

7206A and 7206B 2Wire Switched-Gain Compression Amplifier Modules

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1. general description

1.01 The Tellabs 7206A and 7206B 2Wire Switched-Gain Compression Amplifier modules (figure 1) combine linear gain with automatic gain control to provide a 2wire cable facility with continuously adjustable bidirectional gain and automatic gain control (compression). As such, the 7206A and 7206B are intended for applications where transmission levels vary greatly from call to call, as is typically experienced in extended WATS calling arrangements, key-telephone conferencing applications, and off-premises extensions (OPX).

1.02 In the event that this Practice section is reissued, the reason for reissue will be stated in this paragraph.

1.03 The 7206A and 7206B modules combine the functions of a switched-gain amplifier with those of a compression amplifier. The switched gain circuitry provides simultaneous signal gain in one direction and signal attenuation in the other direction. The dominant (stronger) signal is amplified while the non-dominant (weaker) signal is attenuated by an equal amount. This arrangement results in unconditional stability, independent of gain and terminating impedances, because the sum of signal gain and loss always equals zero.

1.04 The compression-amplifier circuitry on the 7206A and 7206B modules provides from 0 to 15dB of gain in combination with a fixed compression threshold. On the 7206A, the compression threshold is fixed at -9dBm ; on the 7206B, the threshold is -13dBm . Except for this difference, the two modules are identical. The compression-amplifier circuitry provides the adjusted amount of gain for input signals that would result in output levels below the compression threshold. If the combination of input signal level and adjusted gain results in an output level greater than the compression threshold, gain is automatically reduced to maintain an output level equal to the compression threshold. No gain or compression is provided for input signals greater than the compression threshold (nor will the switched-gain circuitry insert any attenuation under these circumstances). The max-

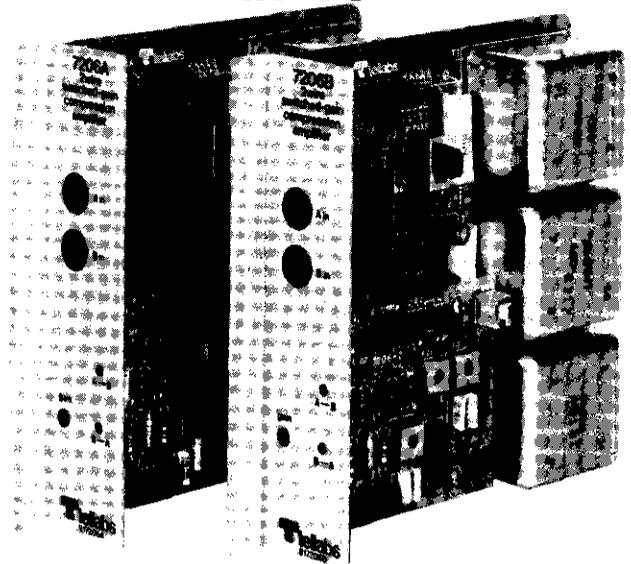


figure 1. 7206A and 7206B 2Wire Switched-Gain
Compression Amplifier Modules

imum output capability of both modules, when input signal levels exceed the compression threshold and gain is disabled, is $+10\text{dBm}$.

1.05 The direction detection circuitry of the 7206A and 7206B is designed to provide a 27dB advantage for remote dual-tone multifrequency (DTMF) pulsing in the presence of precise dial tone, thus ensuring off-net/on-net DTMF access under adverse conditions. All transitions of gain and loss occur smoothly and rapidly and are undetectable to the subscribers at either end of the facility. An option switch reduces the sensitivity of the direction-detection circuitry in the A-to-B direction of transmission to prevent excessive background noise from triggering the direction detector.

1.06 Both ports of the 7206A and 7206B are repeat-coil isolated and derive A and B leads for signaling. An option switch allows the A and B leads to be bypassed or to be brought out for connection to an external signaling unit.

1.07 The A-side and B-side amplifiers of both modules are current sources that can reflect the 2wire circuit impedance to the opposite port, thus maintaining a natural 1:1 impedance ratio. Impedance matching, therefore, need not be considered in conventional applications.

