Technical Service Bulletin 110427

DCX AGC Setup Procedure for ADAPT IV Exciters

This service bulletin provides the procedure to properly install and align the total system automatic gain control (AGC) upgrade (P/N 47267125) in Comark DCX ATSC Transmitters equipped with the ADAPT IV Exciter. This upgrade permits AGC control of total system forward power at the output of the transmitter RF system, while preventing overdrive of individual HPAs during non-standard operating conditions. This upgrade also provides an automatic VSWR fold back function.

CAUTION: The procedure contained below is for advanced users only and should not be attempted without a full understanding of the theory of operation of the transmitter gain control system. Incorrect set-up of the gain control system could create the potential for serious damage to the transmitter amplifiers resulting from RF overdrive conditions.

GC/AGC Simplified Theory of Operation

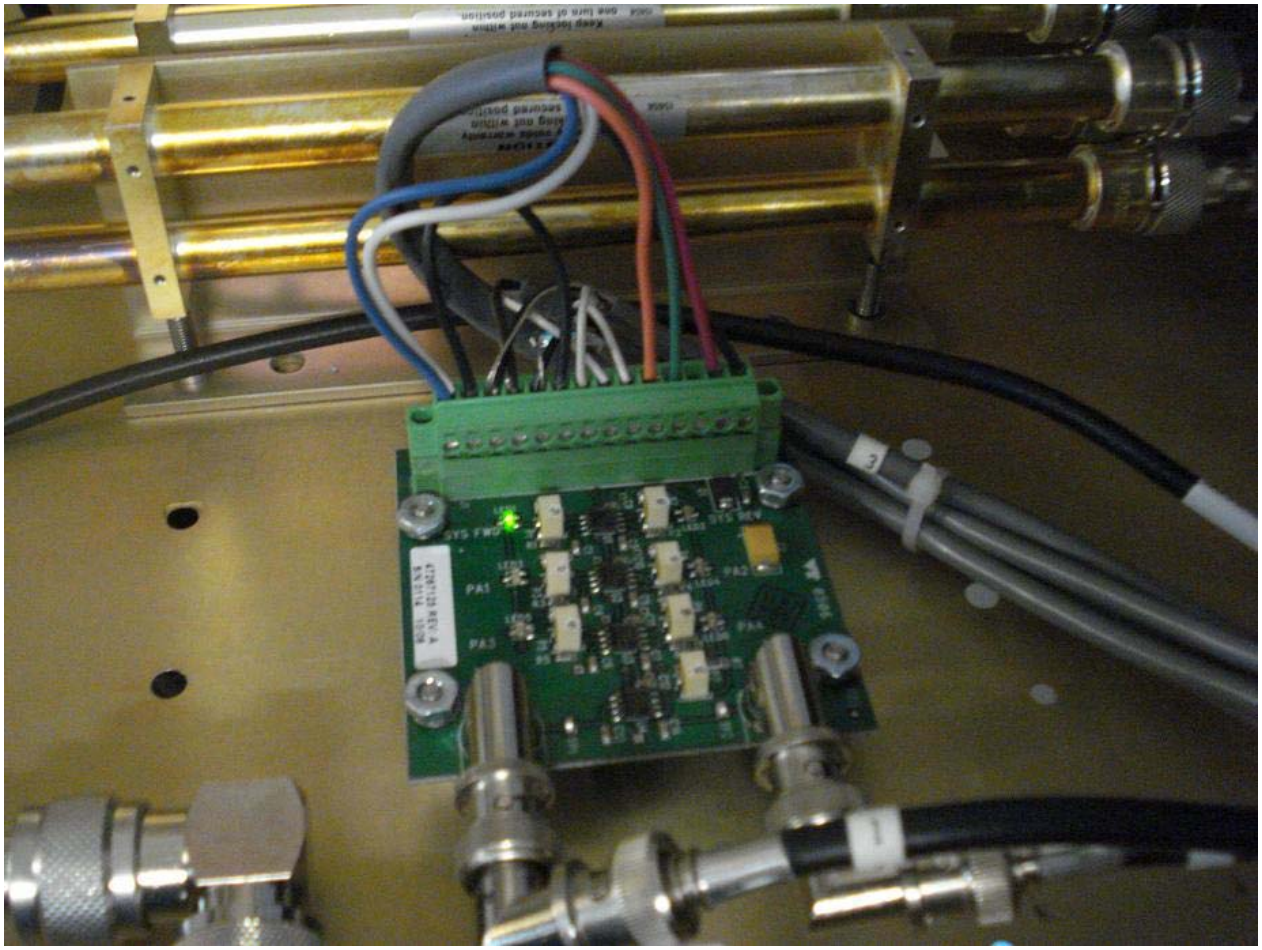
The transmitter gain control system uses the principal of negative feedback to maintain a steady operating power despite changes in amplifier gain due to temperature shifts or other component drift. *(see attached schematic 47267125.030)*

