ALMA Memo No. 328

Room Temperature Measurements of Various Absorbers with the HP 8510 at 75-110 GHz

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An HP 8510 vector network analyzer [1] was used to measure the reflection coefficient and transmission loss of various absorber samples in the frequency range 75-110 GHz. Time gating was used to reduce the effect of small reflections from waveguide and optical components which otherwise seriously corrupt the measurement.

Materials

The materials measured were:

AN-72 [2] (designed for use above 20 GHz),
UMASS FIRAM 500 [3] (for use in the range 500-700 GHz),
and from the microwave engineer's survival kit, ARC Technologies, Inc. [4].
Frequency tuned ultra thin MAGRAM with various binders,
DD-10017 for 2-18 GHz (2 mm thick) Silicone binder
DD-10214 for 4-30 GHz (1 mm thick) Silicone binder
ND-12142 for 6-38 GHz (0.7 mm thick) Nitrile binder
UD-11091 for 0.5-3 GHz (5 mm thick) Urethane binder
UD-11554 for 1-6 GHz (3 mm thick) Urethane binder
and carbon impregnated dielectric absorbers
LS-10055 for 2-18 GHz (3.5 mm thick)
LS-10211 for 4-26 GHz (6.35 mm thick).

Measurements

The system and measurement details are given in ALMA Memo No. 295 [5] and will not be repeated here. Figure 1 shows the measured transmission and reflection of AN-72 with the "green" side facing the transmitter, (port 1). The two sets of measurements show the differences as the material was rotated by 90 degrees about the axis of the beam. Figure 2 gives the results for the "white" side to the transmitter. The results for the FIRAM material in the two orientations are shown in Figure 3. Figures 4 to10 show the measurements for the ARC material in the order given above. Figure 11 shows the results for DD-10017 when the material was held normal to the beam and at 45 degrees. Measurements on all materials were repeated on two consecutive days, and showed a repeatability of 0.5 dB for all the measurements.

Conclusions

Measurements at 75-110 GHz indicate that LS-10211 may be a better load material at these frequencies. Tests will be made of its performance at 200-300 GHz with a test receiver in the near future and of its survivability at liquid nitrogen temperatures.

