Electronic Countermeasures for Radar

Preliminary Design Review

Hunter Scott
Om Kapoor
Thomas Helton

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School of Electrical and Computer Engineering

Project Overview

- Develop a radar and an ECM module
- Small-scale, low-cost radar and ECM experimentation
- Designed for hobbyists and educators
- Cost: $805

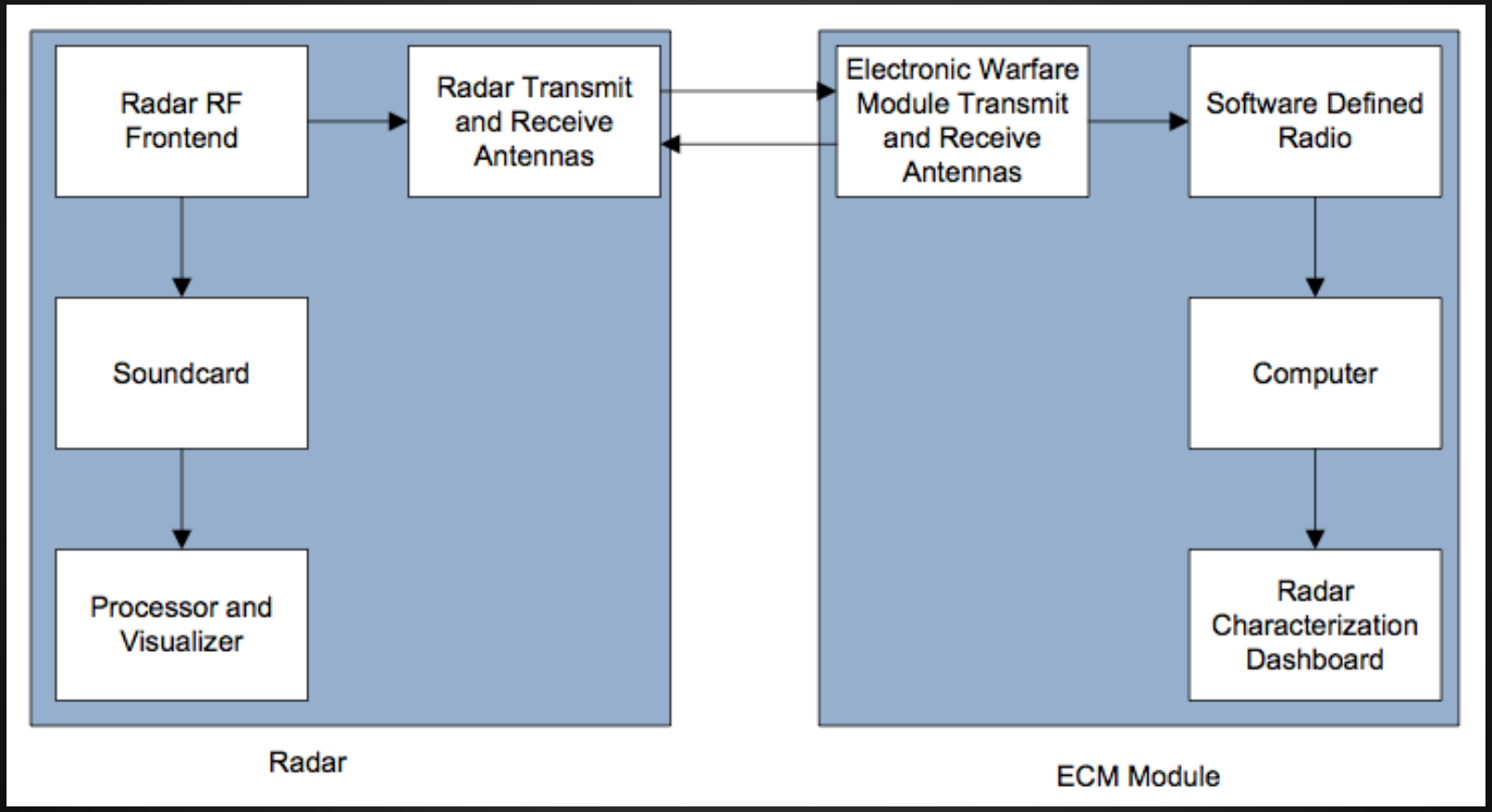
Technical Objectives

- Low-cost implementations
- Build MIT Cantenna Radar
- Program and test countermeasure
- Real-time radar imaging

Current Status

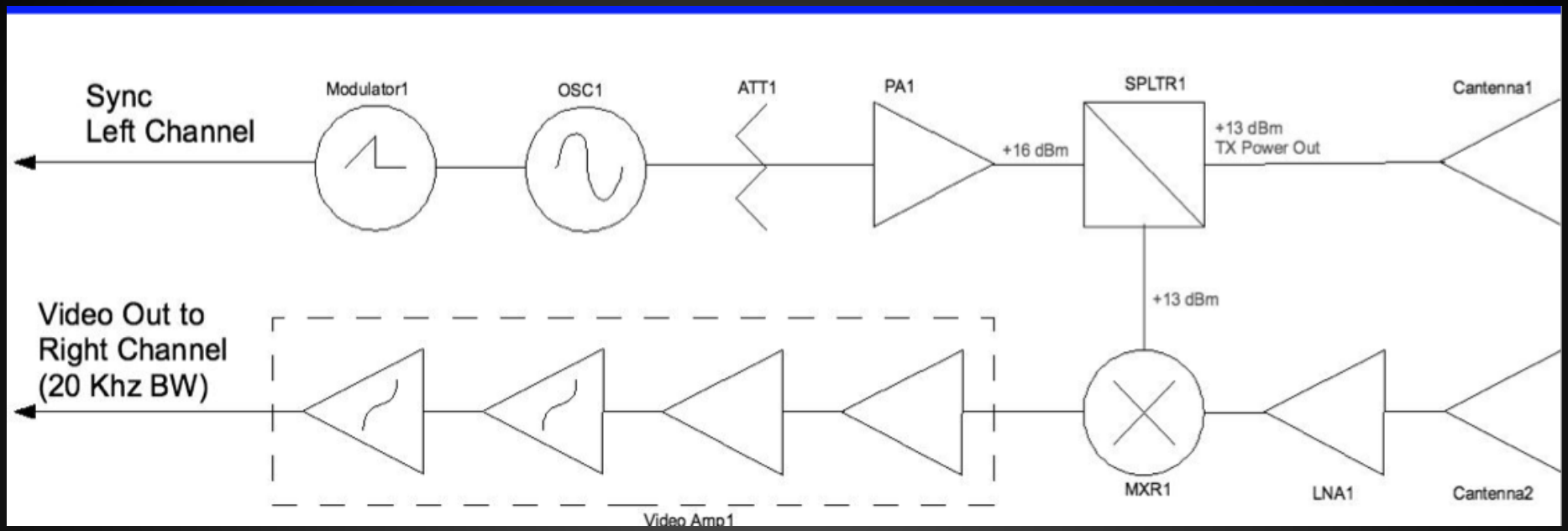
- Built and tested functioning radar prototype
- In process of programming ECM
- In process of programming real-time imaging

Design Approach



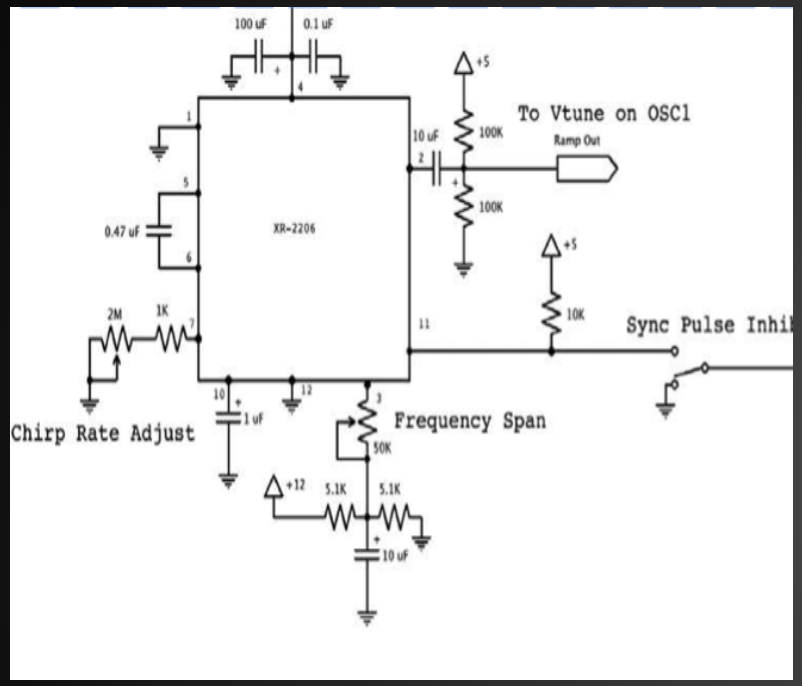
NEW ORLEANS FAMOUS
French
Market
COFFEE AND CHICORY
Medium-Dark Roast
ELENCO PRECISION
MODEL 9438

