Instytut Elektroniki Politechniki Łódzkiej
Wólczańska 223, 90-924 Łódź, Poland, tel. 042 636 00 65, fax 042 636 22 38

Institute of Electronics
Technical University of Lodz

Radio Frequency Circuits Laboratory

Excercise 1
Introduction to the HP8753D Network Analyzer

Goal of the exercise

The goal of the experiment is to become acquainted with the maintenance of the circuit analyzer HP 8753 D and with basic procedures of measurements and calibration performed with the use of this device.

Introduction

Circuit analyzer is the device measuring the parameters of reflection and transmission (matrix S coefficients) for the microwave transmission lines as well as active and passive microwave circuits. HP 8753D device works in frequency range 30 kHz ÷ 3 GHz. Additional module is included in this circuit analyzer, which allows for measuring impulse response of the examined circuit in time domain. Such measurements are useful for the design of filters, delay lines or microwave antennas.
Figure 1 shows the front panel of the circuit analyzer. Marked panel elements have the following functions:

1. **Power switch**

2. **Analyzer's screen** – displays: values of measured parameters in form of plots, available options activated by the keys next to the screen, and other information generated by the analyzer.

3. **Menu keys**

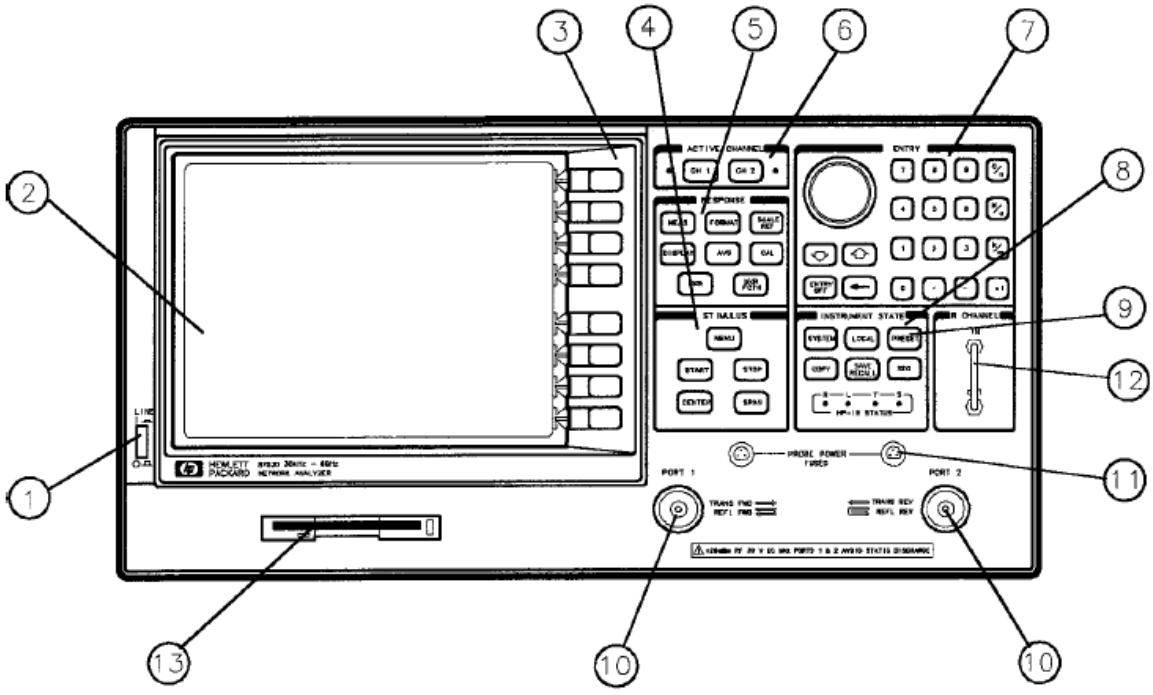

Fig. 1 Front panel of the circuit analyzer

4. **Constraint block –** allows for setting mainly appropriate power and frequency of the inner power generator, and other parameters connected with the control of the power generator.

5. **Answer block** – allows for choosing options connected with the type of the measurement, and displaying data on the screen.

6. **The choice of the active measuring channel** – there are two independent measuring channels available, the active one can be chosen by pressing one of the two keys.

7. **Input data block** – allows for entering input data and controlling the markers.

8. **Control block –** keys for controlling the analyzed independently on the choice of the measuring channel. The following functions can be activated:
   - saving the measurement results and analyzer's state on the floppy disk;
   - self-testing procedures;
   - "external control source" mode;
   - measurements in time domain;
   - controlling HP-BP bus.

9. **PRESET key** – programs the analyzer according to its default settings. This settings can be also defined by the user.

10. **PORT and PORT2** – two independent channels of the analyzer, used for sending steering signals to the examined circuit and receiving the response signal.

11. **Probe input** – supplies the probe or the measuring cable (in case of active element measurement).

12. **R channel** – allows for connecting external signal source of given frequency.

13. **3.5" Floppy Disk Drive** – allows for saving and viewing the measurement results and the analyzer's state on the 3.5" floppy disk.

Task

Calibration of the analyzer for the circuits connected according to the BNC standard, measurement of the load connected to port 1 of the analyzer in predefined frequency range.

Measurement procedure

Attention: description of the function keys is written in bold (e.g. **START**), while the options appearing on the screen of the analyzer are written in italics (e.g. ***CAL KIT***). Options are available when pressing the appropriate key next to the screen.

1. Turn on the circuit analyzer.

2. Connect the load to port 1 using appropriate cable and connectors (type 7mm to N and type N to BNC).

3. Set frequency range: lower frequency value 100kHz by pressing

START 100 k/m

4. Upper frequency value 1 GHz by pressing

STOP 1 G/n

5. Calibrate the analyzer for circuits connected using BNC standard by pressing:

CAL

6. Choose the type of the calibration:

CALIBRATE MENUS11 1-PORT

7. Connect the open-circuit model in BNC standard to the measuring cable (using appropriate connectors) and press

OPEN

8. Connect the short-circuit model in BNC standard to the measuring cable (using appropriate connectors) and press

SHORT

9. Connect the matching load impedance in BNC standard to the measuring cable (using appropriate connectors) and press

LOAD

10. Find correlation coefficients by pressing

DONE: PORT-1 CAL

11. Save calibration result on the floppy disk choosing:

SAVE/RECAL ***SELECT DISK***
INTERNAL DISK
SAVE RECAL ***SAVE STATE***

After calibration, the analyzer is ready for performing measurements in the given frequency range. The calibration procedure includes the influence of external connections of the analyzer, measuring cable, and appropriate connector (from N type standard to BNC). The measurement results will be correct in case of connecting the examined circuit using BNC standard. In case of using different connection standard or connecting the examined circuit directly to the analyzer (without measuring cable), the calibration procedure must be repeated.

12. Measure parameters S_{11} (reflection coefficient) by pressing

MEAS ***Refl : FWD S11***

13. To display the result press

SCALE REF ***AUTOSCALE***

14. Calibrate the device according to instructions in steps 5-10 using different short-circuit and open-circuit models connecting them through additional connector (BNC to BNC). Repeat the measurement procedure for finding the value of S_{11} parameter (steps 12-13) after the calibration procedure for previously used load.

15. Connect the concentric cable ended with BNC connectors To the measurement cable using appropriate connectors (type 7mm to N and type N to BNC). Calibrate the measurement circuit by connecting to the end of the cable short-circuit, open circuit and matching load models. Find S_{11} parameter for previously used load.

Report

Include results of the measurements (in the form of plots), discuss the differences between them, and justify the need of calibrating the analyzer for different measurement conditions.