10-6-98

Memorandum

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

cc: J. Webber

From: J. Effland

Date: 6 October 1998

Subject: Status Report for Automating SIS Mixer Measurements

1. Accomplishments this period:

1.1 Database Structure Defined

A preliminary design has been completed of the database tables and fields that will store the measured data. The software design document was updated with a data dictionary and table relationship drawing and the relevant sections are attached. We should also meet to review the current design, and keep in mind that the database design will surely change as we begin to populate it with actual data.

1.2 HPGL Plots

It appears the Inso Corp. has bought most of their file converter competitors, and their HPGL converter does not properly convert files from either the Tek 2784 spectrum analyzer or from the demo Tek 520 oscilloscope. Investigations of Inso's latest converter (which is part of QuickView Plus) using an HPGL file from the Tek 2784 spectrum analyzer shows that it requires all commands to be in upper case, but more importantly, it does not implement the scaling instruction properly. This is the same problem uncovered with the file converter included with PhotoShop, which is probably also written by Inso.

Inso's converter produced the plot shown in Figure 1 for the Tek 520 oscilloscope, which outputs all commands in upper case and doesn't use scaling, so the plotted elements look reasonable. The wide lines are probably set by a line-width constant that's well hidden in the registry, or worse, hard-coded in their converter code. Repeated e-mails were sent to Susan Burnett of Inso Corp. to notify her of these problems, but she was quite non-committal on when, if ever, they would fix these bugs.

