



Fox Delta

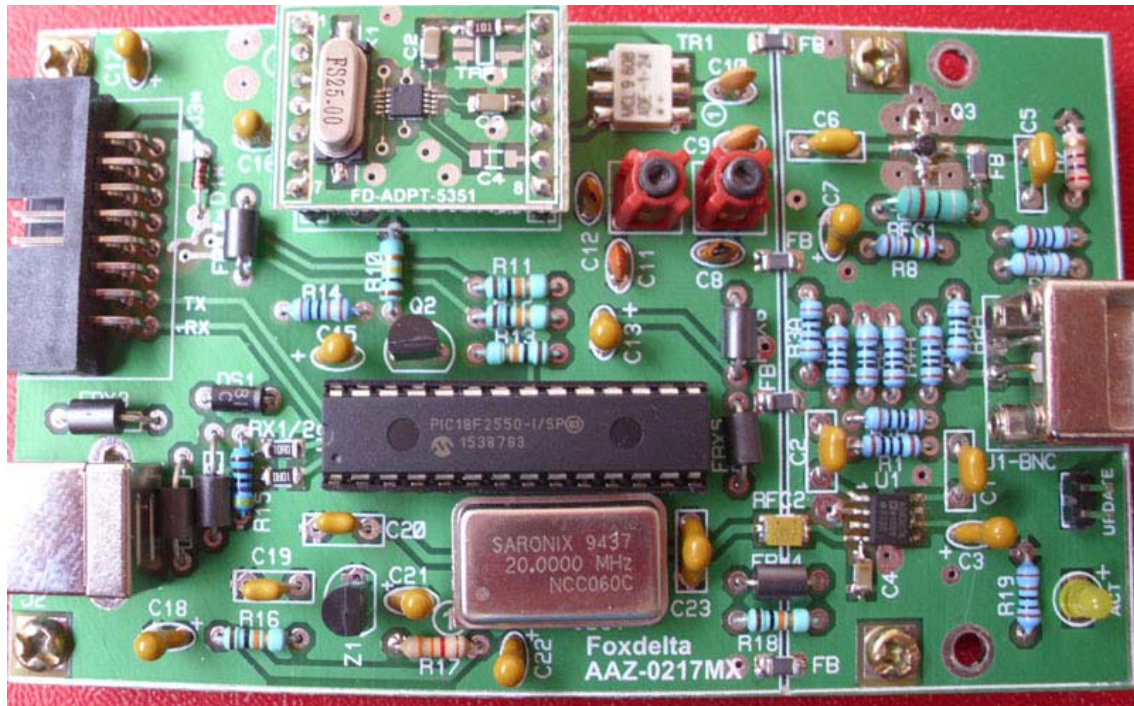
Amateur Radio Projects & Kits

FD- AAZ-0217MX

Project Tech Info Doc: 1 - 60MHZ HF PIC18F2550 USB Antenna Analyzer

AAZ- 0217MX KIT: (MX stands for "Mixer" Type)

1 - 60MHZ USB Antenna Analyzer

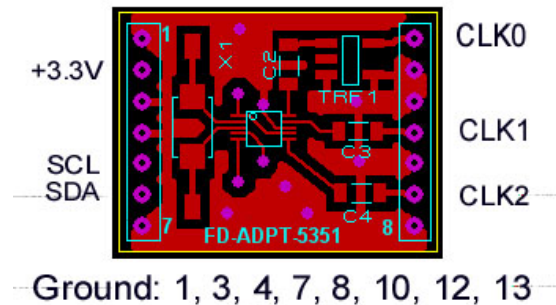


Si5351 Assembly: M1

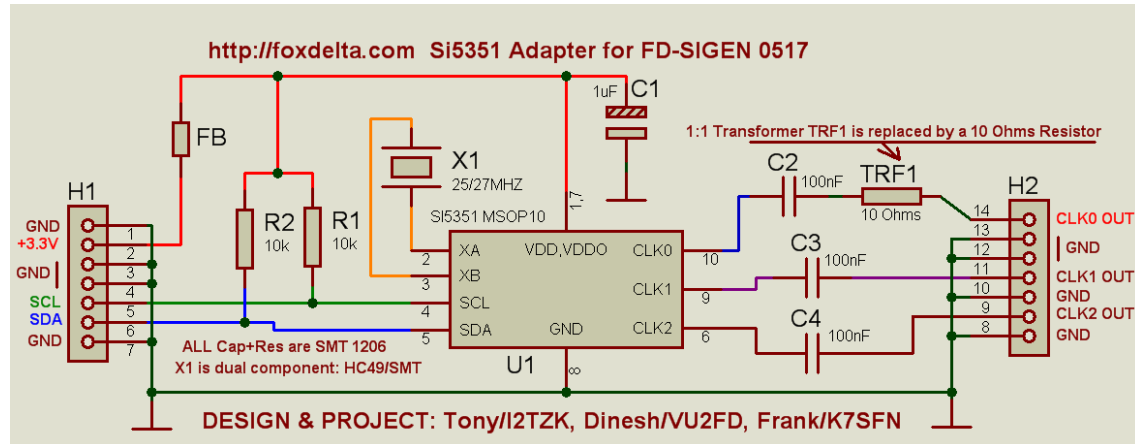
PINOUT details of M1:



