Application Note

T-BERD Communications Analyzer (310)

DS3 Testing

Introduction

Out-of-service tests performed during installation on DS3 ATM switches, DS3 cross-connects, DS3 multiplexers, and SONET add drop multiplexers (ADMs), isolate a host of problems that can interrupt service

DS3 testing with the JDSU T-BERD® Communications Analyzer (310) Overview

Network service providers are under increasing pressure to maintain customer satisfaction by providing high quality service as quickly as possible. Performing comprehensive out-of-service and in-service tests is essential to prequalifying and maintaining network integrity. Out-of-service tests performed during installation on DS3 ATM switches, DS3 cross-connects, DS3 multiplexers, and SONET add drop multiplexers (ADMs), isolate a host of problems that can interrupt service. In-service tests are a valuable tool for isolating faults without interrupting service or increasing downtime. Focusing on DS3 physical layer performance, the tests described here isolate problems such as improper cable length, connector failure, incorrect line build-out, and invalid timing configuration. Despite the value of DS3 testing, locating physical layer problems during installation and maintenance is sometimes not enough to qualify new services quickly and reliably. What is needed is an overall testing strategy to ensure efficient installation and maintenance of end-to-end service that meets the increasing quality demands of service users.

A layered testing strategy

This application note is one in a series of comprehensive guides for service providers using the T-BERD 310 to install and maintain telecommunications networks. Each of the application notes in this series contains specific tests and a troubleshooting appendix to isolate common problems associated with the transport network. If you have difficulty with any of the tests, call JDSU's Technical Assistance Center (TAC) at 1-866-228-3762. The TAC staff also would appreciate hearing from you about additional testing tips to enhance the troubleshooting appendix.

The testing strategy outlined in this series is an efficient, bottom-up testing approach designed to systematically eliminate problems found at various transport testing layers that affect higher layer services. Unlike the layers in the open systems interconnection (OSI) basic reference model, which describe protocol relationships, the testing layers referred to in this series of application notes represent categories of common problems and solutions gathered from numerous field installation and maintenance calls. Figure 1 illustrates the layers referred to in these testing applications.

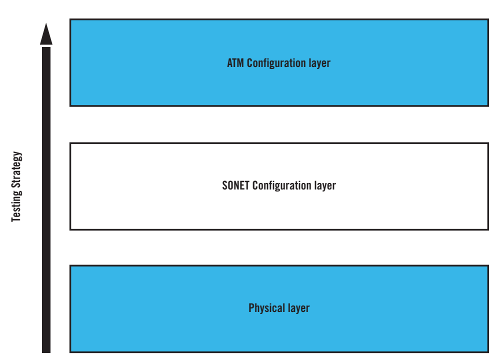

Figure 1 Transport testing layers

Physical layer testing identifies a variety of problems caused by improper line build-out, connector or cabling faults, repeater failure, optical reflections, and optical loss. Tests include pulse shape, jitter, signal measurements, bit error rate test (BERT), optical return loss, and optical insertion loss. Because these tests are performed primarily at two network locations (DS3 demarcation points and in the optical backbone), this application note and Optical testing with the T-BERD Communications Analyzer (310), were developed to thoroughly test the physical layer. Since physical layer problems commonly cause intermittent and hard-to-find trouble at higher layers, it is critical to verify DS3 and optical backbone operation during installation to prevent callbacks.

SONET configuration layer testing eliminates common problems associated with SONET circuit setup. Tests include SONET timing, SONET path configuration, error and alarm reporting, and concatenated signal configuration. These tests, detailed in the SONET testing with the JDSU T-BERD 310 application note, will ensure the circuit is properly installed for the desired service. This testing will result in reduced turn-up time and fewer maintenance calls.

ATM configuration layer testing verifies ATM virtual path/virtual channel (VP/VC) configuration. Specific tests include ATM switch configuration, end-to-end channel setup, alarm and error reporting, errored cell handling, and bandwidth and priority configuration. These tests are performed during installation of the backbone ATM transport network or during configuration of ATM service. It is important to include in-service testing, since data transport problems, such as delay variation and congestion, can only be roughly simulated during out-of-service testing. The unpredictable nature of data networks can cause problems to surface even after out-of-service simulations have functioned properly. These in-service tests include monitoring ATM congestion, alarms, errors, and delay variation. The application note pertaining to this layer is ATM testing with the JDSU T-BERD Communications Analyzer (310). Thorough testing verifies ATM transport configuration to ensure trouble-free service turn-up.

Why test DS3 signals?

As existing DS3 equipment ages in the field, physical layer problems are becoming more prevalent, causing intermittent errors in the service connections of DS3 subscribers. Troubleshooting intermittent errors is difficult. Signals of borderline quality can cause some transmission equipment to generate errors while others perform adequately. Inconsistent signal quality is often the result of loose connectors or network elements with poor receiver sensitivity.

