AMERICAN TELECOMMUNICATIONS CORPORATION
MODEL 204 *TonePulse** CONVERTER
NO. 1 CROSSBAR OFFICES AND STEP-BY-STEP SYSTEMS

1. GENERAL

1.01 This section is a cover sheet for the American Telecommunications Corporation (~~ACT~~ ATC) TonePulse Converter Model 204 instruction, Section 200812. GAEL 1660-1 authorizes the use of this equipment in Pacific Company.

1.02 (Reserved for future use)

1.03 The ATC Model 204 TonePulse Converter replaces the Model 104 (used in step-by-step [SXS] systems only, Section 227-675-900PT). It is used in both No. 1 crossbar offices and SXS.

1.04 The Model 204 is a solid-state device which is used to convert "*Touch-Tone*®" signals to dial pulse and can be used in a combination rotary dial and *Touch-Tone* groups. It was designed for SXS use, but is adaptable for No. 1 crossbar application. The model is available for use on a 1- or 2-party line with or without ANI, party line, or coin lines.

1.05 The converter unit is designed to mount on the line finder frame behind its associated line finder switch. It can also be mounted on the back of a No. 1 crossbar sender.

1.06 A converter is required on a one for one basis with line finder switches in a SXS line group or in a No. 1 crossbar sender group.

1.07 It is installed in the tip and ring path between the line finder switch and its associated first selector, or in the dial pulse of the sender.

1.08 Due to the effects that nonprecise dial tone may have on the converter, it is necessary to limit their installation to offices equipped with precise dial ~~pulse~~ Tone.

Note: In SXS offices, it should be noted that if *Touch-Tone* subscribers wish end-to-end signaling, a polarity guard kit must be installed in the subscriber's *Touch-Tone* set. (Refer to Section 501-321-100.)

1.09 If corrections are required in the manufacturer's instruction, use Form E 3973-1PT as described in Section 000-010-901PT to process the correct information.

1.10 If equipment design and/or manufacturing problems should occur, refer to Section 010-700-010PT for procedures on how to file an Engineering Complaint.

1.11 When revised instructions reflect changes due to modification of equipment, retain the superseded information until equipment is modified.

Note: Equipment shall *not* be modified without the approval of the Equipment Maintenance Engineer.

2. TRAINING

2.01 Minimal training is required as no repair work will be performed on the converter by TELCo maintenance forces.

3. MAINTENANCE

3.01 Field repairs that involve replacement or modification of components within this unit are not recommended.

3.02 If the seals on a returned unit are broken, the warranty could be rendered null and void.

*Trademark of American Telecommunications Corporation

3.03 For those units out of warranty, ATC could (at their discretion) refuse to perform any requested work on these items.

3.04 Acceptance tests for the TonePulse converters are covered in Appendix 1 to Sections 216-251-900PT for No. 1 crossbar offices and 227-675-901PT for SXS.

4. ORDERING PROCEDURES

4.01 The Equipment Engineer will order the equipment directly from ATC. Detailed ordering information is described in GAEL 1660-1.

5. REPAIR/RETURN

5.01 ATC provides a factory repair and/or modification service for the converter. A return authorization must be obtained from ATC (call 213+579-1710).

5.02 ATC will send a packaging label to affix to the package. This label lists the address where the unit is to be shipped for repair and/or modification.

5.03 A GTP 2161 Return Material Tag must be attached to the unit prior to shipping to ATC.

Note: A flat charge of $30.00 will be made for units that require repair after the warranty has expired.

6. EXCLUSIONS/REVISIONS

6.01 The following manufacturer's instruction sections are excluded and/or revised:

Part 21 – Repair And Warranty

Note: This part is not applicable to Pacific Company.

Attachment:
American Telecommunications Corporation TonePulse Converter Model 204, Section 200812, Issue 2, February 1976

TonePulse Converter Model 204

DESCRIPTION, IDENTIFICATION, TECHNICAL SUMMARY AND INSTALLATION INSTRUCTIONS

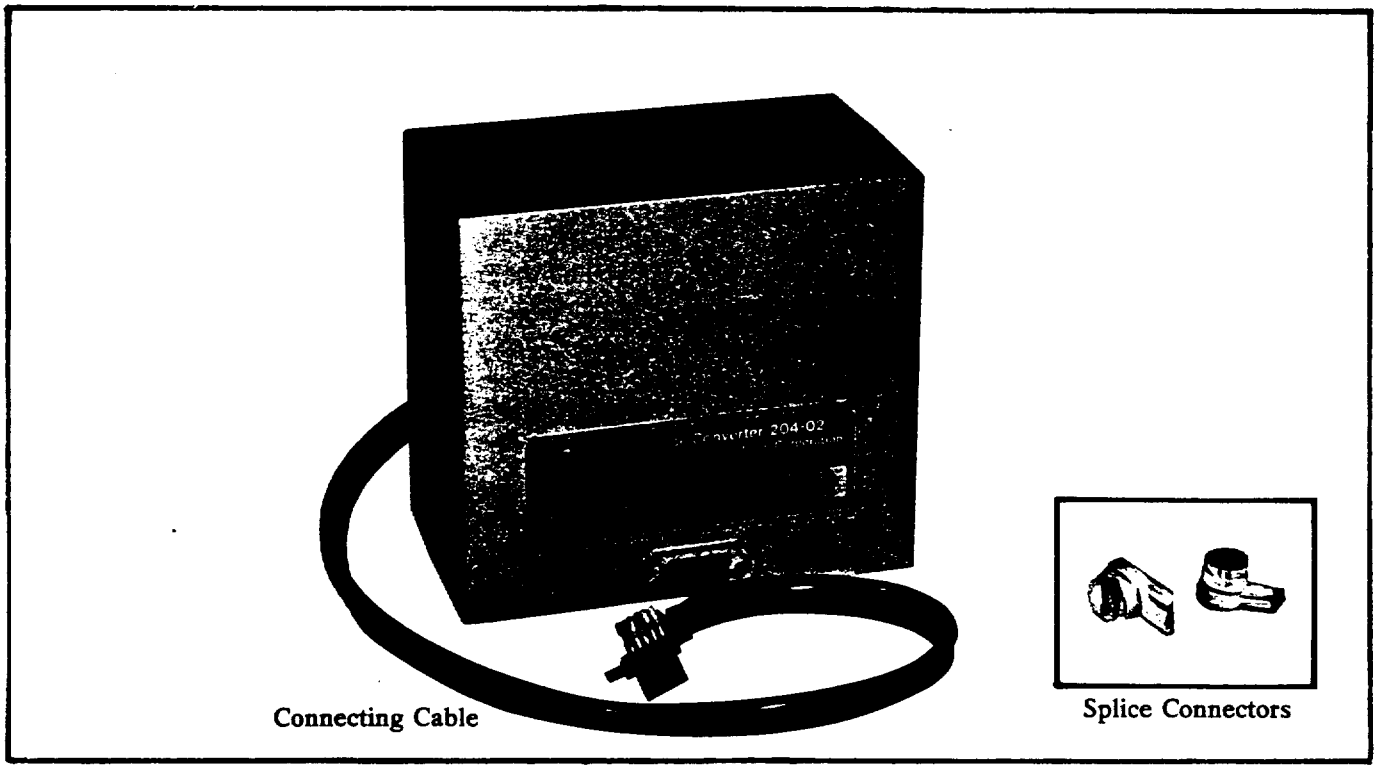


Figure 1. TonePulse Converter

1. GENERAL

This section provides a description of design features, ordering information, technical data summary, installation instructions and trouble shooting procedures for the Model 204 TonePulse Converter. (exceptions included for Model 204-11.)

2. GENERAL DESCRIPTION

2.01 The TonePulse Converter designed and manufactured by American Telecommunications Corporation enables telephone operating companies with step-by-step switching equipment to offer Touch-Tone® telephone service to their subscribers. In order to provide this service, the TonePulse Converter converts DTMF tone signals into dial pulses that are compatible with direct-drive-controlled switching equipment in central offices or PABX equipment. Model 204-11 is not recommended for use with PABX's.

2.02 The Converter can be used with all Touch-Tone® instruments or with a mixture of Touch-Tone® and rotary dial instruments.

2.03 Design Features

- Wide operating temperature range
- #Turn-off option (except Model 204-11)
- Crystal Controlled, Digital Receiver
- Superior bandwidth stability and reliability
- Excellent extraneous noise rejection
- Connects only the tip and ring pair — no sleeve lead connection required (except on Model 204-05)
- Complete D.C. isolation
- Permits end-to-end signalling
- No complex programming
- PBX first digit recognition program (except Model 204-11)
- Quick and simple installation
- Dedicated systems approach avoids additional call blockage
- Several mounting brackets and assemblies to choose from

3. PHYSICAL DESCRIPTION

3.01 The Model 204 TonePulse Converter (Figure 1) is a compact solid state device which measures 4" x 4½" x 2½" deep. The Converter can be, by means of the mounting bracket, furnished with each TonePulse Converter, applied directly to the angle iron framework immediately behind the linefinder switch in Strowger step-by-step switching systems. In this application, additional floor space is not required in central offices.

3.02 When used in non-Strowger offices or in installations where angle iron mounting is restricted, a 100339 mounting frame assembly (Fig. 2) can be used which accommodates five TonePulse Converters. A 24 point terminal block is included with this frame assembly for the purpose of interconnecting the TonePulse Converter between the linefinder and the first selector. The frame assembly is designed for 19" relay-rack mounting and contains its own fusing (1 amp per Converter). An alarm lead is also located on the terminal block. For additional mounting methods, refer to Section 21.

4. APPLICATION

4.01 The TonePulse Converter is applicable to both central offices and PABX's; however, Model 204-11 is not recommended for use of PABX's. Its use is primarily intended for direct drive switching equipment, commonly referred to as step-by-step systems. In these systems, the Converter is applied on a one-to-one basis with each linefinder used in a specific line group. If the grading of a given group is such that 18 linefinders are needed to service that group, then 18 TonePulse Converters would be needed to convert that group to Touch-Tone® service.