Foxdelta Si5351 Module



Schematic: Module M1



AAZ-0217MX: Project Info:

Revision of our USB analyzer project (From [AAZ-0616](#)) became a necessity, as we wanted to replace DDS chips, which became difficult to obtain and getting more and more expensive.

Alternative to DDS chips selected (AD9850/51) is an economical Silicon Lab chip called Si5351.

Si5351 is a tiny 10 pin MSOP chip, rated to output 3 clock signals from 1 to 160MHZ (and beyond). Since soldering of DDS chips was always a painful job but unavoidable, we decided to go for Si5351, which has only 10pins to solder. After discussing this with Tony/I2TZK who showed great interest in this project, we decided to go ahead with new hardware using this chips.

As Si5351 is a good alternative but there are some differences from DDS chips:

1. Si5351 outputs square waves (AD9850 has sine wave output)
2. Required re-writing of code as its an I2C device
3. A plug-in module must be made for easy kit building.
4. Works on 3.3V and requires data line level shifting to match PIC running at 5V

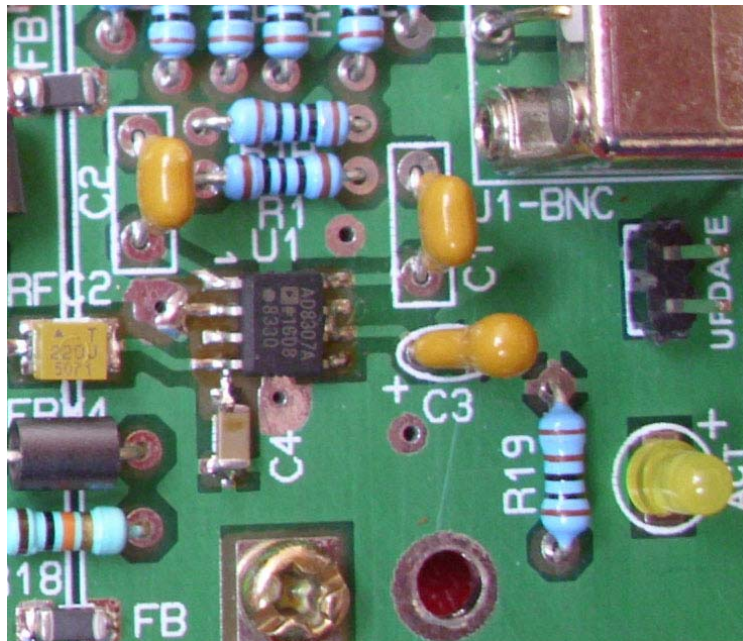
In addition to basic change of Generator chip, some of the changes are implemented in our this AAZ-0217MX version:

1. HC05 Module fits on an FRC16 Socket Firmware will auto activate BT function when this add-on module in plugged into FRC16 socket
2. Dual, auto power select option: PC use or Portable use. AAZ-0217MX may be used as an USB device by connecting USB cable to PC. It may also power Bluetooth module (option)

3. AAZ-0217MX may be powered from external 5V (for field operation) by giving +5V at FRC16 socket. (Future add-on)
4. FRC16 socket has RX/TX, I2C and External +5V IN. **This will facilitate future expansion of this analyzer to be used with any device that requires RX/TX or I2C data lines.**
5. Specified as a **1 to 60MHZ analyzer**. AAZ-0217MX is not intended to generate analyzing freq above 60MHZ. Since VHF Mixing scheme is used to generate 1- 60MHZ analyzing signal, Si5351 chip is already running from 101 to 160MHZ. However, si5351 chips do go up to 200MHZ and you may use this analyzer to 90 or 100MHZ, if LPF permits upper freq to pass through.
6. LPF in AAZ-0217MX is set around 70 - 80MHZ, suppressing all frequencies above 90MHZ and only allow lower portion of band used for analyzing signal at RL Bridge, i.e. below 60MHZ.
7. Firmware and Software for AAZ-0217MX is developed by [Tony/I2TZK](#).
8. PC SW developed by Tony/I2TZK works well with WIN7/XP/10. **Latest dotnet update is essential for your PC's WIN OS.**

Hardware Information:

AAZ-0217MX is a simple single board USB Antenna Analyzer using Si5351 signal generator chip and a return loss bridge, for measurement by a Log Amplifier AD8307.



