

PRO Channel System FAQ's

Management

What is the PRO channel?

The PRO, or Professional Channel, is a private, one-way communication channel. It is ideal for cueing and IFB. The PRO is part of every television station's signal. Because it already belongs to your station, there are no lease or per-use charges for using the PRO channel.

The FCC created the PRO channel at the same time it authorized stereo sound broadcasting. It is part of your sound signal in the same way that stereo is part of the signal of your station. It is very similar to the "SCA" channel used by FM broadcasters to transmit private signals such as background music and reading services for the blind.

The PRO is a "voice grade" channel, with the same sound quality as a conventional telephone. Ideal for delivering cue or IFB to remote crews doing ENG, the PRO channel is not intended for transmitting program-quality sound. The FCC created the channel for use by stations for their internal needs. Television sets and even two-way radio scanners cannot eavesdrop on PRO channel transmissions.

The Modulation Sciences PROceiver II system delivers dramatic cost savings to ENG communications. Using the PRO-II, you can slash news-related cellular telephone charges by 80 to 90%!

Why should I change the way we currently do news cueing (IFB)?

For a number of good reasons.

TO SAVE MONEY

You can save a LOT of money by switching your news IFB to the PROceiver II system. Take a hard look at your News Department's cellular telephone bills. If they are like most stations', the costs are high and are mostly for lengthy, one-way calls that were used for IFB feeds. It is not unusual in large markets for cellular charges to run thousands of dollars per month per ENG van. Installing Modulation Sciences PRO channel equipment can reduce those charges to a few hundred dollars per month--in some cases a ten-fold

reduction in cost! Stations have amortized the entire cost of the PROceiver II system in just a few months.

BETTER THAN 2-WAY

Even if you use two-way radio for news cueing, using the PROceiver II system from MSI offers significant cost saving advantages. The PRO channel belongs to you. You never need to share it with anyone else.

BETTER COVERAGE

The common "holes" in cellular phone coverage are virtually unknown with the MSI PROceiver II. Coverage distance using the PRO-II receiver is three to four times greater than a simple two-way system can deliver. In fact, the range of PRO-II is significantly greater than the station's normal picture coverage.

PRIVACY ASSURED

The PRO channel offers complete privacy. It requires a special receiver and offers immunity from eavesdropping by scanner receivers.

WORKS WHEN CELLULAR FAILS

Cellular telephone service often fails during major news events. During really big stories like earthquakes, severe weather and bombings, the cellular telephone system overloads. Calls can neither go out nor come in.

Less dramatic, but as serious, is that in many places, even a serious highway traffic jam paralyzes the cellular network. People tend to use time spent not moving making calls, thus tying up the limited capacity of the cellular system. On the other hand, the PRO channel is part of YOUR television signal and is always available.

Another common problem with cellular service is the tendency to randomly disconnect during long calls, even when the telephone is not moving. That can't happen with the PRO.

CANNOT BE "CLONED"

PROceiver II ends any concerns about having your cellular I.D. stolen electronically and "cloned" into an illegal phone. This can run up enormous charges in a short time. PRO II also does not require that a bothersome PIN security code be entered each time an IFB circuit is needed.

AIRCRAFT LEGAL

Use of cellular telephone from any type of aircraft when airborne is illegal. In many cities cellular systems can detect when a phone is in an airplane and will disconnect service

during the call. The PRO channel is not only legal for airborne use, the Modulation Sciences PROceiver II is specifically designed for aircraft service.

If the PRO channel is such a great idea, why isn't everyone taking advantage of it?

The PRO channel has been a "sleeper." Although it was created in the mid 1980's by the same FCC action that permitted stereo sound, PRO got lost in excitement over stereo sound. Contributing to the PRO's lack of popularity was the unimpressive performance of early PRO channel hardware. It is technically challenging to make use of the PRO channel. All of the first generation attempts, a few of which are still with us, didn't work very well. Frequently they suffered from limited coverage and unintelligible, noisy audio. These attempts at building a PRO channel receiver were based on consumer-type VCR television tuners that just weren't up to the job.

