

AEQ TH-02 EX Mk-III

Digital Hybrid with Frequency Extender

USER'S MANUAL
ED. 10/06



A.E.Q. S.A., manufacturer of this equipment, is a Registered Company in accordance with UNE EN-ISO-9001 standard by Aenor with reg. nr. ER-080/1/96.

CE The CE equipment marking means that it is in compliance with requirements by the Royal Decree 444/1984 published through the Official State Bulletin of Spain on 1-4-84, transposition of the 89/336/CEE electromagnetic compatibility directive, and by low voltage directive 73/23/CEE. This appliance is connected to telephone networks indirectly through interface.

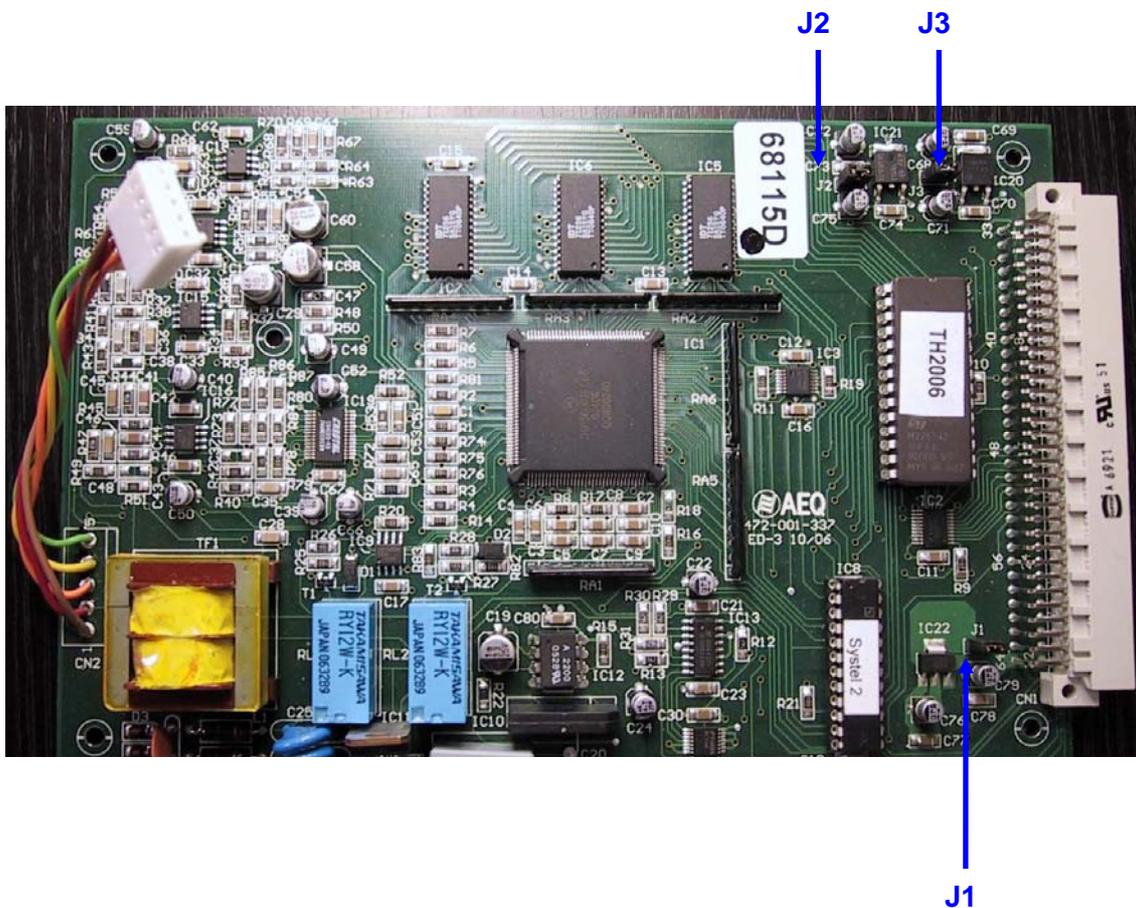
IMPORTANT NOTE

Since end of 2006 there is a new version of the **hybrid board** of **TH-02 EX mkIII** unit (digital hybrid with frequency extender): **ED-2 5/06** and **ED-3 10/06** editions.

These boards are compatible with previous version of equipment (**TH-02 EX mkII**) but there have been changes regarding board power supply.

