Fox Delta

Amateur Radio Projects & Kits

FD- ST3

Tech Info Document: PIC16F84A LCD Satellite Antenna Tracking Interface

Preview:

When ST1 was made available in kits, hundreds of Radio Amateurs took interest. Project proved successful because it provided COM as well as USB interface.

However, many Radio Amateurs wanted some way to "see" where the antenna is and wanted to know effect of Software Running on their PC to get a clear idea as to the position of the Satellite antenna.

Soon I started working on that line & build this little, bit more complex interface, having an LCD display. In this project, I am using Firmware by DL7AOL who has offered it to radio amateurs for free (non commercial use).

ST3 has a 2 line by 16 Character LCD display. This interface addresses following basic points:

1. **Full range of elevations from 0° to 180°**

2. **Compatible with Kenpro/Yaesu rotor controllers**

3. Serial data input with open data protocol(s)

4. Data protocol in readable in ASCII character format so that use of terminal software for rotor control and diagnostic purposes is possible

5. Continuous display of actual rotor position, more precisely than the Yaesu controller does

6. Display of tracking data from computer to enable comparison of actual antenna position and required position

7. Very Economical design even with 12bit A/D, LCD and high quality double sided PTH Boards

8. Measures only 10cm x 5cm and uses two R/A D9 Connectors.

Introduction to Satellite Antenna Tracking:

In view to encourage radio amateurs and schools, to develop an activity that brings space technology at affordable cost, I decided to look for suitable hardware & firmware for an interface for tracking satellite antennas for communication with ISS or other orbiting satellites.

One part of this activity, which might interest to all of us, is ham radio contact with astronauts on board the International Space Station (ISS) through a program called Amateur Radio in the International Space Station (ARISS). (The application for an ARISS contact and other relevant information about ARISS can be found at: http://www.arrl.org/ARISS/)

Satellite communication is projected as an expensive hobby by many. Those who buy expensive equipment to show-off their booty further dilute the charm of operation. However, with some home brewing efforts by amateurs, it's a low cost project with excellent results.

Station Setup for Space Communication:

There are specific station equipment requirements stipulated to qualify for an ARISS contact. A typical ARISS ground station would include:

1. **A 2-meter FM transceiver with 25-100 watts of output power.**
2. **A circularly polarized crossed-Yagi antenna capable of being pointed in both azimuth (N-S-E-W) and elevation (degrees above the horizon) is desirable.**
3. **A suitable Satellite Tracking Software (Freeware or Purchased)**
4. **A PC and an interface suitable for software used.**

Pointing of Satellite Antenna:

Automatic pointing of satellite antennas helps to improve signal quality while working with satellites and also frees the operator to focus on the satellite contact. There are three components in an automatic pointing system; azimuth (AZ) and elevation (EL) rotors, satellite track software loaded on a computer that calculates where the antennas should be pointed in space, and an interface that connects the rotors to the computer.

Rotors are slow motion motors that turn the antenna around the compass horizon (AZ) and above the horizon (EL). Two of the few commercially available rotor systems are the Yeasu G5500 and G5400 rotors

