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Quad ADPCM Voice Compression Card  
for the ELAN Multiplexer:  
MXU9046C

Elan Junior with Quad ADPCM Voice  
Compression: (France Only)  
MXF9600-A411

## Quad ADPCM Voice Compression Card for the Elan Multiplexer



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**ELAN**

**ADPCM VOICE Option  
User Manual Supplement**

**WARNING**

**BEFORE INSTALLATION, PLEASE  
REFER TO SAFETY INSTRUCTIONS IN  
APPENDIX A**



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### *Introduction*

This User Manual Supplement describes Installation, Operation and Use of the ELAN ADPCM Option card, and must be read in conjunction with the ELAN Multiplexer User manual.

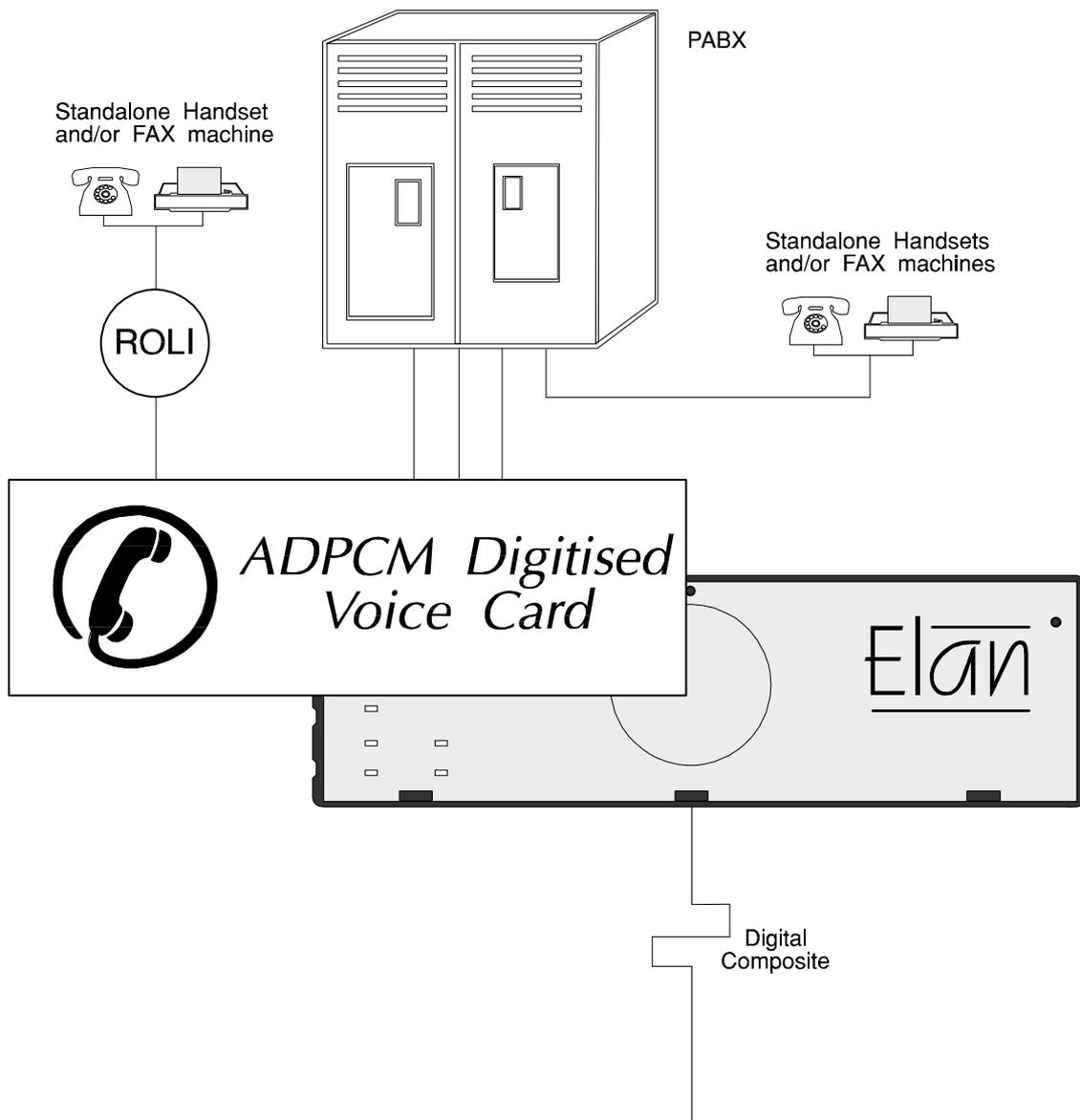
The ELAN ADPCM voice option allows the ELAN multiplexer to transmit voice traffic on the same composite link as data. It compresses voice signals using the ADPCM (Adaptive Differential Pulse Code Modulation) algorithm allowing many voice channels to be carried through the digital data network. Each card hosts 2 voice channels.

