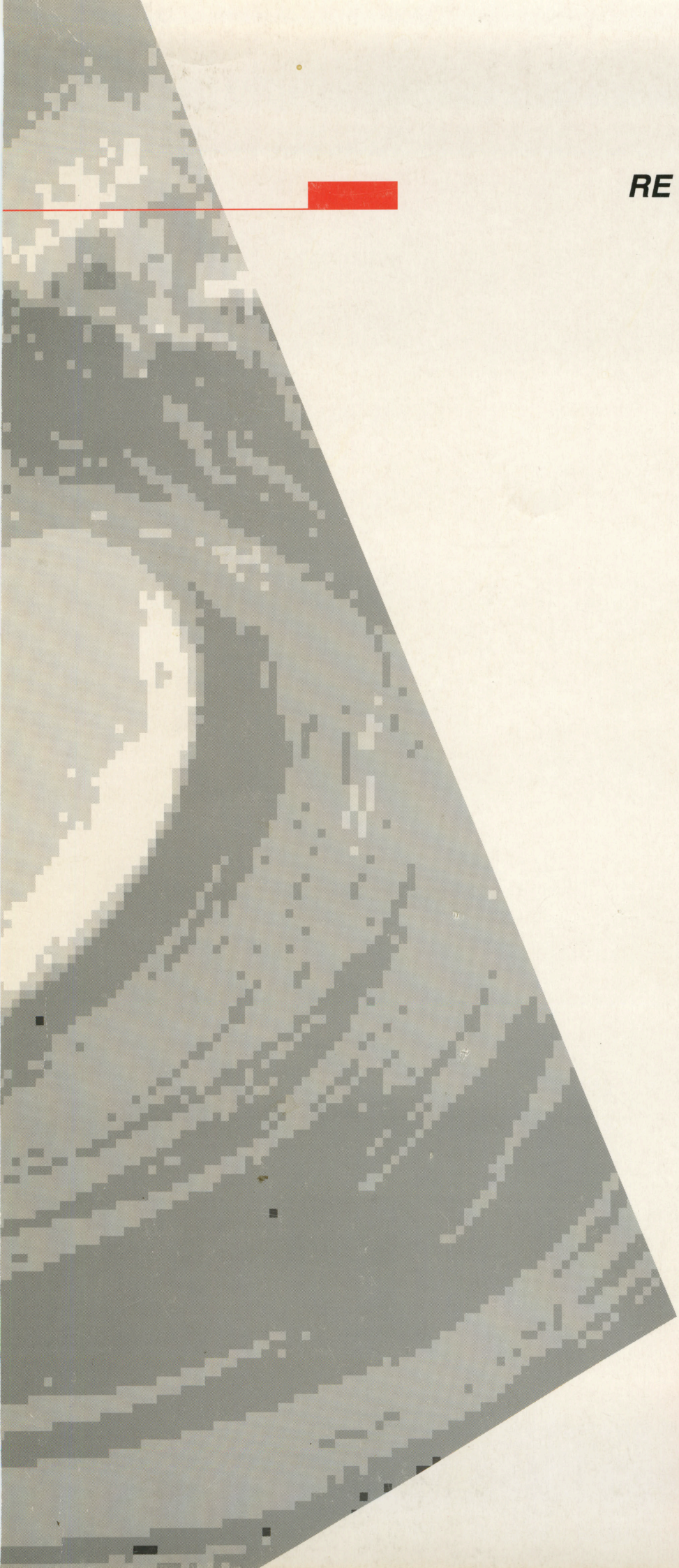

RE 660 Layer II Encoder and RE 661 Layer II Decoder Operator Manual

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RE 660 Layer II Encoder and RE 661 Layer II Decoder Operator Manual

Safety and precautions

General

All electrically powered equipment can be dangerous. At RE TECHNOLOGY AS we have taken great care to ensure safety during the design and production of our equipment. Incorrect installation, handling, or interference can, however, impair the safety.

Installation

This product is a Safety Class I product which requires protective earthing. Normally, this is obtained by the use of the supplied 3-wire power cable.
During installation, observe the following rules:

- Establish a separate protective earth connection if the power installation of the building does not have a direct connection to earth.
- Ensure that the unit has the correct line voltage rating.
- Do not use an extension cord (power cable) without a protective conductor.
- Do not remove the covers.

Servicing

Only trained service personnel should attempt to dismantle and repair the unit. During service observe the following rules:

- Before removing any covers, switch off the power and remove the line cable from the unit. Capacitors inside the unit may hold dangerous charges for a considerable time after the unit has been switched off.
- If it is necessary to replace components in the line connected circuits, use only new parts of the correct and specified type.
- Take care to maintain or re-establish the protective earthing of the unit during service or repair.
- Do not remove any warning labels. Replace damaged or illegible warning labels with new ones.

ESD (electrostatic discharge)

Electronic products contain electrostatic sensitive components. Observe the following rule:

- Do not attempt to open a unit without proper precautions against electrostatic discharge, i.e. use a wrist strap and conductive work-bench surface.
  Reason: the unit may fail or be degraded!

Back-up batteries

For units with back-up batteries, observe the following rules:

- Do not dispose of used batteries through the household garbage collection system, but follow your local regulations.
  Reason: The batteries contain chemicals which may be harmful to the environment.
- Replace back-up batteries with the specified or an equivalent type.

Safety and precautions (continued)

- Insert batteries correctly.
  Reason: There may be danger of explosion if the batteries are incorrectly inserted.
- When you dispose of the unit itself, first remove the batteries and dispose of them separately.
- Do not recharge the batteries or expose them to temperatures above 100 °C (212 °F).

Meeting EMC Requirements

To meet the EMC requirements of Directives 89/336/EEC and 92/31/EEC you must use correctly shielded cables of good quality for all external connections when installing the unit. Observe the following rules:

- Make sure that all multi-connector cables have conductive connector housings with shield clamps.
- Make sure that the coaxial cables are of the double-braided type.

Safety symbols

The following safety symbols are currently used in RE TECHNOLOGY equipment:

Symbol	Meaning	This symbol indicates
	Caution	Dangerous voltages.
	Earth terminal	Protective earth connection to the chassis.
	Attention	The presence of Electrostatic Sensitive Devices.
	Danger	Live voltages exceeding 1000 V.
	Laser radiation	Invisible laser radiation which can cause permanent damage to the eye

Use of Product Names. The product names mentioned herein are used for identification purposes only, and may be trademarks and/or registered trademarks of their respective companies.

Short Contents

Chapter

Table of Contents

1. Introduction

The RE 660 and RE 661 Codec is a full-featured audio codec intended for cost-effective transportation of audio signals on digital networks.

The RE 660 Encoder and RE 661 Decoder can encode and decode a stereo or two-channel mono program according to the ISO/MPEG Layer II standard. It can also encode and decode two independent mono signals according to the ITU-T Rec. G.722 standard.

The basic codec accepts analog audio input and output. Installing the digital audio input or output option provides acceptance of the digital formats AES/EBU and S/PDIF.

The codec can be equipped with a DC or an AC power supply.

In the audio encoder, the audio information is compressed to a bit rate of between 48 and 384 kbit/s, which makes it a streamlined audio head-end for digital networks, such as T-1, 2 Mbit/s, Fractional T1, Switched 56, Clear 64, ISDN, and many more, including satellite and microwave circuits.

In any aspect of audio transmission, the RE 660 and RE 661 Codec offers high quality and reliability. Contribution of programs, such as TV news feeds, weather reports, remote pick-ups satellite back hauls, coverage of concerts, festivals or stadium events, is one main application.

Another main application of the codec is program distribution, such as studio-to-studio connections, Studio-to-Transmitter Links (STL), Inter City Relays (ICR) and satellite and microwave transmissions.

To serve the need for additional data capacity, the codec provides an in-band asynchronous RS-232 data channel.

This manual covers software version 4.4 and onwards.

2. Functionality

The codec operates in either Layer II or G.722 coding mode. The Layer II and G.722 audio coding schemes each have different features.

Layer II is highly suitable for use in audio distribution systems. It covers almost the whole range of audio quality; from voice grade (mono) up to near CD quality (stereo). This is accomplished by using a wide range of bit rates; between 48 and 384 kbit/s. The disadvantage with Layer II is that a significant audio delay (>100 ms) is always present.

G.722 can be used with 56 or 64 kbit/s bit rates and is very close to instantaneous. This makes it highly suitable for use, for example, by broadcasters for transmitting voice to and from remote sites. In such bi-directional applications a low delay is important in order to have a real-time return channel.

The codec operates in all four Layer II modes: Stereo, Joint Stereo, Dual Mono and Mono. The sampling frequency can be selected as 16, 22.05, 24, 32, 44.1 or 48 kHz. The codec can also operate in G.722 mode, and the G.722 modes 1, 2, and 2S, as specified in ITU-T Rec. G.725 and ANSI T1.306, are supported. With G.722, the sampling frequency is always 16 kHz.

When the RE 661 Layer II Decoder receives a Layer II data stream containing a mono signal, the decoded audio mono signal is fed to both the left and the right output.

To enhance sound quality when connected to a low-rate network, the codec can use split-mode operation with Layer II coding. That is, it inverse multiplexes two 56 or 64 kbit/s channels into a virtual data rate of 112 or 128 kbit/s.

The RE 660 and RE 661 Codec automatically adjusts to the network bit rate applied at the appropriate V.35, X.21 or RS-422 network connections on the codec without having to set the matching data rates.

The decoder is totally self-configuring. No user setup is needed. The decoder automatically distinguishes between Layer II and G.722 bit streams, with Layer II given priority.

To serve the need for an auxiliary data channel, the RE 660 and RE 661 Codec provides an in-band asynchronous RS-232 channel. The data channel can be used with either Layer II or G.722 Mode 2 format.

The audio input and output signal can be monitored via a headphone jack, with volume control, on the front panel of the encoder and decoder respectively.

The encoder can be configured from the front panel or via the rear panel remote control. The decoder configuration can be read from its front panel display or via its rear panel remote connector.

The software of the RE 660 and RE 661 Codec is stored in flash EPROM memory, making it easy to perform future software upgrades via the RS-232 interface.

For G.722 operation, note the following:

- G.722 uses statistical timing (G.722 Modes 1, 2, 2S) and H.221 (G.722 Mode 2) in the decoder.
- If two independent G.722 channels are transmitted (one on each network interface), the two network clocks must be locked to each other.
- The encoder does not use any byte-timing signal which may be present on the network interface. This means that the RE 660 in G.722 mode cannot interwork with G.722 decoders that use the network's byte-timing signal for frame synchronization.

