ADVANTEST®

ADVANTEST CORPORATION

INSTRUCTION MANUAL

R3951A

S Parameter Test Set

MANUAL NUMBER OEA00 912

Before reselling to other corporations or re-exporting to other countries, you are required to obtain permission from both the Japanese Government under its Export Control Act and the U.S. Government under its Export Control Law.

© 1989 ADVANTEST CORPORATION
All rights reserved.

Printed in Japan

LIST OF RELATED MANUALS

Manual No.	Manual Title
R4611	Network Analyzer
R3751	Network Analyzer

TABLE OF CONTENTS

1. GENERAL DESCRIPTION ..... 1 - 1
1.1 Outline of Product ..... 1 - 1
1.2 Check of Attachments ..... 1 - 2

2. EXPLANATION OF PRODUCT PANEL SURFACE ..... 2 - 1
2.1 Explanation of Front Panel ..... 2 - 1
2.2 Explanation of Rear Panel ..... 2 - 2

3. CONNECTION WITH NETWORK ANALYZER ..... 3 - 1
3.1 Front Side Connection ..... 3 - 1
3.2 Rear Panel Connection ..... 3 - 2

4. MEASUREMENT ..... 4 - 1
4.1 Measuring of S_{11} and S_{22} ..... 4 - 1
4.2 Measuring of S_{21} and S_{12} ..... 4 - 7

5. EXPLANATION OF PERFORMANCES ..... 5 - 1

6. PERFORMANCES ..... 6 - 1

APPENDIX ..... A - 1
A.1 Softkey Menu List ..... A - 1

EXTERNAL VIEW

1. GENERAL DESCRIPTION

1.1 Outline of Product

R3951A is S parameter test set measuring transmission and reflection characteristics of two-port device and connected to R3751A or R4611 Network Analyzer.
Forward and reverese transmission and reflection characteristics can be measured simultaneously without disconnecting the device from the test port.

1.2 Check of Attachments

Upon receipt of this equipment, run checks thereon as shown below.

① Run visual checks against any and all damages or imperfections.

② Check the quantity and rating of standard accessories to assure their conformance with Table 1-1.

Should there be any flaw, or damage, or missing or insufficient part, contact the nearest dealer or the sales and support offices.

Request to User: When ordering add-on attachments and the like, be good enough to stipulate the model (or stock) No. concerned.

Table 1 - 1 Standard Attachments

Product name	Model	Stock No.	Q'ty	Remarks
Fuse	MF51NR0.315	DFN-AAR315A	2	
BNC cable	-	DCB-FF3767x01	3	160mm
	MI-78	DCB-FF3767x02	1	200mm
Control cable	57FF-314-20P3W	DCB-RR3994x01	1	

2. EXPLANATION OF PRODUCT PANEL SURFACE

2.1 Explanation of Front Panel

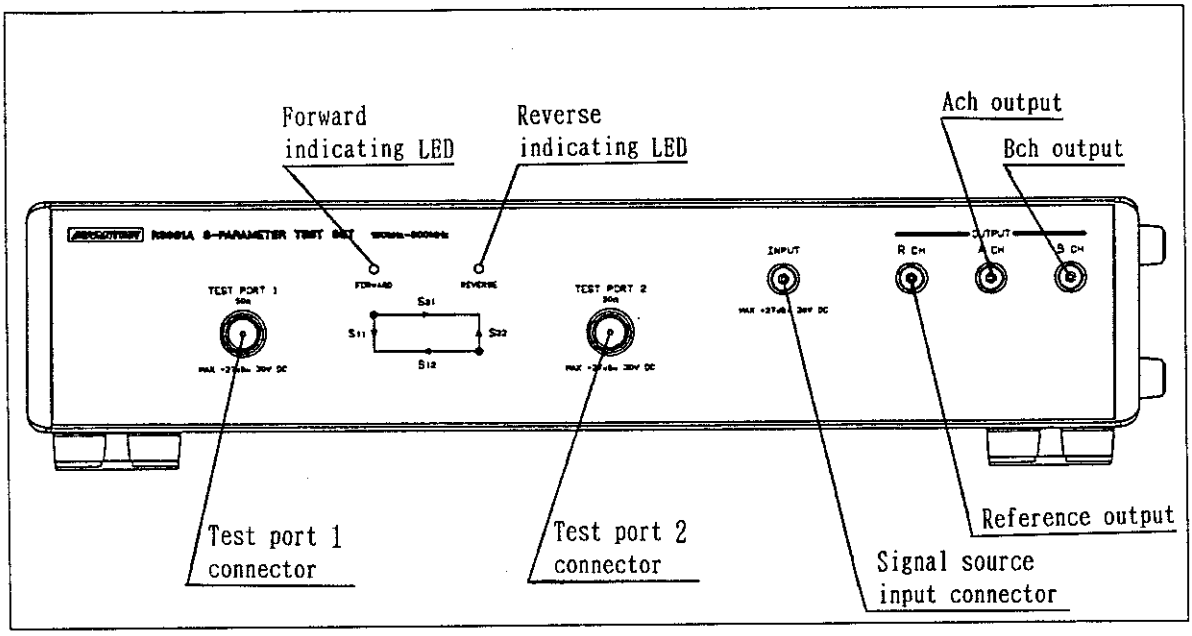


Figure 2 - 1 Explanation of Front Panel

2.2 Explanation of Rear Panel

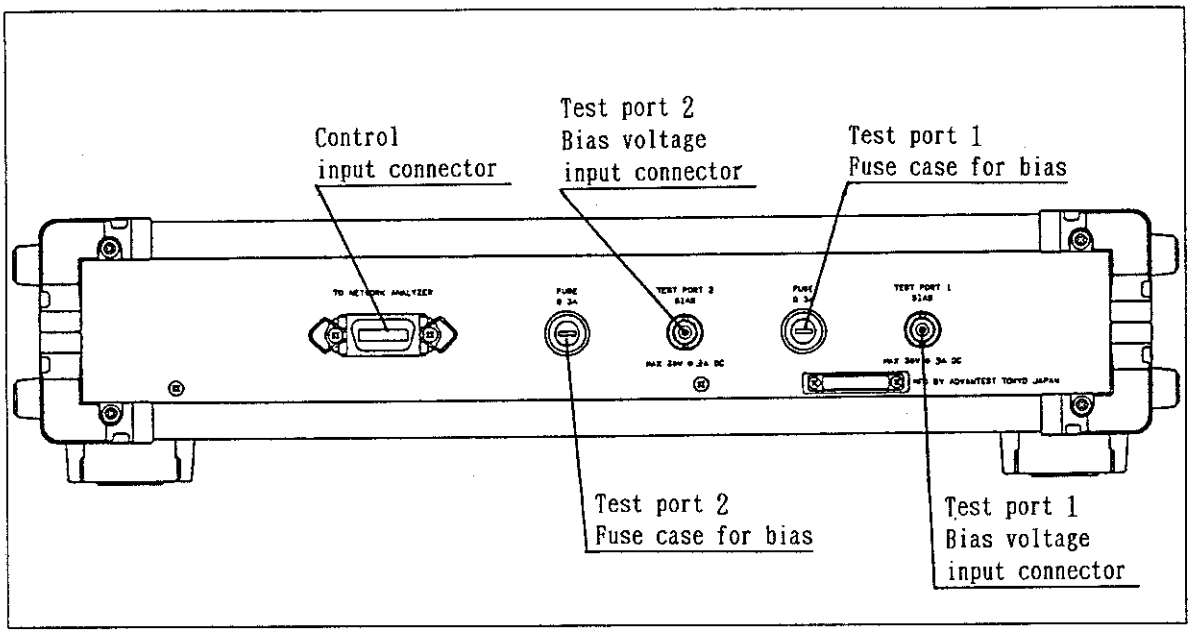


Figure 2 - 2 Explanation of Rear Panel

3. CONNECTION WITH NETWORK ANALYZER

This instrument can be connected with R4611 or R3751A.
Test set cable (separately sold) is necessary for R4611.

3.1 Front Side Connection

Connect as following using attached BNC cable.

