DTTB Transmission Power Basics

This presentation seeks to explain the aspects of both PAL analogue and Digital TV broadcasting relating to transmission power.

**Compiled by Wayne Dickson
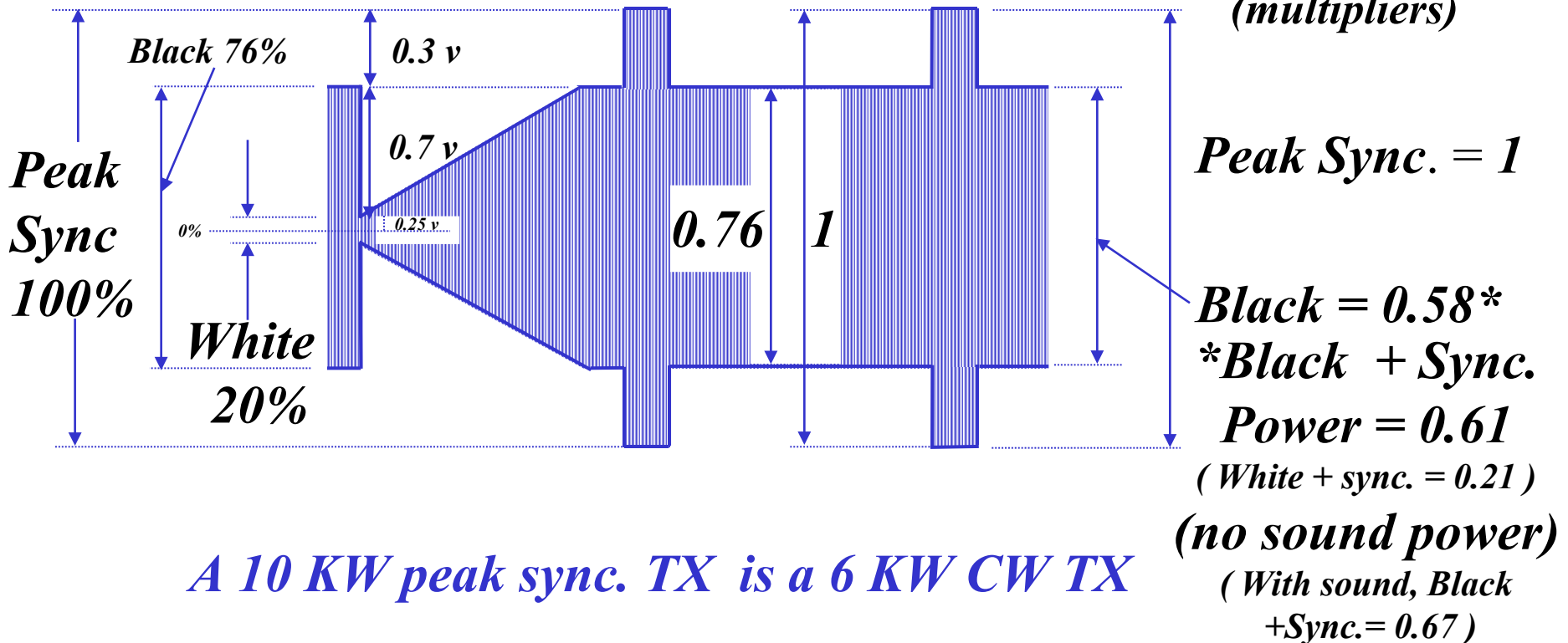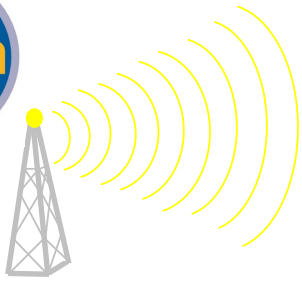SMIREE MIEAust. CPEng. Member SMPTE**

