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NICAM ENCODER

NE 728

TECHNICAL MANUAL

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CONTENTS

CONTENTS	i.1
SECTION I GENERAL INFORMATION	1.1
1 Introduction	1.1
2 General description	1.1
3 NE728 Versions	1.2
4 Possible basic combinations	1.4
4.1 Basic version with Modulator	1.4
4.2 Intercarrier version with demodulator	1.5
SECTION II SPECIFICATIONS	2.1
SECTION III INSTALLATION & OPERATION	3.1
1 Power connection	3.1
2 Front panel	3.3
3 Input and outputs	3.4
Nicam Encoder board	3.4
QPSK Modulator board	3.5
Mains input	3.6
Audio connectors	3.6
Remote 1 connector	3.7
Remote 2 connector	3.8
4 Functional description	3.8
4.1 Layout	3.9
4.2 Encoder	3.10
4.3 QPSK Modulator	3.10
4.4 IF Combiner & mixer	3.10
4.5 Jumper settings	3.11
4.6 Operating modes	3.12
SECTION IV RACK MOUNTING	4.1
SECTION V BLOCK SCHEMATIC DIAGRAM	5.1
SECTION VI SCHEMATIC DIAGRAMS	6.1
1. NICAM ENCODER	
2. INTERCARRIER OPTION BG/I	
3. QPSK MODULATOR BG/I	
4. FRONT PANEL	
5. REAR PANEL	
6. POWER SUPPLY	
OPTIONS	
ASSEMBLY SETS	

SECTION I

GENERAL INFORMATION

1 Introduction

This manual contains all information required to install and operate the NE728 Nicam Encoder. Do not switch on the NE728 before having read this manual first.

2 General Description

The NE728 is a stand alone NICAM encoder-modulator.

It contains a baseband audio to NICAM encoder, a digital QPSK modulator and several audio switching options which allow the unit to be compatible with the CATV products of Barco's 200 and 1000 series.

The unit can be used in several ways :

- NICAM encoder with data and clock outputs
- QPSK modulator with intercarrier output
- QPSK modulator with IF output
- NICAM encoder/QPSK modulator with intercarrier output
- NICAM encoder/QPSK modulator with IF output

The conversion of intercarrier to IF frequencies can be accomplished in different ways :

- by mixing the intercarrier with an external unmodulated vision carrier
- by mixing the intercarrier with an external modulated vision carrier
- by mixing the intercarrier with an internal vision carrier which is also available at the rear of the NE728

In any case the IF coming from the modulator has to be looped through via the NE728 and the NICAM IF is automatically added to the IF output signal.

The NE728 can be upgraded with a NICAM demodulator/decoder which allows frequency translation of the NICAM spectrum with possibly another spectrum shaping. This is done by demodulation to data/clock and afterwards re-modulation. In the meantime, the spectrum is cleaned up.

In this case, analog outputs are provided to monitor the NICAM encoded audio.

The NE728 built-in features are :

- State-of-the-art electronic design using digital signal processing techniques for both encoder and modulation functions, ensuring extremely high reliability.
- Temperature controlled crystal oscillator providing very high stability of both bitrate and frequency modulation.
- Excellent audio S/N ratio.
- Very low total harmonic distortion.
- Easy operation, possibly from a remote location.
- Compact mechanical design.
- Compatible with 200 and 1000 series modulators.

3 NE728 Versions

3.1 NE728 basic version

= 1 encoder + 1 QPSK modulator

The basic version provides the following possibilities:

- NICAM encoding of analog program or local audio with data&clock outputs (program/local remote selection via control lines).
- Selection of encoding mode: stereo/dual sound (switching via switches on front panel or from remote if front settings overruled) and setting of the NICAM reserve sound switching flag (C4 bit) in the NICAM.
- QPSK modulation to intercarrier and IF, of internally generated or external data&clock signals.
- Output of modulated intercarrier signal.
- Vision carrier regeneration from the incoming IF for mixing the NICAM spectrum with this IF signal.

Option 1113: internal vision carrier generation

- the vision carrier is generated from an internal Local Oscillator. In this case the vision carrier is also provided as an output.

Option 1114: external vision carrier

- the vision carrier is fed from an external source

3.2 NE728 with intercarrier input

= 1 encoder + 1 QPSK modulator + 1 QPSK demodulator + 1 NICAM decoder

The version with intercarrier input provides the following possibilities:

- All features of the basic version.
- QPSK demodulation of a modulated intercarrier signal, either the internally generated intercarrier signal (case a) or an externally fed intercarrier signal (case b) ; data and clock signals of this demodulated signal are provided as outputs.
- NICAM decoding of these demodulated data and clock signals to analog audio, provided as audio monitoring outputs

This version can be used in the following configurations:

- 1. Monitoring:** the demodulated/decoded intercarrier signal is the same as the one that is converted to IF. This mode enables the performance of the equipment to be remotely monitored from a dispatching unit.
- 2. Re-modulation:** the incoming intercarrier signal is demodulated to data&clock and can be re-modulated to a new intercarrier. Intercarrier frequency and roll-off depend on the standard. The data&clock signals are provided as outputs, together with the new intercarrier spectrum.

The same two options (1113 & 1114) as in the basic version are available.

3.3 NE728 with encoder only; without QPSK modulator

= 1 encoder

- Nicam encoding of analog program or local audio with data&clock outputs (program/local remote selection via control lines).
- Selection of encoding mode: stereo/dual sound (switching via switches on front panel or remote if front settings overruled) and setting of the NICAM reserve sound switching flag (C4 bit) in the NICAM.

NE 728 NICAM ENCODER:

▶ NE 728 NICAM ENCODER WITH QPSK MODULATOR:

▶ BASIC VERSION: NO DECODER:

- 1) DEFAULT: VISION CARRIER RE-GENERATION
- 2) OPTION 1113: INTERNAL 38.9 MHz GENERATION
- 3) OPTION 1114: 38.9 MHz REFERENCE INPUT

▶ VERSION WITH INTERCARRIER INPUT:

▶ 1) DEMODULATION OF EXTERNAL INTERCARRIER (RE-MODULATION):

- 1.1) DEFAULT: VISION CARRIER RE-GENERATION
- 1.2) OPTION 1113: INTERNAL 38.9 MHz GENERATION
- 1.3) OPTION 1114: 38.9 MHz REFERENCE INPUT

▶ 2) DEMODULATION OF INTERNAL INTERCARRIER (MONITORING):

- 2.1) DEFAULT: VISION CARRIER RE-GENERATION
- 2.2) OPTION 1113: INTERNAL 38.9 MHz GENERATION
- 2.3) OPTION 1114: 38.9 MHz REFERENCE INPUT

▶ NE 728 NICAM ENCODER WITHOUT QPSK MODULATOR:

▶ BASIC VERSION: ENCODER ONLY

▶ VERSION WITH INTERCARRIER INPUT

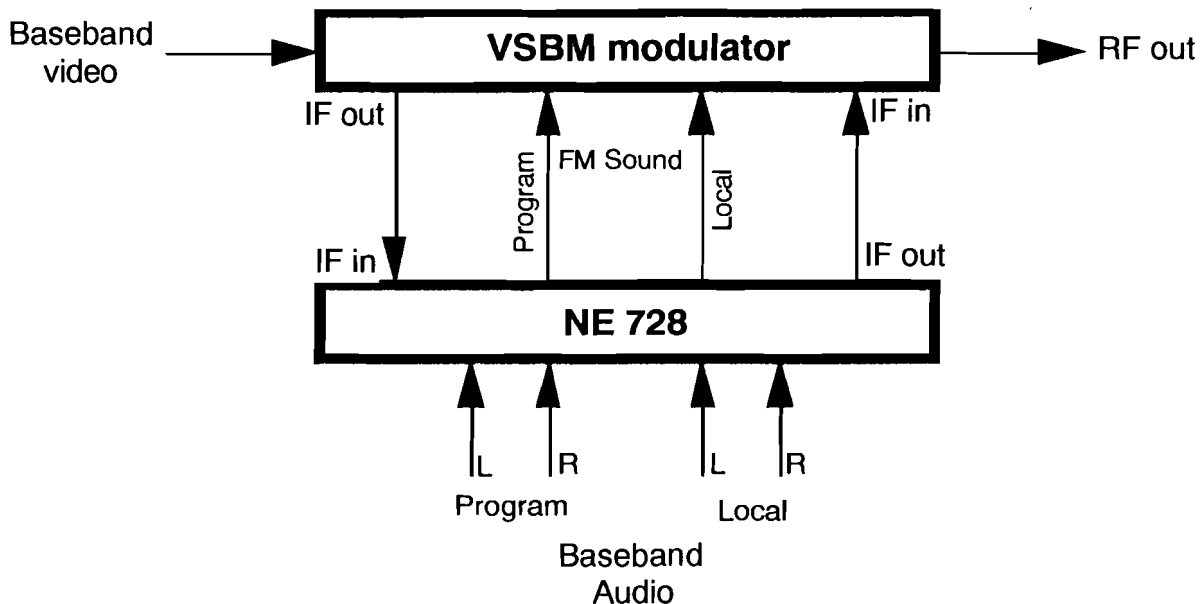
4 Possible basic combinations with Barco equipment.

4.1 Basic version in combination with a BARCO modulator:

4.1.1 With baseband audio:

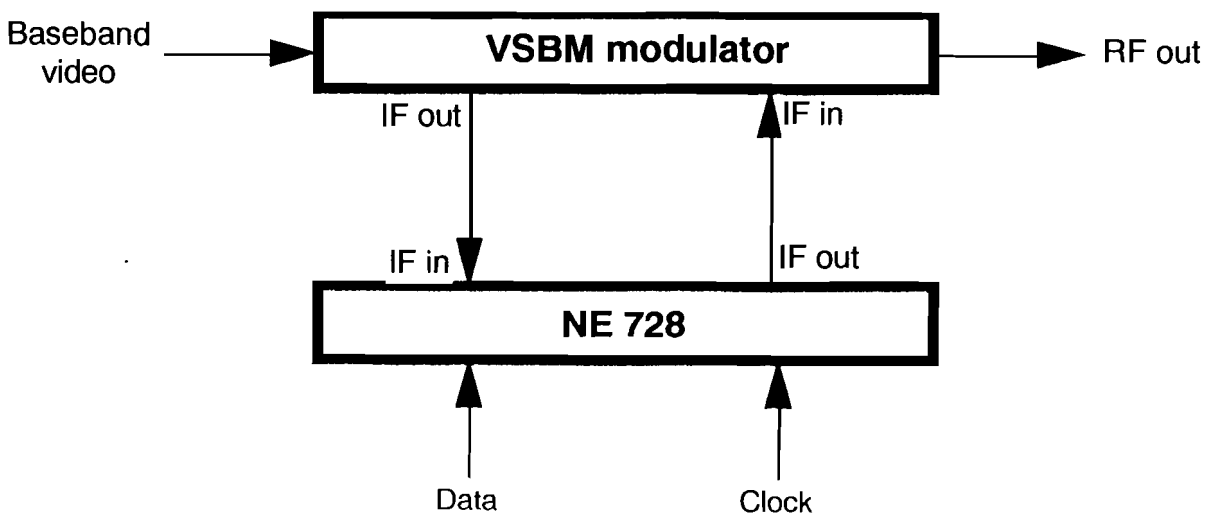
The first method uses the baseband audio inputs left and right and a combined IF coming from the IF loop of the VSBM.