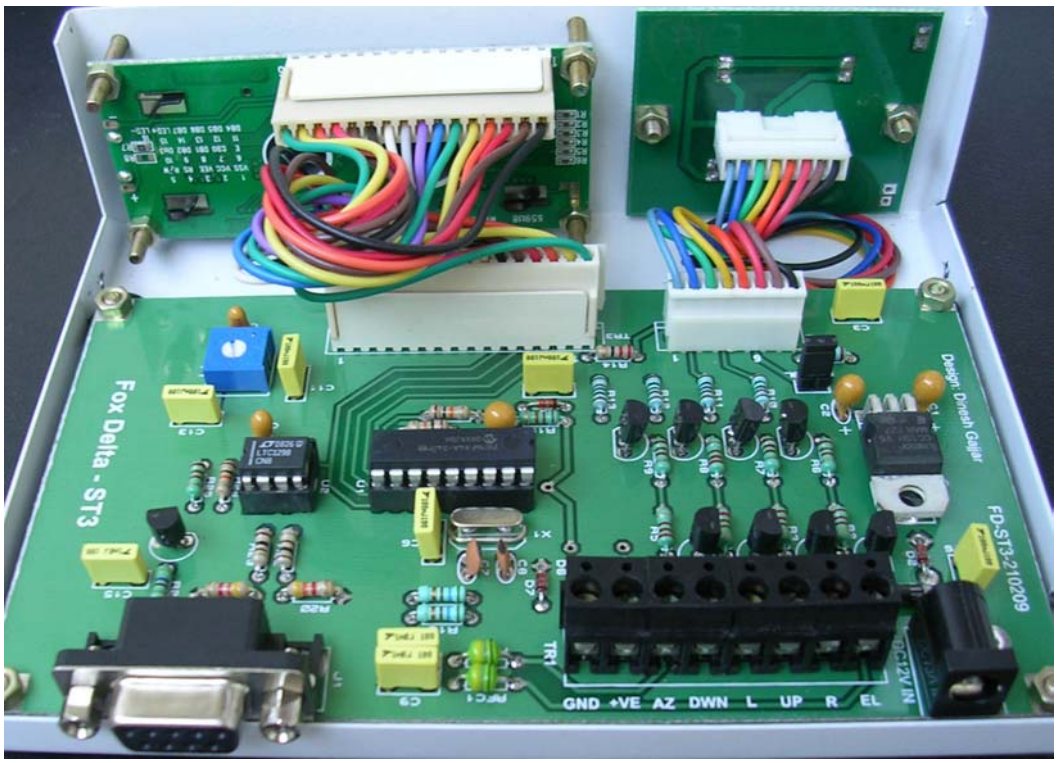
The Satellite Antenna Tracking Interface ST3 detailed here is targeted to interface Yaesu rotators to your favorite software running on your PC thru COM port. (may support USB to COM cables too)

ST3: PIC16F84A Satellite Antenna Tracking Interface:

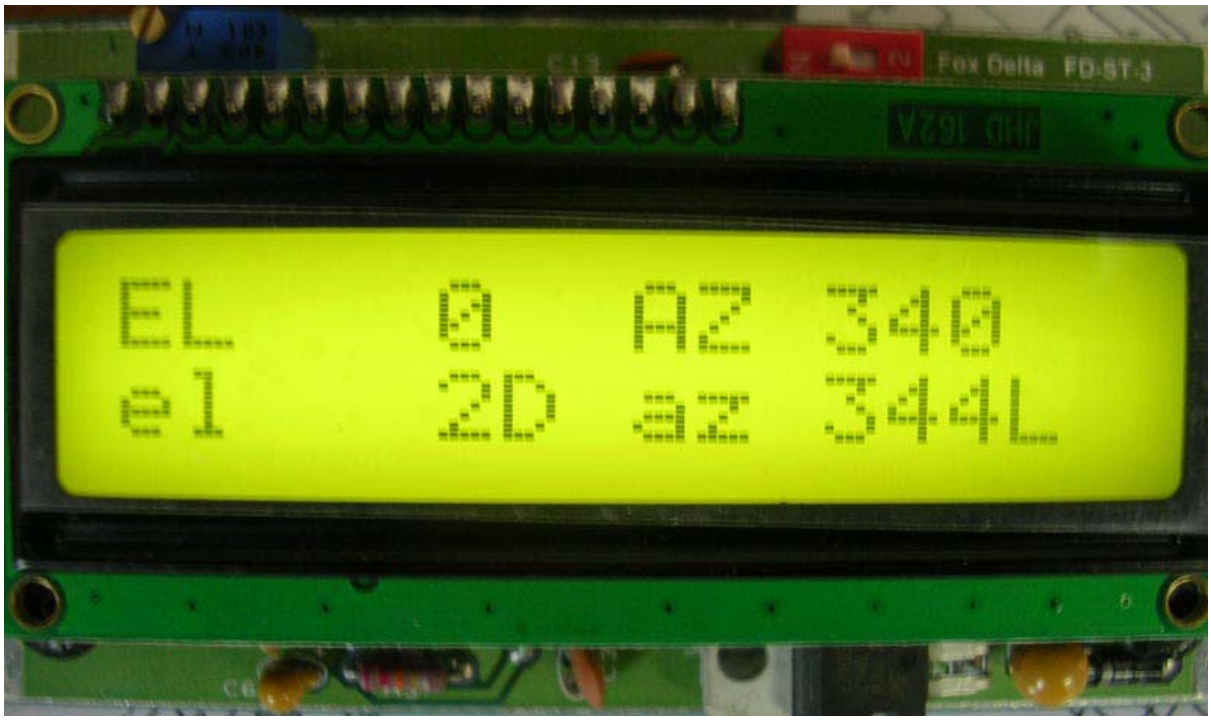
The ST3 interface is based on a PIC16F84A that is programmed to interpret satellite position data in EASYCOM & GS232 format sent by the satellite tracking software running on your PC, to control rotor motors.

