Instruction Manual

Tektronix

SD-43
Optical-to-Electrical Converter

071-0424-00

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.

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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.

Only qualified personnel should perform service procedures.

To Avoid Fire or Personal Injury

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.

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

Wear Eye Protection. Wear eye protection if exposure to high-intensity rays or laser radiation exists.

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.*

Terms on the Product. These terms may appear on the product:

DANGER indicates an injury hazard immediately accessible as you read the marking.

WARNING indicates an injury hazard not immediately accessible as you read the marking.

CAUTION indicates a hazard to property including the product.

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

CAUTION
Static Sensitive

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

Getting Started

The SD-43 is an optical-to-electrical (O/E) converter that converts an optical input signal into an output voltage for display on either a high-speed oscilloscope or spectrum analyzer. The SD-43 O/E converter installs in any of the front panel compartments of an 11800 Series Digital Sampling Oscilloscope, the SM-11 Multichannel Unit, or the CSA 803 Communications Signal Analyzer. An optional stand-alone power supply is also available for the SD-43 O/E converter (see page 23).

Figure 1 shows the front panel of the SD-43 O/E converter.

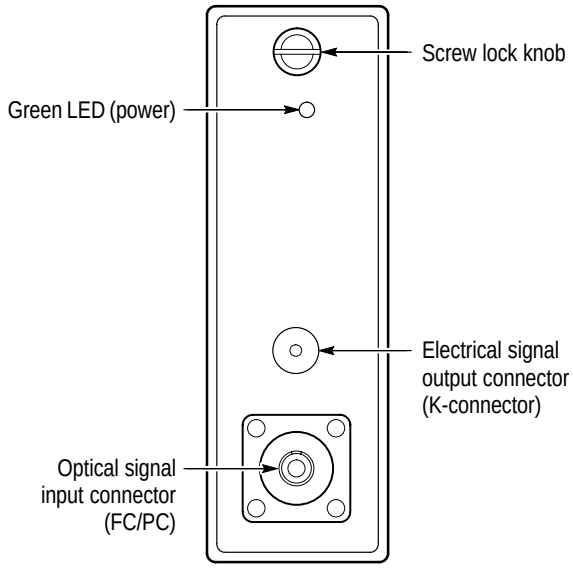

Figure 1: SD-43 front panel

The SD-43 O/E converter has an FC/PC receptacle for optical signal input and a K-style connector for electrical signal output.

The following list highlights the key performance characteristics of the SD-43 O/E converter:

- 700 to 1650 nm wavelength response
- DC to ≥8 GHz optical bandwidth
- ≥ 20 mV/mW at 850 nm, ≥ 30 mV/mW at 1310 nm

For a complete list of specifications, see to page 11.

Standard Accessories

The following accessories are standard with every SD-43 O/E converter:

- Hard case
- Instruction manual
- FC/PC to FC/PC 62.5 μm multi-mode fiber jumper
- FC/ST, FC/SC, and FC/FC hybrid connectors
- Rigid U-cable for electrical sampling heads for the SD-20 Series
- Protective SMA terminator (installed on the electrical output; SMA terminator threads are compatible with K-style threads)
- Certificate of traceable calibration

For a list of replaceable part numbers, see page 23.

Options

The following options are available at the time of purchase:

- Opt D1 Calibration data
- Opt D3 Three years calibration data (requires option C3)
- Opt C3 Three years calibration services
- Opt R3 Three years extended warranty

Optional Accessories

The following recommended accessories are available through Tektronix:

- Fiber-optic cables and adapters with a variety of fiber types and connector styles
- 90/10 single-mode optical splitter with FC/PC connectors
- DIN to FC fiber-optic hybrid connector
- 10 dB in-line single-mode optical attenuator
- Electrical filters for 622 Mbs and 155 Mbs
- Stand-alone power supply

For a list of part numbers, see page 23.

Installation

Follow the instructions in this section to install the SD-43 O/E converter into the 11800 Series Digital Sampling Oscilloscope or CSA 803 Communications Signal Analyzer, or to connect it to the optional power supply for stand-alone operation.

11800 or CSA 803 Series

On the 11800 Series Digital Sampling Oscilloscope or the CSA 803 Communications Signal Analyzer, the SD-43 O/E converter installs into any of the front panel compartments.

NOTE. *For the best performance, connect the SD-43 Optical-to-Electrical Converter to the input of the sampling head using the rigid connector provided. The sampling head must be in the compartment immediately to the right of the O/E converter. See Figure 2 on page 5.*

Choose one of the following Tektronix sampling heads to connect to the output of the O/E converter:

- SD-22 (recommended for lowest noise performance)
- SD-24
- SD-26
- SD-30
- SD-32 (requires a V-K adapter and rigid J-cable, see Figure 3 on page 5)

Use the following procedure to install the O/E converter and sampling head modules:

CAUTION. *The output of the O/E converter and the input of the sampling head are subject to damage from electrostatic discharge (ESD). To prevent damage from ESD, take the following precautions:*

Always wear an anti-static wrist strap when handling a static sensitive instrument.

Keep the short-circuit termination in place when moving or storing the instrument. Remove the termination only to connect a cable.

Discharge the inner conductor of a loose, unterminated cable before connecting it to the instrument.

1. Switch off the measurement instrument.
2. Place the module in a compartment and slowly push it in with firm pressure.
3. Once the module is seated, turn the screw shaft on the plug-in to tighten the module in place.
4. Switch on the measurement instrument and check that all modules have power.
5. Remove the termination on the output of the O/E converter and connect the output to the lower input of the sampling head as follows.

   a. On all sampling heads *except* the SD-32, use the rigid connector and install the shorter leg of the connector on the sampling head. See Figure 2.

   b. On the SD-32 sampling head, use the rigid connector and install the shorter leg of the connector on the sampling head with a V-K adapter. See Figure 3. (The V-K adapter is a standard accessory of the SD-32. If you do not have a V-K adapter, refer to the list of optional accessories on page 23.)

   c. Carefully align the SMA connectors on both ends of the rigid cable.

   d. To avoid damaging the connectors on the SD-43 or the sampling head, alternately tighten the threads of each end of the rigid cable one turn at a time until they are tight enough to use a wrench.

   e. Tighten each nut lightly with a wrench. For best repeatability and to prolong the life of SMA connectors, use a torque wrench and tighten the connection to the range of 7 to 10 lb-in (79 to 112 N-cm).

