Technical Service Bulletin 040126

Advanced ADAPT Correction Procedure

Procedure 040126: Advanced ADAPT Correction Procedure	
Applicability	All ATSC transmitters.
Prerequisites	Transmitter operating at 100% power. ADAPT Control GUI connected to DAP module and communication established. Transmitter in AGC mode *(strongly recommended)*
Equipment Required	HP89441 Vector Signal Analyzer or suitable 8-VSB test measurement set. Spectrum analyzer. PC with ADAPT Control software. RS-232 null modem cable.
Comments	Advanced step-by-step procedure for when basic correction procedures 040123 or 040124 contained in Adapt User's Guide do not produce acceptable results. Consult troubleshooting tables for individual transmitter type if this procedure is unsuccessful.

1. Connect RF sample from transmitter system output (near DAP feedback sample point) to input of vector signal analyzer or other 8-VSB test measurement set.

2. Measure adjacent channel sideband suppression with regard to FCC spectral mask. Measure 8-VSB signal to noise ratio (SNR) with regard to nominal $\geq$27 dB ATSC specification. If transmitter performance in either area is unsatisfactory, continue with this procedure. Otherwise, modification of transmitter correction settings is not required and procedure is complete.

   NOTE: The ADAPT exciter has two precorrection routines: LUT and ALE. Adjacent channel sideband suppression is due to the action of the nonlinear LUT corrector. Improvement of signal to noise ratio is due to the action of the linear ALE corrector. The two effects are entirely independent, with the exception that *extremely poor* sideband performance can have a negative impact on signal to noise ratio. The nonlinear LUT corrector applies transfer curve precorrection to compensate for non-linearities in the PA stage transfer curve, while the linear ALE corrector compensates for errors in frequency response and group delay created principally by the channel mask filter.

   NOTE: The exciter output power level may drop as much as 2dB when the nonlinear (LUT) corrector is engaged. For this reason, it is strongly encouraged that the transmitter be in AGC mode while this procedure is performed. Otherwise, it will be necessary to readjust power once the LUT correction routine is finished and repeat LUT correction at the new power level. For more information on engaging the exciter AGC system in DCX and Advantage transmitters for the first time, consult Service Bulletin 040125 ADAPT Exciter AGC Setup. Note that all Affinity transmitters ship from the factory already in the Upconverter ALC (AGC) mode.

3. Connect null modem cable between serial communication port of the PC and the RS232 port located on DAP module front panel.

4. Launch ADAPT Control GUI Software (Version 2.0 or higher).

5. Select pull-down menu **Comm Ports** and select appropriate number communication port from selections (typically, Comm 1).

6. Select command **Get > CUDC > All**. If a stream of junk characters appears in Received window, then select **Comm Ports > Computer Baud** and select another baud rate and issue a command like **Get > CUDC > All** until you get legible text in the Received window. Once this is established, then issue commands **Comm Ports > ADAPT Baud** and set to 9600 and then issue commands **Comm Ports > Computer Baud** and set to 9600.

7. Check DAP feedback RF sample from transmitter output with spectrum analyzer. Compare sample with RF samples from other forward directional couplers at transmitter output. Verify that DAP feedback sample does not suffer from frequency response or level problems due to poor coax connections or a malfunction of the directional coupler reverse port load.

8. Reconnect DAP feedback to exciter input at J16 (J50 w/ OLDC).

9. Check feedback level by issuing commands **Correction Commands > Feedback** in ADAPT Control GUI software. "Max I" and "max Q" levels reported should be approximately 24000. Add or remove fixed attenuator pads as necessary to establish feedback level of 24000.

10. For transmitters equipped with an OLDC module (only), check demodulator balance by issuing commands **Compute > OLDC Rejection**. "Rejection" value reported should be greater than 40dB. If not, issue commands **Correction Commands > New OLDC** to run one iteration of OLDC demodulator calibration routine, and repeat rejection measurement. If rejection level of greater than 40dB cannot be achieved, contact Comark for further instructions.

