ML11357
Rev. B

T-BERD T1
REPEATER EXTENDER

OPERATING MANUAL

FEBRUARY 1994

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GENERAL INFORMATION

1.1 INTRODUCTION

This manual provides information on the physical features, functional operation, and specifications of the Telecommunications Techniques Corporation's (TTC) T-BERD T1 Repeater Extender.

1.2 INSTRUMENT OVERVIEW

The T-BERD T1 Repeater Extender is a hand-held circuit card extender packaged in a rugged plastic case, which provides easy test access to T1 signals at span repeater housings. The T-BERD T1 Repeater Extender is designed to work in conjunction with a T-BERD 107, 107A, 209, 209A, or 211 T-Carrier Analyzer to perform out-of-service testing or monitoring of T1 signals along repeatered spans.

Through the use of switches and jacks, the T-BERD T1 Repeater Extender enables you to monitor T1 signals at repeater inputs and outputs without disrupting the simplex current. The T-BERD T1 Repeater Extender also further sectionalizes span lines by performing signal loopbacks at the repeater and by terminating repeater outputs.

1.3 STANDARD FEATURES

Four test access jacks permit monitoring of test signals at the input and output of T1 repeaters. These jacks also provide direct access to the T1 span for Time Domain Reflectometer (TDR) and DC testing.

SIGNAL and CURRENT path switches enable the T-BERD T1 Repeater Extender to perform signal and current loopbacks at span repeater housings.

The TRANSMIT switch terminates the SIDE 1 or SIDE 2 output of a repeater with a 100-ohm load and allows test signal insertion at any span repeater location without affecting the simplex current.

SIDE 1 and SIDE 2 CURRENT SENSE TEST POINTS provide access for an external volt-ohmmeter.

INSTRUMENT CHECKOUT AND SERVICE

2.1 UNPACKING

The T-BERD T1 Repeater Extender shipping container should be inspected for damage when it is received. If the shipping container or shipping material is damaged, it should be kept until the contents of the shipment have been checked for completeness and the instrument has been checked mechanically and electrically. If the contents are incomplete, or if the T-BERD T1 Repeater Extender does not operate according to specifications, the customer should notify TTC at (800) 638-2049. If the shipping container is damaged, notify the carrier as well as TTC, and keep the shipping container and materials for the carrier's inspection.

2.2 EQUIPMENT INCLUDED

The following equipment should be present when the T-BERD T1 Repeater Extender is received and unpacked.

- T-BERD T1 Repeater Extender
- Operating manual

2.3 WARNINGS AND CAUTIONS

DO NOT TOUCH THE TESTING JACKS OR CABLES ATTACHED TO THE TESTING JACK WHEN CONNECTED TO A LIVE T1 CIRCUIT

High voltage may be encountered at the T1 Repeater Extender TESTING jacks when used on a working span. *To prevent electrical shock*, always plug test cables into test sets before connecting to the TESTING jacks. Always remove test cables from the TESTING jacks before removing them from the test set.

2.4 WARRANTY POLICY

All equipment manufactured by Telecommunications Techniques Corporation (TTC) is warranted against defects in material and workmanship. This warranty applies only to the original purchaser and is non-transferable unless express written authorization of the warranty transfer is granted by TTC.

The T-BERD T1 Repeater Extender will be repaired or replaced (at our option) at no charge for a period stated in the warranty after shipment to the customer. Liability under this warranty extends only to the replacement value of the equipment. The warranty is void under the following conditions:

- Equipment has been altered or repaired without specific authorization from TTC.
- Equipment is installed other than in accordance with instructions contained in TTC literature and operating manuals.

No other warranty is expressed or implied. TTC is not liable for consequential damages.

2.5 IN-WARRANTY SERVICE

Equipment in warranty must be returned to the factory with shipping prepaid. The equipment should be packed and shipped in accordance with instructions in Section 2.7 Equipment Return Instructions. Before returning any equipment, the customer must obtain a Return Authorization (RA) number by contacting the TTC Repair Department. The RA number should then appear on all paperwork and be clearly marked on the outside of the shipping container.

After the equipment is repaired by TTC, it will be tested to applicable specifications and returned to the customer with shipping prepaid. A brief description of the work performed and the materials used will be provided on the Equipment Repair Report furnished with the returned equipment.

2.6 OUT-OF-WARRANTY SERVICE

The procedure for repairing out-of-warranty equipment is the same as that used for equipment still in warranty. However, there is a minimum charge applied to each request for out-of-warranty service. The minimum charge guarantees the customer an estimate of the repair costs and is used as credit against actual materials and labor costs should the equipment be repaired. Contact the TTC Repair Department for specific information on the minimum out-of-warranty repair charge.

The customer will be billed for parts plus standard labor rates in effect at the time of repair. The customer will also be required to furnish a purchase order number before repair work can be started, and a hard copy of the purchase order must be received by TTC before the repaired equipment may be shipped to the customer. A description of the labor and materials used will be provided in the Equipment Repair Report.

Once an out-of-warranty repair is made, the repaired part or component is warranted for 90 days. This warranty applies only to the part or component that was repaired; other parts or components are not covered under the 90-day repair warranty.

2.7 EQUIPMENT RETURN INSTRUCTIONS

To all equipment returned for repair, the customer should attach a tag that includes the following information:

- Owner's name and address.
- A list of the equipment being returned and the applicable serial number(s).
- A detailed description of the problem or service requested.
- The name and telephone number of the person to contact regarding questions about the repair.
- The Return Authorization (RA) number.

All switches should be left in the positions they were in when the problem occurred.

If possible, the customer should return the equipment using the original shipping container and material. If the original container is not available, the unit should be carefully packed so that it will not be damaged in transit. TTC is not liable for any damage that may occur during shipping. The customer should clearly mark the TTC-issued RA number on the outside of the package and ship it prepaid and insured to TTC.

INSTRUMENT DESCRIPTION

3.1 INTRODUCTION

This section may be used as a guide to understanding the functions of the T-BERD T1 Repeater Extender (see Figure 3-1). The controls, connectors, and test points are discussed in detail in the following order:

Test Setup — Describes the controls used to configure the T-BERD T1 Repeater Extender to access the T1 circuit and to control the signal and simplex current paths.