R3951A		R4611 or 3751A	Applicable cable
INPUT	⟷	OUTPUT 1	DCB-FF3767×02
OUTPUT R	⟷	INPUT R	DCB-FF3767×01
OUTPUT A	⟷	INPUT A	DCB-FF3767×01
OUTPUT B	⟷	INPUT B	DCB-FF3767×01

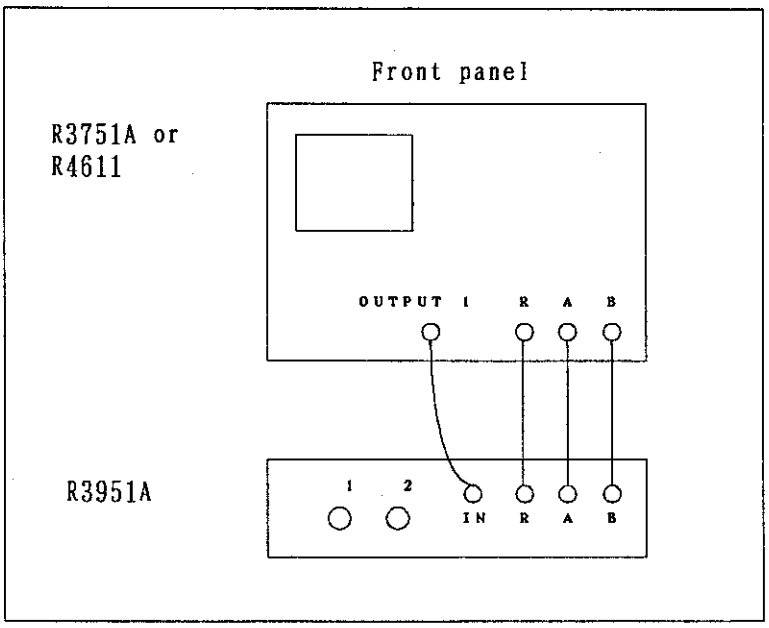


Figure 3 - 1 Front Side Connection

3.2 Rear Panel Connection

Connect as following using the attached control cable (DCB-FF3994x01).

R3951A	R4611 or R3751A
TO NETWORK ANALYZER	TEST SET

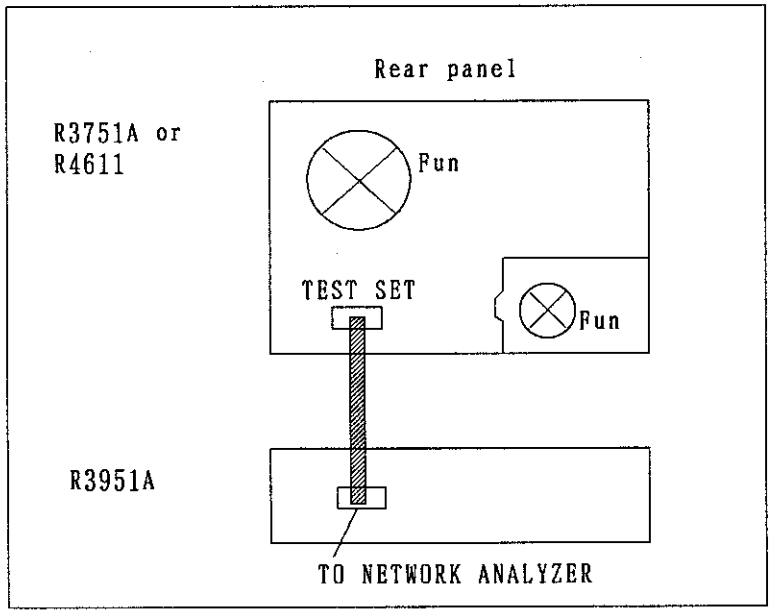
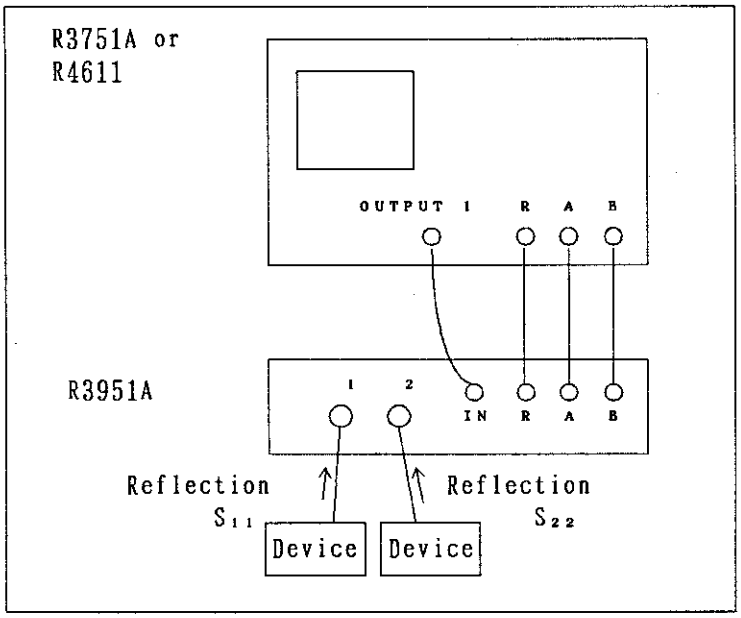


Figure 3 - 2 Rear Panel Connection

4. MEASUREMENT

4.1 Measuring of S_{11} and S_{22}

Reflection characteristics can be measured.



Measuring of S_{11}: Measures reflection characteristics for the device connected to test port 1.

Measuring of S_{22}: Measures reflection characteristics for the device connected to test port 2.

Operating procedures are shown as follows.

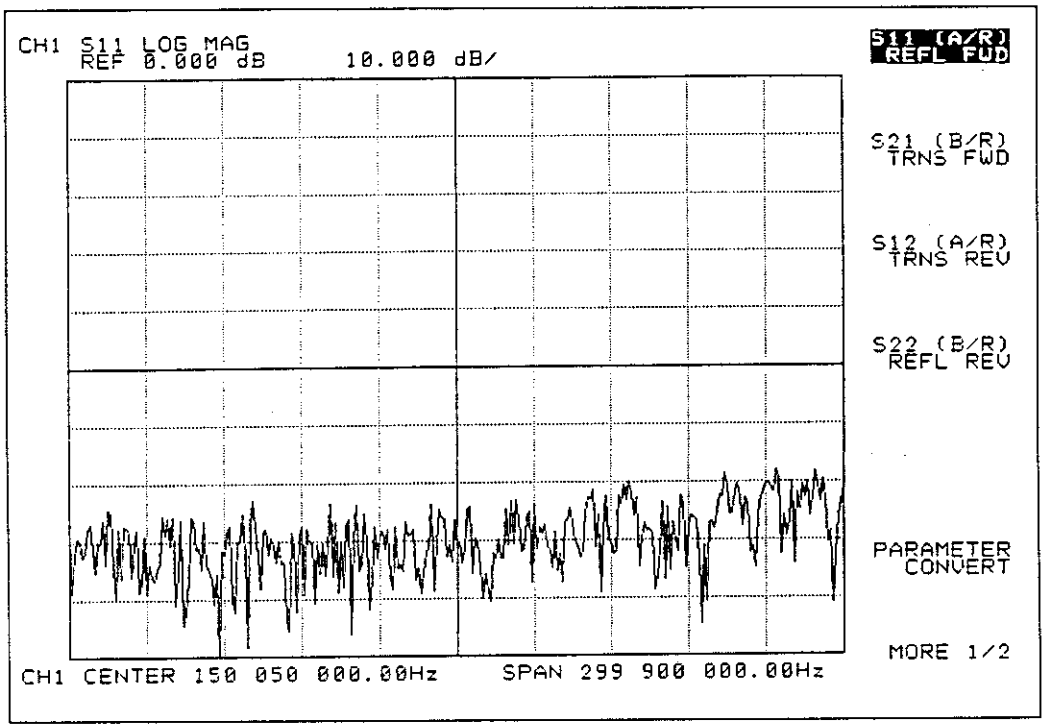
(1) Initial set-up

The frequency band of the instrument is from 100kHz.
Operate the key on the front panel of R3751A or R4611.

① Press START [1] [0] [0] [kHz] [INPUT MEAS].