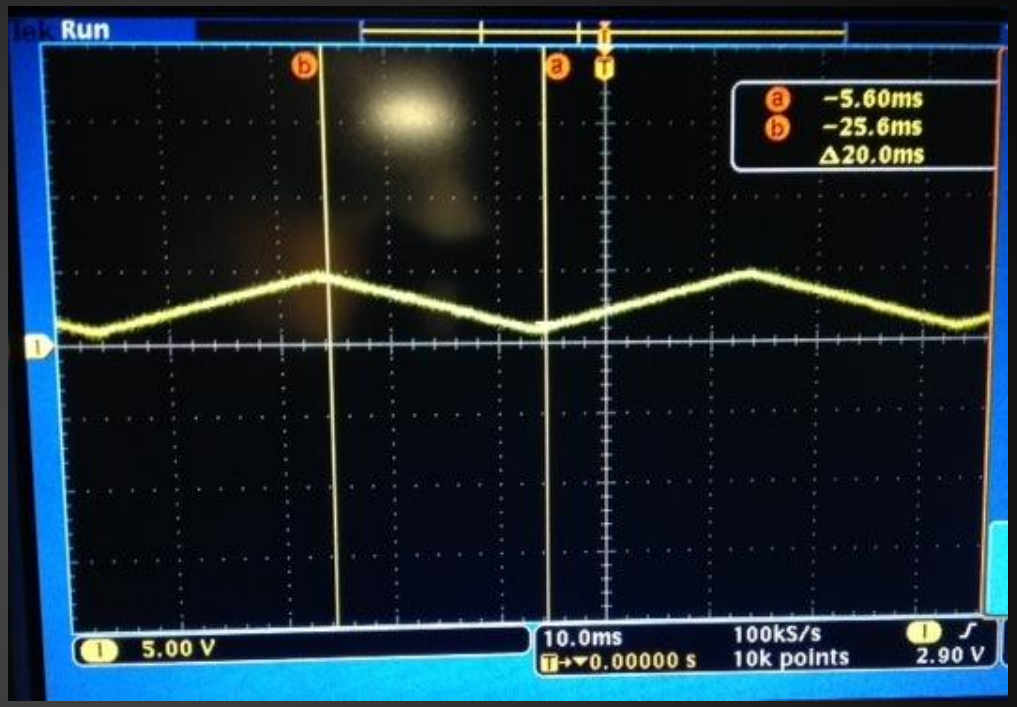
Block Diagram of Radar



- Frequency Modulated Continuous Wave Radar
- Operates in the 2.4 Ghz range
- Max Range ~ 1Km for 10dBsm
- Data and signal processing in MATLAB

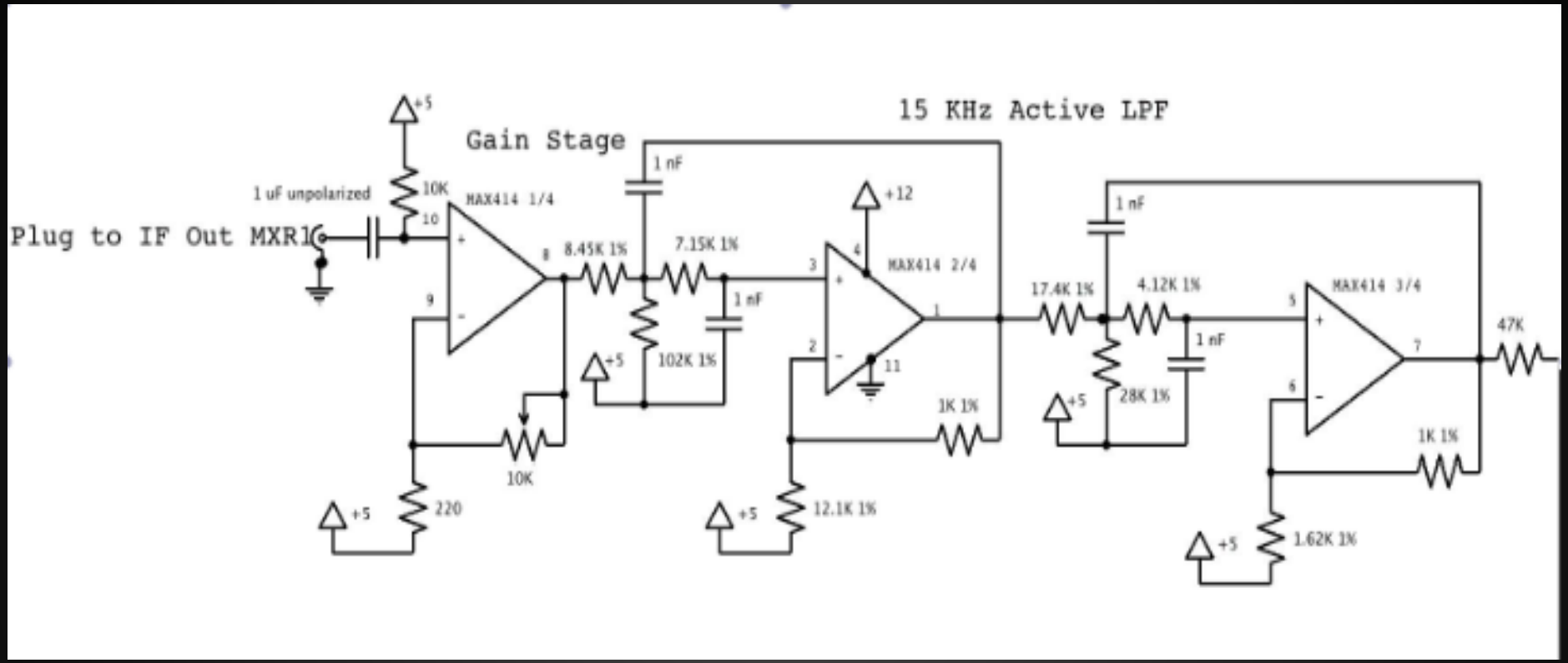
Modulator





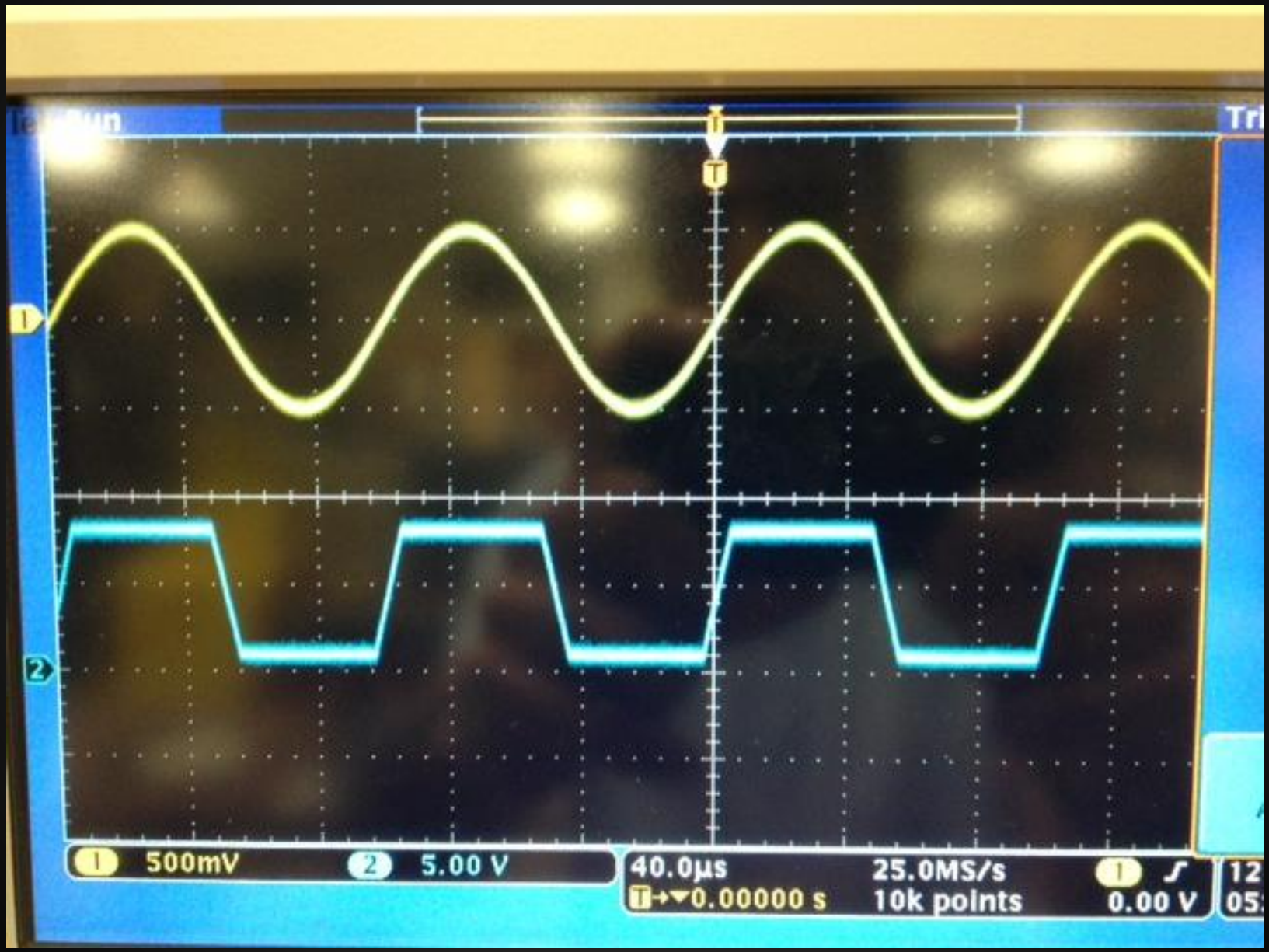
- Modulates the Vtune pin of the Oscillator.
- Vtune pin is proportional to the transmit frequency of the oscillator.
- Linear ramping of Vtune causes the oscillator to produce a linear FM chirp.
- Also connected to left audio input channel to produce a trigger signal synchronized with transmit

