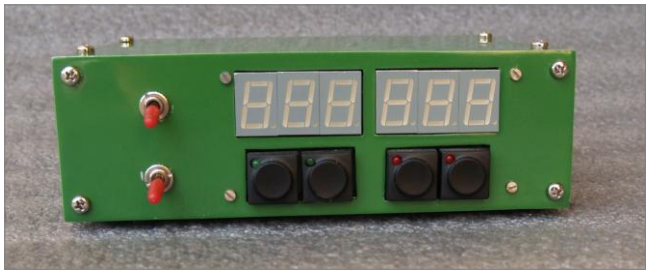
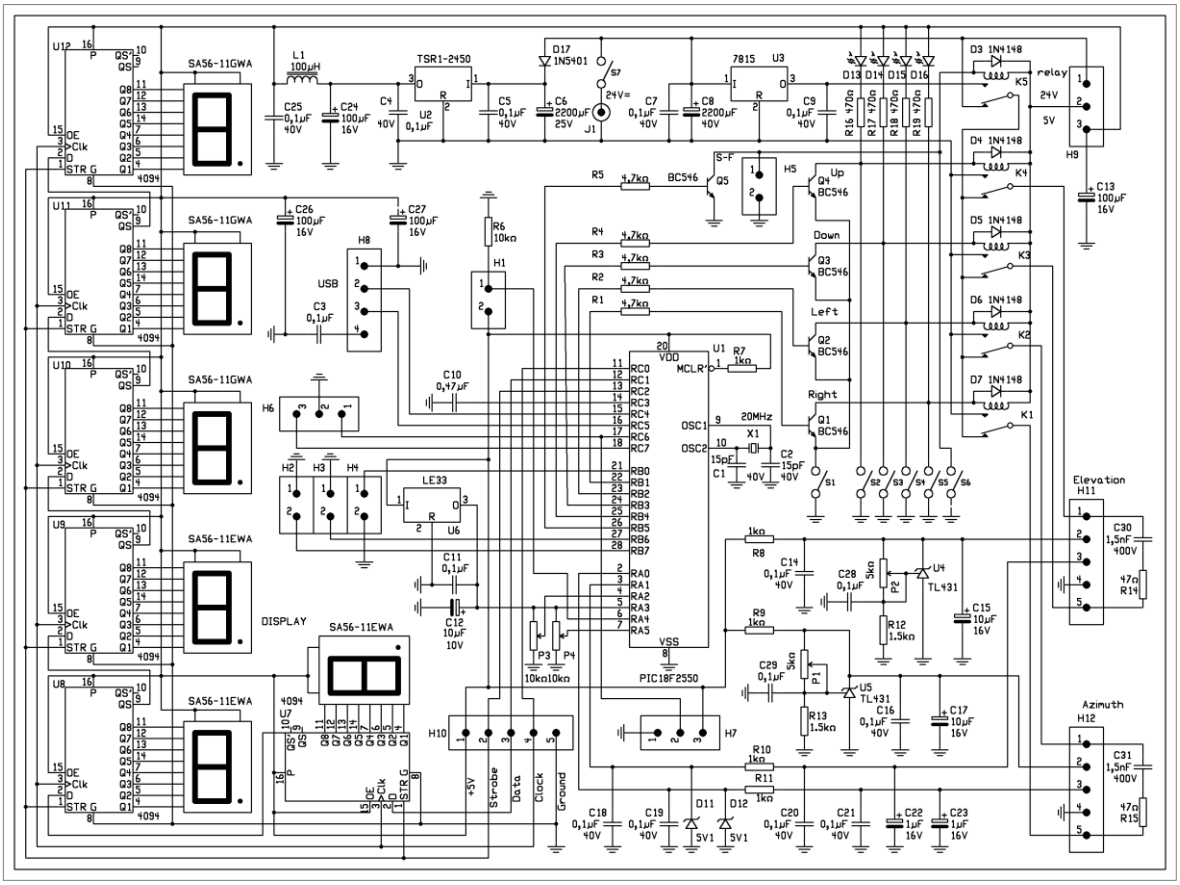
Antenna Rotator with Electronic Control and Display



Development of personal computers trends into a direction where the classic interfaces like COM and LPT are omitted.. Only USB ports can be found on the latest machines. A possible solution may be a USB-COM adapter. Thinking of the future I have decided to develop my circuits so that they could be used for a longer time so the USB interface was chosen.



