STS 3192–9T Terminating Office Repeater

CLEI™ Code: T1R1D0W1AA

CONTENTS PAGE

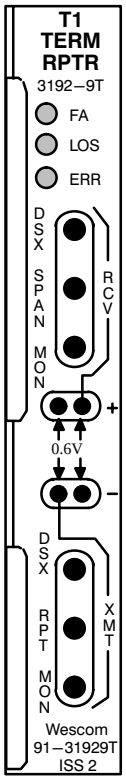

Figure 1. 3192–9T Terminating Office Repeater

1. GENERAL

1.1 Document Purpose

The 3192–9T span looping Terminating Office Repeater, depicted in Figure 1, provides the interface between a T1 span and the DSX. Span current for simplex powering of in-line regenerative repeaters is looped back to the span by this module. The repeater can be powered from the span current or from a local supply.

1.2 Equipment Function

The 3192–9T span looping Terminating Office Repeater provides the interface between a T1 span and the DSX. Span current for simplex powering of in-line regenerative repeaters is looped back to the span by this module. The repeater can be powered from the span current or from a local supply.

1.3 Equipment Location/Mounting

The 3192–9T is designed for use in the Charles Industries Span Termination System (STS) Mounting Shelves, or the Charles Industries 340 Mounting, or the Charles Industries 343 Mounting. For additional information regarding the STS Mounting Shelves refer to:

- Section 319–211–100 (Span Termination System General Description)
- Section 319–211–200 (Span Termination System Installation)

STATIC-SENSITIVE

Units are shipped in static-protective material to protect static-sensitive devices. Use static-preventive measures for storage and handling.

2. APPLICATION GUIDELINES

A typical application for an STS containing 3192–9T OR modules is shown in Figure 2. As noted, the STS would normally be co-located with a lightwave multiplexer (and possibly a subscriber loop carrier) in an outdoor cabinet and would be used to feed downstream loop carrier systems or leased T1 facilities.

As shown in the typical application in Figure 2, consider a span line having two line repeaters with equal end sections of 7.5dB (the distance from office repeater/CSU to the line repeater) and a loss of 30dB between line repeaters.

Using the known figures on cable loss, note that each 7.5dB section is approximately 1630 feet in length (7.5dB divided by a known loss of 4.6dB per 1000 feet = 1.63, or 1630 feet). The simplex loop resistance for 1630 feet of cable is 28.2 ohms (1630 feet x 17.3 ohms per 1000 feet = 28.2 ohms). Therefore, each end section has approximately 28.2 ohms of simplex loop resistance.

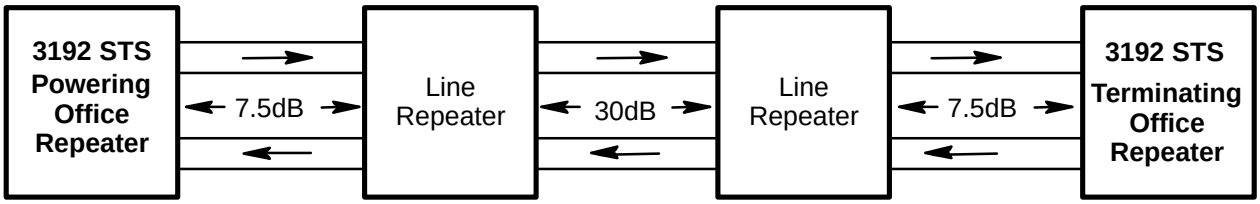

Figure 2. TypicaL Span Line

The simplex loop resistance of the cable between line repeaters can be figured in the same way. Thus,

30dB of cable loss ÷ by 4.6dB per 1000 feet = 6520 feet

6520 feet x 17.3 ohms per 1000 feet = 112.8 ohms of simplex resistance

The total simplex cable resistance is the sum of all of the sections. Thus,

28.2 + 112.8 + 28.2 = 169.2 or 169.2 ohms

In the example just presented, 7.5dB was chosen to be the nominal end-section loss. Commonly, this figure is engineered to be between 7.5 and 22.5dB to reduce the effects of near-end crosstalk (NEXT) and to guard

against over driving the regenerator. In many cases, it is not possible to select this distance so that it remains within these ideals. To compensate for this, the input and output of the STS repeater is equipped with adjustable span pads.