The transmitter remote control interface provides DC metering voltages proportional to the levels of the system forward output power, system reverse power, and each individual PA cabinet output power. These voltages are typically between zero and five volts.

The DCX / ADAPT AGC Interface PCB (AGC card) takes an amplified sample of each of these metering voltages and compares them according to a diode-OR selection rule. The diode-OR circuit allows only the highest metering value to pass on to the next stage: the exciter AGC feedback input. All other diodes are reversed bias by the highest metering value passing through to the next stage.

The diode-OR selection is such that the transmitter gain control system will only track the highest metering voltage coming into the AGC card. Under normal operation, the variable gain controls on the AGC card are adjusted such that system forward power metering voltage is slightly higher that the metering voltages from the individual HPA cabinets. This ensures that the exciter AGC tracks the system forward power. Should the system forward power drop the exciter AGC will attempt to compensate by raising its output power. This will raise the output power levels of the individual HPA cabinets. When an individual HPA power level rises to 110% of nominal, its metering voltage takes control of the diode-OR circuit, thereby preventing further power increases. The level of the system reverse power metering voltage is adjusted such that a reflected power level of 2.5% allows it to seize control of the diode-OR circuit and force the AGC to reduce forward power while keeping the reflected power level constant (VSWR fold back).

The diodes forming the diode-OR circuit are LEDs, thereby allowing easy determination of which metering voltage is current controlling the AGC system.



Non-Millennium mounting location inside phasing drawer

Procedure 030624: AGC Setup Procedure DCX	
Applicability	DCX IOT Transmitters
Prerequisites	Transmitter operating at 100% with acceptable non-linear (LUT) performance.
Equipment Required	P/N 47267125 DCX / ADAPT AGC Interface PCB with supplied hardware kit. Spectrum analyzer 50 ohm RF cable Selection of BNC RF attenuators
Comments	Instructions for optional DCX AGC card made by Dave Sparano.

1. Ensure that transmitter is operating normally at 100% system forward power with 100% HPA forward power on each individual cabinet. Adjust power level and system phasing to achieve this necessary condition before attempting to install AGC PCB.
2. Ensure that transmitter has been satisfactorily corrected for non-linear distortions. That is, ensure that LUT corrector is engaged and adjacent channel sidebands have been reduced to an acceptable level.
3. Mechanically install AGC PCB by performing following steps.
    a. Select suitable unused portion of wall in rear section of DCX exciter cabinet.
    b. Using card as template, trace four mounting holes on wall of DCX exciter cabinet.
    c. Center punch holes, and drill with 1/16" pilot bit.
    d. Drill holes with 7/64" bit.
    e. Tap holes with 6-32 tap.
    f. Mount card to wall with supplied 6-32 hardware and standoffs.
4. Electrically install AGC PCB by performing following interconnects:
    a. Wire from P1-1 (GND) of AGC card mating connector to TB1-87 (GND) for DCX1 or TB1-94(Gnd) for Millennium exciter cabinet.
    b. Wire from P1-2 (+24V) of AGC card mating connector to TB1-48 (unused) of DCX exciter cabinet.
    c. Analog system forward power metering voltage from remote control rack to P1-4 (+) and P1-10 (-/GND) of AGC card mating connector.
    d. Analog system reverse power metering voltage from remote control rack to P1-5 (+) and P1-11 (-/GND) of AGC card mating connector.