Interface handles two basic servers: Easycom & Yaesu-GS232 at 19200bps. On my test bench, I tested it with SatPC32 configured for Yeasu GS-232 Server.

Completed ST3 interface:



Operating ST3 with SatPC32 program with GS-232 Server:



Top line indicates where antenna must, decided by Satellite Tracking Software running on your PC. Second line displays actual position of your antenna.

Any difference between two will activate the related output transistors to move the antenna to the required position.

PIC Firmware:

Firmware for PIC16F84A is ST3.hex.

PC to Rotator Interface Hardware:

Interface is designed on double sided PTH board measuring 5cm x 10cm. A D9F (Female) connector on ST3 connects to your PC's COM port. A simple one transistor level converter is used, which accepts RS232 levels & converts into TTL levels, required by the PIC.

Interface Power:

Power for interface is received from Yaesu Rotor. A 5V 1A regulator (7805) is used to covert rotor supply of 12-15V to 5V DC for this interface. Larger regulator is used keeping in view the current required by Back Light of LCD Display. If you do not want back light, you may use 78L05 regulator instead of 7805.

Rotor Control:

4 NPN transistors (BC547B or any GP NPN) are used to drive rotor motors (thru Yaesu rotor controller). The software running on your PC sends instructions to ST3, which is translated by the firmware residing inside the PIC on ST3. Processor then directs appropriate transistor switch to activate rotor movement.

In revised 210209 Boards, 4 more transistors are added to display status of movement on front panel. ST3 kits & assembled are now supplied with a free metal case. This new version also uses LT1298 in DIP8 package.

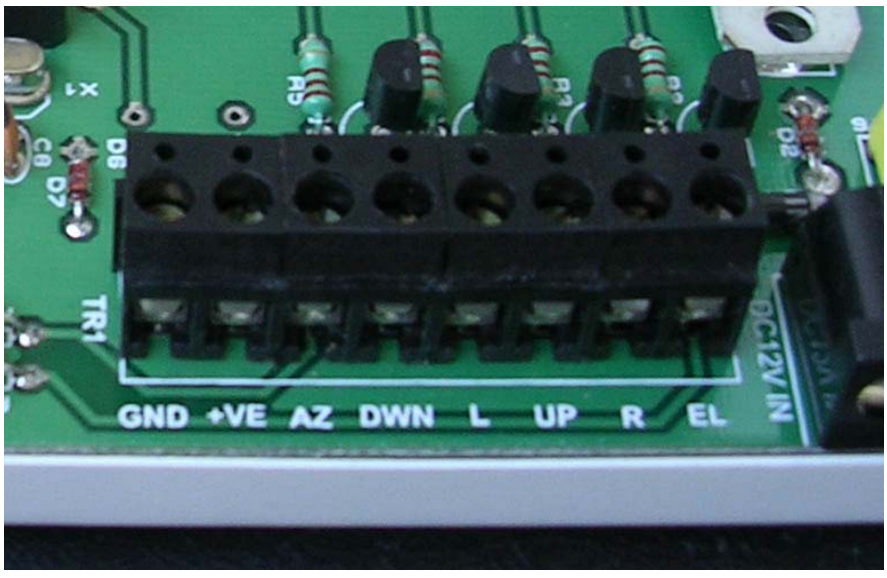
Rotor Interface Connections:

A D9M (Male) type connector is used to take interface connections to rotor's "Ext. Connections" DIN8 socket. You will have to make a suitable cable with DIN8 male at one end and D9F at the other end to connect ST3 to Yaesu Rotor Controller.