In 1992, Modulation Sciences introduced a PRO channel receiver, PROceiver--the first receiver designed from scratch for PRO channel operation. The technical problems that made use of the PRO channel unacceptable had to first be identified, then fixed. The results were impressive -- a PRO channel system that has saved television stations more than a million dollars in cellular phone charges since it was introduced.

We don't do ENG. Can I still derive revenue from my PRO channel?

In many cities, there are organizations that need IFB facilities but are not broadcasters. For example, a live cable channel leases the PRO channel of a noncommercial station for its IFB. They feed the cable channel sound via the PRO. Without the PRO channel, they would be unable to hear the cable's "air" program. By using the PRO-II, the "air" program can be interrupted with cue as needed. Without the PROceiver II, this cable operator would spend many thousands of dollars per month on cell phone usage.

Cable companies are not the only organizations that need remote IFB. Out of town or foreign broadcasters who do live, remote feeds must be able to listen to their own air signal. For anyone doing this regularly, leasing a PRO channel is far less expensive than constant long distance cellular calls.

We have a two-way radio license. What do I need PRO channel for?

Very few stations, even in smaller markets, have exclusive use of a two-way channel. If lucky, you share your two-way channel with other broadcasters. While most broadcasters are good about sharing, conflicts often arise during major news stories. Also, sharing an IFB channel ensures that each station knows what stories the other is working on, unlike using the PRO, which is completely private.

If unlucky, you share a two-way channel with an unrelated business, like a 24-hour heating fuel delivery company. In such a situation, it is unlikely that the two-way channel can be used for a ten to twenty minute uninterrupted IFB feed.

Two-way radio offers no privacy for station news activities. Scanners are popular consumer items and literally millions are in the public's hands. The frequencies assigned to broadcasters are public information and several publications specifically list the two-way channels used by every television station. The PRO channel cannot be picked up except with a receiver specifically designed to do so.

Does the PRO channel really have better coverage than the TV station itself?

Yes.

For both PRO channel and main audio channel, PROceiver II delivers usable IFB much farther away than the visual coverage. With the PROceiver II, IFB coverage 20 to 40% *beyond* where the picture becomes unusable is common.

Without getting too technical, here's why: All consumer television sets depend on the picture to receive the sound. That allows the TV set to be much less expensive. For TV sets this is OK, because who would want sound without a picture? However, this means that the picture quality determines the sound quality. No picture, no sound. And the picture is a much less robust signal than the sound, so the picture degrades a lot sooner than the sound would by itself. By employing a specially designed receiver that does not depend on the picture to recover the sound, audio quality and coverage no longer depend on picture quality. This is called "non-intercarrier" detection and is unique to the Modulation Sciences PROceiver II.

Will the using of the PRO channel affect my main program sound?

No.

Unlike the SCA channel used in FM radio, none of the modulation needed for PRO channel is taken away from the main channel. Rather, it is added. When the FCC created stereo sound for television, they tripled the allowable modulation for TV sound. They made two-thirds of the added capacity available for new services such as stereo, SAP and PRO.

What does "IFB" actually stand for?

"Interruptible Foldback"

Much research went into locating that definition (we called a bunch of people). It appears to be a British expression whose origin is the BBC. If any readers have more documented details, we would like to hear from you.

Why did you include a video output in PROceiver II?

Many customers requested a video output from PROceiver II. It saves space and money in cramped ENG vehicles and avoids a bulky, expensive, difficult to mount, consumer-type component video tuner. PROceiver II is a standard 1 3/4" rack mount unit. PROceiver II outputs technically excellent video. It delivers a quality picture where conventional demodulators cannot. The built-in, automatic antenna selector (diversity) means that in difficult "downtown" situations where ghosting would otherwise make picture reception impossible, PROceiver delivers a usable picture. In helicopters, PROceiver is often the ONLY way to get a picture.

What is "Ducking"?

Ducking reduces the fatigue of listening to the IFB and increases its intelligibility.