NOTE: DCX Millennium transmitter users may skip this step, as reverse power AGC (VSWR foldback) is already provided by the Total Power Control Unit (TCPU) and should disregard all future instructions concerning the reverse channel in this AGC setup procedure.

e. Analog HPA forward power metering voltages from remote control rack to P1-6, 7, 8, 9 (+ for HPAs 1-4) and P1-12, 13, 14 (-/GND for HPAs 1-4) of AGC card mating connector. It will be necessary to double-up some -/GND connections.

f. Place a jumper from the (+) input to ground for any unused HPAs (e.g. jumper P1-8, 9 to P1-10…14 on AGC card mating connector for HPAs 3 & 4 in two cabinet system).

g. Connect P1 to J1 on AGC card.

h. Use multimeter to verify that suitable analog voltages (approx 0.5 - 5V) are being applied between + and GND connections for each input channel.

i. Insert WAGO jumper plug (supplied) between TB1-48 (unused) and TB1-49 (+24V) of DCX exciter cabinet. This should apply +24V to the AGC card. One or more input channel LEDs should light.

NOTE: A silkscreen error on REV A boards mistakenly indicates that a +12V connection is required and that connections J1-10…13 are unused.

5. Ensure that outputs from J1 and J2 are disconnected.
6. Turn all potentiometers on AGC card fully counterclockwise.
7. Adjust SYS FWD potentiometer to obtain a reading of +15.74 volts on test point TP3.
8. Adjust GAIN potentiometer until a reading of +3.2V is obtained on TP1.
9. Adjust PA1 potentiometer until reading of +15.60 volts is obtained on test point TP5.
10. Adjust PA2 potentiometer until reading of +15.60 volts is obtained on test point TP6 (where applicable).
11. Adjust PA3 potentiometer until reading of +15.60 volts is obtained on test point TP7 (where applicable).
12. Adjust PA4 potentiometer until reading of +15.60 volts is obtained on test point TP8 (where applicable).

NOTE: A voltage set point of 15.60 volts will allow a 5% increase of HPA power before taking over AGC control. 15.60 is the nominal set point which is 5% lower than that of the System Fwd meter at nominal power. The amount of change can be adjusted by the user to a greater difference in the set points (to allow a higher change of power) if the system has the adequate headroom. The maximum power an HPA should be allowed to reach is 120%. An increase over 120% will cause the HPA to fault on Forward Power High.

13. Locate system forward power sample coax entering the universal meter driver (UMD) or total power control unit (TCPU) in DCX exciter cabinet.
14. Simulate a system reflected power of 2.5% by connecting forward power sample cable + 6dB attenuator to BNC input of the reverse power metering channel on UMD. Verify that a reading of 2.5% power is registered on system reflected power meter.
15. Adjust SYS REV potentiometer to obtain a reading of +15 volts on test point TP4.

