

APS101 Automatic Protection Switch

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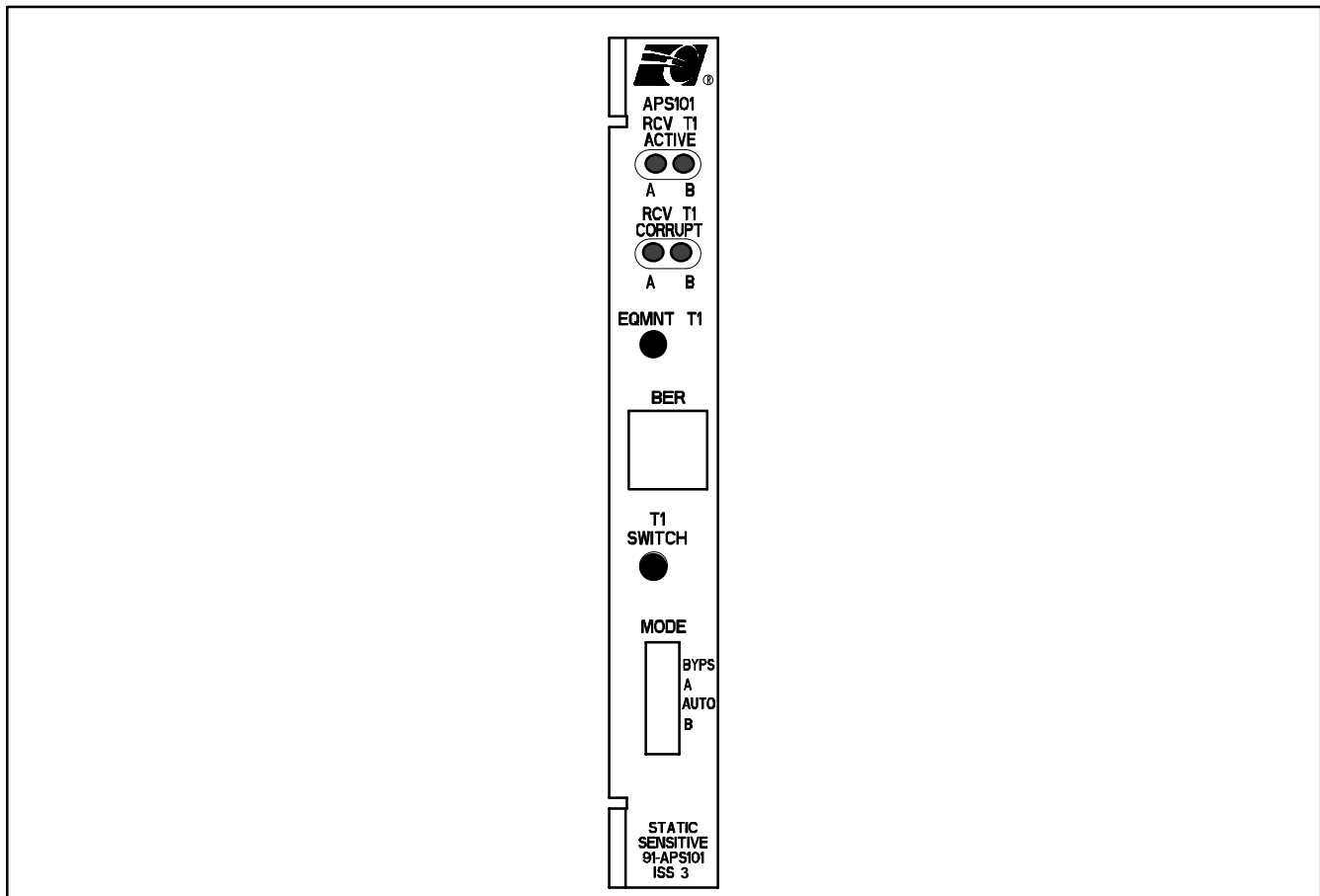


Figure 1. APS101 Automatic Protection Switch Line Unit

1. GENERAL

1.1 Document Purpose

This document provides a general description of the Charles Industries APS101 Automatic Protection Switch (APS). The APS101 is shown in Figure 1.