For Layer II operation, note the following:

- The RE 660 always calculates and inserts the header CRC and sets the protection bit to ON in the outgoing Layer II data stream.
- The RE 661 always resets the Copyright and the Home/Original bits to zero in the outgoing Layer II data stream. The RE 661 does not use either of these two bits.

Digital Audio Option

The digital audio option is a small piggy-back add-on circuit board located in the upper left corner of the Layer II encoder/decoder board.

This option is factory-installed and provides the encoder with a digital audio input possibility and the decoder with a digital audio output and a digital audio SYNC input possibility in order to supply a locked output. Both the digital audio input for the RE 660 Encoder and the digital audio output from the RE 661 Decoder are internally rate-adapted to the transmission network (sampling rate conversion), thus eliminating the need for locking the connected digital audio equipment. Both the input and the output can be rate-converted to any of the three sampling frequencies, 32, 44.1 or 48 kHz, independently of the sampling frequency used in the transmission

3. Installation

3.1 Initial Inspection

When unpacking the RE 660 and RE 661, check the codec, all accessories, and the packing material for any physical damage. If any item is damaged, please notify the carrier and your local RE representative. In case of complaints, please keep the packing material for later inspection by the carrier.

3.2 Mechanical Installation

The RE 660 Encoder and the RE 661 Decoder are intended for mounting in a 19" rack. Each unit occupies one height unit.

Do not place the unit directly onto a surface. Ensure that there is always a minimum of 1 U (44 mm) airspace between the bottom of the unit and any surface, thus allowing air to circulate freely. Units can be stacked on top of each other using external air separation plates. There must be at least one height of free air between every second unit.

To meet the EMC requirements, the units must be installed using correctly shielded cables of good quality for all external connections. This implies that all multi-conductor cables must have conductive connector housings with shield clamps, and the coaxial cables must be of the double-braided type.

3.3 Electrical Installation

Power

The RE 660 Encoder and the RE 661 Decoder can be operated either from a 90 to 250 V AC or from a -20 to -75 V DC power supply. In both cases, the internal voltages (+5 and ±15 V) are generated in a switch-mode supply with a frequency of approximately 100 kHz.

During AC operation, the power is connected through a mains inlet with two fuses, Ø5 x 20 mm, 0.5 A T, 250 V AC, included. Take care that both phase and neutral conductors are fused.

During DC operation, the main fuse is one Ø5 x 20 mm, 2 A T, 250 V AC placed on the power supply unit, and it is accessed by removing the top plate.

Note Disruption of power is accomplished by removing the appliance coupler from the power inlet.

3.4 Internal Settings

3.4.1 General

You can change the codec's internal settings to suit your needs with respect to input and output impedance, clipping and maximum output level, and the format of the digital audio signals for the inputs and output.

To do this, you must first remove the top plate of the encoder and/or decoder. This gives you access to the encoder/decoder Layer II board on which various numbered jumpers are located. Once you have access to the jumpers, you can set them as you require, according to Tables 3.1 to 3.9.

3.4.2 Analog Audio Inputs/Outputs

Input impedance	JP3	JP10
600 Ω [a)]	2-3	2-3
>25 kΩ	1-2 (high)	1-2 (high)

Table 3.1 RE 660 Encoder, Input Impedance

a. Factory setting

Output impedance	TP1	TP5	TP6	TP7
600 Ω	2-3	2-3	2-3	2-3
< 60 Ω [a)]	1-2	1-2	1-2	1-2

Table 3.2 RE 661 Decoder, Output Impedance

a. Factory setting

3.4.3 Clipping Level

Clipping level	TP8	TP7	TP6	TP5	TP9	TP10	TP12	TP11
21 dBu	2-3	2-3	1-2	2-3	2-3	2-3	1-2	2-3
18 dBu	2-3	2-3	2-3	1-2	2-3	2-3	2-3	1-2
15 dBu[a)]	2-3	2-3	2-3	2-3	2-3	2-3	2-3	2-3
12 dBu	2-3	1-2	1-2	2-3	2-3	1-2	1-2	2-3
9 dBu	2-3	1-2	2-3	1-2	2-3	1-2	2-3	1-2
6 dBu	2-3	1-2	2-3	2-3	2-3	1-2	2-3	2-3
3 dBu	1-2	2-3	1-2	2-3	1-2	2-3	1-2	2-3
0 dBu	1-2	2-3	2-3	1-2	1-2	2-3	2-3	1-2
-3 dBu	1-2	2-3	2-3	2-3	1-2	2-3	2-3	2-3

Table 3.3 Encoder Clipping Level

a. Factory setting

3.4.4 Output Level

Output level	SP8	SP7	SP9	SP10	SP14	SP13	SP12	SP6
24 dBu	2-3	1-2	1-2	1-2	2-3	1-2	1-2	1-2
21 dBu	1-2	2-3	1-2	1-2	1-2	2-3	1-2	1-2
18 dBu	1-2	1-2	1-2	1-2	1-2	1-2	1-2	1-2
15 dBu[a)]	2-3	1-2	1-2	2-3	2-3	1-2	1-2	2-3
12 dBu	1-2	2-3	1-2	2-3	1-2	2-3	1-2	2-3
9 dBu	1-2	1-2	1-2	2-3	1-2	1-2	1-2	2-3
1 dBu	2-3	1-2	2-3	1-2	2-3	1-2	2-3	1-2
-2 dBu	1-2	2-3	2-3	1-2	1-2	2-3	2-3	1-2
-3 dBu	1-2	1-2	2-3	1-2	1-2	1-2	2-3	1-2

Table 3.4 Layer II Decoder Output Level with Output Impedance <60 Ω

a. Factory setting

NOTE 15 dBu = 6.16 Vp, 18 dBu = 8.70 Vp, 21 dBu = 12.30 Vp.

If the output impedance is set to 600 Ω, and the output is loaded into 600 Ω, all output levels will be 6 dB lower than stated in Table 3.4.

3.4.5 X.21 Clock Termination

The X.21 clock inputs can be terminated in 100 Ω . All other signals are unterminated.

X.21 Clock input termination	TP13 (X.21A clock input)	TP14 (X.21B clock input)
Unterminated[a)]	1-2	1-2
100 Ω	2-3	2-3

Table 3.5 Encoder, X.21 Clock Input Termination

a. Factory setting

X.21 Clock input termination	JP1 (X.21A clock input)	JP2 (X.21B clock input)
Unterminated[a)]	2-3	2-3
100 Ω	1-2	1-2

Table 3.6 Decoder, X.21 Clock Input Termination

a. Factory setting

3.4.6 Digital Audio Inputs/Outputs

These settings are only relevant if you have the digital audio option installed.

Digital audio input format	JP1 (on option	JP2 (on option)
AES/EBU[a)]	1-2	1-2
S/PDIF	2-3	2-3

Table 3.7 Encoder, Digital Audio Input Format

a. Factory Setting

Digital audio output format	JP3 (on option)	JP4 (on option)	JP3 (on main board)
AES/EBU[a)]	1-2	1-2	1-2
S/PDIF	2-3	2-3	2-3

Table 3.8 Decoder, Digital Audio Output Format

a. Factory Setting

Digital audio SYNC input format	JP1 (on option)	JP2 (on option)
AES/EBU[a)]	1-2	1-2
S/PDIF	2-3	2-3

Table 3.9 Decoder, Digital Audio SYNC Input Format

a. Factory setting

4. Front and Rear Panels

4.1 Front Panels

Fig. 4.1 shows the front panels of the RE 660 Encoder and the RE 661 Decoder.

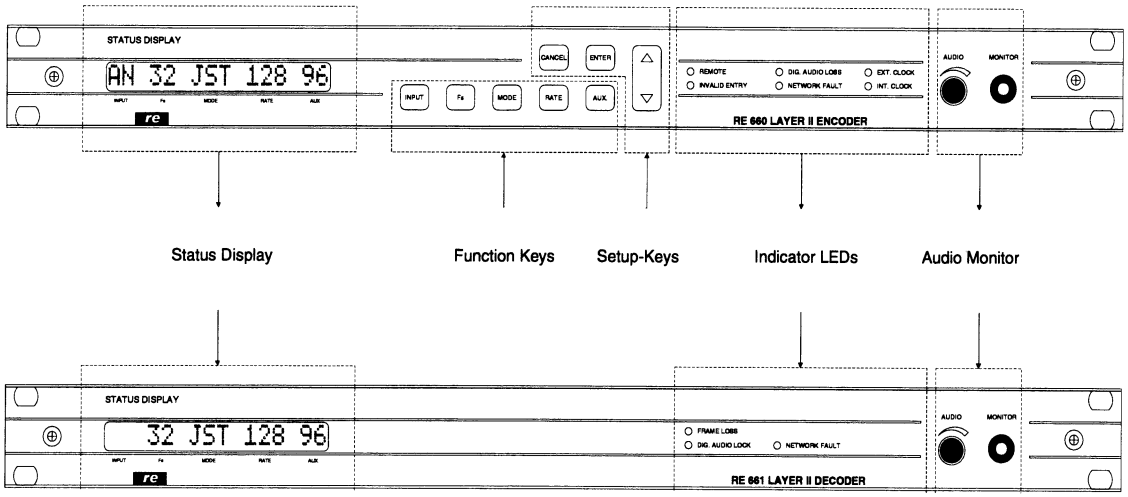


Fig. 4.1 RE 660 & RE 661 Layer II Codec, Front Panel

4.1.1 RE 660 Layer II Encoder

Status Display

Shows the mode of operation of the encoder. Chapter 5.1 describes how to operate the RE 660 Encoder.

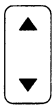
Function Keys

Pressing one of the function keys Input, Fs, Mode, Rate and Aux gives you access to the status display. For information on the various settings, see "RE 660 Layer II Encoder, Changing Settings Locally" on page 19.

NOTE Certain combinations of settings are not valid. See Chapter 5.3 for further details.

SetupKeys

Arrow Up
Arrow Down



Scrolls through the field values.

Enter key

Accepts any changes made, and enters the configuration as shown.

Cancel key

Cancels any changes not yet accepted by [Enter].

Indicator LEDs

REMOTE

A yellow LED indicates that remote control on the encoder is enabled. Consequently, you cannot set up the codec from the encoder front panel.

