

## Improvement of FM sound quality by SWR compensation using the 542 audio processor

Prof Ing. Oscar Bonello, AES Fellow  
Solidyne Labs

The processor Solidyne 542 APC (Audio Processing Core) is the only equipment on the market that controls 24 transmission parameters and improves the transmission chain because it includes a digital FM Modulation Monitor connected to an internal CPU that analyzes the air transmission parameters of the FM and also those of audio quality. The latter is impossible to do with the standard measurement set (Processor + FM Monitor + Audio Analyzer) because it requires cutting the transmission for a long time to make complex tests and having a complete costly measuring set, usually not available on radio stations. The 542 allows you to make all the audio quality measurements that before the invention of the 542 were impossible to achieve. It also does it without cutting the transmission for "technical adjustments" which is today an impossible task in stations operating 24 hours a day. This is because the internal computer handles the signal sent to the transmitter and the signal received from the modulation monitor at the same time. The measurement of 24 parameters takes less than one second in which the 542 generates very short test signals, receives them in the Monitor, evaluates them and generates a technical report. This analysis does not bother the listener as it goes unnoticed. Nobody in the world offers you this advanced technology

From the remote control screen of the 542 (it can be a PC, Notebook, Tablet, etc.) it will be enough to press a button and send a mail to Solidyne for FREE evaluation and correction of problems. In particular it is very important to know the STEREO CHANNELS SEPARATION measured on the air. This is because in real antennas the impedance adaptation is not perfect and this creates standing waves that reduce channel separation (See: Onnigian, AES preprint 502, 31st Convention). This reduction causes the sound to deteriorate and even with processors of \$ 15,000 dollars, the customer can NOT achieve the stereo sound quality of the leading radios that employ several engineers and have expensive measuring instruments.

The remarkable thing is that not only the 542 allows measuring this channel separation in a fraction of a second but it also allows to CORRECT it improving the sound quality perceived by the listener.

Let's see a real example

We have taken an FM station of 500 W located in Tierra del Fuego, Argentina in the southernmost city of the planet. There, 3,000 km away from Buenos Aires, where radio engineers are not available, the owner of the radio installed a good quality FM transmitter with its stainless steel dipole antenna and a Solidyne 542 processor.

The sound quality on the air was very satisfactory for them but also ... the owner pressed the FM Analysis button and sent us the result of the test done in a fraction of a second. We see it in FIG-1

Frec sint:105.3 Mhz  
Valid: true  
Stereo: true  
MODULATION: 126.35 %  
PILOT Mod: 6.5 %  
RDS Mod : 4.8 %  
RF Level Input : 92 dBuV  
Multipath : 1 %  
AUDIO L: 2.30 dB  
AUDIO R: 2.30 dB  
Carrier Offset : -4.4 Khz  
usn: -53 dB (ultra sonic noise)  
assi200: -45 dB ( SNR at 200 kHz offset relative to carrier)  
lassi: -4 dB (Low Side Adjacent 100Khz offset , SNR relative to carrier)  
hassi: -9 dB (High Side Adjacent 100Khz offset , SNR relative to carrier)  
RDS BER (RDS- Bit Error Rate) : 0 %  
RDS Data:  
RT: Maroon 5 Wait (Videoficial)  
PS:  
PTY: 0  
PI:FFEE

ON-AIR FM MEASUREMENT:  
**SEPARATION L>>R: 26.1 dB**  
**SEPARATION R>>L: 21.42 dB**  
**SEPARATION Label: Poor !!**  
THD+N : 0.7 % Fair

Fig-1 First report from the radio station FM 105.3 located at Tierra del Fuego

We see that the level of modulation is too high (126%) and the pilot tone level is low. Then at a great distance the stereo signal can be lost. The most worrisome is that the channel separation of 21 and 26 dB is VERY LOW and the 542 qualify it as "Poor". This is so because the FCC of the USA requires for a FM station a minimum of 29.7 dB of separation of L and R channels so that the station complies with the technical standards for being on the air. In almost all countries, a minimum separation of 30 dB is also required.