4.02 In PBX's, the Converter(except Model 204-11) can be used to provide Touch-Tone® calling for internal and external calls, for tie lines, and most special service trunks. Special trunking applications can be accommodated where DTMF to dial pulse conversion is required.

4.03 In most step-by-step PBX's, one Converter (except Model 204-11) per linefinder and transfer selector is all that is required. In some PBX systems, Converters may be required for internal calling and an additional Converter per trunk would be required if the central office is not equipped for Touch-Tone® service.

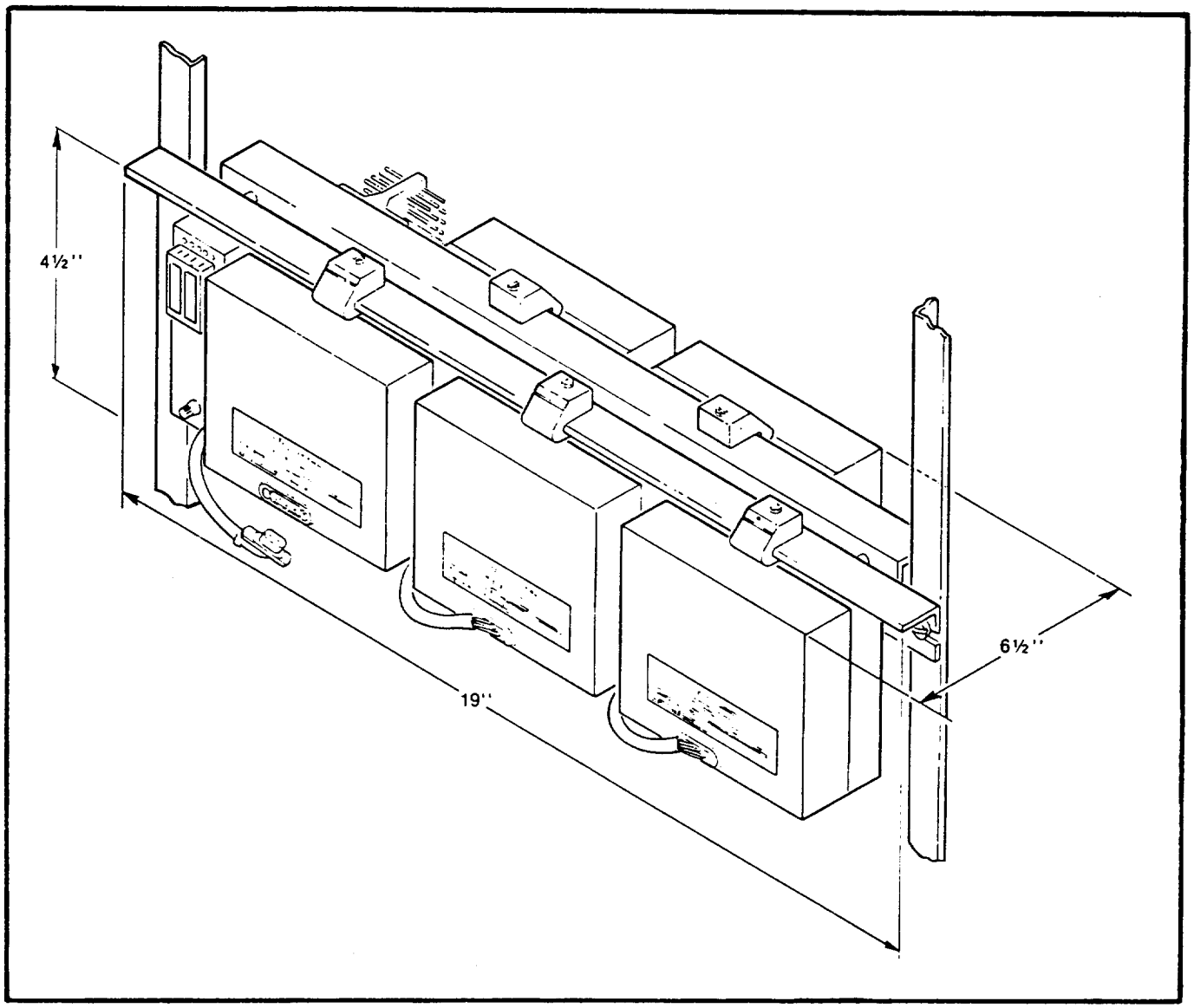


Figure 2. 100339 Mounting Frame Assembly

5. IDENTIFICATION

TonePulse Converter

- Model 204-02 10 pps output, 48 Vdc operation
- Model 204-04 Same as 204-02, except with ANI
- Model 204-05 Same as 204-02, except with Sleeve Control
- Model 204-06 Same as 204-02, except with Early Split
- Model 204-11 Same as 204-02, except without programming (not recommended for PABX's)

6. MAJOR CIRCUIT ELEMENTS

6.01 Each Converter consists of the following major elements:

- Receiver
- Register
- Dial Pulse Sender
- Line Switching Circuit
- On-hook/off-hook sensor
- Internal power supply

6.02 The interior of the Converter (Fig. 3) consists of three printed circuit cards with mutual cross connections provided by an interconnect board.

6.03 The TonePulse Converter utilizes MOS/LSI technology to effect the compact size, relia-

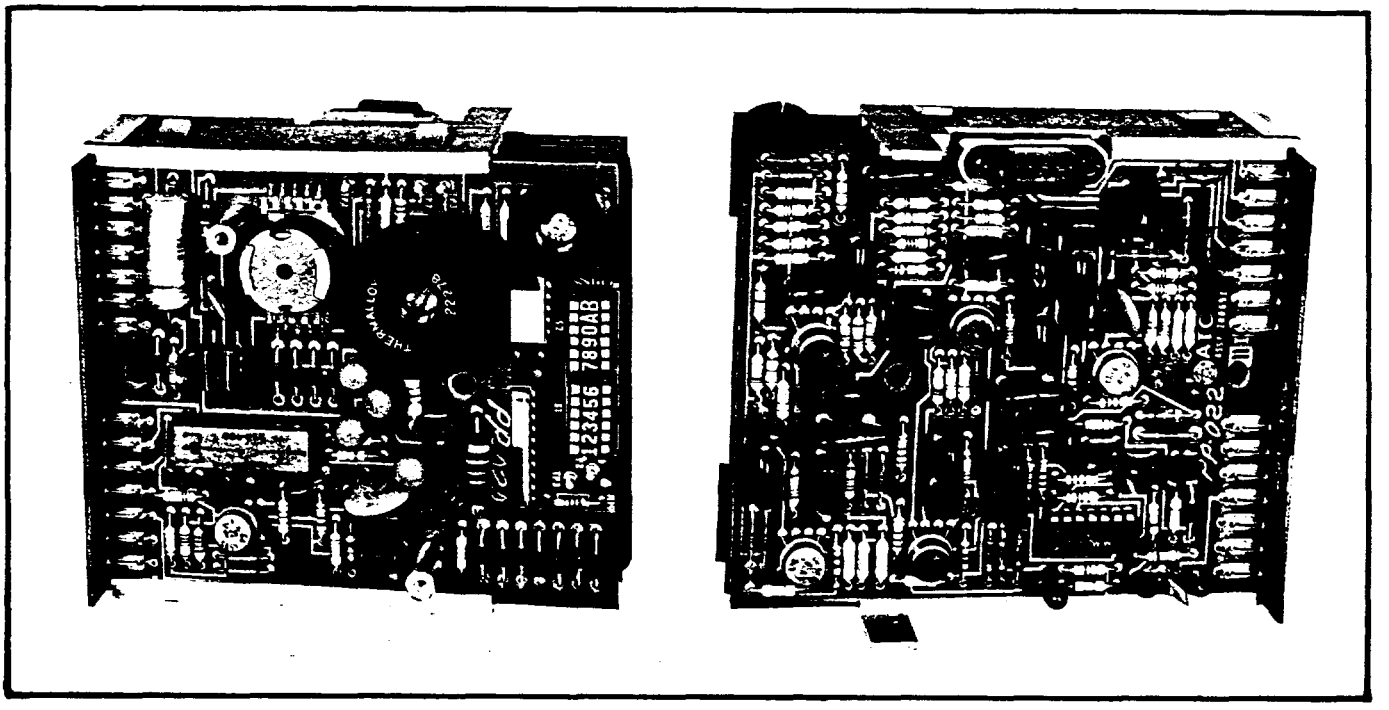


Figure 3. Converter Interior

bility, and stability inherent in its design. The following depicts the functional performance of the Converter; however, it should be understood that various circuit elements, and control logic have been interspersed into the MOS/LSI circuitry.

6.04 The input of the Converter is normally from the linefinder via the connecting cable harness assembly. The output is directed toward the forward equipment normally the first selector. A schematic circuit is included as Figure 4.

7. THE RECEIVER

7.01 The function of the receiver portion of the TonePulse Converter is to identify the DTMF signal from the Touch-Tone® phone and provide information to the register which identifies the specific digit associated with those tones. The tone receiver is bridged across the tip and ring at all times. The input impedance of the receiver is above 30K ohms at all pertinent frequencies. The receiver is a crystal controlled digital device which provides extreme accuracy and long term bandwidth stability and reliability.

7.02 The disciplines of the TonePulse Receiver are extremely demanding. These disciplines are required to correspond to the human factors associated with DTMF telephone button depression; complements telephone instrument tone generator criteria over an extended time interval; and accommodates the loop plant design inherent in the telephone switching network. Some of these design requirements are:

- Verify both a high and low frequency.
- Respond to tone signals whose duration of each frequency is present for at least 40 ms
- Disregard signals of shorter duration or signals not having both a high and low element.
- Tolerate the frequency (bandwidth) deviation attributable to manufacturing tolerances or aging of the tone generating mechanism in the telephone instrument.
- Accommodate signal characteristics attributed to varying telephone loop conditions.
- Tolerate signal amplitude variations occurring between the high and low frequencies of a DTMF signal.

