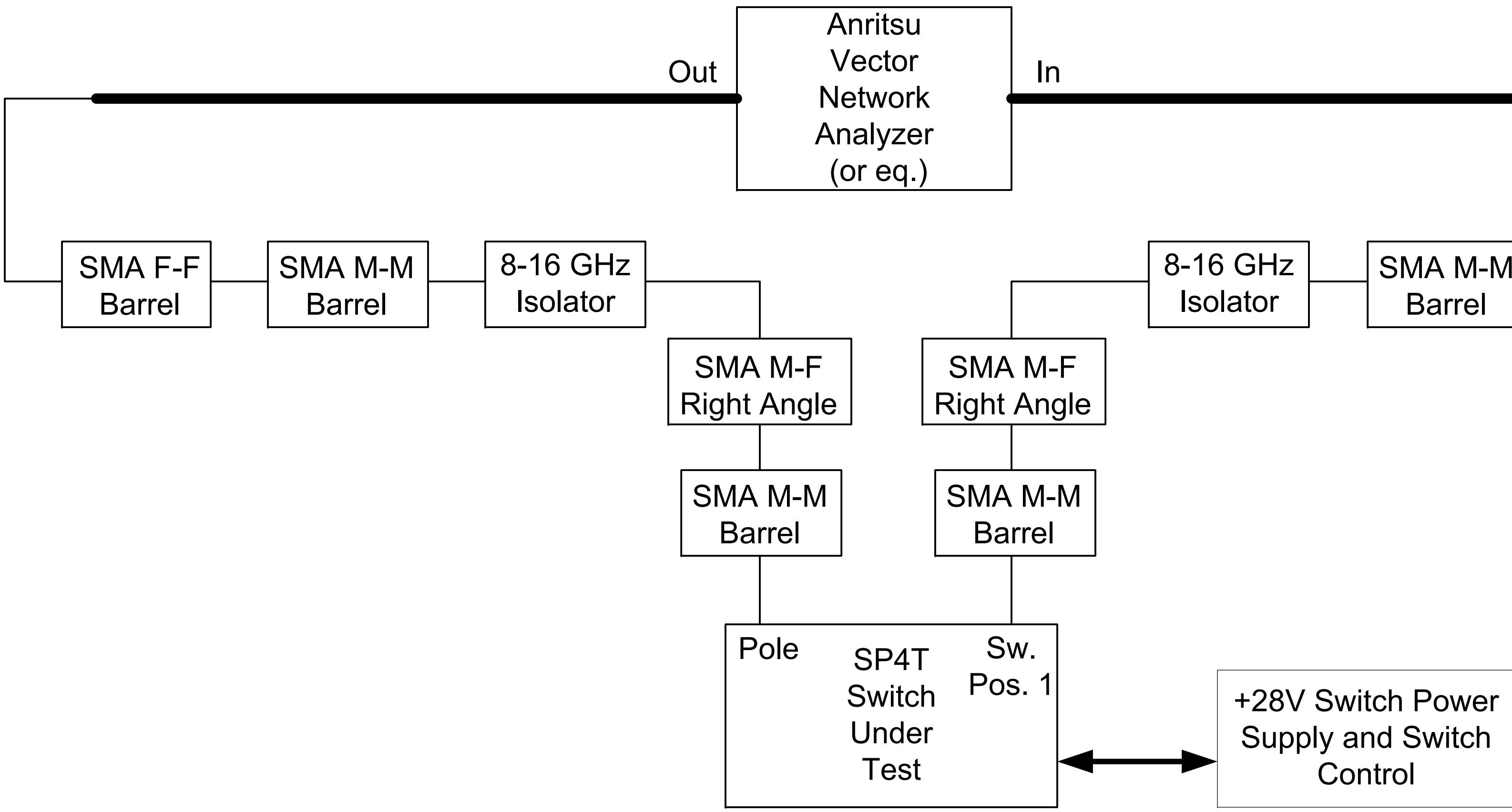
