tellabs
technical manual
76.847201
rev B 10/88

practice section 847201

7201 2Wire Switched Gain Repeater Module

contents

1. general description

1.01 The Tellabs 7201 2Wire Switched Gain Repeater module (figure 1) provides prescription-set bidirectional gain and optional amplitude equalization for a 2wire facility composed of nonloaded cable, loaded cable, or a combination of the two. Flexible design and inherent stability allow the 7201 to be used at any convenient point, terminal or intermediate, on the 2wire facility.

1.02 This practice section is revised to correct the *gain deviation* specification in section 5 and to update the text portion of section 7.

1.03 The switched-gain circuitry of the 7201 combines signal gain in one direction with simultaneous signal attenuation in the opposite direction. The dominant (stronger) signal is amplified while the non-dominant (weaker) signal is attenuated by an equal amount. This arrangement provides unconditional stability, regardless of gain setting and terminating impedances, because the sum of signal gain and loss always equals zero.

1.04 The 7201 Repeater provides from 0 to 15.5 dB of gain in 0.5dB increments, with a maximum output level of +8dBm. Gain levels are prescription-set via DIP switches on the module's printed circuit board. Slope equalization, which is also prescription-set, provides up to 7.5dB of attenuation (in 0.5dB increments) at 1000Hz, referenced to 3000 Hz. In typical applications, the 7201 will equalize a cable facility (loaded or nonloaded) to within ±2dB of the 1000Hz level from 300 to 3000Hz.

1.05 The direction-detection circuitry in the 7201 is designed to consider speech characteristics, line noise, dual-tone multifrequency (DTMF) signaling, and data signals to obtain the best overall performance in a telephone environment. All directional transitions of gain and loss occur smoothly and rapidly and are undetectable to the subscribers at either end of the facility. When the repeater is in close proximity to the station equipment, a B-to-A inhibit option allows proper operation even with large signal-level differences.

1.06 The 7201 Repeater contains an electronic transformer that reflects the 2wire circuit impedances (facility side or terminal side) to the opposite port, thus maintaining a natural 1-to-1 impedance ratio. Impedance matching, therefore, is not a consideration.

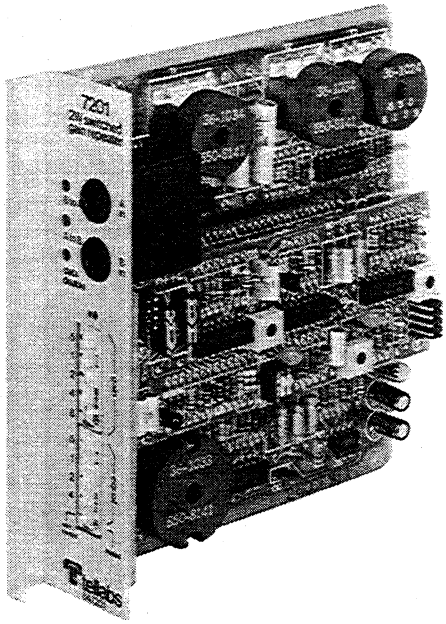


figure 1. 7201 2Wire Switched Gain Repeater Module

1.07 Integral data-detection circuitry automatically disables the 7201 during data transmission in either direction. The 7201 appears to be electronically transparent (lossless) during data transmission and while the 2wire facility is idle. A data-disable-inhibit switch option can be selected to prevent the initiation of the data-disable mode; this option is useful for testing purposes or when the 7201 is used in voice-only circuits. A second switch option provides lessened switched-gain threshold-sensitivity in one direction to allow the module to operate in close proximity to the station equipment.

1.08 For ease of alignment and maintenance, opening jacks are provided on both the facility and terminal sides of the 7201. In addition, three front-panel LED's provide visible indications of the direction of gain insertion and the normal or data-disabled state of the Repeater.

1.09 A Type 10 module, the 7201 mounts 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 7201 2Wire Switched Gain Repeater module provides adjustable gain and optional amplitude equalization for 2wire loaded or nonloaded cable facilities. It is commonly used in applications serving PBX trunk circuits, off-premises stations, tie trunks, exchange loops and foreign-exchange stations.

