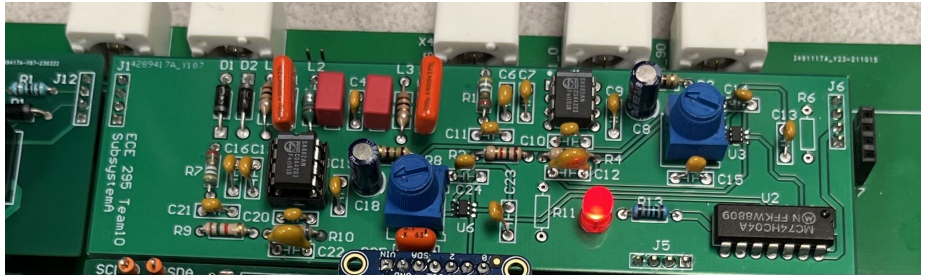


RF/Analog Design Octagon [1]



Results Reconcile with Requirements

Subsystem A Performance Review

David Li
Irving Wang

Team 010

April 29, 2023

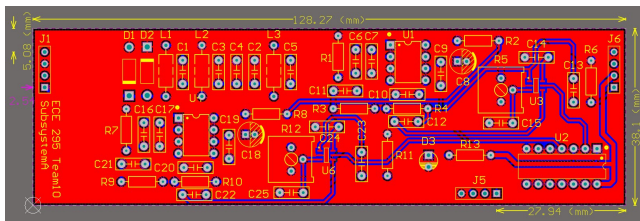


Content Overview

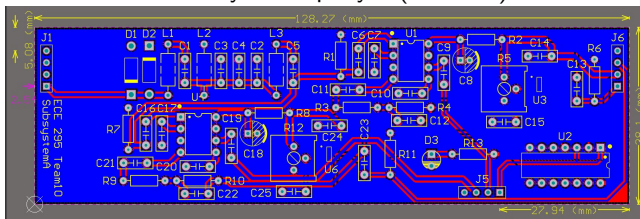
- Subsystem PCB routing, placement
 - Altium implementation
 - Assembling & soldering results
- Subsystem testing results, radio integration prospects (results)
- Monte Carlo Analysis in subsystem manufacturing (Next Steps)

Altium implementation of PCB

Overlay with clear names that match with the schematic to enhance correctness



PCB Layout Top layer (2D view)

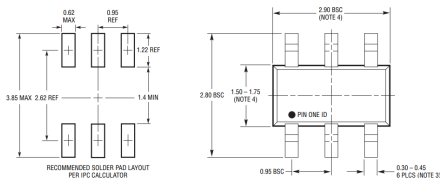


PCB Layout Bottom layer (2D view)

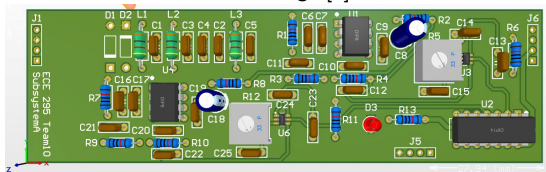
Altium implementation of PCB

Footprint selection and design

- matching with the physical component pinout diagram & dimensions
- unique identifiers to confirm orientation of components
- enable 3d models to further enhance visibility



S6 Package [2]

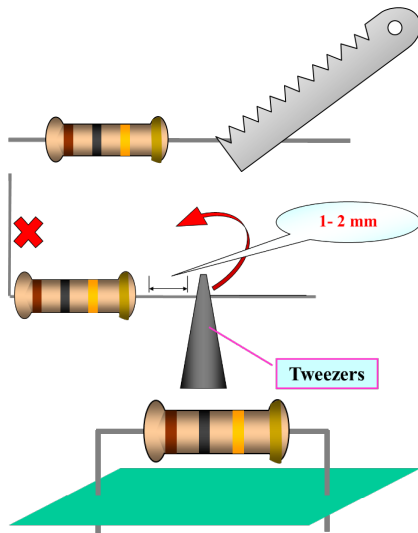


PCB Layout (3D view)