Therefore, when you connect a new **TH-02 EX 2006 hybrid board** on a **TH-02 EX mkII** unit, it's essential to remove **J1**, **J2** and **J3** jumpers.

When this board is connected on a **TH-02 EX mkIII** unit, those **jumpers** must be **mounted**.



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1 GENERAL INSTRUCTIONS

1.1 General precautions

The following precautions should be observed for safety reasons during all operation and maintenance of this unit. Failure to comply with all instructions may seriously alter the functions and performance of the equipment. **AEQ** will not be responsible for any damage or loss due to the improper handling of the equipment.

1.1.1 Read all instructions

Before connecting the equipment to mains and start-up, it is absolutely necessary to read carefully all the instructions in this manual, in the established order. If these basic rules are respected, you will obtain the maximum performance of the equipment from the very start, and, at the same time, you will avoid incorrect or improper operation that could cause damage to the equipment or personnel.

1.1.2 Water and humidity

The operation of the equipment in humid environments, near water or wet floors must be avoided. Nor should it be used in environments where the atmospheric humidity is so high it will produce regular condensation inside the equipment.

1.1.3 Ventilation, fire and flammable vapors

The equipment should never be placed near or over a heat source. The use of electrical or electronic equipment close to fire or flammable vapors is a risk that has to be avoided.

All ventilation grids must be uncovered to allow hot air out and make sure a proper ventilation of the equipment.

1.1.4 Maintenance

Any maintenance of this equipment should be carried out by qualified technical service personnel. **AEQ** will not be responsible for any damage caused by unauthorized maintenance operations, nor for any damage caused to other equipment or persons due to such unauthorized maintenance.

Always bear in mind that inside the equipment there is high voltage and there exists the risk of an electrical shock. The installation of this unit must be carried out by qualified technical personnel.

1.1.5 Warranty

AEQ guarantees that this product has been designed and manufactured under a certified Quality Assurance System and according to the ISO 9001/2002 Standard. AEQ therefore Guarantees that the necessary test protocols to assure the proper operation and the specified technical characteristics of the product have been followed and accomplished. This includes that the general protocols for design and production and the particular ones for this product are conveniently documented.

1. - The present guarantee does not exclude or limit in any way any legally recognized right of the client.

2. - The period of guarantee is defined to be twelve natural months starting from the date of purchase of the product by the first client. To be able to apply to the established in this guarantee, it is compulsory condition to inform the authorized distributor or –to its effect- an AEQ Sales office or the Technical Service of AEQ within thirty days of the appearance of the defect and within the period of guarantee, as well as to facilitate a copy of the purchase invoice and serial number of the product.

It will be equally necessary the previous and expressed conformity from the AEQ Technical Service for the shipment to AEQ of products for their repair or substitution in application of the present guarantee. In consequence, return of equipment that does not comply with these conditions will not be accepted.

3. -AEQ will at its own cost repair the faulty product once returned, including the necessary labour to carry out such repair, whenever the failure is caused by defects of the materials, design or workmanship. The repair will be carried out in any of the AEQ authorized Technical Service Center. This guarantee does not include the freight charges of the product to or from such Authorized Technical Service Center.

4. – No Extension of the Guarantee Period for repaired product shall be applied. Nor shall a Substituted Products in application of this Guarantee be subject to Guarantee Period Extension.

5. - The present guarantee will not be applicable in the following situations:

Improper use or Contrary use of the product as per the User or Instruction Manual; violent manipulation; exhibition to humidity or extreme thermal or environmental conditions or sudden changes of such conditions; electrical discharges or lightning; oxidation; modifications or not authorized connections; repairs or non-authorized disassembly of the product; spill of liquids or chemical products.

6. - Under no circumstances, whether based upon this Limited Guarantee or otherwise, shall AEQ, S.A. be liable for incidental, special, or consequential damages derived from the use or from the impossibility of using the product.

AEQ shall not be liable for loss of information in the disks or data support that have been altered or found to be inexact, neither for any accidental damage caused by the user or other persons manipulating the product.

1.1.6 How to proceed in case of feedback

In case you find any feedback reaction in the **TH-02 EX Mk III** after installation and connection, the technician should check in the mixing console that there is no signal sent from the **TH-02 EX Mk III** talkback module to the console module that sends signal to the hybrid.

