MEASUREMENT OF CRYOGENIC PERFORMANCE OF 4-8 GHz PAMTECH ISOLATORS MODEL CTH-1383-K S/N 101-104

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September 2001

TECHNICAL REPORT C.A.Y. 2001-3

ABSTRACT

The purpose of this report is to present the results of the measurements of input and output reflection, insertion loss and isolation of four 4-8 GHz cryogenic isolators model CTH 1383 (SN 101 to 104). These isolators were made by PAMTECH to be used in the Development Model of the second stage IF made by ETH for the HIFI instrument for FIRST. The Isolators were specified by PAMTECH at 77 K, and the goal of these measurements was to determine the correct operation of the devices at lower cryogenic temperature (15 K). It is planed to use them at similar temperature in HIFI.

1 MEASUREMENT SYSTEM

The set up used is exactly the same as in Technical Report 2000-2 and 2000-3, but the calibration method has been improved. The results presented here should be compared with caution with those presented in previous reports. The isolators were measured in a Dewar with a CTI 1020 refrigerator. The input and output transitions were stainless steel coaxial air lines with K (2.92 mm) home-made vacuum seals. The input port of the isolator was connected to the female connector of the stainless steel line using a K male-male transition (RADIALL R127 703 001). The output was connected using a small length of semi-flexible cable (SUCOFORM 141 by SHUNER) with male SMA connectors (RADIALL R125 055) in both ends (Figure 1). The measurements were performed with a Vector Network Analyzer HP8510 C. A full two-port calibration of the VNA was done with reference planes in the interface of the K connectors at the end of the flexible cables of the VNA (outside the Dewar). The Dewar transitions were measured independently at ambient temperature, and its effect was de-embedded in the post-processing of the data. The de-embedding of the data measured at cryogenic temperature is possible because the S parameters of the stainless steel transitions change very little with temperature. The S parameters obtained after de-embedding corresponded to the cascade of a K m-m transition, the isolator, and a short semi-flexible cable. It was considered unnecessary to de-embed for the K transition and the cable, because its effect is very little, and also because the result will not be accurate, since the losses of these elements will change with temperature. The output reflection of the isolator (S_{22}) was slightly masked by the effect of the reflection of the semi-flexible cable, and a time domain gate was applied to eliminate this effect. Note that the value of S_{21} (insertion loss) is overestimated, since it includes the cryogenic losses of the K transition and semi-flexible cable. The precision of S_{11} and S_{22} obtained is much better than in previous reports, and the ripples in the measurement of S21 (insertion loss) have been eliminated almost completely.

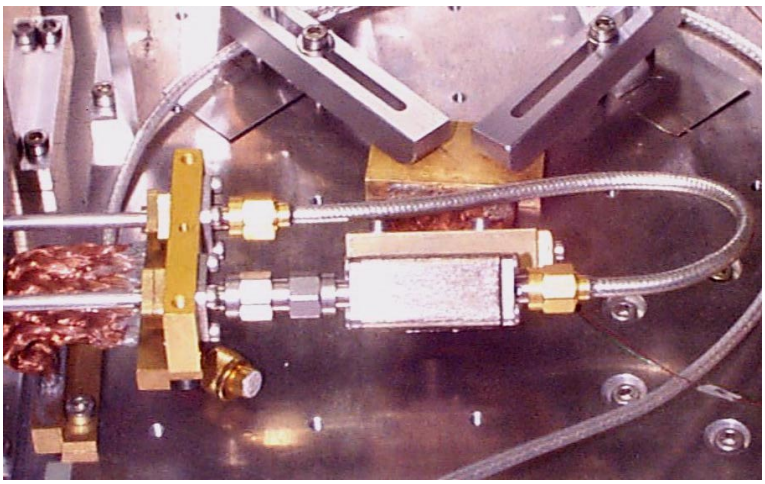

Figure 1: Isolator PAMTECH Inside test Dewar.

2 MEASUREMENTS

The results of the measurements are shown in figures 2 to 5. The worst case values in the 4-8 GHz band are presented in Table I and compared with the data from PAMTECH.