The output is the same combined IF with video and a modulated audio carrier plus the modulated Nicam carrier added to the IF frequency of 33.05MHz. This output is then connected to the IN part of the IF loop leading directly to the UP convertor.

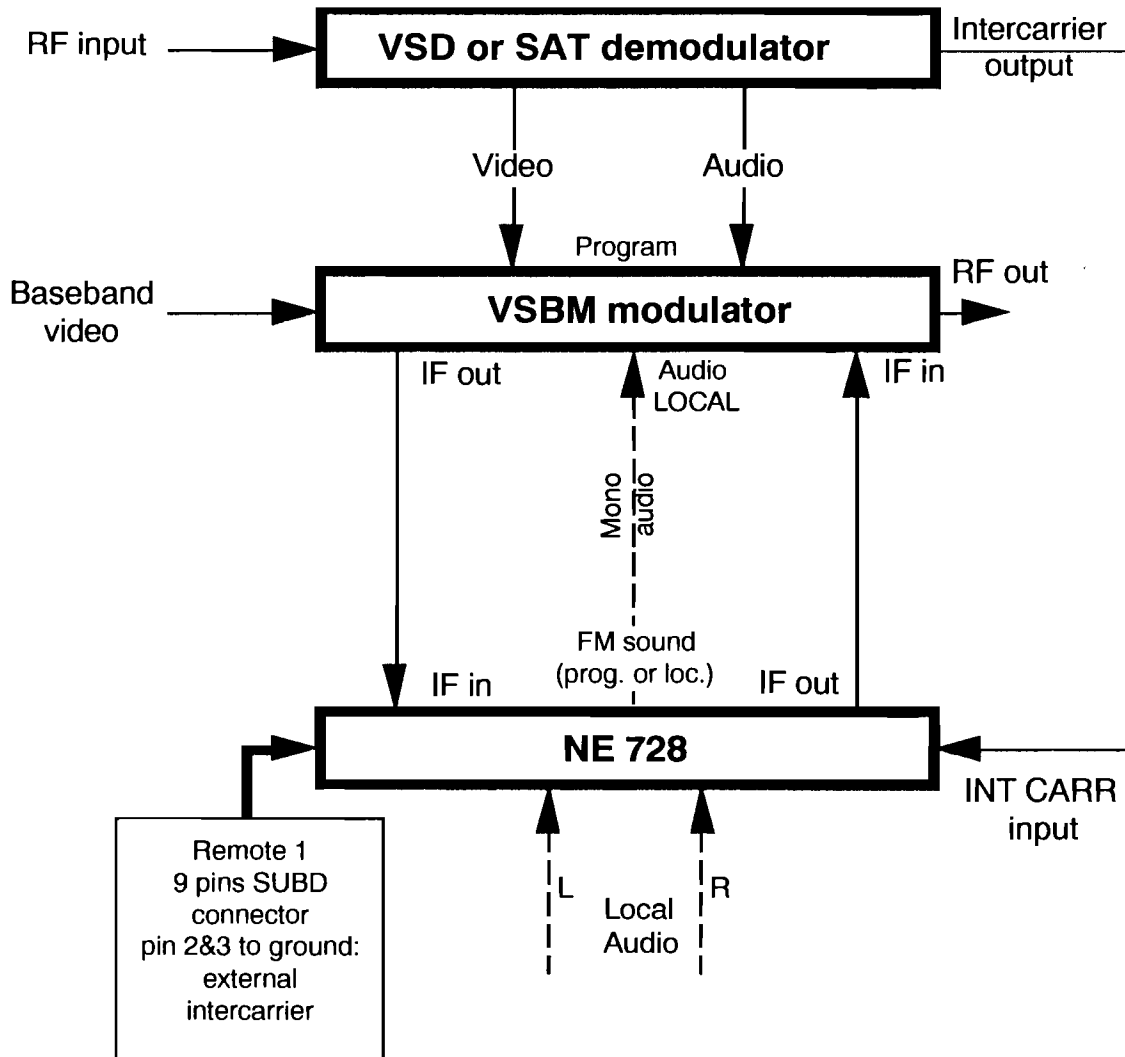


4.1.1 With Data & Clock:

The second method is identical to the first but enters Data and Clock in the NE 728 instead of the BB audio left and right.



4.2 Intercarrier version in combination with a BARCO demodulator & modulator:



SECTION II

SPECIFICATIONS

1 General

Mains voltage	110 Vac \pm 10%
	220 Vac \pm 10%
Mains frequency	48 - 62 Hz
Power consumption	max 60 W
Ambient temperature	Within specs +15 to +25 °C
Weight	6,3 kg

2 Input signal

The input signals have to comply with the "EBU specification for transmission of two-channel digital sound with terrestrial television systems BG and I".

Audio input:

Input level	0dBu for NICAM test level (775mV rms)
Overload (digital)	12dBu @ 15kHz (3.1V rms)
Input impedance	600 Ω / 10k Ω (int. switchable: see page 3.11)
CMRR (Common Mode Rejection Ratio)	>40dB for frequencies<1kHz

Data and clock

Input level clock)	1Vpp<...<7Vpp (data changes on negative transitions of
Input impedance	75 Ω
Connector	BNC

IF input

Minimum level	40dBmV
Impedance	50 Ω
Return loss	>18dB

3 Output signals

FM sound program & local:

Mono mode output	M1 (left)
Stereo mode output	(A+B)/2
Gain	-6 dB
Output impedance	50 Ω balanced
Connector	solderless contact strip
Frequency response	+/-0.1dB (20Hz - 20kHz)
Signal to noise ratio	> 85 dB (weighted, ref = 0dBu)
Harmonic distortion	< 0.01 %
Crosstalk	>85dB

Data and clock

Output level	-2.5V -> +2.5V (data changes on negative transitions of clock)
Output impedance	75 Ω
Connector	BNC

IF output

IF loop through loss	1.5dB
NICAM output power	-32 to -22dBm (10 dB adjustable)
Connector	BNC

Intercarrier

Output level	0dBm
Impedance	50
Connector	BNC

4 Encoder

Sampling rate	12.288MHz (384x oversampled)
Resolution	16 bit
Companding	NICAM -728, compressed to 10bits + 1 parity
Preemphasis	CCITT J17
Clock frequency	728kHz
Accuracy	+/- 2ppm

5 Decoder

Decoder eyeheight	>90%
Frequency response	+/-0.2dB (20Hz - 14.4kHz)
Group delay	<150ns
Digital anti-alias filter	roll off=10% @ 16kHz
Harmonic distortion	<0.05% @ 1kHz
S/N ratio	> 75 dB (weighted, ref = 0dBu)
Crosstalk	>75dB

6 Modulator

Modulation format	DQPSK (Differential Quadrature Phase Shift Keying)
Bit rate	728kbps
Inter-carrier frequency	5.85 MHz (BG), 6.552 MHz (I) (additional programmed intercarrier frequencies at customer's request)
Spectrum shape	$\sqrt{\cos}$ roll off: BG=40%, I=100%
Spurious responses	<50dB

SECTION III

INSTALLATION & OPERATION

1 Power connection

CAUTION

When installing the NE728, do not restrict free air flow through the cooling fins on the left and right sides of the unit.

Before any other connection is made, the unit must be connected to a protected earth terminal in one of the following ways :

- via the protected earth terminal.



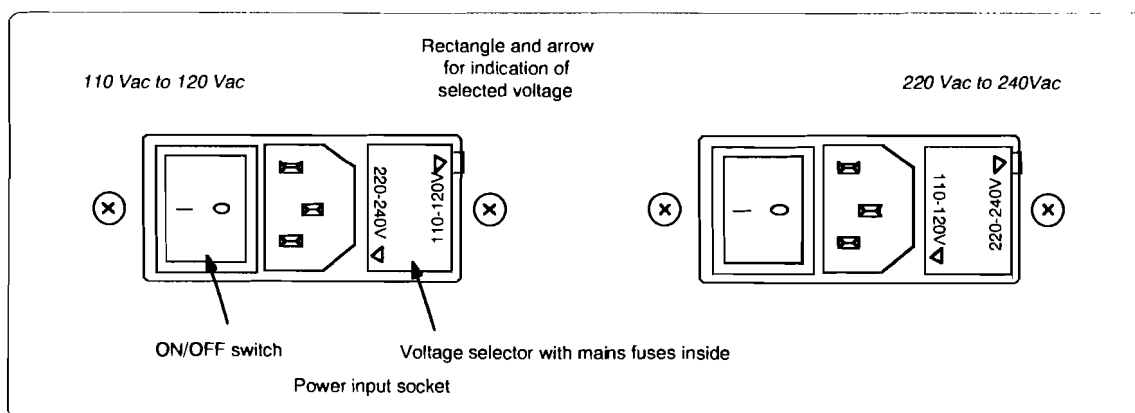
- via the three-wire power cable.

Before connecting the unit to the mains of the building installation, the proper functioning of the protected earth lead of the building installation needs to be verified.

WARNING

Failure to ground the unit properly can result in personal injury. Do not defeat the earth-grounding protection by using an extension cable, power cable or autotransformer without a protective ground conductor.

Check if your ac power source voltage corresponds to the appropriate power input voltage for the apparatus, noted on the voltage selector on the rear panel.
The voltage selector is part of the power input connector and has two positions, 110-120V and 220-240V as shown on the figure below :



The voltage selector plugs into the power input connector and also contains the mains fuses, one for 110-120V and another one for 220-240V.

The mains connector is specially made for safety. It is impossible to change the mains fuses or alter the operating voltage without removing the mains cable first.

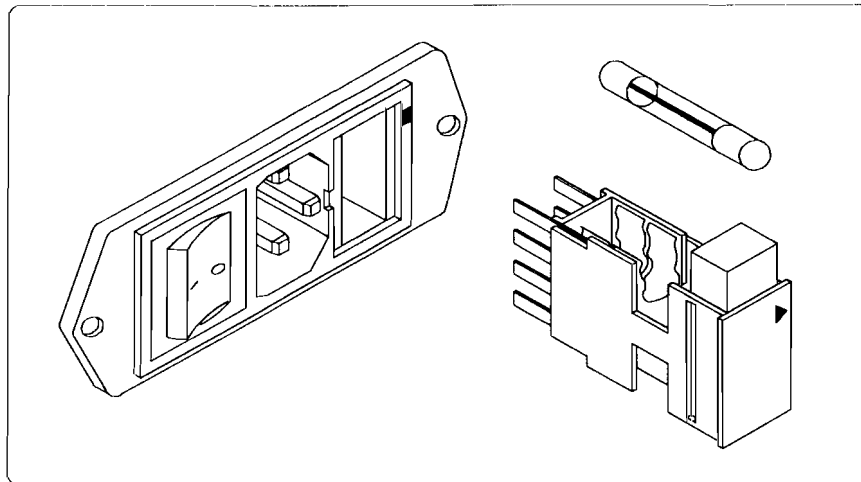
To change the power voltage, disconnect the power cable. Pull out the voltage selector and rotate it through 180°. The small white rectangle on the power connector should face the arrow on the voltage selector which corresponds to the correct voltage range. The fuses are automatically placed in the correct position.