1.2 General description

The **TH-02 EX Mk III** is a configurable system which can be used in two wire mode as a digital hybrid, or in four wire mode as a full duplex intercom. In any of these modes you can take advantage of the frequency extender function.

According to user's requirements, the **TH-02 EX Mk III** is supplied with one or two lines. When the system operates with both lines, the user can take advantage of the built-in Mix-Minus bus. Through this bus it is possible to establish a multiplex and full duplex communication between the user and the two lines connected to the hybrid. As the user can select the operating mode of each line, there are different configurations of the equipment which make the **TH-02 EX Mk III** a highly versatile equipment, with a wide range of applications. In Section 7 (System configuration), the user can find detailed information about any of them.

2 POWER SUPPLY

2.1 General

The description of the front and rear panels of the equipment is described in Section 8. Extend the sheet with the diagrams to obtain a general view and better comprehension of all connections.

The **TH-02 EX Mk III** is prepared to operate with voltages between 90 to 250V AC without any previous operation. The unit's mains connector socket has a fuse box with a 500mA fuse and a spare fuse.

Note: The **TH-02 EX Mk III** is delivered from factory with a euro-plug mains connector. In some countries, this connector must be replaced following the local requirements. If your area does not comply with euro-plug requirements, please, replace the mains connector before continuing.

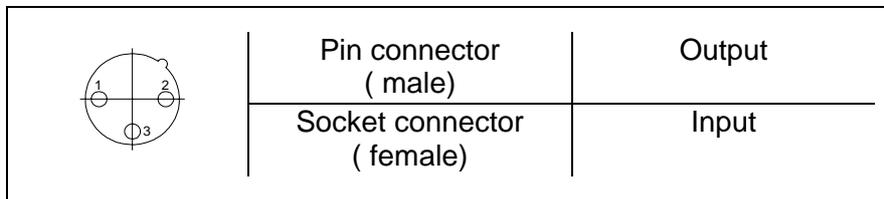
3 AUDIO CONNECTIONS

3.1 General

Note: It is recommended to extend the graphical description of audio connections (Section 8) in order to visualize and improve comprehension of the following instructions. Bear in mind that if the equipment is supplied with a single line, connectors for line 2 will not be available.

The connectors of the **TH-02 EX Mk III** have been made in accordance to the recommendations of **AES 14-1.992 (ANSIS 4.48-1.992)**. This recommendation is based upon the **IEC 268-12 of 1.987 Audio Systems Equipment Part 12, Connector application for Radio Broadcasting and similar use**.

Make sure that the audio cables that you are connecting to the equipment follow this standard. Otherwise, they have to be replaced or modified, since they can cause problems in the phase of the audio signal.



PIN ASSIGNMENT

Appliance	1	2	3	
Balanced mono channel	Shield	Positive polarity	Return	Note 1* If a balanced microphone is connected to an unbalanced amplifier input, the pin number 3 of the input should be connected to pin number 1.
Unbalanced mono channel	Shield and return	Positive polarity	Note 1*	
Balanced mono channel. Phantom power	Shield and negative power	Positive polarity and power	Positive return and power	
Balanced mono channel. Power A-B	Shield	Positive polarity and power	Negative return and power	

3.1.1 Connection of audio inputs and outputs

The **TH-02 EX Mk III** features the following audio connectors:

Program inputs: XLR-3 female connectors for the audio signal inputs to lines **(20)** and **(26)**.

Program output: XLR-3 male connector for the signal output from audio lines "**ON AIR**" **(19)** and **(25)**.

When the switcher **MPLEX (21)** in the back panel is ON, only input **(26)** and output **(25)**, will be operative. They respectively carry the mixed signal to and from both lines.

4 LINE CONNECTION

4.1 General

The equipment is in compliance with the 89/336/CEE electromagnetic compatibility directive, and with the 73/23/CEE low voltage directive.

It is connected to telephone networks indirectly through interface.

Bear in mind that if the equipment is supplied with a single line, connectors for line 2 will not be available.

The **TH-02 EX Mk III** covers all possible connecting options to standard telephone circuits and dedicated telephone lines, even to cellular phones. Operation in two or four wires modes is user selectable with the switches **2W/4W (3)** and **(8)**.

4.1.1 Connection to two wire lines

a) Line: RJ-11 telephone connectors **(17)** and **(23)**, center contacts.

b) Equipment: RJ-11 telephone connectors **(16)** and **(22)**, center contacts.

