

FlexStar[®]

HDx — FM/FM-HD Radio™ Direct Digital Exciter



FlexStar

HD Radio

Make these Harris® FlexStar® exciter benefits yours:

Investment security based on unrivaled digital experience

HD Radio® is not only a safe and wise investment — it's a whole new technology ballgame. As broadcasting's DTV and DAB (Eureka 147) transmission leader, Harris has developed a solid core competency backed by years of experience in the complex technical areas that are essential for maximum HD Radio® performance. And we've put this expertise to the test by providing transmitters for every major HD Radio® test, including multicasting, since the beginning.

Exclusive pre-correction technology for significant cost savings

Featuring Harris' proprietary RTAC™ (Real-Time Adaptive Correction) pre-correction circuitry, FlexStar® HDx enables transmitters to deliver linear amplification without the need for RF bandpass filters that cost up to \$15,000. And this is only the beginning. Harris' exclusive RTAC technology also increases efficiency for ongoing power savings — while comfortably exceeding the FCC's RF mask requirements to prevent signal interference.

Dual-output exciter in one compact package

The FlexStar® HDx is the world's first and only dual-output exciter, designed to drive two FM/HD transmitters for improved performance and operating efficiency. Each output can provide both HD Radio® and/or analog FM modulation so you can configure the system for your optimal combining method. When coupled with the FlexStar® Boost-Pro, you can effortlessly drive dual transmitters and eliminate complex RF-phasing hardware, reducing costly components and ongoing maintenance. The compact size of the FlexStar® HDx also eliminates the need for a deep rack.

A cost-effective and flexible migration path

Not ready to go HD Radio® but need a new transmitter? Purchase an HD Radio-ready transmitter with a FlexStar® HDx analog exciter today, and add a Harris exporter and Exgine™ upgrade card when you wish to commence HD Radio® operation. No other system provides a seamless upgrade path with the power of RTAC™.

Integrated Stereo, Dual SCA and RBDS generators

A multitude of built-in features such as a digital stereo generator with adjustable composite limiter, two frequency agile SCA generators, and a static RBDS generator eliminate the need for costly outboard equipment.

A complete end-to-end solution

Only Harris can provide everything you need as you plan your transition to digital radio ... from source through consoles and studio, through STL, through transmission. And our systems team is available to help you put together the system that makes the most sense for your operation — now and in the future.

Ultimate Performance and Flexibility

From the leader in HD technology comes the most advanced HD Radio® exciter ever invented. The FlexStar® HDx brings HD Radio® to the next level with performance that is unrivaled and key features that ensure your investment in HD pays off today and in the future.

When it comes to one of the most critical components of your air chain, why gamble? Harris digital FM and HD Radio® exciters have logged more hours in “real-time” broadcast use than all the others combined. Hour after hour, day after day, the FlexStar® HDx exciter provides a digital signal of flawless integrity with complete technical and regulatory compliance for Harris tube and solid-state HD Radio® transmitters. And HDx analog FM performance is unsurpassed in the industry.

The exclusive Real-Time Adaptive Correction (RTAC™) incorporated in the FlexStar® HDx exciter continuously monitors the output of your transmitter and any filter or multistation combiner, while it automatically adapts for system nonlinearities. This keeps your station well within FCC compliance and maximizes your coverage.

Sustainable performance is another key benefit of the FlexStar® HDx. Unlike analog exciters whose performance can degrade over time, FlexStar® HDx will deliver the same unsurpassed quality as it did on the day of final test at the factory — year after year.

The integrated digital stereo generator with the adjustable Digital Composite Limiter (DCL) takes your audio to a new level by using proprietary look-ahead algorithms to anticipate and eliminate overmodulation peaks before they occur. The result is the loudest, cleanest sound on the dial.

The FlexStar® HDx is an incredibly versatile exciter that will far exceed your current requirements and position your station for future growth. Designed to accept the broadest range of analog and digital inputs, FlexStar® can be operated in your current configuration, and then upgraded to HD Radio® on your timetable. Even the analog input will provide exceptional audio quality improvements upon installation.

When you are ready for HD Radio® operation, a simple board addition in the FlexStar® HDx exciter and an exporter are all that's needed, and you are on the air in a snap.