Assembling & soldering results

Preparation before soldering

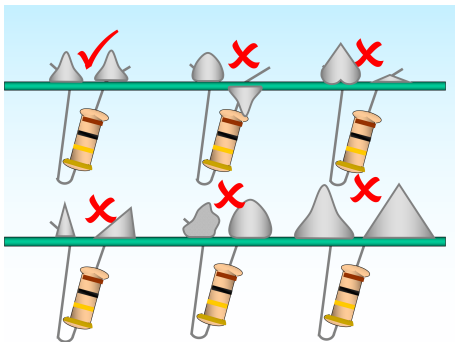
- 1 Component value measurement
- 2 Remove oxidation layer
- 3 Component bending
- 4 Component placement
- 5 Apply the right amount of solder



Assembling & soldering results

Manual Visual Inspection (MVI)

- catch defects & broken joints

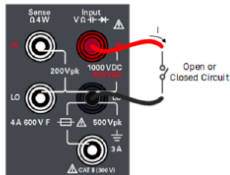


No-clean flux applied to further remove oxides and achieve improvement in the solidity of the soldering joints.

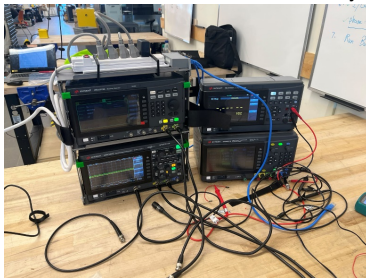
Assembling & soldering results

Continuity Testing

- Detect discontinuities & short circuits

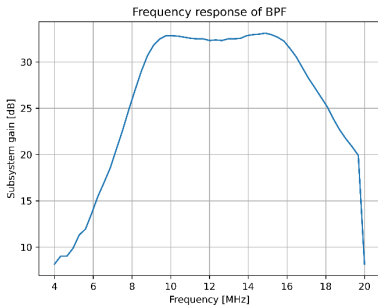


Connection on the multimeter for continuity testing

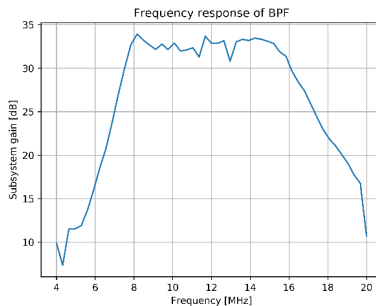


BPF maximally flat response

Testing Result



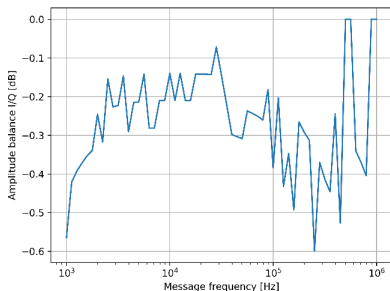
Given solution



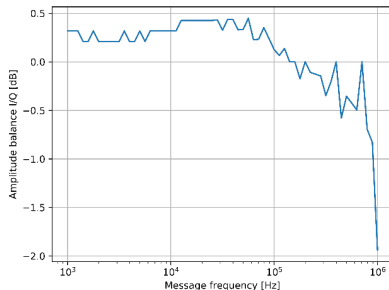
Testing Result improved on the given solution

Amplitude balance between I/Q

Testing Result



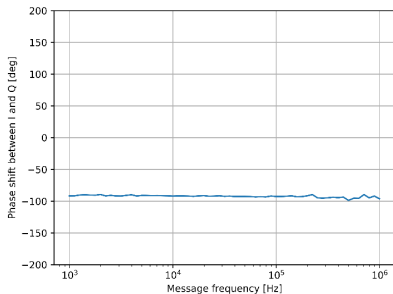
Given solution



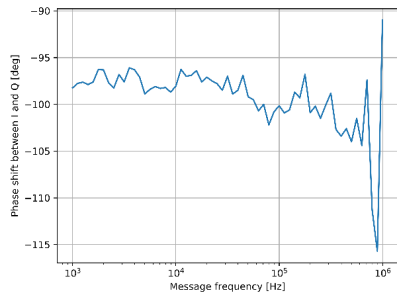
Amplitude balance I/Q 0.0-0.6 is within the range of 1dB specified in the requirements