Above picture: AD8307 and Part of RL Bridge.

Si5351 module data communication:

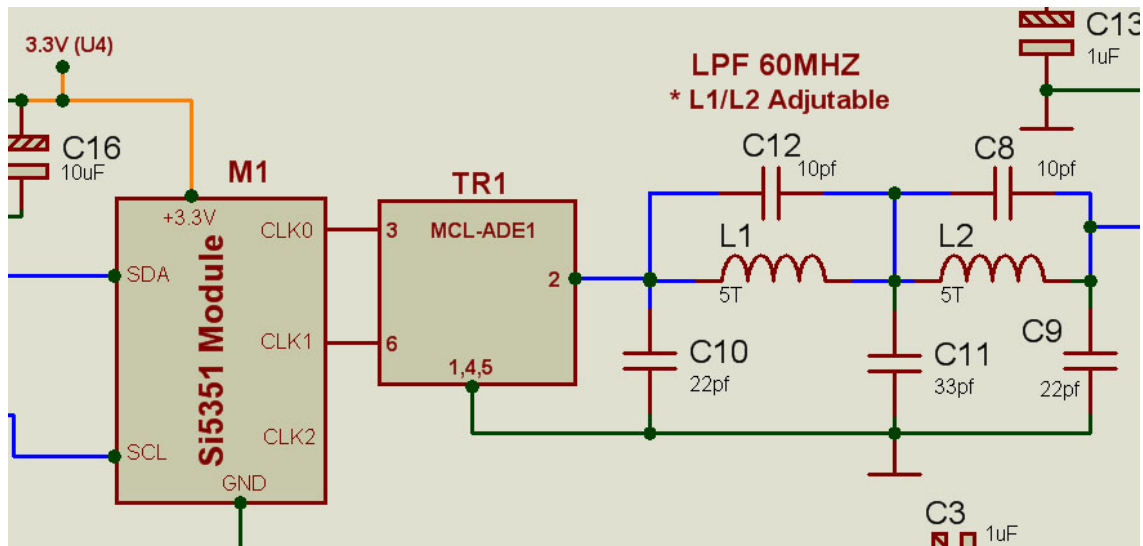
With PIC running at 5V, a level shifting is required for Si5351 (3.3V) Communication. PCA9306 (U3) is used for this purpose.

Si5351 module, under FW V105MX, Generates two independent signals.

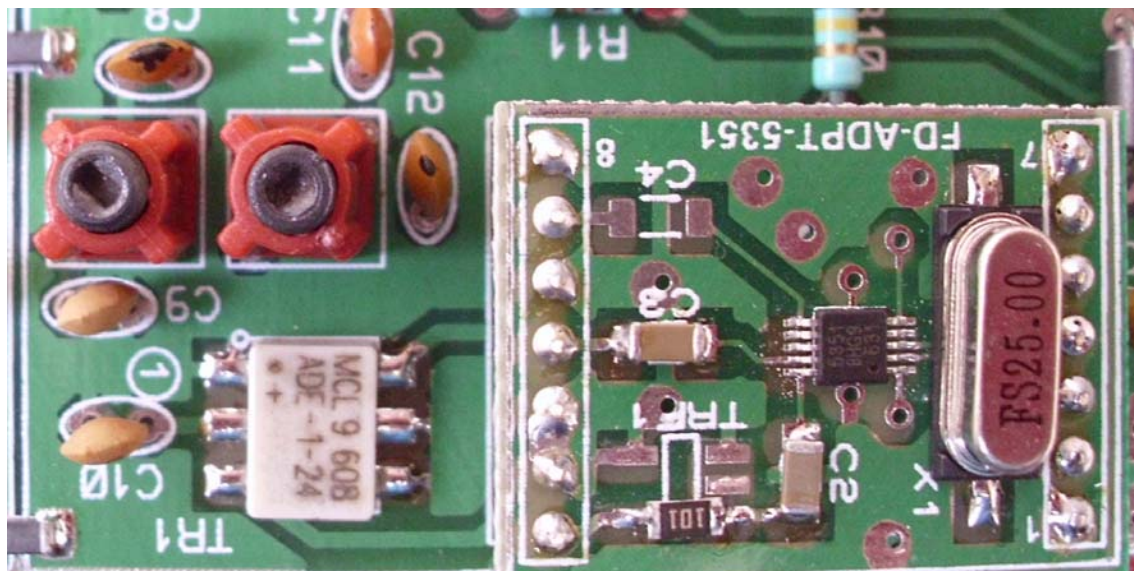
CLK0: 101 to 160MHZ and
CLK1: Fix freq of 100MHZ.

Mixer output: 0 – 60MHZ

Here is a schematic and PCB picture with details of Si5351 Module, ADE1 mixer and LPF.