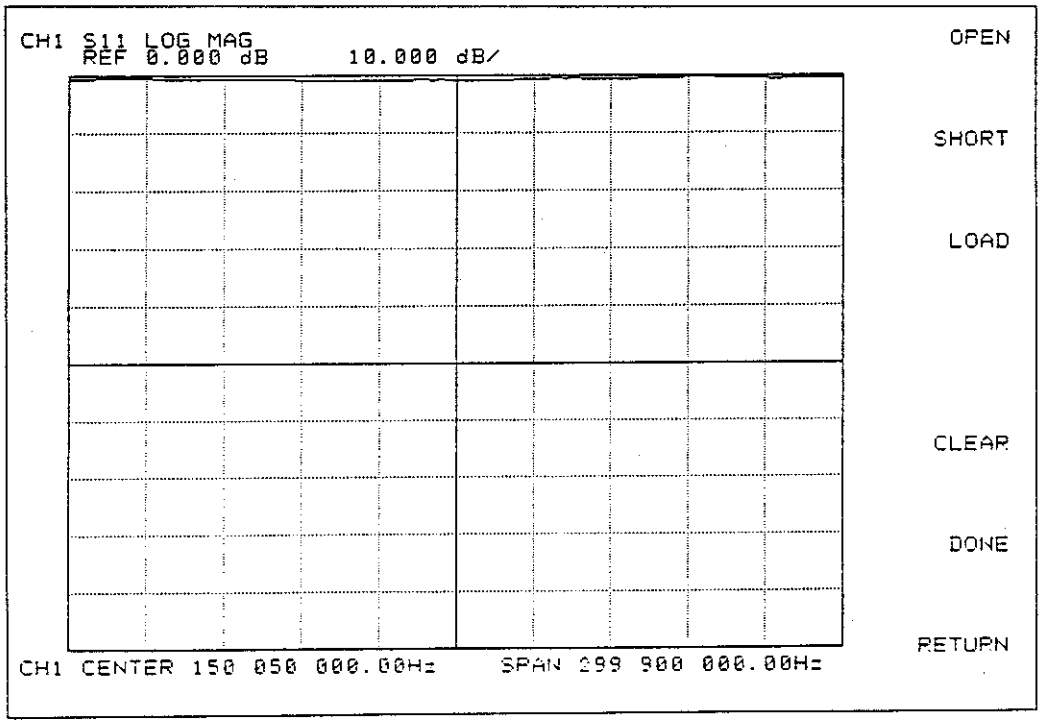
② press [S11 (A/R) REFL FWD] for measuring S_{11}.

Press [S22 (B/R) REFL REV] for measuring S_{22}.



(2) Calibration

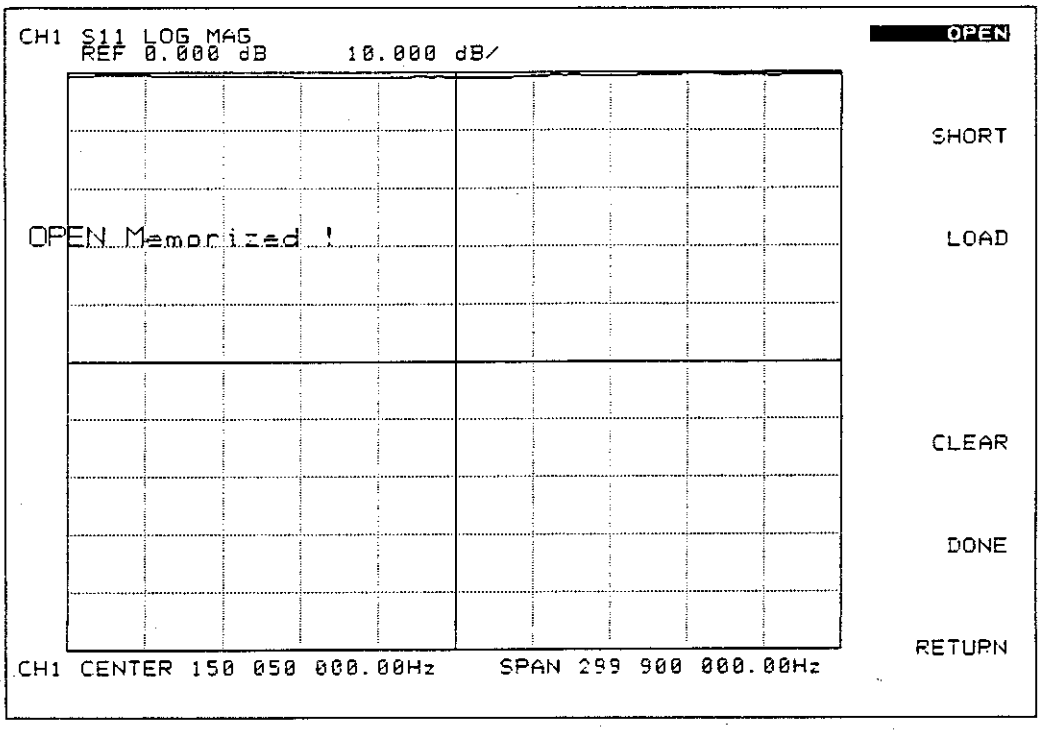
① Press CAL → 1 PORT FULL CAL •



② Execute 1 PORT FULL CAL using OPEN, SHORT and LOAD.

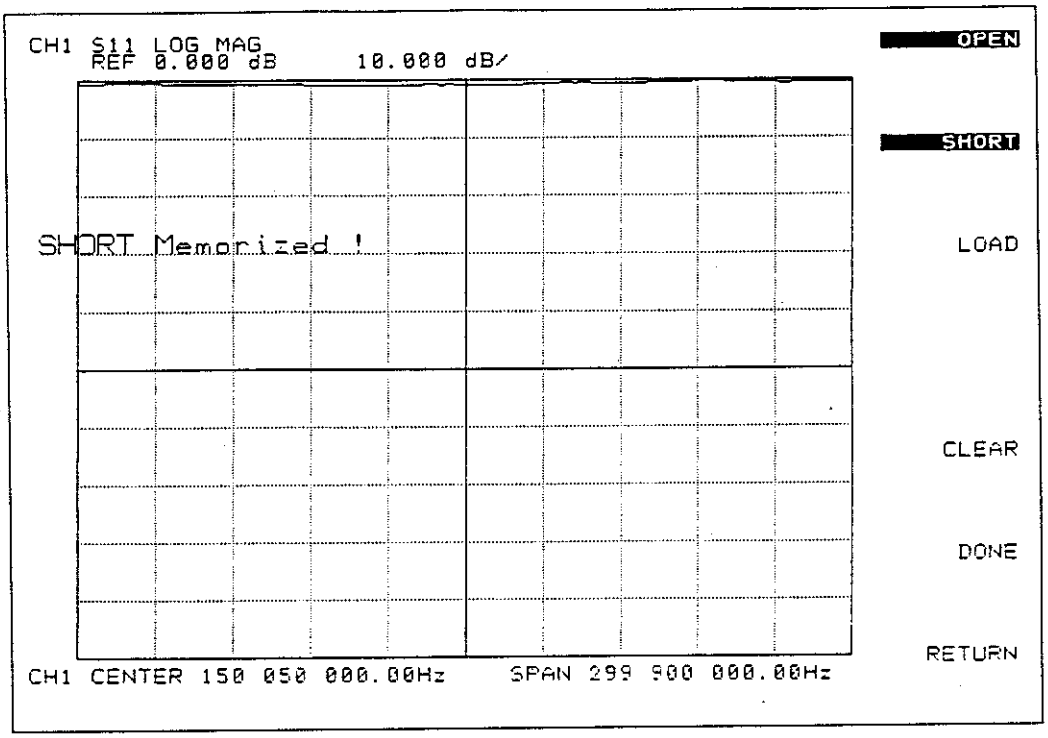
②-1 Connect OPEN to TEST PORT 1 for measuring of S_{11}.
Connect OPEN to TEST PORT 2 for measuring of S_{22}.

Then press [OPEN].