2.02 The 7201 provides from 0 to 15.5dB of adjustable gain to any 2wire cable facility. The amount of gain transmitted in one direction is matched by an equal amount of simultaneous loss in the opposite direction. The sum of the gain and loss, therefore, equals zero, permitting the 7201 to be used on any 2wire loop without causing the instability (singing) that is characteristic of most other 2wire gain devices under various operating conditions.

2.03 The 7201 contains an integral slope equalizer that provides up to 7.5dB of prescription-set attenuation (in 0.5dB increments) at 1000Hz, referenced to 3000Hz. This optional amplitude equalization can be used with nonloaded cable, loaded cable, or a combination of the two. In a typical application, the 7201 can equalize a nonloaded cable facility to within ±2dB of the 1000Hz level from 300 to 3000Hz.

2.04 When speech is detected from station A to station B, the 7201 inserts gain from A to B and an equal amount of loss from B to A. Verification of gain insertion is provided by the lighting of a front-panel LED labeled *A to B*. When speech is detected from B to A, gain is inserted from B to A, and an equal amount of loss is inserted from A to B. The *A to B* LED extinguishes and the *B to A* LED lights, verifying gain in the B-to-A direction. With no speech or data present, all LED's are off, and the Repeater becomes lossless in both directions of transmission. If the application requires that the 7201 be mounted in close proximity to the station equipment, reduced sensitivity in the B-to-A direction may be selected via an option switch to prevent signals from the station equipment from biasing the switched-gain function in the B-to-A direction. When selected, this option provides a threshold response in the B-to-A direction that is approximately 16dB less sensitive than that of the A-to-B direction.

2.05 When doubletalk (simultaneous bidirectional voice transmission) occurs, the 7201 Repeater provides gain in the direction of the stronger speech signal and an equal amount of loss for the weaker signal. Transmission impairment during doubletalk is related to gain settings. Doubletalk is relatively unaffected at lower gain settings. However, when a gain level of about 10dB or more is selected, transmission loss to the weaker signal may be sufficient to inhibit doubletalk because the 7201, in this case, establishes a 20dB difference in levels from one direction of transmission to the other (i.e., 10dB of gain in one direction and 10dB of loss in the other).

Note: *Speech transmission impairment may occur if excessive extraneous signals such as line noise or room background noise reach the threshold level of the 7201's speech detector. Such high noise levels can "bias" the Repeater, resulting in amplification of the noise. Most extraneous signals are, however, well below the 7201's threshold level. The 7201 is actually superior to conventional 2wire gain devices in the presence of moderate noise levels because the Repeater does not amplify any signals below its threshold level of approximately —50dBm.*

2.06 In applications where the facility served by the 7201 is occasionally used for full-duplex 2wire data transmission, the 7201 must be disabled during full-duplex data operation so that data signals will not be attenuated in the weaker direction of transmission. Upon detecting a 2000 to 2250Hz (i.e., nominal 2100Hz) answer-back tone (sent by most data modems at the initiation of a full-duplex 2wire data transmission), the 7201 is automatically disabled. The module is then transparent to transmission in both directions (i.e., the 7201 **does not** provide gain in the data-disable mode). The front-panel *data disable* LED lights during data transmission to indicate that the module is disabled. If data transmission is discontinued for a period of 300ms, the 7201 automatically releases the disabled state and again becomes an active Repeater. (If data is interrupted for 300ms, the transmission facility is routinely put through the disable sequence before transmission is resumed so that the 7201 will again be disabled by answer-back tone upon the resumption of data transmission.) The 7201 is also equipped with a data-disable-inhibit option that prevents initiation of the data-disable mode, and is therefore useful in voice-only circuits and for testing purposes.

2.07 The terminating impedance of the 7201 is provided by an electronic transformer. Unlike conventional 2wire gain devices using fixed or adjustable impedance terminations, the 7201 appears "impedance transparent" to the facility. Therefore, impedance matching need not be of concern when the 7201 is used in conventional 2wire-gain-device applications.

2.08 It should be noted that, when the 7201 is used in conjunction with a 2wire/4wire hybrid terminating set, the gain of the 7201 is quite stable and normally presents no problem with regard to singing. Because of its unique electronic transformer, however, the 7201 does not provide a terminating impedance to the term set. The term set, in effect, "sees" the impedance of the facility through the 7201's transparent electronic transformer. Therefore, requirements for term-set impedance matching and for either a precision balance network or a compromise balance network to provide the term set with acceptable transhybrid loss are determined by facility characteristics and not by the 7201.