Control unit

The software placed in the microprocessor provides communications with USB port and display of antenna position. Since the microprocessor has free inputs these are used for the configuration of the software. There are four jumpers on the board. The use of these are as follows:

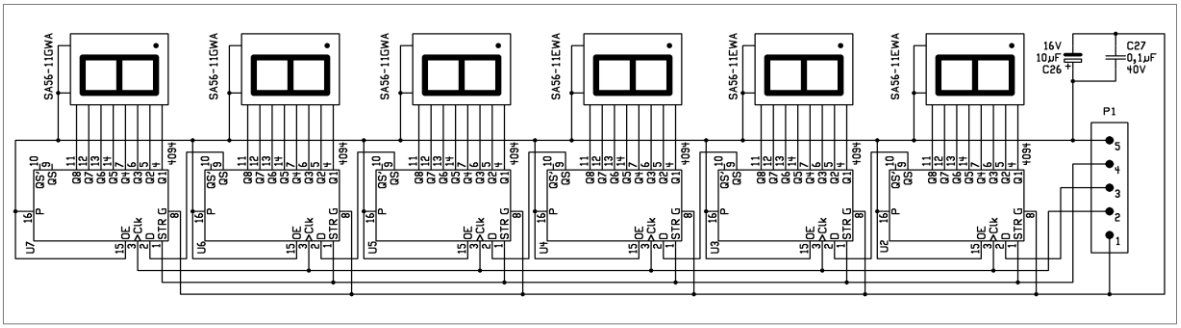
H1: OFFSET – the basic position of the rotator (South or North)
H2: FLIP – elevation 90° or 180°reference voltage by an additional regulator
H3: TEST – data display sent on the serial port
H4: validation by trimmers or by software

The size of both PCB is 87 by 155 mm and is not too complex. They contain simple components so their assembly takes no more than an hour. This version is not contain the power supply. You can use any 24V DC supply with current enough for the motors.

Display LED

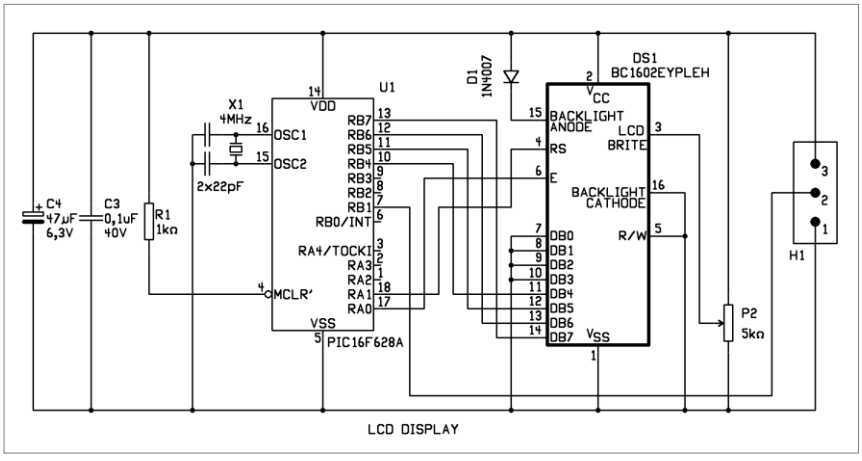
Operation

The display is connected to the microprocessor by three data lines applying serial data transfer. The circuit contains six shift registers which transfers the serial data coming from the microprocessor into parallel data for the LED displays. The operation of the display is as follows: Data arriving to data input are stepped forward continuously in the register by the clock signal. When all the 48 bits are in the right place, the strobe signal writes data to register output. The advantage of this method contrary to the widely used multiplex method is that brightness is much better and the display does not vibrate as it does when the multiplex method is chosen.



Construction

In this case construction of the PCB is a much greater challenge. Drawing the sheet is more complex and dense compared to the firsts. In this case I was successful to make it, using the so called blue foil technology in my home workshop. I guess application of photosensitive sprays like Positiv-20 can't be problematic. Check the PCB thoroughly before implanting because there will not be any more chance to repair it under the integrated circuits. Shift registers are to be put onto foil side and LEDs are to be placed onto component side. If we made careful work the display does not need any additional adjustment. I use red display for azimuth and green for elevation but it's up to you what to choose. It's advisable to use high brightness and low consumption types, like SA56-11EWA, SA56-11GWA, SA56-11YWA.



Display LCD

Since this version does not use the serial port, I connected an LCD display to this freed up port. Any 2 lines 16 character display module could be used. I chose the Bolymin BC1602E type, because it is

quite large and easily readable. We should select such display module which contains European character set, otherwise the graphical signs might be incorrect.