INVALID ENTRY

A red LED indicates that a key selection or remote entry is invalid. For example, the user may have tried to select a 384 kbit/s transmission rate when the network capability is 64 kbit/s.

DIG. AUDIO LOSS

If the digital audio option is installed, a red LED indicates that the digital audio input signal is missing when the digital audio input is selected.

NETWORK FAULT

A red LED indicates that the clock input from the network is missing or deviates beyond the lock range of the encoder.

The LED also lights if the indication signal in the X.21 interface used or the "DSR" signal in the X.35 interface used is inactive.

EXT. CLOCK

A yellow LED indicates that the encoder is operated in slave or external clock mode.

INT. CLOCK

A yellow LED signals that the encoder is operated in master or internal clock mode.

AUDIO MONITOR

Audio Monitor with volume control. If the encoder accepts both analog and digital audio inputs, the monitor circuit converts a digital audio input into analog form. When the analog audio input is used, the monitor DAC is fed from the digital audio output of the audio

ADC. This enables analog headphone monitoring of digital audio inputs as well as "digital" monitoring of analog audio input signals, allowing the monitor to be used to verify the digitization of analog audio input signals.

4.1.2 RE 661 Layer II Decoder

Status Display

The status of the transmission is shown on the status display. The status display of the decoder contains the same information as that of the encoder, except that there is no audio input signal indication.

Indicator LEDs

FRAME LOSS

A red LED signals that the decoder is unable to synchronize to the received digital signal. Frame loss occurs if the decoder cannot detect either Layer II frames or G.722 in the incoming data.

In the case of G.722 coding, frame loss occurs only if synchronization is lost on both network interfaces.

DIG. AUDIO LOCK

If the digital audio option is installed, a green LED signals that the digital audio output signal is locked to an externally applied reference input via the digital Audio SYNC Connector.

NETWORK FAULT

A red LED signals that the clock input from the network is missing or deviates beyond the lock range of the decoder.

The LED also lights if the Indication signal in the X.21 interface used or the "DSR" signal in the X.35 interface used is inactive.

AUDIO MONITOR

As described for the RE 660 Layer II Encoder. See "AUDIO MONITOR" on page 12.

4.2 Rear Panels

Fig. 4.2 shows the rear panels of the RE 660 Layer II Encoder and RE 661 Layer II Decoder with AC power supply.

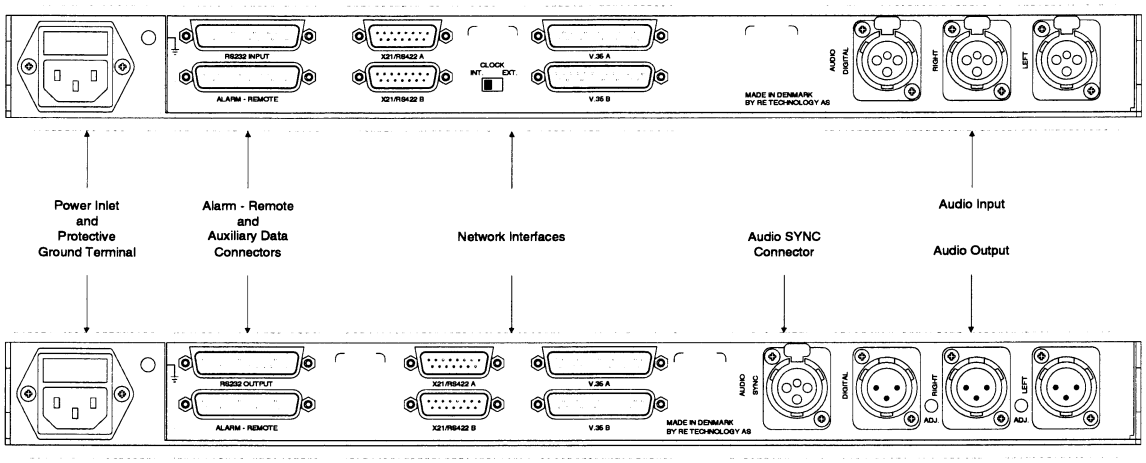


Fig. 4.2 RE 660 & RE 661 Codec, Rear Panels

4.2.1 RE 660 Layer II Encoder

Power Inlet and Protective Ground

The Codec is equipped with an AC *or* DC power supply. The AC power supply accepts an AC line input voltage in the range from 90 to 250 V via an IEC plug. The DC power supply accepts a DC line input voltage in the range from -20 to -75 V via an AMP connector.

When power is applied, the characters in the status display light up. The protective ground is a brass M5 protective ground terminal or the protective ground in the line socket. If the RE 660 Encoder loses power during operation, the last entered configuration is automatically recalled on resumption of power to the encoder.

Alarm - Remote and Auxiliary Data Connectors

The Alarm-Remote connector is used for remote control and alarm indication (digital audio loss or network fault). See Chapter 5.2 for further details.

The alarm output is a simple relay contact output signaling terminal fail/no fail.

The RS-232 interface is the interface for the auxiliary data channel that can be used for the transmission of background information or, for example, the distribution of dynamic RDS/RBDS data. With Layer II coding, the baud rate is selected from the front panel

keys; with G.722 coding it is fixed at 9600 baud. The remote control interface provides an on/off function for the auxiliary data channel. The RS-232 connector is also used for performing software upgrades.

For information on ASTRA and DAB, see "ASTRA Digital Radio and Digital Audio Broadcast" on page 45.

Network Interfaces

The network interfaces are implemented as two 15-pin Sub-D male connectors for the ITU-T X.21 and RS-422 interfaces, and two 25-pin Sub-D female connectors for the ITU-T V.35 interface. The RS-422 clock input can be terminated internally at 100 Ω . The V.35 interface requires an adapter cable to conform to the physical connector type specified in the ISO 2593 document. See "Cables" on page 41.

With G.722 coding, each analog audio input is dedicated to one of the two network interfaces. The left channel operates on Network A, and the right channel operates on Network B. Both single and dual channel operation can be used. For single-channel operation, the audio input used is the Left channel and the data is transmitted by means of Network A; nothing is output on Network B.

Auxiliary data is output on both Network A and Network B.

Internal/External Clock Mode

The clock selector is used to select internal or external clock mode. External clock mode is used when the network supplies a clock input to the encoder to lock it to the network. The encoder detects the applied clock rate at the network interface connectors and sets the coding bit rate accordingly.

With Layer II coding selected and a 56 or 64 kHz clock present on both connectors, you can use the front panel keys to select between 56 and 64 kbit/s redundant transmission, or split transmission at 2 times 56 or 2 times 64 kbit/s. The encoder configures all other clock frequencies for transmission in redundant mode.

Internal clock mode is used when the encoder is the master. In this mode, the encoder outputs the clock signal to be associated with the data output. This setup is commonly used in microwave and satellite transmissions. The setup also eases maintenance as it allows operation of the encoder and decoder back-to-back without using an external master clock source. See "Back-to-Back Test Cable" on page 41. The transmission bit rate can be selected freely using the rate and setup keys on the front panel of the encoder.

A yellow "INT. CLOCK" or "EXT. CLOCK" LED lights on the front panel of the encoder to indicate its clock mode.

Audio Inputs

This section comprises three audio connectors. One left and one right 3-pin XLR female connector are used for analog audio inputs. If the digital audio option is installed, a 3-pin XLR female connector can be used for digital audio input according to the AES/EBU or the S/PDIF specification.

To select between the two digital formats, analog audio input impedance, and clipping level, see "Internal Settings" on page 6.

NOTES

- The audio input used for mono signals (Layer II 1CH or G.722) is the left input.
- If you select digital audio input and G.722 coding mode, make sure that "No pre-emphasis" is signaled in the digital audio signal. "No pre-emphasis" is always signaled to the decoder when G.722 coding mode is selected.

4.2.2 RE 661 Layer II Decoder

Power Inlet and Protective Ground

The codec is equipped with an AC *or* a DC power supply. The AC power supply accepts an AC line input voltage in the range from 90 to 250 V via an IEC plug. The DC power supply accepts a DC line input voltage in the range from -20 to -75 V via an AMP connector.

When power is applied, the characters in the status display light up. The protective ground is a brass M5 protective ground terminal or the protective ground in the line socket.

Alarm - Remote and Auxiliary Data Connectors

The Alarm-Remote connector is used for remote monitoring and indication of alarms (frame loss or network fault). Each of the functions on the status display can be monitored via this connector. See Chapter 5.4 for further details.

The alarm output is a simple relay contact output signaling terminal fail/no fail.

The RS-232 interface is used for output from the auxiliary data channel, for example distribution of dynamic RDS/RBDS data. The RS-232 output connector is also used for software upgrades. See "ASTRA Digital Radio and Digital Audio Broadcast" on page 45.

Network Interfaces

The network interfaces are implemented as two 15-pin Sub-D male connectors for the X.21 and RS-422 interfaces and two 25-pin Sub-D female connectors for the V.35 interface. The RS-422 clock input can be terminated internally in 100 Ω . The V.35 interface requires an adapter cable to conform to the physical connector type specified in the ISO 2593 document. See "Cables" on page 41.

With G.722 coding, each analog audio output is dedicated to one of the two network interfaces. The Left channel operates on Network A, and the Right channel operates on Network B.

Auxiliary data received on Network A has preference. This means that if Network A operates in Mode 2, the auxiliary data output is allocated to this channel, regardless of whether data is received. Auxiliary data from Network B is otherwise output, if present.

Level Adjustment

You can fine adjust the analog audio level by ±2 dB using a screwdriver and two holes in the rear panel.

Audio Outputs

This section comprises four audio connectors. One left and one right 3-pin XLR male connector are used for analog audio output. If the digital audio option is installed, a 3-pin XLR male connector outputs digital audio output according to the AES/EBU or the S/PDIF specification. Both the analog audio and the digital audio outputs are active. During frame loss, the analog audio and digital audio outputs are muted. To select between the two digital formats, analog audio output impedance, and maximum output level, see "Internal Settings" on page 6.

NOTES

- If Layer II coding is selected, and the RE 661 Decoder receives a Layer II stream containing a mono signal, the decoded audio mono signal is fed to both the left and right analog audio outputs.
- If single G.722 coding is selected, the signal is output on the left XLR analog output connector.
- If G.722 coding is selected, only "No pre-emphasis" can be signaled from the encoder, that is, the audio output is always signaled with "No pre-emphasis" when G.722 coding mode is selected.
- If S/PDIF is selected for the digital audio output, pre-emphasis can only be signaled as no emphasis or 50/15 µs pre-emphasis. If, however, the encoder signals ITU-T J.17 pre-emphasis to the decoder, the decoder signals 50/15 µs pre-emphasis in the S/PDIF digital output.