1.2 Equipment Function

The APS101 is a T1 Automatic Protection Switch that provides cost-effective self-healing networking in the event of out-of-frame, excessive bipolar violations/CRC, or loss of signal for any reason including cable cuts, equipment failures or signal degradation. The T1 APS, upon receiving T1 information from the equipment T1 line, provides identical T1 information transmitted on duplicate T1 lines. The receiving APS analyzes the two incoming network T1 lines, and, according to user specified selection criteria, provides the selected T1 line to the equipment T1 connection.

1.3 Equipment Location/Mounting

The APS101 Automatic Protection Switch is designed for use in the Charles Industries Span Termination System (STS) Mounting Shelves, as shown in Table 1. For additional information regarding the shelves, refer to Section 319-211-100 (Charles Industries Span Termination System General Description).

Table 1. APS101-Compatible Shelves

23-inch shelves	Provides protection for...
3192-11 (except Issue 4)	A fully loaded shelf offers protection for 56 T1s in, 28 T1s out.
3192-SA	
3192-SB	
3192-WR	
19-inch shelves	
319-02	A fully loaded shelf offers protection for 44 T1s in, 22 T1s out.
319-04	

1.4 Equipment Features

Features of the APS101 include:

- Single module for two T1s in, one T1 out.
- Line status monitoring.
- Temperature hardened.
- Automatic detection of SF/ESF framing.
- Individual build-out controls for the T1 Network Lines.
- Network side repeaterless up to 6000 feet.
- Metallic bypass.
- Individual switch selectable transceiver sensitivity.
- T1 equalization of equipment line with LIU (0–655 feet) and CSU levels (0, –7.5, –15, and –22 dB).
- Local and remote switching.
- Local manual override.
- Switchable bipolar violation (BPV) thresholds.
- Automatic detection of AMI or B8ZS line coding.

1.5 Front Panel

Descriptions of each LED and switch on the front panel of the APS101 are in Table 2 (see Figure 5 for switch locations).

Table 2. Front Panel LED and Switch Description

Indicator	Type	Description
RCV T1 Active A	Green LED	When the LED is lit (green), the A T1 line is selected.
RCV T1 Active B	Green LED	When the LED is lit (green), the B T1 line is selected.
RCV T1 Corrupt A	Red LED	When the LED is lit (red), the A facility has become faulty due to loss of signal (LOS), out of frame (OOF), or the BPV error rate (BER) threshold has been exceeded.
RCV T1 Corrupt B	Red LED	When the LED is lit (red), the B facility has become faulty due to loss of signal (LOS), out of frame (OOF), or the BPV error rate (BER) threshold has been exceeded.
EQMNT T1	Red LED	The T1 from the equipment side has failed when the LED is lit (red).
BER	Switch (rotary)	BPV Error Rate threshold selector switch. Selectable from 10^{-3} to 10^{-9} BER.
T1 SWITCH	Pushbutton	Manual T1 pushbutton. Allows T1 switching every 2 sec. in <i>auto</i> mode.
MODE	Switch (slide)	Mode Selection: Bypass — Engages metallic bypass. Powers off the unit. Network A — Manual override. Network A side selected. Auto — Selection criteria is used. Network B — Manual override. Network B side selected.

2. INSPECTION

2.1 Inspect for Damages

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

2.2 Equipment Identification

Charles Industries' 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 1 and imprinted on subsequent units manufactured. Therefore, be sure to include both the model number and its issue number when making inquiries about the equipment.

2.3 Static Concerns

Each module is shipped in static-protective packaging to prevent electrostatic charges from damaging static-sensitive devices. Use approved static-preventive measures, such as static-conductive wrist straps and a static-dissipative mat, when handling modules outside of their protective packaging. A module intended for future use should be tested as soon as possible and returned to its original protective packaging for storage.



