Product Development of Expedio

Provides a Digital Video Link
Primarily for
Digital Electronic News Gathering [DENG]

Date:- 21st April 2002	By:- S. Naik
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Contents:

Document Updates

Date of Change	Changes by	General description.
04/21/2002	S. Naik	First Issue

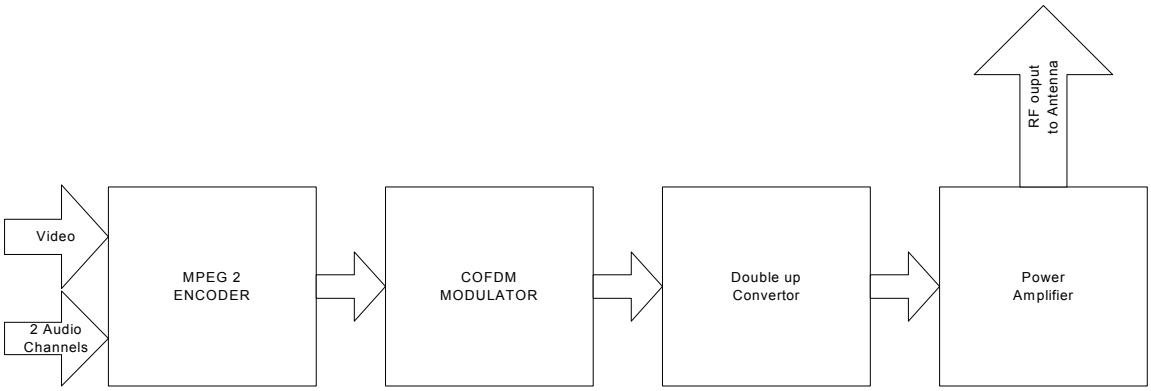
1.0 Introduction

This document describes in general the workings of the 'Expedio' product. The product is designed to address the Video Broadcasting Market for Electronic Newsgathering [ENG]. At present the Broadcasters using the Analogue systems are utilizing the 2GHz band allocated by the FCC as the BAS band. This band is presently 17MHz wide band and the FCC is forcing a change to a 12MHz bandwidth. They also need to provide more than one channel in the 12MHz band. The only way to provide this is via a digital system.

