tellabs
technical manual
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rev C

practice section 814012

4012 Program Distribution Amplifier

contents

1. general description

1.01 The Tellabs 4012 Program Distribution Amplifier is a single input, dual output, wide-band, low-distortion amplifier intended for use in audio program circuits. The 4012 derives two program-level outputs from a common input, with the gain of each output channel independently adjustable from 0 to 20dB. Frequency response of the 4012 is nominally flat from 50 to 20,000Hz.

1.02 The input port of the 4012 may be switch-optioned for either 150 or 600 ohms impedance, or for bridging (high impedance) interface. Each output port may be optioned, again via impedance selection switches, for balanced output impedance of either 150 or 600 ohms. A simplex lead is available at any port optioned for a 600 ohm termination.

1.03 A unique noise threshold circuit in the 4012 can be used to insert loss between the input and output ports when the input signal falls below a predetermined threshold level. All gain is removed and approximately 10dB of loss is inserted between the input port and the two output ports, independent of the gain setting for the two channels, when the input signal level is below threshold. This loss significantly reduces background noise during quiet intervals in program material. The threshold level is adjustable via a front-panel-accessed potentiometer and may be set at any input level between about −53 and −20dBm. An option switch permits removal of the threshold circuit if low-level quieting is not desired.

1.04 A full complement of front-panel-mounted jacks (monitor and access type) affords access to the input and both output ports. Gain and threshold controls are also accessible at the front panel to simplify alignment.

1.05 Mounting for the 4012 Program Distribution Amplifier is provided by any of the Tellabs Type 10 Mounting Assemblies. The unit occupies one mounting position and requires input power at any potential between −23 and −56Vdc, at a maximum current of about 55mA. Transient limiting circuitry and a reverse polarity protection diode are also provided. Filter capacitors minimize susceptibility to high-frequency signals introduced via the power leads.

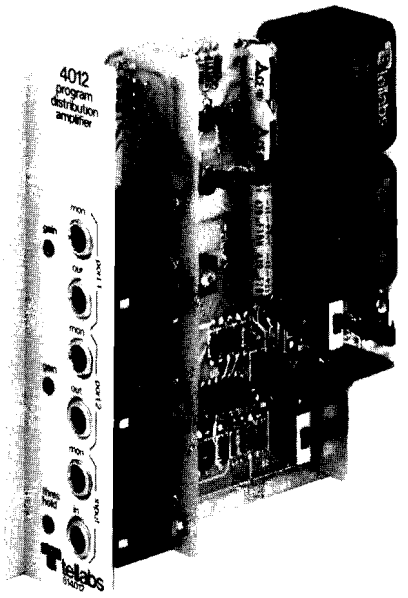


figure 1. 4012 Program Distribution Amplifier

2. application

2.01 The 4012 Program Distribution Amplifier is typically used in applications requiring audio program amplification without slope equalization, and in applications requiring derivation of two program channels from a single program source. It is employed in circuits transmitting high-quality audio signals over non-loaded telephone cable. Its broad frequency response and low distortion permit the 4012 to be used in either AM (100 to 5000Hz) or FM (50 to 15,000Hz) program applications. The module provides adjustable gain from 0 to 20dB, with distortion of less than 0.25% (at +10dBm output level). Maximum output level capability exceeds +18dBm. The 4012's two output ports are completely isolated from each other, with independent gain and impedance options for each port. The 4012 does not require termination of an unused port.

2.02 When input to the 4012 is derived via paired telephone cable, either 150 or 600 ohm input impedance may be selected. Selection of 150 ohm input impedance will provide a moderate amount of slope equalization as a consequence of the mismatch of impedances between the cable pair and the cable termination. The 600 ohm option should be used when input to the unit is provided directly from a local program source, from a carrier system program channel unit, or from an associated 4008 Program Amplifier/Equalizer. The 4012 may also be optioned for high impedance input for bridging interconnection with a properly terminated program circuit.

2.03 The 4012 provides switch-selectable output impedances of 150 or 600 ohms. In general, the 150 ohm option should be used when driving telephone cable pairs, and 600 ohm impedance should be used to drive a carrier program channel unit or a modulation amplifier.

