

Digital On-Air Mixers

Our Community Radio Station needs a new On-Air Mixer.

It must be Digital for us to be modern, and allow us to become a Digital Broadcaster.

This is an issue that comes up regularly with Analog Mixers perceived by Non-Technical people to be Old Fashioned and Outmoded, and not capable of being used for Digital Broadcasting.

Nothing could be further from the truth

Although most Audio Material, such as Recorded Music and "Sponsorship Spots" are recorded and stored digitally, the original sound is Analog, picked up by Analog Microphones, and delivered to your ear by Analog Speakers or Headphones.

This will always be so as nobody we are aware of can actually hear "Digital Sound".

Please be assured that Analog On-Air Mixers are fully capable of being used in Digital Broadcast Systems, and in fact offer a number of advantages which will be discussed later in this.

Digital Audio Mixers

These can be broadly classified as Recording Studio Mixers, Production Mixers, Stage or Public Address Mixers and Broadcast On-Air Mixers.

Recording Studio Mixers

This class of mixer is usually large and very expensive, used by Professional Recording Studios, Film Studios, and by TV Stations for controlling sound during elaborate Television Shows involving "Live" Music.

Performance is usually flawless, using 96 KHz 24 Bit Technology.

Normally operated by highly skilled Audio Operators or Recording Engineers and generally have no application in Community Radio Stations.

Production Mixers

Analog Production Mixers were in the days of "Reel to Reel Tape" a common piece of equipment in Radio Stations and used in the production of "Commercials and Spot Announcements".

Digital and Analog Production Mixers are still available with some delivering High Audio Performance, others having very ordinary to downright terrible performance.

All relied on a reasonable amount of Operator Skill.

Now largely displaced in Radio Stations by Computer Systems and Software Programs.

Stage or Public Address Mixers

Both Digital and Analog types are available from a large number of different manufacturers with some made in China very moderately priced.

Available in many sizes from 8 Inputs up, some are of good quality and perform well, others, particularly the cheaper ones rather flimsy and not good performers.

Stage or Public Address Mixers are generally used by Musical Groups or “Bands” when performing live on stage, or for Conference PA control and other applications where many Microphones are involved.

A Stage or PA Mixer is a very useful tool for Community Broadcasters for Location Recording, or the occasional Live Music Broadcast and may also be used as a Production Mixer.

Like a Production Mixer, it does require a reasonable amount of operator skill to use.

We have no fixed opinion on whether Digital or Analog technology is best for this class of mixer.

Some High Quality Analog Stage or PA Mixers perform better than Poor Quality Digital Mixers using low Sampling and Bit Rates, and cheap marginal Analog to Digital, and Digital to Analog Converters.

Minimum Sampling and Bit Rates should be at least 48 KHz, 20 Bit sampling, with 24 Bit considerably better.

Digital Broadcast On-Air Mixers

These can be broadly divided into two distinct groups, Systems and Stand-Alone Mixers.

Digital On-Air Broadcast and Mixing Systems

These are complete Broadcast Systems consisting of a number of interlinked “Digital Engines” located in a Central Technical Area or Control Room, communicating with Control Panels of varying size and complexity, located in the Studio Areas such as On-Air Studios, News Reading Booths, News Preparation Booths, Production Studios & etc via Data Lines or Optical Fibers.

The various Studio Control Panels, some resembling On-Air Mixers, are not actual audio mixers.

Audio Switching, Mixing and Control takes place in a "Digital Engine", one being dedicated to each Control Panel, plus others dedicated to Audio Switching and control of Incoming and Outgoing Program Lines.

Such systems are very expensive, some costing in excess of \$ 500.000, but economically justifiable for Radio Broadcast Stations handling many lines or circuits carrying incoming program material, as well as many outgoing circuits carrying Network Programs and Mix Minus Feeds to associated Radio Stations.

Examples are the ABC, SBS, Racing Radio and some of the Commercial Broadcast Network "Hub Centers".