16. Do not connect output from J1 or J2 to exciters until max exciter output level (headroom) has been properly restrained by the following procedure:
    a. Place the on-air exciter into Manual Gain and adjust exciter power to obtain 100% forward power. Verify that shoulder performance is in spec.
    b. Connect J1 of the AGC board to the AGC input on back of the exciter.
    c. On the exciter's front panel, press the F3 button twice on the exciter for AGC LVL. You should have an AGC LVL approximately 2000 to 2400.
    d. Select SET REFERENCE; the indicated reference should now match the AGC level.
    e. Change the exciter's gain mode to AUTO. The AGC in the exciter will ramp up until the AGC LVL matches the AGC REFERENCE
    f. The exciter typically has approx 1.5dB of headroom – this is too much for the HPAs and can cause them to trip on high forward power. Lower the LIMITER 1db or 2dB until the exciter will just make it to 100%
    g. Note – when the exciter is put into MANUAL GAIN, the power will drop to approx 80%
17. Verify AGC is working by performing following tests:
    a. Lightly disturb system phasing by adjusting a phasing trombone (multitube systems). System forward power level should spring back to 100% for small changes. AGC should hold power at 100% until any HPA exceeds its set point of 110% HPA power.
    b. While in HPA internal control, de-select RF mode for one HPA (i.e. turn RF off at HPA control panel). Power on remaining HPAs should be held to 110%. Jump in power on remaining HPAs should not cause overpower alarm due to overshoot. (See note at end of procedure).
    c. Run new non-linear LUT correction. Power should always spring back to 100% after each iteration.
    d. Simulate a system reflected power of 5% by connecting the forward sample + 3dB attenuator to system reverse metering channel on UMD. Power on each HPA meter should be reduced from 100%, and system reverse power should be held to 2.5%, thus indicating that VSWR fold back is working.
18. Check and re-adjust MGC levels as necessary.
19. Repeat procedure for second exciter in two exciter systems.
20. Procedure complete.

NOTE: In two exciter systems, it is very important that both exciters be kept in the REMOTE mode at all times (F3 CONTROL). This ensures that the exciters will always shut down when de-selected and ramp start when re-selected. The AGC power level in an exciter that is left on while in the non-selected position will float to either zero power or maximum power, depending on the AGC set point. An exciter that has floated to maximum power level will cause overdrive alarms when it is re-selected for on-air operation.

This effect occurs because the de-selected exciter (in LCL mode) is still on and receiving feedback from the transmitter AGC card. However, none of the internal AGC power adjustments it makes will affect the level of incoming AGC feedback because the transmitter output power is being controlled by the other exciter. The negative feedback loop is effectively broken and the power level will float to the upper or lower rail*…just as an op amp becomes a comparator when the negative feedback loop is removed.* Because it is impossible to set both exciter AGCs to the exact same power level, the exciter with the lower set point will always float to the lower rail (no power) while de-selected. The exciter with the higher set point will always float to the upper rail (max power) while de-selected.

Leaving both exciters in REM mode will prevent this effect. If local control of the exciter is desired, the REM/LCL switch should be switched to the LCL mode for the time necessary to perform the desired adjustments, then placed back in the REM mode.

NOTE: The AGC system has a relatively slow loop response speed. This creates the risk of power level overshoot in response to sudden changes in system power level (e.g. one HPA shutting off). When the exciter headroom has been properly limited to 1dB ~1.5dB (see procedure above), this overshoot should be minimal. However, the higher system gain typical of the first hour of transmitter warm-up will cause the exciter to operate at a lower nominal output level, thereby increasing the exciter headroom available. If AGC overshoot is excessive during this warm-up period, HPA overpower faults on the remaining HPAs may occur when one HPA is switched off, thereby leaving the AGC stranded at the upper rail (max power)…because the exciter is on, but no AGC feedback is returning from the system (all HPAs have faulted). This, in turn, will make it impossible to turn the HPAs back on, due to instant overdrive conditions. If such cases, correct AGC operation may be re-established by commanding the RF OFF then back ON at the system controller. This will force a ramp start of the exciter and allow the exciter AGC circuits to sync back up with the transmitter output power level.

Clearing the LUT corrector will also temporarily create more exciter headroom and create the potential for this overshoot effect. As the LUT correction is re-run, the system will naturally return to the previous exciter headroom range.

If this is a persistent problem, the exciter headroom should be reduced. See step 16.

In summary, the user should always remember this golden rule while using the DCX AGC:

Never leave the exciter ON while the RF feedback is either interrupted (HPAs are off) or being controlled by the other exciter. Failure to observe this rule may cause the exciter AGC to float to the maximum value and cause cyclical overdrive trips. To break this cycle, the exciter must be shut off and ramp started again. This may be done via the RF ON button on the system controller (exciter in REM mode).

Schematic 47267125.030 attached.