Test Connections — Discusses the T1 circuit connectors and test points used to access the T1 circuit at a span repeater housing.

3.2 TEST SETUP

The following controls are described in the order that you would normally use them to access the T1 circuit at a span repeater housing:

- **TEST** switch (1)
- **TRANSMIT** switch (2)
- **SIGNAL PATH** switch (3)
- **CURRENT PATH** switch (4)

TEST Switch (1)

This two-position switch determines the T1 testing mode of the T-BERD T1 Repeater Extender. Figure 3-2 provides a detailed illustration of the T-BERD T1 Repeater Extender in DC and T1 testing modes.

DC — Provides direct access to each cable pair (*Side 1* and *Side 2*) entering and leaving the T-BERD T1 Repeater Extender. In DC testing mode the SIDE 1 and SIDE 2 jacks are directly connected to the span, which enables voltage, resistance, and capacitance measurements as well as TDR tests.

NOTE: The DC selection overrides all other switch positions.

Figure 3-1
T-BERD T1 Repeater Extender

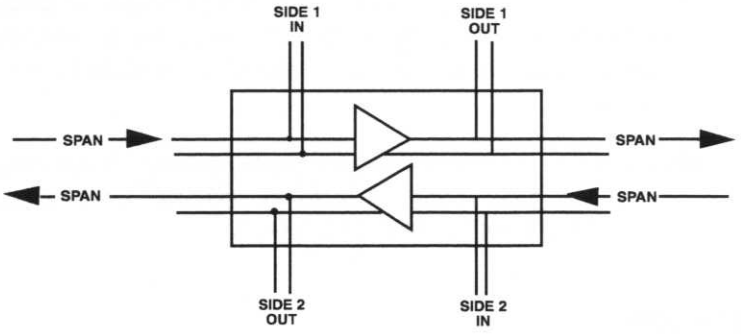


Figure 3-2
TEST Switch T1 Testing Modes

T1 — Enables operation using the **TRANSMIT**, **SIGNAL PATH**, or **CURRENT PATH** switches. In T1 testing mode the SIDE 1, SIDE 2, and TRANSMIT jacks are all connected to the circuit through transformers. The transformers enable the T-BERD T1 Repeater Extender to independently loop both the current and signal, provide access to the simplex current, properly terminate an incoming signal, and insert a test pattern.

NOTE: When set to the T1 position, any combination of switches may be used. For example, **TRANSMIT** switch in TX SIDE 1 with **SIGNAL PATH** switch set to LOOP.

TRANSMIT Switch (2)

You can select which side of the T1 circuit is available for inserting test signals into the span with this three-position switch. Figure 3-3 provides a detailed illustration of the **TRANSMIT** switch configurations.

NOTE: The **TRANSMIT** switch does not affect the simplex current.

TX SIDE 1 — Breaks the signal output of repeater *Side 1*, terminating it in a 100-ohm resistor. A new test signal can be inserted via the TRANSMIT jack. The signal path of *Side 2* remains in the THRU mode.

THRU — Creates a straight-through path which allows the signals to pass through the T-BERD T1 Repeater Extender unchanged.

TX SIDE 2 — Breaks the signal output of repeater *Side 2*, terminating it in a 100-ohm resistor. A new test signal can be inserted via the TRANSMIT jack. The signal path of *Side 1* remains in the THRU mode.

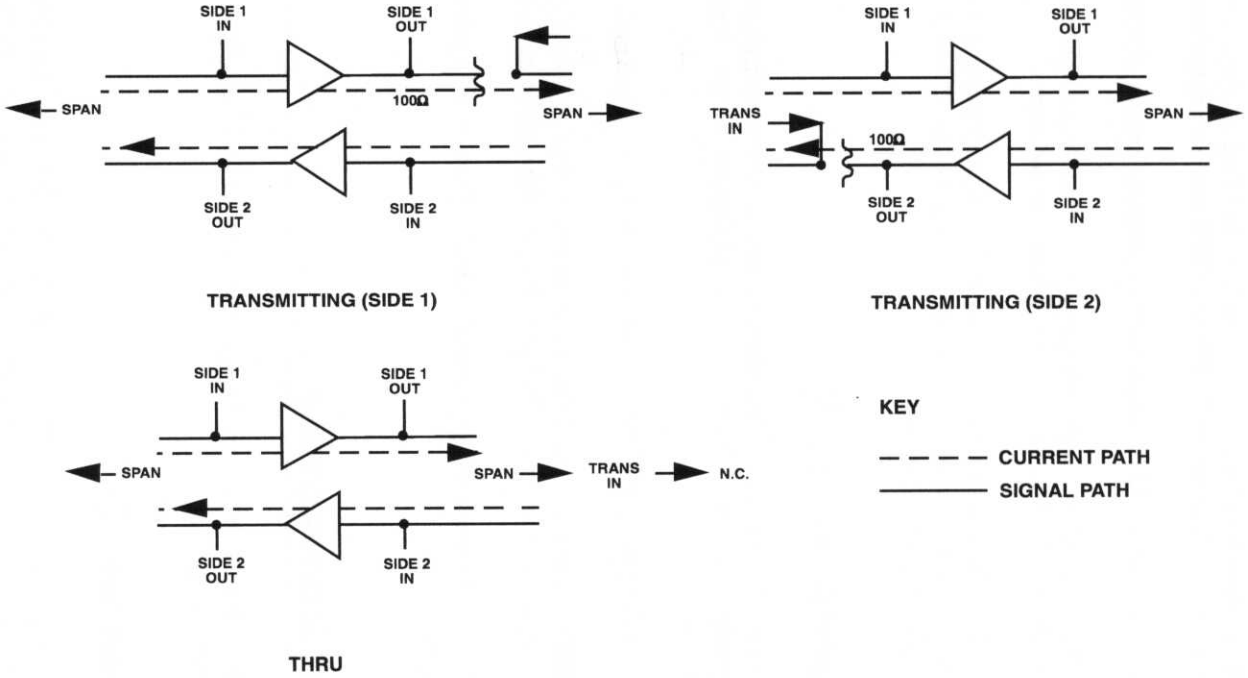


Figure 3-3
TRANSMIT Switch Configurations

SIGNAL PATH Switch (3)

This two-position switch determines the path of the T1 signal. Figure 3-4 provides a detailed illustration of the **SIGNAL PATH** switch configurations.