Two frequencies are mixed in a MCL ADE1 Double Balanced Mixer.



Upper freq (LPF Freq around 70- 80MHZ) are suppressed by Low Pas Filter comprising L1 / L2 and 5 ceramic capacitors.

Lower frequencies i.e. 1 to 60MHZ, are then further amplified by ERA3 Amp and used at RL Bridge for antenna analyzing.

CLK2 of Si5351 is not used in this project

Tunable Inductors: L1/L2

Two Inductors are used in Low Pass Filter and supplied with cores at mid way. Provides good attenuation of harmonics above 60MHZ.

If you desire to use upper most possible range of this analyzer, it may be achieved by modifying LPF components: L1, L2, C9, C10 and C12. In such case, Freq range from 1 to approx 90MHZ is possible for analyzing. LPF must be good to suppress all frequencies above 95MHZ.

3.3V Supply U4:

AMS1117- 3.3 is used to obtain 3.3V from 5V from USB.

Dual Power: AO4405/07

PFET type AO4405/07 is used as a switch to select 5V from USB or 5V from External source at FRC16. External +5V will be needed to run AAZ-0217MX when WIFI Module is added to FRC16. (Future update)

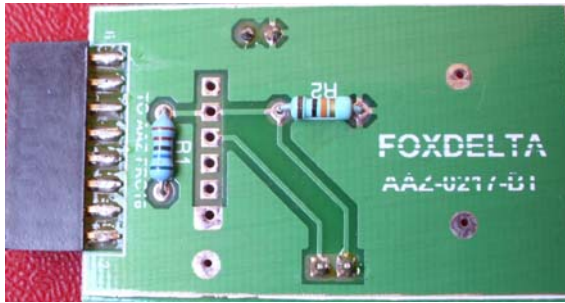
Future ADD-ON Module:

BT Function is realized by using an HC05 module on a FRC Male connector, available as an Option.

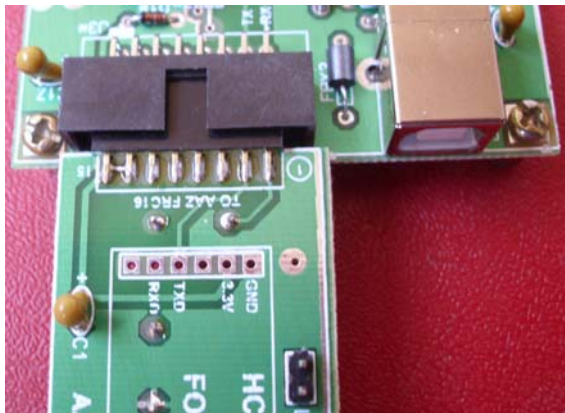


Auto power change and BT activation is implemented in BT adapter. No external power is required for BT add-on as it continues to get power from USB port.

Since BT module HC05 (not part of this kit) is a 3.3V device, two resistors are used to match data line level shift for PIC running at 5V



BOTTOM SIDE



BT module plugged into FRC16 Socket:

Do not install upside down!!

BT add-on PCB with Male FRC16 Connector may be offered free with AAZ-0217MX kits. HC05 module is to be purchased by user.

Please note that since there are many versions of android OS and hardware specific setups in Mobile and Tabs, no help will be available for phone/tab BT operation. This is an option that user may explore on their own.

Q3:



ERA3SM amp is used to amplify signal coming out of LPF.

With series resistor of 27 ohms, 30-35ma current flows.

OSC and 2.5V Reference:



LM385-2.5V is a reference diode.
Provides 2.5V from a 5V supply.

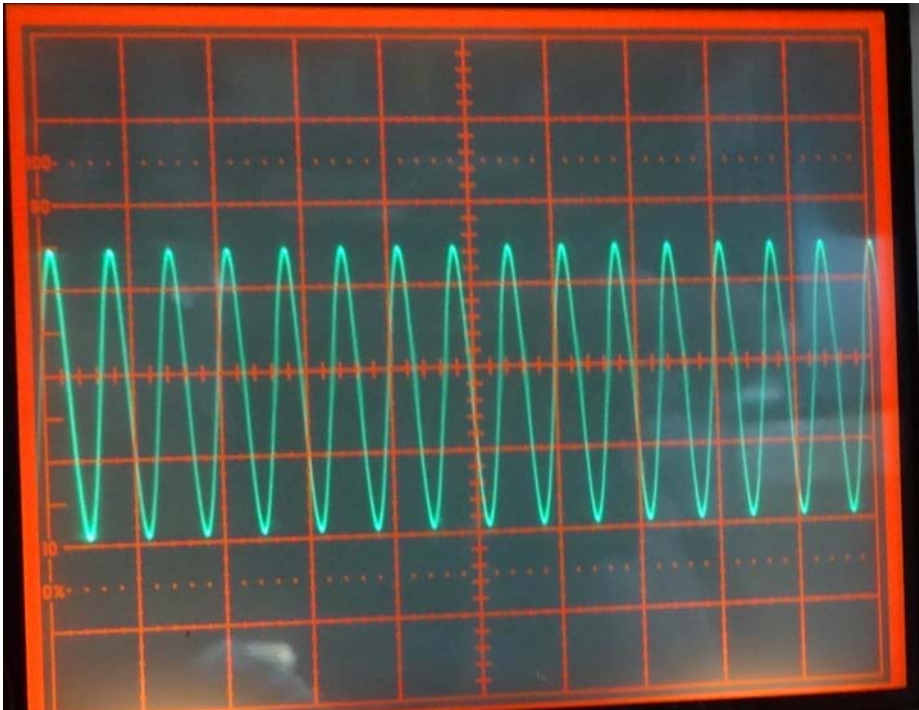
20MHZ clock Osc is a 14DIP type
5V package