Video Amplifier

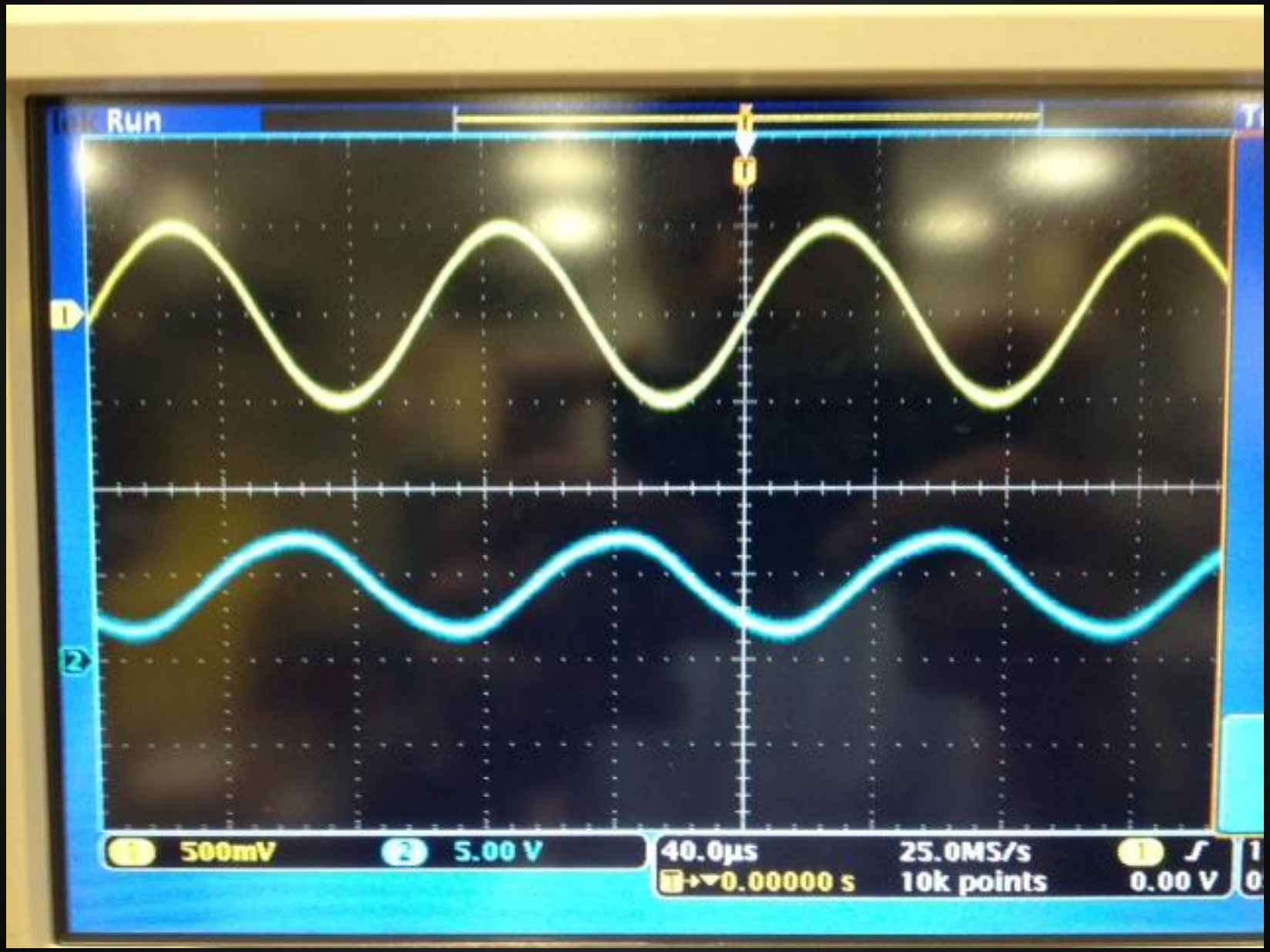


- Consists of Gain Stage and 4th order low pass filter.
- Takes output of mixer; amplifies it.
- Passed through LPF to remove noise and make it compatible with audio port input of computer.