3. installation

Note: *Before "burning in" this module, verify that all front-panel* gain *and* equal *switches are set to the* **out** *position.*

inspection

3.01 The 7201 2Wire Switched Gain Repeater module should be visually inspected upon arrival 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 prior to installation.

mounting

3.02 The 7201 module mounts in one position of the Tellabs Type 10 Mounting Shelf. The module plugs physically and electrically into a 56-pin connector at the rear of the 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 7201 module. All connections are made via wire wrapping at the 56-pin connector at the rear of the module's mounting shelf position. Pin numbers are found on the body of the connector.

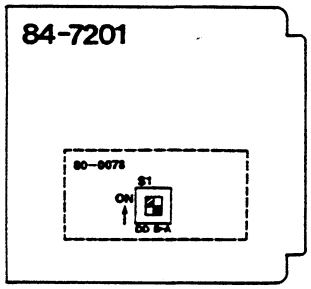
connect:	to pin:
TA (tip, A side)	51
RA (ring, A side)	33
TB (tip, B side)	41
RB (ring, B side)	49
–BATT (–24 to –56Vdc filtered battery)	35
GND (ground)	17

table 1. 7201 Installer Connections

options

3.05 Before the 7201 is aligned and placed into service, two options must be selected. Both options are controlled by two-position DIP switch *S1*, located on the module's baby board as shown in figure 2.

3.06 Option switch S1-1 (labeled *DD*) enables or inhibits the 7201's data-disable function. When *S1-1* is in the *OFF* position, the data-disable circuitry operates normally, i.e., the 7201's switched-gain circuitry is disabled upon receipt of nominal 2100Hz tone. When *S1-1* is in the *ON* position, however, the data-disable circuitry is inhibited, i.e., the 7201's gain circuitry is *not* disabled upon receipt of a nominal 2100Hz tone. If the 7201 is to be used in data applications, set *S1-1* to *OFF*. If the module is to be used in voice-only applications, or if the data-disable feature must be inhibited during testing, set *S1-1* to *ON*.



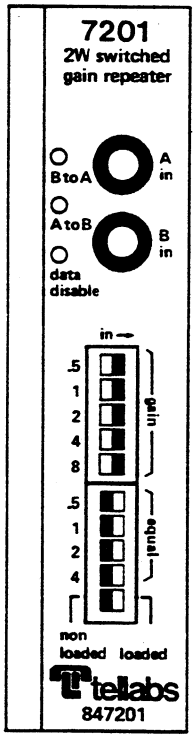


figure 2. 7201 option locations

3.07 Option switch *S1-2* (labeled *B→A*) selects either equal or reduced switched-gain threshold sensitivity in the B-to-A direction compared to that of the A-to-B direction. When *S1-2* is in the *OFF* position, the threshold sensitivity of the 7201 is equal in both direction. When *S1-2* is in the *ON* position, however, the response in the B-to-A direction is depressed approximately 16dB in comparison to that of the A-to-B direction. This reduced threshold sensitivity is useful when the 7201 is located close to the station equipment. In applications where the 7201 is **not** installed at the same location as the station equipment, set *S1-2* to *OFF*. In applications where the 7201 is installed at the same location as the station equipment, set *S1-2* to *ON*.

Note: *When* S1-2 *is set to* ON, *the station equipment must be on the B side and the cable facility on the A side for proper operation.*

alignment

3.08 In order to set the prescription gain and equalization controls of the 7201, the 2wire facility loss must be known. Measure or calculate the end-to-end facility levels at 1000Hz and, if the facility is comprised of nonloaded cable, at 3000Hz as well.

