Fox Delta

Amateur Radio Projects & Kits

FD- SWM6

Tech. Information Document: PIC18F4550 Dual Channel HF/VHF SWR Meter with USB

This project is developed for Amateur Radio Community by:

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Frank Dzuirda / K7SFN

SWM6: 4X20 LCD Dual Channel SWR Meter

SWM6 is an USB / DC12V Powered SWR Meter, a project Based on Microchip's PIC18F4550.

Based on SWM3 design with exception of including a bridge inside the alum case and having a possibility to use second external bridge.

Firmware and PC Software (WinXP/WIN10) for SWM3/6 is developed by Tony / I2TZK and offered free of change for the Amateur Radio Community.

Purpose of this project is to encourage radio amateurs to build their own SWR Meter at a low cost. Project is available in kit and as an assembled, ready to use unit. Few SMD parts used are pre-soldered for kits.

SWM6 has achieved following design task:

- **Simple single Micro Controller: PIC18F4550**
- **Built-in 100+W SWR Bridge for HF**
- **Supports second 1KW bridge: HF Dual Scale**
- **CPU Unit:**
  - **2 Channels SWR Measurement**
  - **4 x 20 LCD with Back light control**
  - **Stable Reference voltage.**
  - **D9 Connector for External Bridge**
  - **SWR, FWD, POWER and Actual Power to antenna calculations/Display.**
  - **Bargraph mode for SWR & Forward Power**
  - **Configure the computational parameters of the LCD Unit (CPU)**
  - **Collect data for statistical analysis**
  - **Works as a Stand alone unit (without PC) or under PC Control. Can be powered from USB or DC12V.**

I2TZK PC Software / PIC Firmware V3.01 for SWM3/6 has:

1. **Interface with PC using USB Port.**
2. **Backlight Control**
3. **Dual channel observation of two SWRs on LCD**
4. **Ability to read RF voltages**
5. **Bar Graph**
6. **Auto Scaling of RF Power from 100 to 2KW. (With dual scale bridge)**
7. **Measures HF or VHF RF Power (Depending on type of bridge connected)**
8. **Stand Alone mode (No PC Required) with 5V supplied to USB port or DC12V.**

Following task achieved thru this new design:

1. Simple single micro controller with built-in A/D converter.
2. Dual Power Source: USB or DC12V
3. Choice of HF and VHF Bridges.
4. Back light control using an FET
5. SWR, FWD, POWER and Actual Power to antenna calculations.
6. Bar graph for SWR & Forward Power
7. Compact Design
8. PC WIN Software by I2TZK, specially developed for this project

Project Bases:

Project is developed on two double-sided PTH boards,

The first one is CPU board where LCD, Regulator and Back Light Controllers are located. This board receives pure DC level from sensors (Bridge: In-built and External) & display results.

Second board is RF Board, which consists of a 100+ Watts Internal Bridge.

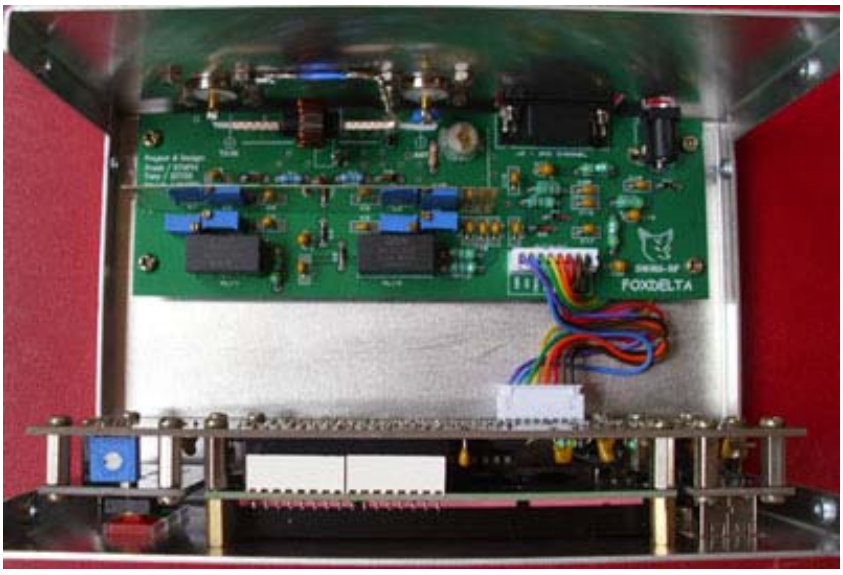
With Internal bridge, SWM6 is 100+ Watt SWR Meter. Dual scaling works well when switching from 10W to 50W or 100W while using a power amp.

Second channel of SWR measurement requires external bridge, which may be a scalable HF bridge with higher power limits. A D9 cable is required to inter-connect SWM6 to external bridge.

External, Second channel bridge, may be purchased with SWM6 or you may add your own DIY bridge (HF or VHF) to this channel

Aluminum metal case is offered free of charge with kits or assembled units.

SWM3-0915 Dual channel SWR Meter Top View:



Choice of External Bridge:

Dual Channel SWR Meter CPU Unit requires that, if second channel measurement is required, we add an external bridge.