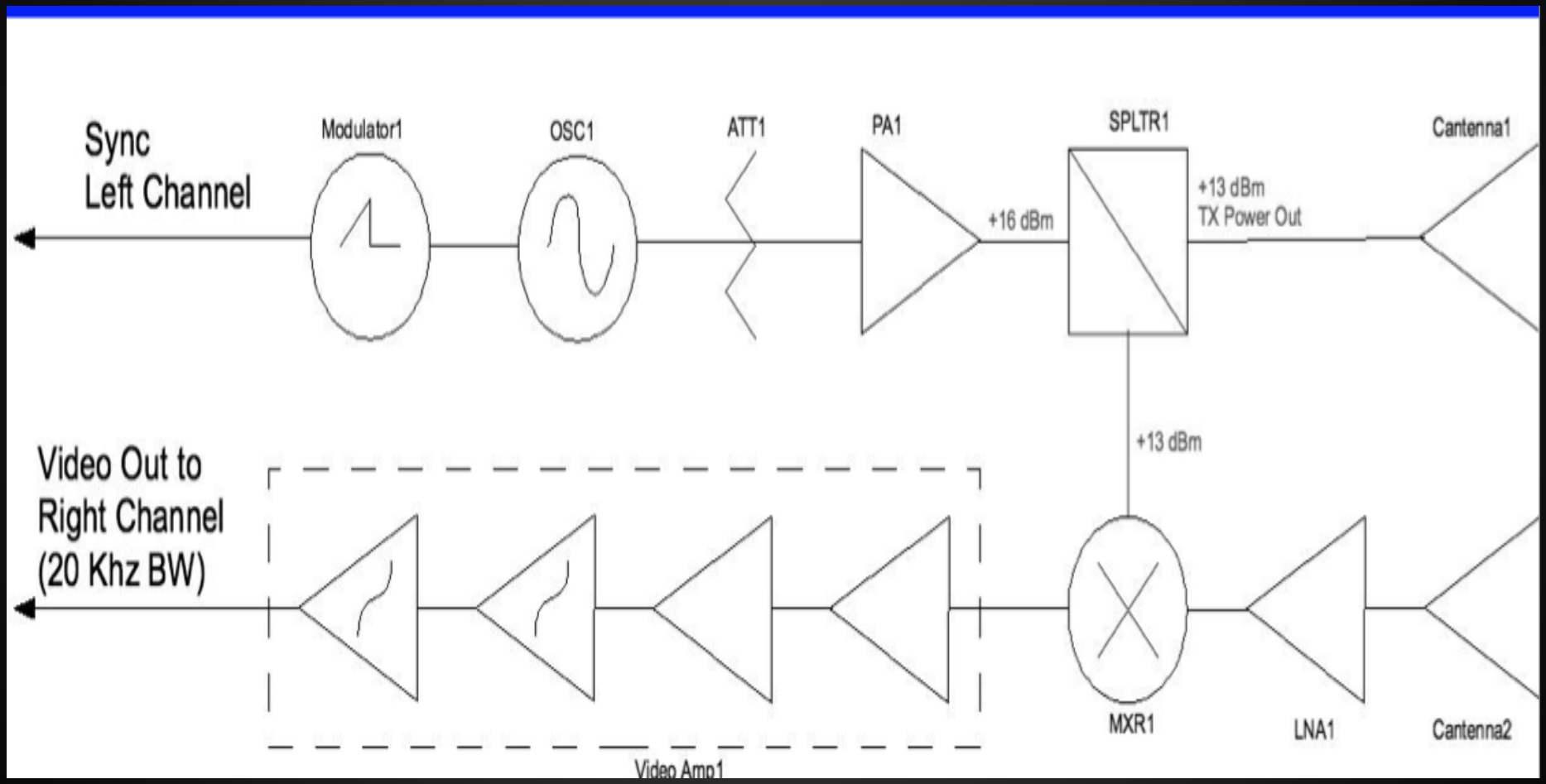
Gain Stage

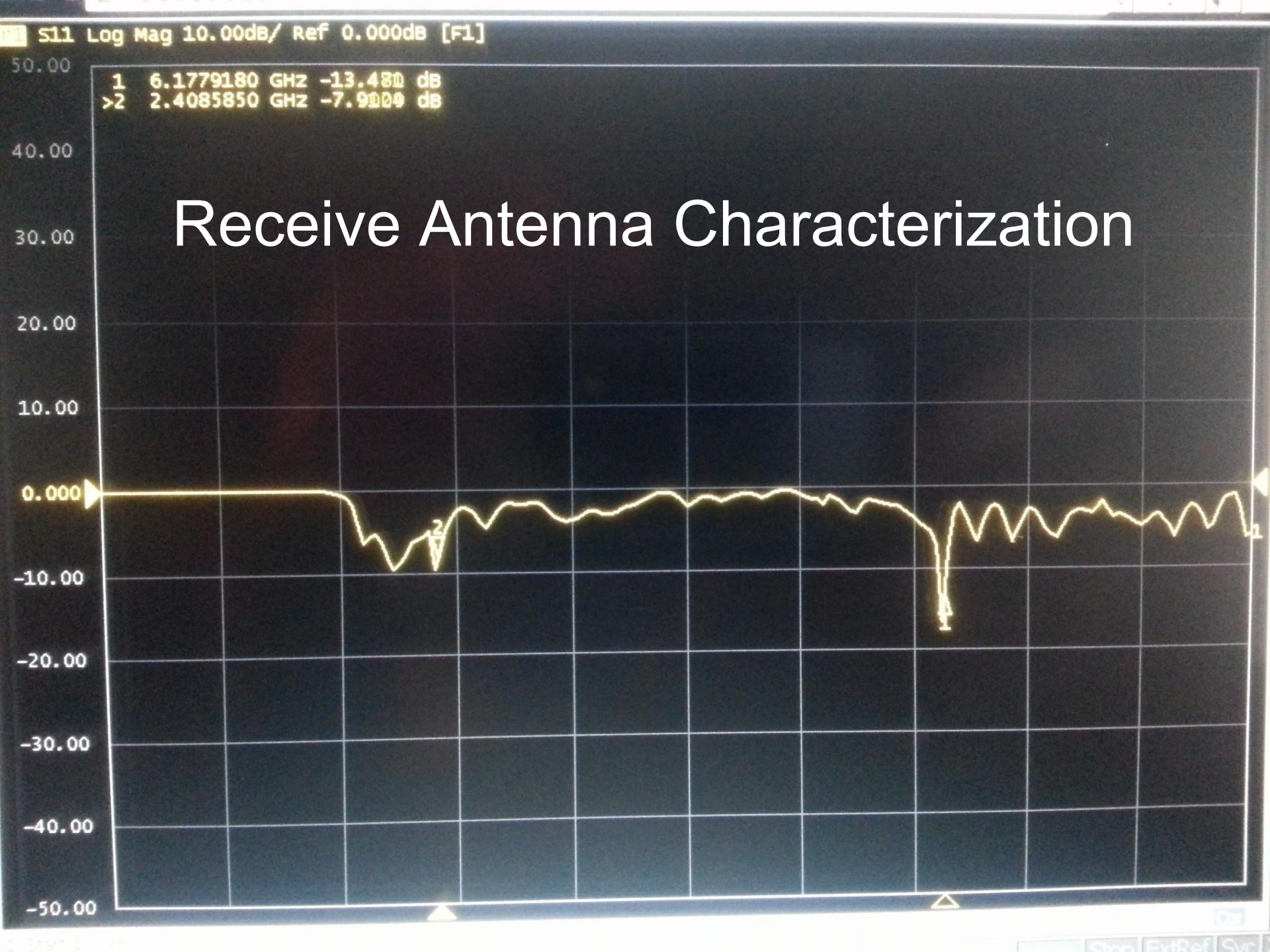


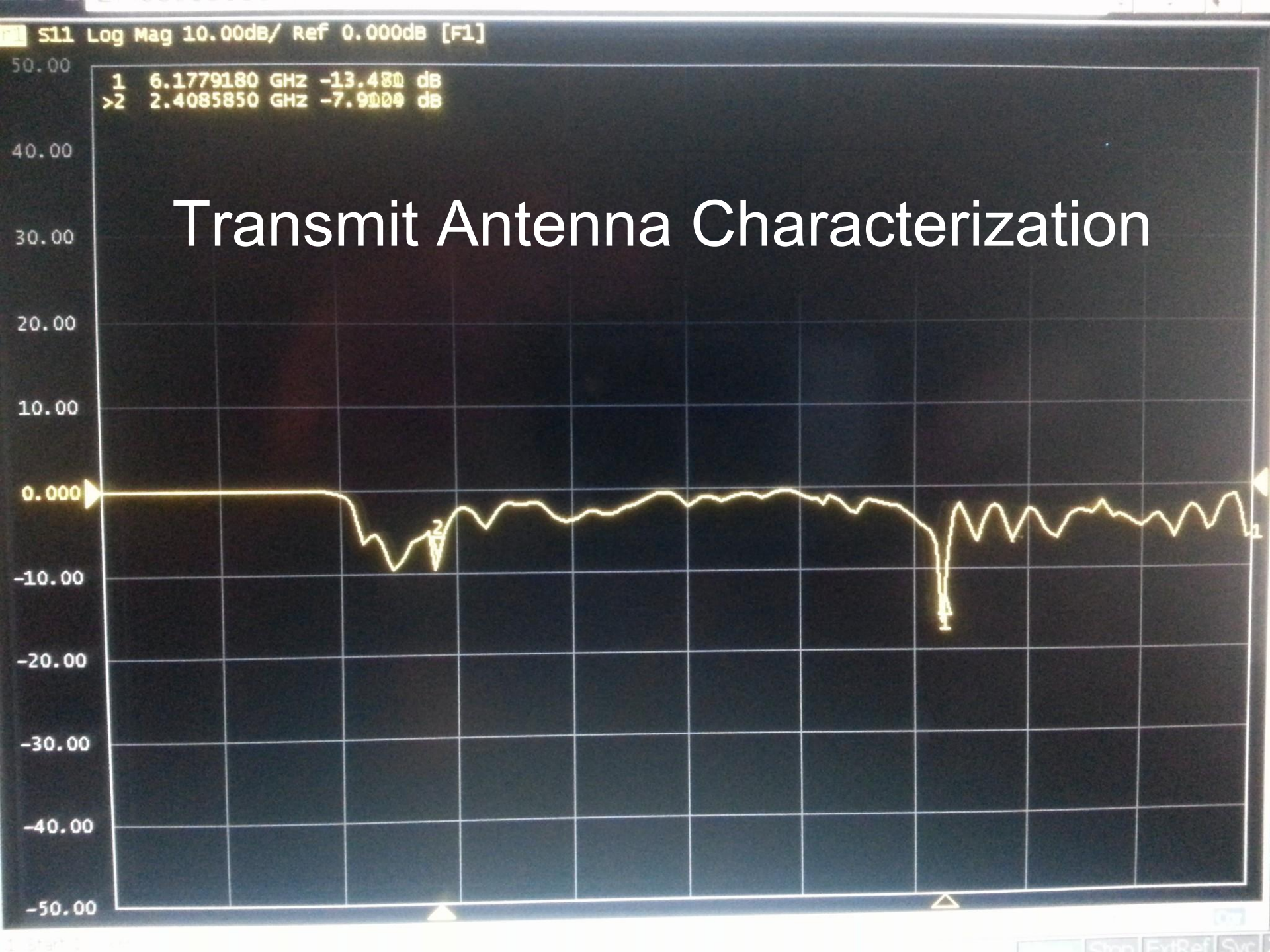
LPF output

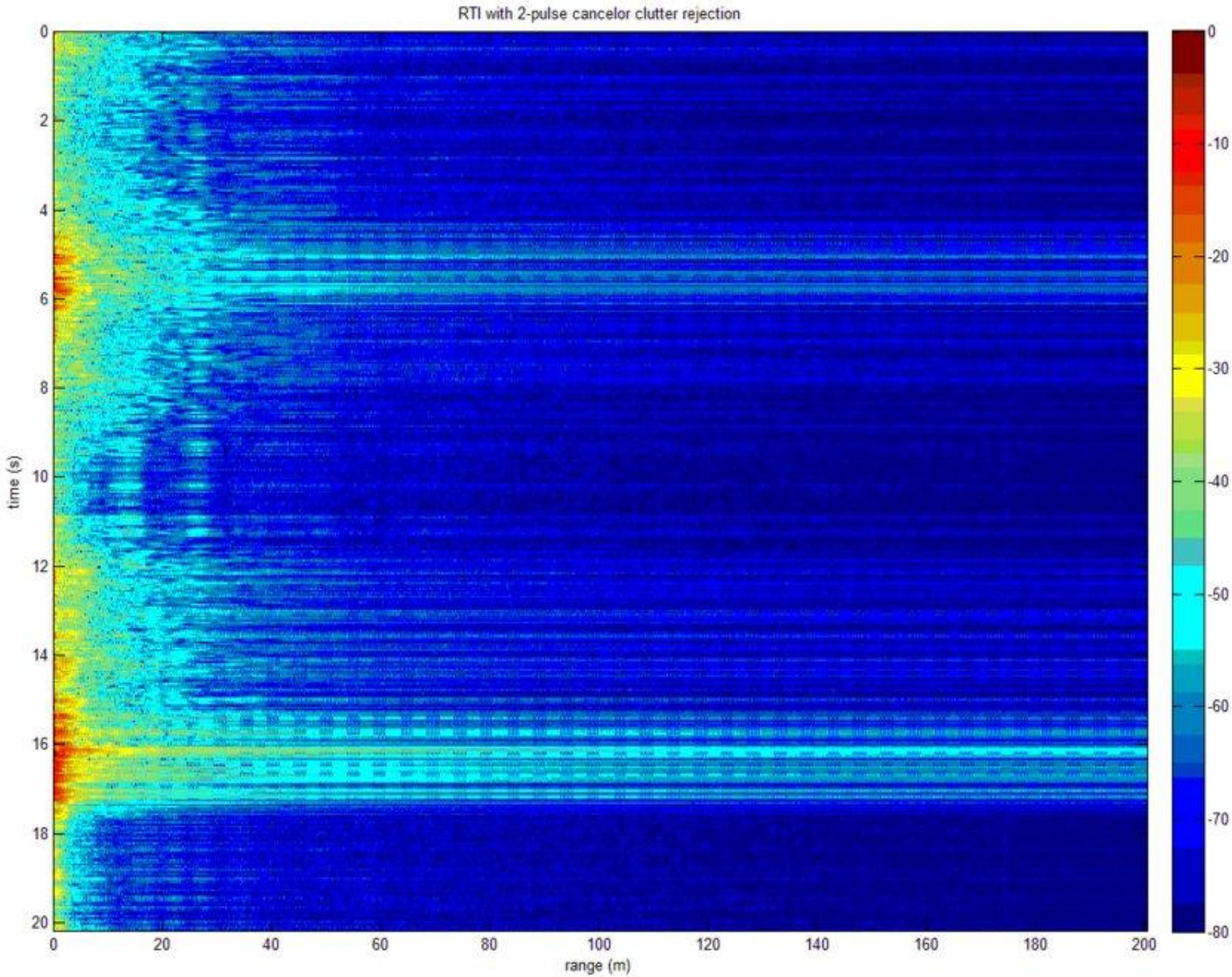


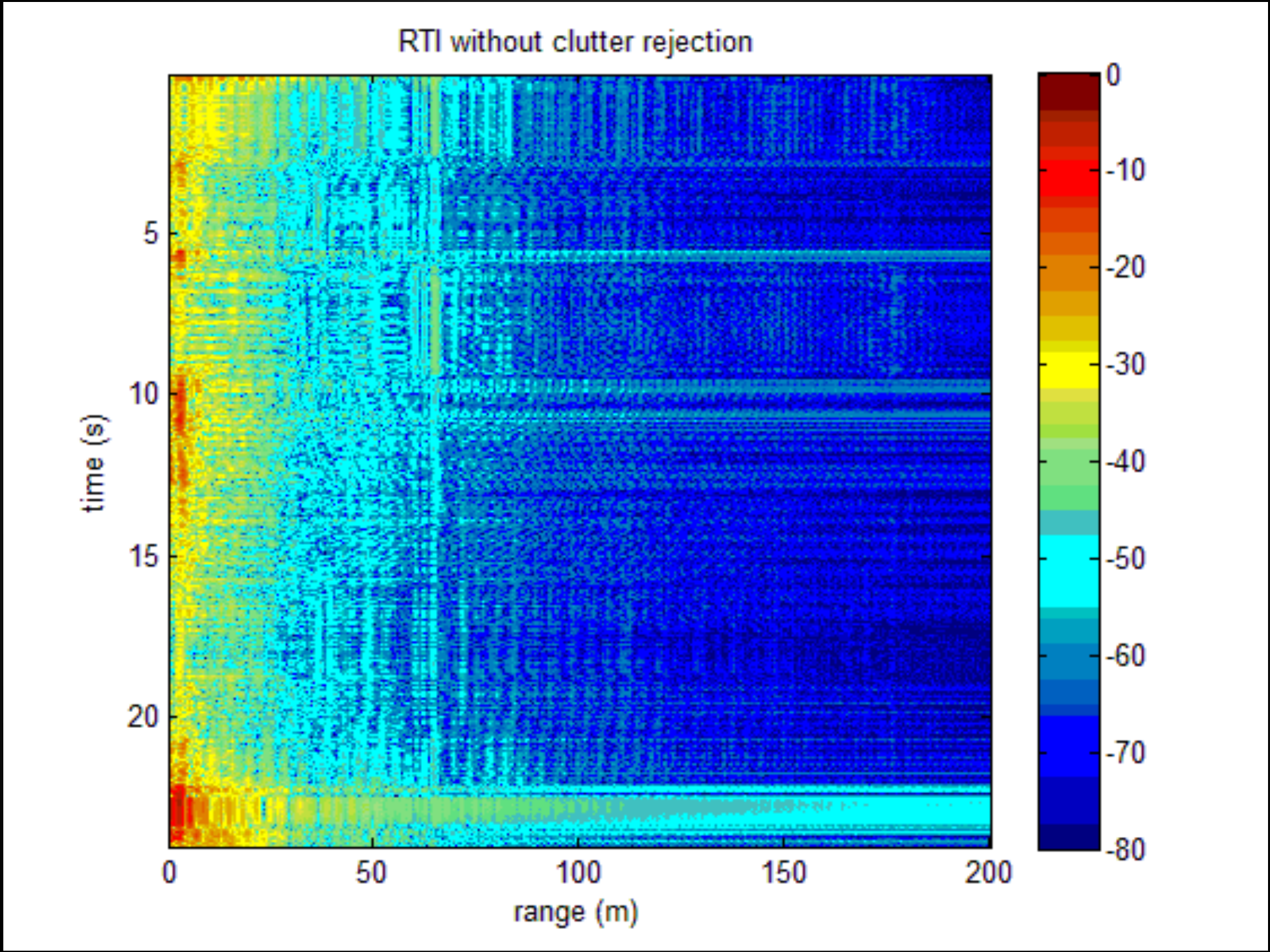
Ranging and Doppler

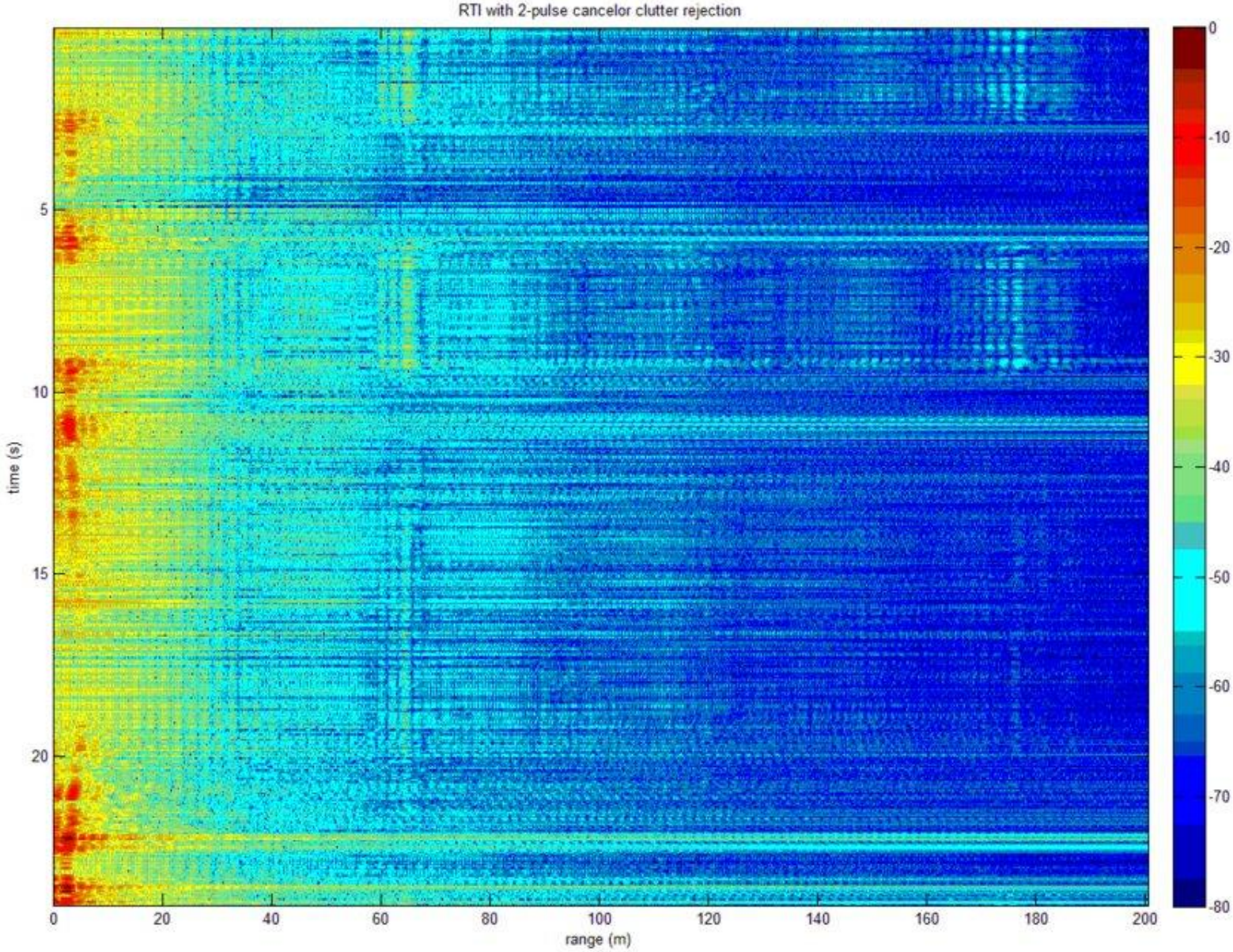