1.08 For ease of alignment and maintenance, 310-type opening jacks are provided on the line and drop sides of each module. In addition to the continuously adjustable gain control, two light-emitting diodes (LED's) provide visible indications of the direction of gain insertion (A-to-B or B-to-A).

1.09 Internal voltage regulation permits either module to operate on filtered, ground-referenced input voltages between -24 and -56 Vdc. Reverse-battery protection and transient-limiting circuitry are also provided.

1.10 Type 10 modules, the 7206A and 7206B each mount in one position of a Tellabs Type 10 Mounting Shelf, versions of which are available for relay rack or apparatus case installation. In relay rack applications, up to 12 modules can be mounted across a 19-inch rack, while up to 14 modules can be mounted across a 23-inch rack. In either case, 6 inches of vertical rack space is used.

2. application

2.01 The 7206A and 7206B 2Wire Switched-Gain Compression Amplifier modules each provide continuously adjustable bidirectional gain and automatic gain control for a 2wire cable facility. For example, when the 7206A is used (compression threshold fixed at -9 dBm), and the gain is set to maximum (15dB), the 7206A maintains a -9 dBm output level for all input signals between -24 and -9 dBm. No gain is provided for input signals above -9 dBm. Compression dynamics are smooth and undetectable; the fast-attack, slow-delay compression dynamic inhibits gain before it is inserted. The 7206A and 7206B modules are intended for applications in which transmission levels vary greatly from call to call.

2.02 When speech is detected from station A to station B, the 7206A or 7206B inserts gain from A to B and an equal amount of loss from B to A. Verification of gain insertion is provided by the $A \rightarrow B$ and $B \rightarrow A$ LED's on the module's front panel. When no speech is present gain is disabled and both LED's are extinguished.

2.03 Transmission impairment of the weaker signal will occur during doubletalk if both signals are below the compression threshold and will be equal (in dB) to the difference between the level of the stronger signal and the compression threshold. In no case will levels be attenuated by an amount greater than the adjusted gain.

extended WATS

2.04 The major application of the 7206A is in extended WATS or combination on-net/off-net calling arrangements. Transmission quality typically ranges from fair to poor in these applications because the call must, in effect, go through the toll network twice. In these applications, it is recommended that the 7206A be aligned for +15dB of gain. Private-line tie-trunk networks should be treated with 7206A's at their access points to improve transmission for on-net/off-net calls without causing crosstalk or excessive loudness for intra-network calls. The direction detector is designed to handle remote DTMF pulsing in the presence of precise dial tone with up to 27dB of measured loss between the station and the dial tone source, thus ensuring DTMF access under the most adverse conditions.

key-telephone conferencing

2.05 Where transmission quality in 2wire key-telephone conferencing systems is poor, it is recommended that one 7206B per line be installed. The module will regulate transmission levels for both conference and regular calls automatically. Because station-to-switch transmission levels are normally greater than transmission levels in the opposite direction, it is recommended that the A side of the 7206B be oriented toward the station and the direction-detection circuitry of the 7206B be desensitized (via option switch *S7* on the module's baby board) to prevent background noise from falsely triggering the direction detector. Recommended gain setting for key-telephone conferencing applications is +10dB.

common mode

2.06 Line treatment is often provided at a point in the circuit that is common to several lines, such as a pbx trunk, to alleviate the cost of treatment on a per-line basis. Because switched connections between an individual line and a trunk are unpredictable, gain will only be required in certain instances. In these applications, the 7206A should be arranged for full gain (15dB) to provide satisfactory transmission for weak talkers and poor connections without instability, crosstalk, or excessive loudness.

wiring options and amplifier orientation

2.07 Figures 2 through 4 show wiring options and amplifier orientation for various signaling modes. In figure 2, A-and-B-lead routing and amplifier orientation for applications using extended range E&M-lead (DX) signaling is shown. In DX-signaling applications, orient the 7206A or 7206B module so that inductor L1 (i.e., the B side of the module) faces the dc-signaling side, and route the module's A and B leads as shown in figure 2. Figure 3

