Anritsu

APPLICATION NOTE

APS Switch Time Measurement

MP1570A

SONET/SDH/PDH/ATM Analyzer

MEASUREMENT SOLUTIONS

ANRITSU CORPORATION

Anritsu

Application Note

Ref # FM-D-AN-003

APS Switch Time Measurement

In the SONET/SDH transmission network, different protection architectures are used to prevent the transmission path downtime in the event of a fiber-cut or equipment failure. In both Linear and Ring network topologies, two types of switching structure are used such as: “1+1” structure & “1:n”.

1+1 Structure:
In this structure, the head-end signal is continuously bridged to working and protection equipment so that the same payloads are transmitted identically to the tail-end working and protection equipment. The receiving end decides which of the two is to be used. A system using the 1+1 structure operates, as default, in the uni-directional mode. In this mode, the switching is complete when a channel in the failed direction is switched to the protection line.

The 1+1 system also uses, as default, non-revertive switching. In the non-revertive switching, a switch to the protection line is maintained even after the working line has recovered from the failure that caused the switch, or the manual switch command is cleared.

1:n Structure:
In this structure, any of the n working channels can be bridged to a single protection line. In a 1:n system, all switching is revertive, and both uni-directional and bi-directional switching modes are provided. In the revertive switching, the traffic is switched back to the working line when the working line has recovered from the failure or the manual command is cleared.

With the “1+1” structure, switch-back to the current system may not be performed when recovering from a failure. With the “1:n” structure, switch-back to the current system is always performed. In either case, switching is performed using the K1 and K2 bytes, and according to the specified protocol which is known as APS (Automatic Protection Switching). This APS function is very important for backup at system failures and it must be tested during the construction of the SONET/SDH networks.

The APS switch time is the time from when the network element receives the alarm status signal for trigger switching (SF: Signal Fail, SD: Signal Degrade) to when it switches to the protection line. ITU-T G.783 & G.841 specifies that this protection switching time should be completed within 50ms of detection of an SF or SD condition that initiates a switch. Protection switching shall be completed within 50 milliseconds for manual commands (Forced Switch, Manual Switch, or LOCKOUT). This time shall be measured from the time the K1 byte request is issued from the originating network element.

The MP1570A can measure APS switching time per ITU-T Recommendations G.783 & G.841.

The switching time of lines is obtained by measuring the duration of the generated error or alarm set as trigger while switching from '*Working*' to '*Protection*' lines. A specific error or alarm is set by the user as the trigger to start the measurement of the switching time. A '*Threshold Time*' is also set by the user for the consideration of '*No Error or Alarm*' condition. The MP1570A considers the switching to be completed when there is '*No Error or Alarm*' detected in the duration of the specified '*Threshold Time*' that is set.

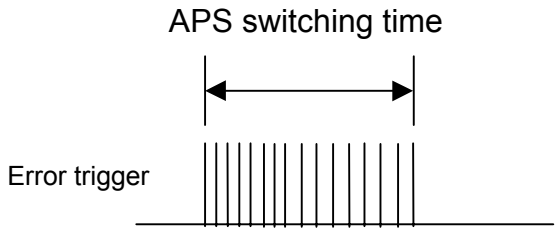


Figure 1.1 : *Error Trigger for APS Switching Time Measurement*

Measurement Method:

MP1570A measures APS switching time according to the following procedure:

(1) At first, a specific '*Error or Alarm*' is set (in the **Test Menu**: APS test) as the '*Trigger*' for the starting time of the "**Switching Time Measurement**". This trigger is set because when switching from the '*Working*' line to the '*Protection*' line, signal will be lost temporarily which will cause the generation of error/alarm and the switching time measurement will start.

(2) A '*Threshold Time*' (1ms, 10ms, or 100ms) is set (in the **Test Menu**: APS test) to identify '*No error or alarm*' condition for the parameter set as 'Trigger'. This threshold time is set so that if there is no error or alarm detected for the period specified, the switching time measurement will stop.