S11 Log Mag 10.00dB/ Ref 0.000dB [F1]
1 6.1779180 GHz -13.480 dB
>2 2.4085850 GHz -7.9004 dB
50.00
40.00
30.00
20.00
10.00
0.000
-10.00
-20.00
-30.00
-40.00
-50.00
Receive Antenna Characterization

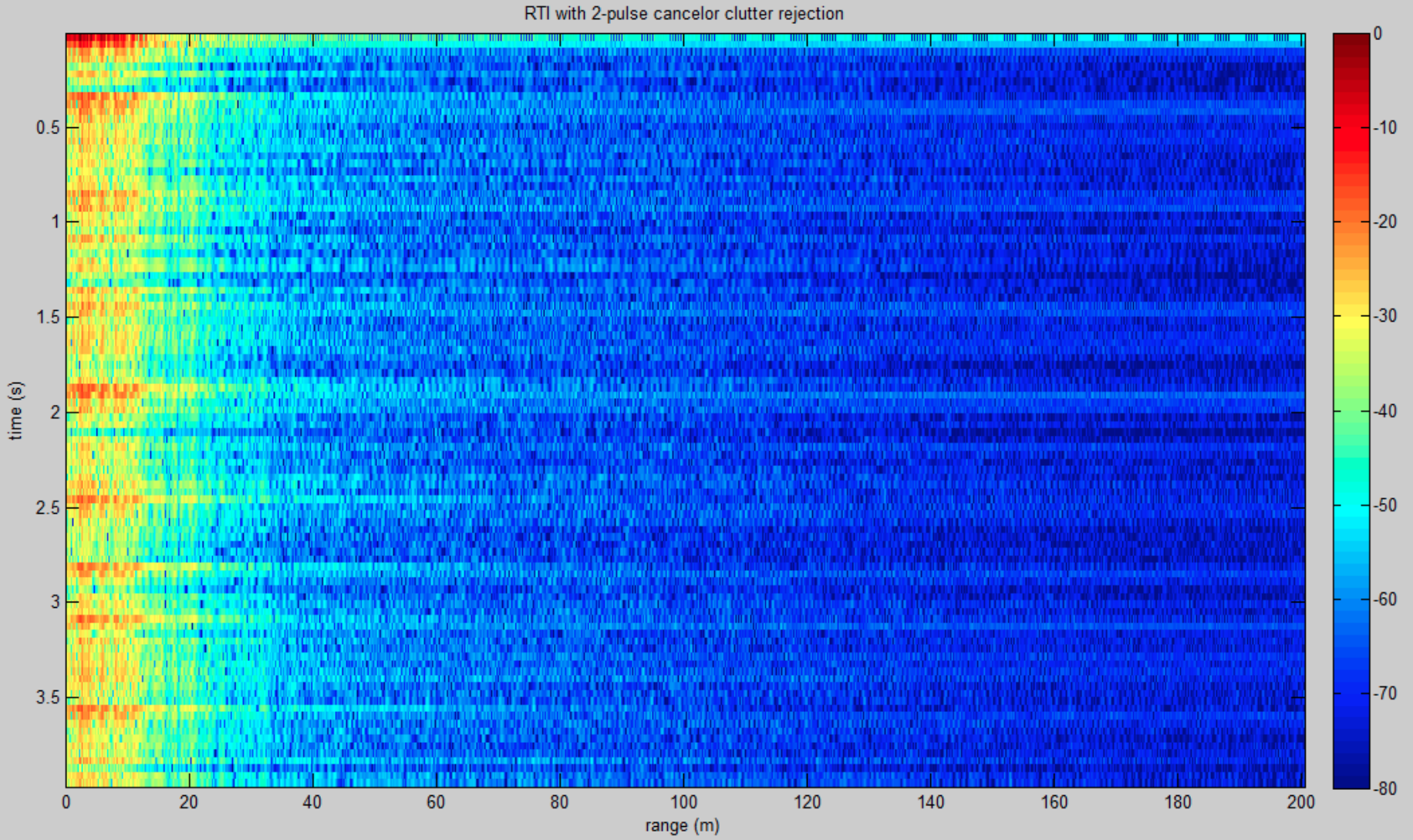

S11 Log Mag 10.00dB/ Ref 0.000dB [F1]
1 6.1779180 GHz -13.480 dB
>2 2.4085850 GHz -7.9004 dB
50.00
40.00
30.00
20.00
10.00
0.000
-10.00
-20.00
-30.00
-40.00
-50.00
Transmit Antenna Characterization


RTI with 2-pulse cancelor clutter rejection
time (s)
range (m)
0
2
4
6
8
10
12
14
16
18
20
0
20
40
60
80
100
120
140
160
180
200
0
-10
-20
-30
-40
-50
-60
-70
-80