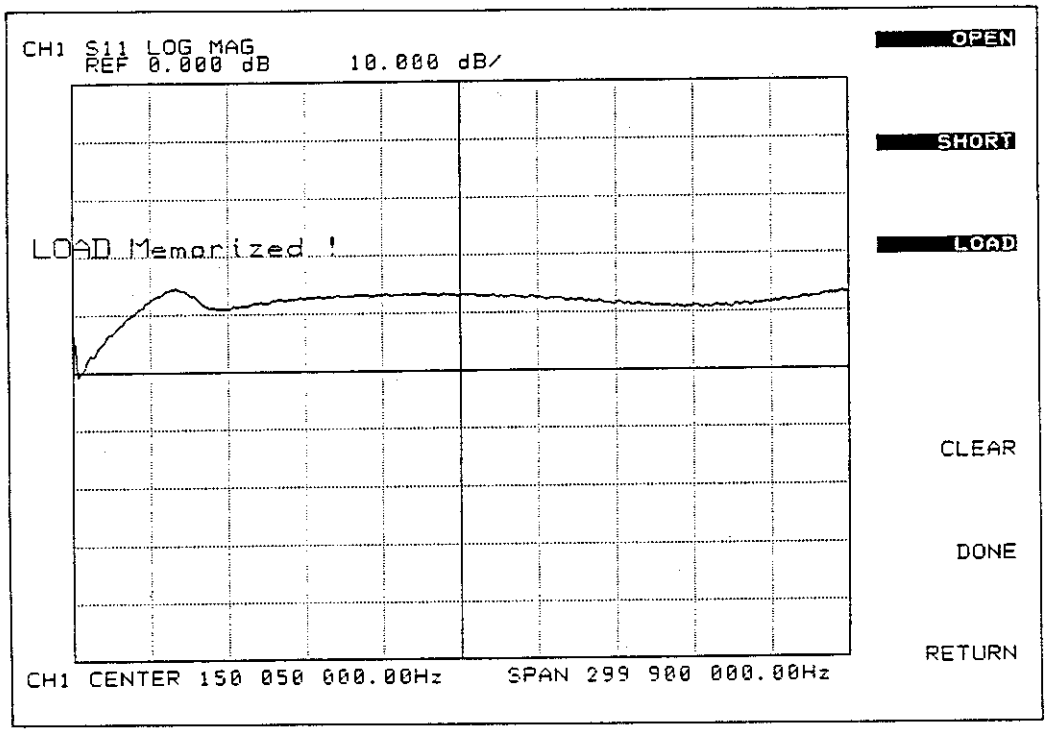
②-2 Connect SHORT to TEST PORT 1 for measuring of S_{11}.
Connect SHORT to TEST PORT 2 for measuring of S_{22}.

Then press SHORT .

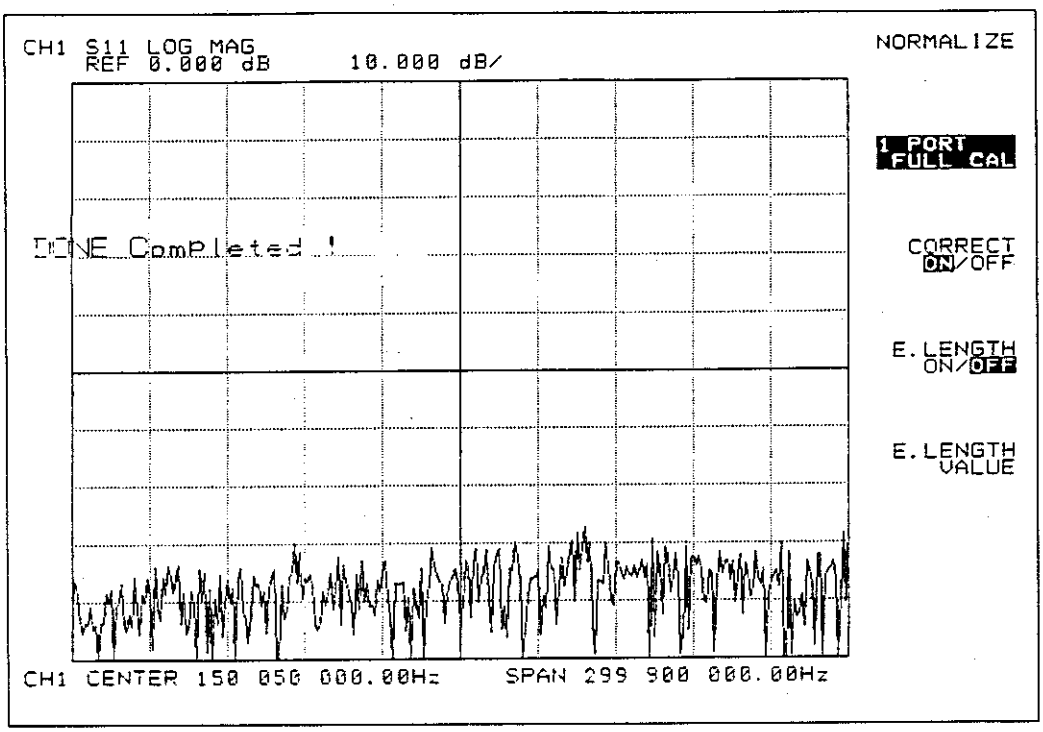


②-3 Connect LOAD to TEST PORT 1 for measuring of S_{11}.
Connect LOAD to TEST PORT 2 for measuring of S_{22}.

Then press [LOAD].



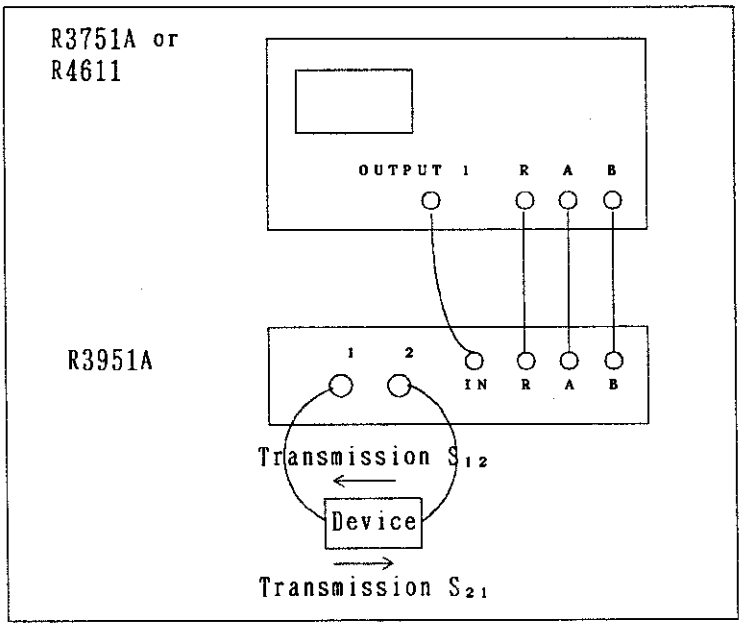
②-4 Press DONE .



③ Disconnect LOAD of TEST PORT 1 or 2 and connect the device. Then S_{11} or S_{22} can be measured.

4.2 Measuring of S_{21} and S_{12}

This is the measurement of transmission characteristics.



Measuring of S_{21}: Connect the device between TEST PORT 1 and 2, and measure the transmission characteristics in the direction from TEST PORT 1 to 2.

Measuring of S_{12}: Connect the device between TEST PORT 1 and 2, and measure the transmission characteristics in the direction from TEST PORT 2 to 1.

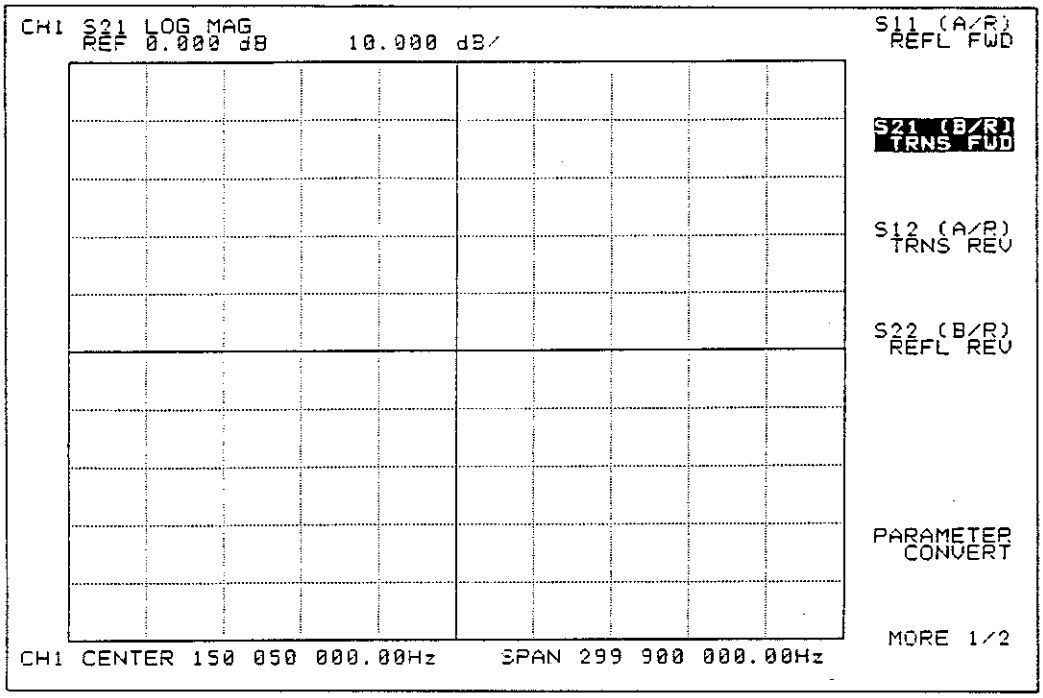
Operating procedures are shown as follows.

