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SCOPE

This document is an addendum to TIA Telecommunications Service Bulletin TSB-88-B. It is intended to clarify the default ENBW of analog FM receivers that are deployed in the VHF and UHF bands as indicated in Annex A and Table 2.

- Radios in the VHF (high band) that utilize ± 5 kHz deviation often use an IF bandwidth of 16 kHz
- Radios in the UHF (380 - 512 MHz) that utilize ± 5 kHz deviation often use an IF bandwidth of 16 kHz.
- Radios in the 800 MHz band but not the NPSPAC band that utilize ± 5 kHz deviation often use an IF bandwidth of 16 kHz
- Radios in the 800 MHz band that operate in the NPSPAC band with ± 4 kHz deviation require a narrower IF bandwidth to achieve a 20 dB ACRR.
- Narrow analog FM radios do not provide 60 dB ACRR unless a very narrow ENBW in utilized. Some manufacturers do not provide this capability as it is not required by TIA/ANSI 603C.

Various editorial errors are also corrected.

5.5.1 BER vs. Eb/No

The 16 kHz ENBW used with the Butterworth 4p-3c model provides over 70 dB ACRR at 25 kHz. However the 800 MHz band involving the NPSPAC channels necessitates a narrower ENBW to meet the 20 dB Offset channel requirement. Using reduced deviation analog modulation, ± 4 kHz deviation, calculates that a 12.6kHz ENBW is needed to provide 20 dB ACRR. To achieve this value against ± 5 kHz deviations necessitates an even narrower ENBW, 11.1 kHz. To clarify these cases, replace Table 2 and its footnotes.

New Table 2

Table 2. IF Filter Specifications for Simulating Receivers

Modulation Type[1]	ENBW (kHz)	IF Filter Simulation[2,3]
Analog FM (25 kHz) ±5 kHz	16.0/12.6[4]	Butterworth 4 - 3
Analog FM (25 kHz) ±4 kHz (NPSPAC)	12.6/11.1[4]	Butterworth 4 - 3
Analog FM (12.5 kHz) ±2.5 kHz	7.8[5]	Butterworth 4 - 3
C4FM / Analog FM (12.5 kHz) ±2.5 kHz	5.5[5]	RRC, α=0.2
CQPSK	5.5	RRC, α=0.2
CVSD (25 kHz) ±4 kHz	12.6	Butterworth 4 - 3
CVSD (25 kHz) ±3 kHz NPSPAC	10.1	Butterworth 4 - 3
DIMRS-iDEN®	18.0	RRC, α=0.2
EDACS® (IMBE) (25 kHz)	8.0 / 6.9[6]	Butterworth 5 - 4/ 4 - 3
EDACS® (IMBE) (25 kHz NPSPAC)	7.5 / 6.2[6]	Butterworth 5 - 4/ 4 - 3
EDACS® (IMBE) (12.5 kHz)	6.7 / 5.4[6]	Butterworth 5 - 4/ 4 - 3
F4FM TDMA-2	9.6	Butterworth, 10 - 4
OPENSKY® F4GFSK (AMBE)	12.4	Butterworth, 10 - 4
π/4 DQPSK (IMBE) TDMA (12.5 kHz)	9.5	Butterworth 4 - 3
TETRA	18.0	RRC, α=0.2
Tetrapol	7.2	Butterworth, 10 - 4
SAM Wideband Digital 50 kHz	38.4	RRC, α=0.2
SAM Wideband Digital 100 kHz	76.8	RRC, α=0.2
SAM Wideband Digital150 kHz	115.2	RRC, α=0.2

