Memorandum

To: A. R. Kerr
S. -K. Pan
K. Crady

cc: J. Webber

From: J. Effland

Date: 22 February1999

Subject: Status Report for Automating SIS Mixer Measurements

1. Summary

We have concentrated over the last two weeks on software development to take advantage of an operating mixer.

Data taken both manually and with the automated system agree well (see attached data for details). The noise temperature measurement software is ready for testing additional mixers, but the bias measurement software needs a number of enhancements to make it useful.

Routines were written to record into the database Dewar temperatures and pressures and to retrieve and plot this data using Excel.

2. Software

The measurement system currently has two main programming tasks:

1. I/V curves for mixer bias and dewar temperature\pressure measurements
2. Mixer noise temperature measurements.

Both tasks use stand-alone Visual Basic, an Access database file, and Excel for data analysis. Excel programming is accomplished using Visual Basic for Applications, which is a subset of the stand-alone Visual Basic. Details of current development are given in the following sections.

2.1 Bias plots and Temperature/Pressure Data

Bias data are collected using routines written in stand-alone Visual Basic. Figure 1 shows the dialog box used when commencing a bias measurement. Details of this interface can be found in the 15 January progress report. About 75% of the widgets in Figure 1 actually operate; the others require additional interfacing code to become functional. The types of measurements currently coded are I *vs.* V when LO power is stepped, and I *vs.* V when magnet current is stepped. LO power must now be manually changed, but magnet current is stepped automatically by the program.