We invite you to closely examine the FlexStar® HDx, a digital FM exciter that will change your expectations by giving you the clearest, cleanest FM sound, the best quality, the least amount of maintenance and the highest value of any digital FM exciter available today.

RTAC™ Explained

RTAC™ is the Harris acronym for “Real-Time Adaptive Correction,” an advanced type of digital pre-correction that enables the FlexStar® HDx FM exciter to more fully utilize the transmitter power amplifier, yet maintain spectral mask compliance of the HD Radio® signal. RTAC™ in FlexStar® was derived from the award-winning Harris® APEX™ DTV exciter and leverages adaptive digital pre-correction technology developed for digital television to correct both solid-state and IOT (tube) transmitters.

Pre-correction is split into two types: linear and nonlinear. Linear pre-correction corrects for the non-ideal amplitude response and time response of the transmission system, including the power amplifier and any bandpass filters. Linear pre-correction is helpful in optimizing the modulation performance of the analog FM signal. Nonlinear pre-correction corrects for the two major types of nonlinearities (AM->AM and AM->PM) in the RF power amplifier that cause undesired spectral components and poor RF mask compliance.

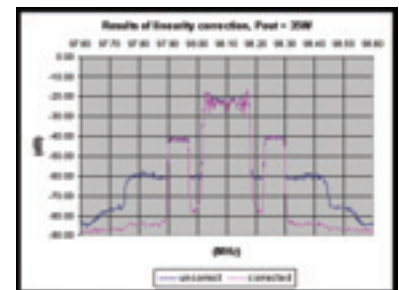
AM to AM nonlinearities cause the RF power amplifier's output amplitude to not exactly track the input amplitude. Typically, these nonlinearities occur near the peak output power of the amplifier where saturation effects cause the output response to flatten as the input continues to increase and where the amplifier output

goes to zero. AM to PM nonlinearities cause the RF power amplifier's output RF phase to not track the input phase. The amplifier acts like a phase modulator as the power output varies to follow the input signal.

Pre-correction is implemented in many ways. In order of sophistication they are:

- Analog, fixed, pre-correction
- Digital, fixed, pre-correction
- Digital, adaptive, pre-correction
- Digital, memoryful, adaptive, pre-correction (RTAC™)

Fixed pre-correction can improve the system linearity for one specific operating point, but has to be manually re-adjusted for changes in power output, antenna load impedance or operating point. Adaptive digital pre-correction utilizes an RF sample taken at the output of the RF amplifier to automatically adjust the shape of the pre-correction to continuously optimize the linearization of the system. The bandwidth limitation, especially in tube type amplifiers, along with the stored energy in tuned circuits, introduces “memory effects.” Digital, adaptive, memoryful, pre-correction can correct for these “memory effects” in addition to simple AM to AM and AM to PM distortions.



- Linear pre-correction is primarily used to improve the analog FM modulation performance, but provides little RF mask benefit.
- Nonlinear pre-correction is required to reduce undesired RF intermodulation products to meet the RF mask compliance.
- All RF amplifiers have some memory effects that make the shape of the non-linearities change with modulation data states.
- Narrowband, tuned vacuum tube amplifiers have significant memory effects that need to be corrected.
- RTAC™ is the only system with simultaneous linear and nonlinear, adaptive, memoryful pre-correction to provide the highest level of correction to all types of RF amplifiers.

World-Class Value

FlexStar® HDx is the choice for market-leading broadcasters around the world to unlock the full potential of their FM and HD Radio® signals because it delivers the features needed to succeed in increasingly competitive markets.

