



System 5000

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**35XA Fiberoptic Delay Spool  
Installation Manual  
Revision D**

## Disclaimer

**Every attempt has been made to make this material complete, accurate, and up-to-date. Users are cautioned, however, that Emcore, reserves the right to make changes without notice and shall not be responsible for any damages, including consequential, caused by reliance on the material presented, including, but not limited to, typographical, arithmetical, or listing errors.**

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## WARNINGS, CAUTIONS, AND GENERAL NOTES

### Safety Considerations

When installing or using this product, observe all safety precautions during handling and operation. Failure to comply with the following general safety precautions and with specific precautions described elsewhere in this manual violates the safety standards of the design, manufacture, and intended use of this product. Emcore assumes no liability for the customer's failure to comply with these precautions.



**Calls attention to a procedure or practice, which if ignored, may result in damage to the system or system component. Do not perform any procedure preceded by a CAUTION until described conditions are fully understood and met.**

### Electrostatic Sensitivity

#### **ESD = Electrostatic Sensitive Device**

**Observe electrostatic precautionary procedures.**

Semiconductor laser transmitters and receivers provide highly reliable performance when operated in conformity with their intended design. However, a semiconductor laser may be damaged by an electrostatic charge inadvertently imposed by careless handling.

### If You Need Help

If you need additional help in installing or using the system, need additional copies of this manual, or have questions about system options, please call Emcore's Sales Department.

### Service

**Do not attempt to modify or service any part of the system other than in accordance with procedures outlined in this Operator's Manual. If the system does not meet its warranted specifications, or if a problem is encountered that requires service, return the apparently faulty plug-in or assembly to Emcore for evaluation in accordance with Emcore's warranty policy.**

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**When returning a plug-in or assembly for service, include the following information: Owner, Model Number, Serial Number, Return Authorization Number (obtained in advance from Emcore's Customer Service Department), service required and/or a description of the problem encountered.**

Warranty and Repair Policy Warranty and Repair Policy Warranty and Repair Policy Warranty and Repair Policy Warranty and Repair Policy

**The Emcore Quality Plan includes product test and inspection operations to verify the quality and reliability of our products.**

**Emcore uses every reasonable precaution to ensure that every device meets published electrical, optical, and mechanical specifications prior to shipment. Customers are asked to advise their incoming inspection, assembly, and test personnel as to the precautions required in handling and testing ESD sensitive opto-electronic components.**

**These products are covered by the following warranties:**

**1. General Warranty**

**Emcore warrants to the original purchaser all standard products sold by Emcore to be free of defects in material and workmanship for one (1) year from date of shipment from Emcore. During the warranty period, Emcore's obligation, at our option, is limited to repair or replacement of any product that Emcore proves to be defective. This warranty does not apply to any product, which has been subject to alteration, abuse, improper installation or application, accident, electrical or environmental over-stress, negligence in use, storage, transportation or handling.**

**2. Specific Product Warranty Instructions**

All Emcore products are manufactured to high quality standards and are warranted against defects in workmanship, materials and construction, and to no further extent. Any claim for repair or replacement of a device found to be defective on incoming inspection by a customer must be made within 30 days of receipt of the shipment, or within 30 days of discovery of a defect within the warranty period.

**This warranty is the only warranty made by Emcore and is in lieu of all other warranties, expressed or implied, except as to title, and can be amended only by a written instrument signed by an officer of Emcore. Emcore sales agents or representatives are not authorized to make commitments on warranty returns.**

In the event that it is necessary to return any product against the above warranty, the following procedure shall be followed:

- a. Return authorization shall be received from the Emcore Sales Department prior to returning any device. Advise the Emcore Sales Department of the**

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model, serial number, and the discrepancy. The device shall then be forwarded to Emcore, transportation prepaid. Devices returned freight collect or without authorization may not be accepted.

