

New Attenuator Relay Design Improves Performance in Ultraminiature Package

An innovative electromechanical attenuator relay — which incorporates the attenuator circuit and bypass path inside the relay — is finding a growing list of applications because it extends the frequency range of the attenuator while maintaining an ultraminiature package size.



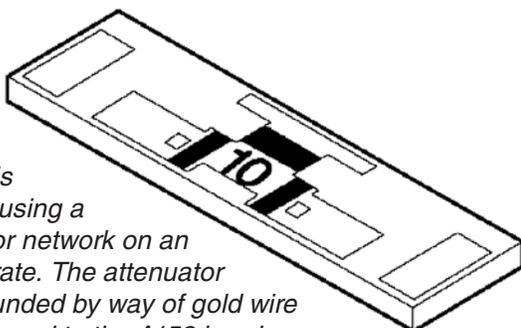
A152 Relay — The A152 family of highly repeatable, ultraminiature broadband attenuator relays attenuates RF signals in 50-ohm and 75-ohm systems over a frequency range from DC to 5 GHz.

Ultraminiature electro-mechanical relays have been used to switch RF signals for many years. One common RF switching application is to attenuate signals by using a relay to switch the signal to an external attenuator circuit. The external attenuator circuit is generally a resistor network, where the resistor network may be several times larger in size than the relay, particularly at high power. This approach increases the total

package size and limits the frequency response of the attenuator.

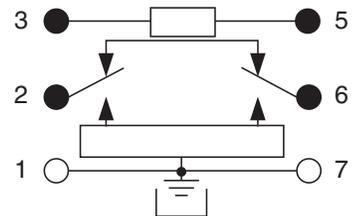
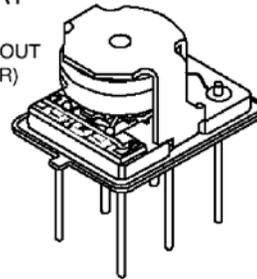
Attenuator Substrate

— The built-in attenuation is accomplished using a thin-film resistor network on an alumina substrate. The attenuator network is grounded by way of gold wire bonds from the pad to the A152 header.



ATTENUATOR RELAY

(WITHOUT COVER)



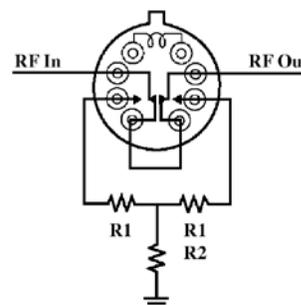
Terminal view. Case ground.

A152 Construction — The A152 construction consists of an all-welded hermetically sealed package. The relay is RoHS compliant. The uni-frame motor design provides high magnetic efficiency and mechanical ruggedness. The precious metal contacts are gold plated utilizing Teledyne's unique in-house plating process. Advanced cleaning techniques reduce the risk of contamination. These features and techniques provide excellent resistance to environmental extremes and overall high reliability.

High Performance

The new A152 relay from Teledyne Relays has demonstrated numerous advantages in RF switching applications. Reasons include:

- High isolation between the signal path and the control voltage.
- Low insertion loss of relay contacts.



A152 Schematic — This schematic illustrates the A152 in the non-energized position. This is the bypass path, $RF_{in} = RF_{out}$. Once the coil is energized, the contacts switch, and the RF In signal will flow through the attenuation path and the signal is attenuated.