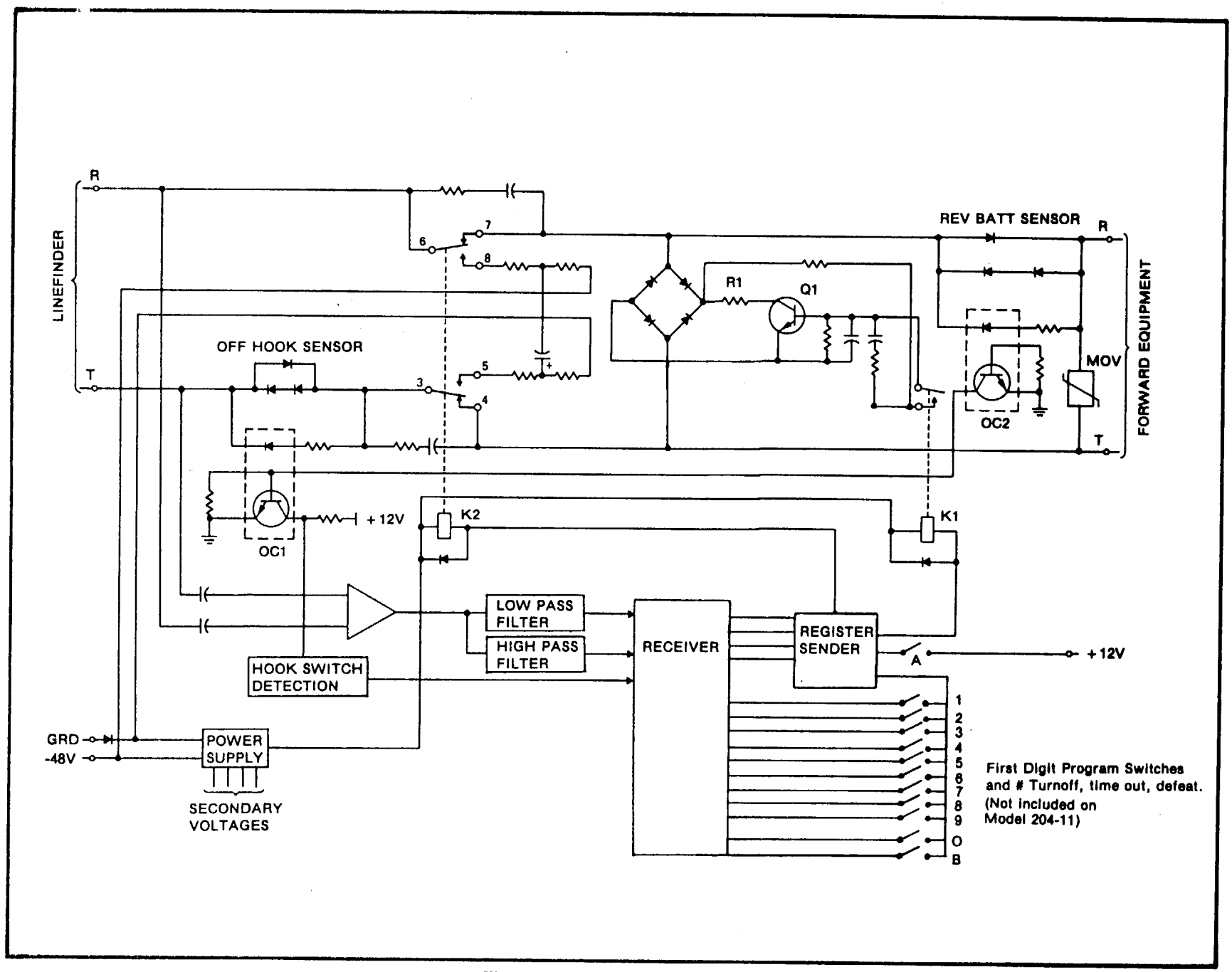


Figure 4. Functional Schematic

7.03 Definitions

There are five main factors that are critical in the operation of the TonePulse receiver. These five factors interrelate and are interdependent with each other and define the receiver's ability to react to proper DTMF signals and reject extraneous noise. These factors are: signal level, skew, twist, signal duration and frequency deviation.

- Signal Level

  The level in VRMS of the combined frequencies of the DTMF signal. The unit of measure is in VRMS since the receiver is a voltage sensitive device. Measurement is made at the receiver in an unterminated voltmeter (0dB = .7746VRMS).
- Skew

  The percentage of frequency differential between the high and low frequencies. This differential shall not exceed 1.5%.
- Twist

  Is defined as the difference in amplitude (dB) between the high and low frequencies. A maximum differential of 6dB is accommo dated in the TonePulse receiver.
- Signal Duration

  The time in ms the full DTMF signal is present and the time interval in ms between DTMF tone signals.
- Tone Frequency Deviation

  The percentage of frequency deviation allowed on each of the Touch-Tone® frequencies.

7.04 Skew

The percent SKEW is a function of the tone oscillator of the telephone set. Zero, with a maximum of 1.5% skew is normally experienced from quality manufacturers of telephone sets.

With a 0% skew and a maximum twist of 6dB the Model 204 receiver will properly function with a minimum signal of 50 millivolts.

7.05 Twist

The difference in amplitude is a function of a combination of loop resistance and telephone set performance. It is a combination of twist and frequency deviation which effect the response time of the receiver. The response time of the Model 204 receiver is EXPLAINED in the receiver characteristics.

7.06 As a result of system design, the TonePulse receiver meets the following characteristics.

- Signal Level (input) per frequency — .078 VRMS to 1.5 VRMS
- SKEW — 1.5% maximum
- TWIST — 6dB maximum
- Signal Duration — 40 ms
- Intertonal Time — 40 ms
- Minimum Cycle Time — 90 ms
- Maximum tone frequency deviation from center frequency — 1.5%

7.07 The effect of dial tone on the Model 204 receiver is an important aspect of receiver design. Since the unit is operational during the dial tone interval the characteristics of the dial tone signal are of importance.

Use of precise dial tone (350 plus 440 Hz at a level of -13dBm per frequency) will guarantee proper operation. Other "standard" dial tones (600 Hz modulated by 120 or 133 Hz) have however been successfully used.

7.08 The Receiver, in addition to providing digital information to the register, also indicates to the K-1 and K-2 relay (Figure 4) when a valid digit has been received and provides an input to the "first digit recognition" program (paragraph 12.03).

8. REGISTER

8.01 Since Touch-Tone® signals can be generated by subscribers faster than the switching equip-

THIS PAGE INTENTIONALLY
LEFT BLANK

ment will accept dial pulses, the register stage is necessary on the TonePulse Converter. The register simply stores the appropriate digit associated with the tones and forwards this information to the dial pulse generating circuit in the proper sequence. Each of these three stages (receiving, storing and sending) operates simultaneously. While the first digits are being outpulsed, the middle digits are being stored and the final few tones are being received. The TonePulse Converter register has the capacity for storing 16 digits. As a digit is outpulsed, the register then becomes available to store additional digits as required.

8.02 Sender

The sender portion of the TonePulse Converter accepts the information from the register and sends dial pulses of the proper shape and speed toward the forward equipment, normally the first selector. The logic associated with the sender circuitry provides a dial pulse output of 10±.1 pps, a percent break of 58%- 62% and an interdigital time of 680 ± 3 ms.

8.03 The register upon receipt of the digital information from the receiver, controls the operation of the K-1 relay. The K-1 relay, by returning to normal and reoperating, drives transistor Q-1 (Figure 4) which opens and closes the loop toward the forward equipment or first selector. The logic which controls K-1 results in dial pulses and interdigital timing which is extremely accurate and stable.

8.04 Switching

Also included in the TonePulse Converter is a logic controlled switching circuit which switches the tip and ring to the receiver when a valid DTMF signal is recognized by the TonePulse Converter. When the switching circuit is activated, a short is placed on the tip and ring output of the Converter and battery and ground is returned to the Touch-Tone® station for further signalling.

8.05 Upon receipt of a signal from the receiver, the K-1 operates first and places a short across the tip and ring leads by placing a ground at the base of transistor Q-1. The tip and ring short can be traced (Figure 4) from the tip side of the line through the diode bridge and transistor Q-1, through resistor R1, to the ring side of the line.

8.06 Relay K-2 operates and breaks the tip and ring continuity through contacts 6 and 7 and 3 and 4. -48 volt battery and ground is returned to the station through the operated contact 6 and 8 and 3 and 5.

8.07 As a result of this switching, the forward equipment is held via the shorting of T and R of the K-1 relay and battery and ground is returned to the station with the operation of K-2.

8.08 These relays are held operated for 1.5 seconds after the last digit has left the register.

8.09 If an extended length of time elapses between digits (slow dialer) relays K-1 and K-2 may return to normal; however, immediately after the next digit is received, the relays will again operate in the sequence as explained in the above paragraphs.

9. ON-HOOK/OFF-HOOK DETECTION

9.01 A detection circuit is inserted in series with the tip side of the line and essentially detects a flow of current when the calling party closes the loop on the input side of the Converter and the first selector furnishes the battery and ground.

9.02 The detection of current flow activates the Converter and specifically the receiver circuitry. The Converter will recognize a current flow of 20 ma or greater and be ready to accept DTMF signals within 400 ms.

9.03 An on-hook signal is detected as a loss of current when it is less than 2 ma and will deactivate the system within 300 ms.

9.04 This detection circuit consists of diodes inserted in series with the tip side of the line and an optical coupler, OC-1 as shown on the functional schematic (Figure 4).

10. POWER SUPPLY

10.01 The TonePulse Converter is powered from a -48 VDC source normally from the switch jacks of the finder. The Converter supply requires a regulation of 44 - 56 VDC. See also paragraph 14.03.

10.02 For fusing requirements in non-Strowger applications, use a ⅓ Amp fuse for each Converter.

11. BASIC OPERATION

11.01 The TonePulse Converter is permanently associated with the tip and ring leads between the linefinder and the first selector. No transmission degradation is imposed on the switching network due to the high impedance A.C. coupling of the receiver section of the TonePulse Converter. The system converts Touch-Tone® signals to dial pulses while passing rotary dial signals to the first selector or switch train.