Following bridge is available at moment:
HF Dual Scale: which may be used up to 1KW

SWM6 CPU UNIT:

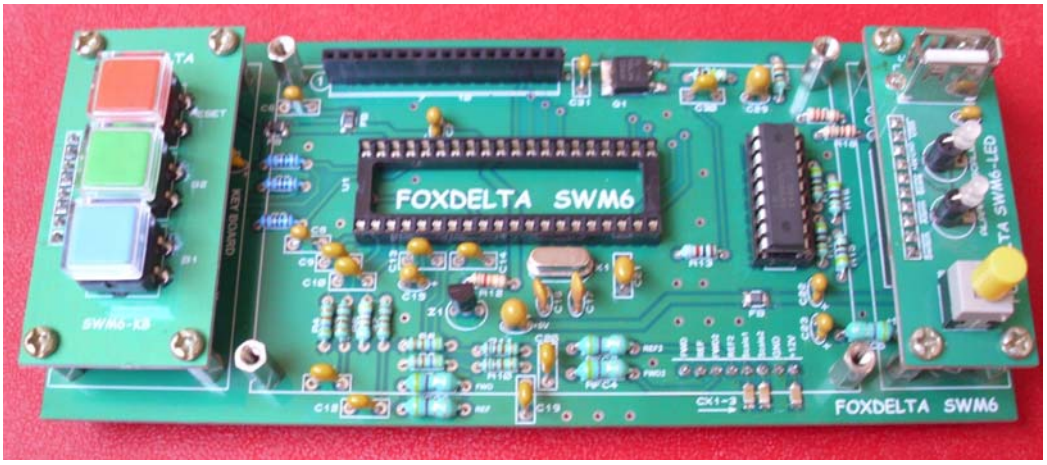
A PIC18F4550 is used for measurement of SWR & FWD voltages using available A/D inputs.

LM385-2.5 is used as an reference

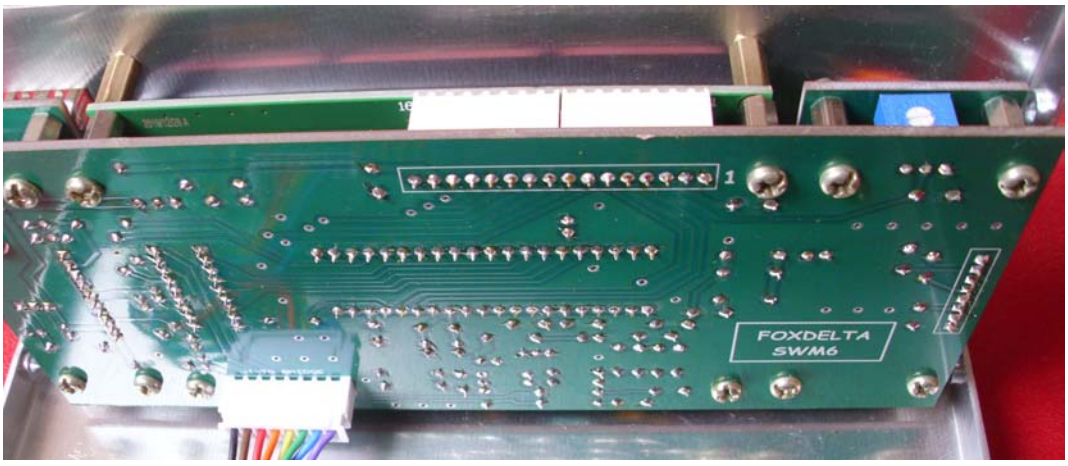
An IRFD120 is used for backlight control

An ULN2803A is used for driving Front Panel LEDs and Scaling relays.

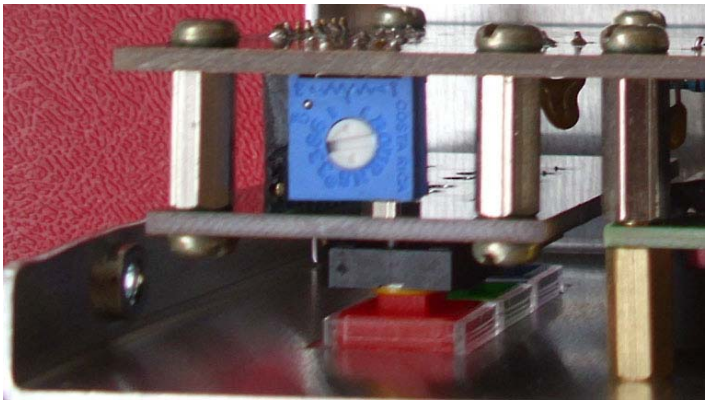
CPU Front Side:



CPU Back Side:



LCD Contrast Preset:

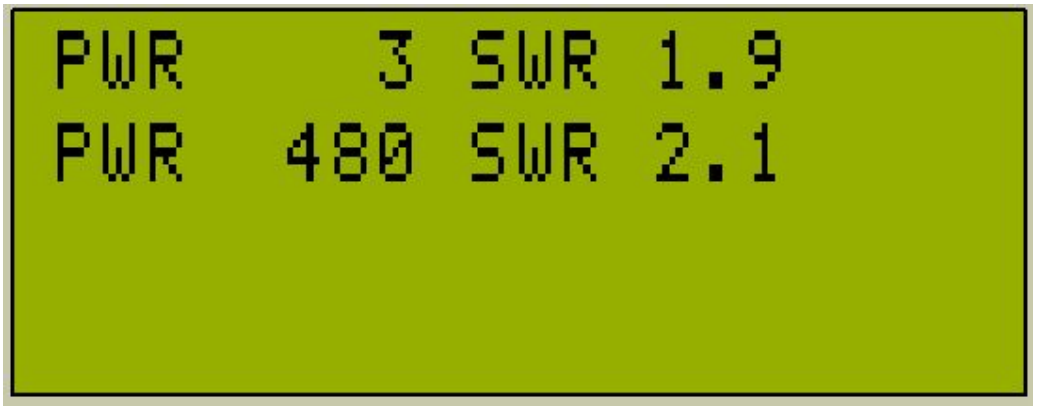


A Contrast preset (P1) is provided and must be adjusted until you see characters on LCD.