References

1. HP 8510 with time domain extension from Hewlett Packard.

2. Emerson and Cumming Microwave Products, Inc., 28 York Avenue, Randolph, MA 02368. http://www.emersoncumingmp.com

3. University of Massachusetts at Lowell, Submillimeter-Wave Technology Lab., 175 Cabot St., Lowell, MA 01854.

4. ARC Technologies, Inc., 11 Chestnut Street, Amesbury, MA 01913. http://www.arc-tech.com

5. ALMA Memo #295, http://www.alma.nrao.edu/memos/html-memos/alma295/memo295.pdf

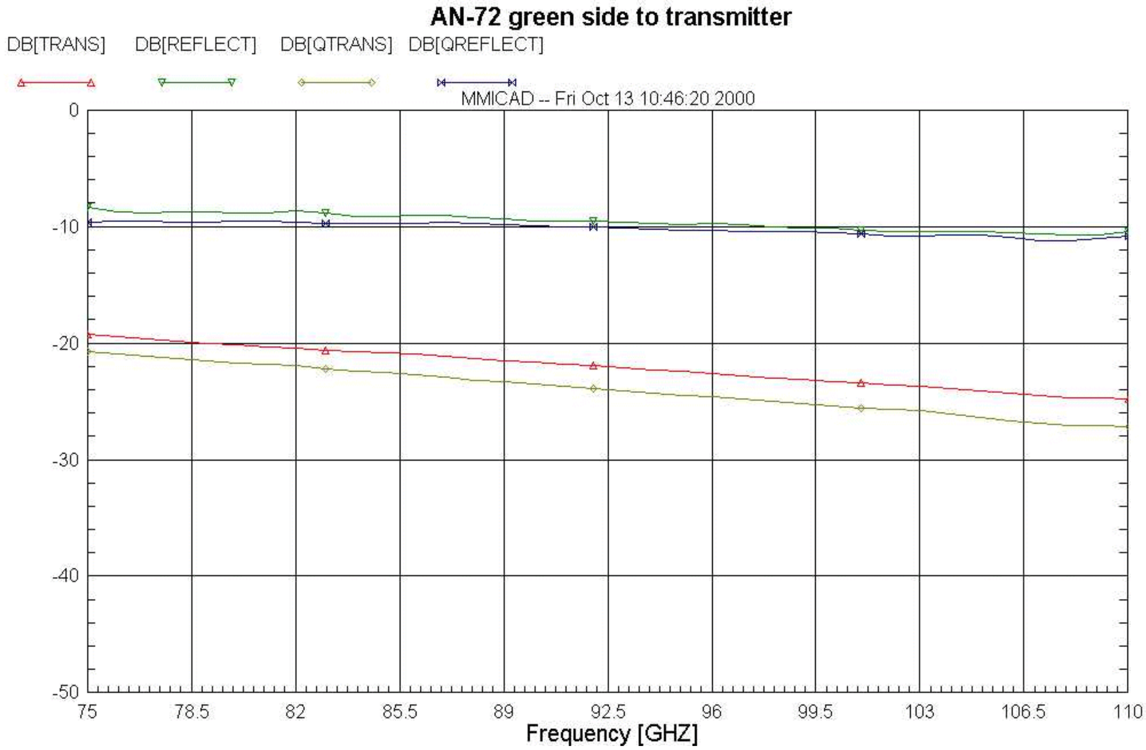


Figure 1

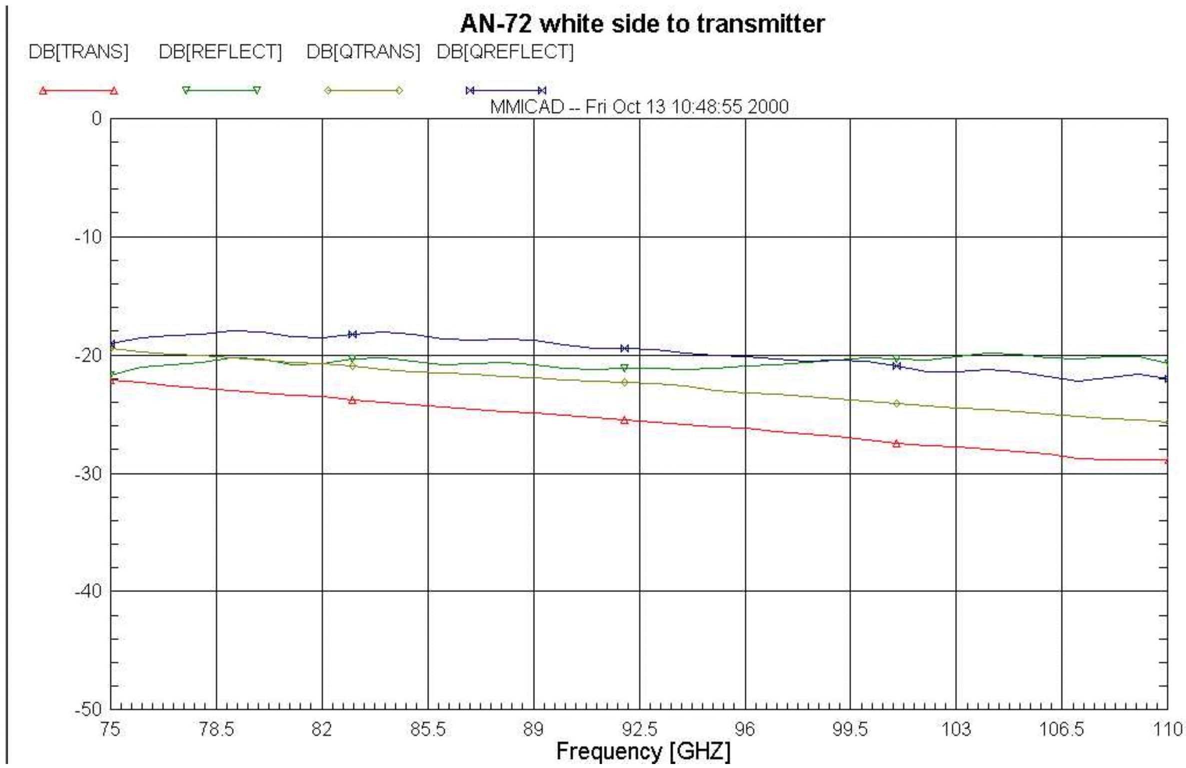


Figure 2