One common method used to isolate physical layer problems is the out-of-service BERT. However, even a BERT can fail to locate problems because intermittent bit errors can appear on some test sets but not on others, depending on the quality of the signal and the sensitivity of the test equipment.

Fortunately, intermittent errors are often caused by problems that can be detected during simple, in-service tests. There are a variety of tests that can be performed to isolate these and other common problems. Testing Pulse Shape and Signal Level is an in-service test designed to isolate connector and cabling problems which are often the cause of intermittent errors. These problems include loose cable crimps, improper line build-out, and incorrect coaxial cable length. In-service pulse shape tests, performed at DSX MONITOR points, will identify major DS3 faults without interrupting service. In-service pulse shape testing can indicate the direction of the fault when a level measurement is taken at the monitor point. The American National Standards Institute (ANSI), however, only specifies pulse shape readings taken from DSX OUT points.

Although out-of-service pulse shape tests taken at the DSX OUT connection are recommended for testing signal quality and detecting subtle problems that can affect service, the in-service test can identify major physical layer faults without downtime. A second in-service test, Testing Bipolar Violations, detects physical layer impairments that can create excessive noise on DS3 signals. Improperly grounded equipment, static charges, unterminated plugs, and signal taps cause bipolar violations (BPVs). BPVs are detected by network elements when a line coding failure has occurred, and can be difficult to isolate. Fortunately, because BPVs are usually local problems, isolation time during testing is reduced. To understand how BPVs occur, it is useful to understand how DS3 signals are coded when they are transmitted.

As illustrated in figure 2, the proper signal pulses for transmitting the data stream "1101" alternate between positive and negative polarity (hence the term, "bipolar"). The first "1" in the data stream is transmitted as a positive pulse, while the second "1" in the data stream is transmitted as a negative pulse. If a signal is received which does not correspond to this format (as illustrated in figure 3), the receiving equipment declares a BPV. Although the network element is not accurately receiving the incoming signal, it is expected to reconstruct the signal and transmit it properly downstream. As a result, the network equipment may improperly "correct" the signal violation and transmit "1100," as shown in figure 4. Testing for BPVs will isolate this type of intermittent data transmission errors.

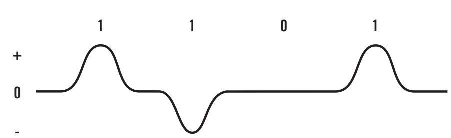

Figure 2 Signal with data "1101" properly coded

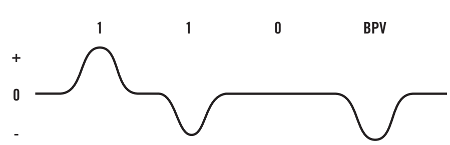

Figure 3 Signal with Bipolar Violation

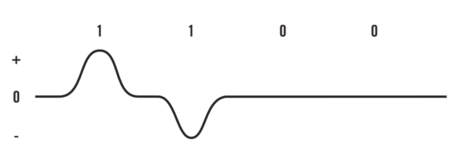

Figure 4 Signal with data adjusted by the NE to transmit "1100"

The third test, Out-of-Service Testing, is used during DS3 circuit installation to verify problems are not present when the circuit is turned over to the customer. This test can also be used to troubleshoot persistent problems that cannot be isolated during in-service testing. This test includes verifying electrical connection faults (such as crimps, cable length, and line build-out). The procedure also includes an end-to-end BERT to verify the circuit setup, and checks for jitter, another hard-to-isolate problem. Like pulse shape testing, jitter testing may detect problems that a traditional BERT may not, depending on the receiver sensitivity of the test equipment used. However, unlike pulse shape, jitter test results indicate a timing problem, not a connector problem. Figure 5 illustrates jitter on a DS3 signal.

Jitter is the difference between the expected and actual arrival time of a signal pulse. The amount of jitter present is directly proportional to the distance between the peaks of the expected pulse and the actual pulse. (The greater the distance between the peaks, the higher the level of jitter.) If a signal exhibits excessive jitter, network elements have difficulty properly decoding the data bits. Jitter can be caused by the improper timing of individual or multiple NEs including cross-connects, SONET ADMs, or repeaters. Verifying the end-to-end timing of the circuit by testing for jitter helps to avoid callbacks and delayed service turn-up. The instructions in this application note are written for the T-BERD 310 SONET/ATM user interface as shown in figure 6.