- b. Prior to repair, Emcore Sales will advise the customer of Emcore test results and will advise the customer of any charges for repair (usually for customer caused problems or out-of-warranty conditions).

If returned devices meet full specifications and do not require repair, or if non-warranty repairs are not authorized by the customer, the device may be subject to a standard evaluation charge. Customer approval for the repair and any associated costs will be the authority to begin the repair at Emcore. Customer approval is also necessary for any removal of certain parts, such as connectors, which may be necessary for Emcore testing or repair.

- c. Repaired products are warranted for the balance of the original warranty period, or at least 90 days from date of shipment.

### 3. Limitations of Liabilities

**Emcore's liability on any claim of any kind, including negligence, for any loss or damage arising from, connected with, or resulting from the purchase order, contract, or quotation, or from the performance or breach thereof, or from the design, manufacture, sale, delivery, installation, inspection, operation or use of any equipment covered by or furnished under this contract, shall in no case exceed the purchase price of the device which gives rise to the claim.**

EXCEPT AS EXPRESSLY PROVIDED HEREIN, EMCORE MAKES NO WARRANTY OF ANY KIND, EXPRESSED OR IMPLIED, WITH RESPECT TO ANY GOODS, PARTS AND SERVICES PROVIDED IN CONNECTION WITH THIS AGREEMENT INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. EMCORE SHALL NOT BE LIABLE FOR ANY OTHER DAMAGE INCLUDING, BUT NOT LIMITED TO, INDIRECT, SPECIAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF OR IN CONNECTION WITH FURNISHING OF GOODS, PARTS AND SERVICE HEREUNDER, OR THE PERFORMANCE, USE OF, OR INABILITY TO USE THE GOODS, PARTS AND SERVICE.

**Emcore test reports or data indicating mean-time-to-failure, mean-time-between-failure, or other reliability data are design guides and are not intended to imply that individual products or samples of products will achieve the same results. These numbers are to be used as management and engineering tools, and are not necessarily indicative of expected field operation. These numbers assume a mature design, good parts, and no degradation of reliability due to manufacturing procedures and processes.**

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## Chapter 1                      General Information

### 1.1      DESCRIPTION

This manual describes the following fiberoptic delay lines, model numbers:

355A, 356A/B and 357A/B/C/D Fiber Delay Unit

These fiberoptic products are designed to delay RF and microwave signals using coils of singlemode optical fiber operating at a nominal wavelength of 1310 nm laser.

The delay line contains a precisely measured length of fiber based upon the fact that 1 kilometer of fiber has 4.89  $\mu$ -Seconds of delay.

The 35XA Fiber Delay product families are available in delays from <0.1  $\mu$ sec to 200  $\mu$ sec.

### 1.2      SPECIFICATIONS

For detailed specifications of an individual product described in this manual, consult the Product Specification Table (PST) included with your manual. If the PST is missing, contact the Emcore Sales Department at (626) 293-3400 for a duplicate copy.

Specifications apply over the entire specified operating range of the product and are guaranteed for 1 year after the date of purchase.

**PRODUCT SPECIFICATION TABLE**

**Optical Delay Parameters**

Frequency Range	
355A	1 n-Sec to 110 μ-Sec
356A	1 n-Sec to 16 μ-Sec
356B	Dual 1n-sec to 8μ-Sec
357A	20 μ-Sec to 280 μ-Sec
357B	Total delay of both spools 240 μ-Sec max
357C	Total delay of all three spools 240 μ-Sec max
357D	Total delay of all four spools 240 μ-Sec max
357E	Total delay of all five spools 240 μ-Sec max

Insertion Loss (T = delay time, in μsec)

1 n-Sec to 280 μ-Sec	$0.4*(T/4.89)$
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Time Delay

.001 to 280 μsec

Denoted by a four digit dash number ( - XXXX) equal to the delay time in μ-sec x 10.