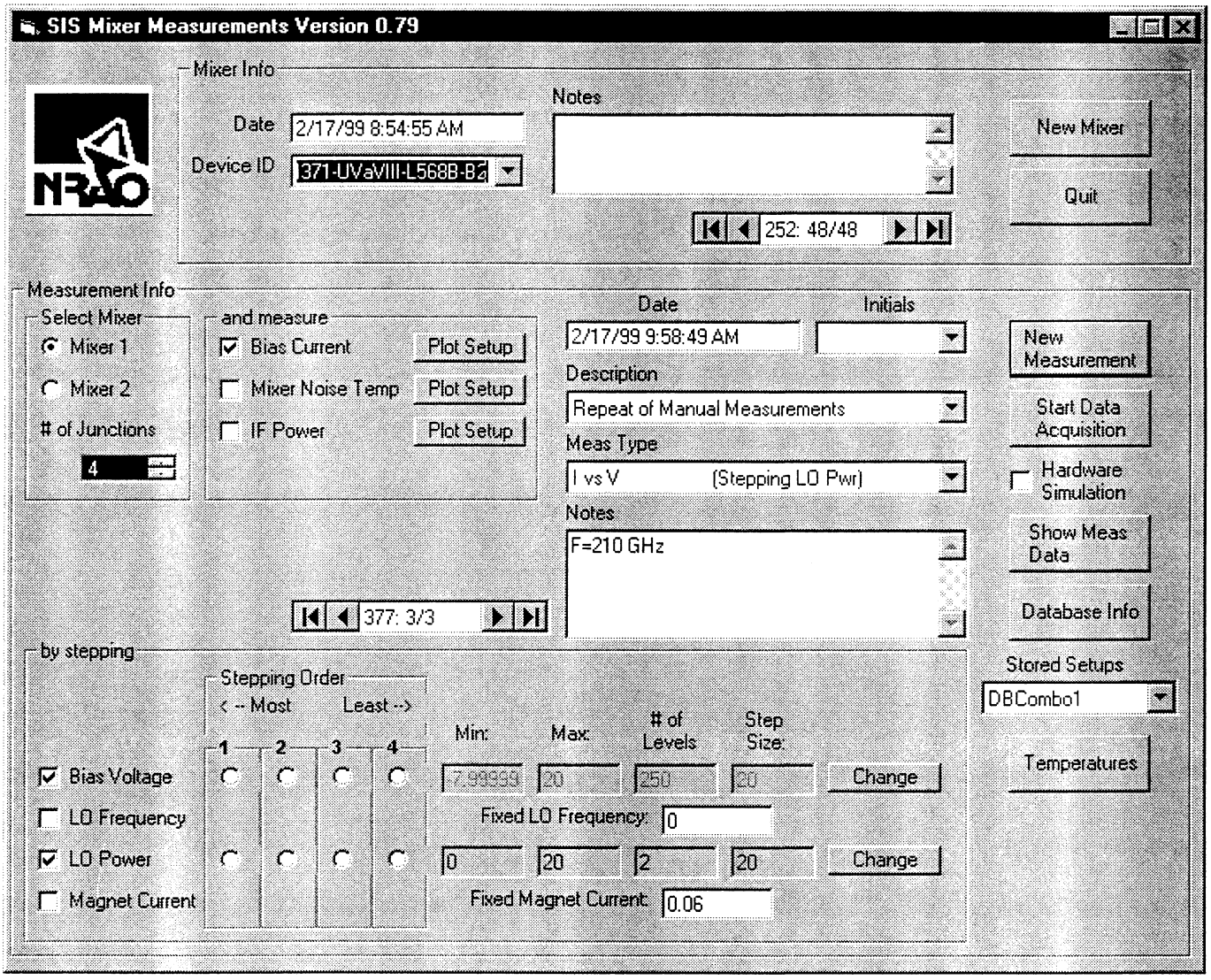

Figure 1: Dialog Box for Bias Measurements

Figure 2 shows the real-time plot of Dewar temperature and pressures that was developed over the last two weeks. Some of the curves are automatically scaled (as annotated in the legend) in an attempt to prevent data overlap. The data acquisition and real-time plotting routines are written in stand-alone Visual Basic.

The real-time plot is admittedly crude due to limitations of the plotting control that was included in stand-along Visual Basic. An enhanced plot, including real-time data display, will be written using Excel. Dewar status can be remotely monitored in near real-time because the data are recorded into the Access database and can be retrieved using Excel. Any number of users can simultaneously retrieve the data, even during data acquisition. Planned enhancements include automatically updating the graph in Excel each time new data are written to the database. The graph available from Excel is shown in Figure 8 in the Results section.

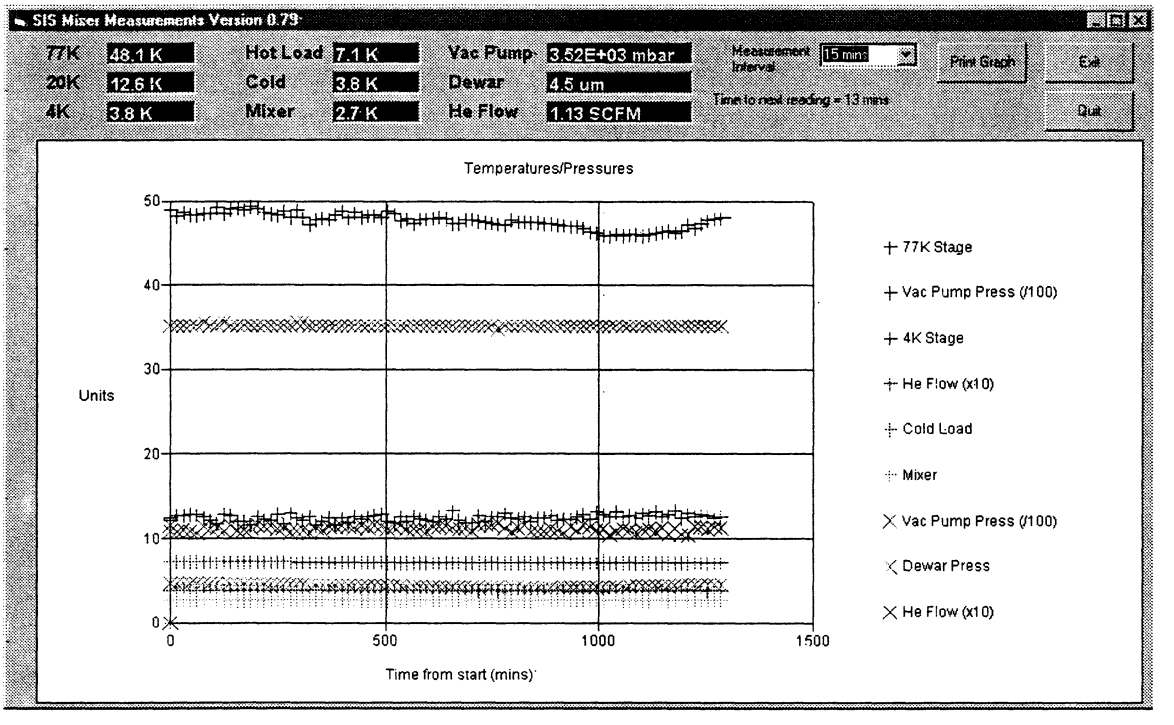

Figure 2: Temperature/Pressure Real-Time Plot

2.2 Bias/Temperature Retrieval, Plotting, and Analysis Software

This software is written in Visual Basic for Applications and runs in Excel. When executed, a dialog box fills its widgets by reading the database, as shown in Figure 3. Programming effort during this period concentrated on retrieving and plotting temperature data.

