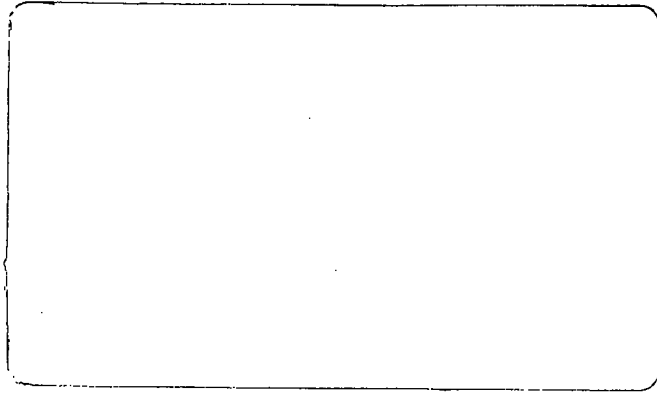THE DESIGN AND DEVELOPMENT OF A

SCPC DIGITAL RADIO PROGRAM RECEIV...

PHASE I

TASK II - SYSTEM DEFINITION

(SPECIFICATIONS)

MCS **MILLER COMMUNICATIONS SYSTEMS LTD.**

THE DESIGN AND DEVELOPMENT OF A

SCPC DIGITAL RADIO PROGRAM RECEIVER

PHASE I

TASK II - SYSTEM DEFINITION
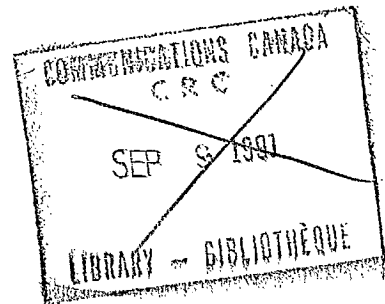
(SPECIFICATIONS)

MCS File No.: 8518.

DSS File No.: 06ST.36001-4-0576

Scientific Authority: E. Tsang

Date: March 29, 1985
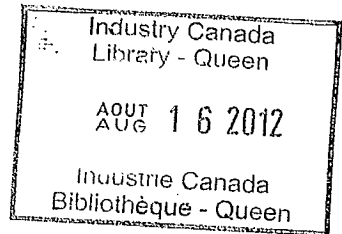
Prepared by: _____
K.M.S. Murthy

Approved by: _____
B. Mazur

SUBMITTED BY:

MCS MILLER COMMUNICATIONS
SYSTEMS LTD.

300 Legget Drive,
Kanata, Ontario,
Canada K2K 1Y5

TABLE OF CONTENTS

PERFORMANCE SPECIFICATION FOR
SCPC DIGITAL RADIO PROGRAM RECEIVER

FEBRUARY 1985

1.0 INTRODUCTION

This specification corresponds to that of a single channel per carrier digital sound program receiver to be developed for use in network radio program distribution. The requirements of both transmit and receive equipment, which consist of a sound codec, multiplexer, forward error correction codec, modem and audio and IF interfaces are covered. However, the specific requirements of the RF transmitter and receiver subsystems are not considered. This specification conforms to those requirements which were considered appropriate at the time of its preparation, taking into account state of the art techniques, technologies and regulatory issues.

In Section 2 a brief description of the equipment is presented. The technical and performance specifications for various subsystems are given in Section 3. These specifications are the outcome of a preliminary study and based on due considerations to the requirements of the networks, capabilities of manufacturers and the existing digital audio standards. The audio performance specifications given here either meet or exceed the existing CCITT standards. Both technical and performance specifications may be improved and/or modified as a result of detailed investigation of Tasks 3-6 of Phase II. These specifications can also be modified to reflect any significant changes in the Standards of CCITT and Radio Network.

It may be noted in Sections 3.2, 3.3, and 3.4 that the specifications of the multiplexing-demultiplexing units, forward error correction codecs and modems are not complete. The detailed specifications depend on the specific techniques used and therefore will be finalized during course of the detailed study in Phase II.

