AMBER
Ghz source test

RM^2, Manoa Oct.17,2011

Source

Signal pulse: 6 μs, 4 Ghz, 0.3V@50Ω

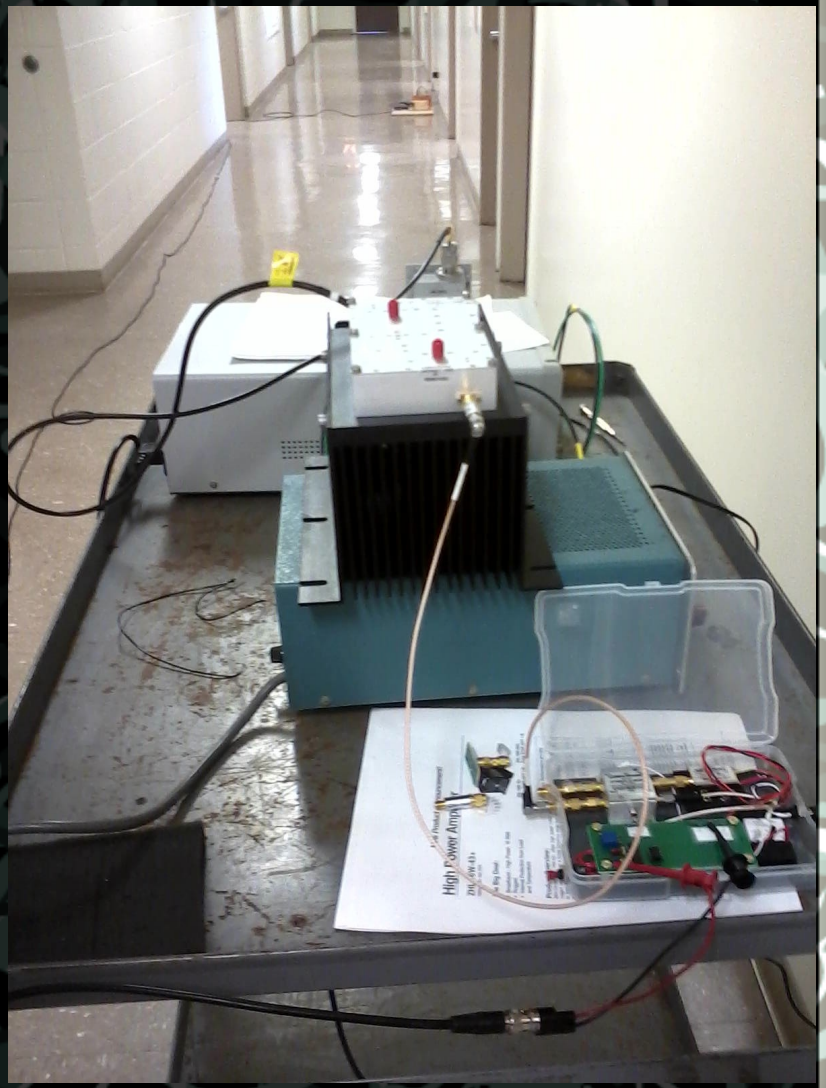
<P> = 1mW ; E(pulse) = 6 nJ

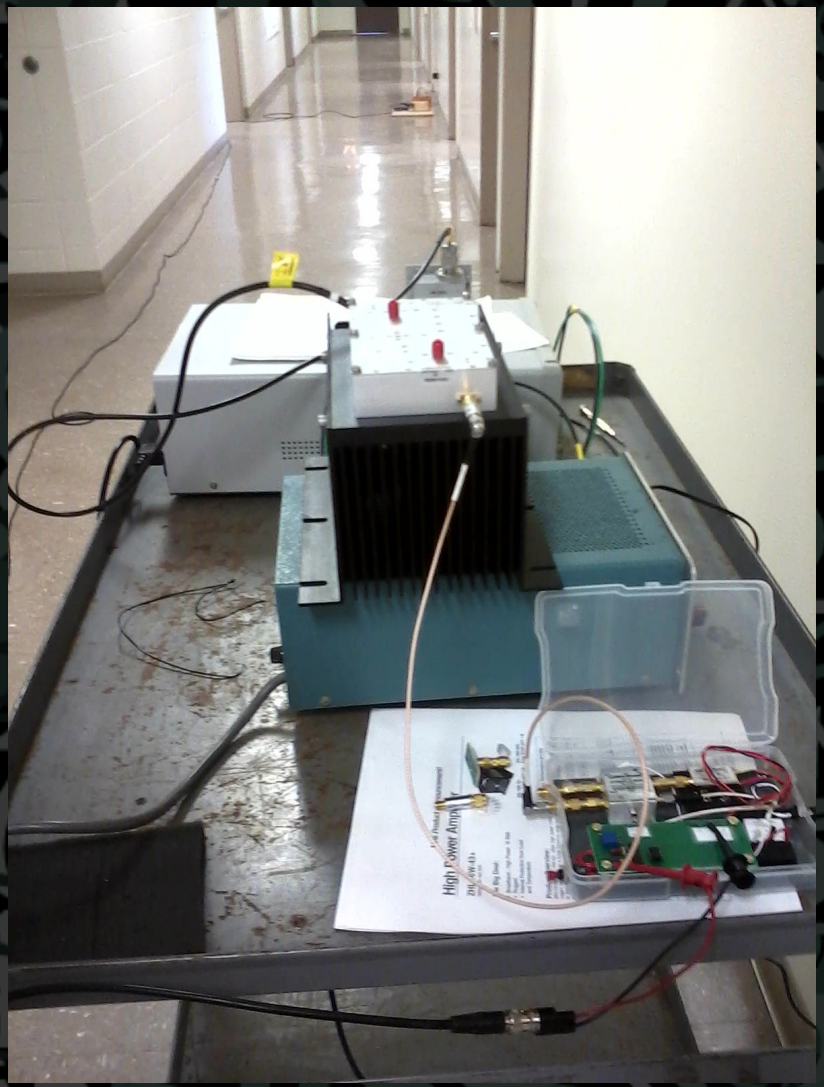
With 100 Hz rep rate: <P> = 0.6 μW

Power amplifier ZHL-16W-43+
gain : 45.1 dB @4. GHz

Cables: switch to Power Amp 1dB
Power Amp to antenna 3 dB

Attenuators:
VAT-6 : 6.4 dB @ 4 Ghz
VAT-10 : 9.6 dB @ 4 GHz
VAT-15 : 15.6 dB @ 4 GHz
VAT-30 : 29.2 dB @ 4 GHz






30 m

Receiver

Power at Scope: 81 μW (±90 mV)
Noise : 4 μW (±20mV)
(from 43 K)

