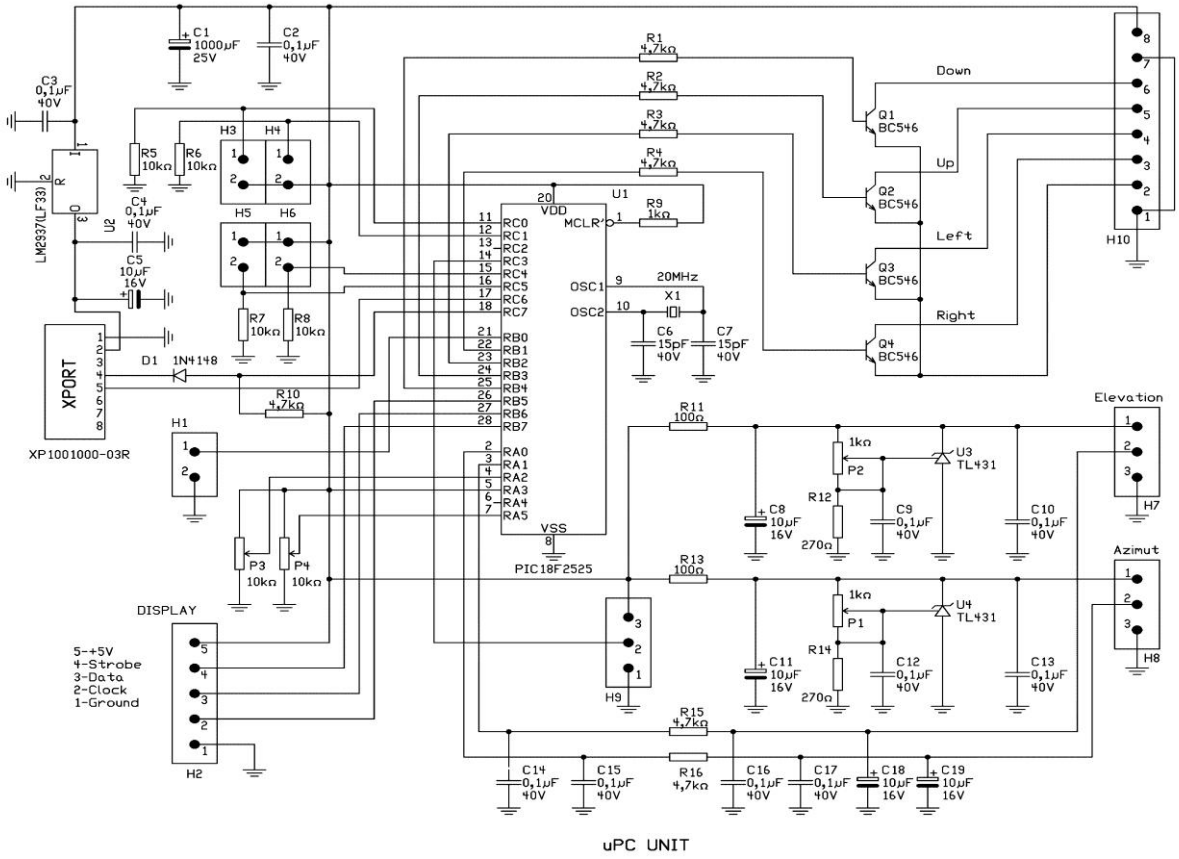
Antenna Rotator with Electronic Control and Display

Development of personal computers is heading into direction where the classic interfaces like COM and LPT disappear. Only USB ports are found on newer machines. A possible solution could be a USB-COM adapter. Thinking of the future I have decided to develop my own circuits so that they could be used for a longer time, so the Ethernet interface was chosen. All the latest computers are equipped with Ethernet connections and it seems to me that will be the case for a long while. This solution makes it possible to control the rotator from a distant place – even from any place on Earth where Internet can be reached.



Control unit

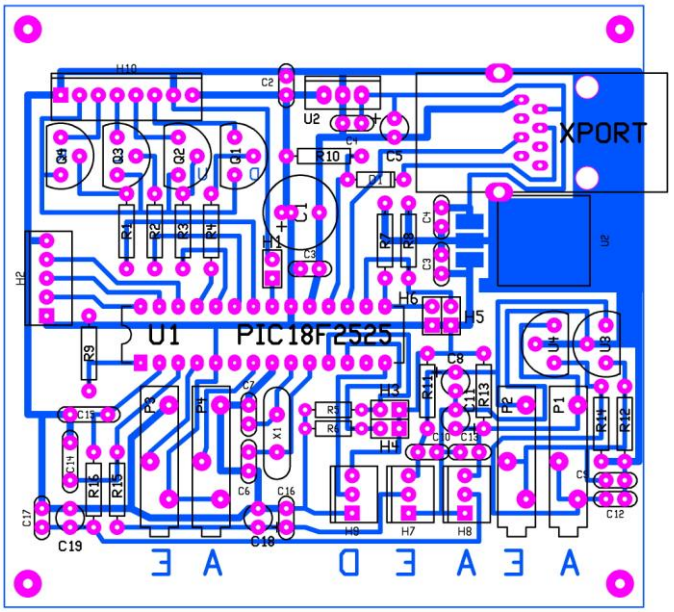
Operation

To make the development of the control unit and its software faster I have used a factory built ETH-COM adapter from a company called Lantronix, namely the XP1001000-03R

