

Design and Fabrication of Small-Sized Radar-Radiometer Sensors with a Single Antenna Configuration in W-Band for Sensor-Fuzed Systems

53rd Annual Fuze Conference
May 19 – 21, 2009

Wan-Joo Kim, Myung - Suk Jung,
Won - Young Uhm, Jae - Hyun Choi

Fuze Group, Agency for Defense Development Republic of
Korea

Contents

- ❖ Why Millimeter Wave for Fuzes ?
- ❖ W-Band Radar / Radiometer Fuzing Sensors
- ❖ Experimental Results
- ❖ Summary

Why Millimeter Wave for Fuzes ?

❖ Advantages of MMW Fuzes

- ❖ Located between microwave and IR, MMW (millimeter wave) can overcome drawbacks of the bands.
- ❖ MMW fuzes can be structurally small in size.
- ❖ If the carrier frequency is high, we can generally get the high space resolution.

Why Millimeter Wave for Fuzes ?

❖ Passive Radiometer

- ❖ Receive the energy emitted from the targets and backgrounds.
- ❖ Receive the reflected energy of sky radiation by the targets and backgrounds.
- ❖ Contrasts exist between the targets and backgrounds.

Why Millimeter Wave for Fuzes ?

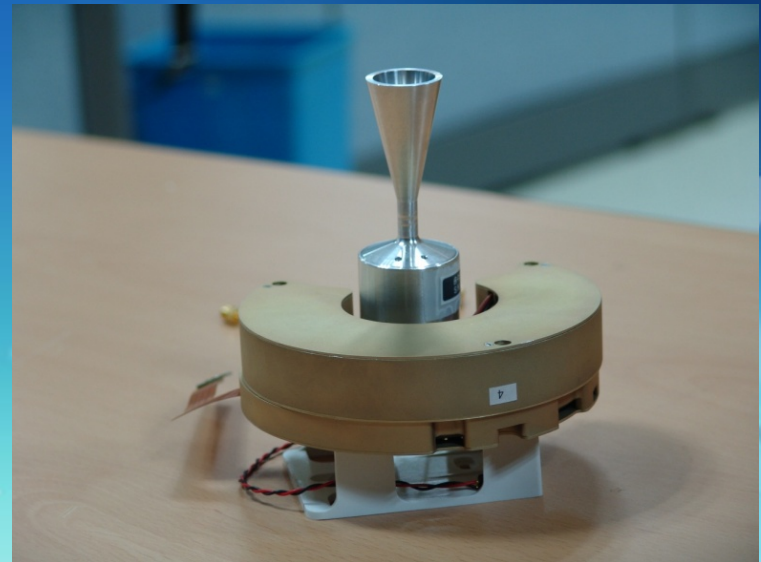
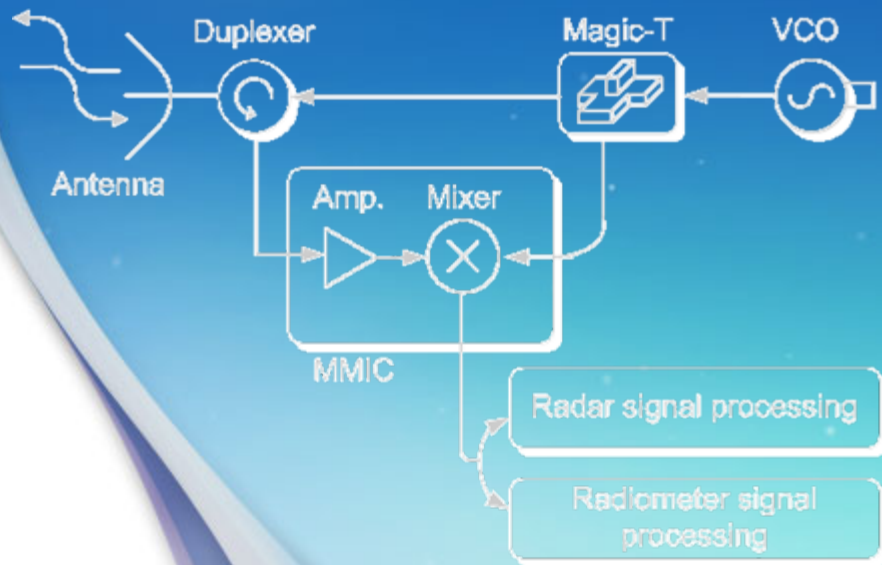
❖ Active Radar

- ❖ Detect the portion of the transmitted signal scattered from a target in the direction of the receiver.
- ❖ Since the reflectivity of a target is larger than that of the clutter, there exists signal level difference between the target and clutter.