NOTE: The **SIGNAL PATH** switch does not affect the simplex current.

THRU — Creates a straight-through path which allows the signals to pass through the T-BERD T1 Repeater Extender unchanged.

LOOP — Creates a loopback in the circuit. The repeater output of *Side 1* is routed to the output of *Side 2* and the repeater output of *Side 2* is routed to the output of *Side 1*.

CURRENT PATH Switch (4)

This two-position switch determines the path of the simplex current. Figure 3-5 provides a detailed illustration of the **CURRENT PATH** switch configuration.

NOTE: The **CURRENT PATH** switch does not disrupt the signal path.

THRU — Creates a straight-through path which allows the simplex current to pass through the T-BERD T1 Repeater Extender unchanged.

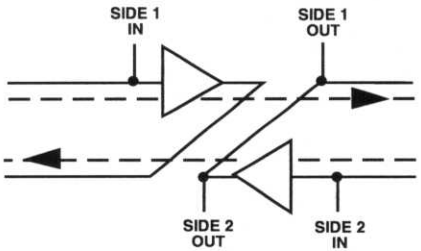
LOOP — Loops the simplex current toward the direction of the power supply.

3.3 TEST CONNECTIONS

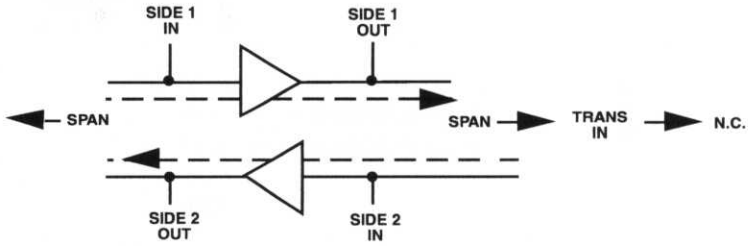
The following test connections provide access to the T1 circuit at a repeater housing.

TESTING Jacks (5)

The four jacks labeled SIDE 1 OUT, SIDE 2 OUT, SIDE 1 IN, and SIDE 2 IN are hardwired to the input and output ports of the repeater. This enables a T-BERD T-Carrier Analyzer to access and monitor T1 signals at span repeater housings.



SIGNAL LOOPING
(CURRENT THRU)



THRU

KEY

— — — — CURRENT PATH

——— SIGNAL PATH

Figure 3-4
SIGNAL PATH Switch Configurations

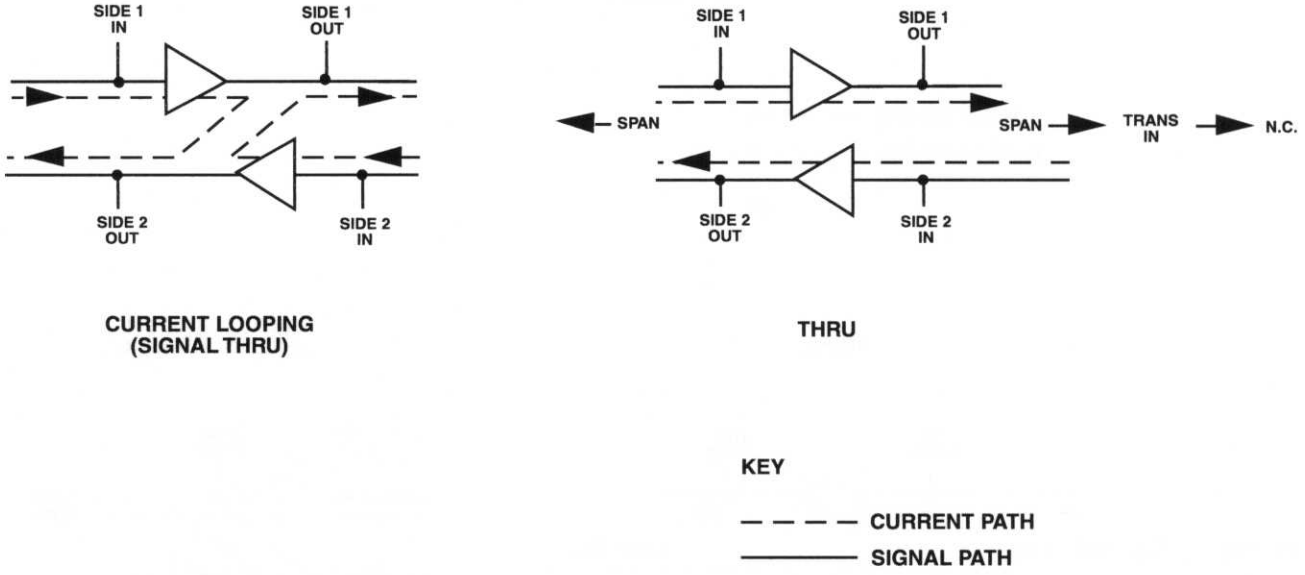


Figure 3-5
CURRENT PATH Switch Configurations

The **TEST** switch determines the operation of these jacks. In DC test mode, the jacks provide direct access to the T1 span. In T1 test mode, a transformer isolates the span enabling the jacks to terminate a signal, transmit a signal, and separate simplex current.

NOTE: Use these jacks with any switch position.

TRANSMIT Jack (6)

The TRANSMIT jack terminates the received signal and allows a T-BERD 107, 107A, 209, 209A, or 211 T-Carrier Analyzer to insert a new T1 test signal down the span line. The **TRANSMIT** switch determines which side of the repeater (*Side 1* or *Side 2*) receives the new T1 test signal.

NOTE: Do not use the TRANSMIT jack when performing DC tests.

CURRENT SENSE TEST POINTS (7)

The CURRENT SENSE TEST POINTS enable a volt-ohmmeter to measure the simplex current. The current is measured by recording the voltage across a 1-ohm resistor. The measured voltage is equal to the simplex current.