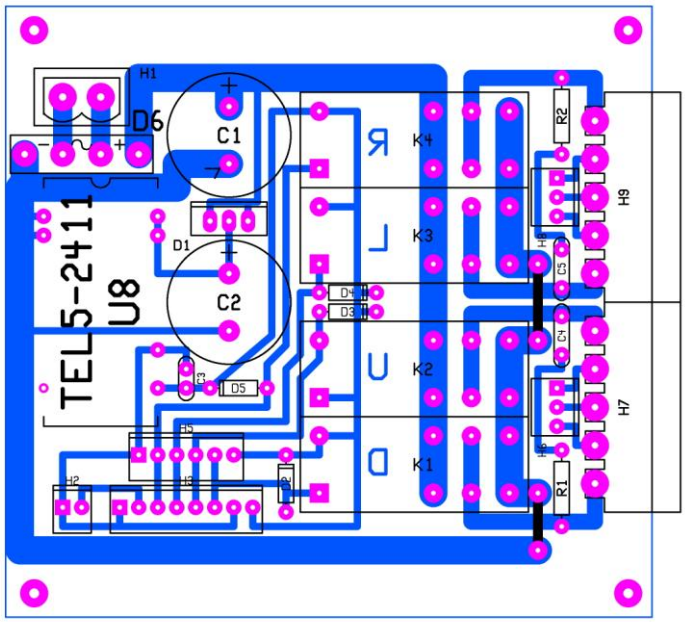
(XP1001000-04R is also usable). This adapter fits the purpose perfectly since it is configurable through a web interface and has serial port for interfacing with the microprocessor.

Construction

The size of both PCBs is 87 by 80 mm and is not too complex. They contain simple components so their assembly takes no more than a few minutes. It is necessary to mount a heat sink with a minimum size of 25 cm^2 on the main voltage regulator. It is advisable to use the microprocessor in a socket in the interest of the additional development. The 3.3 V regulator – which feeds the XPORT – may be either a LF33 in the classic TO220 package or an LM2937 in an SMD D2-PAK. It is necessary to cool the first type but the other which is in SMD package must be mounted onto the bottom side of the PCB where cooling is provided by the copper foil itself so further cooling is not necessary. When all components were soldered except for the microprocessor, voltage regulators may be tested. The main reference voltage regulator is not necessary and the H2 jumper needs to be shorted when it is not in use. On the other hand in this case the precision of display will not be so exact. In case we find voltages right then we set the helipot trimmers into middle position and insert the microprocessor into its socket.