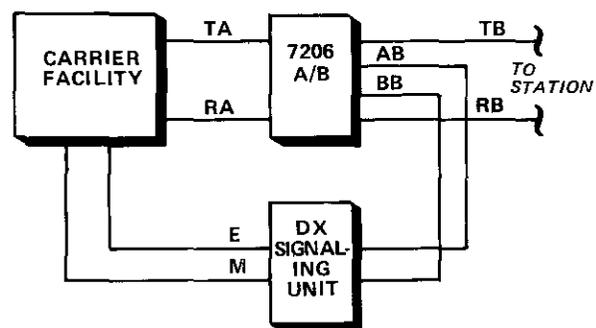


figure 2. A-and-B-lead routing and amplifier orientation for DX-signaling applications

shows A and B-lead routing in applications where the 7206A or 7206B module is used with an associated dial long line (DLL) unit. In these applications, the B side of the module should face the station equipment. In figure 4, the through-signaling configuration is shown. In all station applications, where a DLL is not used in conjunction with the 7206A or 7206B however, orient the A-side of the 7206A or 7206B toward the station end to permit use of the module's direction-detector sensitivity option (see paragraph 3.08).

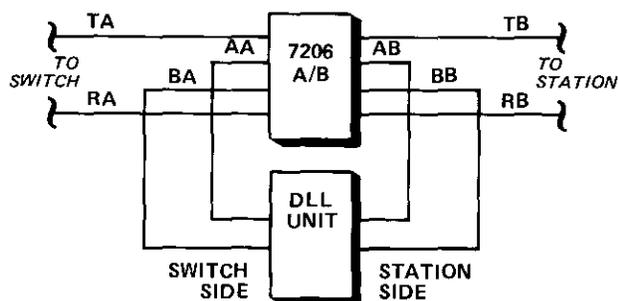


figure 3. A-and-B-lead routing and amplifier orientation when 7206A/B is used with associated DLL

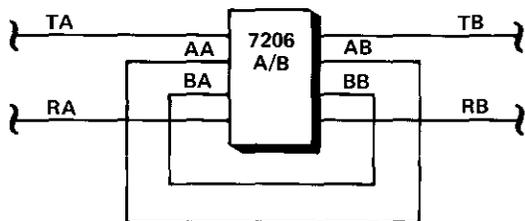


figure 4. Through signaling configuration

3. installation

inspection

3.01 The 7206A or 7206B 2Wire Switched-Gain Compression Amplifier module should be visually inspected upon arrival in order to find possible damage incurred during shipment. If damage is noted, a claim should immediately be filed with the carrier. If stored, the module should be visually inspected again prior to installation.

mounting

3.02 The 7206A and 7206B each mount in one position of a Tellabs Type 10 Mounting Shelf, which is available in configurations for both relay-rack and apparatus-case installation. The modules plug physically and electrically into 56-pin connectors at the rear of the Type 10 Shelf.

installer connections

3.03 Before making any connections to the mounting shelf, make sure that power is **off** and modules are **removed**. Modules should be put into place only **after** they are properly optioned and **after** wiring is completed.

3.04 Table 1 lists external connections to the 7206A and 7206B modules. All connections are made via wire wrapping at the 56-pin connector at the rear of each module's mounting shelf position. Pin numbers are found on the body of the connector.

connect:	to pin:
TA (tip, A side)	51
RA (ring, A side)	33
AA (A lead, A side)	53
BA (B lead, A side)	31
TB (tip, B side)	41
RB (ring, B side)	49
AB (A lead, B side)	45
BB (B lead, B side)	43
-BATT (24 to -56Vdc filtered input)	35
GND (ground)	17

table 1. Installer connections to 7206A/B

amplifier orientation and wiring

3.05 A-and-B-lead derivation for various signaling modes is shown in figures 2 through 4 and described in paragraph 2.07. To summarize, in DX-signaling applications, orient the amplifier and route the A and B leads of the 7206A or 7206B as shown in figure 2. Figure 3 shows signaling-lead arrangements and amplifier orientation for applications where the 7206A or 7206B is used with a DLL. Figure 4 shows the through signaling configuration. In all station applications where a DLL is **not** used in conjunction with the 7206A or 7206B, the A side of the 7206A or 7206B faces the station and the B side faces the switching equipment.

option selection

3.06 Two option switches must be set before the 7206A or 7206B can be placed into service and aligned. The locations of these switches on the module's printed circuit board and baby board are shown in figure 5. Switch designations are indicated adjacent to each switch.