When working with any office repeater or line repeater, remember that the regenerator is extremely sensitive and will not work correctly when applying signals to its input that are in excess of its Automatic Line Build-Out (ALBO) range. Line repeaters, in most cases, are designed to be used with signals that vary from 7.5 to 35dB in loss from 3 volts base-to-peak. Signals greater than those that are 7.5dB down from 3 volts can either result in poor performance or damage to the regenerator. For this reason, the line repeaters have a minimum spacing of 7.5dB.

When the end section is less than 7.5dB, or more than 22.5dB, the transmit span pad can be set to one of four positions (0, 7.5, 15.0, or 22.5dB), depending upon the distance between the DSX and the closest repeater. Since the transmit portion of most office repeaters (including the 3192–9T and the 3192–9T) is passive, the loss between the DSX and the office repeater will sometimes become a factor. For instance, if the distance from the office repeater to the DSX is 655 feet, a calculation based on 4.6dB in loss per 1000 feet would place the signal at 3dB down from 3 volts base-to-peak (DSX-1 level) before transmission by the office repeater. Also, adding any transmit padding decreases the signal even further before it is sent toward the span line.

Referring again to the previous example, the end-section loss was 7.5dB. Most often, a transmit pad setting of 7.5dB is used on this length section. This provides a signal to the line repeater that is 15dB down from 3 volts (7.5dB cable, plus a 7.5dB pad with no loss to the DSX). If the end-section were 0dB in length, it would be desirable to use 15dB of attenuation. In cases where the transmitted signal is being combined with the DS1 signals that are already present in the same cable, the transmit pad should be set to attenuate the signal so that it comes closest to matching the other signals it will be joining. This is the purpose of the 22.5dB and 0dB positions.

Coming out of the line repeater is a signal that is at 3 volts base-to-peak (refer to Figure 2, the sample span line). Since this signal is attenuated by 7.5dB of cable loss, theoretically no loss would be required prior to regeneration by the STS. Since it was previously mentioned that only a maximum signal of 7.5dB, down from 3 volts, can be applied to the regenerator, it can be seen that a 0dB receive pad would then leave no margin for error; therefore, the receive pad should be set for 7.5dB. This setting is adequate for the entire range of 0 to 27.5dB in cable loss. It is recommended that the pad be removed if the loss is greater than 22.5dB.

A real-time performance monitor serves to provide an indication of excessive bipolar violations (format error), as well as Loss of Signal (LOS). The error threshold can be set to error rates of 10^{-3}, 10^{-4}, 10^{-5}, 10^{-6}, 10^{-7}, 10^{-8} bits. Since the error detector contains time-versus-errors and clearance settings, small bursts of errors may not cause an alarm. A disable feature is provided for cases when B8ZS coding is present. The LOS detector is set off whenever the signal coming from the span is absent for more than 150ms. Both alarms are extended via Pins E and G of the 3192–9T edge connector and appear as open collector outputs that switch during an alarm to a ground, capable of sinking a 100mA load. Also, both alarms are indicated on the front panel by LEDs, labeled LOS and ERR.

An internal electronic switch can be optioned with the performance monitor to send an unframed, all-zero code back toward the DSX during periods of excess errors. This feature can be used as a means of tripping a span switch that is upstream in a lightwave network. Ordinarily, any bipolar violations received by the STS from the span are lost in transmittal over the lightwave system. By using this feature, the bipolar violations can be used to cause the 3192–9T and 3192–9T to transmit an all-zeros signal and cause the equipment at the opposite end of the lightwave to switch to an alternate line.

The 3192–9T contains a pre-equalizer on its output toward the DSX that may be set for one of three positions to compensate for up to 655 feet of ABAM cable.

In addition to the performance monitor LEDs, a front-panel LED, labeled FA, is provided to indicate that the internal fuse on the 3192–9T has opened. A –48 volt alarm output also is present at the module's edge connector, on Pin 10. The 3192–9T circuitry is designed to tolerate any external fault without damaging the repeater. If the fuse opens, it is certain that a non-field-replaceable component has failed, thus necessitating module repair. Because the fuse is not field-replaceable, the module must be delivered to an authorized repair center.

