

REED SWITCHES

REED SENSORS

REED RELAYS



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Products for tomorrow...

Relays for RF applications

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Special interest in RF applications

- The industry is calling for computers, cell phones and various other electronic equipment to be smaller, run faster and have more capabilities.
- Components need to switch and carry fast digital pulses and RF frequencies.
- Component volumes continue to grow with less price pressure and more about performance.
- If you have a computer processor running at 2 GHz. It is processing digital pulses at that rate. The faster these clocks run the faster the computers will run.
- Therefore there is a continued push to make computers (semi.'s) run faster.



Signal level RF

- To make up a digital pulse, it takes a minimum of 5 harmonics of a sine wave.
- What does this mean in the practical world?
 - It means: if you have a computer processor running at 2 GHz it is processing digital pulses at that rate.
 - If you add in the 5 harmonics - this means that components have to be capable of passing 2 x 5 or 10 GHz.



Signal level RF

Consider the 1 nanosecond digital pulse below



- If the switch is not designed to pass these fast pulses you may have this result



- If the switch is designed for RF but not very well, this could be the result





Signal level RF

- If the switch is designed to pass these fast pulses you will have this result



- There are three components able to switch those signals:
 - Semiconductors
 - Electromechanical Relays
 - Reed Relays



High frequency switching devices

Switching Device	Frequency response	Cost	Size	Frequency response	Technology Issues
Semiconductors	Unlimited (>100GHz)	Proportionally higher with increased frequency	Smallest	Not flat from DC, has discontinuities	Inter modular distortion. Needs added circuitry to maintain uniform frequency response
Electromechanical relays	Up to 12 GHz	Very expensive	Very large	Flat frequency from DC	Very expensive and very large, too much board space and requires a lot of power to operate
Reed relays	Up to 16 GHz	Moderate and stable	Becoming smaller and smaller	Flat frequency from DC	A technology haunted by poor quality. Stepping up with the quality could ignite this technology



RF parameters

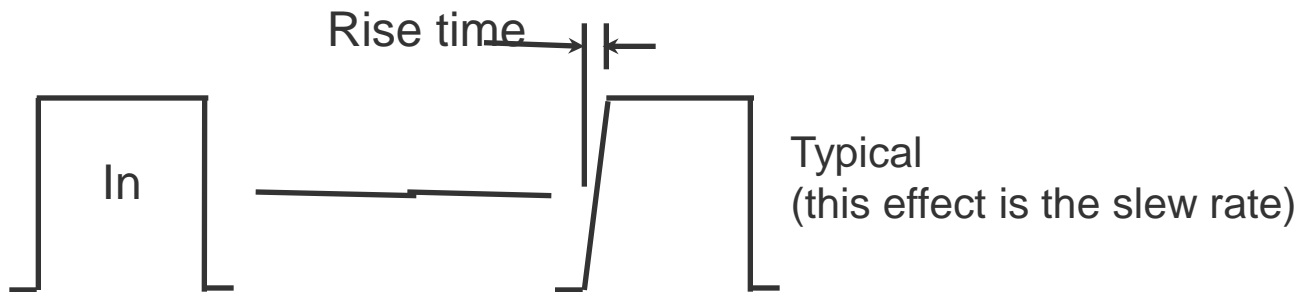
- Rise Time, Slew Rate, Characteristic Impedance, Insertion Loss and Isolation are the key parameters we can control
- Further parameters are: S-Parameters, VSWR (Voltage Standing Wave Ratio) and Return Loss



