Why this RF switch?

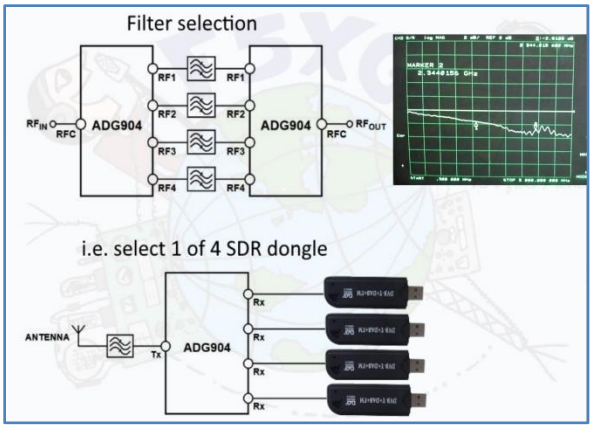


Figure 1 Examples of use

This board was developed in the project "tracking weather-meteo probes".
And to retrieve the probe after his landing on earth.
In some cases it is useful to track different radio "sources" quickly and safely.
This board allow doing this without any effort.

This board can be used for many other applications.
For instance to select different SDR dongles.
Selection is made via a µcontroller using 3-bit binary address lines.

Making

This small RF Multiplexer board (31*71mm):

- Is made with 0,8mm FR4 double sided circuit, metallized holes in order to reduce dielectric losses at high frequencies >2 GHz.
- Uses high quality SMA female connectors, measurement have been conducted to select good devices.
- Is powered by a 4.5V to 12V Supply, logics inputs are 3.3V to 5V compatible (read explanations below).
- Can be used without enclosure or with RF enclosure when used in a high RF power level environment.

When using this board, no problem with the external circuitry or electromagnetic compatibility (EMC), if an enclosure is used.

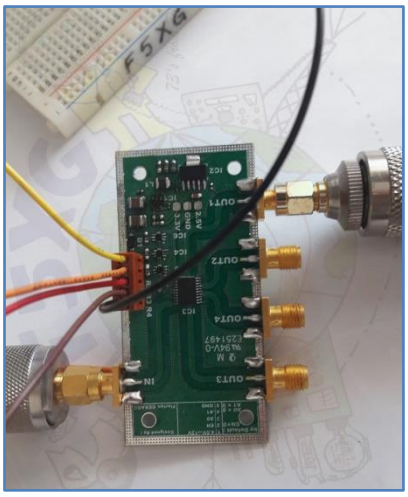


Figure 2 Proto #1 under test

Specifications

The core of this circuit is the ADG904 from **ANALOG DEVICES**:

- Wideband 2.5 GHz, but usable with more loss up to 3 GHz
- Low insertion loss (1.1 dB dc to 1 GHz)
- 37 dB Isolation at 1 GHz,
- has 50 Ω terminated shunt legs
- -2,3 dB @ 2.34 GHz(measured on the boards)

The curve at right, show the use up to 3GHz.

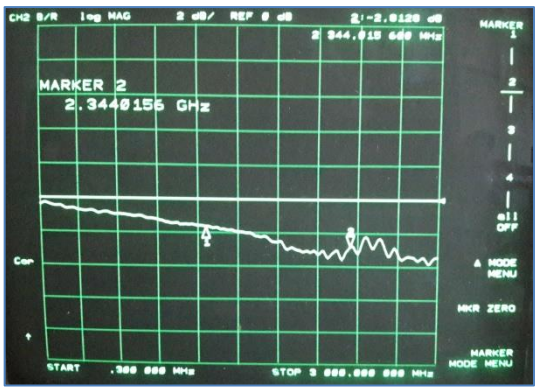


Figure 3 Frequency response

Be careful!

There are some precautions to take in account:

This CMOS chip from **ANALOG DEVICES** is a wideband 2.5 GHz, 37 dB isolation at 1 GHz, with 50 Ω terminated shunt legs.