Ducking, also sometimes called "pushdown," allows the main program portion of the IFB to be a high quality, full fidelity signal (the main channel). When the producer breaks in with cue (an "interrupt"), the main program is "ducked," or "pushed down" so cue information, sounding telephone-like in quality, then comes through at full volume.

This means that the time spent listening to main program, which is most of the time, is much less fatiguing. In contrast, the brief interrupt cue is very distinctive and attention getting because it sounds significantly different. On-air personnel tell us that the clear change in sound "texture" between cue and program insures that important cues are not missed.

Can I direct a cue to just one ENG crew without disturbing any others?

Yes. We call it Selective Calling and it's available only from Modulation Sciences.

Selective calling means that you can have many ENG vans on the road, but be able to send an interrupt cue to just one crew without disturbing the main program feed to everyone else. On the other hand, any PROceiver II can be set to receive all cues, regardless of which crew they are addressed to.

Can anyone with a scanner still eavesdrop on our IFB?

Not if you use the PRO.

A great benefit of the PRO is privacy. Scanners cannot receive it. The same properties that made a good PRO receiver challenging to design mean that NO scanner available can receive PRO channel. To the best of our knowledge, no magazines catering to scanner users have ever even mentioned the PRO channel.

Even cellular phones do not offer as much privacy as PRO channel. Although there are laws intended to protect the privacy of cellular radio channels, scanners are readily available that pre-date those laws. In addition, most currently manufactured scanners are easily modified to receive cellular calls. Instructions on how to do that are readily available.

We have an older transmitter and are not operating in stereo. Can we use PRO?

Yes.

Not long ago, we added the PRO channel to a vintage 1963 UHF transmitter. Transmitters that cannot be converted to stereo can employ the PRO with no problems.

Can we send cues to ENG vehicles while they're moving?

Yes.

While it's unlikely that you will want to do a live shot while the van is moving, it is useful to be able to monitor while traveling to a story location. The MSI PRO-II system includes a unique antenna diversity circuit that enables it to receive while in motion, even in difficult downtown areas. This same feature protects the PRO-II from "multipath" interference by tall buildings and other ghost-causing structures.

How can the PROceiver help with helicopter ENG?

PROceiver II can often be the only way to do IFB in a helicopter. Cellular phone is not an option. Use of cell phones is illegal in any aircraft once its wheels leave the ground. Some cellular systems can automatically detect that a call is originating from an aircraft and cut it off immediately.

PROceiver II has proven invaluable not just for IFB, but as the only system able to receive main channel sound and picture RELIABLY in a helicopter.

Aircraft operation was a design goal for PROceiver II. Several of its unique features make helicopter operation flawless.

Most important is antenna diversity. Multipath, really ghost causing reflections from the ground, is the biggest problem in helicopter ENG. Antenna diversity allows using dual antennas that cannot "see" the ground. This makes for excellent IFB reception as well as clear, usable video.

The PROceiver II will operate with any kind of power found in aircraft--12 or 28 volts DC, 117 volts AC, 60 or 400 cycles.

Another benefit of the PRO in an aircraft is the vast coverage possible. If a helicopter is at 1,000 feet altitude and the station transmitting antenna is at a 1,000 feet elevation (typical), coverage will be greater than 90 miles!

Engineering

Why the big deal about non-intercarrier detection?

There is nothing wrong with intercarrier detection for television sets. If the picture is degraded, who would want to listen to just the sound? Intercarrier detection significantly reduces the parts count and complexity of TV sets, thus keeping the cost down. However, intercarrier detection is a significant compromise in the technical quality of TV sound. It's not usually thought of that way because the aural and visual signals are always taken together as a system. For example, ICPM would not be a matter for concern were it not for intercarrier detection. And TV stereo sound would be no more complex than FM stereo were it not for intercarrier detection.

Because of the high-frequency sync crosstalk inherent in intercarrier detection (mostly above 15,734 Hz), the difference (L-R) signal in TV stereo had to be companded using a complex and difficult to build noise reduction circuit. Even with companding, it is still necessary to keep the ICPM below 3 degrees in order to obtain full performance from the stereo audio system.