2.04 Input and output simplex leads are derived when the 600 ohm impedance options are selected. These leads may be connected to circuit ground to lower longitudinal impedance in applications characterized by extremely high longitudinal potentials on the input or output transmission leads.

2.05 The noise threshold circuit in the 4012 is most useful when the program source material is contaminated by low-level background noise, as might occur, for example, through exposure to 60Hz power potentials. While the noise threshold circuit cannot improve the overall signal-to-noise ratio or reduce background noise simultaneously present with the desired program signal, it does decrease circuit noise appreciably during silent intervals, when noise is most noticeable. The noise threshold should be adjusted above the idle circuit noise level, which should be several dB below the level of the weakest useable signal. Experience has indicated that a threshold level of about –46dBm or so is optimum for most program applications.

2.06 The noise threshold circuit is designed so that the amplifier gain-disable threshold to decreasing signals is approximately 4dB lower than the gain-enable threshold. This, together with noise detector time constants, ensures that the noise detector will not introduce "choppiness" into the program material. If "choppiness" or "break-up" is heard at the output of the 4012, the noise threshold has been adjusted for too high a level and should be readjusted to a lower level.

2.07 The 4012 Program Distribution Amplifier may be used as part of the 248 System of Program Transmission Equipment. The module shares common pin assignments for interchangeable use (within the framework of the 248 System wiring scheme) with the 4008 Program Amplifier module. In this application the input port and output port 1 of the 4012 correspond with the 4008 input and output ports, and output port 2 remains unterminated. As such, the 4012 may be used as a single-channel (one input / one output) program amplifier in those situations that do not require the more sophisticated slope equalization of the more expensive 4008 module. Refer to practices or brochures describing the 4008 module and 248 System for further details.

2.08 Because the location in which the 4012 is installed may be, for example, an unheated equipment enclosure or shed, the module has been designed to operate within a –40° to +140°F temperature range.

3. installation

inspection

3.01 Upon receipt, the 4012 module should be inspected to determine whether or not the module incurred damage during shipment. If any damage is noted, a claim should immediately be filed with the carrier. If stored prior to use, the module should again be inspected before installation.

mounting

3.02 Each 4012 module mounts in one position of any of the Tellabs Type 10 Mounting Shelves, which are available in configurations for both relay rack and apparatus case installation. The module plugs physically and electrically into a 56-pin connector at the rear of the shelf.

3.03 The 4012 module may be installed in a Tellabs Type 248 Program Amplifier Assembly. The 248 Assemblies, also available in relay rack or apparatus case configuration, employ the Type 10 Shelf. Internal wiring in these Assemblies is completed, and external wiring may or may not be brought out to 25-pair, plug-ended, connectorized cables. The prewired 248 Assembly provides leads only to output 1 of the 4012. Output 2 remains unterminated, unless additional wiring is installed. For details, see the associated 248 Assembly practice or catalog sheet.

installer connections

3.04 Before making wiring connections or changes to the 4012 connector, make certain that power is **off** and that the module is not inserted into the connector. Modules should be put in place and powered only **after** proper optioning and **after** all wiring has been completed.

3.05 External connections to the 4012 Program Distribution Amplifier are listed in table 1. All connections are made via wire wrap to the 56-pin connector at the rear of each module's mounting shelf position. Pin numbers are shown on the body of the connector.

connect	to pin(s)
Amplifier Input	7 and 13
Input Simplex	9
Output, Port 1	5 and 15
Output Simplex, Port 1	3
Output, Port 2	41 and 47
Output Simplex, Port 2	43
Noise Threshold Control Lead	39
–Vin (–23 to –56Vdc)	35
Ground (Power Ground)	17

table 1. External connections for 4012

Note: The 4012 input and port 1 output have the same pin assignments as the input and output ports of the 4008 Program Amplifier.

option selection

3.06 Several option switches must be programmed before the 4012 Program Distribution Amplifier is placed into service. The location of these switches is shown in figure 2, and switch functions are described in table 2.

alignment

3.07 Alignment of the 4012 consists of adjusting the insertion gain of each of the two output channels consistent with the intended application, and adjustment of the noise threshold if the noise quieting circuit is to be used. Insertion gain of the two

output channels is controlled by potentiometers accessed through the module's front panel. The two adjustments are independent. The input port and both output ports may be accessed via front-panel - mounted jacks to assist in alignment.