4.1.2 Connection to four wire lines

Four wire inputs and outputs: Hartmann pin headers for each line **(18)** and **(24)**.

From left to right:

pin 1: Output V-

pin 2: Output V+

pin 3: Input V+

pin 4: Output V-

4.1.3 Connection to two wire microphone lines

Sometimes, microphone lines operate in two wire mode. In these cases, the connector is the same one used for the normal line, this means, connectors **(17)** and **(22)**.

5 REMOTE CONTROL

5.1 Remote control connections

15 pin Sub-D type connectors (15):

5.2 Automatic recording option

The **AEQ TH-02 EX Mk III** digital hybrid featuring the "automatic recording option" is manufactured under client's demand. The lettering "**AUTOMATIC RECORDING OPTION**" is printed on the rear panel of the equipment. Line 1 should be used in remote mode, with the **MPLX** back switch deactivated.

Pin Nr.	SIGNAL	Pin Nr.	SIGNAL
1	CALL IN LINE 1	10	NOT CONNECTED (*)
2	WAITING LINE 2	11	NOT CONNECTED (*)
3	ON AIR LINE 2	12	NOT CONNECTED (*)
4	WAITING LINE 1	13	NOT CONNECTED (*)
5	ON AIR LINE 1	14	NOT CONNECTED (*)
6	CALL IN LINE 2	15	NOT CONNECTED (*)
7	ACTIVE EXTENDER LINE 1		
8	ACTIVE EXTENDER LINE 2		
9	COMMON GROUND		
			(*) Except special versions.

When needed, these connections must be carried out only by qualified technical personnel

6 CONTROL FUNCTIONS

The **TH-02 EX Mk III** features control functions for selecting the operation mode of each connected line. Some of these functions can be executed through a remote control which uses the signals available in the remote control connector.

All functions are independent for each line. In local mode, control functions are performed using the keys on the front panel.

6.1 Control keys

Each line of the **TH-02 EX Mk III** incorporates a group of keys placed in the front panel, with the following assigned functions:

- **EX**: When the keys **(1)** and **(6)** are activated, the frequency extension function is activated, displacing all transmission frequencies 250 Hz upwards, and all the reception frequencies 250 Hz downwards. For a correct operation of the **EX** function, it must be carried out in the opposite direction at the other side of the line, by using another **TH-02 EX** or an **AEQ TLE-02**.

- **LOC/REM**: When it is disconnected, using the keys **(2)** or **(7)**, the assigned line operates in local mode, and the remote control of the line does not work.

- **2W/4W**: When it is disconnected, using the keys **(3)** or **(8)**, the assigned line operates in two wire mode, this means, as a digital hybrid connected to the normal line.

- **T / W**: In two wire mode, when pushing the keys **(4)** or **(9)**, the incoming signal remains in stand by (**WAIT**). The caller hears the program, but can not take part. When the key is released, the line returns to the telephone set or on air, if the **ON AIR** switcher is activated. In four wire mode, the four wire input signal is in telephone mode. Likewise, the line is in two wire mode.

- **ON AIR**: In two wire mode, when the keys **(5)** and **(10)** are activated, the line is connected to the digital hybrid, and the incoming signal is **ON AIR**, this means, goes out through the respective **PROG-OUT** connector.

In four wire mode, the incoming signal is **ON AIR**, and so it is available in the respective **PROG-OUT** connector.

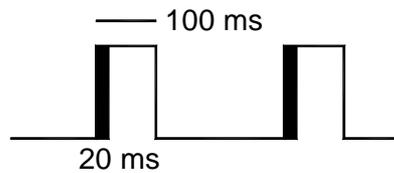
6.2 Remote mode

When the **LOC/REM** key of a line **(2)** or **(7)** is activated, the function of the control keys **EX**, **T/W** and **AIR** of that line become available in the remote connector. To activate one of those functions from a remote control the only requirement is to connect the respective remote signal to ground.

Additionally, there are two signals in the remote connector, **RING 1** and **RING 2**, for recognizing the incoming call tone for each telephone line. These signals have the following electric characteristics:

When the incoming call tone is connected:

CALL IN SIGNAL:



When it is disconnected:

CALL IN SIGNAL:



These signals can be used to feed a LED. When an incoming signal is detected in the line, the LED connected will blink.