This equipment contains static-sensitive electronic devices. To prevent electrostatic charges from damaging static-sensitive units:

- Use approved static preventive measures (such as a static-conductive wrist strap and a static-dissipative mat) at all times whenever touching units outside of their original, shipped static-protective packaging.
- Do not ship or store units near strong electrostatic, electromagnetic, or magnetic fields.
- Use static-protective packaging for shipping or storage.

3. APPLICATION GUIDELINES

Can be used with any equipment requiring T1 reliability. A typical application is shown in Figure 2. The APS101 block diagram is shown in Figure 3.

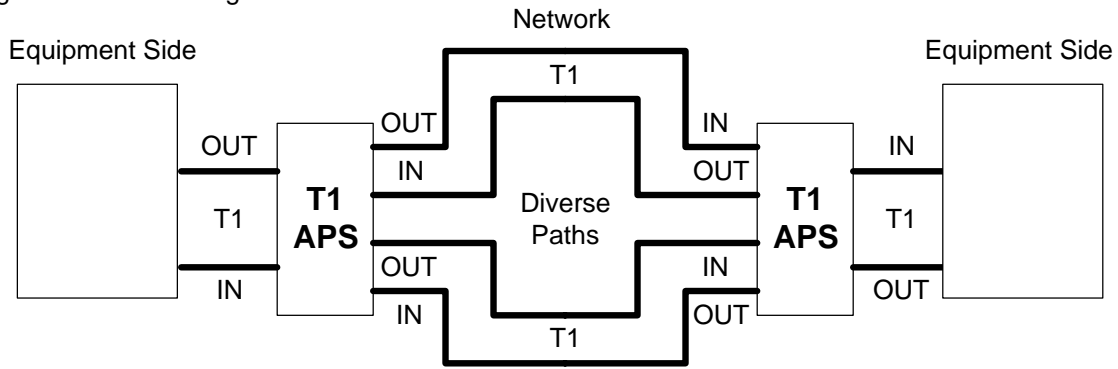


Figure 2. Typical APS Application

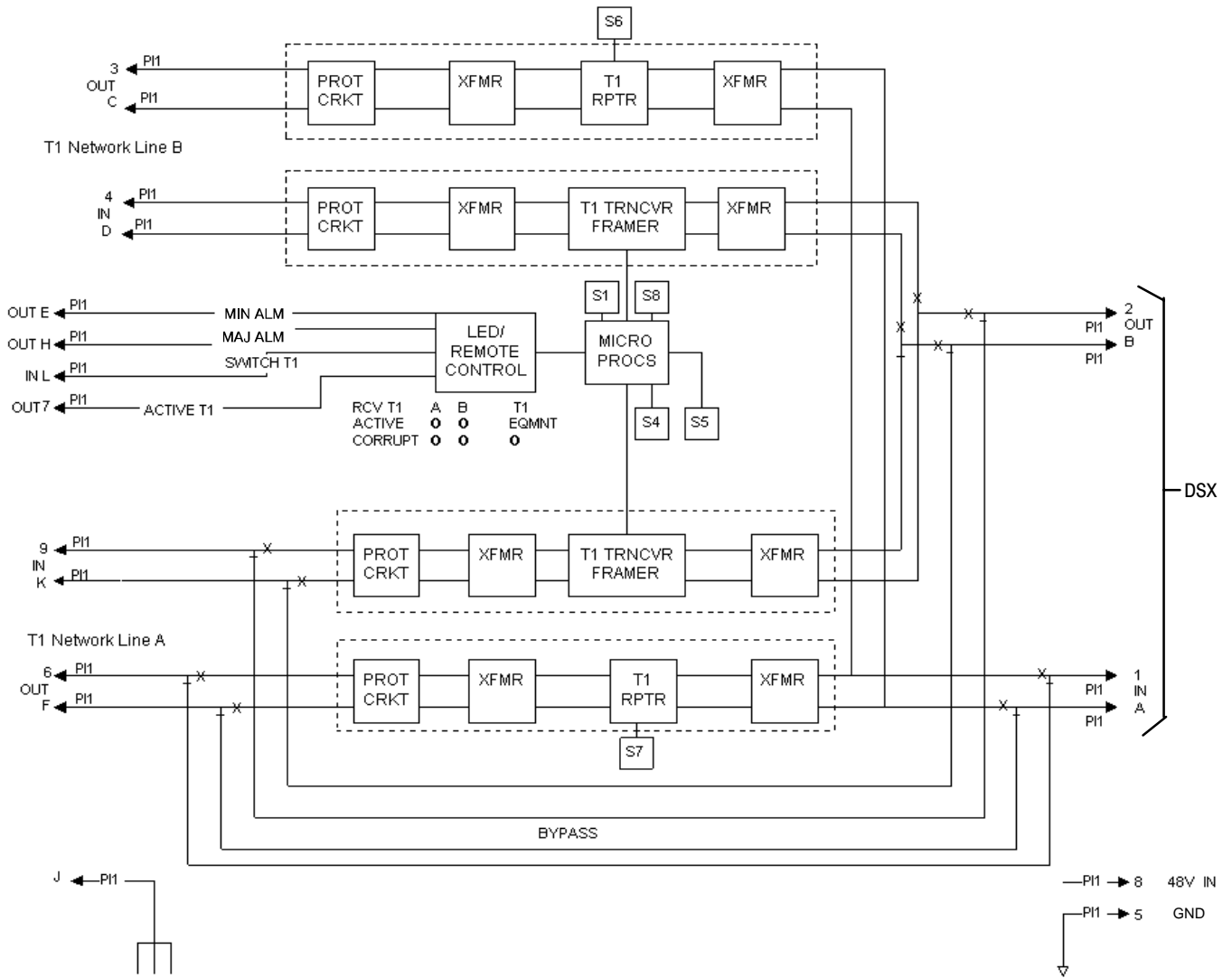


Figure 3. APS101 Block Diagram

4. INSTALLER CONNECTIONS

The pin connections for the APS101 Automatic Protection Switch are shown in Table 3.

Table 3. Pin Connections

Description	Pin	Pin	Description
Input from Equipment T1 (DSX) (P2)	A	1	Input from Equipment R1 (DSX) (P2)
Output to Equipment Tip (DSX) (P1)	B	2	Output to Equipment Ring (DSX) (P1)
Output to Network B Tip	C	3	Output to T1 Network B Ring
Input from Network B T1	D	4	Input from T1 Network B R1
Output—ground indicates minor alarm	E	5	+ GND/48VR
Output to T1 Network A Tip (P3)	F	6	Output to T1 Network A Ring (P3)
Output—ground indicates major alarm	H	7	Output— ground =B select, open = A select
Chassis Ground	J	8	–48 VDC 1N
Input from Network A T1 (P4)	K	9	Input from T1 Network A R1 (P4)
Input—momentary ground to switch receive network T1 lines	L	10	Not Used