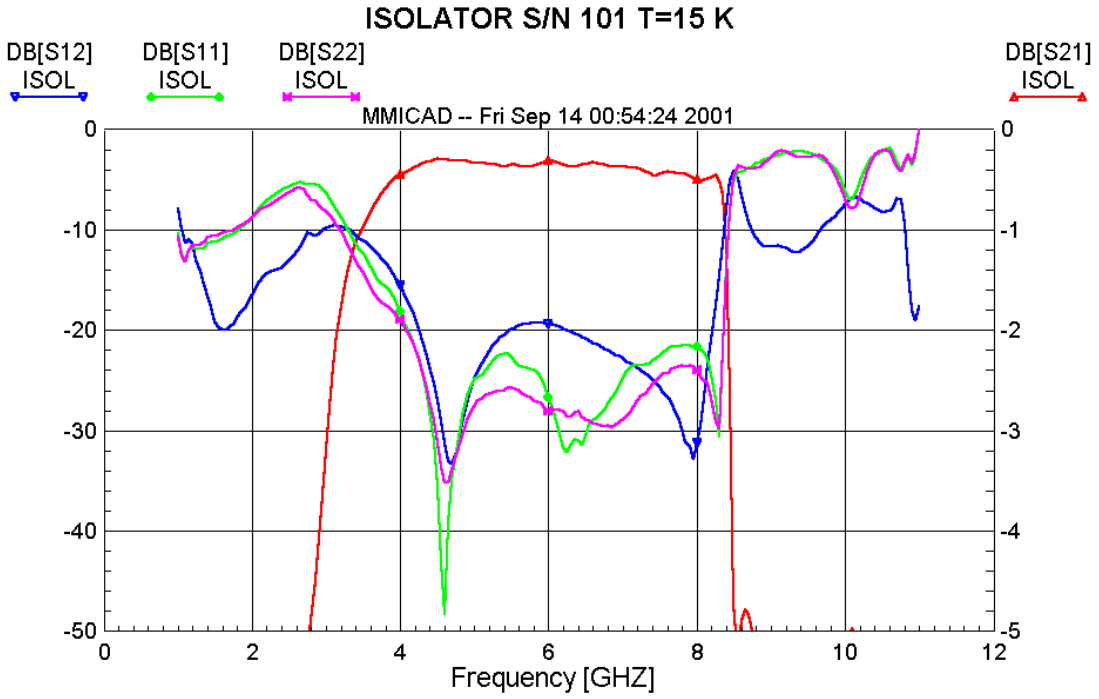

Figure 2: Isolator PAMTECH CTH1383 S/N 101.