Note: Some telephone switchboards can generate exceptionally low incoming call signals, much lower than 75 VRMS, which the equipment will not detect. In this case, consult our Technical Service, which will give you advice about the required modifications for solving the problem.

7 SYSTEM'S CONFIGURATIONS

7.1 One communication line

If the **AEQ TH-02 EX Mk III** has only one line connected, the user can use it in two wire mode, as a digital hybrid, or in four wire mode, as a full duplex intercom.

7.1.1 Two wire mode. Digital hybrid

Operative principles: Circuits called "telephone hybrids" were defined by the telephone companies in order to separate the sent and received signals of a standard two wire telephone pair. The isolation between both signals is evaluated using the parameter "hybrid rejection" or "transhybrid loss", regarding the amount of electrical echo that can be rejected by the hybrid. The higher the rejection is, the lower will be the signal sent to the reception circuit.

The electrical echo, besides of being a source of distortion, can cause echo on a communication when it is carried out through a long distance link. These problems get even worse when you want to implement a teleconference terminal or to join several speakers in a telephone conference.

Analog hybrids: The analog hybrid's operation is based in obtaining the greatest adaptation possible between its balance impedance and that of the telephone line at every moment. The only way of obtaining it is measuring the loop of the telephone and connecting a balanced impedance according to the measure.

This system has two great drawbacks:

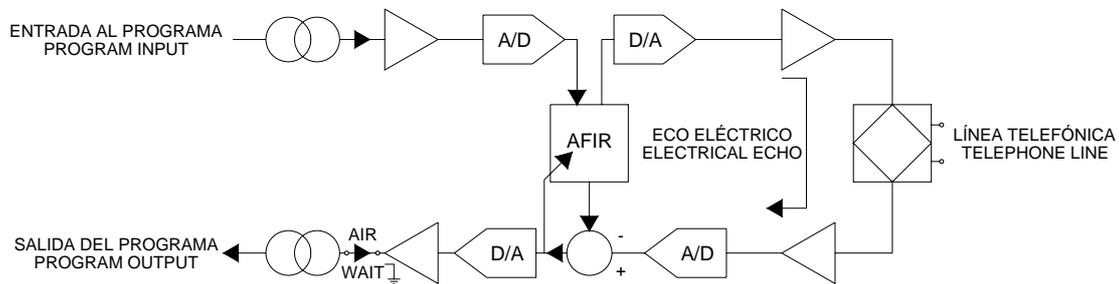
- a) It does not consider the variations generated by the distant telephone loop, nor the variations due to changes of temperature, humidity, etc.
- b) If the system is transferred it will be needed to measure impedance and to balance it again.

Digital hybrid: This model is based on an electrical echo cancellation system, generated by a conventional analog hybrid, through digital signal processing.

Using an adaptative digital filter, it is possible to analyze the features of the telephone line and adapt the system to them as much as possible. The response of the filter is automatically set up to synthesize a signal, and obtain one similar to the electrical echo, and then subtract it for eliminating the real signal.

The advantage of this process is that it is fully automatic and so, it does not require any measurement or pre-adjustment of the system depending on the connected wire pairs. Using high resolution digital signal processors, it is also possible to reach levels of acoustical echo cancellation high enough to guarantee a real multiconference system.

AEQ TH-02 EX Mk III digital hybrid: The lay-out of the equipment operating in two wire mode is the following:



The telephone line is connected to the digital hybrid when you select **T / W** or **AIR** on the keyboard.

When the function **T / W** is activated, and the function **AIR** not, the person calling can listen to the program, but can not take part (there is not output signal). If **AIR** is selected, he can listen and also take part in the program (there is output signal).

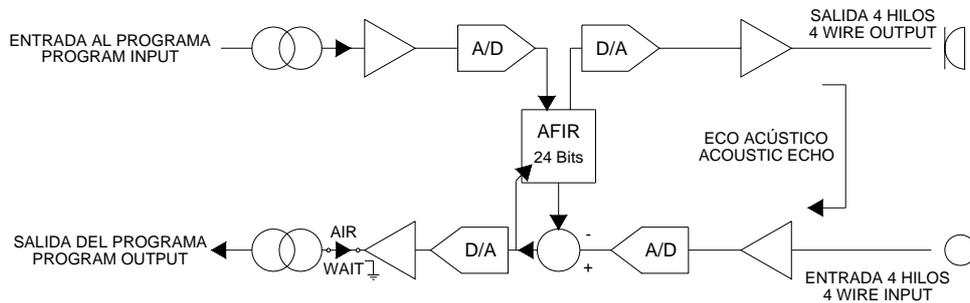
7.1.2 Four wire mode. Full duplex intercom

When the **2W/4W** function is activated, the **AEQ TH-02 EX Mk III** operates in four wire mode, it means, as a full duplex intercom. This operation mode is based on the same principles explained in the precedent chapter. In this case, the **AEQ TH-02 EX Mk III** cancels the acoustical echo in the remote terminal, generated by feed-back between the microphone and the speaker when they are both on.

