DAP3 – BROADCAST DIGITAL ADAPTIVE PRE-DISTORTION

OVERVIEW

Digital Adaptive Predistortion (DAP) has become the industry standard for linearity improvement in digital amplifier designs. By measuring transmitter distortion and applying an inverse correction at the digital modulator output, adaptive pre-distortion provides predictable transmitter linearity, low out of band emissions, improved efficiency and lower overall amplifier cost.

The Affarii DAP3 predistortion processor is a third generation adaptive pre-distortion engine optimised specifically for the linearization of Class-AB and Doherty amplifiers in Broadcast applications.

The DAP3 core provides complete signal control including modulation preconditioning with peak reduction, linear output filter correction, non-linear amplifier distortion correction, and output automatic gain control (AGC) functions.

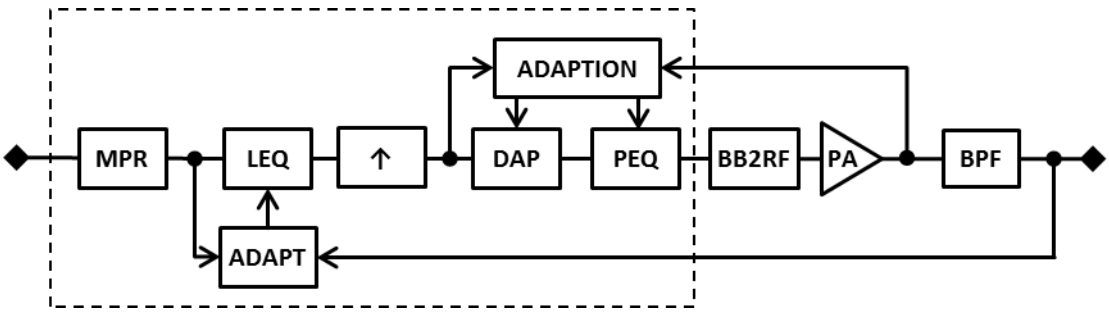
The DAP3 non-linear correction capability includes extended length reactive memory compensation designed specifically to enhance performance in large scale combined amplifier arrays. The inclusion of reactive memory compensation allows DAP to achieve up to 30dB of shoulder correction, improved MER and higher output power.

The DAP3 core includes optional monitor capability for modulation output shoulder, flatness, CCDF, and MER parameters allowing detailed real time reporting of amplifier operational status.

FEATURES

- Linear and Non-Linear Correction.
- Class-AB & Doherty PA Support.
- 25-30dB Shoulder Improvement.
- Modulation Peak Reduction.
- Reactive Memory Compensation.
- Modulation Monitor (MER, CCDF).

BLOCK DIAGRAM



DESCRIPTION

The DAP3 digital predistortion processor is an IP firmware block target for application in low cost FPGA fabric and software processing designs.

The IP core has a modular design which consists of independent forward path processing and adaption blocks that can be configured for specific target hardware and applications.

The forward path processing blocks include Modulation Peak Reduction (MPR), Linear Equalization (LEQ), Data Rate Interpolation (DRI), Adaptive Predistortion (DAP) and Post Equalization (PEQ) functions. Each of the LEQ, DAP and PEQ element provide configurable filter length and depth to support high performance linear and non-linear memory compensation.

Adaption of the DAP forward filter components is provided by a hardware capture (CAP) buffer and associated DAP algorithms running on a soft or hard CPU predistortion adaption engine (PAE).

