Instructions

Tektronix

AFTDS
Differential Signal Adapter

070-9483-00

CE

Printed in the U.S.A.

Tektronix, Inc., P.O. Box 1000, Wilsonville, OR 97070–1000

WARRANTY

Tektronix warrants that the products that it manufactures and sells will be free from defects in materials and workmanship for a period of one (1) year from the date of shipment. If a product proves defective during this warranty period, Tektronix, at its option, either will repair the defective product without charge for parts and labor, or will provide a replacement in exchange for the defective product.

In order to obtain service under this warranty, Customer must notify Tektronix of the defect before the expiration of the warranty period and make suitable arrangements for the performance of service. Customer shall be responsible for packaging and shipping the defective product to the service center designated by Tektronix, with shipping charges prepaid. Tektronix shall pay for the return of the product to Customer if the shipment is to a location within the country in which the Tektronix service center is located. Customer shall be responsible for paying all shipping charges, duties, taxes, and any other charges for products returned to any other locations.

This warranty shall not apply to any defect, failure or damage caused by improper use or improper or inadequate maintenance and care. Tektronix shall not be obligated to furnish service under this warranty a) to repair damage resulting from attempts by personnel other than Tektronix representatives to install, repair or service the product; b) to repair damage resulting from improper use or connection to incompatible equipment; c) to repair any damage or malfunction caused by the use of non-Tektronix supplies; or d) to service a product that has been modified or integrated with other products when the effect of such modification or integration increases the time or difficulty of servicing the product.

THIS WARRANTY IS GIVEN BY TEKTRONIX IN LIEU OF ANY OTHER WARRANTIES, EXPRESS OR IMPLIED. TEKTRONIX AND ITS VENDORS DISCLAIM ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. TEKTRONIX' RESPONSIBILITY TO REPAIR OR REPLACE DEFECTIVE PRODUCTS IS THE SOLE AND EXCLUSIVE REMEDY PROVIDED TO THE CUSTOMER FOR BREACH OF THIS WARRANTY. TEKTRONIX AND ITS VENDORS WILL NOT BE LIABLE FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES IRRESPECTIVE OF WHETHER TEKTRONIX OR THE VENDOR HAS ADVANCE NOTICE OF THE POSSIBILITY OF SUCH DAMAGES.

Service Assurance

If you have not already purchased Service Assurance for this product, you may do so at any time during the product's warranty period. Service Assurance provides Repair Protection and Calibration Services to meet your needs.

Repair Protection extends priority repair services beyond the product's warranty period; you may purchase up to three years of Repair Protection.

Calibration Services provide annual calibration of your product, standards compliance and required audit documentation, recall assurance, and reminder notification of scheduled calibration. Coverage begins upon registration; you may purchase up to five years of Calibration Services.

Service Assurance Advantages

- Priced well below the cost of a single repair or calibration
- Avoid delays for service by eliminating the need for separate purchase authorizations from your company
- Eliminates unexpected service expenses

For Information and Ordering

For more information or to order Service Assurance, contact your Tektronix representative and provide the information below. Service Assurance may not be available in locations outside the United States of America.

Name	VISA or Master Card number and expiration
Company	date or purchase order number
Address	Repair Protection (1,2, or 3 years)
City, State, Postal code	Calibration Services (1,2,3,4, or 5 years)
Country	Instrument model and serial number
Phone	Instrument purchase date

General Safety Summary

Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it. To avoid potential hazards, use this product only as specified.

To Avoid Fire or Personal Injury

Connect and Disconnect Properly. Do not connect or disconnect probes or test leads while they are connected to a voltage source.

Ground the Product. This product is indirectly grounded through the grounding conductor of the mainframe power cord. To avoid electric shock, the grounding conductor must be connected to earth ground. Before making connections to the input or output terminals of the product, ensure that the product is properly grounded.

Observe All Terminal Ratings. To avoid fire or shock hazard, observe all ratings and markings on the product. Consult the product manual for further ratings information before making connections to the product.

The common terminal is at ground potential. Do not connect the common terminal to elevated voltages.

Do Not Operate Without Covers. Do not operate this product with covers or panels removed.

Do Not Operate With Suspected Failures. If you suspect there is damage to this product, have it inspected by qualified service personnel.

Do Not Operate in Wet/Damp Conditions.

Do Not Operate in an Explosive Atmosphere.

Keep Product Surfaces Clean and Dry.