W-Band Radar / Radiometer Fuzing Sensors

- ❖ **Common Tx / Rx with a single antenna configuration**
 - ❖ FMCW radar / TP radiometer
 - ❖ Simultaneous operation
 - ❖ Compact size

W-Band Radar / Radiometer Fuzing Sensors



W-Band Radar / Radiometer Fuzing Sensors

❖ Front-end & Antenna

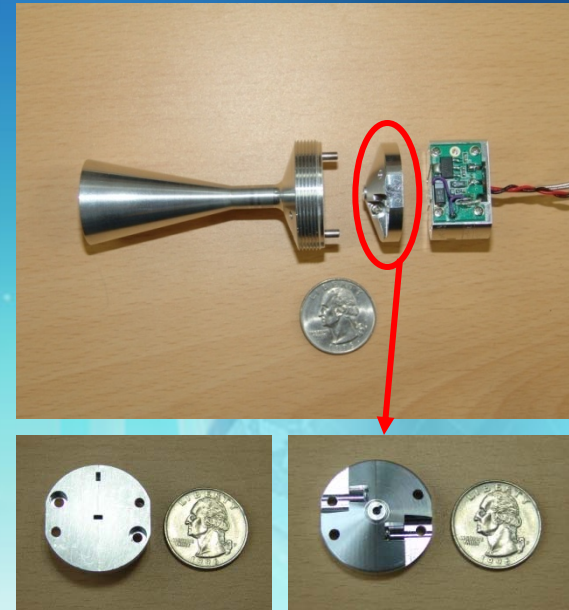
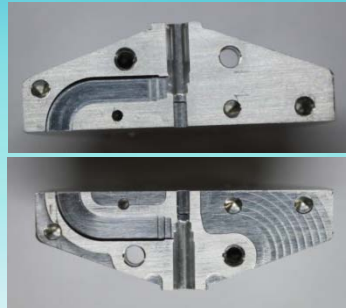
- ❖ Pout : 11 dBm
- ❖ Rx Loss : 6.5 dB
- ❖ NF : 10.2 dB
- ❖ Ant. Gain : 23 dB
- ❖ Ant. BW : 12.5°



W-Band Radar / Radiometer Fuzing Sensors

❖ Duplexer

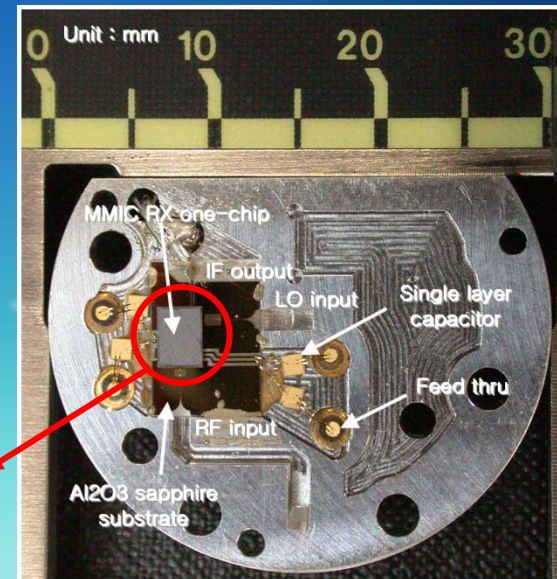
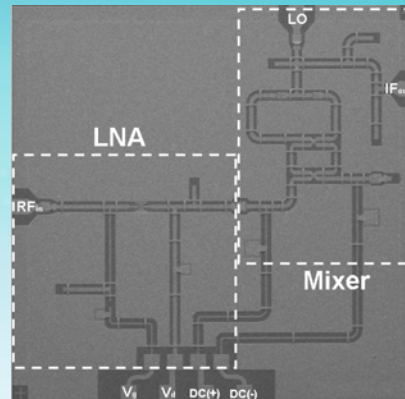
- ❖ OMT & Polarizer
- ❖ Insertion Loss : < 0.5 dB
- ❖ Isolation : > 30 dB