- Embedded DSP-based FM, HD or FM+HD exciter
- Direct-to-channel digital FM modulation
- Dual-output, Tri-Mode FM, HD, or FM-HD operation (two exciters in one)
- RTAC™ Real-Time Adaptive Correction
- Digital adaptive group delay equalization
- Optimized correction for FM tube and solid-state transmitters
- RF-Mode switching on-the-fly
- Integrated N+1 control system
- World's best FM analog performance
- Built-in synchronous booster (SFN) support
- Easy-to-use Graphic User Interface (GUI)
- Spectrum Display shows real-time performance
- Integrated digital stereo generator with updated digital composite limiter
- Two built-in subcarrier (SCA) generators
- Integrated static RBDS generator
- Up to three external subcarrier inputs
- Auto-Switching between analog, AES3, AES3 AUX, and composite inputs ensures you are on the air
- Compact design eliminates external racks; fits in any Harris transmitter; only 12" deep
- Efficient, easy-to-service interior
- High-efficiency, auto-ranging power supply
- Internal harmonic filter for standalone transmitter



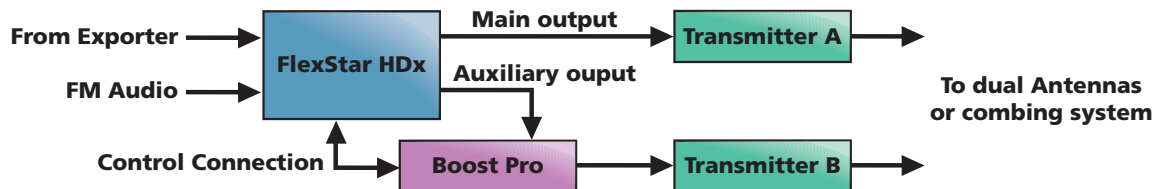
Extensive Front-Panel Spectrum Monitoring

Multiple Transmitter Installations Just Got Easier

Designed to complement the FlexStar® HDx exciter, the FlexStar® Boost-Pro is built to provide a seamless interface of the HDx exciter's second RF output to a second transmitter. Boost-Pro allows a single FlexStar® to drive dual-transmitter configurations for high-level, separate antennas or Harris' exclusive efficiency-improving Split Level™ combining. Operating dual transmitters has never been easier thanks to the integrated electronics phasing control, which eliminates costly and complicated RF phasing equipment. Boost-Pro features the same bullet-proof, tri-mode RF amplifier as the FlexStar® HDx, so you can be sure it will stand the test of time. Boost-Pro has the same logic connections as award-winning Harris FM exciters such as the FlexStar® HDx, the world



standard DIGIT®CD, or the SuperCiter™. The Boost-Pro plugs directly into Harris transmitters, so installation is a snap. It can also be used with non-Harris transmitters.



Front-Panel View



Front-Panel USB Port

Convenient front-panel USB port permits quick system updates. Harris' exclusive USB back-up capability allows quick back-up of system configuration for later recovery, or for rapid set-up of additional FlexStar excitors.

RTAC™ Monitoring

One of the most powerful features of the FlexStar® is Harris' patented RTAC™, which allows for higher transmitter power and efficiencies. Verify performance with the built-in monitoring system.

User Control

Straightforward tactile control and intuitive touch-screen GUI allows for quick setup and accurate monitoring.

Main RF Output

Main high-level output of the Tri-Mode amplifier can operate in FM, HD only or hybrid, with up to 55 watts of analog power.

RF Sample

Ideal for connection to test equipment or a modulation monitor to measure system performance.

Audio Inputs

Mono, stereo analog and dual AES inputs w/auto-switching ensure your station will be on the air. Two internal SCA generators for maximum flexibility.

Engine™ Connections

Optional Engine™ board provides connection to HD Radio® exporter when you are ready to begin digital broadcasting. Additional RF-45 connector provides Ethernet access to Engine board for updates and monitoring.

Rear-Panel View



Aux RF Output

Like the main output, this can independently operate in any mode — FM, HD or hybrid — with up to 10 mW of power. Couple with a Boost-Pro to drive a second transmitter.

RTAC™ RF Samples

RTAC™ monitors both the output of the transmitter and the output of any filters or multistation combiners to optimize your station's performance for maximum clarity and coverage.

Composite & SCA Inputs

Main and aux composite inputs with auto-switch ensure your station will be on the air. Connections for up to three external SCA or RBDS generators cover even the most demanding installations. Includes 19 kHz output for external RBDS.

Serial Connectivity

Multiple communications ports provide standard serial connectivity.

Parallel Remote Control

Dedicated DB-type connectors provide standard interfacing for transmitter connections, interface to user remote controls, and a built-in N+1 interface for simple multichannel back-up operation.