uPC UNIT



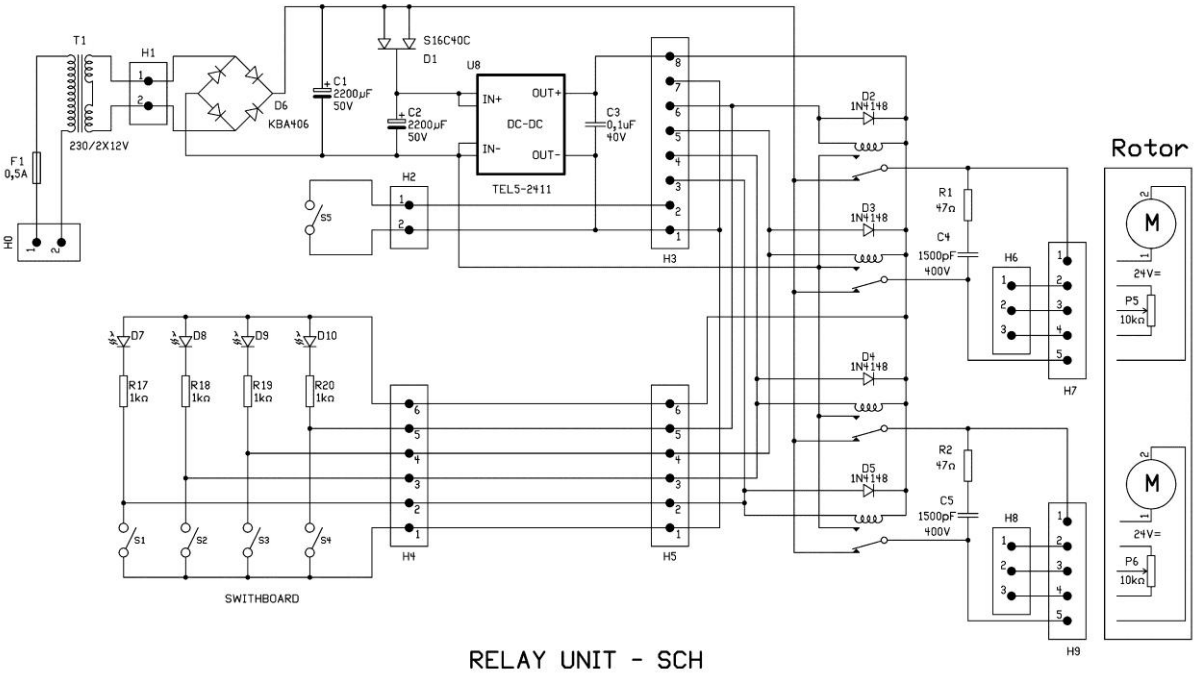
RELAY UNIT

Display

Operation

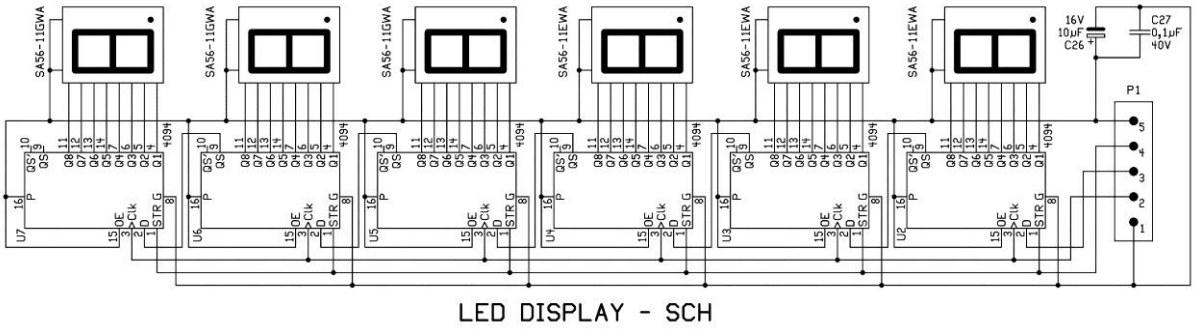
The display is connected to the microprocessor by three data lines applying serial data transfer. The circuit contains six shift registers which transfers the serial data coming from the microprocessor into parallel data for the LED displays. The operation of the display is as follows: Data arriving to the 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 the register output. The advantage of this

method in contrary to the widely used multiplex method is that brightness is much better and the display does not blink as it does when the multiplex method is chosen.

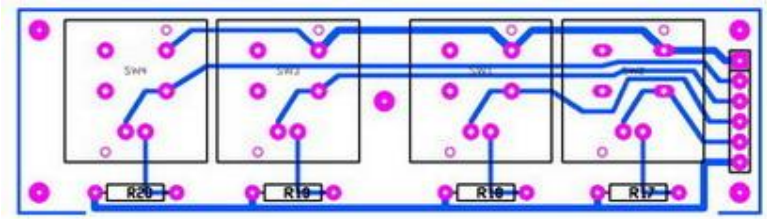


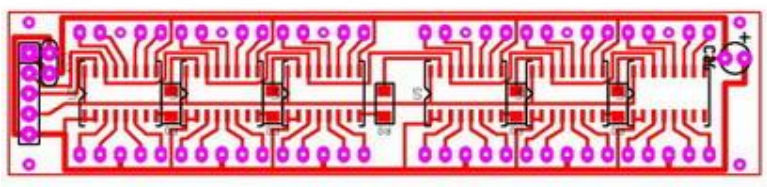
RELAY UNIT - SCH

Construction



LED DISPLAY - SCH





In this case construction of the PCB is a much greater challenge. The drawing of the sheet is more complex and dense compared to the first. In this case I was successful making it using the so called blue foil technology in my home workshop. I guess application of photosensitive sprays like Positiv-20 can not be problematic. Check the PCB thoroughly before soldering because there will be no more chance to repair it under the integrated circuits. The shift registers are to be mounted on the foil side and LEDs are to be

placed on the 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 is up to you what to choose. It is advisable to use high brightness and low consumption types, like SA56-11EWA, SA56-11GWA or S56-11YWA.