11.02 When the subscriber goes off-hook and the linefinder and first selector seized, dial tone is returned to the subscriber from the first selector. Current flowing in the tip and ring leads is detected by the TonePulse Converter and the unit stands ready to receive Touch-Tone® signals.

11.03 If the subscriber telephone is a rotary dial instrument, the TonePulse Converter performs no function other than allowing the metallic path to continue from the linefinder through the TonePulse Converter to the first selector. If the subscriber telephone is a Touch-Tone® instrument, the first tone is detected and switching of the tip and ring link is initiated.

11.04 A 330 ohm short is placed across the tip and ring to hold the first selector seized. -48 volt battery and ground is returned to the subscriber for purposes of further signalling. The initial tone, as well as all the tones following, are recognized by the receiver, stored in the register and outpulsed at a rate of 10 pps toward the first selector.

11.05 The subscriber, when depressing the Touch-Tone® button on the telephone, will hear the DTMF tones. Additionally when the pulses are being sent to the forward equipment, a muted dial pulse click will be heard by the subscriber.

11.06 The receiver portion of the TonePulse Converter will be disabled upon recognition of a reverse battery condition which occurs when the called party answers. If reverse battery is not returned to the Converter, the unit will automatically disable itself within 20 seconds (10 seconds for Model 204-05 or 204-06). This allows the station to end-to-end signal without the Converter converting the tones to dial pulses.

12. PABX OPERATION

12.01 All TonePulse Converters (except Model 204-11) can be used for PABX application to provide Touch-Tone® capabilities for internal calling, as well as for outgoing trunk or tie line calls.

12.02 In a PABX application where the central office is equipped for Touch-Tone® conversion, the TonePulse Converter (except Model 204-11) can be used to provide Touch-Tone® capabilities for internal calls only. In this application, the Converter uses a standard feature known as "first digit recognition."

12.03 The TonePulse Converter has as an integral part of its system the ability to analyze the first combination of tones transmitted and to decide whether the following tones are to be converted to dial pulses or allowed to process through the system unconverted. (not included in Model 204-11.)

This feature can be used, for example, in a PABX where the digit "9" is used to access a central office which is equipped for Touch-Tone® dialing. The TonePulse Converter would be set by the installer (specific instructions in the installation section) to act differently when the first digit outpulsed is a "9" which is received in the receiver section of the Converter, recorded in the register and the digit "9" is outpulsed. During the outpulsing, a link between the receiver and register is opened which will not allow any more tones to be converted. After completion of the pulsing of the digit "9", the tip and ring leads are extended directly to the subscriber so that any tone combination which follows will simply be extended to the central office without being converted to dial pulses.

13. INSTALLATION — GENERAL

This section provides installation instructions and connecting information pertaining to the installation of TonePulse Converter, Model 204 to Strowger type central offices and PABX equipment.

14. PRE-INSTALLATION REQUIREMENTS

14.01 The TonePulse Converter consists of basically two elements, the Converter proper and a connecting plug-in cable.

14.02 To install the connecting cable requires two splices. 3M Company's Scotchlock Type UY Connector is recommended for this purpose and is furnished with the Converter.

Power Requirements

14.03 Models 204-02, 204-04, 204-05, 204-06, and 204-11 are 48 Vdc, 10 pps Converters. These units will operate satisfactorily over a voltage range of 44 - 56 Vdc (must be common to telephone line). Each Converter will nominally consume 130 ma.

14.04 The battery source for the linefinder should be adequately fused with approximately 1⅓ amp fuse per finder or a 5 amp fuse for each 5 linefinders. This fusing will serve to protect the TonePulse Converter since it also uses a battery and ground connection from the linefinder. A Converter will always operate after the linefinder has found the line requesting service and, therefore, this fusing will suffice for both the linefinder and the TonePulse Converter.

15. INSTALLATION PROCEDURE

(a) Carefully remove the Converter, its associated cable harness and splices from the packing containers.

(b) Check the linefinder or transfer selector for busy, and when it is idle, make it busy.

(c) Remove the linefinder fuse.

(d) Unsolder or unwrap the tip and ring leads from the jacks of the linefinder.

(e) Splice the white-orange lead of the cable harness to the tip lead that was disconnected from the linefinder jacks in step (d). Similarly, splice the orange-white lead of the harness to the ring lead.

(f) Connect the white-blue and blue-white leads of the harness to the tip and ring jacks of the linefinder respectively.

(g) Connect the red lead of the harness to the linefinder ground jack terminal.

(h) Connect the white lead of the harness to the linefinder battery jack terminal.

(i) (On the Model 204-05 only) Connect the blue harness lead to the sleeve jack terminal.

(j) Dress the cable harness along the shelf wiring and secure (tie wraps can be used for this purpose). Leave about four inches of harness cable extending beyond the last tie. The last tie should be approximately at the center of the linefinder.

(k) Replace the linefinder fuse.

16. PROGRAMMING THE CONVERTER (Not applicable to Model 204-11)

16.01 When used in a dial PBX, programming is required when the dial PBX is trunked to a central office which is equipped for Touch-Tone®. A programming field to accommodate this requirement is located on the back of the Converter. (See Figure 6)

16.02 Determine the access code to the central office equipped with Touch-Tone®. Only a single digit access code can be accommodated.

16.03 Depress the appropriate code digit to the "ON" position. There is no maximum number of codes that may be programmed.

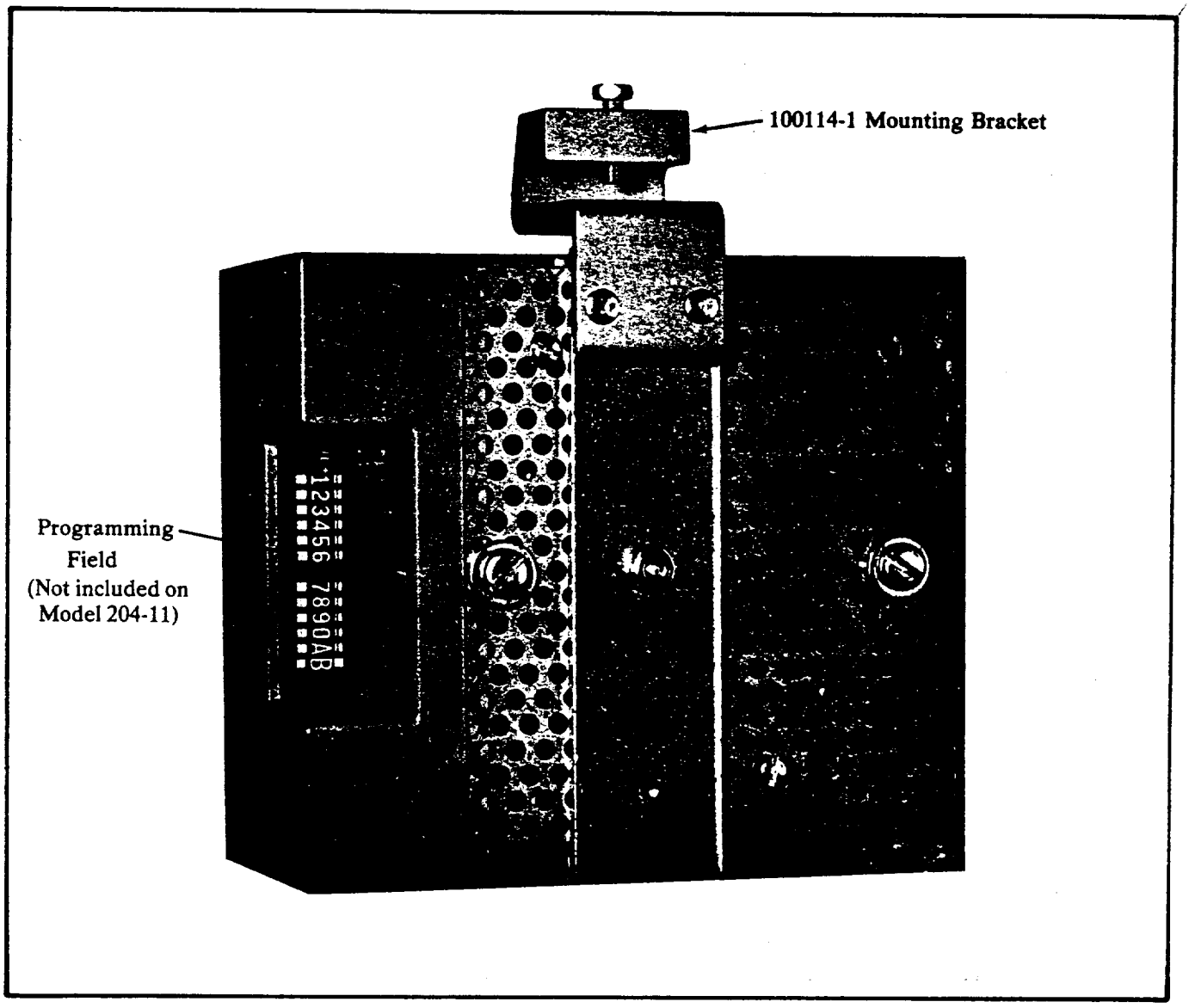


Figure 6. TonePulse Converter (Rear view)

16.04 When the converter is used in an application where time-out is not required, depress program Switch A to the "ON" position. None of the ten code switches will cause the unit to time-out when A is programmed.

16.05 When the converter is used in an application accessing computer equipment and a fast time-out is desired, depress Switch B to the "ON" position. In this mode when # is depressed in a sequence of digits, the digits prior to the # will be converted while those following the # will not. Code digits or Program Switch A may be used in conjunction with this option.

17. MOUNTING THE CONVERTER

(a) Place the mounting bracket over the shelf angle iron approximately at the center of the linefinder switch.

(b) In most Strowger installations, the shelf angle iron on which the Converter is to be located is positioned such that the Converter can be mounted directly in the configuration as illustrated in Fig. 6. However, in some vintages of equipment the angle iron is located toward the lower portion of

the switch, and therefore, requires repositioning of the 100114-1 Standard Converter mounting bracket. This is easily accomplished by removing the ¼" nut at the rear of the Converter, rotating the bracket 180° and retightening the nut. (Figure 7)

(c) Tighten the locking screw with a screwdriver or a switch adjusting wrench until the Converter is secure. Do not overtighten the locking screw.