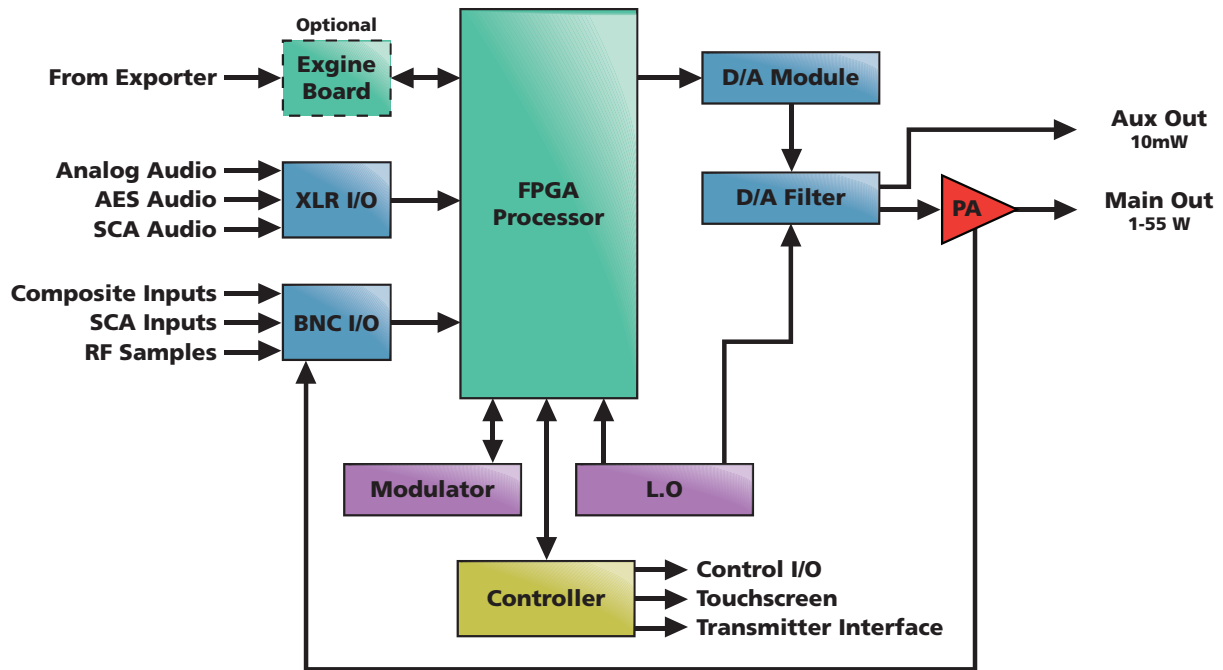
GPS Reference Input

Support for single frequency networks is included with every FlexStar®. GPS synchronization with Harris' Intraplex® SynchroCast® provides the world's most robust SFN system. Supports both 10 mHz and 1 PPS inputs.

Ethernet Connectivity

Dual RJ-45 connector provides system Ethernet connectivity to the FlexStar® to facilitate diagnostics, monitoring and system updates.

Functional Diagram



HDx Specifications

General

Power Output Range, Main Output: 1 W to 55 W for FM mode; 0.5 W to 20 W for FM+HD mode; 0.2 W to 10 W for HD mode, each adjustable from front panel, via remote IO, and remote GUI. Mode independent from aux output.

Power Output Range, Aux Output: -30 to +3 dBm (2 mW) into 50 Ohms. Requires Harris Flexboost Pro or IP-1/2D to drive transmitter. Modulation independent of main output. Mode independent from main output.

RF Output Impedance: 50 ohms unbalanced (BNC).

VSWR: 1.9:1 at rated power. Open and short circuit protected at all phase angles.

RF Harmonic and Spurious Suppression: Internal harmonic filter meets or exceeds all FCC, IC, CE, CCIR and IEC215 requirements. Meets or exceeds standard NRSC-5A emission limits in all modes.

Frequency Range: 87.5-108.0 mHz, programmable in 10 kHz steps.

Frequency Stability: ± 150 Hz, 0° to 50°C using high-accuracy internal (59.535 MHz) TCXO. 10 MHz input for synchronization to external (GPS) reference. Automatic switching to internal oscillator if external reference fails.