Digital Broadcast Systems of this type are generally not economically justifiable for smaller Commercial or Community Broadcast Stations.

Audio Performance of such systems are generally excellent, operating at 48 or 96 KHz using 20 or 24 Bit sampling with local audio sources, and incoming program lines converted and synchronized using very high quality converters and other equipment, to this standard.

Communication between each "Digital Engine" is via optical fiber using Time Division Multiplexing technology with each "Digital Engine" synchronized to a common Systems Clock.

Well known manufacturers are Klotz Digital, Lawo and Stage Tec of Germany, and Logitek of the USA.

Such complex Digital On-Air Broadcast Systems are usually installed by experienced contractors, and set up and commissioned by engineers employed by the manufacturer.

Maintenance, changes to the System Set-Up and periodic Software Upgrades of such systems requires an intimate technical understanding of it, as well as considerable expertise.

In addition, it is necessary to carry essential spare modules, and spare parts not readily available in Australia.

Modules and sub assemblies usually require special jigs for tests and calibration, and generally repairable only at the factory in the country of origin.

This is normally not a problem to the larger broadcasters who all have qualified full time technical staff, and the funds available to carry all necessary spare parts and modules.

A Digital On-Air Broadcast System is great if you can afford, and really do need it

Analog Systems suffer occasional technical problems and breakdowns.

Digital Systems suffer from the same problems and may in addition require Software Upgrades which in some cases require a complete systems shutdown.

Elan Audio have supplied basic Analog Back-Up systems to several Broadcasters to allow them to Stay-On-Air during Breakdowns or Software Upgrades to Digital Systems.

Digital Stand-Alone On-Air Mixers

The following is an attempt to explain the facts however unpleasant, and not intended to “Pan or Knock” small self contained Digital On-Air Mixers.

First to clarify, Elan Audio have been manufacturing conventional Analog On-Air Mixers for many years, and have refined these to produce excellent audio quality, be practical and easy to use and incorporate all functions needed for On-Air program presentation by a single person as is customary in most Australian Radio Stations including the majority if not all Community Broadcast Stations.

The technical performance of Elan Audio Analog On-Air Mixers is equal to the best and notably better than some self contained or Stand Alone Digital On-Air Mixers.

They also run cool (essential for a long operational life), proved themselves to be highly reliable in service, easy to install, require little maintenance and can be repaired easily by station technicians should this ever be necessary.

They are also “Format Independent” being able to interface to any Analog Audio Source.

As mentioned in the previous section, Digital On-Air Broadcast Systems are great, and probably the only modern and practical solution for large and complex Broadcast Station Systems.

We have difficulties in finding justification for Self Contained Digital On-Air Mixers

They are currently all more expensive than Analog Mixers having a similar number of Input Channels.

Technical performance is no better, and in some cases worse than Analog Mixers.

Many lack the essential standard features found on all Elan Audio Analog Mixers and often require outboard “Add On” equipment to become practical and workable as On-Air Mixers.

Reports from clients have been interesting.

One client owning two Digital On-Air Mixers are describing them as “Possessed” with channels suddenly turning On and Off and setups changing for no known reason with no help being available from the manufacturer.

Another client reported serious problems and had to return a faulty mixer twice to its country of origin.

Yet another client reported problems with Overheating causing reliability problems and “Crashes”.

It is highly unlikely, unless it is something very obvious, that the station technician will be able to locate and repair a Digital Mixer and will probably have to return the mixer or modules to the agents or factory for repairs.

This will leave the station without the mixer for several days or weeks, and is also likely to be expensive when the warranty runs out, or impossible if the manufacturer has gone out of business.

Compare the Main Board of a Digital Mixer to a Personal Computer Motherboard, if something serious goes wrong with it, it is a “Throw Away”, it is a relatively cheap mass produced item, costing maybe \$ 200 to \$ 300 so “No Great Disaster”.