Delay Accuracy

±1%

**Optical Parameters**

Fiber	singlemode (9/125)
Connectors	FC/APC Bulkhead FC/APC Pigtail

**Mechanical Dimensions**

**355A**

Height	0.05 - 35 μ-Sec	6 x 6 x 2.37 inches
	35 - 55 μ-Sec	6 x 6 x 3.5 inches
	55 - 75 μ-Sec	6 x 6 x 4.6 inches
	75 - 100 μ-Sec	6 x 6 x 6.4 inches
Width		6.0 in
Depth		6.0 in

**356A/B**

Height	2.37 in
Width	6.0 in
Depth	6.0 in

**357A/B/C/D/E**

Height	5.25 in
Width	19.0 in
Depth	12.0 in

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The 35XA-XXXX Fiber Delay Unit which contains a fiber spool which has either and two FC/APC Bulkhead connectors or two 3mm jacketed singlemode fiber pigtails approximately 1 m in length, each terminated with an FC/APC optical connector.

## NUMBERS

Each Emcore product is assigned a unique model number and serial number, which appears on the label of the transmitter. Model numbers for this series have the form

35XY-nnnn

here, X is a letter designation specifying the model (5, 6 or 7), Y designates either A or B (the B only applies to the 356 family) and nnnn is a four digit numeric designation equal to the delay time in  $\mu\text{sec} \times 10$ . The exact delay time must be specified separately to  $\pm 1\%$  accuracy.

Fiber Delay Units have model numbers where nnnn is a four digit numeric designation equal to the delay time in  $\mu\text{sec} \times 10$ .

### 1.3.1 OPTIONS

Changes to the PST can be accommodated by requesting a non-standard option to meet specific performance requirements. Such options are designated by an alpha-numeric suffix,

-XNN

where X is alpha, and NN is numeric. Such custom options must be agreed upon in advance with the Emcore Sales Department.

## Chapter 2 - Operation

### 2.0 THEORY OF OPERATION

The Model 35XA series fiberoptic delay line uses an Emcore high speed laser module to generate an intensity modulated optical signal at 1300 nm wavelength. The 5015 A/B/C uses a high performance distributed feedback (DFB) laser with a built-in optical isolator. This signal is sent through a length of singlemode optical fiber and received by a high speed photodiode which outputs the RF signal. Delays under 35  $\mu\text{sec}$  include an additional 4 dB of optical attenuation to prevent the photodiode from being overdriven. The fiber provides the delay time of approximately 5 nsec/meter. For more complete information on the operating principles of analog fiberoptic links, consult Emcore's RF/Microwave Fiberoptic Link Design Guide.

## Chapter 3 Installation and Setup Procedures

### 3.1 UNPACKING AND VISUAL INSPECTION

The product described herein was inspected before shipment and found to be free of mechanical and electrical defects. Observe ESD precautions while handling the delay line. Unpack and examine the product for any damage due to shipping. Keep all packing materials until you are satisfied that the product works according to specifications. Verify that the pins and connectors are free from obvious shipping or handling damage. If damage is discovered, file a claim with the carrier immediately. Notify the Emcore Sales Department as soon as possible.