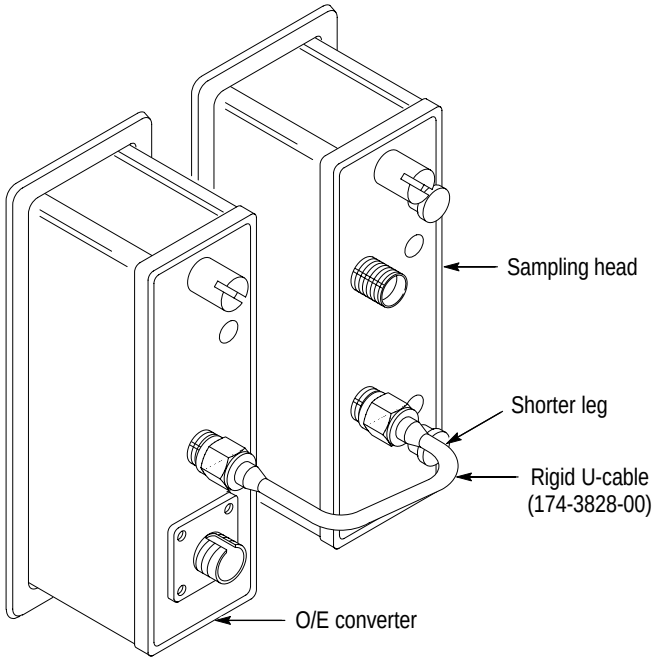

Figure 2: Using the rigid connector (all sampling heads except SD-32)

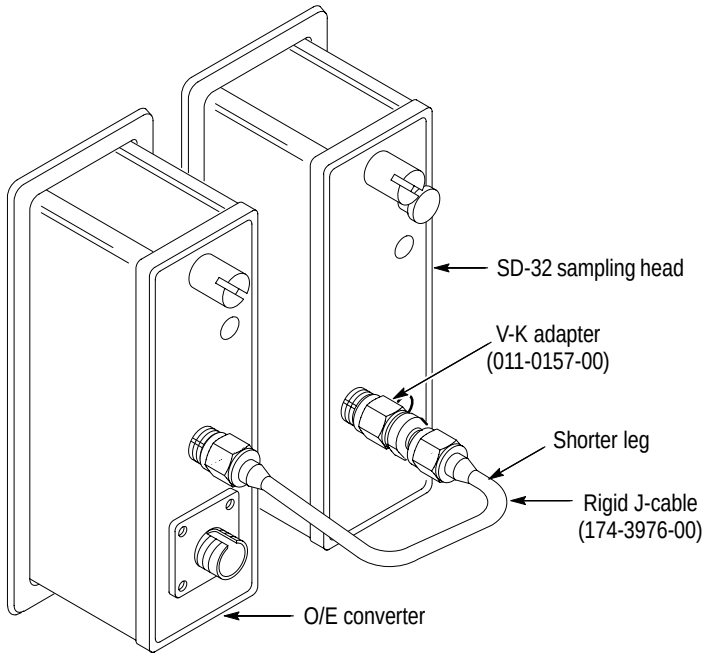

Figure 3: Using the rigid connector and V-K adapter (SD-32 sampling head only)

***NOTE**. On the CSA803 series, the O/E converter will work in any of the power-only or sampling head compartments, but the sampling head must be installed in one of the two sampling head compartments on the right. See Figure 4.*

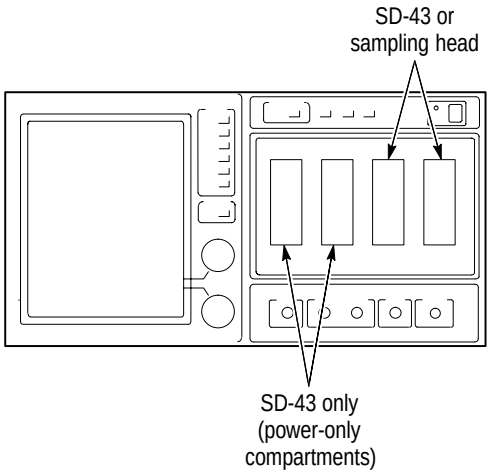

Figure 4: Front panel compartments in a CSA 803 Communications Signal Analyzer

Optional Power Supply

The optional power supply kit (Figure 5) allows the user to power the SD-43 O/E converter by itself. This allows the O/E converter to operate with other types of measurement instruments independent of a CSA or 11800 series mainframe. The part number for the kit is on page 23.

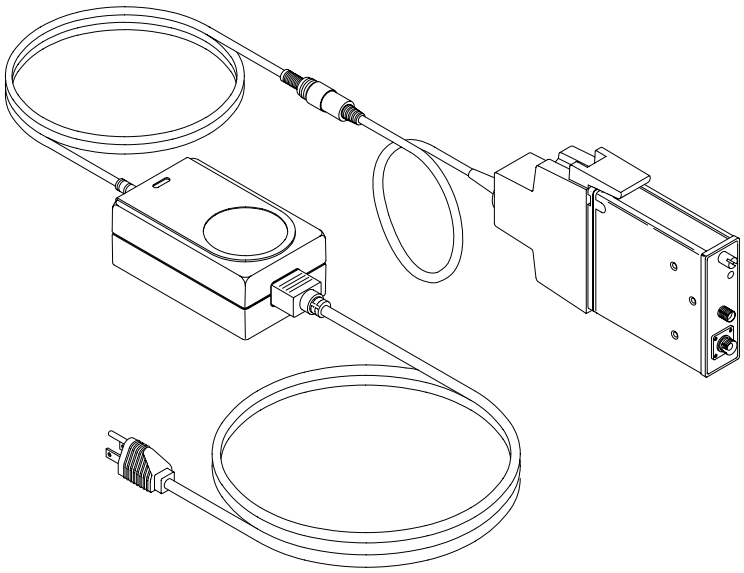

Figure 5: Installation with optional power supply kit

Operating Basics

To prolong the life of the SD-43 O/E converter observe the following handling, cleaning, and operating instructions.