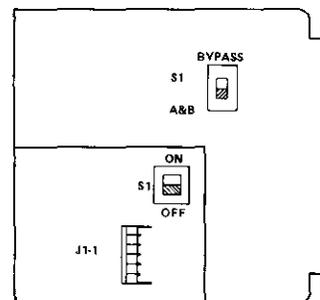


figure 5. Option switch locations

3.07 Switch *S1* on the module's printed circuit board options the module for bypassed-signaling or for derived A and B leads. For bypassed signaling, set *S1* to the *bypass* position. When derived A and B leads are required, set *S1* to the *A & B* position.

3.08 Switch *S1* on the module's baby board is used to reduce the sensitivity of the module's direction-detection circuitry to background noise in the A-to-B direction of transmission. In station applications, the A side of the module should face the station and *S1* on the module's baby board set to *ON*. In all other applications, set *S1* to *OFF*.

alignment

3.09 Alignment of the 7206A and 7206B modules consists of adjusting the linear gain. After the module is properly optioned, turn the *gain* control fully counterclockwise and insert the module into its mounting position. Procedures for adjusting the gain level of the module are contained in paragraph 3.10. Suggested gain and compression settings for typical 7206A/B module applications are contained in table 2.

gain adjustment

3.10 Connect the receive portion of a transmission measuring set (TMS), arranged for 600-ohm terminated measurement, to the *B in* jack. Arrange the transmit portion of the TMS to output 1004Hz tone at -30dBm and insert this signal into the *A in* jack. Turn the *gain* control clockwise until the measured level at the *B in* jack equals -30dBm plus the desired gain. If the *gain* control is adjusted fully clockwise, gain will be 15dB.

application	suggested gain setting	suggested compression threshold
extended WATS, on-net, off-net calls	maximum (<i>gain</i> control fully clockwise)	-9dBm
key-phone conferencing	+10dB	-13dBm
common mode (line treatment)	maximum* (<i>gain</i> control fully clockwise)	-9dBm
OPS ports	As required	-13dBm

*Less gain can be used if required.

table 2. Suggested gain and compression adjustments for typical 7206A/B applications

4. circuit description

4.01 This circuit description is intended to familiarize you with the 7206A and 7206B 2Wire Switched-Gain Compression Amplifier modules for engineering and application purposes only. Attempts to troubleshoot these modules internally are not recommended and may void your warranty. Troubleshooting procedures should be limited to those prescribed in section 7 of this Practice. Please refer to the block diagram, section 5 of this Practice, as an aid in following the circuit description.

4.02 The *power supply* in the 7206A and 7206B is a series-regulated bipolar supply that uses a zener diode as a reference source. A series diode in the negative input lead protects the circuit against reversed input power connections.

4.03 The 7206A and 7206B modules are transformer isolated at both ports. In addition to providing the facility interface, these transformers provide excellent immunity from 60Hz longitudinal voltages. For signaling purposes, A and B leads are derived at each transformer via coupling capacitors. On the B side of both modules, these A and B leads pass through inductor *L1*, which isolates them from any possible interference when the modules are used with an external signaling unit. An option switch provides the means to internally connect the A and B leads together, while disconnecting both leads from the 56-pin connector. Lightning protection is provided by means of varistors located across the secondaries of each transformer.

4.04 The *A-SIDE* and *B-SIDE AMPLIFIERS* are current sources that can reflect any terminating impedance based on the signal from the *CONTROL CIRCUIT*. This control signal is designed so that the *A-SIDE AMPLIFIER* reflects the impedance at the B-side port and the *B-SIDE AMPLIFIER* reflects the impedance at the A-side port, thus maintaining a 1:1 impedance ratio regardless of gain or loss inserted in either direction. The *DIRECTION DETECTOR* also causes the amplifier to appear transparent below the *DIRECTION DETECTOR'S* threshold or to have gain inserted in the A-to-B direction or the B-to-A direction, depending upon the direction of the dominant signal.

4.05 The gain provided by both modules is adjusted via the *gain* potentiometer, which places increasing dc bias on the pair of linear multipliers, thus increasing the gain request signal to the *CONTROL CIRCUIT*. When the *DIRECTION DETECTOR* is *ON*, as indicated by lighting of the *A→B* or *B→A* LED, the *CONTROL* circuit provides the appropriate amount of gain.