Symbols and Terms

Terms in this Manual. These terms may appear in this manual:

WARNING. *Warning statements identify conditions or practices that could result in injury or loss of life.*

CAUTION. *Caution statements identify conditions or practices that could result in damage to this product or other property.*

Symbols on the Product. The following symbols may appear on the product:

NOT TERMINAL EQUIPMENT
This unit is not for connection to the Public Telecommunications Network

CAUTION
Refer to Manual

Contacting Tektronix

Product Support	For application-oriented questions about a Tektronix measurement product, call toll free in North America: 1-800-TEK-WIDE (1-800-835-9433 ext. 2400) 6:00 a.m. – 5:00 p.m. Pacific time Or contact us by e-mail: tm_app_supp@tek.com For product support outside of North America, contact your local Tektronix distributor or sales office.
Service Support	Contact your local Tektronix distributor or sales office. Or visit our web site for a listing of worldwide service locations. http://www.tek.com
For other information	In North America: 1-800-TEK-WIDE (1-800-835-9433) An operator will direct your call.
To write us	Tektronix, Inc. P.O. Box 1000 Wilsonville, OR 97070-1000

AFTDS Differential Signal Adapter

The AFTDS Differential Signal Adapter allows you to connect a 50 Ω terminated oscilloscope or other measurement instrument to differential telecommunication signals that require 100 Ω, 110 Ω, or 120 Ω termination impedance. The AFTDS adapter complies with ANSI T1.102 and ITU-T G.703 recommendations and minimizes measurement errors due to aberrations and reflections.

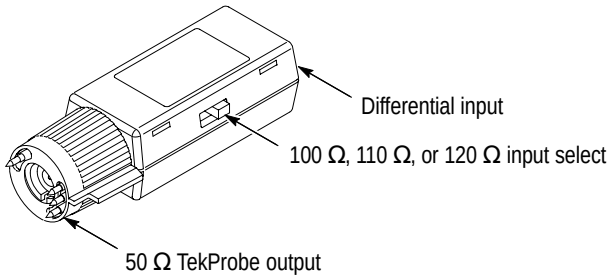

Figure 1: AFTDS Differential Signal Adapter

Oscilloscope Connections

As shown in Figure 2a, the output of the AFTDS adapter connects directly to the TekProbe II interface on Tektronix TDS Series oscilloscopes. With the addition of optional accessories, the AFTDS adapter connects to any instrument with a 50 Ω BNC or 50 Ω SMA input. The shell of the input on all oscilloscopes must connect to earth ground.

Instruments with TekProbe II

When you connect the adapter to instruments with the TekProbe II interface, the instrument automatically adjusts the scale factor and sets the oscilloscope input impedance to 50 Ω.

NOTE. *TDS 400 and TDS 400A series oscilloscopes always interpret the attenuation of the AFTDS adapter as ÷ 10. The attenuation of the adapter is actually ÷ 5. When you use this adapter on these oscilloscopes, divide the measurement (or scale factor) by 2 to obtain the correct value.*

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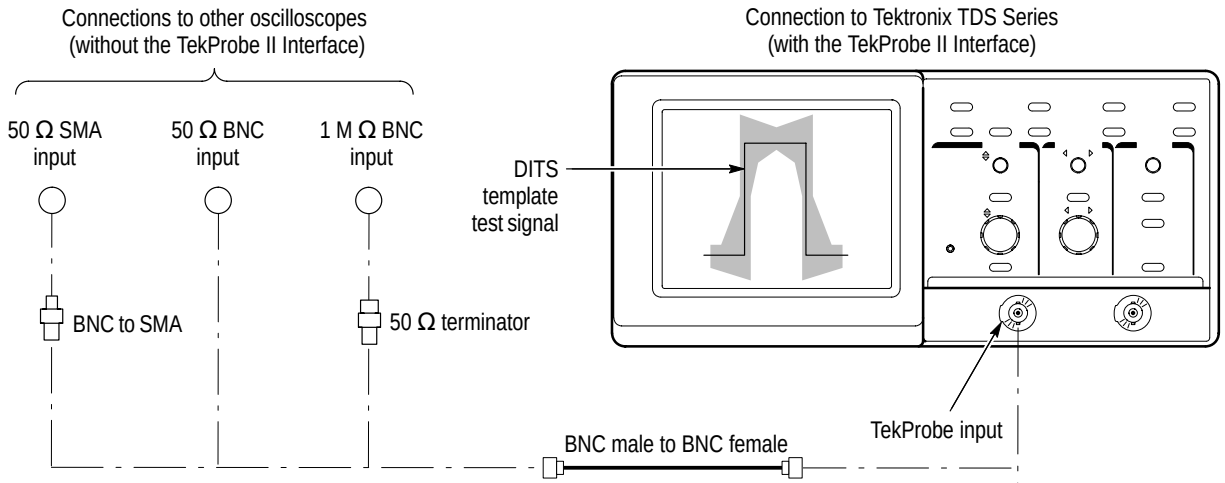
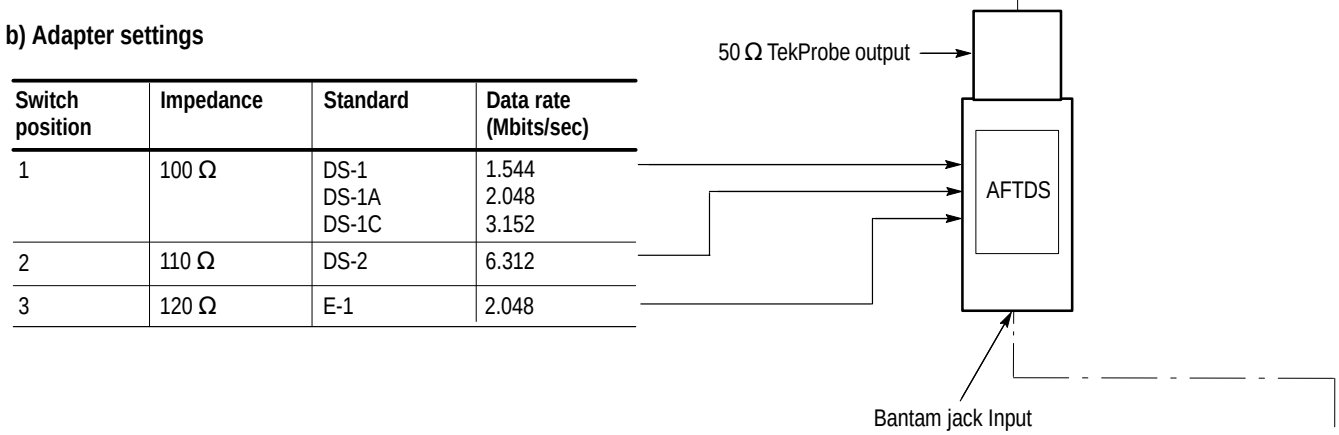
a) Oscilloscope connections