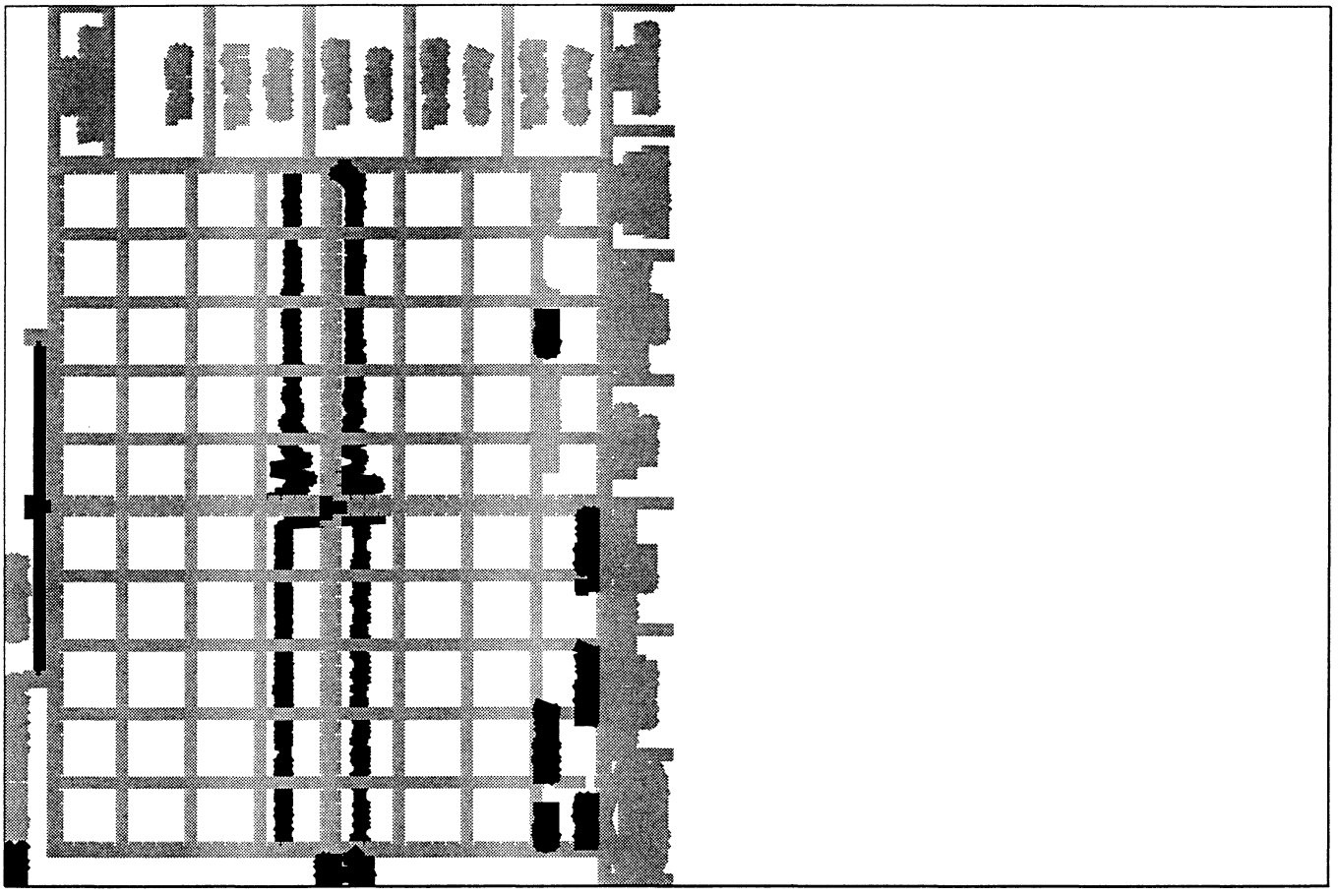

Figure 1: Tek 520 Plot Using Inso's QuickView Plus

Given these problems, we wrote our own converter software in Visual Basic for Applications (VBA) that is included with Excel 97. Total effort (*sans* the all-important documentation) is about 10 hours, with documentation expected to take another 4 hours. Figure 2 shows the Tek 520 plot using NRAO's converter software. Figure 3 shows how WordPerfect 7's converter plots the Tektronix 2784 spectrum analyzer output, and the same file is plotted using NRAO's converter in Figure 4. The diagonal line is from a corrupt source file command; it was manually removed from Figure 4.

2. Tasks for Next Reporting Period

- Review database structure with SIS mixer team and update design as necessary.
- Continue building data analysis screens for bias measurements.
- Document the HPGL plotting software.