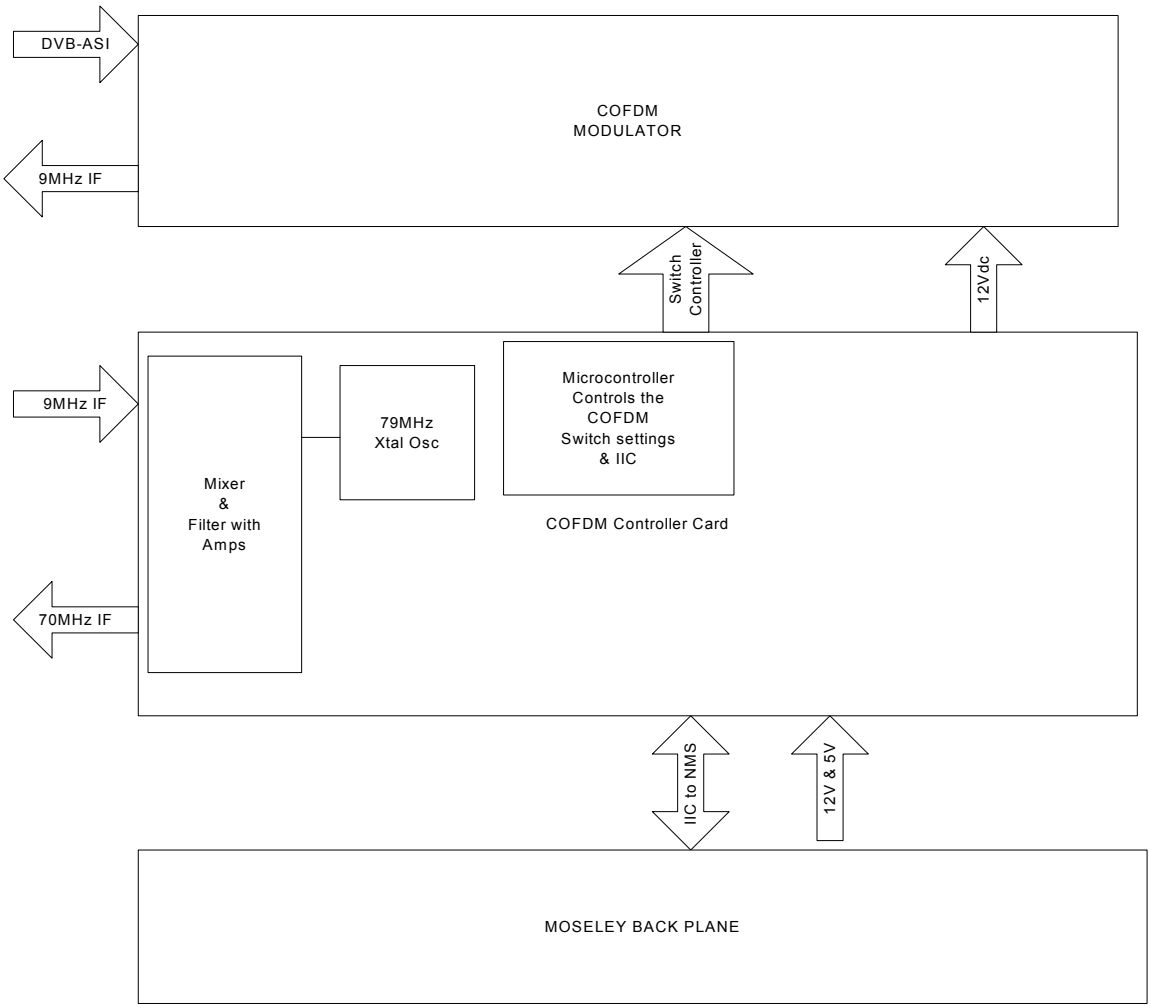
The digital system comprises of a Transmitter and a Receiver, whose output RF frequency is in the Band 1.9GHz to 2.9GHz. The RF will not to cover the full 1GHz band, but in bands of approximately 300MHz.

Transmitter is comprised of a MPEG2 Video Encoder whose data output, is transport stream [DVB-TS] output, which is then Modulated with COFDM (or any other digital modulators). This modulated signal is then converted to the appropriate RF signal.

Receiver will down convert from the RF signal to the UHF band where a Standard Commercial Tuner will be utilized. The output of this is a DVB-TS, which is then MPEG2 Video Decoded and provided as analogue Video output.



2.0 Transmitter



2.1 Video Encoder

The first stage of development will utilize the Exatel Video Encoder will be an encoder which ulitlises the compression in the 4:2:0 domain. The Exatel unit has an input of 1 Video and 2 Audio channels. This input shall be from the Moseley MPEG2 carrier board.
This board shall be designed to provide the inputs/ and outputs as follows

a] The Video input shall have a buffer stage with the ability to change level.

b] The Audio input shall have a buffer stage with the ability to change level and impedance.

c] The Data Output which is DVB-SPI shall be converted to DVB-ASI with the ability to change from 188 data byte only to 204 which has the data bytes plus the blank for Reed Solomon Encoding. This change can be carried out with a dip switch on board.
The Transport Stream out of an MPEG2 unit is made up as follows

<table>
<tr><td colspan="3">204 Bytes (8bits-per Byte)</td></tr>
<tr><td colspan="2">188 Bytes</td><td>16 Bytes</td></tr>
<tr><td>4 Bytes</td><td></td><td></td></tr>
<tr><td>Packet Header</td><td>Utility Data</td><td>RS FEC</td></tr>
</table>

d] The DC power requirements will be from this board.
+5v with **xxx mA**
+12V with **xxx mA**
TBD

e] The control signal of RS232 will be carried out from the Video Encoder board directly with Moseley Written software. It shall be possible to program the Encoder and save its settings so that on start up it comes up with the saved settings.