Handling

Handle the SD-43 O/E converter carefully at all times.

CAUTION. *To avoid damaging the SD-43 O/E converter, take the following precautions:*

Do not drop the SD-43 O/E converter since damage and misalignment of the photodiode optical assembly can result. Store the SD-43 O/E converter in a secure location when not in use.

Replace the protective caps on the input and output connectors when the SD-43 O/E converter is not in use.

WARNING. *Do not look directly into any optical output port. Laser light can be harmful to your eyes.*

Cleaning Optical Connectors

Small dust particles and oils can easily contaminate optical connectors and reduce or block the signal. Take care to preserve the integrity your connectors by keeping them free of contamination.

CAUTION. *To prevent loss of optical power or damage to the optical connectors, keep the connectors clean at all times.*

When cleaning the connectors with a swab, use gentle circular motions. Use only high quality cleaning supplies that are non-abrasive and leave no residue.

To reduce the need for cleaning, immediately replace protective caps on the optical connectors when not in use.

Equipment Required

Use the following items to clean the optical connectors:

- clean compressed air
- fiber-optic cleaning swabs
- isopropyl alcohol

Procedure

To clean the optical connectors, follow these steps:

1. Hold the can of compressed air upright and spray the can into the air to purge any propellant.
2. Spray the clean compressed air on the connectors to remove any loose particles or moisture.
3. Moisten a clean optical swab with isopropyl alcohol and then lightly swab the surfaces of the connectors.
4. Spray the clean compressed air on the connectors again to remove any loose particles or isopropyl alcohol.

NOTE. *Cleaning kits for optical connectors are available from a number of suppliers.*

Connecting Optical Signals

Attach the fiber optic cable with an FC/PC connector to the FC/PC input receptacle as follows:

1. Carefully align the keyway on the receptacle with the key on the connector.
2. Tighten the nut lightly with finger pressure only.

The input of the SD-43 O/E converter can couple to optical fibers with a core diameter of up to 62.5 μm. Alternate connector styles can be accommodated by the use of an FC-FC jumper and the FC-FC, FC-ST, FC-SC adapters or hybrid fiber optic jumper cables. (Refer to *Optional accessories* on page 23.)

CAUTION. *To maintain the high performance (low return loss) of the optical interface, connect an adapter and cable between the input of the SD-43 O/E converter and the device under test. When you make connections to other devices, leave the adapter and cable in place to protect the optical interface of the SD-43 O/E converter from wear.*

If you connect fiber cores larger than 62.5 µm, the SD-43 O/E converter may still couple light, but the mismatch in core diameter will cause lower conversion gain and higher insertion loss.

Attenuating Optical Signals

To keep the optical input power to an appropriate level, it may be necessary to use an optical attenuator (such as the OA5022 Optical Attenuator) to attenuate the optical signal.

CAUTION. *To avoid damaging the optical input of the SD-43 O/E converter, attenuate optical signals to less than 5 mW average power or 10 mW peak power.*

For linearity and measurement accuracy, attenuate the peak-to-peak swing of signal to within the specified performance of 2 mW_{p-p}.

WARNING. *Do not look directly into any optical output port. Laser light can be harmful to your eyes.*

Specifications

This section contains the specifications for the SD-43 Optical-to-Electrical Converter. All specifications are guaranteed unless noted as "typical." Typical specifications are provided for your convenience but are not guaranteed. Specifications marked with the ✓ symbol have corresponding checks in the *Performance Verification* section on page 13.

Table 1: SD-43 Specifications

Specification	Description
Effective wavelength range, typical	700 nm to 1650 nm
✓ DC conversion gain	≥ 17 mV / mW at 780 nm ± 20 nm, ≥ 20 mV / mW at 850 nm ± 20 nm ≥ 30 mV / mW at 1310 nm ± 20 nm and ≥ 25 mV / mW at 1550 nm ± 20 nm
Relative responsivity, typical	See Figure 6
Absolute maximum nondestructive optical input	5 mW average power; 10 mW peak power at wavelength with highest relative responsivity
✓ Bandwidth	DC to ≥8 GHz (– 6 dB electrical power into 50 Ω) for signals < 2 mW_{p-p}
Input fiber diameter	Accepts 62.5 µm multi-mode diameter; Numerical Aperture (NA) ≤ 0.27
Internal fiber diameter	core: 62.5 µm multi-mode fiber cladding: 125 µm
Fiber connector style	female FC/PC
Optical return loss	> 14 dB minimum for external mating fibers 62.5 µm core or smaller and PC mating style
✓ Noise equivalent power	≤ 15 $pW/\sqrt{Hz}$ electrical output noise when terminated into 50 Ω
Impulse response width	≤ 48 ps FWHM (Full Width Half Maximum)
Aberrations	≤ $10\%_{p-p}$ total
✓ Output zero	≤ 1 mV
External termination impedance	50 Ω ± 2 Ω
Output impedance, typical	1 kΩ
Temperature	Operating: +10° C to +40° C Non-operating: –22° C to +60° C
Humidity	75% non-condensing
Altitude	Operating: 4,572 m (15,000 ft) Non-operating: 15,240 m (50,000 ft)