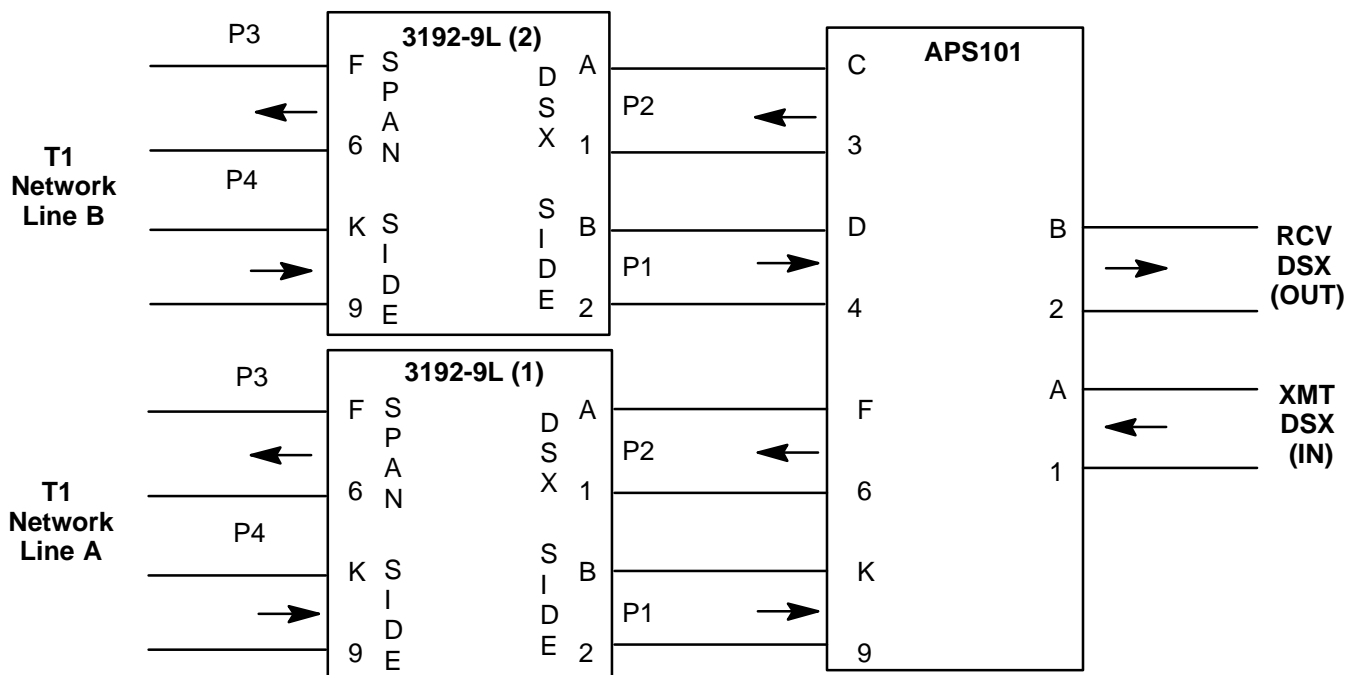


Figure 4. Connections for Span Line Powering

4.1 Remote/Card Edge Control

When pin L is momentarily grounded, the unit will switch between the two received Network T1 lines if the *mode* switch is in the AUTO position. In order for a switch to occur again, another ground needs to be applied after a 2-second interval.

An open condition between ground and pin 7 indicates the received T1 Network Line A is routed to the Equipment T1 Line connection. If pin 7 is grounded, received T1 network line B is routed to the equipment.

4.2 Major Alarms

When one of the following events occurs, pin H (LOS alarm bus) is grounded to indicate a major alarm:

- Both receive network T1 lines have failed
- The T1 equipment has failed
- The unit is in reset
- Power is lost

4.3 Minor Alarms

If either network T1 line has failed, or the front panel switch is in the A or B position, pin E (ERR alarm bus) will be grounded to indicate a minor alarm.

See Table 4 for status and alarms.

Table 4. Alarms

Conditions				Connector Pin Outputs			Alarm Condition
MODE Switch	Equipment T1	Network A T1	Network B T1	E	H	7	
Auto	OK	OK selected	OK	Open	Open	Open	None
Auto	OK	OK	OK selected	Open	Open	Ground	None
Auto	OK	OK selected	Not OK	Ground	Open	Open	Minor
Auto	OK	Not OK	OK selected	Ground	Open	Ground	Minor
Auto	OK	Not OK	Not OK	Open	Ground	Open	Major
Auto	Not OK	OK selected	OK	Open	Ground	Open	Major
Auto	Not OK	OK	OK selected	Open	Ground	Ground	Major
A	OK	OK selected	OK	Ground	Open	Open	Minor
B	OK	OK	OK selected	Ground	Open	Ground	Minor
BYPS	OK	OK	OK	Open	Ground	Open	Major

5. OPTIONS

The APS Shorting Connector option for the STS shelf allows an APS101 Automatic Protection Switch card to be removed without traffic interruption. Once the APS Shorting Connector is installed it can be used to turn a bypass on and off. When in the bypass mode (on) the APS Shorting Connector reroutes the T1 signal, disabling the function of the APS card. The APS Shorting Connector is transparent to the function of the APS card when it is not in the bypass mode (off), and therefore can be left installed.