LCD Display and SWR Measurement Menus:

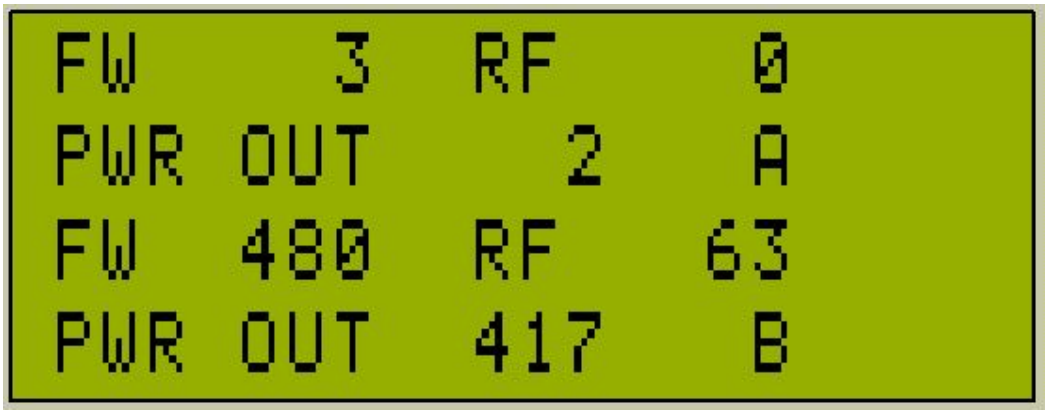
A 4x20 LCD with Backlight is used for this project.

Basic two Ch display:

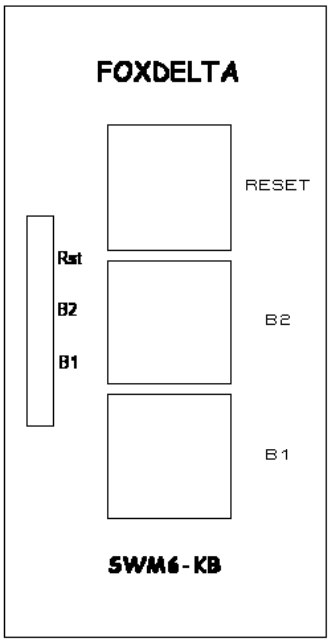


With Bar Graph:

Power, FW/RF:



Keyboard:

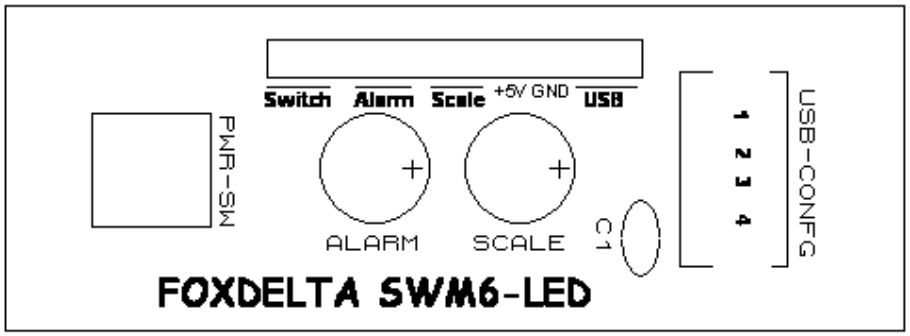


Keyboard has three keys:

1. **CPU Reset**
2. **B2: Main Menu/Mode button**
3. **B1: Backlight control**

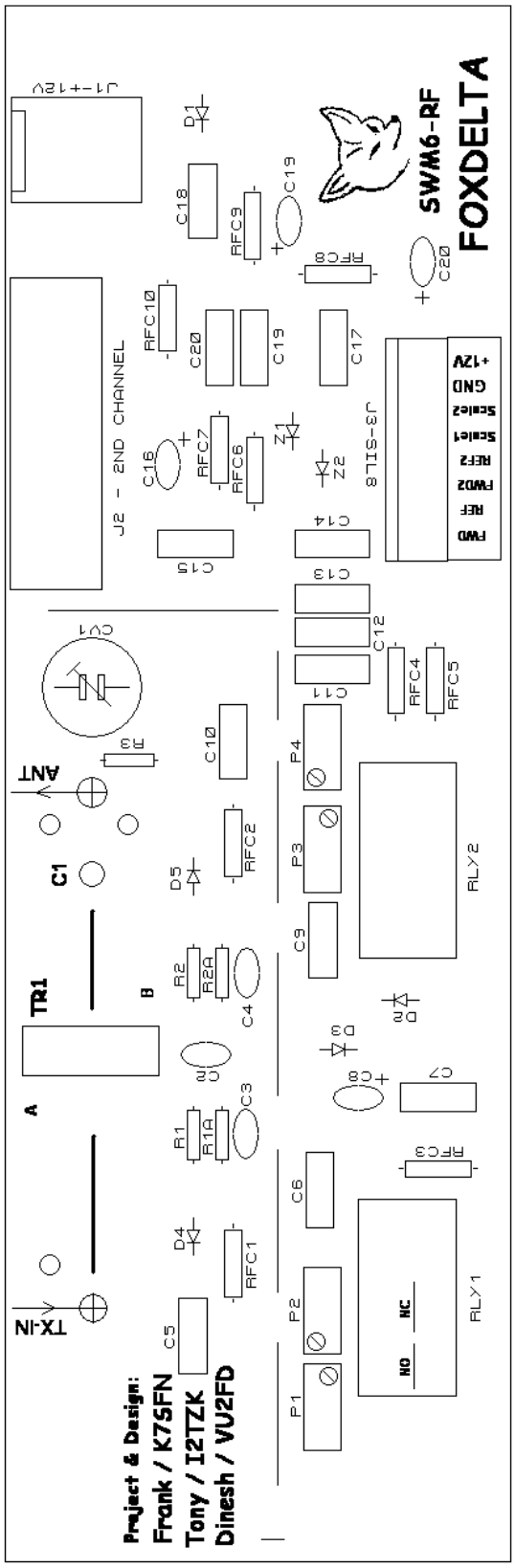
Reset button is provided to reset CPU in case where RF enters into SWM6 and hangs CPU. (Possibility in high power stations where RF shielding is poor)

