

4018 Program Distribution Amplifier

CLEI* code: PGALT101

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1. Description

- 1.1 The 4018 Program Distribution Amplifier is a single input, 8-output splitting amplifier for use in 8kHz and 15kHz audio program distribution networks. The 4018 derives eight independent outputs from a single, switch selectable, 600-ohm or bridging (high impedance) input.
- 1.2 The output ports of the 4018 provide balanced 600-ohm impedance and are isolated via a balanced, low impedance distribution bus.
- 1.3 The 4018 provides adjustable insertion gain (or loss) of from -8 to $+8$ dB between input and output ports. Output levels up to $+16$ dBm (all ports terminated) are accommodated, with distortion less than 0.5 percent for output levels below the overload point. Frequency response is nominally flat from 50 to 50,000Hz.
- 1.4 A unique noise threshold circuit in the 4018 can be used to significantly reduce background noise during quiet intervals in program material. The circuit does this by removing all gain and inserting approximately 10dB of loss between the input and output ports when the input signal level falls below a predetermined threshold level. This threshold level is adjustable via a front panel accessible potentiometer from approximately -50 to -20 dBm. Signals above the threshold level are amplified in the normal fashion and distributed to the output ports. Thus, noise energy is attenuated during quiet intervals without affecting distribution of desired signal energy. An option switch permits removal of the noise threshold circuit if quieting is not desired.
- 1.5 Front panel module access and monitor jacks are provided on both the input and output ports. Gain and threshold controls are also accessible from the front panel to simplify alignment.
- 1.6 The 4018 requires input power at any potential between -32 and -56 VDC, at a maximum current of approximately 135mA. An integral voltage regulating power supply derives internal power potentials of -15 and -30 VDC. Transient limiting circuitry and a reverse polarity protection diode are also provided. Tantalum filter capacitors minimize susceptibility to high frequency signals introduced via the power leads.
- 1.7 As a Type-10 Module, the 4018 mounts in one position of any of Tellabs' Type-10 Mounting Shelves, which are available for relay rack and apparatus case installations.

Reason for Change

- 1.8 This practice has been revised to remove references to the 4018A Program Distribution Amplifier, which has been discontinued.

2. Application

- 2.1 In circuits transmitting high-quality audio signals over non-loaded telephone cable, the 4018 is used where a single program source must be distributed to more than two terminations. The broad frequency response and low distortion of the 4018 permits its use in either am (100 to 5000Hz), television audio (100 to 8000Hz), or fm (50 to 15,000Hz) program applications. The 4018 provides adjustable insertion gain (or loss) from -8 to $+8$ dB, with distortion of less than 0.25 percent (at a $+10$ dBm output level). Any number of output ports may be used, and unused ports need not be terminated.
- 2.2 The 4018 is normally used in program distribution applications, where a number of 600-ohm outputs must be derived from a single input. Such networks are commonly encountered in radio and television studios and at network branching points comprised of carrier derived channels or very short cable distribution loops.
- 2.3 Isolation between the output ports is provided by a low impedance common bus, to which are multiplied the impedance determining resistors for each output port. Because the output ports are resistively derived, output simplex leads are not available. If such leads are required – e.g., if wetting current is to be applied to the facility – separate wideband repeat coils (Tellabs 4425) must be used to derive the simplex leads.
- 2.4 The input port is derived via a shielded input transformer that provides an input simplex lead. This center tap is used primarily in applications characterized by relatively high longitudinal potentials at the input port.
- 2.5 Because the 4018 can be optioned for either terminating or bridging input impedance, more than one module may be connected to a program source if more than eight output ports are needed. Similarly, a 4018 optioned for bridging input may be connected across an output port of another 4018 without disturbing the port loading. The module's front panel jack arrangement permits bridging the input of one module across either the input or output of another module by means of patch cords with 310-type plugs.
- 2.6 The noise threshold circuit in the 4018 is most useful when the program source material is contaminated by low level background noise (usually 60Hz or a harmonic thereof caused by exposure to a 60Hz power potential). While this circuit cannot improve the overall signal to noise ratio or reduce background noise simultaneously present with a desired signal, it does decrease circuit noise appreciably during silent intervals, when noise is most noticeable. The noise threshold should be adjusted above idle circuit noise level, which should be several dB below the level of the weakest usable signal. Experience has shown that a threshold level of approximately -46 dBm is optimal for most program applications.
- 2.7 The noise threshold circuit has approximately 4dB of hysteresis, so that the gain dropout level is approximately 4dB lower than the gain activate level. This hysteresis, together with the time constants of the noise detector, ensure that the noise threshold circuit will not activate during momentary pauses in the audio input signal. If choppiness or breakup is heard in the output of the 4018, especially on the trailing portions of speech segments, the noise threshold is set too high and should be adjusted for a lower level.

