AFE5809: Analog Front End for Ultrasound

Imaging

TEXAS INSTRUMENTS
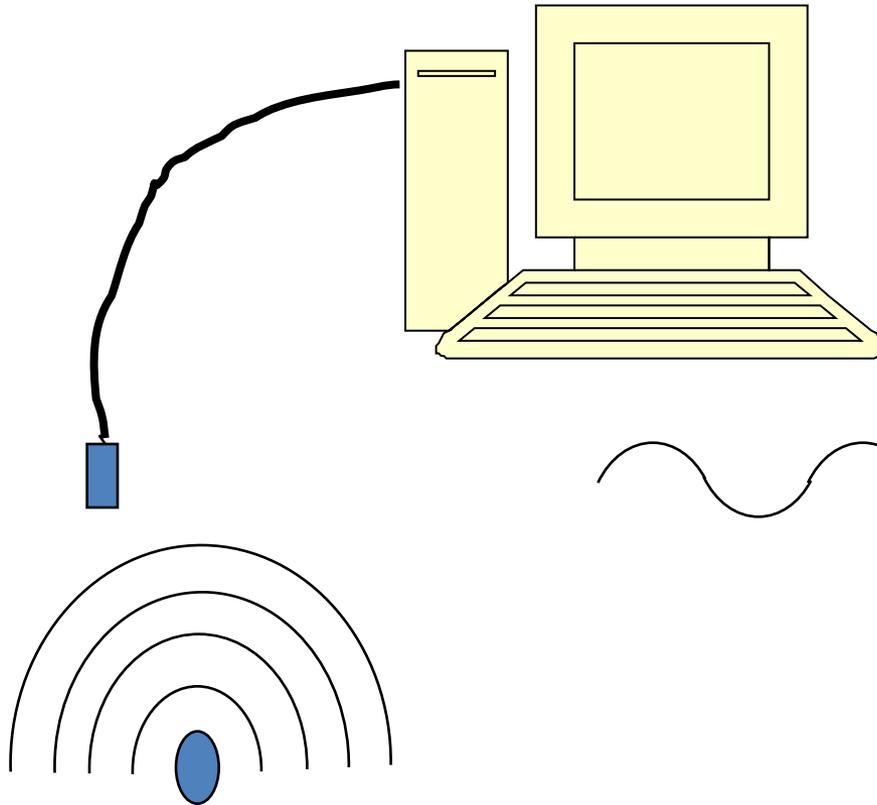
Introduction

- Purpose
  - To introduce TI's AFE5809 for Ultrasound Rx path

- Objective
  - To discuss AFE5809's features and benefits

- Content
  - Medical Ultrasound Basics
  - Typical Ultrasound Block Diagram
  - AFE5809 Analog Front End
  - Why is the AFE5809 so great?
  - AFE58xx Family for Ultrasound Rx
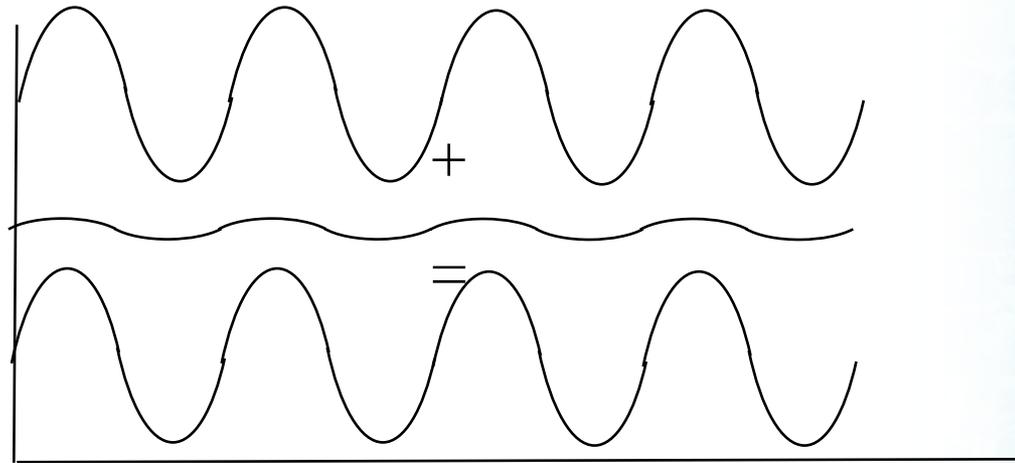
Medical Ultrasound Basics

- Short electrical pulses make the transducer ring at the desired frequency

- The sound wave from the transducer is partially reflected from the layers between the different tissues.

- The echo sound wave returns to the transducer which turn it back into electrical pulses.

