

Automated Distortion Characterization and Information System



**Designed and developed for:
Matrix Test Equipment**

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by

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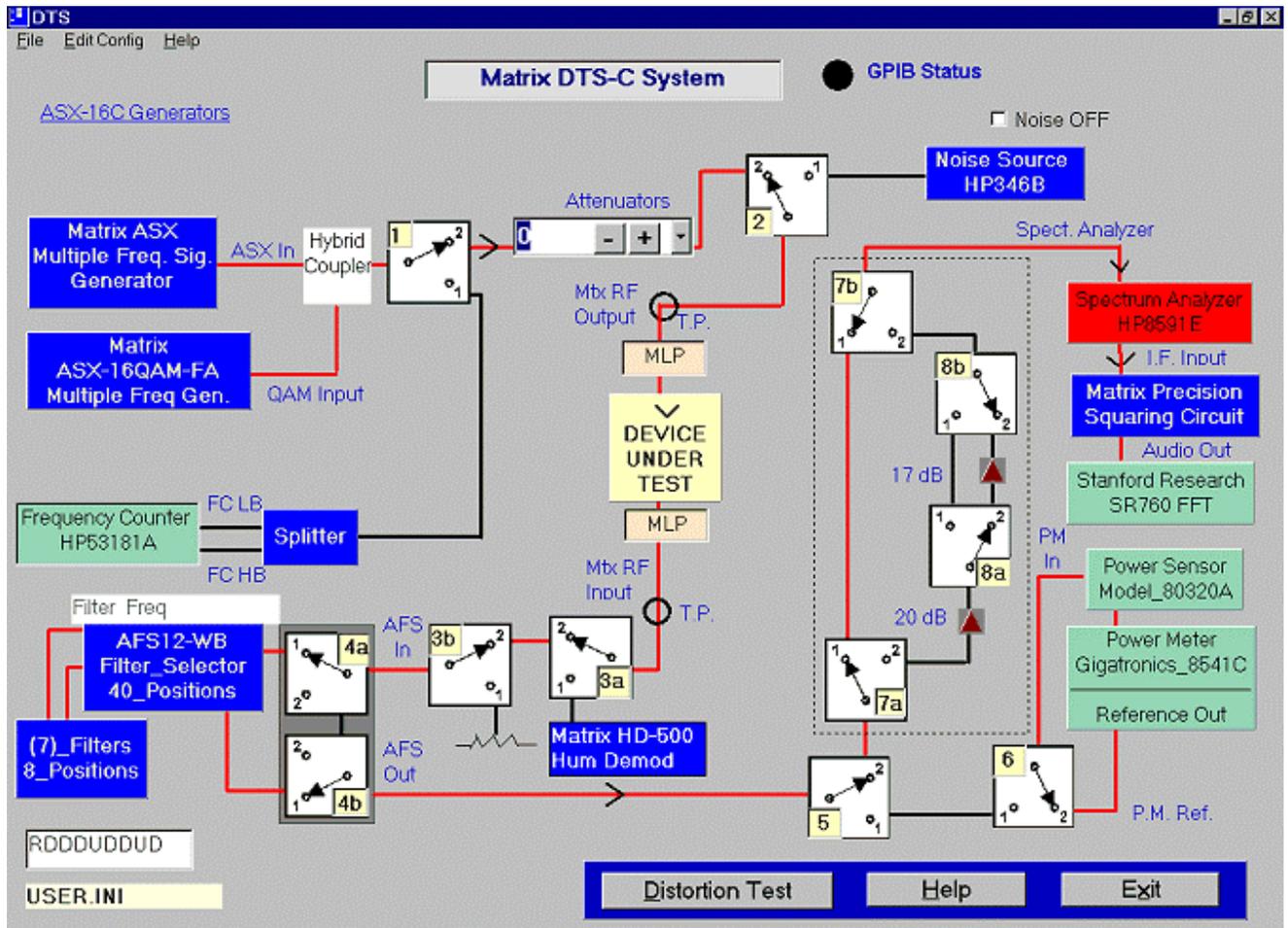
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Automated Distortion Characterization and Information System