Typical use of the ADPCM voice channels is to interconnect two or more PABX systems. If ADPCM is used over a 64K digital circuit up to 6 tie lines may be replaced using a single 3U ELAN multiplexer.

A number of hardware configurations are achievable including Tie-Line replacement, PABX Extension, Extension Piggy-Back or a simple Hot-line. Some of these are illustrated on pages 9 and 10.

Installation details for the ADPCM VOICE module are covered in the installation section on pages 15-19.





## Functional Overview

The Elan ADPCM voice option provides excellent quality, low bandwidth voice transmission, over a digital data link, using the ADPCM (Adaptive Differential Pulse Code Modulation) algorithm. It compresses voice signal data to between 32Kbps and 8K bps depending on required voice quality, de-compressing and re-constituting the analogue signal at the remote site.

The option is designed to interconnect PABXs using the inter-PABX signalling protocols DC5 (also known as E&M) and AC15.



# Quad ADPCM Voice Compression

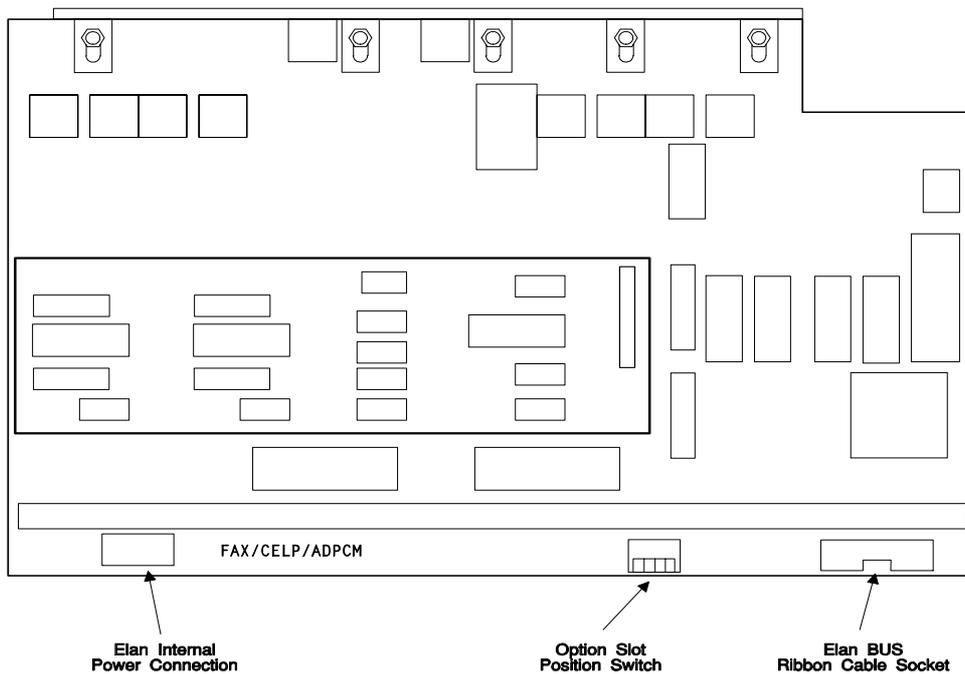
The compression bit-rate and other voice parameters are selected using the same configuration methods used for the ELAN MULTIPLEXER. This is outlined in the ELAN MULTIPLEXER manual and in the Voice Channel Configuration section.