b) Adapter settings

Switch position	Impedance	Standard	Data rate (Mbits/sec)
1	100 Ω	DS-1 DS-1A DS-1C	1.544 2.048 3.152
2	110 Ω	DS-2	6.312
3	120 Ω	E-1	2.048



c) Telecommunication connections

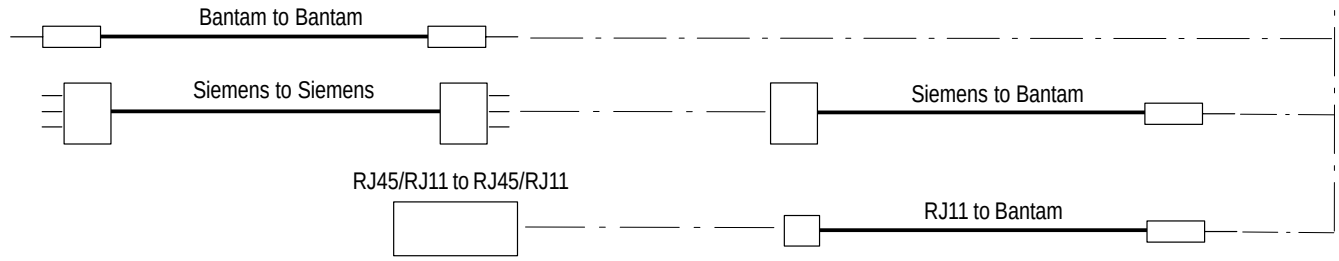


Figure 2: Connecting the AFTDS Differential Signal Adapter

Instruments without TekProbe II

When you connect the adapter to instruments that *do not* have the TekProbe II interface, make the settings and calculate the amplitude as follows:

- Set the oscilloscope input impedance to 50 Ω or use an external 50 Ω termination.
- Correct your measurements for the 5X attenuation factor of the AFTDS adapter:

  Displayed Amplitude × 5 = Actual Amplitude

Adapter Settings

Set the impedance selection on the adapter as necessary to match the impedance of the signal source. See Figure 2b.

Telecommunication Connections

The female Bantam input of the AFTDS adapter accepts a male Bantam connector. Standard and optional accessories allow the AFTDS adapter to connect to Siemens or RJ45/RJ11 connector styles. See Figure 2c. The input cable (source) and hybrid cables must be 100 Ω, 110 Ω, or 120 Ω.

CAUTION. *The AFTDS adapter is intended for the testing of telecommunications equipment where impulses are limited to less than 300 V. The AFTDS adapter is "Not Terminal Equipment" for connection to the Public Telecommunications Network.*

Use only cables and accessories designed, rated, and approved for telecommunications applications.

Specifications

All specifications in Table 1 are guaranteed unless noted as "typical." Typical specifications are provided for your convenience but are not guaranteed. Specifications that are marked with the ✓ symbol are checked in the *Performance Verification* on page 9.

