



# Fox Delta

Amateur Radio Projects & Kits

FD- SWM3-0915

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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**HF/VHF 100W to 1KW LCD DUAL Channel SWR / POWER Meter: SWM3-0915**



## Introduction:

SWM3 is an USB CPU, Powered by USB port. Project is based on Microchip's PIC18F4550 40DIP Chip. All that we require for this project is a PIC and a few components.

SWM3-0915 CPU is developed keeping in mind existing HF and VHF Bridges. SWM3-0915 is dual power, i.e. USB or DC12V from external adapter.

Firmware and PC Software for SWM3is developed and distributed free of charge by [Antonio Alfinito / I2TZK](#) for the Amateur Radio Community.

Purpose of this project is to encourage radio amateurs to build their own SWR Meter at a low price.

## **I2TZK PC Software / PIC Firmware V2.06 for SWM3 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 concept being that the CPU unit be placed on your ham shack and the bridge placed suitably at the RF level points (Mostly back of the shack)

The CPU board has LCD, Voltage Regulator and Back Light Controllers. It requires 12V DC for operation and receives pure DC level voltages from sensor (Bridge) board for calculation & display.

Dual power option is created simply by using a 12V Relay, which perform the +5V changeover.

SWM3-0915 is multipurpose SWR measuring device.

Although various HF/VHF bridges are available, you may build your own bridge and calibrate it in the PC software to achieve expected results.



## Choice of Bridges:

Dual Channel SWR Meter CPU Unit requires that we connect a suitable bridge for RF measurement.

Following four types of bridges are available at moment:

1. HF Simple or HFB3 Bridge – Measures 0-30MHZ but do not have auto scaling
2. HF Dual Scale Bridge – Same as above but with scaling relays.
3. HFB5: Balanced Tandem 1KW bridge with Diode Detectors

Note:

SWM3-0915 requires at least one Bridge to start with. You may have two bridges if your station has two radios.

If you run 2KW HF Transmitter, you will require either a dual scale bridge or a HFB5 type bridge, which can handle high power.

HF Bridges may not measure very low RF Power (below 20W). For QROP purpose we will have another meter, which supports low power measurement.

## SWM3-0915 CPU UNIT:

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

LM385-2.5 is used to supply a reference voltage to CPU.

An IRFD110 is used for backlight control

An ULN2803A is used for driving Front Panel LEDs.

## 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 2x16 LCD with Backlight is used for this project.

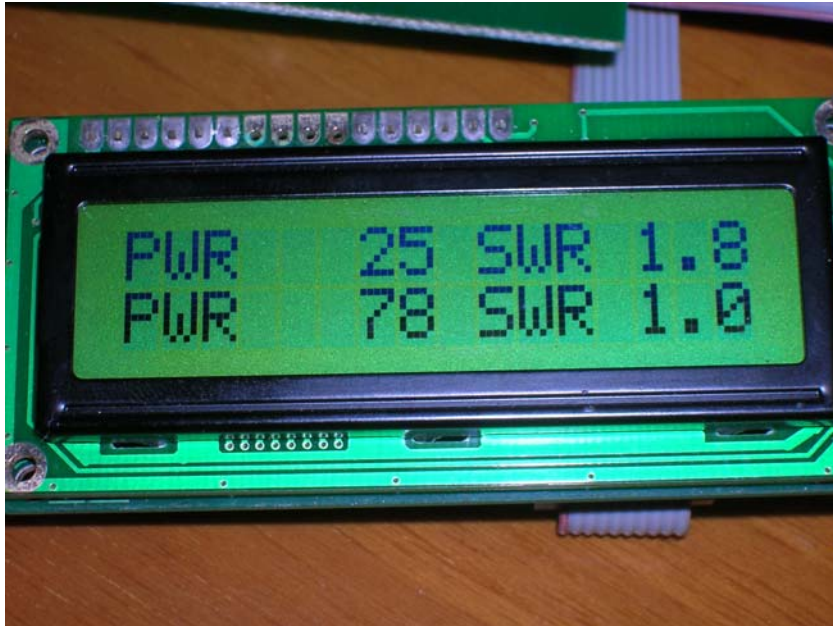
Channel A:



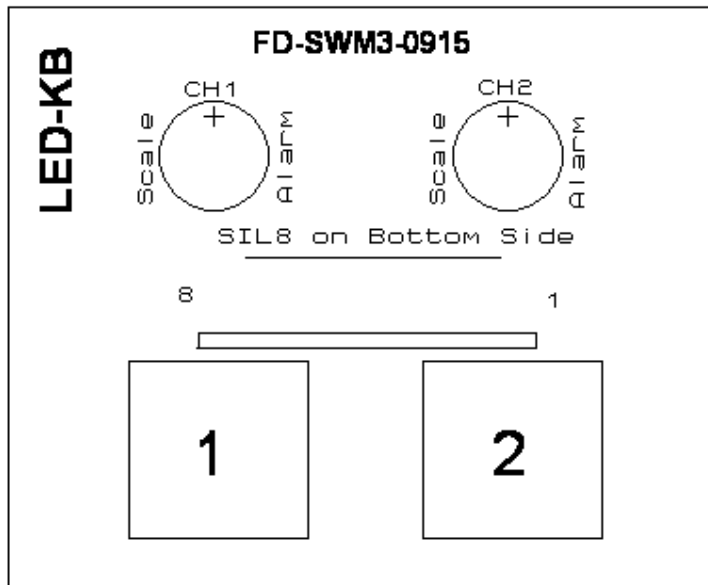
Channel B:



**Channel A+B:**



**Front Panel keyboard:**



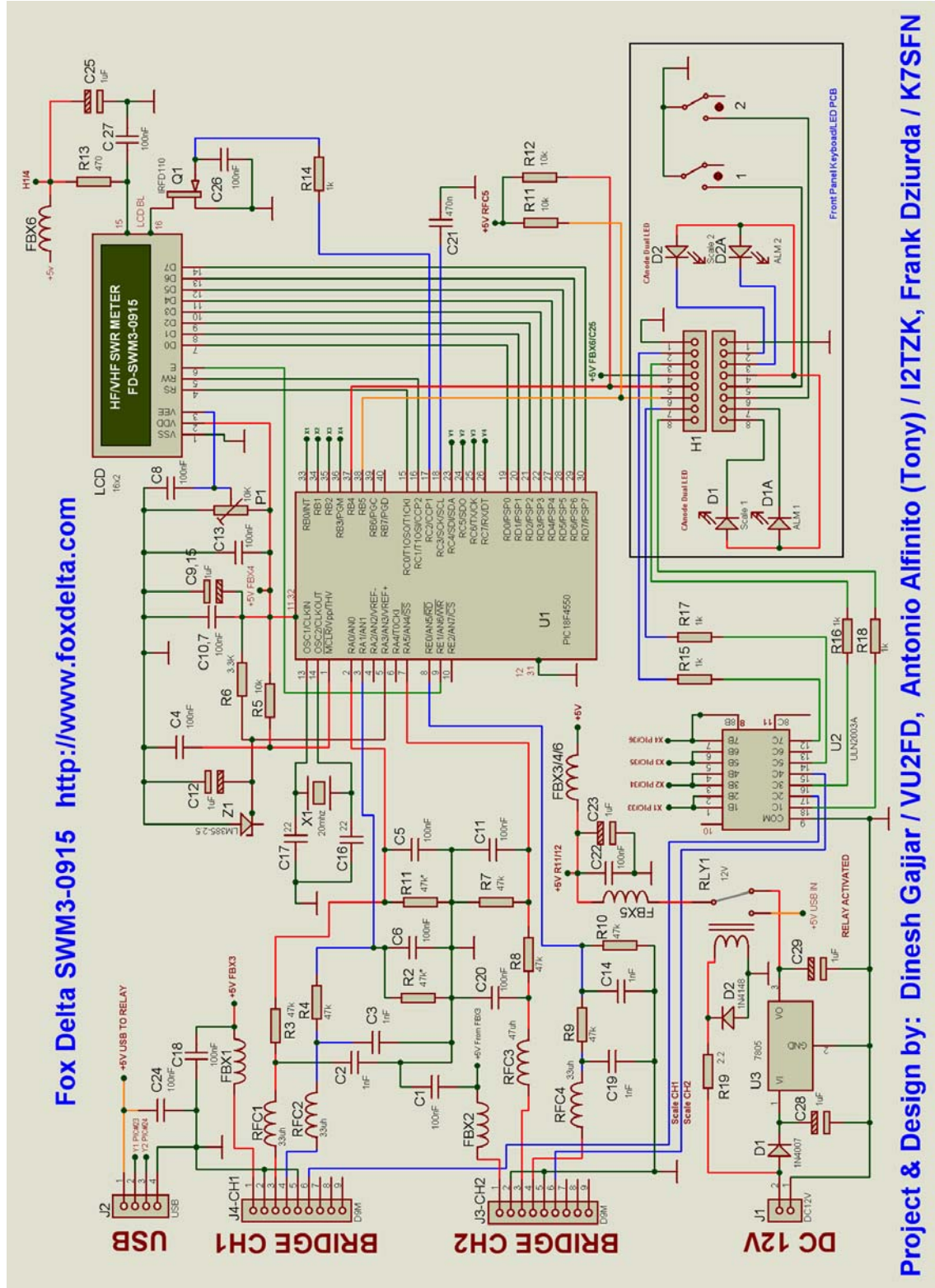
**SWM3-0915 Keyboard PCB is a small double-sided PTH Board. It has 2 push buttons for menu operation and two dual color Common Anode LEDs.**

