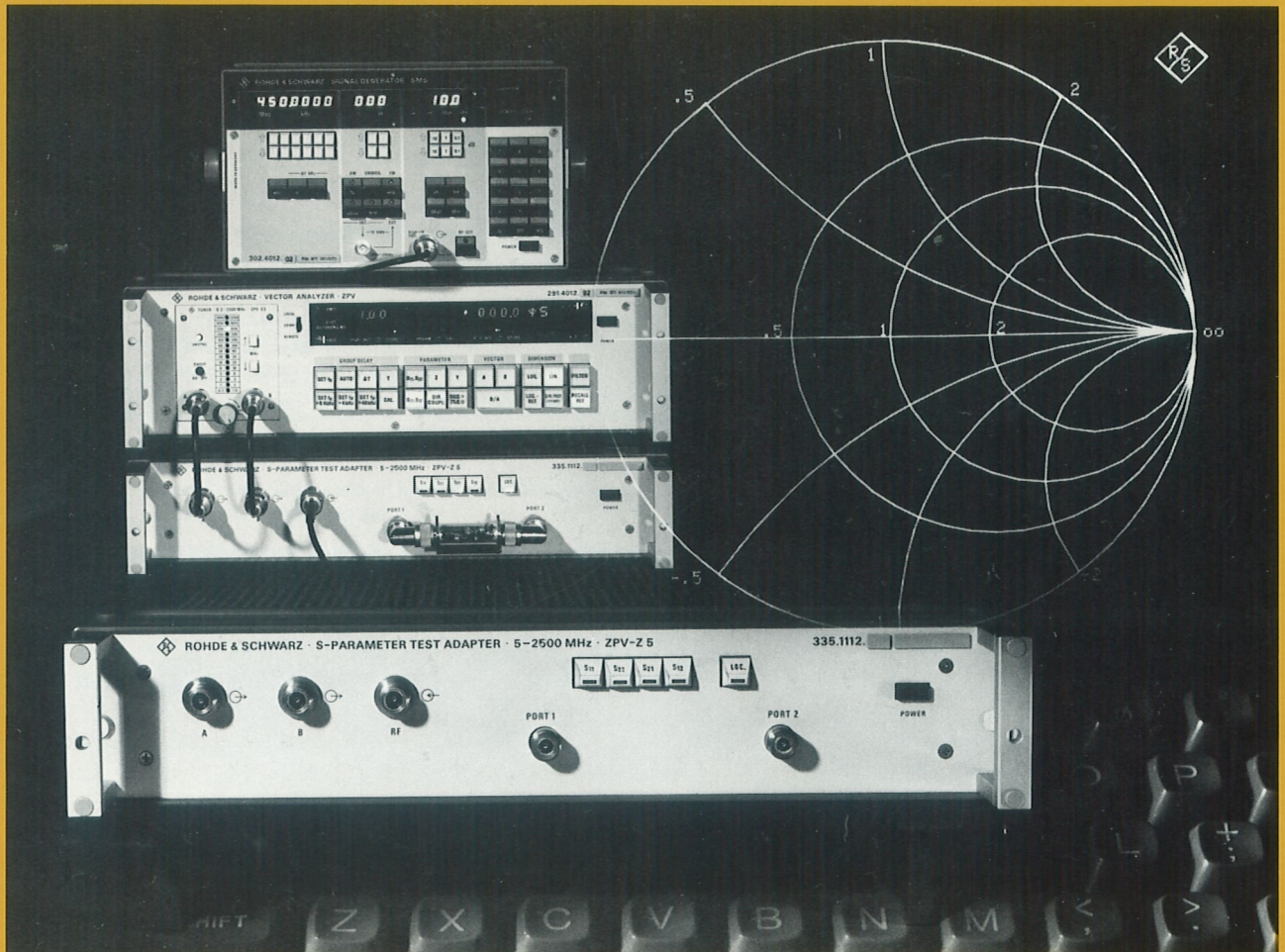


S-PARAMETER TEST ADAPTER ZPV-Z5

5 to 2500 MHz



- Measurement of all four s-parameters without modification to the test setup
- High directivity: 46 dB
- IEC-bus compatible

S-PARAMETER TEST ADAPTER ZPV-Z5

In conjunction with a suitable network analyzer, e.g. the Vector Analyzer ZPV, the **S-parameter Test Adapter ZPV-Z5** permits measurement of all four s-parameters without modification to the test setup.