RF parameters – Rise Time and Slew Rate



1 nano second pulse



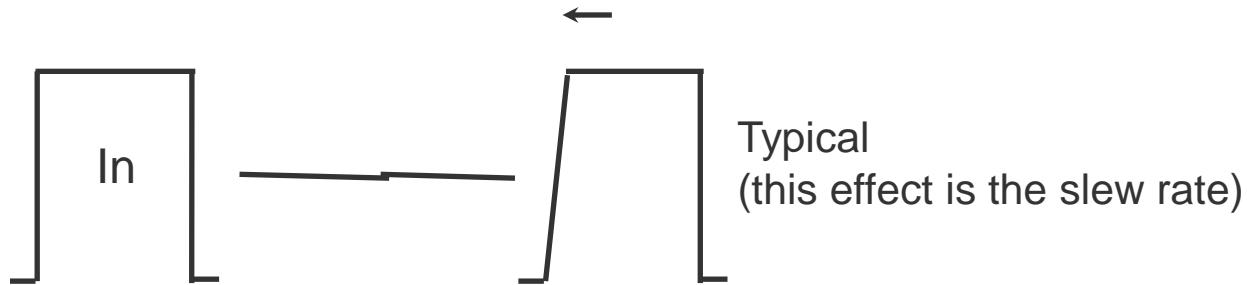


RF parameters – Rise Time and Slew Rate

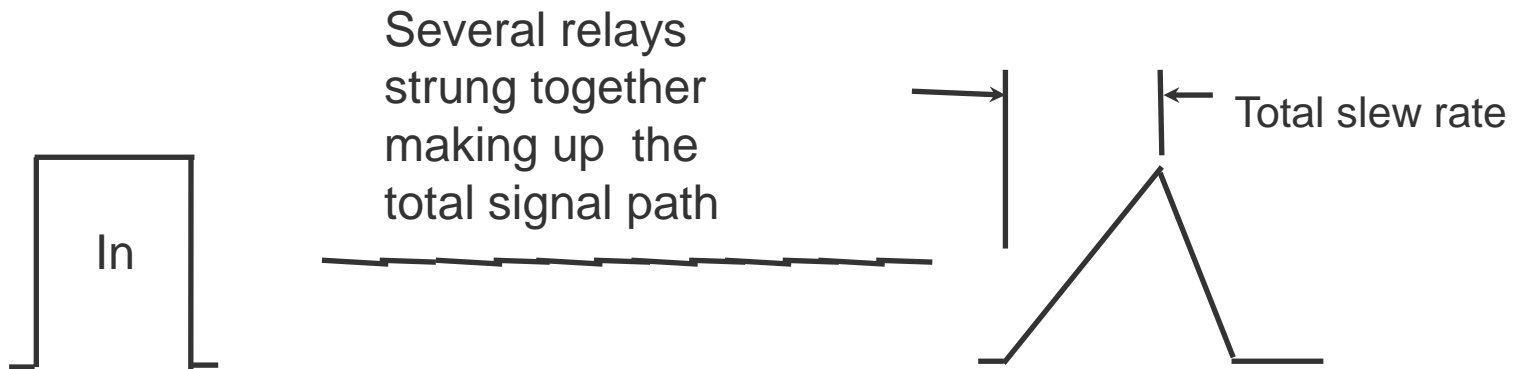
- So the rise time and its subsequent slew rate are very important in determining how narrow (time) a digital pulse can be and still pass through a relay with minimal distortion.
- We also need to take into consideration that relays may be used in matrices such that the digital pulse may have to pass through several relays on its path to where it is going.



RF parameters – Rise Time and Slew Rate



So if one has the slew rate shown, the square wave may result in the following:





RF parameters – Characteristic Impedance

- Signal path length is critical
- Consistent impedance is critical
- A consistent shield is very important (the shield is part of the signal path).
- It is the signal path, the shield and the material between them that makes up the impedance.
- RF looks at the distributed impedance along the signal path.
- When the RF comes upon a change in impedance it will reflect part of its signal backwards. This is an actual loss in signal strength.



RF parameters – Characteristic Impedance

What causes the impedance to change along the signal path?

- The impedance is made up of three resistive components: path resistance, capacitive reactance, and inductive reactance. These three add vectorially for the final result



RF parameters – Insertion Loss

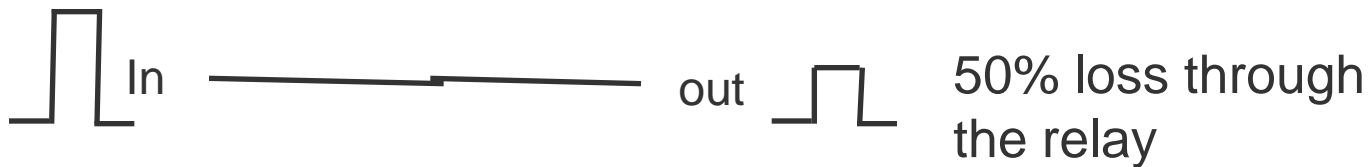
Signal reflections increase the insertion loss and can be caused by the following:

Detailed potential change	Parameter Affected	Resistance
Path resistance	Resistance change along the signal path	contact resistance change; resistance change along the signal path
Capacitive reactance	Change in the distributed capacitance along the signal path	The capacitance between the signal path and the shield changes
Inductive reactance	Change in the distributed inductance along the signal path	The Inductance between the signal path and the shield changes



RF parameters – Insertion Loss

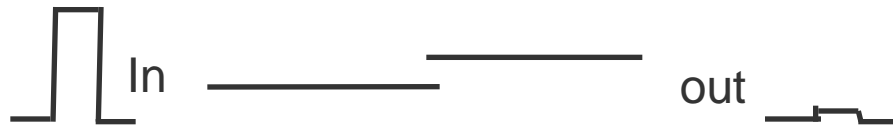
- Insertion loss is essentially the measure of the loss of a signal going thru a relay. It is measured in dB(decibels).
- -3dB is considered the limit of usable range (the 50% loss point) .





RF parameters – Isolation

- Isolation is defined also in dB and represents the amount of signal that passes from the input of the relay to the output of the relay when the relay contacts are open.



Signal crosses over the open contacts at higher frequencies

- The isolation for a reed relay is basically determined by the gap distance.



RF parameters – S-Parameters

- S-parameters are vectors and have a magnitude and direction for each frequency point that is measured.
- These are important to the designer of an RF circuit because they use them by placing them in RF software, giving them an idea how our relay will interact with other RF components in their circuit.
- S-parameters are generated by our network analyzer when we make RF measurements.
- Therefore, we can easily pass these along to our potential customers via email.



Reed Switch Basics

- **End of part I**

Reed Relays for RF Applications part II:

- Ways to improve RF performance
- MEDER's Relays for RF Applications