Table 1: Specifications

Electrical standards	DS-1 (1.544 Mb/s) DS-2 (6.312 Mb/s) DS-1A (2.048 Mb/s) E-1 (2.048 Mb/s) DS-1C (3.152 Mb/s)
Compliance with Industry Standards	ANSI T1.102 and ITU-T G.703
Selectable input impedance	100 Ω, 110 Ω, or 120 Ω ± 3% from 50 kHz to 30 MHz
VSWR, (return loss) – typical	≤ 1.1:1 (≥ 26.45 dB) from 50 kHz to 30 MHz
Load impedance	50 Ω ± 3%
✓ Attenuation	5X (–14 dB) ± 5% from 50 kHz to 30 MHz
✓ Droop	≤ 2.0% per 700 ns
Bandwidth – typical	7 kHz to 120 MHz (–3dB)
✓ Rise time	≤ 3.0 ns
Maximum input voltage and frequency Differential-mode AC Differential-mode DC Common mode	CAT I 4.4 V_{RMS} 200 V 300 V_{pk}
Temperature Operating Nonoperating	Class 5 Limits 0° C to + 50° C –55° C to + 75° C
Humidity Operating Nonoperating	Class 5 Limits +30° C to + 50° C, 90 to 95% RH –55° C to + 60° C, 90 to 95% RH
EC Declaration of Conformity	Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Communities: Low Voltage Directive 73/23/EEC, as amended by 93/68/EEC: EN 61010-1/A2 Safety requirements for electrical equipment for measurement, control, and laboratory use Telecommunications Directive 91/263/EEC, as amended by 93/68/EEC: EN 41003 Particular safety requirements for equipment to be connected to telecommunication networks.
Approvals	UL3111-1 – Standard for electrical measuring and test equipment CAN/CSA C22.2 No. 1010.1 – Safety requirements for electrical equipment for measurement, control and laboratory use

Table 1: Specifications (Cont.)

Installation Category Descriptions	Terminals on this product may have different installation category designations. The installation categories are: CAT III Distribution-level mains (usually permanently connected). Equipment at this level is typically in a fixed industrial location CAT II Local-level mains (wall sockets). Equipment at this level includes appliances, portable tools, and similar products. Equipment is usually cord-connected CAT I Secondary (signal level) or battery operated circuits of electronic equipment
Pollution Degree 2	Do not operate in environments where conductive pollutants may be present.

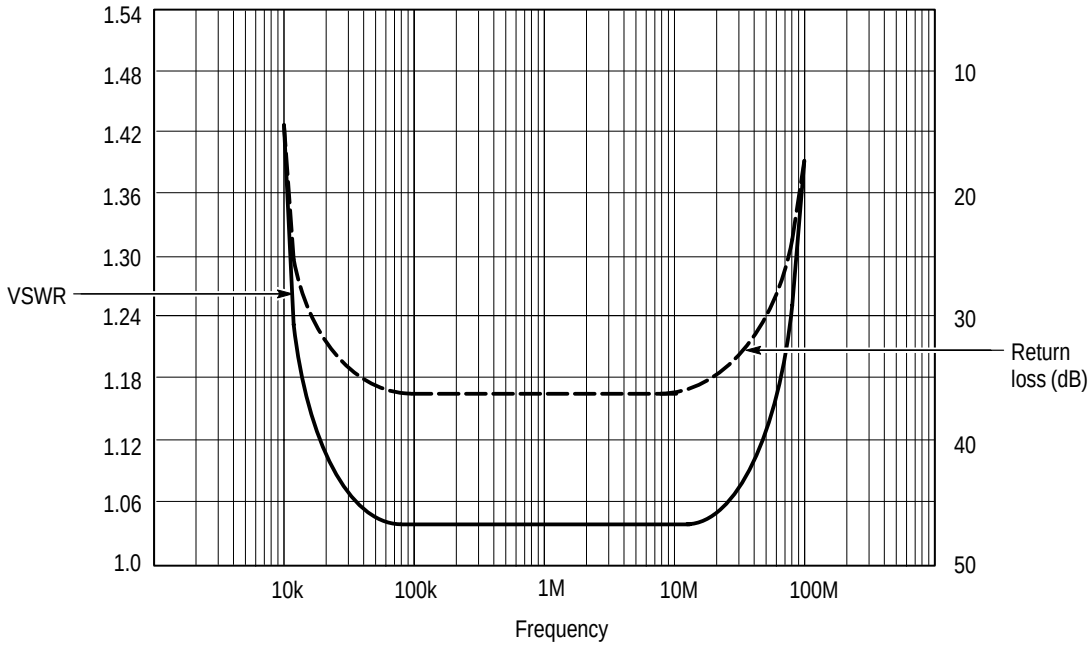


Figure 3: Typical input VSWR and return loss

Performance Verification

Use the following procedures to verify the warranted specifications of the AFTDS Differential Signal Adapter. Before beginning these procedures, photocopy the test record on page 13 and use it to record the performance test results for your AFTDS Differential Signal Adapter. The recommended calibration interval is one year.