Characteristics and uses

High directivity, wide frequency range Thanks to the high directivity of the VSWR bridges of 46 dB (for typical values, see page 4), even items with very small reflection coefficients can be tested. The Test Adapter covers almost the entire frequency range of the Tuner ZPV-E3 due to its wide bandwidth of 5 to 2500 MHz; it can of course also be used with the Tuner ZPV-E2 in the range 5 to 1000 MHz.

IEC-bus compatibility The Test Adapter can be controlled via the IEC bus and thus combined with an IEC-bus-compatible signal generator and a desktop calculator to form a favourably priced, automatic network analyzer (see Fig. 2 and text on page 3).

Connections, settings, measurements The Test Adapter is connected to the RF generator and to channels A and B of the Vector Analyzer (see Fig. 1). The test item input and output are taken to ports 1 and 2 of the ZPV-Z5.

In manual operation the s-parameter to be measured is selected by pressing the corresponding front-panel key; in automatic operation (Fig. 3) it is set via the IEC bus by a desktop computer, e.g. the PUC or PCA.

The key labelling and the programming commands correspond to the s-parameters to be measured. To measure for instance the input reflection coefficient S_{11} , "S11" is simply entered via the computer, e.g.

IEC OUT 23, "11" for Process Controller PUC.

Description

The ZPV-Z5 was designed with symmetrical circuits for measuring input and output parameters (Fig. 1). The reference branch includes a line for compensating the electrical lengths in the circuits under test; tedious length compensation by adding a suitable line section is thus no longer required. If a test item cannot be linked up directly to the test sockets of the ZPV-Z5, the input and output of the test item are simply connected via identical cable sections and a third section of the same length is inserted into the reference branch. To provide a power supply for active components, two DC Feed Units ZPV-Z6 can be connected externally (page 4).

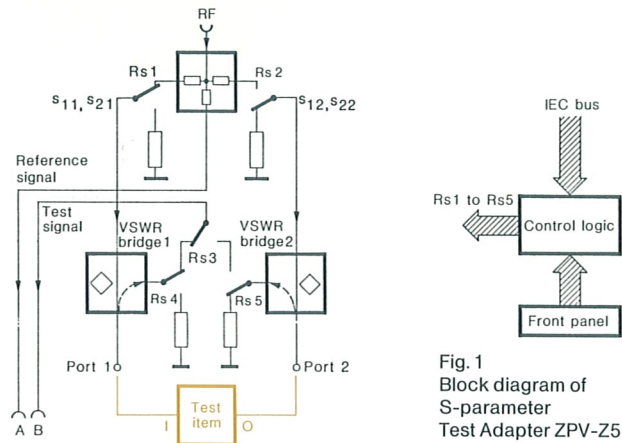


Fig. 1 Block diagram of S-parameter Test Adapter ZPV-Z5



Fig. 2 Automatic network analysis using Vector Analyzer ZPV, S-parameter Test Adapter ZPV-Z5, Sweep Generator SWP and Process Controller PUC

S-PARAMETER TEST ADAPTER ZPV-Z5

Automatic network analysis

The combination of Vector Analyzer ZPV (see data sheet 292401) with S-parameter Test Adapter ZPV-Z5, Signal Generator SMS2 and Process Controller PUC constitutes a favourably priced **automatic network analyzer**. This test setup permits high-precision S-parameter measurements.