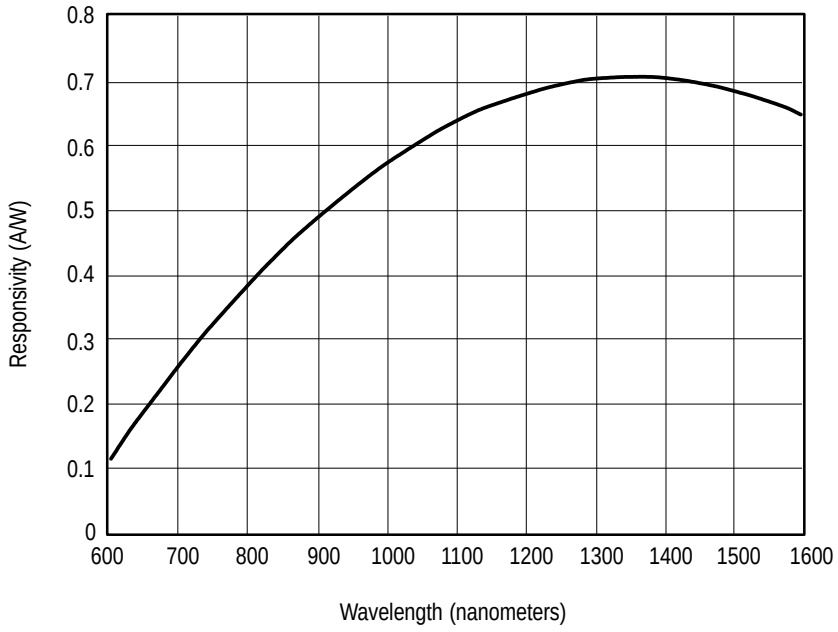

Figure 6: Typical responsivity

Table 2: Certifications and compliances

Category	Standards or description	
EC Declaration of Conformity – EMC	Meets intent of Directive 89/336/EEC for Electromagnetic Compatibility. Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Union:	
	EN 55011	Class A Radiated and Conducted Emissions
	IEC 1000-3-2	AC Power Line Harmonic Emissions
	EN 50082-1 Immunity:	
	IEC 1000-4-2	Electrostatic Discharge Immunity
	IEC 1000-4-3	RF Electromagnetic Field Immunity
	IEC 1000-4-4	Electrical Fast Transient/Burst Immunity
	IEC 1000-4-5	Power Line Surge Immunity
	IEC 1000-4-6	Conducted RF Immunity
	IEC 1000-4-11	Voltage Dips/Interruptions Immunity
Australia/New Zealand Declaration of Conformity – EMC	Complies with EMC provision of Radiocommunications Act per the following standard(s):	
	AN/NZS 2064.1/2	Industrial, Scientific, and Medical Equipment: 1992

Performance Verification

Use the following procedures to verify the warranted specifications of the SD-43 Optical-to-Electrical Converter. Before beginning these procedures, see page 20; photocopy the test record and use it to record the performance test results. The recommended calibration interval is one year.

These procedures test the following specifications:

- Output zero
- DC conversion gain
- Noise equivalent power
- Bandwidth/frequency response (for characterization purposes only)

Equipment Required

Table 3 lists the equipment required to perform the performance verification procedure. The types and quantities of connectors may vary depending on the specific equipment you use.

Table 3: Test equipment

Description	Minimum requirements	Example product
Optical power meter with head and adapters	Accuracy ± 3%, Dynamic range > 0 dbM to –50 dbM, Max power > 1 mW, calibrated from 700 nm – 1650 nm	Tektronix TFC 200
780 nm cal source	output > 200 µW (CW)[1], stability > 0.1 dB over 5 minutes	BCP 400 A-0XXT-239
850 nm cal source	output > 200 µW (CW)[1], stability > 0.1 dB over 5 minutes	BCP 400 A-1XXT-239
1310 nm cal source	output > 200 µW (CW)[1], stability ± 0.1 dB over 5 minutes	BCP 400 A-2XXT-239
1550 nm cal source	output > 200 µW (CW)[1], stability ± 0.1 dB over 5 minutes	BCP 400 A-3XXT-239
RF power meter	noise < .1 mV, BW > 4 GHz	HP 436A with power sensor HP 8484A
1300 or 1550 nm impulse generator	pulse width < 2 ps	Calmar Optcom FPL-01 1550 nm impulser

Table 3: Test equipment (cont.)

Description	Minimum requirements	Example product
Sampling oscilloscope with sampling head		11K (1180X, CSA80xX with SD-32 sampling head, V-K adapter and rigid cable. Option RR also requires the SD-22 sampling head.)
V–K adapter	for use with SD-32 sampling head	011-0157-00
Rigid cable	for use with SD-32 sampling head	174-3976-00
Reference receiver for trigger source	trigger signal for sampling oscilloscope	10/90 or 50/50 splitter with ORR24 or P6703B and 1103 TEKPROBE Power Supply
PC with GPIB port and printer	printer output of sampled waveforms	
Two adjustable multi-mode optical attenuators	4 decades, 62.5 µm core fiber, FC-style connectors	Tektronix OA5022
Digital voltmeter	4 1/2 digit	Tektronix TX3, TX1
50 Ω termination	± 1%	011-0049-01
BNC-to-banana adapter	BNC female to dual banana	103-0090-00
Optical cable (3)	FC-FC multi-mode, 62.5 µm, 2 meters	174-2322-00
Inline optical adapter	FC female to FC female	131-5039-00

1 **CW and modulated mode available: modulation with OFF level at or below 0.1 µW, optical falltime < 1 µs**

The SD-43 O/E converter under test and the test equipment should be warmed up for 20 minutes at an ambient temperature between 20 and 30° C.

Output Zero

1. Attach the output of the SD-43 O/E converter to the voltmeter inputs with a 50 Ω termination and BNC-to-banana adapter.
2. Install the optical dust cover on the input of the SD-43 O/E converter.
3. Check that output voltage is ≤ ± 1 mV. Record the result on the test record.

DC Conversion Gain

***NOTE**. Make sure that the optical connector ends of both the fiber from the optical attenuator output and the SD-43 under test input fiber are well cleaned before performing this step. See the cleaning instructions on page 8.*

1. Connect the 1310 nm laser source to attenuator input.

***NOTE**. The longer wavelength of 1310 nm in single mode fiber is sensitive to loss in fiber due to bending of the fiber. The fiber bend radius of the SD-43 fiber input should lay with >1.5 inch bend radius along the fiber's entire length. Although this precaution must be maintained throughout the entire performance verification procedure, it is especially important for this step in order to accurately adjust and measure the DC conversion gain of the SD-43.*

2. Connect the optical attenuator output to the optical power meter using multi mode optical cable with FC connectors. Use the appropriate optical power meter sensing head with calibrated measurement for a wavelength span including 1550 nm, 1310 nm, 780 nm, and 850 nm. Be sure the optical power meter wavelength setting and optical attenuator setting is at 1310 nm. Enable the optical output.