LNB Trumpline 70-
Gain : 65 dB @4. GHz

Cables:
LNB to scope -20dB

Get directions | My places

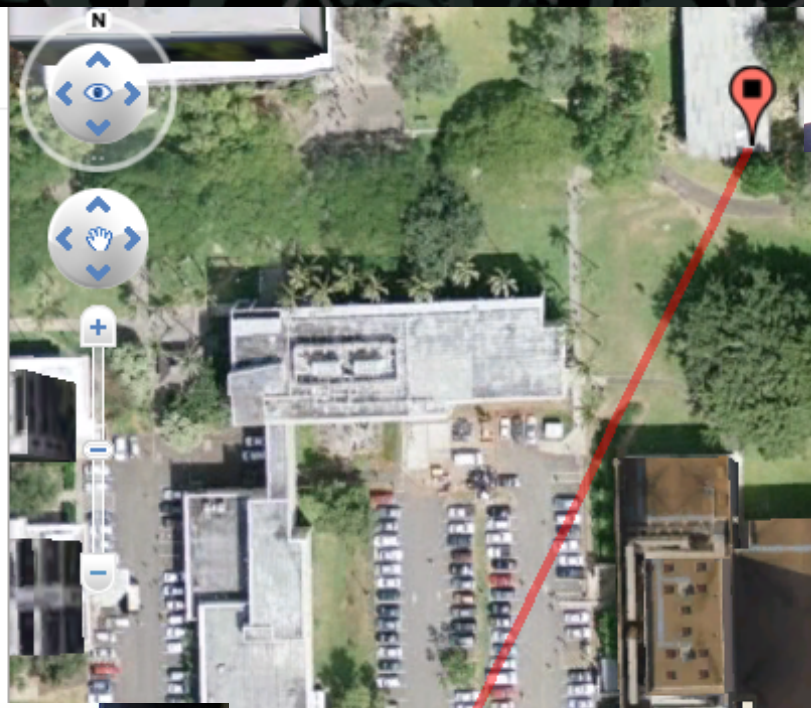
Distance Measurement Tool