(d) Insert the plug of the Converter cable harness into the receptacle of the TonePulse Converter until it locks in place.

(e) To remove plug, insert screwdriver under one ear of the plug and pry outward.

18. TESTING THE CONVERTER

(a) Connect a Touch-Tone® telephone equipped with a proper plug to the linefinder test jacks.

(b) TonePulse any number. Verify that the correct number has been reached and that a transmission path exists. Depress a button on the test telephone. Verify that no further outpulsing occurs.

(c) TonePulse a digit and hold the button down for an extended period of time (1-2 seconds) — no pulsing should occur. Release the button and the correct digit should be pulsed.

(d) TonePulse any digit. Wait approximately 20 seconds (10 seconds for Models 204-05 and 204-06) and attempt to TonePulse additional digits. Verify that no outpulsing occurs. If option A is programmed "ON", the Converter will continue to outpulse each time a button is depressed and released.

(e) If the TonePulse Converter (except on Model 204-11) has been programmed for first digit recognition, TonePulse the digit programmed. Verify that second dial tone is heard. TonePulse additional digits. No outpulsing should take place.

(f) Connect a rotary dial telephone (or hand test telephone) to the linefinder test jacks. Dial a test number. Verify that the desired number is reached.

(g) (On the Model 204-05 only) Program all 12 option switches to the "OFF" position. Insert the Sleeve Control Test Cable (ATC P/N 200970) between the Converter and its cable, setting the slide switch to the "OFF" position. TonePulse any digit. Wait at least 20 seconds and attempt to TonePulse additional digits. Verify that no outpulsing occurs. Next set the slide switch on the Test Cable to the "ON" position. Hang up for at least 1 second. TonePulse any digit. Verify that no outpulsing occurs. Return the slide switch to the "OFF" position. Hang up for at least 1 second. TonePulse any digit. Verify that the correct number is outpulsed.

19. TROUBLE CONDITIONS

19.01 Dial tones containing frequency harmonics in the detection bands with amplitudes greater than -30dBV may cause the following conditions.

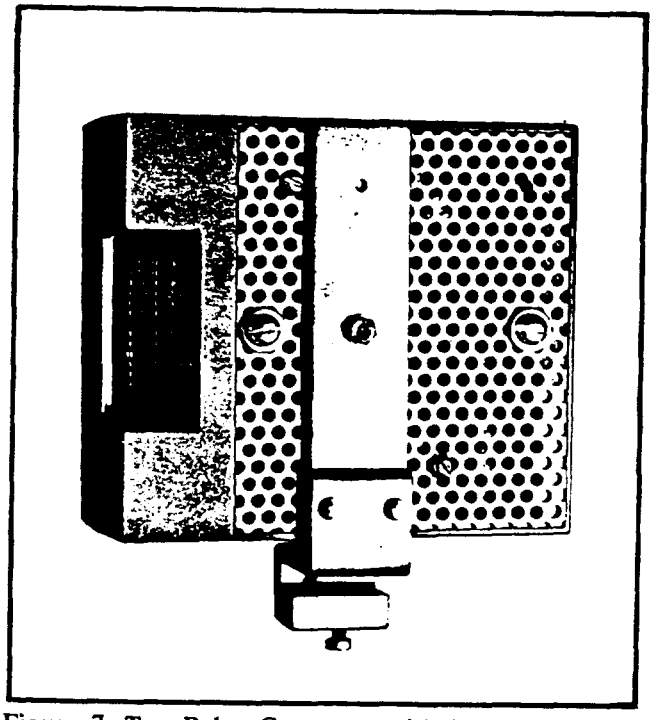


Figure 7. TonePulse Converter with Bracket Repositioned.

19.02 Pulsing may occur when the pushbutton is depressed on the test telephone as indicated in paragraph 8.03. Double digits may occur (i.e., if the digit 5 is the first digit, two 5's may occur in the outpulsed digit) or the converter may not recognize the tones at all.

19.03 The TonePulse Converter is sensitive to tip and ring reversal. If a reversal occurs, for example on the wipers of a second or third selector the TonePulse Converter will pulse digits towards equipment until this reversal occurs. If only a partial number is outpulsed from the Converter, an inadvertent reversal of tip and ring is probably occurring in the forward equipment.

20. TECHNICAL DATA

20.01 Input Impedance

Receiver input impedance is 30K ohms at 1KC or greater in audio band (DC blocking). Receiver input is connected directly to line ring and tip.

20.02 Input Signal Requirements

- Signal level per frequency—0.078V rms to 1.5V.
- Minimum signal detection time—40 ms (includes build-up time for instrument tone oscillator).
- Minimum intertone time—40 ms
- Minimum tone cycle time—90 ms
- Maximum tone frequency deviation from center frequency ±1.5%
- Maximum difference in levels between frequencies (maximum twist) 6 dB
- Maximum SKEW 1.5%

20.03 Register Capacity

The Converter will be capable of storing a maximum of 16 digits.

20.04 Dial Pulse Sender Output

- At 10 ±.1 pps
- % Break: 58% - 62%
- Interdigital Time: 680 ±1 ms

20.05 Loop Characteristics

The Converter will function properly with a 0 to 1200 ohm loop (not including the telephone) between the instrument and the Converter and the line relay.

20.06 Drop Out Criteria

The Converter will be transparent to DTMF signals under the following conditions:

- The first digit dialed is a programmed digit and Switch A is OFF.
- Time out has occurred — Time out will occur if 20 ±1 seconds (10 ±1 seconds on the Model 204-05 and 204-06) have elapsed since a proper DTMF signal has been outpulsed.
- Line voltage polarity is reversed.

20.07 Line Switching

Within 40 ms of good DTMF signal, line switching will occur. Line switching will consist of opening the linefinder and first selector and terminating the first selector with a 437 ohm resistance.

Line continuity will be restored:

- Within 50 ms of battery reversal.
- Within 1.5 seconds of the last pulse of a programmed digit.
- Within 1.5 seconds of the last pulse of the last digit dialed.
- Within 300 ms of a recognized on-hook condition.

20.08 On-Hook, Off-Hook Detection

An on-hook or off-hook condition is recognized by current flow in the direction from the tip side of the line to the ring side of the line.

Off-Hook — The Converter will recognize an off-hook and be ready to accept DTMF signals within 400 ms at a line current of 20 ma or greater.

On-Hook — The Converter will recognize an on-hook condition when the line current is less than 2 ma and will restore line continuity within 300 ms of the recognized on-hook condition.

21. REPAIR AND WARRANTY

21.01 American Telecommunications offers a complete repair and return facility and suggests the use of this facility for servicing of TonePulse Converters. A flat rate, as specified on the current pricing schedule, will apply on all units out of warranty considered repairable as determined by American Telecommunications.

21.02 The standard ATC warranty policy applies. The unit is warranted against defective material and factory workmanship for a period of 1 year. Units in warranty requiring servicing shall be returned to ATC, transportation prepaid, and will be serviced and returned, transportation prepaid. A Return Authorization should be secured from American Telecommunications Corporation, 9620 Flair Drive, El Monte, CA. 91731 or by calling the Customer Service Manager at 213/579-1710.

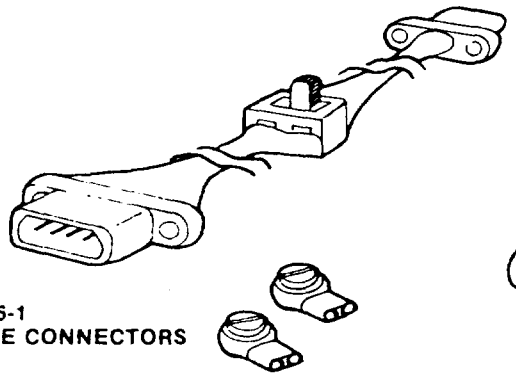
22. CONVERTER ACCESSORIES

22.01 Several of the accessories described on the following pages (those listed in Table A) are furnished with the Converter as shipped from the factory. Additional items should be ordered separately.

22.02 For ordering purposes, specify each item by its 6-digit part number along with the designated name as given below each illustration.

TABLE A
ACCESSORIES FURNISHED WITH CONVERTER

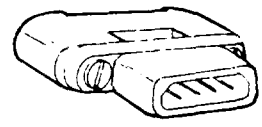
CONVERTER MODEL	ITEM FURNISHED		QTY.
204-02, 204-04, 204-06, 204-11	100342-4	18" Cable Harness Assembly	1
		Splice Connector	2
	100114-1	Long Throat Bracket	1
204-05	100342-6	18" Cable Harness Assembly	1
		Splice Connector	2
	100114-1	Long Throat Bracket	1



721006-1
SPLICE CONNECTORS

200970 SLEEVE CONTROL TEST CABLE

This Test Cable allows a functional test of the Model 204-05 Converter to be made without unwiring the Converter from the existing hookup cable. See paragraph (g) of section 18, page 12 for this test.

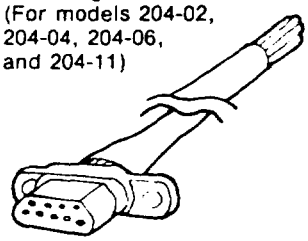


100319-9
CONVERTER CONNECTOR PLUG

Used to provide circuit continuity when converter cable harnesses are to be installed prior to the converters.