Phase difference between I/Q

Testing Result



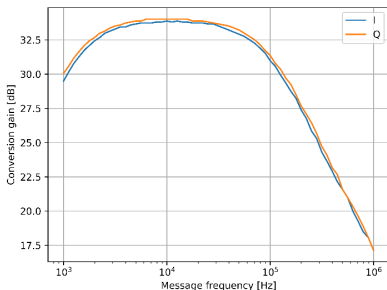
Given solution



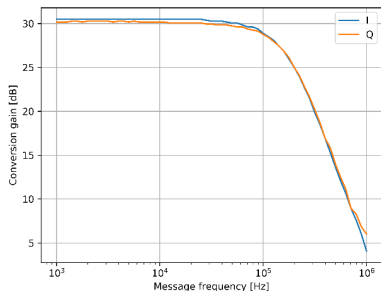
Testing Result improved on the given solution

Gain and graph of lowpass filter

Testing Result



Given solution



Testing Result improved on the gain and meet the requirement of the upper cutoff frequency of 96 kHz

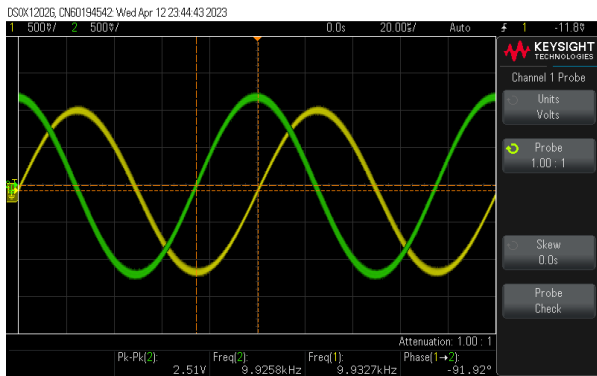
“Your design is better than the reference solution!”

- Professor Hum

Subsystem testing results

Testing set up

RF Frequency: 14Mhz , 50mVpp Sinusoid IO Frequency: 14.01Mhz 90 degrees in phase message signal frequency: 10khz

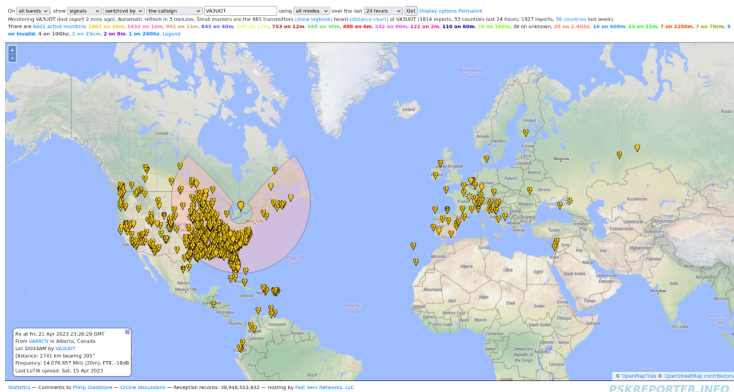


Oscilloscope traces showing the expected conversion gain of the entire subsystem and output signal frequency

Radio integration prospects (results)

Receiver portion of the SDR alongside with team 21 & 35.

SDR successfully picked up 881 unique radio stations across the world over a period of 24 hours.