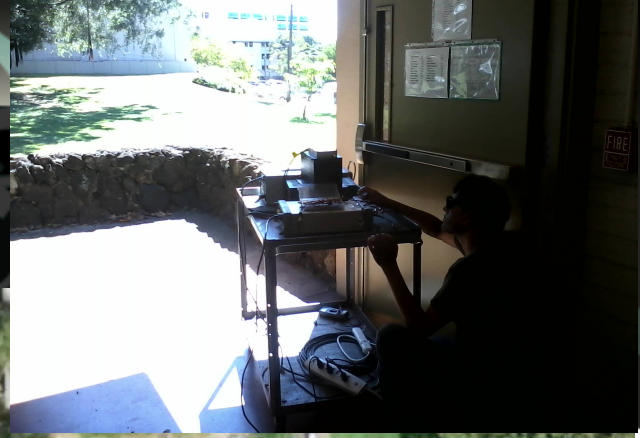
Click on the map to trace a path you want to measure.

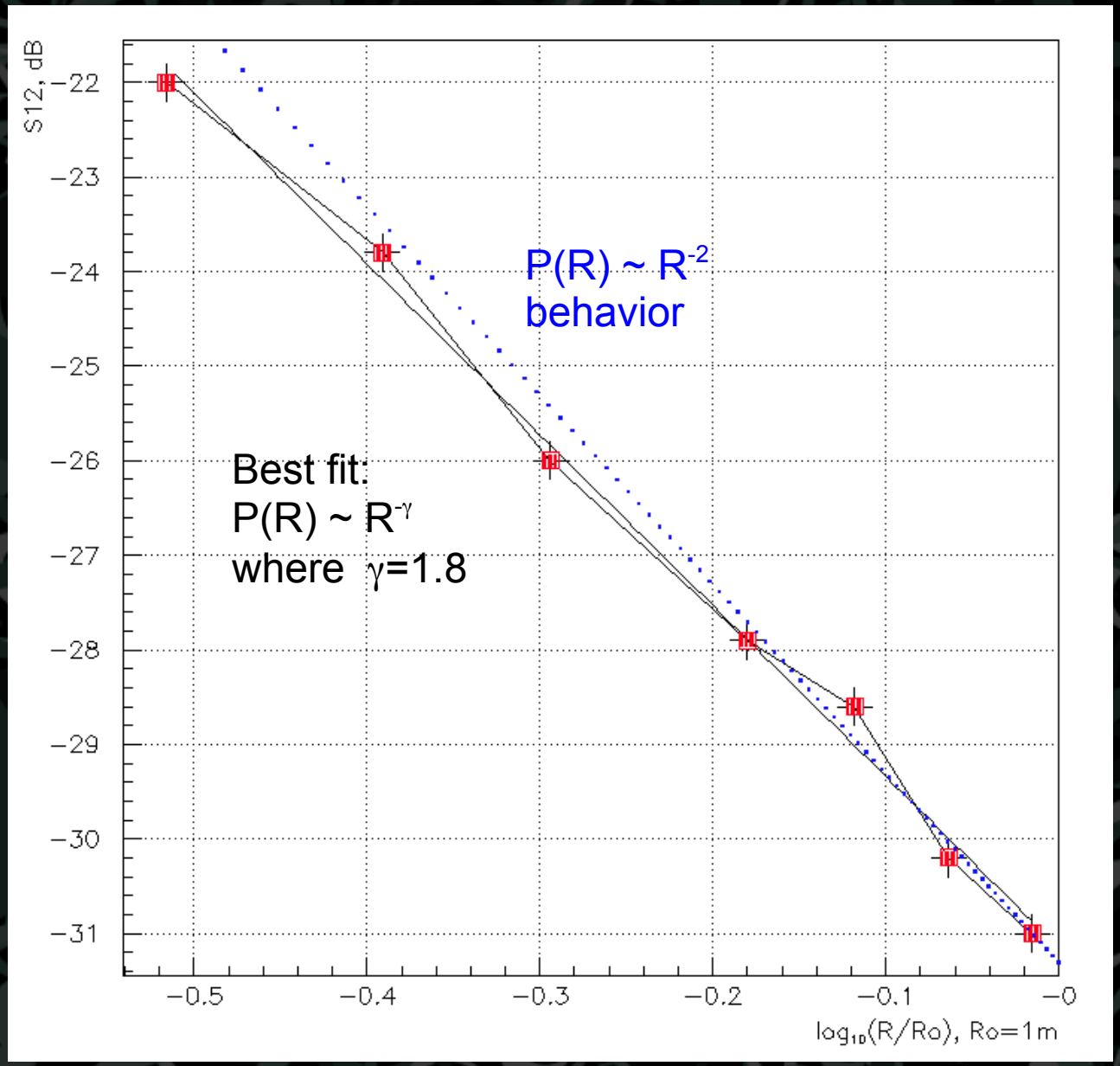
Units:
(•) Metric ( ) English I'm feeling geeky