Note: *Before beginning the procedures below, ensure that all front-panel* **gain** *and* **equal** *switches are set to the* **out** *position.*

flat gain (nonloaded cable)

3.09 Determine the difference in dB between the net facility loss specified on the circuit layout record (CLR) and the 1000Hz loss determined in paragraph 3.08. With the front-panel *loaded/nonloaded* switch in the *nonloaded* position, set to *in* that combination of *gain* switches which equals this difference.

shaped gain (loaded cable)

3.10 When the front-panel *loaded/nonloaded* switch is set to the *loaded* position, the 7201 provides shaped gain for loaded cable that results in better frequency-response characteristics for the facility. Determine the difference in dB between the net facility loss specified on the CLR and the 1000Hz loss determined in paragraph 3.08. Refer to table 2 for the values of the *gain* switches when the *loaded/nonloaded* switch is in the *loaded* position, and set to *in* that combination of *gain* switches which equals (or most closely approximates) the level difference.

gain and slope equalization (nonloaded cable)

3.11 When the 7201 interfaces nonloaded cable, equalization and, in some cases, gain are required for proper alignment. Set the *loaded/nonloaded* switch to the *nonloaded* position, and set to *in* that combination of *equal* switches which equals the difference between the 1000Hz and 3000Hz levels (determined in paragraph 3.08). After setting the equalization, determine from table 3 the amount of 1000Hz gain added by the selected *equal* switches. Compare this gain with the 1000Hz facility loss determined in paragraph 3.08. The difference between the 1000Hz facility loss and the 1000Hz gain already added by the *equal* switches indicates the amount of gain to be added via the *gain* switches. If less loss is desired, merely add the amount of nonloaded gain necessary to reach the desired level.

shaped gain and slope equalization (mixed loaded and nonloaded cable)

3.12 When the 7201 is used with a combination of loaded and nonloaded cable, perform the slope equalization procedure in paragraph 3.11 and add gain as described in paragraph 3.10.

alignment verification

3.13 After alignment, you may desire to verify circuit levels through the 7201 module. End-to-end facility measurements at 1000Hz and 3000Hz are the most effective means of verification. If you desire verification of the insertion gain and equalization of the module itself, this can be done by measuring insertion gain between 600-ohm terminations from the *A IN* and *B IN* jacks on the front panel.

trim correction

3.14 In applications where you have performed prescription alignment of the 7201 by using calculations derived from cable records, a final trimming may occasionally be desired to compensate for possible errors in records or equipment. To trim, you will, of course, have to make end-to-end measurements. Trim only with the *gain* switches to arrive as closely as possible to the desired 1000Hz end-to-end levels. Gain introduced by trimming will not affect the equalization characteristics that may have been previously introduced into the circuit by *equal* switches. It is strongly recommended that no trimming be attempted with the *equal* switches. These switches should remain exactly as set previously.

programmed installation

3.15 The 7201 module is designed so that all options, including gain, equalization and attenuation, can be specified prior to installation. This "engineered" installation is made possible by the 7201 module's switch-selectable options and prescription alignment capability. Where computer-controlled test equipment is used, a subsequent printout will verify the engineering results. Any deviation from the required levels can then be adjusted, in 0.5dB increments, via the front-panel *gain* and *equal* switches. Tables 2 and 3 and several examples of a typical programmed installation are provided to aid the engineer in designing a programmed installation.

gain indicated by gain switches in dB	actual gain at 1000Hz for loaded gain in dB
0.5	0.42
1.0	0.83
2.0	1.67
4.0	3.33
8.0	6.67

table 2. Actual gain of gain *switches in loaded mode*

equalization setting in dB	actual gain at 1000Hz in dB
0.5	0.1
1.0	0.2
1.5	0.3
2.0	0.4
2.5	0.6
3.0	0.7
3.5	0.9
4.0	1.1
4.5	1.3
5.0	1.4
5.5	1.7
6.0	1.9
6.5	2.1
7.0	2.3
7.5	2.5

table 3. Actual gain at 1000Hz from equalizer

ALIGNMENT EXAMPLES

Loop #1

- Facility: 18kft of 26Ga nonloaded cable
- Requirement: Equalized 4dB-loss loop
- Loaded/Nonloaded Switch: Nonloaded

Equalization required
= 3000Hz loss −1000Hz loss
= 16.0dB −9.2dB
= 6.8dB

Therefore, 7.0dB of equalization is added via *equal* switches
Equalization gain = 2.3dB (from table 3)

Additional gain required
= Actual 1000Hz loss − (Desired 1000Hz loss + Equalization gain)
= 9.3dB − (4.0dB + 2.3dB)
= 2.9dB

Therefore, 3.0dB of gain is added via *gain* switches

Required switch settings:
cumulative *gain* = 3.0dB
cumulative *equal* = 7.0dB
loaded/nonloaded = nonloaded