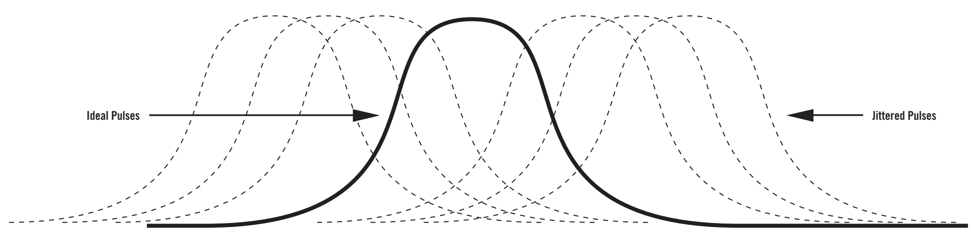

Figure 5 DS3 jitter

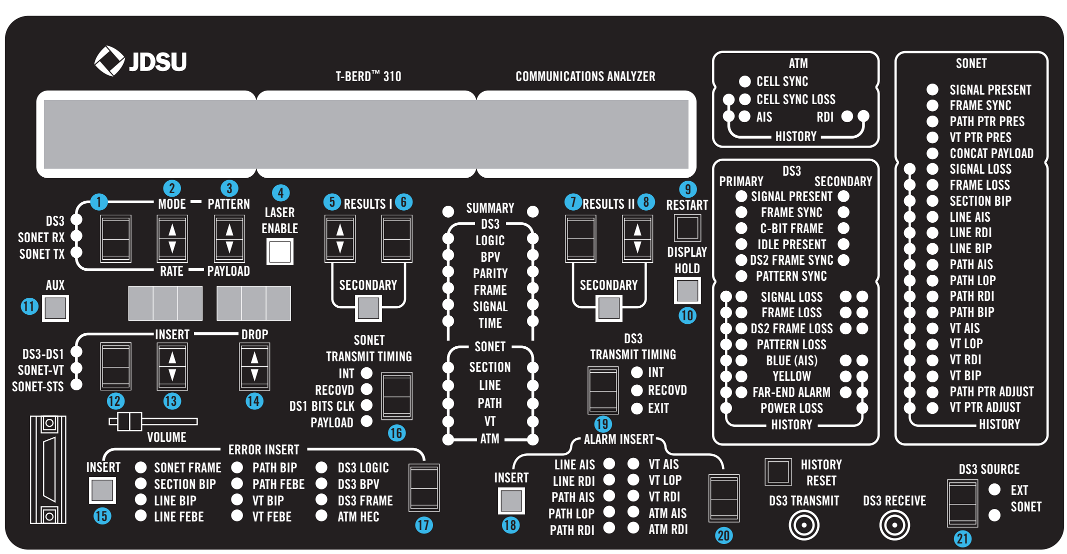

Figure 6 The T-BERD 310 with SONET/ATM user interface

1. SETUP
2. MODE
3. PATTERN
4. LASER ENABLE button
5. RESULTS I arrowed switch
6. RESULTS I blank switch
7. RESULTS II blank switch
8. RESULTS II arrowed switch
9. RESTART
10. DISPLAY HOLD
11. AUX
12. CHANNEL CONTROL
13. INSERT
14. DROP
15. ERROR INSERT button
16. SONET TRANSMIT TIMING
17. ERROR INSERT select switch
18. ALARM INSERT button
19. DS3 TRANSMIT TIMING
20. ALARM INSERT select switch
21. DS3 SOURCE

Equipment required

In order to perform the tests detailed in this application note, the following equipment is required:

- One T-BERD 310 test set with these options:
  310-3 DS1 Insert/Secondary DS3 Receiver
  310-5 DS3 Jitter Analysis
- Two coaxial cables
- JDSU PR-40A or B thermal printer
- Software revision G-S or higher (J-S is higher)

Equipment verification

To determine if the correct software revision and options are installed in your T-BERD 310, complete the following steps:

- Turn off power to the test set
- Press and hold MODE switch while turning power on
- When the software and hardware revision appears, release the MODE switch. Verify software revision is G-S or higher
- Press the MODE switch down arrow and scroll through the list of installed boards and options

Look for these option codes:

- DS1 INSERT OPTION (310-3)
- JITTER OPTION (310-5)

If the option is installed, the display will show "Installed" or "Module Code = a revision number". If the option is not installed, the option code may not appear or will show "Not installed".

If the required option is not installed, please call your local JDSU Sales Office or Distributor listed on the inside back cover, or call 1-866-228-3762 and ask for Customer Support.

Pretest setup

Each test setup in this application note assumes that the T-BERD 310 has been restored to factory default settings before testing begins. Restore factory default settings as follows:

- Turn off power to the test set
- Press and hold RESTART
- Turn on power. Look for the "RELOADING NOVRAM" message. When this message appears, release the RESTART button, factory default settings will be restored in about 60 seconds.