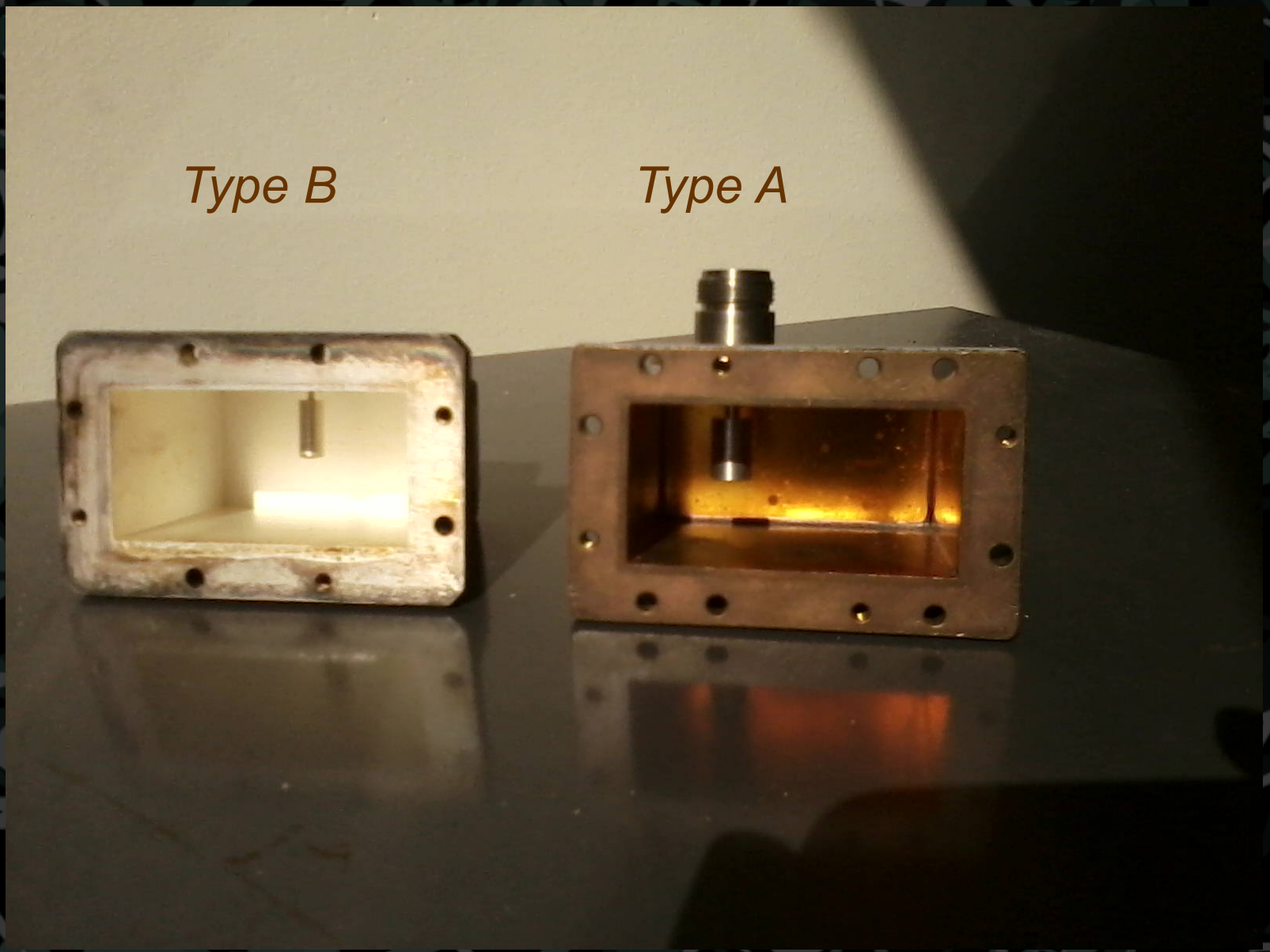
Total distance:
193.066 m

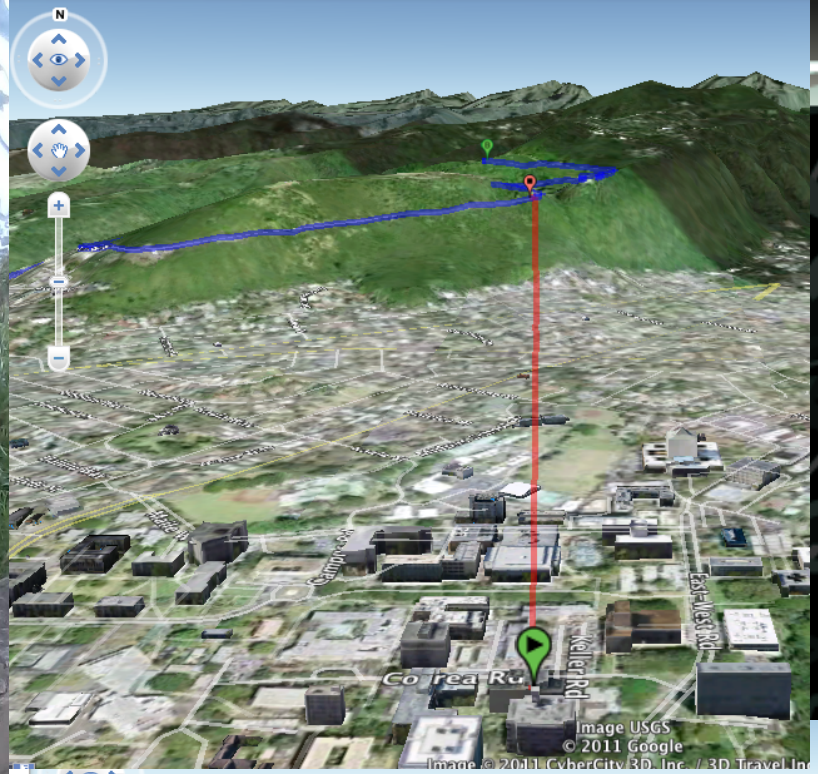
Delete last point | Reset

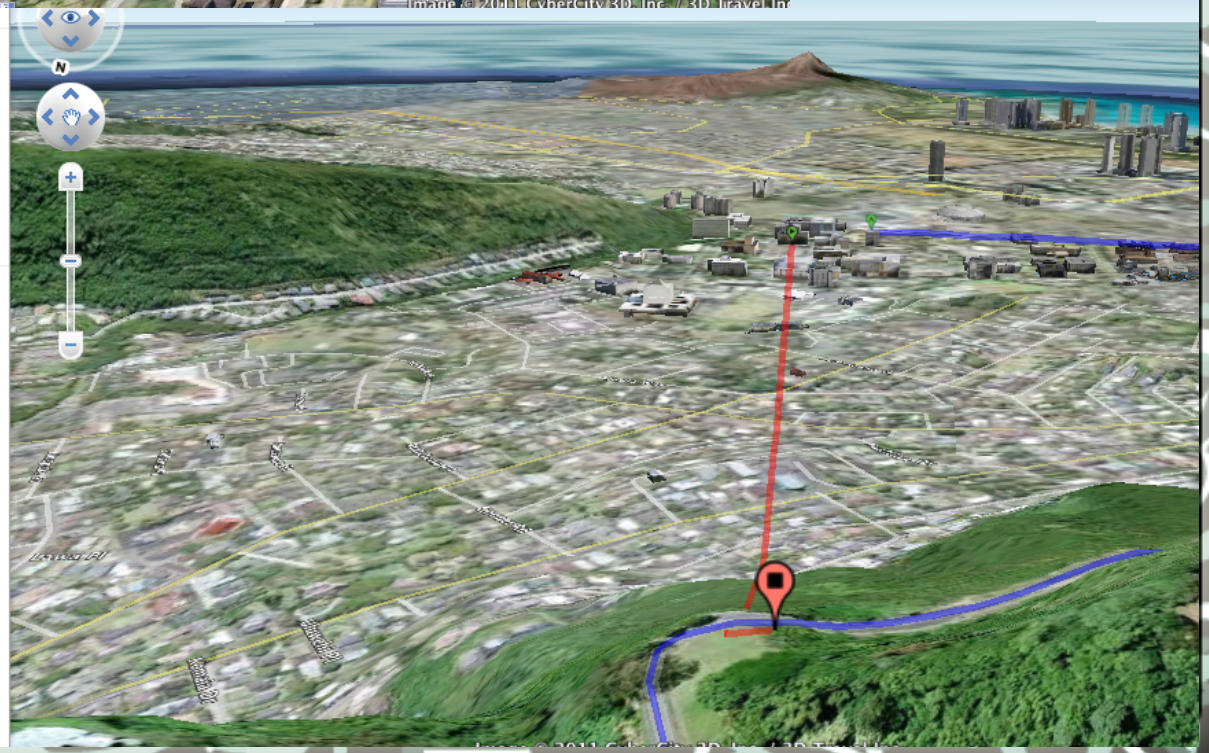





S12, dB
−22
−23
−24
−25
−26
−27
−28
−29
−30
−31
−0.5
−0.4
−0.3
−0.2
−0.1
−0
log10(R/Ro), Ro=1m
P(R) ~ R-2
behavior
Best fit:
P(R) ~ R-γ
where γ=1.8