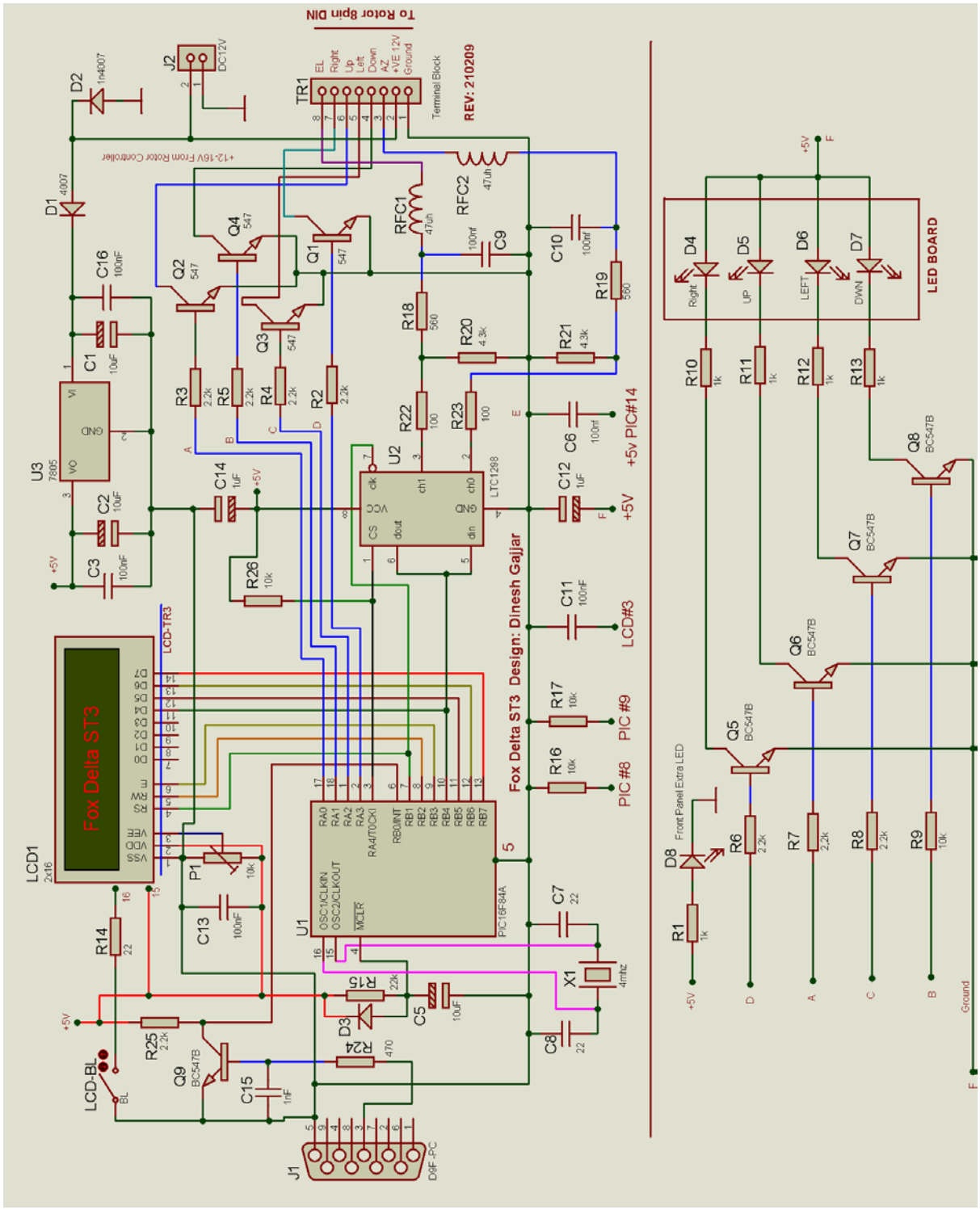
Details of 8Pin Terminal connector TR3 for Rotor Connection:

From Left to Right:

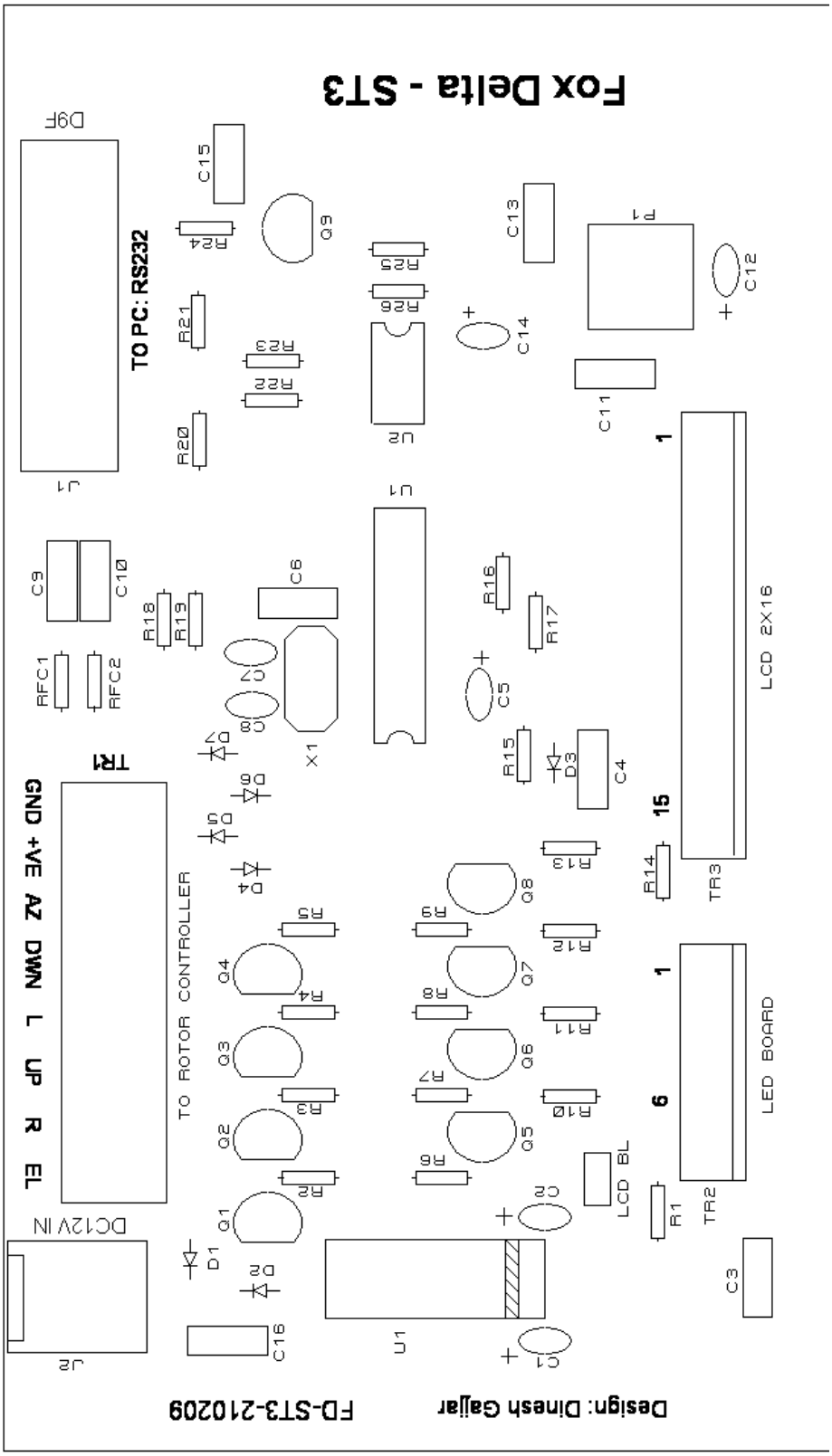
1. **Ground**
2. **+12V From Rotor Controller**
3. **AZ (Position voltages from Rotor Pots)**
4. **Down**
5. **Left**
6. **Up**
7. **Right**
8. **EL (Position voltages from rotor Pots)**



ST3: Satellite Antenna Tracking Interface Schematic:



Silk Snap of Satellite Tracker & Rotor Controller Board:



73s/Dinesh Gajjar / 4th March 2009

For more details, please visit Project Page: http://www.foxdelta.com