A. Testing pulse shape and signal level

This in-service test uses the DSX MONITOR point for test access. Since pulse shape specifications established by ANSI are based on tests performed at the DSX OUT point, the pulse graph taken during in-service testing may not fit into the mask, and the pulse shape test result may indicate “fail.” This is normal and should not cause concern. To prevent interrupting service, pulse shape tests at the DSX MONITOR point allow the technician to print out and examine the shape of the pulse and identify major physical layer faults. Signal level measurements taken in-service also indicate the direction ofthefault. Any pulse shape measurement taken at the DSX OUT point during out-of-service testing, however, should fit inside the mask and indicate “pass.”

The objectives of this test are as follows:

- Identify major physical layer faults caused by connectors, cabling, and equipment configuration without causing downtime
- Isolate the direction of the fault using signal level measurements

Test setup

1. Connect a cable from the DSX monitor jack to the DS3 RECEIVE connector on the front panel of the T-BERD 310, as shown in figure 7.

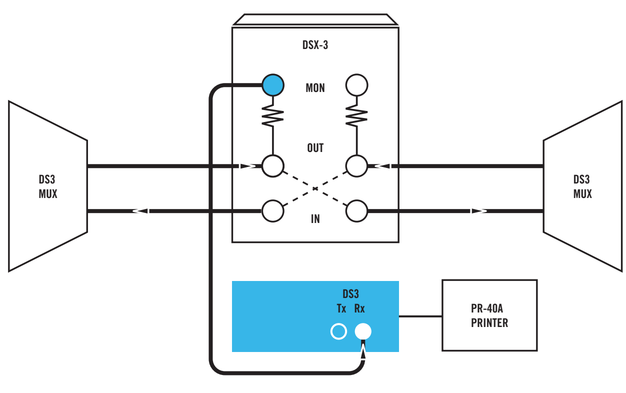

Figure 7 In-service test connections for pulse shape and signal level

2. Connect the printer to the RS-232 port on the side panel of the T-BERD 310. Configure the printer for 9600 baud, parity disabled and data bits set to 8 (graphics).
3. Configure the test set for monitoring a live DS3 signal as follows:
   - Press DS3 SOURCE, select EXT
   - Press Setup, select DS3
   - Press MODE, select AUTO
   - Verify SIGNAL PRESENT and FRAME SYNC LED are illuminated (green)
   - Verify no RED LEDs are illuminated

4. Configure for pulse shape testing as follows:
   – Press AUX
   – Press MODE, select MISC
   – Press PATTERN, select PULSE MASK
   – Press RESULTS I arrowed switch, select 93 ANSI
   – Press AUX
   – Press RESULTS II blank switch, select SIGNAL
   – Press RESULTS II arrowed switch, select RISE TIME
   – When the rise time result is calculated, proceed to Step 3
5. Print out the pulse shape mask to the printer as follows:
   – Press AUX
   – Press MODE, select PRINT
   – Press PATTERN, select BAUD RATE
   – Press RESULTS I arrowed switch, select 9600
   – Press PATTERN, select PARITY
   – Press RESULTS I arrowed switch, select NONE
   – Press PATTERN, select PORT (this may not appear, depending on installed options)
   – Press RESULTS I arrowed switch, select RS-232 (this may not appear, depending on installed options)
   – Press PATTERN, select GRAPH
   – Press RESULTS I arrowed switch to generate printout
   – Press AUX

Test results analysis

1. Examine results as follows:
   – Press RESULTS I blank switch, select SUMMARY. Verify RESULTS I window indicates “ALL RESULTS OK”
   – Press RESULTS II blank switch, select SIGNAL
   – Press RESULTS II arrowed switch. Verify the following results: POWER is between -14.3 dBm and -21.8 dBm LEVEL is between 0.031 V and 0.075 V
2. Verify signal frequency as follows:
   – Press DISPLAY HOLD
   – Press RESULTS II arrowed switch. Verify the following result: RX FREQ is between 44,735,106 and 44,736,894
   – Press DISPLAY HOLD
3. Examine the printed pulse shape graph for faults. Verify the pulse shape graph is smooth as shown in figure 8. (A pulse graph from the DSX MONITOR point need not fit inside the mask.)

