Fox Delta

Amateur Radio Projects & Kits

FD- ST1

Schematic & Parts List: PIC16F688 Satellite Tracker & Rotor Controller

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.

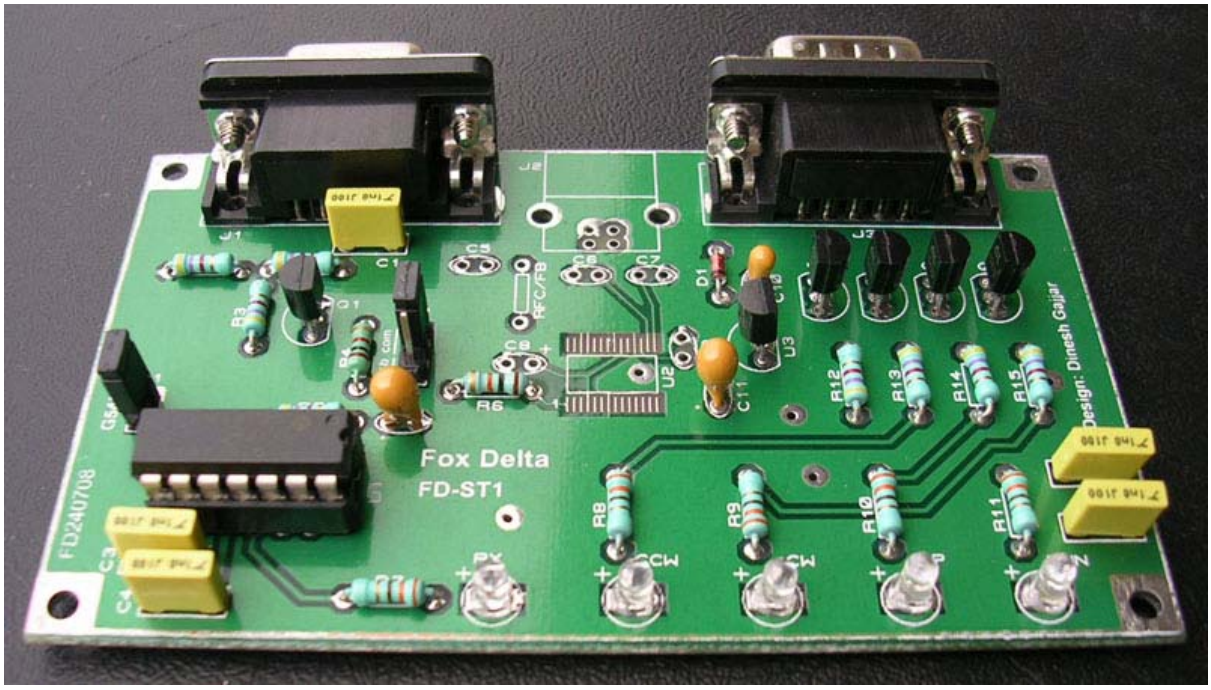
Rotors are slow motion motors that turn the antenna around the compass horizon (AZ) and above the horizon (EL). Two of the few commercially available rotor systems are the Yeasu G5500 and G5400 rotors

The Satellite Antenna Tracking Interface ST1 detailed here is targeted to interface Yaesu rotators to your favorite software running on your PC thru COM or USB port.

ST1 PIC16F688 Satellite Antenna Tracking Interface:

The ST1 interface is based on a PIC16F688 that is programmed to interpret satellite position data in EASYCOM format sent by the satellite tracking software and control rotor motors. The ST1 can be set up through jumper connections to work with both the G5500 and G5400 rotors as well as serial or USB computer connections. The interface has been tested and verified to work with NOVA and SatPC32 software.

Picture of the completed ST1 interface:



PIC Firmware:

Firmware for PIC16F688 is developed by Mark Spencer/WA8SME.

PC to Rotator Interface Hardware:

Interface is designed on double sided PTH board measuring 6cm x 10cm. Interface may be connected to your PC thru a COM port of USB port. PCB has both options but if you are buying kits or assembled units, you may order what is required for your PC.

For COM port interface a simple one transistor level converter is used which accepts RS232 levels & converts into TTL levels, required by the PIC.

For USB, an FTDI232 chip is used. You will require FTDI chip drivers installed on your PC for this interface to work properly. Drivers may be downloaded from FTDI website. Basically, this is a virtual COM port chip, which will create a COM port on your PC but communicates thru your USB port.

Interface Power:

Power for interface is received from Yaesu Rotor. A 5V 100ma regulator (78L05) is used to covert rotor supply of 12-15V to 5V DC for this interface.

Rotor Control:

4 NPN transistors are used to drive rotor motors. The software running on your PC, translated by the firmware on Interface board PIC and executed thru transistors will initiate commands for rotor movement. LED indication of all four transistors' operation is available on front panel. In addition, Received data (From COM or USB) LED is also provided on front panel.

