



Plug-In Protector Units (3-, 4-, 5-, and 7-Type)

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1. General

1.01 This practice covers the description, use, maintenance, and test procedures for voltage-only, voltage and sneak current, and continuity only (no protection) protector units. These protector units are used with the 302, 303, 305, 307, 308, 309, 310, 310M, and 311 central office connectors on distributing and protector frames, and with customer premises building entrance protectors.

1.02 This practice is reissued to add information concerning solid-state protector units which conform to the breakdown voltage requirements of Bellcore Technical Reference TR-NWT-000974, *Generic Requirements for Telecommunications Line Protector Units (TLPUs)*.

1.03 The AT&T plug-in protector units are utilized with central office connectors and customer premises building entrance protectors to safeguard personnel, equipment, and the network from hazards such as electrical shock, equipment damage, and fire caused by lightning and AC power faults. Each protector unit provides protection for one tip-ring subscriber pair. The plug-in protector units are not included with the various connectors and must be ordered separately.

1.04 All standard plug-in protector units are equipped with four gold-plated tip and ring pins and a solder-plated ground pin.

1.05 Protector units with gold-plated pins should be used with connectors containing gold-plated socket terminals (that is, all current protector unit and connector codes). Protector units with gold-plated or solder-plated pins can be used in vintage connectors containing solder-plated socket terminals.



CAUTION:

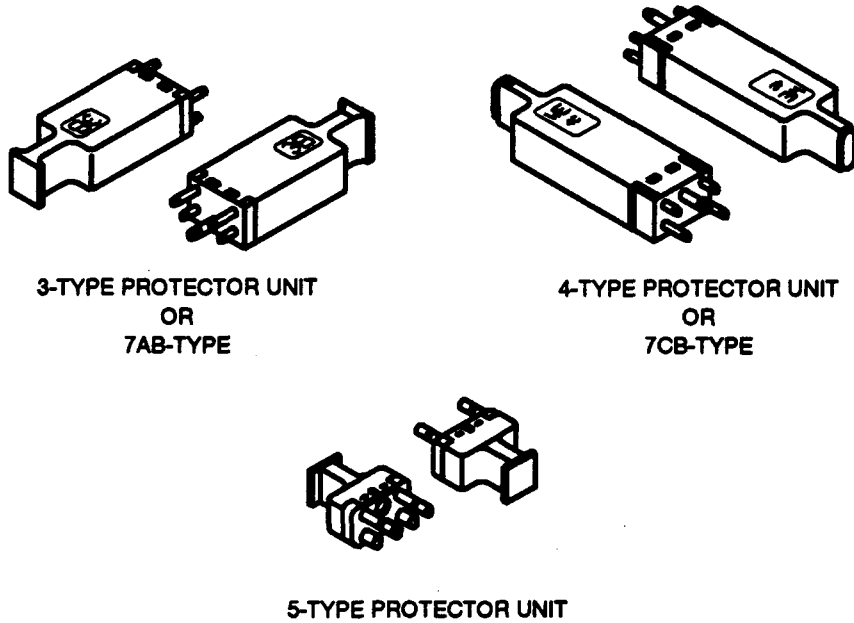
Protector units with solder-plated pins should not be used on connectors with gold-plated socket terminals. This combination of plating and contact surfaces results in higher contact resistance and surface degradation of gold-plated socket terminals.

1.06 These protector units are also compatible with AT&T multistation protectors (188-, 189-, and 190-type building entrance protectors) and any other connectors/protectors with a plug-compatible footprint configuration. All plug-in protector units are characterized by the industry standard 1/2-inch by 3/4-inch footprint with 5-pin arrangement.

1.07 The voltage-only protector units may also be used with the 1990-type protector. (See AT&T 631-460-125 for details.)

2. Description

2.01 The plug-in protector units (Figure 1) are categorized by four types. The protector types and their corresponding AT&T and Bellcore designation codes are summarized in Table A.



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Figure 1. Typical 3-, 4-, 5-, and 7-Type Protector Units

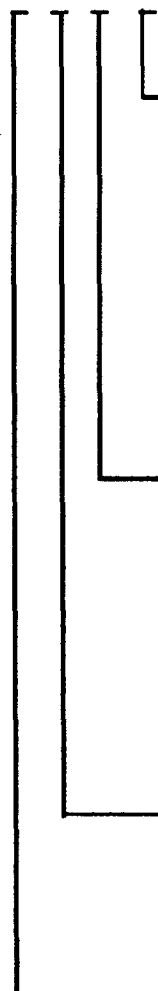
Table A. Plug-In Protector Descriptions

Protector Type Code	AT&T Designation Code	Bellcore Designation Code	Description
Voltage-only	3-Type	7A	Provides protection against abnormal voltage surges only.
Voltage and Sneak Current	4-Type	7C	Includes heat coils for sneak current protection, and devices for over-voltage protection.
Continuity-only	5-Type	7AA8	Dummy protector units that provide continuity only, used only where protection is not required.

AT&T Standard Protector Unit Coding Scheme

EXAMPLE:

3 B 1 A



Denotes - Voltage Limiter Type

- A Carbon blocks
- C Carbon blocks
- E General purpose gas tubes
- E-R REA approved gas tubes
- E-W General purpose gas tubes (wide gap)
- F **5ESS**® gas tubes
- S Balanced Solid-state
- FS **5ESS**® Balanced Solid-state

Denotes - Color/Application

- 1 = Black Standard Service
- 2 = Green Denied Service
- 3 = Red Special Service
- 4 = Yellow PBX Battery
- 9 = White Tip/Ring Reversal
- 11 = Orange Minibridge Lifter
- 12 = Gray Continuity Only