11. For exciters equipped with an OLDC module (only), check modulator balance by issuing commands **Compute > OLMC Quality**. "Modulator Adjustment" value reported should be less than 1.5%. If not, issue commands **Correction Commands > New OLMC** to run one iteration of OLMC modulator calibration routine and repeat modulator adjustment measurement. If modulator adjustment level of less than 1.5% cannot be achieved, perform these steps:

    a. Issue commands **Correction Commands > New Non-Linear** to perform one iteration of nonlinear LUT correction routine.

    b. Issue commands **Correction Commands > New Linear** to perform one iteration of linear ALE correction routine.

    c. Issue commands **Correction Commands > New OLMC** to perform one iteration of OLMC modulator calibration routine.

    d. Return to start of this step.

> **NOTE:** If the DAP feedback signal from the transmitter output suffers from severe linear and/or nonlinear distortions, the OLMC may not return a satisfactory result. For this reason, running one iteration of the LUT and ALE correction routines often improves the operation of the OLMC routine in those exciters that have had their LUT and ALE corrections previously cleared (…by linearizing the transmitter output)

However, in rare cases, if the modulator balance is grossly misaligned, the LUT and ALE routines will abort and return error messages, thereby creating a "chicken and egg" scenario. To break this loop, the user may either:

➢ Loop exciter output from J23 back to feedback input J50, pad accordingly to achieve feedback level of 24000, clear LUT and ALE correctors to remove (pre)distortion from feedback sample, perform OLDC & OLMC routines per steps above until satisfactory results are achieved, and re-establish original coax connections. This procedure is described in greater detail in Service Bulletin 040129 *ADAPT Exciter DAP & CUDC Alignment*.

➢ Manually adjust modulator balance using **I Mod Offset** and **Q Mod Offset** parameters, as described in the next step.

12. For exciters not equipped with an OLDC module, or exciters unable to achieve satisfactory "modulator adjustment" in the previous step, modulator balance may also be manually adjusted with ADAPT Control by following these steps:

Residual LO carrier

    a. Check for presence of residual LO carrier in center of transmitted signal by examining output spectrum with spectrum analyzer. (See graphic at right).

    b. Check current values of **I Mod Offset** and **Q Mod Offset** parameters by issuing commands **Get > CUDC > All**. Note "I mod offset" and "Q mod offset" values returned and compare to values recorded at time of proof (when possible).

    c. Issue commands **Set > CUDC > I Mod Offset** and/or **Set > CUDC > Q Mod Offset,** and slowly modify these parameters from their original values until complete elimination of residual LO carrier is observed in output spectrum. Note final values for future reference.

    d. If complete cancellation of residual LO carrier cannot be achieved, contact Comark for further instructions.
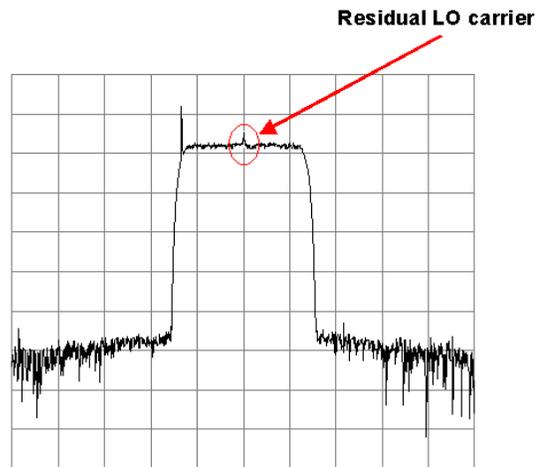
NOTE: The upconversion process in the CUDC module is accomplished by the direct AM modulation of the LO carrier at the center channel frequency by the inphase (I) and quadrature (Q) baseband signals. The I and Q baseband signals must have no DC offset for true *suppressed carrier* AM modulation to take place. Otherwise, a remnant of the unmodulated LO carrier will appear in the transmitted signal, thereby degrading the transmitted signal to noise ratio and potentially interfering with correct reception.