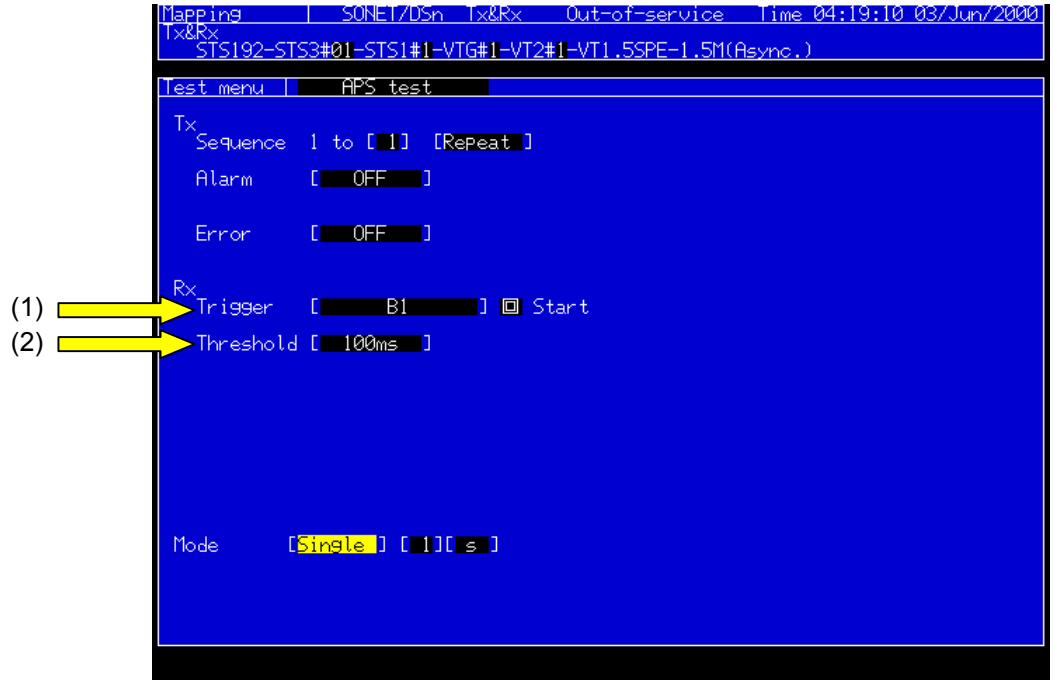
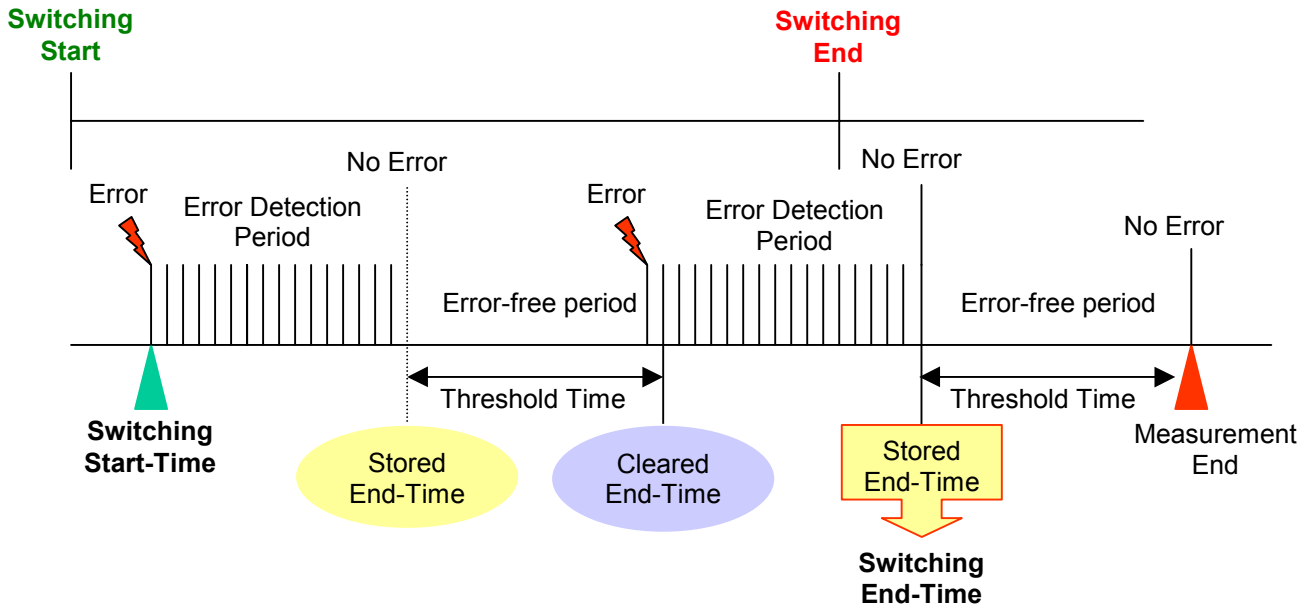


