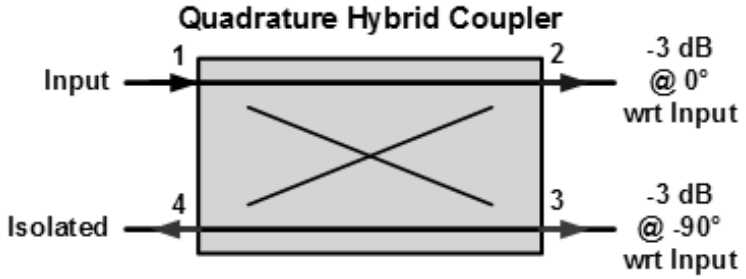
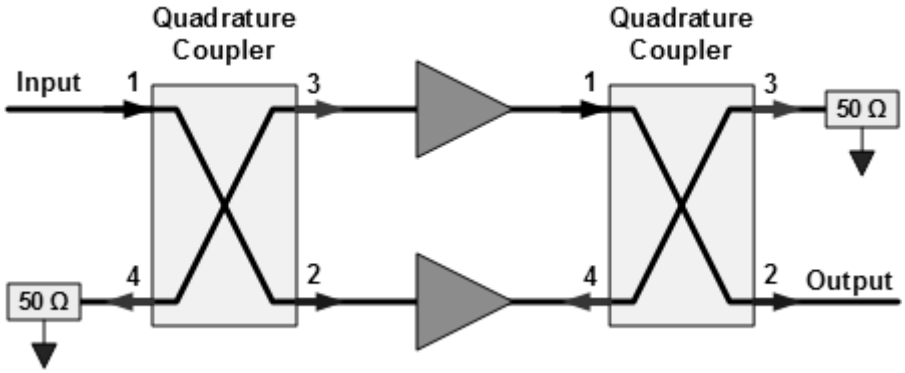
2.4 GHz hybrid 90 degree couplers for QO-10

Matthias DD1US July 27th2019

90 degree hybrid couplers are very useful for various RF applications.



For satellite operation via QO-100 for instance it can be used to combine 2 power amplifiers



or to generate a proper circular polarization combining linear polarized antennas (e.g. yagis, logarithmic periodic or monopoles in a waveguide).

Recently I was able to acquire a batch of SMD type 90 degree hybrid couplers from SOSHIN. The part number is GSC356-HYB2500. Here is a picture of such a coupler:

These couplers are perfect for the 2.4 GHz uplink frequency band of QO-100 and they can handle up 100 Watt continuous output power as they are designed for power amplifiers in base stations.

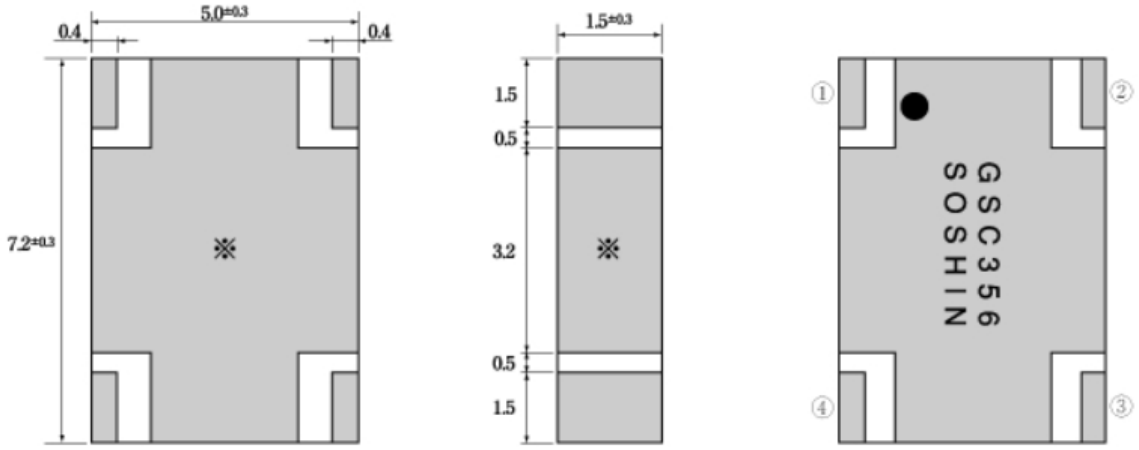
Here is a datasheet of the device:

Characteristics

GSC356-HYB2500

Impedance	50 ohm Nominal
Frequency Range	2400-2700MHz
Insertion Loss	0.25dB max (Typ. 0.2dB at 25 Deg.C)
	0.35dB max (-40 up to 125 Deg.C)
Amplitude Level Balance	0.3dB max (at 25 Deg.C)
	0.4dB max (-40 up to 125 Deg.C)
Phase Balance	90+/-3 Degrees
V.S.W.R	1.18 max
Isolation	23dB min
Input Power	100W Avg/CW
Operating Temperature	-40 up to 125 Deg.C
Storage Temperature	-40 up to 85 Deg.C
	(-20 up to 35 Deg.C for tape and reel materials)

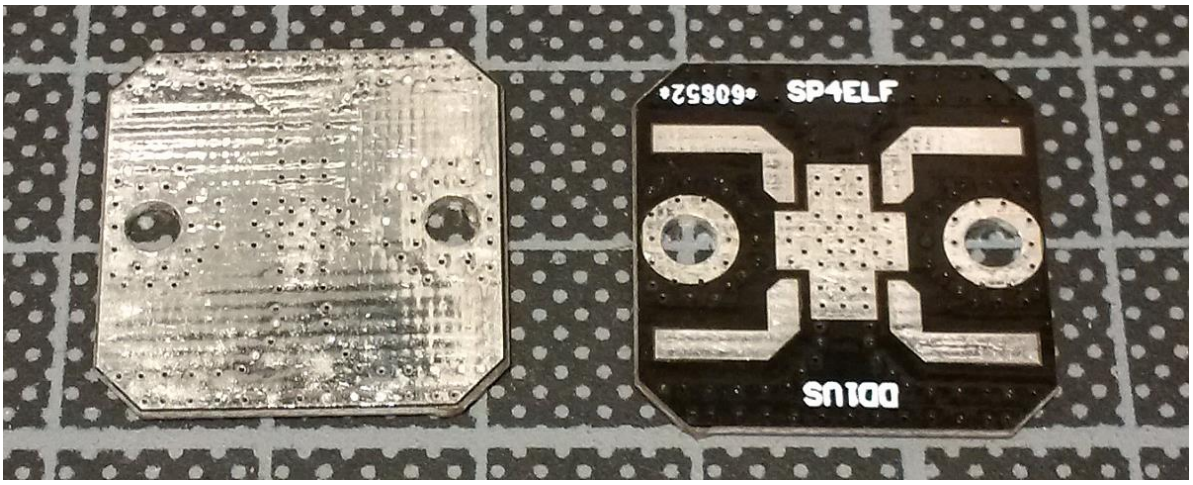
Dimension (Unit : mm)