Loop #1 cable response in dB

	300Hz	400Hz	600Hz	1000Hz	2000Hz	2800Hz	3000Hz
Without 7201	−7.2	−7.4	−7.9	−9.2	−12.7	−15.4	−16.0
With 7201	−5.5	−4.1	−3.7	−3.4	−3.2	−3.8	−4.1

Loop #2

- Facility: 30kft of 24Ga loaded cable
- Requirement: Equalized 4dB-loss loop
- Loaded/Nonloaded Switch: Loaded

Gain required
= Actual 1000Hz loss – Required 1000Hz loss
= 6.8dB – 4.0dB
= 2.8dB

Therefore, from table 2, set the following switches to the ON position (the indicated gain of each switch is shown below, with the actual loaded gain shown in parentheses):

Indicated (nonloaded) gain = 0.5 + 1.0 + 2.0
Actual (loaded) gain = (0.42) + (0.83) + (1.67)
= 2.92dB

Required switch settings:

cumulative (indicated) *gain*	= 3.5dB
cumulative (actual) *gain*	= 2.92dB
cumulative *equal*	= 0.0dB
loaded/nonloaded	= *loaded*

Loop #2 cable response in dB

	300Hz	400Hz	600Hz	1000Hz	2000Hz	2800Hz	3000Hz
Without 7201	–5.7	–5.9	–6.3	–6.8	–7.1	–7.9	–8.9
With 7201	–5.7	–4.2	–3.7	–3.8	–3.7	–4.4	–5.4

Loop #3

- Facility: 18kft of 26Ga nonloaded and 30kft of 24Ga loaded cable
- Requirement: Equalized 4dB-loss loop
- Loaded/Nonloaded Switch: Loaded

Determine equalization required for length of nonloaded cable. For this example, 7.0dB is required (from Loop #1). This 7.0dB of equalization results in 2.3dB of loaded gain (from table 3).

Gain required
= Actual 1000Hz loss –(Desired 1000Hz loss + Equalization gain)
= 16.0dB – (4.0dB + 2.3dB)
= 9.7dB

Therefore, 11.5dB of indicated gain (9.59dB of loaded gain) is required (from table 2).

Loop #3 cable response in dB

	300Hz	400Hz	600Hz	1000Hz	2000Hz	2800Hz	3000Hz
With 7201	–7.2	–4.4	–2.6	–2.6	–2.7	–5.0	–6.8

Note: *The level is too high for the requirement, so the indicated gain is changed to 10.0dB (8.34dB loaded gain).*

Required switch settings:
cumulative *gain* = 10.0dB (indicated)
cumulative *equal* = 7.0dB
loaded/nonloaded = *loaded*

	300Hz	400Hz	600Hz	1000Hz	2000Hz	2800Hz	3000Hz
With 7201	–8.3	–5.4	–3.6	–3.9	–4.2	–6.4	–8.1

4. circuit description

4.01 This circuit description is designed to familiarize you with the 7201 2Wire Switched Gain Repeater for engineering and application purposes only. Attempts to test or troubleshoot the 7201 internally are not recommended. Procedures for recommended testing and troubleshooting in the field are limited to those prescribed in Section 7 of this Practice.

4.02 The *power supply* in the 7201 Repeater 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 An *electronic transformer* maintains a 1:1 impedance ratio. By altering current and voltages within the transformer, simultaneous gain and loss, directional in nature, can be introduced without physically changing that impedance reflection.

4.04 The direction of gain through the *electronic transformer* is controlled by field-effect-transistor (FET) switches, which are gated by internally generated dc voltages. Directional control is provided by the *switched-gain control circuit*. This *switched-gain control circuit* is equipped with an option switch that selects either equal or reduced switched-gain threshold sensitivity in the B-to-A direction compared to that of the A-to-B direction, useful when the 7201 is installed close to the station gear. Gain and equalization levels are set by front-panel DIP switches that determine values in a level-control circuit composed of operational amplifiers (op amps) and resistors. This circuitry establishes the secondary voltage ratio and the primary current ratio of the *electronic transformer*.