Figure 1.2 : *Error/Alarm Trigger and Threshold Time Setting*

(3) When the '*Error or Alarm*' is detected on the MP1570A after the switching of the lines, the MP1570A starts measuring the switching time. From the "**Switching Start-time**" to the time when the MP1570A receives '*No Error*', it stores this elapsed time in the memory. If there is no error detected within the specified '*Threshold Time*' since the start of the "*No Error*" condition, the measurement stops. Then the MP1570A declares the "Stored End-Time" as the "**Switching End-time**".

(4) If an error or alarm is detected within the specified '*Threshold Time*' since the start of the "*No Error/Alarm*" condition, then the memory of the "Stored End-Time" is cleared. Then the MP1570A waits for another "*No Error/Alarm*" condition for the specified '*Threshold Time*' and stores the new elapsed time in the memory again. The procedure from step (3) and (4) is repeated until "*No Error/Alarm*" condition exists for the specified '*Threshold Time*'.



An application example:

The below is an example of "**APS switch time measurement**" of an OC-192/STM-64 ring in the *out-of-service* mode. **Figure 2.1** shows the '*working line'* of a ring before the switching occurs. We will cause the switching of the line from '*Working*' to '*Protection*' by manually (externally by the user, not with the analyzer) breaking the connection between the **Node A** and **Node B** as in **Figure 2.2**. As soon as the connection is broken, the MP1570A will start receiving error/alarm which acts as the 'trigger' for the start of the switch time measurement.