The arrows also show the location of the fuses inside the voltage selector for the two voltage ranges 110-120V and 220-240V.

For the NE728, these fuses are :

110-120V : 1 AT (slow blow)
220-240 V : 0.5AT (slow blow)

Use 250 V type fuses only.



To change the mains fuse, disconnect the power cable and pull out the voltage selector. The fuse corresponding to the selected source voltage is on top of the fuseholder. Pull up the cap and replace the fuse by a new one. Plug in the voltage selector in the correct position.

WARNING

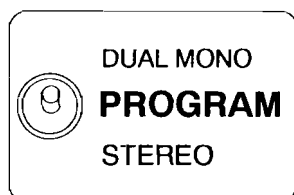
The use of repaired (jumped) fuses and/or the short circuiting of the fuse holders is prohibited.

2 Front panel



POWER

Green LED lits when the apparatus is switched on and mains voltage is applied.



PROGRAM

DUAL MONO / STEREO

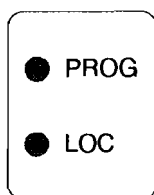
This switch determines operating mode of the program input when used stand alone. This setting can be overruled by remote control.



LOCAL

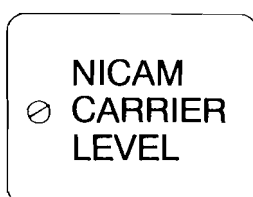
DUAL MONO / STEREO

This switch determines operating mode of the local input when used stand alone. This setting can be overruled by remote control.



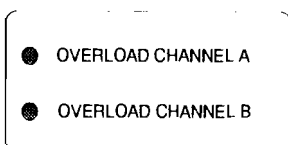
PROGRAM / LOCAL

A led indicates whether program or local audio channels are selected for the NICAM encoding.



NICAM CARRIER LEVEL

This attenuator can be used to adjust the IF signal level in a range of 10dB



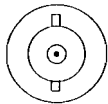
OVERLOAD CHANNEL A / OVERLOAD CHANNEL B

Two leds indicate an overload on the A/D convertor. When lit, the analog audio volume should be decreased.

3 Inputs and outputs

BNC Inputs and outputs of the NICAM encoder board

DATA in

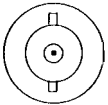


DATA IN

DATA INPUT

BNC connector for the entry of external NICAM DATA. This external data input, to be used together with the CLOCK IN input, is QPSK modulated on the NICAM carrier if the appropriate operating mode is selected via remote control.

CLOCK in

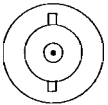


CLOCK IN

CLOCK SIGNAL INPUT

BNC connector for an external 728kHz clock input.

DATA out

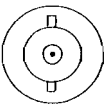


DATA OUT

DATA OUTPUT

This BNC connector contains the data that are QPSK modulated. Dependent on the operating mode, this data signal will be the internally encoded NICAM, the externally fed DATA IN signal or the demodulated intercarrier signal. (This last mentioned only in the version with intercarrier input)

CLOCK out

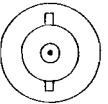


CLOCK OUT

CLOCK SIGNAL OUTPUT

This BNC connector contains the clock signal belonging to the DATA OUT signal.

INT CARR in



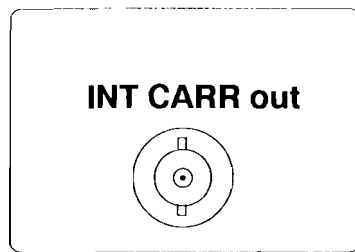
INT CARR in

INTERCARRIER INPUT

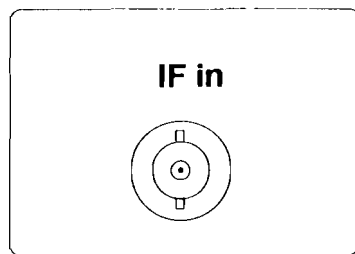
(Only with NE728 with intercarrier input)

This intercarrier signal can be internally demodulated to data and clock which subsequently will be re-modulated. Data and clock are also decoded to analog audio, provided on the monitor outputs.

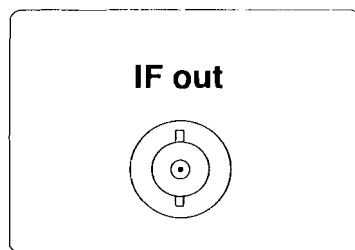
BNC Inputs and outputs of the QPSK modulator board



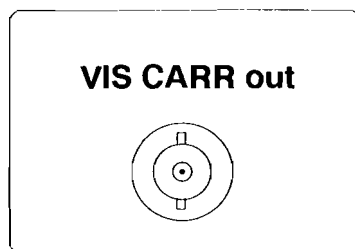
INT CARR out
INTERCARRIER OUTPUT
BNC connector provides the output of the QPSK modulator at the selected intercarrier frequency.



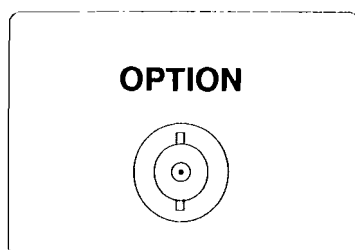
IF in
IF INPUT
BNC connector for the external IF input coming from a modulator.



IF OUT
IF OUTPUT
This BNC connector contains the IF input signal from the modulator combined with the NICAM spectrum at IF.

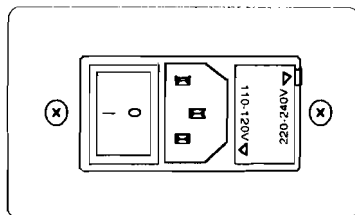


VIS CARR OUT
VISION CARRIER OUTPUT
(Only in combination with option 1113)
This BNC connector contains the vision carrier internally generated from a vision carrier local oscillator.



OPTION
38.9 MHz input
(Only in combination with option 1114)
BNC connector for the entry of an unmodulated vision carrier at IF.

Other inputs and outputs



MAINS INPUT

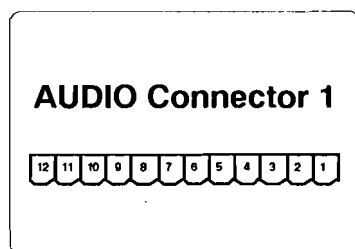
MAINS INPUT

Mains Input socket with integrated Mains ON/OFF Switch, Mains Filter, Mains Fuse and Voltage Selector.

Refer to SECTION III "1 Power Connection" for more info.

AUDIO Connector 1

Bover

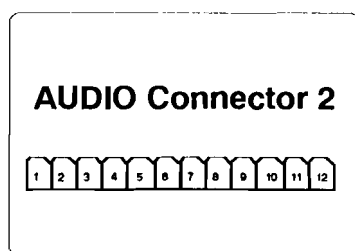


On strip-Connector 1
(Incoming analog audio signals)

1. Program audio A / M1 +
2. Program audio A / M1 -
3. GROUND
4. Program audio B / M2 +
5. Program audio B / M2 -
6. GROUND
7. Local audio A / M1 +
8. Local audio A / M1 -
9. GROUND
10. Local audio B / M2 +
11. Local audio B / M2 -
12. GROUND

AUDIO Connector 2

Broda



On strip-Connector 2
(Outgoing analog audio signals)

1. FM sound program +
2. FM sound program -
3. GROUND
4. FM sound local +
5. FM sound local -
6. GROUND
7. Monitor out left +
8. Monitor out left -
9. GROUND
10. Monitor out right +
11. Monitor out right -
12. GROUND

Connections 7 to 12 can only be used with the special version NE728 with intercarrier input.

REMOTE CONNECTORS

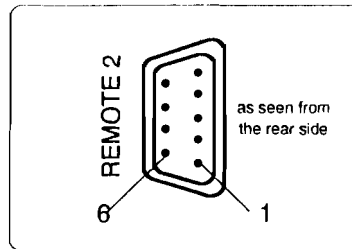
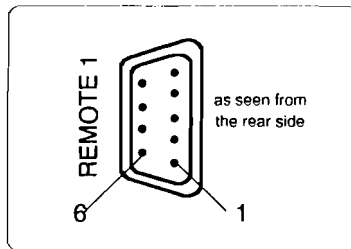
Different operation modes can be selected with the remote control connectors.

For the full description of the different modes refer to the tables on page:

3.11: Modes with front panel stereo/dual sound control.

3.12: Modes with rear panel stereo/dual sound control.

3.13: Modes with external data&clock or intercarrier signals.



REMOTE 1

SUBD 9 pins connector from the NICAM ENCODER pcb.

All these TTL signals are active low and internally pulled up.

PINS

PIN	FUNCTION
1	PROGRAM/LOCAL input switching
2	INTERNAL/EXTERNAL data&clock input
3	FRONT/REMOTE selection input or BASEBAND/INTERCARRIER selection input*
4	NICAM C4 bit ON/OFF input**
5	DUAL MONO/STEREO program mode selection input
6	DUAL MONO/STEREO local mode selection input
7	GROUND
8	OVERMODULATION CHANNEL A output
9	OVERMODULATION CHANNEL B output

INPUTS

PIN	FUNCTION	HIGH (+5V, open)	LOW (OV,ground)
1	PROGRAM/LOCAL	PROGRAM	LOCAL
2	INTERNAL/EXTERNAL data&clock	INTERNAL	EXTERNAL
3	FRONT/REMOTE selection BASEBAND/INTERCARRIER sel.	FRONT BASEBAND	REMOTE INTERCARRIER
4	NICAM C4bit	ON	OFF
5	DUAL MONO/STEREO program	DUAL MONO	STEREO
6	DUAL MONO/STEREO local	DUAL MONO	STEREO

* This signal has two meanings depending on the setting of the INTERNAL/EXTERNAL, see operation mode table on page 3.13 for more details.

** C4 is the NICAM RSSF (Reserve Sound Switching Flag). C4 bit ON means the audio modulated on the NICAM carrier is identical to the FM sound channel (mono carrier). In this case, a TV set equipped with a NICAM decoder may switch to analog sound in case the NICAM signal is lost or has excessive BER (bit error rate). The unit changes the C4 bit in the Nicam frame only when a mode switch occurs (stereo/dual mono).

OUTPUTS

PIN	FUNCTION	HIGH (+5V)	LOW (0V)
8	OVERMODULATION CHANNEL A	NO	YES
9	OVERMODULATION CHANNEL B	NO	YES

REMOTE 2

SUBD 9 pins connector from the QPSK MODULATOR pcb.
All these TTL signals are active low and internally pulled-up.