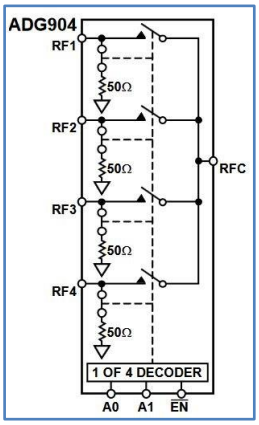


Figure 4 Block diagram

The ADG904 switch one of four inputs (or outputs) to a common output (or input) RFC, there is neither input nor output; we select the "route" between RFC and RF1, 2, 3 or 4, or vice versa.
The "route" is determined by three control lines (a 2 bits address A0, A1, and an optional enable line /EN), each line having a pull down resistor.
A logic level "1" on the /EN pin disables the device.

The ADG904 uses a single 1.65 V to 2.75 V power supply, so not usable for instance with µcontrollers like Arduino even in the 3,3V mode!
We have taken that in account in this development using a level converter for these command lines and power supply.

Let's analyse the full schematic:

IC1 is powered via D1 to protect against polarity inversion; IC1 is a step down switching converter that produce 3.3V to power efficiently the whole board. IC2 is an ultra low noise, High Psrr low dropout regulator setup to provide 2.5V feeding the ADG904 and level converters
IC4, IC5 and IC6 are single-bit dual-supply bus transceiver to adjust the address lines levels (from 1.65-V to 5.5-V) to the required 2,5V (data sheet : should be < 2,75V!) lines level A0, A1, and /EN of the ADG904.

Note: there is neither input nor output; we select the "route" between RFC and RF1, 2, 3 or 4, or vice versa. There is no protection against current return.