A Digital Mixer Main Board is not a mass produced item, and could cost ten times that amount, if you can buy one at all.

Most Analog Mixers have a “Working Life” of around 15 Years after which Switches and Connectors becomes unreliable, Electrolytic Capacitors “Dry Out” and obtaining spare parts becomes a problem.

There are several examples of Analog PKE On-Air Mixers, originally designed by myself having lasted in service as much as 30 Years.

We do not know the expected life of a Digital Mixer, but if it is similar to a Personal Computer, probably as low as 4 to 5 Years.

If your station “Must Have” Digital On-Air Mixers, buy three, one for each Studio, and one to keep as a spare.

As mentioned earlier in this, Analog Mixers are “Format Independent”

Analog Audio is completely universal with only three common audio levels to consider, Standard Balanced Broadcast Line Level +4 dBu, Standard Unbalanced Hi-Fi Level 300 mV, and Balanced Microphone Level - 60 dBV

Unfortunately, Digital or Digitized Audio is not “Universal or Format Independent”

There is a number of Non-Compatible Digital Audio Formats in common use.

These are at 32 KHz, 44.1 KHz, 48 KHz and 96 KHz Sampling Rates, and varying from 16 Bit to 20 and 24 Bit Sampling, all requiring Conversion and Synchronization to the format used internally in the Mixer.

In addition, there is a bewildering number of Digital Audio Compression Formats in use with too many to list here and with more being invented regularly, none of these can be handled by the mixer whether it be Analog or Digital without conversion to Wave format or to Analog.

Some of the more expensive "Stand Alone" Digital On-Air Mixers have built in Sample and Bit Rate Conversion Circuitry while others require this to be done by external "Add On" converters, often in the form of combination Digital to Analog combined with an Analog to Digital Converter to provide the correct format required by the mixer.

Another and easier method is to feed the Analog Signal, always available from CD Players and Computer Based Audio Delivery Systems directly into the mixer, and let the mixer do the Analog to Digital Conversion.

Audio Quality loss will occur every time a format Conversion or Re-Synchronization takes place whether this is done in the Digital domain, or by converting from Digital to Analog and back to Digital again, with the severity of the quality loss dependent on the quality of the converters used.

We fail to see any real advantage from "Stand Alone" Digital On-Air Mixers, particularly when considering the number of format conversions necessary between "Source Equipment" and the final Transmission System.

One example is Compact Disk, 44.1 KHz 16 Bit requiring Conversion and Synchronization to say 48 KHz 20 Bit for use within the mixer, or simply use the High Quality Analog output available from Commercial CD Players.

Another example is PC Based Audio Delivery Systems, commonly using 44.1 KHz Sampling, Compressed to MP3, requiring conversion within the PC from MP3 to 16 Bit Wave Format, still at 44.1 KHz requiring further conversion for use by the mixer, or simply use the Analog output available from the PC Sound Card.

Most Digital On-Air Mixers produce both Digital and Analog Outputs.

Unless the Mixer forms part of a larger Digital Broadcast System, the Digital Output is of no real use, and will require conversion to Analog for Broadcasting on AM or FM.

The Digital Output is also largely useless for Digital Broadcasting including Web and Pod Casting, as it will require Format Conversion to suit the Transmission System.

It is easier to simply use the Analog Output which will probably produce better results anyway.

The Special Feature provided on some Digital On-Air Mixers of being able to Re-Configure the inputs looks at first glance like a good idea, and so it is, in the hands of highly trained and skilled presenters.

It is not a difficult feature to incorporate, and believe it was promoted by the manufacturers of the smaller types of Digital On-Air Mixers out of necessity.

Making a Digital Mixer having up to 8 Fader Channels is comparatively easy, and can be done using only one Digital Signal Processor (DSP).

Unfortunately 8 Inputs is generally not enough for the main On-Air Studio Mixer in even the smallest Radio Station, so another eight or more Inputs were added with internal Digital Switching arranged so that any input could be switched to any of the 8 faders provided.