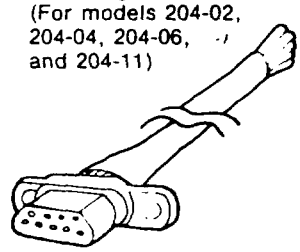
100342-4*
CABLE HARNESS

18" Length
(For models 204-02, 204-04, 204-06, and 204-11)



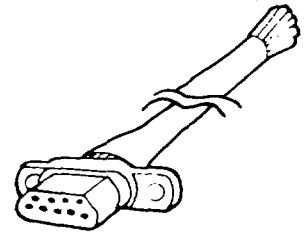
100342-5*
CABLE HARNESS

48" Length
(For models 204-02, 204-04, 204-06, and 204-11)



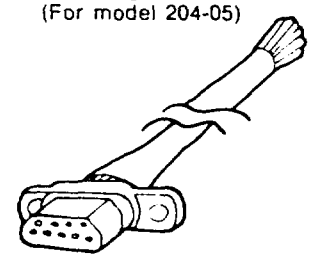
100342-6*
CABLE HARNESS

18" Length
(For model 204-05)

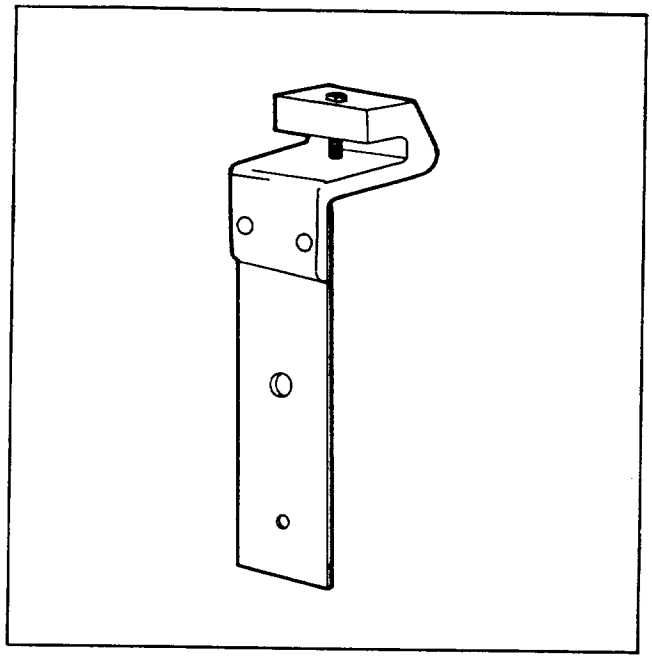


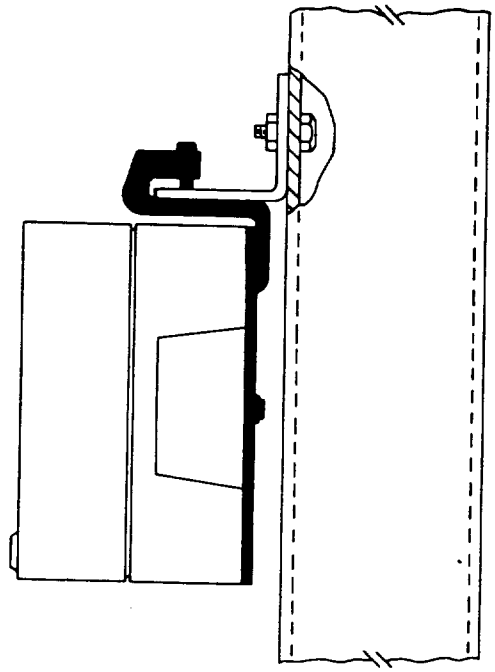
100342-7*
CABLE HARNESS

48" Length
(For model 204-05)



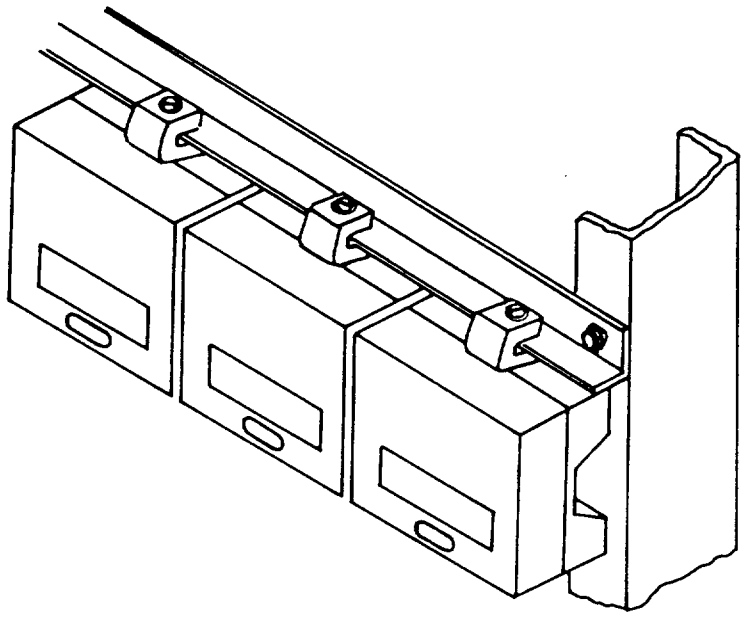
(*) Each cable includes two splice connectors.



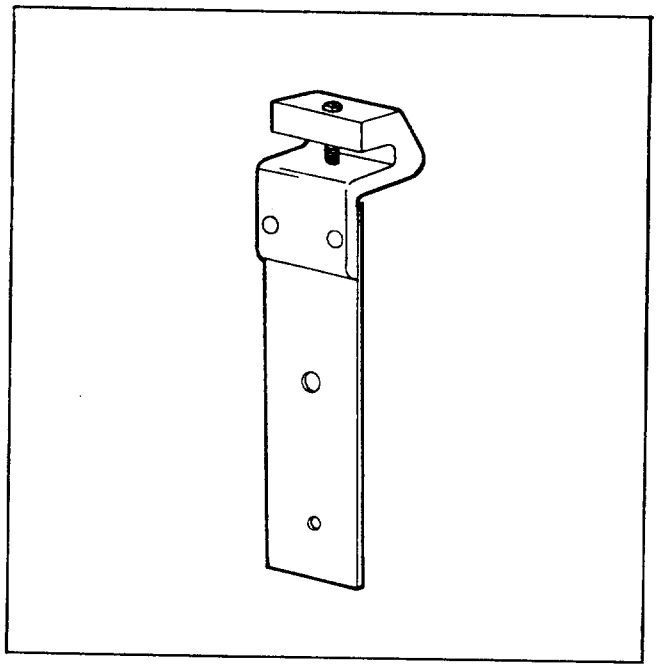


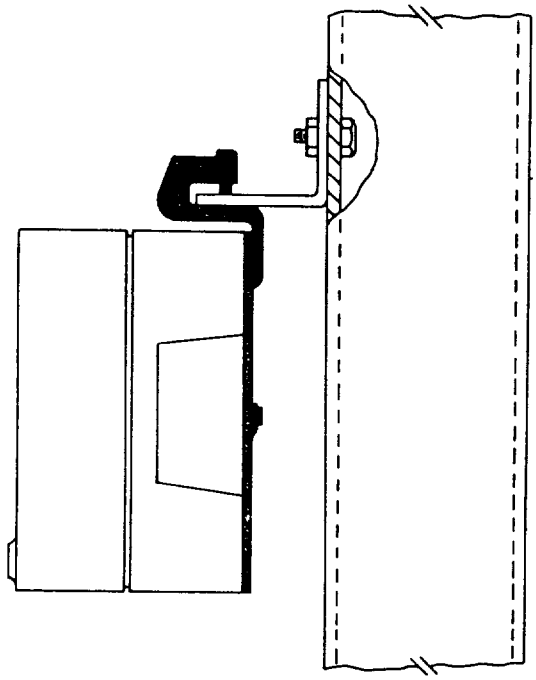
100114-1 LONG THROAT

A typical mounting behind a line finder is shown here. This bracket is used where there are no wires, components or other protrusions extending beyond the channel. Converters are not position sensitive, and may be mounted upside down or sideways (see for example, the 100111 bracket).



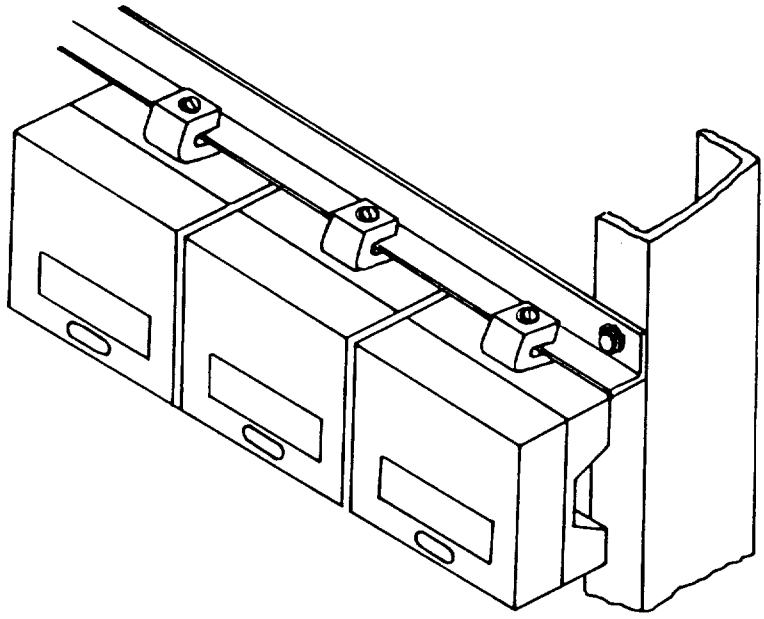
Typical installation with number 100114-1 bracket.