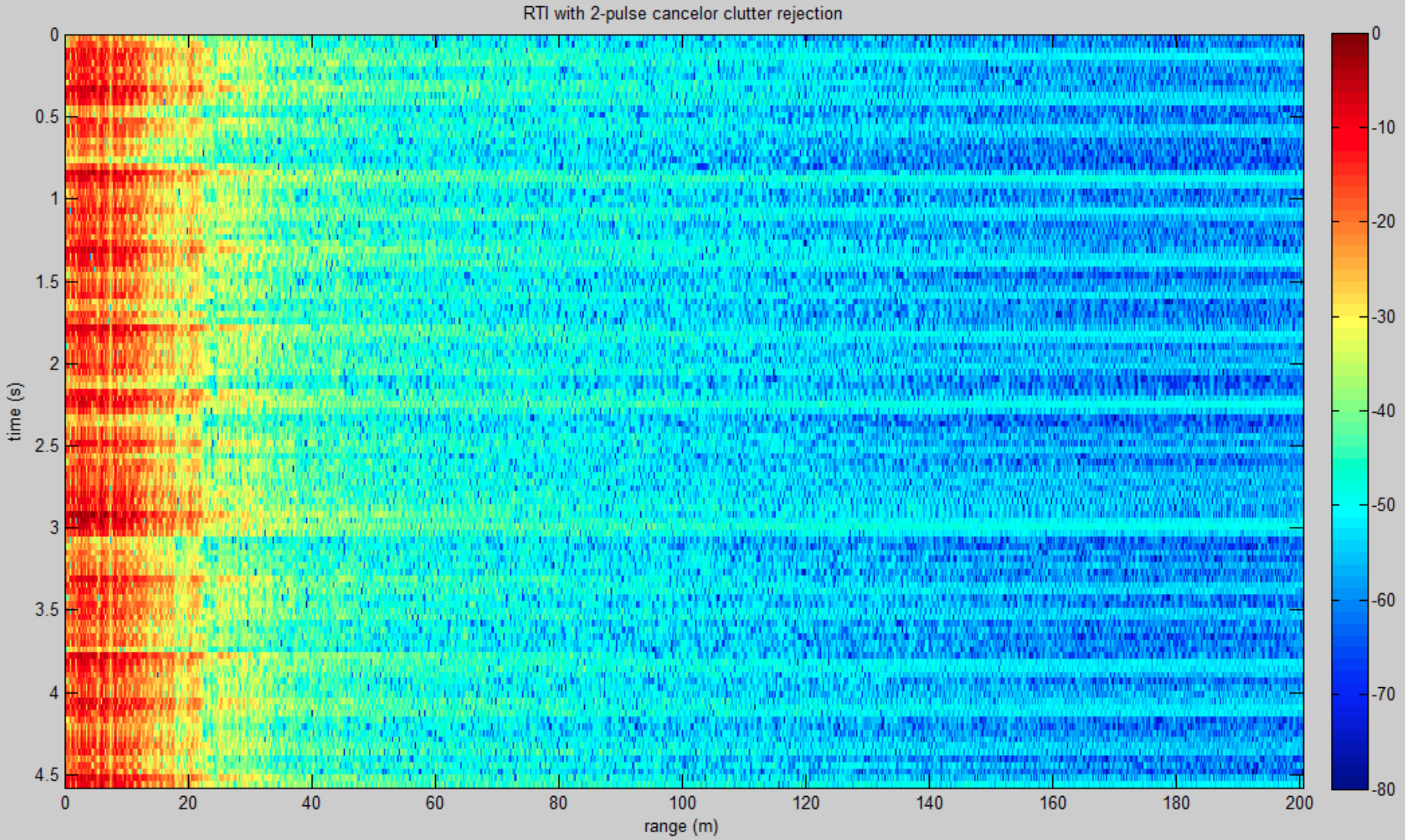

RTI without clutter rejection
time (s)
range (m)
0
50
100
150
200
5
10
15
20
0
-10
-20
-30
-40
-50
-60
-70
-80

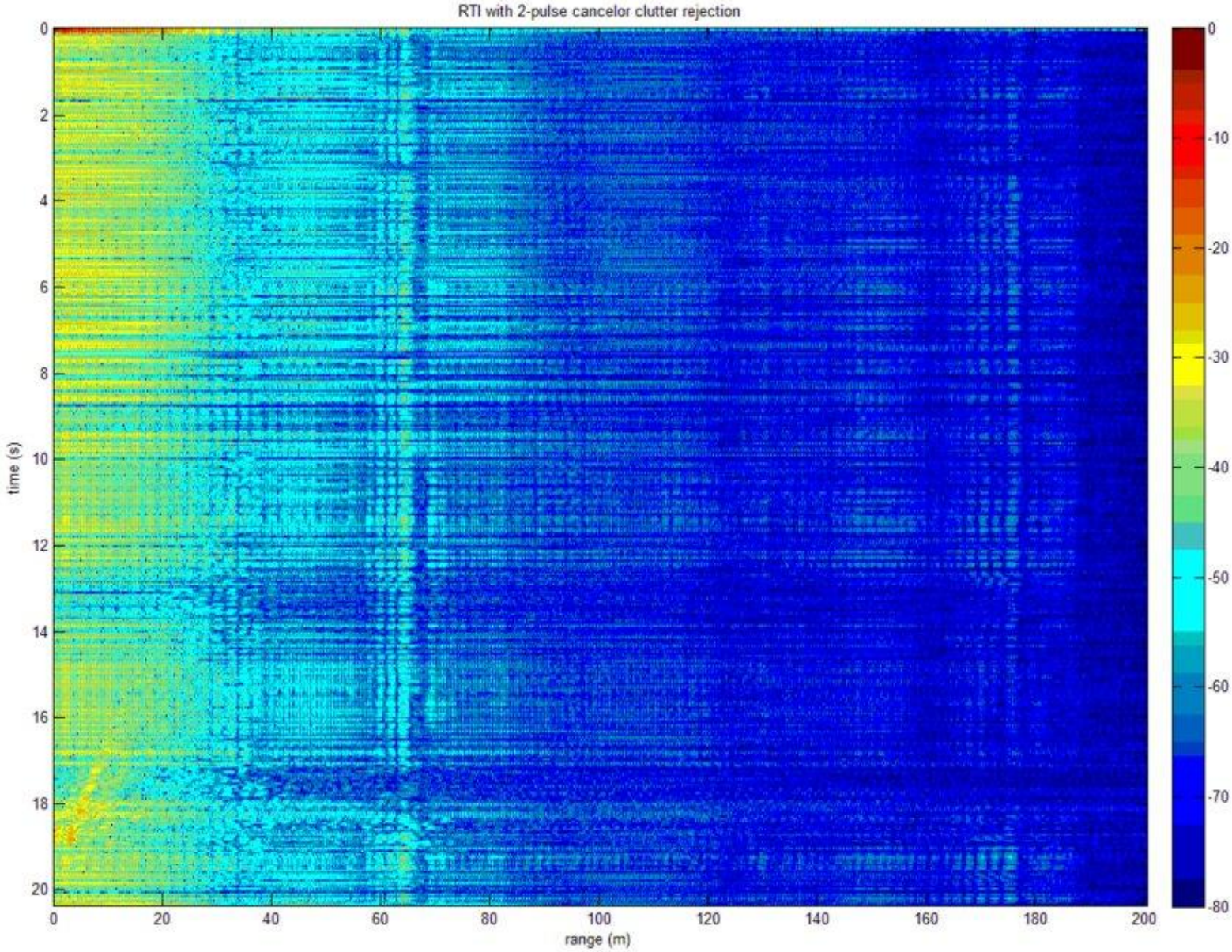

RTI with 2-pulse cancelor clutter rejection
time (s)
range (m)
0
20
40
60
80
100
120
140
160
180
200
5
10
15
20
0
-10
-20
-30
-40
-50
-60
-70
-80