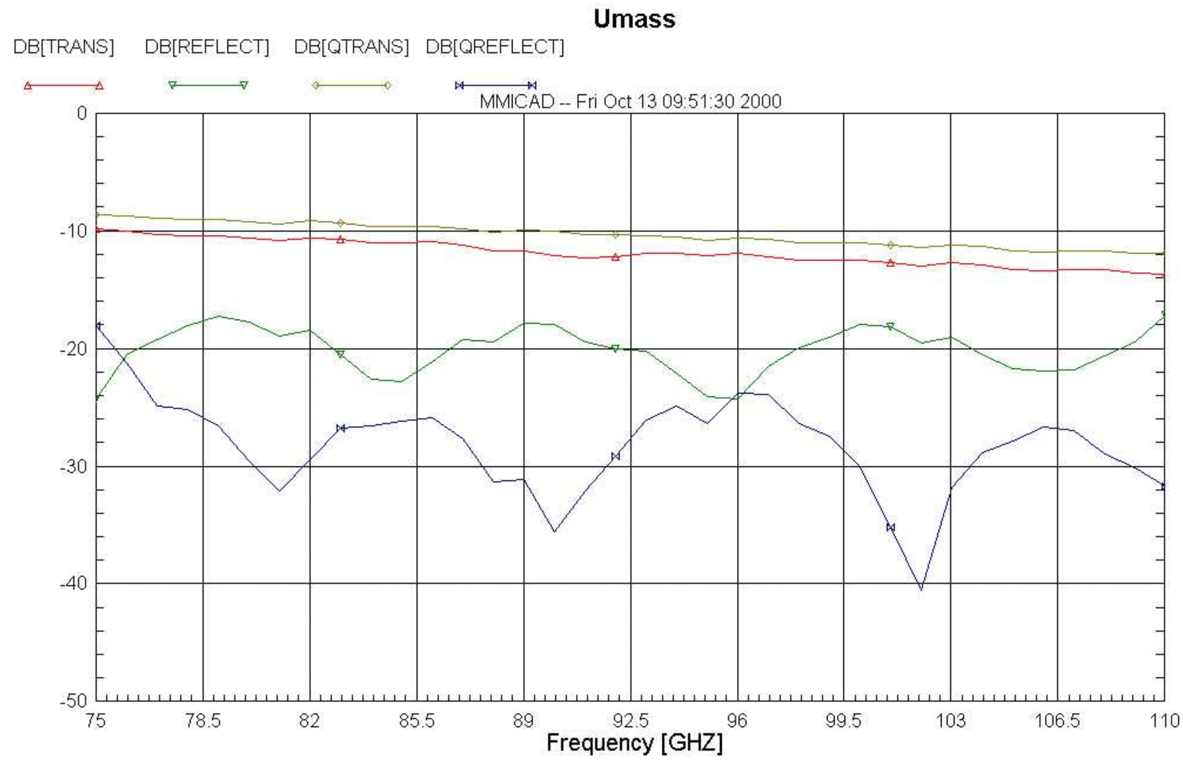


Figure 3

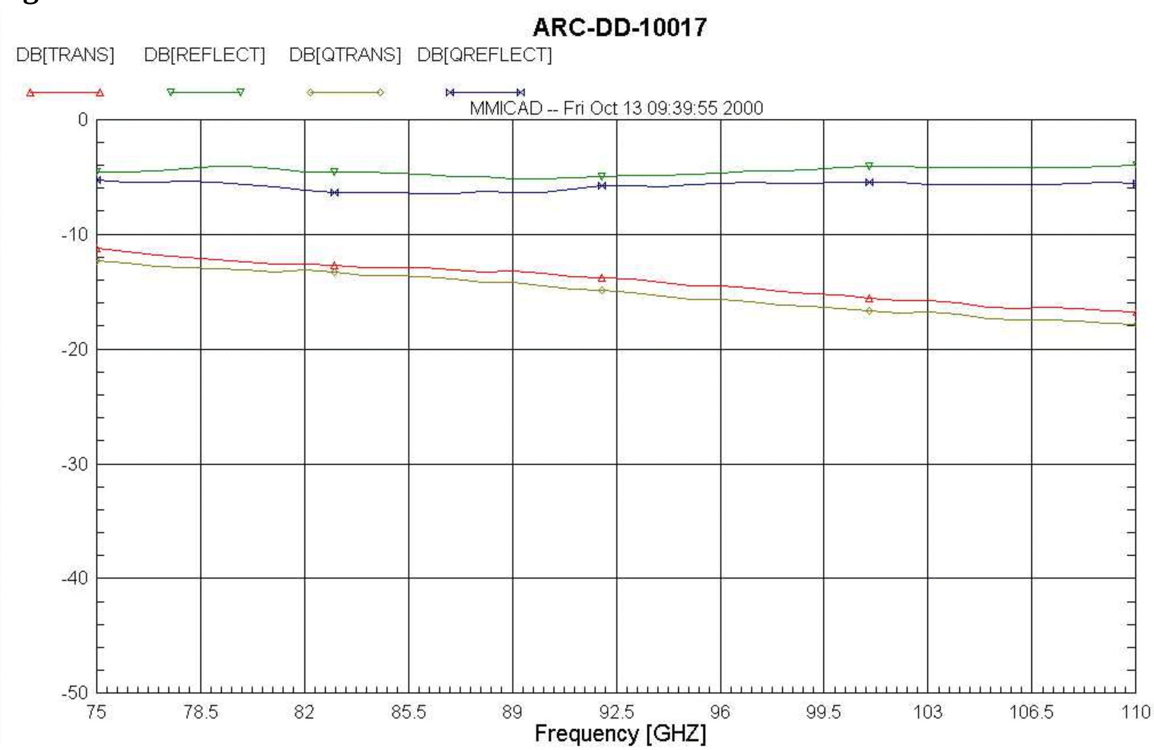


Figure 4

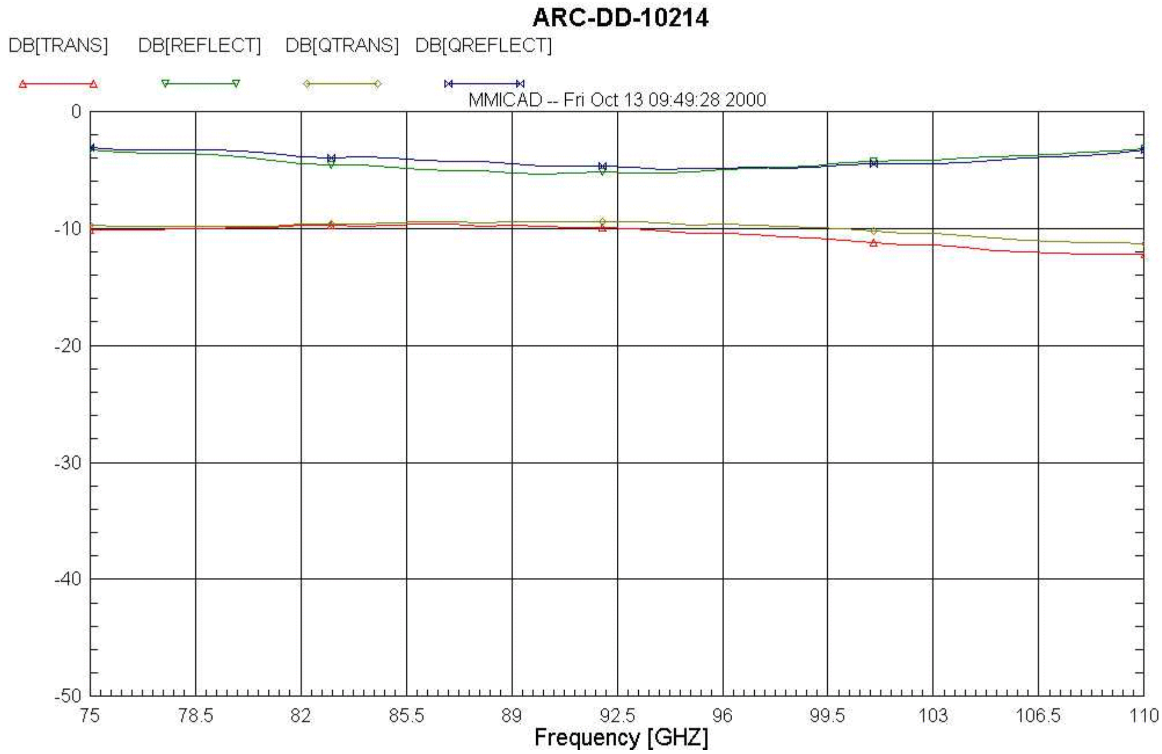
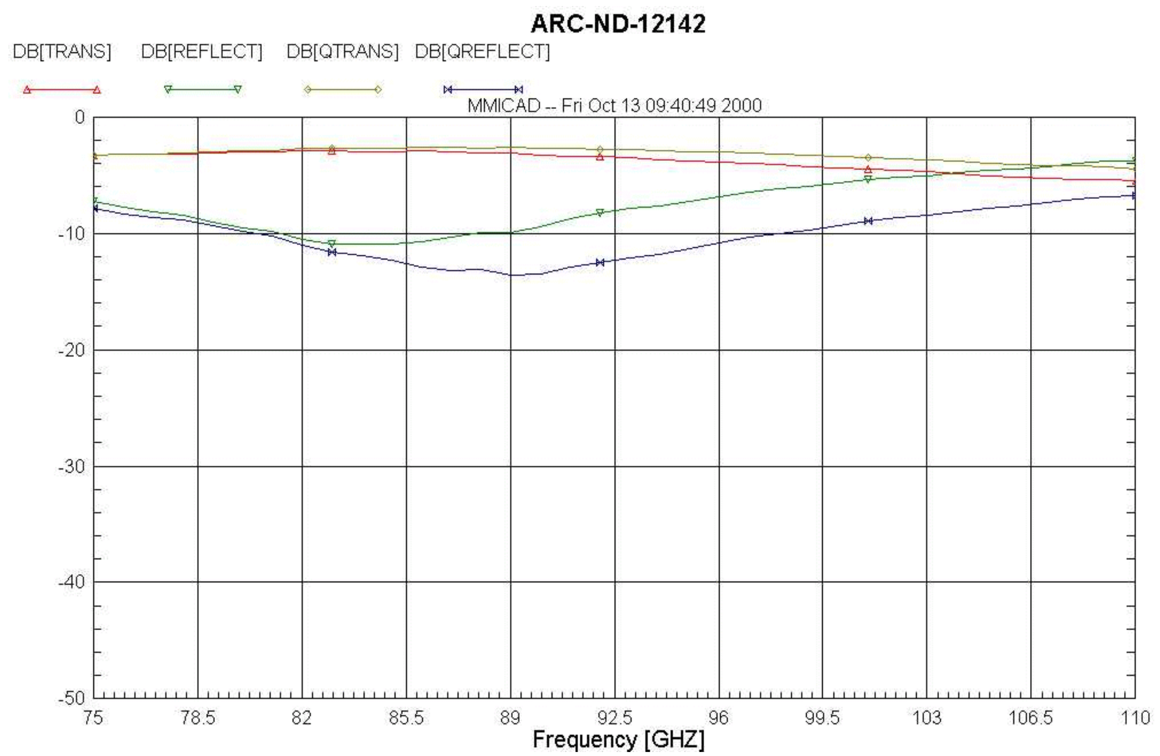