A152 Through-Path Insertion Loss

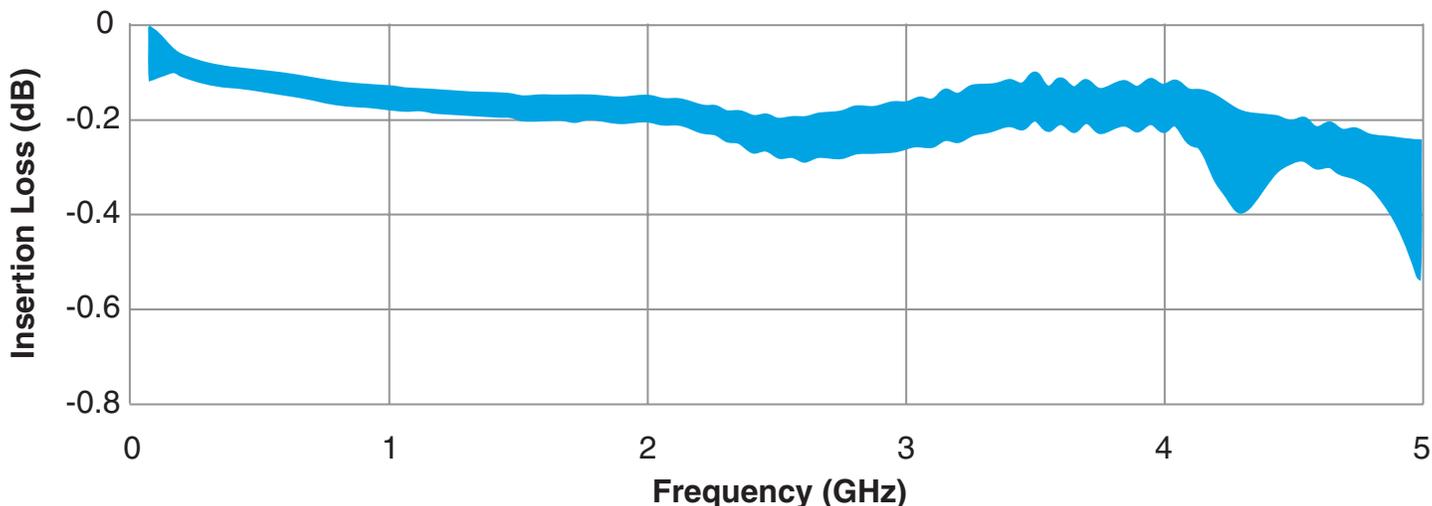


Figure 1 — The A152 delivers low insertion loss.

- Insertion loss repeatability of ± 0.1 @4.5 GHz
- A large bandwidth, allowing usage from DC to 5 GHz.

The RF characteristics of the A152 are stable over the temperature range of -55°C to $+85^{\circ}\text{C}$. Unlike plastic RF relays, the A152 is hermetically sealed and can be exposed to extreme environments. The A152 is currently offered with a 20dB attenuation path. Other attenuation values such as 1, 2, 4, 8 and 16 dB are also available.

This high performance comes in a very small package. The A152 attenuator relay measures 12.07 x 9.53 x 7.11 mm (.475 x .375 x .280 inches). Six leads are spaced on two rows 5.08 mm (0.20 inches) apart and spaced 3.81 mm (0.150 inches) on centers. The unit weighs less than 3.12 grams (0.11 ounces).

High Reliability

The A152 is an extremely reliable attenuator relay as well. Life tests were performed at 125°C while switching 1 watt, 2 GHz CW power. The test was stopped after every 1 million cycles to measure the attenuation. After 10 million cycles, the attenuation changed less than 0.5% in the frequency range from DC to 1 GHz. The change was less than 1.0% in the frequency range from 1 to 2 GHz and less than 3.0% in the 2 to 3 GHz frequency range.

To verify the power handling capability of the attenuator relay, the relay was subjected a high temperature test with 1 watt applied to the attenuator pad. The test was performed at 85°C with the coil energized at rated coil voltage for 2800 hours. Following the test the attenuation was measured and compared to the initial attenuation measurement. The change in attenuation was less than 1%.

The switching reliability of the attenuator relay was tested at 25°C with 1 watt, 2 GHz CW RF power. Each operation was monitored during the 1 million cycles. No misses occurred during the test. A miss was defined as a change in attenuation, or insertion loss, greater than 0.5 dB.

Recorded data from samples tested at -65°C and at 125°C indicate the measured attenuation varies less than 1.0% from the room temperature value.

Phase linearity was measured and found to be typically $\pm 0.6^{\circ}$ over the frequency range from DC to 3 GHz for the attenuated path. The phase linearity of the through path is typically $\pm 1.2^{\circ}$ over the same frequency range.

The isolation of the signal path to the control voltage input was measured. The isolation exceeds 40dB from DC to 3 GHz.