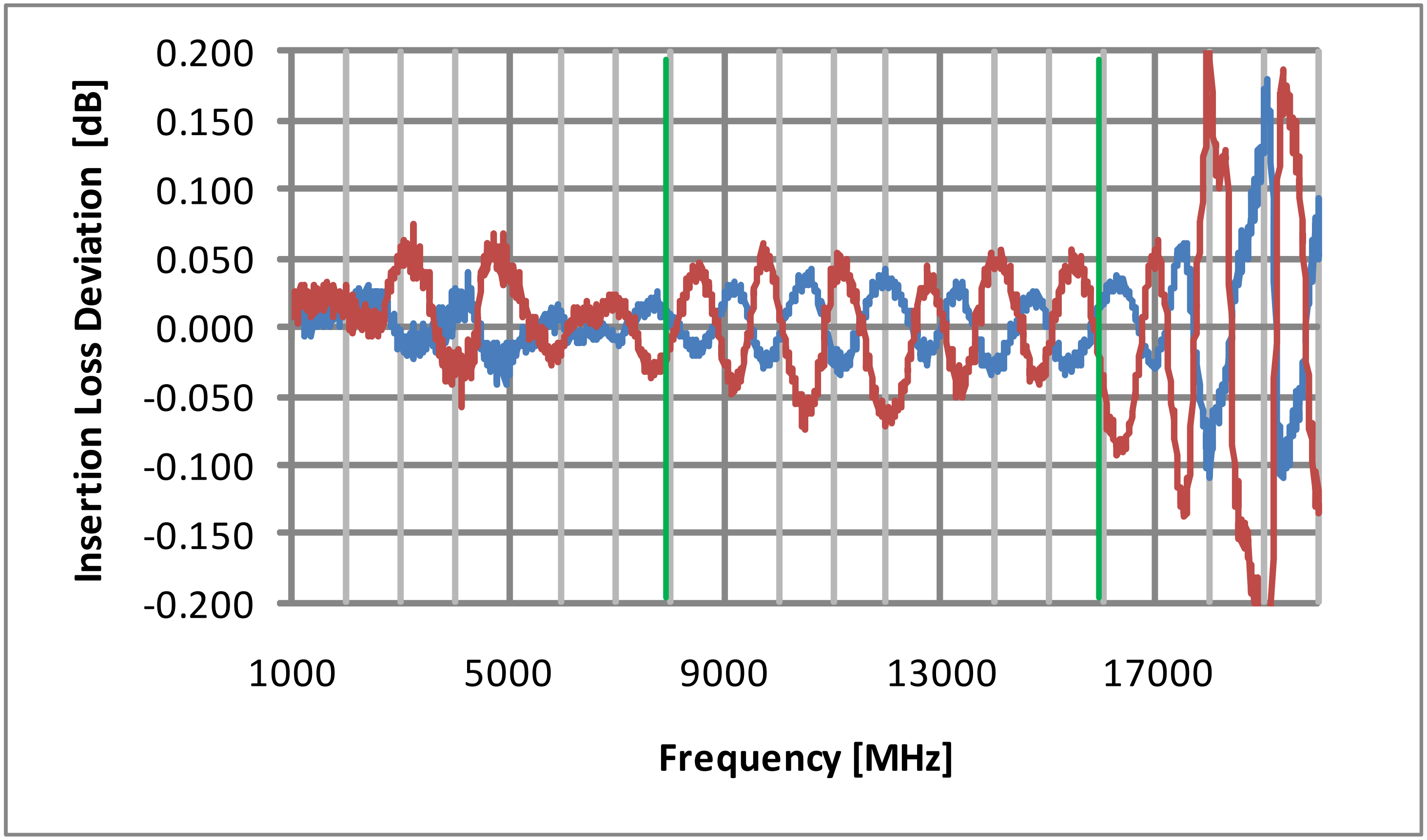
Switch Repeatability Test