These procedures are for use by qualified service personnel only.

Test Equipment

Table 2 lists the equipment required to perform the performance verification procedure.

Table 2: Test equipment

Description	Minimum requirements	Example product
Fast Edge Generator	1 MHz square wave, 1 V_{p-p}, ≤ 1ns rise time	Wavetek 9100 with option 250
Standard Amplitude with variable frequency or Time Mark Generator	720 kHz and 143 kHz square wave, 1 V_{p-p}	
Oscilloscope (1) and probe (1)	350 MHz combined bandwidth	TDS520C P6139A
Calibration fixture (1)	See Figure 4 and Table 3	—
Probe-tip-to-BNC adapter	50 Ω terminator and adapter	013-0227-00
BNC adapter	BNC female to BNC female	103-0028-00

To adapt the single-ended signal source to the input of the AFTDS adapter, assemble the calibration fixture shown in Figure 4 from the parts listed in Table 3. Observe the following techniques:

- Use circuit board or prototype board to connect components.
- For good RF response, keep distances between connections to less than 6 mm (1/4 inch).
- Do not connect the braided wire of the Bantam connector. Fold back and tape the braid so it is out of the way.

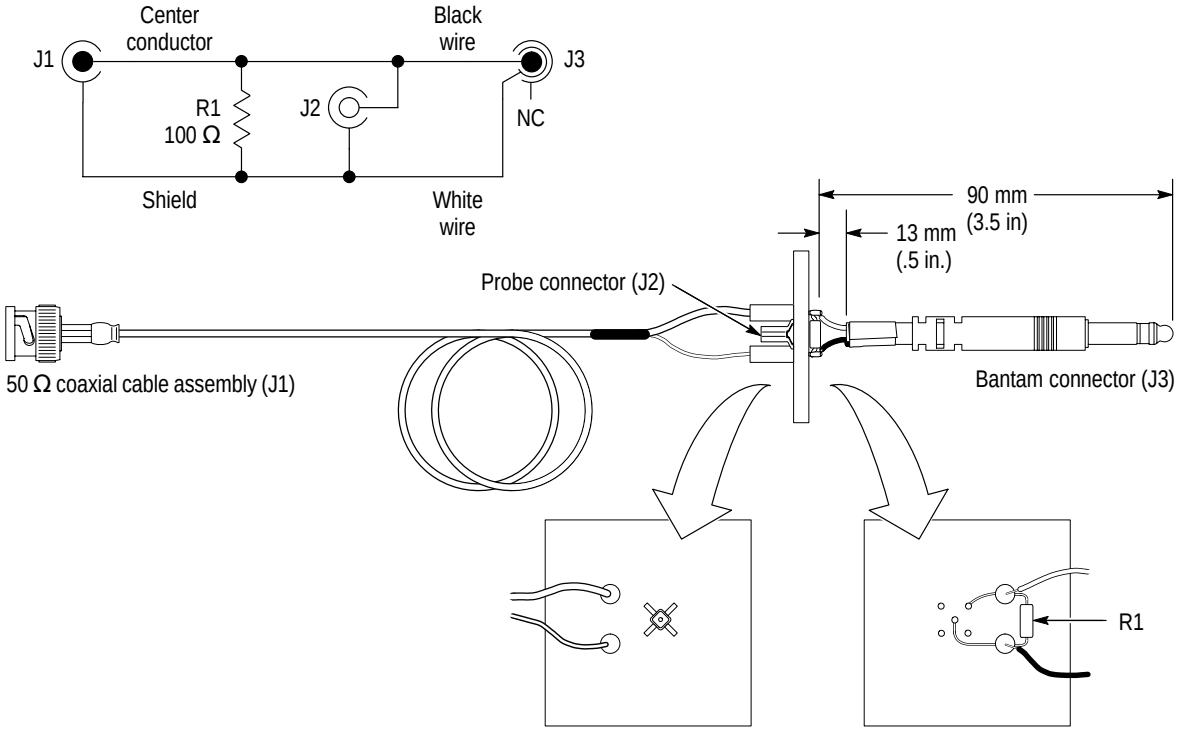


Figure 4: Schematic and layout diagrams for building the calibration fixture

The input and output connectors of the calibration fixture function as follows:

- The J1 input connects to the generator by means of a BNC connector.
- The J3 output connects to the input of the AFTDS adapter under test by means of a Bantam plug.
- The J2 output connects to the oscilloscope probe for monitoring the J3 output.