2.0   SYSTEM DESCRIPTION

The equipment described here will form part of a small aperture earth station terminal used for the distribution of radio networks' sound program material in a point-to-multi-point delivery system. Alternatively, this equipment with its appropriate complementary transmitter subsystems can be used to collect program material from the remote production centers to the network center.

This equipment is essentially a single channel per carrier system and will require only a portion of the power and the bandwidth of a satellite transponder which can operate in a "dedicated" or "shared" mode. This system will distribute one stereo-pair sound channel and a multipurpose data channel to network affiliates or other users.

The audio program is transmitted in a digitized, compressed form, to take advantage of the noise immunity improvements offered by digital transmission techniques.

2.1   Traffic Capability

The standard system configuration will provide the services of

- two 15 kHz audio channels
- one 32 kb/s data channel

Alternatively, with the service flexibility incorporated, each of the 15 kHz audio channels can be replaced by

(1)   two 7.5 kHz audio channels

or

(2)   six VF (64 kb/s) channels

or

(3)   twelve voice cue (32 kb/s) channels

or

(4)   one 7.5 kHz audio plus three VF channels

or

(5)   twelve 32 kb/s data channels

or

(6)   combinations of the above.

3.0   TECHNICAL/PERFORMANCE SPECIFICATIONS

The specifications provided below correspond to an end-to-end (typically a single hop satellite link) sound channel performance assuming that the bit error rate (BER) is < 10^{-7}. This performance also holds good for multiple-hop and/or multiple-link transmissions as long as the BER specified is maintained and there is no digital-analog-digital conversion(s) involved between the origin and destination. The audio performance specifications are better than those of CCITT-J.21 and it is expected that the performance of (up to) three encoder/decoder pairs connected in tandem at audio frequencies will meet CCITT-J.21.

3.1   Sound Coding

3.1.1 Audio bandwidth   : 0.04 – 15 kHz (standard)
                                         0.04 – 7.5 kHz (optional)

3.1.2 Sampling frequency   : 32 kHz (for 15 kHz audio)
                                         16 kHz (for 7.5 kHz audio)

       Sampling frequency stability : ± 5 x 10^{-5}
                                         (CCIR Recommendation 606)

3.1.3 Digital Encoding and Decoding: Linear PCM 14 bits/sample
                                         (full range)

3.1.4 Digital Compression

       Companding type   : Instantaneous
       Companding law   : A-law (A = 43.8)
       Segmenting   : 11 Segments (full range)
       Digital compression   : 14 to 11 bits/sample (full
                                         range)
       Digital Expansion   : 11 to 14 bits/sample (full
                                         range)

3.1.5 Bit Error Protection   : 1 bit Parity for each 11 bit
                                         word
       Parity Coverage   : 7 most significant bits
       Error Concealment   : zero order extrapolation for
                                         fewer parity errors
                                       : muting for consecutive
                                         parity errors

3.1.6   Bit Rate Per 15 kHz Audio Channel

      Nominal sample bit rate   : 352 kb/s
        (32 kHz x 11 bits/sample)

      Error Protection   : 32 kb/s
        (32 kHz x 1 bit/sample)

      Total information bit rate   : 384 kb/s
        per channel

3.1.7   Bit Rate Per 7.5 kHz Audio Channel (Optional)

      Nominal sample bit rate   : 176 kb/s
        (16 kHz x 11 bits/sample)

      Error protection   : 16 kb/s
        (16 kHz x 1 bit/sample)

      Total information bit rate   : 192 kb/s
        per channel

3.1.8   Emphasis Network   : CCITT Recommendation J.17

      Pre- and De-emphasis   : ±0.25 dB
        Compatibility

      Provision   : Selectable

3.1.9   Signal Levels

      Full Load Level (FLL)   : 21 dBm

      Level Adjustment   : (to be specified)