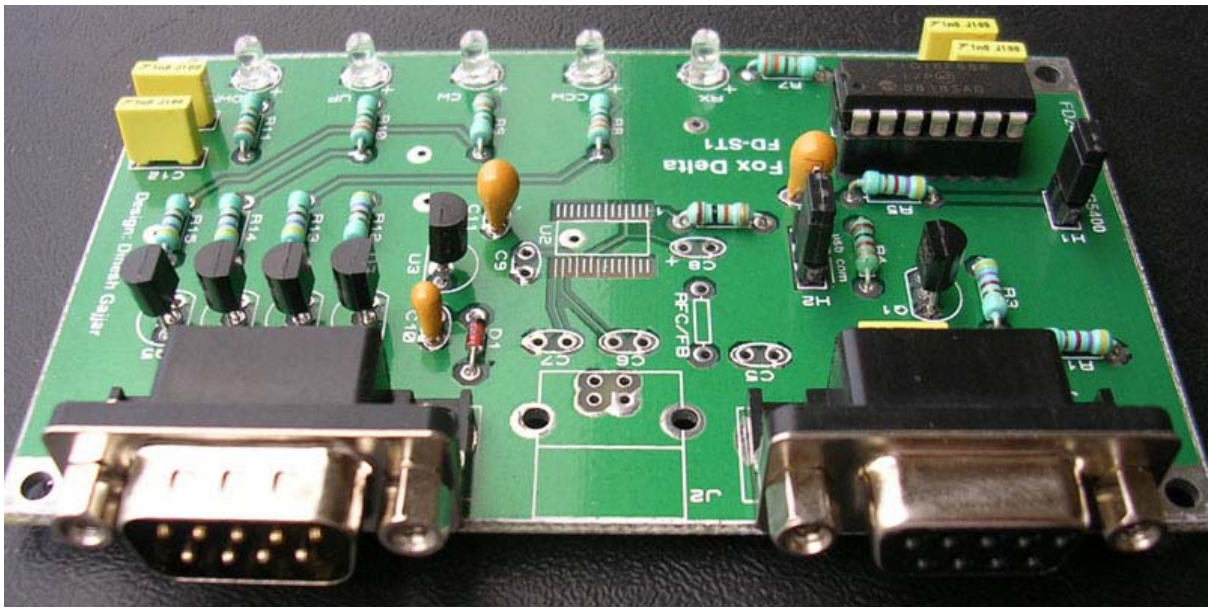
Rotor Connections:

A D9M 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.

Details of D9M connections at the back of ST1:

1. EL ADC
2. CW
3. UP
4. CCW
5. DWN
6. AZ ADC
7. +12V from Rotor
8. GND
9. GND

Picture of the ST1 from Connector Side:



Header Selection:

Two headers are provided for configuration of this interface.

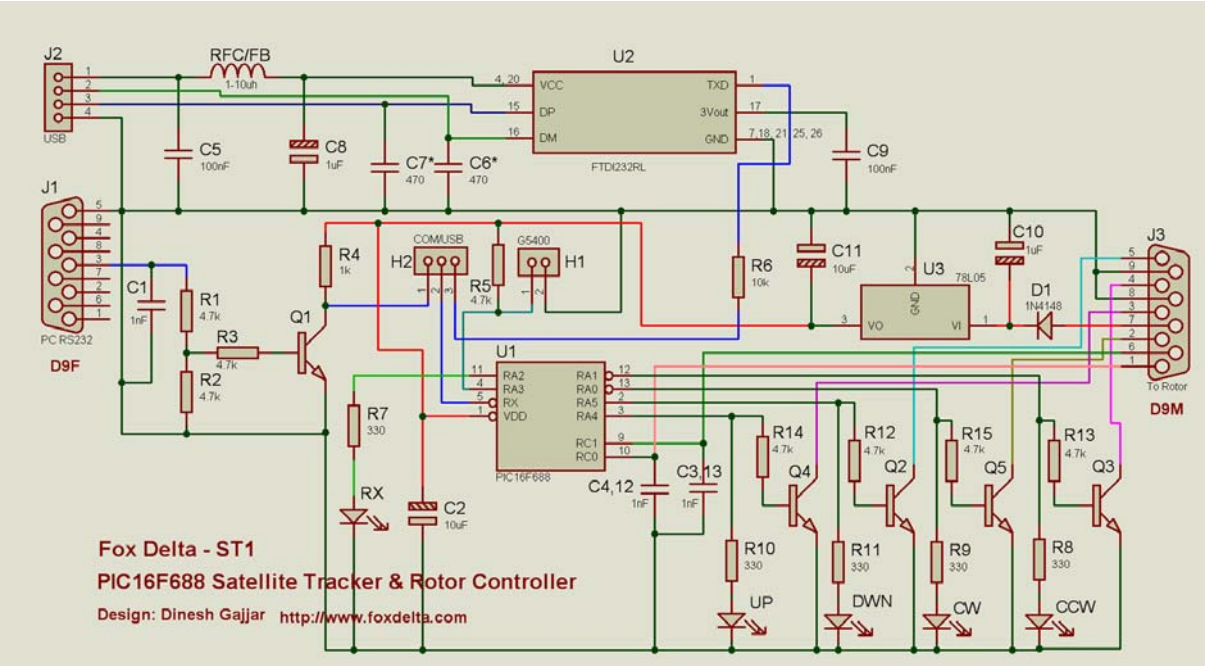
H1: A shorting pin on this header will enable support for G5400