Type B
Type A



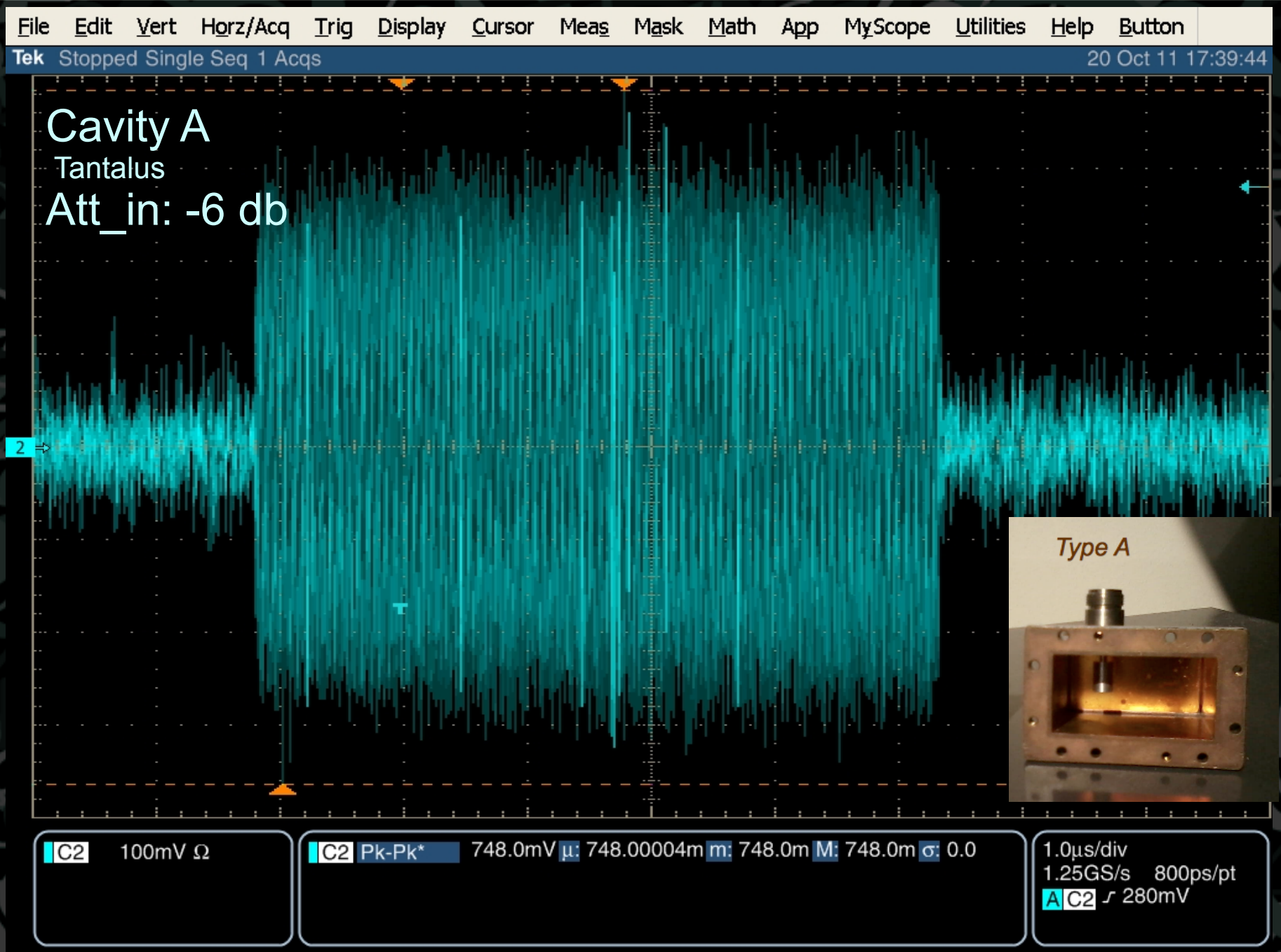