For better understanding of the four wire operation mode, let's think of a typical application. The user adjusts the gain of the speaker, in such way that the level of the speaker on the remote terminal is the same as the level of the near speaker when he listens to himself. As a result, the gain in the system is almost 0 dB. This, of course, generates oscillation if the acoustic echo is significant. Depending on the features of the acoustic medium, the acoustic echo and its effects will be different and the cancellation degree must be introduced in the path of the echo. Ideally, the cancellation of the acoustic echo requires a delay of the same duration than the response time of the echo.

The **AEQ TH-02 EX Mk III**, operating in four wire mode, cancels the near acoustic echo. The 256 steps adaptative filter cancels the echo with a delay equal or lower than this response. It means that there are operative limits when the **AEQ TH-02 EX Mk III** operates in four wire mode. Controlling the speaker's gain properly and using directional microphones, it is possible to operate with a speaker without problem.

The diagram of the **AEQ TH-02 EX Mk III** operating in four wire mode is the following:



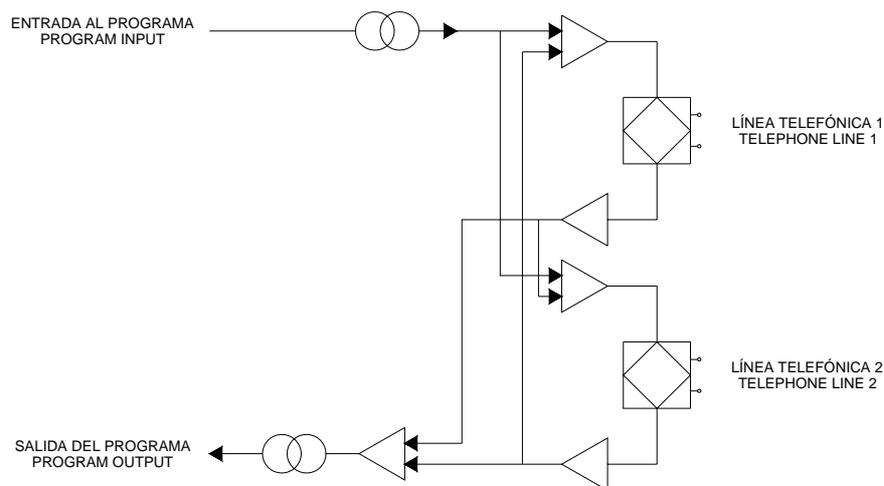
7.2 Two communication lines

When the **AEQ TH-02 EX Mk III** features two communication lines and the switcher **MPLX** at the back panel is activated, the user can benefit from the built-in Mix-Minus bus. The possible configurations of the equipment when it operates in this mode are the following:

7.2.1 Multiconference mode

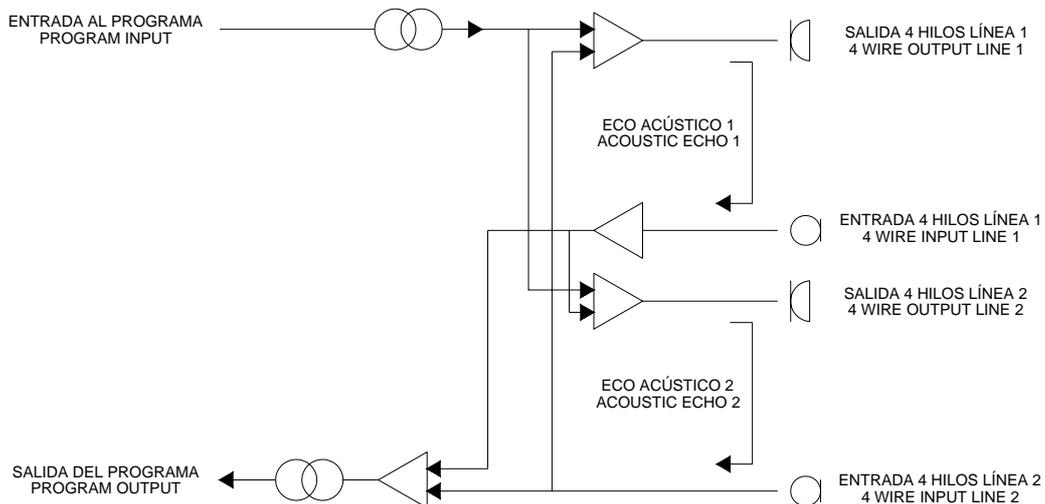
When both lines operate in two wire mode, the **AEQ TH-02 EX** operates in multiconference mode. In this case, the user of the **AEQ TH-02 EX** and two more participants at the ends of both lines can maintain a conversation in full duplex mode, it means, everybody talks with each other and listens to each other simultaneously in every moment.

The diagram for this mode is the following:



7.2.2 Multiplex intercom mode

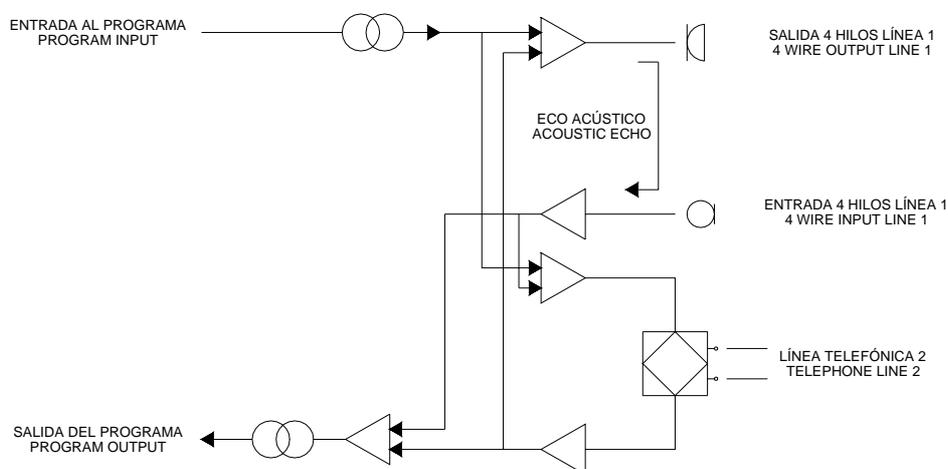
If both lines operate in four wire mode, it is possible to establish a full duplex communication between two intercoms and the **AEQ TH-02EX Mk III**, in the same way a multiconference is set up when both lines are operating in two wire mode .



Both intercoms are interconnected through the Mix-Minus bus, and the user of the **AEQ TH-02EX Mk III** can also maintain communication with them. The equipment cancels the acoustic echo generated in each terminal connected to the equipment.

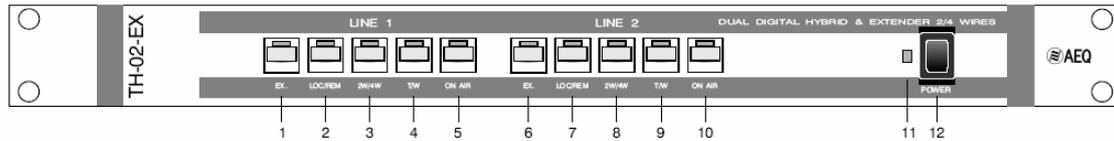
7.2.3 Dual mode

In this operation mode, a line operates as a digital hybrid and the other as a full duplex intercom. In this way, the user of the **AEQ TH-02 EX Mk III** is connected with an intercom on one line and a caller on the other, connecting both of them with each other.



