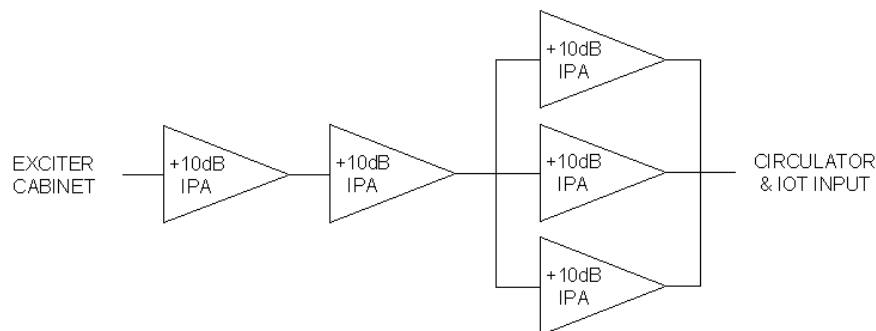


Technical Service Bulletin 030631

IOX / DCX IPA Troubleshooting

This service bulletin provides a procedure to successfully locate and diagnose problems occurring in the IPA driver stage of the IOX and DCX families of television transmitters. With some minor modifications, the procedure may be easily adapted to other popular transmitter models such as the Comark S series IOT and Advantage.

The driver stage in the IOX or DCX transmitter consists of series of solid-state amplifier units arranged in series and parallel. The IPA drive chain accepts a low-level on-channel signal from the exciter cabinet and amplifies it to level sufficient to drive the input stage of the IOT. At the start of the chain, amplifiers are arranged in series to increase signal gain, at the final stage of the drive chain, amplifiers are arranged in parallel to increase overall power handling capability. The block diagram for a typical drive chain is shown below. Depending on the model of transmitter, the number of amplifiers in parallel may be 2, 3, 4, 5, or 6, while the series amplifiers may be one of three types: +10dB, +18dB, or +27dB gain.



The failure of an IPA amplifier is often detected by the IPA monitoring LEDs located on the driver status monitoring panel (*DCX and CIOX models*) or on the IPA amplifier drawers themselves (*original IOX model with separate IPA cabinet*). Occasionally, however, an amplifier will fail without providing a clear indication of failure. Especially difficult to detect are “soft failures” where the amplifier gain drops several dB but the unit continues to output RF power. Such failures are consistent with the failure of one or more transistors inside the amplifier unit.

The procedure below provides a systematic means for checking the performance of the IPA drive chain and identifying a “soft” (partially failed) amplifier.

Procedure 030631: IOX / DCX IPA Troubleshooting Procedure	
Applicability	All IOX and DCX transmitters.
Prerequisites	Transmitter in RF mode. Gain low / signal performance poor on one HPA cabinet.
Equipment Required	Spectrum analyzer. 8-VSB test measurement set or other device capable of measuring DTV peak-average ratio. Television demodulator and waveform monitor (IOX). Two identical N-type directional couplers (Comark P/N 700961-01 or equivalent). N Male-Male adapter barrel. N Female-Female adapter barrel. TNC-N adapters (optional).
Comments	Contact Comark Customer Service at 1-800-345-9295 to order P/N 700961-01 directional couplers.

1. If HPA output power is low, observe driver forward power level on suspected cabinet. Compare driver power level to past log readings and/or other HPA cabinets (where applicable). If drive level is too low, proceed to check IPA stages for failed IPA amplifier unit. If drive level is normal, but HPA output power is low, problem is likely due to poor IOT tuning. Consult Service Bulletins 030528 or 030615 for more information on IOT tuning.
2. If HPA output power and drive power are normal compared to past log readings or other HPA cabinets (where applicable), but suspected HPA cabinet exhibits excessive signal compression (excessive IMD sidebands in DTV service or excessive sync compression in NTSC / PAL service), it could be that IPA drive power/gain had previously dropped, and someone else already increased exciter output power and/or system phase & gain adjustments to compensate. In such cases, increased exciter drive power will overload some or all of remaining IPA amplifiers, thereby creating excessive signal compression. Confirm excessive signal compression by performing following steps:
 - a. **IOX:** Connect RF sample cable from IPA output sample directional coupler to television demodulator RF input connector.
 - b. Measure sync amplitude on waveform monitor.
 - c. Repeat measurement on other HPA cabinets or compare to past log readings.
 - d. If sync amplitude is noticeably lower on suspected HPA cabinet, proceed to troubleshooting IPA section according to this procedure.

NOTE: It is a good idea to keep a reference reading of the sync amplitude of the drive signal for each HPA cabinet under normal operating conditions

- a. **DCX:** Connect RF sample cable from IPA output sample directional coupler to 8-VSB test & measurement set or other device capable of measuring peak-average ratio of 8-VSB signal.

NOTE: it is possible to measure the 8-VSB peak-average ratio using the ADAPT Control software GUI by connecting the DAP sample cable to the point to be measured, adjusting the feedback signal level to obtain “max I” and “max Q” readings of approx 20,000 to 24,000, and noting the “mag peak factor” reading returned during the calculate FEEDBACK routine. The value returned is in dB x 1000. i.e. 6700 cdB = 6.7 dB peak-average ratio. Do not invoke any correction routines while the DAP sample cable is connected to the IPA output. Otherwise, the exciter will correct for a perfect signal at the IPA output...and an imperfect signal at the transmitter output!