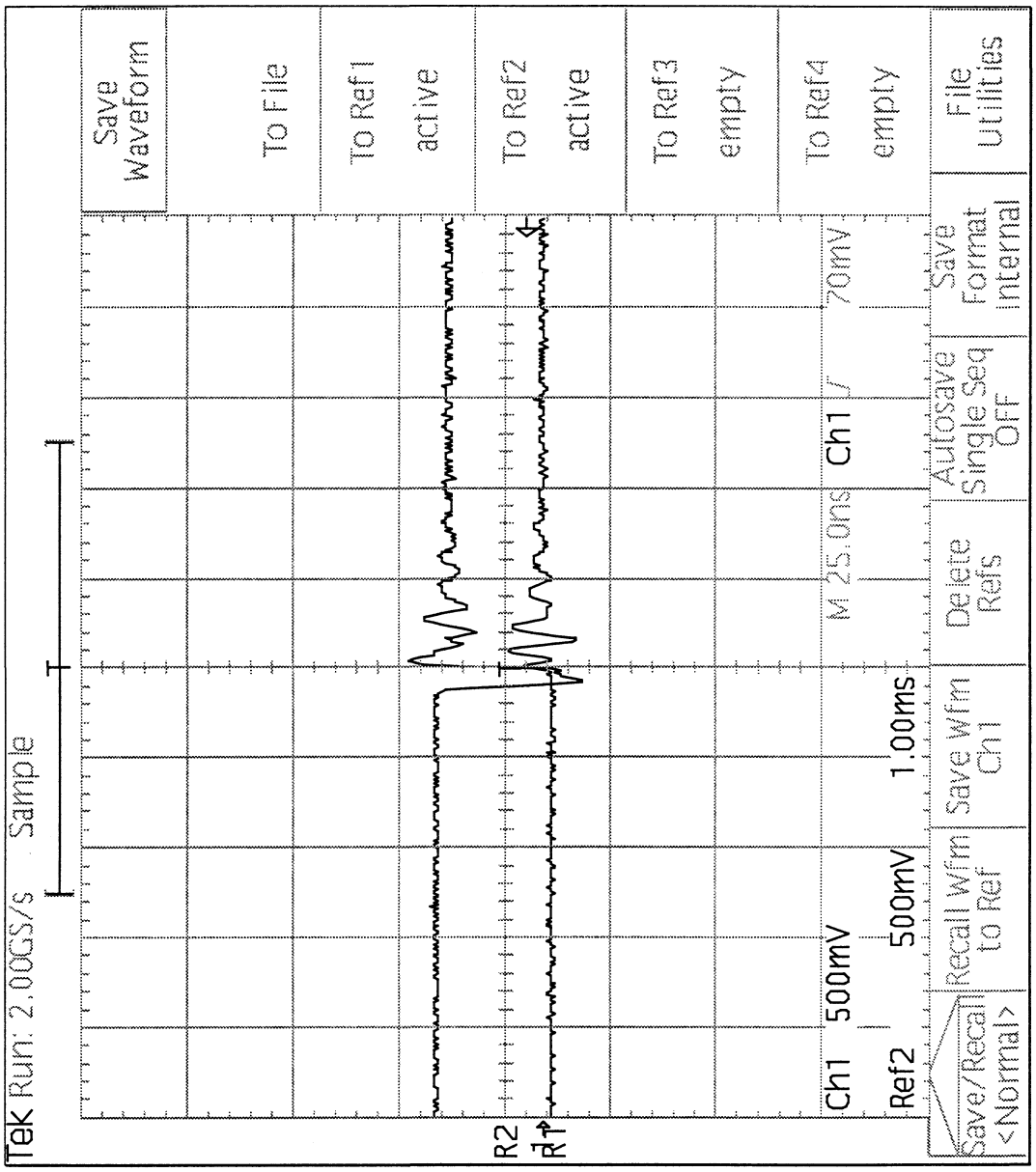

Figure 2: HP 520 Plot using NRAO's VBA Software

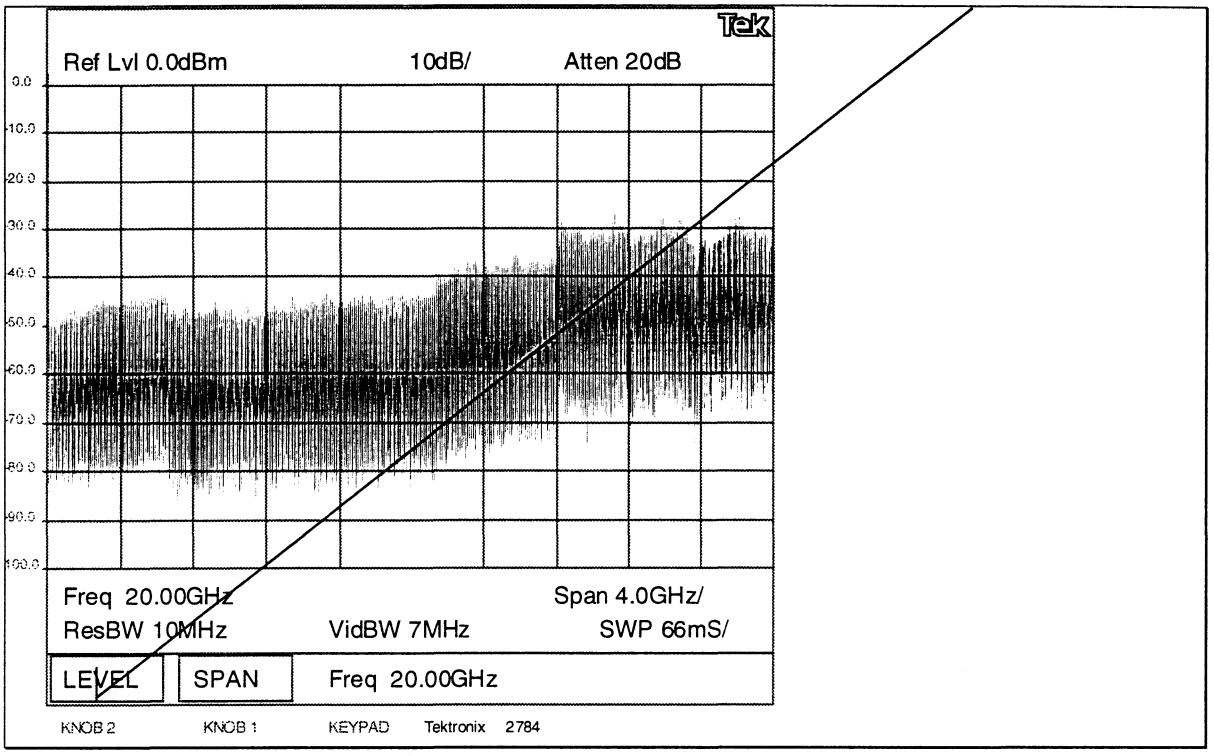

Figure 3: HPGL Plot from Tek 2784 Spectrum Analyzer Using WordPerfect 7's File Converter