W-Band Radar / Radiometer Fuzing Sensors

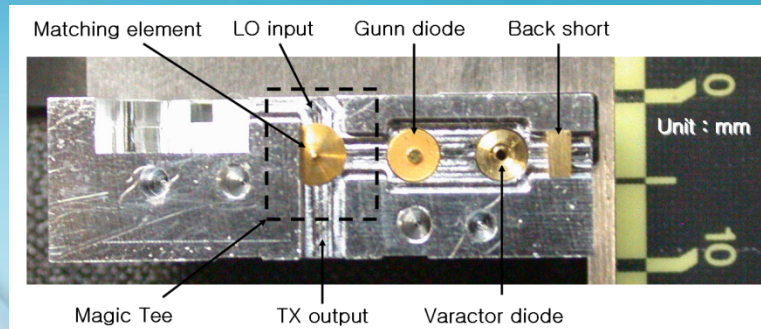
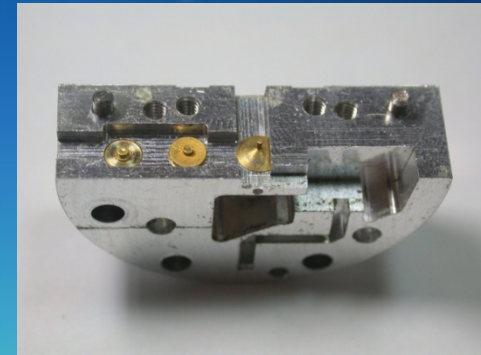
❖ MMIC Receiver

- ❖ LNA + Mixer
- ❖ LNA NF : 3 dB
- ❖ Total CL : 6.5 dB



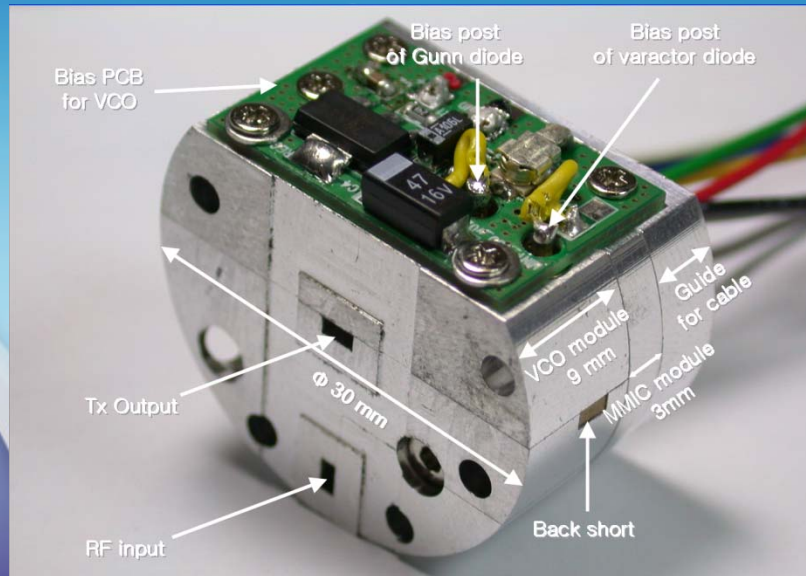
W-Band Radar / Radiometer Fuzing Sensors

- ❖ **VCO & Magic Tee**
 - ❖ VCO Pout : 15.5 dBm
 - ❖ Sweep BW : 300 MHz



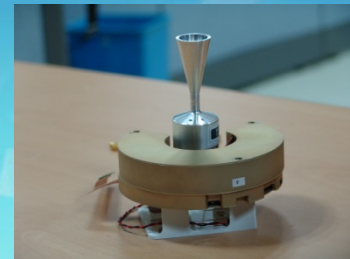
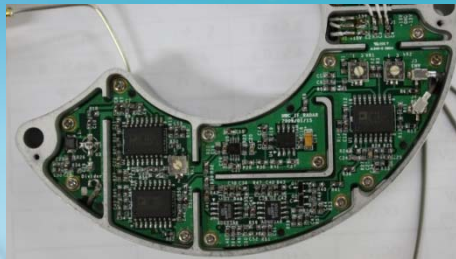
W-Band Radar / Radiometer Fuzing Sensors