The PRO channel at 102.3 kHz, with a noise floor 14 dB worse than the 31 kHz stereo carrier, has a lot to overcome. In addition, consider that the stereo difference signal is authorized for 25 kHz injection, but the PRO channel for only 3 kHz. That's another 18 dB against the PRO. On top of that, because the PRO is so "far out" in frequency on the aural baseband, it becomes susceptible to RF interference from the chroma signal sideband at 3.58 MHz above the visual carrier.

True non-intercarrier detection eliminates or reduces all of these problems. Using it, the aural of the TV signal is much more like a well-behaved FM broadcast signal. This is not

important to consumer television reception, but it makes a huge difference in PRO channel operation.

How do I know if a receiver is REALLY non-intercarrier?

From time to time, consumer equipment modified for the PRO channel comes on the market. None of this equipment that we've ever seen, regardless of claims to the contrary, is non-intercarrier. Beware of trick words like "quasi-parallel" or "split system." These are NOT other names for non-intercarrier detection but techniques that attempt to cure some of intercarrier detection's limitations. They don't help with PRO channel reception.

It's easy to tell if a receiver is intercarrier or not: Turn off the visual carrier but leave the aural on. If the receiver continues to work, it's non-intercarrier. If it stops when the visual carrier is removed, then it's an intercarrier detector of some type. And if it's an intercarrier detector, it will be much noisier and have significantly less coverage than a non-intercarrier PROceiver II.

What were some of the unique technical challenges of making PRO work correctly?

Non-intercarrier detection, minimizing visual chroma noise in the aural and solving the multi-path problem.

NON-INTERCARRIER DETECTOR

The reason that non-intercarrier aural reception is so uncommon is that it is difficult to implement. Most off-the-shelf TV components, like tuners, have a lot of phase noise. With intercarrier detection, phase noise in the receiver does not matter. The visual carrier is phase modulated with the same noise as the aural carrier because they both pass through exactly the same signal path together. Since the visual carrier has exactly the same phase modulation as the aural, the noise cancels in the first detector. It required special effort in the selection of components and in the front end circuit design to maintain an acceptable aural signal-to-noise ratio.

SAW FILTER

Minimizing visual chroma noise in the aural was difficult. With chroma information spreading upward and downward in frequency from 3.58 MHz above the visual carrier, keeping it out of an aural receiver 4.5 MHz above the visual carrier was a concern. Narrow RF bandwidth protects monaural reception, while companding helps stereo and SAP audio overcome chroma splatter. The PRO has none of those advantages. An excellent SAW filter provides the needed protection.

ANTENNA DIVERSITY

Multipath is unavoidable in any VHF/UHF transmission system. Because the PRO channel is a subcarrier 27 dB below the stereo and SAP signals, it is especially vulnerable to the nonlinear effects of multipath. With so much power in the main channel signals and so little in the PRO channel, only a small amount of nonlinearity will cause overwhelming crosstalk into the PRO channel. The receive antenna's exact location is crucial in multipath. Moving the antenna just a few inches can drastically affect the amount of multipath distortion.

PROceiver II includes antenna diversity to cope with multipath. By being able to automatically select between antennas separated by even a fraction of a wavelength, improvements in multipath performance can be attained. Antenna diversity offers more than 25 dB reduction in multipath effects. No other technology can offer so much improvement.

Your claims of extended coverage for PROceiver II seem too good to be true. Can you justify them?

PROceiver II operates reliably to beyond the radio horizon. This is often 20% to 30% past the point where the video can be recovered reliably.

Extended coverage is a characteristic of the Modulation Sciences PROceiver II, NOT of the PRO channel. Non-intercarrier detection is responsible for the superior coverage. Once the performance of the aural channel no longer depends on the signal-to-noise ratio of the visual, the aural can be treated as a nearly ideal FM broadcast station.

Co-channel interference is so distant by FM standards as to be insignificant. This is because the visual signal, being AM and wideband, is far more prone to co-channel interference than the narrow band FM aural signal. And adjacent channel interference, aside from the station's own chroma, does not exist. The result is an FM signal that is limited only by running out of RF, not by interference or the SNR of a wideband video signal.