[1]Annex A contains additional information on the various modulation types.
[2]Butterworth filters. The first number indicates the number of poles, the second number, indicates the number of cascaded sections. The 4p-3c configurations are limited to older analog type radios.
[3] See Table 4 and Table 5 for additional information.
[4] Wideband analog radios can achieve 70 dB ACRR @ ± 25 kHz spacing with the 16 kHz ENBW IF in the 150, 450 and 800 MHz bands. The narrower ENBW is appropriate for 800 MHz band radios that also operate in the NPSPAC portion of the 800 MHz band where an Offset Channel Selectivity of 20 dB [603] is produced by ± 4 kHz deviation interferers. The 11.1 ENBW is appropriate for radios providing 20 dB from ± 5 kHz interferers offset by 12.5 kHz.
[5] Narrow analog receivers can achieve 45 dB ACRR (Class A [603]) with an ENBW of 7.8 kHz. To achieve an ACRR ≥ 60 dB as might be applicable where narrow analog and C4FM are intermixed on adjacent channels, the IF similar to the C4FM digital radios is more appropriate.
[6] The EDACS® uses the wider ENBW for specifications, and the narrower ENBW for ACCPR determination using the 4p-3c model.

Note 5 points out the concern of mixing narrow analog FM and digital C4FM using only the analog requirement that is satisfied by the 7.8 kHz ENBW model. The analog radio 45 dB Class A and 40 dB Class B ACRR values [603] are low compared to the 60 dB Class A and 50 dB Class B digital requirements [102].

In addition, comments are added in A.4.2.2 and A.4.3.2 pointing out the different ENBW requirements.

A.4.2.2 Typical Receiver Characteristics

12K6B0403, to achieve 20 dB offset channel selectivity in the 800 MHz NPSPAC band

11K1B0403, to achieve 20 dB offset channel selectivity in the entire 800 MHz band for 12.5 kHz channel spacing.

A.4.3.2 Typical Receiver Characteristics

Use 16K0B0403 for high band (150 MHz) and UHF (460 MHz) receivers and 800 MHz receivers in the 800 MHz band that do not operate in the 800 MHz NPSPAC band.

Use 12K6B0403 for receivers that operate in the 800 MHz NPSPAC band.

Use 11K1B0403, for receivers claiming 20 dB offset channel selectivity from ± 5 kHz modulation at 12.5 kHz channel spacing in the non NPSPAC portion of the 800 MHz band.

7.6 Terrain Elevation Dataset

Last paragraph, first sentence. Delete “Despite these uncertainties”. This is a carry over comment from TSB-88-A and is no longer applicable.

8.7.5.4 Inbound vs. Outbound Measurements

Replace Table 26 with the corrected Table 26 below. Incorrect footnote 4 for Undefined test should be footnote 5.

Table 26 – CATP Metric

		Objective Test	Subjective Test
Talk-Out Test	Digital (Single Site)	BER% & SSI[1)]	OK
	Analog (Single Site)	SSI	OK
	Digital (Simulcast)	BER% & SSI[1)]	OK
	Analog (Simulcast)	N/A (data for info only)	Recommended
Talk-In Test	Digital (Single Site)	BER% & SSI [2)]	OK
	Analog (Single Site)	SSI [2)]	OK
	Digital (Multi-Site) [3,4)]	BER% & SSI [2)]	OK
	Analog (Multi-Site) [3,4)]	SSI [2)]	OK
	Digital (Voting)	Undefined test [5)]	Recommended
	Analog (Voting)	Undefined test [5)]	Recommended

1. Measured BER% is the preferred method. However, SSI provides additional information about identifying potential interference. See §8.11.
2. Failures due to interference should be agreed upon prior to testing as to whether they are counted or not.
3. Evaluate difference in link budget and use in conjunction with Talk-Out Testing as applicable, §**Error! Reference source not found.**.
4. Individual tests per site.
5. Current test signals (Table A-2, O.153) cannot proceed past the base receiver. Therefore enhancements due to voting cannot be objectively determined until a more elaborate test is developed.

A-1 Projected CPC Requirements for Different DAQs.

Under EDACS® Narrowband Digital an inadvertent 7 was included in the Cf/(I+N) for DAQ = 3 column. Replace Table A-1 with the corrected Table A-1 below.