Overview

There is a growing need to perform automated distortion measurements and be able to record and track these results along with other test conditions. The data should be easily retrievable by various parameters such as date, product, description, test identifier, etc. This data must be exportable to other applications for analysis and graphing. Described below is a basic software system that has been developed to offer these capabilities. It can be customized to your needs and environment at a fraction of the cost and delay of developing a new system. You can maintain control of the spectrum analyzer downloadable programs, modify or add reports/macros in Microsoft Access/Excel, configure different options through initialization files, or output results to spreadsheets or word processors.

1. Block Diagram of Distortion Test Configuration Form (Optional – custom integrated systems)



The above screen is a typical DTS software control panel representing the block diagram of the system that is used to control the components of the Distortion Test System. It is not necessary for running the Distortion Characterization System. It allows switching states by

clicking on a relay in the block diagram to interconnect the various signal sources, amplifiers, filters, and measuring instruments. It is tightly integrated with the Matrix CATV Control Program to control the functions of the ASX generator. It also permits selection of filters, and provides an interface to automated distortion testing and database storage and retrieval functions. The distortion testing functions are selected by clicking on the **Distortion Test** button on the bottom of the screen above. These functions and the series of interactive screens are described below:

2. Test Profile Form

- Defines and maintains a profile of a test.
- An identification number (**Test Id**) is automatically assigned for a new test.
- Specify the group of frequencies to be used for a test measurement (See **Test Frequency Selection Form**).
- Enter information about the conditions under which the tests are conducted, i.e. **Date, Test Description, and Notes**, etc..
- Direct how the tests will be conducted -- (e.g. CSO Above Carrier, or both Above and Below the carrier).
- Specify bandwidth for normalizing Carrier to Noise (C/N) measurements
- Select method to perform the test, -- with a spectrum analyzer, or with an FFT
- Enter multiple criteria for setting up tests by using different **Test Sub Id's**. Criteria such as Carrier levels, Tilt, and the point of measurement (e.g. "After 3 cascaded amplifiers").
- **Duplicate** function to clone descriptions from a previous test when defining a new test.

3. Test Frequency Selection Form

Master Frequency Table

Chan	Frequency	Filter	Dsocrtrb1	Dsocrtrb2	Dlocntrb1	Dlocntrb2	Dlocntrb3	CsoFrg	CsoFrgL	TstCtrl	Desc
160	7	9	162	163				1	1	T	
166	43	13	160	167				1	1	T	
2	55.25	2						.75	1.25	A	
2	55.25	2						1.25	.75	S	Special -.75 CSO
2	55.25	2						1.25	1.25	A	
3	61.25							.75	1.25	A	
3	61.25	38						1.25	1.25	S	
4	67.25							.75	1.25	A	

Test Frequency Table

Freq. Group: 3 Description: Full test filter List except 169.25MHz

2	55.25	2						.75	1.25	A
6	83.25	6						.75	1.25	A
16	133.25	16						1.25	1.25	A
13	211.25	13						1.25	1.25	A
30	259.25	30						1.25	1.25	A
37	301.25	37						1.25	1.25	A

- Select frequencies to be used for making distortion measurements from a **Master Frequency table** containing all of the **frequencies** in your generator with their corresponding **channels** and **filters**, if any.
- Specify **contributing channels** to be automatically turned on for Discrete second and third order distortion product measurements.
- Specify **frequency offsets** at which to measure CSO
- The bottom panel allows configuring frequency groups that contain the collection of frequencies at which the measurements will be made. New **frequency groups** may be created by selecting channels from the **Master Frequency Table**.
- Multiple or groups of channels may be selectively copied to the bottom panel by highlighting the channels and clicking **Transfer Records**.
- The new frequency group is defined in the database when **Commit/Save** button is clicked.
- Frequency groups that are referenced by collected test results are prohibited from being deleted.
- A special entry identified in the Channel Number field as "**spec**" with a frequency > 9999 can be used to specify distortion limits that is used by the spread sheet macro to identify and highlight unacceptable distortion measurements.