How good is the wideband composite audio signal from the PROceiver II?

Very good.

In recent tests, the composite output of the PROceiver II produced BTSC Equivalent Mode stereo separation values of better than 60 dB. This compares favorably with the results obtained, at the same time, by using a brand new \$19,000 precision aural/visual demodulator.

Such excellent results demonstrate that PROceiver II can serve as a measurement grade aural demodulator for TV stereo sound.

We have an older transmitter that is not stereo capable. Can we still use PRO?

Yes.

The Modulation Sciences PCG-II PRO Channel Stereo Generator is completely stand-alone and does not depend on a stereo generator for any signal. Thus it will work with any stereo system or directly with any aural exciter.

Even older, indirect FM aural exciters such as those found on RCA UHF transmitters have "SCA" inputs for wideband subcarriers. A transmitter need not be stereo capable in order to carry PRO channel because, unlike stereo and SAP, there is no requirement for phase coherence between the PRO subcarrier and H sync.

My diplexer has a narrow aural bandwidth. Can I still employ PRO channel?

Yes, by all means.

Concern about diplexer performance affecting stereo, SAP or PRO are based on myth rather than measurement.

Fortunately, the actual RF bandwidth needed to transmit a wideband FM signal with subcarriers is less than intuition, or Carson's Rule, would suggest. In many, many stereo performance measurements made over the past ten years, we have never seen a diplexer have any significant impact on stereo, SAP or BTSC performance, even when RF bandwidth measurements raised concerns.

How is selective calling implemented?

Using "Continuous Tone Coded Squelch System" (CTCSS), sometimes known by its Motorola trademark, "PL."

PROceiver II uses 16 of the standard EIA tones. Each receiver is assigned to a specific tone using a DIP switch located under the top cover. A cue message intended for that receiver is transmitted with its tone continuously mixed in at a low level. Only when a message with its assigned tone is received will PROceiver II drop the level of the main program audio about 15 dB and insert the subcarrier cue message at full level. When the CTCSS tone is removed, the receiver reverts to main channel program at full level.

My transmitter is a long way from the studio. How do I control selective calling?

The PCG PRO Channel Generator includes a CTCSS encoder that is controlled by optically-isolated binary lines. This is a practical way to implement selective calling when the PRO generator and studio intercom share the same location. However, when the PRO

generator is located at the transmitter, communicating real-time binary data from the studio can be difficult. Therefore, the Modulation Sciences PRO system can be CTCSS encoded by adding the signaling tones to the cue audio at the studio. This is inexpensive, costing less than \$30 per channel, and avoids having to involve the transmitter remote control system in ENG IFB.

How difficult is it to change channels?

The station channel is selected by a DIP switch under the top cover. The choice is made in Binary Coded Decimal (BCD). To avoid errors, a complete chart of all channels and their DIP switch settings is attached to the inside of the top cover.

What's the PROceiver like mechanically?

Rugged.

The basic enclosure is made of heavy gauge steel with welded corners. The rack ears are detachable brackets. The rack mount brackets attach to the box by machine screws threaded into inserts that are part of the steel box. When the rack ears are removed, the threaded inserts remain as convenient points to attach simple right angle mounting brackets. This makes it easy to secure the PRO-II to any flat surface.

The circuit boards are mounted using asymmetrically-arranged holes to avoid high Q mechanical resonances. This, combined with over-engineered mountings, provides a great deal of resistance to vibration.

We already own a "brand X" PRO channel generator. Can we use it with PROceiver II?

The PRO channel has an inherently poor signal-to-noise ratio because of limited injection and low peak deviation. For these reasons, the audio processing built into the PCG PRO Channel Generator from MSI was especially designed for the restricted bandwidth, voice grade signals found in IFB cueing. A very high ratio compressor is used, with an additional high frequency limiter tailored to the greatly accelerated pre-emphasis. The audio characteristics of the PROceiver II match the Modulation Sciences PRO generator. PROceiver II will function with other PRO channel generators but, depending on the audio processing, a significant degradation in subjective signal-to-noise ratio will result.

