# EIA IS-15 INTERFACE COMPATIBILITY WITH RF SYNC SUPPRESSED SCRAMBLING

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## ABSTRACT

The video descrambling portion of IS-15, EIA MULTIPORT, can be compatible with present day RF Sync Suppression schemes. Industry consensus seems to indicate that for this standard to survive, a "phasing-in" period will be required. During this time, compatibility with RF Sync Suppressed scrambling is imperative. This scheme, in one form or another, is presently used by a majority of CATV plants. As a result, millions of RF descramblers are currently in use. Furthermore, as bandwidth in existing systems is at a premium, duplication of service, for IS-15 compatibility, is economically prohibitive.

The ideal scenario for a Cable Operator is to modify or replace the scramblers in his headend, retain all his descramblers in the field and achieve IS-15 compatibility,without compromising security.

## INTRODUCTION

The Electronic Industries Association, in July 1986 released Interim Standard (IS-15) titled:- "Standard Baseband (Audio/Video) Interface Between NTSC Television Receiving Devices and Peripheral Devices." Baseband descrambling techniques, compatible with RF Sync Suppression systems will be developed. A merging of the two technologies, and how they can both survive in an already existing cable system is discussed.

This standard emerged as the result of a need to make CATV services friendlier to future television sets, VCRs, etc. A compatible Cable System will be able to deliver Broadband RF service (with scrambled premium channels) to a compatible receiver. The receiver will demodulate the signal and loop it through a baseband video descrambler. Clear signals will pass through unaltered. Scrambled and authorized channels will be descrambled. Channels not authorized will not be descrambled.

Advantages of this standard to a TV set (or VCR) capable of tuning the entire CATV spectrum would be the full use of it's advanced features (remote control, picture-on-picture, VCR switching, programmability, etc). The Cable Operator will benefit from lower cost in hardware and less investment in the subscriber's home.

A disadvantage is that, given the long lifespan of an average television, it could take several years for a significant percentage of compatible sets to reach the subscriber. Also, there is a considerable amount of investment in RF descramblers currently in the field.

One feasible approach to IS-15 would be to make it "backwards" compatible. That is, to make it work in an RF Sync Suppressed system, without major and costly modifications.

This report will start by a brief overview of one RF Scrambling/Descrambling system currently in use. An IS-15 Baseband descrambler is presented, with pertinent addressing required. Modifications needed at the headend will be considered.

## RF SYNC SUPPRESSED SCRAMBLING/DESCRAMBLING AN OVERVIEW

RF Sync Suppressed Scrambling is a standard method to secure video transmission in the CATV environment, and has been successfully used for many years.

The system includes a video scrambler in the headend operating in conjunction with a modulator. A converter (or Set-Top Terminal) tunes the scrambled channel to Channels 2, 3 or 4. An appropriate descrambler is placed inline to decode the signal. The clear signal is presented to the television set.

A method traditionally used to scramble a video signal is to suppress approximately 12 uSec of the horizontal blanking interval including the horizontal sync and the color burst. (See Figures 1 & 2). Suppression is achieved by switching in a 6dB attenuator during this time. As the signal is Amplitude Modulated, the carrier is "envelope suppressed." As shown in Figure 2, the horizontal sync has been suppressed, and the TV will attempt to find sync in the black level. Also note the "pivot" point of this modulated signal--the zero carrier level.

To descramble this signal at the Set-Top Terminal, synchronization information is needed. This information is carried on the Sound Carrier (fpix + 4.5MHz). As the Sound Carrier is Frequency Modulated to carry the audio, synchronization information may be Amplitude Modulated on it. In addition to this, many addressable systems carry data in or near the FM band. This data is in the Frequency Shift Keyed (FSK) format. Addressable data is decoded in a stand alone receiver.

## BASEBAND DESCRAMBLING AM RF SYNC SUPPRESSED SIGNAL

In the IS-15 Multiport environment, a multichannel broadband RF signal is received by the TV. This signal is tuned to a particular channel and demodulated. Demodulated video and audio are separated, and the video is looped through the baseband descrambler. Figures 3 & 4 show