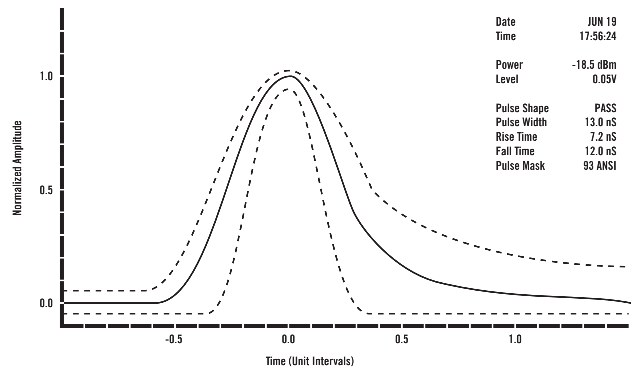

Figure 8 Pulse shape printout from a DSX monitor point showing no fault

If a noisy pulse is printed, as shown in figure 9, a likely cause is a poor or loose crimp on the shield surrounding the coaxial connector.

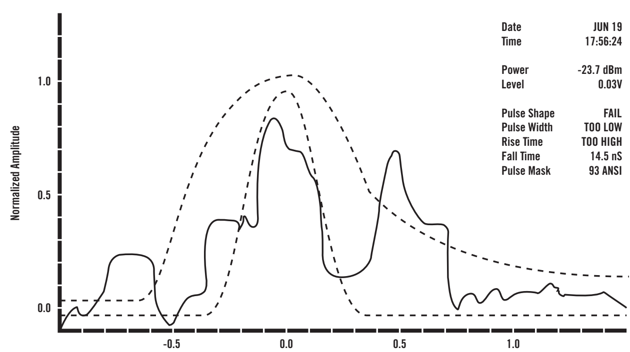

Figure 9 Pulse shape graph showing upstream fault, open shield

To isolate the direction of a connector fault, examine the signal power measurement in the pulse graph. Notice the power has dropped 5.2 dBm from the power measurement in figure 8. The fact that the signal at the DSX MONITOR point now has a lower power than a previous measurement indicates that the fault occurs upstream (near-end) as shown in figure 10.

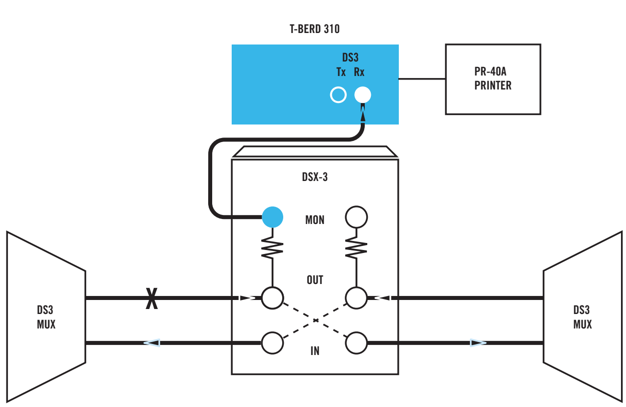

Figure 10 Location of upstream (near-end) fault

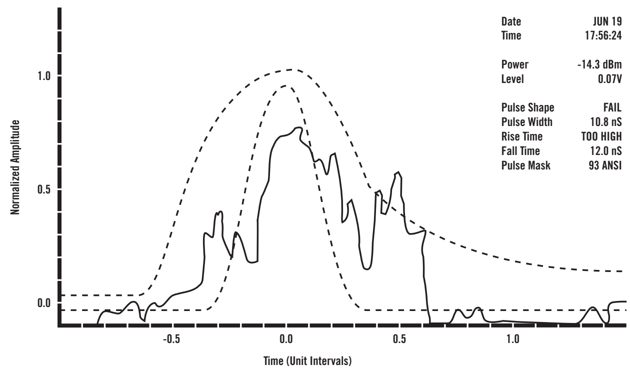

Figure 11 Pulse shape graph showing downstream fault, open shield

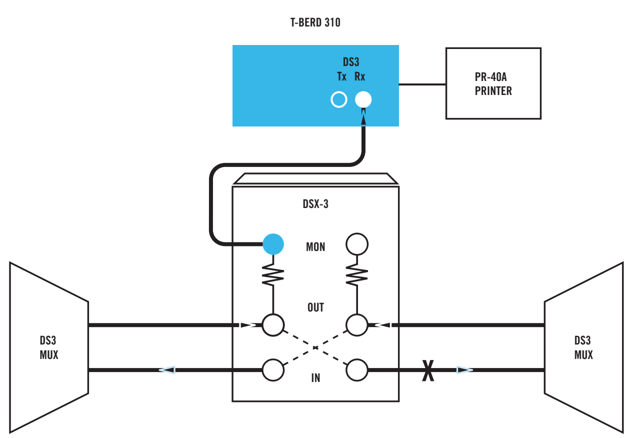

Figure 12 Location of downstream (far-end) fault

Figure 11 shows another noisy pulse graph where the power is 4.2 dBm higher than the power measurement from a previous, acceptable measurement. This indicates the problem is downstream (far-end), as shown in figure 12. These types of connector problems can cause electrical reflections back to the transmitter and ultimately cause bit errors on the signal. If the pulse graph is very flat, the line-build out on the equipment may be set too low or there may be too much cable installed between the equipment and the DSX patch bay.