External Frequency Control: Parallel I/O control of up to eight frequencies and modulation setups. Unlimited frequency selection via optional N+1 controller.

Modulation Types: FM digitally synthesized direct to channel, HD digital direct to channel, FM+HD digital direct to channel.

Operating Modes: "On-the-Fly" switching among FM only, HD only, FM+HD, and Split Level™ in any combination on either of two RF outputs.

FM Modulation Capability: Greater than ± 300 kHz.

Modulation Indication: Auto-ranging (14% / 140% full scale) GUI modulation display with peak hold.

Asynchronous AM S/N Ratio: 75 dB minimum below equivalent 100% amplitude modulation by 400 Hz using 75 μ s de-emphasis (no FM modulation present).

Synchronous AM S/N Ratio: 60 dB minimum below equivalent 100% amplitude modulation with 75 μ s de-emphasis and 400 Hz high-pass filter (FM deviation ± 75 kHz by a 1 kHz sine wave). Measured at wideband input.

Diagnostics: Front-Panel 1/4 VGA color touch-sensitive Graphical User Interface.

AC Input Power: 90-264 VAC, 47-63 Hz, 260W max.

Operating Temperature Range: 0° to 50°C, derated 2°C per 1000 ft AMSL.

Humidity: 95% non-condensing.

Altitude: 15,000 ft. (4,573 m).

Dimensions: 19 inches (48.3 cm) wide by 7 inches (17.8 cm) high by 12.5 inches (31.8 cm) deep, slide-out mounting rails included.

Mounting: Standard 19" (48.3 cm) EIA rack with optional rackmount adapter.

Weight: 22.1 lbs. (10 kg).

Input/Output Specifications

AES3 Audio Inputs: (2) auto-switching AES3 inputs, female XLR, 110 Ohms balanced; -2.8 dBfs nominal; GUI adjustable level from 0 dBfs to -15 dBfs in 0.1 dB steps for ± 75 kHz deviation; input sample rate 32 to 96 kHz.

Analog L/R Inputs: Female XLR, > 10K Ohms, balanced, resistive; default level is +10 dBu for ± 75 kHz deviation. Level GUI adjustable from -10 dBV to +10 dBV.

Specifications

Specifications and designs are subject to change without notice.

Analog Composite Input: Two BNC inputs (one balanced, one unbalanced); Balanced impedance is 10K Ohms or 50 Ohms (selectable); Unbalanced is 10K Ohms; Input level: 3.5 V P-P for +/-75 kHz deviation; Adjustable 2 V P-P to 5 V P-P.

SCA Audio Inputs: Two inputs combined on one 5-pin XLR-female connector (mating male connector supplied); >10K Ohms balanced, resistive; +10 dBV nominal for +/- 6 kHz of FM sub-carrier.

External SCA inputs: Two BNC female, unbalanced; >10K Ohm; 1.5 V p-p nominal for +/-7.5 kHz (10% deviation of main carrier; adjustable from 1V P-P to 4V P-P.

External 10MHz Clock Input: BNC female, unbalanced, 50 Ohm, -10 dBm to +10 dBm.

External 1 PPS Clock Input: BNC female, unbalanced, 50 Ohm, TTL level.

User Remote Interface: Sub-D 25-pin female.

Transmitter Interface: Sub-D 15-pin female.

N+1 Interface: Sub-D 25-pin female.

RF Sample Out: BNC jack, -40 dBc, post harmonic filter.

RF Output: Two BNC female connectors; main RF channel and auxiliary RF channel. 19 kHz Pilot Sync Output: BNC female, unbalanced, 50 Ohms resistive, sine wave, Phase adjustable, AC coupled, 4.5 V P-P nominal, unterminated.

Communication ports: Two Sub-D 9-pin female; RS232 protocol, for RBDS or VT-100 data.

Ethernet ports: Two RJ-45 on main processor board; (2) RJ-45 on Engine board (HD version only); all Ethernet ports 10/100; supports static or dynamic IP address.

USB port: Front panel USB type-A connector; USB 1.1 / 2.0 compliant; supports configuration save/restore and software updates via flash drive.