Switch Repeatability Procedure

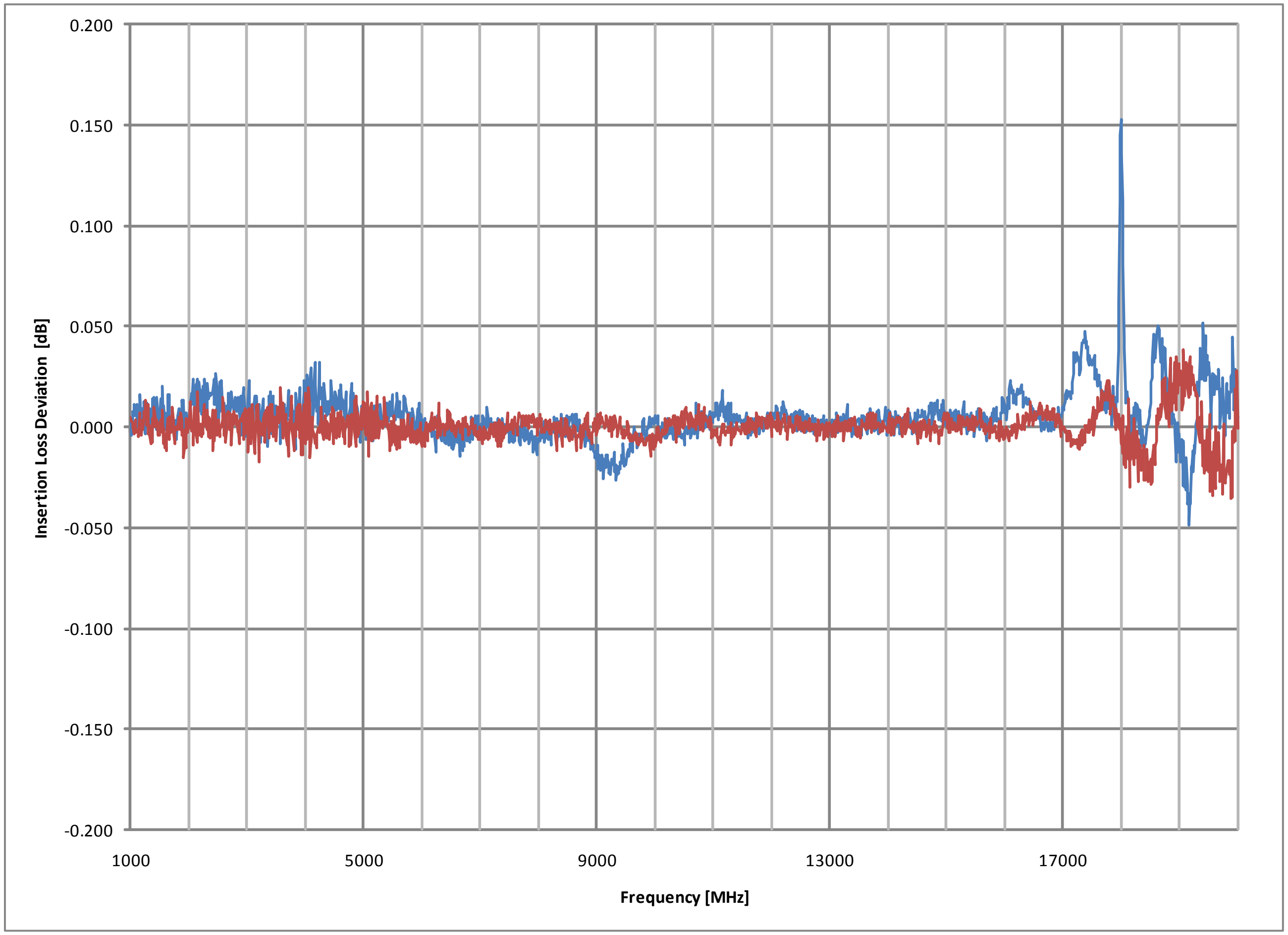
- Select Switch Position 1
- Calibrate S21 Switch Position 1 as a through path (reference)
- Switch to any other position then back to Switch Position 1
- Record data

Dow-Key 545JK Non-latching Switch



- Isolators used in test are good over 8-16 GHz range
- Size of the ripples is related to the VSWR of the switch as: $-10*\log(1-|\rho|^2)$ where ρ is the reflection coefficient
- Phase repeatability not shown but much better than 1°