Table 3: Calibration fixture parts list

Circuit number	Part number	Description
J1	175-1178-00	CABLE ASSY,RF 50 OHM COAX,20.0 L
J2	131-5031-00	CONNECTOR,PROBEPKG OF 25,COMPACT
J3	012-1522-00	CABLE,INTCON SHLD CMPST,;SD1,3 COND,36 L,BANTAM,3 COND PLUG BOTH ENDS
R1	322-3097-00	RES,FXD,FILM 100 OHM,1%,0.2W

Perform the verification procedures in order.

Attenuation

1. Connect the input of the AFTDS adapter to the J3 output of the calibration fixture.
2. Connect the output of the AFTDS adapter to the BNC-female-to-BNC-female adapter and then to the 50 Ω probe-tip-to-BNC adapter.
3. Connect a probe to channel 1 of the oscilloscope. Connect the probe tip to the J2 output of the calibration fixture.
4. Connect the signal source to the J1 input of the calibration fixture.
5. Set the signal source for a 720 kHz square wave (700 ns wide pulses) of 1 V_{p-p} amplitude. Enable the output.
6. Set the oscilloscope acquisition to >32 averages and set the measure function to amplitude. Set the volts/division to 200 mV and the time/division to 400 ns.
7. Measure the exact amplitude of the input waveform with the measurement function of the oscilloscope.
8. Move the probe tip to the probe-tip-to-BNC adapter on the output of the AFTDS. Change the volts/division to 50 mV and read the amplitude on the oscilloscope.
9. Calculate the the exact attenuation by dividing the input amplitude by the output amplitude. Check that the attenuation is 5X and is within ± 5% (4.75 to 5.25).

Rise Time

1. Remove the BNC-female-to-BNC-female adapter and the 50 Ω probe-tip-to-BNC adapter from the output of the AFTDS adapter.
2. Connect the output of the AFTDS adapter to the input of the oscilloscope.
3. Set the output of the generator for a fast edge (≤ 1 ns) 1 MHz square wave (500 ns wide pulses) of 1 V_{p-p} amplitude. Enable the output.
4. Set the oscilloscope volts/division to 250 mV and the time/division to 10 ns. Set the measure function of the oscilloscope to rise time and read the rise time on the oscilloscope.
5. Check that the rise time is ≤ 3.0 ns.

Droop

1. Set the signal source for 143 kHz square wave (3.5 μs wide pulses) of 1 V amplitude. Enable the output.
2. Set the oscilloscope volts/division to 250 mV and the time/division to 1.0 μs. Use the cursors on the oscilloscope to measure the droop of the 3.5 μs wide "high" part of the waveform and the peak-peak amplitude of the waveform.
3. The percent droop is the magnitude of the droop divided by the step amplitude (see Figure 5). Divide this number by 5 to obtain the droop per 700 ns.
4. Check that the droop is ≤ 2.0% per 700 ns.

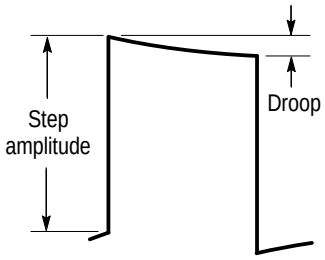


Figure 5: Step amplitude and droop

AFTDS Test Record

Photocopy this page and use it to record the performance test results for your AFTDS Differential Signal Adapter.

AFTDS Test Record

Instrument Serial Number: _____ Certificate Number: _____

Temperature: _____ RH %: _____

Date of Calibration: _____ Technician: _____

AFTDS Performance Test	Minimum	Incoming	Outgoing	Maximum
Attenuation: 5X ± 5%, –14 dB (50 kHz to 30 MHz)				
Input amplitude	N/A	_____	_____	N/A
Output amplitude	N/A	÷ _____	÷ _____	N/A
Input ÷ Output (attenuation factor)	4.75	= _____	= _____	5.25
Rise time: ≤ 3.0 ns	N/A	_____	_____	3.0 ns
Droop: ≤ 2.0% for 700 ns				
Droop amplitude	N/A	_____	_____	N/A
Step amplitude	N/A	÷ _____	÷ _____	N/A
Droop ÷ output = % droop	N/A	= _____	= _____	N/A
% droop ÷ 5 =	N/A	÷ 5	÷ 5	N/A
% droop per 700 ns	N/A	= _____	= _____	2.0%