The 3192–9T contains front-panel jacks for line, drop, and monitor. While the line jacks (RPT) look toward the metallic facility, the drop jacks (DSX) access the signal going toward the DSX. The monitor jacks are non-service-affecting and can be used at any time to check the transmit and receive signals.

As mentioned, the 3192–9T is, for the most part, fully backward-compatible with the 3401-00. Obvious differences lie within the 3192's enhancements, such as the performance monitor and pre-equalization, and the fact that it uses a half-width front panel. Unlike the 3401-00, the 3192–9T can be used only with 60mA span lines.

A fault-locate output (pin L) is provided for use with an auxiliary fault-locate panel and filter. If fault-locating equipment is required, the Charles Industries 3408-00 and associated filters may be used with the STS. Refer to Section 340-408-100 for interconnection and use.

3. CIRCUIT DESCRIPTION

Refer to Figure 3, the 3192–9T Block Diagram, while reading the following circuit description.

3.1 Transmit Signal Path

A bipolar signal from the DSX appears at the XMT FROM DSX input (pins A and 1) and is isolated by transformer T3. The SPAN PAD provides the roll-off and attenuation of a PIC/PULP cable to provide an acceptable level and wave shape to the line repeater. Switch S1 selects 0 to 22.5 dB of span pad at 772 kHz. The center tap of T1 allows the transmit path to distribute the DC current powering the repeatered span line. The SURGE PROTECTION circuit prevents lightning from damaging the power and signal circuits.

3.2 Receive Signal Path

A bipolar signal at the RCV FROM SPAN input (pins K and 9) is routed through SURGE PROTECTION circuitry to transformer T2 which provides isolation and impedance matching. The center tap allows the receive path to be used to distribute the DC current of the repeatered span line. An ARTIFICIAL LINE, optioned by switch S6, adjusts the level into the LOW–POWER REGENERATOR. The LOW–POWER REGENERATOR compensates for cable signal loss and regenerates the signal pulses. The LOW–POWER REGENERATOR also provides Automatic Line Build Out (ALBO). A signal level of 7 to 35 dB, down from 3V base–to–peak can be detected and regenerated by the receive signal path circuitry. The regenerated bipolar signal is amplified by the OUTPUT DRIVER. Transformer T4 provides output isolation toward the PRE–EQUALIZER, which adjusts the output level toward the DSX.

3.3 Powering

The 3192–9T Terminating Office Repeater can be powered by the span or can operate from local –48Vdc power supply. Span Powering requires a regulated 60 mA source of span voltage.

4. INSPECTION

Inspect the equipment thoroughly upon delivery. If the equipment has been damaged in transit, immediately report the extent of damage to the transportation company.

Wescom equipment is identified by a model and issue number imprinted on the front panel or located elsewhere on the equipment. Each time a major engineering design change is made on the equipment, the issue number is advanced by one number on any following models that are manufactured. Therefore, be sure to include both the model number and its issue number when making inquiries about the equipment.

Modules are shipped in static-protective material to prevent electrostatic charges from damaging CMOS devices. Use approved static-preventative measures when handling modules outside of this protective material. A module intended for future use should be tested as soon as possible and returned to its protective shipping material for storage.

5. MOUNTING

The 3192–9T OR is designed for mounting in the Span Termination System (STS) Mounting Shelves, or the 340 Mounting, or the 343 Mounting.

CAUTION

Installation and removal of modules should be done with care. Do not force a module into place. If excessive resistance is encountered while installing a module, remove the module and check the card guides and connector to verify proper alignment and the absence of foreign material.

6. INSTALLER CONNECTIONS

All connections to the 3192–9T are made through the shelf. See the shelf documentation for connector and cable information.