OPERATION

4.1 INTRODUCTION

This section contains step-by-step instructions on using the T-BERD T1 Repeater Extender in conjunction with the T-BERD 107, 107A, 209, 209A, or 211 (T-BERD T-Carrier Analyzer). A variety of common test scenarios, instrument set-ups, and troubleshooting procedures are provided.

4.2 MONITORING SIGNALS AT THE REPEATER

The T-BERD T1 Repeater Extender provides access to the T1 circuit at a span repeater. A T-BERD T-Carrier Analyzer or similar test instrument transmits a signal down the span line, and the signal is looped at the network interface.

Perform the following procedure to set up a test at a T1 repeater.

1. **Remove the selected repeater from the repeater housing unit**

   CAUTION: Removing the repeater will disable the selected T1 span line.

2. **Insert the T1 repeater into the repeater slot on the T-BERD T1 Repeater Extender**

3. **Configure the T-BERD T1 Repeater Extender switches:**

TEST	T1
TRANSMIT	THRU
SIGNAL PATH	THRU
CURRENT PATH	THRU

4. Insert the T-BERD T1 Repeater Extender into the appropriate repeater slot

CAUTION: High voltage may be encountered at the T1 Repeater Extender TESTING jacks when used on a working span. *To prevent electrical shock*, always plug test cables into test sets before connecting to the TESTING jacks. Always remove test cables from the TESTING jacks before removing them from the test set.

5. Configure the test set to receive a T1 signal

Set the RECEIVE/RX INPUT switch to BRIDGE. For more information on configuring the test set, consult the test set's User's Guide.

6. T1 test set connection

Use a WECO 310 cable to connect the test set's INPUT/RECEIVE jack to either the SIDE 1 IN, SIDE 1 OUT, SIDE 2 IN, or SIDE 2 OUT jack on the T-BERD T1 Repeater Extender (see Figure 4-1). For best results, use a short cable to minimize the effect of bridging on the test.

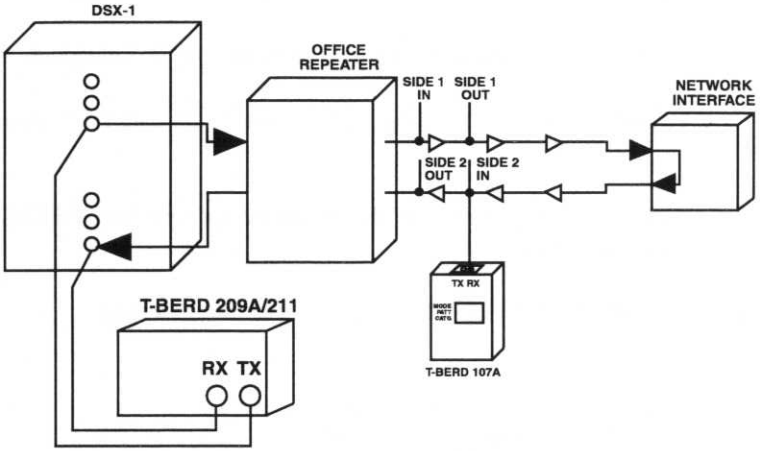


Figure 4-1
Monitoring Signals

7. RESTART switch

Press the **RESTART** switch to clear any test results and begin the test.

8. Status LEDs

These LEDs should illuminate: T1 Pulses, Frame Sync, Pattern (if appropriate), and B8ZS (if applicable).

9. Results interpretation

If the Error Event LED (or other alarm LED) is illuminated, the signal contains errors. Refer to the following for help in interpreting the results obtained from the test.

Pulses are not received at the repeater housing

Cause 1: A test signal has not been applied to the span.

Action: Apply a test signal to the span using a T-BERD T-Carrier Analyzer.

Cause 2: The simplex current level is too low.

Action: Measure the simplex current in accordance with Section 4.7 Measuring Simplex Current. Also check for cable shorts, proper office repeater connections, etc. See Section 4.8, Performing TDR and DC Tests.

Violations (BPVs), frame/CRC errors, and bit errors at the repeater input

Cause: Check the test set's RECEIVE LEVEL result. If the signal level is below engineering specifications, a fault may exist on the span immediately preceding the repeater input or may be caused by a repeater or cable section closer to the signal source.

Action: Check for faults along the span line coming into the repeater. To isolate the location of the fault, see Section 4.8, Performing TDR and DC Tests.

More BPVs, frame/CRC errors, and bit errors at repeater output than at repeater input

Cause 1: The repeater may not be operating properly.

Action: Replace the repeater and repeat the test.

Cause 2: A cable problem may exist on the output side of the repeater. Typical problems include bridge taps, load coils, and unbalanced pairs due to incorrect splices.

Action: To isolate the problem, terminate the repeater output (See Section 4.4 Terminating Repeater Outputs) or loop the signal (see Section 4.3 Signal Loopbacks at Span Repeaters).

4.3 SIGNAL LOOPBACKS AT SPAN REPEATERS

The T-BERD T1 Repeater Extender provides a signal loopback at a span repeater. The signal at the output of *Side 1* is looped to the output of *Side 2*, and vice versa. This procedure helps to sectionalize long span lines and to isolate the location of faults. The test set monitors the signal at the output of *Side 1*, and a T-BERD T-Carrier Analyzer, or equivalent, generates the appropriate test pattern at the central office.

Perform the following procedure to set up a test at a mid-span T1 repeater.

1. **Remove the selected repeater from the repeater housing unit**

   CAUTION: Removing the repeater will disable the selected T1 span line.

2. **Insert the T1 repeater into the repeater slot on the T-BERD T1 Repeater Extender**

3. **Configure the T-BERD T1 Repeater Extender switches:**

TEST	T1
TRANSMIT	THRU
SIGNAL PATH	LOOP
CURRENT PATH	THRU

4. **Insert the T-BERD T1 Repeater Extender into the appropriate repeater slot**

   CAUTION: High voltage may be encountered at the T1 Repeater Extender TESTING jacks when used on a working span. *To prevent electrical shock*, always plug test cables into

test sets before connecting to the TESTING jacks. Always remove test cables from the TESTING jacks before removing them from the test set.

5. Configure the test set to receive a T1 signal

Set the RECEIVE/RX INPUT switch to BRIDGE. For more information on configuring the test set, consult the test set's User's Guide.