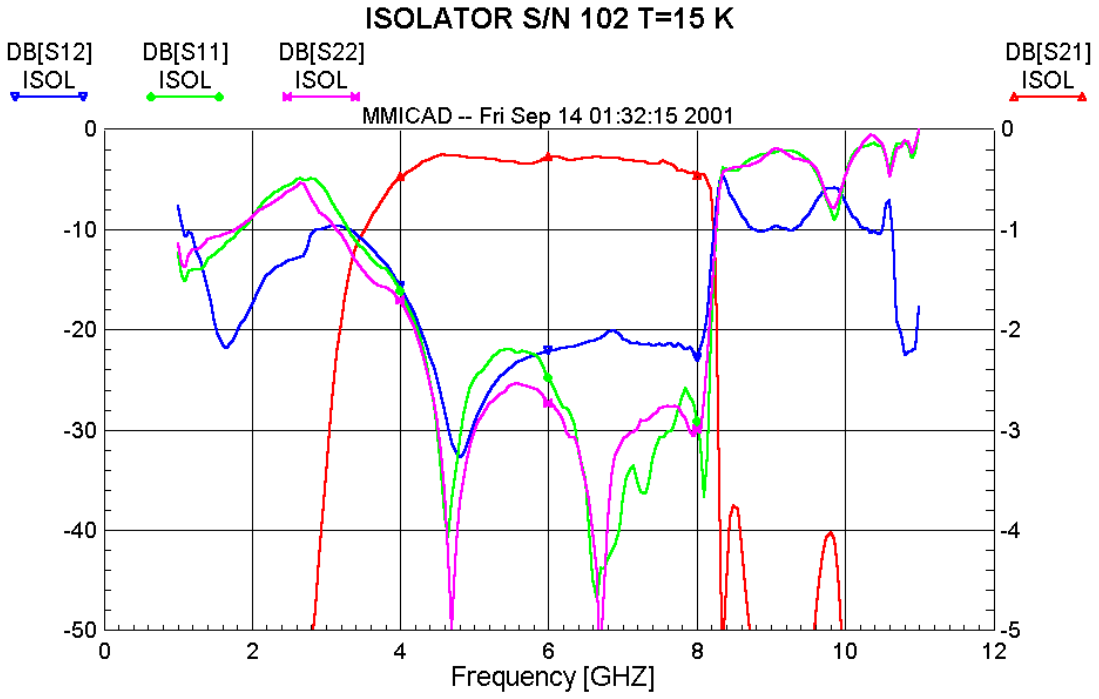

Figure 3: Isolator PAMTECH CTH1383 S/N 102.

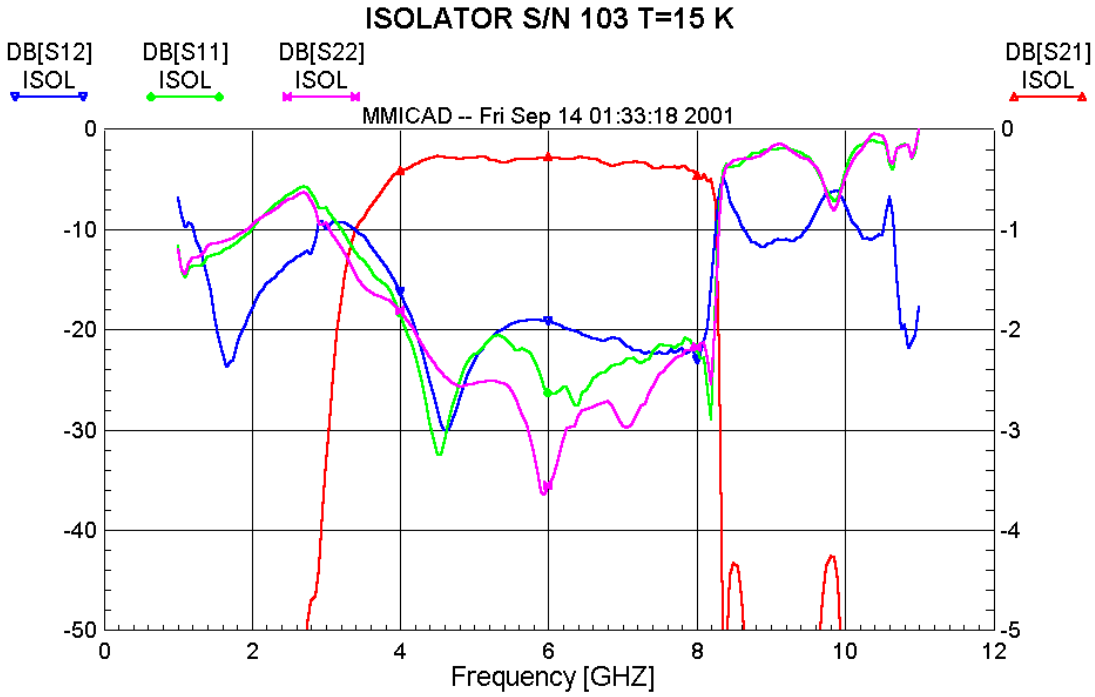

Figure 4: Isolator PAMTECH CTH1383 S/N 103.