This switching of channels, we believe can and will lead to confusion to the average Community Station Presenter who may only do one or two On-Air shifts per week.

Just imagine the potential for confusion, on your previous On-Air shift the mixer was set up as follows

1. Presenters Microphone
2. Guest Microphone
3. Telephone Talk Back
4. CD-1
5. CD-2
6. Computer 1
7. Computer 2
8. Comratsat

In the meanwhile, somebody changed the configuration to the order he or she wanted and forgot to restore it to normal

1. Mini Disk
2. CD-1
3. Computer 1
4. Computer 2
5. CD-2
6. Presenters Microphone
7. Guest 1 Microphone
8. Guest 2 Microphone

Not a good Idea for Community Radio unless you want to confuse the Presenter

You need an On-Air Mixer with more Input Channels, and these should always stay the same

Final Concern, Propagation Delay inherent to Digital Mixers, and Digital Audio Systems in general

Normal accepted Broadcast Practice is to have someone monitor and listen to the station Off-Air using a High Quality Monitor Receiver in order to check for Audio Quality and Transmission problems with that someone usually being the Presenter.

Unfortunately, Digital Audio Systems including Stand Alone Off-Air Mixers, unlike Analog Mixers, does produce a slight Audio Delay caused by the various internal processes such as Audio Conversion and Digital Signal Processing.

The effect is called Processing or Propagation Delay and can be quite significant on some Digital Mixers to the point where it becomes highly irritating if not impossible for the Presenter to monitor his or her own voice Off-Air due to the Echo Effects caused by this delay.

Digital Audio Processors used in the Transmission System can and usually do cause similar Audio Delays.

Audio Delay is also inherent to Digital Audio Broadcast Systems such as Eureka 147 and others making Off-Air Monitoring by the Presenter impossible.

The writer is aware of several notable disasters involving Community Broadcast Stations not monitoring their transmission Off-Air, such as One Channel Missing, Out Of Balance Stereo, Bad Distortion caused by Over Modulation, and one station actually being Off-Air for 6 Hours without the presenter knowing.

I personally feel strongly that someone directly involved with the station "Must Keep an Ear" on the station, and not rely on an embarrassing phone call from a listener to alert it about a transmission problem.

Future plans by Elan Audio in regard to On-Air Mixers

Elan Audio has the technology and experience necessary to develop a Stand-Alone Digital On-Air Mixer

This was acquired during development of our RTD-01 Digital Telephone Delay System which incorporates very high quality, 96 KHz 24 Bit Analog to Digital and Digital to Analog Conversion, and advanced Digital Signal Processing.

However, after carefully looking at the Pro's and Con's in regard to Digital On-Air Mixers, we find the Disadvantages outweigh the Advantages and have made the decision to develop an Advanced Analog On-Air Mixer instead.

The new On-Air Mixer, the "Eagle", will be Modular and have all the standard features generally missing on the current generation of Stand Alone Digital On-Air Mixers.

Unlike Digital Mixers, most of which rely on one powerful shared Microprocessor for Control, the "Eagle" will employ "Distributed Processing" using a number of smaller Microprocessors located on the individual modules and elsewhere in the mixer to perform the required control functions.

Electronic Equipment can and will occasionally fail

The "Eagle" Mixer will be supplied with full circuit documentation and designed to be repairable by any competent station technician.

Using "Distributed Processing" makes it highly unlikely that failure of one minor Microprocessor will cause anything more serious than the loss of some minor function, or a module becoming inactive.

The "Eagle", unlike a mixer relying on one shared Microprocessor is unlikely to ever suffer complete failure.

Using only one shared, and by necessity more complex Microprocessor will increase the probability of failure or the familiar "Lock Up" regularly experienced with Personal Computers.

A Microprocessor failure or lockup in a single processor system will result in complete mixer failure.

Written by Poul Kirk

Elan Audio

2 Steel Court

South Guildford WA 6055