Software

The software placed in the microprocessor provides communication with the XPORT and displays antenna position. Since the microprocessor has free inputs, these are used for the configuration of the software. There are six jumpers on the board. The use of these is as follows:
H1: validation by trimmers or by software
H2: reference voltage by an additional regulator
H3: TEST – data display sent on the serial port
H4: spare
H5: FLIP – elevation 90° or 180°
H6: OFFSET – the base position of the rotator (South or North)

Guidelines for adjustments

As the first step you have to set the jumpers according to the elevation rotation to be 90° or 180°. The validation is made by potentiometers or from software, according to the base position of your antenna to be South or North. In case you decide to validate by potentiometer (e.g. we do not intend to turn the antenna by computer – there is no need for the XPORT and its surrounding components), then the procedure is as follows: Turn the antenna to or near to its end position. With the potentiometer P1 adjust the value belonging to the end position (180° or 360°). Turn the antenna back to its base position and rotate it physically into the chosen direction (South or North). With the potentiometer P3 adjust the value belonging to the base position (180° or 0°). Rotate the antenna by 360° and with the potentiometer P1 adjust again the value belonging to the end position (180° or 360°). The procedure is similar for the elevation, but use P2 instead of P1 and P4 instead of P3. It is simpler if you use validation by software. In this case set 4.5 V on point 1 of H7 and H8 (uPC UNIT) connectors using P1 and P2 potentiometers. 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 set up first. The first step is to configure the XPORT. For this we use the application called DeviceInstaller which can be downloaded free of charge from the manufacturer's website (http://ltxfaq.custhelp.com/app/answers/detail/a_id/644). Using this application you can set XPORT IP-address and port number, the communication speed between XPORT and the microprocessor (e.g. 9600 bps) and other parameters if required.

You need a communication program like the HyperTerminal for Windows XP which can communicate directly with the Ethernet port. In case you are using different software or you are intended to rotate your antenna using software which can only communicate on serial port, then you need to redirect the serial port by other software like the CPR (Com Port Redirector) which can also be downloaded from the website of Lantronix.

When you can communicate with the XPORT then validation can be made as follows:

Turn the antenna into basic position, i.e. South or North exactly and adjust elevation to 0 degree. Issue an O2 (Enter) command in a terminal program, or O (Enter) when we want to validate azimuth only. (Issue a G command if you want adjust elevation.) In case we gave the right command, then the controller will put the question "Are you sure?" and waits for a Y command as a confirmation. When we did it we will get an answer: ""Offset Value For Azimuth And Elevation Is Set. Then make a full rotation with the antenna and point exactly the North or the South, adjust 90 or 180 degrees elevation, according to the usage of FLIP function. Issue F2 (Enter) command or F (Enter) for azimuth only. (In case of elevation only, use the J command). For the "Are you sure?" question appears again. It can be confirmed by Y. If the rotator meant the command then we will get the "Full Scale Value For Azimuth & Elevation Is Set" answer. Then validation of our antenna rotator is complete.

Using command P 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 command P and the antenna will turn into the previously set direction. Beside this you can use the command P? which sends the stored values or the command P! which saves the actual antenna position into the EEPROM. Operation of the system may be checked by commands M, K, A, U, D, E, L, R, P and S. (See below!) Each command must be terminated by the ENTER key. Exception is the command S command which is accepted immediately.

Commands:

H Help
C Clockwise Rotation
L Counter Clockwise Rotation
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
aaa Is An Value For The Azimuth
eee Is An Value For The Elevation

The rotator accepts commands written in CAPITAL LETTERS only! The not interpreted commands are answered with the ?> character sequence. Each command is to be terminated by the Enter ($0D) key. Time delay between each keystroke must be no more than 3 seconds.

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

Abstract

This control unit was created for my own rotator design with the purpose of being controlled using a computer. Of course the unit can be used with any kind of rotator which has potentiometer feedback and is powered with 24 V DC motor.

The software of my control unit can be found on my website (http://www.om3bc.com/). There you can find software called EthRot which uses data coming from WSJT software and rotates the antenna to the direction of the Moon. The contents of the compressed file needs to be copied into WSJT folder – or direct azel.dat file into EthRot folder in WSJT Options menu. The IP address and port number given for XPORT have to be set in EthRot.cfg file.

In case of problems you can reach me at om3bc@geniusnet.sk

Attachments:

Schematic uPC, schematic RELAY, schematic LED
PCB1 PCB2 PCB3 PCB4
Assemply1 Assembly2 Assembly3 Assembly4

Post Script:
If anyone chooses the traditional serial port and the usage of a USB-COM adapter then he/she needs to change only the PCB 1. All the other parts are unchanged including the software of the microprocessor.
This version of this antenna control unit can be found here: Schematic PCB Assembly