If any results fail, refer to appendix A on page 15 for additional troubleshooting tips. When testing pulse shape and signal level results are okay, continue to testing bipolar violations.

B. Testing bipolar violations

This in-service test isolates the source of BPVs in a network using two DS3 receivers. BPVs caused by local static charges, improperly grounded equipment, or unterminated plugs will cause downstream bit errors. Monitoring both the span side and the mux side simultaneously allows intermittent errors to be detected quickly, reducing troubleshooting time by half.

Test setup

1. Connect the mux side DSX monitor jack to DS3 RECEIVE on the T-BERD 310 as shown in figure 13.

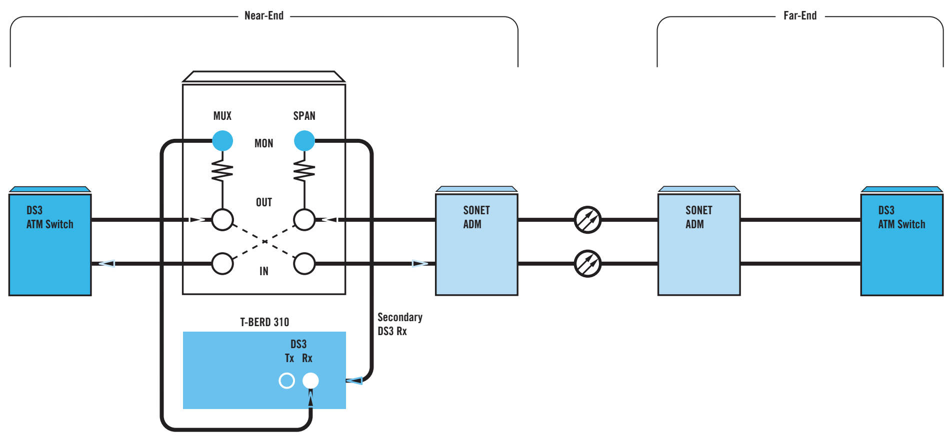

Figure 13 Connecting the T-BERD 310 to test for bipolar violations

2. Connect the span side DSX monitor jack to the SECONDARY DS3 RECEIVE jack on the side panel of the T-BERD 310.
3. Configure the test set as follows:
   – Press DS3 SOURCE, select EXT
   – Press Setup, select DS3
   – Press MODE, select AUTO
4. Verify the following LEDs on the PRIMARY and SECONDARY LED panels:
   – Verify no red LEDs are illuminated
   – Verify the following DS3 LEDs are illuminated (green): SIGNAL PRESENT, FRAME SYNC, C-BIT FRAME (if applicable)

Test results analysis

1. Examine the mux side results as follows:
   – Press RESULTS I blank switch, select SUMMARY
   – Verify RESULTS I window indicates “ALL RESULTS OK”
   – Press RESULTS I blank switch, select BPV
   – Press RESULTS I arrowed switch
   – Verify the following results: VIOLATIONS = 0 BPV ERR RT = 0.E-08 BPV ERR SEC = 0

2. Examine the span side results as follows:
   – Press SECONDARY button under the RESULTS II blank switch
   – Press RESULTS II blank switch, select SUMMARY
   – Verify RESULTS II window indicates "ALL RESULTS OK"
   – Press RESULTS II blank switch, select BPV
   – Press RESULTS II arrowed switch
   – Verify the following results: VIOLATIONS = 0 BPV ERR RT = 0.E-08 BPV ERR SEC = 0
3. Continue to monitor the mux side in the RESULTS I window, while monitoring the span side in the RESULTS II window.
   – Press RESULTS I blank switch, select SUMMARY
   – Press RESULTS II blank switch, select SUMMARY

BPVs will appear in the SUMMARY category of the T-BERD 310. If one or both directions indicate BPVs, progressively isolate the problem by moving upstream or downstream as necessary to identify the DS3 network element generating the errors.

C. Out-of-service DS3 testing
This test should be performed when installing DS3 circuits. This procedure generates a DS3 pulse shape printout of the circuit for future comparison as an aid to locate service degradation problems. The objective of this test is to prevent call-backs due to degraded service by proactively verifying the following:

– Configuration of DS3 NEs responsible for DS3 signal transmission
– Quality of the transmitted signal and circuit connections
– Correct synchronization of the DS3 circuit

Test setup
1. Loop back the far-end of an out-of-service DS3 span at the DSX patch panel, as shown in figure 14.
2. Connect the span side DSX OUT jack to DS3 RECEIVE on the T-BERD 310.