## Mechanical Construction

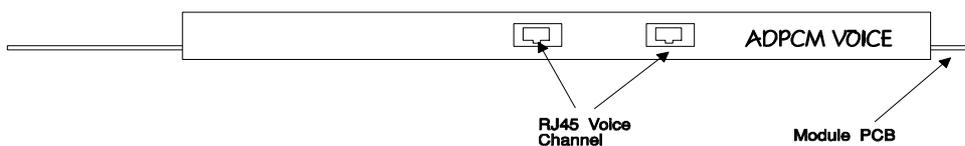
The ADPCM voice module is built onto a single printed circuit board assembly, which must be installed in one of the three option slots in the ELAN MULTIPLEXER enclosure. Two or four voice channels are fitted on each option card. When operating correctly, the MULTIPLEXER illuminates option LED 1, 2 or 3 on the ELAN front panel depending on the physical position of the card within the MULTIPLEXER. The following diagram shows the layout of the voice module:

### ADPCM MODULE PCB Layout

Plan View



Rear View



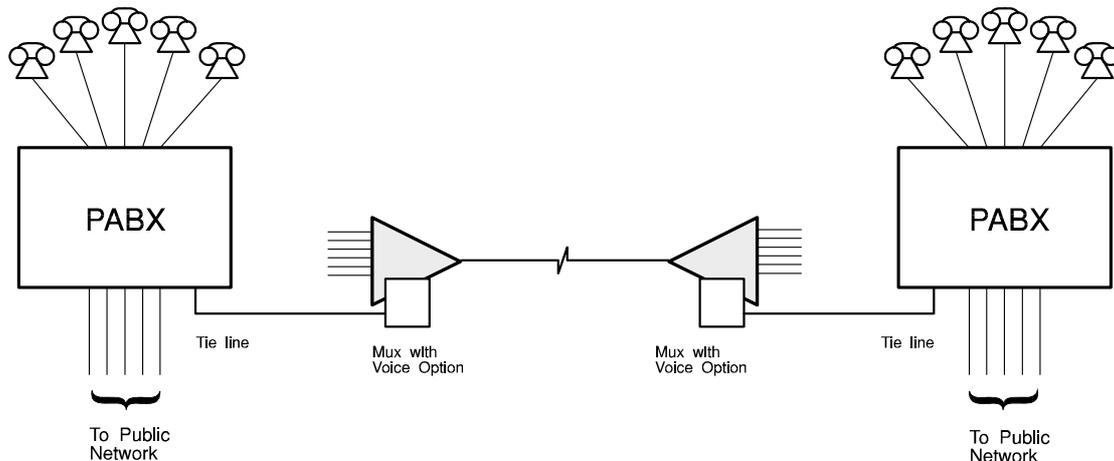
## Voice Channel Signalling

The ADPCM module supports pulse (E&M/DC5) dialling between telephone or PABX systems. It will also carry tone (Basic AC15 and DTMF) signalling, providing that the bandwidth allocated to the channel is sufficient. This is discussed further in the installation section.

AC15 signalling uses a tone of 2280 Hertz, pulsed at the same rate as DC5 (or E&M) that is 10pps. AC15 is often preferred, since many PABXs incorporate AC15 signalling as standard and no cost is incurred purchasing signalling converters. Providing that sufficient bandwidth is allocated, the ADPCM card option supports basic AC15 signalling without the need for such converters.

## Voice Tie Line

The diagram below illustrates a voice Tie-Line connection. Extension telephones may direct dial extensions at the remote location, and call out or receive calls from the PSTN connected to the remote location.



## Voice Tie Line

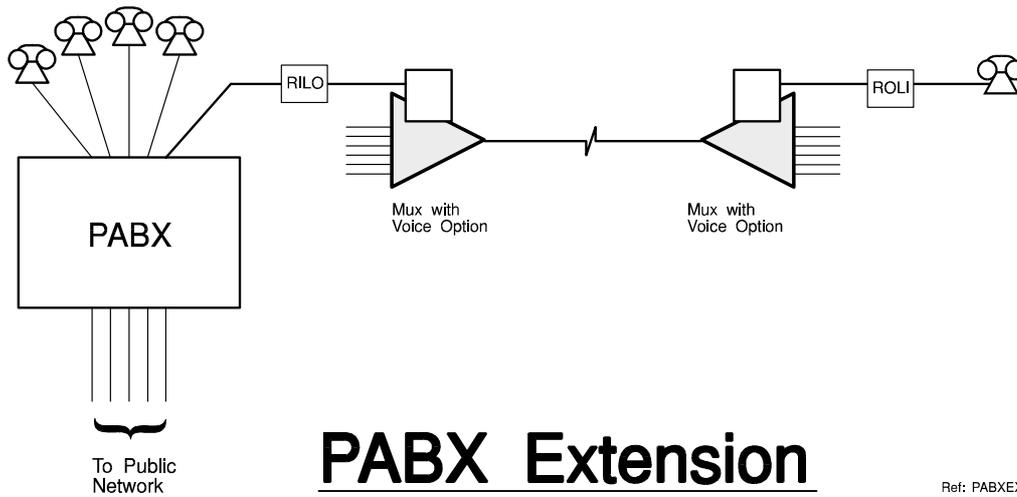
Ref: 2PABX.CDR

## Telephone Extensions

The voice card may be used to extend an **extension** line to a remote site as shown in the following diagram. This allows the remote telephone to behave as if it is directly connected to the PABX. Note that this may not be suitable for extending Key-System extensions, as there is no standard for Key-System extension interfaces.