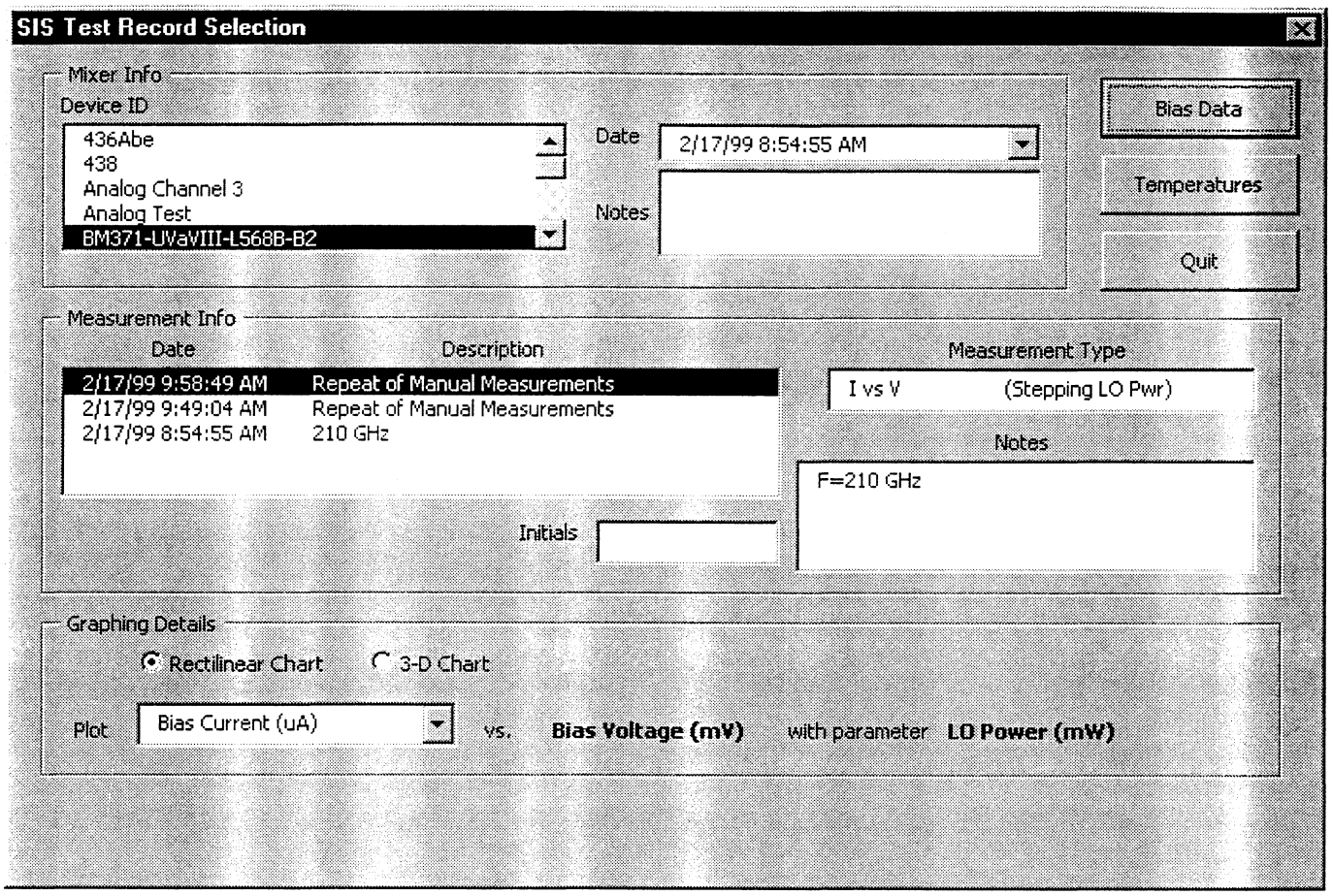

Figure 3: Dialog Box to Display Bias, Temperature, and Pressure in Excel

2.3 Mixer Noise Temperature Measurements

Mixer noise temperatures are measured from Excel using a combination of stand-alone Visual Basic (VB) and Visual Basic for Applications. The stand-alone VB was used to construct an "ActiveX" dynamic link library that contains all of the equipment interface code. "ActiveX" is Microsoft's complicated attempt to provide compatibility between differing versions of dynamic link libraries. Function names are stored as "globally unique identifiers (GUID's)" in the registry and the calling programs (clients) actually reference these GUID's rather than the function names.

The noise temperature software required little modification to characterize the operating mixer. Only the code that controls the Dewar coax switches required changing. The switch command is now held for 500 ms to insure the switches actually change state. The most time-consuming task was getting the ActiveX features working again after this modification.