4. Setup and Run Tests

Distortion Measurement

Test Identifier: 3 TestSubId: 1 Point Loc./Comment: 13dBmV Flat @ Input

Selected Chan. in CW

C/N Offset: Fixed Prompt Auto Detect

Load Freq. Plan: [CHAN 55.25 - 1003.25]

Select Plan for Dig Meas.:

Module	Freq.	Filter No.	XMD (FFT)	CTB Raw	CTB Cor	CTB Nflr	CSO abv-Raw	CSO abv-Cor	CSO blw-Raw	CSO blw-Cor	C/N	Noise Drop	CSO frq-abv	CSO Nflr-abv	CSO frq-blw	CSO Nflr-blw	Amplit. (dBm)
58	427.25	58	79.0	81.3	83.5	85.2	75.7	76.1	69.5	69.7			428.50	85.8	426.00	83.5	-16.0
64	463.25	64	77.3	81.3	83.5	85.2	75.7	76.2	69.7	69.8			464.50	85.2	462.00	84.2	-16.2
72	511.25	72	78.2	80.7	82.9	84.7	74.2	74.6	69.3	69.6			512.50	84.8	510.00	82.3	-17.0
78	547.25	78	78.8	80.3	82.5	84.2	73.7	74.1	69.8	70.0			548.50	84.2	546.00	83.2	-17.5
84	583.25	84	77.5	80.5	82.7	84.7	72.8	73.2	69.5	69.7			584.50	84.5	582.00	83.3	-17.3
92	631.25	92	77.1	80.3	82.5	84.2	72.0	72.3	70.0	70.2			632.50	84.2	630.00	83.0	-17.7
105	679.25	105	78.6	81.0	82.4	86.7	71.2	71.3	70.2	70.2			680.50	86.8	678.00	87.0	-3.2
112	721.25	112	79.3	81.5	82.8	87.7	71.3	71.4	70.5	70.6			722.50	87.2	720.00	86.7	-3.7
117	751.25	117	78.6	81.0	82.4	86.5	70.7	70.8	70.5	70.6			752.50	86.7	750.00	86.3	-4.5
125	799.25	167	79.5	81.2	82.6	86.5	70.2	70.3	71.5	71.6			800.50	86.7	798.00	86.5	-5.5
129	823.25	154	79.1	80.8	82.5	86.0	70.2	70.3	71.5	71.6			824.50	86.3	822.00	86.3	-5.5
134	853.25	157	80.1	80.3	81.8	85.7	69.5	69.6	72.3	72.5			854.50	86.0	852.00	86.0	-5.5
158	997.25	158	80.0	80.5	82.4	85.0	67.0	67.0	84.5	88.8			998.50	85.0	996.00	85.0	-7.7
spec	9999		70.0		77.0			67.0		67.0	51.0						