PINS

PIN	FUNCTION
1	QPSK INTERCARRIER ON/OFF input switching
2	QPSK INTERCARRIER STATUS output
3	MUTE ON/OFF status output*
4	NOT CONNECTED
5	GROUND
6 to 9	NOT CONNECTED

INPUT

PIN	FUNCTION	HIGH (+5V, open)	LOW (0V, ground)
1	QPSK INTERCARRIER ON/OFF	ON	OFF

OUTPUTS

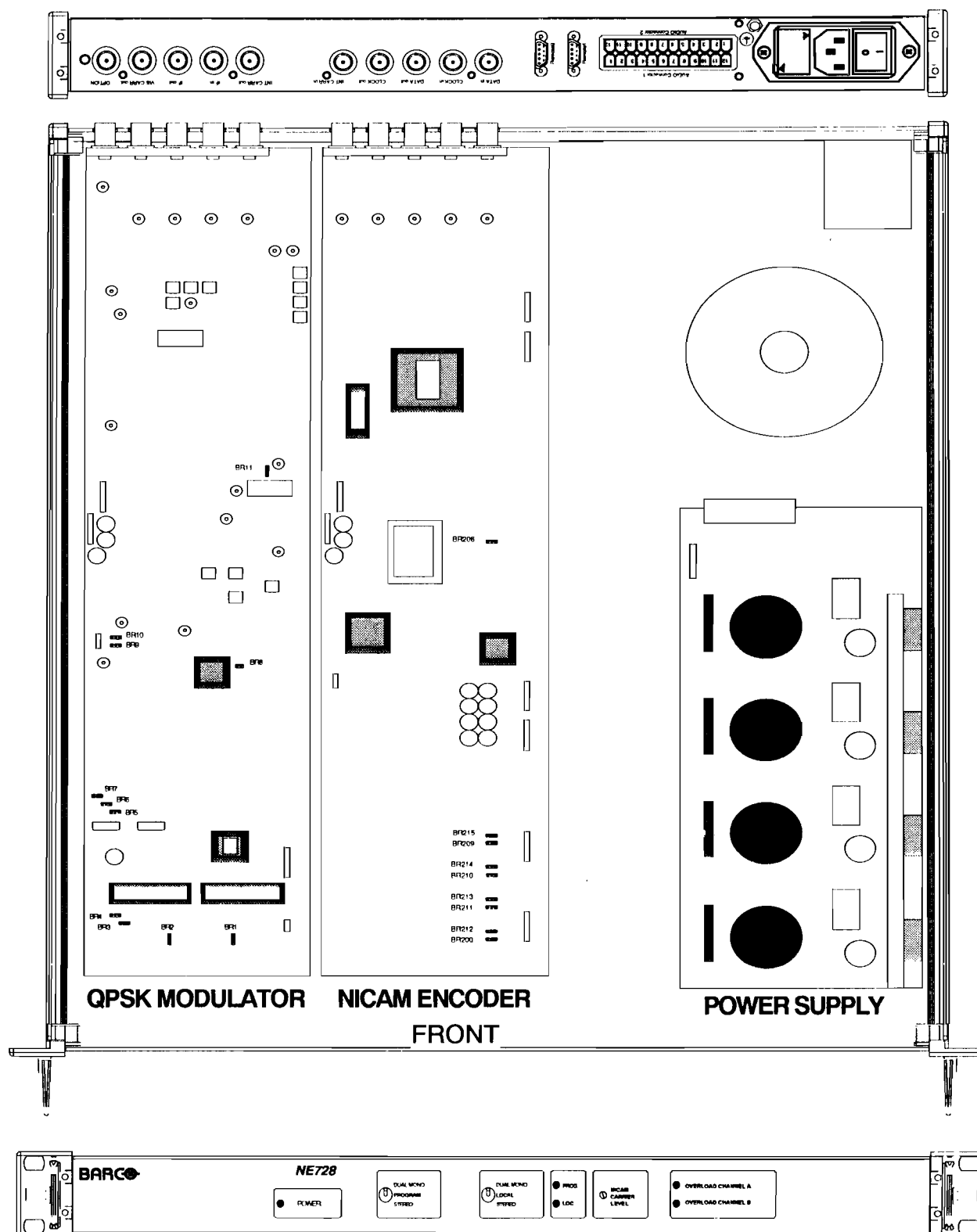
PIN	FUNCTION	HIGH (+5V)	LOW (0V)
2	QPSK INTERCARRIER STATUS	ON	OFF
3	MUTE ON/OFF*	OFF	ON

* MUTE ON/OFF status output only for NE728 with INTERCARRIER.

- 1) The QPSK INTERCARRIER can manually be switched off by connecting pin 1 to ground.
- 2) The internal NICAM decoder provides an active low mute signal on pin 3 of REMOTE 2 connector. This output is ON when the decoded signal from the INT CARR IN has an excessive BER (bit error rate) or when there is no signal at the input. The mute signal can be used for monitoring purposes and/or can switch off the QPSK INTERCARRIER: when MUTE is externally connected to QPSK INTERCARRIER ON/OFF (pin 3 to 1). The status of the QPSK INTERCARRIER is also available on pin 2.

4. Functional description

4.1. Internal lay out.



4.2. Encoder.

The encoder has two pairs of audio inputs : one for the program sound and one for the substitution or local sound. Each pair consists of two balanced channels :

A/M1 : left or mono1

B/M2 : right or mono 2

Selection of dual mono or stereo mode is possible by frontal switching, both for program or local sound. These switches can be overruled by remote signals at the rear of the NE728.

Two identical audio outputs are provided allowing the external FM sound modulator (both on its program and local inputs) to be driven by the appropriate sound signal : M1 in case of dual sound transmission and the average value of the left and right channel in case of stereo transmission. Incoming audio is pre-emphasised, A/D converted, digitally anti-alias filtered and NICAM encoded using DSP technology. Both data and clock signals are available at the rear panel of the NE728. The NICAM encoder works in one of two modes : stereo or dual mono. NICAM modes including data transmission are not supported. The RSSF (reserve sound switching flag = C4) can be set or cleared by remote signals.

4.3. QPSK modulator.

External or internal data and clock signals are digitally filtered and QPSK modulated on an (inter)carrier using the latest digital technologies. This means that no alignment is necessary to obtain ideal amplitude and phase balance of the modulated output signal. This also means that both parameters remain constant during the NE728 lifetime.

The intercarrier frequencies can be fixed by use of internal jumpers.

2 standard frequencies are programmed : 5.85 & 6.552; additionally 4 frequencies in the range 4.85-6.85 MHz can be programmed at user-request. If the frequency is less than 5.85 MHz, another analogue bandpass filter set is required.

The modulated intercarrier frequency is also available at the rear of the encoder/ modulator.

2 Pulse-shaping roll-off factors are programmed (40% and 100%); additionally, 2 other roll-offs can be programmed at user-request.

4.4. IF combiner, mixer.

The intercarrier signal is internally fed to a convertor module which allows conversion of the input signal to the appropriate IF frequency. This NICAM IF frequency is added to the IF spectrum which is looped through via the NE728.

The conversion process is performed by mixing the intercarrier with the vision carrier which can either be internally (re)generated or externally generated.

The default mode is a vision carrier regeneration. Achieving the right intercarrier distance in case of *received IF* signals is possible in this case e.g. when the NE728 has to add the NICAM signal to the IF signal of a channel convertor (CC1000 or CC200).

With option 1114, an *external vision carrier* is used that is fed to the NE728. This technique is used with the VSBM200 TV modulator, in order to maintain the intercarrier distance within acceptable limits.

With option 1113, *internal* generation of the vision carrier is done. This vision carrier is also available on the rear panel and has to be linked to the vision carrier input of the accompanying TV modulator (VSBM1000).

Note: an external vision carrier or an external modulated IF should have a level of 40 dBmV as noted in the Specifications section. In case the necessary level is not reached, the carrier regenerator may fail to lock.

4.5 Jumper settings

- for the NICAM ENCODER PCB (V5637550)





The jumpers on the V5637550 are meant to switch between

- balanced, 600 Ohm (default, set at factory) and
- unbalanced 10kOhm.





The settings are given when looking at the unit from the front side.

Settings marked in bold are factory set.





• jumper setting for PROGRAM LEFT

-  ● BR212 **PRG LEFT BALANCED**
-  BR212 PRG LEFT UNBALANCED (PRG LEFT- to GND)
-  ● BR200 **600 Ohm between PRG LEFT+ and PRG LEFT-**
-  BR200 10 kOhm between PRG LEFT+ and PRG LEFT-





• jumper setting for PROGRAM RIGHT

-  ● BR213 **PRG RIGHT BALANCED**
-  BR213 PRG RIGHT UNBALANCED (PRG RIGHT- to GND)
-  ● BR211 **600 Ohm between PRG RIGHT+ and PRG RIGHT-**
-  BR211 10 kOhm between PRG RIGHT+ and PRG RIGHT-

• jumper setting for LOCAL LEFT

-  ● BR214 **LCL LEFT BALANCED**
-  BR214 LCL LEFT UNBALANCED (LCL LEFT- to GND)
-  ● BR210 **600 Ohm between LCL LEFT+ and LCL LEFT-**
-  BR210 10 kOhm between LCL LEFT+ and LCL LEFT-

• jumper setting for LOCAL RIGHT

-  ● BR215 LCL RIGHT UNBALANCED (LCL RIGHT - to GND)
-  BR215 **LCL RIGHT BALANCED**
-  ● BR209 **600 Ohm between LCL RIGHT + and LCL RIGHT -**
-  BR209 10 kOhm between LCL RIGHT + and LCL RIGHT -

(Note: jumper settings for LOCAL RIGHT differ from other ones.)

Other jumpers on the NICAM encoder PCB are for factory testing only and should be left unchanged.

4.6. Operating modes

4.6.1. Modes with front panel stereo/dual sound control:

REMOTE 1						REM.2	CONFIGURATION:
pin1	pin2	pin3	pin4	pin5	pin6	pin1	
PROG/ LOC	INT/ EXT	FRONT/ REMOTE	C4 ON/ OFF	STEREO/ DUAL MONO PROG	STEREO/ DUAL MONO LOC	QPSK INTCAR.	
PROG or LOC.	INTER- NAL	FRONT	ON or OFF	don't care	don't care	ON or OFF	<ul style="list-style-type: none"> - PROG or LOC audio encoded. - STEREO or DUAL MONO as set by front panel switch. - C4 bit set as indicated. - Nicam spectrum disabled if QPSK INTCAR. OFF

Default mode of the unit: REMOTE1 & 2 not connected=
PROGRAM input + C4 bit ON + QPSK INTERCARRIER ON

The audio outputs are dependent on stereo or dual mono configuration AND the C4 bit. Suppose the program (PROG) audio input is encoded, then the audio outputs will be (vice versa when LCL audio selected):

MODE	C4	FM SOUND PRG & LCL (baseband audio)
STEREO	0	(A+B) / 2 of LOC input
STEREO	1	(A+B) / 2 of PROG input
DUAL MONO	0	(A+B) / 2 of LOC input
DUAL MONO	1	A/M1 of PROG input

Note that:

- 1) program & local audio outputs always contain the same audio.
- 2) if C4=0, the sound to the TV modulator is always (A+B)/2.