3. Project Status

I am still listing all the tasks to be accomplished in MS Project 98, and have not yet begun assigning milestones and task durations

4. Hardware

4.1 Chassis Construction

Hardware construction has suffered lately because all effort concentrated on improving the software using an operational mixer.

The switch control chassis will be complete after installation of a front-panel switch (which has now been delivered from the vendor).

The refrigerator control chassis, which also contains the computer analog and digital IO, requires another 6 hours of work to be complete.

4.2 Computer Replacement

The replacement computer was received and Kirk Crady is installing the requisite software. Unfortunately, the replacement for the originally specified computer is one inch wider than the rack opening, so we will swap the new computer with the one in Pan's system, since his computer is not installed in a rack.

5. Measurement Results

Graphs of representative data collected with the UVa mixer are attached at the end of this section.

Figure 4 is a pumped I-V curve at F_{LO} = 210 GHz with magnet current stepped between 10 and 100 mA. Bias current monotonically changes about 10 μA over this range of magnet currents.

Figure 5 shows a series of I-V curves magnified near zero bias voltage, again with stepped magnet current. Each curve is intentionally offset by 10 mA to prevent overlap. The offset was manually introduced in Excel once the data were retrieved from the database. For this frequency (not recorded), the bias shows instability at low magnet currents.

Figure 6 is a plot of receiver temperature data and LO rejection recorded both manually and with the data acquisition system. The automated data were measured only for the lower third of the frequencies, since some of the manual data were questionable there. The automated data follows the manual data closely where the mixer is well behaved, but discrepancies are evident near 210 GHz where the mixer shows some instabilities. The discrepancies are primarily due to differences when retuning the mixers. The automated data shows that the questionable LO rejection at 240 GHz that was measured manually is erroneous – the correct LO rejection is about 24 dB.

Manual and automatic mixer loss and noise temperature data are compared in Figure 7.

Dewar temperatures and pressures are shown in Figure 8. The flat data around noon on 18Feb result since no data were collected during that time. The large change in vacuum pump pressure around 2 PM on 18Feb is an anomaly caused by a program change in how the data were recorded.

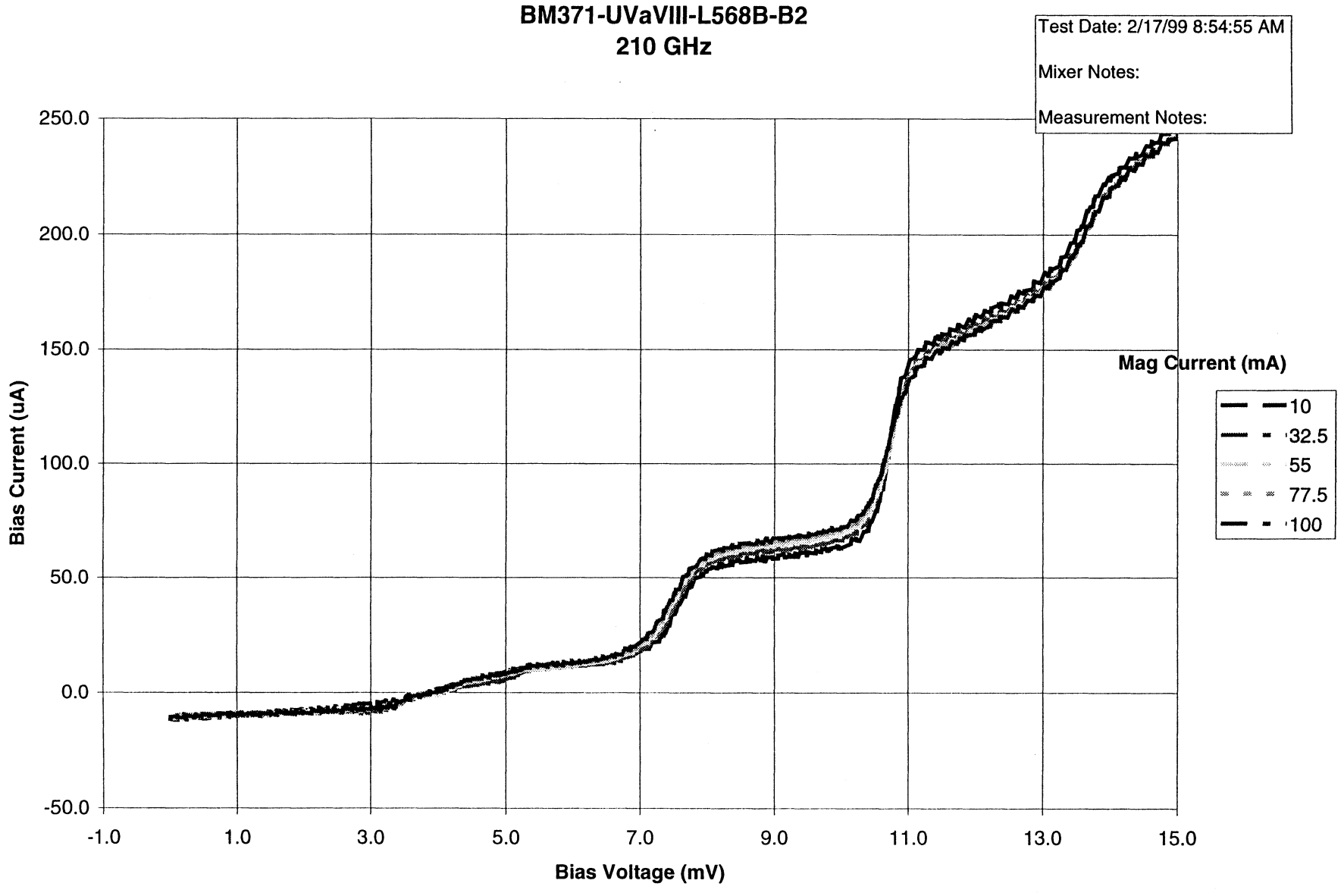
BM371-UVaVIII-L568B-B2
210 GHz
Test Date: 2/17/99 8:54:55 AM
Mixer Notes:
Measurement Notes:
Bias Current (uA)
250.0
200.0
150.0
100.0
50.0
0.0
-50.0
-1.0
1.0
3.0
5.0
7.0
9.0
11.0
13.0
15.0
Bias Voltage (mV)
Mag Current (mA)
10
32.5
55
77.5
100