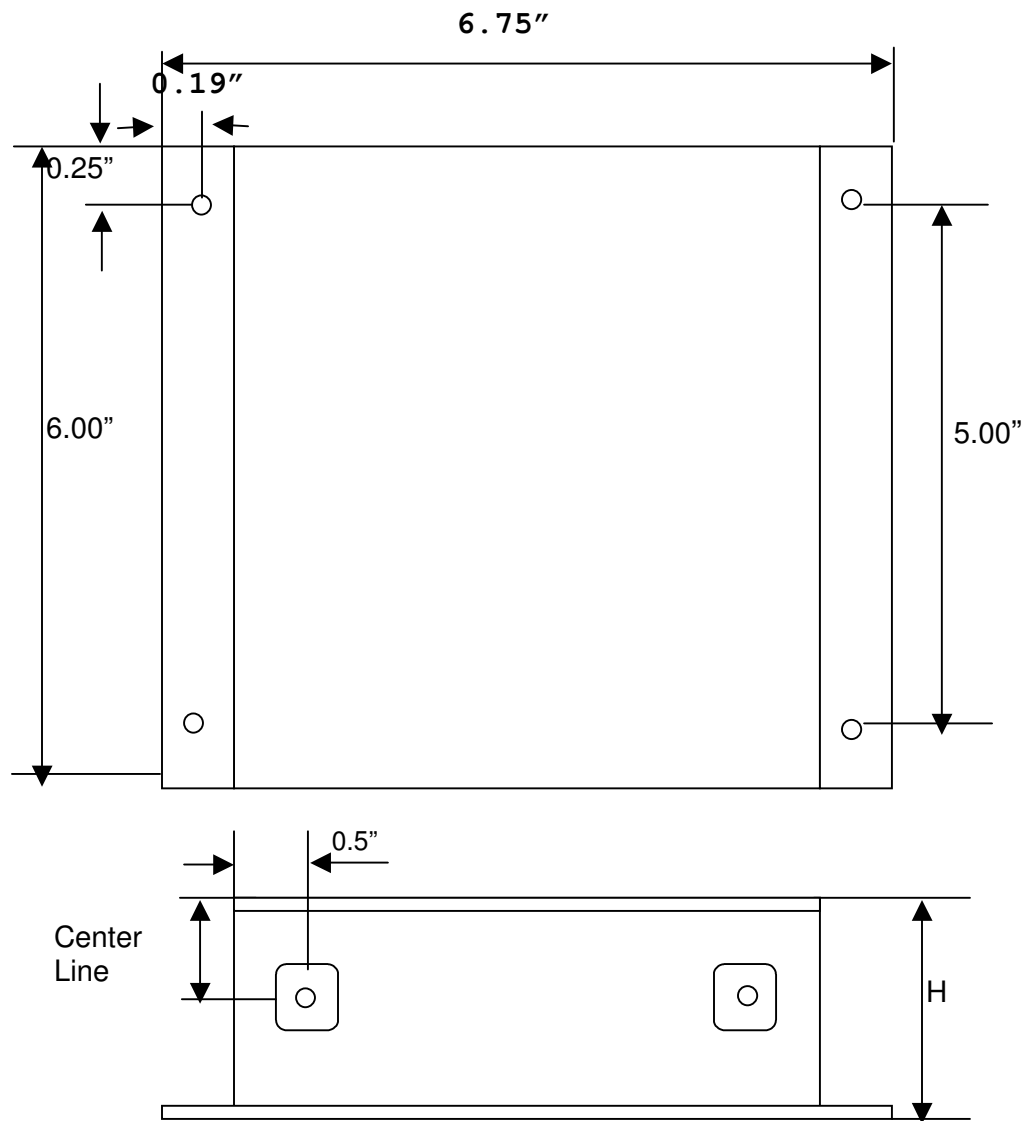
### 3.2 CONNECTION INSTRUCTIONS

To operate the delay line at room temperature in a laboratory setting, it can be placed on a convenient flat surface without any particular concern for a good heat sink. In a field operating environment, to obtain reliable operation over the full temperature range, fasten the delay line to a solid metallic surface with a good heat sink using screws through the mounting holes provided. Make the fiberoptic connections before applying power to the delay line. Observe I/O labels on delay spools (355A-XXXX).

**Outline Diagram**

Dimensions are in inches.