USB/LED Board:

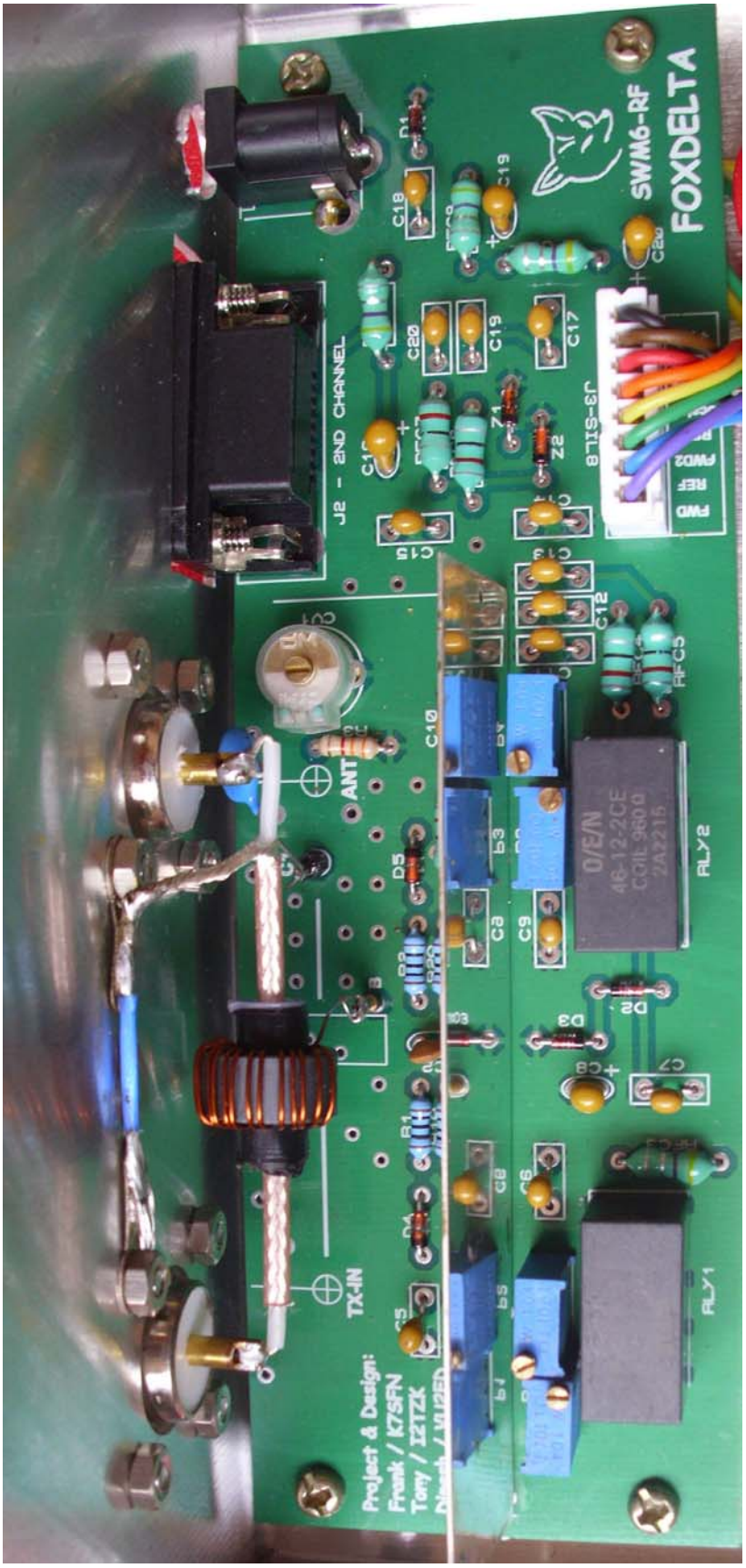


This board has a power ON/OFF switch, USB connector and two Dual LEDs for Scaling indication and "Alarm"