Figure 5



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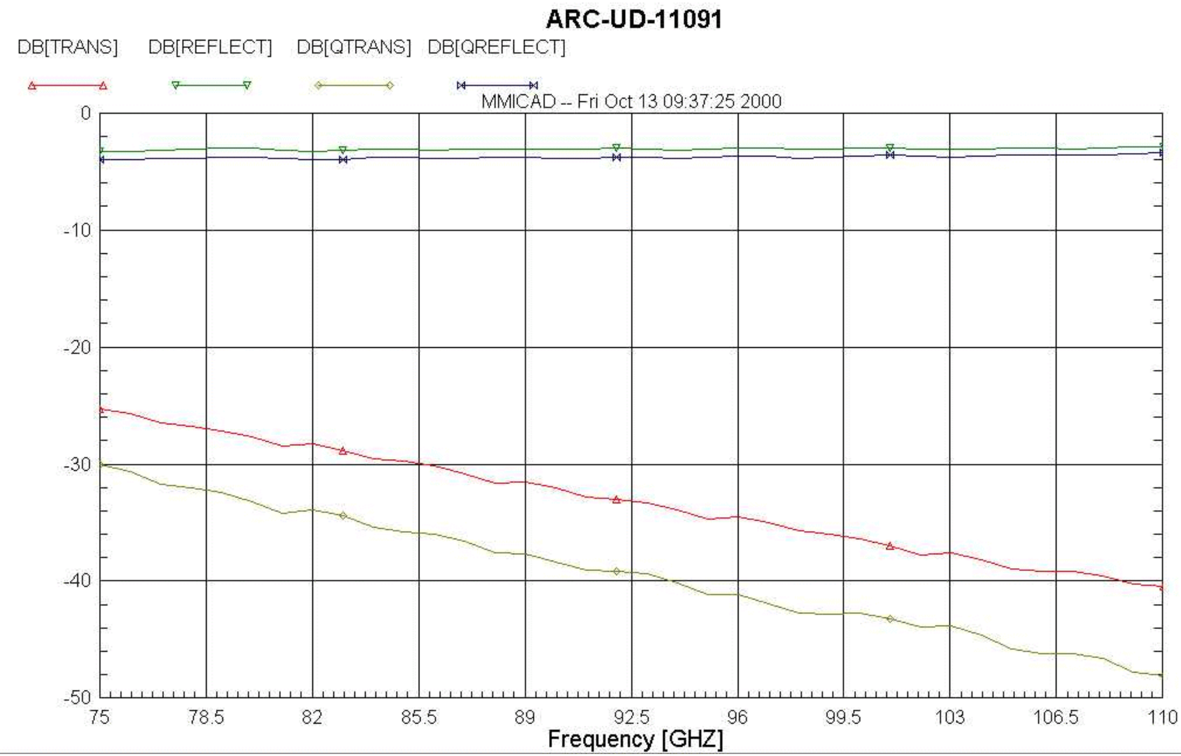