Table A- 1. Projected CPC Requirements for Different DAQs

Modulation Type, (channel spacing)	**Static[1].** $ref / \frac{C_s}{N}$	**DAQ-3.0[2].** $BER\% / \frac{C_f}{(I+N)}$	**DAQ-3.4[3].** $BER\% / \frac{C_f}{(I+N)}$	**DAQ-4.0[4].** $BER\% / \frac{C_f}{(I+N)}$
Analog FM ± 5kHz (25 kHz)	12 dBS/4dB	N/A/17 dB	N/A/20 dB	N/A/27 dB
Analog FM ± 4kHz (25 kHz) [5]	12 dBS/5dB	N/A/19 dB	N/A/22 dB	N/A/29 dB
Analog FM ± 2.5kHz (12.5 kHz)	12 dBS/7dB	N/A/23 dB	N/A/26 dB	N/A/33 dB
C4FM (IMBE) (12.5 kHz) [6]	5%/5.4 dB	2.6%/15.2 dB	2.0%/16.2 dB	1.0%/20.0 dB
C4FM (IMBE) (12.5 kHz) [7]	5%/7.6 dB	2.6%/16.5 dB	2.0%/17.7 dB	1.0%/21.2 dB
CQPSK (IMBE) (12.5 kHz) [6]	5%/5.4 dB	2.6%/15.2 dB	2.0%/16.2 dB	1.0%/20.0 dB
CQPSK (IMBE) (12.5 kHz) [7]	5%/7.6 dB	2.6%/16.5 dB	2.0%/17.7 dB	1.0%/21.2 dB
CQPSK (IMBE) (6.25 kHz)	5%/7.6 dB	2.6%/16.5 dB	2.0%/17.7 dB	1.0%/21.2 dB
CVSD "XL" CAE (25 kHz)	8.5%/4.0 dB	5.0%/12.0 dB	3.0%/16.5 dB	1.0%/20.5 dB
CVSD "XL" CAE (NPSPAC) [8]	8.5%/4.0 dB	5.0%/14.0 dB	3.0%/18.5 dB	1.0%/22.5 dB
C4FM (VSELP)* (12.5 kHz) [6]	5%/5.4 dB	1.8%/17.4 dB	1.4%/19.0 dB	0.85%/21.6 dB
C4FM (VSELP)* (12.5 kHz) [7]	5%/7.6 dB	1.8%/17.4 dB	1.4%/19.0 dB	0.85%/21.6 dB
DIMRS (25 kHz)	5%/12.5 dB	2.0%/22.0 dB	1.5%/23.0 dB	1%/25.0 dB
EDACS® Wideband Digital (25 kHz)	5%/5.3 dB	2.6%/14.7 dB	2.0%/15.7 dB	1.0%/19.2 dB
EDACS® NPSPAC[8] Digital	5%/6.3 dB	2.6%/15.7 dB	2.0%/16.7 dB	1.0%/20.2 dB
EDACS® Narrowband Digital	5%/7.3 dB	2.6%/16.7dB	2.0%/17.7 dB	1.0%/21.2 dB
F4FM (IMBE) TDMA-2 (12.5 kHz)	5%/6.2 dB	2.6%/15.6 dB	2.0%/16.9 dB	1.0%/20.0dB
F4GFSK (AMBE) OpenSky®	5%/9.0 dB	3.5%/15.3 dB	2.5%/16.4 dB	1.3%/20.1 dB
π/4 DQPSK (IMBE) TDMA (12.5 kHz)	5%/6.9 dB	2.6%/15.2 dB	2.0%/16.4 dB	1.0%/19.5 dB
TETRA	5%/8 dB	4%/12.0 dB	2%/16.0 dB	1%/18.0 dB
Tetrapol	5%/4.0 dB	1.8%/14.0 dB	1.4%/15.0 dB	0.85%/19.0 dB

[1] Static is the reference sensitivity of a wireless detection sub-system (receiver) and is comparable to 12 dB SINAD in an analog system

[2] DAQ-2.0 (not shown) is comparable to 12 dB SINAD equivalent intelligibility,
DAQ-3.0 is comparable to 17 dB SINAD equivalent intelligibility

[3] DAQ-3.4 is comparable to 20 dB SINAD equivalent intelligibility, used for minimum CPC for some public safety entities.

