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*Ersetzt durch Ausgabe*

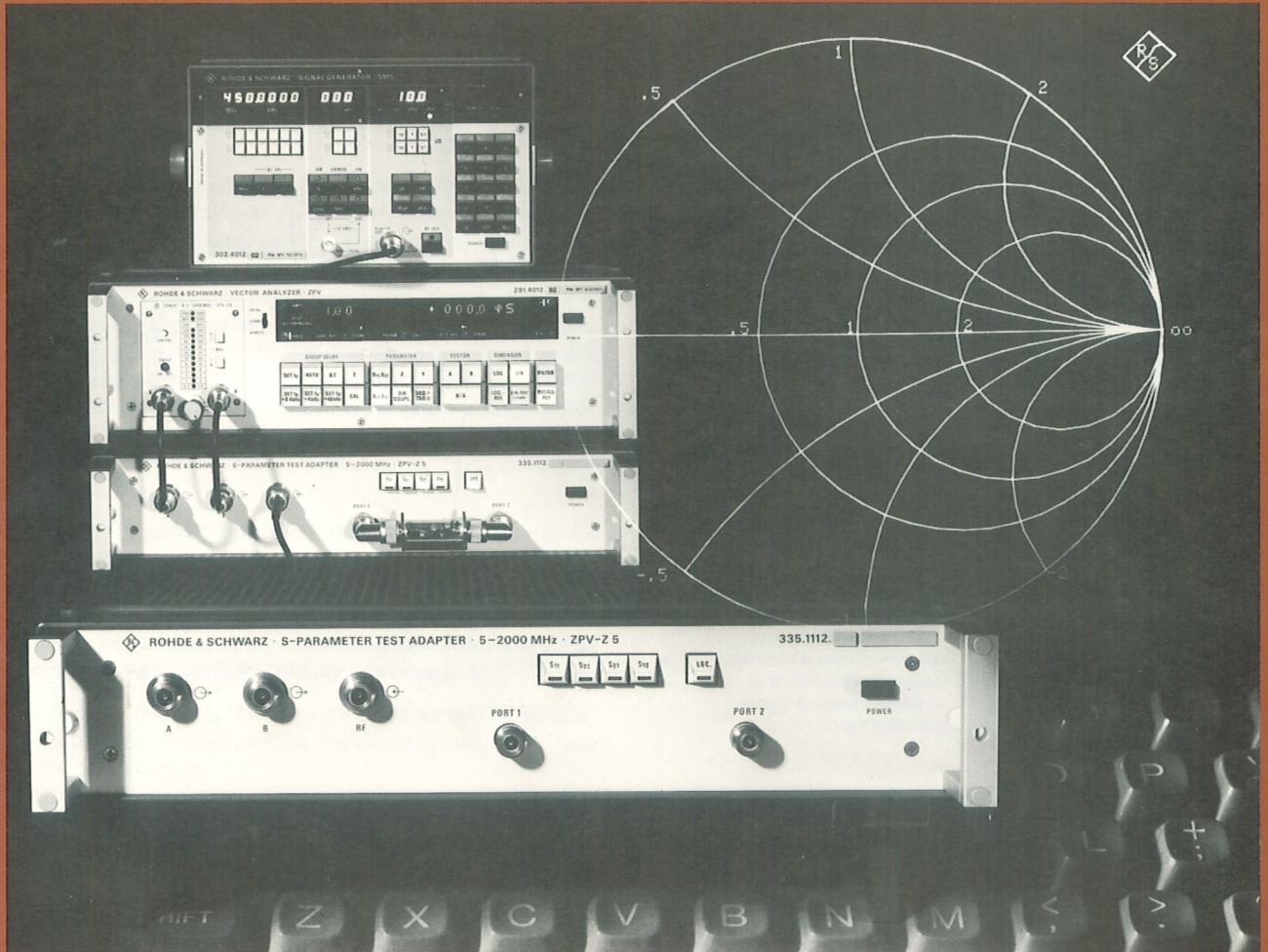
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ZPV-Z5

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# S-PARAMETER TEST ADAPTER ZPV-Z5

5 to 2000 MHz



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



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, 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 2000 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 PPC or the Tektronix 4051, 4052.

The key labeling 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.