4.05 The *data-detect gain disable* circuit, upon receipt of the nominal 2100Hz tone transmitted by most modems prior to initiating data transmission, prevents the 7201 from adding gain to transmissions in either direction. The circuit is equipped with an option switch to defeat this function when the 7201 is used in voice-only applications.

4.06 Front-panel LED's provide visible indications of the operating modes of the 7201 (i.e., direction of gain insertion and presence of data transmission).

6. specifications

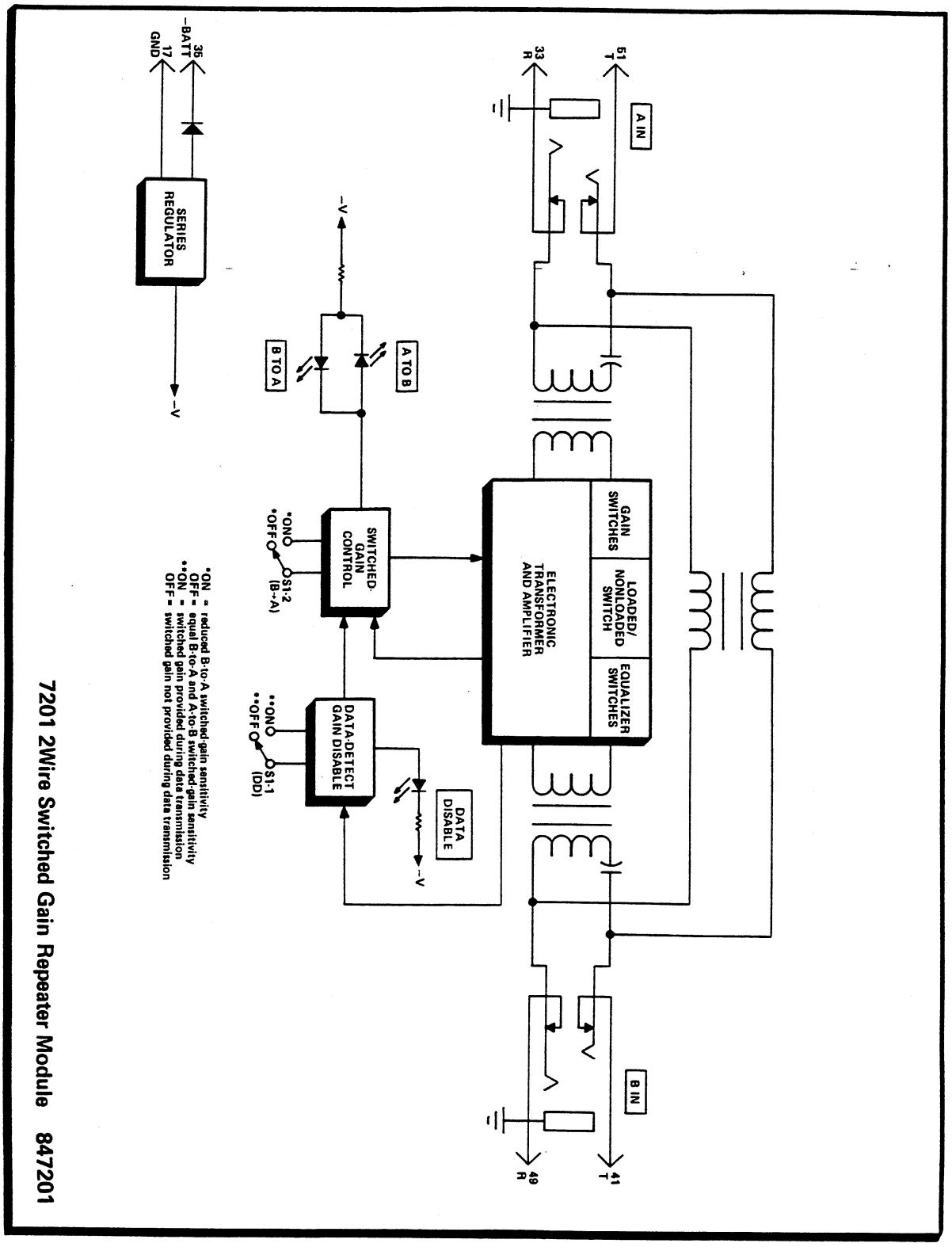
gain range
0 to +15.5dB in 0.5dB increments (re 1000Hz for nonloaded [flat] gain, re 2500Hz for loaded [shaped] gain)