6. T1 test set connection (if desired)

When testing between the central office and the repeater housing, use a WECO 310 cable to connect the test set's INPUT/RECEIVE jack to either the SIDE 1 IN or SIDE 1 OUT jack on the T-BERD T1 Repeater Extender (see Figure 4-2). For best results, use a short test cable to minimize the effect of bridging on the test.

When testing between the repeater housing and the remote terminal, customer, or other central office, use a WECO 310 cable to connect the test set's INPUT/RECEIVE jack to either the SIDE 2 IN or SIDE 2 OUT jack on the T-BERD T1 Repeater Extender (see Figure 4-2). For best results, use a short test cable to minimize the effect of bridging on the test.

7. RESTART switch

Press the **RESTART** switch on the test set to clear any test results and begin the test.

8. Status LEDs

These LEDs should illuminate: T1 Pulses, Frame Sync, Pattern (if appropriate), and B8ZS (if applicable).

NOTE: When using a T-BERD T-Carrier Analyzer, or equivalent, to generate test signals, Pattern Sync should be achieved when the signal is looped at the repeater (Pattern Sync LED illuminated on the T-BERD T-Carrier Analyzer, or equivalent).

9. Results interpretation

If the Error Event LED (or other alarm LED) is illuminated, the signal contains errors. Refer to the following for help in interpreting the results obtained from the test.

Errors do not occur at the repeater or the central office

Cause: The span between the central offfice and the repeater is operating correctly.

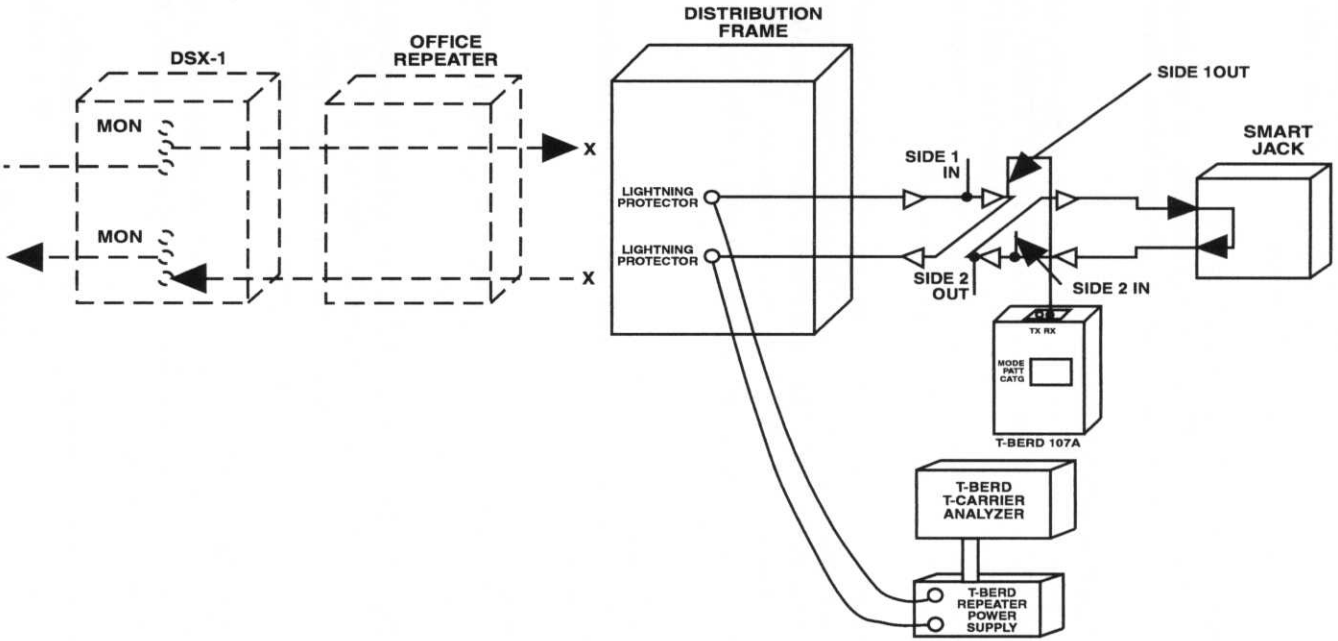


Figure 4-2
Signal Loopbacks

Action: To fully verify the operation of the span line, test with a number of different patterns (QRSS, 1:7, or 3 IN 24).

Violations (BPVs), frame/CRC errors, and bit errors at the repeater input and at the central office

Cause: A problem may exist on the span line or with the repeaters coming from the central office.

Action: To isolate the problem, perform this test at the next repeater closer to the central office. This will sectionalize the span line and help to isolate the location of the problem.

More BPVs, frame/CRC errors, and bit errors register at the central office only

Cause: A problem may exist on the span line toward the central office.

Action: Verify the performance of repeaters closer to the central office and check the cable for bad splices, bridge taps, and load coils. See Section 4.8, Performing TDR and DC Tests.

4.4 TERMINATING REPEATER OUTPUTS

The T-BERD T1 Repeater Extender terminates the repeater output of *Side 1*. Perform this test when more errors occur at the output of the repeater than occur at the input of the repeater. Errors occurring at the output of the repeater can be caused by a bad repeater or a fault (bridge taps, one side open, etc.) in the outgoing cable. Terminate the output of the repeater to isolate the source of the problem.

Perform the following procedure to set up a test at a mid-span T1 repeater.

1. **Remove the selected repeater from the repeater housing unit**

   CAUTION: Removing the repeater will disable the selected T1 span line.

2. **Insert the T1 repeater into the repeater slot on the T-BERD T1 Repeater Extender**

3. Configure the T-BERD T1 Repeater Extender switches:

TEST	T1
TRANSMIT	TX SIDE 1 (if testing toward Customer Premises) TX SIDE 2 (if testing toward the Central Office)
SIGNAL PATH	THRU
CURRENT PATH	THRU

4. Insert the T-BERD T1 Repeater Extender into the appropriate repeater slot

CAUTION: High voltage may be encountered at the T1 Repeater Extender TESTING jacks when used on a working span. *To prevent electrical shock*, always plug test cables into test sets before connecting to the TESTING jacks. Always remove test cables from the TESTING jacks before removing them from the test set.

