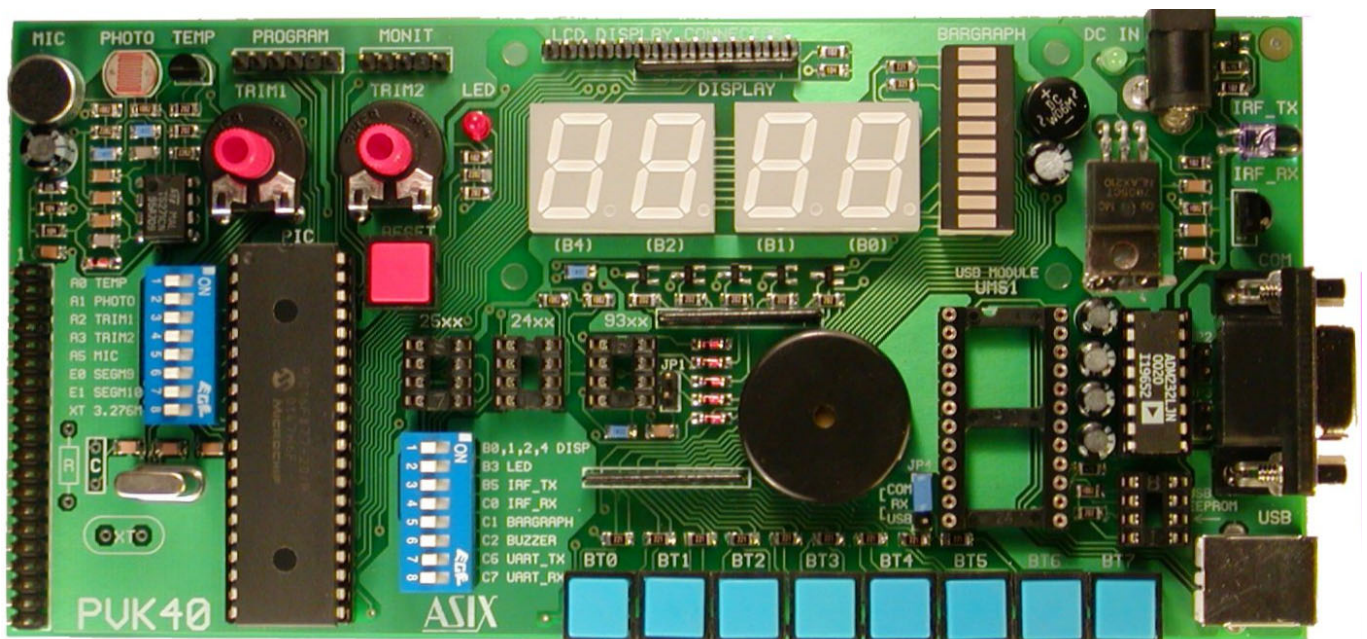
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PVK40

PVK40 is a feature rich development board for the 40-pin PIC[®] Flash MCUs - PIC16F87x, PIC16F7x, PIC18Fxx.

The board includes all the circuitry necessary for an in-depth study of most of the microcontroller on-chip peripherals and for experimenting with several external peripherals. This board will help you to become an expert in PIC MCU programming.

The 40-pin PIC MCUs contain a superset of the peripherals found in the lower pin count devices, while the register mapping is still compatible. This is the reason why all the knowledge and experience gained on the 40-pin devices apply also to practically all other PIC[®] microcontrollers.