Analogue TV
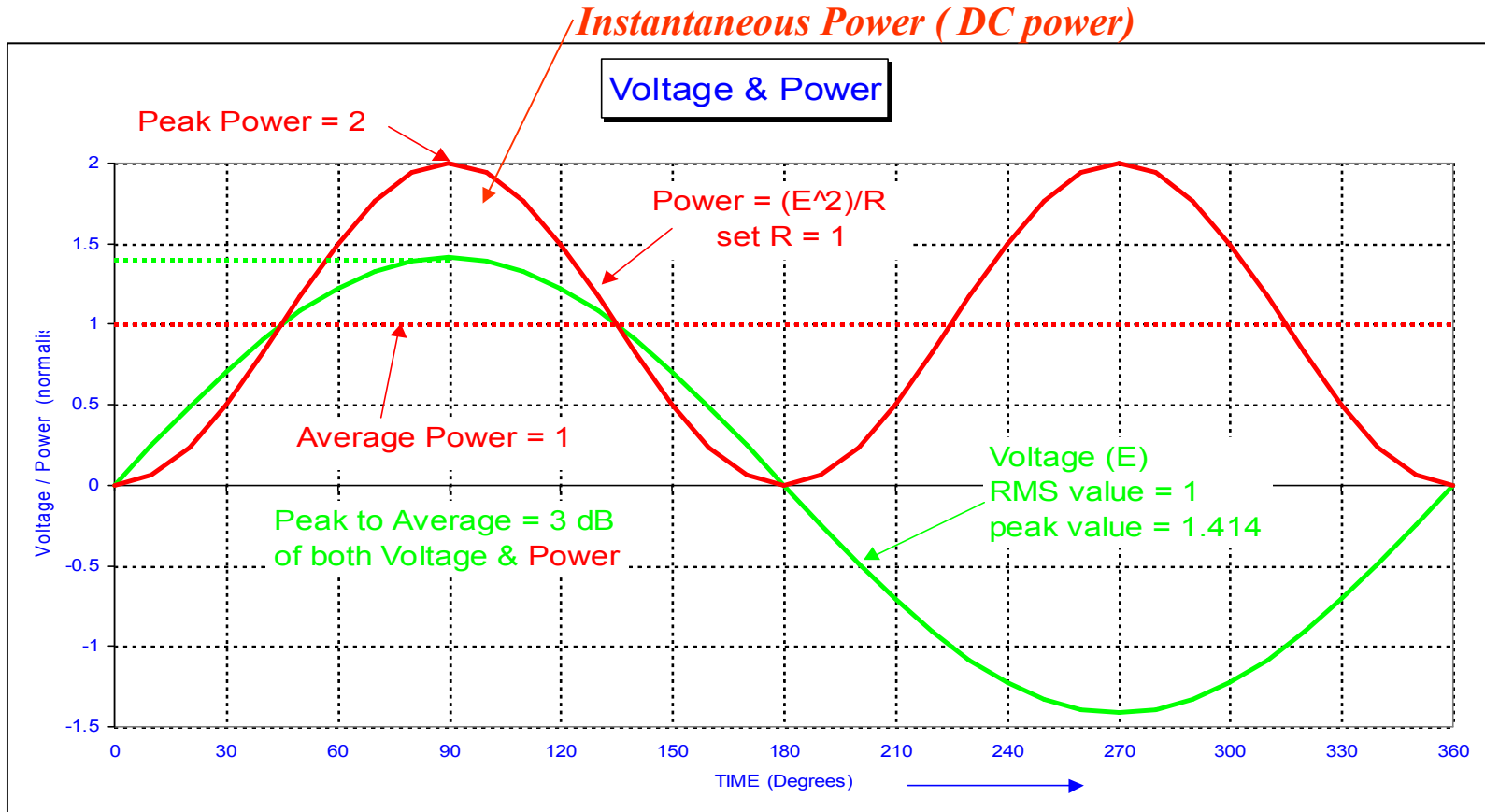
Modulation   *Video*   **_Voltage_**   **_Power_**
(multipliers)

Black 76%   *0.3 v*

Peak Sync 100%   *0.7 v*

0%   *0.25 v*   **0.76** **1**

Peak Sync. = 1

White 20%

Black = 0.58*
*Black + Sync.
Power = 0.61
(White + sync. = 0.21)

(no sound power)
(With sound, Black +Sync.= 0.67)

A 10 KW peak sync. TX is a 6 KW CW TX

RMS Voltage to Average Power

Instantaneous Power (DC power)

Voltage & Power

Peak Power = 2

Power = (E^2)/R
set R = 1

Average Power = 1

Peak to Average = 3 dB
of both Voltage & Power

Voltage (E)
RMS value = 1
peak value = 1.414

Voltage / Power (normali:

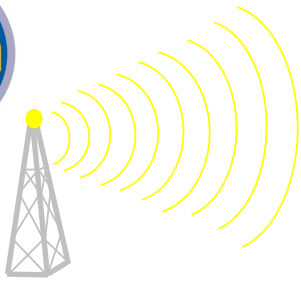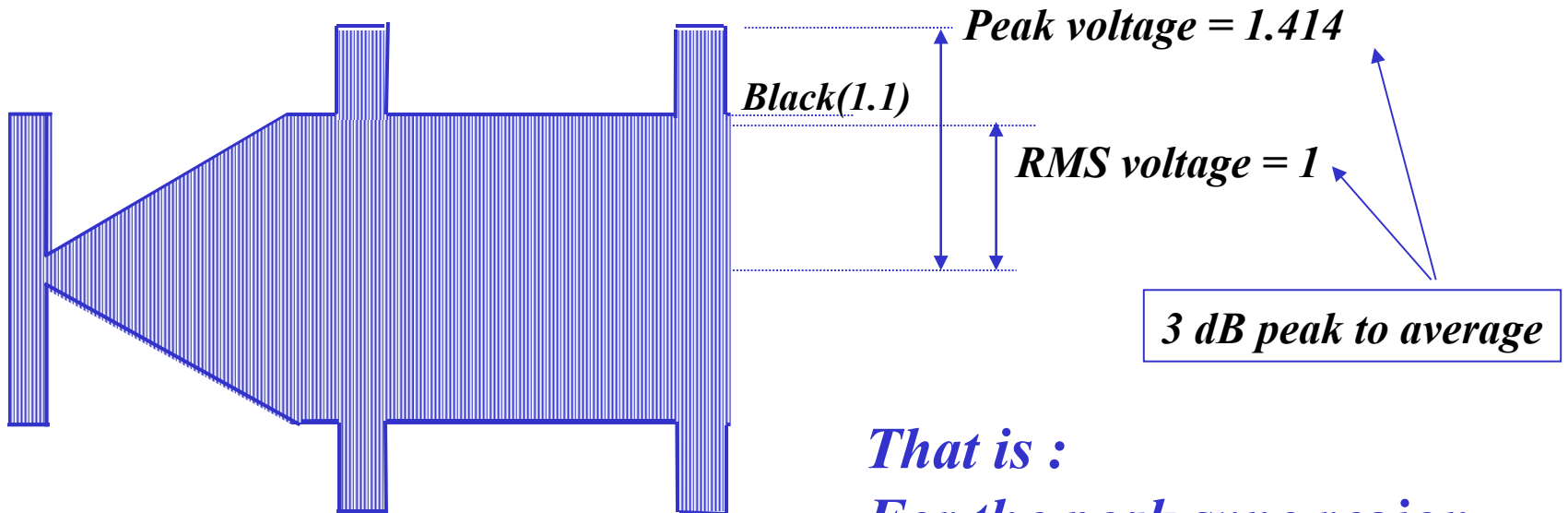TIME (Degrees)

The RMS voltage equals the equivalent DC voltage required to provide
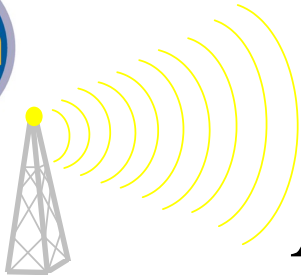*the same heating or average power when applied to a resistive load.*