Print @23: "S11" for Tektronix 4051/4052, IEC OUT 23, "S11" for Process Controller PPC.

**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).

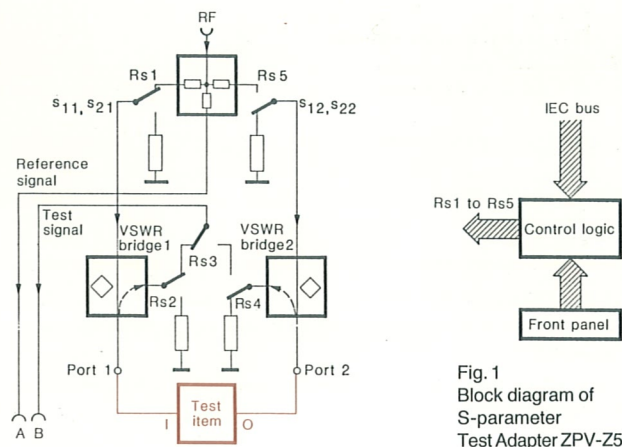


Fig. 1 Block diagram of S-parameter Test Adapter ZPV-Z5

**Automatic network analysis**

The combination of Vector Analyzer ZPV (see data sheet 292 401) with S-parameter Test Adapter ZPV-Z5, Signal Generator SMS and Process Controller PPC constitutes a favourably priced **automatic network analyzer**. This test setup permits high-precision S-parameter measurements.

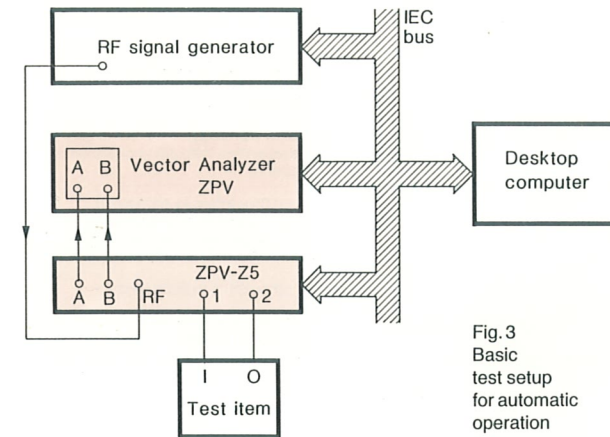


Fig. 3 Basic test setup for automatic operation

The **S-parameter Accuracy-improvement Software** 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 Tektronix desktop calculators 4051 or 4052 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.

```

100 REM**CORRECTED MEASUREMENT OF ALL 4 S-PARAMETERS**
110 REM
120 REM**INPUT DATA **
130 V=4
140 GOSUB 1 GENERATOR SELECTION SMS
150 V=100 START FREQUENCY 100MHZ
160 GOSUB 9 STOP FREQUENCY 200MHZ
170 Y=500 FREQUENCY STEP 10MHZ
180 GOSUB 10
190 V=10
200 GOSUB 11
210 REM**OPERATIONAL SETTINGS **
220 GOSUB 22 FILTER ON
230 REM**S11 CALIBRATION**
240 GOSUB 20 SET ZPV-Z5 TO S11
250 GOSUB 47 SELECT REFLECTION MEASUREMENT ON ZPV
260 GOSUB 35 CALIBRATE WITH 3-POINT CORRECTION
270 REM**S22 CALIBRATION**
280 GOSUB 21 SET ZPV-Z5 TO S22
290 GOSUB 71 CALIBRATE WITH 3-POINT CORRECTION
300 REM**S21 CALIBRATION**
310 GOSUB 73 SET ZPV-Z5 TO S21
320 GOSUB 51 SELECT TRANSMISSION MEASUREMENT ON ZPV
330 GOSUB 33 CALIBRATE WITH SIMPLE CORRECTION
340 REM**S12 CALIBRATION**
350 GOSUB 74 SET ZPV-Z5 TO S12
360 GOSUB 33 CALIBRATE WITH SIMPLE CORRECTION
370 PRINT "CONNECT DEVICE UNDER TEST"
380 GOSUB 42 HALT
390 REM**S11 MEASUREMENT**
400 GOSUB 70 SET ZPV-Z5 TO S11
410 GOSUB 47 SELECT REFLECTION MEASUREMENT ON ZPV
420 PRINT "S11"
430 GOSUB 37 NUMERICAL OUTPUT OF MEASUREMENTS
440 REM**S22 MEASUREMENT**
450 GOSUB 71 SET ZPV-Z5 TO S22
460 PRINT "S22"
470 GOSUB 37 NUMERICAL OUTPUT OF MEASUREMENTS
480 REM**S21 MEASUREMENT**
490 GOSUB 73 SET ZPV-Z5 TO S21
500 GOSUB 51 SELECT TRANSMISSION MEASUREMENT ON ZPV
510 PRINT "S21"
520 GOSUB 37 NUMERICAL OUTPUT OF MEASUREMENTS
530 REM**S12 MEASUREMENT**
540 GOSUB 74 SET ZPV-Z5 TO S12
550 PRINT "S12"
560 GOSUB 37 NUMERICAL OUTPUT OF MEASUREMENTS
570 GOTO 350
580 END
READY.
    
```