On-board peripherals:

- Two potentiometers connected to the A/D converter inputs
- Photoresistor connected to the A/D converter input
- Microphone with preamplifier connected to A/D converter input
- Thermo sensor
- 24LC01 - I²C Serial EEPROM
- Sockets for other types of serial EEPROMs (MicroWire - 93xx, SPI - 25xx)
- RS232 driver and 9-pin SubD connector
- Socket for USB-to-serial module UMS1 (with FTDI FT232 chip) and EEPROM
- IR LED (transmitter)
- IR receiver with 36 kHz filter and demodulator
- 4-digit 7-segment LED display
- 10 level bargraph
- Interface for LCD character dot matrix display

- LED diode
- 8 pushbuttons
- Buzzer (connected to the PWM output pin)
- Crystal 3.2768 MHz
- Position to connect RC oscillator
- Position for crystal
- Reset button
- ICSP/ICD connector (In-Circuit Serial Programming/In-Circuit Debugging)
- Application monitoring connector (INSIDER interface)
- Expansion connector with all microcontroller signals
- DIP switches for connecting/disconnecting the peripherals
- Stabilized 5 Volt power supply

Power supply

A power supply with voltage of 9 .. 12 V can be used. The power consumption varies according to peripherals being used and/or external circuitry powered from the board. A power supply which can deliver 300 mA and more is recommended.

Microcontroller

The 40-pin Flash PIC microcontrollers are supported, e.g.:

- PIC16F74
- PIC16F77
- PIC16F871
- PIC16F874, PIC16F874A
- PIC16F877, PIC16F877A
- PIC18F442
- PIC18F448
- PIC18F452
- PIC18F458

PVK40 is delivered with PIC16F877-20/P device. Further it is possible to use any microcontroller with compatible pinout.

Reset circuitry

The -MCLR pin is connected through pull-up resistor to +5V, thus preprogrammed microcontroller starts running just after power is applied (if the oscillator is connected and set up properly). In addition the RESET button can be used to force microcontroller reset.

Oscillator

The board is equipped with 3.2768 MHz crystal which can be connected to microcontroller by turning on the XT 3.276M DIP switch. Otherwise either a crystal soldered to prepared XT position or RC oscillator soldered to R and C positions may be used. In such case the XT 3.276M DIP switch must be turned off.

Note: *only one of the crystal or RC oscillator can be connected at a time.*

Ports

Most of the supported microcontrollers are capable of analog to digital conversion at port A inputs, thus analog circuitry is connected to these pins (thermo sensor, photo resistor, 2 potentiometers and microphone).

Port B is general purpose, digital. It is used to drive display anodes, LED, infra LED. Serves also for in-circuit programming.

Some of the port C pins have special capability and are used for IR receiver, bargraph, buzzer, UART and EEPROM memory.

Port D is general purpose, digital. The display, bargraph and pushbuttons connect to its pins.

Port E has only 3 pins which are used for 2 remaining bargraph segments and application monitoring connector.

Port usage on PVK40 board

PORT A

Port A	Pin Type	Function
bit 0	analog input	thermo sensor (TEMP)
bit 1	analog input	photoresistor (PHOTO)
bit 2	analog input	potentiometer 1 (TRIM1)
bit 3	analog input	potentiometer 2 (TRIM2)
bit 4		unused
bit 5	analog input	microphone with preamplifier (MIC)
	output	CS signal for 93xx EEPROM

PORT B

Port B	Pin Type	Function
bit 0	output	log.0 activates first (lowest) display digit
bit 1	output	log.0 activates second display digit
bit 2	output	log.0 activates third display digit
bit 3	output	log.0 turns on standalone red LED
bit 4	output	log.0 activates fourth (highest) display digit
bit 5	output	log.1 turns on IR LED (IRF_TX)
bit 6		reserved for ICSP programming (CLK)
bit 7		reserved for ICSP programming (DATA)

PORT C

Port C	Pin Type	Function
bit 0	input	IR receiver (IRF_RX)
bit 1	output	log.0 activates bargraph
bit 2	output	buzzer
bit 3	input/output	EEPROM: clock signal - 25xx, 24xx, 93xx
bit 4	input/output	EEPROM: data out for 25xx, 93xx, SDA for 24xx
bit 5	output	EEPROM: data in for EEPROM 25xx, 93xx
bit 6	output	UART_TX or -CS for EEPROM 25xx
bit 7	input	UART_RX

PORT D

Port D	Pin Type	Function
bit 0..7	input	button state – log.0 = button BT0..BT7 is pressed
	output	log.0 turns on segment A..G, DP of active display digit or segment 1..8 of bargraph

In case the LCD module is used, PORT D serves as the data bus.