Figure 7

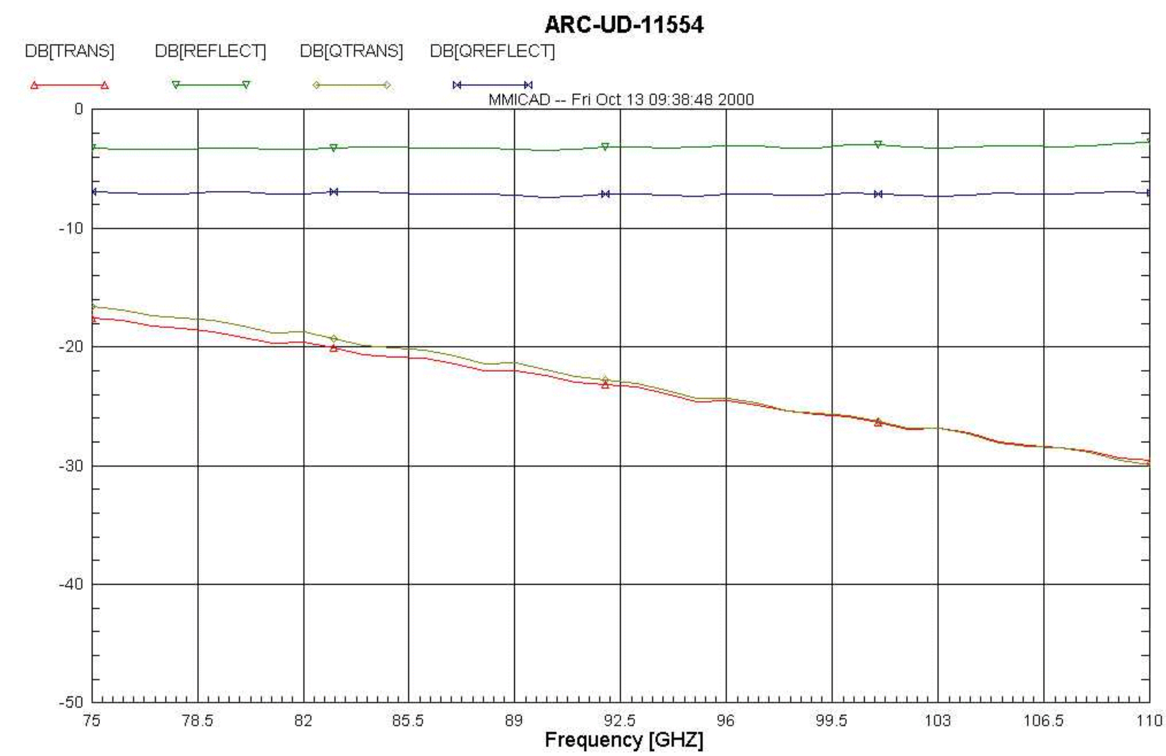

Figure 8

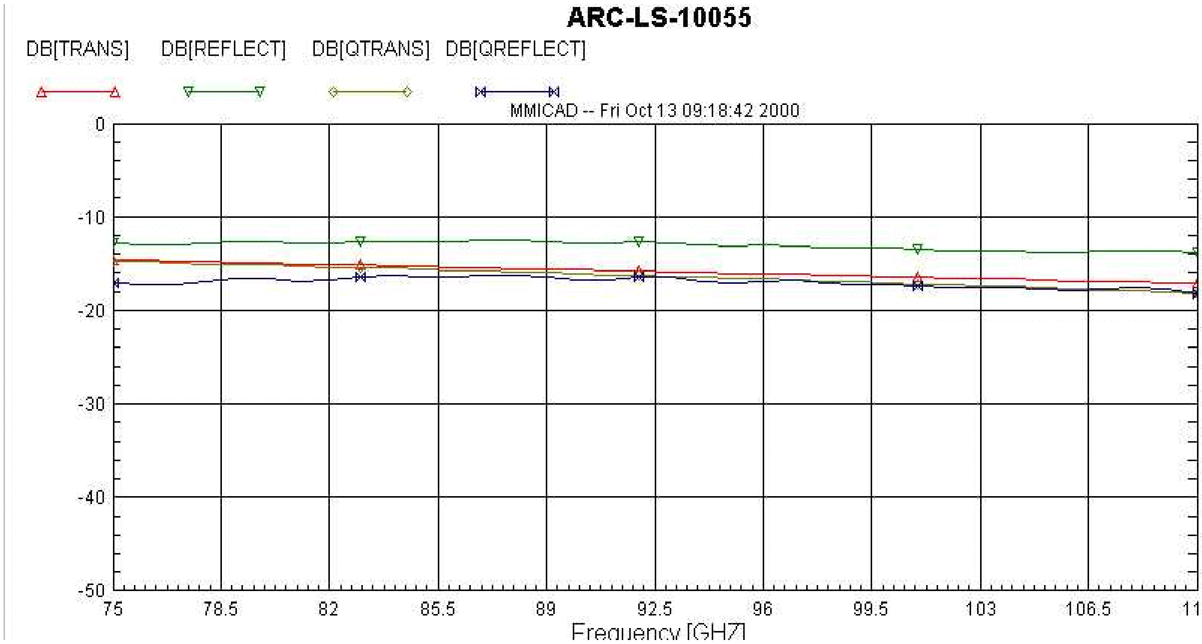

Figure 9

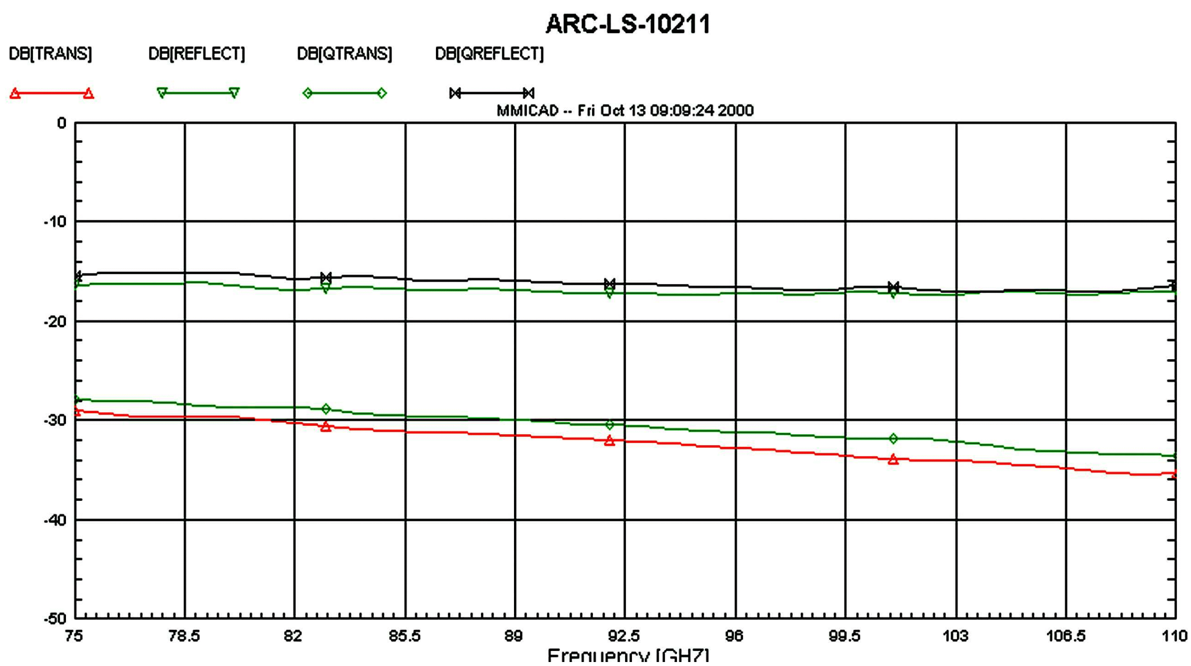

Figure 10

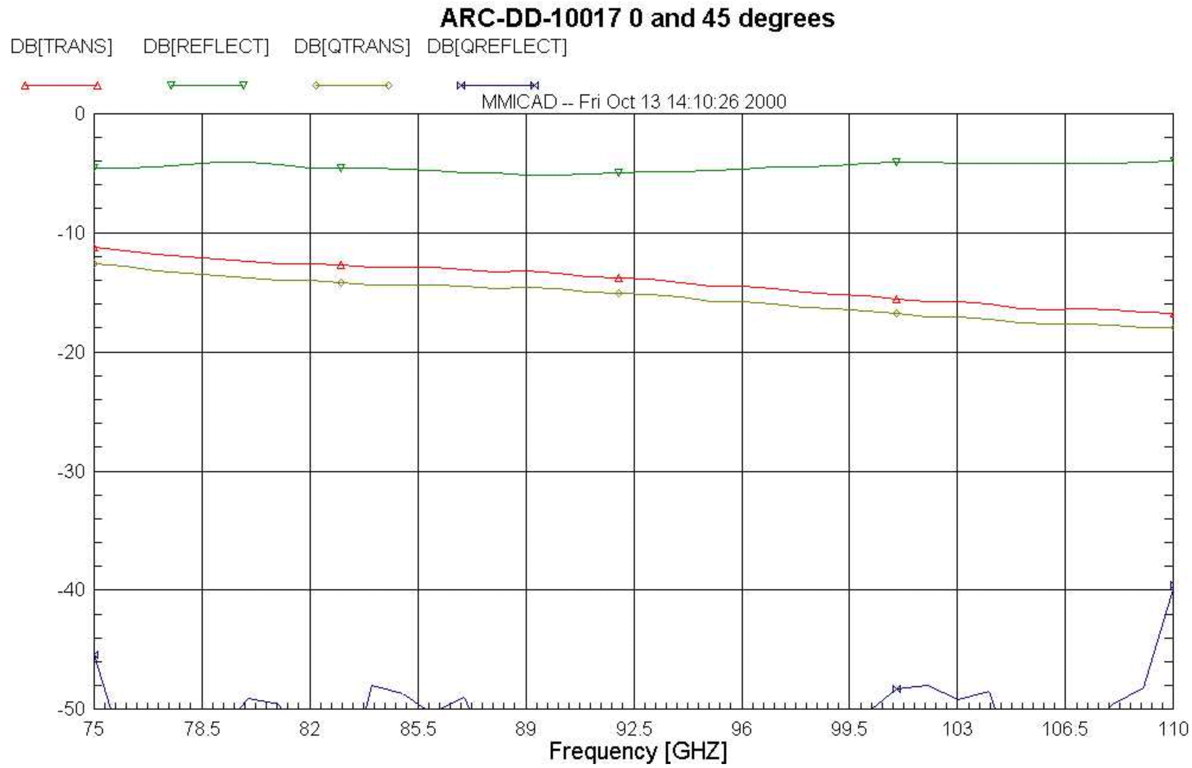
ARC-DD-10017 0 and 45 degrees
DB[TRANS]
DB[REFLECT]
DB[QTRANS]
DB[QREFLECT]
MMICAD -- Fri Oct 13 14:10:26 2000
0
-10
-20
-30
-40
-50
75
78.5
82
85.5
89
92.5
96
99.5
103
106.5
110
Frequency [GHZ]

Figure 11