Fig. 4

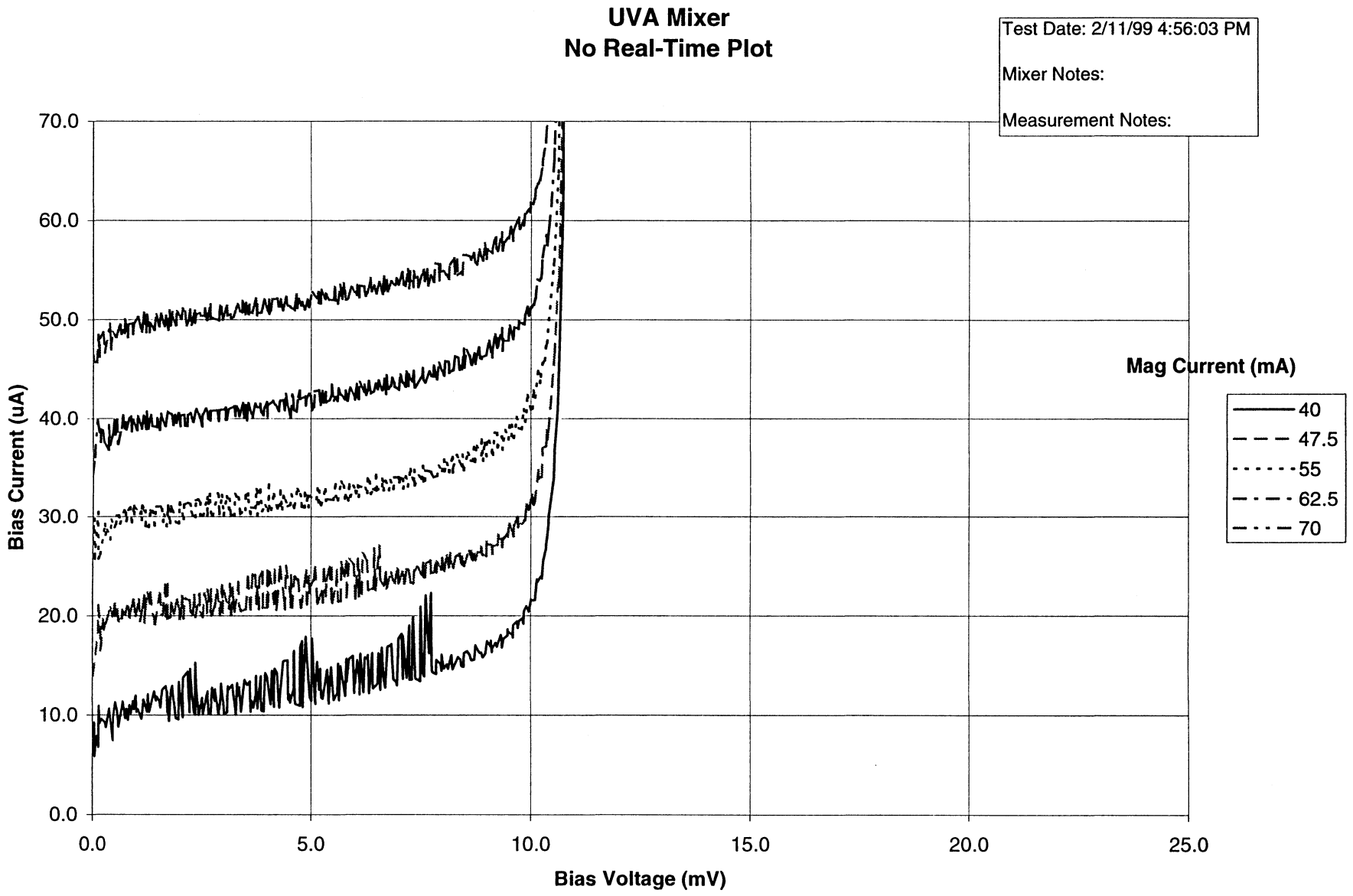
UVA Mixer
No Real-Time Plot
Test Date: 2/11/99 4:56:03 PM
Mixer Notes:
Measurement Notes:
Bias Current (uA)
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
0.0
5.0
10.0
15.0
20.0
25.0
Bias Voltage (mV)
Mag Current (mA)
40
47.5
55
62.5
70