Analogue TV
Peak & RMS Voltage

Peak voltage = 1.414

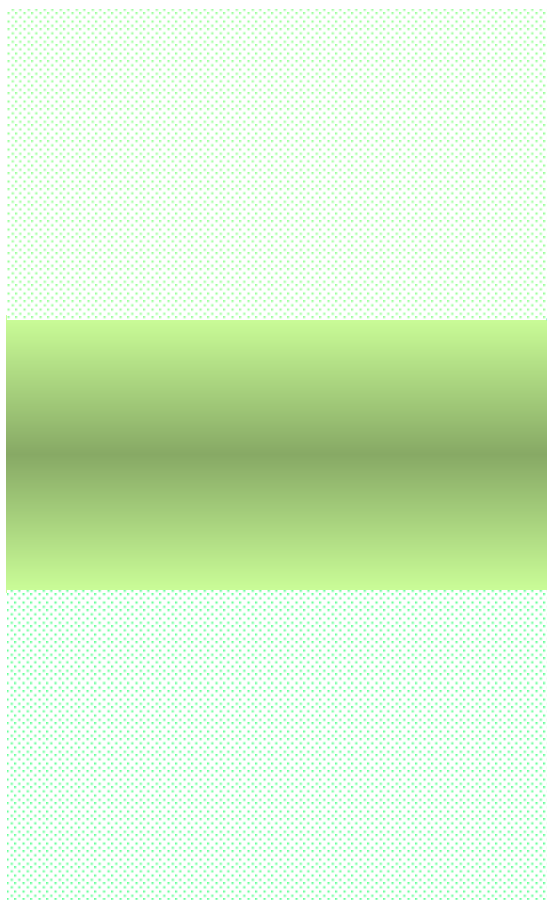*Black(1.1)*

RMS voltage = 1

3 dB peak to average

That is :
For the peak sync region
the "peak to average" ratio,
like a Sine Wave, is 3 dB and
applies to voltage & power.

COFDM
Amplitude Distribution
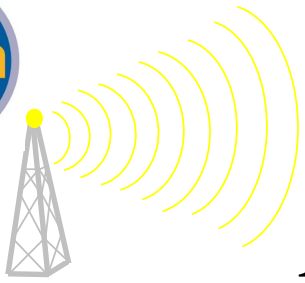
(CDF = 99.99%)

Peak voltage = 3 (9.5dB) - COFDM

(for CDF = 95% peak voltage = 1.7 (4.7dB))

("CDF" - Cumultive Distribution Function)

RMS voltage = 1 (0dB)