5.1 Mid Board Switches

S4 — Line Build Out/Equalization for transmit equipment lines (pos. 1–3) (see Table 6). Receive Network sensitivity selection of 30 or 36 dB (pos. 4 & 5) (See Table 7).

S6/S7 — Line Build Out/Equalization for transmit network lines (See Table 5).

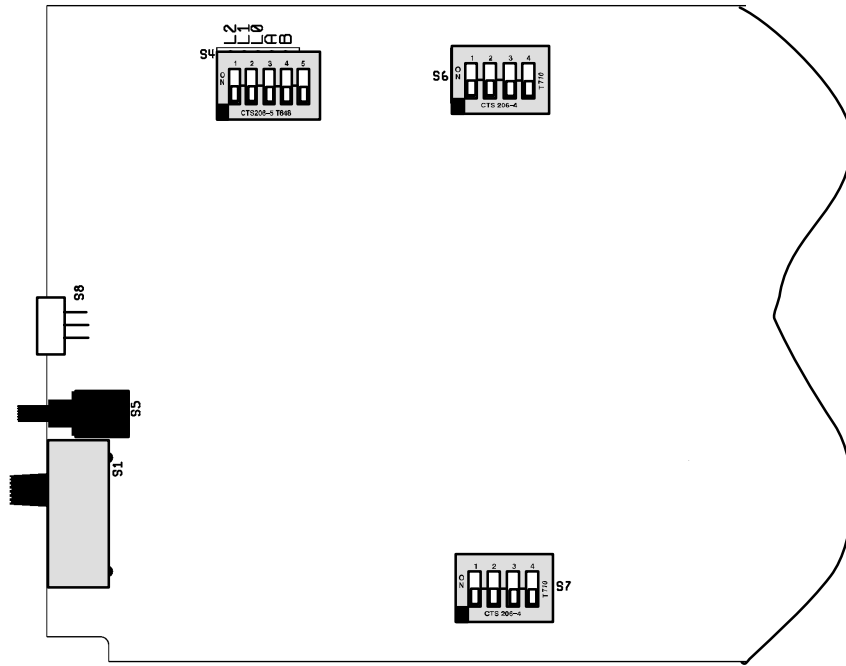


Figure 5. Switch Locations

Table 5. S6 (Network B) & S7 (Network A) Positions

S6 & S7 POSITIONS (Pre-equalizing) to Network T1 Outputs				CABLE FEET
1	2	3	4	
OFF	OFF	ON	OFF	0–133
ON	ON	OFF	OFF	133–266
OFF	ON	OFF	OFF	266–399
ON	OFF	OFF	OFF	399–533
OFF	OFF	OFF	OFF	533–655
S6 & S7 POSITIONS (Pad)				DECIBELS
OFF	ON	ON	ON	0.0
OFF	OFF	ON	ON	–7.5
OFF	ON	OFF	ON	–15.0
OFF	OFF	OFF	ON	–22.5

Table 6. S4 Positions (Part 1)

S4 POSITIONS (Pre-equalizing) to Equipment T1 Output			CABLE FEET
S4-1 (L2)	S4-2 (L1)	S4-3 (L0)	
ON	ON	ON	0–133
ON	ON	OFF	133–266
ON	OFF	ON	266–399
ON	OFF	OFF	399–533
OFF	ON	ON	533–655
S4 POSITIONS (Pad)			DECIBELS
OFF	ON	OFF	–7.5
OFF	OFF	ON	–15.0
OFF	OFF	OFF	–22.5

Table 7. S4 Positions (Part 2) from Network T1 Input

POSITION	STATUS	NETWORK	DECIBELS
S4-4 (A)	OFF	A	30
	ON	A	36
S4-5 (B)	OFF	B	30
	ON	B	36

Table 8. BER Selection vs. Detection Time

S8 Position	Detection/Threshold
0	Not Used
1*	Not Used
2*	Not Used
3	$10E^{-3}$ /over 1 second
4	$10E^{-4}$ /over 1 second
5	$10E^{-5}$ /over 3 seconds
6	$10E^{-6}$ /over 7 seconds
7	$10E^{-7}$ /over 70 seconds
8	$10E^{-8}$ /over 700 seconds
9	$10E^{-9}$ /over 7000 seconds
* T1 switching on BER is disabled.	