Denotes - Housing Type

- A, B = Without test access
- C = With test access

Denotes - Type

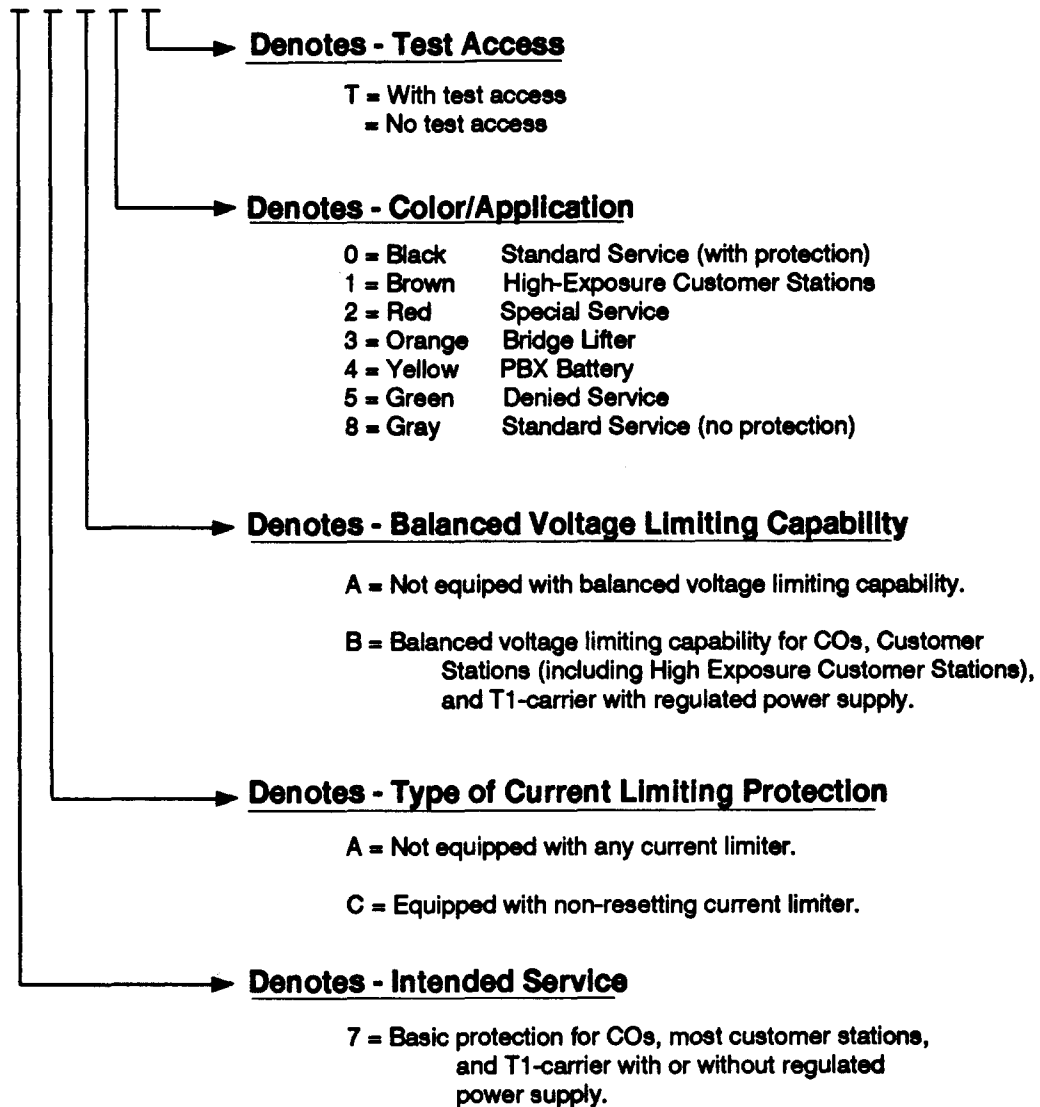
- 3-Type = Voltage protection only
- 4-Type = Voltage and sneak current
- 5-Type = Continuity only

Note: The end of the housing handle is typically stamped with symbols to further identify type/application information.

Protector Unit Coding Scheme (AT&T Bellcore Protectors)

EXAMPLE:

7 A B 0 T



Note: The end of the housing handle is typically stamped with symbols to further identify type/application information.

3-Type Protector Units — Voltage Protection Only

2.02 The 3-type plug-in protector units (Figure 2 and Tables B and C) provide voltage protection only, using carbon blocks, gas tubes, or solid-state devices for voltage limiting. (If sneak current protection is a concern, the 4-type protector units with heat coils should be considered.)

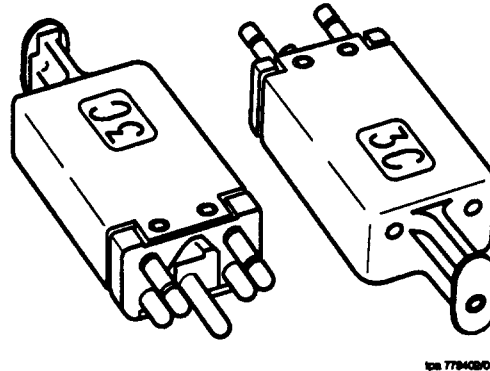


Figure 2. Typical 3-Type Protector Unit

- 2.03 The 3B-A protector units are 1-11/16 inches high and utilize carbon blocks for voltage protection.
- 2.04 The 3BE-W protector units are also 1-11/16 inches high and utilize wide-gap 331-RL gas tubes for voltage protection. Note that the 3BE-W series has replaced the 3B-E series which has been discontinued.
- 2.05 The 3CE-W protector units include test access through the protector and are intended primarily for use with 307-type connectors for *SLC*[®]-96 and *SLC* Series 5 carrier protection requirements. Note that the 3CE-W series has replaced the 3C-E series which has been discontinued.
- 2.06 The 3D1F protector units include two 205A gas tubes and are intended solely for use with *5ESS*[®] switch LNI (line network interface) (312-type connector and 128-type connecting block) arrangement. The 3D1F and associated *5ESS*[®] switch LNI apparatus have been discontinued.
- 2.07 The 3B1E-R and 3B3E-R protector units have Rural Electrification Administration (REA) PE-80 approved gas tubes and are accepted for use by REA for central office and customer premises applications.
- 2.08 The 3C1S and 3C3S protector units have balanced electronic solid-state voltage-limiting devices that provide superior protection for all applications and are compatible with all AT&T central office connectors and building entrance protectors.