RF Sample Inputs: Two digital precorrection inputs, SMA female, unbalanced 50 Ohm, resistive, maximum input is +5 dBm average in HD mode, maximum is +9 dBm average in FM or FM+HD mode.

Stereo Generator Performance (AES3 or analog inputs)

Modes: Stereo, Mono L+R, Mono L, and Mono R; remote controllable.

Pre-emphasis: Selectable 0, 25, 50, or 75 microseconds.

Stereo Pilot Tone: 19 kHz \pm 0.03 Hz; injection adjustable 0% to 12% in 0.05% steps; Nominal: 9%.

38kHz, 57kHz, 76 kHz, 95 kHz Suppression: 80 dB below +/-75 kHz deviation.

Stereo Separation: 80 dB*/60 dB, 10 Hz to 15 kHz.

Dynamic Stereo Separation: 80 dB*/60 dB, 10 Hz to 15 kHz*.

Stereo Amplitude Response: \pm 0.1 dB, 10 Hz to 15 kHz referenced to selected pre-emphasis curve, LPF cutoff selectable.

Stereo Signal-to-Noise Ratio (L or R): 85 dB below 100% modulation at 400 Hz; measured in a 10 Hz to 22 kHz bandwidth with 75 μ s de-emphasis and DIN "A" weighting.

Stereo Total Harmonic Distortion: 0.005%*/0.02%, any modulating frequency 10 Hz to 15 kHz, in bandwidth 10 Hz to 22 kHz; with 75 μ s de-emphasis.

Stereo Intermodulation Distortion (L or R): CCIF: 0.005%*/0.02% Note 1; (14/15 kHz 1:1), SMPTE: 0.02% (60 and 7000 Hz 1:1).

Transient Intermodulation Distortion (DIM): 0.008%*/0.02%; (2.96 kHz square wave/14 kHz sine wave modulation).

Linear Crosstalk: 90 dB below 100% modulation reference (AES3 Input); L+R to L-R or L-R to L+R due to amplitude and phase matching of L&R channels (10 Hz - 15 kHz).

NonLinear Crosstalk: 80 dB below 100% modulation reference; L+R to L-R or L-R to L+R due to distortion products.

Audio Overshoot: Less than 0.16 dB.

Mono Performance (AES3 or analog input)

Pre-emphasis: Selectable 0, 25, 50 or 75 microseconds.

FM Mono Signal-to-Noise Ratio: 100 dB*/94 dB below 100% modulation at 400 Hz; measured in a 10 Hz to 22 kHz bandwidth with 75 μ s de-emphasis and DIN "A" weighting.

Amplitude Response: \pm 0.05 dB, referenced to selected pre-emphasis curve (no low-pass filter).

Mono Total Harmonic Distortion: 0.002%*/0.01% THD, 10 Hz to 22 kHz bandwidth.

Mono Intermodulation Distortion: CCIF: 0.005% (14/15 kHz 1:1); SMPTE: 0.005% (60/7000 Hz 1:1).

Mono Transient Intermodulation Distortion (DIM): 0.005% (2.96 kHz square wave/14 kHz sine wave).

Wideband Analog Input Performance

FM Signal-to-Noise Ratio: 100 dB*/94 dB below \pm 75 kHz deviation at 400 Hz; measured in a 10 Hz to 100 kHz bandwidth with 75 μ s de-emphasis; DIN "A" weighting.

Amplitude Response: +/- 0.005 dB 20 Hz to 53 kHz; +/- 0.03 dB, 53 kHz to 100 kHz.

Total Harmonic Distortion: 0.002%*/0.01% THD over stereo sub band (10 Hz to 53 kHz) with 75 microsecond de-emphasis.

Intermodulation Distortion: CCIF: 0.005% (14/15 kHz, ratio 1:1); SMPTE: 0.005% (60/7000 Hz, Ratio 1:1).

Transient Intermodulation Distortion (DIM): 0.005% (2.96 kHz square wave/14 kHz sine wave modulation).

Slew Rate: 11.8 V/ μ s - symmetrical.

Phase Response Variation: \pm 0.05° from linear phase, 10 Hz to 100 kHz.