3. Installation

Inspection

- 3.1 Visually inspect the equipment upon its arrival to determine possible shipping damage. If damage is found, immediately file a claim with the carrier. If the equipment is stored, re-inspect it prior to installation.

Mounting

- 3.2 The 4018 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.

Connections

- 3.3 Before making connections or wiring changes to the 4018's connectors, ensure that power is off and modules are removed. The module should be placed only after wiring is completed.
- 3.4 External connections to the 4018 are listed in Table 3-1. 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:	Connect:	To Pin:
AMP INPUT (amplifier input)	7 and 13	PORT 5 output	45 and 46
INPUT SX (input simplex)	9	PORT 6 output	43 and 44
PORT 1 output	53 and 55	PORT 7 output	41 and 42
PORT 2 output	51 and 52	PORT 8 output	39 and 40
PORT 3 output	49 and 50	–V IN (–32 to –56VDC input)	35
PORT 4 output	47 and 48	GND (power ground)	17

Table 3-1 External Connections to the 4018

Option Selection

- 3.5 Two option switches must be set before the 4018 is placed in service. The locations of these switches are shown in Figure 3-1. Option switch S1 selects the input impedance, which may be either 600 ohms (terminating) or high impedance (bridging). Set S1 to the 600 position for 600-ohm terminating impedance, or to the HI Z position for bridging operation. Switch S2 is used to enable or disable the noise threshold circuit. Set S2 to the NORM position if quieting is desired, or to the OFF position if the noise threshold circuit is not to be used.

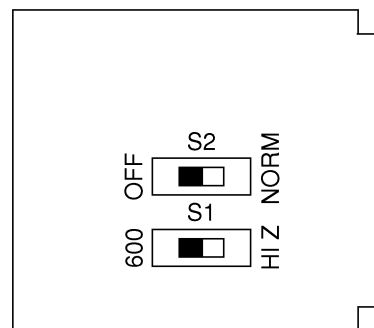


Figure 3-1 Switch Positions

Alignment

- 3.6 Alignment consists of adjusting the module's insertion gain as required for the application and adjusting the noise threshold if the noise threshold (quieting) circuit is to be used. Insertion gain is adjusted by means of the potentiometer, labeled gain on the front panel (Figure 3-2). The input port and output port 1 may be accessed via the module's front panel jacks to assist in alignment.

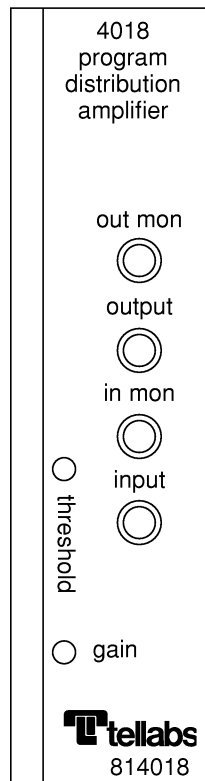


Figure 3-2 4018 Front Panel

Note: Ensure 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 set to the HI Z position.

3.7 To adjust the noise threshold, proceed as follows:

1. Insert a 1000Hz signal at the desired threshold level, e.g., -40dBm , at the amplifier input. (The input jack may be used to introduce this signal.)
2. Adjust the threshold potentiometer (accessible through the module's front panel) fully clockwise (maximum threshold level).
3. Connect a transmission measuring set (TMS) terminated in 600 ohms to any output port or, via suitable patch cord, to the output jack on the module's front panel. Observe the output level, which will be approximately 16dB below the input signal level.
4. Slowly rotate the threshold potentiometer counterclockwise until the output level suddenly increases markedly. (To prevent meter damage, it is advisable to set the TMS 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.