Digital Audio SYNC Connector

This feature applies only if the digital audio option is installed. The 3-pin XLR female digital audio SYNC input connector is used to lock the digital audio output to an external reference, such as a studio reference. The reference input can also be used to choose the sampling frequency for the digital audio output signal. Sampling rate conversion and/or sampling rate equalization takes place in the decoder, eliminating the need for additional outboard rate converters.

5. Operation

5.1 RE 660 Layer II Encoder, Changing Settings Locally

The status display on the front panel of the encoder shows the current configuration. The setup keys and the function keys are used to configure the codec. To configure the codec manually, do as follows:

1. Press a function key. A cursor is shown under the field selected.
2. Press [Arrow Up] or [Arrow Down] to choose a new value. The field in question flashes indicating that a new value has been selected.
3. Press [Enter] to accept the change. The field in question stops flashing, and the cursor disappears indicating that the new setup has been accepted.

Pressing [Cancel] cancels all changes not yet accepted by [Enter].

If you try to enter a value which is not valid, the "INVALID ENTRY" LED lights for approximately 5 seconds. See "Combining Settings" on page 24 for further details.

Input Setting

If you have the Digital Audio Option installed, and you use Layer II coding, you can set the Input to be either analog or digital audio, as shown in Table 5.1.

Input	Explanation
AN	Analog audio input
DI	Digital input

Table 5.1 Input - Audio Input

Fs (Sampling Frequency) Setting

With Layer II coding you can set Fs to any of the frequencies shown in Table 5.2 (certain combinations are not valid; see Chapter 5.3 for further details).

With G.722 coding, the sampling frequency is fixed at 16 kHz. If you select G.722, the sampling frequency automatically changes to 16 kHz. The last used sampling frequency is restored if you change back to Layer II coding.

Fs	Explanation
16	16 kHz sampling
22	22.05 kHz sampling
24	24 kHz sampling
32	32 kHz sampling
44	44.1 kHz sampling
48	48 kHz sampling

Table 5.2 Fs - Sampling Frequency

Mode Setting

You can select Layer II coding by entering any one of the first four mode settings listed in Table 5.3. Alternatively, you can select G.722 coding as the mode, with transmisson bit rates of 56 or 64 kbit/s.

Mode	Explanation
ST	Stereo
JST	Joint stereo
2CH	Dual mono
1CH	Single channel
722	G.722

Table 5.3 Mode - Coding Mode

G.722 can be formatted in a number of different ways and the G.722 mode must also be specified. In the codec, this can be Mode 1, Mode 2, or Mode 2S (in accordance with ITU-T Rec. G.725 and ANSI T1.306). The mode is determined jointly by the transmission bit rate and what you specify in the Aux field.

Rate (Transmission Bit Rate) Setting

With Layer II coding and Internal clock selected you can set any of the rates shown below.

Rate	Explanation	Rate	Explanation
48	48 kbit/s	192	192 kbit/s
56	56 kbit/s	224	224 kbit/s
64	64 kbit/s	256	256 kbit/s
80	80 kbit/s	320	320 kbit/s
96	96 kbit/s	384	384 kbit/s
112	112 kbit/s	X56	112 kbit/s routed as two times 56 kbit/s
128	128 kbit/s	X64	128 kbit/s routed as two times 64 bkit/s
160	160 kbit/s		

Table 5.4 Network Transmission Rate, Layer II coding

Two connectors allow the encoder to feed two network paths in parallel (redundant mode), or to split the bit rate of 112/128 kbit/s into 2 times 56/64 kbit/s. In redundant mode, two lines are used as mutual back-up to ensure operation even if network failure occurs. Transmission in split mode via two 56 or 64 kbit/s lines (X56 or X64 setting) produces a virtual 112 or 128 kbit/s transmission. This feature gives a higher audio quality and yet connects directly to the standard public digital networks. The two network paths are assumed to be clocked from the same master clock, but they may have up to 0.5 second of differential delay between them.

With G.722 coding you can select one of four valid bit rates:

56 kbit/s: A single 56 kbit/s channel is transmitted on Network A. The left audio input channel is used for single-channel operation.

If you select 56 kbit/s, you automatically select G.722 Mode 2S.

64 kbit/s: A single 64 kbit/s channel is transmitted on Network A. The left audio input channel is used for single-channel operation.

If you select 64 kbit/s, the channel can use either G.722 Mode 1 or G.722 Mode 2 format. You specify this in the Aux field, as shown in Table 5.6.

D56 kbit/s: Two independent 56 kbit/s audio channels are transmitted, one on each network interface.[1)] The left channel operates on Network A, the right channel on Network B. This is dual-channel operation. If you select D56 kbit/s, you automatically select G.722 Mode 2S for both channels.

D64 kbit/s: Two independent 64 kbit/s audio channels are transmitted, one on each network interface.[1)] This is dual-channel operation.

If you select D64 kbit/s, each channel can use either G.722 Mode 1 or G.722 Mode 2 format. You specify this in the Aux field, as shown in Table 5.6.

NOTE If G.722 is selected, and the bit rate changes to an invalid one for G.722, the codec automatically switches to Layer II. If the rate changes back to a valid one, G.722 coding is automatically re-selected.

Aux (Auxiliary Data Channel) Setting

With Layer II coding you can set the baud rate for the auxiliary data channel to any of the settings shown in Table 5.5.

Aux (Layer II)	Explanation
00	None
03	300 baud
06	600 baud
12	1200 baud
24	2400 baud
48	4800 baud
96	9600 baud
AS	ADR/DAB mode

Table 5.5 Auxiliary Data Channel, Layer II Coding

1) The two network paths must be clocked from the same master clock.

Aux (G.722)	Explanation[a)]
11	Aux. data is off for both Ch.A/Left and Ch.B/Right
12	Aux. data is off for Ch.A/Left. Aux. data is on for Ch.B/Right
21	Aux. data is on for Ch.A/Left. Aux. data is off for Ch.B/Right
22	Aux. data is on for both Ch.A/Left and Ch.B/Right

Table 5.6 Auxiliary Data Channel, G.722 Coding

a. Operation modes are those specified in ITU-T Rec. G.725 and ANSI T1.306.

In ADR (ASTRA Digital Radio) mode the codec is able to insert and extract a block of ancillary data into the Layer II frame, as specified in the ASTRA Standard, version 1.3. This standard also includes Scale Factor Protection (SCF-CRC) as specified in the standard ETS 300 401 Digital Audio Broadcast.

Furthermore, the codec is able to insert and extract ancillary data into the Layer II frame, as specified in the standard ETS 300 401 Digital Audio Broadcast. See Chapter 7.1 for further information.

With G.722 coding you can set the auxiliary data channel on or off for either network interface, using the settings shown in Table 5.6. At the same time, this determines which G.722 format the encoder uses. If you select 2, the auxiliary data channel is on and G.722 Mode 2 is selected. If you select 1, the auxiliary data channel is off and either Mode 1 or Mode 2S is used, depending on the transmission bit rate. If dual-channel operation is not enabled, the second digit in the Aux field shows a "–". The baud rate for auxiliary data is fixed at 9600 baud, though the auxiliary data is carried with an effective bit rate of 4.8 kbit/s.

NOTE Hardware handshaking is used by the encoder when G.722 is selected, and the PC (or other data source) must support this.

5.2 RE 660 Encoder, Remote Operation

The encoder can be configured via the rear panel Alarm-Remote connector. You can use either relays or TTL-signals to control the remote input. The alarm output is a relay with both normally-open and normally-closed contacts available. See "Alarm - Remote Connector" on page 35 for pin allocations.

To enable remote control, connect pin 3 in the Alarm-Remote connector to ground. Remote operation is indicated by the yellow LED "REMOTE" on the front panel. When remote control is enabled, you cannot use the front panel keys.

Remote control allows almost the same selections as control by means of the front panel keys, with the following exceptions:

- You can set the Auxiliary Data on/off, but you cannot select the baud rate for the RS-232 interface. The baud rate must be selected on the front panel.

- When you select G.722 dual-channel operation, you have a common selection of Mode 1/Mode 2 for the two channels. This setting is ignored if the transmission rate is 56 kbit/s, as Mode 2S is automatically selected.

An INVALID ENTRY signal is available at the remote control interface. This TTL-output is active (HIGH) if you set up an illegal remote entry; the red front panel LED INVALID ENTRY also lights.

If the encoder is set to external clock (See "Internal/External Clock Mode" on page 15) the bit rate selected on the remote control input is compared to the actual bit rate detected on the network interface. If the two bit rates differ, an INVALID ENTRY has been made.

While G.722 coding is selected, pins 5, 6, 7, 8, and 17, which determine Layer II coding mode and sampling frequency, are ignored.

The alarm relay is activated in the following situations:

- If the encoder is set to external clock, but no valid clock input is detected (NETWORK FAULT).

- If the Digital Audio Option is installed, and the digital audio input is selected, but no digital audio input signal is present (DIG. AUDIO LOSS).

Furthermore, the relay is active during power-down.

5.3 Combining Settings

5.3.1 Rate, Mode, and Sampling Frequency

Table 5.7 shows which combinations of transmission bit rate, coding mode and sampling frequency are valid in the RE 660 Encoder setup. Check-marked areas indicate valid combinations.

Table 5.7 applies for both the external and internal clock mode of the encoder.

Mode	Fs	Transmission bit rate															
		48	56	D56	64	D64	80	96	112	X56	128	X64	160	192	224	256	320	384
ST	16/22/24				✓		✓	✓	✓	✓	✓	✓	✓					
JST	16/22/24				✓		✓	✓	✓	✓	✓	✓	✓					
2CH	16/22/24				✓		✓	✓	✓	✓	✓	✓	✓					
1CH	16/22/24	✓	✓		✓		✓	✓	✓	✓	✓	✓	✓					
G.722[a)]	16		✓	✓	✓	✓												
ST	32/44/48				✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
JST	32/44/48				✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
2CH	32/44/48				✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
1CH	32/44/48	✓	✓		✓		✓	✓	✓	✓	✓	✓	✓	✓				

Table 5.7 Valid Combinations of Rate, Mode, and Sampling Frequency

a. G.722 can only use a sampling frequency of 16 kHz.