[4] DAQ-4.0 is comparable to 25 dB SINAD equivalent intelligibility

[5] This is a NPSPAC configuration, 25 kHz channel bandwidths, but 12.5 kHz channel spacing. 20 dB ACIPR receivers assumed

[6] A wide IF bandwidth assumed as part of a migration process

[7] A narrow IF bandwidth is assumed after migration is completed.

[8] Reduced deviation for NPSPAC requirement.

These values were obtained from the manufacturers and should be verified with the manufacturer prior to usage.
VSELP values represent worst case, low speed.

A.15 Wide Pulse

The wrong description was included. Replace the first page of section A.15 with the following page. Added C4FM to title.

A.15 Wide Pulse C4FM

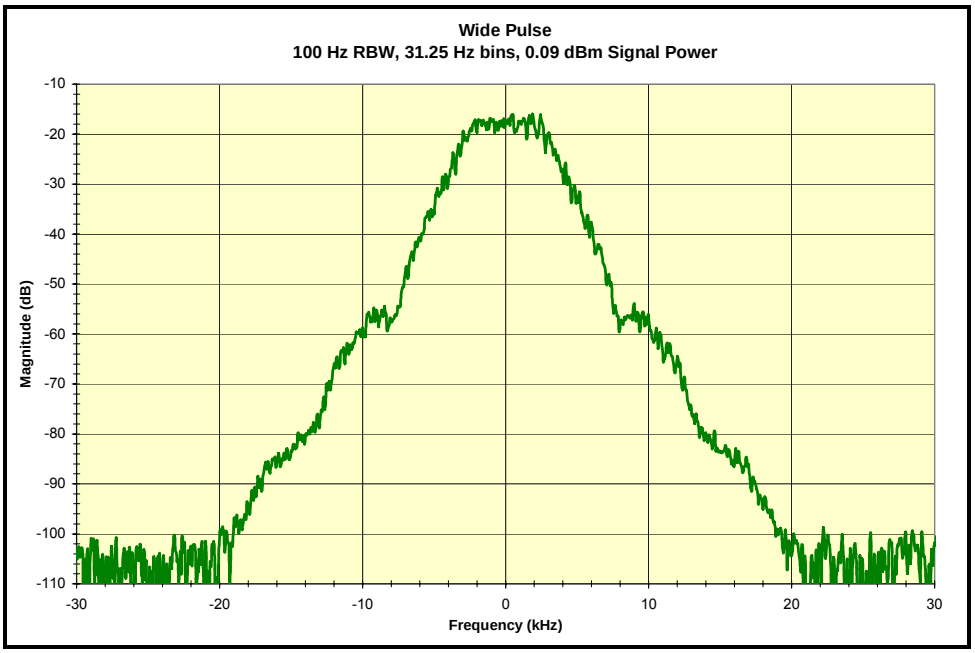

Figure A- 1 - Wide Pulse Simulcast Modulation

A.15.1 Emission Designator

10K0F1D	Data channel and Control channel
10K0F1E	Voice Channel

A.15.2 Typical Receiver Characteristics

11K1B0403
12K6B0403

A.15.3 Discussion

Used in simulcast systems to increase delay spread tolerance. Four level C4FM modulation is used. Modified transmitter filtering allows the symbol to change state more rapidly allowing for a better probability of correctly decoding the symbol at higher levels of delay spread. Limited to 25 kHz channel bandwidths. The inbound path uses normal C4FM.