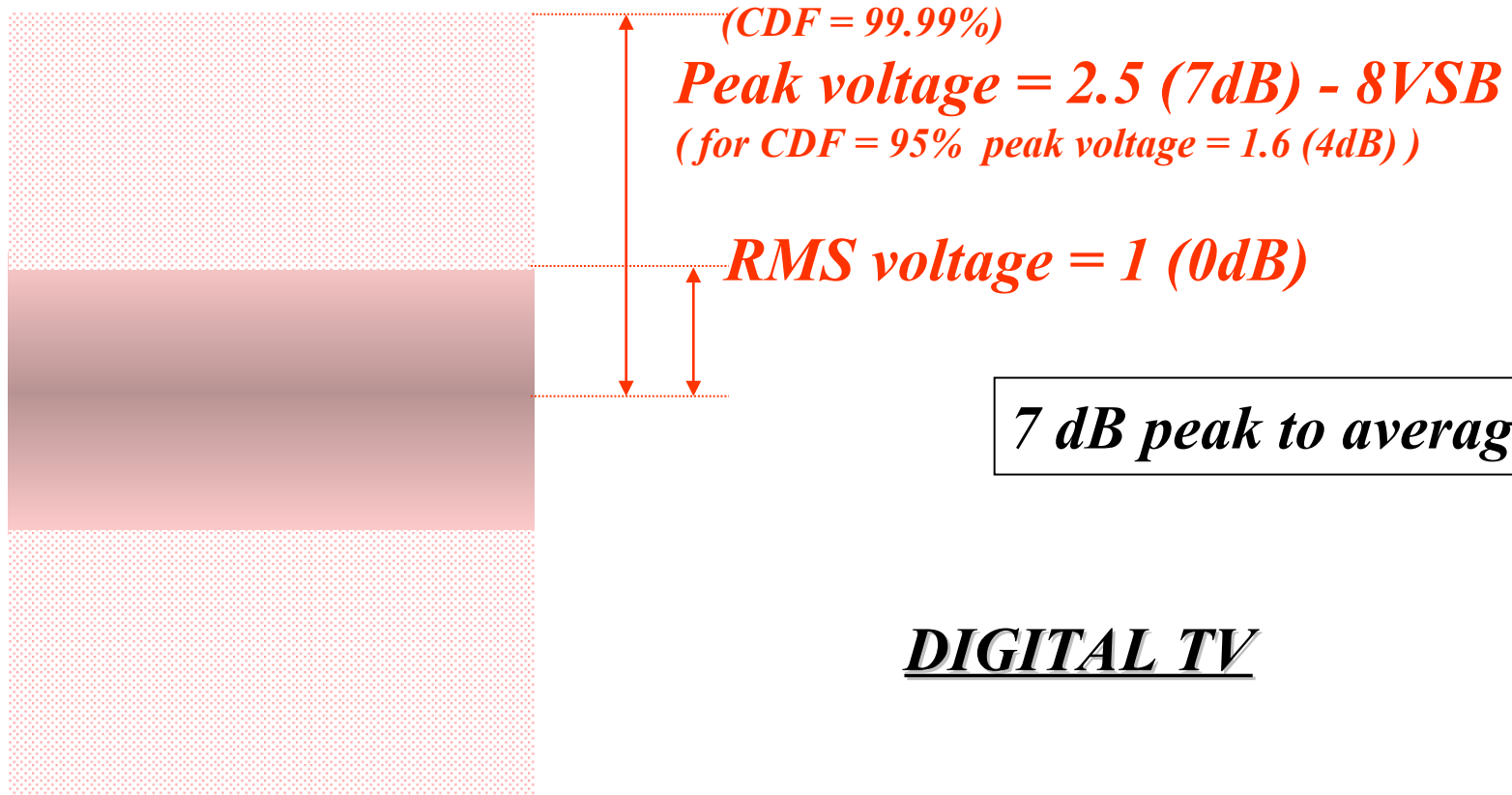**9.5 dB peak to average**

DIGITAL TV

8-VSB
Amplitude Distribution

(CDF = 99.99%)

Peak voltage = 2.5 (7dB) - 8VSB
(for CDF = 95% peak voltage = 1.6 (4dB))

RMS voltage = 1 (0dB)
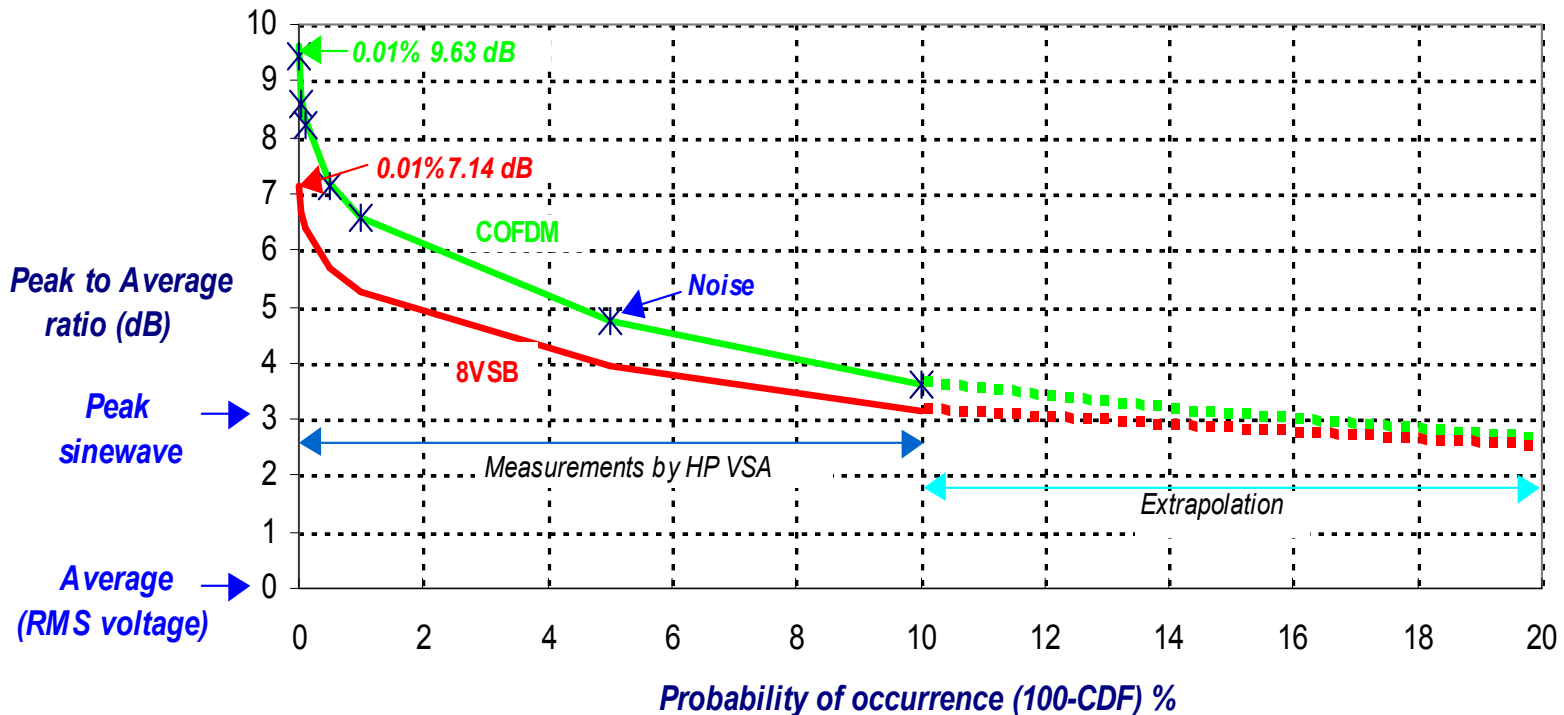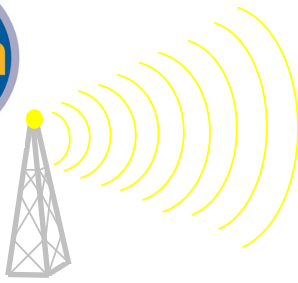
7 dB peak to average