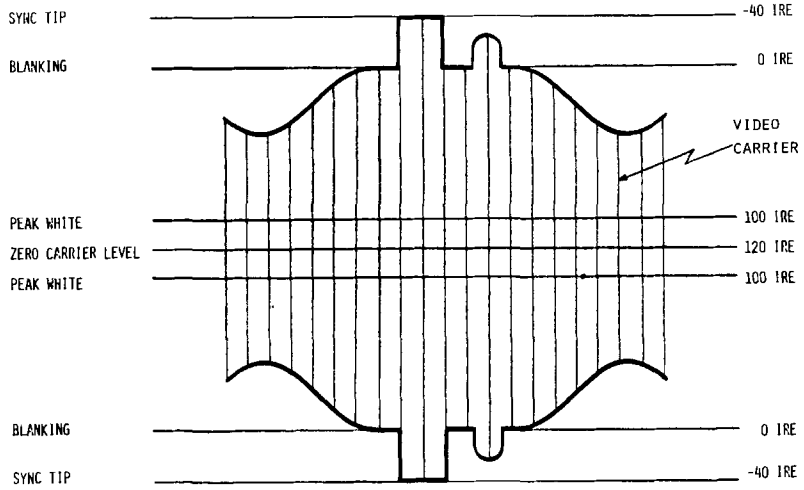


Fig. 1 MODULATED NON-SCRAMBLED HORIZONTAL BLANKING INTERVAL

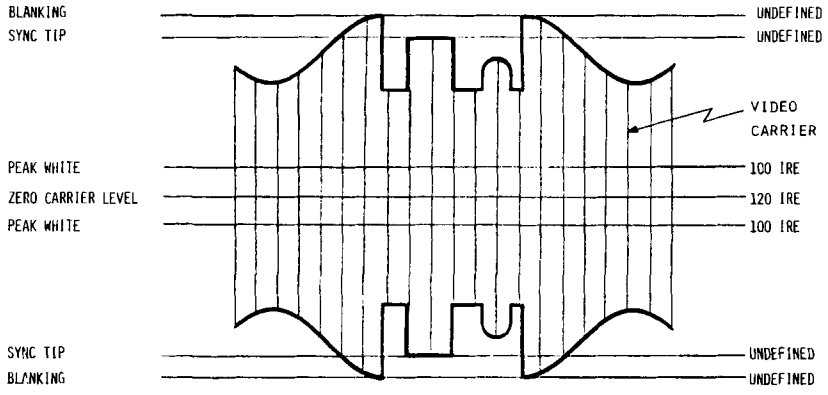


Fig. 2 MODULATED SCRAMBLED HORIZONTAL BLANKING INTERVAL

a non-scrambled and scrambled video signal as it appears to the descrambler. The non-scrambled signal is passed unchanged. In the case of a scrambled and authorized signal, the descrambler will restore the sync.

The 6dB Attenuator

Sync restoration at baseband presents a different set of problems than does restoration at RF. In an RF descrambler, sync would be restored by switching in a 6dB attenuator during active video. This, in effect, causes the horizontal blanking interval to have 6dB additional gain. Note that this is done at RF, and the additional gain is with respect to zero carrier.

A switched gain amplifier will not necessarily amplify with respect to the zero carrier level, which corresponds to +120IRE. Depending on the video content, an attenuator on this signal may or may not restore sync. Even if the sync is restored, video levels would be incorrect. (Figure 5).

To clarify, Figures 1 & 2 show a modulated video signal. In baseband, only the portion below the zero carrier level (120IRE) is available. Therefore, for proper video restoration using the 6dB attenuator method, the zero carrier level would have to be at 0.0VDC. This can be used as a fixed reference level.

The "Zero Carrier Level"

As has been noted above, a fixed reference level is available, which remains stationary during scrambled and non-scrambled video. This is the "Zero Carrier Level." In IRE scale this level occurs at 120IRE in baseband video. (See Figures 1 through 4).

IS-15 requires the Receiver baseband output in non-scrambled mode to be 2.00V +/- 0.1V at 100IRE (Paragraph 4.19.11 EIA IS-15, July 1986). Also, sync tip to peak white will be 1.00V +/- 0.16V (140IRE), (Paragraph 4.19.8). (See Figure 3).