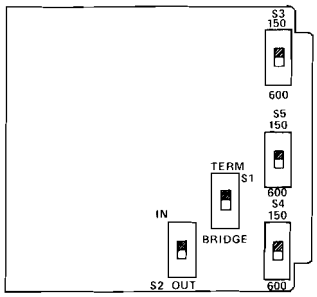


figure 2. Switch locations

switch designation	option	function
S1	BRIDGE or TERM	Selects either bridging (high impedance) or terminating (150 or 600 ohms impedance, depending upon position of S4) mode at input.
S2	IN or OUT	Enables (IN) or disables (OUT) the noise threshold circuit.
S3	150 or 600	Selects output impedance for port 1.
S4	150 or 600	Selects input impedance when Switch S1 is in TERM position. Set S4 to "600" position when S1 is optioned for BRIDGE impedance.
S5	150 or 600	Selects output impedance for port 2.

table 2. 4012 option selection

Note: Be sure that the input impedance is taken into account when aligning levels via the INPUT jack, as the input source will be unterminated if switch S1 is in the BRIDGE position.

3.08 To adjust the noise threshold, set switch S2 to the *IN* position and proceed as follows:

1. Insert a 1000Hz signal at the desired threshold level (say, for example, −46dBm) at the amplifier input. (The *in* jack may be used to introduce this signal.)
2. Adjust the *threshold* potentiometer, accessed through the 4012 front panel, fully clockwise (maximum threshold level).
3. Connect a terminated Transmission Test Set (150 or 600 ohms, as appropriate) to either output port, either via the connector terminals or the *out* jacks accessed through the front panel. Observe the output level, which will be approximately 8dB below the input signal level.
4. Slowly rotate the THRESHOLD potentiometer counterclockwise until the output level suddenly increases markedly. (To prevent meter damage, it would be advisable to set the Transmission Test Set scale to the expected output level, taking into account the gain previously established, before adjusting the *threshold* potentiometer.)

Note: There will be no observable change in the output level until the threshold level is reached.

5. Decrease the input signal level approximately 6dB and then slowly raise the level toward the desired threshold to verify that the gain is enabled at the desired threshold point. If it is not, the threshold has been adjusted slightly too high. Adjust the *threshold* potentiometer approximately 1/8 turn counterclockwise. Re-check the threshold level by slowly increasing the input signal level from below the threshold level while observing the output level. Repeat, if necessary, until the output level increases markedly when the input signal reaches the desired threshold level.

This completes alignment of the 4012. Remove all test cords.

Note: The gain of either amplifier may subsequently be adjusted as required without affecting the noise threshold level.

4. circuit description

Note: Please refer to the associated Functional Block Diagram (section 5) as an aid in understanding the following circuit description.

4.01 The 4012 Program Distribution Amplifier consists basically of a pair of wideband preamplifiers connected in parallel to a common input transformer, with a power amplifier stage following each preamplifier. Associated with the input circuit and the preamplifiers is a level thresholding circuit that enables preamplifier gain when the input signal level exceeds a preselected threshold level.

4.02 Input to the 4012 is via an input transformer that provides either 150 ohm or 600 ohm balanced terminating impedance or, through switch selection, a balanced bridging impedance. Input jacks are provided that afford access to both the amplifier and to the connecting facility.

4.03 The secondary of the wideband input transformer provides input to two preamplifiers that provide voltage gain and gain control for the two output channels. Following each preamplifier is a power amplifier stage comprised of temperature-compensated complementary transistors in an emitter-follower configuration. Each power amplifier drives an output transformer that provides balanced 150 or 600 ohm output impedance. Each output port has both monitor and module access jacks.