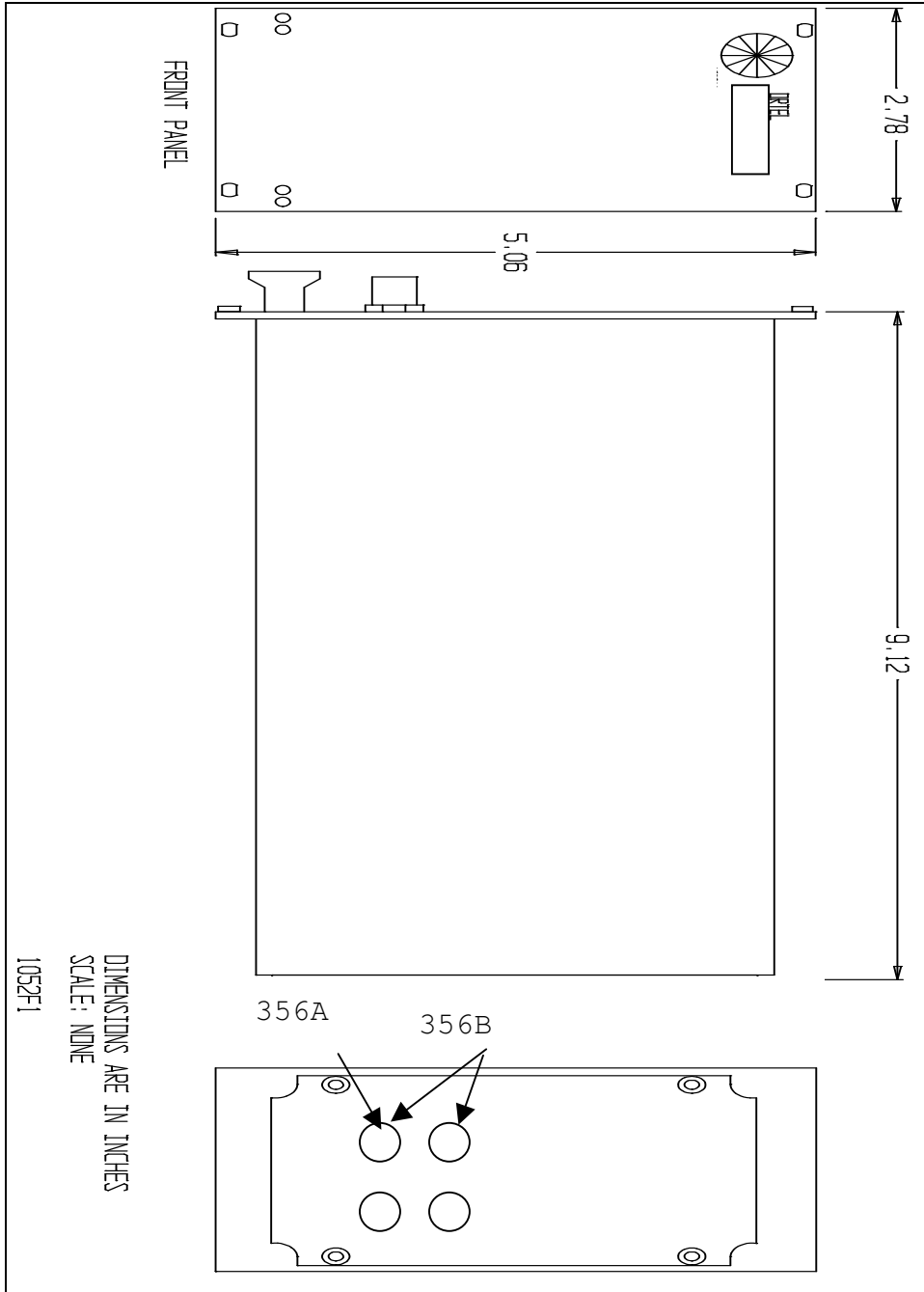
**355A**



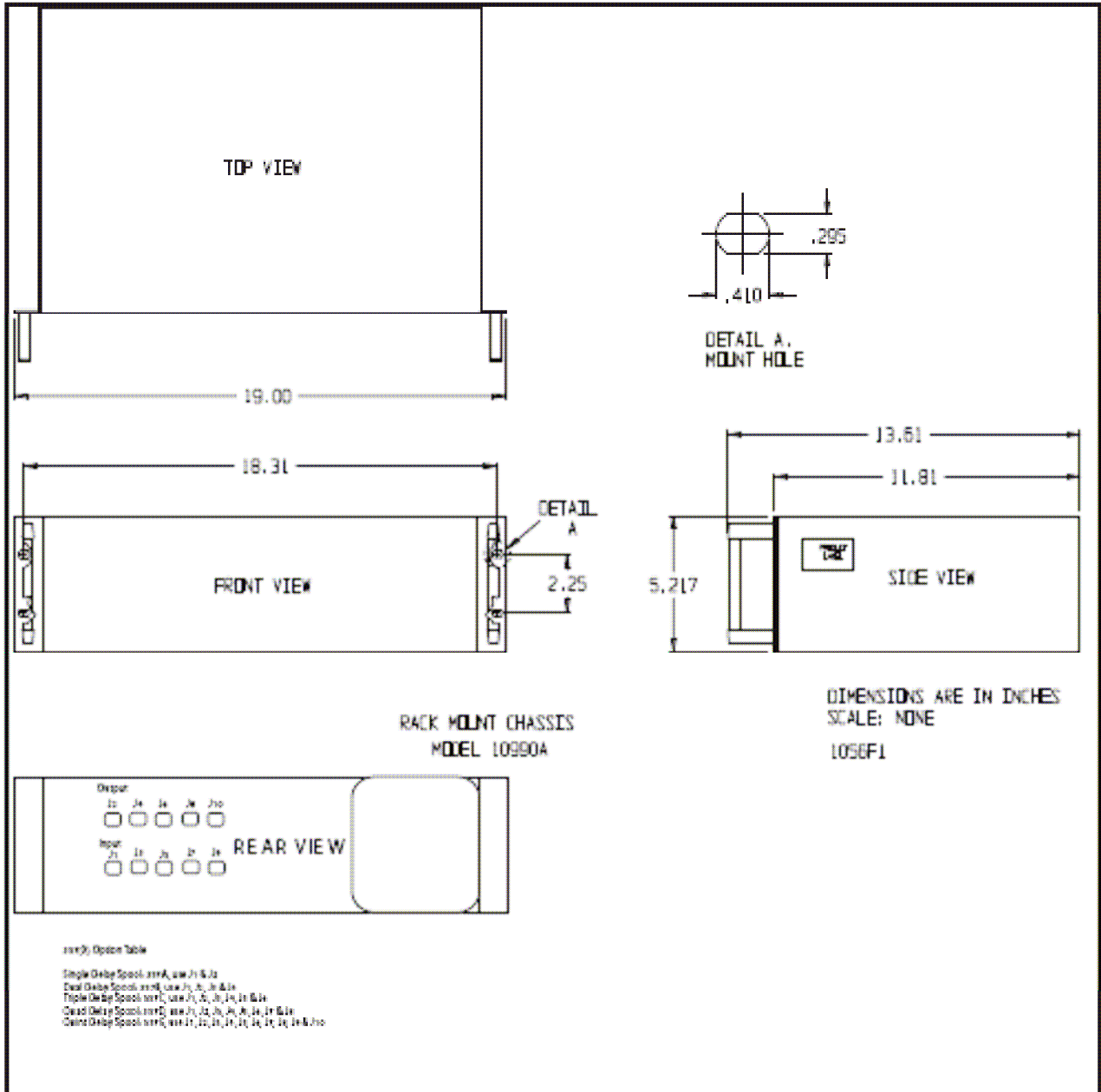
Delay ( $\mu$ -sec)  
0.5 – 35  
35 – 60  
55 – 80  
75 – 110

Dimension "H"  
2.38"  
3.90  
4.80"  
6.40"