(1) Operate the key on the front panel of R3751A or R4611.

① Press [INPUT MEAS].

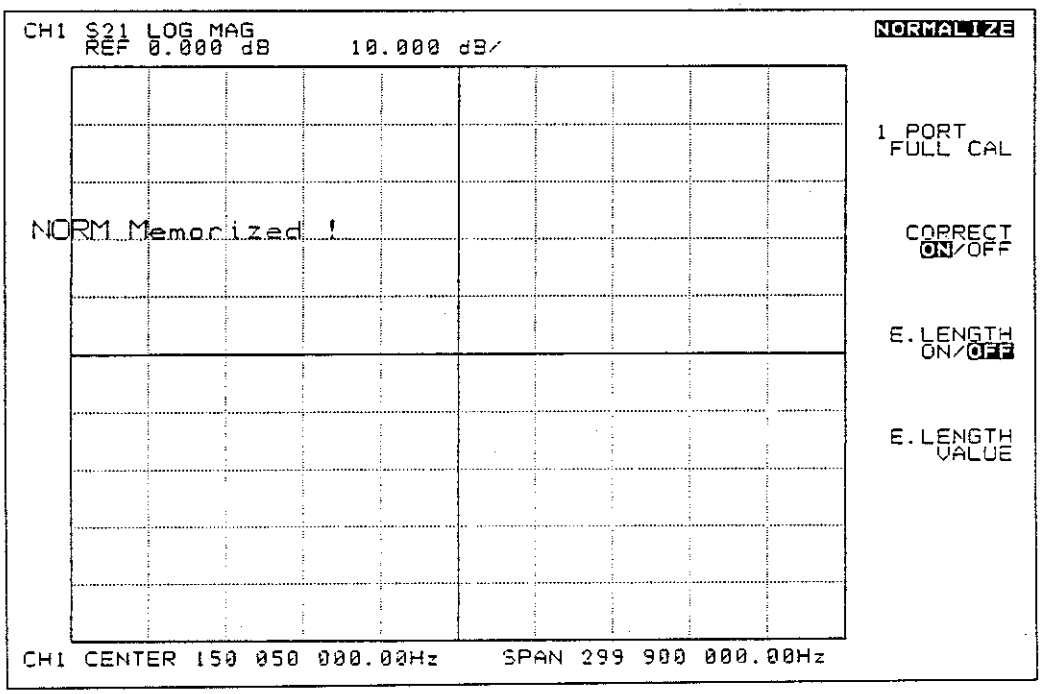
② Press [S21 (B/R) TRNS FWD] for measuring S_{21}.

③ Press [S12 (A/R) TRNS REV] for measuring S_{12}.



③ Make a through state between TEST PORT 1 and 2.

④ Press CAL ☐ NORMLIZE to normalize the frequency characteristics.



⑤ Connect the device between TEST PORT 1 and 2. Then S_{21} or S_{22} can be measured.

5. EXPLANATION OF PERFORMANCES

(1) Block Diagram

The block diagram is shown as follows.

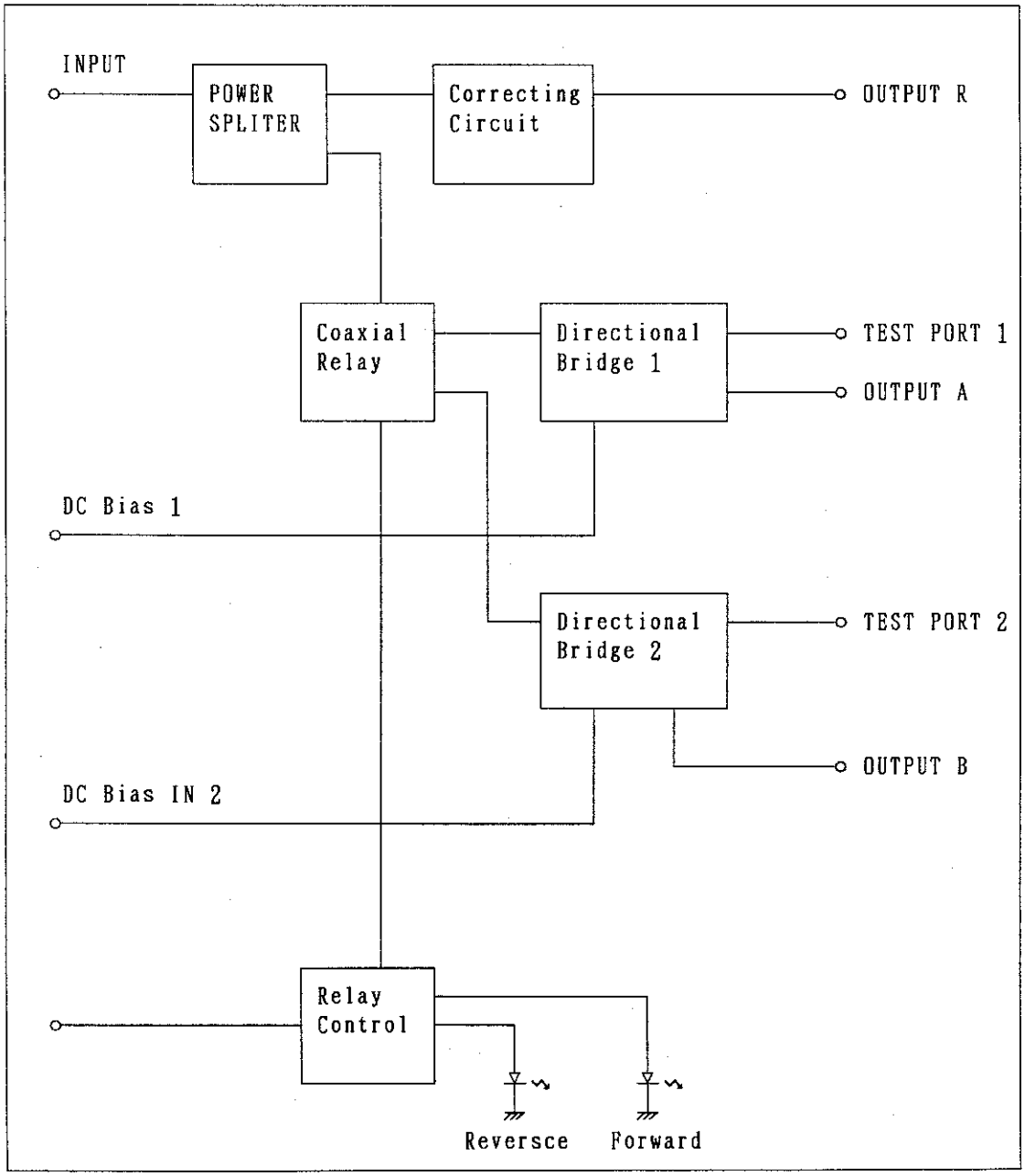


Figure 5 - 1 Block Diagram

(2) Explanation of Performances

① Measurement of Reflection

The input signal through <INPUT> passes through the route → or → and outputs to Part 1 to 2. Reflecting component is output to "OUTPUT A" or "OUTPUT B".
The network analyzer will then compare the output of "OUTPUT R" and "OUTPUT A" or "OUTPUT B", and indicate the results.

② Measurement of Transmission

The input signal through <INPUT> passes through the route ⇢ or → and is output to "OUTPUT B" or "OUTPUT A". The network analyzer will then compare the output of "OUTPUT R" and "OUTPUT B" or "OUTPUT A", and indicate the results.