3. Adjust attenuator or the optical source so that the power meter reads 200 μW.

4. Move the FC fiber end (the one now adjusted to 200 μW average power) from the optical power meter and connect it to the SD-43 input under test.

5. Attach a voltmeter with 50 Ω termination to SD-43 O/E converter output.

6. Record the voltmeter reading. The 1310 nm Conversion Gain in units of V/mW is

(voltmeter reading) $\times 5$

7. Record the 1310 nm conversion gain on the test record.

8. Disconnect the 1310 nm laser from the optical attenuator, and reconnect the 780 nm laser source. Set the optical attenuator to the correct wavelength.

***NOTE**. Do not disturb the fiber connection between the optical attenuator output and the SD-43 O/E converter input.*

9. Adjust the optical attenuator until the voltmeter reading is the same as in step 6 above ± 1%.

10. Without moving the optical attenuator from the position in the previous step, disconnect the output fiber of the optical attenuator from the input of the SD-43 and insert the optical attenuator output into the optical power meter.

11. Adjust the optical power meter to the calibrated wavelength setting of 780 nm. Note the absolute power displayed. The 780 nm conversion gain in units of V/mW_{opt} is

((200 µW) / (measured 780 power)) × (1310 nm conversion gain)

12. Record the 780 nm conversion gain on the test record.

13. Disconnect the 780 nm laser from the optical attenuator, and connect the 850 nm laser source. Set the optical attenuator to the correct wavelength.

14. Connect the attenuator output to the voltmeter.

***NOTE**. Do not disturb the fiber connection between the optical attenuator output and the SD-43 input.*

15. Adjust the optical attenuator until the voltmeter reading is the same as in step 6 above, ± 1%.

16. Without moving the optical attenuator from the position in the previous step, disconnect the optical attenuator output fiber from the input of the SD-43 and then insert the fiber into the optical power meter.

17. Adjust the optical power meter to the calibrated wavelength setting of 850 nm. Note the absolute power displayed. The 850 nm conversion gain in units of V/mW_{opt} is

((200 µW) / (measured 850 power)) × (1310 nm conversion gain)

18. Record the 850 nm conversion gain on the test record.

19. Disconnect the 850 nm laser from the optical attenuator, and connect the 1550 nm laser source. Set the optical attenuator to the correct wavelength.

20. Connect the attenuator output to the voltmeter.

***NOTE**. Do not disturb the fiber connection between the optical attenuator output and the SD-43 input.*

21. Adjust the optical attenuator until the voltmeter reading is the same as in step 6 above, ± 1%.

22. Without moving the optical attenuator from the position in the previous step, disconnect the output fiber of the optical attenuator from the input of the SD-43 and insert the optical attenuator output into the optical power meter.

23. Adjust the optical power meter to the calibrated wavelength setting of 1550 nm. Note the absolute power displayed. The 1550 nm conversion gain in units of V/mW_{opt} is

((200 μW) / (measured 1550 power)) × (1310 nm conversion gain)

24. Record the 1550 nm conversion gain on the test record.

Noise Equivalent Power

Power the SD-43 O/E converter under test using an 11801 DSO or the stand alone power supply.

1. Zero the RF power meter.

2. Connect the SD-43 O/E converter electrical output to the RF power meter.

3. With the dust cover on the input to the SD-43 O/E converter, the power meter should read less than

$$\frac{[(15\ pW_{opt}\ /\ \sqrt{Hz}\ ) \times \sqrt{18\ GHz} \times (measured\ conversion\ gain\ in\ V/W_{opt})]^2}{50\ \Omega}$$

$$= 8.1 \times 10^{-14} \times (measured\ conversion\ gain\ in\ V/W_{opt})^2$$

$$= W_{elec}$$

(**NOTE :** $V/W_{opt} = V/mW_{opt} \times 1000$)

Example : $18\ V/W_{opt}$ (*or* $0.018\ V/mW$) = *measured conversion gain*

$$W_{elec} = 8.1 \times 10^{-14} \times (18\ V/W_{opt})^2$$
$$= 2.6 \times 10^{-11}$$
$$= 26\ pW$$

4. Record the measured and calculated results on the test record.

Bandwidth/Frequency Response

NOTE. *The performance of every component of your setup has an affect on the overall performance of your system. This procedure allows you to characterize and plot the performance of your particular setup which includes the channel of your sampling oscilloscope, the sampling head, the SD-43 O/E Converter, the electrical cable, and the filter (if any).*

To optimize performance, make sure that all connections are clean and secure and that all components of the system are in good condition. Optical fiber, in particular, can gradually degrade the system performance as it is repeatedly flexed over time.

1. Connect the output of the optical impulse generator to the 10 dB inline attenuator, 90/10 splitter, and optical attenuators as shown in Figure 7. Start with about 30 dB of attenuation on both variable attenuators.

NOTE. *To avoid dispersing the narrow optical impulse signal, keep all fiber lengths as short as possible. Lengths that are 2 to 3 meters long are acceptable.*

2. Before you connect the attenuator to the ORR24, you must adjust the signal on the 10% path to the proper level. To measure the output of the attenuator on the 10% path, you can use another oscilloscope or you can use an optical power meter.

a. If you are using another oscilloscope to display the trigger signal, adjust the attenuation of the 10% path until the ORR24 produces more than 200 mV_{p-p}, but less than 1 V_{p-p} impulse response.

b. If you are using an optical power meter, connect the output of the optical attenuator on the 10% path to the optical power meter. With a pulse width of ~500 fs and a frequency of 10 MHz, adjust the optical attenuator until the power meter reads about 1 μW average power.