❖ VCO & MMIC Module



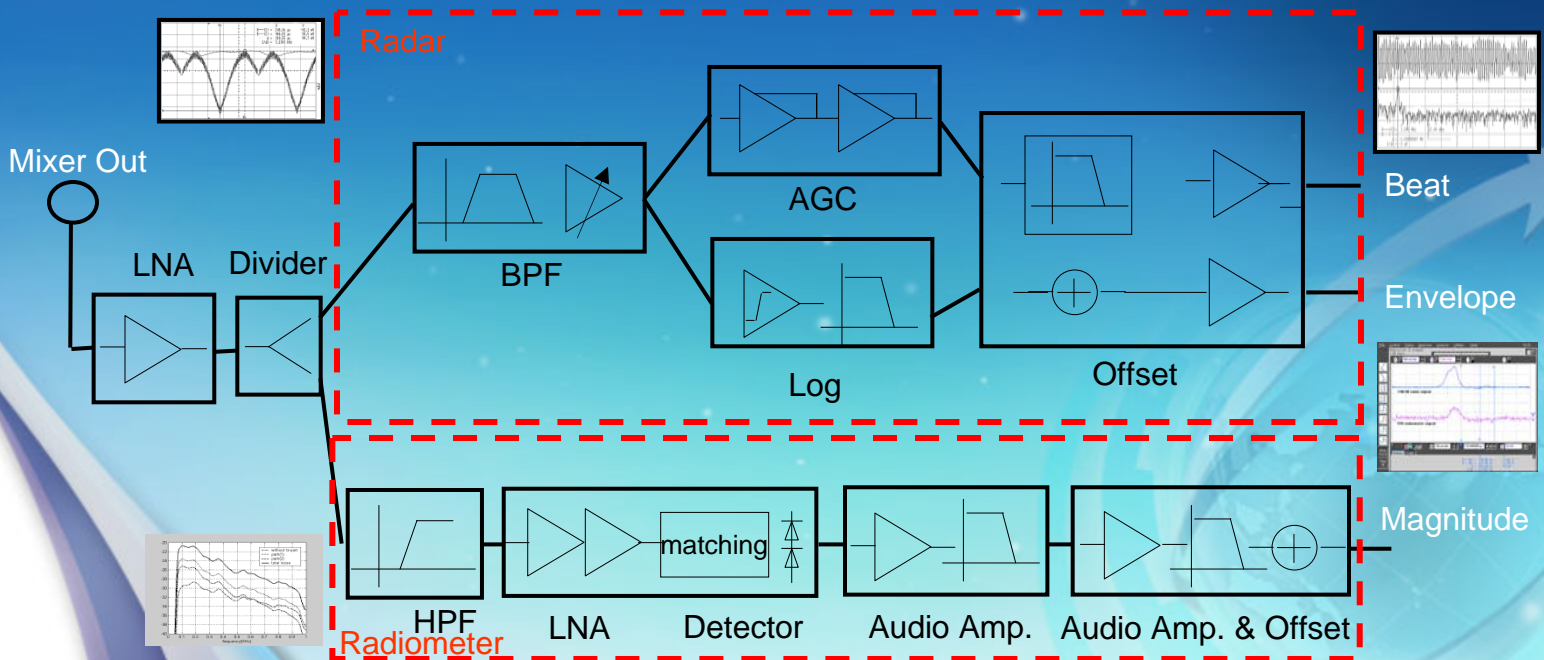
W-Band Radar / Radiometer Fuzing Sensors

- ❖ Radar & Radiometer Signal Processing
 - ❖ Radar BW : 2 MHz
 - ❖ Radiometer BW : 500 MHz