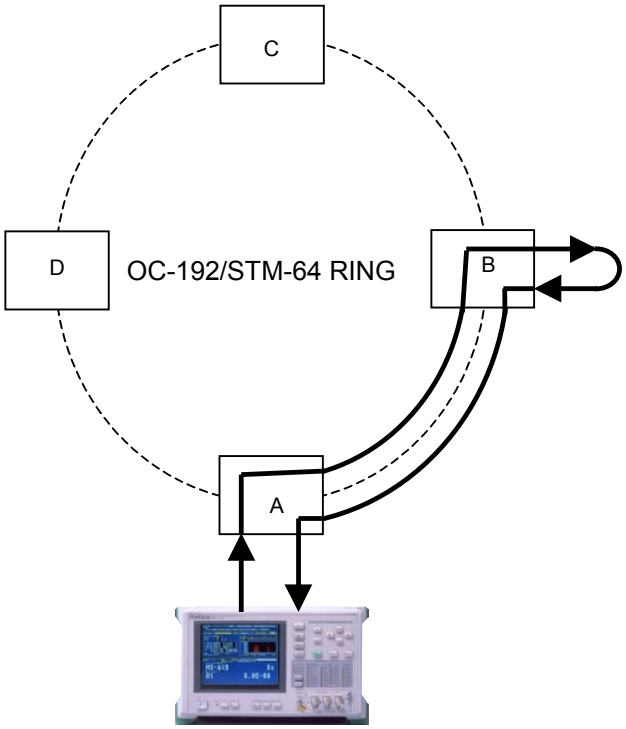


Figure 2.1: *Before Switching*

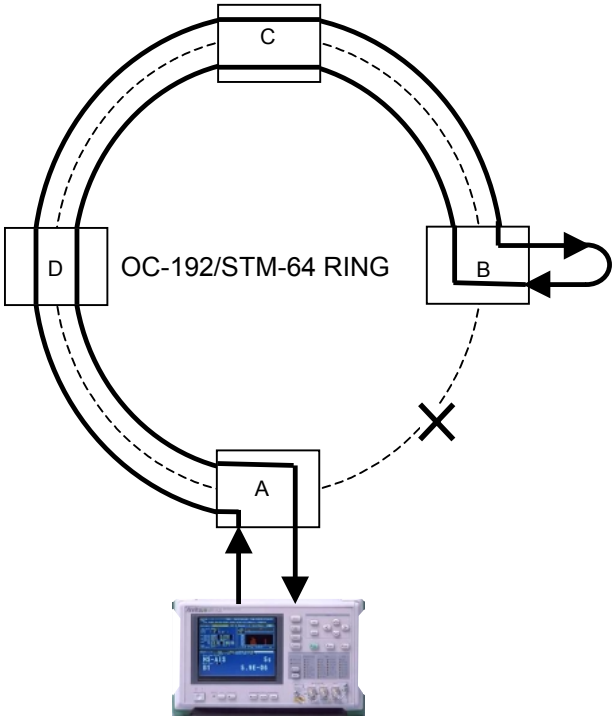


Figure 2.2: *After Switching*

To perform APS switching time measurement, only two screens are used on the MP1570A besides the **SETUP Main Menu** Screen. The "**Test Menu:** APS Test" screen is used to set up the test parameters for the RX only (*the TX section is not used*) and the "**Result Menu**" screen is used for the display of the APS switching time. However, the following preparation is required before starting the measurement.

(1) Cable Connection:

Connect the optical cables from/to the TX and RX of the MP1570A to/from the OC-192/STM-64 ring network to be tested as in the **Figure 2.1** above. Make sure there is no errors or alarms displayed on the MP1570A.

(2) SETUP Main Menu Screen:

- Open the “SETUP” Main Menu Screen
- Select → Mapping
- Setup the parameters as in **Figure 2.3** below of the example

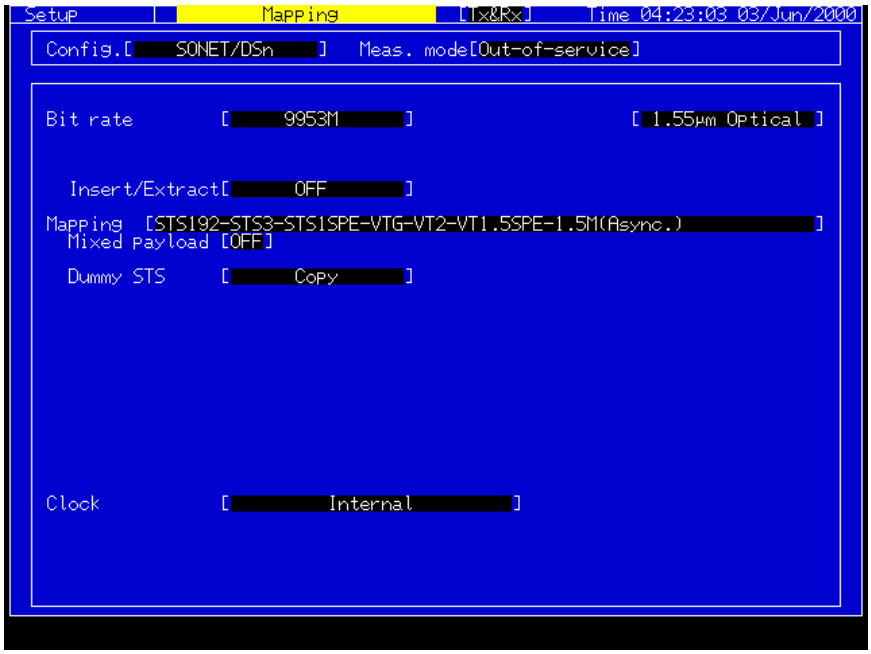


Figure 2.3: *SETUP Main Menu Screen parameter setting*

Details of parameter setting:

- **TX&RX**
  The analyzer will be coupled, i.e. the same parameters for both TX&RX
- **Meas. Mode:** Out-of-Service
  The analyzer will operate in the “Out-of-Service” mode
- **Bit Rate:** 9953M
  Select the desired bit rate of operation
- **Wavelength:** 1550nm
  Select the desired wavelength. Make sure the optical TX cable is also connected to the same wavelength that is selected on the MP1570A
- **Mapping:** STS192–STS1–STS1SPE-VTG-VT2-VT1.5SPE-1.5M (Async.)
  Select the desired Mapping
- **Dummy STS:** Copy
- **Frame:** OFF
- **Clock:** Internal
  The analyzer will supply the clock from its built-in clock source