356A/B Outline Drawing

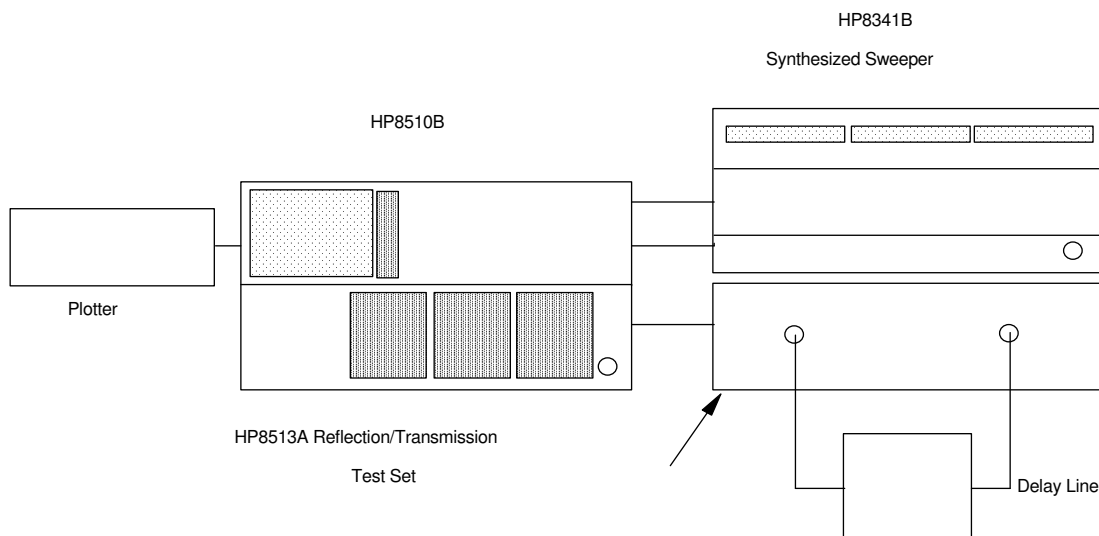


357A Outline Drawing



## Chapter 4 PERFORMANCE VERIFICATION PROCEDURES

### 4.1 Time Domain Impulse Response



**Figure 1.** Test Set-up: Time Domain Impulse Response

*General Note:* The synthesized sweeper must be used for any meaningful phase measurement when the device has any appreciable delay. Any instability, nonlinearity or non-repeatability in the source gets magnified by the delay time resulting in a phase measurement error given by:

$$\text{Phase error} = T \times \text{frequency error (Hz)}$$

Where T = delay time (sec)

1. Set up the HP8510B network analyzer in the frequency domain with the following parameters;

Source Power        +10 dBm  
Step Sweep  
Number of points    801  
Frequency            1 GHz  
Span (MHz)         800/3.5 T  
where T = the delay time in microseconds

Calibrating over this span will allow any triple transit signal to be viewed within the display in the time domain mode without aliasing.

2. Perform a response calibration ( you only need a "THRU" connection for this).
3. Connect the delay line- port 1 of the test set to the device input and port 2 to the output.
4. Make sure that  $S_{21}$  is the parameter being measured. Go to the time domain band pass measurement mode. Press Restart Measurement.
5. When the measurement is done the HP8510B will display the time domain response. Set the display parameters as follows;

Start    0 microseconds  
Stop    3.5 T (T=delay in microseconds)  
Scale   10 dB/div

The impulse response of the device should be displayed as a narrow peak within +/-1% of the specified delay time T in microseconds. Adjust the reference level and position if necessary to bring the peak and the noise into view.

6. Activate marker 1 and set it at the peak of the response. This will display the exact delay time and the insertion loss. Multiply the delay time by three and set marker 2 at this time. This would be the location of the triple transit signal. Verify that this signal is at least 75 dB below the main pulse (it should be below the noise). Press the marker 1 soft key so that the device delay and insertion loss is displayed.
7. Go to the System menu and press the "Title" soft key. Enter the part number, serial number and test date for the device. Go to the Copy menu and copy all on the plotter.