Table B. Carbon Block and Gas Tube Protector Units — Voltage Protection

Carbon Block Protector Units				
Circuit Application	Housing		Product Code	Comcode
	Color	Stamping		
Standard	Black	None	3B1A	102381779
Service denied	Green		3B2A	102381787
Special	Red		3B3A	102381795
PBX battery	Yellow		3B4A	102381803
Check cable fault	Green		⌘	3B13A
Gas Tube Protector Units				
Standard	Black	○	3B1E*	103090395
		R	3B1E-R	105494248
		○	3B1E-W	104410147
		• ○ •	3C1E*	104030671
		• ○ •	3C1E-W	104410188
Service denied	Green	○	3B2E*	103090403
			3B2E-W	104410154
Special	Red	○	3B3E*	103090411
		R	3B3E-R	105499255
		○	3B3E-W	104410162
		• ○ •	3C3E*	104411129
		• ○ •	3C3E-W	104410196
PBX battery	Yellow	○	3B4E*	103090429
			3B4E-W	104410170
5ESS [®] LNIs	White	Φ	3D1F*	103810685

* Discontinued Availability (DA) (7-1-88). The 3B-Es are replaced by 3B-E-Ws; the 3C-E's are replaced by 3C-E-W's.

⇒ NOTE:

The 3B-type protector units are compatible with AT&T 302-, 303-, 305-, 308-, 310-, 310M-, and 311-type central office connectors and 188-, 189-, 190-, and 195-type building entrance protectors.

The 3C-type protector units are intended primarily for AT&T 307- and 309-type central office connectors that do not have a separate test field. However, 3Cs may also be used with all AT&T 300 series connectors and building entrance protectors where test access through the protector unit is desirable.

Table C. Solid-State Protector Units — Voltage Protection

Circuit Application	Housing		Product Code	Comcode
	Color	Stamping		
AT&T Standard	Black	. S .	3C1S	105514756
AT&T Special	Red		3C3S	105695969
Bellcore - Standard	Black	•	7AB0	106945066
Bellcore - Standard (with test ports)*	Black	• • •	7AB2T*	106945074
Bellcore - Special	Red	•	7AB2	106945462
Bellcore - Special (with test ports)*	Red	• • •	7AB2T*	106945470
Bellcore - PBX Battery†	Yellow	•	7AB4	106945488
Bellcore - PBX Battery† (with test ports)*	Yellow	• • •	7AB4T*	106945496
Bellcore - Service Denied	Green	•	7AB5	106945504
Bellcore - Service Denied (with test ports)*	Green	• • •	7AB5T*	106945512

* Bellcore Specification TR-NWT-000974 does not discuss provision of circuit test access. This feature is incorporated into the indicated protector unit codes manufactured by AT&T. We have added a "T" to the product code to identify protector units with test access.

† Bellcore Specification TR-NWT-000974 does not address protector codes for PBX Battery circuits, and yellow housing color is listed as "Not in Use" in Issue 1, dated August 1991. AT&T offers this product in response to customer interest, and we have employed a product code consistent with the Bellcore coding scheme.

7AB-Type Protector Units — Voltage Protection Only

2.09 Like the 3C1S and 3C3S protector units, the 7AB-type protector units (Table C) have balanced electronic solid-state voltage-limiting devices that provide superior protection for all applications. They are also compatible with all AT&T central office connectors and building entrance protectors. They differ from the 3C1S and 3C3S in that their breakdown voltage range and other performance characteristics conform to the applicable requirements of Bellcore TR-NWT-000974.

4-Type Protector Units — Voltage and Sneak Current Protection

2.10 The plug-in protector units which provide both overvoltage and sneak current

protection include overvoltage protection options of carbon blocks, gas tubes, or solid-state devices (Figure 3 and Tables D, E, and F). Heat coils are utilized to protect against sneak current (abnormal overcurrent conditions with associated voltages which are too low to cause "firing" of the voltage-limiting devices).

- 2.11 The 4C-type protector units include test access through the protector housing and are designed for use with connectors that do not have a separate test field such as 307- and 309-type central office (CO) connectors.
- 2.12 The 4B-type protector units are 2 inches high, and the 4C-types are 2-1/2 inches high.
- 2.13 The 4B-C and 4C-C protector units utilize carbon blocks for overvoltage protection.
- 2.14 The 4BE-W and 4CE-W protector units have two 331-RL wide-gap gas tubes for general purpose overvoltage protection applications. Note that the 4BE-Ws and 4CE-Ws have replaced the 4B-E and 4C-E series, respectively, and the -E series has been discontinued.
- 2.15 The 4B-F and 4C-F protector units utilize two 205A gas tubes and are intended primarily for 5ESS[®] switch primary protection applications.

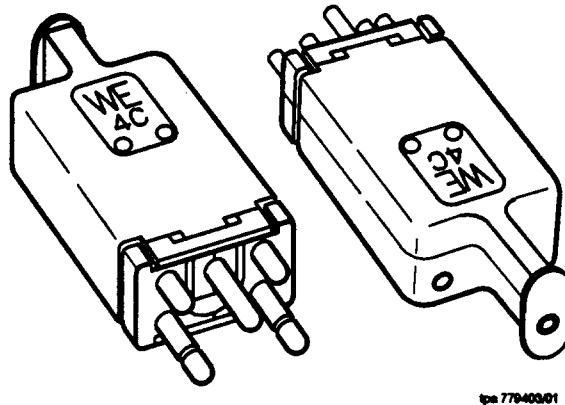


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Figure 3. Typical 4-Type Protector Unit

2.16 The 4B9F and 4C9F protector units contain a polarity reversing circuit board in addition to the gas tube protection, and are utilized for tip/ring reversal applications at the central office. Note that the 4B9C, 4B9E, 4C9C, and 4C9E codes have been discontinued and replaced by the F codes. The 4B11F and 4C11F protector units are minibridge lifter protector units. In addition to providing protection, they contain a miniature solid-state bridge lifter switch and can be used to bridge a maximum of four subscriber lines to the same central office equipment. Note that the 4B11C, 4C11C, 4B11E, and 4C11E minibridge lifter codes have been discontinued and replaced by the F codes.