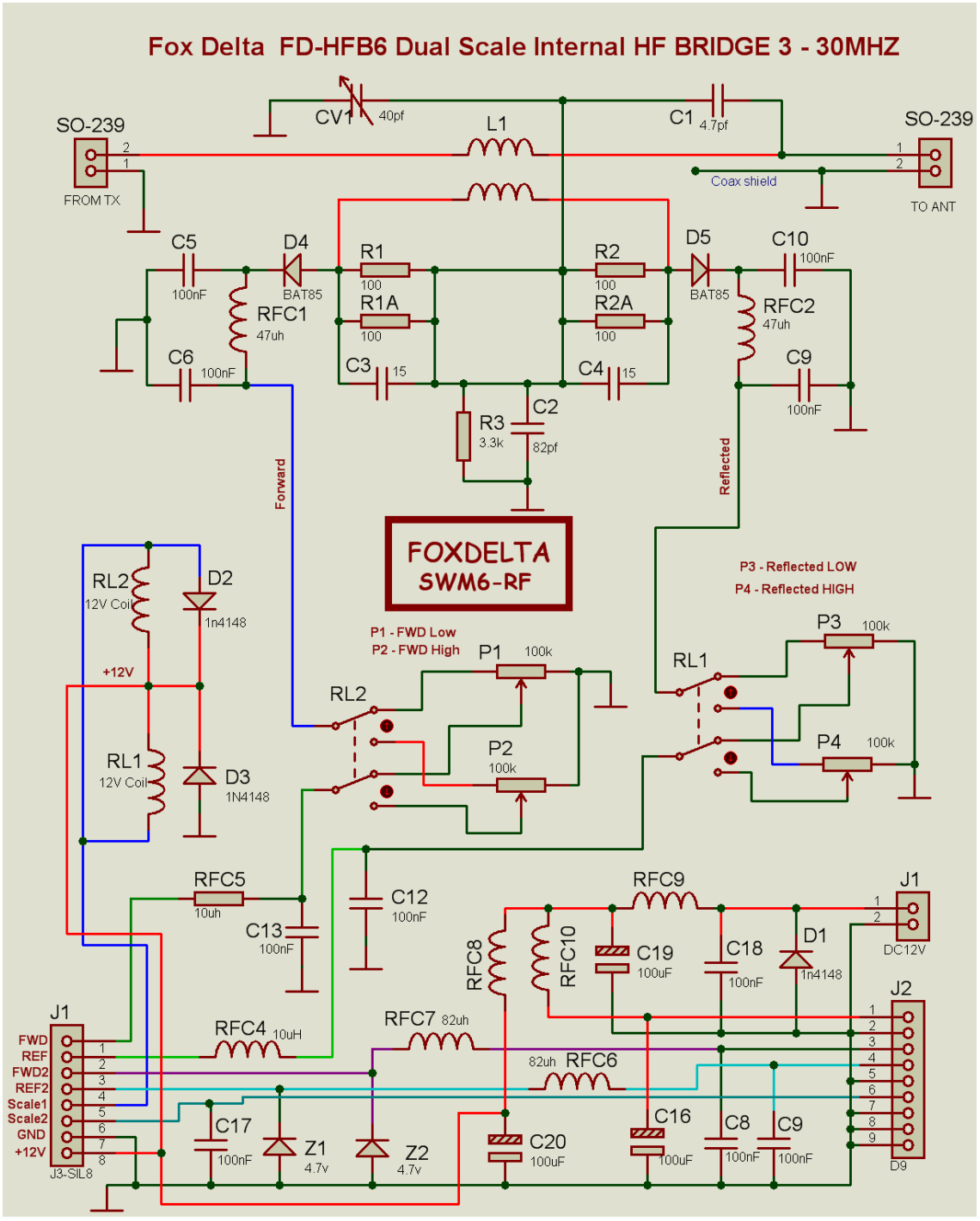
SWM6 RF BOARD SILK:



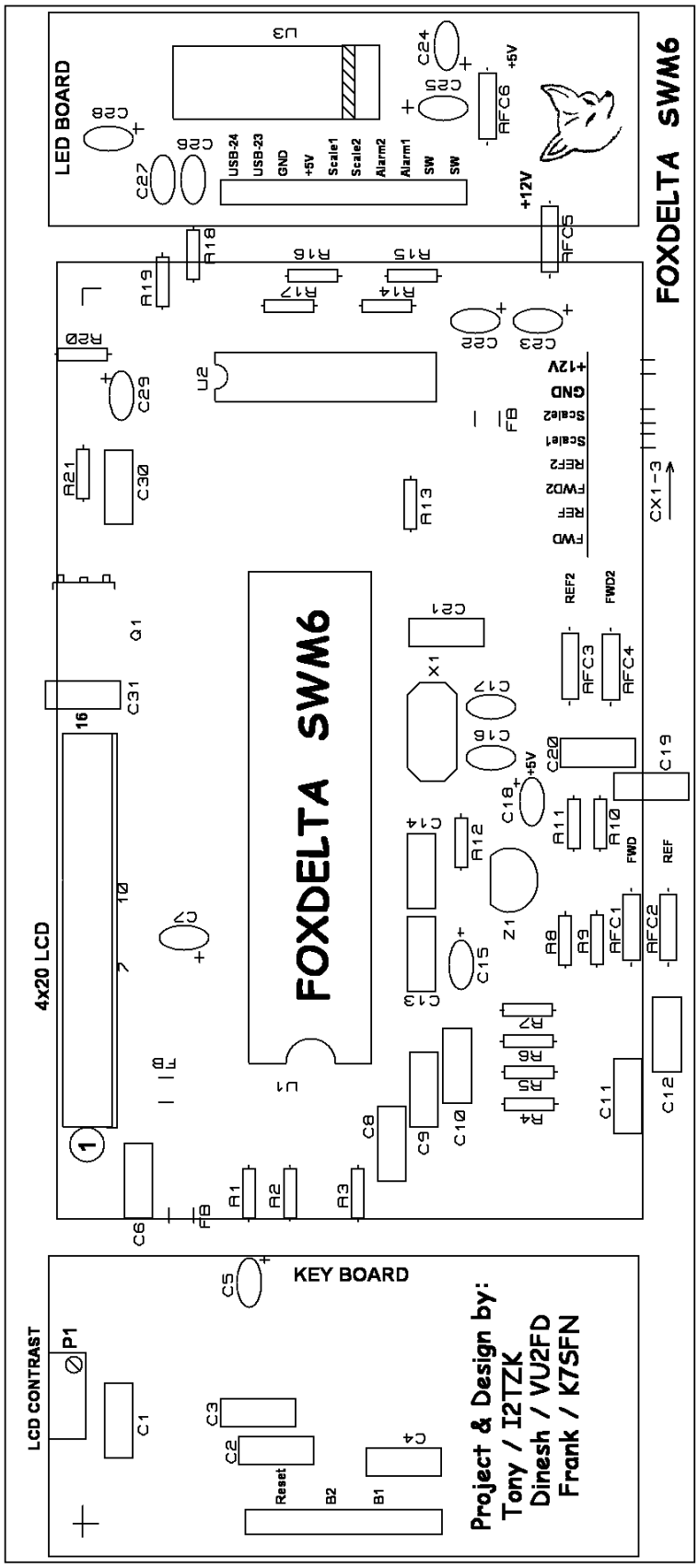
RF BOARD:


FOXDELTA
SWM6-RF
J2 - 2ND CHANNEL
J3-SIL8
FWD
REF
FWD2
ANT
TX-IN
RLY1
RLY2
O/E/N
46-12-2CE
COIL 9600
2A2215
Project & Design:
Frank / K7SFN
Tony / IZ1TZK

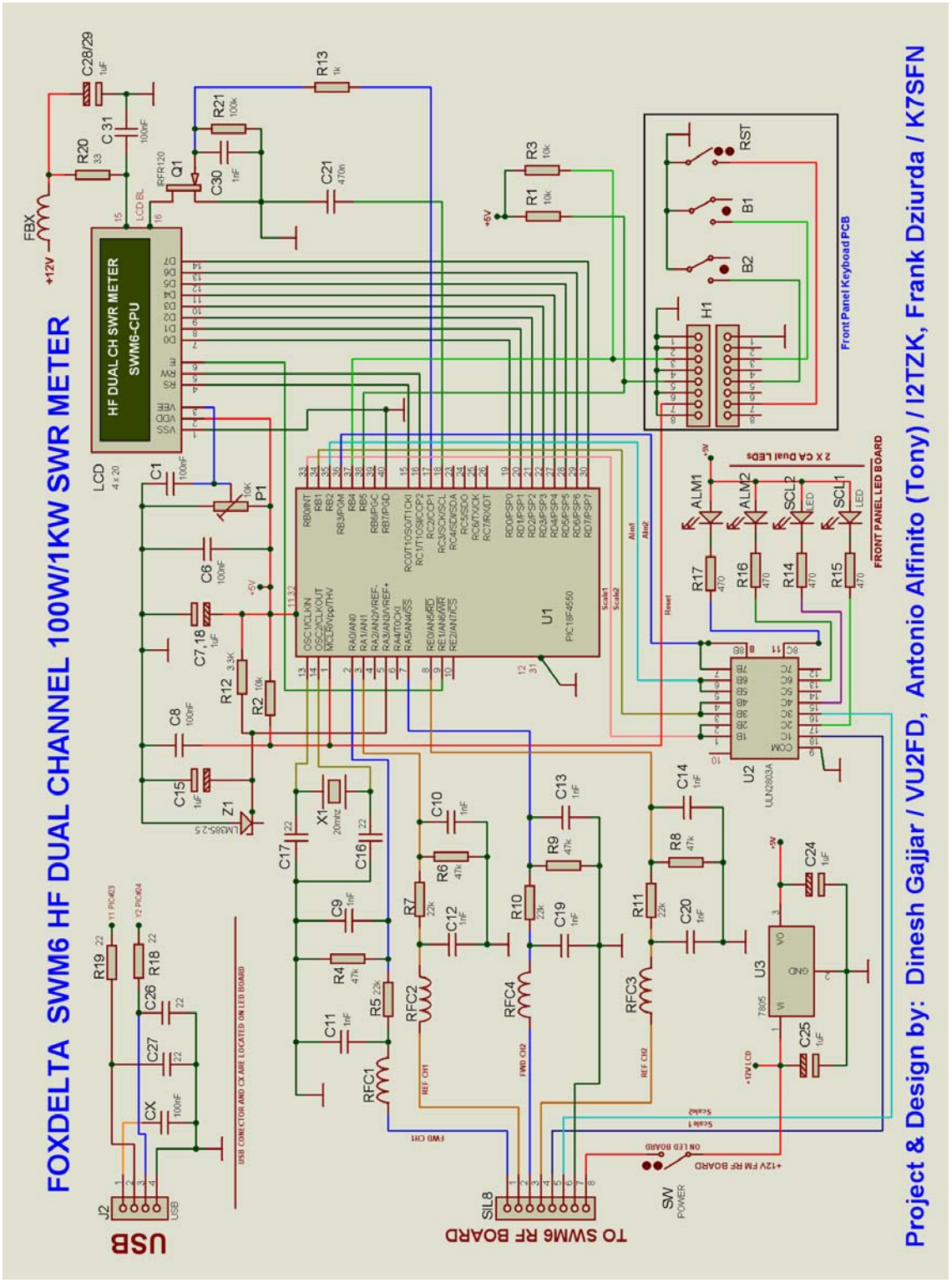
RF BOARD SCHEMATIC:



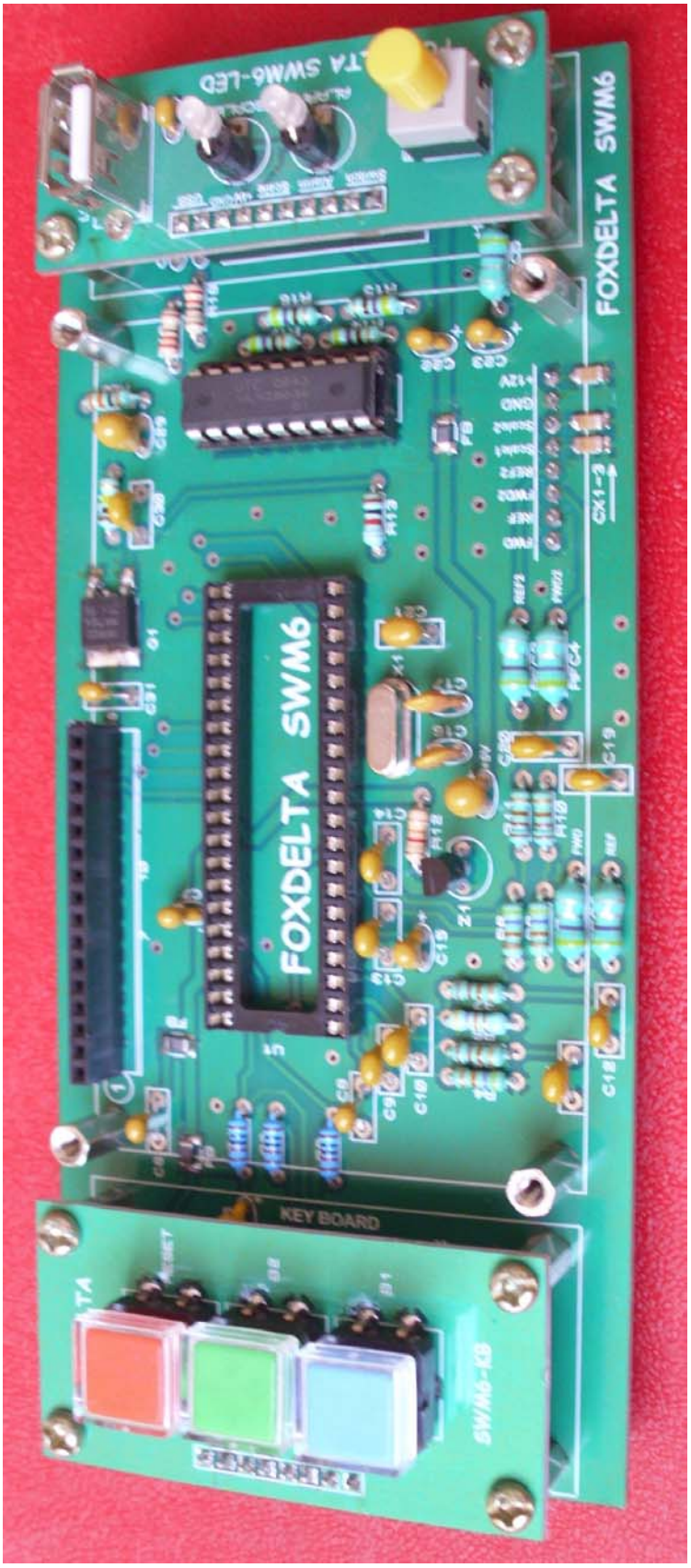
SWM6 CPU Silk:



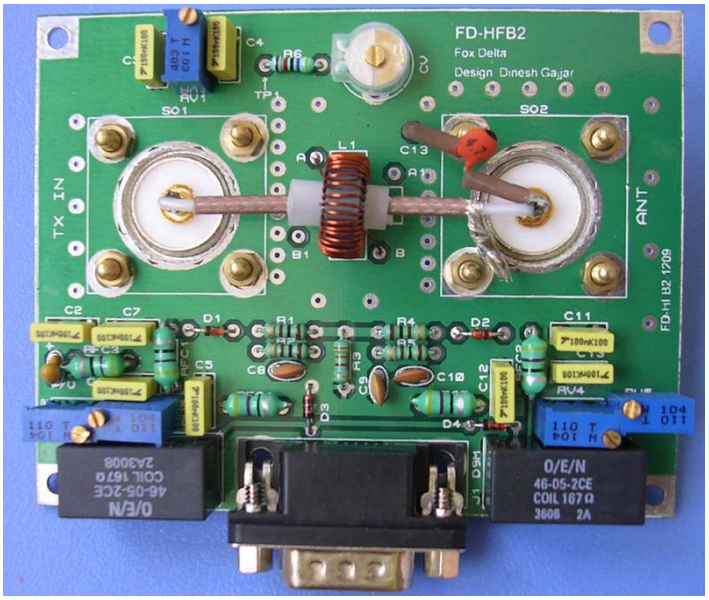
CPU Schematic:



CPU:

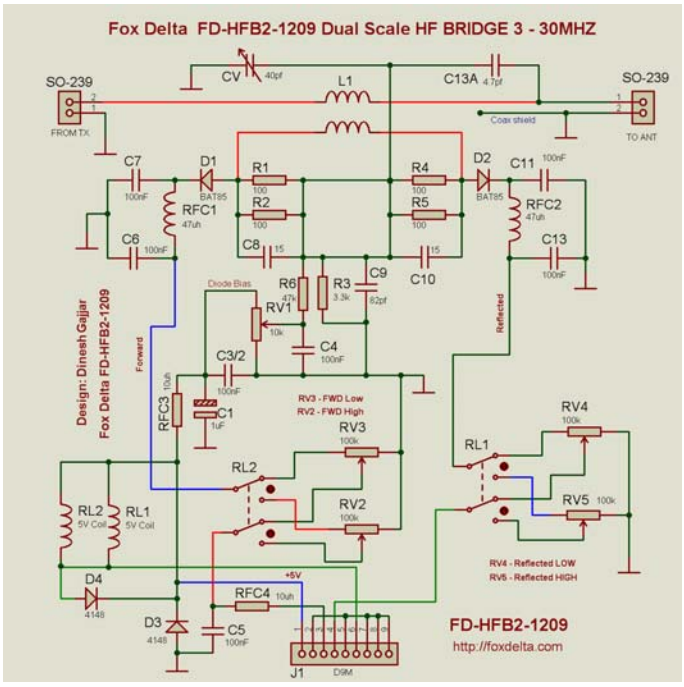


Suitable External, Second Channel HF Bride for SWM6:



Dual Scale HF Bridge has two scaling relays under CPU control.
Basic procedure would be to adjust bridge with first set of presets for "Lower" range and then, adjust "HIGH" range using second set of presets.
Relays used in this project are OEN 12V DC and has 2CO contacts.
Bridge will work from 100W to over a KW

Dual Scale Bridge Schematic:



[Please visit Bridge section for details on other available HF/VHF Bridges]

SWM6 CPU KIT Parts List:

Qtty	Part ID	Part Details
1	U1	PIC18F4550 DIP40: FW-V301, SW-103
1	U2	ULN2803A DIP18
1	Q1	IRFD120 (SMT)
1	Z1	LM385-2.5V TO92
1	PCB	SWM6 DSPTH PCB
1	SIL8	SIL8 Male PCB Connector+ Ribbon Cable
1	USB	USB PCB Connector Vertical
2	LED	Dual LED Common Anode (LED)
3	SW1, 2, 3	12MM Push Buttons (KB)
1	SWM6-KB-PCB	Double Sided PTH PCB “KB”
1	SWM6-PCB	Double Sided PTH PCB SWM6
1	SWM6-LED-PCB	Double sided PTH PCB “LED”
1	Pair	16PIN SIL M/F For 4x20 LCD
1	Pair	8PIN SIL M/F For Keyboard
1	Pair	10PIN SIL M/F for LED Board
1	LCD	2x16 LCD with Backlight
1	P1	10K Preset: LCD CONTRAST
1	X1	20MHZ Crystal in HC49U
1	U3	7805
1	18DIP	IC Socket
1	40DIP	IC Socket
3	FB	1210 Ferrite Bead
6	RFC1, 2, 3, 4,	RFC 82uH
2	RFC5, 6	RFC 0.47uH
1	Set	Nuts / Bolts for LCD and KB Mounting
1	Case	Free Alum Metal Case
1	SW	Power ON/OFF Switch (LED BOARD)
3	FB	1206 Ferrit Beads
	All Resistors ¼ W 5%	
4	47K	R4. 6. 8. 9
6	1K	R13
4	22K	R5, 7, 10, 11,
6	10K	R1. 2, 3,
1	3.3K	R12
1	33 ohms	R20
2	100k	R21
4	470 Ohms	R14, 15, 16, 17
2	22 ohms	R18, 19
	Capacitors	
10	1uf Tantalum/35V	C5, 7, 15, 18, 22, 23, 24, 25, 28, 29
4	22pf	C16, 17, 26, 27
1	0.47uf Ploy	C21
8	0.1uf Poly	C1, 2, 3, 4, 8, 6, 30, 31
8	0.001uF Poly	C9, 10, 11, 12, 13, 14, 19, 20

Above includes parts for Keyboard

RF BOARD PARTS LIST:

Qtty	Part ID	Part Details
1	J3	SIL8 Connector + Ribbon Cable
1	J2	D9 Male PCB
1	J1	DC12V PCB CONNECTOR
2	SO239	RF CONNECTORS
1	TR1	Fair-rite 59 4300 1101
1	TR1: Copper Wire	#26 35CM Long
1	L1: RG316	8CM LONG
1	C1	4.7pf 1kv
1	CV	40pf Air Variable
2	D4, D5	BAT 85 Diodes
2	RFC1, 2	82uH Inductors
2	RLY1,2	OEN42 12V 2CO Relays
4	P1, 2, 3, 4	20K Pesets 10T
2	Z1, 2	4.7V Zener Diodes
3	D1, 2, 3	1N4148 Diodes
8	RFC3, 4, 5, 6, 7, 8, 9, 10	RFCs 0.47uH
1	SWM6-RF	PCB
1	Copper Shield	10cm x 2.5cm
1	Set	Mounting Hardware PCB + SO239
	All Resistors ¼ W 5%	
4	R1,1A, 2, 2A	100 ohms 1 %
1	R3	3.3K
	Capacitors	
14	C5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 17, 18, 19, 20,	0.1uf Poly
4	C8, 18, 19, 20	1uF Tant of 100uF Electro
2	C3, 4	15pf Ceramic
1	C2	82pf Ceramic

73s
Dinesh Gajjar / VU2FD
02nd June 2025