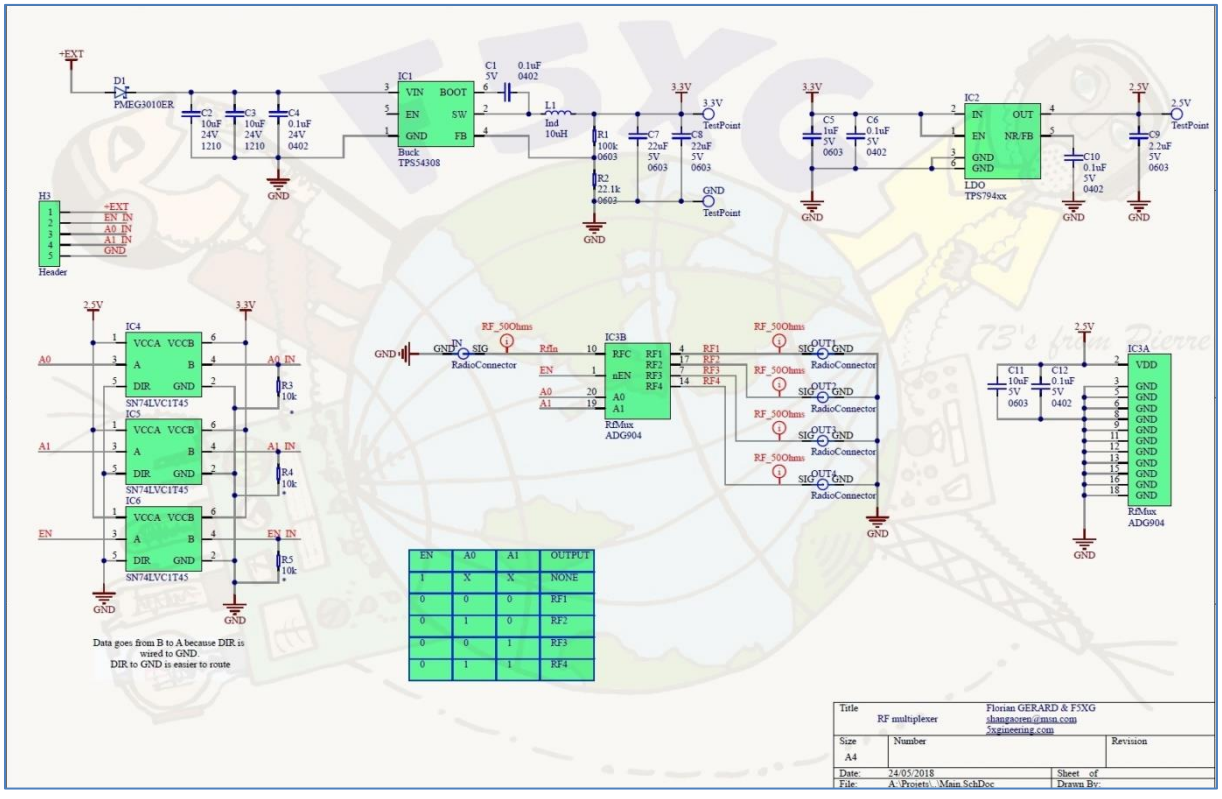


Figure 5 Full schematic

Address Bits

The table describes the logical levels to carry the signal through.

Remember:
There is neither input nor output; we select the "route" between RFC and RF1, 2, 3 or 4, or vice versa

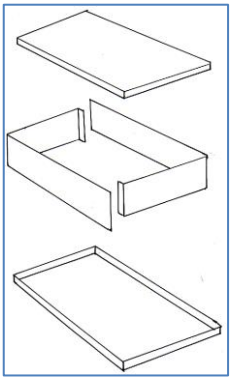
Address Bits			RFC to
EN	A0	A1	
1	X	X	NONE
0	0	0	RF1
0	1	0	RF2
0	0	1	RF3
0	1	1	RF4

Table 1 Addressing table

Enclosure

This tin plate enclosure "REF2" is available from Otto SCHUBERT GmbH : http://www.schubert-gehaeuse.de/prod01.htm
It's made of two covers and two sides to be assembled to form an efficient RF box.

You have to drill yourself the holes for the connectors.
See the dimensions on the sheet below, all dimensions are in millimeter.