Table D. 4B-Type Protection Units — Voltage and Sneak Current Protection

Carbon Block Protector Units				
Circuit Application	Housing		Product Code	Comcode
	Color	Stamping		
Standard	Black	None	4B1C	102904893
Service denied	Green		4B2C	102904901
Special	Red		4B3C	102904919
PBX battery	Yellow		4B4C	102904927
Reverse ring & tip	White	X	4B9C*	102904976
Minibridge lifter	Orange	None	4B11C*	102904984
Continuity only	Gray		4B12C†	103626016

Gas Tube Protector Units				
Standard	Black	○	4B1E*	103090437
			4B1E-W	104401856
		Φ	4B1F	103550992
Service denied	Green	○	4B2E*	103090445
			4B2E-W	104401864
		Φ	4B2F	103551016
Special	Red	○	4B3E*	103090452
			4B3E-W	104401872
		Φ	4B3F	103551024
PBX battery	Yellow	○	4B4E*	103090460
			4B4E-W	104401880
		Φ	4B4F	103551032
Reverse ring & tip	White	⊗	4B9E*	103090478
		⊕	4B9F	103551040
		○	4B11E*	103090486
Minibridge lifter	Orange	Φ	4B11F	103551008

* DA (Discontinued Availability). The 4B9C and 4B9E are replaced by 4B9F; the 4B11C and 4B11E are replaced by 4B11F; the 4B-Es are replaced by 4B-E-Ws.

† 4B12C is used for continuity only and does not have carbon blocks or gas tubes for protection.

⇒ **NOTE:**

The 4B-type protector units are compatible with AT&T 302-, 303-, 305-, 308-, 310-, 310M-, and 311-type central office connectors and 188-, 189-, 190-, and 195-type building entrance protectors.

Table E. 4C-Type Protector Units — Voltage and Sneak Current Protection

Carbon Block Protector Units				
Circuit Application	Housing		Product Code	Comcode
	Color	Stamping		
Standard	Black	• •	4C1C	103051470
Service denied	Green		4C2C	103051488
Special	Red	None	4C3C	103051496
	Red	• •	4C3C-2‡	104271101
PBX battery	Yellow		4C4C	103051504
Reverse ring & tip	White	X	4C9C*	103051512
Minibrige lifter	Orange	• •	4C11C*	103051520
Continuity only	Gray		4C12C†	103290755

Gas Tube Protector Units				
Standard	Black	◦	4C1E*	102869450
			4C1E-W	104401898
		Φ	4C1F	103324034
Service	Denied	◦	4C2E*	102869468
			4C2E-W	104401906
		Φ	4C2F	103324059
Special	Red	○	4C3E*	102869476
			4C3E-W	104401914
		Φ	4C3F	103324067
		◦	4C3E-2‡	104271093
		Φ	4C3F-2‡	104152152
PBX battery	Yellow	◦	4C4E*	102869484
			4C4E-W	104401930
		Φ	4C4F	103324075
Reverse ring & tip	White	⊗	4C9E*	102869492
		⊕	4C9F	103324083
Minibrige lifter	Orange	◦	4C11E*	102869500
		Φ	4C11F	103324042

* Discontinued Availability (DA). The 4C9C and 4C9E are replaced by 4C9F; the 4C11C and 4C11E are replaced by 4C11F; the 4C-Es are replaced by 4C-E-Ws.

† 4C12C is used for continuity only and does not have carbon blocks or gas tubes for protection.

‡ DA 4C3C-2 (6/1/91); 4C3F-2 (1/1/92); 4C3E-2 (11/1/93).

NOTE:

The 4C-type protector units are intended primarily for AT&T 307- and 309-type central office connectors that do not have a separate test field. However, 4Cs may also be used with all AT&T 300 series connectors and building entrance protectors where test access through the protector unit is desirable.

Table F. Solid-State Protector Units — Voltage and Sneak Current Protection

Circuit Application	Housing		Product Code	Comcode
	Color	Stamping		
AT&T Standard	Black	• S •	4C1S	104386545
AT&T Special	Red		4C3S	105605596
AT&T - 5ESS [®] - Standard	Black	• § •	4C1FS	105605620
AT&T - 5ESS [®] - Special	Red	• § •	4C3FS	105605646
AT&T - Low Voltage - Special	Red	• S-75 •	4C3S-75	105581086
Bellcore - Standard	Black	C•	7CB0	106945520
Bellcore - Standard (with test ports)*	Black	• C• •	7CB0T	106945538
Bellcore - Special	Red	C•	7CB2	106945546
Bellcore - Special (with test ports)*	Red	• C• •	7CB2T	106945553
Bellcore - PBX Battery†	Yellow	C•	7CB4	106945561
Bellcore - PBX Battery† (with test ports)*	Yellow	• C• •	7CB4T	106945579
Bellcore - Service Denied	Green	C•	7CB5	106945587
Bellcore - Service Denied (with test ports)*	Green	• C• •	7CB5T	106945595

* Bellcore Specification TR-NWT-000974 does not discuss provision of circuit test access. This feature is incorporated into the indicated protector unit codes manufactured by AT&T. We have added a "T" to the product code to identify protector units with test access.

† Bellcore Specification TR-NWT-000974 does not address protector codes for PBX Battery circuits, and yellow housing color is listed as "Not in Use" in Issue 1, dated August 1991. AT&T offers this product in response to customer interest, and we have employed a product code consistent with the Bellcore coding scheme.

2.17 The 4B12C and 4C12C protector units do not provide any protection, and are intended for use with 310-/311- and 307-/309-type connectors, respectively, to provide continuity only.

2.18 The 4C1S solid-state protector (SSP) is an alternative to plug-in protectors with carbon blocks or gas tubes for central office, building entrance, and other applications where superior protection and improved reliability are desirable. Fast clamping at low voltages as well as stable, quiet, and truly balanced SSP performance can significantly reduce failure rates for both protector units and protected surge-sensitive equipment. Where improved protector reliability is important for applications

such as critical service lines, the SSP is ideal because of its:

- precise breakover voltage
- perfect balance between tip and ring breakover voltage
- high surge-current capability
- stable operating characteristics
- lower power dissipation which results from its low on-state voltage.

2.19 The 4C3S-75 SSP unit provides the same benefits as the 4C1S solid-state protector unit, but is intended only for building entrance and central office applications on circuits not subject to normal ringing voltages such as those serving digital terminals.

2.20 The 4C1FS and 4C3FS SSP units provide the same benefits as the 4C1S SSP, but the breakover voltage of these units is slightly lower in order to provide protection appropriate for those *5ESS*[®] switch circuits which require special protection.

7CB-Type Protector Units — Voltage and Sneak Current Protection

2.21 The Bellcore 7CB series SSP units (Table F) provide the same benefits as the 4C1S. They differ from the 4C_S codes in that their breakover voltage range and other performance characteristics conform to the applicable requirements of Bellcore TR-NWT-000974.

