BBC Engineering Design Information

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NICAM 3

NICAM 3 is a high quality PCM transmission system for programme sound which uses companding to reduce the transmitted bit rate. It has been developed as a modular system to allow a complex transmission network to be built as economically as possible. The name stands for Near Instantaneously Companded Audio Multiplex, and bitstreams have been defined for a single channel in 338 kbit/s and for six channels in 2048 kbit/s. In the latter six single channel bitstreams complete with individual framing, signalling and housekeeping are combined together with 2048 framing, signalling and housekeeping.

Equipment is required to operate over a number of different bearers, but particularly 2048 kbit/s, the first order British Telecoms (BT) digital line system using HDB3 line code in conjunction with re-generators. Other bearers will include analogue video links and dedicated digital radio links for only two channels, usually stereo.

All six channels possible in a 2048 kbit/s bearer may not be required. Maximum flexibility would be achieved with individual channel coders and decoders and maximum economy would be obtained with shared digital processing in a six channel equipment. However, the latter advantage would be limited because the major cost is in analogue units which are needed "per channel" in any case, and the former is qualified by the need to carry stereo pairs together which results in a strong tendency to need circuits in even numbers. Thus the basic equipment for NICAM 3 has been designed to encode or decode two high quality audio signals. Three such equipments can be assembled to provide a full six channel in 2048 kbit/s coder or decoder.

The coder-pair CD2M/17 and decoder pair CD3M/33 each comprise a 4U BMM card-frame PN3/54, containing a 5V, 5A supply and a ± 18V, 1A supply. A card-slot is provided (already wired) in each coder-frame for a multiplexer (MUX) and in each decoder frame for a demultiplexer (DEMUX). Different MUXs and DEMUXs for different bit rates have been designed to be interchangeable. The GE7/9 MUX and UN16/8 DEMUX are used with up to three CD2M/17s and CD3M/33s respectively to provide up to six channels in 2048 kbit/s and the GE7/13 MUX and UN16/9 DEMUX provide two channels in 676 kbit/s from one each CD2M/17 and CD3M/33. Multiplexers and demultiplexers for other bit-rates or formats may be designed in future if requirements arise for them. For example, four channels could be easily multiplexed to 1544 kbit/s.

The coder can be fitted with variable-emphasis limiters and low pass filters AM6/27 (Option 1), or with no limiters and low pass filters FL4/68B (Option 2). The latter option can be used where programme material is already limited and accurately aligned, and this saves considerable cost and reduces system noise. The AM6/27 is a low noise modern limiter and filter in a single chassis, replacing the FL4/68A and AM6/23 which were used in early models.

Each audio input has a male and female XLR connector in parallel so that programmes can be looped through to the "Reserve Facilities Management Unit" (RFMU). With this unit a single coder (or decoder) can be used as a reserve for any of the three working coders. If these are called X, Y and Z coders according to their 2048 time slot designation and the reserve coder R, then X and R will carry the main multiplexer M and reserve multiplexer R respectively. Each coder has extensive self-diagnostic capability and can inform the RFMU of a fault condition. The RFMU will then route the appropriate programme to coder R and switch the multiplexers to insert R to the appropriate time slot. The multiplexers outputs are also monitored and the reserve selected when necessary independently of the state of the host coder. The RFMU for decoders is substantially different in detail but operates on the same overall principle. In addition, the self-diagnostic circuits of a decoder can be extended to include external audio distribution equipment and the rear panel includes audio inputs labelled "MON I/P" for this purpose.

Equipment has also been designed for the insertion of two channels of high quality audio from a remote digital source to a six-channel 2048 kbit/s bitstream, the CD2M/23. This comprises a 4U BMM card-frame PN3/54 and may include the "sample rate synchroniser" so that the bitstream to be inserted can be asynchronous within the usual frequency tolerance. Following insertion this bitstream is synchronous with the main bitstream.

Another unit, the GE7/14, extracts the data bits corresponding to a coder pair from a 2048 kbit/s bitstream in conjunction with the UN16/8 DEMUX. A 676 kbit/s two-channel bitstream is generated in HDB3 format for use with radio links of limited bandwidth, to feed Local Radio stations. This comprises a single card CH1/64J which can be fitted to a CD3M/33.

Further equipment will include half-bandwidth coders and decoders to provide up to twelve $7\frac{1}{2}$kHz channels in 2048 kbit/s. A single 4U card-frame will handle four channels and may be used in conjunction with the 15kHz two channel coders and decoders to provide combinations of half and full bandwidth coding. Digital test generators will also be provided to assist maintenance.