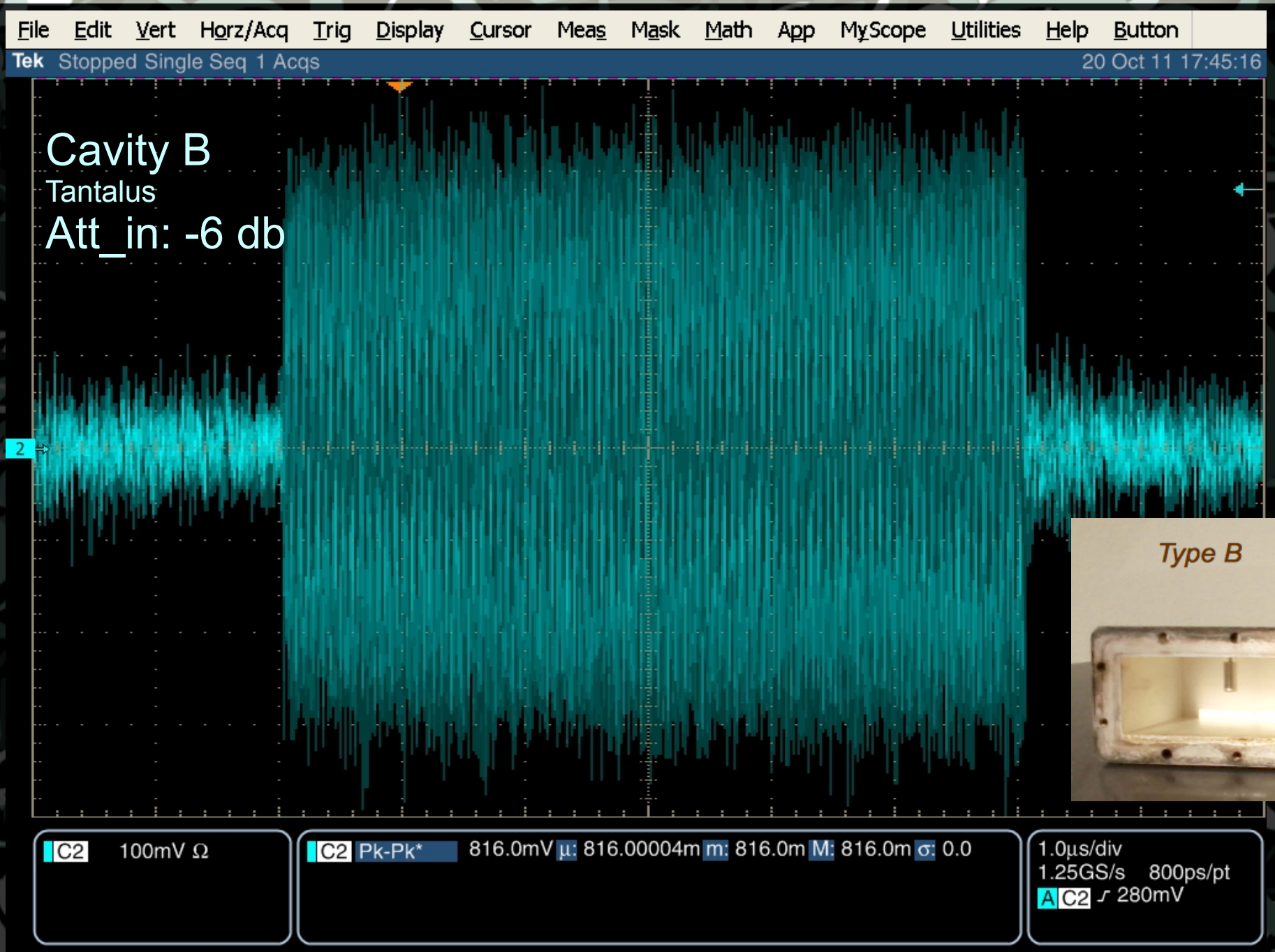
Click on the map to trace a path you want to measure.