5-Type Protector Units — Continuity and/or Ground Only

2.22 The 5-type protector unit (Figure 4 and Table G) provides no electrical protection and contains no carbon blocks, gas tubes, or heat coils. It is used to maintain circuit continuity between outside plant and central office equipment.

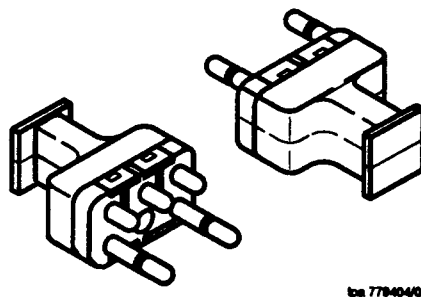


Figure 4. Typical 5-Type Protector Unit

- 2.23** The 5A2D protector unit, used to deny service, does not provide continuity to the central office equipment.
- 2.24** The 5A9D protector unit contains a polarity-reversing circuit board. Tip and ring out are reversed from tip and ring in.
- 2.25** The 5AGND protector unit is a grounding device used to ground unused feeder pairs for customer premises applications.

Table G. 5-Type Protector Units — Continuity Only — No Protection

Circuit Application	Connector Application	Housing		Product Code	Comcode
		Color	Stamping		
Standard	302, 303, 305, 308	Gray	None	5A1D	100828268
Service denied		Green		5A2D	100828276
Special		Red		5A3D	100828284
PBX battery		Yellow		5A4D	100828292
Reverse ring & tip		White	X	5A9D	102234481
Grounding tip & ring	188, 189, 190 & 195 Building Entrance Protectors	Gray	∇	5AGND	105300578

3. Characteristics and Applications

Instant Identification

3.01 All protector units are color coded to key you to a specific circuit application. For example, the red protector units for special service circuits virtually eliminate accidental interruption of service for critical data or alarm circuits. Symbols permanently stamped on the end of housing handles provide additional application and identification information for craft. For example, general purpose gas tube protectors are stamped with an O in a color that contrasts with the housing color. Tables B, C, D, E, F, and G show the colors associated with the circuit application.

Color	Application
Black	Standard circuit
Green	Service denied
Red	Special circuit
Yellow	PBX battery
White	Tip and ring reversal
Orange	Minibridge lifter
Gray	Dummy — continuity only

3.02 Full insertion of plug-in protector units into the connector panel interconnects outside plant with central office or customer premises equipment, providing electrical protection.

3.03 When the plug-in protector units are properly inserted into a terminal group on the connector panel, they provide contacts for one pair as follows:

(a) The **central office application** will provide:

- Tip and ring to outside plant conductors (long pins)
- Tip and ring to central office (short pins)
- Ground which also serves to properly orient the protector unit relative to the connector panel (center pin).

(b) The **station application** will provide:

- Tip and ring to outside plant conductors or toward the central office (long pins)
- Tip and ring toward the customer premises (short pins)
- Ground, which also serves to properly orient the protector unit relative to the connector panel (central pin).

3.04 For short-term testing or service denial, protector units may be partially withdrawn to the "detent" position. When the protector unit is pulled out to the detent position, the **central office or customer premises equipment** is disconnected to isolate outside plant cable pairs for testing purposes. In this position, voltage protection is still provided on the outside plant cable pair. Removing the protector unit from the connector opens the circuit and removes all protection.

Stamping

3.05 The stamping or symbols embossed on the top of the protector housing identify certain characteristics of the protector unit. Tables B, C, D, E, F, and G show the stamping and test-point holes for each protector unit. The symbols are defined as follows:

None (Blank) — carbon blocks or no carbon blocks or gas tubes in the case of continuity only units

⌘ — resistor connected between tip and ring terminals

○ — general purpose gas tubes

Φ — 205A gas tubes for 5ESS[®] switch

× — polarity (tip and ring) reversing circuit board

S — general purpose balanced solid-state device

‡ — 5ESS[®] range balanced SSP

R — REA approved gas tubes

S-75 — 75-volt balanced solid-state devices

∇ — grounding device

• — Basic Telecommunications Line Protector Unit (TLPU), Voltage Protection Only

C_• — Basic TLPU with Non-Resetting Current Limiter

• • — These are test points - actually holes through the top of the protector housings that provide test access via a P2FL test cord.

3.06 For many protector unit codes, a combination of the symbols is utilized. Protector codes with combination symbols are noted in the tables for the 3-, 4-, 5-, and 7-type protector units.

Overvoltage Protection

3.07 For overvoltage protection, three protection technologies are available:

- Carbon Blocks
- Gas Tubes
- Solid-State Electronics.

Carbon Block Overvoltage Protection

3.08 The carbon block protector units (3B-A, 4B-C, and 4C-C types) are intended for use in low lightning risk areas, typically, for applications where a technician is available to perform expected routine maintenance such as manned central offices with electromechanical switches.

- (A) Overvoltage protection is accomplished with 3-mil surge-limiting carbon blocks. When voltage on a tip or ring conductor exceeds a predetermined level (typically 500 volts), the voltage will be limited by arcing across the 3-mil air gap. If current flow across this gap is large or persists for an appreciable time (substained power cross faults), the protector unit's thermal overload mechanism will operate and the protector unit will become permanently grounded (fail-safe condition).
- (B) Carbon block protector units are discharge-type devices. Applications are primarily intended for manned central offices with electromechanical switches. The performance and service life of carbon block protector units are significantly affected by use and operation, and technicians must be available to perform routine maintenance to clear shorted or noisy protector units. Carbon block protector units lack the precision performance and service life of gas tube and new solid-state protector units and are characterized as having high-maintenance characteristics.
- (C) Typical electrical characteristics for carbon block protector units are as follows:

DC Breakdown @2 kV/s	Nominal 500 volts
Surge breakdown voltage (@ 100 v/μs)	Nominal 700 volts Maximum 1000 volts
Insulation resistance	100 megohms

- (D) All AT&T carbon block protector units meet the Bellcore requirements per Specification TR- TSY-000300, Issue 1, June 1985, *Plug-In Carbon Block Protectors for Use in CO Connectors and Building Entrance Terminals*.