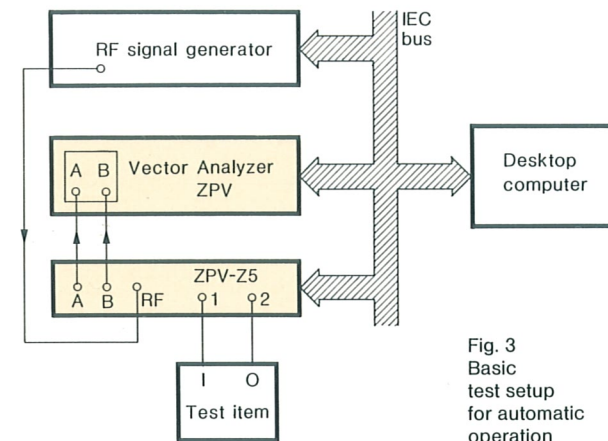


Fig. 3 Basic test setup for automatic operation

```

100 REM**CORRECTED MEASUREMENT OF ALL 4 S-PARAMETERS**
110 REM
120 REM**INPUT DATA **
130 V=3
140 GOSUB 1 GENERATOR SELECTION SMS
150 F=100 START FREQUENCY 100MHZ
160 GOSUB 9 STOP FREQUENCY 200MHZ
170 V=200
180 GOSUB 10 FREQUENCY STEP 10MHZ
190 F=10
200 GOSUB 11 FILTER ON
210 REM**OPERATIONAL SETTINGS **
220 GOSUB 22
230 REM**S11 CALIBRATION** SET ZPV-Z5 TO S11
240 GOSUB 70 SELECT REFLECTION MEASUREMENT ON ZPV
250 GOSUB 47 CALIBRATE WITH 3-POINT CORRECTION
260 GOSUB 35
270 REM**S22 CALIBRATION** SET ZPV-Z5 TO S22
280 GOSUB 70 CALIBRATE WITH 3-POINT CORRECTION
290 GOSUB 35
300 REM**S21 CALIBRATION** SET ZPV-Z5 TO S21
310 GOSUB 70 SELECT TRANSMISSION MEASUREMENT ON ZPV
320 GOSUB 51 CALIBRATE WITH SIMPLE CORRECTION
330 GOSUB 33
340 REM**S12 CALIBRATION** SET ZPV-Z5 TO S12
350 GOSUB 70 CALIBRATE WITH SIMPLE CORRECTION
360 GOSUB 33
370 PRINT"CONNECT DEVICE UNDER TEST" HALT
380 GOSUB 42
390 REM**S11 MEASUREMENT** SET ZPV-Z5 TO S11
400 GOSUB 70 SELECT REFLECTION MEASUREMENT ON ZPV
410 GOSUB 47 NUMERICAL OUTPUT OF MEASUREMENTS
420 PRINT"S11" SET ZPV-Z5 TO S22
430 GOSUB 37 NUMERICAL OUTPUT OF MEASUREMENTS
440 REM**S22 MEASUREMENT** SET ZPV-Z5 TO S22
450 GOSUB 70 SELECT REFLECTION MEASUREMENT ON ZPV
460 PRINT"S22" NUMERICAL OUTPUT OF MEASUREMENTS
470 GOSUB 37
480 REM**S21 MEASUREMENT** SET ZPV-Z5 TO S21
490 GOSUB 70 SELECT TRANSMISSION MEASUREMENT ON ZPV
500 GOSUB 51 NUMERICAL OUTPUT OF MEASUREMENTS
510 PRINT"S21" SET ZPV-Z5 TO S12
520 GOSUB 37 NUMERICAL OUTPUT OF MEASUREMENTS
530 REM**S12 MEASUREMENT**
540 GOSUB 70
550 PRINT"S12"
560 GOSUB 37
570 GOTO 380
580 END
READY.
    
```

Fig. 4 Program for corrected measurement of all four s-parameters without manual switchover

The **S-parameter Accuracy-improvement** eliminates to a large extent errors due to the test setup. To this effect, the test setup should be calibrated for each test frequency under short-circuit, open-circuit or matching conditions and the corresponding calibration values stored in the computer. Then the measurement accuracy depends only on the calibration standards used. Using a synthesizer ensures that the results are highly reproducible. When measuring the reflection coefficient for matched components, the error is about 0.2%; in the case of total mismatch it is about 1%. Fig. 4 shows the program for corrected measurements of all four s-parameters without having to reconnect the test item.

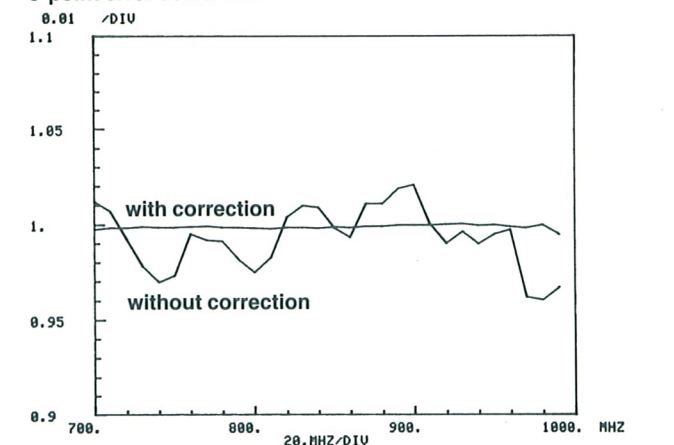
The desktop calculators PUC or PCA 5 permit **graphic display** of the test results in cartesian, polar or Smith-chart formats on the calculator screen or a plotter. Fig. 5 shows the numerical and graphic displays of results obtained with and without S-parameter Accuracy-improvement Software when measuring the input reflection coefficient of a shorted waveguide.