maximum output level
+8dBm

gain deviation from that indicated by gain-switch label for nonloaded (flat) gain
±0.2dB from 0.0 to 13.0dB of gain
±1.0dB from 13.0 to 15.5dB of gain

equalization
nonloaded: 0.0 to 7.5dB of slope equalization at 3000Hz (re 1000Hz) in 0.5dB steps
loaded: flat gain shaped via low-end roll off

dc insertion resistance
150 ohms, typical



5. block diagram

7201 2Wire Switched Gain Repeater Module 847201

longitudinal balance
60dB minimum, 150 to 3000Hz

crosstalk loss between units
80dB minimum, 300 to 3000Hz

switched-gain 1000Hz detection threshold
nominal –50dBm (900 ohm impedance)

data disable activation
responds to single tones of 2000 to 2250Hz applied for 300ms at a –30dBm ±3dBm level; defeatable via switch option

data disable release
–34 dBm maximum (re 1000Hz) for a minimum of 300ms

data disable energy
5dB greater than speech energy

echo return loss
greater than 20dB between 900 ohm terminations with +8dB of gain

harmonic distortion
less than 1% THD at +5dBm

delay distortion
less than 175μs between 600 and 3000Hz (re 1000Hz)

noise
self-generated noise less than 5dBrnC at full gain and less than 0dBrnC at idle

frequency response (between 900 ohm terminations)

gain setting:	typical deviation: 300Hz	600Hz	1000Hz	3000Hz
8.0	–2.3	0.0	+0.1	–0.1
12.0	–3.2	+0.1	0.0	–0.6
15.5	–4.2	+0.9	+0.7	–0.8

input power requirements
voltage: –24 to –56Vdc, filtered, ground referenced
maximum current: 60mA at –48Vdc
idle current: 45mA at –48Vdc

switched-gain threshold sensitivity
switch-selectable choice of equal threshold sensitivity in both directions or 16dB greater sensitivity in A→B direction than in B→A at 1000Hz

operating environment
20° to 130°F (–7° to 54°C), humidity to 95% (no condensation)

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

weight
approximately 10 ounces (284g)

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 7201 2Wire Switched Gain Repeater module. The checklist is intended as an aid in the localization of trouble to this specific equipment. If the equipment is suspected of being defective, substitute new equipment (if possible) and conduct the test again. If the substitute operates correctly, the original should be considered defective and returned to Tellabs for repair or replacement as directed below. We strongly recommend that no internal (component-level) testing or repairs be attempted on the equipment. Unauthorized testing or repairs may void its warranty. Also, if the equipment is part of a registered system, unauthorized repairs will result in noncompliance with Parts 15 and/or 68 of the FCC Rules and Regulations.

***Note:** Although repair service always includes an attempt to remove any permanent markings made by customers on Tellabs equipment, the success of such attempts cannot be guaranteed. Therefore, if equipment must be marked **defective** or **bad**, we recommend that it be done on a piece of tape or on a removable stick-on label.*

technical assistance via telephone

7.02 If a situation arises that is not covered in the **testing guide checklist**, contact Tellabs Customer Service as follows:

USA customers: Contact your Tellabs Regional Office listed below.

region	telephone	office location
US Northeast	(203) 798-0506	Danbury, CT
US Capital	(703) 359-9166	Washington, DC
US Central	(312) 357-7400	Chicago, IL
US Southeast	(407) 834-8311	Orlando, FL
US Southwest	(214) 869-4114	Dallas, TX
US Western	(714) 850-1300	Orange County, CA

Canadian customers: Contact our Canadian headquarters in Mississauga, Ontario. Telephone (416) 858-2058.