DIGITAL TV

DTTB Peak Amplitude Distribution

Peak Amplitude Distribution
for COFDM and 8VSB DTTB Systems

DTTB Transmission Some Questions

- ***Some questions to be answered*** :
  - *What is the relationship between the allowed level of the peaks, to the impairment(s) in the digital transmission ?*
  - *What is the minimum level of Peaks required ?*
    - *For the Main Transmitter (and feeders, antenna systems)*
    - *For a Translator*
    - *For the Receiver*
  - *Should the level of peaks, be the choice of the system designer ?*
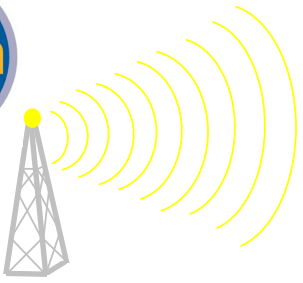
Peak to Average Summary

Summary :

Peak to Average

Analogue :   ***3 dB***

Digital - COFDM :   ***9.5 dB***

Digital - 8VSB :   ***7 dB***
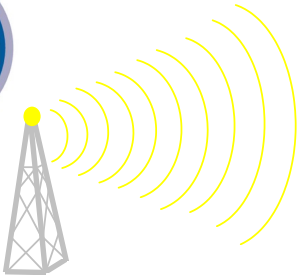
DTTB Peak Power

Peak Power : *(Equivalent DC power)*

	Peak to Average	**Peak power for 10KW av.**
Analogue :	**3 dB**	**20 KW instantaneous**
Digital - COFDM :	**9.5 dB**	**90 KW instantaneous**
Digital - 8VSB :	**7 dB**	**50 KW instantaneous**
(Noise	**9.5 dB**	**90 KW instantaneous)**
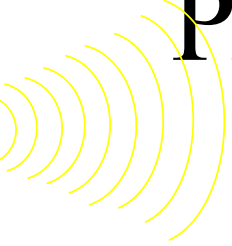
PAL-DTTB @ -10 dB Relative Power

Relative Power : for DTTB to PAL ratio = -10 dB

	Peak to Average	Ratio (DTTB to PAL)	Peak Power (ref. Analogue peak sync. "peak power")
Analogue :	3 dB	0 dB	0 dB
Digital - COFDM :	9.5 dB	-10 dB	-3.5 dB
Digital - 8VSB :	7 dB	-10 dB	-6 dB
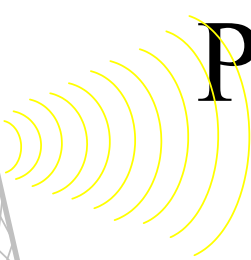
PAL-DTTB @ -10 dB
Relative Levels

Relative Levels for | **_PAL/DTTB Ratio = -10 dB_**

Peak

3dB ....

Average 0dB ————————

-0.5dB .... **-3dB** ....

Analogue
(Peak Sync.)