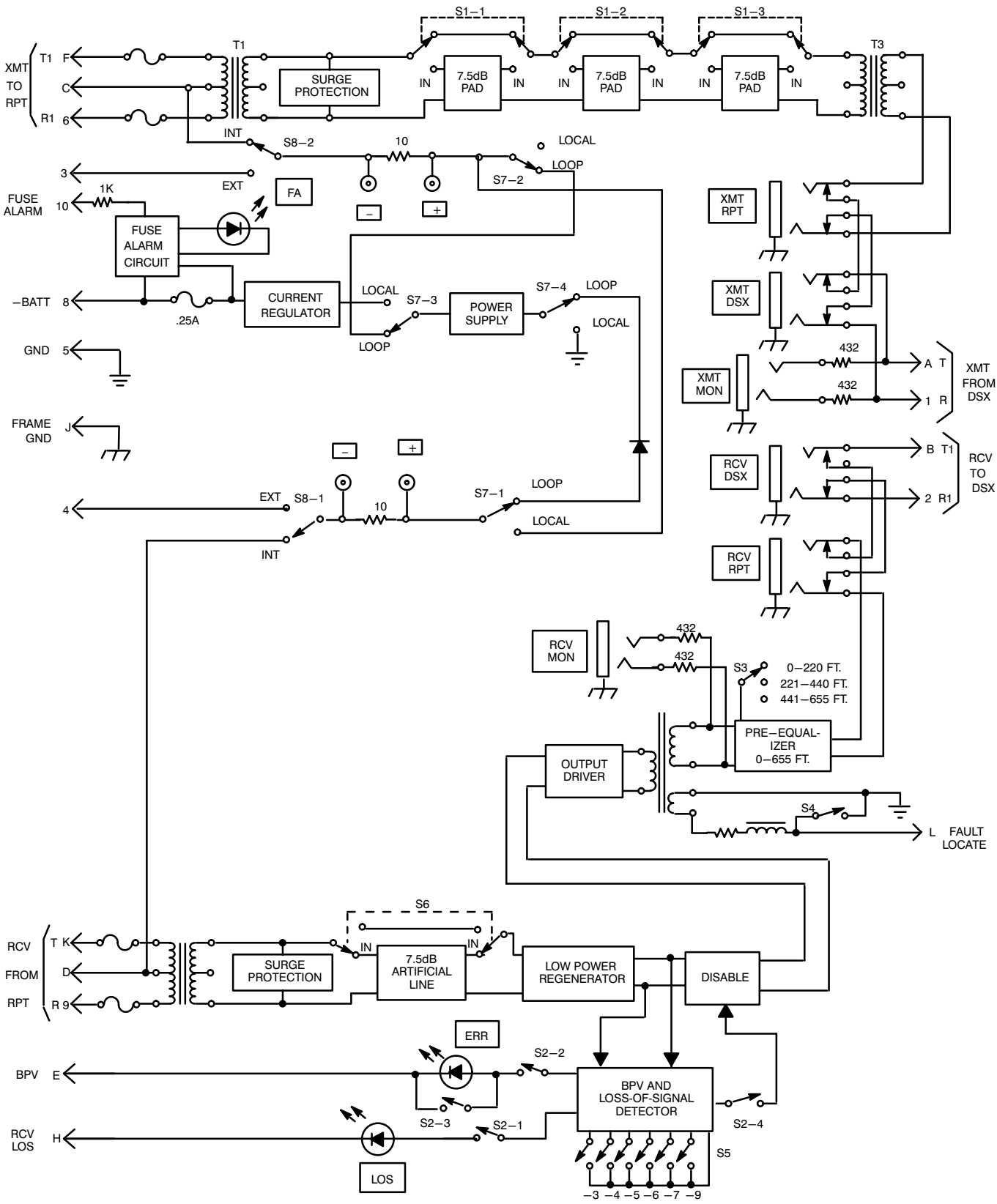

Figure 3. 3192–9T T1 Terminating Repeater Block Diagram

7. OPTIONS

The 3192–9T is equipped with DIP switches and slide switches that are used to condition the module for proper application and operation. Refer to Figure 4 for option locations and option summary.

7.1 XMT PAD – S1–1 through S1–3

S1 is a three-section DIP switch which can be selected for 0 to 22.5dB of transmit padding in 7.5 dB increments. With all switches in the IN position, 22.5dB of transmit padding will be inserted.

7.2 LOS – S2–1

When in the ON position, the S2–1 switch enables a loss of signal (LOS) alarm by placing a ground on the backplane alarm bus. In cases where a repeater is being inserted into the shelf without being connected to a working span line, disable the LOS alarm to prevent corruption of the alarm bus. (The alarm bus is tied to the in-service repeaters.)