Attenuator relay samples have been tested and

A152 Insertion Loss Repeatability (Through Path)

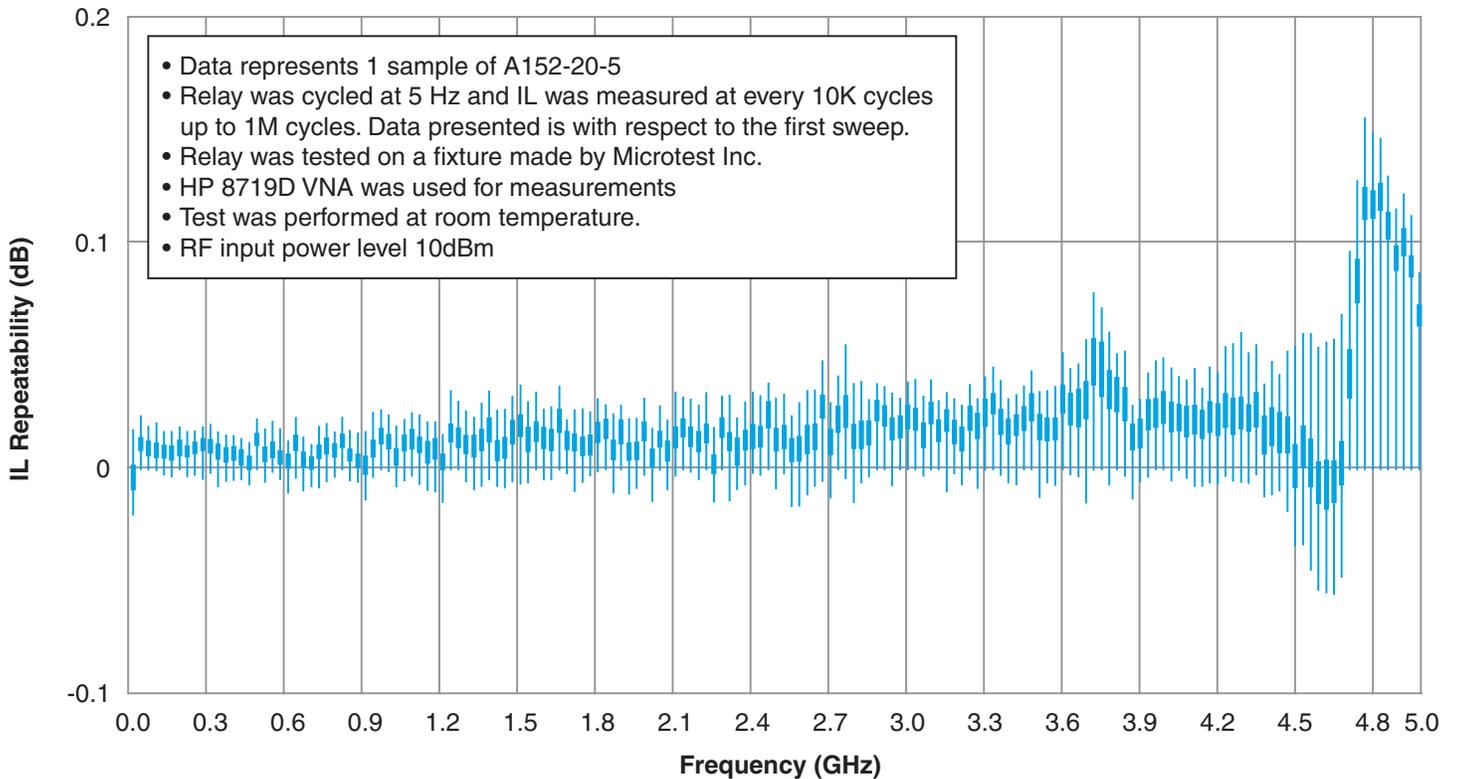


Figure 2 — The A152 provides insertion loss repeatability of ± 0.1 @4.5 GHz.

have survived sinusoidal vibration levels greater than 20 G's, from 10 to 3,000 Hz, for 12 hours, as well as half-sine mechanical shock pulses with amplitude levels of 50 G's and 6 msec duration.

Summary

The A152 attenuator relay design delivers excellent RF characteristics over the frequency range from DC to 5 GHz. Built-in functionality — A152 relays

offer a normally closed low-loss, bypass path and an attenuation path — eliminates the need for additional external resistors. The small package lends itself to multistage attenuator designs requiring less weight, space and volume.

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