-10dB ———————— **-10dB** ————————

COFDM **8VSB**

PAL-DTTB @ -10 dB Transmitter Power

Transmitter Power *for* | **_PAL/DTTB Ratio = -10 dB_**

Peak

3dB ·······························

Average 0dB — **6 KW(CW)**

                                -0.5dB ··························   **-3dB** ··························

Analogue
(Peak Sync.)
10 KW
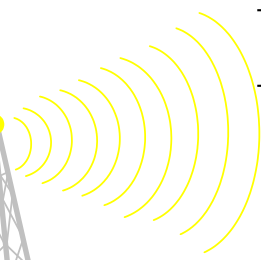
                                -10dB — **1 KW**   **-10dB** — **1 KW**

                                   COFDM   *8VSB*

PAL-DTTB @ 0 dB
Relative Levels

Relative Levels _for_ | **_PAL/DTTB Ratio = 0 dB_** |

Peak

_9.5dB_ ....

_7dB_ ....

_3dB_ ....

Average **_0dB_** ———————— **_0dB_** ———————— **_0dB_** ————————

Analogue
(Peak Sync.)
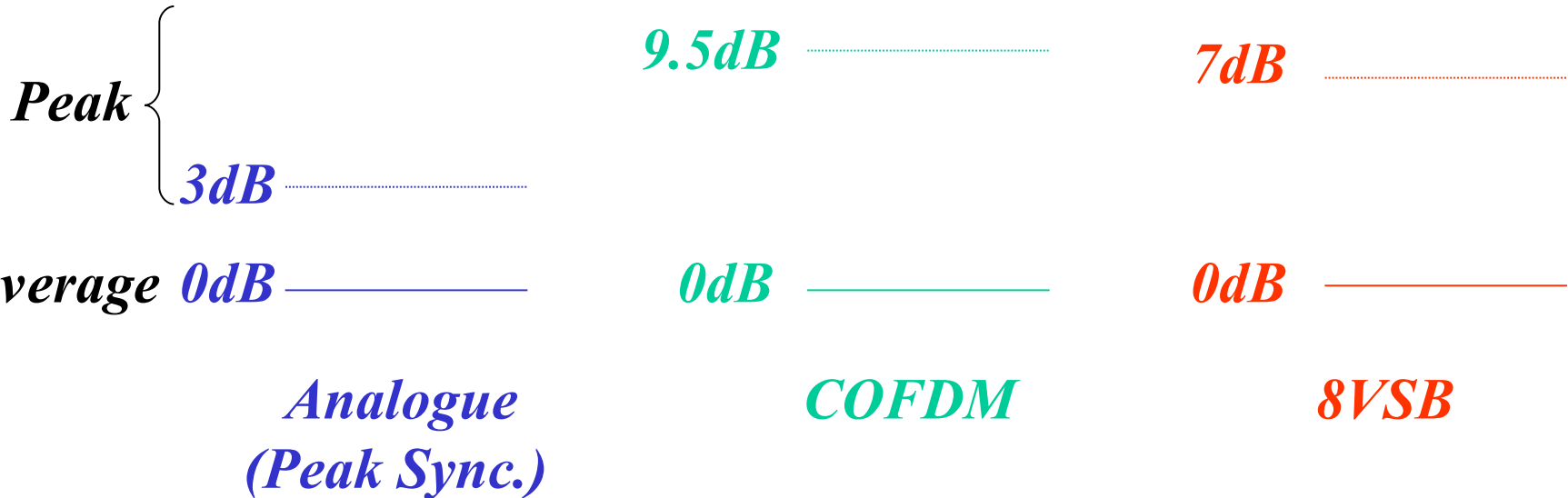
COFDM

8VSB

PAL-DTTB @ 0 dB Transmitter Power

Transmitter Power _for_ | **_PAL/DTTB Ratio = 0 dB_** |

Peak {

                          9.5dB ·············   **7dB** ···············

3dB ························

Average **0dB** **6 KW(CW)**   **0dB** **10 KW**   **0dB** **10 KW**

Analogue   **COFDM**   **8VSB**
(Peak Sync.)
10 KW
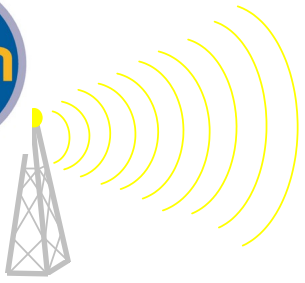
DTTB Transmission Characteristics

- DTTB Transmitters are characterised by :

    - *the average power capacity*

    - *the peak power (or really peak voltage) capacity*

    - *the intrinsic linearity without correction*

- For an Analogue Tx used for a DTTB Tx :