4.6.2. Modes with rear panel stereo/dual sound control:

REMOTE 1						REM.2	
pin1	pin2	pin3	pin4	pin5	pin6	pin1	
PROG/ LOC	INT/ EXT	FRONT/ REMOTE	C4 ON/ OFF	STEREO/ DUAL MONO PROG	STEREO/ DUAL MONO LOC	QPSK INTCAR.	CONFIGURATION:
PROG	INTER- NAL	REMOTE	ON or OFF	STEREO or DUAL MONO	don't care	ON or OFF	<ul style="list-style-type: none"> - PROG audio is NICAM encoded. - STEREO or DUAL MONO channel mode - C4 bit set as indicated. - Nicam spectrum disabled if QPSK INTCAR. OFF
LOC	INTER- NAL	REMOTE	ON or OFF	don't care	STEREO or DUAL MONO	ON or OFF	<ul style="list-style-type: none"> - LOC audio is NICAM encoded. - STEREO or DUAL MONO channel mode - C4 bit set as indicated. - Nicam spectrum disabled if QPSK INTCAR. OFF

The audio outputs are adjusted according to stereo/dual sound encoding and C4 as indicated above.

Note: The front/rear signal only determines the source of stereo/dual mono selection. Program/ Local selection is always done on the rear panel, with the default program.

4.6.3. Modes with external data&clock or intercarrier signals:

REMOTE 1 pin1	pin2	pin3	pin4	pin5	pin6	REM.2 pin1	
PROG/ LOC	INT/ EXT	BB/ INTCAR	C4 ON/ OFF	STEREO/ DUAL MONO PROG	STEREO/ DUAL MONO LOC	QPSK INTCAR.	CONFIGURATION:
don't care	EXTER- NAL	BASE- BAND	don't care	don't care	ON care	- NE728 basic version or OFF	- External data & clock are QPSK modulated and converted to intercarrier and IF. - C4 bit set as indicated. - Nicam spectrum disabled if QPSK INTCAR. OFF
don't care	EXTER- NAL	INTER- CARRIER	don't care	don't care	don't care	ON or OFF	- NE728 with INTERCARRIER version - Intercarrier input is demodulated and re-modulated to intercarrier and IF. - Nicam spectrum disabled if QPSK INTCAR. OFF

Notes:

- In all cases the encoded data and clock signals (internally generated or fed from external) are available at DATA OUT and CLOCK OUT.
- Monitoring output is tied to the Intercarrier IN signal or to the internally generated intercarrier frequency (in the NE728 with Intercarrier input version). This provides (depending on the source of the Intercarrier input signal):
 - +monitoring of internally generated Intercarrier signal or
 - +monitoring of external intercarrier signal.
- The QPSK INTERCARRIER can be switched off manually by connecting pin 1 to ground.
- The internal NICAM decoder provides an active low mute signal on pin 3 of REMOTE 2 connector. This signal is asserted when the decoded signal from the INT CARR IN has an excessive BER (bit error rate) or when there is no signal at the input. The mute signal can be used for monitoring purposes and/or can switch off the QPSK INTERCARRIER: when MUTE is externally connected to QPSK INTERCARRIER ON/OFF (pin 3 to 1). The status of the QPSK INTERCARRIER is also available on pin 2.

SECTION IV

RACK MOUNTING

When mounting your BARCO NE728 units, use 19 inch racks, preferably those with a depth of at least 70 cm.

The units should be mounted adequately, so as to secure optimal operation and reliability of your unit. Use sliders compatible with the used 19 inch racks to support the NE728 properly.

When mounting more than one unit, we would advise you to leave a space of at least one unit in between. These spaces can be covered afterwards by means of ventilation profiles. Mounting other units together with your NE728 obviously requires that the air flow must be able to reach all units.

Additional components such as combiners and netstrips are preferably to be mounted at the back of the racks, so that the free air flow between the sides of the unit and the rack is not restricted.

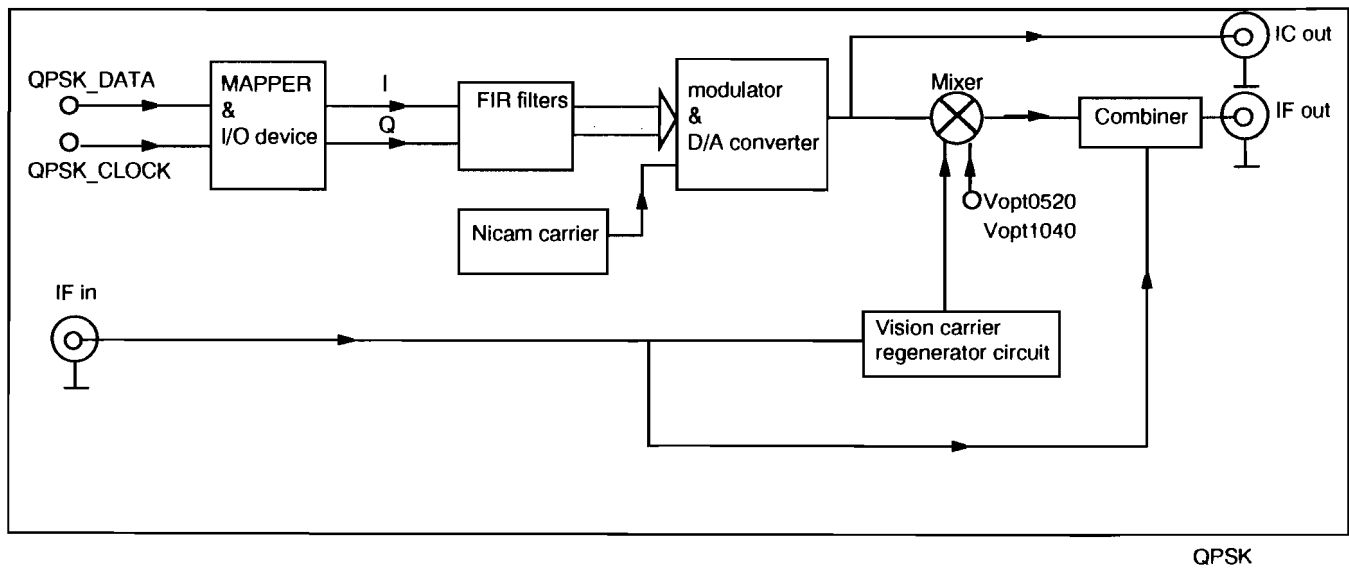
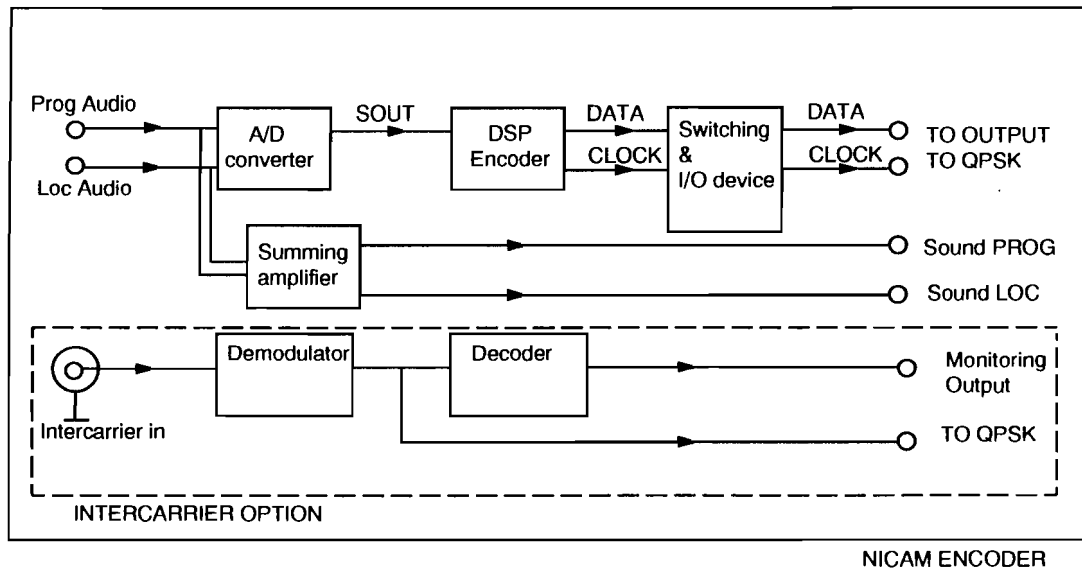
At the bottom and the top of the rack, ventilation profiles should be mounted so as to allow the fresh cold air to enter and the hot air to leave the rack. It is of great importance to place the racks in a conditioned room with a constant temperature of about 25°C.

When mounting 5 or more units above one another, the use of fans is necessary. The power of the fan depends on the number of units mounted. For a rack containing 15 units with a free space of one unit between the units, an airflow of 300 m³/hour is required.

Mounting the fans requires taking into account that the air should blow alongside the units and that it can enter the rack through the lower ventilation profiles.

SECTION V

BLOCK SCHEMATIC DIAGRAM



SECTION VI

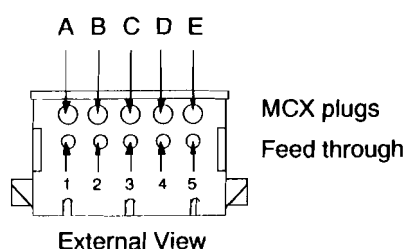
SCHEMATIC DIAGRAMS

How to use symbols

On the schematic diagrams in this manual, each board or module is identified by means of a number printed in a square box in the right hand lower corner.

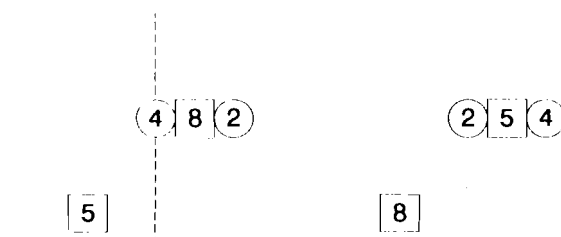
5

Each board or module has pins and coax connectors to make interconnections between different boards and/or modules. A module can have up to 5 pin connections and up to 5 coax connections. All pins and coax connections have their own identification, see illustration below.



An interconnection between two boards or modules can be as follows :

Pin 4 of board or module 5 goes to board or module 8 where it finds pin 2. On board 8 one finds the corresponding indication.



How to use parts lists

1 General

Each parts list starts with the reference to the unit and the unit name. The next line gives the company order number of the complete unit. The next line gives the column headings : ORDER NUMBER, DESCRIPTION and ITEM.

The ORDER NUMBER is the company order number.

The DESCRIPTION is a coded description of the component. See paragraph CODE DESCRIPTION for more info.

The ITEM column gives the component location of the component or a description of the mechanical parts and/or the quantity (QTY:).

2 Code description

The component description for resistors and capacitors consists of 4 groups of characters with a total quantity of maximum 19 characters.

XXXXXXXXXXXXXXXXXXXX			
A	B	C	D

- GROUP A: This group of maximum 7 characters gives the component code described in paragraph CODED TO COMPONENTS.
e.g. CPOMEPO: potted metal polyester capacitor.
- GROUP B: This group of maximum 6 characters gives the component value.
e.g. 3K3 kilo Ω for resistors.
e.g. 3.3 nanofarads for capacitors.
- GROUP C: The tolerance code, given with one characters and listed in paragraph TOLERANCE CODES.
- GROUP D: This group of maximum five characters gives the maximum permissible power dissipation for resistors and the limiting voltage for capacitors.
e.g. 0.25 for resistors means 0.25W.
e.g. 63 for a capacitor means 63V.