13. Once proper modulator balance has been achieved, check DAP correction level parameter by issuing commands **Get > DAP > Correction Level**. "Correction Level" value returned should be approximately 195 for IOT transmitters or 200 for solid state

transmitters. Issue commands **Set > DAP > Correction Level** to modify correction level parameter. This is typically a one-time adjustment, but may be adjusted +/- 20 points to improve nonlinear corrector performance.

NOTE: The DAP correction level parameter determines how far into the saturation portion of the transmitter amplifier transfer curve the LUT corrector will attempt to correct. As the correction level parameter is increased, adjacent channel sideband suppression by the LUT corrector will improve, up to a certain limit imposed by PA saturation in the transmitter. The exciter output (rms) power drop created by the activation of the LUT corrector will also increase, as the exciter employs increasing amounts of peak signal stretch. This effect will be masked (within limits) when the exciter is properly operated in AGC mode. The goal in setting the correction level parameter is to find the minimum value that achieves an acceptable suppression of adjacent channel sidebands in accordance with the FCC spectral mask. This value is typically 195-200.

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14. Ensure that power boost feature is deactivated by issuing commands **Set > Power Boost > Off**. This is a one-time adjustment.

15. Issue commands **Correction Commands > New Non-Linear** to invoke a single iteration of the LUT correction routine. Wait for routine to finish and observe results on adjacent channel sidebands of transmitted spectrum.

CAUTION: If it should become necessary to clear the correction settings, lower power to approximately 50% as a precaution before clearing the LUT corrector. The exciter output power may jump as much as 2dB when the LUT corrector is cleared, and the loop response speed of the exciter or transmitter AGC may cause a delay of up to one second before the power level is brought under control (where applicable).

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16. Issue commands **Correction Commands > New Linear** to invoke a single iteration of the ALE correction routine. Wait for routine to finish and observe results on transmitted signal to noise ratio.

17. Repeat previous two steps as necessary until adequate sideband suppression and transmitted signal to noise ratio are achieved. If satisfactory results cannot be achieved, perform these steps:

    a. Move DAP sample cable from directional coupler after RF channel mask filter to one before it.

    b. Issue commands **Correction Commands > Feedback** in ADAPT Control GUI software to measure DAP feedback levels. Add BNC attenuators at J50 as necessary to achieve a max I and max Q level of 19000 - 24000.

    c. Issue commands **Correction Commands > Clear Linear** to remove all linear correction from transmitted signal.

    d. Perform nonlinear correction routine (**Correction Commands > New Non-Linear**) multiple times until adjacent channel sideband level is acceptable.

    e. Restore DAP sample cable and BNC attenuators to original conditions (after channel mask filter).

    f. Perform linear correction (**Correction Commands > New Linear**) routine until signal to noise ratio is acceptable.

18. If satisfactory performance is still not possible, consult troubleshooting table for particular transmitter model for possible diagnosis of exciter hardware malfunction or malfunction downstream in transmitter.

> 030328 IOX/DCX Troubleshooting Table
> 030516 Advantage Troubleshooting Table
> 030404 Optimum/Ultimate Troubleshooting Table
> 030405 Affinity Troubleshooting Table
> 040127 DCX Paragon Troubleshooting Table

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19. Once signal is within specifications, save new correction settings by issuing commands **Correction Commands > Save Correction**. Correction settings are saved as a baseline for use after an AC power failure.

20. Also issue commands **Software > Save CUDC Settings to File** and save CUDC settings under a new file name.

NOTE: The **Save CUDC Settings to File** command saves only the drive level and modulator/demodulator adjustment parameters. This information may be recovered at any time via the command **Software > Load CUDC Settings from File**. The **Correction Commands > Save Corrections** command saves all exciter parameters (including precorrection curves), but may only be recovered (automatically) by cycling AC power to the exciter (or resetting the DAP module).

21. Procedure complete.

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