CX3: (Under BNC Socket)

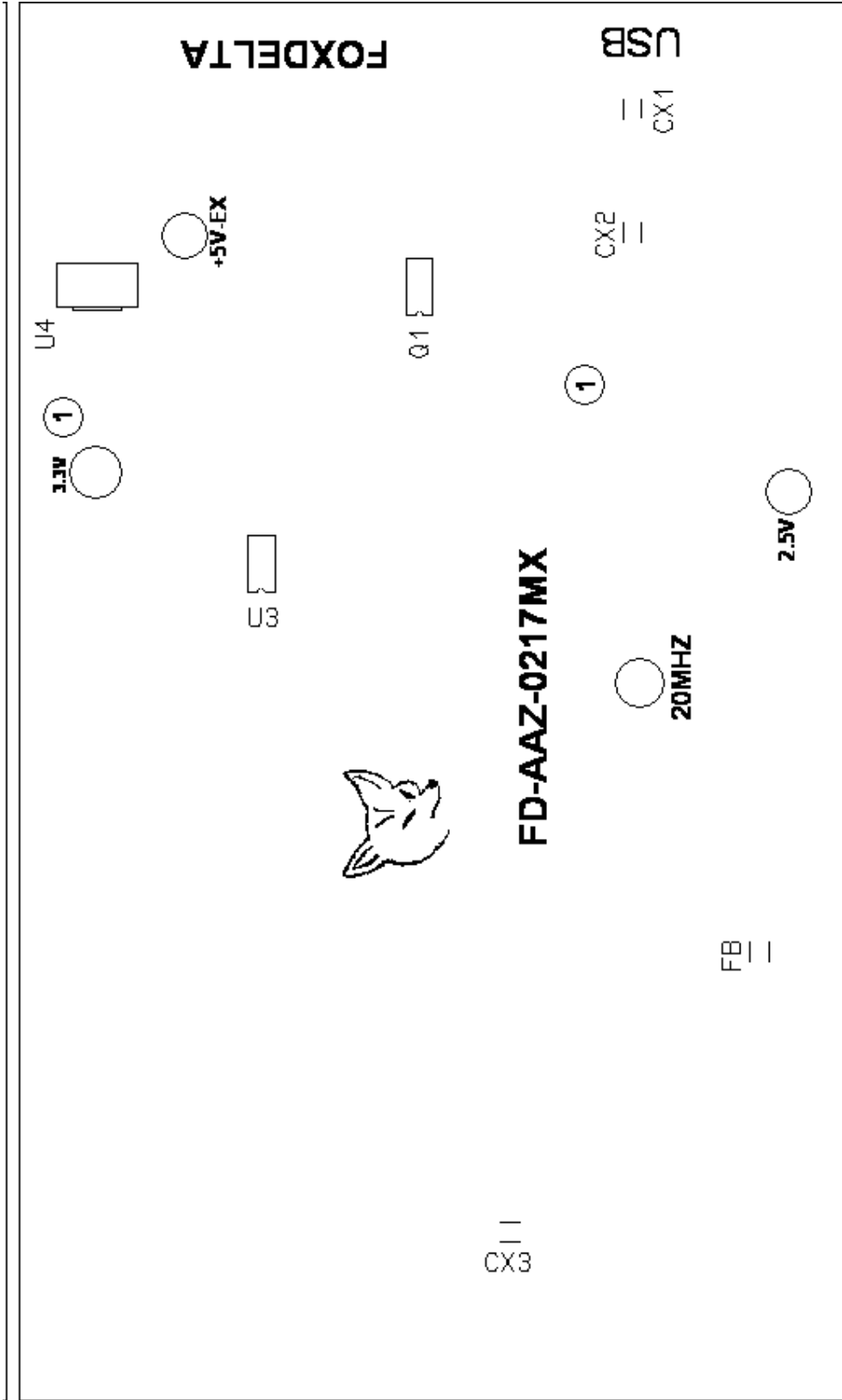
User may improve performance of the analyses by adding a small capacitor at CX3. Typical value may be between 3.3pf to 10pf.