Finish connecting the setup as follows:

3. For an SD-43 with the standard configuration, finish connecting the setup as shown in Figure 7. Note that the setup requires an SD-32 sampling head.

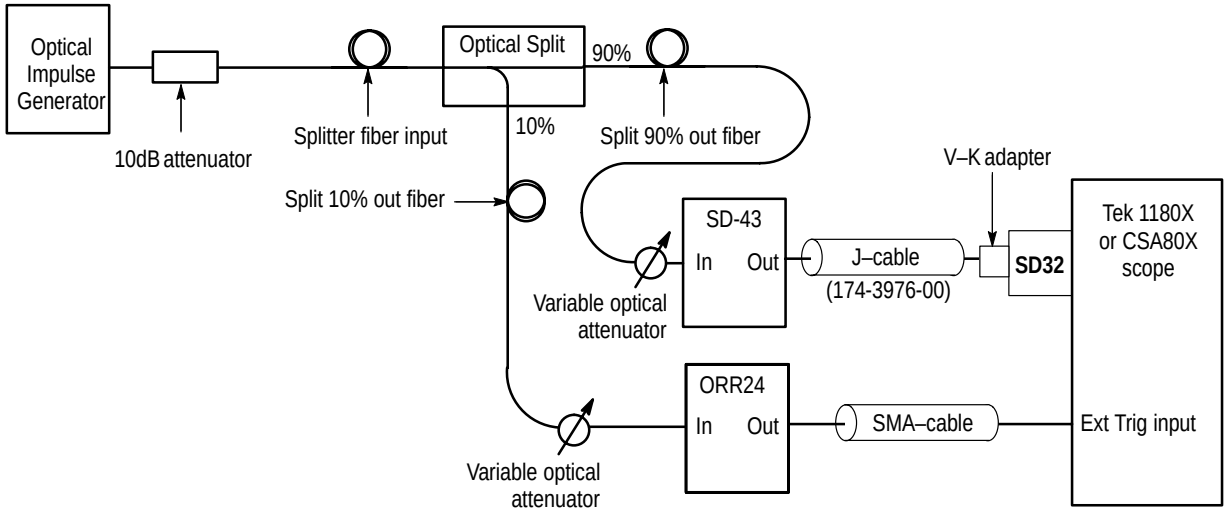

Figure 7: Setup for frequency response measurement, SD-43 standard configuration

4. Set the trigger point midway on the rising edge of the trigger signal.
5. Adjust the attenuation of the 90% path until the SD-43 produces more than 30 $mV_{p\text{-}p}$, but less than 80 $mV_{p\text{-}p}$ impulse response.
6. Locate and center the first impulse (after time zero) on the oscilloscope display. (For a 10 MHz repetition rate, the impulse should occur at about 100 ns. You may experience signal jitter if you try to display a signal that is not the first impulse and is late in relation to time zero.)

Finish setting the oscilloscope controls as follows:

7. For an SD-43 with the standard configuration, set the horizontal time to 100 ps/div, set the vertical controls for maximum screen usage, and set the signal averaging to 64 times and 2048 points.
8. Using a controller (for example, a PC, MAC, workstation, etc.) attached to the scope via GPIB, download the waveform.
9. Using the available controller software (for example, Labview, etc.) perform an FFT (Fast Fourier Transform) on the waveform; this transforms the time-domain (1024-point) impulse response to a scalar frequency response.
10. Normalize the FFT result such that DC or low frequency is 0 dB.
11. Plot the frequency response.
12. Check that the frequency response from DC to 8 GHz is greater than or equal to –6 dB where dB = 20log (V_{log}/V_{dc}) for electrical power into 50 Ω.

This completes the performance verification procedure.

Test record

Model/Serial Number: _____ Certificate Number: _____

Temperature: _____ RH %: _____

Date of Calibration: _____ Technician: _____

Performance test		Minimum	Measured	Maximum
Output zero		N/A		±1 mV
DC conversion gain	at 1310 nm ± 20 nm	0.030 V/mW		N/A
DC conversion gain	at 780 nm ± 20 nm	0.017 V/mW		N/A
DC conversion gain	at 850 nm ± 20 nm	0.020 V/mW		N/A
DC conversion gain	at 1550 nm ± 20 nm	0.025 V/mW		N/A
Noise equivalent power		N/A		_____ W_{elec} (calculated)
Bandwidth DC to 8 GHz		– 6 dB	(attach plot)	N/A

Replaceable Parts

For information about replaceable parts, contact your Tektronix sales representative.