5. Configure the test set to receive a T1 signal

Set the RECEIVE/RX INPUT switch to TERM. For more information on configuring the test set, consult the test set's User's Guide.

6. T1 test set connection

Use a WECO 310 cable to connect the test set's INPUT/RECEIVE jack to the SIDE 1 OUT jack on the T-BERD T1 Repeater Extender (see Figure 4-3). For best results, use a short test cable to minimize the effect of bridging on the test.

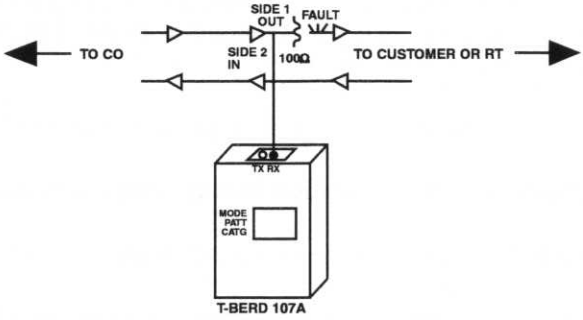


Figure 4-3
Terminating Repeater Outputs

7. RESTART switch

Press the **RESTART** switch on the test set to clear any test results and begin the test.

8. Status LEDs

These LEDs should illuminate: T1 Pulses, Frame Sync, Pattern (if appropriate), and B8ZS (if applicable).

NOTE: When using a T-BERD T-Carrier Analyzer, or equivalent, to generate test signals, Pattern Sync should be achieved when the signal is looped at the repeater (Pattern Sync LED illuminated on the T-BERD T-Carrier Analyzer, or equivalent).

9. Results interpretation

If the Error Event LED (or other alarm LED) is illuminated, the signal contains errors. Refer to the following for help in interpreting the results obtained from the test.

Violations (BPVs), frame/CRC errors, and bit errors disappear when the repeater output is terminated

Cause: A problem may exist on the span line beyond the repeater.

Action: Check the cable for load coils, bridge taps, build out capacitors, or improper splices. See Section 4.8 Performing TDR and DC Tests.

More BPVs, frame/CRC errors, and bit errors register at the repeater output after the line has been terminated

Cause: The repeater is not operating correctly.

Action: Replace the repeater and perform the test again.

4.5 TRANSMITTING TEST SIGNALS FROM SPAN REPEATERS

The T-BERD T1 Repeater Extender enables a test set to test the cables between the network interface and the span repeaters. This test permits a T-BERD T-Carrier Analyzer, or equivalent, to insert signals at span repeater locations, and it enables technicians to perform test loopbacks at the apparatus case.

Perform the following procedure to set up a test at a mid-span T1 repeater.

1. **Remove the selected repeater from the repeater housing unit**

   CAUTION: Removing the repeater will disable the selected T1 span line.

2. **Insert the T1 repeater into the repeater slot on the T-BERD T1 Repeater Extender**

3. **Configure the T-BERD T1 Repeater Extender switches:**

TEST	T1
TRANSMIT	TX SIDE 1
SIGNAL PATH	THRU
CURRENT PATH	THRU

4. **Insert the T-BERD T1 Repeater Extender into the appropriate repeater slot**

   CAUTION: High voltage may be encountered at the T1 Repeater Extender TESTING jacks when used on a working span. *To prevent electrical shock*, always plug test cables into test sets before connecting to the TESTING jacks. Always remove test cables from the TESTING jacks before removing them from the test set.

5. **Configure the test set to receive a T1 signal**
   Set the RECEIVE/RX INPUT switch to TERM. For more information on configuring the test set, consult the test set's User's Guide.

6. **T1 test set connection**
   Use a WECO 310 cable to connect the test set's TRANSMIT jack to the TRANSMIT jack on the T-BERD T1 Repeater Extender (see Figure 4-4). For best results, use a short test cable to minimize the effect of bridging on the test.

Use a WECO 310 cable to connect the test set's INPUT/ RECEIVE jack to the SIDE 2 IN jack on the T-BERD T1 Repeater Extender (see Figure 4-4). For best results, use a short test cable to minimize the effect of bridging on the test.

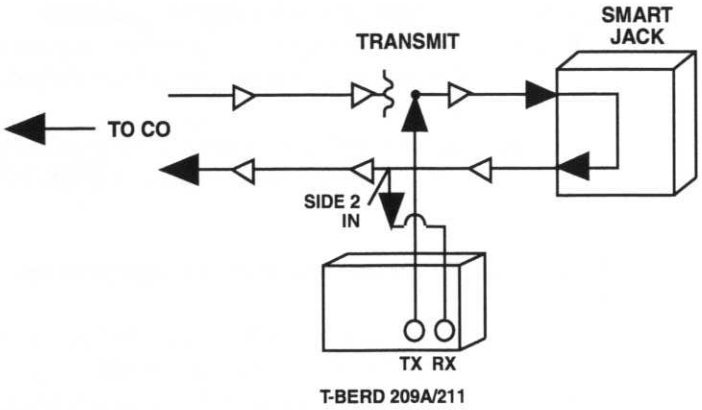


Figure 4-4
Transmitting Test Signals

7. **Configure the T-Carrier Analyzer for the appropriate pattern and loop codes**

   Select the pattern and loop codes needed for the T1 circuit. Press the **LOOP UP** switch to send the selected loop-up code. For more information on configuring the test set, consult the appropriate User's Guide.

8. **Select SUMMARY results category**

9. **Status LEDs**

   These LEDs should illuminate: T1 Pulses, Frame Sync, Pattern (if appropriate), and B8ZS (if applicable).

   NOTE: When using a T-BERD T-Carrier Analyzer, or equivalent, to generate test signals, Pattern Sync should be achieved when the signal is looped at the repeater (Pattern Sync LED illuminated on the T-BERD T-Carrier Analyzer, or equivalent).

10. Results interpretation

If the Error Event LED (or other alarm LED) is illuminated, the signal contains errors. Refer to the following for help in interpreting the results obtained from the test.

***ALL RESULTS OK* appears in the RESULTS display**

Cause: The span between the apparatus case and the network interface is operational with the pattern selected.