7.3 BPV ALM – S2–2

When in the ON position, the S2–2 switch enables the output of the BPV error detector to feed the BPV backplane alarm bus. In situations where the span is being fed by a signal implementing an algorithm which employs bipolar violations, such as B8ZS, switch S2–2 must be set to the OFF position.

7.4 ERR LED – S2–3

When in the ON position, the S2–3 switch disables the ERR front-panel indicator for spans that implement algorithms, such as B8ZS, which are meant to contain BPVs.

7.5 RCV INT – S2–4

Switch segment 4 of DIP switch S2 is used to option the 3192-9T for a pseudo loss of signal upon receipt of high BPV errors from the span (as determined by the setting of the error detector threshold S5). With segment 4 placed to ON this forces the received output toward the DSX to an unframed all-zeros condition (no signal) whenever the threshold of the error detector is exceeded. With segment 4 placed to OFF, any bipolar violations received from the span are repeated toward the DSX. Place switch segment 4 in the OFF position for normal applications.

7.6 DXS PRE EQ – S3

Slide switch S3 provides pre–equalization of the output signal from the office repeater to the DSX for up to 655 feet of ABAM cable. Set S3 to equal the approximate distance from the 3192–9L to the DSX. If the distance is between 0 and 220 ft., set S3 to the 220 position (as shown in Table 1 and illustrated in Figure 3). Similarly, if the distance is between 220 ft. and 440 ft., set S3 to the 440 (middle) position. Lastly, if the distance is between 440 ft. and 655 ft., set S3 to the 655 (top) position. Refer to Table 1.

Table 1. Slide Switch S3 Pre-equalization—Switch Settings for Optimal Output Signal

	S3 Switch Setting		
	220	440	655
22 Gauge Cable (ft.)	0–220	221–440	441–655
24 Gauge Cable (ft.)	0–150	151–220	221–320

7.7 FL – S4

Slide switch S4 terminates the fault locate windings when the 3192–9L is not being used with a fault locate filter. Placing S4 in the SHORT position shorts out the winding, eliminating undesirable reflections in the output transformer. If a fault locate filter is used, S4 should be in the OPEN position.

7.8 ERR THRESHOLD S5

DIP switch segments 1 through 6 of S5 set the error threshold of the performance monitor. Each switch is assigned a number that is equal to the exponential value of the error rate. This DIP switch sets the threshold for the BPV error detector