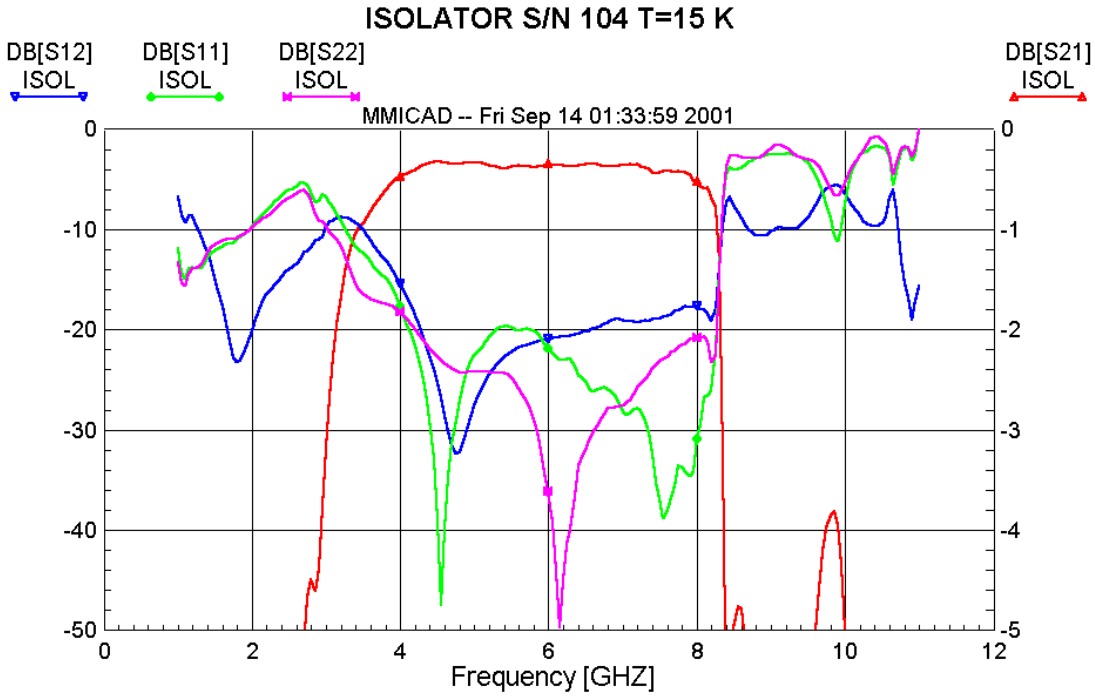

Figure 5: Isolator PAMTECH CTH1383 S/N 104.

TABLE I

Results of measured S parameters compared with data from PAMTECH

	MEASURED @ 15 K				PAMTECH DATA @ 77 K			
S/N	S_{11} (dB)<	S_{12} (dB)<	S_{21} (dB)>	S_{22} (dB)<	S_{11} (dB)<	S_{12} (dB)<	S_{21} (dB)>	S_{22} (dB)<
101	-18.1	-15.5	-0.50	-18.9	-20.4	-18.2	-0.28	-20.8
102	-16.1	-15.6	-0.47	-17.1	-19.7	-18.5	-0.28	-19.1
103	-18.3	-16.2	-0.46	-18.1	-18.5	-18.8	-0.28	-19.4
104	-17.6	-15.4	-0.52	-18.2	-18.8	-18.9	-0.28	-20.1
SPEC.	-	-	-	-	-18.2	-18.0	-0.30	-18.2

3 CONCLUSIONS

During the cooling procedure it was observed a clear shift in all the parameters to higher frequencies when the temperature was reduced. Near 77 K, the band-pass was well defined and perfectly centered. However, when the temperature was further reduced from 77 K to 15 K, the band was shifted in excess, and a degradation of performance appeared at the low frequency end of the band (4 GHz). As the performance is severely degraded at the edges of the band, for future versions of these isolators it will be important to center the band for the real working temperature of the device, and not for 77 K as was done in these prototypes. Other than this, the isolators perform quite well, and are usable at 15 K.

4 ADNOWLEDGMENTS

This work has been founded in part with the CICYT and European Commission project 1FD1197-1442.