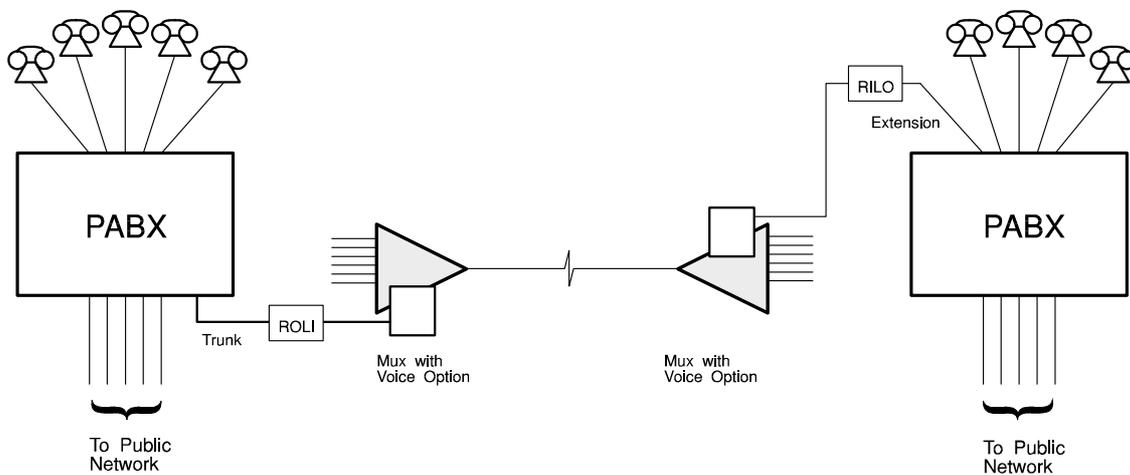


# Quad ADPCM Voice Compression



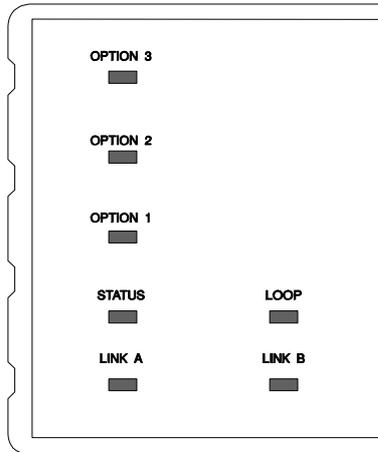
## Voice Piggy Back

A piggy back arrangement using telephone extensions and trunk lines may be arranged as shown below. This gives less flexibility than the Tie-Line approach, as direct extension dialling is not possible in the extension-to-trunk direction.



Suitable signalling converters, ROLI / RILOI, are available from Black Box.

## Use & Configuration



The voice channel Options can be modified using the simple terminal configuration process, described in the next section, similar to that for the ELAN MULTIPLEXER.

Assuming that the composite link and the option card are functioning correctly, at least three lights should be illuminated on the front panel, namely **STATUS**, **LINK A**, and one, two, or three of the **OPTION** lights. The option card lights are lit if the related card is fitted.

### Voice Channel Configuration

This section only describes configuration of the ELAN ADPCM voice option card. Configuration of MULTIPLEXER TDM channels is described in the Configuration section of the ELAN MULTIPLEXER manual.

If you are not familiar with general configuration of the ELAN MULTIPLEXER, please refer to the **Use & Configuration** section of the ELAN MULTIPLEXER user manual before reading the following sections or attempting to configure the ADPCM VOICE option card.