Gas Tube Overvoltage Protection

3.09 The general purpose gas tube plug-in protector units (3BE-W, 3CE-W, 4BE-W, and 4CE-W types) are intended for most central office and customer premises applications where longer service life, reduced maintenance, and more predictable overvoltage protection performance are desirable. The newer wide-gap, general-purpose gas tube protector units are economical alternatives versus carbon block units for protection of central office and customer premises equipment that have an overvoltage threshold greater than 265 volts (typically, all applications except certain models of the AT&T **5ESS**[®] switch).

- (A) For digital central office and PBX equipment that requires tighter DC breakdown voltage protection, such as some models of the AT&T **5ESS**[®] switch, the applicable gas tube plug-in protector codes are the 4B-F and 4C-F. The corresponding SSP is the 4C1FS (Table F).
- (B) For gas tube protector units, overvoltage protection is accomplished with 331-RL wide-gap technology gas tubes (for the general purpose -W codes) and narrow-gap 205A gas tubes (for the -F **5ESS**[®] switch codes). When the voltage across tip and/or ring conductors exceeds the specified range (typically, 350 V DC for the W codes or 240 V DC for the F codes), the voltage will be limited by arcing across the internal gap of the sealed gas tubes. The gas tubes will recover after the potentially damaging energy has been dissipated to ground. If current flow across the gas tubes is large or persists for an appreciable time (sustained power faults), the protector unit's thermal overload mechanism will operate and the protector unit will become permanently grounded (fail-safe condition).
- (C) Gas tube protector units are recommended as preferred economical alternatives versus carbon block protector units for all customer premises and unmanned applications such as remote pair gain systems and unmanned central offices. Gas tubes provide longer service life (typically 10 times longer) and require significantly less maintenance as compared to carbon block protector units.

(D) Electrical and service life characteristics for the general purpose gas tube W codes (3BE-W, 3CE-W, 4BE-W, 4CE-W) are as follows:

Electrical Characteristics

DC breakdown voltage (@ 2 kV/s)	265-465 volts
Surge breakdown voltage (@ 100 V/ μ s)	200-800 volts
Insulation resistance (PE-80)	100 megohms typical
DC holdover voltage (<i>IEEE</i> * C62.31-1987)	150 volts typical
Vented breakdown voltage (meets <i>UL</i> [†] reqts)	< 1000 volts
DC arc voltage	20 volts typical
Glow-to-arc transition current (<i>IEEE</i> C62.31-1987)	0.5 amp typical
Capacitance (PE-80)	< 10 picofarads
AC discharge (PE-80)	> 65 amps (11 cycles @ 60 Hz)
Maximum impulse discharge (PE-80)	20 K amps (8 x 20 μ s waveform)
Sneak current @ 68° F (20° C)	< 210 sec. @ 0.54 amps*

* For 4B4E-W and 4C4E-W < 210 sec. @ 1.875 amps

Service Life Characteristics	No. of Operations
-------------------------------------	--------------------------

Short duration 60 Hz AC	
1 amp 60 Hz AC/1 s burst	> 60
10 amps 60 Hz AC/1 s burst	> 60
Continuous 60 Hz AC .5 amp	140 seconds
Surges:	
10 amp (10 x 1000 μ s waveform)	> 1000
100 amp (10 x 1000 μ s waveform)	> 100
300 amp (10 x 1000 μ s waveform)	> 50
For the stated number of operations, VB, VL and RL values remain within required ranges as follows:	
VB: 265-425 volts	
VL: < 1000 volts	
RL: > 10M ohms	

* *IEEE* is registered trademark of Institute of Electrical and Electronic Engineers, Inc.

† *UL* is registered trademark of Underwriters Laboratory, Inc.

- (E) Electrical characteristics for the F codes (4BF, 4CF, and 3DF) for **5ESS[®]** switch protection are as follows:

Electrical Characteristics

DC Breakdown voltage (@2 kV/s)	215-265 volts
Surge breakdown voltage (@ 100 V/ μ s*)	180-1000 volts
Insulation resistance @ 100 V dc	100 megohms
Capacitance	< 10 picofarads
Sneak current @ 68° F (20° C)	< 210 s @ 0.54 ampst

* With a **5ESS[®]** switch, peak surge voltages are limited by diodes (secondary protection) incorporated in the input circuits of the line unit.

† For 4B4F and 4C4F < 210 sec. @ 1.875 amps

Service life characteristics are similar to that for the W codes.

Solid-State Overvoltage Protection

3.10 The newer family of SSP units provides a premium alternative to both carbon block and gas tube protector units for central office, building entrance, and other applications where superior protection and improved reliability are desirable. Fast clamping at low voltages as well as stable, quiet, and truly balanced electronic SSP performance can significantly reduce failure rates for both protector units and protected surge-sensitive equipment. Where improved protector reliability is important for applications such as critical service lines, the SSPs are ideal because of their precise breakover voltage, lower power dissipation due to the low on-state voltage, and high surge-current capability.

- (A) Solid-state overvoltage protection is accomplished with semiconductor devices in a design which ensures excellent balance across tip, ring, and ground. Upon reaching the specified breakdown voltage in either direction between any two conductors (tip, ring, or ground), the SSP switches to a low-voltage, on-state condition, shorting tip and ring to ground simultaneously. Conduction and power dissipation will continue until the fault current drops below the holding current. The normal off-state condition is a high-impedance, low-leakage state that prevents loading of the telecommunication line. If the current flow across the SSP device is large or persists for an appreciable time, the heat coil mechanisms will operate and permanently ground tip and ring terminals.
- (B) Electrical characteristics for the various solid-state protector codes are shown in Table H.