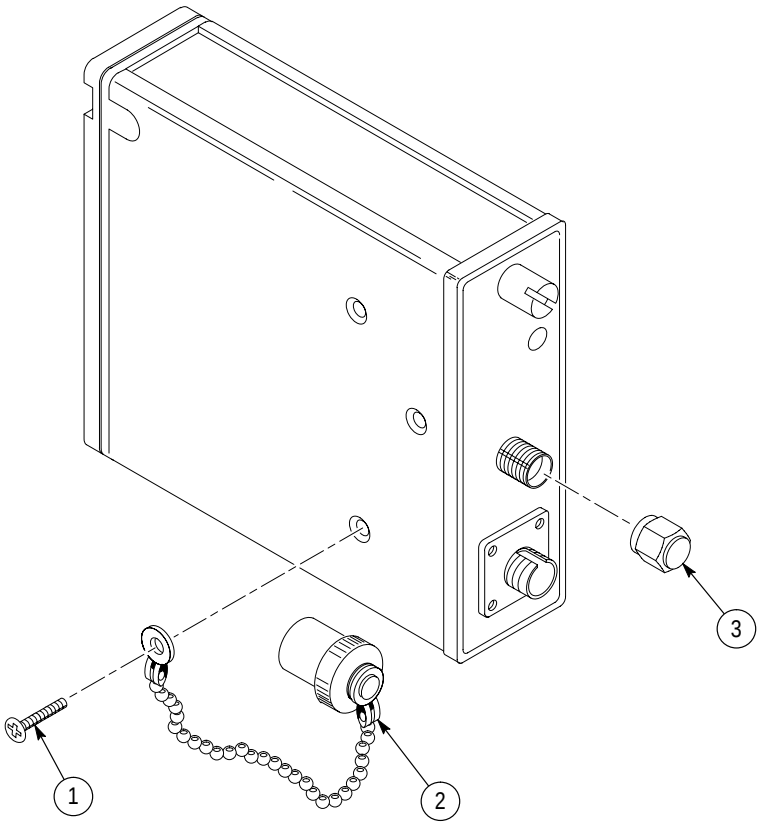

Figure 8: SD-43 replaceable parts

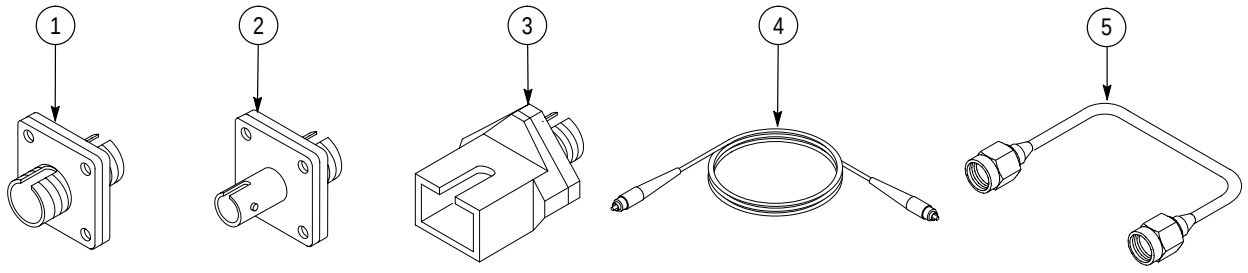

Figure 9: Standard accessories

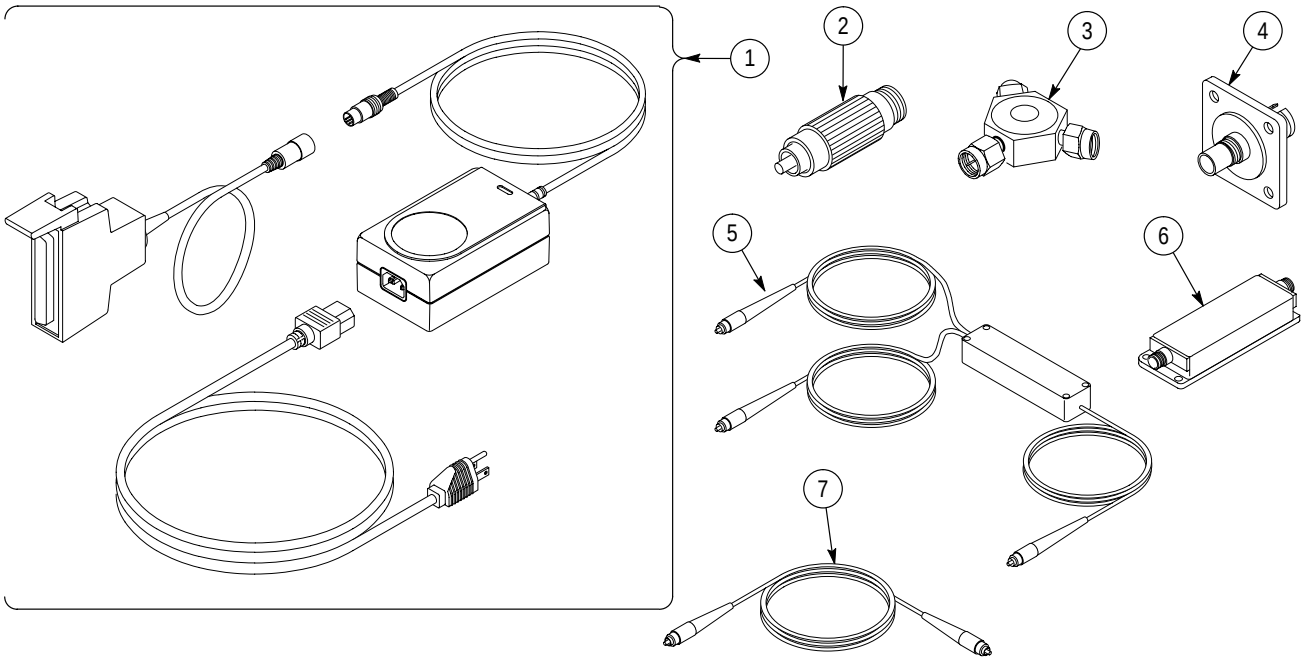

Figure 10: Optional accessories

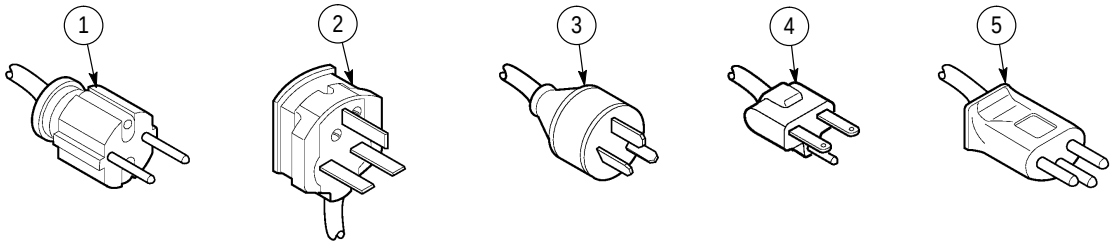

Figure 11: Optional power cords

Replaceable parts list

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description	Mfr. code	Mfr. part number
8–1	211–0062–00			1	SCREW,MACHINE:2–56 X 0.312,PNH,STLCD PL,POZ	93907	ORDER BY DESCRIP
–2	200–3658–00			1	COVER,CONNECTOR:FC,W/CHAIN	80009	200–3658–00
–3	015–1020–00			1	TERM,COAXIAL:SHORT CIRCUIT,SMA	0GZV8	64SMA–50–0–1
					Standard accessories		
9–1	131–6252–00			1	CONN:FC TO FC SQUARE MOUNT ADAPTER,W/ZIRCONIA CERAMIC SLEEVE	0C5R7	CO92290
–2	131–6250–00			1	CONN:FC TO ST ADAPTER W/ZIRCONIA CERAMIC SLEEVE	0C5R7	C032980
–3	131–6251–00			1	CONN:SC TO FC SQUARE FLANGE ADAPTER W/ZIRCONIA CERAMIC SLEEVE	0C5R7	C002453
–4	174–2322–00			1	CA ASSY FBR OPT:MM 2ML FC/PC TO FC/PC	05JW7	174–2322–00
–5	174–3828–00			1	CA ASSY,RF:COAXIAL,RFS,50 OHM, SMA X SMA	060D9	174–3828–00
	016–0156–03			1	CASE,CARRYING:PROBE CARRYING CASE,	0KB01	OBD
	071–0424–00			1	MANUAL,TECH:INSTRUCTION	80009	071–0424–00
					Optional accessories		
10–1	016–1609–00			1	POWER CORD KIT:ADAPTER CABLE & US POWER CORD	80009	016–1609–00
–2	119–5118–00			1	ATTEN,OPTICAL:30MM,L10DBFOR 1310/1550NM,FC CONN.FA100–35–10–HP	0LK97	FA100–35–10–HP
–3	015–0565–00			1	POWER DIVIDER:50 OHM,3 SMA,FEMALE CONN	64537	D293S
	015–1014–00			1	PWR DIVIDER,RES:50 OHM,SMA	64537	D241S
–4	020–2209–00			1	ACCESSORY KIT:CONNECTOR,OPTICAL,DIN RCPT TO FC SQUARE MOUNT ADAPTER,	80009	020–2209–00
–5	174–3737–00			1	FIBER OPTIC:COUPLER, 1 X 2 SPLITTER, WAVELENGTH INDEPENDENT, 90/10 RATIO, ATT. 0.1 DB, REFLE	0C5R7	C166893
–6	119–5929–00			1	FILTER,RFI:LOW PASS,467MHZ –3DB,622.08 MBPS,INS LOSS < 0.02 DB,VMAX=50V,IMAX=1A,50 OHM	80009	119–5929–00
	119–5936–00			1	FILTER,RFI:LOW PASS,117MHZ –3DB,155.52 MBPS,INS LOSS < 0.02 DB,VMAX=50V,IMAX=1A,50 OHM,SDH	80009	119–5936–00