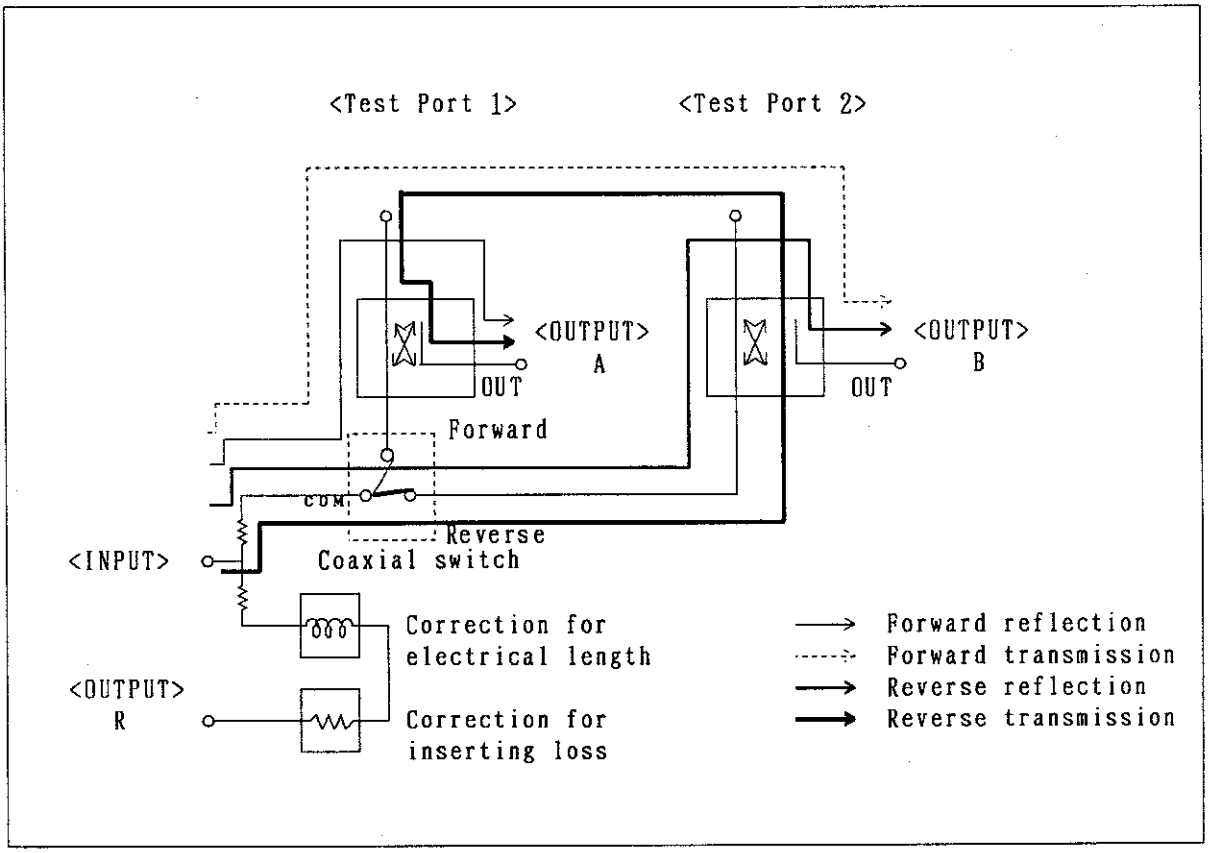


Figure 5 - 2 Description of Performances

6. PERFORMANCES

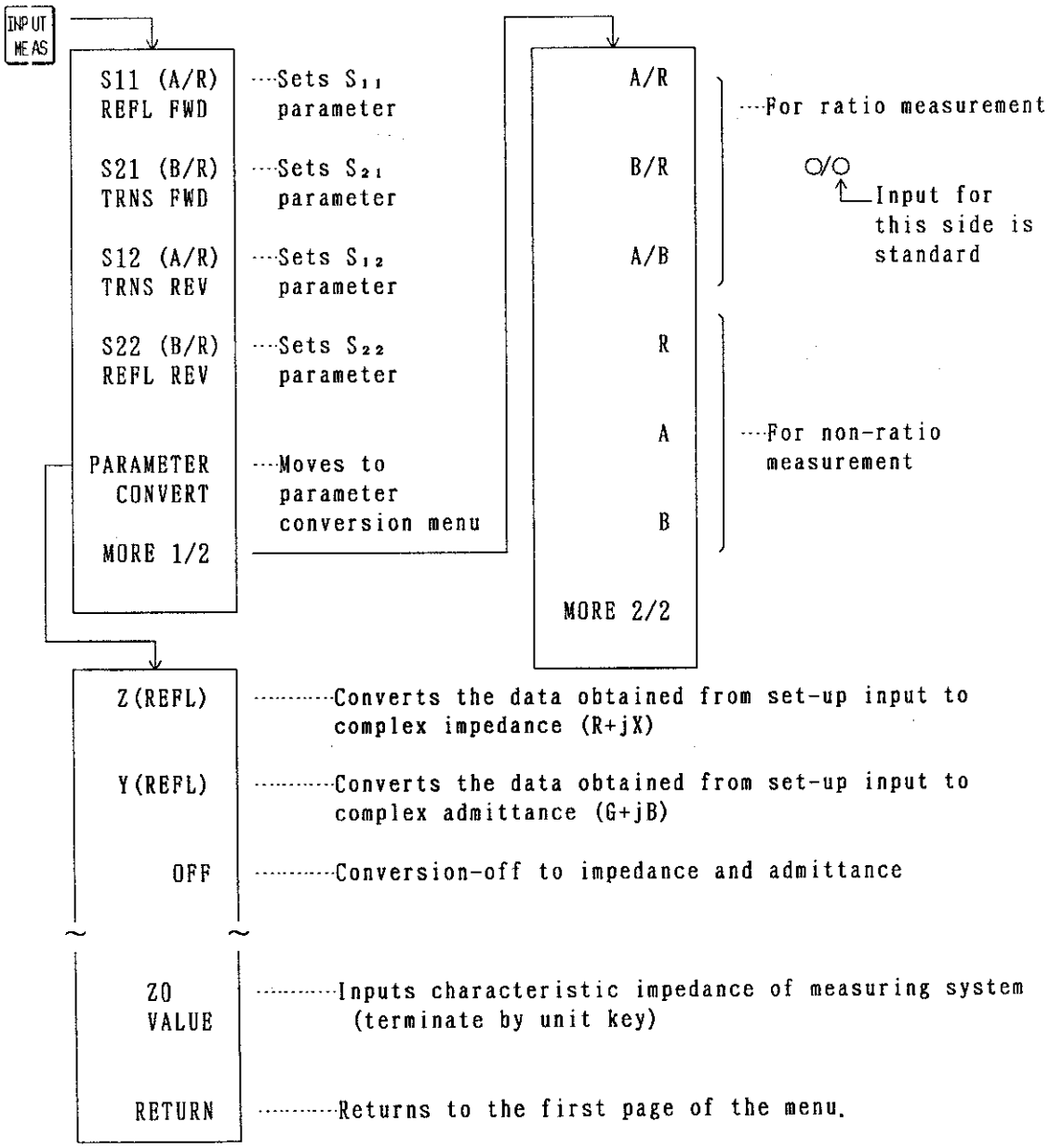
Frequency range	:	100kHz to 300MHz
Test port impedance	:	50Ω
Directionality	:	30dB
Frequency responce	:	Transmission (Amplitude/Phase); 1.5dBp-p/±15°
		Reflection (Amplitude/Phase); 2.0dBp-p/±15°
Effective source match	:	Test port 1, 2 ; 26dB
Test port isolation	:	100dB
Insertion loss	:	RF input→Test port 1, 2; 14dB (100kHz to 100MHz) 16dB (100MHz to 300MHz)
		RF input→Output port A, B, R; 20dB (100kHz to 100MHz) 22dB (100MHz to 300MHz)
		Damage level ; +27dB or ±30VDC (Port 1, 2)
Terminal	:	Input port, Output port A, B, R; 50Ω, BNC connector
		Test port 1, 2 ; 50Ω, N(f) type connector
		DC bias input ; Back side BNC connector
DC bias range	:	±30VDC, ±20mA
		Damage level 300mA
Programming	:	All performances can be controlled by R3751A or R4611. Then Remote controlling is common for GPIB interface of R3751 or R4611.
Power source	:	Supplied by R3751A or R4611
Weight	:	Less than 6kg
External dimensions	:	Approx. 424(W) x 87(H) x 500(D) mm

APPENDIX

A.1 Softkey Menu List

The following shows softkey menu construction (common) of R3751A and R4611 with S parameter test set.