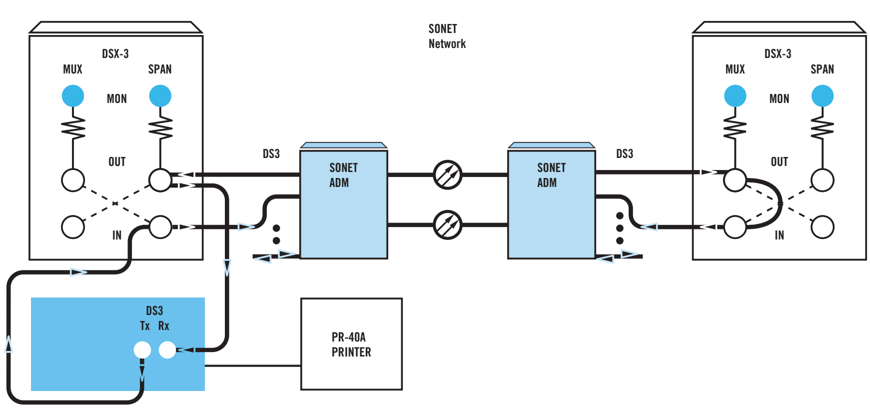

Figure 14 Connecting the T-BERD 310 for out-of-service testing

3. Connect the span side DSX IN jack to DS3 TRANSMIT on the T-BERD 310.
4. Connect the printer to the RS-232 port on the side panel of the T-BERD 310. Configure the printer for 9600 baud, parity disabled and data bits set to 8 (graphics).
5. Configure the DS3 signal as follows:
   - Press DS3 SOURCE, select EXT
   - Press Setup, select DS3
   - Press MODE, select M13
   - Press PATTERN, select 2^23-1
   - Press DS3 TRANSMIT TIMING, select INT
6. Configure pulse shape and signal levels as follows:
   - Press AUX
   - Press MODE, select MISC
   - Press PATTERN, select DS3 LEVEL
   - Press RESULTS I arrowed switch, select DSX
   - Press RESULTS II arrowed switch, select DSX
   - Press PATTERN, select PULSE MASK
   - Press RESULTS I arrowed switch, select 93 ANSI
7. Configure error insertion as follows:
   - Press MODE, select ERR INSERT
   - Press PATTERN, select LOG/BPV BUR
   - Press RESULTS I arrowed switch, select SINGLE
8. Configure jitter as follows:
   - Press MODE, select JITTER
   - Press PATTERN, select JIT FILTER
   - Press RESULTS I arrowed switch, select AUTO
   - Press PATTERN, select JIT SCALE
   - Press RESULTS I arrowed switch, select AUTO
   - Press PATTERN, select JIT THRESH
   - Press RESULTS I arrowed switch, select 0.4 UI
9. Configure printer operation as follows:
   - Press MODE, select PRINT
   - Press PATTERN, select BAUD RATE
   - Press RESULTS I arrowed switch, select 9600
   - Press PATTERN, select PARITY

– Press RESULTS I arrowed switch, select NONE

– Press PATTERN, select PORT (this may not appear, depending on installed options)

– Press RESULTS I arrowed switch, select RS-232 (this may not appear, depending on installed options)

– Press AUX

Test results

1. Verify primary DS3 signal status as follows:
   - Press RESTART
   - Verify no red LEDs are illuminated
   - Verify the following LEDs are illuminated (green): SIGNAL PRESENT, FRAME SYNC, PATTERN SYNC, C-BIT FRAME (if applicable)
   - Press RESULTS I, select SUMMARY
   - Verify RESULTS I window indicates"ALL RESULTS OK"
2. Verify loopback as follows:
   - Press ERROR INSERT select switch, select DS3 LOGIC
   - Press ERROR INSERT button five times to insert error
   - Verify RESULTS I window indicates "BIT ERRORS =5"
3. Press RESTART to initiate test. Allow the test to run for at least five minutes.
4. When test period is complete, verify test results as follows:
   - Press RESULTS II blank switch, select LOGIC
   - Press RESULTS II arrowed switch
   - Verify the following results: BIT ERRORS = 0
   - Press RESULTS II blank switch, select PARITY
   - Press RESULTS II arrowed switch
   - Verify the following results: PAR ERRORS = 0, C-BIT ERRORS = 0 (if applicable)
   - Press RESULTS II blank switch, select SIGNAL
   - Press RESULTS II arrowed switch
   - Verify the following results: PULSE SHAPE is PASS, WB JITTER is less than 0.5 UI, MAX WB JITTER is less than 0.5 UI, HB JITTER is less than 0.1 UI, MAX HB JIT is less than 0.1 UI, RX LVL dBdsx is between -3.75 and 3.75 dBdsx(1) POWER is between -1.8 dBm and +5.7 dBm LEVEL is between 0.36 V and 0.85 V

(1)RX LVL dBdsx measurements are supported by T-BERD 310 software revisions J-S and higher. The dBdsx measurement provides a simplified, reliable result relative to the signal level. The optimal dBdsx measurement taken at the DSX-3 patch panel is zero (0).