4.06 An option switch on the module's baby board provides the means to reduce the *DIRECTION DETECTOR'S* sensitivity to background noise, thus preventing room noise from falsely triggering directional changes of the *DIRECTION DETECTOR* in applications where the 7206A/B is located at the station. Two LED's (*A→B* and *B→A*) associated with the *DIRECTION DETECTOR* indicate the direction of gain insertion.

4.07 Two 310-type opening jacks, one at each port (*A IN* and *B IN*) of each module, facilitate alignment and maintenance activities while the module is mounted in place.

6. specifications

gain range

0 to 15dB ±1dB, continuously adjustable

maximum output capability

+10dBm

gain compression level into a 600-ohm load

7206A: -9dBm ±1dB

7206B: -13dBm ±1dB

harmonic distortion

less than 1% (for any gain setting)

noise

5dBmC, typical

10dBmC, maximum

crossstalk loss between units in adjacent shelf slots

80dB minimum at 2000Hz

echo return loss

20dB minimum for any gain/compression setting

between 900-ohm terminations

dc resistance

124 ohms maximum

frequency response (full gain)

-6 ±1dB at 300Hz, re 1004Hz

+1 ±0.5dB at 2804Hz, re 1004Hz

direction-detector sensitivity

-50 ±3dB at 1004Hz, approximately 25dB less at 300Hz

dial tone takeaway (DTMF capability)

will operate through connection loss of 27dB (minimum) with all cable gauges (assumes -10dBm precise dial tone level and 0dBm DTMF signal level)

delay distortion

less than 175µs between 500 and 2804Hz, re 1004Hz

power requirements

input voltage: -24 to -56Vdc, filtered, ground referenced

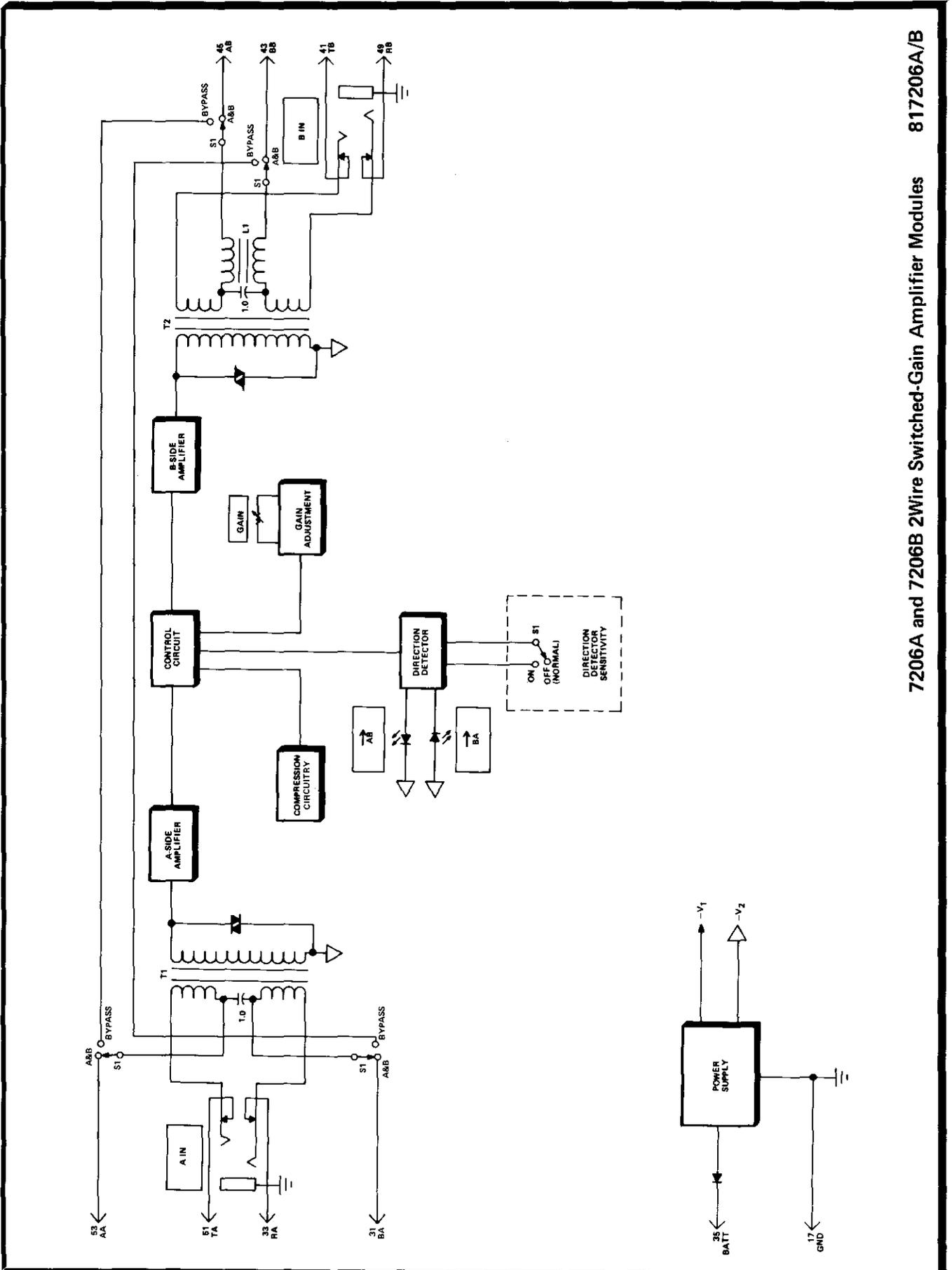
input current: 45mA maximum at -52.1Vdc and 0dB gain