(1) Softkey Menu of INPUT MEAS

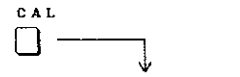


The cordinates for complex impedance and admittance will be executed by the following calculation:

$$Z(REFL) = \frac{1+\Gamma}{1-\Gamma} Z0 = R+jX \qquad Y(REFL) = \frac{1-\Gamma}{1+\Gamma} \times \frac{1}{Z0} = G+jB$$

On the basis of complex reflection coefficient Γ obtained from set-up input (A/R, B/R, A/B, R, A, B ...). So it will be necessary for input to set up the reflection coefficient measuring of DUT.

(2) Sofktey Menu of CAL



NORMALIZE	Excludes the frequency charateristic of measuring system.
1 PORT FULLCAL	Goes to 1 port calibration menu. This function calibrates the reflection measurement with the external bridge.
CORRECT ON/OFF	ON/OFF for NORMALIZE or calibration 1 port. But it is necessary to execute NORMALIZE or OPEN, SHORT, LOAD and DONE.
E.LENGTH ON/OFF	ON/OFF for correction of electrical length.
E.LENGTH VALUE	Electrical length is entered by data key. Electriacl length will be performed for the results of the set-up of INPUT MEAS and AVG.

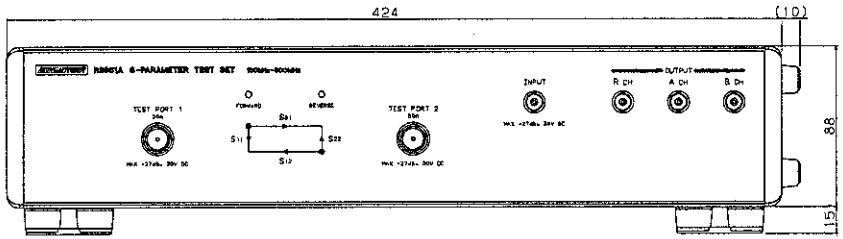
OPEN	After opening test port, press this softkey. The reflection characteristic at OPEN will be saved in the internal memory.
SHORT	After short-circuiting test port, press this softkey. The reflection characteristic at SHORT will be saved in the internal memory.
LOAD	After connecting the terminater having characteristic impedance to test port, press this softkey. The reflecton characteristic by LOAD will be saved in the internal memory.
CLEAR	Clears CAL.DATA.
DONE	The error will be calculated internally by each reflection characteristic obtained by OPEN, SHORT and LOAD, and then the system goes to CORRECT ON automatically.
RETURN	Returns to the first page of the menu.

LIST OF FIGURES

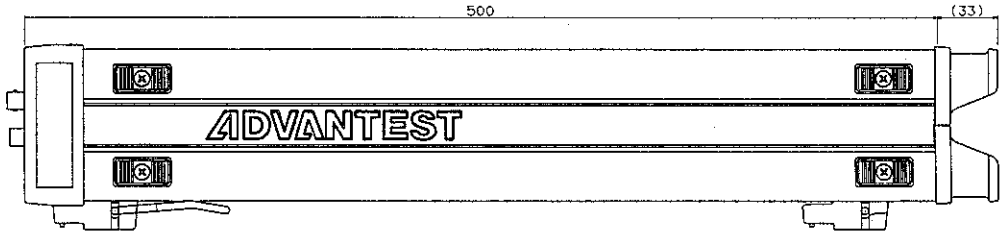
No.	Title	Page
2 - 1	Explanation of Front Panel	2 - 1
2 - 2	Explanation of Rear Panel	2 - 2
3 - 1	Front Side Connection	3 - 1
3 - 2	Rear Panel Connection	3 - 2
5 - 1	Block Diagram	5 - 1
5 - 2	Description of Performances	5 - 2

LIST OF TABLES

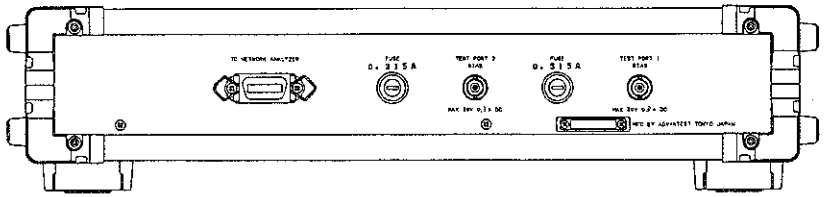
No.	Title	Page
1 - 1	Standared Attachments	1 - 2



FRONT VIEW



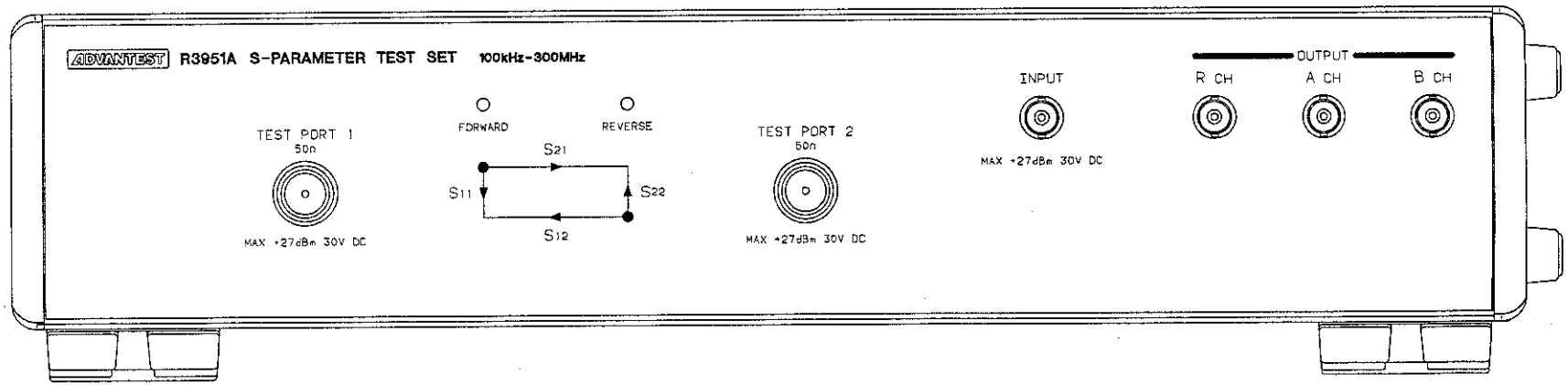
SIDE VIEW



REAR VIEW

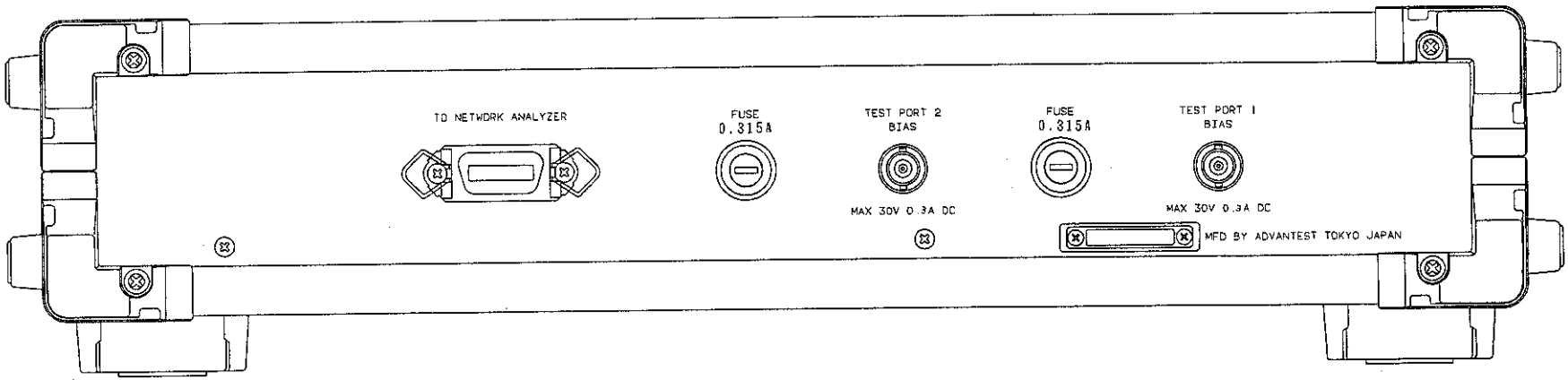
Unit: mm

R3951A
EXTERNAL VIEW



R3951A
FRONT VIEW

R3951AEXT2-809-A



R3951A

REAR VIEW

R3951AEXT3-910-B

IMPORTANT INFORMATION FOR ADVANTEST SOFTWARE

PLEASE READ CAREFULLY: This is an important notice for the software defined herein. Computer programs including any additions, modifications and updates thereof, operation manuals, and related materials provided by Advantest (hereafter referred to as "SOFTWARE"), included in or used with hardware produced by Advantest (hereafter referred to as "PRODUCTS").