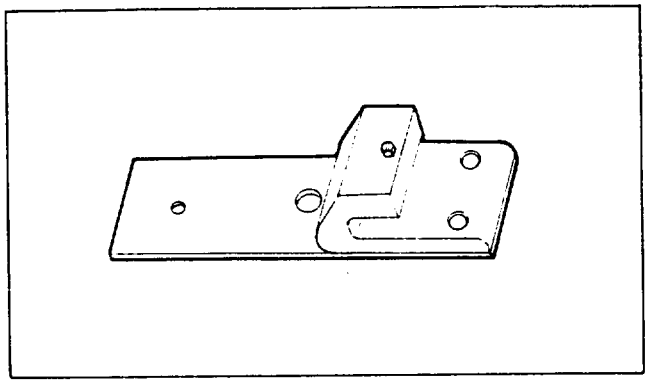


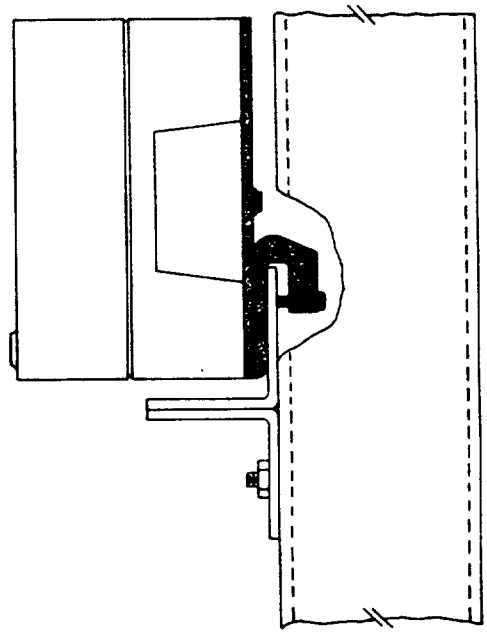
100114-2 SHORT THROAT

This bracket is used in place of the 100114-1 version when components or other protrusions occur up to 0.75 inches beyond the channel.



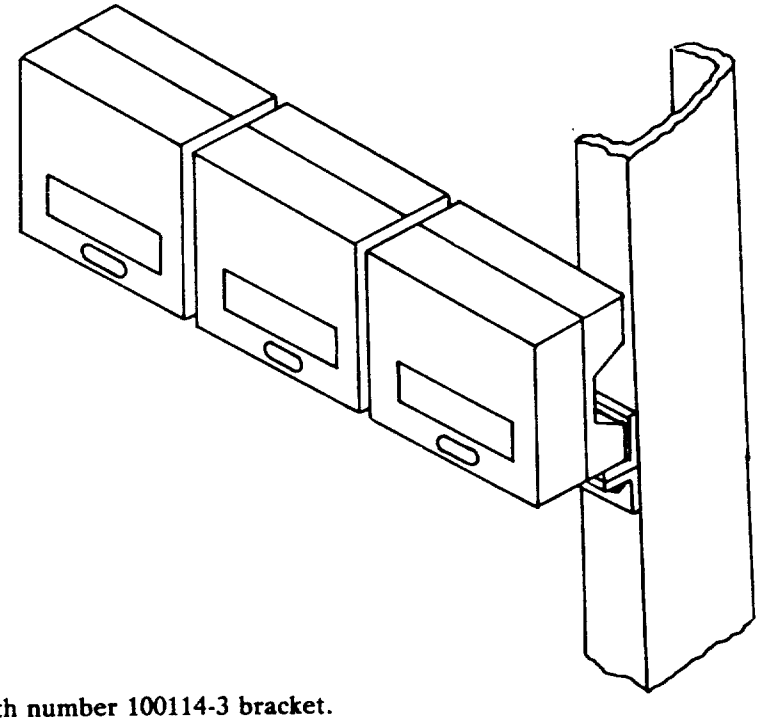
Typical installation with number 100114-2 bracket.



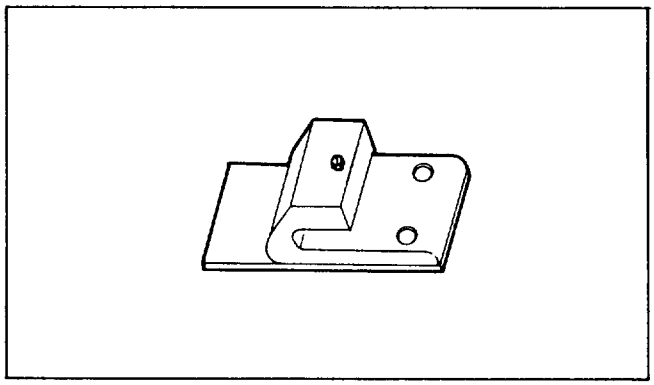


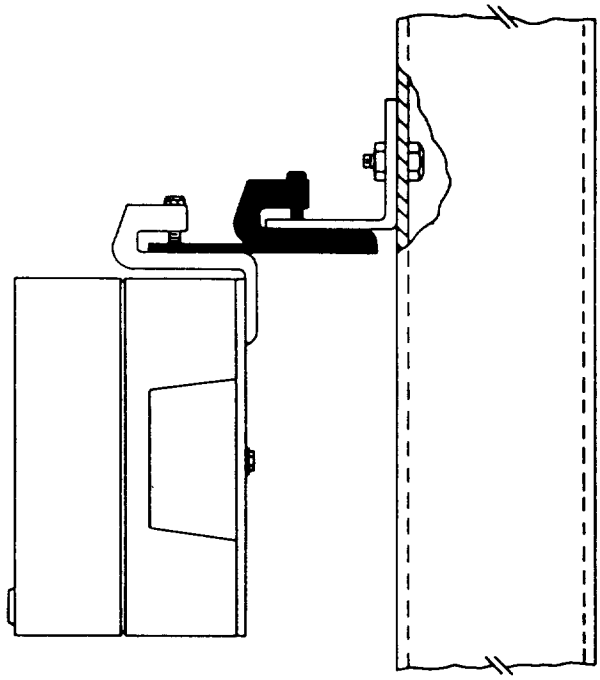
100114-3 VERTICAL

This bracket is used on ED-30427 type line finder frames (or equivalent) when double angle iron sections preclude standard mounting.



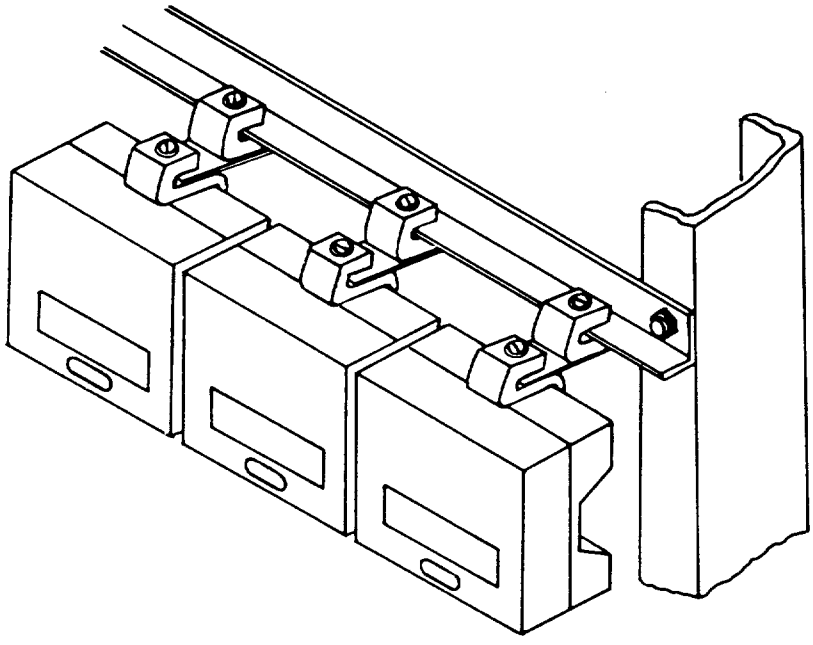
Typical installation with number 100114-3 bracket.



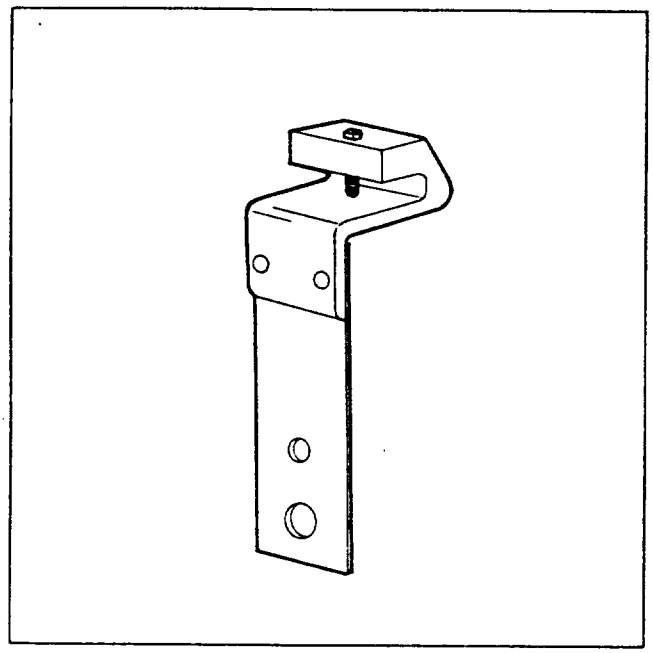


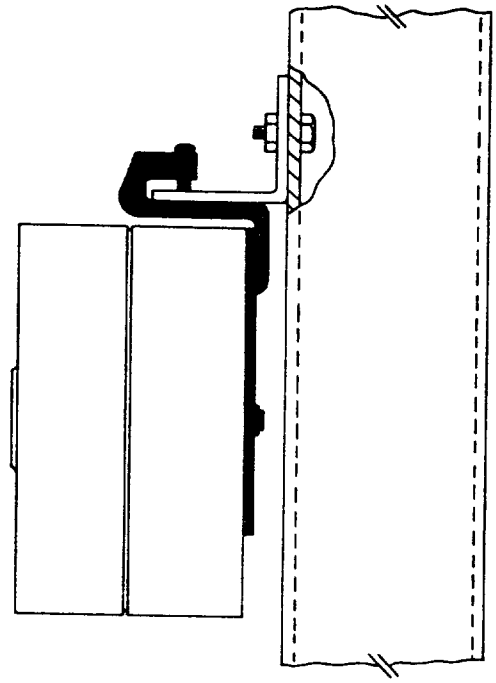
100114-4 EXTENDER

This bracket is intended as an extender for other brackets (shown here with the 100114-1 bracket) when protrusions occur up to 1.5 inches beyond the channel, providing that the converter does not extend beyond the guard rail. This bracket must be used in conjunction with one of the other brackets.