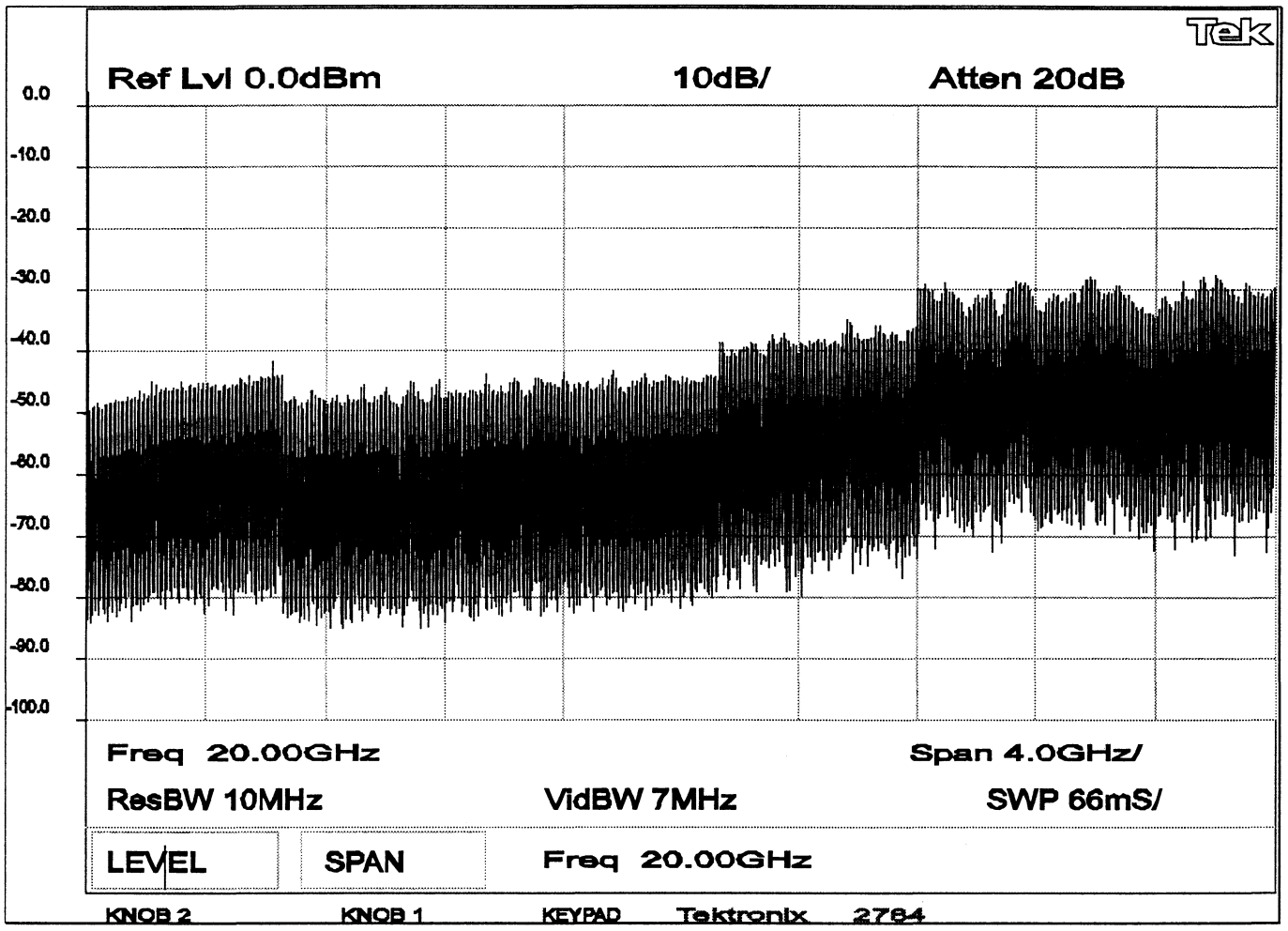

Figure 4: HPGL Plot from Tek 2784 Spectrum Analyzer using NRAO's Converter

4. Database Design

The tables are designed to minimize data redundancy by using relational design concepts as defined in Section "4.2 Table Relationships".