5. Verify signal frequency as follows:

- Press DISPLAY HOLD
- Press RESULTS II arrowed switch
- Verify the following results: RX FREQ is between 44,735,106 and 44,736,894
- Press DISPLAY HOLD

6. Verify pulse shape graph as follows:
   - Press AUX
   - Press MODE, select PRINT
   - Press PATTERN, select GRAPH
   - Press RESULTS I arrowed switch to generate a pulse shape printout
   - Press AUX
   - Verify the printed pulse mask is smooth and fits entirely within the mask. If any results fail, refer to appendix A for troubleshooting tips

Appendix A Troubleshooting tips

This appendix provides a list of items to check when your test setup or test results do not match what is described in this application note

Trouble found	*Items to check*
DS3 SIGNAL PRESENT LED on front panel does not illuminate	— Replace possibly defective coaxial patch cord — Verify the POWER of the signal. At the DSX OUT point, signal power should be between -1.8 dBm and 5.7 dBm to be received by other DS3 NEs — Verify primary and secondary (if applicable) cables are properly connected
DS3 SIGNAL PRESENT LED illuminated FRAME SYNC LED or C-BIT FRAME LED are not illuminated	— Check DS3 SOURCE switch is set to EXT — If the circuit is not configured for framed DS3 or C-bit signals, ignore this problem
RX FREQ is out of specified range, or the following flashing message appears: “NO DS3 SIG TRY STS-1”	— Verify configuration on NEs in the span to verify timing configuration is correct — Verify rate of patch panel to ensure the signal is not an STS-1 SONET signal (DS3 and STS-1 DSX patch panels are often identical) — Ensure DS3 TRANSMIT TIMING = INT
PULSE SHAPE = FAIL	— Check cabling for possible coaxial faults — Verify proper line build-out of NE — Ignore this result if measuring from DSX MONITOR
PULSE SHAPE = N/A	— Verify DS3 SOURCE is set to EXT — Verify RX Level setting is set to DSX in the auxiliary function
PULSE SHAPE = UNAVAILABLE or PULSE SHAPE = DENSITY ERR	— Ensure that enough isolated pulses are received by using live data or the 2^23-1 pattern — Wait several seconds for the result to calculate — Verify the DS3 test signal is connected to the PRIMARY DS3 receiver, not the SECONDARY — Older T-BERD 310s are not able to make a pulse shape measurement on muxed DS3 signals An upgrade is available by contacting JDSU Customer Support
PR-40A or PR-40B printer will not print pulse shape, or prints message: “PULSE GRAPH UNAVAILABLE”	— Verify baud rates on the T-BERD 310 and the printer — Verify auxiliary parity selection for the T-BERD 310: PARITY = NONE and PORT = RS-232 (if applicable) — Verify printer configuration: On-line, connected to a power source or batteries, disabled parity, 8 data bits — Wait several seconds for the pulse graph to calculate
DS3 TRANSMIT TIMING LED flashes	— This indicates the T-BERD 310 is unable to recover the selected timing source for retransmission — Verify DS3 TRANSMIT TIMING = INT — Verify DS3 MODE is M13 or C-bit. If using DS1 INSERT mode for another test, verify SECONDARY DS3 Receiver has a good, external DS3 clock source. If using THRU mode, verify the PRIMARY DS3 Receiver has a good, external DS3 clock source. Since the T-BERD 310 retransmits this timing, the external source must be different than the T-BERD 310 generated signal
WB JITTER and MAX WB JIT are too high, or HB JITTER and MAX HB JIT are too high	— Wideband (WB) frequency bandwidth is 10 Hz to 400 kHz. If WB jitter is too high, check the highband (HB) (30 kHz to 400 kHz) jitter results to determine what frequency range is most affected — If HB shows jitter, then the jitter is probably caused by numerous sources throughout the network (e.g., a repeater span) — If HB does not show jitter, then the WB jitter is caused in the lowband region, between 10 Hz and 30 kHz This usually indicates a single NE is misconfigured and causing jitter (e.g., multiplexer)
POWER is too low, or LEVEL is too low	— If the signal level is too low, verify the cable distance from the equipment meets the 450 ft requirement. Too much cable will degrade the signal — Verify the line build-out setting of the NE

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