ENGINEERING DESIGN INFORMATION SHEETS WILL BE PUBLISHED ON THE FOLLOWING EQUIPMENT FOR THE NICAM SYSTEM

UNIT		EDI NO.
2 Channel Coder	CD2M/17	10439 (1)
2 Channel Decoder	CD3M/33	10440 (1)
Multiplexer (for 2048 kbit/s)	GE7/9	10441 (1)
Multiplexer (for 676 kbit/s)	GE7/13	10442 (1)
Demultiplexer (for 2048 kbit/s)	UN16/8	10443 (1)
Demultiplexer (for 676 kbit/s)	UN16/9	10444 (1)
Insertion Equipment	CD2M/23	10410 (1)
Bitstream Separator	GE7/14	10445 (1)
Reserve Facilities Management Unit		10446 (1)
Digital Test Generators		10447 (1)

SPECIFICATION

1. Audio to Audio one coder and decoder, 600Ω load

Amplitude/Frequency Response

40Hz - 15kHz	+0.2 to -1 dB
40Hz - 14kHz	+0.2 to -0.6 dB
125Hz - 10kHz	+0.2 to -0.2 dB

Noise Level (weighted)	- 60dB4W
(unweighted)	- 65dB4
THD (1kHz at +8dB (0.775V))	62dB separation

2. Signalling

Separate access is provided to eight signal bits per pair of audio channels, designated A1, A2, A3, A4, B1, B2, B3, and B4.

Both input and output are accompanied by a 3ms frame-rate strobe pulse which enables the full capacity of 2.6 kbit/s to be realised.

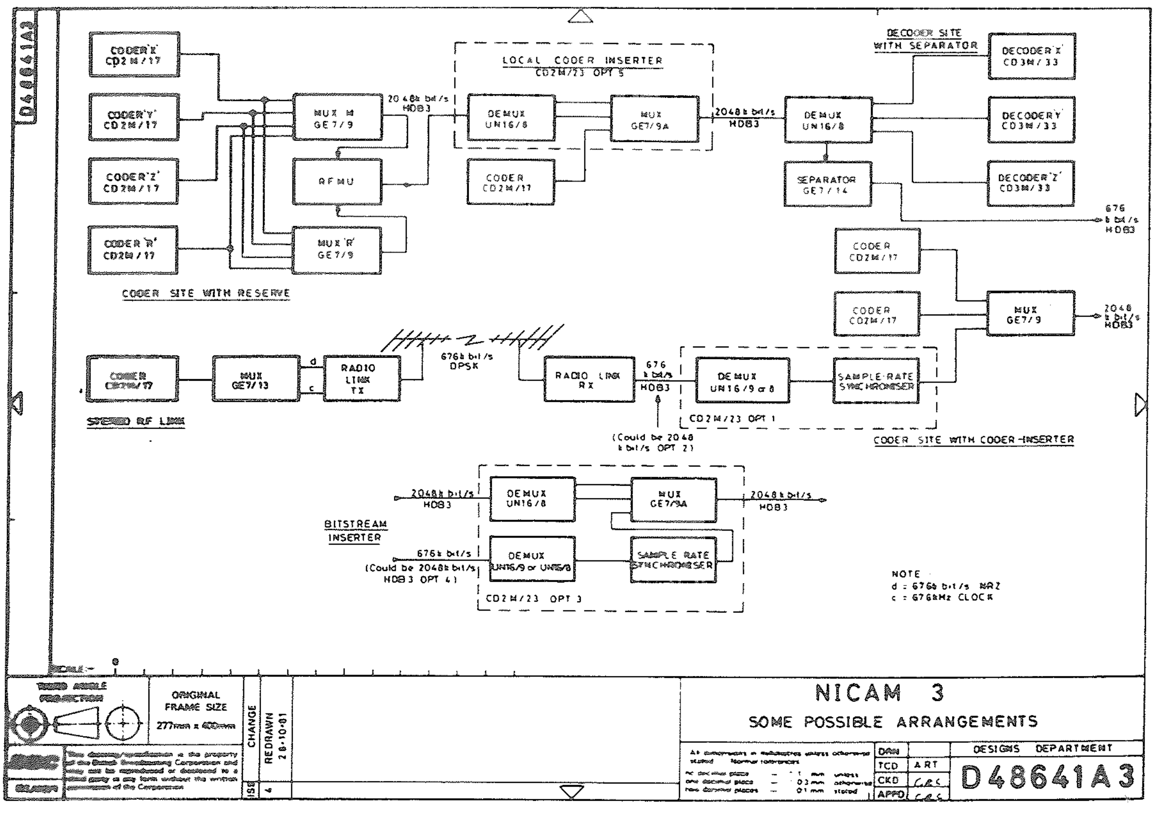
Half the signalling is carried in each single-channel bitstream. Note that A1 may be used to denote whether limiters have been ganged for stereo, i.e. Mono = "1", Stereo = "0".

3. Digital Signals

The usual line code is HDB3 at 4.7 volts p-p. However, the de-multiplexers can be switched to operate with an input of 400mV p-p for use with video bearers.

Redundant channels are filled with 1's as per BT practice. Special provision can be made to randomise redundant channels for non-transparent links.

4. Some Possible Arrangements



For further information please refer to Designs Department Handbooks No. 6.185(81) and 6.186(81) or contact Mr. R. Caine, Room 516 Western House, PABX LBH 4081.