The **modular design of the software** which is made up of individual subroutines enables even the unexperienced user to produce test programs rapidly.

Frequency	r	<r
700.0000	0.9934	-91.0066
710.0000	0.9956	-97.2942
720.0000	0.9959	-103.5903
730.0000	0.9968	-109.8903
740.0000	0.9965	-116.1878
750.0000	0.9963	-122.5132
760.0000	0.9967	-128.8499
770.0000	0.9964	-135.1799
780.0000	0.9963	-141.6089
790.0000	0.9965	-147.9974
800.0000	0.9972	-154.3816
810.0000	0.9962	-160.7765
820.0000	0.9963	-167.1590
830.0000	0.9957	-173.5942
840.0000	0.9960	-179.9590
850.0000	0.9965	-173.5522
860.0000	0.9974	-167.0837
870.0000	0.9970	-160.5765
880.0000	0.9981	-154.1822
890.0000	0.9973	-147.6854
900.0000	0.9985	-141.2815
910.0000	0.9987	-134.6395
920.0000	0.9974	-128.0688
930.0000	0.9979	-121.4991
940.0000	0.9973	-114.9146
950.0000	0.9977	-108.2798
960.0000	0.9972	-101.5989
970.0000	0.9968	-94.9332
980.0000	0.9976	-88.3213
990.0000	0.9930	-81.6578

Fig. 5 Numerically and graphically displayed test results obtained when measuring the input reflection coefficient of a shorted waveguide (with and without S-parameter Accuracy-improvement Software)

3-point error correction



S-PARAMETER TEST ADAPTER ZPV-Z5

DC supply for active test items

The **DC Feed Unit ZPV-Z6** (see Fig. 6) is used for supplying active test items with direct current. It contains a broadband inductor for the current supply and an isolating capacitor blocking the inner conductor of the coaxial line for DC.

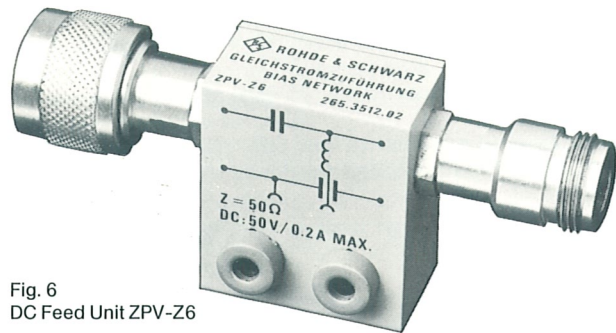


Fig. 6
DC Feed Unit ZPV-Z6

Specifications of ZPV-Z6

Frequency range	5 to 2500 MHz
Impedance	50 Ω
Maximum voltage	50 V DC
Maximum current	200 mA DC
Reflection coefficient	see Fig. 7
Connectors: RF	N male } can be
RF + DC	N female } interchanged
DC	telephone jacks (4 mm)
Order designation	► DC Feed Unit ZPV-Z6 265.3512.02 (2 units required)