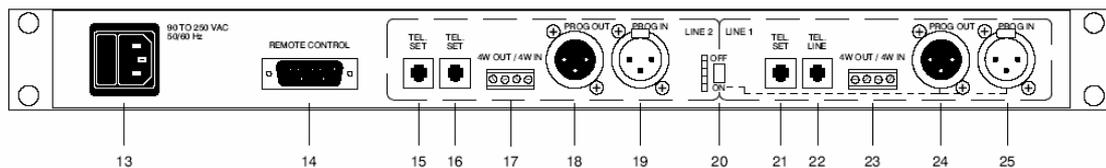
8 DESCRIPTION OF FRONT AND REAR PANELS

8.1 Front panel



- 1) Line 1 frequency extensor function key.
- 2) Line 1 local / remote mode selector key.
- 3) Line 1 2W / 4W mode selector key.
- 4) Line 1 hook on / hook off key.
- 5) Line 1 key for connection of audio signal to program output.
- 6) Line 2 frequency extensor function key.
- 7) Line 2 local / remote mode selector key.
- 8) Line 2 2W / 4W mode selector key.
- 9) Line 2 hook on / hook off key.
- 10) Line 2 key for connection of audio signal to program output.
- 11) Power On LED indicator.
- 12) On / Off switch.

8.2 Rear panel



- 13) Mains connector.
- 14) Remote control connector.
- 15) RJ-11 connector for Line 2 telephone set.
- 16) RJ-11 connector for Line 2.
- 17) Four wire input / output connector for Line 2.
- 18) XLR male connector for Line 2 program output.
- 19) XLR female connector for Line 2 program input.
- 20) Key for Multiplex or independent operation.
- 21) RJ-11 connector for Line 1 telephone set.
- 22) RJ-11 connector for Line 1.
- 23) Four wire input / output connector for Line 1.
- 24) XLR male connector for program output to Line 1 (or both lines in Multiplex operation mode).
- 25) XLR female connector for input program from Line 1 (or both in Multiplex operation mode).

9 TECHNICAL SPECIFICATIONS

AUDIO INPUTS

Program input: Transformer balanced.
Input impedance: > 6 KOhms.
Nominal input level: 0 dBm.
Four wire input: Transformer balanced.
Input impedance: > 1 KOhms.
Nominal input level: 0 dBm.

AUDIO OUTPUTS

Program output: Transformer balanced.
Nominal output level: 0 dBm.
Four wire output: Transformer balanced.
Nominal output level: 0 dBm.

TELEPHONE LINE INTERFACE

Input / Output: Transformer balanced.
Impedance: 600 Ohms.
Nominal input level: - 10 dBm.
Nominal output level: - 6.5 dBm.

*In multiconference mode, the output level of the telephone line proviniient from the other line (nominal input level) is - 7.5 dBm.

TWO WIRE MODE

Bandwidth (extender not active):	Bandwidth (extender active):
Line: 300 - 4.000 Hz +/- 1 dB.	Line: 50 - 3.750 Hz +/- 1 dB.
Program output: 300 - 4.000 Hz +/- 1 dB.	Program output: 50 - 3.750 Hz +/- 1 dB.
Distortion + THDN:	1 KHz with nominal input and output levels:
Line:	< 0.20 %.
Program output:	< 0.15 %.
Absolute noise:	TX =< - 66 dBm. RX =< - 68 dBm.
Frequency extensor:	TX = 250 Hz. Rx = - 250 Hz.
Cross-talk in any case:	Lower than absolute noise.

SUPPRESSION OF ELECTRICAL ECHO

- One line connected:
Line impedance: 600 Ohm.
Signal source: 1 KHz.
Nominal input and output levels.
Program output level: < - 64 dBm typical.

- Two lines connected:
Line impedance: 600 Ohm.
Signal source: 1 KHz.
Nominal input and output levels.
Program output level: < - 58 dBm typical.

FOUR WIRE MODE

Bandwidth (extender not active):	Bandwidth (active extender):
Line: 300 - 4.000 Hz +/- 1 dB.	Line: 50 - 3.750 Hz +/- 1 dB.
Program output: 300 - 4.000 Hz +/- 1 dB.	Program output: 50 - 3.750 Hz +/- 1 dB.
Distortion + THDN:	1 KHz with nominal input and output levels.
Four wire output:	< 0.10 %.
Program output:	< 0.10 %.
Absolute noise:	TX =< - 66 dBm. RX =< - 68 dBm.
Frequency extender:	TX = 250 Hz. Rx = - 250 Hz.
Cross-talk in any case:	Lower than absolute noise.

AC POWER SUPPLY: 90 / 250 V 50 - 60 Hz

DIMENSIONS: 19 " rack (1 unit height).
Width: 482 mm. (19 ").
Height: 44.5 mm. (1.75 ").
Depth: 356 mm. (14 ").