4.1 Access Database Definitions

A Microsoft Access database is a file that contains a number of elements as detailed below:

- Tables – which hold
- Queries - are desci
  measurement syster
- Forms – are dialog
  query.
- Reports – are essent
  a query or from a ra
- Macros and Code –
  are limited in scope
  The data dictionary

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to as a database.
several tables. The SIS
of SQL statements.
or filtered records from a
that is either the result of
use a simple language and
nd can be quite powerful.

The SIS measurement system employs Excel for data retrieval for analysis, so tables are the only elements employed in the design.

4.2 Table Relationships

A large amount of data can be collected and stored in a short period of time, which could allow the database size to quickly become unmanageable. To prevent this, data is spread across several tables, which minimizes redundancy as shown in the relationship diagrams in Figure 7. These relationships are described next.

A large number of tests can be run on a particular mixer, so the top-level mixer table (`SIS Mixer`) contains fields that characterize the mixer undergoing testing. The type of measurement is stored in the table (`MeasType`), which is linked to the SIS mixer table though a key field. Most of the static data (data that doesn't significantly change during a measurement) recorded during each measurement is stored in the measurement table (`Meas`), and many measurement records can exist for each mixer record. Data that changes for each measurement is stored in another table called the data table (`Data`). The data table includes the following fields:

1. A parameter field , which holds the value being stepped, such as magnet current,
2. a field to hold the independent quantity being measured, such as bias voltage,
3. and three fields for dependent variable results, such as
   - mixer noise power using a hot load,
   - mixer noise power using a cold load, and
   - bias current.

The independent field, parameter field, and dependent fields are generic and represent different quantities depending on the measurement. The definition of these generic fields is stored as integers in the measurement type table, and the mapping of these integers to measurement descriptions is stored in another table (`MeasTypeDefs`). This allows adding new measurement types by entering new database records in the `MeasTypeDefs` table, and minimizes software changes.

Measurement settings (such as voltage limits and the number of steps) are stored in two tables. The table `SettingsDefault` contains the standard settings for a measurement. The information in this table is keyed to the field `Meas Type` in the table `MeasType`. The settings actually used during a measurement are stored in the table `SettingsActual`, and that table is keyed to the `Data Key` field in the `MeasType` table, which allows these settings to be recalled for each measurement. The structure of the actual and default settings tables are identical.