SOFTWARE License

All rights in and to the SOFTWARE (including, but not limited to, copyright) shall be and remain vested in Advantest. Advantest hereby grants you a license to use the SOFTWARE only on or with Advantest PRODUCTS.

Restrictions

(1) You may not use the SOFTWARE for any purpose other than for the use of the PRODUCTS.
(2) You may not copy, modify, or change, all or any part of, the SOFTWARE without permission from Advantest.
(3) You may not reverse engineer, de-compile, or disassemble, all or any part of, the SOFTWARE.

Liability

Advantest shall have no liability (1) for any PRODUCT failures, which may arise out of any misuse (misuse is deemed to be use of the SOFTWARE for purposes other than it's intended use) of the SOFTWARE. (2) For any dispute between you and any third party for any reason whatsoever including, but not limited to, infringement of intellectual property rights.

LIMITED WARRANTY

1. Unless otherwise specifically agreed by Seller and Purchaser in writing, Advantest will warrant to the Purchaser that during the Warranty Period this Product (other than consumables included in the Product) will be free from defects in material and workmanship and shall conform to the specifications set forth in this Operation Manual.

2. The warranty period for the Product (the "Warranty Period") will be a period of one year commencing on the delivery date of the Product.

3. If the Product is found to be defective during the Warranty Period, Advantest will, at its option and in its sole and absolute discretion, either (a) repair the defective Product or part or component thereof or (b) replace the defective Product or part or component thereof, in either case at Advantest's sole cost and expense.

4. This limited warranty will not apply to defects or damage to the Product or any part or component thereof resulting from any of the following:

   (a) any modifications, maintenance or repairs other than modifications, maintenance or repairs (i) performed by Advantest or (ii) specifically recommended or authorized by Advantest and performed in accordance with Advantest 's instructions;

   (b) any improper or inadequate handling, carriage or storage of the Product by the Purchaser or any third party (other than Advantest or its agents);

   (c) use of the Product under operating conditions or environments different than those specified in the Operation Manual or recommended by Advantest, including, without limitation, (i) instances where the Product has been subjected to physical stress or electrical voltage exceeding the permissible range and (ii) instances where the corrosion of electrical circuits or other deterioration was accelerated by exposure to corrosive gases or dusty environments;

   (d) use of the Product in connection with software, interfaces, products or parts other than software, interfaces, products or parts supplied or recommended by Advantest;

   (e) incorporation in the Product of any parts or components (i) provided by Purchaser or (ii) provided by a third party at the request or direction of Purchaser or due to specifications or designs supplied by Purchaser (including, without limitation, any degradation in performance of such parts or components);

   (f) Advantest's incorporation or use of any specifications or designs supplied by Purchaser;

   (g) the occurrence of an event of force majeure, including, without limitation, fire, explosion, geological change, storm, flood, earthquake, tidal wave, lightning or act of war; or

   (h) any negligent act or omission of the Purchaser or any third party other than Advantest.

5. **EXCEPT TO THE EXTENT EXPRESSLY PROVIDED HEREIN, ADVANTEST HEREBY EXPRESSLY DISCLAIMS, AND THE PURCHASER HEREBY WAIVES, ALL WARRANTIES, WHETHER EXPRESS OR IMPLIED, STATUTORY OR OTHERWISE, INCLUDING, WITHOUT LIMITATION, (A) ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE AND (B) ANY WARRANTY OR REPRESENTATION AS TO THE VALIDITY, SCOPE, EFFECTIVENESS OR USEFULNESS OF ANY TECHNOLOGY OR ANY INVENTION.**

6. **THE REMEDY SET FORTH HEREIN SHALL BE THE SOLE AND EXCLUSIVE REMEDY OF THE PURCHASER FOR BREACH OF WARRANTY WITH RESPECT TO THE PRODUCT.**

7. **ADVANTEST WILL NOT HAVE ANY LIABILITY TO THE PURCHASER FOR ANY INDIRECT, INCIDENTAL, SPECIAL, CONSEQUENTIAL OR PUNITIVE DAMAGES, INCLUDING, WITHOUT LIMITATION, LOSS OF ANTICIPATED PROFITS OR REVENUES, IN ANY AND ALL CIRCUMSTANCES, EVEN IF ADVANTEST HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES AND WHETHER ARISING OUT OF BREACH OF CONTRACT, WARRANTY, TORT (INCLUDING, WITHOUT LIMITATION, NEGLIGENCE), STRICT LIABILITY, INDEMNITY, CONTRIBUTION OR OTHERWISE. TORT (INCLUDING, WITHOUT LIMITATION, NEGLIGENCE), STRICT LIABILITY, INDEMNITY, CONTRIBUTION OR OTHERWISE.**

8. **OTHER THAN THE REMEDY FOR THE BREACH OF WARRANTY SET FORTH HEREIN, ADVANTEST SHALL NOT BE LIABLE FOR, AND HEREBY DISCLAIMS TO THE FULLEST EXTENT PERMITTED BY LAW ANY LIABILITY FOR, DAMAGES FOR PRODUCT FAILURE OR DEFECT, WHETHER ARISING OUT OF BREACH OF CONTRACT, TORT (INCLUDING, WITHOUT LIMITATION, NEGLEGENCE), STRICT LIABILITY, INDEMNITY, CONTRIBUTION OR OTHERWISE.**

CUSTOMER SERVICE DESCRIPTION

In order to maintain safe and trouble-free operation of the Product and to prevent the incurrence of unnecessary costs and expenses, Advantest recommends a regular preventive maintenance program under its maintenance agreement.

Advantest's maintenance agreement provides the Purchaser on-site and off-site maintenance, parts, maintenance machinery, regular inspections, and telephone support and will last a maximum of ten years from the date the delivery of the Product. For specific details of the services provided under the maintenance agreement, please contact the nearest Advantest office listed at the end of this Operation Manual or Advantest 's sales representatives.

Some of the components and parts of this Product have a limited operating life (such as, electrical and mechanical parts, fan motors, unit power supply, etc.). Accordingly, these components and parts will have to be replaced on a periodic basis. If the operating life of a component or part has expired and such component or part has not been replaced, there is a possibility that the Product will not perform properly. Additionally, if the operating life of a component or part has expired and continued use of such component or part damages the Product, the Product may not be repairable. Please contact the nearest Advantest office listed at the end of this Operation Manual or Advantest's sales representatives to determine the operating life of a specific component or part, as the operating life may vary depending on various factors such as operating condition and usage environment.

SALES & SUPPORT OFFICES

Advantest Korea Co., Ltd.
22BF, Kyobo KangNam Tower,
1303-22, Seocho-Dong, Seocho-Ku, Seoul #137-070, Korea
Phone: +82-2-532-7071
Fax: +82-2-532-7132

Advantest (Suzhou) Co., Ltd.
Shanghai Branch Office:
Bldg. 6D, NO.1188 Gumei Road, Shanghai, China 201102 P.R.C.
Phone: +86-21-6485-2725
Fax: +86-21-6485-2726

Shanghai Branch Office:
406/F, Ying Building, Quantum Plaza, No. 23 Zhi Chun Road,
Hai Dian District, Beijing,
China 100083
Phone: +86-10-8235-3377
Fax: +86-10-8235-6717

Advantest (Singapore) Pte. Ltd.
438A Alexandra Road, #08-03/06
Alexandra Technopark Singapore 119967
Phone: +65-6274-3100
Fax: +65-6274-4055

Advantest America, Inc.
3201 Scott Boulevard, Suite, Santa Clara, CA 95054, U.S.A
Phone: +1-408-988-7700
Fax: +1-408-987-0691

ROHDE & SCHWARZ Europe GmbH
Mühldorfstraße 15 D-81671 München, Germany
(P.O.B. 80 14 60 D-81614 München, Germany)
Phone: +49-89-4129-13711
Fax: +49-89-4129-13723

ADVANTEST

http://www.advantest.co.jp

ADVANTEST CORPORATION
Shin-Marunouchi Center Building, 1-6-2 Marunouchi, Chiyoda-ku, Tokyo 100-0005, Japan
Phone: +81-3-3214-7500