G] The software should have the following functions as a minimum:-
Video Data Rate 1 – 15Mbps for 4:2:0 format and upto 50Mbps for 4:2:2
Video Format:- PAL/NTSC
Video Field size 4:3 or 16:9

MPEG-2 Encoding (VisionTech KFIR 2 based)	
Compliance	ISO/IEC 13818-3,2(MPEG-2)
Stream Types	Elementary, Program, and Transport

Video Encoder	Horizontal Resolution: 720, 640, 544, 480, 360, 320, 160 Vertical Resolution: 480, 240, 112(NTSC) 576, 288, 144(PAL) Preprocessor: programmable 2D (7X6) filter spatial noise reduction Motion Estimation: P and B-pictures +/-100(H) X+/-34(V) Half PEL accuracy Aspect Ratio: Square, 4:3, 16:9, 2.11:1 GOP Structure: M = 0, 1, 2 or 3

Audio Data Rate

f] There should be the ability to have the Closed Captioning, which exist in the earlier lines (line 14 to 20), to be enabled or disabled.

Future Development
This has to be an Video Encoder which has the capability of compressing video down to MPEG2 4:2:2 upto 50Mbps. The encoder has to be able to interact with the modulator

2.2 Modulator

The Input to the Modulator will be DVB-ASI [DVB-SPI for the future] in the form of 204bytes, of which 188 will be data and the rest will be blank as required within the DVB Specifications. **See Appendix for DVB specifications**. The input and outputs shall be as follows:

a] DVB-ASI for video encoded data 75ohms BNC connector
b] Modulated output to be a Low IF [IQ for future use] which is up-converted to 70MHz with 0dBm output with the IF Control board being utilised
c] Power Supply to be +12v with **xxx mA**
d] Control of the modulation type shall be carried out by the Moseley IF Control Board.
e] The control will be to enable the switches with the appropriate state.
f] It shall be possible to control this unit via RS232 and store the settings. Hardware setup is an alternitive way of expediting the product with the switch setting as below.

The modulation Scheme will be compliant to DVB-T 2K option in the non-hierarchical mode.

In-band flatness --- <+/- 0.2dB
Spurious output ---< -50dB [there will be another filter in the up-converter]

Future consideration for the modulator is to use the Moseley / Broadcom with DVB-SPI interface. If there is a design change in the modulator then we should consider the ability to use the design for interfacing with Video Encoders.

2.2.1 COFDM Switch Settings

Yellow S3	Blue S2	Brown S1	Viterbi Setting	Switch Setting
1	1	1	1/2	10
1	1	0	2/3	1
1	0	1	3/4	2
1	0	0	5/6	1 and 2
0	1	1	7/8	4

Red S5	Green S4	Modulation Setting	Switch Setting
1	1	QPSK	10
1	0	16QAM	1
0	1	64QAM	2

Grey S7	Orange S6	Guard Interval	Switch Setting
1	1	1/32	10
1	0	1/16	1
0	1	1/8	2
0	0	1/4	1 and 2

2.3 Up-converter

This unit is designed to convert the first Intermediate Frequency from the Modulator, of 70MHz to 485MHz. It then takes this and goes through a second conversion whose output is at the required frequency of 2.4GHz. The second conversion process having a 485MHz IF frequency would mean that one is able to tune 200MHz without the requirement of very narrow filters. It should also be possible to program this unit using RS232 directly onto the board for a stand alone system.

2.3.1 First Conversion: -
With its input frequency of 70MHz, the signal will be further conditioned by feeding though a Surface Acoustic Wave (SAW) filter. This is done to ensure that the signal is as required when mixing with the Local Oscillator, the output signals are as expected and that no unwanted signals are present. The Local Oscillator LO(1) used in this system is 415MHz, which is locked to a reference of 12.8MHz, which is the system reference Oven Controlled Crystal Oscillator [OCXO]. This OCXO resides in the Modulator and has the frequency stability of less than 1ppm. The output of the mixed signal is the difference between 415MHz and 70MHz by selecting a filter of 485MHz means that the signal of 485MHz is now available on the output port of this section of the conversion. Further signal conditioning is carried out in order to ensure the level required is as designed.