Next Steps

Minor PCB layout revision

Collaboration with other subsystems

Monte Carlo Analysis

Monte Carlo Analysis in subsystem manufacturing

Monte Carlo analysis helps to predict the risk of defects in PCB manufacturing

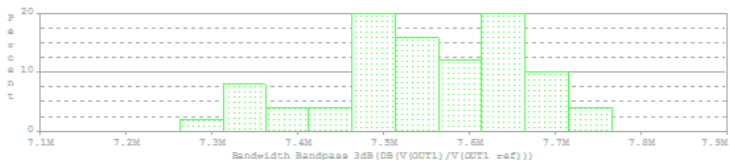
Position	Normalized parameter value	Digi-key code	Tolerance
L1	1uH	8230-20-RC	±10%
L2	220nH	8230-04-RC	±10%
L3	1uH	8230-20-RC	±10%
C1	200pF	BFC237525201	±3.5%
C2	33pF	FKP2O100331D00KSSD	±10%
C3	150pF	FKP2C001501D00JSSD	±5%
C4	680pF	FKP2C006801D00HSSD	±2.5%
C5	200pF	BFC237525201	±3.5%

The performance indicators of concern are the bandwidth and center frequency of the bandpass filter

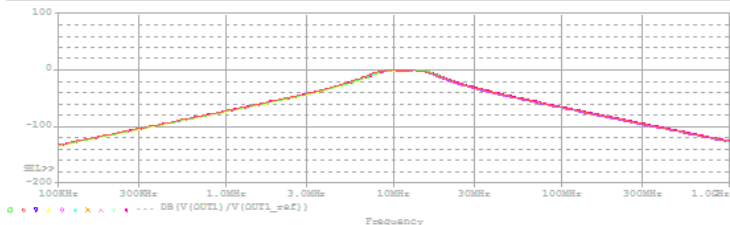
Monte Carlo Analysis in subsystem manufacturing

Bandwidth within the range of 7.0-8.0Mhz

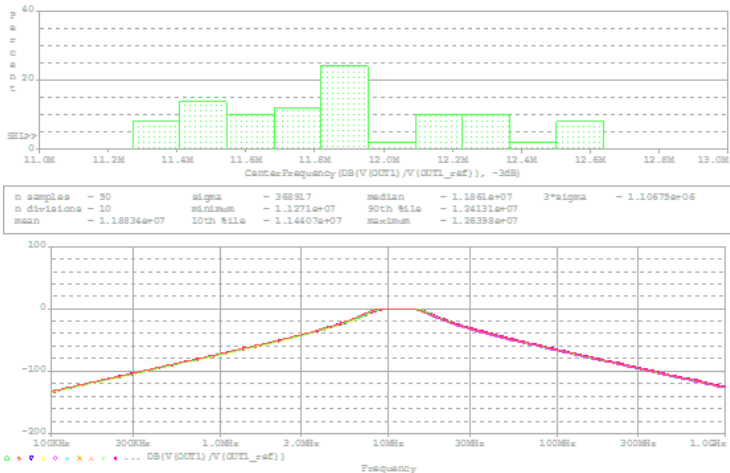
Center frequency within the range of 11-13 Mhz



n samples	- 50	sigma	- 112819	median	- 7.55713e+06	3*sigma	- 338456
n divisions	- 10	minimum	- 7.26224e+06	90th %ile	- 7.67366e+06		
mean	- 7.54822e+06	10th %ile	- 7.36556e+06	maximum	- 7.76337e+06		



Monte Carlo Analysis in subsystem manufacturing



Subsystem Unit Functionality Test

	Measured Result	Compare to ICD Requirement	Compare to reference solution
I/Q 90 degrees apart in phase	Pass	Fully met	Improved on given solution graph
I/Q amplitude-balanced	Pass	Fully met	N/A
Output not exceeding 5v	Pass	Fully met	N/A
BPF maximally flat response with center 12Mhz	Pass	Fully met	Improved on given solution graph
Minimum 30db gain post-mixing	Pass	Fully met	Improved on given solution graph
First-order filtering with LPF	Pass	Fully met	N/A
Implementing the active-low transmit-enable signal	Pass	Fully met	N/A

Results Reconcile with Requirements

Reference

- [1] Behzad. Razavi, RF Microelectronics, 2nd Ed., Boston, MA: Prentice Hall, 2012.
- [2] LT6230, Linear Technologies 215MHz, Rail-to-Rail Output, 3.5mA Op Amp Family Datasheet