6. TESTING

Use the following table to determine the status of the APS101 during testing:

Step	Action	Response
1.	Move the MODE switch to AUTO and disconnect all three T1 connections from the APS101.	The Receive T1 Corrupt A and B LEDs are ON. The EQMNT T1 LED is ON.
2.	Reconnect the T1 equipment to the APS101.	The EQMNT T1 LED goes OFF.
3.	Reconnect the Network B T1 signal to the APS101.	The Receive T1 Corrupt B LED goes OFF and the Receive T1 Active B LED goes ON.
4.	Reconnect the Network A T1 signal to the APS101.	The Receive T1 Corrupt A LED goes OFF.
5.	Remove the Network B T1 signal from the APS101.	The Receive T1 Corrupt B LED goes ON, the Receive T1 Active A LED goes ON, and the Receive T1 Active B LED goes OFF.
6.	Reconnect the Network B T1 signal to the APS101.	The Receive T1 Corrupt B LED goes OFF.

7. TECHNICAL ASSISTANCE

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)

8. WARRANTY & CUSTOMER SERVICE

8.1 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
847-806-6300 (Main Office)
847-806-6231 (FAX)

8.2 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.

8.3 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 pre-addressed shipping label provided. Call your customer service representative at the telephone number above for more details.

8.4 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
503 N.E. 15th St., P.O. Box 339
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.

9. SPECIFICATIONS

The specifications of the APS101 are listed below.

9.1 Electrical

The electrical specifications of the APS101 are as follows:

- (a) *T1 Network Transmit Signal*: 6 volt peak to peak with DSX-1 or CSU line build-outs.
- (b) *T1 Equipment Transmit Signal*: 6 volt peak to peak with DSX-1 or CSU line build-outs.
- (c) *T1 Network Receive Sensitivity*: Switch selectable 30 or 36 dB of gain.
- (d) *T1 Switching*: Within 10 milliseconds after loss of signal (LOS) or out of frame (OOF) condition. BPV error rate (BER) switching threshold up to 7000 seconds for a setting at 10^{-9} .
- (e) *Current Draw*: 65 milliamps at 49 VDC.
- (f) *Operating Voltage*: -42 to -56 VDC.
- (g) *Port Impedances*: 100 Ohms nominal at 772 kilohertz.
- (h) *Input Bit Rate*: 1.544 Mbits per second.

9.2 0 to 6000 Specification

FCC 68.308 Option B and ANSI T1.403,95.

9.3 Agency Compliance Requirements

Unit shall meet UL1950 and FCC Part 15.

(a) EMI Requirements

This unit meets FCC Part 15 Class A and Bellcore GR-1089-CORE EMI requirements.

Unit meets all the requirements of this document when subjected to ESD tests specified GR-1089-CORE, section 2.

(b) T1 Signal Requirements

Unit meets Bellcore 62411, ANSI 403.

(c) Interface Requirements (Network T1 lines)

Unit shall meet Bellcore 1089, UL 1950 and FCC Part 68.

9.4 Physical

See Table 9 for the physical characteristics of the APS101.

Table 9. Physical Specifications

Feature	U.S.	Metric
Height	4.75 inches	12 centimeters
Depth	10 inches	25.4 centimeters
Width	0.69 inch	1.75 centimeters
Weight	7 ounces	198 grams
Temperature	-40° to 149° F	-40° to 65° C
Humidity	0 to 95% (no condensation)	