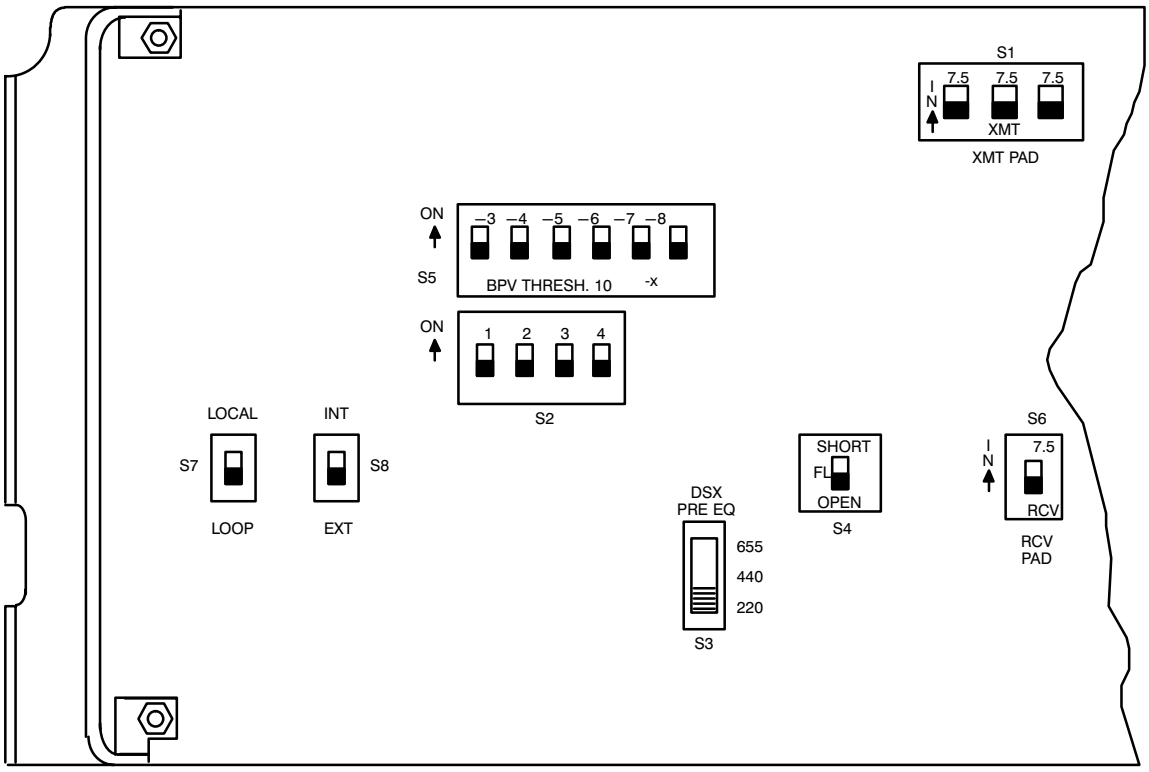

Figure 4. 3192–9T Option Locations

Table 2. 3192–9T Option Summary

Option	Function	Position
S1	Placing each DIP switch in the IN position adds 7.5dB to the transmit attenuation (0, 7.5, 15, or 22.5dB.	Position as required
S2-1	Placing DIP switch S2-1 in the ON position enables loss-of-signal alarm by sending a ground to the backplane alarm bus. Turning it OFF, disables the alarm.	ON/OFF as required
S2-2	Placing S2-2 in the ON position (normal) enables the alarm output of the error detector, and placing it to OFF, disables the alarm output.	ON/OFF as required
S2-3	Placing S2-3 in the ON position disables the ERR indicator on the front panel of the repeater on spans that use bipolar violations.	ON/OFF as required
S2-4	Placing S2-4 in the ON position forces received output toward the DSX to an unframed all-zero condition when the threshold of error detector is exceeded. Turning it OFF, repeats any violations from the span toward the DSX.	ON/OFF as required
S3	Slide switch S3 optimizes the output signal from the repeater to the DSX for 0-220, 221-440, or 441-655 feet of ABAM cable.	Position as required
S4	Placing S4 in the SHORT position terminates the fault locate windings when the STS is not used with a fault locate filter. Place S4 in the OPEN position if the filter is used.	Position as required
S5	This DIP switch sets the error threshold of the performance monitor. (Only one switch segment must be switched ON at a time.) Allows errors in excess of 10^{-3}, 10^{-4}, 10^{-5}, 10^{-6}, 10^{-7}, and 10^{-8} bits to be monitored.	Position as required
S6	Slide switch S6 selects 0 (OUT) or 7.5dB (IN) of receive padding.	Position as required
S7	Slide switch S7 selects whether the 3192–9T is powered from local battery or from the span simplex current.	Position as required
S8	When S–8 is set in the INT position, an internal termination for span powering is provided. Select INT for span power, or for local power and loop span. When S–8 is set in the EXT position, an external termination is required; this is necessary when one way line repeaters are used. Select EXT for local power and open span.	Position as required

7.9 RCV PAD – S6

Slide switch S6 selects 0 or 7.5dB of receive padding. Ordinarily, the unit is set for 7.5dB (S6 to IN), except when used with extremely long end sections (those exceeding 22.5dB in loss).

7.10 LOCAL/LOOP – S7

Slide switch S7 selects whether the 3192–9T is powered from local battery or from the span simplex current.

7.11 INT/EXT – S8

Slide switch S8 optioned in the INT position will provide an internal termination for the span powering. In the EXT position, an external termination is required. This is necessary when one-way line repeaters are used.

8. TESTING

The following test equipment is recommended for testing the 3192–9T:

- LSI/Sierra 415A–2 PCM Span and Repeater Test Set (or equivalent).
- Simpson 260 Volt/Ohm Meter (or equivalent).