Several brands of professional channel generators include NO audio compression, as compared with the Modulation Sciences PCG-II that features a 40 to 1 ratio audio compressor. It is unlikely that acceptable PRO channel operation can be achieved without a considerable amount of audio compression.

The selective calling and ducking features of PROceiver II depend on the PRO channel generator. The generator must encode CTCSS into the cue audio stream, so the CTCSS

function was designed into the PCG-II PRO channel generator. There are many potential pitfalls in attempting to add CTCSS to an existing generator.

In order to get full performance from the Modulation Sciences PROceiver system, we suggest a PCG-II PRO channel generator. If you are skeptical, feel free to contact Modulation Sciences or your dealer to arrange a comparison of the PCG-II with your PRO generator.

What are the advantages of using two receive antennas?

There are several important ones:

First is the assurance of reliable reception wherever the van is parked. Just like stopping your car at a traffic light and having to roll it a few inches to move out of a multipath null to clear up FM reception, an ENG van can be parked with its antenna in a null. The problem is, once the microwave shot is lined up, it's usually impossible to roll the truck a few inches.

The antenna diversity built into the PRO-II avoids this dilemma. Typically, the primary antenna is an RV-style "pancake" antenna. The secondary antenna need only be a whip, mounted as far away horizontally from the pancake as is practical. The whip need not be cut for your channel. Even a car antenna will do.

This second antenna, set up as described above, permits reception of IFB, main channel audio, and video while the truck is moving. While you may never do a live shot while in motion, being able to monitor the station and IFB while heading to a story can be very useful.

Of course, cueing to a helicopter or fixed wing aircraft always occurs while in motion. Here diversity reception based on two antennas is a necessity.

Dual antenna diversity combined with the PROceiver II video output also helps ensure that a clean picture will be available under the most difficult reception conditions. For example, during helicopter tests in Los Angeles, FOX's KTTV found that the only way to achieve usable video reception in a helicopter was through the use of antenna diversity.

How do I switch between 117 VAC and 12 VDC power?

Stock PROceiver II receivers operate from either AC line power (117 or 240 VAC) or 12 volts DC. Switching diodes permit simultaneous operation from both power sources, with current being drawn from AC supply if it is active, and automatic "glitchless" switching to the DC source when AC is unavailable. The user need not take any action to go back and forth between DC and AC power.

What about avionics power, like 28 VDC and 400 Hz 117 VAC?

The AC supply is rated from 45 to 440 Hertz power for 117 or 220 volts. An optional 28 volt DC supply module is available for aircraft or bus operation.

Overall, the PROceiver II can operate from any power source of 117 or 220 volts AC, 12 volts DC, or 28 volts DC. And if that does not suit some special need, the internal power for the unit is single-ended, positive 10 volts DC, regulated at less than 500 mA.

Modulation Sciences Biography

Founded in 1981, Modulation Sciences is a broadcast equipment manufacturer with extensive experience in broadcast subcarrier technology.

In 1983, MSI introduced the SideKick FM SCA generator. It rapidly became the dominant subcarrier generator worldwide. A few years later, we brought a full line of BTSC stereo television audio products to the industry. Today our television stereo generator and stereo reference decoder are the performance standards of the industry. Organizations such as the Grand Alliance HDTV Advanced Television Laboratory, Scientific Atlanta, and Consumer Reports depend on MSI stereo equipment as their performance standard.

In 1992, Modulation Sciences brought out its first PRO channel receiver and generator. Right from the start, MSI recognized the importance of non-intercarrier detection as a necessity for reliable PRO channel operation. Since 1992, MSI has continued to refine its PRO equipment, responding to improvements in technology and customer suggestions. In November of 1995, MSI introduced the PROceiver II, the innovative PRO channel receiver described in this booklet, and the PCG-II PRO channel generator.

We thank you for your interest in our products and for taking the time to read this booklet. Your comments on our products are always welcome. Please feel free to write or call us. You can also E-mail MSI at sales@modsci.com , tech_support@modsci.com or call (800) 826-2603 or (732) 302-3090.