Replaceable Parts and Accessories

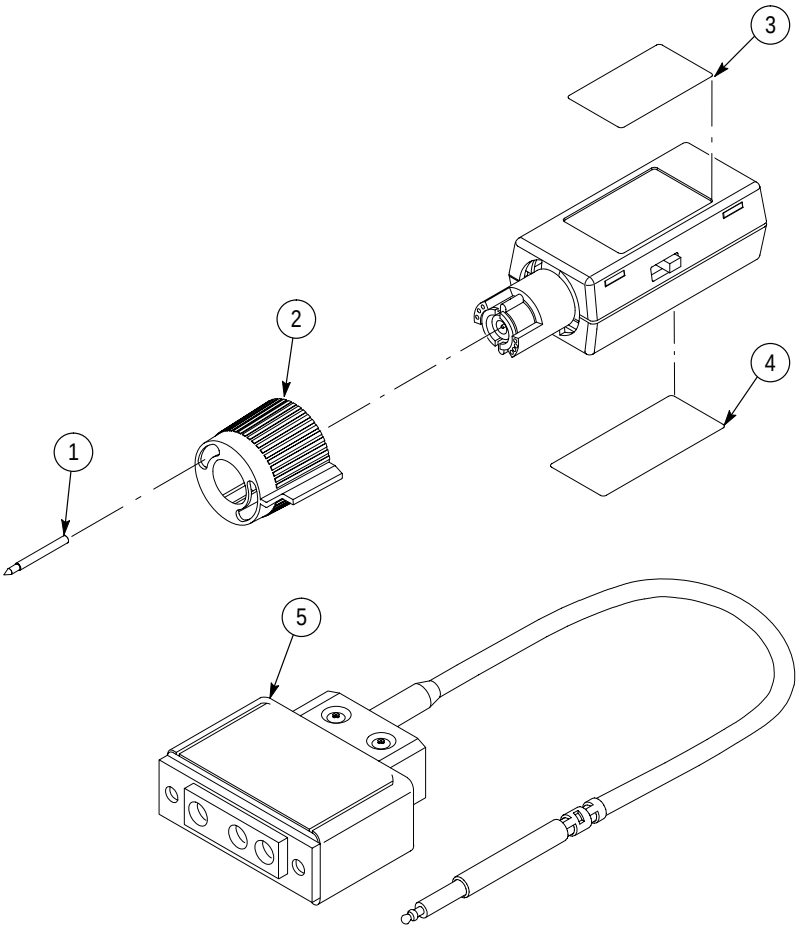


Figure 6: Replaceable parts and standard accessories

CAUTION. *To avoid damage to the AFTDS adapter, do not remove covers. Removing the covers voids the factory warranty. The internal components of this product are not user serviceable.*