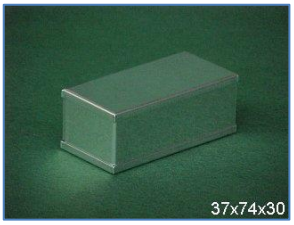


Figure 6 How to assemble

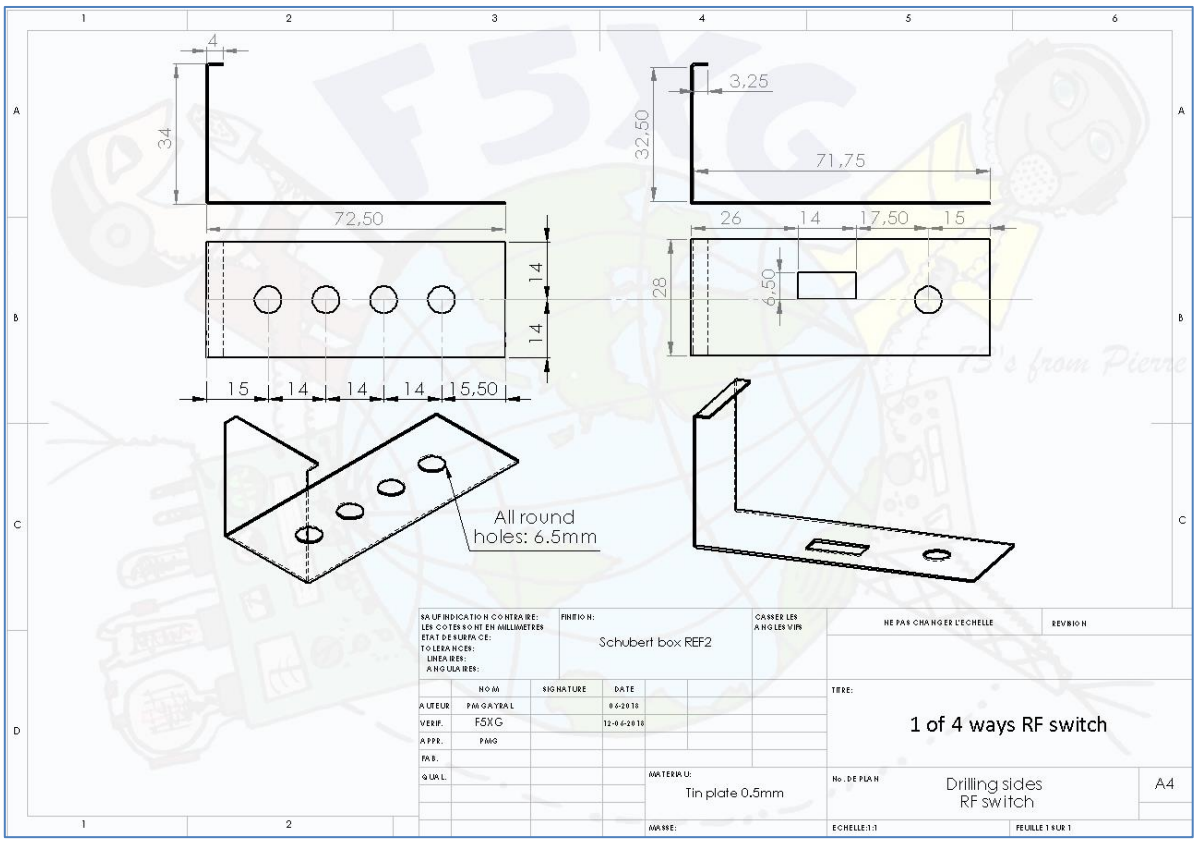


Figure 7 Drill dimensions

Bill of materials

Comment	Description	Designator	Footprint	LibRef	Qty	Value	Supplier
CerCap	Ceramic Capacitor	C1, C4, C6, C10, C12	0402_CAPACITOR_LOWDENSITY	CerCap	5	0.1uF	Reichelt
CerCap	Ceramic Capacitor	C2, C3	1210_CAPACITOR_LD	CerCap	2	10uF	Reichelt
CerCap	Ceramic Capacitor	C5	0603_Capacitor_LowDensity	CerCap	1	1uF	Reichelt
CerCap	Ceramic Capacitor	C7, C8	0603_Capacitor_LowDensity	CerCap	2	10uF	Reichelt
CerCap	Ceramic Capacitor	C9	0603_Capacitor_LowDensity	CerCap	1	2.2uF	Reichelt
CerCap	Ceramic Capacitor	C11	0603_Capacitor_LowDensity	CerCap	1	10uF	Reichelt
Diode	Nexperia 1A low Vf Mega Schottky barrier rectifier	D1	SOD123W	PMEG3010ER	1	LL 103B SMD	Reichelt
Header	PCB connector angled, brown, 5-pin	H3	PS 25/5W BR	Header_5x1	1	PS 25/5W BR	Reichelt
Buck	TPS54308 4.5V to 28V Input - 3A output synchronous 350kHz Step Down Converter	IC1	MO-193AA	TPS54308	1	TPS54308	Mouser
LDO	TI TPS794xx LDO regulator - ultra low noise - high PSRR - RF - 250mA	IC2	SOT223-6	TPS79425DGNR	1	TPS79425DGNR	Mouser
RF Mux	Wideband 2.5GHz - 37dB Isolation at 1GHz - 4:1 Mux	IC3	RU-20	ADG904BRUZ	1	ADG904BRUZ	Mouser
SN74LVC1T45	Single Bit Dual Supply Buffer	IC4, IC5, IC6	MO-203AB_LD	SN74LVC1T45	3	SN74LVC1T45	Mouser
RF Connector	RF Connector with signal and ground	IN, OUT1, OUT2, OUT3, OUT4	SMA	RF Connector	5	SMA SV1AFN	SV1AFN
Ind	Inductor	L1	1210_INDUCTOR	Inductor	1	10uH	Reichelt
Resistor	Resistor	R1	0603_Resistor_LowDensity	Resistor	1	100k	Reichelt
Resistor	Resistor	R2	0603_Resistor_LowDensity	Resistor	1	22.1k	Reichelt
Resistor	Resistor	R3, R4, R5	0603_Resistor_LowDensity	Resistor	3	10k	Reichelt
Option :							
Enclosure	Shielded Box Tin plate		37x74x30		1	REF2	Otto Shubert