PORT E

Port E	Pin Type	Function
bit 0	output	log.0 turns on segment 9 of bargraph
bit 1	output	log.0 turns on segment 10 of bargraph
bit 0..2		MONIT - connector for application monitoring device (INSIDER)

Note: If the peripherals are disconnected using DISPSW1 or DISPSW2 switches, user peripherals may be connected to unused microcontroller pins using expansion connector.

Peripheral description

LED diode

Red LED diode can be turned on by setting bit 3 of port B as output and writing log.1 to it. Writing log.0 turns the LED off.

LED display

7-segment LED display devices are used. The display is designated to be used in multiplexed mode. The segment is on if there is log. 0 on the appropriate bit of the port D (which selects a segment) and at the same time log. 0 is on the appropriate pin of the port B (which selects a 7-segment device). If the switching is fast enough (>25 Hz), display shows characters without noticeable flashing of the segments.

BARGRAPH

The bargraph is controlled the same way as display. A segment is on if appropriate bit of port D is set to log.0 (selects a segment to be lit), and at the same time bit 1 of port C is set to log.0 (selects the bargraph). Remaining segments (9 and 10) are driven from port E, bit 0 and 1.

Pushbuttons BT0 .. BT7

Reading data from port D defined as input allows to detect the state of the pushbuttons. Log.0 on the appropriate pin indicates that the button is pressed. Since the buttons are serially connected with resistors, no short connections appear when a button is pressed, which ensures that the display can be controlled concurrently while reading the buttons in meantime.

Buzzer

Buzzer is connected to pin C1 which can be also configured as PWM output thus sounds can be generated easily. Because the buzzer acts as a capacitor, it is connected directly to microcontroller pin – the DC part of the signal does not affect its operation.

Microphone (MIC)

An electret microphone MCE100 is used. Preamplified signal is connected to pin A5.

Photoresistor (PHOTO)

Photoresistor to sense light intensity is provided. Its response is pretty slow, (1/10 s to several seconds), but the sensitivity is high. The photoresistor is connected in a voltage divider output of which is wired to pin A1 of the microcontroller.

Thermo sensor (TEMP)

Its resistance changes with the temperature. It is connected in a voltage divider which is balanced at about 20°C. The output of the divider is wired to pin A0.

Potentiometers (TRIM1, TRIM2)

The potentiometers are connected to pins A2 and A3 and can deliver a voltage of 0 to 5 V to these pins, which is convenient for testing of A/D converter function or setting a parameter of application program.

Infrared remote control (IRF_TX, IRF_RX)

This part of the board can be used as both IR receiver and transmitter compatible with most remote controlled consumer electronic products like TV, Hi-Fi, DVD players and so on. The board contains a receiver with 36 kHz filter and demodulator, thus the signal to be received must be modulated at about this frequency. The IR LED can be used to transmit modulated signal. It is possible to communicate between two PVK40 boards this way. If it is desired to test the

communication with a single board only, an object reflecting the IR light (e.g sheet of paper) must be placed nearby the receiver and transmitter.

The IR LED is turned on by log.1 on B5 pin. The LED is typically driven by pulses with momentary current reaching 0.5 A. In case of PVK40 the current is only 60 mA, thus the range of the transmitter is smaller, but leaving the LED accidentally on will not result to its damage.

The receiver is connected to C0 pin and delivers digital demodulated signal.