(3) Test Menu Screen:

- Open the “TEST MENU” screen
- Select → “APS Test” from the ‘pull down menu’ of the “TEST Menu” screen
- Select the parameters as in **Figure 2.4** below of the example

Note: *The TX section of the “APS test” is not necessary for this application. The MP1570A will send/TX normal PRBS patterns to the network and will expect to receive the same pattern. We will not inject any error or alarm in this application. So, both error and alarm should be turned OFF in the TX section of the APS test.*

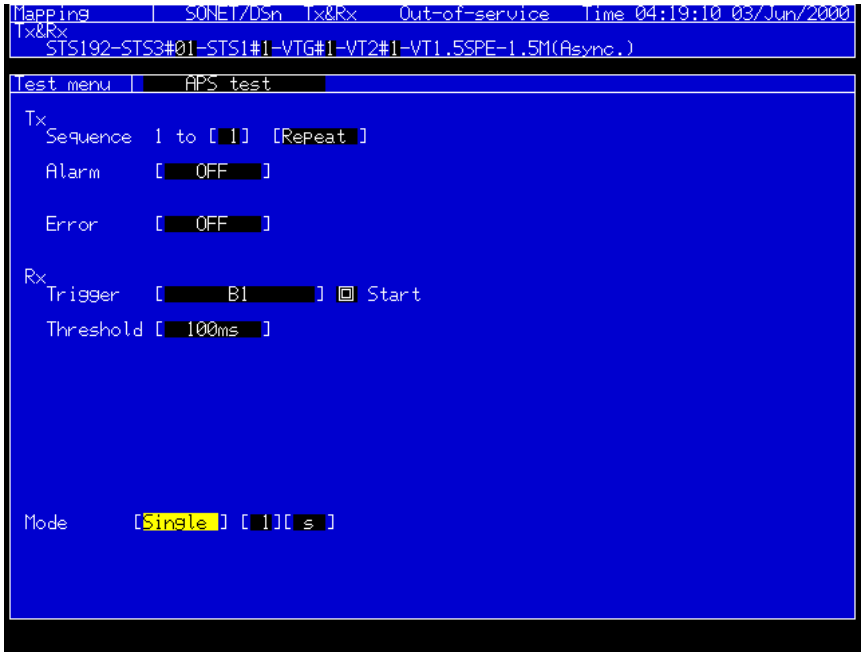


Figure 2.4: *TEST Menu Screen parameter setting*

Details of parameter setting:

- **TX Sequence:** 1 to [1][Repeat]
- **Alarm:** OFF
- **Error:** OFF
- **RX Trigger:** [B1]
- **Threshold:** [100ms]

Note: *In this application, the TX sequence is not used at all. So, the selection of “Repeat” in the TX Sequence doesn’t function although shows selected. Although, there is an option/parameter selection for “Mode”, this item is also not necessary for APS switch time measurement.*

However, the “Mode” is the setting condition and can be useful to see the “Error/Alarm” in the “RESULT” display screen.

(4) Result Menu Screen:

- Open the “RESULT Menu” Screen
- Select → APS Test as in **Figure 2.5** below of the example

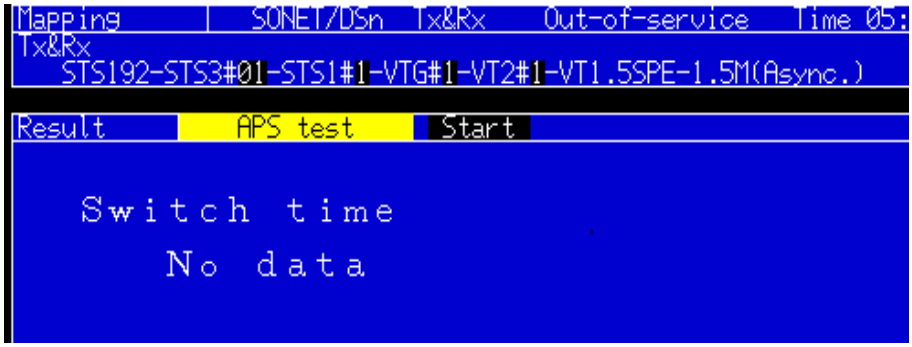


Figure 2.5 : *RESULT Menu Screen Display*

Note: *“**ANALYZE**” menu screen is not necessary to perform APS switch time measurement.*

(5) Measurement START:

Make sure both the “**Test Menu**” and “**Result**” screens are opened/displayed simultaneously. Also make sure that there is no “error or alarm” by checking the display of the “Error/Alarm” LED before the start of the measurement.