UHF O/P	=	LO(1)	+	IF
485 MHz	=	415	+	70

2.3.1 Second Conversion: -
This takes the 485MHz UHF signal as its input and goes through further signal conditioning before it is fed into the Mixer. The Local Oscillator LO(2) Drive is a Synthesized unit, which has the ability to tune down to 1650MHz to 2200MHz. The reference is once again the OCXO from the modulator. This mixer is now capable of providing an output, which is as follows

RF O/P = LO(2) + UHF

This means that the output of this device is from: -

RF O/P	=	LO(2)	+	UHF
2135 MHz	=	1650	+	485
2685 MHz	=	2200	+	485

Having an output from 2135MHz to 2685MHz means that with an appropriate filter you are able to achieve the output required.

Having selected an RF frequency band, which does not exceed 200MHz then an external filter, is added to the output of this unit in order to ensure that no unwanted signal are transmitted.

A] Input of 70MHz with level of 0dBm to –15dBm level adjustment to it.
B] At 70MHz a filter to improve the Modulator spurious specifications from 50dB spec to 80dB
c] The 70MHz will be converted to UHF frequency of around 400MHz with appropriate filtering such that its spurious are better than 70dB.
D] This UHF frequency will be up converted further to the 2GHz Band
e] The output level at 2GHz will be better than 10dBm [spurious free better then70dB]
f] The control to this unit shall be to Moseley I^2C
G] The PSU requirement will be +12Vdc xxx mA and +5Vdc xxx mA

3.2 Power Amplifier:-

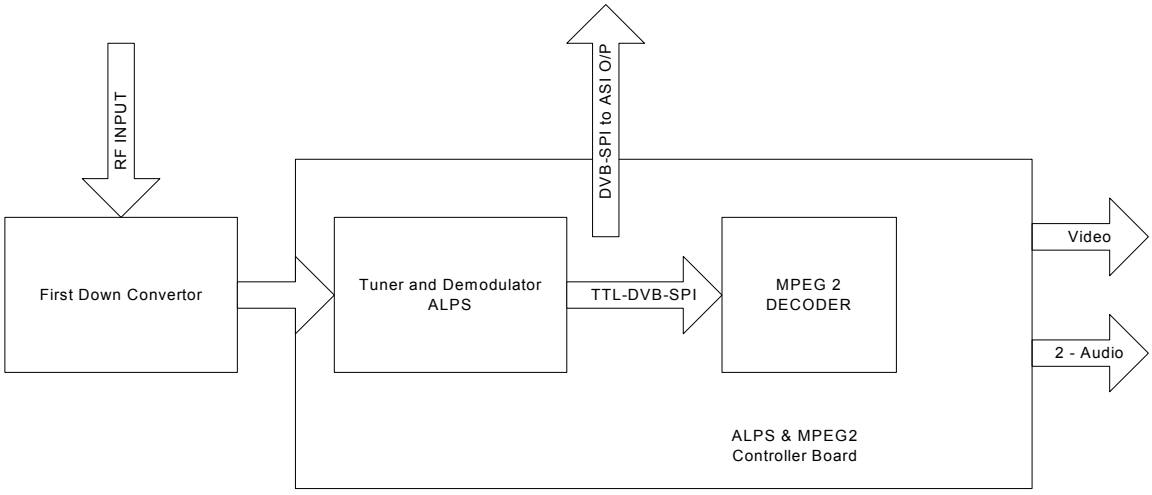
This amplifier will be the same as used in the NXE1 product

A] Forward Power Detection 0 to 5Vdc
b] Reverse Power Detection 0 to 5Vdc
c] Temperature sensor
d] Power Supply voltage not to exceed 10.5Vdc
e] Input power of +5dBm [TBD]
e] Output power to be +27dBm with 40dB Inter-modulation re-growth
f] Output Power of +30dBm with a maximum of 28dB Inter-mod for use on QPSK systems only.