    - *a "10 KW "peak sync. Tx could potentially be a :*

        - *a 2 KW COFDM DTTB Transmitter*

        - *a 4 KW 8VSB DTTB Transmitter - the intrinsic linearity would reduce this rating.*
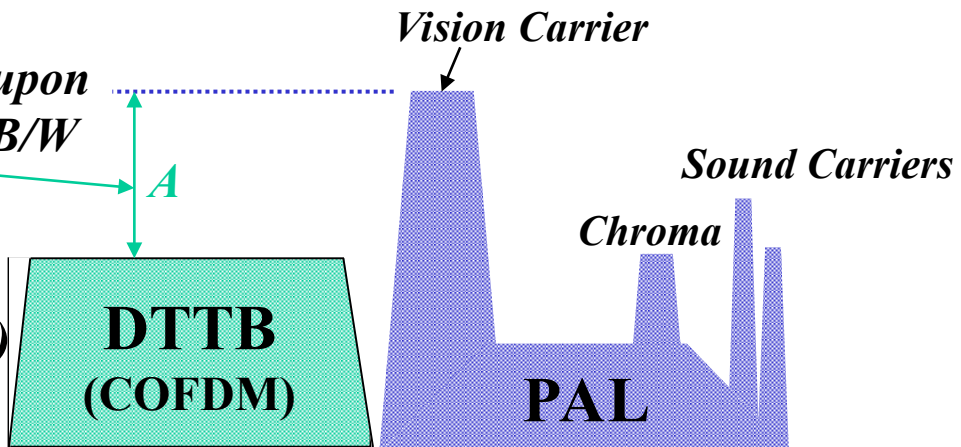
COFDM - PAL
Spectrum Analyser Display

Spectrum Analyser display :

Dependent upon Resolution B/W setting.

Vision Carrier

Sound Carriers

Chroma

A

DTTB (COFDM)

PAL

eg. If Res. B/W = 300KHz
"A"= D + 10Log (6.6 / 0.3)
= 23.5 dB

Note : It is usually less than this value as resolution B/W shape collects more power than the ideal rectangular filter. When Res. B/W approaches or is less than the separation between the carriers of COFDM :
A = D + 10Log (No. of Carriers)

D = DTTB to PAL ratio (eg D = 10 dB)

DTTB power = average heating power

PAL power = the equivalent CW power of peak sync Vision Carrier power

8-VSB - PAL
Spectrum Analyser Display

Spectrum Analyser display :

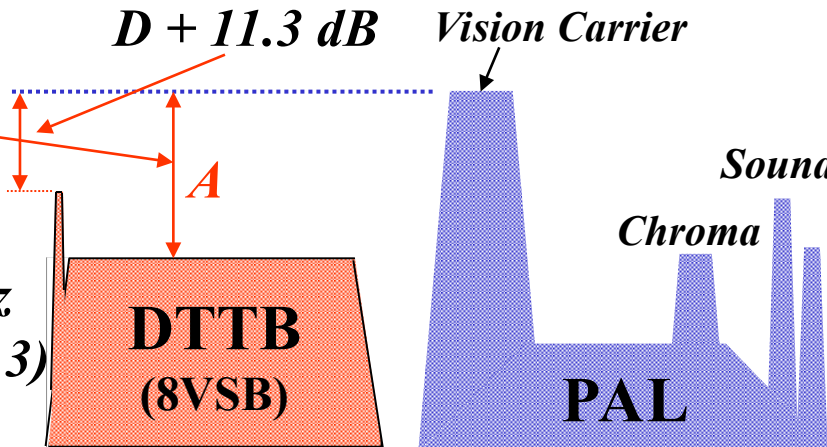**Dependent upon Resolution B/W setting.**

D + 11.3 dB

Vision Carrier

A

Sound Carriers

Chroma

DTTB (8VSB)

PAL

eg. If Res. B/W = 300KHz
"A"= D + 10Log (5.4 / 0.3)
= 22.5 dB

Note : It is usually less than this value as resolution B/W shape collects more power than the ideal rectangular filter. Also the peak to average character modifies this value.

D = DTTB to PAL ratio (eg D = 10 dB)

DTTB power = average heating power

PAL power = the equivalent CW power of peak sync Vision Carrier power