operating environment

20° to 130° F (-7° to 54°C), humidity to 95%

(no condensation)

specifications continued on page 6



7206A and 7206B 2Wire Switched-Gain Amplifier Modules 817206A/B

5. block diagram

dimensions

5.58 inches (14.17cm) high
1.42 inches (3.61cm) wide
5.96 inches (15.14cm) deep

weight

28 ounces (784 grams)

mounting

relay rack or apparatus case via one position of Tellabs
Type 10 Mounting Shelf

7. testing and troubleshooting

7.01 The Testing Guide Checklist in this section may be used to assist in the installation, testing, or troubleshooting of the 7206A and 7206B 2Wire Switched-Gain Amplifier modules. The Checklist is intended as an aid in the localization of trouble to a specific module. If a module is suspected of being defective, a new one should be substituted and the test conducted again. If the substitute module operates correctly, the original module should be considered defective and returned to Tellabs for repair or replacement. We strongly recommend that no internal (component-level) testing or repairs be attempted on the 7206A or 7206B module. Unauthorized testing or repairs may void the module's warranty.

Note: *Warranty service does not include removal of permanent customer markings on the front panels of Tellabs modules, although an attempt will be made to do so. If a module must be marked defective, we recommend that it be done on a piece of tape or on a removable stick-on label.*

7.02 If a situation arises that is not covered in the Checklist, contact Tellabs Customer Service at your Tellabs Regional Office or at our Lisle, Illinois, or Mississauga, Ontario, Headquarters. Telephone numbers are as follows:

- US central region: (312) 969-8800
- US northeast region: (412) 787-7860
- US southeast region: (305) 645-5888

US western region: (702) 827-3400
 Lisle Headquarters: (312) 969-8800
 Mississauga Headquarters: (416) 624-0052

7.03 If a 7206A/B is diagnosed as defective, the situation may be remedied by either *replacement* or *repair and return*. Because it is more expedient, the *replacement* procedure should be followed whenever time is a critical factor (e.g., service outages, etc.).

replacement

7.04 To obtain a replacement 7206A/B module, notify Tellabs via letter (see addresses below), telephone (see numbers above), or twx (910-695-3530 in the USA, 610-492-4387 in Canada). Be sure to provide all relevant information, including the 8X7206X part number that indicates the issue of the module in question. Upon notification, we shall ship a replacement module to you. If the module in question is in warranty, the replacement will be shipped at no charge. Pack the defective 7206A/B in the replacement module's carton, sign the packing slip included with the replacement, and enclose it with the defective module (this is your return authorization). Affix the preaddressed label provided with the replacement module to the carton being returned, and ship the module prepaid to Tellabs.