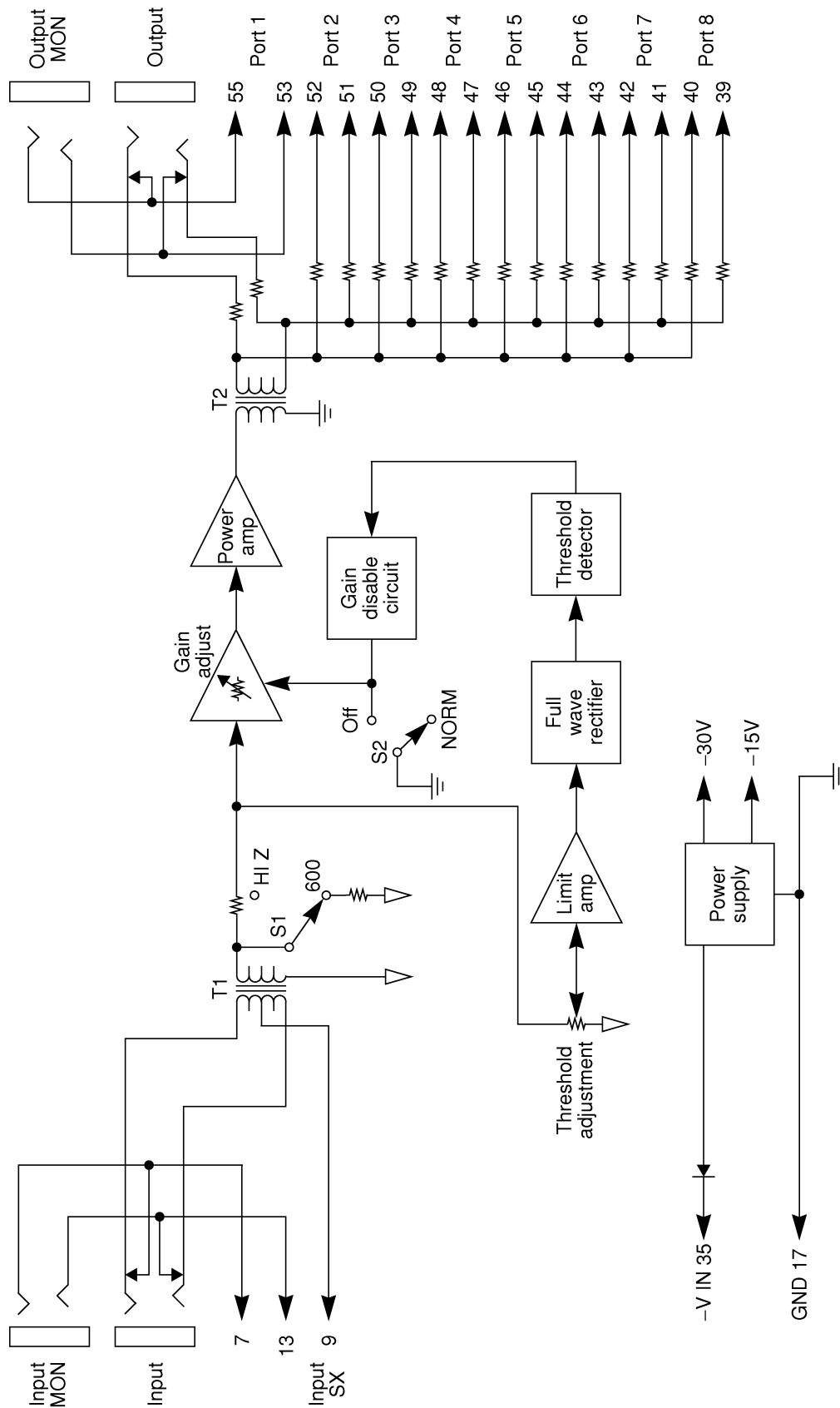
5. Decrease the input signal level approximately 6dB; then slowly raise the level toward the desired threshold to verify that the gain is enabled at the desired threshold point. If it is not, the threshold is adjusted slightly too high. Adjust the threshold potentiometer approximately one-eighth turn counterclockwise. Then 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 decreases markedly when the input signal reaches the desired threshold level.

4. Circuit Description

Note: For help in understanding this section, refer to the Block Diagram, Section 5.