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

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	-141.2015
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)

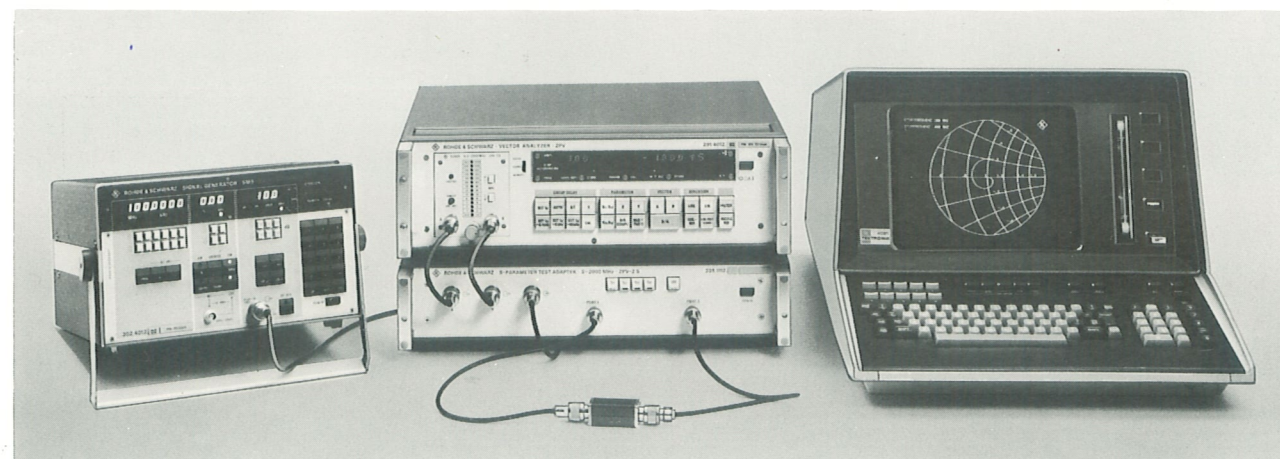
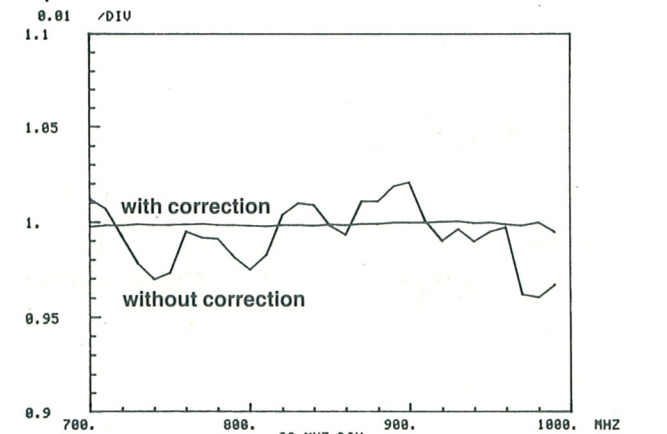


Fig. 2 Automatic network analysis using Vector Analyzer ZPV, S-parameter Test Adapter ZPV-Z5, Signal Generator SMS and Tektronix desktop calculator 4051