- b. Measure peak-average ratio on measurement device.
- c. Repeat measurement on other HPA cabinets or compare to past log readings.
- d. If peak-average ratio is noticeably lower on suspected HPA cabinet, proceed to troubleshooting IPA section according to procedure.

NOTE: It is a good idea to keep a reference reading of the peak-average ratio of the drive signal for each HPA cabinet under normal operating conditions

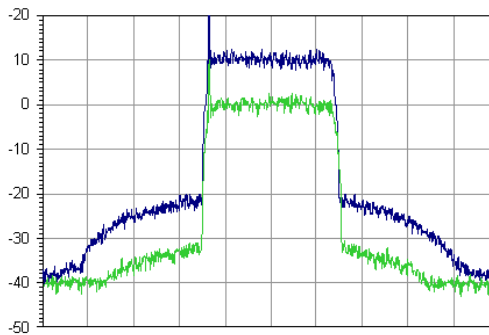
3. Switch affected HPA cabinet to internal control mode via HPA control panel.
4. Change RF system pattern on system controller to steer output of HPA cabinet under test to magic tee reject load.
5. Extinguish RF drive by placing affected HPA cabinet in Beam Mode.
6. Break coaxial cable connection to first IPA amplifier input and insert first N-type directional coupler in series with connection. Use N-barrel adapters, as necessary, to ensure correct orientation of directional coupler section (e.g. “transmitter” port toward RF source, “load” port toward amplifier input).
7. Connect RF sample cable from directional coupler to input of spectrum analyzer.
8. Break coaxial cable to connection to first IPA amplifier output and insert second N-type directional coupler in series with connection.

NOTE: It is imperative that both coupler sections have the same degree of coupling. Otherwise, the gain readings obtained in this section will not be accurate. If two identical coupler sections are not available, the input and output readings may be taken in two steps. e.g. Insert coupler at input, take input reading, insert coupler at output, take output reading, compare readings.

9. Place HPA cabinet in RF Mode to re-establish drive power.
10. Observe RF level on spectrum analyzer. Store spectrum analyzer trace if possible.
11. Move RF sample cable from input directional coupler to output directional coupler.
12. Observe new RF level on spectrum analyzer. Compare new trace level to original stored trace level (where applicable). Measure difference in trace levels in dB. This is the

amplifier gain. If amplifier gain is more than 1 dB below nominal level indicated in transmitter manual, amplifier should be repaired or replaced.

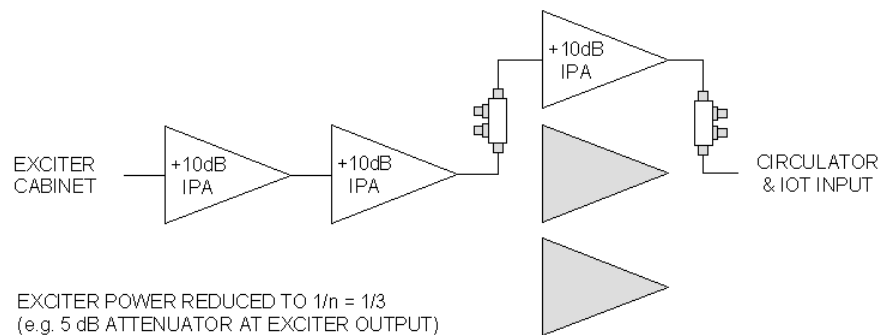
NOTE: Comark IPA amplifiers generally fall into three categories: +10dB, +18dB, and +27dB gain. Generally speaking, +18dB, +27dB gain amplifiers have a TNC input connector, while +10dB amplifiers have a N-type input connector. Additionally, +27dB gain amplifiers have a 100mW max. input level warning sticker; +18dB gain amplifiers have a 1W max. input level warning sticker. The transmitter manual set should be consulted for the final determination of the correct gain for a given amplifier type / part number.



Example of +10dB IPA amplifier gain

*Green trace: IPA input sample
Blue trace: IPA output sample*

13. Place HPA cabinet in Beam Mode to extinguish drive, move directional couplers to input and output ports of next amplifier in chain, return to RF Mode, and repeat measurement.
14. Repeat measurement for each IPA amplifier connected in series. For IPA amplifiers connected in parallel, special precautions must be made while testing: each amplifier must be tested in a single-ended configuration with exciter drive power reduced to $1/n$ of its nominal level, with n being the number of amps normally connected in parallel.



CAUTION: Do not attempt to insert the directional couplers in a parallel driver stage and reconnect the amplifier output to the RF combiner network. The added electrical length of the coupler sections will destroy the proper phase relationship between the parallel amplifiers. This will result in high reflected power and possible damage to the amplifiers.

15. Contact Comark Customer Service to obtain replacement / repair of any IPA amplifiers exhibiting low gain.

NOTE: Be prepared to offer the serial number of the defective amplifier to Comark Customer Service. Both the part number and revision level of an IPA amplifier must be matched to ensure complete compatibility.

16. Return equipment to original condition.
17. Procedure complete.

At Comark, we are constantly striving to improve the satisfaction of both our new and existing customers. Please do not hesitate to contact Comark Customer Service with any questions you may have concerning the contents of this service bulletin.

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