The bit rate is considered the "master" setting as the encoder has no control over the received network clock in external clock mode. For all parameters other than the bit rate, if you try to enter a value which would result in an invalid combination, the value is rejected. The "INVALID ENTRY" LED lights for about 5 seconds.

If the bit rate changes to a value which would result in an invalid combination, the mode and/or sampling frequency is forced to a valid setting. The user setting is saved and restored whenever the bit rate reverts to a value where the original setting is valid, even after a power disruption.

If you have selected the external clock, the following dependencies between the received network clocks and the selected bit rate exist:

- **If a bit rate of 48 or between 80 and 384 kbit/s is received on one or more of the network connectors,** this bit rate is selected, and the "INVALID ENTRY" LED lights if you try to select another.

- **If a bit rate of 56 or 64 kbit/s is received on one (and only one) of the network connectors,** this bit rate is selected, and the "INVALID ENTRY" LED lights if you try to select another.

  If you select G.722 mode together with a bit rate of 56 or 64 kbit/s (that is, single-channel operation), and the bit rate is then received on network connector B only, the text "NON" is shown as the rate in the encoder's display. A Network Fault alarm is also issued.

- **If a bit rate of 56 or 64 kbit/s is received on both Networks A and B,** and a Layer II coding mode is selected, you can select 56 or X56 if two 56 kbit/s clocks are received, or you can select 64 or X64 if two 64 kbit/s clocks are received. If you set the rate to 56 or 64 the setting retains that value when two clocks are received. If, however, you set it to any other value, the rate changes to X56 or X64 when two clocks are received.

  If G.722 mode is selected you can select either 56 or D56 with two 56 kbit/s clocks, or 64 or D64 with two 64 kbit/s clocks. The setting does not automatically change when two clocks are received but remains default set to 56, 64, D56 or D64.

- **If two clocks are received with different bit rates,** a NETWORK FAULT alarm is issued. The bit rate on network A is selected as the default, but you can select the other bit rate from the front panel. If you try to select a bit rate different from the two ones received the "INVALID ENTRY" LED lights.

5.3.2 Sampling Frequency and Rate

Table 5.8 shows which combinations of sampling frequency and bit rate are valid in the Layer II coding modes. Check-marked areas indicate valid combinations.

Fs		Transmission bit rate														
		48	56	64	80	96	112	128	X56	X64	160	192	224	256	320	384
"Lower"	16 kHz	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
	22 kHz	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
	24 kHz	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					
"Normal"	32 kHz	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	44 kHz	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	48 kHz	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Table 5.8 Valid Combinations of Rate and Sampling Frequency for Layer II

If the selected sampling frequency becomes invalid due to a change of bit rate, a "lower" Fs is changed to a "normal" sampling frequency as follows:

- 16 kHz is changed to 32 kHz
- 22 kHz is changed to 44 kHz
- 24 kHz is changed to 48 kHz

In G.722 mode, the only valid sampling frequency is 16 kHz. If you change the coding mode from one of the Layer II modes to G.722 the sampling frequency is forced to 16 kHz. In this case, the sampling frequency used for Layer II is restored the next time one of the Layer II modes is selected.

5.3.3 Mode and Rate

Table 5.9 shows which combinations of coding mode and bit rate are valid. Check-marked areas indicate valid combinations

Mode	Transmission bit rate																
	48	56	D56	64	D64	80	96	112	X56	128	X64	160	192	224	256	320	384
G.722		✓[a)]	✓	✓[a)]	✓												
ST						✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
JST						✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
2CH						✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
1CH	✓	✓		✓		✓	✓	✓	✓	✓	✓	✓	✓				

Table 5.9 Valid Combinations of Rate and Coding Mode

a. Network A only

If the selected mode becomes invalid due to a change of bit rate it changes to a valid one as follows:

- If 1CH becomes invalid, the mode changes to the preferred stereo mode. Preferred stereo mode means the stereo mode (ST, JST or 2CH) last selected by the user.
- If JST, ST or 2CH becomes invalid, the mode changes to 1CH.
- If G.722 becomes invalid, the mode changes to the last selected Layer II mode.

If DI has been selected as input, the received digital audio specifies the mode in the channel status. The channel status of digital audio can be received in two formats: AES/EBU (professional use) or S/PDIF (consumer use).

Selection of coding mode in the encoder is independent of the mode signaled in the digital audio, that is you can change the coding mode at any time. However, if the encoder detects a change in the mode signaled in the digital audio, or if input changes to DI (Digital Input), the encoder changes coding mode as shown in the table below.

AES/EBU channel mode change to	Comment	Encoder changes to mode
0000	Mode not indicated. Power-up setting	No change
0001	Two-channel mode	2CH
0010	Single-channel mode	1CH
0011	Primary/secondary mode	2CH
0100	Stereo mode	Preferred stereo[a)]
All other		No change

Table 5.10 AES/EBU Channel Mode Change and Encoder Coding Mode Change

a. Preferred stereo is the stereo mode last selected (ST, JST or 2CH).

If input is changed to AN (analog) input, the encoder changes back to the coding mode last selected by the user.

Note, that if the coding mode signaled in the channel status changes to an invalid mode, the encoder does not react to this change. Even if the coding mode changes to a valid mode at a later time, the encoder still takes no action.

5.3.4 Aux Rate

If the mode is set to one of the Layer II modes you can select any of the Aux rates 00, 03, 06, 12, 24, 48, and 96.

If G.722 is selected the baud rate is always set to 96.

See "ASTRA Digital Radio and Digital Audio Broadcast" on page 45 for further information.

5.3.5 G.722 Modes

With a bit rate of 64 kbit/s, the Aux data channel may be enabled by selecting G.722 Mode 2. This is not possible for 56 kbit/s. If the bit rate changes from 56 to 64 kbit/s, the Mode changes to the last G.722 Mode used with 64 kbit/s.

Table 5.11 shows which combinations of transmission bit rate and G.722 mode are valid. Check-marked areas indicate valid combinations.

G.722 modes	Transmission bit rate			
	56	64	D56	D64
11	✓	✓	✓	✓
12		✓		✓
21		✓		✓
22		✓		✓

Table 5.11 Valid combinations of Rate and G.722 mode

5.4 RE 661 Decoder, Remote Monitoring

The current setting of each of the front panel status display functions of the decoder can be monitored via the rear panel alarm-remote connector, with the exception of the baud rate of the auxiliary data RS-232 interface; an Auxiliary data channel on/off status output is provided, while the baud rate is only shown on the front panel.

The alarm output is a relay with both normally-open and normally-closed contacts available. The alarm relay is activated if no valid network input is detected (NETWORK FAULT), or the decoder is not able to synchronize to the received digital signal (FRAME LOSS). Frame loss occurs only if neither Layer II frames nor G.722 is received on any of the network interfaces. Furthermore, the relay is active during power-down.

5.5 RE 661 Decoder, Synchronization Principles

If the decoder detects Layer II on one Network interface and G.722 on the other, the following applies:

- If the two bit streams are detected at the same time, for example after power-up, the decoder locks to the Layer II signal.
- The decoder always remains locked to the bit stream currently being decoded. It only changes if synchronization is lost.
- If G.722 is detected on both Network interfaces, two channels of audio are output; the data from Network A is output on the Left channel, and the data from Network B is output on the Right channel. This is in contrast with redundant operation used for Layer II signals.

Example: G.722 is input on the Network A interface and Layer II on the Network B interface when power is applied. The decoder selects Layer II.

If the Layer II bit stream starts to fade and synchronization is lost, the decoder tries to synchronize on either interface. If it cannot re-synchronize to the Layer II bit stream, it selects the G.722 bit stream.

Even if the Layer II bit stream returns to the Network interface the decoder remains locked to the G.722 bit stream.

Frame Loss is only signaled if synchronization to either Layer II or G.722, on either Network interface, is not possible.

6. Connectors and Cables

6.1 Connector Pin Allocations

6.1.1 Analog Audio Connectors

Fig. 6.1 shows the pin allocation for the analog audio connectors:

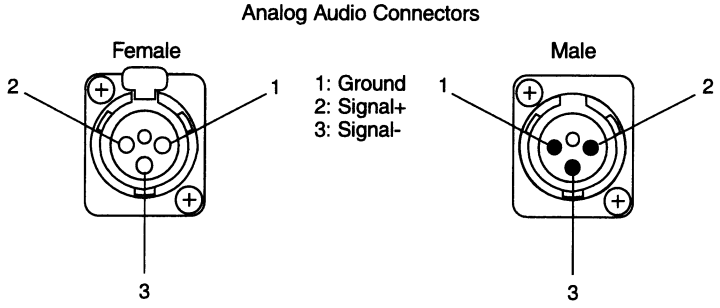


Fig. 6.1 Analog Audio Connectors

6.1.2 Digital Audio and SYNC Connectors

(Only with the Digital Audio Option installed.)

Fig. 6.2 shows the pin allocation for the digital audio connector:

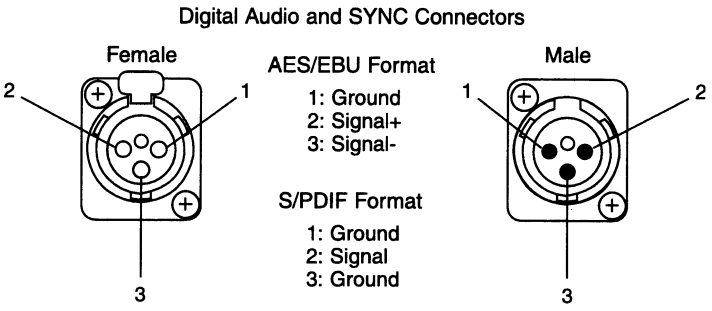
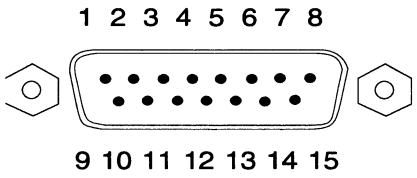


Fig. 6.2 Digital Audio Connector

6.1.3 Network Connectors

X.21 and RS-422 Connectors

Fig. 6.3 shows one of the two 15-pin male connectors for the X.21 and RS-422 interfaces, together with its pin allocation.