H2: Selects between RS232 and USB

Connections to Rotor may be made by: (Not supplied with kit)

You will be required to make a suitable cable (10core shielded) with D9F at one end & DIN8 Male at the other end. Both plugs are supplied with kit.

ST1: Satellite Antenna Tracking Interface Schematic:

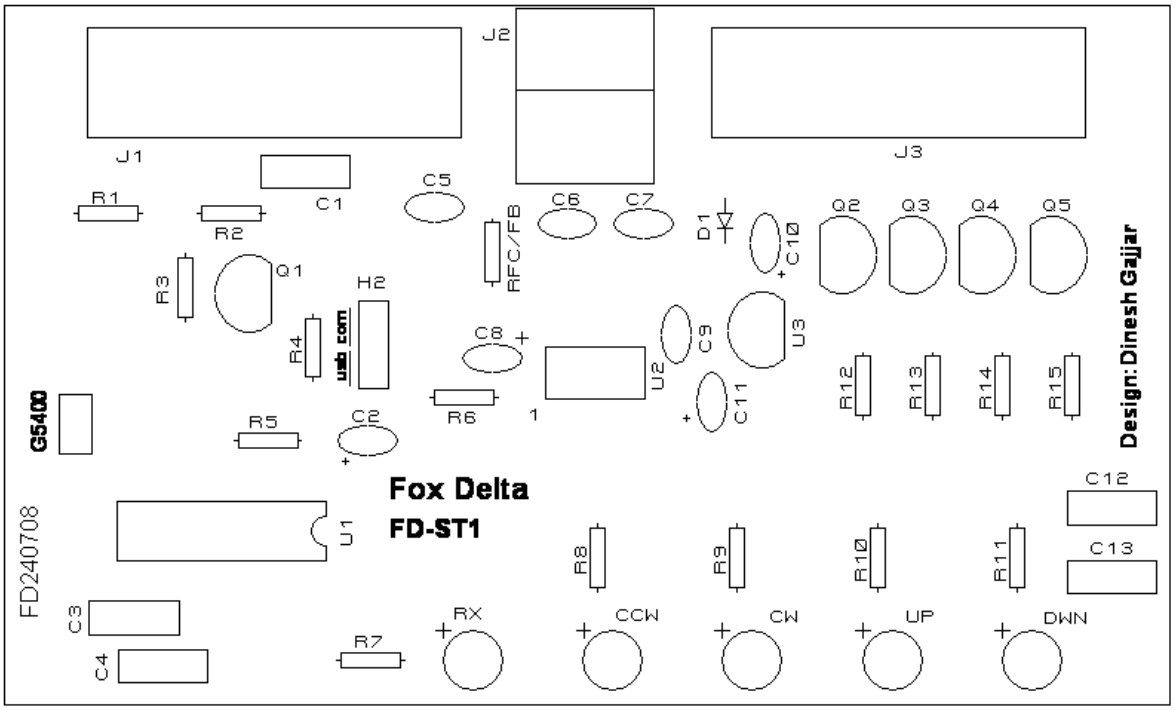


ST1 Kit Parts List: (Parts for USB kit are marked *)

8	R1, 2, 3, 5, 12,13,14,15	4.7k	1	PIC16F688 with Firmware: U1
1	R4	1k	5	BC547B Transistors (Q1 to Q5)
5	R7-11	330	1	1N4148 Diode (D1)
1	R6	10k	1	14pin IC Socket for U1
5	C1, 3, 4, 12, 13	1000pf Poly	1*	USB B Type PCB Connector
2*	C6*, 7*,	470pf Cer.	5	3mm LEDs
1*	C5*	0.1uf Cer.	1	78L05 (U3)
2	C11, 2	10uf Tan	1*	FTDI- FT232RL 28 SOIC (U2)
1	C10	1uf Tan	1	D9-F-RA
			1	D9-M-RA
1*	RFC/FB*	10uh RFC	2+2	3 & 2 Pin Headers + Shorting Pins
1	D9F Connector	For Rotor Connection	1	DIN8 Male (Plug) For Rotor Controller Connection

*= Parts for USB version. **=Not supplied with kit. (A Jumper is required at FB1 & 2)

Silk Snap of Satellite Tracker & Rotor Controller Board:



73s/Dinesh Gajjar / Last Revised 17th August 2008

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