3 Codes to components

CCEDI	CAPACITOR VERTICAL MOUNTED
CCEMI	CAPACITOR CERAMIC MINIATURE
CELAX	CAPACITOR ELECTROLYTIC AXIAL
CELBI	CAPACITOR ELECTROLYTIC BIPOLAR
CELPR	CAPACITOR ELECTROLYTIC PRINTED CIRCUIT
CELSN	CAPACITOR ELECTROLYTIC SNAP IN
CFDTRH	CAPACITOR FILM DIELECTRIC TRIMMER HORIZONTAL MOUNTING
CFDTRV	CAPACITOR FILM DIELECTRIC TRIMMER VERTICAL MOUNTING
CMAINS	CAPACITOR Y MAINS
CNPOMI	CAPACITOR CERAMIC CLASS 1 TEMP COEFF NPO MINIATURE
CN750	CAPACITOR TEMP COEFF N750
COIL LIN	COIL LINEARITY
CON DIL	CONNECTOR DUAL IN LINE
CONFOBSE	CONNECTOR FEMALE ON BOARD SIDE ENTRANCE
CONFOC	CONNECTOR FEMALE ON CHASSIS
CONMOBTE	CONNECTOR MALE ON BOARD TOP ENTRANCE
CONMOW	CONNECTOR MALE ON WIRE
CONSNAP	CONNECTOR SNAP WIRING
CPCPO	CAPACITOR POLYCARBONATE POTTED
CPOMEFF	CAPACITOR POLYESTER METAL FILM FOIL
CPOMEPO	CAPACITOR POLYESTER METAL POTTED
CPOPO	CAPACITOR POLYESTER SAVE POTTED
CPPPR	CAPACITOR POLYPROPYLENE PRINTED CIRCUIT

RMCE	RESISTOR GROUP MULTITURN POTENTIOMETER CERAMIC
RRCF	RESISTOR GROUP CARBON FILM
RRCFF	RESISTOR GROUP CARBON FILM FUSING
RRHOLDER	RESISTOR GROUP RESISTANCE HOLDER
RRMF	RESISTOR GROUP RESISTOR METAL FILM
RRMO	RESISTOR GROUP RESISTOR METAL OXIDE
RRPTC	RESISTOR GROUP RESISTOR POSITIVE TEMP COEFF
RRWW	RESISTOR GROUP RESISTOR WIRE WOUND
RRWWH	RESISTOR GROUP RESISTOR WIRE WOUND HORIZONTAL
RTCEMV	RESISTOR GROUP TRIM POTENTIOMETER CERAMIC MINIATURE VERT
RMCEM	RESISTOR GROUP MULTITURN POTENTIOMETER CERAMIC MINIATURE
RTCEMH	RESISTOR GROUP TRIM POTENTIOMETER CERAMIC MINIATURE HOR
RTWW	RESISTOR GROUP TRIM
SMCDIO	SEMICONDUCTOR DIODE
SMCDIOLED	SEMICONDUCTOR DIODE LED
SMCDIOREC	SEMICONDUCTOR DIODE RECTIFIER
SMCDIOVAR	SEMICONDUCTOR DIODE VARICAP
SMCDIOZEN	SEMICONDUCTOR DIODE ZENER
SMCIC	SEMICONDUCTOR INTEGRATED CIRCUIT
SMCIDL	SEMICONDUCTOR INTEGRATED CIRCUIT LINEAR
SMCICLOPA	SEMICONDUCTOR INTEGRATED CIRCUIT LINEAR OPERATIONAL AMPLI
SMCICCMOS	SEMICONDUCTOR INTEGRATED CIRCUIT CMOS
SMCICLVOL	SEMICONDUCTOR INTEGRATED CIRCUIT LINEAR VOLTAGE
SMCPOWFED	SEMICONDUCTOR POWER FET
SMCTHY	SEMICONDUCTOR THYRISTOR
SMCOPTCOU	SEMICONDUCTOR OPTO COUPLER
SMCTRA	SEMICONDUCTOR TRANSISTOR
SMCTRA CLIP	SEMICONDUCTOR TRANSISTOR CLIP
SMCTRAFIX	SEMICONDUCTOR TRANSISTOR FIXER
SMCTRACOOLER	SEMICONDUCTOR TRANSISTOR HEATSINK
SMCTRAPOW	SEMICONDUCTOR TRANSISTOR POWER
SMCTRA ISO	SEMICONDUCTOR TRANSISTOR INSULATION
TRF CUR	TRANSFORMER CURRENT SENSING
TRF SHIFT	TRANSFORMER SHIFT
TRF DRIV	TRANSFORMER DRIVER
WTRF SUP	TRANSFORMER SUPPLY

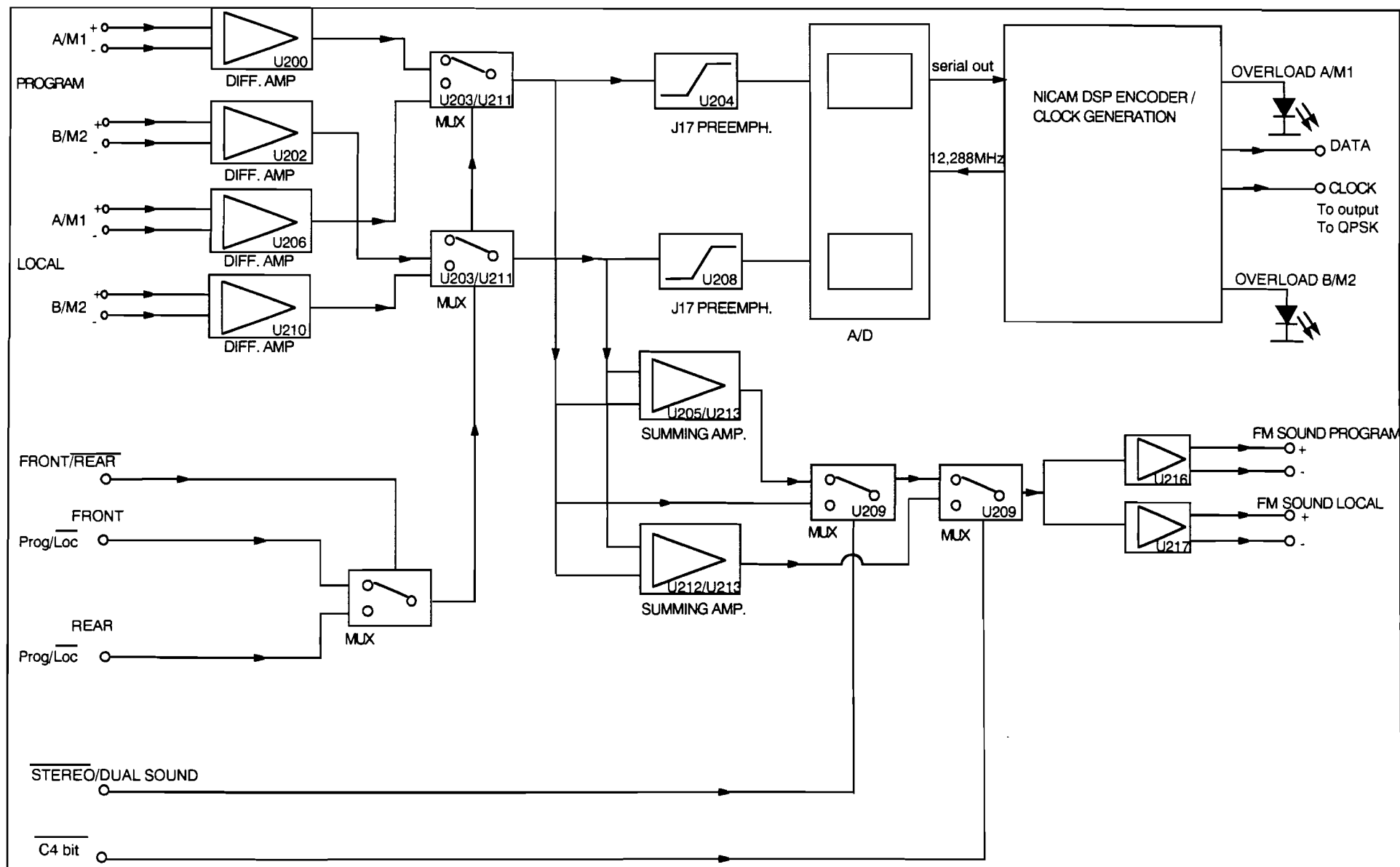
4 How to order spare parts

To place an order for spare units, boards or components, specify your required parts as follows :

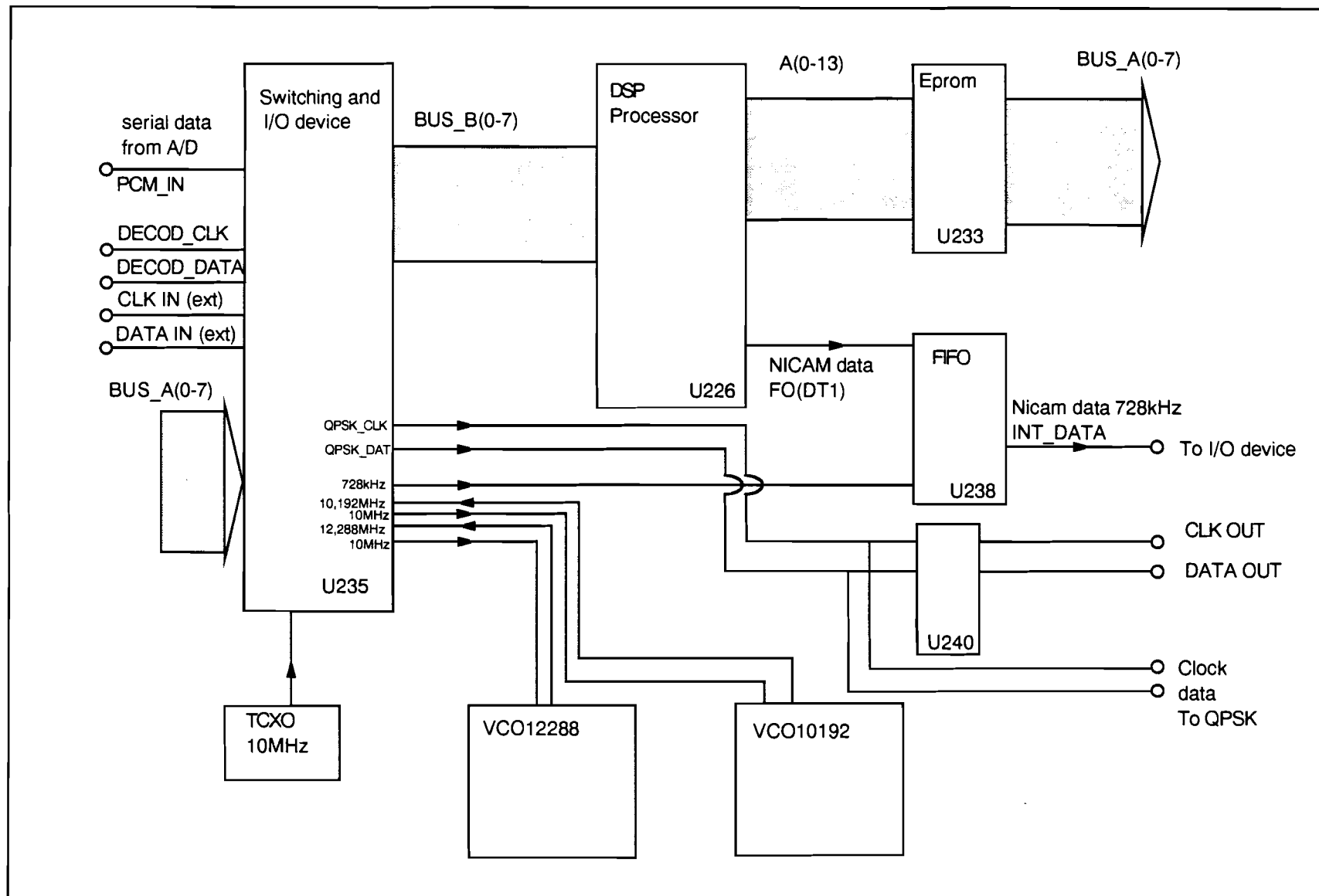
1. The coding of the component according to the circuit diagram.
2. A brief description of the component.
3. The order number in the parts list.
4. The sub-unit it makes part of.
5. The apparatus type and version.
6. Serial number and revision state.