Pin	Description
1	Shield
2	Data output (a) (RE 660)
3	Clock output/Control Element[a)] (a) (RE 660)
4	Data input (a) (RE 661)
5	Indicator (a) (both)
6	Clock input (a) (both)[b)]
8	Signal ground
9	Data output (b) (RE 660)
10	Clock output/Control Element[a)] (b) (RE 660)
11	Data input (b) (RE 661)
12	Indicator (b) (both)
13	Clock input (b) (both)

a. If you use internal clock, pins 3 and 10 provide a clock output.

b. The clock input can be internally terminated in 100 Ω. All other inputs are unterminated

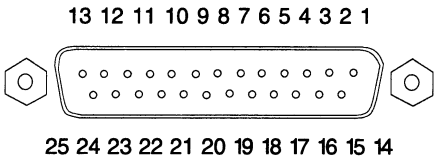
Fig. 6.3 The X21 and RS-422 Connectors

The remaining pins are not connected.

When the RE 660 Encoder is operated in internal clock mode, the unit disregards any input on pins 6 and 13. In external clock mode, pins 3 and 10 are inactive with the voltage on pin 10 greater than the voltage on pin 3, providing the X.21 specified control (C) signal.

V.35 Connectors

Fig. 6.4 shows one of the two 25-pin Sub-D female connectors for the V.35 interface.



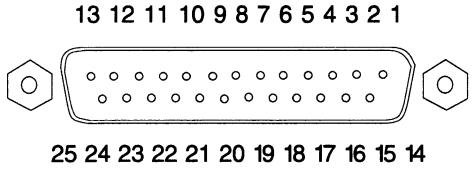
Pin	Description
1	Shield
2	Data output (a) (RE 660)
3	Data input (a) (RE 661)
4	RTS (both)
6	DSR (both)
7	Signal ground
12	Clock input (b) (RE 661)
13	Data output (b) (RE 660)
14	Clock input (b) (RE 660)
15	Clock input (a) (RE 660)
16	Data input (b) (RE 661)
17	Clock input (a) (RE 661)
20	DTR (both)

Fig. 6.4 The V.35 Interface Connector

The remaining pins are not connected.

6.1.4 Auxiliary Data Connector (RS-232 Connector)

Fig. 6.5 shows the 25-pin Sub-D female connector for the Auxiliary Data interface.



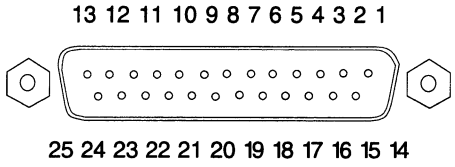
Pin	Description	
1	Protective ground	
2	Rx	Input
3	Tx	Output
4	CTS	Input
5	RTS	Output
6	DTR	Output (+9 V)
7	Signal Ground	
8	DCD	Output (+9 V)
22	RI	Output (+9 V)

Fig. 6.5 The Auxiliary Data Connector

The remaining pins are not connected.

6.1.5 Alarm - Remote Connector

Fig. 6.6 shows the Sub-D female connector for the alarm and remote control interface for both the encoder and the decoder.



Alarm delay output	
Normal operation	Pins 1 and 14 connected Pins 2 and 15 not connected
Alarm state	Pins 1 and 14 not connected Pins 2 and 15 connected

Ground and +5V	
Ground	Pins 16 and 25
+5 V (Z_{out} = 4.7 kΩ)	Pin 13

Fig. 6.6 The Alarm -Remote Connector

6.1.6 -20 to -75 V DC Power Supply

Fig. 6.7 shows the pin allocation for the DC power supply.

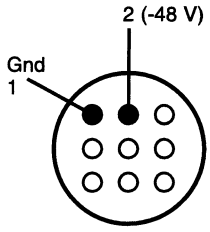


Fig. 6.7 DC Power Supply Connector

6.2 Remote Control of the Codec Inputs

6.2.1 Remote Control of the RE 660 Layer II Encoder (Inputs)

NOTE "H" means open or connected to +5 V. "L" means connected to ground.

Sampling frequency	Pin 17	Pin 6	Pin 5
16 kHz	L	L	H
22.05 kHz	L	L	L
24 kHz	L	H	H
32 kHz	H	L	H
44.1 kHz	H	L	L
48 kHz	H	H	H

Table 6.1 Sampling Frequency

Remote control	Pin 3
Enable	L
Disable	H

Table 6.2 Remote Control

Coding mode	Pin 18
G.722	L
Layer II	H

Table 6.3 Coding Mode

Layer II coding mode	Pin 8	Pin 7
Stereo	L	H
Joint stereo	H	H
Dual	L	L
Mono	H	L

Table 6.4 Layer II Coding Mode

G.722 coding mode	Pin 19
Mode 1 (Aux off)	L
Mode 2 (Aux on)	H

Table 6.5 G.722 Coding Mode

Audio inputs	Pin 4
Analog	H
Digital	L

Table 6.6 Audio Inputs (only with the Digital Audio Option installed)

Aux. data channel	Pin 19
Off	L
On[a)]	H

Table 6.7 Auxiliary Data Channel (Layer II Coding)

a. Position "On" provides the baud rate shown on the front panel display.

Invalid entry output	Pin 20
Invalid entry	High (+5 V)
No invalid entry	Low (0 V)

Table 6.8 Invalid Entry Output

Transmission bit rate	Pin 12	Pin 11	Pin 10	Pin 9
48 kbit/s	H	H	L	L
56 kbit/s	L	L	L	L
64 kbit/s	L	L	L	L
80 kbit/s	H	H	L	H
96 kbit/s	L	L	H	L
112 kbit/s	L	L	H	H
128 kbit/s	L	H	L	L
160 kbit/s	H	H	H	L
192 kbit/s	L	H	L	H
224 kbit/s	H	H	H	H
256 kbit/s	L	H	H	L
320 kbit/s	L	H	H	H
384 kbit/s	H	L	L	L
X56/D56 kbit/s	H	L	L	H
X64/D64 kbit/s	H	L	H	L

Table 6.9 Transmission Bit Rate

6.2.2 Remote Monitoring of the RE 661 Layer II Decoder

NOTE "H" means a logical 1 (+5 V). "L" means a logical 0 (0 V).

Sampling frequency	Pin 17	Pin 6	Pin 5
16 kHz	L	L	H
22.05 kHz	L	L	L
24 kHz	L	H	H
32 kHz	H	L	H
44.1 kHz	H	L	L
48 kHz	H	H	H

Table 6.10 Sampling Frequency[a)]

a. Settings remain unchanged if G.722 is selected.

Coding mode	Pin 18
G.722	L
Layer II	H

Table 6.11 Coding Mode

Layer II coding mode	Pin 8	Pin 7
Stereo	L	H
Joint Stereo	H	H
Dual	L	L
Mono	H	L

Table 6.12 Layer II Coding Mode[a)]

a. Settings remain unchanged if G.722 is selected.

G.722 mode	Pin 19
Mode 1(Aux off)	L
Mode 2(Aux on)	H

Table 6.13 G.722 Mode

Transmission bit rate	Pin 12	Pin 11	Pin 10	Pin 9
48 kbit/s	H	H	L	L
56 kbit/s	L	L	L	L
64 kbit/s	L	L	L	H
80 kbit/s	H	H	L	H
96 kbit/s	L	L	H	L
112 kbit/s	L	L	H	H
128 kbit/s	L	H	L	L
160 kbit/s	H	H	H	L
192 kbit/s	L	H	L	H
224 kbit/s	H	H	H	H
256 kbit/s	L	H	H	L
320 kbit/s	L	H	H	H
384 kbit/s	H	L	L	L
X56/D56 kbit/s	H	L	L	H
X64/D64 kbit/s	H	L	H	L
None	H	L	H	H

Table 6.14 Transmission Bit Rate

Aux. data channel	Pin 19
Off	L
On[a)]	H

Table 6.15 Auxiliary Data Channel

a. Position "On" provides the baud rate shown on the front panel display.

6.3 Cables

6.3.1 Back-to-Back Test Cable

The following cable, connected between the 15-pin Sub-D X.21/RS-422 input/output connectors, can be made for signal confidence checking of an RE 660 Encoder and RE 661 Decoder placed back-to-back. This test can be made by setting the clock selector to internal clock mode, allowing the codec to accept inputs, compress the audio information, decompress and restore audio information as if a digital network were connected. The codec may still be connected to public networks via the 25-pin Sub-D V.35 connectors while the tests are performed.

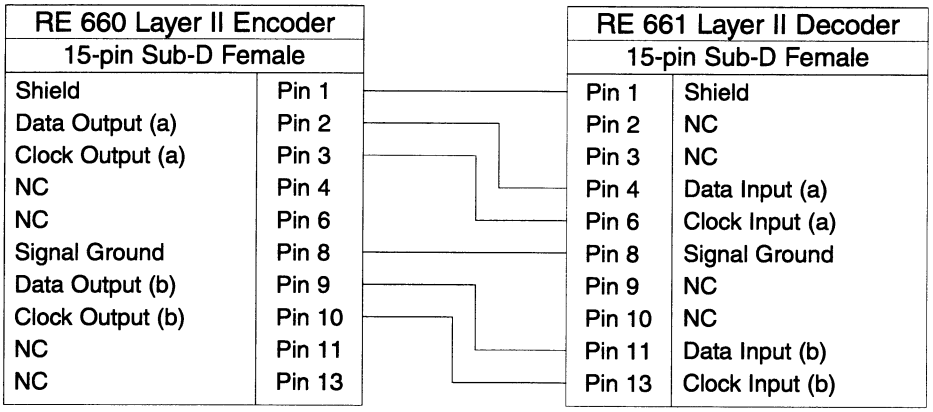
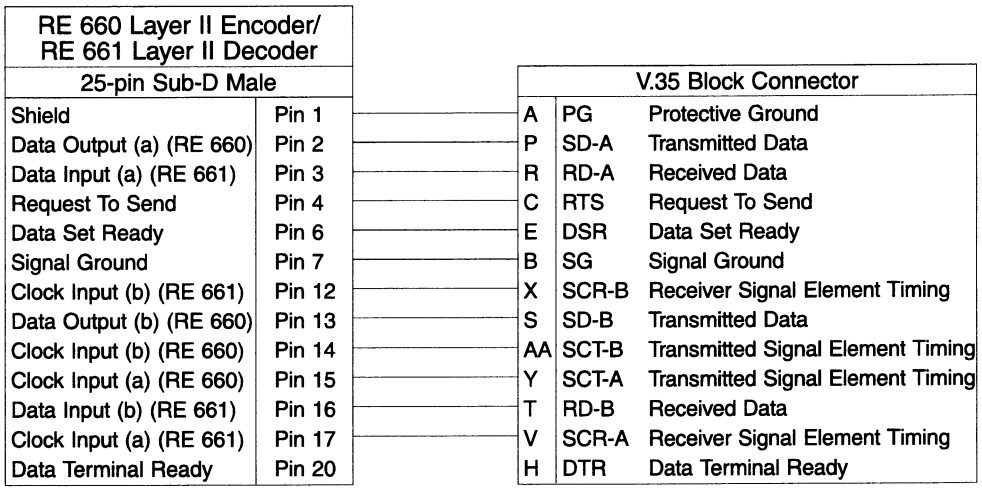


Fig. 6.8 Back-to-Back Test Cable

Please note that if internal clock mode is selected the X.21 specified control (C) output of the RE 660 Encoder is converted to a clock output (pins 3 and 10).