Guidelines for adjustments

As the first step you have to set jumpers according to the elevation rotation to be 90 or 180 degrees, the validation is to be made by potentiometers or from software, according to the basic position of your antenna to be South or North. In case you decide to validate by potentiometer, then the procedure is as follows: Turn the antenna to end position or near to it. Adjust the value on the display which belongs to full rotation (180 or 360 degrees) by P1 potentiometer. Direct the basic bearing exactly (South or North) than adjust the value which belongs to the basic position (0 or 360 degree) on the display, using P3 potentiometer. Then rotate the antenna again by 360 degrees and adjust the 180 or 360 degree value once more by P1 on the display. The procedure is similar in case of elevation.(Use P2 instead of P1 and P4 instead of P3.) It's more simple when we validate by software. This case set 4.5 V on point 2 of H7 and H8 connectors using P1 and P2 potentiometers, in case we use 5V as a reference voltage, 4.0 V for PIC18F26K22 and 3.3 V when we put the fitting reference regulator. Position of P3 and P4 is not important these van even be omitted from PCB.

Since the validation by software requires communication between the rotator and the computer, it is to be adjusted first. The first step is to configure USB port. When you connect this rotator to the PC, you must install the driver for USB from file mchpcdc.inf. You need a communication program like the Hyperterminal for Windows XP (Linux, W7, etc.)
When you can communicate with XPORT then validation can be made as follows:
Turn the antenna into basic position –exactly to the South or to the North and adjust elevation to zero degree. Using the terminal program send the command O2 (enter) or O (enter) if you want to validate azimuth only. (G command for elevation only.) Rotator answer with question: "Are you sure?". You must answer with command Y. If you sent the correct command then the "Offset Value For Azimuth & Elevation Is Set" answer arrives. Then turn the antenna around and adjust the South or North direction exactly and elevation to 90 degrees i.e. the antenna points straight up to the sky. Send F2 command, or F only to azimuth. (J command for elevation only.) Rotator answer with question: "Are you sure?". You must answer with command Y. If the command was correct then you are to get the "Full Scale Value For Azimuth & Elevation Is Set" answer. Values are stored in the EEPROM memory of the microprocessor. With this you finished the validation of your rotator. Using P command you may rotate the antenna into a predefined direction –which can be your favorite direction or which is to be used for wind protection. The Paaa eee command turns the antenna into the required direction. In this case the values of aaa and eee will be stored in the EEPROM. Afterwards it is enough to issue a P command and the antenna will turn into required direction. Beside this you can use the P? command, which calls for the stored values or the P! command, which saves the actual antenna position into the EEPROM. Operation of the system may be checked by M, K ,A, U, D, E, L, R, P and S. (See below!) Each command must be terminated by the ENTER key.

Commands:

H Help
R Clockwise Rotation
L Counter Clockwise
A CW/CCW Rotation Stop

U Up Direction Rotation
D Down Direction Rotation
E Up/Down Direction Rotation Stop
B Elevation Antenna Direction Value
C Antenna Direction Value
C2 Antenna Direction Value AZ, EL
M Antenna Direction Setting In Azimuth Maaa
K Antenna Direction Setting In Elevation Keee
S All Stop
P Parking to Paaa eee
G Offset Calibration in Elevation
O Offset Calibration in Azimuth
O2 Offset Calibration AZ, EL
J Full Scale Calibration in Elevation
F Full Scale Calibration in Azimuth
F2 Full Scale Calibration in AZ, EL
W Antenna Direction Setting Waaa eee
Z Switch N Center / S Center
V Software Version
Q Overturn in ms Qaaa eee

The rotator accepts commands written in CAPITAL LETTERS only! Those commands which were not interpreted the system sends ?> as an answer. Each command is to be terminated by ENTER ($0D) key. Time difference between each keystroke must be not more than 3 seconds.

These commands are compatible with those used by YAESU for GS232B rotator. We did not use every command but we use commands which are not used by YAESU although they may be useful in everyday life.

Connections:
J1 - power supply (24V=)
H1 - OFFSET – the basic position of the rotator (South or North)
H2 - elevation 90 or 180°
H3 - TEST – data display sent on the serial port
H4 - validation by trimmers or by software
H5 - speed
H6 - serial port with TTL level
H7 - LCD display
H8 - USB port
H9 - relays 5/24V
H10 - LED display
H11 - actuator for elevation
H12 - actuator for azimuth

Abstract

This command unit was manufactured for my own rotator design with the purpose to handle using a computer. Of course the unit can be used with any kind of rotator which feeds back its heading by potentiometer and which is powered with 24 V DC motor.

The software of my control unit can be found on my website (http://www.om3bc.com/). You can find on this site a software named rotorx which uses data coming from WSJT software and rotates the antenna to the direction of the Moon. The file containing the software is to be extracted and to be copied into WSJT folder.
In case of a problem you can reach me at om3bc@geniusnet.sk

Attachments:
Schematic
PCB
Assembly
LCD schematic
LCD PCB
LCD assembly
LED schematic
LED PCB
LED assembly
Firmware