The repeater-powering current on span lines terminated by 3192–9T repeaters can be verified by measurements taken across the pin test points on the repeater's front panel. To check for current and for balance, measure the voltage across the XMT, as well as the RCV test points. The measured voltage should read 0.6 $\pm$ 0.03Vdc. This corresponds to a span line current of 60mA $\pm$ 5 percent.

The RCV span current is measured by placing the meter's positive lead in the upper right test point and the negative lead in the lower right test point. The XMT span current is measured by placing the meter's positive lead in the upper left test point and the negative lead in the lower left test point.

The span voltage can then be checked by reversing the lead polarity of the test leads and measuring between the upper right test point with the meter's negative lead and the lower left test point with the positive lead. After completing the span termination equipment installation and initial test procedures, take the voltage readings and record them. Check subsequent voltage readings against the recorded values.

If trouble is suspected with the 3192–9T Repeater, perform the test procedure described in Table 3. Table 3 may also be used for acceptance testing of spare modules.

The test procedure assumes a functional knowledge of the 3192–9T. This includes the measurement of span line current and voltage. It also assumes that all associated T1 source system equipment has been in service and is functioning properly, and that all installer connections and equipment options have been correctly accomplished.

The test procedure provides a basic check on two-way signal continuity through the 3192–9T module under test and correct signal regeneration checking.

This test is to be performed in-service, with the 3192–9T under test and continuing to receive T1 signals from the metallic facility as well as the DSX. Also, the test can be performed out-of-service, in an appropriate test set-up that would provide an equivalent T1 signal source.

Step	Action	Verification
1.	Check for DC voltage between pin 8 (–48V) and pin 5 (Battery Return) with a voltmeter. Check span current at front panel test points.	Local battery voltage should be between –42V and –56V (–48V nominal). When checking span current, the DC voltage between the front panel test points is measured with the volt meter and converted to span current in milliamps. The span current value should be 60mA $\pm$ 5 percent.
2.	Check for the existence of the regenerated receive signal. Observe LOS indicator on the front panel. To double check, connect the Sierra 415A–2 SIG IN jack to the RCV MON jack on the 3192–9T.	On the 3192–9T, the LOS light should be out if receiving a signal. When checking with the Sierra 415A–2, the PULSES lamp should light (green). If not, replace the 3192–9T (see Note 2).

Step	Action	Verification
3.	Check for signal error (bipolar violations) in the regenerated receive signal. Observe the ERR indicator on the front panel. To double check, connect the Sierra 415A–2 as in Step 2.	On the 3192–9T, the ERR light should be out if the BPV rate is lower than the threshold setting of S5. Also, the ERRORS lamp on the 415A–2 should not light (an occasional flicker may be acceptable). If excessive errors are evident, replace the 3192–9T. If this condition persists, check the span line with a test set capable of measuring BPV rates. *Note: Before replacing the unit,, verify that the distant end is sending a valid T1 signal.*
4.	Check for existence of the transmit signal on the span line. Connect the Sierra 415A–2 SIG IN jack to the XMT MON jack on the 3192–9T.	The PULSES lamp on the 415A–2 should light. If not, verify a valid signal is being received from the DSX and/or verify the wiring before replacing the 3192–9T. (This test assumes that the XMT from DSX signal input is a 3V (base to peak)1.544mb/s T1 signal).

9. TECHNICAL ASSISTANCE

9.1 Technical Assistance — U.S.

If technical assistance is required, contact Charles Industries' Technical Services Center at:

847–806–8500
847–806–8556 (FAX)
800–607–8500
techserv@charlesindustries.com (e-mail)

9.2 Technical Assistance — Canada

Canadian customers contact:

905–821–7673 (Main Office)
905–821–3280 (FAX)

10. WARRANTY & CUSTOMER SERVICE

10.1 Warranty

Charles Industries, Ltd. offers an industry-leading, 5-year warranty on products manufactured by Charles Industries. Contact your local Sales Representative at the address or telephone numbers below for warranty details. The warranty provisions are subject to change without notice. The terms and conditions applicable to any specific sale of product shall be defined in the resulting sales contract.