–7	174–4093–00			1	JUMPER,FIBER:OPTIC,62.5UM MULTIMODE,2 METER,SIMPLEX,FC/PC TO SC/PC,ORS20	0CKD9	S2–7YM–2–FIS
					Optional Power Cords		
11–1	161–0066–09			1	CA ASSY,PWR:3,0.75MM SQ,250V/10A,99 INCH,STR,IEC320,RCPT,EUROPEAN,	2W733	ORDER BY DESCRIPTION
–2	161–0066–10			1	CA ASSY,PWR:3,1.0 MM SQ,250V/10A,2.5 METER,STR,IEC320,RCPT X 13A,FUSED UK PLUG(13A FUSE),UNI	TK2541	ORDER BY DESCRIPTION
–3	161–0066–11			1	CA ASSY,PWR:3,1.0MM SQ,250V/10A,2.5 METER,STR,IEC320,RCPT,AUSTRALIA	80126	ORDER BY DESCRIPTION

Replaceable parts list (cont.)

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description	Mfr. code	Mfr. part number
–4	161–0066–12			1	CA ASSY,PWR:3,18 AWG,250V/10A,98 INCH,STR,IEC320,RCPT X NEMA 6–15P,US	S3109	ORDER BY DESCRIPTION
–5	161–0154–00			1	CA ASSY,PWR:3,1.0MM SQ,250V/10A,2.5 METER,STR,IEC320,RCPT,SWISS	5F520	86515030

Manufacturers cross index

Mfr. code	Manufacturer	Address	City, state, zip code
05JW7	PURDY ELECTRONICS CORP	INTEROPTIC DIVISION 720 PALOMAR AVE	SUNNYVALE, CA 94086
060D9	UNITREK CORPORATION	3000 COLUMBIA HOUSE BLVD, SUITE 120	VANCOUVER, WA 98661
0C5R7	ALCOA FUJIKURA LTD	150 RIDGEVIEW CIRCLE	DUNCAN, SC 29334
0CKD9	FIBER INSTRUMENT SALES INC	161 CLEAR ROAD	ORISKANY, NY 13424
0GZV8	HUBER & SUHNER INC	19 THOMPSON DRIVE	ESSEX JUNCTION, VT 05452–3408
0KB01	STAUFFER SUPPLY CO	810 SE SHERMAN	PORTLAND, OR 97214–4657
0LK97	JDS FITEL INC	570 WEST HUNT CLUB RD	NEPEAN, ONTARIO CA ONTARIO K2G 5W8
2W733	BELDEN WIRE & CABLE COMPANY	2200 US HWY 27 SOUTH PO BOX 1980	RICHMOND, IN 47374
5F520	PANEL COMPONENTS CORP	PO BOX 115	OSKALOOSA, IA 52577–0115
64537	KDI/TRIANGLE ELECTRONICS INC	60 S JEFFERSON RD	WHIPPANY, NJ 07981
80009	TEKTRONIX INC	14150 SW KARL BRAUN DR PO BOX 500	BEAVERTON, OR 97077–0001
80126	PACIFIC ELECTRICORD CO	747 WEST REDONDO BEACH PO BOX 10	GARDENA, CA 90247–4203
93907	CAMCAR DIV OF TEXTRON INC	ATTN: ALICIA SANFORD 516 18TH AVE	ROCKFORD, IL 611045181
S3109	FELLER U.S. CORPORATION	72 VERONICA AVE UNIT #4	SOMERSET, NJ 08873
TK2541	AMERICOR ELECTRONICS LTD	UNIT–H 2682 W COYLE AVE	ELK GROVE VILLAGE, IL 60007