Active PAs: 0 Noise Drop (dB): Batch Id: Serial Num: 123 A36

Test Perf: Channel Loading: 55.25-745.25/112c Simulation! Data Not Valid

- Allows selection of the distortion tests to be performed by checking off the check boxes
- The channel at which to begin the tests may be selected by highlighting a row.
- Provides capability to load a frequency plan and automatically captures the range of frequencies and number of channels to store in the test profile.
- Displays a description of the test result column by clicking on a column.
- Makes distortion measurements at the selected frequency if the **Single FRQ Distortion** button is selected, to rerun selected tests, or change filters if no filter selector available.
- Performs all of the selected tests beginning at the highlighted channel for all channels that contain a filter channel number if **Automatic Distortion** is selected.
- Testing may be paused by clicking on the **Pause** button, and resumed by clicking it again (the Pause label will change to **Resume** automatically).
- The **Save Results** button will save the test results, the current date and time, and channel loading to the database. It will automatically set the **Lock Update** flag to help prevent accidental erasure of data. If the **Lock Update** flag had been previously set, it will issue a warning and provide a means to cancel or override and save.
- Audio cues announce the completion of each test and channel.
- The sizes of the columns may be adjusted by dragging header grid line with a mouse.
- Allows 3 options for measuring the noise floor for Carrier/Noise. Clicking on **Run Reports** will launch the database to permit displaying reports or searching the database.

Batch Test Setup

This feature allows queuing up a sequence of tests to automatically run in succession, with certain changes specified in a list of events. For each test sequence the tests to perform, a channel plan, levels, and generator commands may be specified. The result for each batch item are automatically stored in the database according to the designated TestId and SubId.

Batch	TestId	SubId	Freq Plan File	Level File	Gen. Cmd	XMD	CTB	CSO	CTN	DSO	DTO	Desc	TestCtrl
1	1	1	(CHAN 55.25 - 547.2	LEV AT 42DB		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
2	2	1	(CHAN 55.25 - 1003.	LEV AT 43DB		<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
3	2	2			V5	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Reduce lev 5dB	
4	2	3			V-10	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Incr lev 10 dB	
5	3	1	(74 CHAN QAM)	40-41DBMV (<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
*						<input checked="" type="checkbox"/>							

The test sequence may be saved to a file and later loaded and edited. The batch testing is initiated by selecting the **Run Batch Test** button. The testing will begin and the **Setup & Run Test** screen will appear with the currently executing **Batch Id** displayed on the screen. This will help track the progress of the testing. The results will display on the grid as the measurements are made, and stored in the database under the **Test Id** and **SubIds** specified as each batch is completed.

- **5. Test Results Form**

Distortion Test Results for FRQ:55.25

Test Ident. 27 Test Sub Id 1

ChanNum	Frequency
2	66.25
5	77.25
98	109.25
13	211.25
42	331.25
61	446.25
78	547.25
93	637.25

C/N D/SO D/IQ
XMOD CTB CSO

CTB Corr-FFT mthd(CBF) -101.6
CTB Noise-FFT mthd(CBNF) 102.6

Save CTB Delete

Select a Form
Test Frequencies
Test Profile
Setup & Run Test
Test Results

Test Profile
Setup & Run Test
Run Reports
RETURN
Help

- Permits viewing or editing the test results of a test profile.
- Can select any frequency of any Test Sub ID for any Test Identifier of interest.
- Focus on a specific set of test results by clicking on the tab for the test to be displayed.
- Display the stored values for the selected test.
- Provides capability to edit an existing value in a field, or enter new data.
- Changes may be saved to the database.
- Capability to delete the contents of a single test result.
- Protects previously collected data where the lock flag has been set, until the lock flag is reset.

6. Reports

A set of generic reports have been developed to provide basic information about the distortion test results and a description of some of the useful data in the database. Additional reports may be developed by **Hye Level Software**, or you may develop your own reports in a Microsoft Access database. The software launches the MS Access database application when the **Run Reports** button is pressed. The reports may be printed or written to files. Macros are provided that will transfer data to a spreadsheet for analysis to highlight data outside of specifications.