Group Delay Variation: \pm 5 ns, 10 Hz to 53 kHz, \pm 30 ns, 53 kHz to 100 kHz.

External SCA, RBDS Performance

SCA Format: Externally generated, analog FM subcarriers in the range 53-99 kHz.

SCA sub-band Amplitude Response: +/-0.5 dB, 40 kHz to 100 kHz; high-pass filtered.

SCA Channel FM Signal-to-Noise Ratio: 80 dB below +6 kHz subcarrier deviation at 400 Hz with 150 μ s de-emphasis.

Harmonic Distortion: less than 0.2% in audio pass-band of SCA generator.

Intermodulation Distortion: SMPTE (60 and 7000 Hz, 1:1): 0.2% or less, no pre/de-emphasis, SCA generator low-pass filter bypassed.

Crosstalk, SCA to Stereo: 80 dB below 100% modulation, L or R channel with 75 μ s de-emphasis.

Crosstalk, Stereo to SCA: 80 dB below 100% modulation referenced to +/-6 kHz deviation and 150 μ s de-emphasis.

Crosstalk, SCA to SCA: 80 dB below 100% modulation (referenced to +6 kHz deviation and 150 μ s de-emphasis per channel).

Dual Internal SCA Performance

Pre-emphasis: Selectable: 150 μ s, 75 μ s, none.

Amplitude Response: \pm 0.5 dB, 10 Hz to 7.5 kHz; selectable 4.3 kHz or 7.5 kHz lowpass filter.

Subcarrier Frequency: 57 kHz to 99 kHz in 1 kHz steps.

Signal-to-Noise Ratio: 80 dB with de-emphasis (150 μ s), 65 dB without de-emphasis at +/-6 kHz deviation.

Total Harmonic Distortion: 0.1% 10 Hz to 5 kHz.

SCA Deviation Capability: +/-1 kHz to +/-12 kHz; +/-6 kHz default.

Injection Level: 2 to 20%, adjustable in 0.1% increments.

Spurious & Harmonic Performance: Second Harmonic: better than 40 dB below subcarrier; Third Harmonic: better than 45 dB below subcarrier; All other components: 50 Hz to 100 kHz: better than 80 dB below subcarrier.

RBDS Generator Performance

Functionality: Static field entry.

Subcarrier Frequency: 57 kHz, \pm 0.09 Hz.

Injection Level: 2 to 20% in 0.1% increments.

HD Radio® Performance

Compliant with iBiquity and NRSC 5A standards

***NOTE:** Specifications marked with (*) were measured using laboratory digital demodulation techniques for product performance verification. All other specifications were measured to the performance limits of currently available production test equipment.

HD Radio® is a registered trademark of iBiquity Digital Corp.

ONE Company for Workflow Solutions Throughout the Media Chain

Harris is the ONE company delivering interoperable workflow solutions across the entire media delivery chain — providing today's broadcaster with a single, integrated approach to capitalize on the benefits of IT and mobile applications. By providing unparalleled interoperability across our product portfolio, Harris is able to offer customers integrated solutions that improve workflows, save money, enable new revenue streams and provide a migration path to emerging media business models. To meet the evolving needs of broadcast, distribution, government agencies and entertainment businesses, Harris is the ONE answer for change.

Service And Support

At Harris, we are committed to customer service excellence. It is our goal to provide the highest level of support by applying a simple rule: We take ownership of helping our customers succeed. Our support teams consist of innovative technical experts who support all situations regarding product performance, integration and operational processing. We are adept at providing proven solutions, making workflows better and ensuring reliability of the product and system. At Harris, our experienced and dedicated teams stand ready to help you meet your goals for premium product performance, 100% up-time and reduced maintenance investment.

Warranty

Because we want to assure you that Harris stands beside its products and system solutions, our products carry a standard set of warranty services, which are competitive with — and in some cases outperform — others in the industry.

Service Packages

We offer value-add services that allow you to customize the level of services you need in meeting mission-critical performance levels. Our service package options offer many ways to upgrade your standard warranty by choosing the All-Inclusive OnePak, or by selecting individual services from our extensive portfolio. Our service and support advisors can assist in the selection of the individual services that best suit your requirements.

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