	Level stability	: ±0.1 dB (24 hours)
	Overload level	: (to be specified)
3.1.10	Impedance (input/output)	: 600 ohms (or 150 ohms) balanced and floating
3.1.11	Return Loss	: > 26 dB (50 Hz – 5 kHz) : > 20 dB (40 Hz – 15 kHz)
3.1.12	Surge Protection (Input/Output)	: 600 V transient with 10 μs rise time decaying to 300 V in 1s.
3.1.13	Idle-circuit noise	: More than 76 dB below FLL in a flat 15 kHz band. (<-55dBmO)
3.1.14	Signal to Quantizing Noise Ratio	: > 52 dB for a -6 dBmO to +18 dBmO sinusoid at 1004 Hz measured in a flat 15 kHz band.
3.1.15	Total Distortion	: < 0.5% 40 – 125 Hz < 0.35% 0.125 – 15 kHz for -6 dBmO to +18 dBmO sinusoidal input.
3.1.16	Total Harmonic Distortion	: < 0.4% 40 Hz to 125 Hz < 0.3% 125 Hz to 15 kHz for -6 dBmO to +18 dBmO input.
3.1.17	Intermodulation Distortion	: < 0.2% for 500 Hz and 2 kHz inputs each at +12 dBmO.

3.1.18 Single Frequency Interference: <-55 dBmO   40 Hz - 300 Hz

<-65 dBmO 300 Hz - 1 kHz

<-75 dBmO 1 kHz - 12 kHz

<-65 dBmO 12 kHz - 15 kHz

with audio input

terminated by 600Ω.

3.1.19 Spurious Tones   : The level of all spurious (excluding the fundamental and harmonics of input) tones at the following frequencies when a single tone from 20 Hz to 20 kHz at -5 dBmO to +18 dBmO is applied at the channel input must be:

> 55 dB below input, 0-300 Hz

> 60 dB below input, 0.3-1 kHz

> 65 dB below input, 1-12 kHz

> 60 dB below input, 12-15 kHz

> 55 dB below input, above 15 kHz

3.1.20 Gain/Frequency Response   : +0.3 to -0.7 dB, 0.04-14 kHz
(See Figure 3.1)

±0.3 dB,   0.125-10 kHz

+0.3 to -1.0 dB, 14-15 kHz

3.1.21 Envelope Delay Variation : < 4 ms,   40 Hz-15 kHz
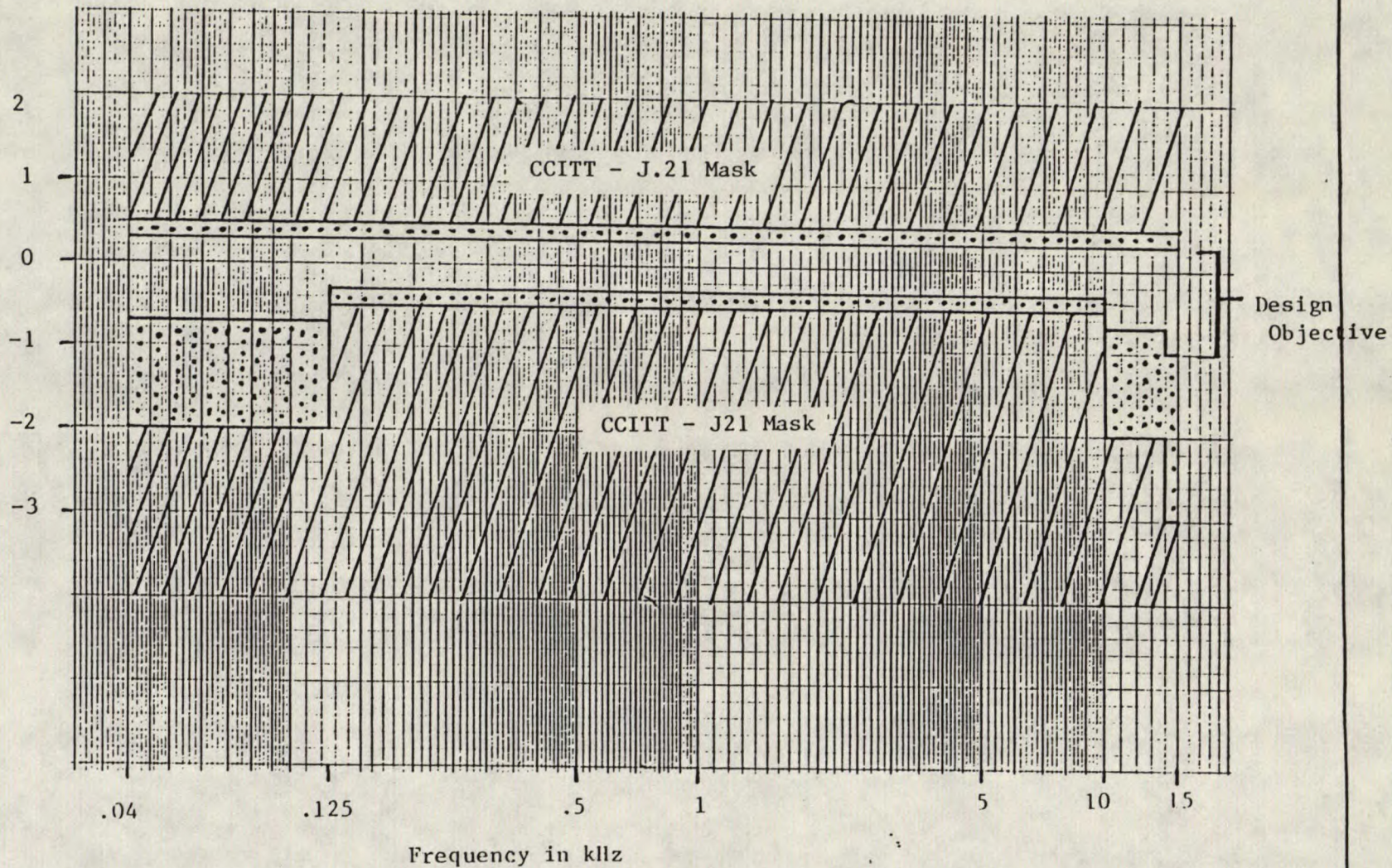
Fig. 3.1 - 15 kHz Channel Gain/Frequency Response