Fig. 5

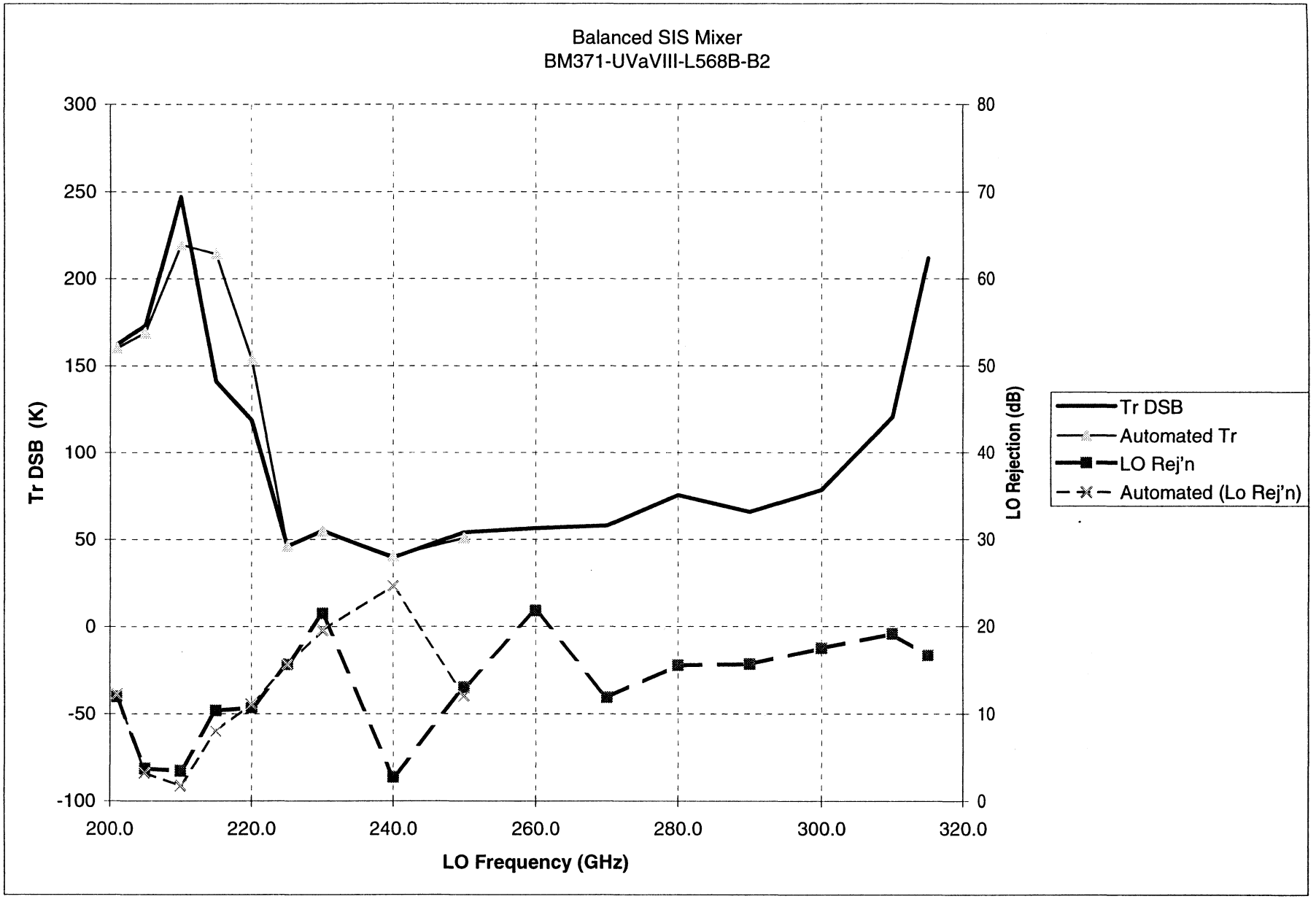

Fig. 6

File: F:\SIS_Meas\021699.xls

Printed: 2/19/99
4:13 PM

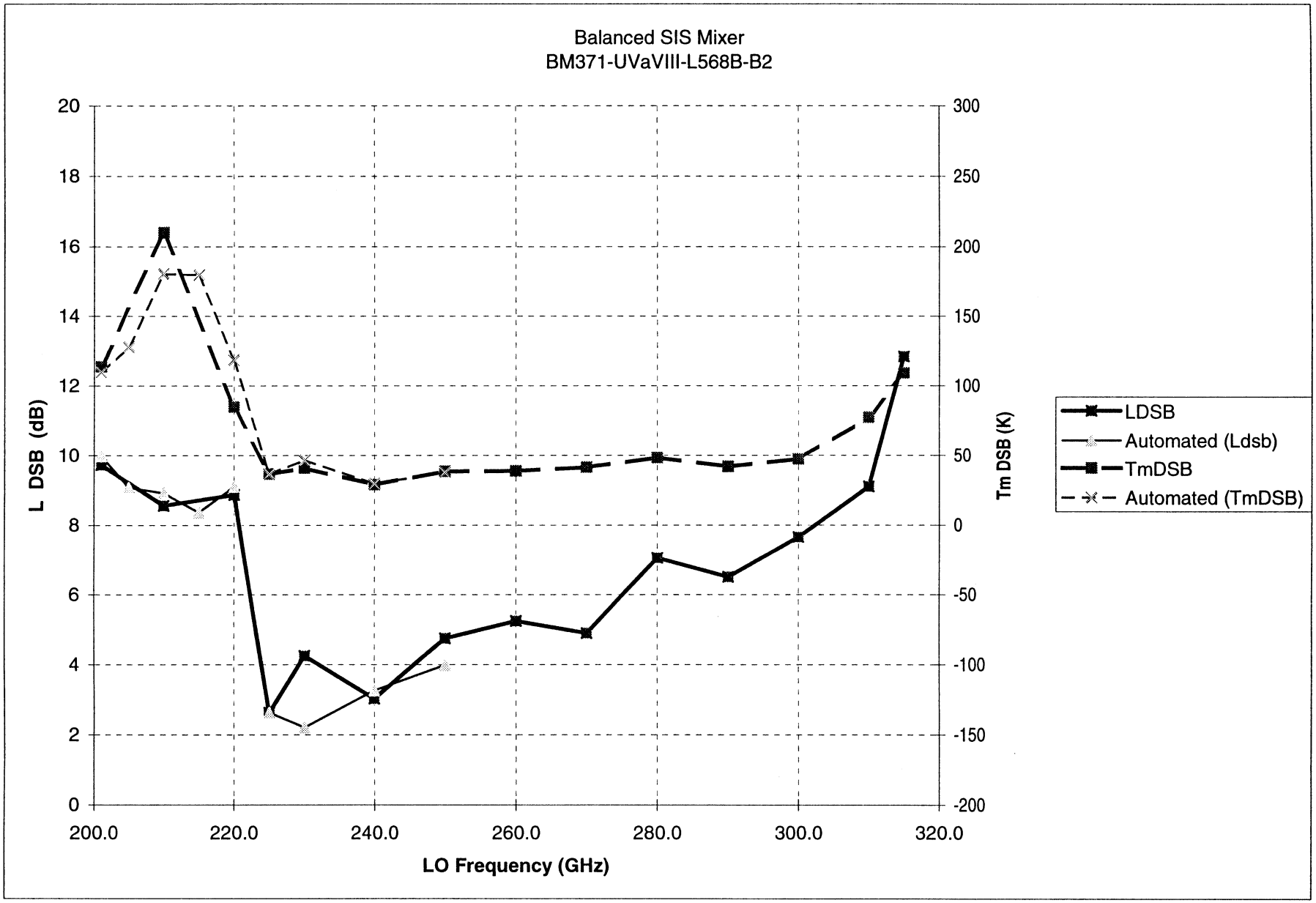

Fig. 7

File: F:\SIS_Meas\021699.xls

Printed: 2/18/99
1:15 PM

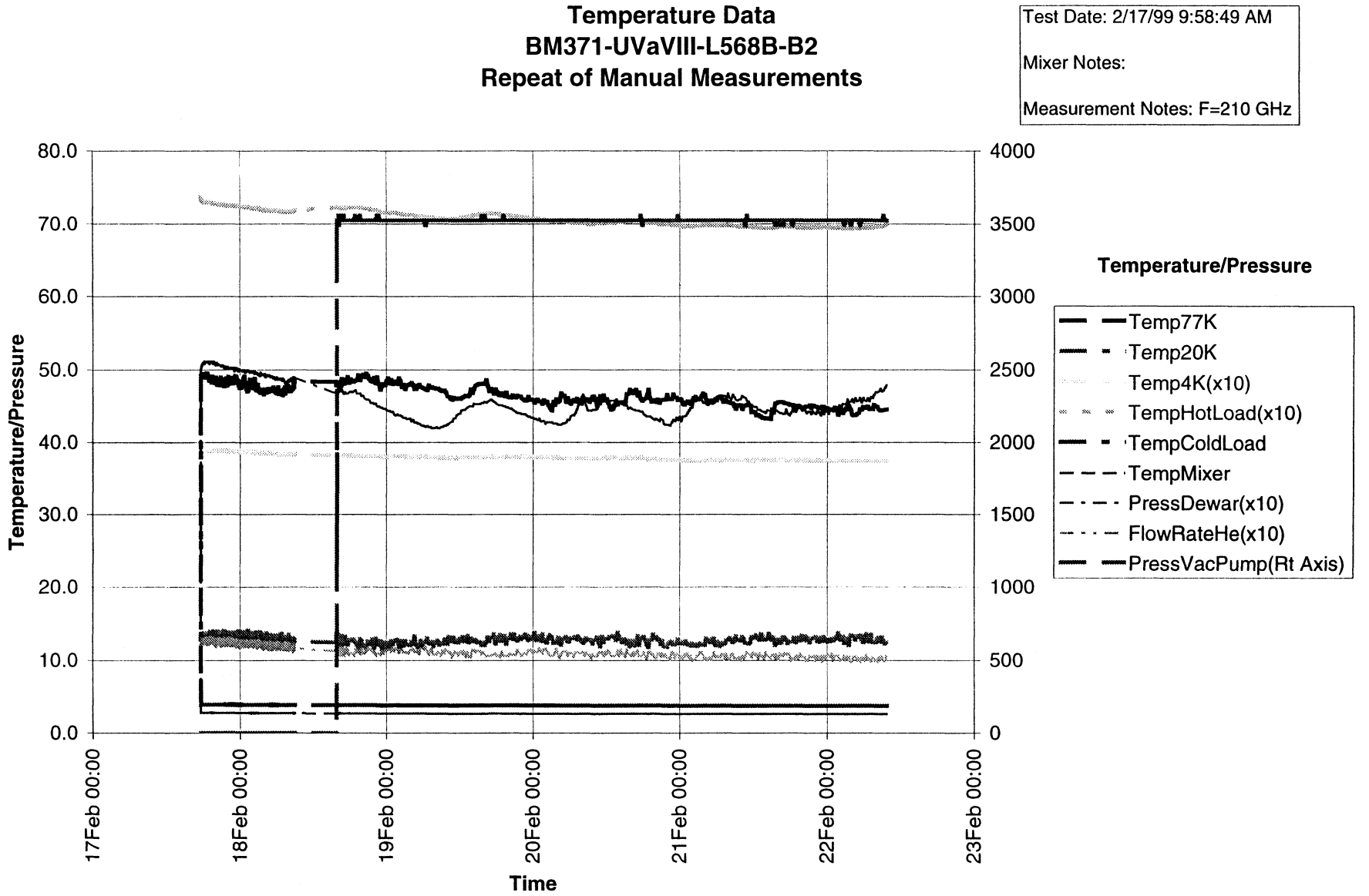
Temperature Data
BM371-UVaVIII-L568B-B2
Repeat of Manual Measurements
Test Date: 2/17/99 9:58:49 AM
Mixer Notes:
Measurement Notes: F=210 GHz
Temperature/Pressure
Temp77K
Temp20K
Temp4K(x10)
TempHotLoad(x10)
TempColdLoad
TempMixer
PressDewar(x10)
FlowRateHe(x10)
PressVacPumpRt Axis)
Temperature/Pressure
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
4000
3500
3000
2500
2000
1500
1000
500
0
17Feb 00:00
18Feb 00:00
19Feb 00:00
20Feb 00:00
21Feb 00:00
22Feb 00:00
23Feb 00:00
Time

Fig. 8