4.04 The noise thresholding circuit consists of a high gain limiter/amplifier followed by a full-wave rectifier and a threshold detector. The output of the threshold detector is used to enable or disable the gain of the two preamplifiers, using field-effect transistors as the gain control element. The composite thresholding circuit time constants are designed to ensure rapid gain enabling upon detection of signal energy above threshold and delayed disabling when the input signal is reduced below the threshold level.

4.05 The 4012 includes an integral voltage regulating power supply that derives internal power potentials of −11 and −22 volts. Transient limiting

circuitry and a reverse polarity protection diode are also provided. Filter capacitors are used to minimize susceptability to high-frequency signals introduced via the power leads.

6. specifications

input impedance
TERM Option – 150 ohms ±15% or 600 ohms ±5%, balanced, 50Hz to 15kHz
BRIDGE Option – Greater than 15k ohms, 50Hz to 15kHz

output impedance
150 or 600 ohms ±10%, balanced, 50Hz to 15kHz

frequency response
±0.5dB re 1000Hz, 50Hz to 15kHz
±1dB re 1000Hz, 50Hz to 20kHz

gain range
0 ± 1dB to 20 ± 1dB, at 1kHz, continuously adjustable

output overload
+18dBm minimum

distortion
less than 0.25% THD at +10dBm output level, 50Hz to 50kHz

noise
at 20dB gain, noise at output ports is less than 20dBrN (15kHz flat weighting) with noise threshold circuit disabled, and less than 0dBrN with the noise threshold circuit enabled.

noise threshold circuit
range: –54 to –22dBm input level
hysteresis: 4.0 ±1dB
gain enable time: less than 0.5ms
gain disable delay: 75 to 300ms, depending upon input signal level
insertion loss below threshold: approximately 10dB, independent of gain setting

power requirements
input voltage: –23 to –56Vdc, with positive ground
input current: approximately 25mA idle, 55mA with both outputs at +18dBm level

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

operating environment
–40° to +140° F (–40° to +60° 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
17 ounces (0.482kg)

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 4012 Program Distribution Amplifier module. 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 4012 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: (213) 595-7071
Lisle Headquarters: (312) 969-8800
Mississauga Headquarters: (416) 624-0052

7.03 If a 4012 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 4012 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 8X4012 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 4012 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