3.2 High Power Amplifier

This is has the following specification

3.0 Receiver


RF INPUT
DVB-SPI to ASI O/P
First Down Convertor
Tuner and Demodulator
ALPS
TTL-DVB-SPI
MPEG 2
DECODER
Video
2 - Audio
ALPS & MPEG2
Controller Board

3.1 First Down Converter

This unit is designed to convert the first Conversion from the Receiver signal of 2GHz (band filter dependant) to a UHF band, of 485MHz. It then takes this and goes through a second conversion whose output is at the required Intermediate Frequency of 70MHz. The first conversion process having an output frequency of 485MHz would mean that one is able to tune 200MHz external filter dependant filters.

3.1.1 First Conversion: -

This takes an RF frequency in the 2GHz Band dependant of the filter fitted. The input signal goes through a Low Noise Amplifier then goes to a filter for image rejection as well as Band selection. This signal is further amplified to ensure the dynamic range requirements and some matching circuits before it is fed into the Mixer. The Local Oscillator LO(2) Drive is a Synthesized unit, which has the ability to tune the band of 1650MHz to 2200MHz. The reference is once again the OCXO from the modulator. This mixer is now capable of providing an output, which is as follows

UHF O/P = LO(2) + RF I/P

This means that the output of this device is from: -

UHF O/P	=	LO(2)	-	RF I/P
485 MHz	=	1650	-	2135
485 MHz	=	2200	-	2685

3.2 Tuner and Demodulator for OFDM

This is an ALPS Tuner which has an input of the UHF band and its specification is as follows:-

- Input Frequency Range:- 470-860MHz
- Input Return Loss is 8dB [NEED TO ENSURE BETTER]
- Channel Bandwidth:- 8MHz
- Input Signal Level:- –90dBm to –20dBm
- Input impedance is:- 75Ohms [NEED TO TRANSFORM FROM 50Ohms]
- OFDM 2K carrier non-hierarchical (DVB-T Compliant)
- Modulation Modes:- QPSK, 16QAM, and 64QAM
- Guard Interval Modes:- 1/32, 1/16, 1/8, 1,4 active symbol duration
- FEC Modes:- Rate 1/2, 2/3, 3/4, 5/6, 7/8.
- Output MPEG-2 Transport Stream [TTL - Compatible]
- Control Format IIC Bus interface
- Power Supply +32V(10mA) , +9V(80mA), +5V(220mA) +3V(650mA) dc
- Operating Range 0 to 60 deg.C.
-

Shortcut to TDMB7_701A.PDF.lnk

3.3 MPEG2 Decoder

The first stage of development will utilize the Exatel Video Decoder, with ability to decode both 4:2:0 and 4:2:2 type pictures. The Exatel unit has 1 Video and 2 Audio channels output.
This input shall be from the Moseley MPEG2 carrier board.
This board shall be designed to provide the inputs/ and outputs as follows

a] The Video output shall have a buffer stage with the ability to change level.

b] The Audio output shall have a buffer stage with the ability to change level and impedance.

MPEG-2 Decoding (STi5512 based)	
Compliance	Video: MPEG-2 MP @ ML Letter Box (16:9 and 14:9), 2:1, 3:1, 4:1 downsizing Audio: MPEG-1 (layers 1 and 2), AC-3
Transport Interface	Parallel DVB Bit-Streams More than 32 PIDs
On-Screen-Display	Hi-res chroma mode (4:4:4) for RGB output Link list control 4-bit mixing factor by region or 6-bit mixing for each CLUT entry (anti-aliasing) 8-bit Y, U and V resolution palette 2D, paced BLT engine with "fill" function Anti-flicker and anti-flutter filters

The other video cards to be considered is the Spase Technology professional IC whose development system we have and is alleged to have lower delay for decoding the

3.4 ALPS and MPEG2 Controller Card

This card will carry both the to bought out items and will have the following items addressed:

- Power supplies
- Convert DVB TS from the ALPS to DVB-SPI using LVDS and provide that as the input to the MPEG2 encoder and also convert the DVB-SPI to DVB-ASI and provide that as an output.
- The processor shall control the ALPS and the MPEG2 card.
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