- 4.1 The 4018 consists basically of a wideband preamplifier, followed by a power amplifier with low output impedance. The power amplifier drives a distribution bus from which eight resistively coupled outputs are derived. Associated with the preamplifier is a noise threshold circuit that enables preamplifier gain when the input signal level exceeds a pre-selected threshold level.
- 4.2 Input to the module is via an input transformer that derives an input simplex lead and provides for either balanced 600-ohm or high impedance termination. Input jacks are provided that afford access to both the amplifier and the connecting facility.
- 4.3 The preamplifier is a wideband compensated operational amplifier with gain control in the negative feedback path. The power stage makes use of complementary transistors in an emitter-follower configuration, driving an output transformer with a turns ratio of nearly unity. Individual output ports are connected to the transformer secondary through matched resistors that establish individual port impedances.
- 4.4 The noise threshold circuit consists of a high gain limiter/amplifier, followed by a full wave rectifier and a threshold detector. The output of the threshold circuit, through a gain control stage, either enables or disables preamplifier gain, depending upon the input signal level. Time constants associated with the threshold detector ensure rapid gain enabling and delayed disabling.
- 4.5 The 4018 has an integral voltage regulating power supply that derives internal power potentials of -15 and -30 VDC. Transient limiting circuitry and a reverse polarity protection diode are also provided. Tantalum filter capacitors minimize susceptibility to high frequency signals introduced via the powering leads.

5. Block Diagram



6. Specifications

General

Input Impedance	<ul style="list-style-type: none"> 600-ohm option: 600 ohms \pm 10%, balanced, 50 to 15,000Hz High impedance (HI Z) option: greater than 15kohms, balanced, 50 to 15,000Hz
Output Impedance	<ul style="list-style-type: none"> 600 ohms \pm 5%, balanced, 50 to 15,000Hz, with any number of ports terminated
Frequency Response	<ul style="list-style-type: none"> \pm 1.0dB re 1000Hz level, 50 to 15,000Hz \pm 1.5dB re 1000Hz level, 50 to 20,000Hz
Output Overload	<ul style="list-style-type: none"> 1 to 8 ports terminated: +16dBm, maximum
Distortion	<ul style="list-style-type: none"> Less than 0.25% THD at +10dBm output level
Output Level Change as Ports are Terminated	<ul style="list-style-type: none"> Approximately 0.5dB per port, maximum change of 2.2dB from 1-port to 8-port loading
Gain Range (All Ports Terminated)	<ul style="list-style-type: none"> Approximately -8 to +8dB
Noise Threshold Range	<ul style="list-style-type: none"> Approximately -50 to -20dBm input signal level, continuously adjustable
Output Noise	<ul style="list-style-type: none"> Noise threshold in: 0dBm 15kHz flat weighting, independent of gain Noise threshold out: 5dBm 15kHz flat weighting at 0dB gain, 15dBm at maximum gain
Gain Enable Timing	<ul style="list-style-type: none"> Approximately 200μs
Gain Disable Timing	<ul style="list-style-type: none"> Approximately 140ms
Insertion Loss Below Threshold	<ul style="list-style-type: none"> Approximately 10dB, independent of gain

Power Requirements

Input Voltage	<ul style="list-style-type: none"> -32 to -56VDC, with positive ground
Input Current	<ul style="list-style-type: none"> 30mA idle, 135mA, maximum at +16dBm output level, all ports terminated

Physical

Dimensions	<ul style="list-style-type: none"> Height: 5.58 inches (14.17cm) Width: 1.42 inches (3.61cm) Depth: 5.96 inches (15.14cm)
Weight	<ul style="list-style-type: none"> 16 ounces (0.454kg)
Mounting	<ul style="list-style-type: none"> Relay rack or apparatus case in one position of Tellabs Type-10 (or Wescom Type-400) Mounting Shelf
Operating Environment	<ul style="list-style-type: none"> -40° to $+140^{\circ}$ F (-40° to $+60^{\circ}$ C), humidity to 95% (no condensation)

7. Testing, Technical Assistance, Repair and Return

- 7.1 Table 7-1 will assist in testing and troubleshooting the 4018 Module and will aid in the localization of trouble to this specific equipment. If further technical assistance is required, refer to paragraph 7.2 for phone numbers. If the equipment seems to be defective, substitute new equipment (if possible) and conduct testing again. If the substitute operates correctly, the original should be considered defective and returned to Tellabs for repair or replacement; see paragraph 7.3. We strongly recommend that no internal (component-level) testing or repairs be attempted on the equipment; unauthorized testing or repairs may void its warranty.