RS-232 interface (COM)

This type of interface is still common part of most computers. Its levels are +12V for log.0 and -12V for log.1. The cable may be several tens of meters long. The level converter between TTL and RS-232 is part of the board and is connected to UART of the microcontroller, pins C6 and C7. Jumper JP2 and JP3 can be used to shorten pins 7 (RTS) and 8 (CTS) of SubD 9-pin connector or pins 4 (DTR) and 6 (DSR) respectively. If the RS-232 interface is to be used, jumper JP4 must be set to COM-RX position.

USB interface (USB)

This fast and convenient interface is recently getting popular and is wide spreaded in PC world these days. Since the USB communication is much more complicated than for example RS-232, there are integrated circuits which cover its complexity. One of the possibilities is FT232 by FTDI Ltd. (www.ftdichip.com) which is able to communicate with the microcontroller serially at speeds up to 1 MBaud and it is possible to connect it directly to UART of the microcontroller. The drivers for common operating systems (Windows, Linux, MacOS) are available from FTDI for free. A module UMS1 (available from ASIX) equipped with this circuit fits directly into socket on PVK40 board. It is also possible to connect an EEPROM memory with USB configuration data (although this is not an necessity). More information can be found on websites www.pic-tools.com and www.ftdichip.com.

If USB communication is to be used, it is necessary to set jumper JP4 to RX-USB position.

EEPROM memories (24xx, 25xx, 93xx)

There are sockets for popular serial EEPROM memories available onboard. 24LC01 is part of the PVK40. It is possible to test all standard communication protocols - I²C, MicroWire and SPI. In case of MicroWire memories, data organization (8 or 16 bit) can be set using jumper JP1. The wiring to microcontroller pins can be found in PVK40 schematics.

DIP switches

Most of the peripherals can be disconnected from the microcontroller using DIP switches. This is convenient if the user wishes to connect custom peripherals. If the onboard peripherals are to be used, remember to set appropriate DIP switches to ON position.

Expansion connector

A 40-pin connector with all microcontroller signals is placed in the lower left part of the board. This connector can be used to connect user peripherals. The pinout corresponds with the microcontroller package:

-MCLR	1	40	B7
A0	2	39	B6
A1	3	38	B5
A2	4	37	B4
A3	5	36	B3
A4	6	35	B2
A5	7	34	B1
E0	8	33	B0
E1	9	32	+5V
E2	10	31	GND
+5V	11	30	D7
GND	12	29	D6
OSC1	13	28	D5
OSC2	14	27	D4
C0	15	26	C7
C1	16	25	C6
C2	17	24	C5
C3	18	23	C4
D0	19	22	D3
D1	20	21	D2

PROGRAM connector

The PROGRAM connector serves for ICSP programming of the microcontroller. The pins are connected according to following chart:

1

0	0	0	0	X	0
---	---	---	---	---	---

Pin	Function
1	B6 (clock)
2	B7 (data)
3	GND
4	+5V
5	not connected
6	-MCLR

MONIT connector

This connector is designated for external application monitoring device such as INSIDER by ASIX. The pins are connected according to following chart:

1

0	0	0	X	0
---	---	---	---	---

Pin	Function
1	E2
2	E1
3	E0
4	not connected
5	GND

LCD display connector

This connector provides with connectivity to optional intelligent LCD display module. Recommended type is MC1602E-TRV. Pin layout of the connector is:

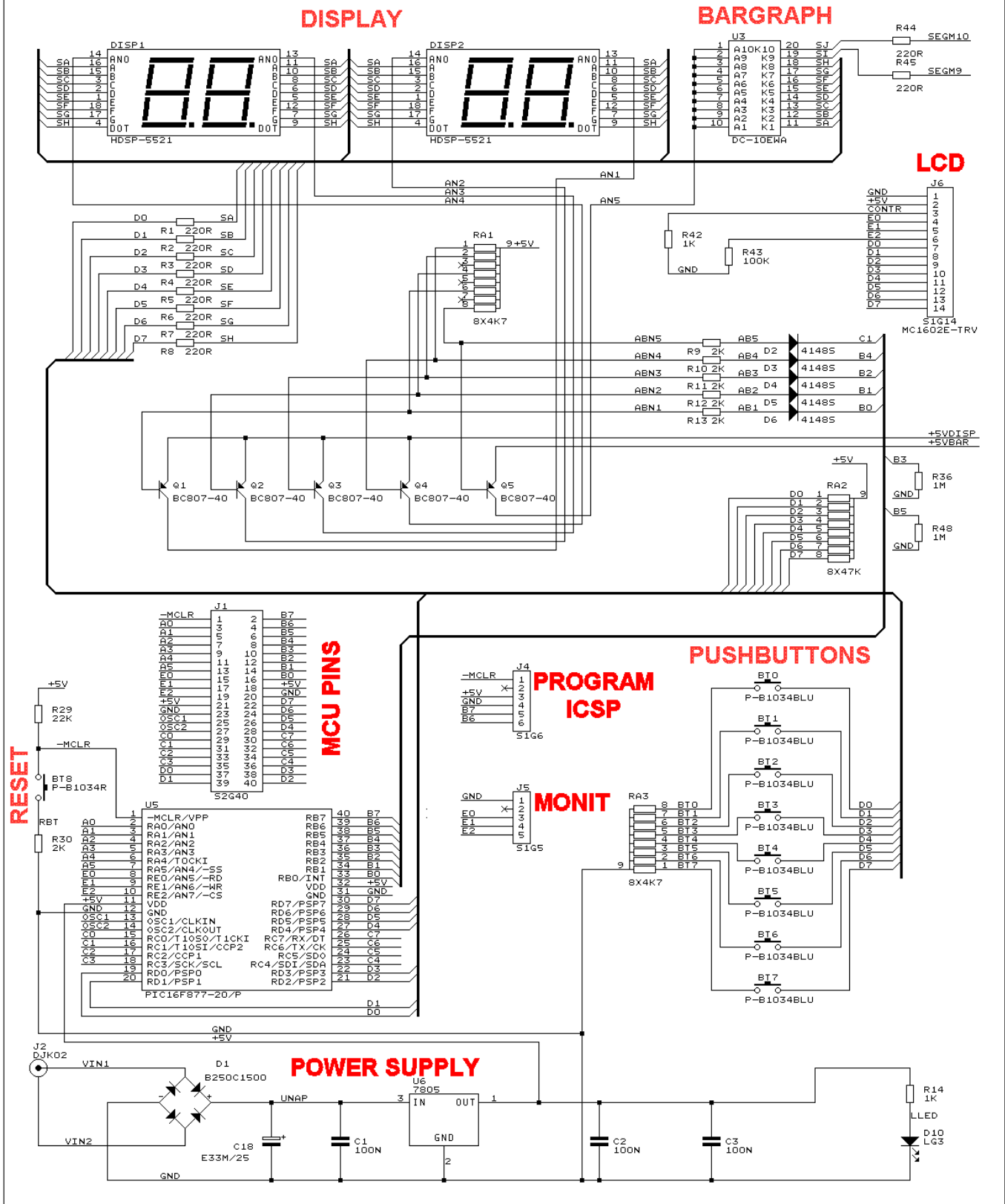
1	2	3	4	5	6	7	8	9	10	11	12		13	14
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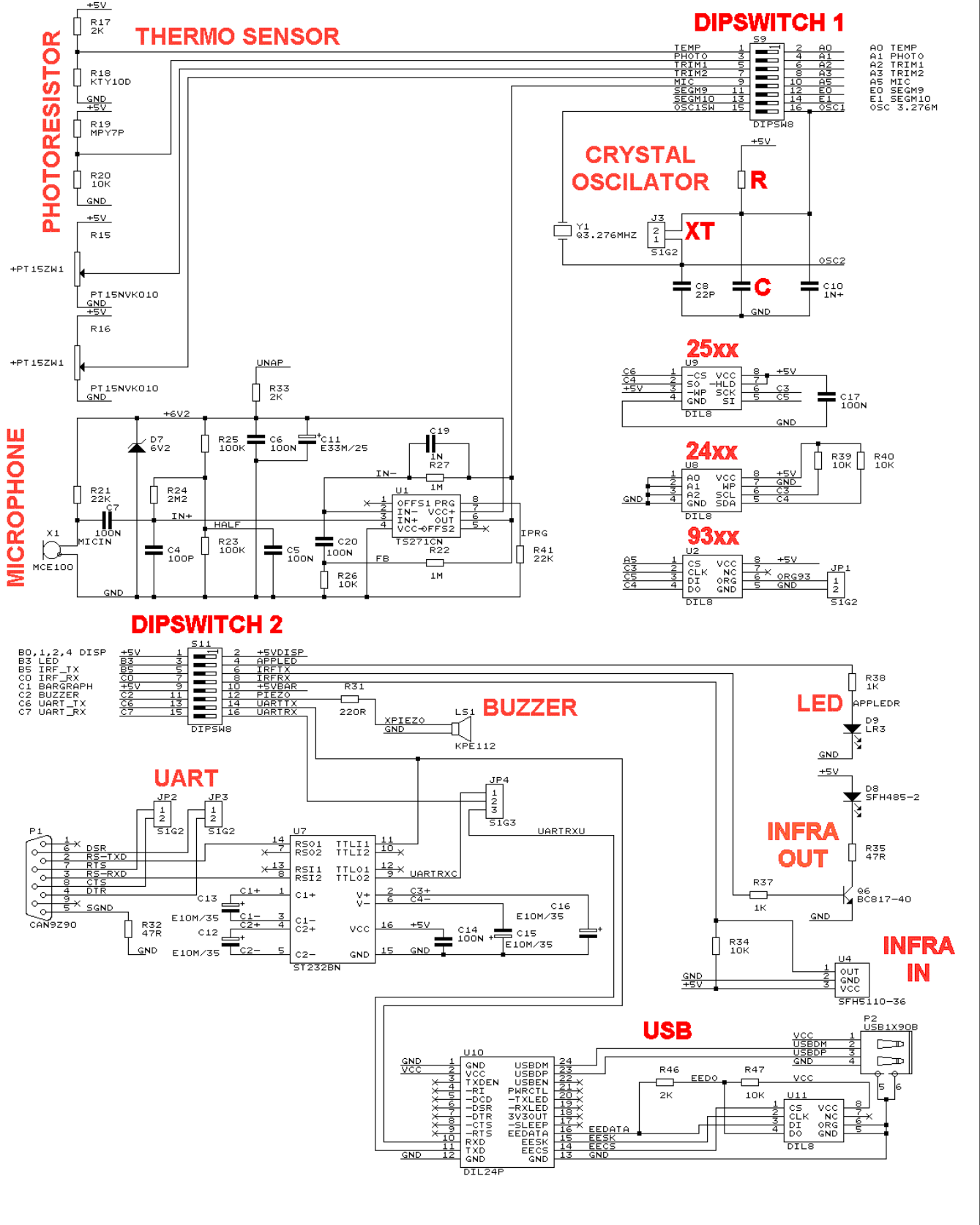
D7 D6 D5 D4 D3 D2 D1 D0 E2 E1 E0 CONTRAST +5V GND

The data format is 8-bit (D0..D7), control signals are wired to E0..E2, contrast is controlled by CONTRAST signal.

Schematics

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Recommended add-ons

MW903GS	Power supply adaptor 9 V DC, 300 mA (EURO)
MC1602 module	LCD display module MC1602E-TRV with connector
UMS1	USB-to-UART interface module
93LC46B	EEPROM for UMS1 module USB configuration data

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