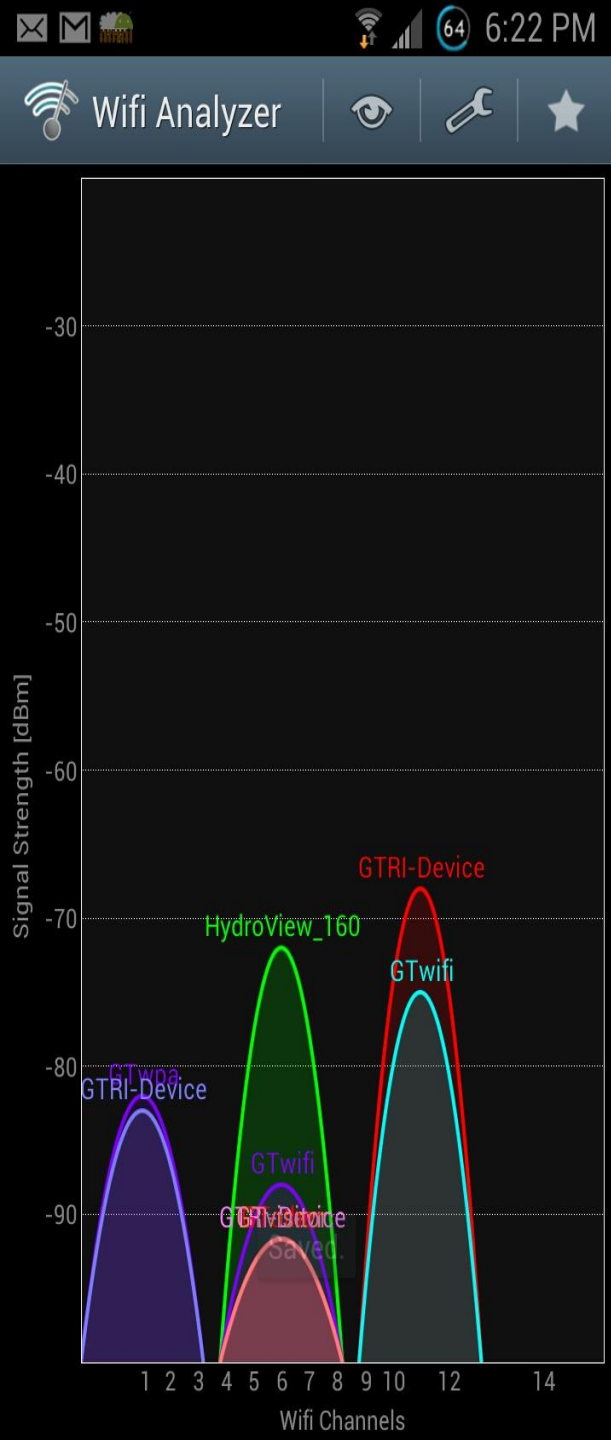
Range without Jamming

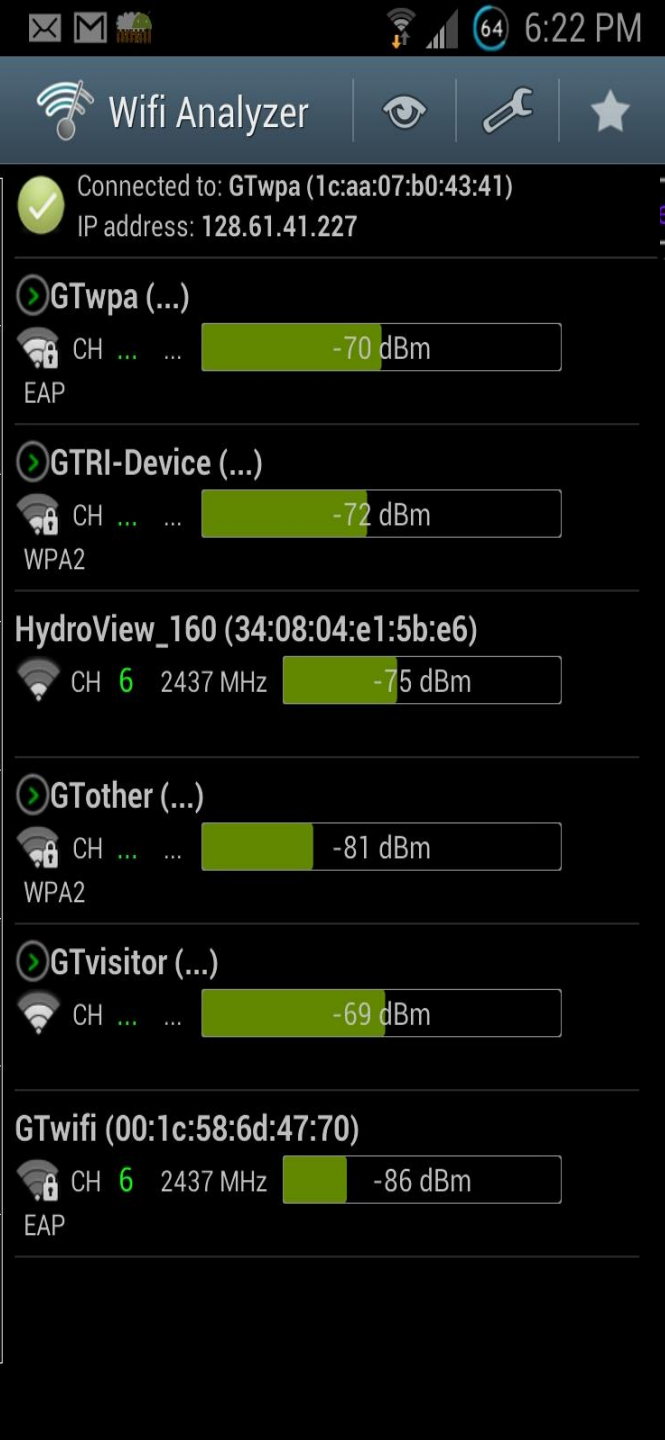


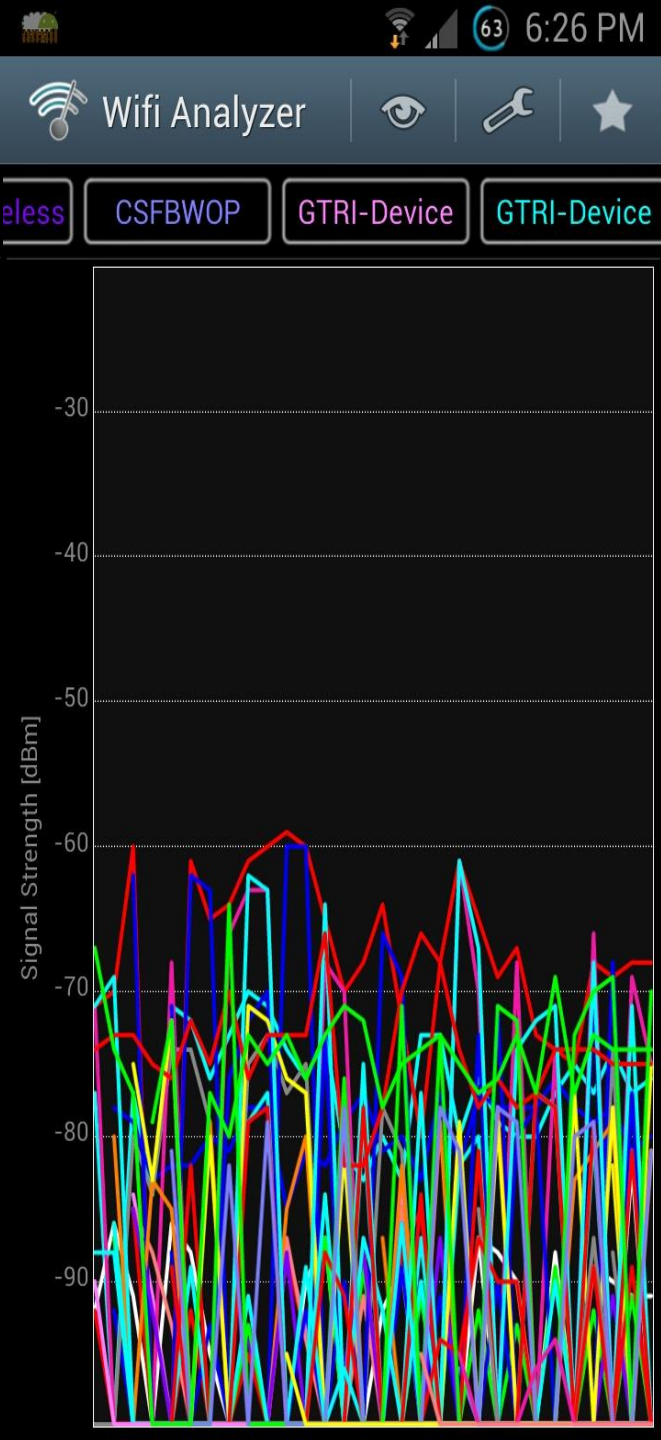
Range with Jamming




RTI with 2-pulse cancelor clutter rejection
time (s)
range (m)
0
2
4
6
8
10
12
14
16
18
20
0
20
40
60
80
100
120
140
160
180
200
0
-10
-20
-30
-40
-50
-60
-70
-80


6:22 PM
Wifi Analyzer
-30
-40
-50
-60
-70
-80
-90
Signal Strength [dBm]
GTRI-Device
HydroView_160
GTwifi
1 2 3 4 5 6 7 8 9 10 12 14
Wifi Channels


6:22 PM
Wifi Analyzer
Connected to: GTwpa (1c:aa:07:b0:43:41)
IP address: 128.61.41.227
GTwpa (...)
CH ... ...
-70 dBm
EAP
GTRI-Device (...)
CH ... ...
-72 dBm
WPA2
HydroView_160 (34:08:04:e1:5b:e6)
CH 6 2437 MHz
-75 dBm
GTother (...)
CH ... ...
-81 dBm
WPA2
GTvisitor (...)
CH ... ...
-69 dBm
GTwifi (00:1c:58:6d:47:70)
CH 6 2437 MHz
-86 dBm
EAP


6:26 PM
Wifi Analyzer
CSFBWOP
GTRI-Device
GTRI-Device
-30
-40
-50
-60
-70
-80
-90
Signal Strength [dBm]

Future Work

- ECM Module Completion
  3/28/13

- GUI Development and Testing
  4/01/13

- Comprehensive ECM and Radar Test
  4/15/13

Questions?