Table H. Electrical Characteristics of Solid-State Protector Units

Electrical Characteristics (@ 20°C)	3C1S, 3C3S 4C1S, 4C3S	4C1FS 4C3FS	4C3S-75	7AB_ 7CB_
DC Breakdown Voltage @ 2 kV/s*	220 - 300 V	215 - 260 V	60 - 90 V	265 - 400 V
Surge Breakdown Voltage (@ 100 V/μs)*	220 - 300 V	215 - 260 V	60 - 90 V	265 - 400 V
Insulation Resistance (PE-80)	> 100 MΩ	Same	Same	Same
DC Holdover Current †	260 mA/52 V 200 mA/135 V 140 mA/150 V	Same	Same	Same
On-state Voltage (@ 100A)	< 10 V	Same	Same	Same
Response Time	< 100 nanosec	Same	Same	Same
Rated Impulse Current ‡	200 A	Same	Same	Same
Capacitance §	< 100 picofarads	Same	Same	Same
Line Series Resistance	< 4 Ω (4-types only)	Same	Same	Same (7CB_-types only)
Operational Temperature Range	-40° C to +75° C	Same	Same	Same
Sneak Current @ 68° F (20° C)	< 210 sec @ 0.54A (4-types only)	Same	Same	Same (7CB_-types only)

* Breakover voltages remain within the specified limits regardless of age, use, or rate-of-rise of applied voltage.

† DC holdover test per *IEEE* (ANSI/*IEEE* C62.31 1984) is used to establish the level of DC current for a specified open circuit voltage in which a device will extinguish in less than 150 ms.

‡ Impulse discharge test applies 200 amp 10X1000 current waveform between any two long terminals (T-R, T-G, or R-G) or 100 amp 10X1000 applied simultaneously to T-G and R-G. Below rated impulse current, the number of operations is unlimited.

§ Capacitance is measured between any two terminals at a frequency of 1 kHz at 1 V AC rms with an applied bias of 50 V DC.

4. Maintenance

4.01 Any protector units that are defective or suspected of being defective should be discarded, except the minibridge lifters (4B11F and 4C11F). Return the minibridge lifters to the appropriate AT&T repair facility for repair.

4.02 If evidence is found or if there is suspicion of abnormally high voltage conditions or contact between CO main frame terminations, observe the following precautions:

- (1) Identify and mark the location.
- (2) Notify the office supervisor and test center.
- (3) Notify other employees who may have occasion to work on the frame.
- (4) Avoid all contact with associated frame terminations until authorized by the test center.
- (5) Wear insulation gloves to remove the protector unit if the test center requests that the protector units and associated circuits be inspected.



NOTE:

Insulation gloves shall be mechanically inspected before they are used in accordance with AT&T 075-141-501.

4.03 To remove protector units from circuits which do not have abnormally high voltages present, grasp the handle of the protector unit and withdraw the unit from the connector jack.

4.04 When it is necessary to remove protector units from circuits that are suspected of having abnormally high voltages present, insulation gloves (note in paragraph 4.02) should be worn in all cases.

5. Test Procedures

5.01 Protector units may be tested without disassembly by using the KS-20100 test set and the 182A test set.

5.02 The KS-20100, L5 test set (Figures 5 and 6) is used to test for the presence or absence of tip and ring continuity as well as shorted or grounded protector blocks. The KS-20100 test set also provides a burnout feature to clear protector blocks shorted by carbon or dust particles. For the KS-20100 test set piece-part replacement, see AT&T 201-208-803.

5.03 The 182A test set (Figures 7 and 8) is used to test the minibridge lifter protector units (4B11F and 4C11F) for tip and ring continuity and for shorted protector blocks. It also tests the function of the 410A switch contained in the protector unit. The 182A test set is housed in a conduit box for wall mounting.

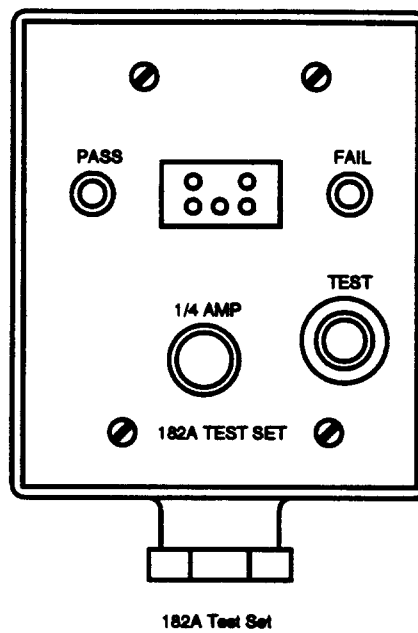


Figure 7. 182A Test Set

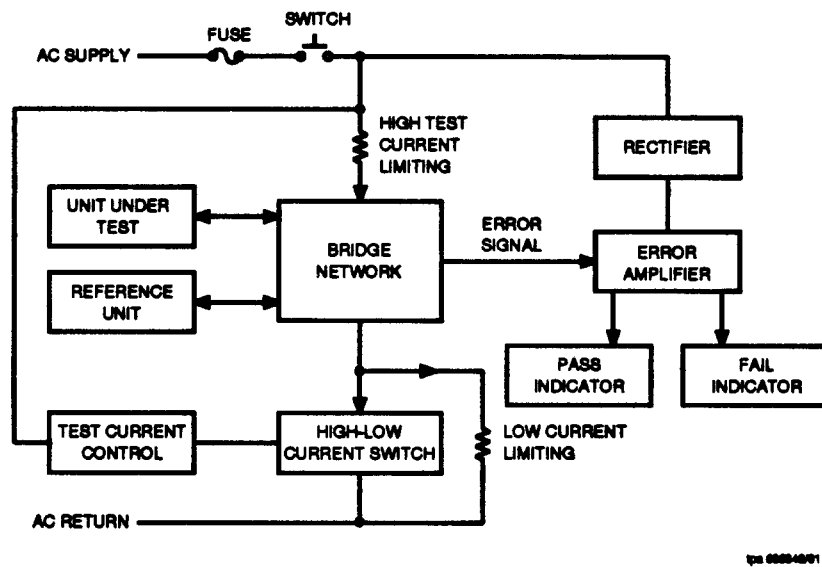


Figure 8. 182A Test Set Block Diagram

5.04 For short-term testing or service denial, protector units may be partially withdrawn to the "detent" position. When the protector unit is pulled out to the detent position, the **central office or customer premise equipment** is disconnected to isolate outside plant cable pairs for testing purposes. In this position, voltage protection is still provided on the outside plant cable pair. Removing the protector unit from the connector opens the circuit and removes all protection.

5.05 Three tests are provided in the following paragraphs to test all the protector units. The protector units are placed in three categories by color for testing.



DANGER:

Testing a protector unit while it is disassembled can expose the tester to hazardous voltages.