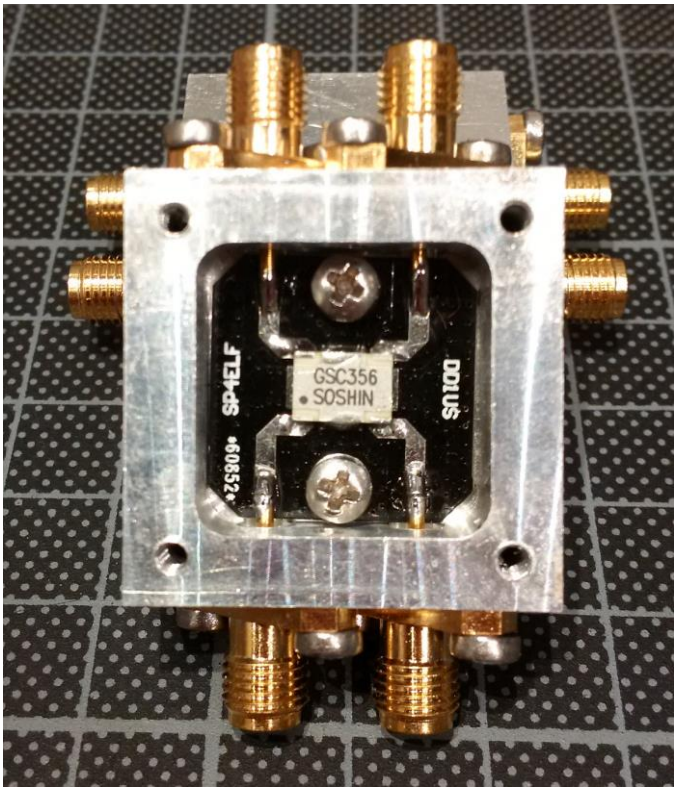
Tolerance : ±0.2

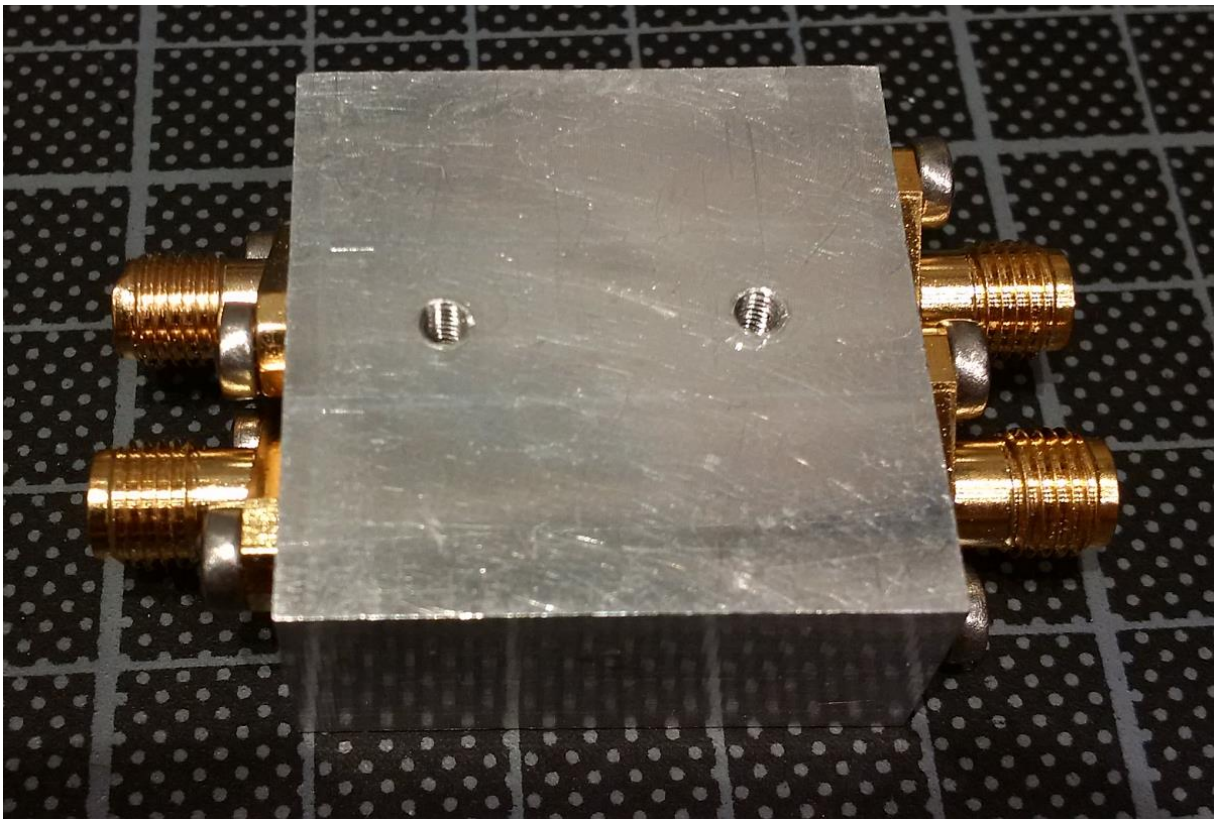
Terminal	
①	IN
②	0° OUT(S21)
③	90° OUT(S31)
④	ISO
※	GND