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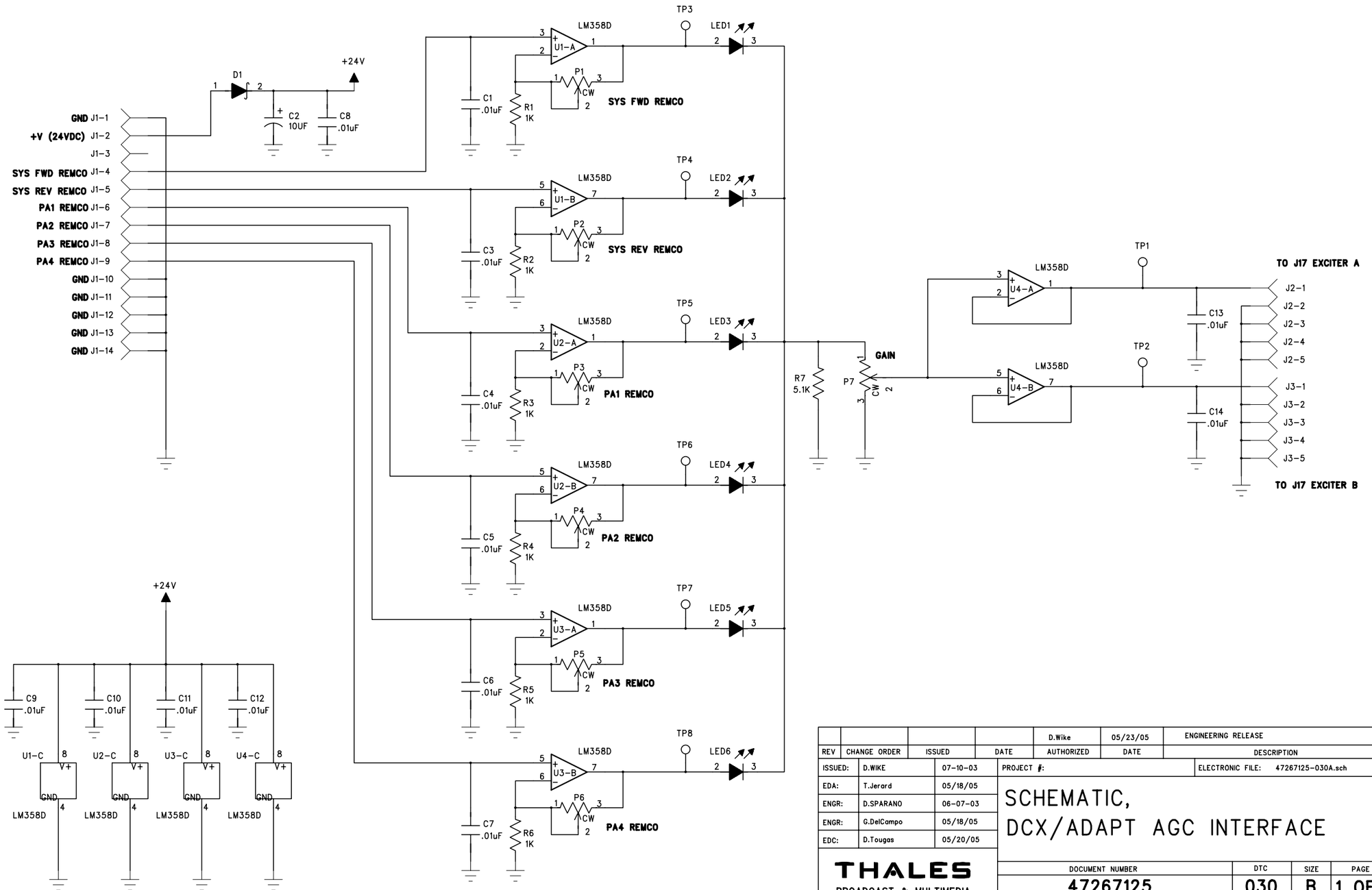

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SCHEMATIC, DCX/ADAPT AGC INTERFACE

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