1) Test Frequency Groups

RptFrqGrp : Report											
Frequency Group List											
<i>As of 09/12/2002</i>											
GroupID: 1		Description: In house filters corresponding with DTS filter selector filters									
Channel	Frequency	Filter	DSO cntrb1	DSO cntrb2	DTO cntrb1	DTO cntrb2	DTO cntrb3	CSO FRQ	CSO FRQ_L	Tst Cntl	Freq Desc
2	55.25	2						.75	1.25	A	
5	77.25	5						.75	1.25	A	
13	211.25	13						1.25	1.25	A	
42	331.25	42						1.25	1.25	A	
60	439.25	60						1.25	1.25	A	
61	445.25	61						1.25	1.25	A	
78	547.25	78						1.25	1.25	A	
86	595.25	86						1.25	1.25	A	
Spec	9999							1.25	1.25	A	
GroupID: 6		Description:									
Channel	Frequency	Filter	DSO cntrb1	DSO cntrb2	DTO cntrb1	DTO cntrb2	DTO cntrb3	CSO FRQ	CSO FRQ_L	Tst Cntl	Freq Desc
2	55.25	2						1.25	.75	S	Special -.75 CS 0
58	427.25	58						1.25	.75	A	Special -.75 CS 0
134	853.25	134						1.25	.75	A	Special -.75 CS 0
GroupID: 9		Description:									
Channel	Frequency	Filter	DSO cntrb1	DSO cntrb2	DTO cntrb1	DTO cntrb2	DTO cntrb3	CSO FRQ	CSO FRQ_L	Tst Cntl	Freq Desc
3	61.25	38						1.25	1.25	S	
39	313.25	42						1.25	1.25	A	
Page: 1											

2) Test Profile Summary

RptTestProfilebyTestId : Report

Test Profile Report

As of 09/12/2002 Sort by Date

T#	SN	Title	Type	Descr	Date	T(S)	LOAD	PARAMS
11	S123-5601		SYS	2 Way Spliter, @50 DbmV, T= 150F	10/31/2001			CSCB
12	S123-5601		SYS	2 Way Spliter, @50 DbmV, T=72F	11/1/2001			CSCB
13	S123-5601		SYS	2 Way Spliter, @50 DbmV, T= -40F	11/1/2001			CSCB
14	S123-5601		SYS	2 Way Spliter, @50 DbmV, T=70F	11/3/2001			CB
15	S123-5601	Discrete Second Order Tests	SYS	2 Way Spliter, @50 DbmV, T=70F	11/4/2001			DS
16	S123-5703	Discrete Second Order Test	SYS	3 Way Spliter, @50DbmV, T=70F	11/4/2001			DS
17	S123-5801	Discrete Secind Order Test	SYS	4 Way Spliter, @50 DbmV, T=70F	11/4/2001			DS
18	S123-5601	CSD, CTB	SYS	2 Way Spliter	11/4/2001			CSCB
19	S123-5703	CSD, CTB	SYS	3 Way Spliter	11/4/2001			CSCB
20	S123-5801	CSD, CTB	SYS	4 Way Spliter	11/4/2001			CSCB
21	S123-5601	CSD, CTB	SYS	2 Way Spliter	11/4/2001			CSCB
22	S123-5601	Discrete Second Order Tests	SYS	2 Way Spliter, @50 DbmV, T= -40F	11/4/2001			DS
23	S123-5601	Discrete Second Order Tests	SYS	2 Way Spliter, @50 DbmV, T=150F	11/5/2001			DS
24	S123-5601	CSD, STB	SYS	2 Way Spliter	11/5/2001			CSCB
25	S123-5703	CSD, CTB	SYS	3 Way Spliter	11/5/2001			CSCB
26	S123-5703	Discrete Second Order Tests	SYS	3 Way Spliter, @50 DbmV, T=150F	11/5/2001			DS
27	S123-5703	CSD, CTB	SYS	3 Way Spliter	11/8/2001			CSCB

Page: 1

3) Test Results by Profile

Test Results for Test Ident No. 3

Test: **3** Serial Number: **S875-2125**
 Title: **Amp Optimization Tests**
 Date: **10/11/2001** Time: **2:24:56 PM**
 Temp:
 Data Origin: **Matrix Test Equipment, Inc.**
 Notes:

Location:
 Level: 25dBmV at Output Tilt: Flat

FRQ	XMD(NCTA)	CTE_COR	N.FLR	CSU_RAW	CSU_COR	CSU_FRQ	CSL_RAW	CSL_COR	CSL_FRQ	AMP(dBm)
55.25	72.7	82.6	88.1	87.1	91.4	56.00	75.0	75.2	54.00	2.8
259.25	73.3	80.1	86.6	85.2	89.5	260.50	77.0	77.6	258.00	-1.3
427.25	73.9	78.9	86.7	81.9	83.8	428.50	81.5	83.1	426.00	-1.0
631.25	72.6	79.6	85.9	76.0	76.5	632.50	83.1	86.7	630.00	-3.6
823.25	72.9	78.9	84.3	70.8	71.0	824.50	84.2	88.5	822.00	-6.6

Location: Amp 11
 Level: 25dBmV at Output Tilt: Flat

FRQ	XMD(NCTA)	CTE_COR	N.FLR	CSU_RAW	CSU_COR	CSU_FRQ	CSL_RAW	CSL_COR	CSL_FRQ	AMP(dBm)
55.25	71.6	81.4	87.9	87.0	91.4	56.00	72.7	72.9	54.00	2.6
259.25	71.6	79.1	86.5	84.3	88.7	260.50	75.3	75.7	258.00	-1.4
427.25	72.6	78.4	86.8	80.8	82.2	428.50	79.9	81.0	426.00	-1.0
631.25	71.6	78.4	85.8	74.1	74.5	632.50	81.8	84.4	630.00	-3.8
823.25	71.6	79.0	84.0	68.6	68.7	824.50	84.1	88.5	822.00	-6.9

Location: Amp 3
 Level: 25dBmV at Output Tilt: Flat

FRQ	XMD(NCTA)	CTE_COR	N.FLR	CSU_RAW	CSU_COR	CSU_FRQ	CSL_RAW	CSL_COR	CSL_FRQ	AMP(dBm)
55.25	82.1	88.8	87.6	87.0	91.4	56.00	81.9	84.1	54.00	2.5
259.25	81.7	89.4	86.6	85.3	89.6	260.50	82.9	85.5	258.00	-1.4
427.25	82.4	89.2	86.8	82.9	85.5	428.50	83.7	86.7	426.00	-1.0
631.25	80.9	88.4	85.9	78.4	79.4	632.50	83.1	86.7	630.00	-3.9
823.25	80.8	87.3	84.1	74.7	75.3	824.50	84.1	88.4	822.00	-6.9

This sheet is an extract from our documentation demonstrating the automatically created spreadsheet from the test results. The values not meeting the specifications entered on the line with “spec” in the FRQ column, are highlighted.

- A prompt for the File Id to use as the input data will appear (see Fig. 9). Enter the file name (without the path or ending e.g. 2, or rpt) as created in step 5. Then click **OK** to have the spread sheet computed and the out of spec tests highlighted, if the **spec** data row was entered.

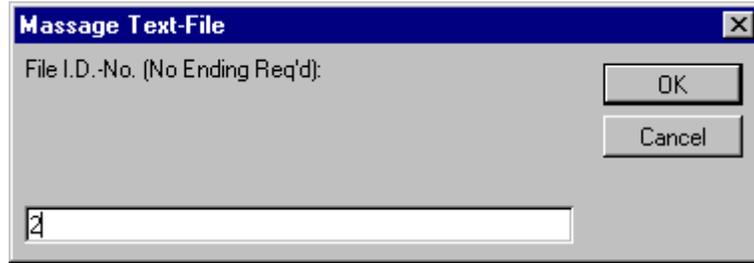


Fig. 9

- When the macro has completed, the spreadsheet will appear as in Fig. 10.

A dialog window will display giving you a choice to save the spreadsheet file as an XLS file that could later be opened and revised by itself. Choose Yes if you want to save the spreadsheet to use later, or No if you do not wish to save or update the spreadsheet file.