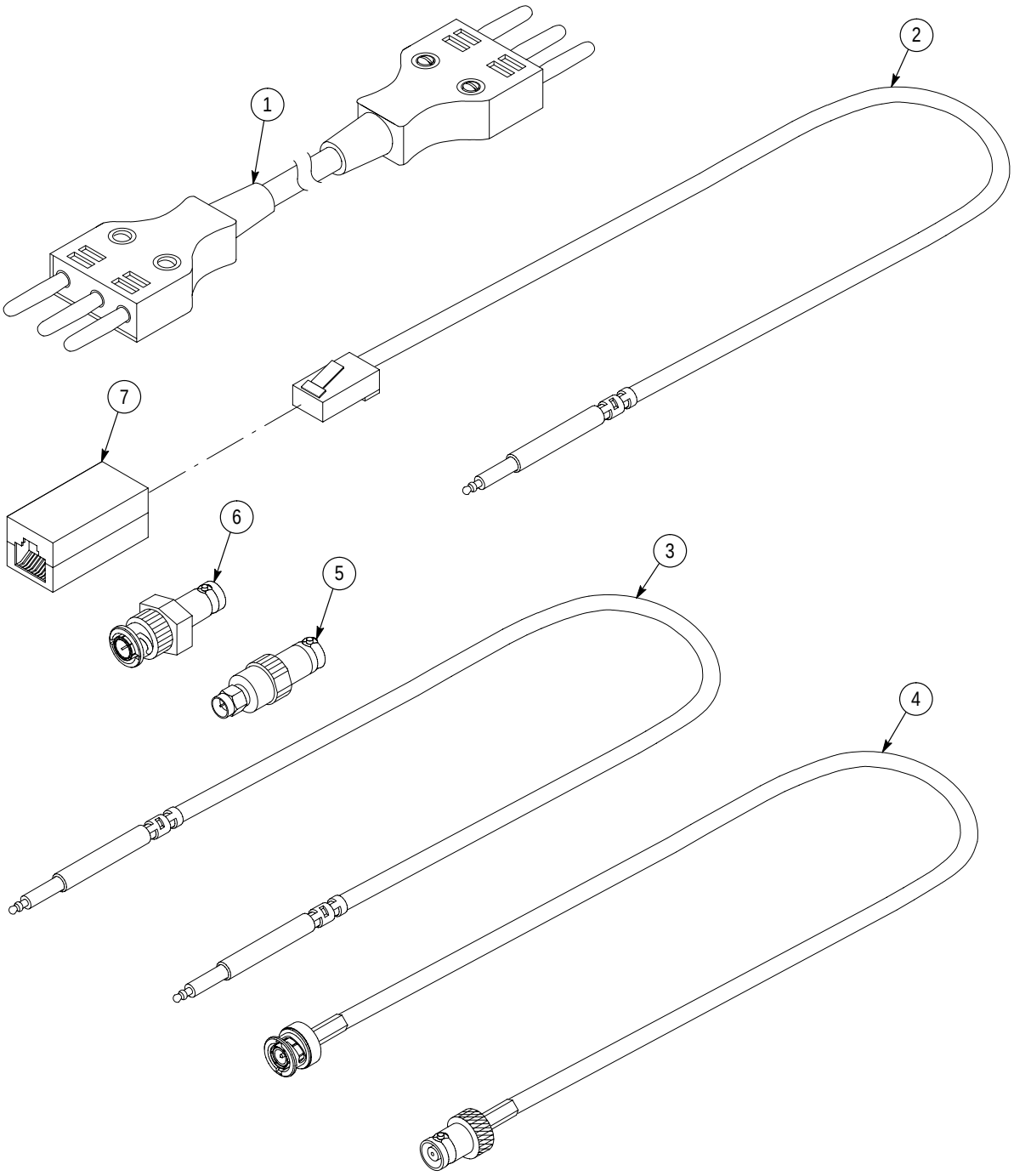


Figure 7: Optional accessories

Replaceable parts list

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description	Mfr. code	Mfr. part number
6–					ADAPTER:AFTDS		
–1	131–3627–01			1	CONTACT,ELEC:GOLD PLATED TIP	18359	P–6158–1
–2	205–0191–00			1	SHELL,ELEC CONN:BNC,ABS,DOVE GRAY	80009	205–0191–00
–3	334–9321–00			1	MARKER,IDENT:INSTRUMENT LABEL,AFTDS	80009	334–9321–00
–4	334–9354–00			1	MARKER,IDENT:SAFETY LABEL,AFTDS	80009	334–9354–00
					Standard Accessories		
–5	012–1520–00			1	CABLE, ADAPTER:SHLD,SDI,5.0 L,BANTAM TO SIEMENS TRIPLE BANANA	TK2469	012–1520–00
	070–9483–00			1	MANUAL,TECH:INSTRUCTIONS,XBS,AFTDS,DP	TK2548	070–9483–00
					Optional Accessories		
7–1	012–1469–00			1	CABLE,SIEMENS:CMPST,DIN41628,SDI,2 METER, 3 POS,MALE,SIEMENS BANANA PLUG BOTH ENDS	TK2469	012–1469–00
–2	012–1521–00			1	CABLE,INTCON:SHLD CMPST,CRC,2 CONDUCTOR,72 .0,RJ11 PLUG TO BANTAM PLUG	70674	BJR2M6
–3	012–1522–00			1	CABLE,INTCON:SHLD CMPST,SD1,3 COND,36 L,BANTAM,3 COND PLUG BOTH ENDS	70674	PJ–716
–4	012–0104–00			1	CA ASSY,RF:COAXIAL,RFD,50 OHM,RG58/U,18.0 L,MALE,BNC X FEMALE,BNC,	74868	35001–1
–5	015–0554–00			1	ADPTR,SMA,ELEC:FEMALE BNC TO MALE SMA	24931	29JP170–1
–6	011–0049–01			1	TERMN,COAXIAL:50 OHM,2W,BNC	24931	28A123–1
–7	103–0409–00			1	ADAPTER,CONN:ADAPTER,FEMALE,STR,FEMALE RJ45 X FEMALE RJ45,PHONE JACK BOTH ENDS	TK1857	TM5RL–88–JJ

Manufacturers cross index

Mfr. code	Manufacturer	Address	City, state, zip code
18359	PYLON CO. INC.	51 NEWCOMB ST	ATTLEBORO, MA 02703–1403
24931	BERG ELECTRONICS INC	BERG ELECTRONICS RF/COAXIAL DIV 2100 EARLYWOOD DR PO BOX 547	FRANKLIN, IN 46131
70674	ADC PRODUCTS	2680 BAYSHORE FRONTAGE RD. SUITE 602	MOUNTAIN VIEW, CA 94043
74868	AMPHENOL CORP	RF/MICROWAVE OPERATIONS 1 KENNEDY AVE	DANBURY, CT 06810–5803
80009	TEKTRONIX INC	14150 SW KARL BRAUN DR PO BOX 500	BEAVERTON, OR 97077–0001
TK1857	HIROSE ELECTRIC USA INC	2688 WESTHILLS COURT	SIMI VALLEY, CA 93065–6235
TK2469	UNITREK CORPORATION	3000 LEWIS & CLARK HWY SUITE 2	VANCOUVER, WA 98661
TK2548	XEROX CORPORATION	14181 SW MILLIKAN WAY	BEAVERTON, OR 97005