International customers: Contact your Tellabs distributor.

selecting correct product service procedure

7.03 If equipment is diagnosed as defective or if in-service equipment needs repair, follow the **product return procedure** in paragraph 7.04 in all cases except those where a critical service outage exists (e.g., where a system or a critical circuit is down and no spares are available). In critical situations, or if you wish to return equipment for reasons other than repair, follow the **product replacement procedure** in paragraph 7.05.

product return procedure (for repair)

7.04 To return equipment for repair, first contact Tellabs Product Services (see addresses and numbers below) to obtain a Material Return Authorization (MRA). A service representative will request key data (your company's name and address, the equipment's model and issue numbers and warranty date code, and the purchase order number for the repair transaction). The service representative will then give you an MRA number that identifies your particular transaction. After you obtain the MRA number, send the equipment prepaid to Tellabs (attn: Product Services).

in the USA:
Tellabs, Inc.
4951 Indiana Avenue
Lisle, Illinois 60532-1698
telephone (312) 969-8800

in Canada:
Tellabs Communications Canada, Ltd.
2433 Meadowvale Boulevard
Mississauga, Ontario, Canada L5N 5S2
telephone (416) 858-2058

Enclose an explanation of the malfunction, your company's name and address, the name of a person to contact for further information, and the purchase order number for the transaction. Be sure to write the MRA number clearly on the outside of the carton being returned. Tellabs will inspect, repair, and retest the equipment so that it meets its original performance specifications and then ship the equipment back to you. If the equipment is in warranty, no invoice will be issued. Should you need to contact Tellabs regarding the status of a repair, call or write the Product Services department at our Lisle or Mississauga headquarters as directed above.

product replacement procedure

7.05 For critical service outages, Tellabs offers a choice of two replacement services (if the product is in replacement stock) in lieu of the 15-day repair and return service described above. These are **overnight express service** (at extra cost) anywhere in the USA and **five-day expedited delivery** (at no extra cost) anywhere in the USA and Canada. To obtain replacement equipment via either of these services, contact your Tellabs Regional Office in the USA or our Canadian headquarters in Mississauga, Ontario, for details, costs (if applicable), and instructions. Telephone numbers are given in paragraph 7.02. A service representative will request key data (your company's name and address, the equipment's model and issue numbers and warranty date code, and the purchase order number for the replacement transaction). Tellabs will then ship the replacement to you in accordance with the replacement service you request. An invoice in the amount of the replacement's current price plus any applicable service charges will be issued after the replacement is shipped. When you receive the replacement, pack the equipment to be returned in the replacement's carton, sign and enclose the packing list, affix to the carton the preaddressed label provided, and ship the carton prepaid to Tellabs at our USA or Canadian headquarters. The defective equipment must be received within 30 days of the replacement's ship date. When we receive the defective equipment, a credit will be issued, leaving a balance due on the replacement's invoice that reflects only the express service and/or out-of-warranty charges, if any. Returns received more than 30 days after the replacement's ship date **will not be accepted for credit** but instead will be returned to you, thereby rendering the replacement's invoice due and payable. Please note that OEM, modified, and manufacture-discontinued equipment is not available via overnight express service.

testing guide checklist

test	test procedure	normal conditions	if normal conditions are not met, verify;
gain, A to B	Arrange xmt portion of transmission measuring set (TMS) to output 1000Hz tone at −10dBm, and connect this signal to *A in* jack. Arrange rcv portion of TMS for 900-ohm terminated measurement and connect it to *B in* jack.	*A to B* LED lights ☐. Signal level corresponds to gain settings ☐.	Power ☐. Wiring ☐. Gain settings ☐. Replace 7201 and retest ☐.
gain, B to A	Arrange xmt portion of transmission measuring set (TMS) to output 1000Hz tone at −10dBm, and connect this signal to *B in* jack. Arrange rcv portion of TMS for 900-ohm terminated measurement and connect it to *A in* jack.	*B to A* LED lights ☐. Signal level corresponds to gain settings ☐.	Power ☐. Wiring ☐. Gain settings ☐. Replace 7201 and retest ☐.
data disable	Set option switch *S1-1 (DD)* to *OFF*. Arrange xmt portion of TMS for 2100Hz tone output at −40dBm, and connect this signal to A in jack. Arrange rcv portion of TMS for 900-ohm terminated measurement and connect it to B in jack. Slowly increase 2100Hz level until *data disable* LED lights.	TMS indicates −30 ±3dBm ☐.	Switch *S1-1* set to *OFF* ☐. Power ☐. Wiring ☐. Replace 7201 and retest ☐.
data disable inhibit	Set option switch *S1-1 (DD)* to *ON*. Apply 2100Hz tone as directed in preceding step.	*Data disable* LED remains unlighted ☐.	Switch *S1-1* set to *ON* ☐.