(1) Highlight the “**START**” cursor in the “**TEST**” menu screen and press “**Set**” key
The “**RESULT**” screen will display “**waiting for trigger**” as in **Figure 2.6** below. That means the MP1570A will start the switching time measurement as soon as “Error/Alarm” occurs that is set as “Trigger” earlier in the “**Test Menu**: APS test” screen.

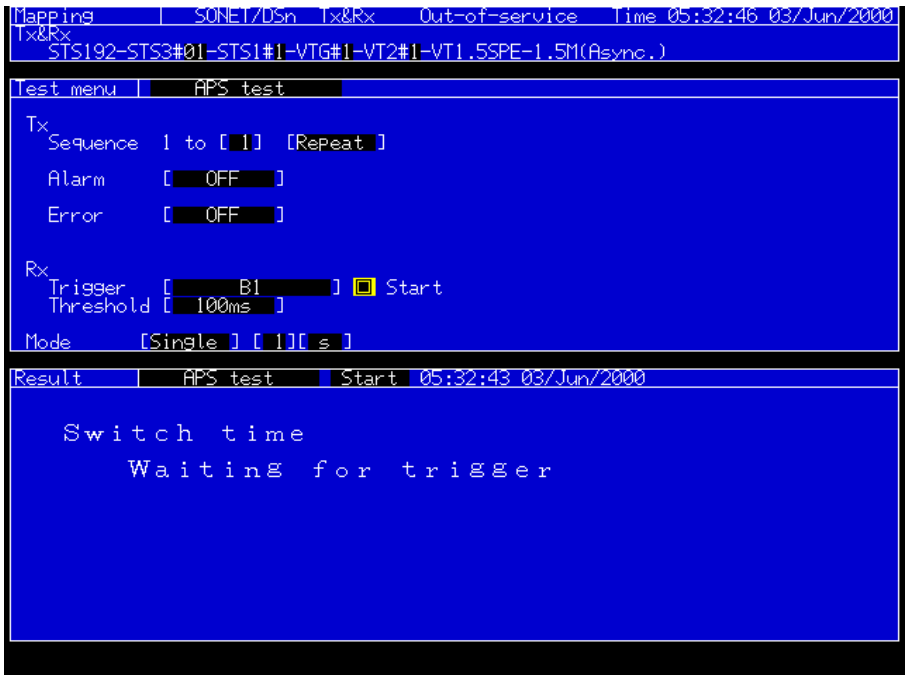


Figure 2.6: *RESULT Menu Screen Display after pressing “Set” key on the “Start” cursor*

(2) Break the connection manually between the **Node A** and **Node B**. The MP1570A will receive errors and accordingly the “Error” LED will be ON.

(3) Observe the APS Switch Time measurement result in the “**RESULT”** menu screen as in **Figure 2.7** below.