As, Sync tip to Blanking = 0.29V -> 40IRE

And, Blanking to Peak White = 0.71V -> 100IRE

0.29V + 0.71V = 1.00V -> 140IRE

Therefore, 1IRE = 1/140 = 0.007V

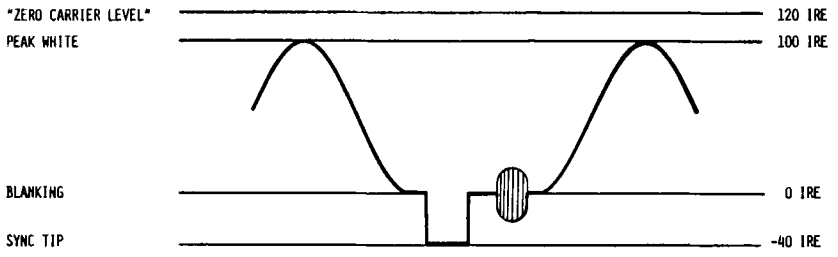


Fig. 3 BASEBAND NON-SCRAMBLED HORIZONTAL BLANKING INTERVAL

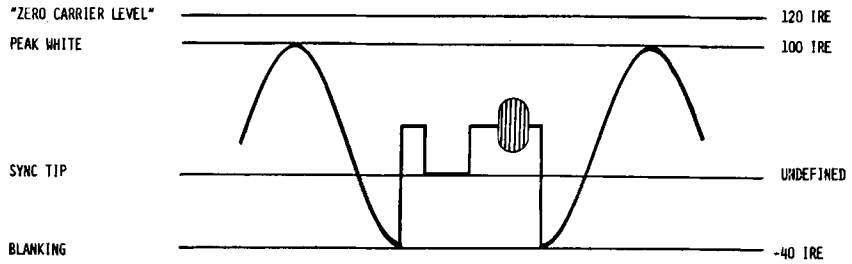


Fig. 4 BASEBAND SCRAMBLED HORIZONTAL BLANKING INTERVAL

And, 20IRE = .007V x 20 = 0.143V

In IS-15 Peak White at 100IRE = 2.00V

And, Zero Carrier at 120IRE = 2.00V + 0.143V = 2.143V

The incoming video signal "zero carrier level" must be clamped at 0.0VDC, using a precision reference. This may be a fixed reference in the vertical interval or an internal AGC loop.

## Descrambling at Baseband

Once the video signal is clamped such that the 2.143V, 120IRE zero carrier level is set to 0.0VDC, the attenuation method can be applied. A 6dB attenuator is switched in during active video. This results in the horizontal blanking interval to be restored by 6dB. (Figure 6). Descrambled video is amplified, and the DC level is then restored using the same reference.

This signal is also supplied to the TV AGC circuit in the form of Decoder Restored Sync.

## Timing Information

In traditional RF scrambling, timing pulses are transmitted on the audio subcarrier. This is not available at baseband. Other "reliable" pulses , the sync tip and the color burst are suppressed. The color burst amplitude will also depend on the television manufacturer, and cannot be relied upon. The vertical interval is also suppressed, and is not a good reference point.

A reliable source had to be generated. This is in the form of a 16 bit Manchester encoded dynamic word, placed on lines 11 and 12 of each field. The information sent by the scrambler is decoded in the descrambler. Successful decoding starts a clock which generates the timing for horizontal and vertical restoration. For additional security this word may be spread through any of the seven or eight lines in the vertical interval not currently assigned. Channel or program identification is included to allow the decoder to know what channel has been tuned.

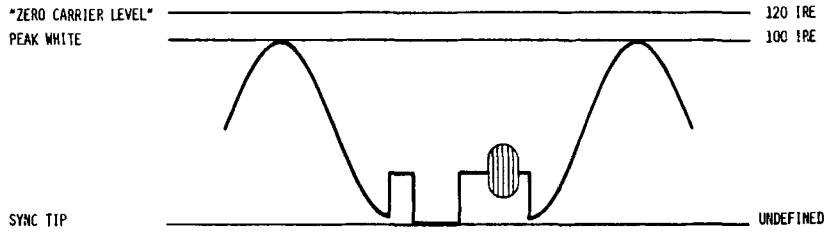


Fig. 5 SYNC RESTORATION AT BASEBAND WITHOUT ZERO CARRIER CLAMP

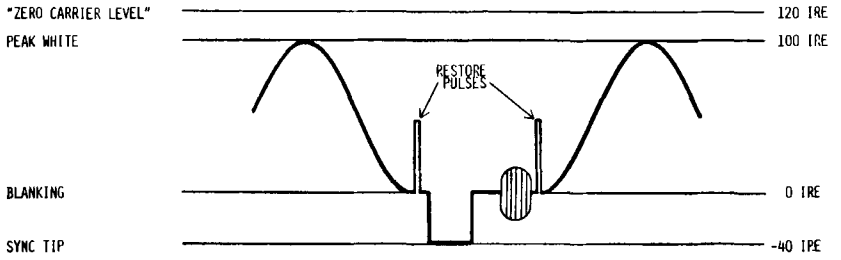


Fig. 6 BASEBAND DESCRAMBLED HORIZONTAL BLANKING INTERVAL

## ADDRESSABILITY

Addressability can be achieved by sending information on a separate carrier as in the RF System. A directional coupler placed in the broadband RF line would provide signal to an address receiver. The address receiver will decode the information and provide the necessary inputs to the baseband decoder. (See Figure 7)

Information needed for addressing a baseband descrambler should be identical to the data used in RF Sync Suppressed schemes.

## AUDIO

IS-15 Multiport provides a wideband audio output. It also gives the descrambler a choice between looping the audio through or processing it. This gives the Cable Operator an opportunity to scramble/descramble the sound.