Units:
Metric English I'm feeling geeky

Total distance:
1.90125 km

Delete last point Reset


File Edit Vert Horz/Acq Trig Display Cursor Meas Mask Math App MyScope Utilities Help Button
Tek Stopped Single Seq 1 Acqs
20 Oct 11 17:39:44
Cavity A
Tantalus
Att_in: -6 db
2
Type A
C2 100mV Ω
C2 Pk-Pk* 748.0mV µ: 748.00004m m: 748.0m M: 748.0m σ: 0.0
1.0µs/div
1.25GS/s 800ps/pt
A C2 280mV


File Edit Vert Horz/Acq Trig Display Cursor Meas Mask Math App MyScope Utilities Help Button
Tek Stopped Single Seq 1 Acqs
20 Oct 11 17:45:16
Cavity B
Tantalus
Att_in: -6 db
2
Type B
C2 100mV Ω
C2 Pk-Pk* 816.0mV μ: 816.00004m m: 816.0m M: 816.0m σ: 0.0
1.0µs/div
1.25GS/s 800ps/pt
A C2 280mV

To be on safe side...
Link budget in Tantalus test

Pin = 1mW
Attenuation (VAT-6 + cable) = -10 dB
Antenna attenuation = -3dB
Amplifier Gain = 45 dB @ Ghz (from specs sheet)
Pulse Power out = $Pin*10^{3.2}$ = 1.6W
Pulse Energy = 1.6W*6 μsec = 10 μJ

Sending single pulses , manually.... coarsely, with 2rad divergence

Power/surface at 1 meter : 1.6W / 6 ~ 0.025 mW/cm^2

Lidar shots: 333 Hz rep rate , 60 μJ/pulse, 355 nm wavelengh,
1 mrad divergence.

Input parameters:					
Peak pulse voltage (in band, measured)	Vpk		3.00E-01	V	measured at VCO output (8GHz scope)
transmit amplifier gain (dB)	Gxmit		4.50E+01	dB	use if necessary
Peak output pulse voltage from amplifier	Vamp	=Vpk*10^(Gxmit-Acable0/20)	1.34E+44	V	
splitter loss factor (2-way assumed)	Asplit		0.00E+00	dB	at present , only one way
cable+connector losses to transmit amplifier	Acable0		7.00E+00	dB	
cable+connector losses amplifier to antenna	Acable		3.00E+00	dB	cable (type?) attenuation measured by Rishi want to add extra 0.5?
insertion loss to antenna	Aant		2	dB	
effective pulser bandwidth	BW_pulse		4.00E+09	Hz	base on scope bandwidth above
antenna xmit/rcv gain (dBi)	GdBi		65	dBi	Power Amp TrunkLine (from specs, not measured)
antenna xmit/rcv gain	G	=10^(GdBi/10)	3162277.7		
antenna single-mode bandwidth	BWsm		4.0E+09	Hz	in our case the BW ratio is 1
off-axis angle	theta		0	deg	assuming cos\theta from dipole
mean frequency	f		4.00E+09	Hz	based on antenna response, used to determine mean wavelength
reference distance from pulser to receiver	R		1.900E+02	m	assume receiver on far side of 10m radius ring, 20m below pulser
Receiver noise temperature	Trec		1.00E+02	K	we assume an excellent (eg. Miteq or similar) low-noise amplifier
ice noise temperature	Tice		2.30E+02	K	dipole sees mostly ice, some sky
System noise temperature	Tsys	=Trec+Tice	3.30E+02	K	ice + LNA
Receiver bandwidth	df		4.00E+09	Hz	comes into total rms noise calculation
Air attenuation length	La		6.00E+04	m	assume 60km attenuation length here
Air index of refraction at pulser+receiver avg depth	n		1.00E+00		n/a to air
mean wavelength in ice	lambda		7.50E-02	m	wavelength at 4GHz
Derived quantities:					
Input peak power (pulse) to PowerAmp	P_in0	=[Vpk*10^((-Acable0)/20]^2/50/2	1.80E-04	W (peak)	assume 50 ohm matching
Input peak power (pulse) to Antenna	P_in1	=[Pin*10^((Gxmit-Asplit-Acable-Aant)/10)	1.80E+00		
peak incident power at 1m from source	Psrc	=(BWsm/Bwpulse)^2 * P_in1*G*cos^2(theta)/(4pi)	1.43E-01	W/m^2	**note: power for pulse goes as square of rcv to xmit bandwidth ratio!**
power loss factor through ice	f_loss	=1	1.00E+00		assume no losses in air
incident power per pulse at receive antenna	Pr	=Psrc*f_loss*G/R^2	3.96E-06	W (peak)	
receive antenna effective area	Aeff	=G*lambda^2/(4pi)	1.42E+03	m^2	
received pulse power in antenna load/receiver input	Prec	=Pr*Aeff*10^(Aant/10)	3.54E-03	W	assume same SWR=4 as above