5 Tolerance codes

CHARACTER	CAPACITOR/RESISTOR TOLERANCE	CHARACTER	CAPACITOR/RESISTOR TOLERANCE
A		N	±30%
B	±0.1%	P	+100%, -0%
C	±0.25%	Q	+30%, -10%
D	±0.5%	R	+30%, -20%
E		S	+50%, -20%
F	±1%	T	+50%, -20%
G	±2%	U	+80%, -0%
H	±2.5%	V	+100%, -10%
J	±5%	W	+20%, -0%
K	±10%		



NICAM ENCODER BLOCK SCHEMATIC OVERVIEW

**NICAM DSP ENCODER + CLOCK GENERATION**

1. NICAM Encoder:

The encoder has two pairs of audio inputs: one for the program sound and one for the substitution or local sound. Each pair consists of two channels:

A/M1: left or mono 1

B/M2: right or mono 2

The analog audio input can be selected as balanced or unbalanced by the bridges BR212 and 213 (connect 1 with 2 for balanced). Bridges 200 and 211 are used to select between 600 Ohm and 10 KOhm input-impedance.

The CMRR is calibrated to be as high as possible. The switching between Program and Local is controlled by U203 (TTL).

The analog signal passes a preemphasis circuit (J17 preemphasis) before it is A/D converted. When stereo mode is selected, switch U209 is set so that the left and the right input are summed with the consequence that an average value of left and right input is fed to the FM-outputs. This output is converted to a balanced signal by U216.

When the dual sound mode is selected, only the left signal is fed to the output.

There is also a second switch available. This switch selects between the program and local input and is controlled by 'C4'. 'C4' is the NICAM RSSF (Reserve Sound Switching Flag). C4 bit ON means the audio modulated on the NICAM carrier is identical to the FM sound channel(mono carrier). In this case, a TV set equipped with a NICAM decoder may switch to analog sound in case the NICAM signal is lost or has excessive BER (bit error rate). The unit changes the C4 bit in the NICAM frame only when a mode switch occurs (stereo/dual mono). The local and the program output of the NICAM decoder are always equal and balanced.

The preemphased signal is then fed to the A/D-converter (AD1877).

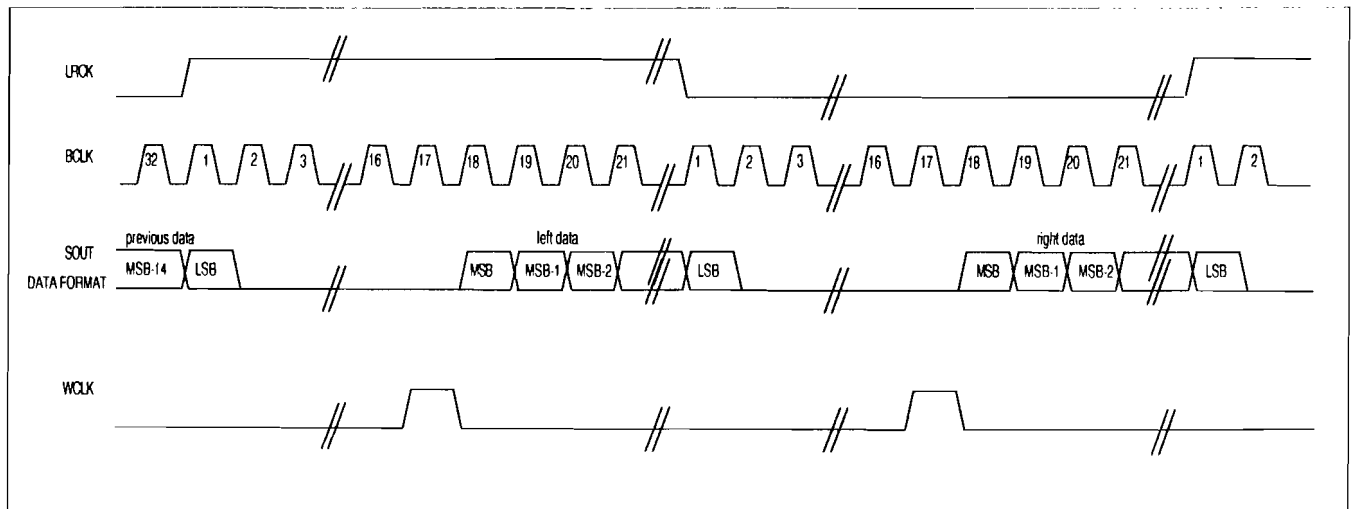
The clock of the A/D is set to 12,288 MHz ($384 \times 32\text{kHz}$ (sampling frequency)). The clock is derived from a VCO locked on a TCXO (temperature controlled crystal oscillator) of 10 MHz. The digital audio output is serial. When the input level of the analog audio is too high, it will be detected by two LED's (overload left/right).

'LRCK' indicates if it is Left or Right audio.

'WCLK' indicates when there is a new sample.

'BCLK' is the bitclock on 2,048MHz ($64 \text{ bits} \times 32\text{kHz}$).

DATA FORMAT: '16 bits 0, 16 bits LEFT, 16 bits 0, 16 bits RIGHT'.



The data are fed to the NICAM encoder DSP (U226). The DSP code, loaded at boot time, is stored in an EPROM (U233). The codes are protected because they are fed through the Altera(U235) where they are unscrambled. All the data flow through the I/O device(U235). The output data from the DSP-processor flow in bursts of 728 bits/ms.

To generate a continuous serial output, a FIFO-buffer (U238) is used from which the data (INT_DATA) are read continuously at 728 kHz. To avoid overflow/underflow of the FIFO, the 728kHz clock should be locked to the 12,288 MHz master frequency. Therefore another VCO is used with a clock frequency of 10,192 MHz locked on the TCXO. This data stream passes the Switching device (u235). This device switches between internal data/clock and external data/clock.

The default settings for the device are set by the switches on the front. They are: 'Program input', QPSK INTERCARRIER ON, 'C4'-bit on and STEREO/DUAL MONO as set on the front panel switch.

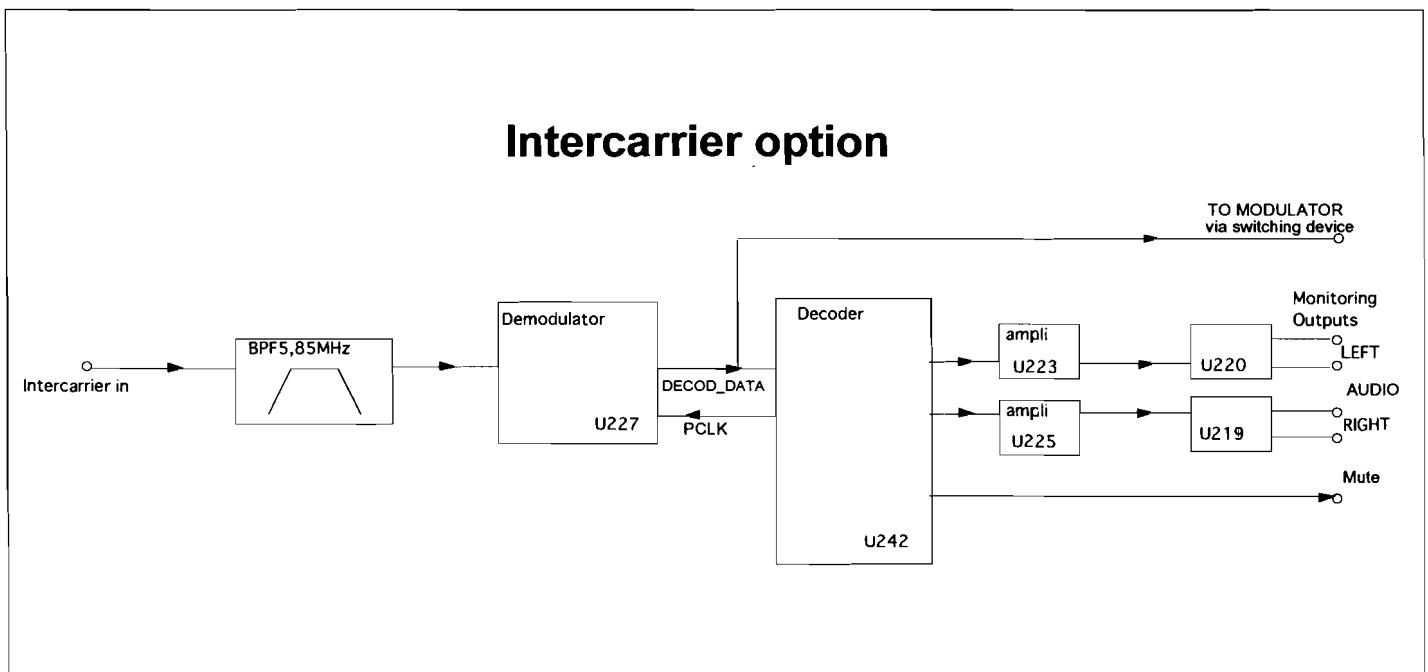
These switches can be overruled by remote signals at the rear of the NE728.

2. INTERCARRIER option:

The intercarrier frequency is filtered and fed to a demodulator IC(U227).

The demodulated NICAM data go to the decoder(U242), where they are converted into left and right analog audio and to the modulator where it will be processed to a different system. The data and clock signals of this decoded signal are provided as outputs. The analog audio is available on the monitoring outputs (left/right).

When the quality of the NICAM data isn't sufficient enough, the intercarrier can be switched off so no data will be modulated. The NICAM decoder provides then an active low mute signal on pin 3 of 'REMOTE 2' connector. This output is on when the decoded signal from the 'INT CARR IN' has an excessive BER (bit error rate) or when there is no signal at the input. The mute signal can be used for monitoring purposes and/or can switch off the QPSK intercarrier when 'MUTE' is externally connected to 'QPSK INTERCARRIER ON/OFF' (pin 3 to 1). The MUTE signal is then fed to the I/O device (U8) of the QPSK-module with the consequence that the 'IC out'- and the 'CARR'-contact goes low. The status of the QPSK intercarrier is also available on pin 2.