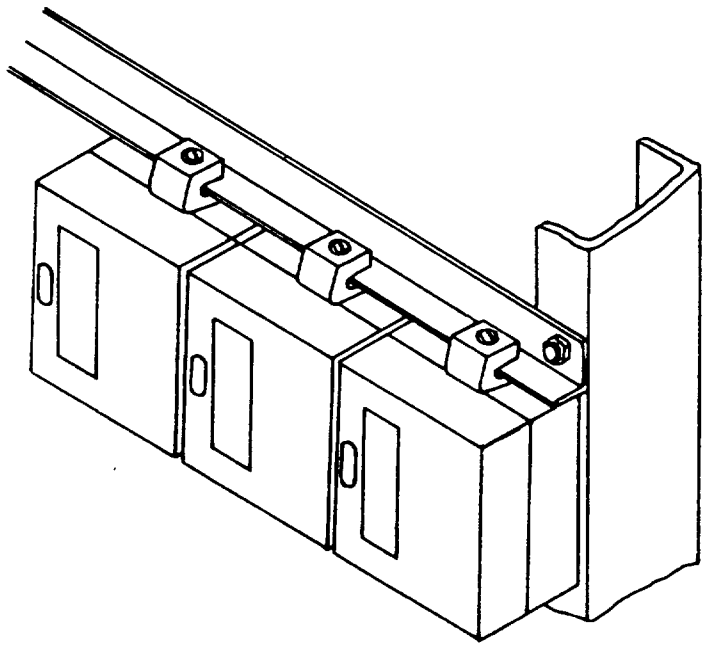
Typical installation with number 100114-4 bracket.



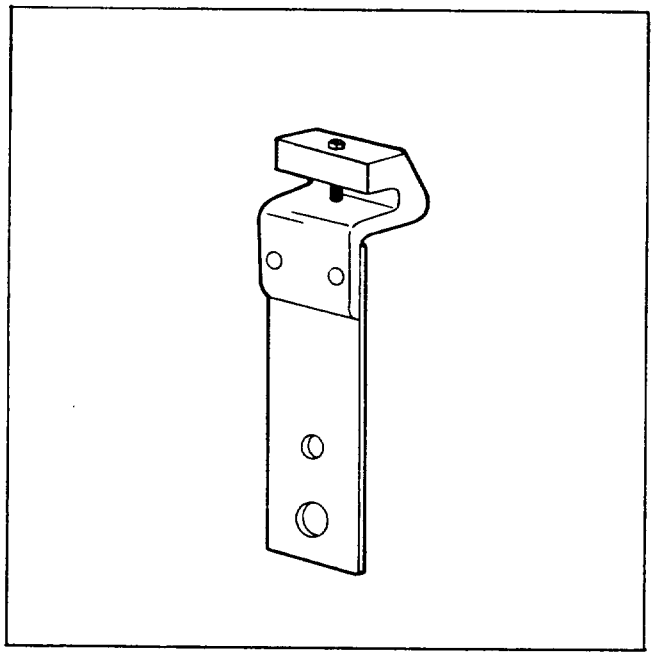


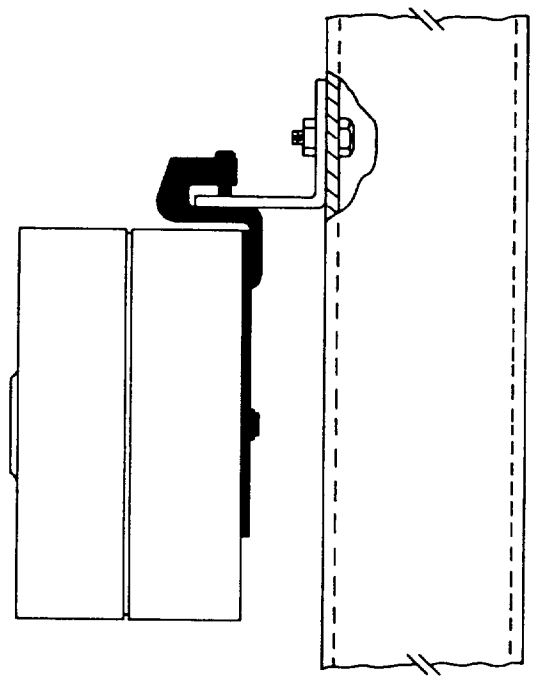
100111 SIDE MOUNT LONG THROAT

This bracket is attached to a converter that has been turned on its side. Thus the converter in this position, has a width of 4 inches, as opposed to 4.5 inches when mounted in the upright position. Side mounting allows 10 converters to fit in the same space as would 9 converters mounted in upright position.



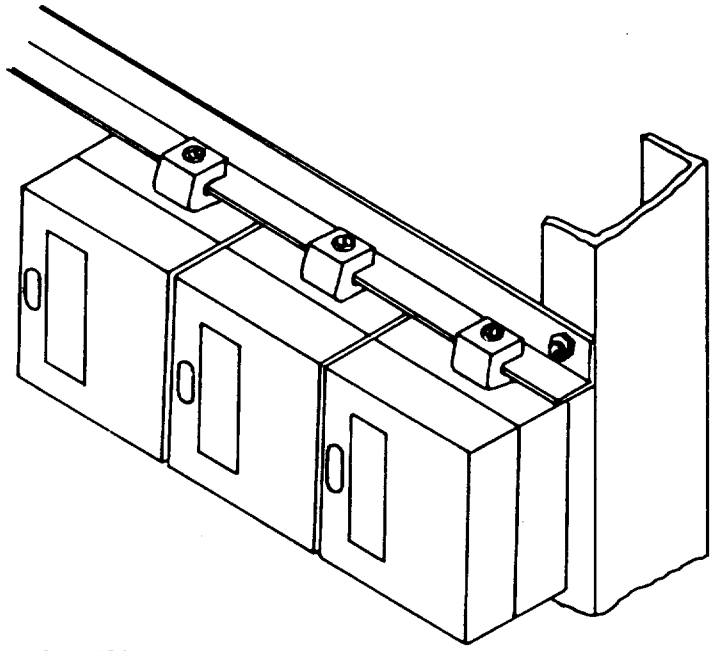
Typical installation with number 100111 bracket.



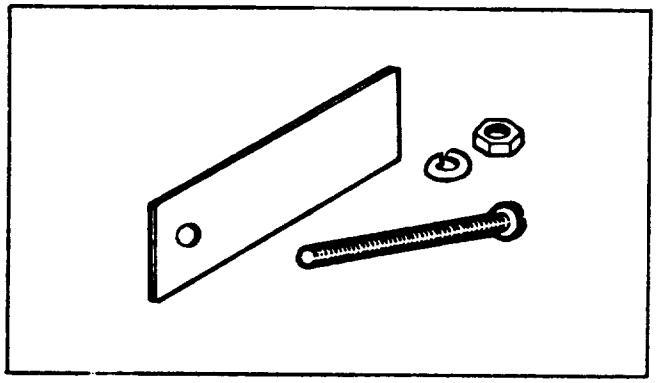


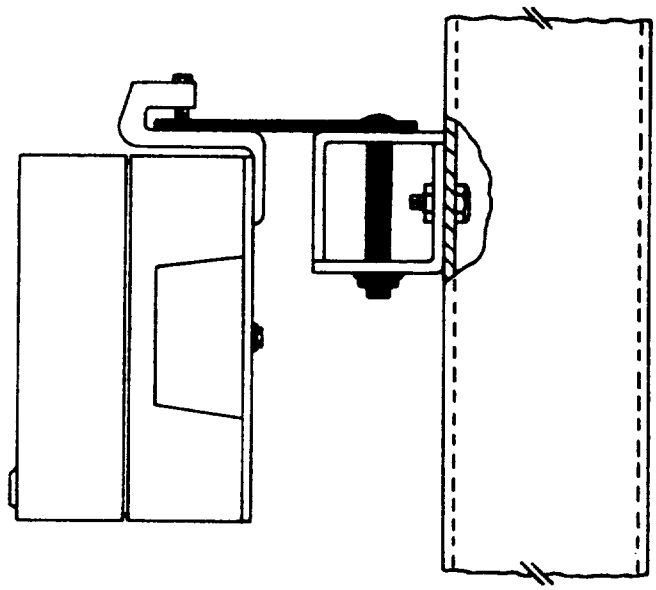
100111-1 SIDE MOUNT SHORT THROAT

This bracket is used in place of the 100111 version when components or other protrusions occur up to 0.75 inches beyond the channel.



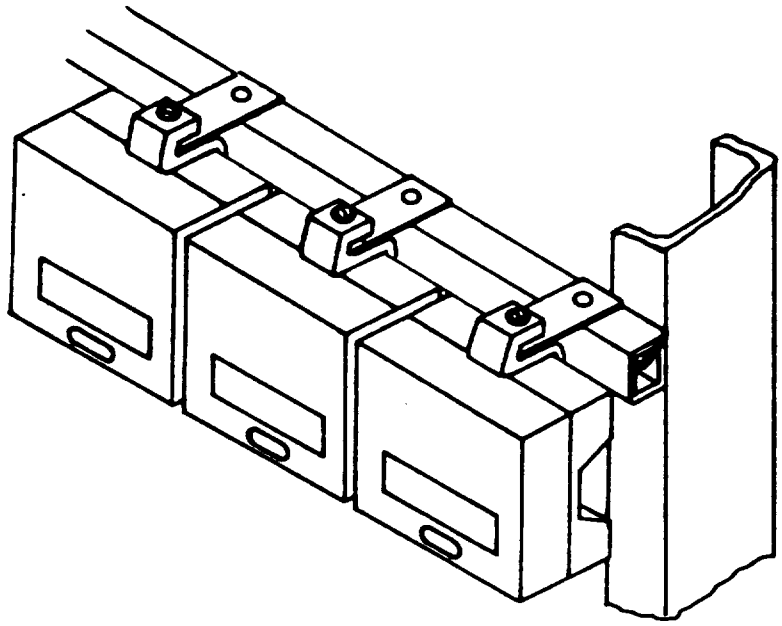
Typical installation with number 100111-1 bracket.





201036 BOXED ANGLE

This bracket (consisting of a metal strap and hardware) is used to mount converters to boxed angle sections which are drilled for 2¼-inch ¼-20 bolts.



Typical installation with number 201036 bracket.