6.3.2 25-Pin Sub-D to V.35 Block Network Cable

The following wiring diagram for a 25-pin Sub-D to V.35 connection is shown as a common cable for use on the RE 660 Encoder or RE 661 Decoder.



RE 660 Layer II Encoder/ RE 661 Layer II Decoder					
25-pin Sub-D Male		V.35 Block Connector			
Shield	Pin 1	A	PG	Protective Ground
Data Output (a) (RE 660)	Pin 2	P	SD-A	Transmitted Data
Data Input (a) (RE 661)	Pin 3	R	RD-A	Received Data
Request To Send	Pin 4	C	RTS	Request To Send
Data Set Ready	Pin 6	E	DSR	Data Set Ready
Signal Ground	Pin 7	B	SG	Signal Ground
Clock Input (b) (RE 661)	Pin 12	X	SCR-B	Receiver Signal Element Timing
Data Output (b) (RE 660)	Pin 13	S	SD-B	Transmitted Data
Clock Input (b) (RE 660)	Pin 14	AA	SCT-B	Transmitted Signal Element Timing
Clock Input (a) (RE 660)	Pin 15	Y	SCT-A	Transmitted Signal Element Timing
Data Input (b) (RE 661)	Pin 16	T	RD-B	Received Data
Clock Input (a) (RE 661)	Pin 17	V	SCR-A	Receiver Signal Element Timing
Data Terminal Ready	Pin 20	H	DTR	Data Terminal Ready

Fig. 6.9 25-Pin Sub-D to V.35 Block Network Cable

6.4 Duplex Cable Wiring Diagram

For duplex transmissions where an RE 660 and RE 661 are co-located, the following cables can be used.

6.4.1 X.21/RS-422 to X.21/RS-422 Cable

The following diagram shows a typical cable assembly for X.21 or RS-422-A to similar connections:.

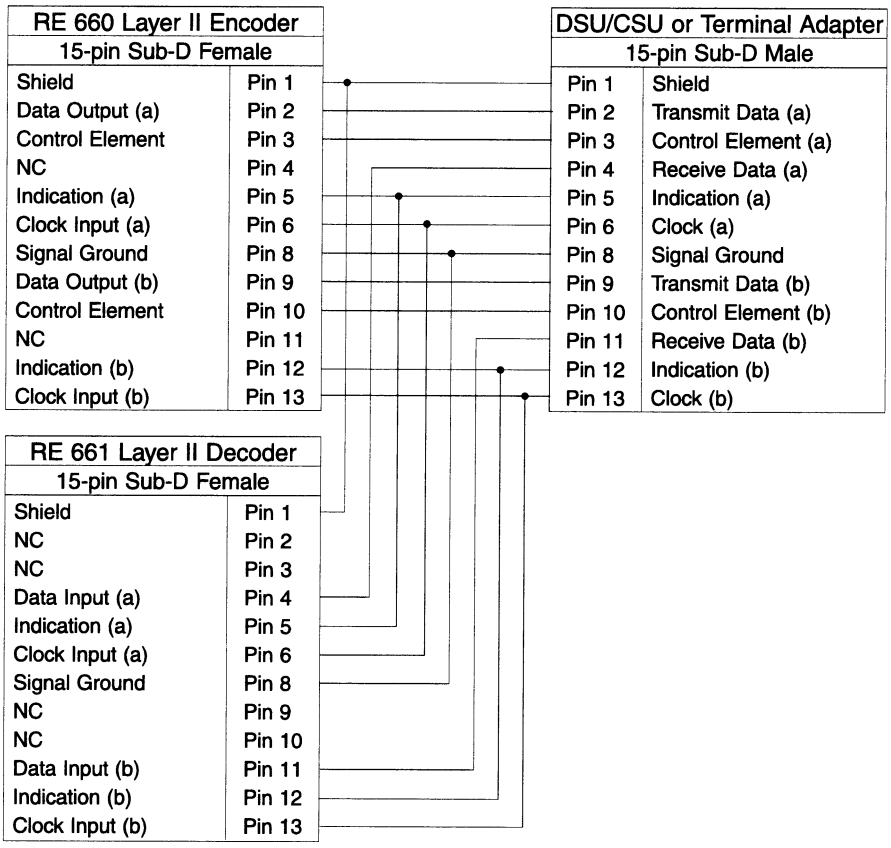


Fig. 6.10 X.21/RS-422 to X.21/RS-422 Cable

NOTE When inverse multiplexing of two times 56 kbit/s or two times 64 kbit/s, or when using the redundant back-up mode, two of the above assemblies are needed.

6.4.2 V.35 to V.35 Adapter Cable

The following diagram shows a typical cable assembly for V.35 to V.35 connections:

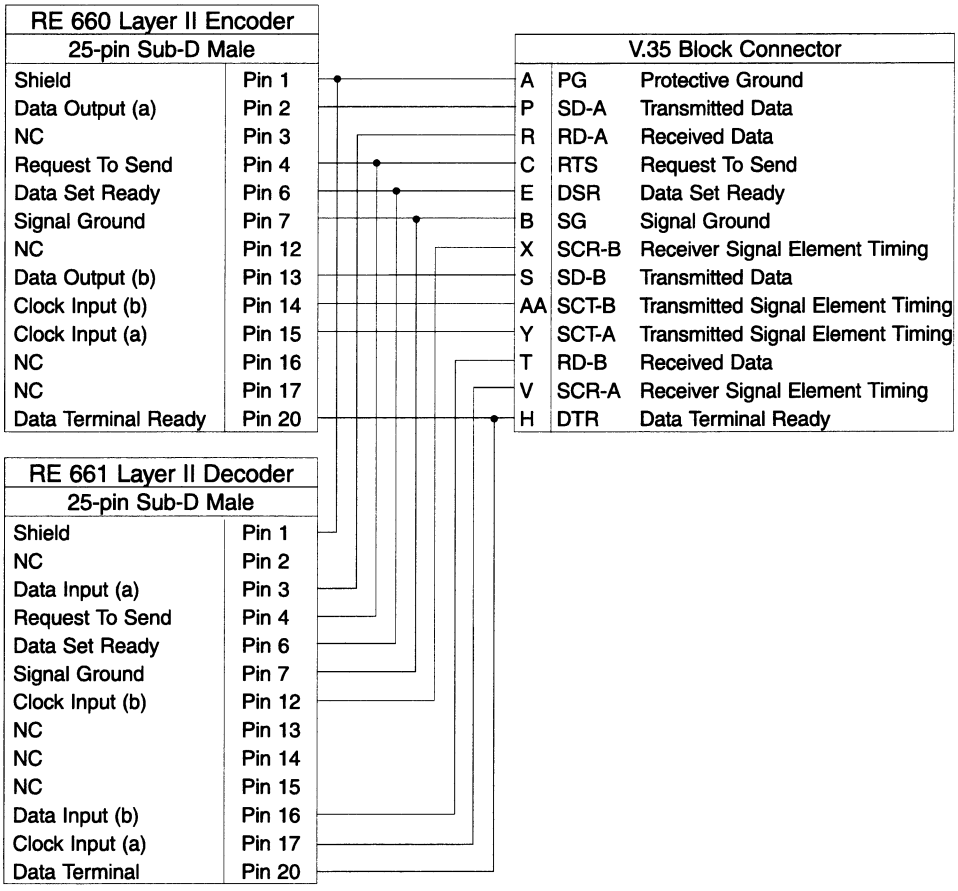


Fig. 6.11 V.35 to V.35 Adapter Cable

NOTE Some DCU/CSU or Terminal Adapters do not use a V.35 block connector for V.35 connections. Please refer to the manufacturer's pinout diagram for correct cable assembly.

When inverse multiplexing of two times 56 kbit/s or two times 64 kbit/s, or when using the redundant back-up mode, two of the above assemblies are needed.

7. Serial Interface

7.1 ASTRA Digital Radio and Digital Audio Broadcast

When delivered from RE TECHNOLOGY AS, the ADR (ASTRA Digital Radio) mode interface and the DAB (Digital Audio Broadcast) mode interface on the RE 660 and RE 661 Codec are disabled.

In the RE 660 Encoder, the ADR/DAB mode can be enabled and covers both the ADR mode and the DAB mode.

The RE 661 Decoder, however, needs to be set up to receive ancillary data in the Layer II frame formatted as specified in the ASTRA standard or the Digital Audio Broadcast standard.

In order to enable the ADR or the DAB interface, connect a PC to the RE 660 and RE 661 Layer II Codec using the RS-232 Sub-D connector, and open a terminal program. Any standard terminal program can be used for communication with the codec.

Note, that the communication parameters are set to 8N1, 9600 baud. The PC must support hardware handshaking. On the RE 660, the Aux field in the status display must show "00" or "96".

To enable the interface, do the following:

1. Enter the command `!!!` to bring the codec into SERVICE mode. The Status Display on the codec now shows SERVICE MODE.
2. If you are setting up an RE 660 Encoder, type the command `AS,1`, and press [ENTER] to enable the ADR/DAB mode for the encoder.

or

   If you are setting up an RE 661 Decoder, type the command `AS,1` and press [ENTER] to enable the ADR mode, or type the command `AS,2` and press [ENTER] to enable the DAB mode.

3. Type the command `rr`, and press [ENTER] to bring the codec back to the normal operation mode again.

If the RE 661 is forced into ADR mode, ancillary data in the Layer II frame is always decoded as ASTRA auxiliary data, and the Aux field of the status display on the RE 661 always shows AS.

If the RE 661 is forced into DAB mode, ancillary data in the Layer II frame is always decoded as DAB auxiliary data, and the Aux field of the status display on the RE 661 always shows DA.

To disable the interface, do the following:

1. Enter the command `!!!` to bring the codec into SERVICE mode. The Status Display on the codec now shows SERVICE MODE.
2. Type the command `AS,0`, and press [ENTER].
3. Type the command `rr`, and press [ENTER] to bring the codec back to the normal operation mode again.