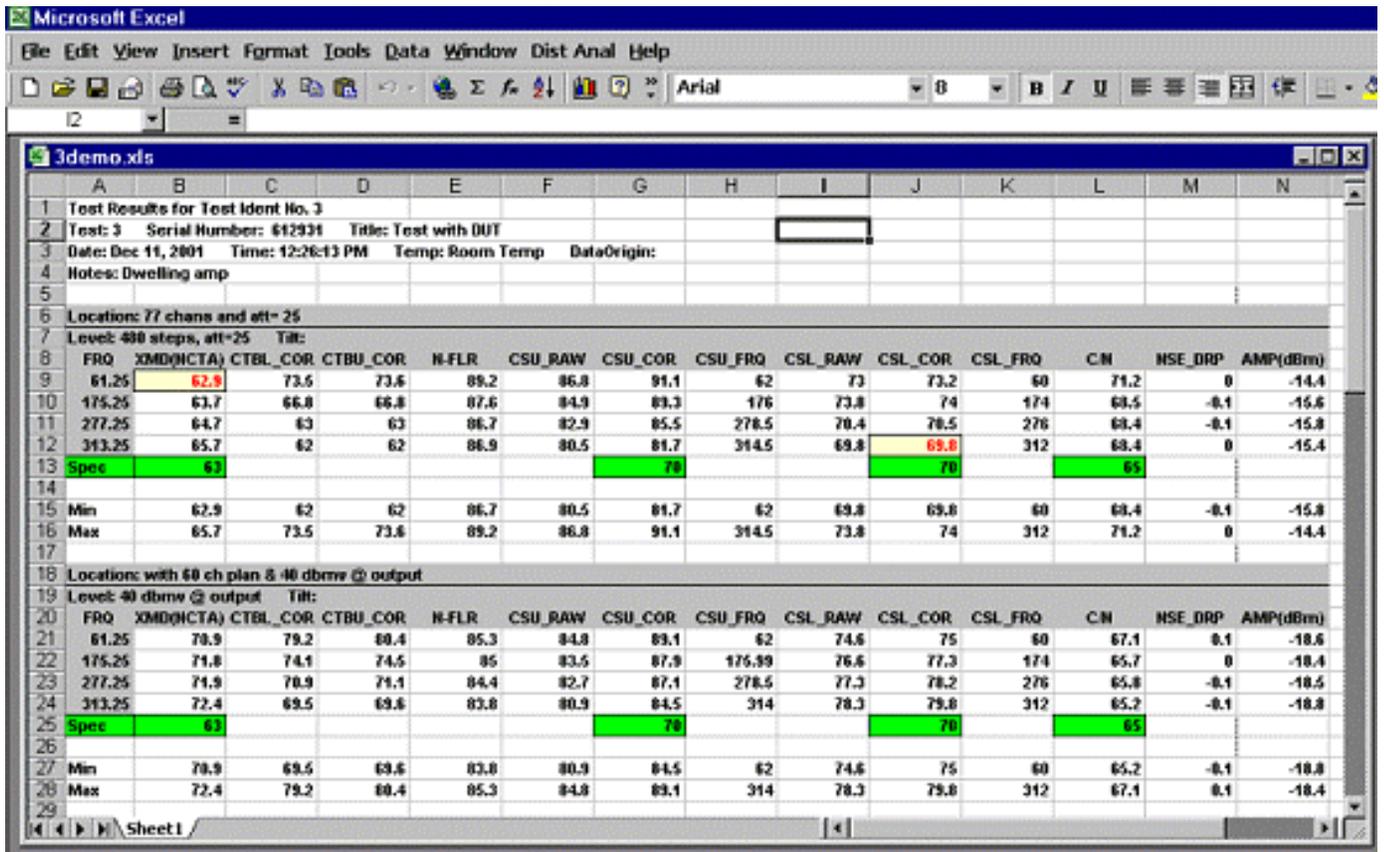


Fig. 10