As wideband audio is provided, a future option to provide high quality stereo is available.

## MODIFICATIONS NEEDED AT THE HEADEND

### The Scrambler

The Scrambler for an RF Sync Suppressed system generates the timing pulses for descrambling, and amplitude modulates them on the audio carrier. This is usually done in the IF section.

Baseband video is also looped through the scrambler, to provide sync information. This signal may be used to insert information needed to descramble in IS-15 format. Data required would be the dynamic word inserted in the vertical interval. Information would include channel tags, descramble authorization and

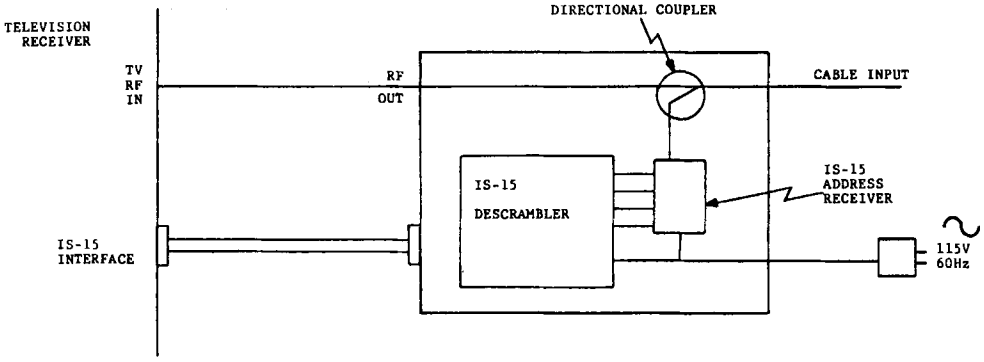


Fig. 7 IS-15 EIA MULTIPORT DESCRAMBLER WITH ADDRESS RECEIVER IN RF LOOP

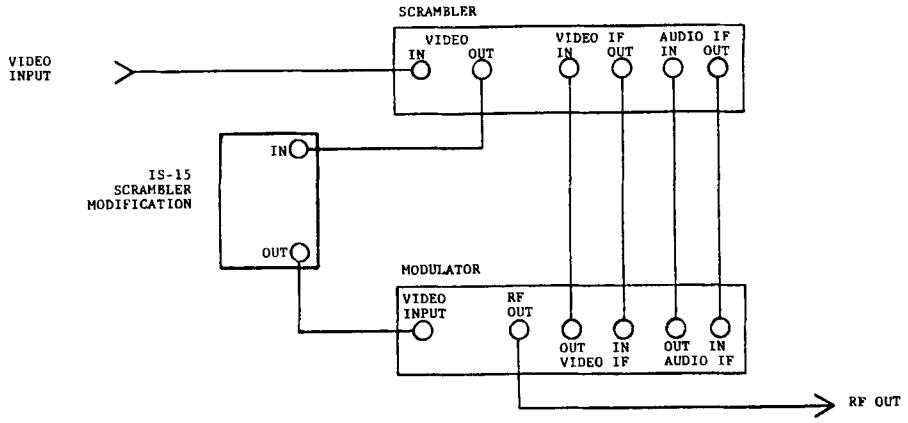


Fig. 8 SCRAMBLER/MODULATOR WITH IS-15 MODIFICATION

timing information. Figure 8 shows a possible interface. Economics would dictate whether the IS-15 board is "stand-alone" or built into the scrambler.

## Addressable Systems

Addressable systems in RF sync suppressed scrambling poll each descrambler to determine presence and status of the service provided. This is accomplished by an Address Transmitter (ATX) in the headend. The ATX modulates data on a carrier in or near the FM band, which is coupled into the downstream Broadband RF.

In IS-15 EIA Multiport, a similar scheme would be employed. The amount and speed of data may require the use of a separate carrier.

## CONCLUSION - MERGING OF THE TWO TECHNOLOGIES

RF Sync Suppression and IS-15 Multiport systems can co-exist in the same channel. This can be accomplished without the expense of replacing all the descramblers and Set-Top terminals in the field. Use of additional bandwidth to carry the same service would not be necessary.

Scientific-Atlanta has developed a system where compatibility is achieved by sending baseband descrambling information in the vertical interval. The data is continuously moved and/or updated, providing adequate security. This has no effect on the performance of RF descrambling in the Set-Top Terminal.

Similarly, timing information in the Audio Carrier used for RF descrambling is not available to the IS-15 descrambler.

Address receiver information may be contained on separate carriers in the FM band or elsewhere, and may be the exact data transmitted to the Set-top terminals.

## ACKNOWLEDGEMENTS

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