MEASUREMENT RESULT DISPLAY

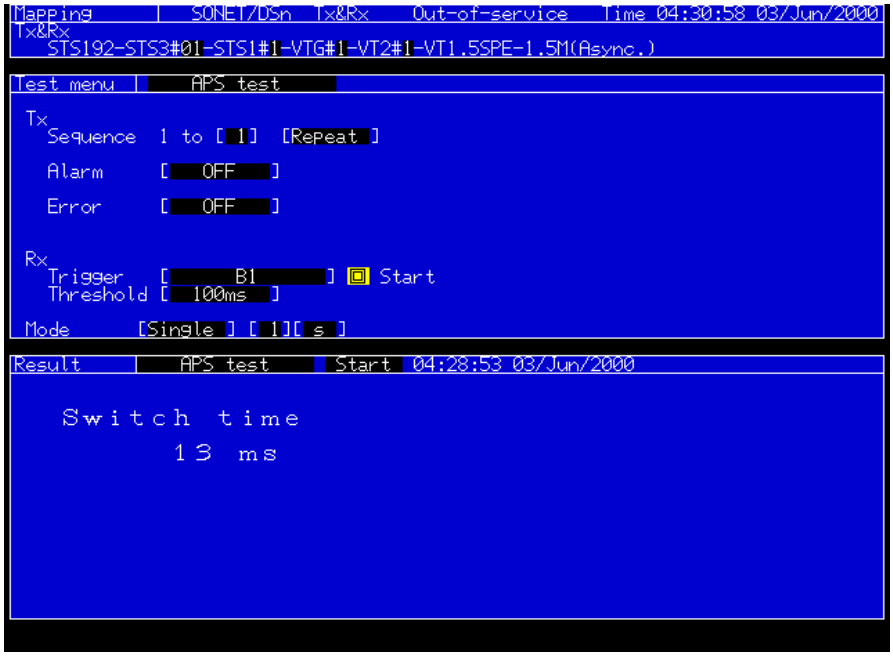


Figure 2.7: *APS Switch Time Measurement Result*

End of measurement

Version 1.0

Anritsu

Specifications are subject to change without notice.

ANRITSU CORPORATION
MEASUREMENT SOLUTIONS
5-10-27, Minamiazabu, Minato-ku, Tokyo 106-8570, Japan
Phone: +81-3-3446-1111
Telex: J34372
Fax: +81-3-3442-0235

Overseas Subsidiaries

● **U.S.A.**
ANRITSU COMPANY
North American Region Headquarters
1155 East Collins Blvd., Richardson, Tx 75081, U.S.A.
Toll Free: 1-800-ANRITSU (267-4878)
Phone: +1-972-644-1777
Fax: +1-972-671-1877

● **Canada**
ANRITSU ELECTRONICS LTD.
Unit 102, 215 Stafford Road West
Nepean, Ontario K2H 9C1, Canada
Phone: +1-613-828-4090
Fax: +1-613-828-5400

● **Brasil**
ANRITSU ELETRÔNICA LTDA.
Praia de Botafogo 440, Sala 2401 CEP 22250-040,
Rio de Janeiro, RJ, Brasil
Phone: +55-21-5276922
Fax: +55-21-537-1456

● **U.K.**
ANRITSU LTD.
200 Capability Green, Luton, Bedfordshire LU1 3LU, U.K.
Phone: +44-1582-433200
Fax: +44-1582-731303

● **Germany**
ANRITSU GmbH
Grafenberger Allee 54-56, 40237 Düsseldorf, Germany
Phone: +49-211-96855-0
Fax: +49-211-96855-55

● **France**
ANRITSU S.A.
9, Avenue du Québec Z.A. de Courtabœuf 91951 Les Ulis Cedex, France
Phone: +33-1-60-92-15-50
Fax: +33-1-64-46-10-65

● **Italy**
ANRITSU S.p.A.
Via Elio Vittorini, 129, 00144 Roma EUR, Italy
Phone: +39-06-509-9711
Fax: +39-06-502-24-25

● **Sweden**
ANRITSU AB
Botvid Center, Fittja Backe 1-3 145 84 Stockholm, Sweden
Phone: +46-853470700
Fax: +46-853470730

● **Singapore**
ANRITSU PTE LTD.
6, New Industrial Rd., #06-01/02, Hoe Huat Industrial Building, Singapore 536199
Phone: +65-282-2400
Fax: +65-282-2533

● **Hong Kong**
ANRITSU COMPANY LTD.
Suite 719, 7/F., Chinachem Golden Plaza, 77 Mody Road, Tsimshatsui East, Kowloon, Hong Kong, China
Phone: +852-2301-4980
Fax: +852-2301-3545

● **Korea**
ANRITSU CORPORATION
14F Hyun Juk Bldg. 832-41, Yeoksam-dong,
Kangnam-ku, Seoul, Korea
Phone: +82-2-553-6603
Fax: +82-2-553-6604~5

● **Australia**
ANRITSU PTY LTD.
Unit 3/170 Forster Road Mt. Waverley, Victoria, 3149, Australia
Phone: +61-3-9558-8177
Fax: +61-3-9558-8255

● **Taiwan**
ANRITSU COMPANY INC.
6F, 96, Sec. 3, Chien Kou North Rd. Taipei, Taiwan
Phone: +886-2-2515-6050
Fax: +886-2-2509-5519

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