This procedure must be carried out on both the RE 660 Layer II Encoder and the RE 661 Layer II Decoder.

7.2 Software Upgrades

Equipment Requirements

A computer equipped with a COM port and a 3 1/2" disk drive, which is able to read a DOS formatted disk. A standard RS-232 cable (one-to-one).

How to Update

1. Insert the software update disk from RE TECHNOLOGY AS in the computer disk drive.
2. Read the **README.TXT** ASCII file on the disk.
3. Follow the instructions in the file.

8. Equipment and Accessories

This chapter contains a list of the accessories supplied with the RE 660 and RE 661 Layer II Codec and a list of optional equipment and accessories.

8.1 Standard Equipment and Accessories

The following equipment and accessories should be found when unpacking the RE 660 Layer II Encoder or the RE 661 Layer II Decoder.

Order number	Description
395-024	RE 660 Layer II Encoder **or**
395-025	RE 661 Layer II Decoder
983-474	Operator Manual

Table 8.1 Standard Equipment and Accessories

8.2 Optional Equipment and Accessories

The following optional equipment and accessories can be ordered for the RE 660 and RE 661 Layer II Codec.

Order number	Description
902-416	Digital Audio Input Option
902-417	Digital Audio Output Option
983-486	Service Manual

Table 8.2 Optional Equipment and Accessories

9. Specifications

Analog Audio Specifications

Type of connector	3-pin XLR, female for inputs and male for outputs
Companding	ISO/MPEG Layer II or G.722
A/D and D/A converter resolution	16 bits sigma-delta, 64/128 times oversampling
Sampling frequency	Selectable: 16, 22.05, 24, 32, 44.1 or 48 kHz
Input impedance	600 Ω or > 25 kΩ, balanced
Output impedance	600 Ω or < 60 Ω, balanced
Clipping level	21, 18, 15, 12, 9, 6, 3, 0, -3 dBu
Output level	
Low output impedance	24, 21, 18, 15, 12, 9, 1, -2, -5 dBu
600 Ω output impedance into 600 Ω load	18, 15, 12, 9, 6, 3, -5, -8, -11 dBu
Insertion gain	0 dB ±0.2 dB

Layer II coding[1)]

Frequency response[2)]	±0.3 dB relative to 1 kHz
Fs = 16 kHz	20 to 7,500 Hz
Fs = 22.05 kHz	20 to 10,300 Hz
Fs = 24 kHz	20 to 11,250 Hz
Frequency response	±0.15 dB relative to 1 kHz
Fs = 32 kHz	20 to 14,500 Hz
Fs = 44.1 kHz	20 to 20,000 Hz
Fs = 48 kHz	20 to 20,000 Hz
Total harmonic distortion	
3 dB below clippling, 1 kHz	< -80 dB at 1 kHz

1) The analog audio specifications are given for a codec pair coupled back-to-back at 384 kbit/s stereo transmission rate unless otherwise indicated

2) This specification is given for a codec pair coupled back-to-back at 128 kbit/s stereo transmission rate.

SINAD	
3 dB below clippling, 1 kHz	< -60 dB at 1 kHz
Idle channel noise, +15 dBm0 clipping	
Quasipeak, unweighted	< -67 dBq0
Quasipeak, weighted	< -60 dBq0ps
RMS, unweighted	< -71 dBm0
Signal-to-Noise ratio	> 86 dB
Crosstalk	< -85 dB
Phase difference between channels	< 3 °
Delay	
Fs = 16 kHz	< 310 ms
Fs = 22.05 kHz	< 225 ms
Fs = 24 kHz	< 210 ms
Fs = 32 kHz	< 160 ms
Fs = 44.1 kH	< 120 ms
Fs = 48 kHz	< 110 ms

Maximum Bandwidth vs. Bit Rates and Audio Modes											
Bit Rate (kbit/s)	Audio Mode				Bandwidth (kHz) vs. Sampling Frequency						
	Mono	Dual	Stereo	Joint Stereo		16 kHz	22.05 kHz	24 kHz	32 kHz	44.1k Hz	48 kHz
48	✓				1 ch	7.5	10.3	11.2	4.0	5.5	6.0
56	✓				1 ch.	7.5	10.3	11.2	6.8	9.4	10.2
64	✓	✓	✓	✓	1 ch.	7.5	10.3	11.2	6.8	9.4	10.2
					2 ch.	7.5	10.3	11.2	6.0	5.5	6.0
80	✓	✓	✓	✓	1 ch	7.5	10.3	11.2	15.0	20.6	20.2
					2 ch	7.5	10.3	11.2	-	-	-
96	✓	✓	✓	✓	1 ch.	7.5	10.3	11.2	15.0	20.6	20.2
					2 ch.	7.5	10.3	11.2	6.0	5.5	6.0
112[a)]	✓	✓	✓	✓	1 ch.	7.5	10.3	11.2	15.0	20.6	20.2
					2 ch.	7.5	10.3	11.2	6.8	9.4	10.2
128[a]	✓	✓	✓	✓	1 ch.	7.5	10.3	11.2	15.0	20.6	20.2
					2 ch.	7.5	10.3	11.2	6.8	9.4	10.2
160	✓	✓	✓	✓	1 ch	7.5	10.3	11.2	15.0	20.6	20.2
					2 ch	7.5	10.3	11.2	15.0	20.6	20.2
192	✓	✓	✓	✓	1 ch.	-	-	-	15.0	20.6	20.2
					2 ch.	-	-	-	15.0	20.6	20.2
224		✓	✓	✓	1 ch	-	-	-	15.0	20.6	20.2
					2 ch	-	-	-	15.0	20.6	20.2
256		✓	✓	✓	2 ch.	-	-	-	15.0	20.6	20.2
320		✓	✓	✓	2 ch.	-	-	-	15.0	20.6	20.2
384		✓	✓	✓	2 ch.	-	-	-	15.0	20.6	20.2

Table 9.1 Maximum Bandwidth vs. Bit Rates and Audio Modes

a. In the joint stereo mode the bandwidth is: 32 kHz sampling rate 13.5 kHz, 44.1 kHz sampling rate 18.6 kHz, 48 kHz sampling rate 20.2 kHz.

G.722 Coding

Frequency Response	±0.3 dB, 20 to 6400 Hz
relative to1 kHz	+0.3/-3.0 dB, 20 to 7000 Hz
Total Harmonic Distortion	
3 dB below clipping, 1 kHz	< -50 dB
SINAD	< -46 dB, 64 kbit/s Mode 1
3 dB below clipping, 1 kHz	< -40 dB, 64 kbit/s Mode 2, 56 kbit/s
Idle Channel Noise, +15 dBm0 clipping	

Quasipeak, unweighted	< -55 dBq0
Quasipeak, weighted	< -44 dBq0ps
RMS, unweighted	< -60 dBm0
Signal-to-Noise ratio	> 75 dB
Delay	< 10 ms
Group Delay Variation	< 0.05 ms

Auxiliary Data Channel Specifications

Type of connector	25-pin Sub-D, female
Baud rate	
Layer II	300, 600, 1200, 2400, 4800 or 9600 baud
G.722[3)]	9600 baud
Mode	8 data bits, no parity bit, and 1 stop bit (8N1)
Data flow control	Hardware handshake

Network Interface Specifications

Interface	Two times V.35, and two times X.21/RS-422-A
Type of connector	Two 25-pin, Sub-D female for V.35, two 15-pin, Sub-D, male for X.21/RS-422-A
Bit rate	48, 56, 64, 80, 96, 112, 128, 160, 192, 224, 256, 320 or 384 kbit/s
Mode of operation	
Layer II:	Split mode merging two times 56/64 into 112/128 kbit/s, redundant or single line
G.722:	Single- or dual-channel, 56 or 64 kbit/s per channel
Split mode delay equalization	Max. 0.5 s
Lock range	±100 ppm

3) The effective bit rate, when using G.722 is limited to 4.8 kbit/s

Digital Audio Specifications

(Only when the Digital Audio Option is installed)

Type of connector	3-pin XLR, female for inputs and male for outputs
Data format	AES/EBU or S/PDIF
Impedance	110 Ω, balanced or 75 Ω, single ended
Lock range	±400 ppm

General Specifications

Environmental Conditions	
Storage temperature	-40 to 70 °C (-40 to 158 °F)
Operating temperature	5 to 45 °C (41 to 113 °F)
Relative humidity	20 to 80 %, non-condensing
Power Supply AC	
Input voltage	90 to 250 V AC
Frequency	47 to 65 Hz
Power consumption	Approximately 26 VA per terminal
Type of connector	IEC 320 inlet with 2 fuses
Power Supply DC	
Input voltage	-20 to -75 V DC
Power consumption	Approximately 20 W per terminal
Type of connector	9-pin AMP
EMC compliance	EN 55022, B, and EN 50082-1
Safety compliance	EN 60950
Dimensions and Weight	
Height	44.5 mm (1.75")
Width	482 mm (19")
Depth	310 mm (12.2")
Weight	Approximately 2.5 kg (5.5 lbs)
Shipping weight	Approximately 8.9 kg (19.6 lbs)
Data subject to change	

10. Glossary

The following is a list of the abbreviations used in this Operator Manual.

AC	Alternating Current
ADC	Analog to Digital Converter
AES	Audio Engineering Society
ATM	Asynchronous Transfer Mode
BSW	Bank SWitch signal
CRC	Cyclic Redundancy Check
CTS	Clear To Send
DAC	Digital to Analog Converter
DC	Direct Current
DCE	Data Communication Equipment
DSP	Digital Signal Processor
DSR	Data Set Ready
EBU	European Broadcasting Union
EMC	Electro-Magnetic Compatibility
EPROM	Erasable and Programmable Read Only Memory
IEC	International Electrotechnical Commission
ISDN	Integrated Services Digital Network
ITU-R	International Telecommunications Union-Radiocommunication Sector
ITU-T	International Telecommunications Union-Telecommunication Sector
LED	Light Emitting Diodes
MPEG	Moving Picture Expert Group
MSB	Most Significant Bit
PCB	Printed Circuit Board
RAM	Random Access Memory
RTS	Request To Send
SINAD	SIgnal to Noise ratio And Distortion

S/PDIF	Sony/Philips Digital InterFace
STL	Studio to Transmitter Link
TTL	Transmitter-Transition Logic
UART	Universal Asynchronous Receiver Transmitter

11. Index

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