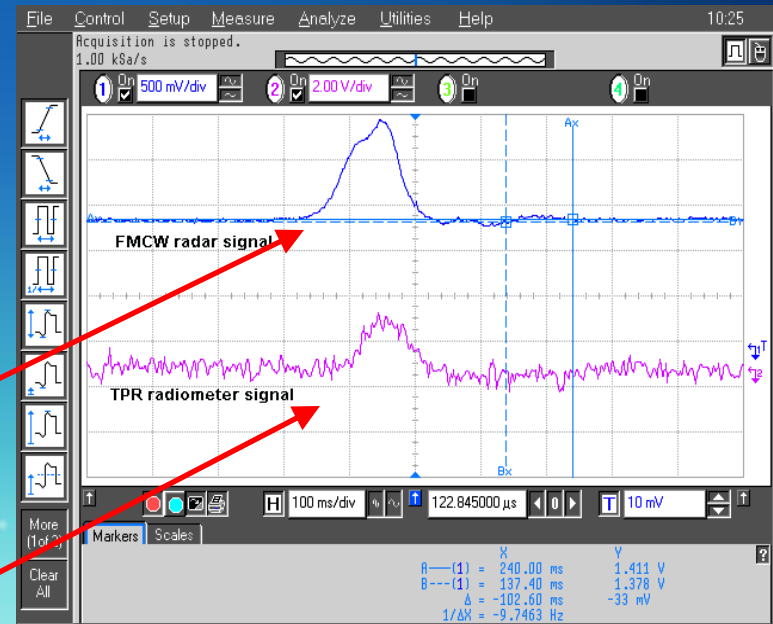
W-Band Radar / Radiometer Fuzing Sensors

❖ Radar & Radiometer Signal Processing



Experimental Results

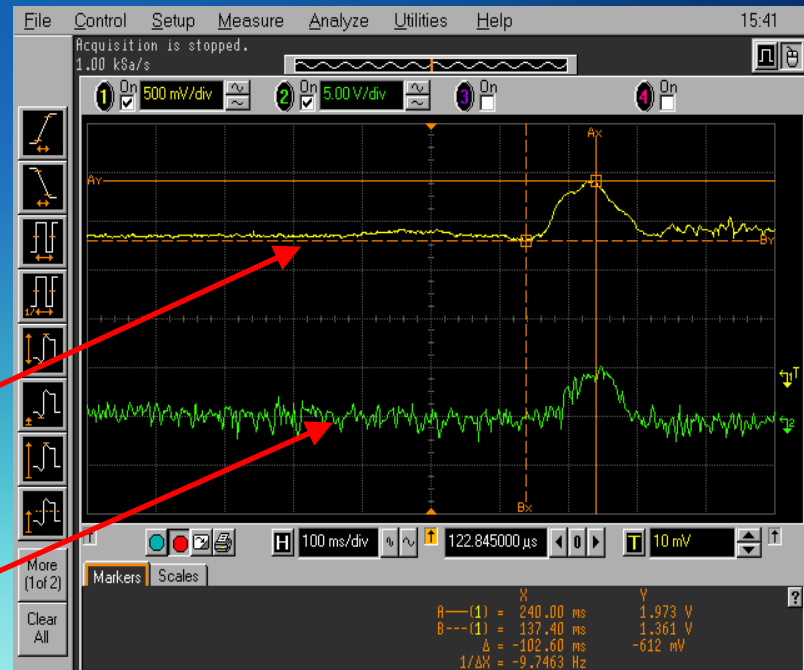
❖ Target Detection (1)



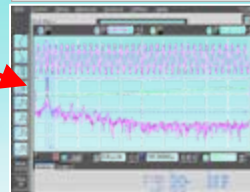
- ❖ Top : radar
- ❖ Bottom : radiometer
- ❖ Range : 25 m

Experimental Results

❖ Target Detection(2)



- ❖ Top : radar
- ❖ Bottom : radiometer
- ❖ Range (FFT) : 60 m



Summary

- ❖ W-band radar / radiometer fuzing sensors
- ❖ Compact size with MMIC receiver
- ❖ High output power because of the low insertion loss of duplexer (OMT & polarizer)
- ❖ MMW fuzing sensors will be widely used because of high resolution and small size.



Thank You

Fuze Group, Agency for Defense Development Republic of
Korea