# Quad ADPCM Voice Compression

## ADPCM Setup Display

The ADPCM VOICE configuration display shown below is reached from any other configuration page by locating the cursor in the upper right area of the screen alongside the **Option** number relating to the ADPCM option board to be examined or updated, then pressing return.

```
Black Box Catalogue Ltd      ELAN TIME DIVISION MULTIPLEXER      Vx.xx
=====                      17.53                      05/11/93
=====

Mode           :      Normal           Baseboard      :      TDM 8 Channel
Link Clock     :      EXT 64000        Option 1 :      ADPCM 2 Chan
V.11 Carrier   :      Present          Option 2 :      NOT FITTED
Residual       :      1600             Option 3 :      NOT FITTED
Configure      :      LOCAL            System  :      Management
```

### OPTION CARD 1 - ADPCM 2 CHANNEL Vx.xx

```
Channel       :           1           2
Rate          :           32000      16000
Wire          :           2           4
O/P Gain      :           0dB        0dB
I/P Gain      :           -3dB       -3dB
'E'lead ref   :           A           A
Sampling      :           4 bit      2 bit
Mode          :           RUN        RUN
```

Cursor Keys to move, CTRL-U to save, ESC to quit

```
=====
===== Use <SPACEBAR>/<+>/<-> to select
```

This display is an example of a four channel ADPCM configuration screen. The one, two or three channel card displays are similar (The unused channel columns are of course not displayed).

## Voice Channel Parameters

Parameters for the voice channels are accessed by locating the cursor alongside the entry for a particular channel, in exactly the same manner as used on the TDM MULTIPLEXER.

To view the valid choices for the parameter, press the **spacebar**, + or - keys.

The choices by parameter are :

PARAMETER	CHOICES	NOTES
<b>Channel</b>	1 to 4	Voice channel selected
<b>Rate</b>	0 8000 to 16000, 400bps steps 16000 to 32000, 400bps steps	<u>Voice channel bit rate:</u> Channel OFF With 2 bit sampling selected With 4 bit sampling selected
<b>Wire</b>	2 or 4	Analogue interface for voice connection
<b>O/P Gain</b>	+6dB, +3dB, 0dB, -3dB, -6dB, -9dB, -12dB, -15dB	Receive gain setting for voice circuit
<b>I/P Gain</b>	+6dB, +3dB, 0dB, -3dB, -6dB, -9dB, -12dB, -15dB	Transmit gain setting for voice circuit
<b>'E' lead ref</b>	A or B	Link settings are required to change E-lead NO/NC settings : refer to manufacturer.
<b>Sampling</b>	2 bit or 4 bit	2 bit sample, 8K to 16K 4 bit sample, 16K to 32K
<b>Mode</b>	RUN LOOP	Channel run or loop

The LOCAL and REMOTE setup pages are accessed as usual to configure either location.

Channels may be copied in the same way as TDM channels.

## Quad ADPCM Voice Compression

### Voice Quality / Bandwidth

The sampling rate used for each voice channel is totally at the discretion of the user, depending on the voice **quality** required.

The highest quality achievable is at 32000bps, 4 bit sampling. With this selection, voice quality is extremely good, near Toll Quality.

At 16000bps 2 bit sampling, quality is again very good, the most obvious difference being slightly increased background noise.

In each of the above cases, the bandwidth available to speech **and signalling** is 3.4Khz. Bandwidth falls off linearly with bit rate, towards a minimum of 1.7Khz at either 16000bps 4-bit, or 8000bps 2-bit sampling.

This **must** be born in mind if AC15 signalling, MODEM Tones, of FAX tones are to be suitably preserved. The following table shows bandwidth calculated at various bit rates:

ADPCM BANDWIDTH		
4 bit (bps)	2 bit (bps)	Bandwidth (KHz)
32000	16000	3400
31000	15500	3294
30000	15000	3188
29000	14500	3081
28000	14000	2975
27000	13500	2869
26000	13000	2763
25000	12500	2656
24000	12000	2550
23000	11500	2444
22000	11000	2338
<u>21000</u>	<u>10500</u>	2231
<u>20000</u>	<u>10000</u>	2125
<u>19000</u>	<u>9500</u>	2019
<u>18000</u>	<u>9000</u>	1913
<u>17000</u>	<u>8500</u>	1806
<u>16000</u>	<u>8000</u>	1700

Note: Avoid bandwidths shaded if AC15 signalling is to be used.