**KB PCB mounts on front panel by way of 8mm spacers. KB PCB connects to main CPU board by an 8pin SIL connector and a ribbon cable.**



# Schematic: SWM3-0915

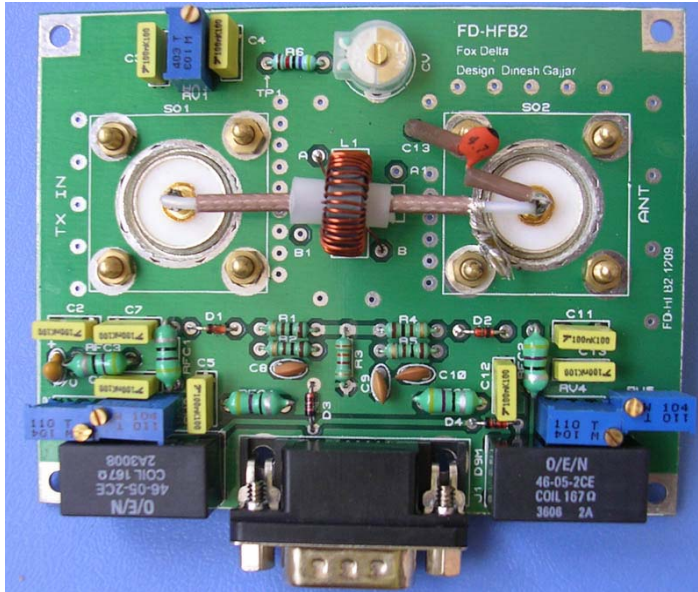
Fox Delta SWM3-0915 <http://www.foxdelta.com>



Project & Design by: Dinesh Gajjar / VU2FD, Antonio Alfinito (Tony) / I2TZK, Frank Dziurda / K7SFN