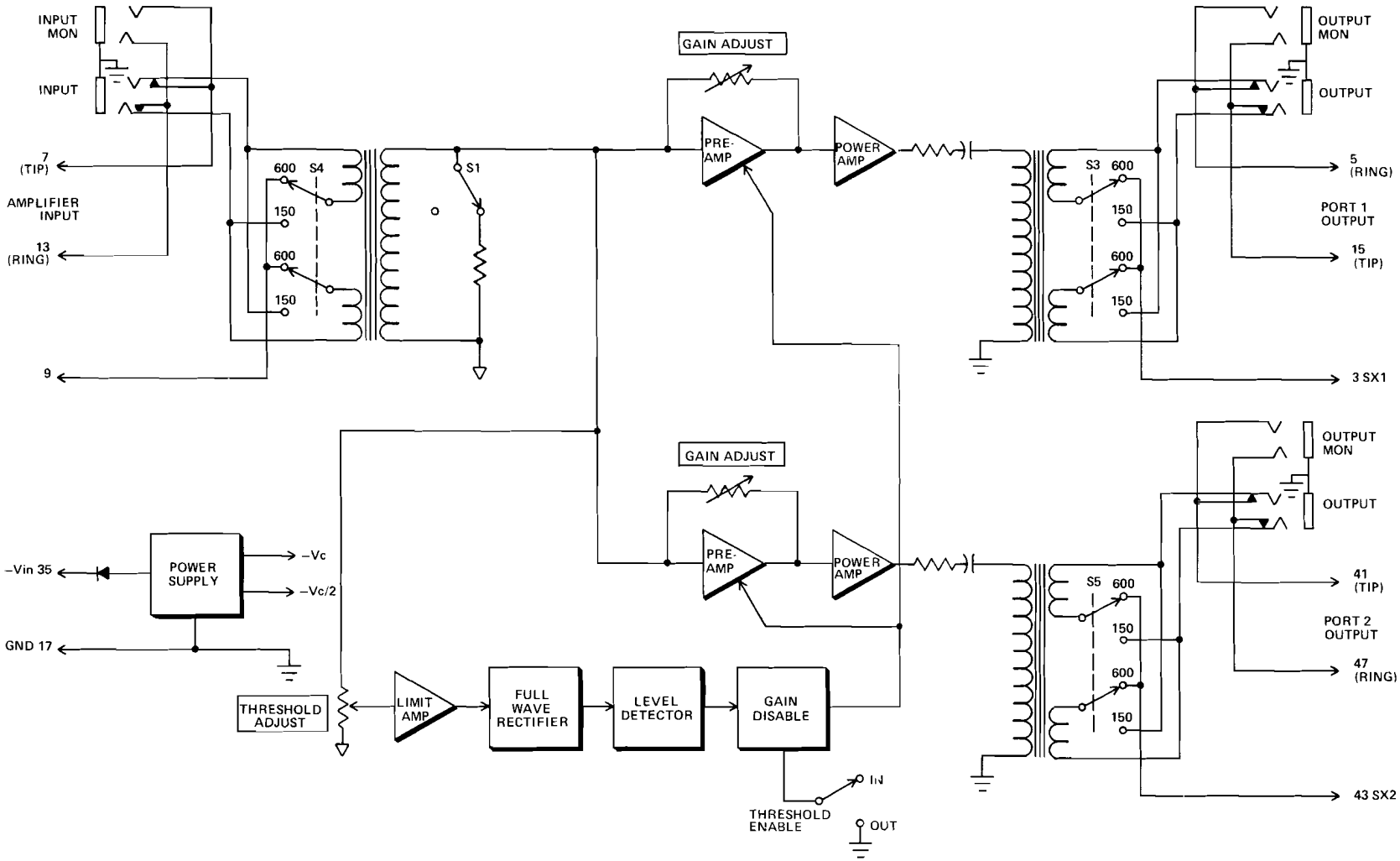
7.05 Return the defective 4012 module, shipment prepaid, to Tellabs (attn: repair and return).

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

in Canada: Tellabs Communications Canada, Ltd.
1200 Aerowood Drive, Unit 11
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 on page 6



4012 Program Distribution Amplifier 814012

5. block diagram

testing guide checklist

test	test procedure	normal result	if normal conditions are not met, verify:
Insertion Gain	Connect an input 1000Hz signal source to connector pins 7 and 13, or insert signal via INPUT jack, and measure output signal at each port, using the OUTPUT jacks.	Gain ranging from 0 to 20dB, depending upon position of GAIN potentiometers ☐.	Unit properly powered ☐ input level above threshold ☐. Input and output impedances properly optioned ☐. Ports, including input, properly terminated ☐.
Noise Threshold	With signal source connected as above, lower input signal level below threshold and observe level at either output port.	For signal levels above the preset threshold, output level should be consistent with unit gain ☐. As input level is lowered through the (lower) threshold level, output level should drop 8 to 28dB, depending upon gain setting ☐.	Option switch S2 in IN position ☐. Output port properly terminated ☐.
Distortion	Insert input signal as in "Insertion Gain" test and observe output signal at either output port, using an oscilloscope or a Distortion Analyzer.	Observe undistorted output, with no peak clipping, for output levels below +18dBm ☐.	Input power voltage between −23 and −56Vdc ☐. Input signal not distorted ☐. Input signal above threshold ☐. Output level below +18dBm ☐.
Noise	Short input terminals or insert shorting or terminating plug into INPUT jack. Measure noise at either output port (OUTPUT jack), using a noise measuring set with 15kHz program filter.	With S2 in IN position and gain potentiometer fully clockwise, measure less than 0dBrN ☐. With S2 in OFF position, measure less than 20dBrN.	Proper optioning of port impedances ☐. Power supply noise less than approx. 40dBrNC ☐. Noise meter set for proper terminating impedance ☐. Associated Power supply properly grounded ☐.