6. Test Protector Units with Orange Housing (Minibridge Lifter)

Purpose

- 6.01** This test checks for the presence of tip and ring continuity and checks the function of the 410A switch contained in the protector unit.
- 6.02** Protector units that pass the test on the 182A test set may be returned to service without further testing.
- 6.03** Protector units that fail the test on the 182A test set must also be tested with the KS-20100 test set.
- 6.04** Protector units with shorts that "burn out" successfully when tested on the KS-20100 test set must be retested, using the 182A test set.

Test Procedure

6.05 At the 182A test set, perform the following steps:

- (1) Insert the protector unit into the test jack.
- (2) Press and hold the TEST pushbutton.

Indication: PASS (green) lamp or FAIL (red) lamp lighted.

Comment: If neither lamp is lighted, check the 1/4 AMP fuse. The FAIL lamp may flash momentarily when the TEST pushbutton is first pressed and should be ignored.

- (3) Release the TEST pushbutton.

Indication: PASS or FAIL lamp goes off.

- (4) If the PASS lamp lighted in Step 2, remove the protector unit from the test set and place it back in service.
- (5) If the FAIL lamp lighted in Step 2, remove the protector unit from the test set and perform the test using the KS-20100 test set per Part 7.

7. Test All Protector Units Except Those with Green Housing

Purpose

- 7.01** This test checks for the presence of tip and ring continuity as well as defective protector blocks. Also, attempts are made to "burn out" defective carbon blocks.

Test Set Preparation

- 7.02** At the KS-20100 test set, perform the following steps:

- (1) Press and release the CONTINUITY R pushbutton.

Indication: The CONTINUITY R pushbutton should light for a moment.

Comment: If the pushbutton does not light, check the 1/4 AMP fuse.

- (2) Press and release the CONTINUITY T pushbutton.

Indication: The CONTINUITY T pushbutton should light for a moment.

Comment: If the pushbutton does not light, check the 1/4 AMP fuse.

- (3) Press and release the GROUND pushbutton.

Indication: The GROUND pushbutton should light for a moment.

Comment: If the pushbutton does not light, check the 1/4 AMP fuse.

Test Procedure

- 7.03** At the KS-20100 test set, perform the following steps:

- (1) Insert the protector unit into the test jack.

Indications: CONTINUITY R and CONTINUITY T pushbuttons should light. GROUND pushbutton should remain off.

- (2) If indications of Step 1 are correct, remove the protector unit from the test jack and return it to service.
- (3) If both CONTINUITY pushbuttons did not light, remove the protector unit from the test jack and dispose (paragraph 4.01).
- (4) If the GROUND pushbutton lighted, press the BURN OUT pushbutton for 2 or 3 seconds.

Indication: GROUND pushbutton should go off.

Comment: If the pushbutton does not remain off, repeat this step several times.

- (5) If the GROUND pushbutton remained lighted after repeating Step 4 several times, remove the protector unit from the test jack and dispose (paragraph 4.01).
- (6) If the GROUND pushbutton remains off after performing Step 4 once or several times, remove the protector unit from the test jack and, if the housing is not orange, return the unit to service.
- (7) If the protector unit housing is orange, the unit must be retested using the 182A test set per Part 6. If the unit fails the retest, return it to the appropriate AT&T repair facility.

8. Test Protector Units with Green Housing

Purpose

- 8.01** This test checks for the absence of tip and ring continuity as well as defective protector blocks. Attempts should be made to "burn out" defective carbon blocks.

Test Set Preparation

- 8.02** Verify operation of the KS-20100 test set by performing the preparation steps listed in paragraph 7.02.

Test Procedure

- 8.03** At the KS-20100 test set, perform the following:
- (1) Insert the protector unit into the test jack.

Indications: All pushbuttons should remain off.

- (2) If indications of Step 1 are correct, remove the protector unit from the test set and return it to service.
- (3) If either or both CONTINUITY pushbuttons lighted, remove the protector unit from the test jack and dispose (paragraph 4.01).
- (4) If the GROUND pushbutton lighted, press the BURN OUT pushbutton for 2 or 3 seconds.

Indication: GROUND pushbutton should go off.

Comment: If the pushbutton does not remain off, repeat this step several times.

- (5) If the GROUND pushbutton remains off after performing Step 4 once or several times, remove the protector unit from the test jack and return it to service.
- (6) If the GROUND pushbutton remained lighted after performing Step 4 several times, remove the protector unit from the test jack and dispose (paragraph 4.01).

9. Associated Equipment and References

Associated Equipment

P2FL	Test Cord (Comcode 103105268) — For protector units with test points (AT&T 201-208-106)
3D1F	LNI Protector Unit Handle (Comcode 843824194) — To remove 3D1F protector unit (AT&T 201-208-103)
KS-20100, L5	Test Set (Comcode 402632590) (AT&T 201-208-106)
182A	Test Set (Comcode 103016549) (AT&T 201-208-106)
A4H402, L1	Protector Breakdown Test Set (Comcode 104271911) — For 4CF-type and 3D1F protector units (AT&T 201-208-106)

References

Number	Title
AT&T 201-208-103	<i>Tools and Aids — Distributing and Protector Frames</i>
AT&T 201-208-106	<i>Test Equipment, Cords, Plugs, Warning Markers, Indicators, and Insulators</i>
AT&T 636-300-099	<i>Cable Terminating Apparatus — Selection — Distributing and Protector Frames</i>
AT&T 636-320-100	<i>302-Type Connectors — Description, Use, Installation, and Repair Procedures</i>
AT&T 636-330-100	<i>303-Type Connectors — Description, Use, Installation, and Repair Procedures</i>
AT&T 636-330-105	<i>305-Type Connectors — Description, Use, Installation, and Repair Procedures</i>
AT&T 636-330-107	<i>307-Type Connectors — Description, Use, Installation, and Repair Procedures</i>
AT&T 636-330-108	<i>308-Type Connectors — Description, Use, Installation, and Repair Procedures</i>
AT&T 636-330-109	<i>309-Type Connectors — Description, Use, Installation, and Repair Procedures</i>
AT&T 636-330-110	<i>310- and 310M-Type Connectors — Description, Use, Installation, and Repair Procedures</i>
AT&T 636-330-111	<i>311-Type Connectors — Description, Use, Installation, and Repair Procedures</i>
AT&T 680-122-010	<i>Customer Loop Bridge Lifters — Application and Administration</i>