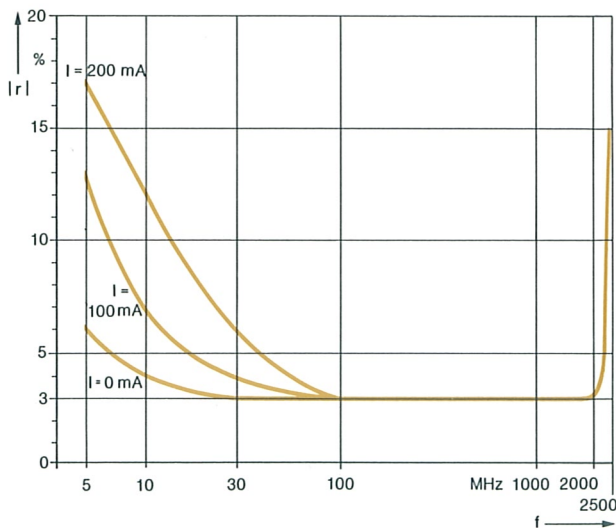


Fig. 7 Reflection coefficient of DC Feed Unit ZPV-Z6 as a function of frequency

Specifications of ZPV-Z5

Frequency range	5 to 2500 MHz
Input and output impedance	50 Ω, N female connectors for A, B, RF; N precision female connectors for port 1, 2
Permissible input loading	0.5 W
Directivity	≧ 46 dB up to 2000 MHz ≧ 40 dB up to 2500 MHz
Insertion loss at 5 MHz	
RF input – reference output A	6 dB ± 1 dB
– ports 1, 2	13 dB ± 1 dB
– test output B	18 dB ± 1 dB
Measurement error	
Variation with frequency of reflection coefficient and transmission factor	≦ ± 1.2 dB (difference-frequency response between test output B and reference output A)
Frequency-proportional phase error	≦ ± 6° x f (f in GHz) (between test output B and reference output A)
Measurement error due to inherent reflection	≦ ± 0.05 x r ² r = reflection coefficient of item under test
Phase error due to inherent reflection	≦ ± 6° x r ²
VSWR mismatch (ports 1, 2)	r ≦ 7%
Relay switching time	30 ms (life: 1 x 10 ⁶ switching actions)
Programming	
System	IEC 625-1 24-contact Amphenol connector
Factory-set address	23
Interface functions	AH1, L2, RL1
General data	
Nominal temperature range	+18 to +30 °C
Operating temperature range	-10 to +45 °C
Storage temperature range	-45 to +70 °C
AC supply	115/125/220/235 V ± 10% 47 to 440 Hz (25 VA)
Dimensions, weight	492 mm x 116 mm x 514 mm, 7.7 kg

Ordering information

Order designation ► S-parameter Test Adapter ZPV-Z5 335.1112.52

Recommended extras

Vector Analyzer ZPV (basic unit)	291.4012.93
Tuner	
ZPV-E1 (10 Hz to 50 MHz)	303.0510.02
ZPV-E2 (0.1 to 1000 MHz)	292.0010.02
ZPV-E3 (0.3 to 2000 MHz)	301.7018.02
Insertion Adapter ZPV-Z1	
(for ZPV-E2 only)	292.2713.50 (2 units required)
IEC-bus Cable PCK, 1 m	292.2013.10
Precision Termination RNA, 50 Ω	272.4510.50
Termination RNB, 50 Ω	
(for ZPV-E2 only)	272.4910.50 (2 units required)
Shortcircuit connector 50 Ω (N)	017.8080.00
Pair of Test Cables ZPV-Z4	
(with ZPV-E3 only)	335.1012.50

For computer-controlled operation

Basic Software for	
Process Controller PCA 5	ZPV-K13 818.4811.02
Process Controller PUC	ZPV-K10 291.8818.02
Tektronix 4051, 4052	ZPV-K1 292.2113.02
HP 9835 and 9845	ZPV-K4 292.2413.02

S-parameter Accuracy-improvement

Software for	
Process Controller PCA 5	ZPV-K14 818.4911.02
Process Controller PUC	ZPV-K11 291.8918.02
Tektronix 4051, 4052	ZPV-K2 292.2213.02
HP 9835 and 9845	ZPV-K5 292.2513.02

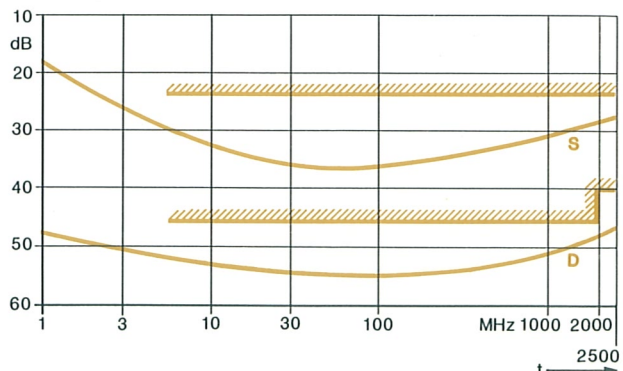


Fig. 8 Typical characteristic and tolerance limits of return loss S at the test port and directivity D of the ZPV-Z5