Test	Test Procedure	Normal Result	If Normal Conditions Are Not Met, Verify:
Insertion Gain	Connect a 1000Hz input signal source to connector pins 7 and 13, or insert signal via input jack, and measure signal at any output port (or at output jack).	Gain of approximately 8dB (gain potentiometer fully clockwise).	Unit properly powered. Input level above threshold. Ports properly terminated. Switch S1 properly optioned.
Noise Threshold	With signal source connected as above, lower input signal level below threshold and observe output level.	For signal levels above the preset threshold, output level should be consistent with unit gain. As input level is lowered through the threshold level, output level should drop 10 to 20dB, depending upon gain setting.	Option switch S2 in NORM position. Output port properly terminated.
Distortion	Insert input signal as in insertion gain test and, using an oscilloscope or a distortion analyzer, observe output signal at any output port.	Observe undistorted output, with no peak clipping, for output levels below +16 to +20dB, depending upon port loading.	Input power voltage between -32 and -56VDC. Input signal not distorted. Input signal above threshold. Output port terminated properly.

Table 7-1 Testing Guide Checklist

Technical Assistance

7.2 Contact Tellabs Technical Assistance as follows:

Location	Telephone	FAX
Tellabs International, Inc., Sucursal Buenos Aires, Argentina	+541.393.0764, .0892, or .0835	+541.393.0732
Tellabs Pty Ltd., Milsons Point NSW, Sydney, Australia	+61.2.9966.1043	+61.2.9966.1038
Tellabs Comm. Canada Ltd., Mississauga, Ontario, Canada	905/858-2058	905/858-0418
Tellabs International, Inc., Beijing, China	+86.10.501.1873	+86.10.501.1871
Tellabs International, Santa Fe de Bogota, Colombia	+571.623.3162 or .3216	+571.623.3047
Tellabs International, Inc., Dubai, U.A.E.	+971.4.373250	+971.4.376526
Tellabs U.K. Ltd., Bucks, England	+44.1494.555800	+44.1494.555801
Martis Oy, Espoo, Finland	+358.0.502.771	+358.0.502.7815
Tellabs SAS, France	+33.1.345.20838	+33.1.309.60170
Tellabs GmbH, Munich, Germany	+49.89.54.90.05.+ext. or 0 (switchboard)	+49.89.54.90.05.44
Tellabs H.K. Ltd., Hong Kong	+852.2866.2983	+852.2866.2965
Tellabs GmbH Rep. Office, Budapest, Hungary	+36.1.2681220	+36.1.2681222
Tellabs International, Inc., Bangalore, India	+91.80.6610826	+91.80.6615908
Tellabs, Ltd., County Clare, Ireland	+353.61.471433	+353.61.471000/472004
Tellabs de Mexico	525.282.1107, .1432, .1050, or .0981	525.282.0218
Tellabs Singapore Pte, Ltd., Singapore	+65.736.2855	+65.736.1231
Tellabs International, Inc., Seoul, South Korea	+82.2.589.0667 or .0668	+82.2.589.0669
Tellabs Southern Europe s.a., Barcelona, Spain	+34.3.414.70.16	+34.3.414.69.25
Tellabs AB, Stockholm, Sweden	+46.8.678.4040	+46.8.678.4041
Tellabs International, Inc., Bangkok, Thailand	+662.262.9065	+662.661.1141
USA and Puerto Rico	(800) 443-5555*	708/512-7097
*All other Caribbean and South American locations, or if the toll-free number is busy, telephone 708/969-8800		

Repair and Return

7.3 If equipment needs repair, contact Tellabs' Product Services Department with the equipment's model and issue numbers and warranty date code. You will be issued a Material Return Authorization (MRA) number and instructions on how and where to return the equipment.

Location	Telephone	FAX
Martis Oy, Espoo, Finland	+358.0.502.771	+358.0.502.7815
Tellabs Comm. Canada Ltd., Mississauga, Ontario, Canada	905/858-2058	905/858-0418
Tellabs, Ltd., County Clare, Ireland	+353.61.471433	+353.61.471000/472004
Tellabs Operations, Inc., Lisle, IL USA	(800) 443-5555 (USA and Puerto Rico only) 708/969-8800 (other International)	708/512-7097 (both)

- 7.4 Repair service includes an attempt to remove any permanent markings made by customers on Tellabs equipment. If equipment must be marked, it should be done with non-permanent materials and in a manner consistent with the correct handling of electrostatically sensitive devices.

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