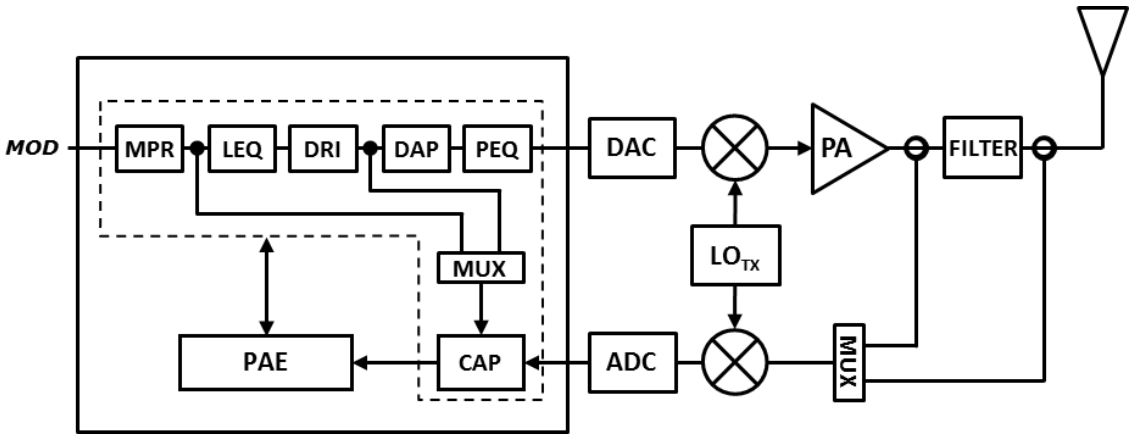


Figure 1: DAP3 - Internal Block Architecture

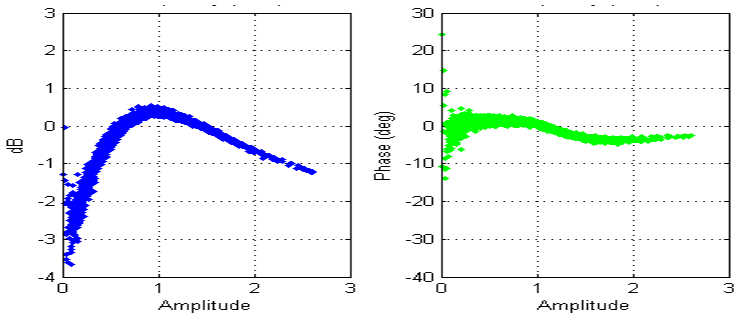
The DAP3 adaption software actively monitors both the direct PA output and the post channel filter output, allowing it to provide correction of PA non-linear distortion and the output filter linear group delay and ripple distortion.

As an optional feature, the DAP3 capture mechanism includes a rate adaptive sampling capability that supports rate matched sampling of the transmit modulation. This allows the DAP3 software to perform modulation performance analysis including monitoring COFDM transmit MER, with personalities available for DAB, DVB-T and DVB-T2 formats.

For further details of the DAP3 processor setup, operation and performance are available by contacting **sales@affarii.com**.