Si5351 RF OUTPUT at BNC:

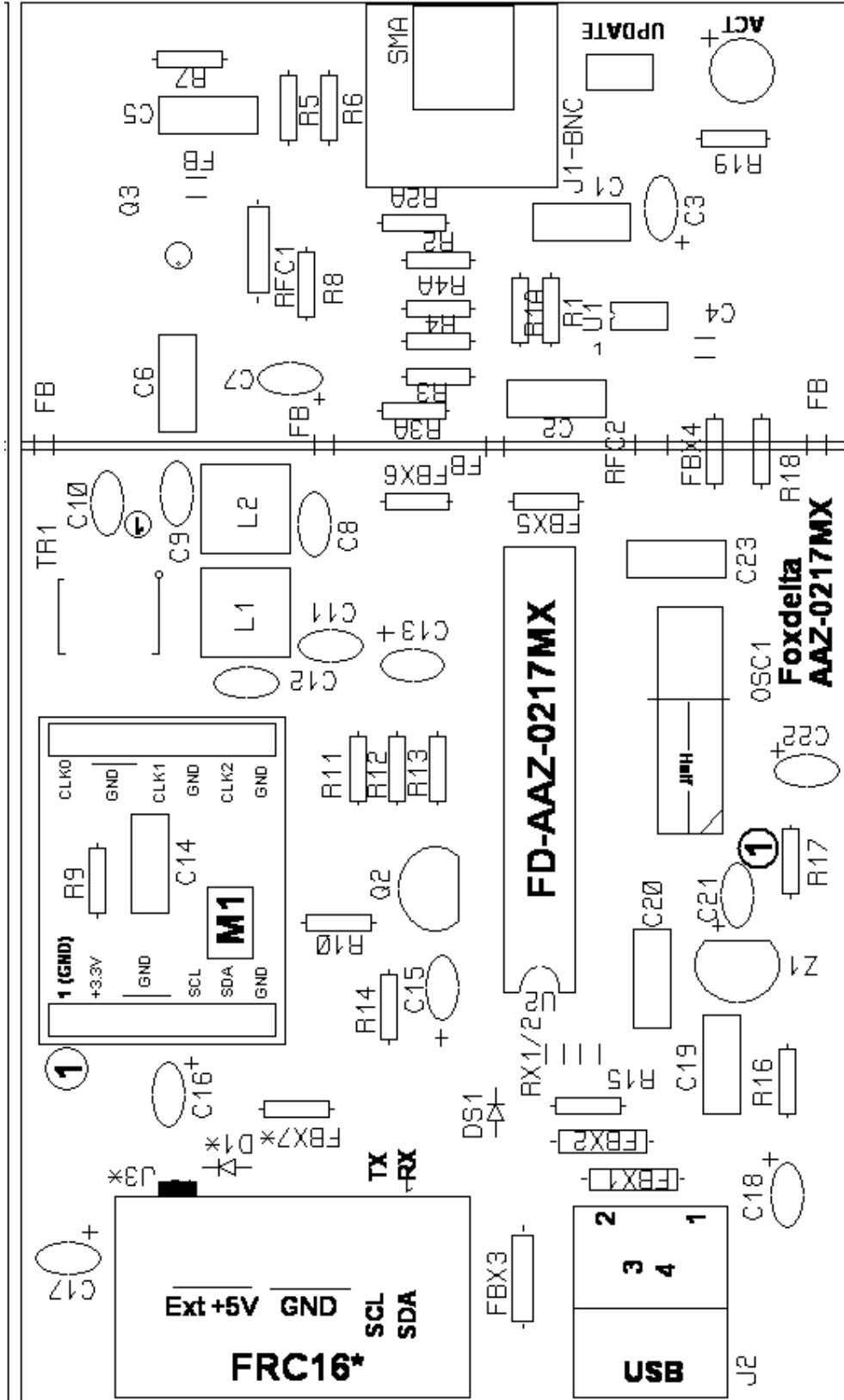
30MHZ:



AAZ-0217MX SOLDER SIDE SILK:



AAZ-0217MX SILK: TOP SIDE



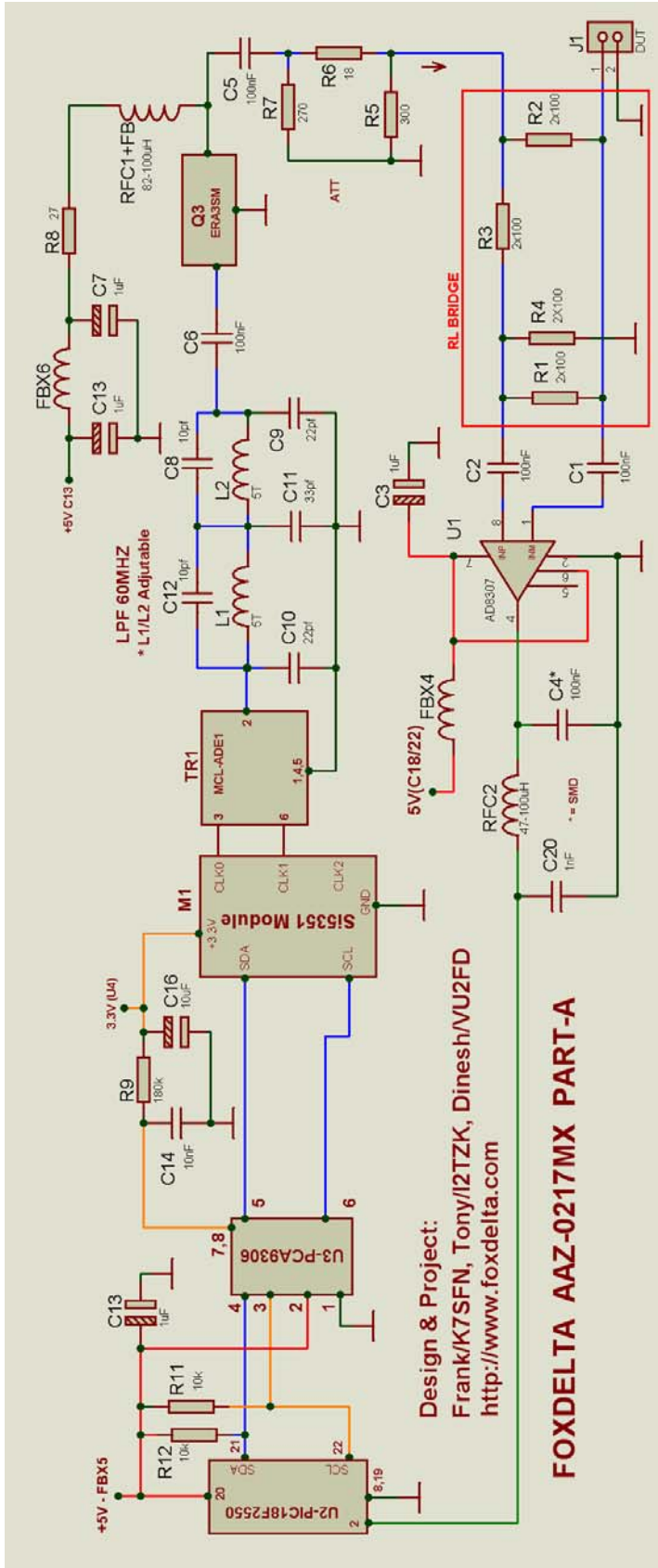
Foxdelta
AAZ-0217MX

AAZ – 0217MX KIT Parts List:

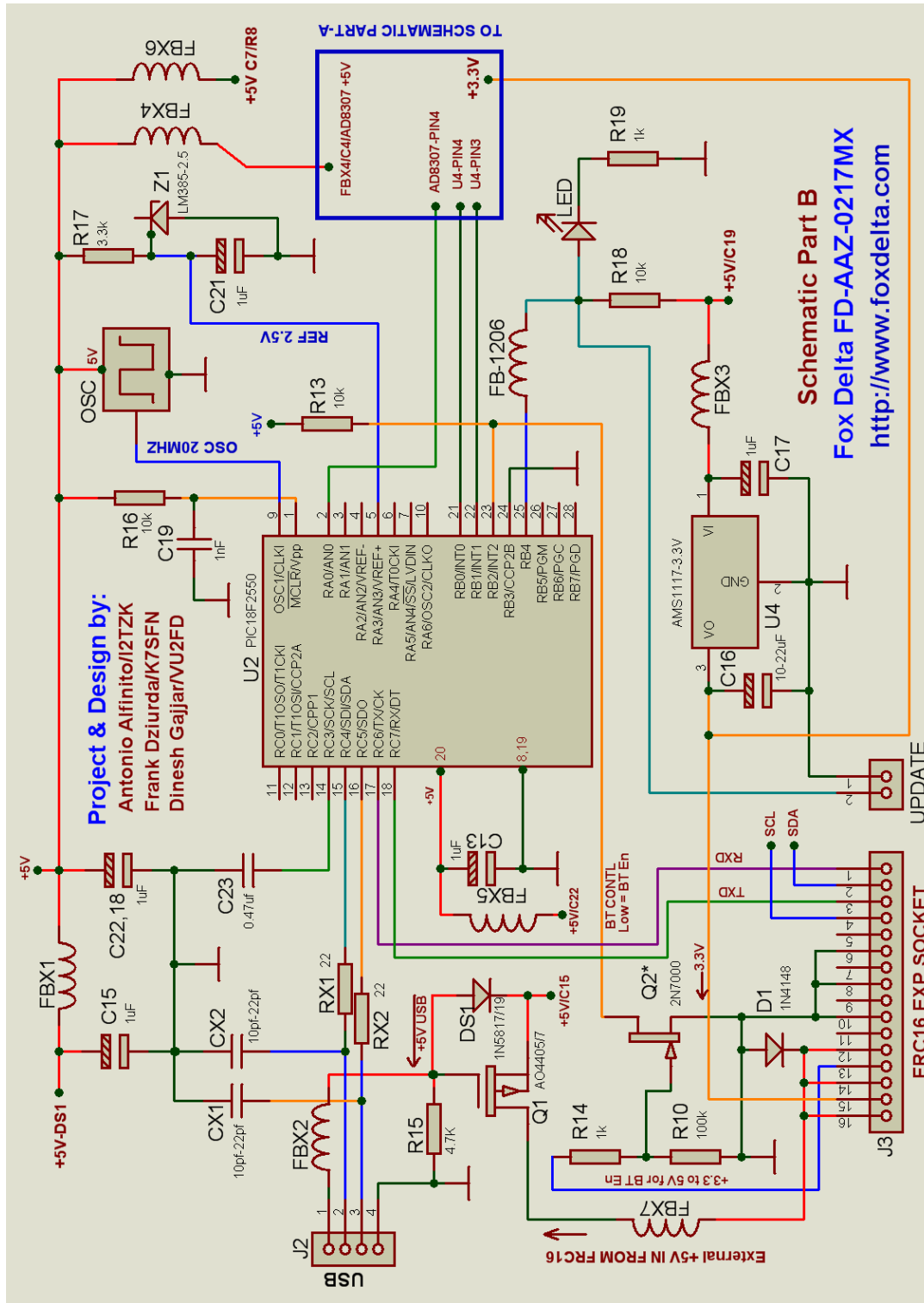
Quantity	Part ID	Part Details
1	U2	PIC18F2550 FW V1.05
1	M1#	Si5351: Assembled and Tested
1	U1#	AD8307 SO8
1	TR1#	ADE1 SO6
1	U3#	PCA9306 SO8
1	OSC	20MHZ OSC FULL or HALF
1	LED	3mm
1	Q3#	ERA3SM
1	Q2	2N7000
	Q1#	AO4405 (PNP Switch)
1	IC Socket	28PIN DIP
1	PCB	FD-AAZ-0217MX DSPTH PCB
1	Z1	LM385-2.5V
1	U4#	AMS1117 – 3.3V
2	L1, 2	Air Inductors
7	FBX1, 2, 3, 4, 5, 6, 7	Ferrite Bead Inductors
1	RFC1	82 -100uH RFC
1	RFC2#	22 – 47uH 1206
1	J1	BNC R/A PCB or SMA R/A
1	J2	USB Socket, R/A, PCB Type
1	J3	FRC16 R/A PCB
6	Ferrite beads #	FX and FB Beads 1206 SMT Pre-Soldered
1	D1	1N4148
1	2PIN Header	FW Update Header
1	DS1	1N5718/19
	All Resistors ¼ W 5%	
1	R5	300 Ohms
1	R6	18 Ohms
1	R7	270 Ohms
8	R1/A, R2/A, R3/A, R4/A,	100 Ohms
1	R8	27 Ohms
1	R10	100K
1	R9	180K
3	R11, 12, 13, 16, 18	10K
1	R17	3.3K
2	R14, 19	1K
1	R15	4.7K
2	RX1, RX2#	1206 10 to 22 ohms
	Capacitors	
1	C23	0.47uF Poly
2	C19, 20	.001uf Poly
1	C4#	0.1uF 1206
5	C6, 5, 2, 1, 14	0.1uf Poly
8	C3, 7, 13, 15, 17, 18, 21, 22	1uf Tantalum
1	C16	10uF Tantalum
2	C10, 9	22pf Ceramic
2	C 11	33pf Ceramic
2	C8, 12	10pf Ceramic
2	CX1, CX2#	10 to 22pf 1206
1	CX3	10pf Ceramic or 10pf 1206

Pre-soldered on board for Kits

AAZ-0217MX Schematic A:



AAZ-0217MX Schematic B:



73s / Dinesh/VU2FD, Frank/K7SFN, Tony/I2TZK
 27th August 2017

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