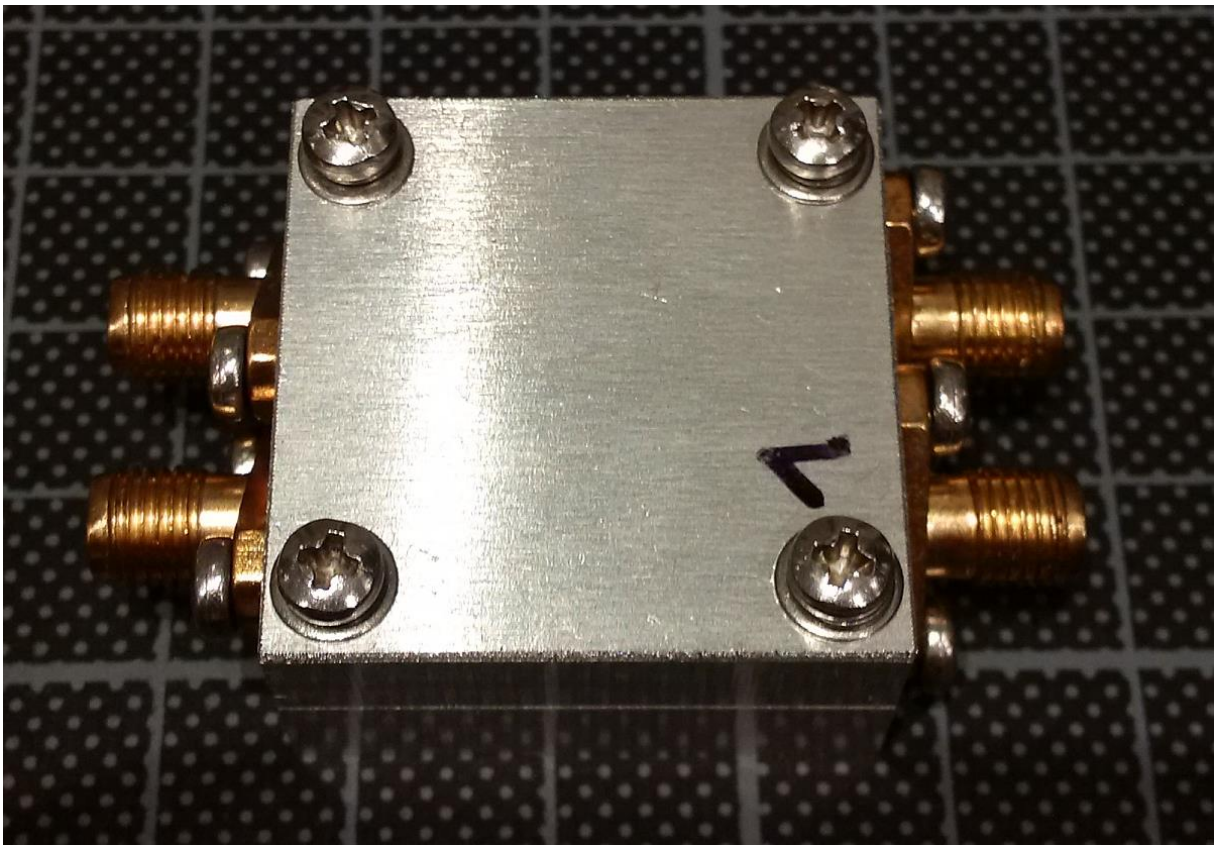
The SMD type device is supposed to be soldered on a PCB. Marek SP4ELF was kind enough to help me designing and producing such a PCB to fit it in a milled aluminium encasing. Here is a picture of the blank PCB before mounting the coupler on it:



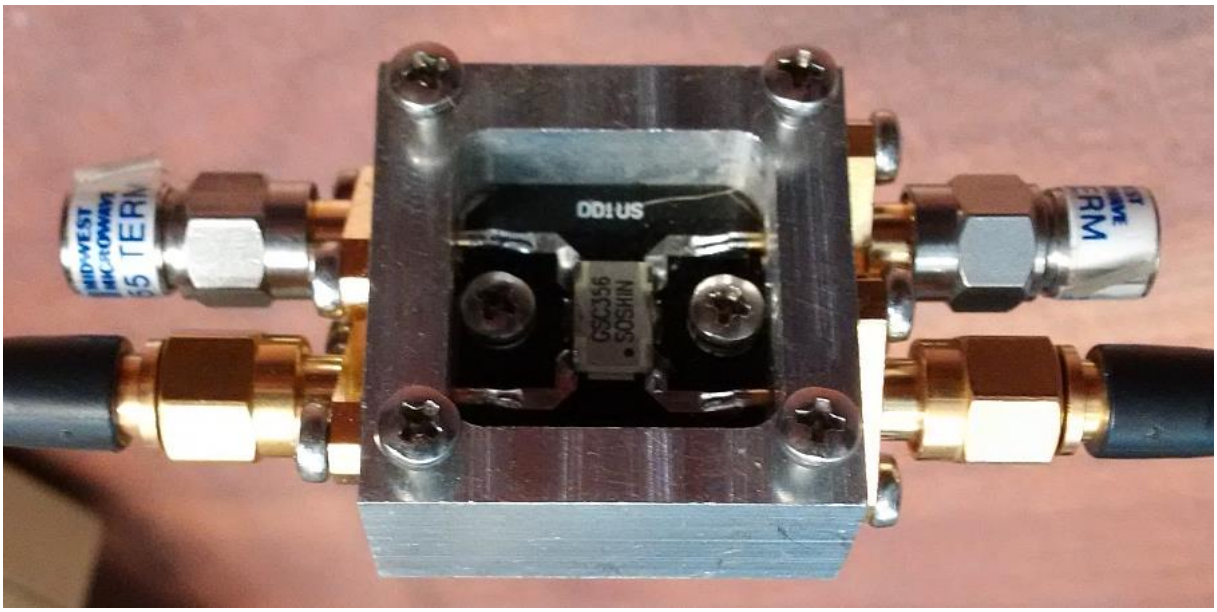
The PCB can be mounted in a specially milled aluminium encasing with 4 SMA jacks. Here are pictures of the finished coupler:





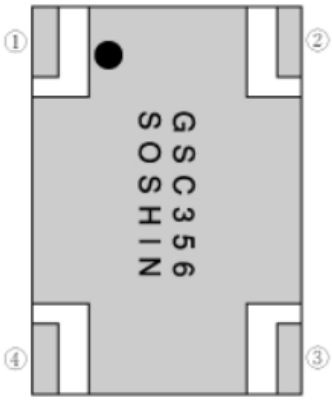


Finally, here are some measurements which basically verified the specified parameters which were given in the datasheet above.



The measurements were done with a HP8753E vector network analyser. There measurement frequency was 2400 MHz but as the device is quite broadband the values are very similar in the range 2300-2500 MHz.

port 1 (with dot)	IN
port 2	Out 0 degree
port 3	Out 90 degree
port 4	ISO



S11 (1-3)	-25 dB	(VSWR 1.11)
S11 (1-2)	-21 dB	(VSWR 1.19)
S22	-21dB	
S33	-26dB	
S21	-3.31 dB	-164.55 degree
S31	-3.43 dB	+104.75 degree
S41	-22.5dB	(isolation)

In summary here are the measured values:

Amplitude imbalance	0.12 dB
Phase imbalance	0.7 degree
Insertion loss	0.4 dB (in addition to the 3dB)
Isolation	22.5 dB

If other users of QO-100 are interested in such a coupler, I can offer the couplers in limited quantities basically at cost. The options are:

SMD coupler alone

SMD coupler with blank PCB

SMD coupler in a milled aluminium encasing with 4 SMA jacks

I hope this might help other radio amateurs to get QRV on QO-100 respectively optimize their station.

If you have questions or comments please send them to the Email address given below.

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