Crew Green
CONSULTING

Our evaluation of a third-party broadcast radio receiver design for a client's successful OEM submission.

Performance measurements

FM frequency range	87.5–108MHz
Channel spacing	200kHz
IF	10.4MHz and DSP sub-system at 120kHz
Usable sensitivity	+9dBµV EMF/2 for 26dB SINAD
Noise figure	3dB approx. at 100MHz
S/N ratio @ 1mV in	59dB A-wtd @ 1kHz for 1mV EMF/2
IF rejection	In excess of 95dB
Image rejection	>82dB at 100MHz
1dB gain compression	-12dBm
IPI3	-3dBm
Reciprocal mixing	96dB @ 20kHz spacing
	99dB @ 50kHz spacing
	>102dBdB @ 100kHz spacing
Calculated SFDR	89dB
RFIM fig of merit	53% (Nelson-McKenzie method)
Blocking (±1MHz)	-88dB
Blocking (±5MHz)	>100dB
In-band conducted spurii	at least -60dBm
AM suppression	77dB below full deviation at 98MHz
THD @ ref.output	0.22% @ 1kHz (L + R)
-3dB response points	40Hz & 14.1kHz @ 1mV EMF/2
Separation @ 1mV input	28dB A-wtd R-L
	29dB A-wtd L-R
19kHz suppression	80dB
AGC fig of merit	67% (Nelson-Bobbett method)
Multipath fig of merit	73% (Nelson-Bobbett method)
RF input VSWR @ 98MHz	1.43:1
AM channel spacing	10kHz switchable
Sensitivity	+25dBµV EMF/2 for 10dB S/N + N
	+29dBµV EMF/2 for 20dB S/N + N
	+34dBµV EMF/2 for 30dB S/N + N
S/N ratio @ 5mV input	54dB A-wtd @ 1kHz
IF rejection	81dB
Image rejection	66dB

Selectivity	-6dB @ 4.3kHz, -60dB @ 9.8kHz
Input impedance at 1MHz	102 + j17ohms.

Weather-band performance (all measured at Channel 3, 162.475MHz):

Noise figure	3dB approx. at 162MHz
12dB SINAD	-113dBm
S/N ratio at 1mV	44dB 'A'-wtd
Distortion	1.8% A-wtd
IF rejection	76dB
Image rejection	57dB
Selectivity	-6dB @ 4.9kHz, -60dB @ 12.8kHz

Performance notes

Noise figure: About 3dB on FM and WB, close to theoretical optimum for low-gain RF stage and diode ring mixer. Input matching even across band, sensitivity very even across band (probably a consequence of the wideband four-port mixer and correct termination). Measured 12dB SINAD figure for weather-band NBFM receiver very good; WB limiting curve slightly sigmoid with almost ideal hysteresis and good squelch action.

Strong-signal handling: Very good in all respects. Calculated SFDR corresponds to MDS of about -124dBm, remarkably good for consumer-grade FM receiver. Reciprocal mixing very low reflecting quiet synthesiser. AGC performance outstandingly good for consumer-grade receiver.

RFIM/SFDR: Very low overall levels of birdies and extraneous noises from strong out-of-band signals on FM. Overall AM performance generally very good, evidently assisted by DSP-based IF stage. Sensitivity evidently optimised for fairly short capacitive antennas.
FM IF performance: Extremely even passband and excellent stopband suggesting DSP-based IF. Filter overall passband well optimised for standard stereo FM broadcast transmissions and remarkably symmetrical. Pre-emphasis correct, step size correct for US market.

Spurious AM suppression very good. Some form of noise blanking evidently present in DSP system and gives slightly strange audible results near limiting threshold, probably not operationally significant. Laboratory measurements show steep increase in AF distortion under some circumstances but this is apparently an artefact of the DSP system and is not reflected by quality of programme material.

Crew Green
CONSULTING

Limiting/SINAD: Very well defined and controlled transition to full quieting at about +33dBµV, blending smoothly to about 12dB with slightly sigmoid limiting curve. Excellent performance and probably ideal for noisy environments.
AM sensitivity: Very good and should be adequate for general reception.

AM selectivity: Remarkably good, again presumably assisted by well implemented DSP. Overall passband shape almost ideal, skirt selectivity very well tailored to typical AM broadcaster, stopbands very good

AM image/IF rejection: Image rejection and IF rejection both very good.

AM IF performance: Very good in all respects.

Field tests

The [redacted] radio was [redacted] and used for a period of about two weeks in direct A-B comparison with good-quality [redacted] and [redacted] receivers used as long-term references. It proved to be notably better than both, and its performance can best be summarised by saying that it is one of the best-performing in-vehicle receivers ever tested by this facility. In addition its constructional quality was excellent and very similar to that of high-grade OEM products supplied by Alpine, Philips and Blaupunkt to European VMs.

Conclusions

The [redacted] radio is a very well designed and made unit which exhibits no significant design or manufacturing weaknesses. There are no significant observations or limitations in respect of the design of a suitable antenna for it except that the AM portion of the front end clearly expects an electrically short antenna with considerable capacitive reactance. For practical reasons this is always the expected case but it is unusual to see a radio designed with a non-conjugate match to its input impedance; the manufacturer clearly has some knowledge of the factors involved. Overall, a fine product which it was a pleasure to assess.