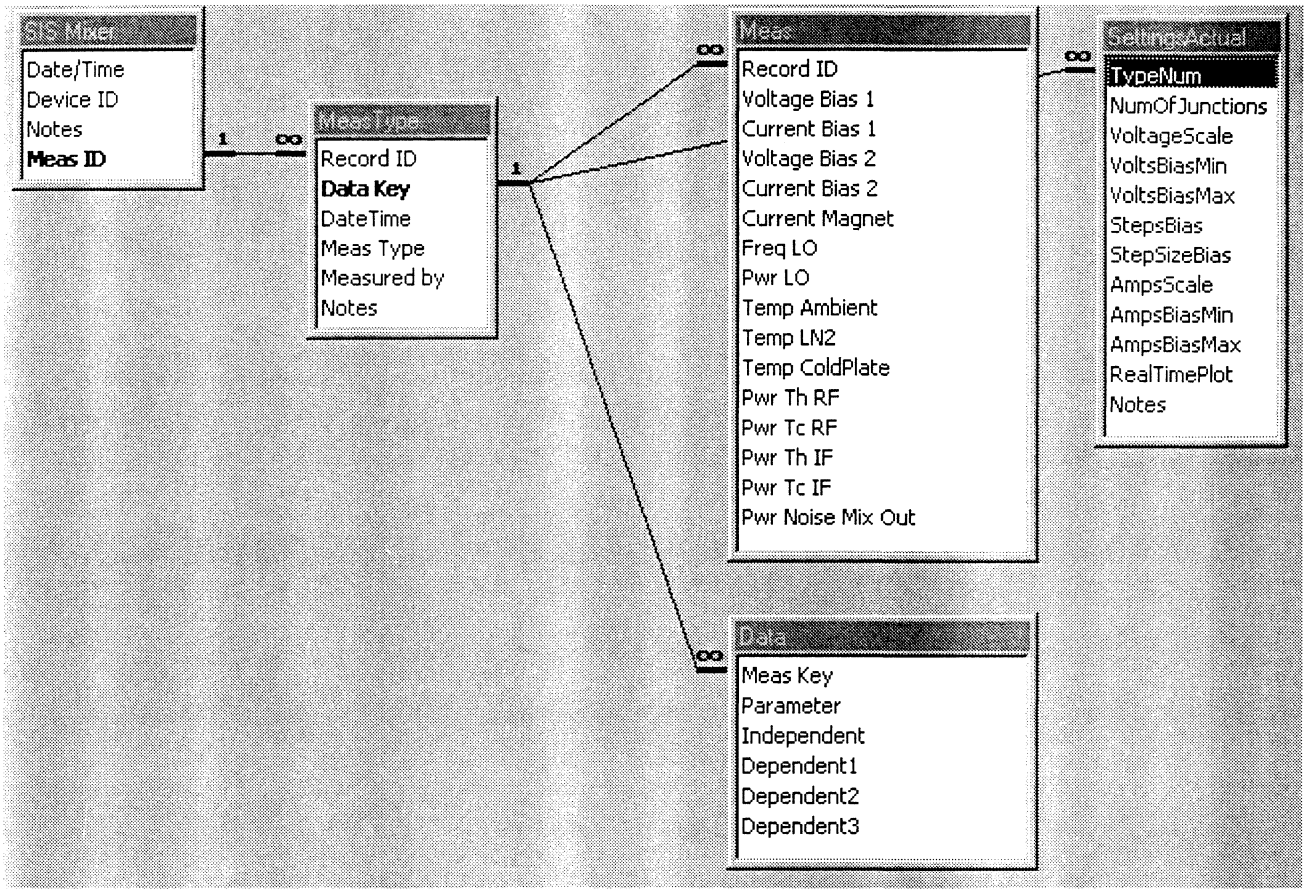

Figure 7: Database Table Relationships

4.3 Measurement Type Definitions

Basic types of measurements are tabulated in Table 4. Three dependent data fields are provided (`Dependent1` through `Dependent3`) in the `Data` table, because many measurements require recording results using both hot and cold load once a particular mixer operating point is set. The non-changing parameters of these measurements are stored in the `Meas` table.

To provide measurement flexibility, data can also be collected using just the `Meas` table, so that all measured data for all variables can be recorded for each step of the parameter. The `Data` table is not used in this case.

Table 4: Types of Measurements

Meas Type #	"Data" Table Fields					Notes	Tables Used	
	Independent Variable	**Parameter**	**Dependent Variable 1**	**Dependent Variable 2**	**Dependent Variable 3**		Meas	Data
1	Bias voltage	LO power	Bias Current			This includes pumped and un-pumped cases.	X	X
2	Bias voltage	Magnet Current	Bias Current				X	X
3	Bias voltage	LO power	Mixer Noise Temperature (hot load)	Mixer Noise Temperature (cold load)	Bias Current		X	X
4	Bias voltage	Magnet current	Mixer Noise Temperature (hot load)	Mixer Noise Temperature (cold load)	Bias Current		X	X
5	Bias voltage	LO power	IF power (hot load)	IF power (cold load)	Bias Current		X	X
6						Notes field in "Meas" table describes the measurement.	X	

4.4 Data Dictionary

In the listing below, table descriptions are given immediately following the table names, and field definitions follow the "- - -" divider.

```
Data Dictionary for Database: F:\GPIBTEST\BiasMeas6\sis97.mdb
 (using routine: "PrintSISDataDictionary")
 Printed:  30Sep1998 04:57 pm


*****************************
*****************************
Table Name : SIS Mixer
Description: Contains mixer information, such as device ID, date/time, etc
Updated    : 9/30/98 4:19:30 PM
-----------------------------

Date/Time        Date (8)    Date and time information is entered
Device ID        Text (50)   Description of device
Notes            Memo (0)    Free-Field input for general annotation
Meas ID          Long (4)    Key for child tables linked to this table


*****************************
*****************************
Table Name : MeasType
Description: Defines the type of measurement
Updated    : 9/30/98 4:20:07 PM
-----------------------------

Record ID        Long (4)    Maps to appropriate record in SIS Mixer table
Data Key         Long (4)    Key for child tables linked to this table
DateTime         Date (8)    Date and time of individual measurement
Meas Type        Integer (2) Type of Measurement
Measured by      Text (15)   Name of person taking the data
Notes            Memo (0)    General notes for each entry


*****************************
*****************************
Table Name : Meas
Description: Includes fields for all variables of a measurement
Updated    : 9/30/98 4:23:28 PM
-----------------------------

Record ID        Long (4)    Maps to appropriate record in SIS Run table
Voltage Bias 1   Single (4)  Bias voltage (device 1)  in volts
Current Bias 1   Single (4)  Bias current (device 1) in mA
Voltage Bias 2   Single (4)  Bias voltage  (device 2) in volts
Current Bias 2   Single (4)  Bias current (device 2)  in mA
Current Magnet   Single (4)  Magnetic field coil current in mA
Freq LO          Single (4)  Frequency of local oscillator in GHz
Pwr LO           Single (4)  Power of local oscillator in mW
Temp Ambient     Single (4)  Ambient temperature in degs C
Temp LN2         Single (4)  Hot load physical temperature in K
Temp ColdPlate   Single (4)  Cold plate (4K)  temperature in K
Pwr Th RF        Single (4)  Hot-Load power at RF input to mixer (dBm)
Pwr Tc RF        Single (4)  Cold-Load power at RF input to mixer (dBm)
Pwr Th IF        Single (4)  Hot-Load power at Mixer IF (dBm)
Pwr Tc IF        Single (4)  Cold-Load power at mixer IF (dBm)
Pwr Noise Mix Out Single (4)  Noise power reflected from mixer output (mW)


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```