3. QPSK Modulator:

The external or internal data and clock signals are QPSK modulated (U18) on an (inter)carrier using the latest digital technologies. This means that no alignment is necessary to obtain ideal amplitude and phase balance of the modulated output signal. This also means that both parameters remain constant during the NE728 lifetime.

The carrier frequency can be selected by manipulating the bridges BR5, 6, 7 ((8 possibilities). Two standard frequencies are programmed: 5.85 & 6.552; additionally 4 frequencies in the range 4.85-6.85 MHz can be programmed at user-request. If the frequency is less than 5.85 MHz, another analog bandpass filter set is required.

The data is first split up in the Mapper (U8) to an I- and Q-signal. These two signals are filtered by a low-pass filter(U4 or U5 FIR filter). Those filters can be selected by manipulating bridges 3 and 4. The two filters have a different roll off (40% and 100%); additionally, 2 other roll-offs can be programmed at user-request. The larger the roll-off, the wider the spectrum. The settings are stored in Eproms (U13, U14, U15).

The filtered signals enter the QPSK modulator where they are modulated and D/A-converted. The modulated data (DDS_OUT) are fed to a converter module which allows conversion of the input signal to the appropriate IF frequency. The modulated intercarrier frequency is also available at the rear of the encoder/modulator.

This conversion is done to obtain the right intercarrier spacing. The NICAM IF frequency is added to the IF spectrum which is looped through via the NE728.

The conversion process is performed by mixing the intercarrier with the vision carrier which can be internally (re)generated or externally generated.

The default mode is a vision carrier regeneration. Achieving the right intercarrier distance in case of received IF signals is possible in this case e.g. when the NE728 has to add the NICAM signal to the IF signal of a channel converter (CC1000 or CC200).

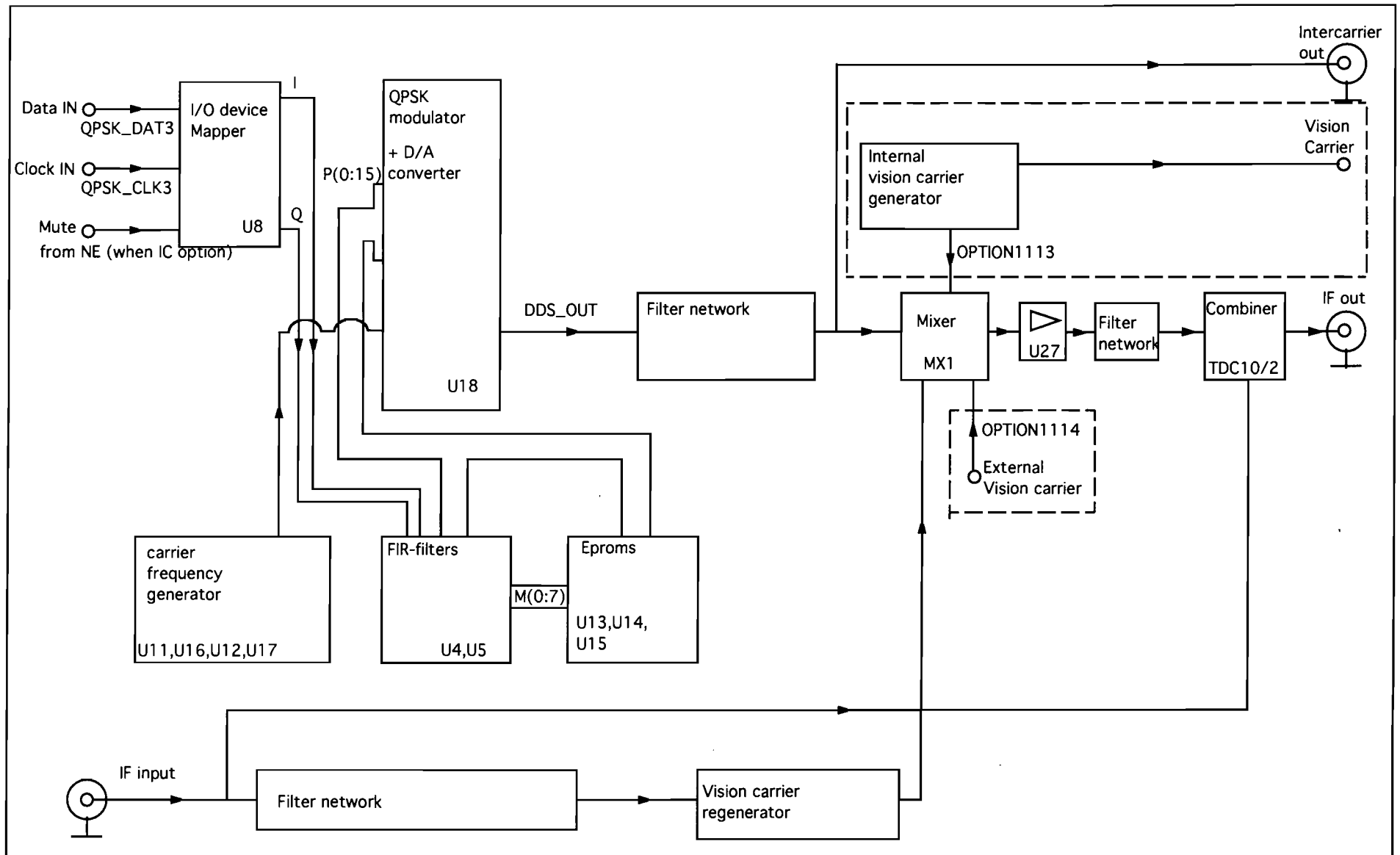
With option 1114, an external vision carrier is used that is fed to the NICAM encoder. This technique is used with the VSBM200 TV modulator, in order to maintain the intercarrier distance within acceptable limits.

With option 1113, internal generation of the vision carrier is done. This vision carrier is also available on the rear panel and has to be linked to the vision carrier input of the accompanying TV modulator (VSBM1000).

NOTE: an external vision carrier or an external modulated IF should have a level of 40 dBmV as noted in the specifications section. In case the necessary level is not reached, the carrier regenerator may fail to lock.

In case an internal vision carrier is used, it is also available at the rear of the NE728.

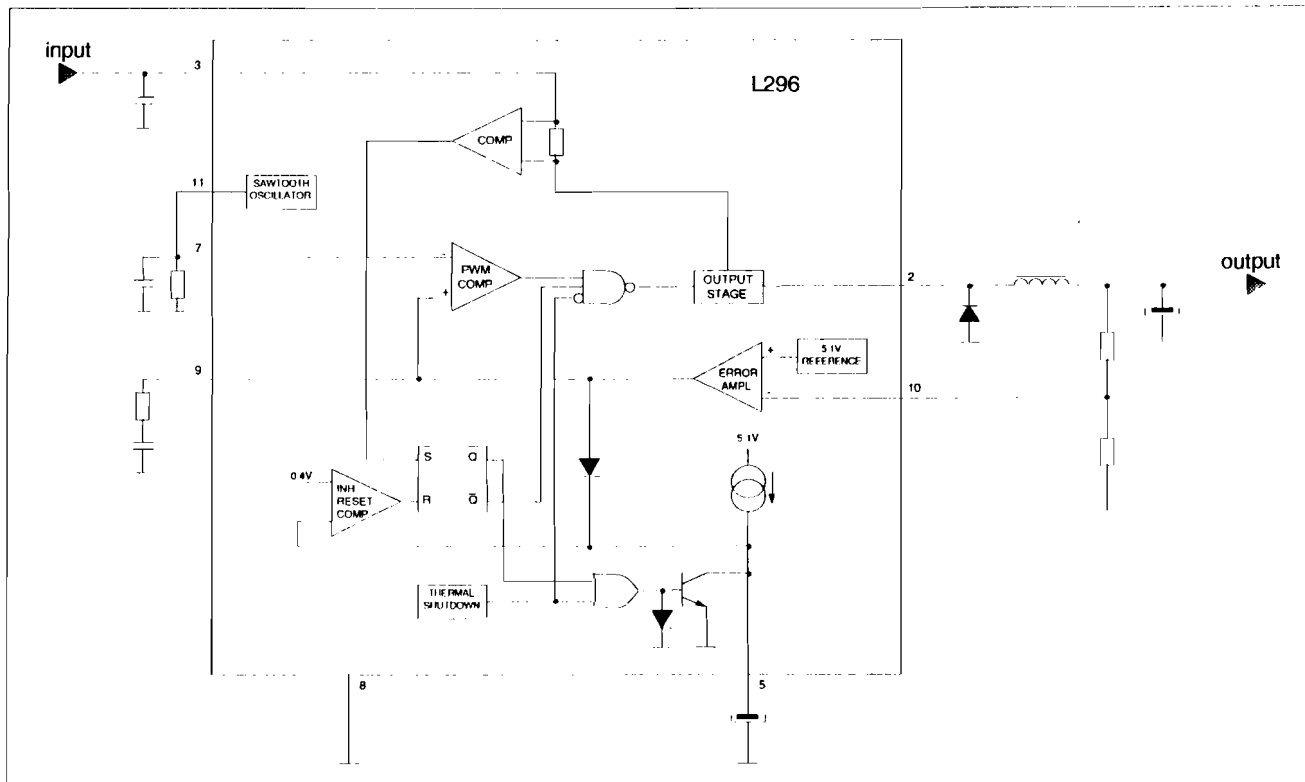
At last the signal is amplified (U27) and filtered before it is combined with the incoming IF and placed at the IF-output.



QPSK MODULATOR CIRCUIT

6. POWER SUPPLY:

Block schematic diagram :



Description :

The switch mode power supply can be described conform the above block schematic diagram.

The regulation loop consist of a sawtooth oscillator, error amplifier, comparator and the output stage. An error signal is produced by comparing the output voltage (via a voltage divider) with a precise 5.1V on-chip reference. This error signal is then compared with the sawtooth signal to generate the fixed frequency pulse width modulated pulses which drive the output stage. The gain and frequency stability of the loop can be adjusted by an external RC network connected to pin 9.

Output overcurrents at switch on are prevented by the soft start function. The error amplifier output is initially clamped by the external capacitor connected to pin 5 and allowed to rise, linearly, as this capacitor is charged by a constant current source. Output overload protection is provided in the form of a current limiter. The load current is sensed by an internal metal resistor connected to a comparator. When the load current exceeds a threshold this comparator sets a flip flop which disables the output stage and discharges the soft capacitor at pin 5. A second comparator resets the flip flop when the voltage across the soft start capacitor has fallen to 0.4V. The output stage is thus re-enabled and the output voltage rises under control of the soft start network. If the overload condition is still present the limiter will trigger again when the threshold current is reached. The average short circuit current is limited to a safe value by the dead time introduced by the soft start network. The thermal overload circuit disables circuit operation when the junction temperature reaches about 150 °C and has a hysteresis to prevent unstable conditions.