Teledyne Relays CCR59Latching Switch



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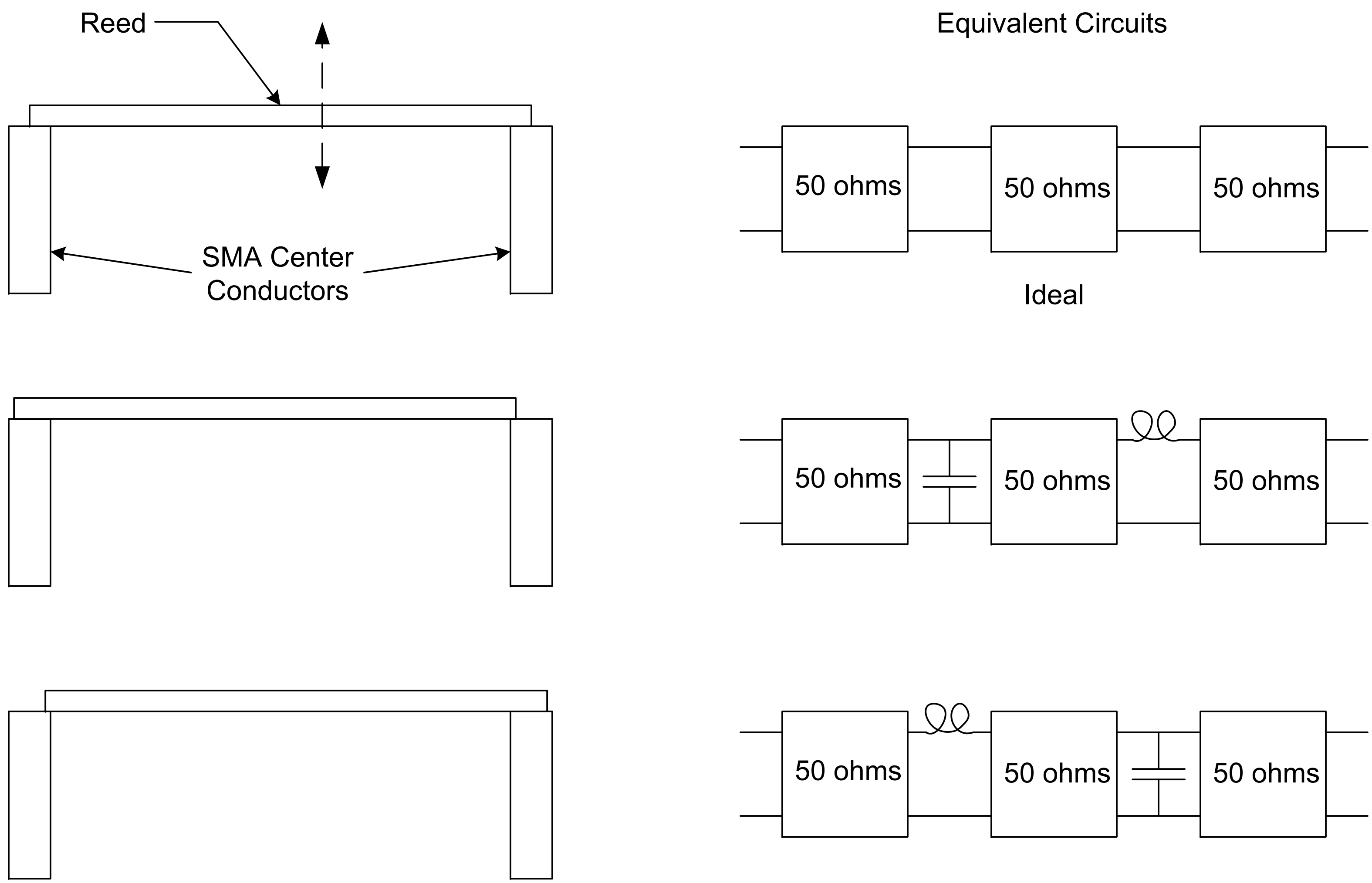
Affect of Reed Position on VSWR



Electro-Mechanical Switches Compared to Solid State Switches

FET Switches

- FET switches seem to be good to < 6 GHz.
- SP4T configuration not seen

PIN Diode Switches

- PIN diode switches generate IMD products (worse at lower frequencies)
- Agilent version of SP4T costs roughly 3 times the cost of electromechanical switches.
- Unsure of repeatability of amplitude/phase switch cycle to switch cycle, as a function of power supply variations or temperature (would need to evaluate).

Solid State in general

- Unclear reliability of SS switches is superior to EM due to complexity of drive circuitry, etc.
- SS switches not readily compatible with the circular DC and Control connectors.
- Footprint of SS switches varies greatly from existing EM design.
- Electrical performance of SS switches inferior to EM switches.

Comparison of Switch Characteristics

Parameter	Agilent P9404C (Absorptive)	Herley 9140-500 (Reflective)	Teledyne CR-59 (Latching)
Type	PIN diode with drivers	PIN diode with drivers	Electro-mechanical
Frequency Range	100 MHz – 18 GHz	1-18 GHz	DC-26.5 GHz
Insertion Loss	<3.5 dB @ 8 GHz <4.5 dB @ 18 GHz	1.5 dB @ 8 GHz 2.8 dB @ 18 GHz	<0.2 dB @ 8 GHz <0.3 dB @ 20 GHz
Isolation	>80 dB	50 dB	>80 dB @ 16 GHz >75 dB @ 20 GHz
VSWR	1.92:1 max @ 18 GHz	2.0:1 max @ 18 GHz	1.20:1 max @ 20 GHz
Ripple from VSWR	0.45 dB	0.51 dB	0.04 dB
Switching Speed	450 ns typical	250 ns max	20 ms typical
DC Power	±5V DC	+5V, -12V both DC	+28V DC
TTL Control	Yes	Yes	Yes
Price quantity 1	$1779	unknown	$843

Latching versus Non-latching

- Non-latching switch requires power applied to the switch coil 100% of the time
- The location of the coils in the switch can and transient switching can cause transient thermal events to the RF body (assume the correlator can see this).
- Latching switches apply current to the coil only long enough to accomplish switching

Stop beating the switches

(you can beat a Timex but don't beat a Rolex!)

- Treat the switch as the precision device that it is.