```
Table Name : Data
Description: Contains generic fields to record only changing data during a measurement
Updated    : 9/30/98 4:23:49 PM
-----------------------------

Meas Key          Long (4)    This field maps to the measurement key.
Parameter         Single (4)  Parameter being stepped
Independent       Single (4)  Independent variable
Dependent1        Single (4)  Data field for first dependent variable
Dependent2        Single (4)  Data field for second dependent variable
Dependent3        Single (4)  Data field for third dependent variable


*****************************
*****************************
Table Name : MeasTypeDefs
Description: For a particular measurement, defines the generic fields in the Data table
Updated    : 9/30/98 4:24:31 PM
-----------------------------

TypeNum           Integer (2) Measurement type number
SubTypeNum        Integer (2) Measurement sub type number
IndependentVar    Text (20)   Description of independent variable
DependentVar1     Text (20)   Description of first dependent variable
DependentVar2     Text (20)   Description of second dependent variable
DependentVar3     Text (20)   Description of third dependent variable
Parameter         Text (20)   Description of parameter variable
Notes             Memo (0)


*****************************
*****************************
Table Name : SettingsDefault
Description: Contains default equipment settings for a measurement
Updated    : 9/30/98 4:09:29 PM
-----------------------------

TypeNum           Long (4)    Maps to appropriate record in MeasType table
NumOfJunctions    Integer (2) Number of SIS junctions / mixer
VoltageScale      Single (4)  Voltage scale for graph in mV/cm
VoltsBiasMin      Single (4)  Minimum bias voltage in mV
VoltsBiasMax      Single (4)  Maximum bias voltage in mV
StepsBias         Long (4)    Number of voltage steps for each bias sweep
StepSizeBias      Single (4)  Size of each step for bias sweep in mV
AmpsScale         Single (4)  Current scale for plot in uA/cm
AmpsBiasMin       Single (4)  Minimum scale for bias plot in uA
AmpsBiasMax       Single (4)  Maximum scale for bias plot in uA
RealTimePlot      Boolean (1) Is real-time plot turned on for this measurement?
Notes             Memo (0)


*****************************
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Table Name : SettingsActual
Description: Contains actual equipment settings for a measurement
Updated    : 9/30/98 4:12:22 PM
-----------------------------

TypeNum           Long (4)    Maps to appropriate record in MeasType table
NumOfJunctions    Integer (2) Number of SIS junctions / mixer
VoltageScale      Single (4)  Voltage scale for graph in mV/cm
VoltsBiasMin      Single (4)  Minimum bias voltage in mV
VoltsBiasMax      Single (4)  Maximum bias voltage in mV
StepsBias         Long (4)    Number of voltage steps for each bias sweep
StepSizeBias      Single (4)  Size of each step for bias sweep in mV
AmpsScale         Single (4)  Current scale for plot in uA/cm
AmpsBiasMin       Single (4)  Minimum scale for bias plot in uA
AmpsBiasMax       Single (4)  Maximum scale for bias plot in uA
```

RealTimePlot	Boolean (1) Is real-time plot turned on for this measurement?
Notes	Memo (0)