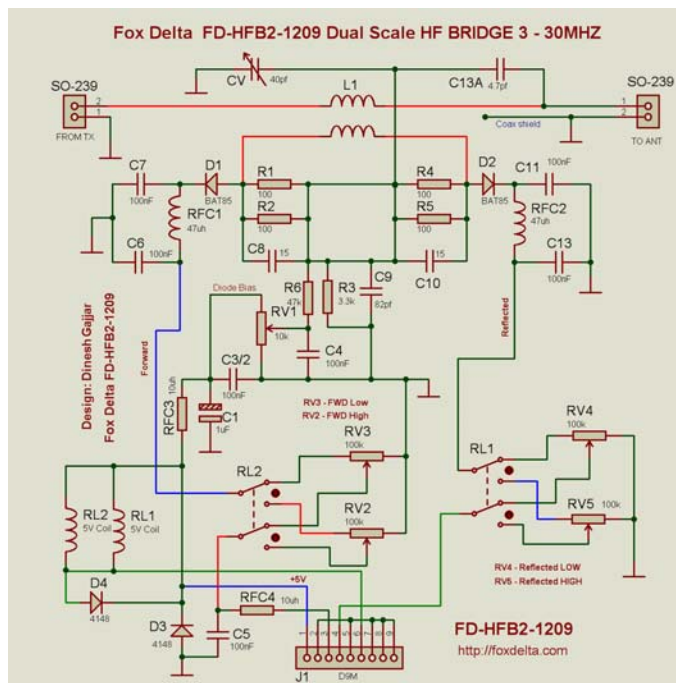


**Suitable HF Bride for SWM3-0915: Dual Scale HF Bridge: (Not part of this kit)**



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 5V 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](#)**

**SWM3-0915 Complete Kit Parts List:**

Qty	Part ID	Part Details
1	U1	PIC18F4550 Pre-Programmed DIP40
1	U2	ULN2803A DIP18
1	Q1	IRFD110
1	Z1	LM385-2.5V
2	J4, 3	D9 Male R/A PCB Connector
1	J1	DC12V PCB Connector
1	J2	USB PCB Connector
2	LED	Dual LED Common Anode (LED-KB)
2	SW1/2	12MM Push Buttons (LED-KB)
1	SWM3-KB-PCB	Double Sided PTH PCB LED-KB-0915-A
1	SWM3-PCB	Double Sided PTH PCB SWM3-0915
1	Pair	16PIN SIL Male and Ribbon for LCD (2X8)
1	Pair	8PIN SIL Male and Ribbon for Keyboard
1	LCD	2x16 LCD with Backlight
1	RLY	OEN42 or Similar 12V mini Relay 1CO
1	P1	10K Preset
1	X1	20MHZ Crystal in HC49U
1	U3	7805
1	18DIP	IC Socket
1	40DIP	IC Socket
4	RFC1 - 4	33-47uH
6	FBX1-6	FB Inductors
1	D1	1N4007
1	D2	1N4148
1	Set	Nuts / Bolts for LCD and KB Mounting
1	Case	Free Powder Coated Metal Case
<b>All Resistors ¼ W 5%</b>		
8	47K	R1, 2, 3, 4, 7, 8, 9, 10
5	1K	R14, 15, 16, 17, 18,
3	10K	R5, 11, 12,
1	3.3K	R6
1	470	R13
<b>Capacitors</b>		
7	1uf Tantalum/35V	C12, 15, 9, 23, 25, 28, 29
2	22pf	C17, 16 Ceramic
1	0.47uf Ploy	C21
10	0.1uf Poly	C1, 7, 8, 10, 13, 18, 22, 24, 26, 27
9	0.001uF Poly	C6, 5, 4, 2, 3, 11, 14, 19, 20,

**PIC18F4550 is supplied pre-programmed.**

## **Kit Assembly:**

Kits are specially designed for radio amateurs with necessary expertise in understanding SWR, RF power measurement etc  
A dummy load and a Variable RF power source (Trx) will complete the alignment requirements.

Do not buy this kit if you do not know what is an RF Bridge or if you do not understand what "SWR" means!!

For those who do not have time to build kits, Assembled SWR Meters in a metal case (Powder Coated) are available at small extra charge or free for Senior Radio Amateurs.

Although we have made few kits for sales, the basic concept of this project is to make available complete details on hardware and firmware/software. We expect that radio amateurs build this project on their own, using components from their own ham shack!!

Following files are available for Homebrewers:

1. This info doc
2. CPU Schematic and parts list
3. Schematic and parts list for all four types of bridges
4. A Free PC Program by [Tony / I2TZK](#)
5. PIC Firmware by Tony /I2TZK for PIC18F4550
6. Microchip PIC18 USB Boot loader for future updates

Also do not forget to refer calibration procedure detailed on [Bridge web pages](#) by [Frank / K7SFN](#)

SWM3-0915 is the latest revision of our last SWM3 project. Revision was done keeping in view good response (and demand for more kits) received from radio amateurs interested in having a Simple and Good quality LCD SWR meter for their station at an affordable cost

73s

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