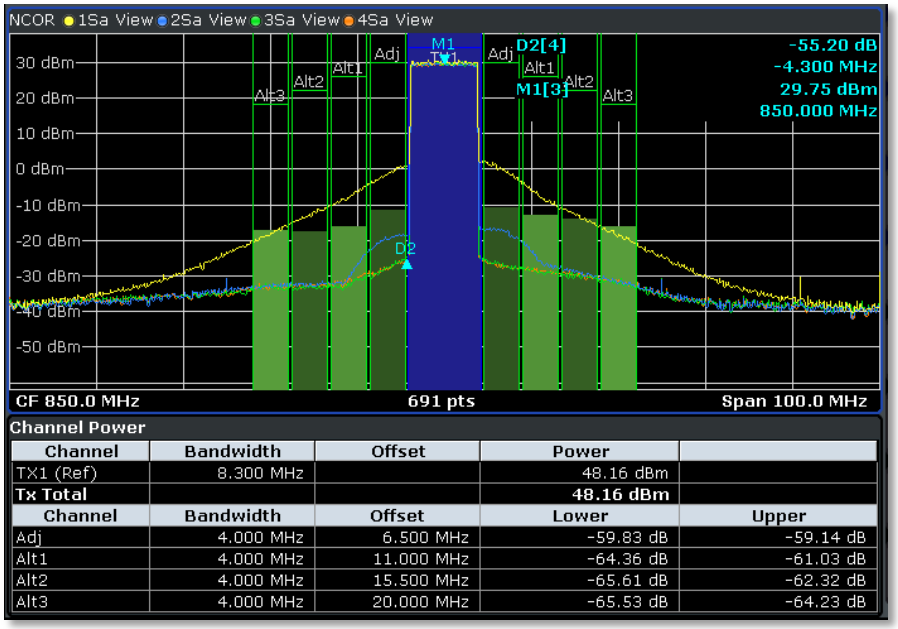
EXAMPLE: DVB-T DOHERTY HPA

- 50W Doherty amplifier in Band V (750-850MHz).
- DVB-T peak reduced to 8.2dB Peak with 34dB MER.
- PA power increased until 3.0dB compression point reached with DPD linearisation active.
- PA initial shoulder is -28.8dBc unlinearized.
- Linearised shoulders are -48.3dBc (no memory) and -55.1dBc (memory) respectively.
- Final output efficiency >46% at 60W RMS.
- Linearity improvement is >26dB with final shoulders below 55dBc level.
- Implementation is on low cost Lattice ECP3 FPGA with all PAE algorithms on FPGA soft CPU (MICO32).



AM-AM/AM-PM UNLINEARISED

PERFORMANCE



Channel Power

Channel	Bandwidth	Offset	Power	
TX1 (Ref)	8.300 MHz		48.16 dBm	
Tx Total			**48.16 dBm**	
Channel	**Bandwidth**	**Offset**	**Lower**	**Upper**
Adj	4.000 MHz	6.500 MHz	-59.83 dB	-59.14 dB
Alt1	4.000 MHz	11.000 MHz	-64.36 dB	-61.03 dB
Alt2	4.000 MHz	15.500 MHz	-65.61 dB	-62.32 dB
Alt3	4.000 MHz	20.000 MHz	-65.53 dB	-64.23 dB

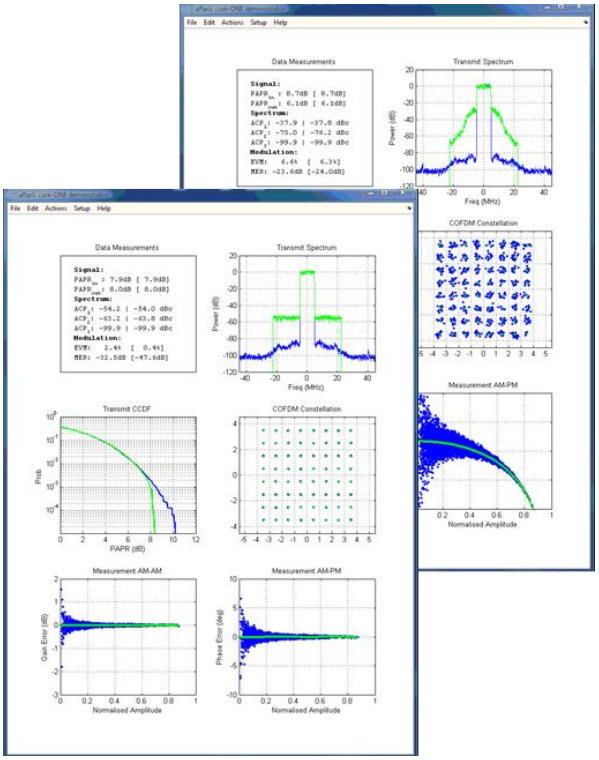
HIGH EFFICIENCY DOHERTY– DVB-T2, 8MHz (EXTENDED BW)						
PLATFORM	**INITIAL**		**NON MEMORY**		**MEMORY EFFECT**	
	4.3MHz	**ACP**	**4.3MHz**	**ACP**	**4.3MHz**	**ACP**
DOHERTY 800MHz	-28.8dBc	-32.6dBc	-48.3dBc	-49.8dBc	-55.1dBc	-59.1dBc

TOOL SUPPORT

The DAP3 pre-distortion core is supported with comprehensive PC based analysis tools to assist in amplifier design and performance analysis.

Analysis tool include advanced visualisation in the MATLAB environment with USB based In Circuit Evaluation (ICE) debug interface that provide PA compression, AM-AM, AM-PM and equalisation characteristic data.

Support for the visualisation of the DAP3 cores DVB-T and DVB-T2[1] modulation analysis capabilities is possible through the MATLAB GUI for both development and production test environments.



Note:

1. Support for DVB-T2 analysis modes (Full or Lite) is dependent on DAP core configuration and available memory.

AVAILABILITY

The DAP3 predistortion solution is available for Altera, Xilinx and Lattice FPGA cores with either embedded soft processor adaption or external CPU hosts. For further information please contact **sales@affarii.com**.

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