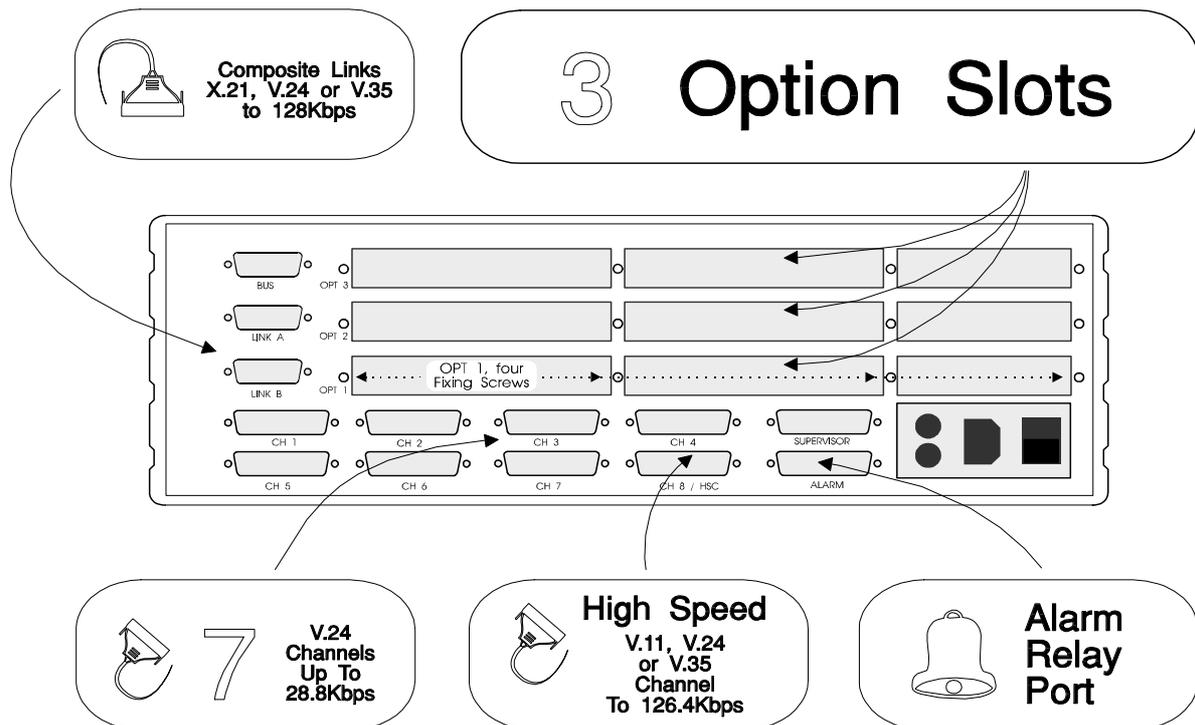
FAX transmission behaves similarly. It has been shown to work successfully even below 12000bps 2-bit, but it is advisable to allow as much bandwidth as possible to ensure reliable transmission, as external influences such as the kind of FAX machine, PABX, and Network losses also affect transmission quality significantly.

## Installation

The multiplexer must be disconnected from the power supply and all peripheral connections before opening.

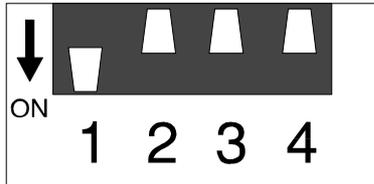
### Option Module Installation

With power turned **OFF**, the screws on the left and right of the front panel are removed using a 3mm Allen Key to access the interior of the MULTIPLEXER. Option modules are slid into position from the **front** of the enclosure using the card guides on each side panel. The appropriate blanking panel should be removed before the option card is inserted. This is achieved by removing **four screws** (shown) on the back panel. These screws are used to retain the option card once fitted. Power must be connected to the option module (by its cable) from any one of the three power sockets (one or more should be vacant) on the motherboard. Once the BUS ribbon cable on the right hand side has been fitted, only option switch setting remains (below).



## Option Card Position Selector

The option module can occupy any physical position in the enclosure, but the software will recognise each card by the position selected on the switches at the front of the card. This switch is located at the front of the card as can be seen in the illustration on page 8.



The switches (shown **white**) are in the **on** position when pushed down, and should be set as follows:

Option slot 1 (shown)	=	<b>ON</b>	OFF	OFF	OFF
Option slot 2	=	OFF	<b>ON</b>	OFF	OFF
Option slot 3	=	<b>ON</b>	<b>ON</b>	OFF	OFF

## Voice Loop Testing

Adjacent voice channels may be looped to themselves or **to each other** for test purposes. This allows local PABX connection tests to be performed at a single site location.