Action: To fully verify the operation of the span line, test with a number of different patterns (QRSS, 1:7, or 3 IN 24).

BPVs, frame/CRC errors, and bit errors register at the repeater

Cause: The span between the apparatus case and the network interface is not operational.

Action: To isolate the problem, perform this test at the next repeater housing toward the network interface.

4.6 LOOPING SIMPLEX CURRENT AT SPAN REPEATERS

The T-BERD T1 Repeater Extender loops the simplex current at the repeater back to the sending office. This test is useful in locating power loop faults in a span line. Since T-Carrier span lines are series circuits, a power fault anywhere along the span will disable the entire span. Do not loop current at repeaters in a loop power mode.

CAUTION: Looping the simplex current on older model office repeaters may blow span fuses. Consult with the central office before performing this test.

Perform the following procedure to loop simplex current at a span repeater housing.

1. Remove the selected repeater from the repeater housing unit

CAUTION: Removing the repeater will disable the selected T1 span line.

2. **Insert the T1 repeater into the repeater slot on the T-BERD T1 Repeater Extender**

3. **Configure the T-BERD T1 Repeater Extender switches:**

TEST	T1
TRANSMIT	THRU
SIGNAL PATH	LOOP
CURRENT PATH	LOOP

NOTE: Looping the simplex current disables the span beyond the looped repeater (see Figure 4-5).

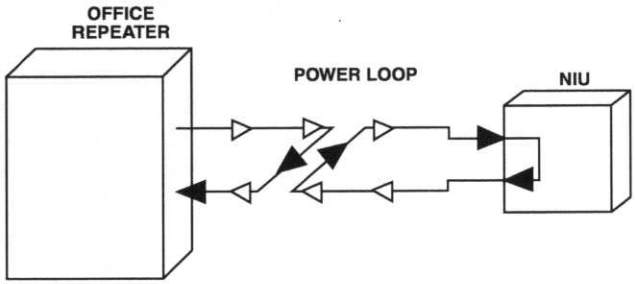


Figure 4-5
Looping Simplex Current

4. **Insert the T-BERD T1 Repeater Extender into the appropriate repeater slot**

CAUTION: High voltage may be encountered at the T1 Repeater Extender TESTING jacks when used on a working span. *To prevent electrical shock*, always plug test cables into test sets before connecting to the TESTING jacks. Always remove test cables from the TESTING jacks before removing them from the test set.

5. **Measure loop simplex current**

Simplex current in the central office-to-repeater loop can be measured across the SIDE 2 CURRENT SENSE TEST POINTS. Simplex current in the repeater-to-remote terminal loop can be measured across the SIDE 1 CURRENT SENSE TEST POINTS.

6. Results interpretation

Refer to the following for help in interpreting the results obtained from the test.

The simplex current fails to appear after looping the current.

Cause: A fault may exist closer to the power source.

Action: To isolate the location of the fault, perform this test at the next repeater closer to the power source. If the simplex current appears, a fault exists on the span between the two repeaters.

Simplex current appears after looping the current.

Cause: A cable fault exists on the cable further down the span.

Action: To isolate the location of the fault, perform this test at the next repeater further from the power source. If the simplex current does not appear, the fault exists on the span between the two repeaters.

4.7 MEASURING SIMPLEX CURRENT

The T-BERD T1 Repeater Extender provides volt-ohmmeter access to a span repeater to measure the voltage across a known resistance. The current is directly proportional to the voltage (60 mv = 60 mA). Use this test to determine if the span is properly powered.

Perform the following procedure to measure simplex current at a span repeater housing.

1. Remove the selected repeater from the repeater housing unit

CAUTION: Removing the repeater will disable the selected T1 span line.

2. **Insert the T1 repeater into the repeater slot on the T-BERD T1 Repeater Extender**

3. **Configure the T-BERD T1 Repeater Extender switches:**

TEST	T1
TRANSMIT	THRU
SIGNAL PATH	THRU
CURRENT PATH	THRU

4. **Insert the T-BERD T1 Repeater Extender into the appropriate repeater slot**

CAUTION: High voltage may be encountered at the T1 Repeater Extender TESTING jacks when used on a working span. *To prevent electrical shock*, always plug test cables into test sets before connecting to the TESTING jacks. Always remove test cables from the TESTING jacks before removing them from the test equipment.

5. **Measure the SIDE 1 voltage**

Place the volt-ohmmeter voltage setting on the lowest value (300 mv or lower). Place the positive and negative leads of your volt-ohmmeter across the positive and negative terminals of the SIDE 1 CURRENT SENSE TEST POINTS (see Figure 4-6).

NOTE: The current is directly proportional to the voltage (60 mv = 60 mA).

CAUTION: High voltage potential may exist between the SIDE 1 and SIDE 2 CURRENT SENSE TEST POINTS. Connecting a volt-ohmmeter set on the lowest value across SIDE 1 and SIDE 2 simultaneously could damage the volt-ohmmeter.

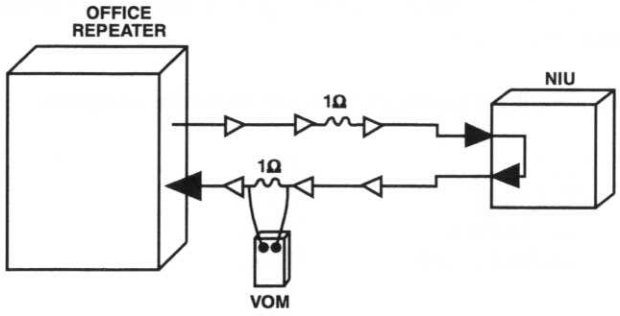


Figure 4-6
Measuring Simplex Current

6. Measure the SIDE 2 voltage

Place the positive and negative leads of your volt-ohmmeter across the positive and negative terminals of the SIDE 2 CURRENT SENSE TEST POINTS (see Figure 4-6). With the T-BERD T1 Repeater Extender **CURRENT PATH** switch set to THRU, the current measured on SIDE 2 should equal that measured at SIDE 1.