0 dB : Reference Input

3.1.22 Interchannel Gain Difference : < 0.4 dB,   40-125 Hz

                                             < 0.3 dB,   0.125-10 kHz

                                             < 0.8 dB,   10-15 kHz

3.1.23 Interchannel Phase Difference: < 6°,   40-125 Hz

                                             < 3°,   0.125-10 kHz

                                             < 6°,   0.40 -15 kHz

3.1.24 Crosstalk Attenuation   : > 75 dB,   0.40 - 15 kHz

3.2   Multiplexing/Demultiplexing*

3.2.1 Number of audio channels   : Two 15 kHz mono channels 384 kb/s each. Four 7.5 kHz audio channels of 192 kb/s each (optional).

3.2.2 Data Channel   .   : one synchronous channel of 32 kb/s

3.2.3 Multiplexed information bit
                                rate : 800 kb/s

3.2.4 Interface   : Tl compatible

3.3   Forward Error Correction*

3.3.1 Encoding   : Convolutional or BCH

3.3.2 Decoding   : Threshold or Sequential or MLD

3.3.3 Code Rate   : 7/8 or 3/4 or 1/2

NOTE: *Specs incomplete

3.3.4   Coding gain at BER=10^{-7} : >2.5 dB

3.3.5   Phase Ambiguity Resolution   : Inbuilt

3.4   Modulation/Demodulation*

3.4.1   Type of Modulation   : PSK

3.4.2   Type of Demodulation   : Coherent

3.4.3   IF Carrier frequency   : 70 ± 18 MHz

3.4.4   Impedance   : 75 ohms/50 ohms

3.4.5   Frequency Agility   : Programmable IF Synthesizer
                                       (optional)

3.4.6   Automatic Gain Control   : Inbuilt

Note: *Specs incomplete

4.0   ELECTRICAL AND ENVIRONMENTAL SPECIFICATIONS

4.1   POWER-LINE OPERATING VOLTAGE : 105-130 VAC

4.2   POWER-LINE FREQUENCY   : 60 Hz ± 5%

4.3   EQUIPMENT OPERATING   : 0°C to 40°C
          TEMPERATURE

LKC
P91 .C654 M87 1985 v.4
The design and development   pment.
of a SCPC digital radio
program receiver