To carry out a channel loop test configure a **single** channel **Mode** parameter to **LOOP** on the ADPCM setup page. This will loop voice signals on this channel back i.e. speech will be heard echoing in the earpiece.

Adjacent channels **1 and 2** (or 3 and 4) may be looped to each other - speech at the telephone attached to Channel 1 will be heard at the earpiece of the telephone at Channel 2 and vice versa.

This is achieved by setting both of the two adjacent channels **LOOP mode** as before.

## Voice Interface Cabling & Connections

Suitable connection may be arranged using a Krone™ wallboxes type 251 or similar. The private voice equipment is connected to the Krone strips in the wallbox using a Krone IDC tool.

Each **pair** of voice channels is wired using two RJ45 cables to a 237A type Krone connection block as follows:

<b>RJ45 pin</b>	<b>Krone pair</b> Ch1/Ch2 Ch3/Ch4 Ch5/Ch6 etc	<b>Colour</b>	<b>Name</b>	<b>Type</b>
4	1a / 6a	Blue	RXa/TXa	O/P when 4 wire I/O when 2 wire
5	1b / 6b	White/Blue	RXb/TXb	O/P when 4 wire I/O when 2 wire
3	2a / 7a	White/Green	TXa	I/P 4 wire only
6	2b / 7b	Green	TXb	I/P 4 wire only
7	3a / 8a	White/Brown	E	O/P, Closing Contact to ground
8	3b / 8b	Brown	E Lead Reference	Signal ground for UK link positions
2	4a / 9a	Orange	M	I/P, loop to ground
1	4b / 9b	White/Orange	M Lead Reference	Internal -12V bias, <b>Do not connect</b>

Where the following types apply:

O/P	=	Output <b>from</b> multiplexer
I/P	=	Input <b>to</b> multiplexer
I/O	=	Both input and output

Connection may be made directly to the RJ45 connector where the connection is to Private PABX equipment.

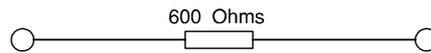
It is an approval requirement that the **RJ45 connector tabs must be clipped short** to prevent user access.

The above cables may be ordered separately where required from Black Box.

## Voice Impedance Matching

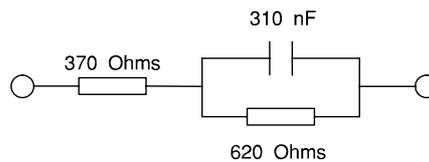
The port impedances are standard for both 2 wire and 4 wire interfaces as follows:

4 Wire Impedance = 600 Ohms :



Return Loss better than -25dB

2 Wire Impedance = Complex :



Return Loss better than -30dB

Transhybrid loss better than -17db, then active echo cancellation

The private system's impedance must be correctly matched to the above to achieve optimal echo cancellation.

### Voice Signalling Configuration

The voice channels are configured for BT standard keying (E&M) and AC15 unless specified by the customer. Please contact Black Box if you require an alternative configuration.

If DC5 (E&M) signalling will not function, the most common cause is that there is no GROUND RETURN connection between the Multiplexer and the PABX system. At least one of these SIGNAL GROUND connections must be made to the PABX ground for each voice card used.

The DC5 (E&M) and SIGNAL GROUND connections are not required for AC15 signalling.

**AC15 signalling** requires sufficient bandwidth to allow the 2280Hz signalling tones to be passed without degradation. This should be considered with reference to the table in the Voice Quality / Bandwidth section on page 14.



*Appendix A - Warnings*

**WARNING:      THIS EQUIPMENT MUST BE EARTHED**

**This equipment relies on the EARTH connection to ensure safe operation such that the user and TELECOM Network are adequately protected. It must not under any circumstances be operated without an earth connection, which could nullify its approval for connection to a network.**

**WARNING:      INSTALLATION OF EQUIPMENT**

**Installation of this equipment must only be performed by suitably trained service personnel.**

**WARNING:      CONNECTION OF OTHER EQUIPMENT**

**This equipment allows connection only of suitably approved equipment to its ports, the safety status of which are defined below:**

TNV Ports:

- i)      **Voice 1**
- ii)     **Voice 2**

The above named ports are classified as TNV (Telecom Network Voltage) in accordance with Clause 4.2 of EN41003, and **must only** be connected to equipment which similarly complies with the TNV safety classification.