Charles Industries, Ltd.
5600 Apollo Drive
Rolling Meadows, Illinois 60008–4049

Telephone: 847–806–6300 (Main Office)
847–806–6231 (FAX)

10.2 Field Repairs (In-Warranty Units)

Field repairs involving the replacement of components within a unit are not recommended and may void the warranty and compatibility with any applicable regulatory or agency requirements. If a unit needs repair, contact Charles Industries, Ltd. for replacement or repair instructions, or follow the *Repair Service Procedure* below.

10.3 Advanced Replacement Service (In-Warranty Units)

Charles Industries, Ltd. offers an “advanced replacement” service if a replacement unit is required as soon as possible. With this service, the unit will be shipped in the fastest manner consistent with the urgency of the situation. In most cases, there are no charges for in-warranty repairs, except for the transportation charges of the unit and for a testing and handling charge for units returned with no trouble found. Upon receipt of the advanced replacement unit, return the out-of-service unit in the carton in which the replacement was shipped, using the preaddressed shipping label provided. Call your customer service representative at the telephone number above for more details.

10.4 Standard Repair and Replacement Service (Both In-Warranty and Out-Of-Warranty Units)

Charles Industries, Ltd. offers a standard repair or exchange service for units either in- or out-of-warranty. With this service, units may be shipped to Charles Industries for either repair and quality testing or exchanged for a replacement unit, as determined by Charles Industries. Follow the *Repair Service Procedure* below to return units and to secure a repair or replacement. A handling charge applies for equipment returned with no trouble found. To obtain more details of this service and a schedule of prices, contact the CI Service Center at 217–932–5288 (FAX 217–932–2943).

Repair Service Procedure

1. Prepare, complete, and enclose a purchase order in the box with the equipment to be returned.

2. Include the following information:

   – Company name and address
   – Contact name and phone number
   – Inventory of equipment being shipped
   – Particulars as to the nature of the failure
   – Return shipping address

3. Ship the equipment, purchase order, and above-listed information, transportation prepaid, to the service center address shown below.

   CI Service Center
   Route 40 East
   Casey, IL 62420–2054

4. Most repaired or replaced units will be returned within 30 or 45 days, depending on the product type and availability of repair parts. Repaired units are warranted for either 90 days from the date of repair or for the remaining unexpired portion of the original warranty, whichever is longer.

11. SPECIFICATIONS

The electrical and physical characteristics of the 3192-9T T1 Terminating Repeater are as follows:

11.1 Electrical

- OFFICE REPEATER TYPE: Passive transmit, regenerative receive.
- LINE SIGNAL TYPE: Bipolar at 1.544Mbps ± 200 bps.
- TRANSMIT PATH: Selectable 0 to 22.5dB span pad (in 7.5dB increments). Balanced input and output.
- SPAN SIGNAL PULSE AMPLITUDE: 3V Peak ±0.6V (6V Peak-to-Peak, pre-equalized).
- SPAN SIGNAL PULSE WIDTH: 324 ±45nsec.
- SPAN PULSE WIDTH UNBALANCE: 15nsec maximum.

- SPAN SIGNAL PULSE OVER–SHOOT: 10 to 30 percent of pulse height.
- SPAN SIGNAL PULSE RISE AND FALL TIME: 100nsec maximum.
- INPUT/OUTPUT IMPEDANCE: 100 ohms nominal at 772kHz.
- RECEIVER LINE BUILD–OUT: Automatic, 7.5dB to 35dB. (Effective range is 0 to 27.5dB when 7.5dB art line is in.)
- SURGE PROTECTION: Input/output to ground, ±1000V; metallic, ±1000V.
- ERROR DETECTOR THRESHOLD: Adjustable from 1×10^{-3} to 1×10^{-8} BPV/Bits ±5 percent.
- RECEIVER LOS THRESHOLD: Pulses absent from more than 150Msec ±5 percent.

11.2 Physical

See Table 3 for the physical characteristics of the repeater.

Table 3. Physical Specifications

Feature	U.S.	Metric
Height	4.75 inches	12.06 centimeters
Width	0.687 inches	1.746 centimeters
Depth	10.5 inches	26.67 centimeters
Weight	6.2 ounces	171 grams
Temperature	–40 to 149°F	–40 to 65°C