**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.

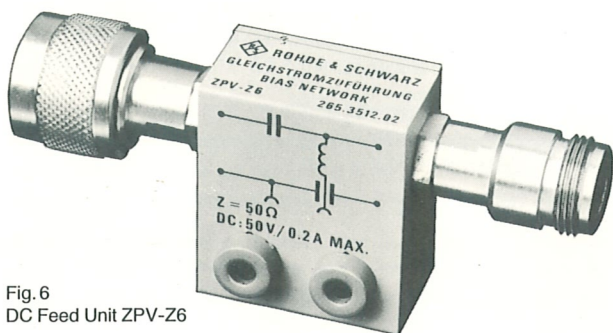


Fig. 6  
DC Feed Unit ZPV-Z6

### Specifications of ZPV-Z6

Frequency range	5 to 2000 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)
<b>Order designation</b>	► DC Feed Unit ZPV-Z6 265.3512.02 (2 units required)

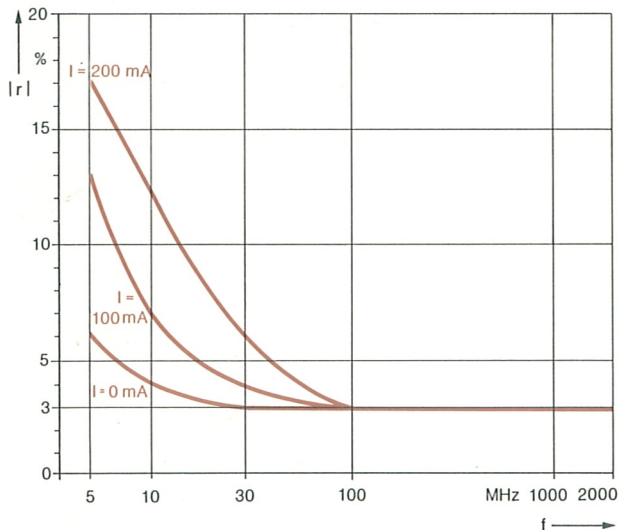


Fig. 7 Reflection coefficient of DC Feed Unit ZPV-Z6 as a function of frequency

### Specifications of ZPV-Z5

Frequency range	5 to 2000 MHz
Input and output impedance	50 Ω, N female connectors for A, B, RF; N precision female connectors for ports 1, 2
Input loading	≤ 0.5 W
Directivity	46 dB
Insertion loss	
RF input – reference output A	approx. 8 dB
– ports 1, 2	approx. 15 dB
– test output B	approx. 22 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  <sup>2</sup> (up to 1000 MHz) ≤ ± 0.1 x  r  <sup>2</sup> (up to 2000 MHz) r = reflection coefficient of item under test
Phase error due to inherent reflection	≤ ± 6° x  r  <sup>2</sup> (up to 2000 MHz)
VSWR mismatch (ports 1, 2)	r ≤ 10% (up to 1000 MHz) r ≤ 15% (up to 2000 MHz)
Relay switching time	30 ms (life: 1 x 10 <sup>6</sup> switching actions)
Programming System	IEC 625-1 24-way Amphenol connector
Factory-set address	23
Interface functions	AH1, L2, RL1

<b>General data</b>	
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
Colour: front panel	light grey RAL 7035
cabinet	grey blue
Inscriptions	English

**Order designation** . . . . . ► S-parameter Test Adapter ZPV-Z5 335.1112.50

<b>Recommended extras</b>	
Vector Analyzer ZPV (basic unit)	291.4012.92
Tuner	
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

<b>For calculator-controlled operation</b>	
Basic Software for	
Process Controller PPC	ZPV-K10 . . . . . 291.8818.02
Tektronix 4051, 4052	ZPV-K1 . . . . . 292.2113.02
HP 9835	ZPV-K4 . . . . . 292.2413.02
Commodore CBM 2001, 3001	ZPV-K7 . . . . . 291.8518.02
S-parameter Accuracy-improvement software for	
Process Controller PPC	ZPV-K11 . . . . . 291.8918.02
Tektronix 4051, 4052	ZPV-K2 . . . . . 292.2213.02
HP 9835	ZPV-K5 . . . . . 292.2513.02
Commodore CMB 2001, 3001	ZPV-K8 . . . . . 291.8618.02