repair and return

7.05 Return the defective 7206A/B module, shipment prepaid, to Tellabs (attn: repair and return).

in the USA: Tellabs Incorporated
4951 Indiana Avenue
Lisle, Illinois 60532

in Canada: Tellabs Communications Canada, Ltd.
1200 Aerowood Drive, Unit 39
Mississauga, Ontario, Canada L4W 2S7

Enclose an explanation of the module's malfunction. Follow your company's standard procedure with regard to administrative paperwork. Tellabs will repair the module and ship it back to you. If the module is in warranty, no invoice will be issued.

testing guide checklist

test	test procedure	normal conditions	if normal conditions are not met, verify:
gain, A to B	Connect receive portion of transmission measuring set (TMS) terminated in 600 ohms to <i>B in</i> jack. Arrange transmit portion of TMS to output 1000Hz tone at -30dBm below the adjusted gain level (e.g., for gain setting of +15dB [<i>gain</i> control fully clockwise], TMS output is -15 dBm). Insert this signal into the <i>A in</i> jack.	<i>A</i> → <i>B</i> LED lights <input type="checkbox"/> . TMS indicates -30dBm plus gain setting (e.g., if gain control is fully clockwise, TMS will indicate -15dBm <input type="checkbox"/> .	Power <input type="checkbox"/> . Wiring <input type="checkbox"/> . Gain control adjustment <input type="checkbox"/> . Replace module and retest <input type="checkbox"/> .
gain, B to A	Repeat above procedure except insert signal into <i>B in</i> jack and terminate <i>A in</i> jack.	Same as above except <i>B</i> → <i>A</i> LED lights <input type="checkbox"/> .	Same as above <input type="checkbox"/> .

testing guide checklist continued on page 7

test	test procedure	normal conditions	if normal conditions are not met, verify:
compression	With test equipment connected as in <i>gain, B to A</i> test above, insert 1004Hz tone at -40dBm level. Slowly increase signal level until it equals measured level.	<i>B</i> → <i>A</i> LED lights <input type="checkbox"/> . Measured level initially reflects gain control setting <input type="checkbox"/> . As input level increases to exceed compression level, measured level is approximately equal to input signal level <input type="checkbox"/> .	Gain setting <input type="checkbox"/> . Power <input type="checkbox"/> . Wiring <input type="checkbox"/> . Replace module and retest <input type="checkbox"/> .
direction-detector sensitivity	Set switch <i>S1</i> on module's baby board to <i>ON</i> . Connect receive portion of TMS, terminated in 600 ohms, to <i>A in</i> jack. Connect transmit portion of TMS, arranged to output 1004Hz tone at -45dBm level, to <i>B in</i> jack.	<i>B</i> → <i>A</i> LED lights <input type="checkbox"/> .	Option switches <input type="checkbox"/> . Power <input type="checkbox"/> . Wiring <input type="checkbox"/> . Replace module and retest <input type="checkbox"/> .
	With test connections as above, insert 300Hz tone at -20dBm level.	<i>B</i> → <i>A</i> LED lights <input type="checkbox"/> .	Same as above <input type="checkbox"/> .
	Set switch <i>S1</i> on module's baby board to <i>OFF</i> . Connect receive portion of TMS, terminated in 600 ohms, to <i>B in</i> jack. Connect transmit portion of TMS, arranged to output 1004Hz tone at -45dBm level, to <i>A in</i> jack.	<i>B</i> → <i>A</i> LED lights <input type="checkbox"/> .	Same as above <input type="checkbox"/> .
	With test connections as above, insert 300Hz tone at -20dBm level.	Same as above <input type="checkbox"/> .	Same as above <input type="checkbox"/> .
	Repeat above procedure except insert 1004Hz tone at -25dBm level into <i>A in</i> jack and terminate <i>B in</i> jack.	<i>A</i> → <i>B</i> LED lights <input type="checkbox"/> .	Same as above <input type="checkbox"/> .



Tellabs Incorporated

*4951 Indiana Avenue, Lisle, Illinois 60532
telephone (312) 969-8800 twx 910-695-3530*