For this reason we decided to enter from Buenos Aires to the control PC of the 542 radio using TeamViewer. This is a free Solidyne service that also includes the adjustment of presets, compression

bands, equalizers, etc. It is evident that the transmitter (specified in 40 dB of channel separation) when connected to the antenna created standing waves that reduced this separation.

This happens on almost all FM radios

After a few minutes of adjustments and without interrupting the air programming of the radio, the following report of Fig-2 was obtained

542 APC TECHNICAL REPORT – FM RECEIVER DATA – DATE(D/M/Y – 24hr):15/03/2018, 18:51:27

Frec sint:105.3 Mhz  
Valid: true  
Stereo: true  
MODULATION: 109.08 %  
PILOT Mod: 9.9 %  
RDS Mod : 5.9 %  
RF Level Input : 85 dBuV  
Multipath : 2 %  
AUDIO L: 0.42 dB  
AUDIO R: 0.42 dB  
Carrier Offset : -4.4 KHz  
usn: -48 dB (ultra onic noise)  
assi200: -35 dB ( SNR at 200 kHz offset relative to carrier)  
lassi: 2 dB (Low Side Adjacent 100Khz offset , SNR relative to carrier)  
hassi: 0 dB (High Side Adjacent 100Khz offset , SNR relative to carrier)  
RDS BER (RDS- Bit Error Rate) : 0 %  
RDS Data:  
RT:  
PS:  
PTY: 0  
PI:FFEE

ON-AIR FM MEASUREMENT:

**SEPARATION L>>R: 36.58 dB**

**SEPARATION R>>L: 36.72 dB**

**SEPARATION Label: Very Good**

THD+N : 0.7 % Fair

FIG-2 Final report of the FM radio after the free Solidyne adjustment.

We see that now the separation of channels went from "Poor" as before adjustment to "Very Good" because now it has more than 35 dB which is considered in several psychoacoustic studies as very good. Also both channels have the same separation value.

## How did the miracle happen?

Very simple; the 542 allows, in addition to varying the phase of the 38 kHz subcarrier, to modify the module thereof as well. This corrects the errors that the transmitter and the mismatches of the antenna and cable produce due to SWR. The ease of instantly measuring the result of these corrections allows you to fine-tune the separation of channels by making repeated measurements (since they take less than a second). Something that was impossible to do until the appearance of 542.

The Radio manager now reports an excellent sound on the air with a incredible stereo sensation that surpasses all its competitors.

Note that even if the customer had invested 5 times more in a Top of line processor of another leading brand, NEVER HAVE BEEN ABLE TO RESOLVE THE DEFICIENT STEREO QUALITY.

This happens today with 95% of FM radios around the world that spend money on sophisticated high-price processors without achieving the perfect sound in the air.

We note that we have also remotely adjusted the modulation to 110% (100% audio + 10% pilot tone) and we have raised the pilot tone which is now 9.9%. We also inform the client that his transmitter has the frequency slightly out of specifications (- 4.4 kHz) which is not perceived by the audience.

The harmonic distortion plus noise (THD + N) is 0.7% that matches the transmitter specifications (less than 1%).

It is interesting to note that with transmitters of more advanced technology, for example a model RVR (Italian) of 1 KW with low distortion PTX 30 exciter, the values measured with a good antenna and an adjustment with the 542, modulating at 110% are of ;

### ON-AIR FM MEASUREMENT:

SEPARATION L>>R: Excellent dB

SEPARATION R>>L: Excellent dB

SEPARATION Label: Excellent!

**THD+N : 0.05 % Excellent!**

FIG-3 Audio Quality measurement of the real ON-Air transmission using RVR PTX30

NOTE: The rating of "excellent" in channels separation is obtained with values greater than 40 dB as any increase above this value will not be perceived by the ear

It is interesting to note that an FM radio with these specifications (FIG-3) will surpass the audio quality of the latest generation of digital radios (HD Radio) because the distortion components are inaudible to the human ear. While in HD digital radios it is mandatory to use bit compression (like MP3, AAC+) to maintain the bandwidth compatible with the FM band and therefore there will always be some audible distortion components called "artifacts".