CAUTION: High voltage potential may exist between the SIDE 1 and SIDE 2 CURRENT SENSE TEST POINTS. Connecting a volt-ohmmeter set on the lowest value across SIDE 1 and SIDE 2 simultaneously could damage the volt-ohmmeter.

7. CURRENT PATH switch

Set the **CURRENT PATH** switch to LOOP.

8. Repeat Step 5

With the T-BERD T1 Repeater Extender **CURRENT PATH** switch set to LOOP, the current measured at SIDE 1 should remain the same.

9. Results interpretation

Refer to the following for help in interpreting the results obtained from the test.

Simplex current is not present on the span.

Cause: A power fault may exist.

Action: To determine if a fault exists, loop the simplex current. See Section 4.6, Looping Simplex Current at Span Repeaters.

Simplex current level is too high.

Cause: A ground fault may exist along the span.

Action: To isolate the problem, sectionalize the line by looping the simplex current. Verify that shorts do not exist along the span. Also see Section 4.8, Performing TDR and DC Tests.

4.8 PERFORMING TDR AND DC TESTS

The T-BERD T1 Repeater Extender provides test access to the cable pairs entering and leaving the repeater apparatus case. This access enables the T-BERD 209A/211 to perform TDR tests when testing a new span or when troubleshooting an existing span. This configuration can also be used to perform voltage, resistance, and capacitance measurements.

1. **Remove the selected repeater from the repeater housing unit**

   CAUTION: Removing the repeater will disable the selected T1 span line.

2. **Configure the T-BERD T1 Repeater Extender switch:**

   TEST DC

   NOTE: DC mode overrides all other switch positions.

3. **Insert the T-BERD T1 Repeater Extender into the appropriate repeater slot**

   CAUTION: High voltage may be encountered at the T1 Repeater Extender TESTING jacks when used on a working span. *To prevent electrical shock*, always plug test cables into test sets before connecting to the TESTING jacks. Always remove test cables from the TESTING jacks before removing them from the test set.

   NOTE: Do not insert the T1 Repeater into the repeater slot on the T-BERD T1 Repeater Extender.

4. Configure the test set to perform a TDR test

Configure the T-BERD 209A/211, or equivalent, to test cable pairs with the TDR Option. For more information on configuring the T-BERD 209A/211, consult the *T-BERD 209A/211 T-Carrier Analyzer User-s Guide.*

5. T1 test set connection

Use a WECO 310 cable to connect the test set's TRANSMIT jack to the SIDE 1 IN, SIDE 1 OUT, SIDE 2 IN, or SIDE 2 OUT jack on the T-BERD T1 Repeater Extender (see Figure 4-7). For best results, use a short test cable to minimize the effect of bridging on the test.

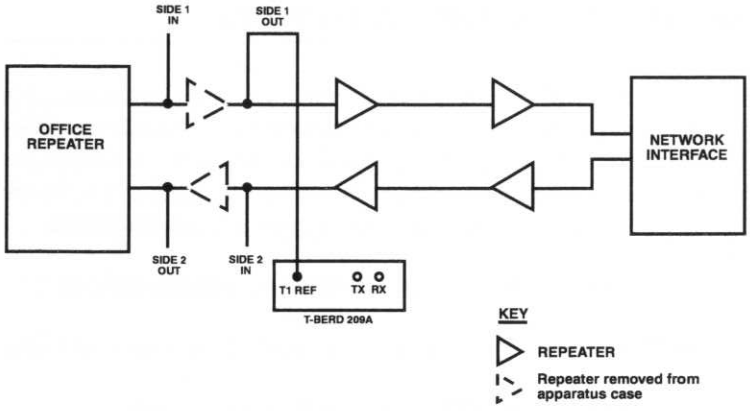


Figure 4-7
TDR Measurements Test

6. RESTART switch

Press the **RESTART** switch on the test set to clear any test results and begin the test.

7. TDR test verification

Verify the following on the T-BERD 209A/211, or equivalent:

- The word *testing* appears in the PATTERN display
- Initially, the message *RESULTS NOT AVAILABLE* appears in the RESULTS I display

- When the test is complete, the fault and distance information appears in the RESULTS I display

8. Results interpretation

The TDR test can identify multiple faults. Due to the reduction of the signal strength caused by multiple faults, additional faults may exist beyond those indicated in the first test. Therefore, the TDR test should be repeated after the identified faults are cleared. Refer to the following for help in interpreting the TDR results.

An open is reported at the distance corresponding to the expected cable pair length.

Cause: The cable pair is good.

Action: No further testing is required on this cable pair.

A single fault (open, short, or bridge tap) is reported at a distance less than the expected cable pair length.

Cause: The cable pair has an open, short, or bridge tap at the indicated distance.

Action: The fault must be cleared and the TDR test procedure repeated.

Multiple faults are reported at different distances less than the expected cable pair length.

Cause: The cable pair has multiple faults at the indicated distances.

Action: The faults must be cleared and the TDR test procedure repeated.

Unrecognized fault is reported at a distance less than the expected cable pair length.

Cause: The cable pair has a fault the test set could not identify at the indicated distance.

Action: Printout the TDR trace and compare the fault's shape to known fault traces. Check the TDR setup parameters to ensure they are correct (an open on a PIC/24 cable may be an unrecognized fault if PIC/22 is selected). The fault must be investigated and cleared, and the TDR test procedure should be repeated.

SPECIFICATIONS

5.1 GENERAL SPECIFICATIONS

Physical

Size:	2.4"H x 4.0"W x 12.1"L (6.1 cm x 10.2 cm x 30.8 cm).
Weight:	1.9 lbs (.86 kg).

Operational

Operating Temperature Range:	0°C to +60°C (32°F to +140°F).
Storage Temperature Range:	-20°C to +70°C (-4°F to +158°F).

5.2 INPUT SPECIFICATIONS

Connectors:	WECO 310 jack.
Terminating Resistance:	100 ohms ± 5%.
Current Sense Resistors:	1 ohm ± .5%.

5.3 REPEATER TYPES

T1 Mini Type: WECO 238/239 or equivalent.

5.4 GROUNDING

WECO 310 TRANSMIT jack sleeve connected to chassis ground. All other WECO 310 jack sleeves float; connection to ground made at test instrument.