Medical Ultrasound Basics
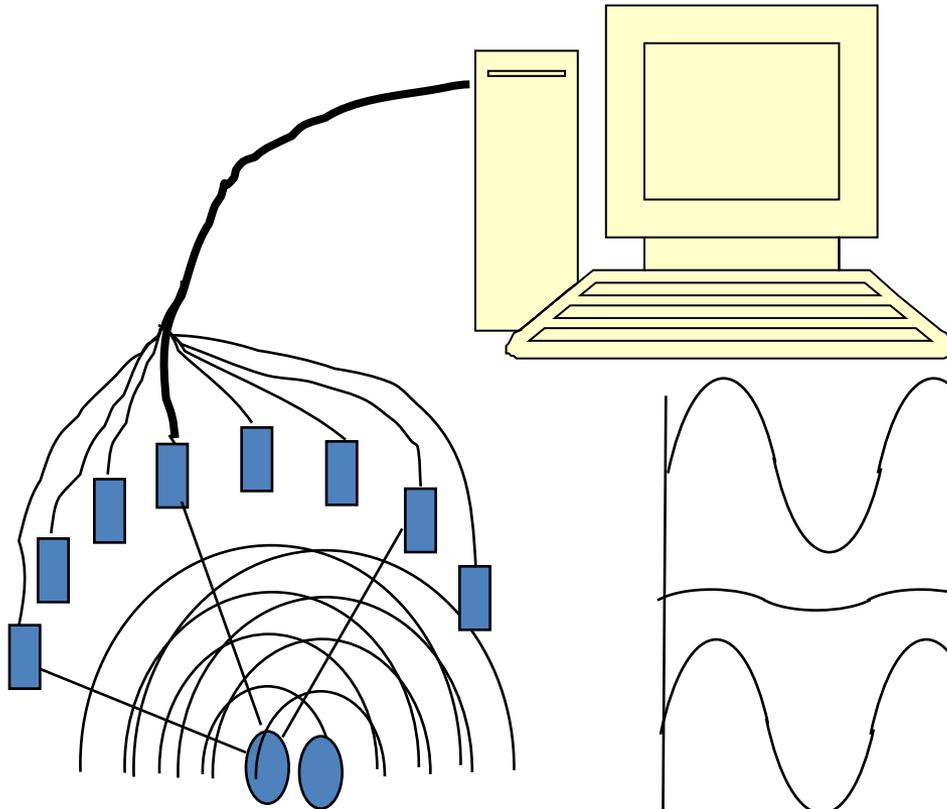
- In Beamforming, the sound is focused by control pulses that produce an arc-shaped sound wave from the face of the transducer

- Receivers placed in an arc – all the same distance from the point to be viewed

- Waves from that point arrive at the same time

- When summed – the signals rectify.

- All other emissive points appear as noise

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Medical Ultrasound Basics
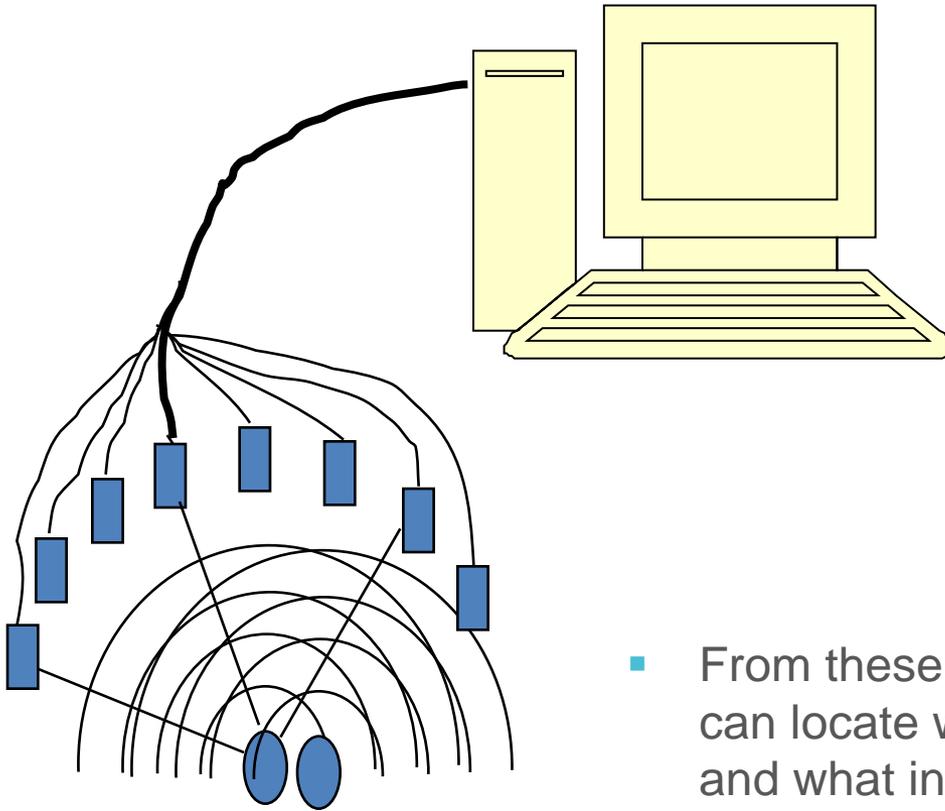
- Three things are determined from each echo
 - How long it took the echo to be received from when the sound was transmitted.
  - From this the focal length for the phased array is deduced, enabling a sharp image of that echo at that depth.
  - How strong the echo was.

- From these 3 things, the ultrasound machine can locate which pixel in the image to light up and what intensity and what hue (if frequency is also processed).

Typical Ultrasound Block Diagram

Embedded processing
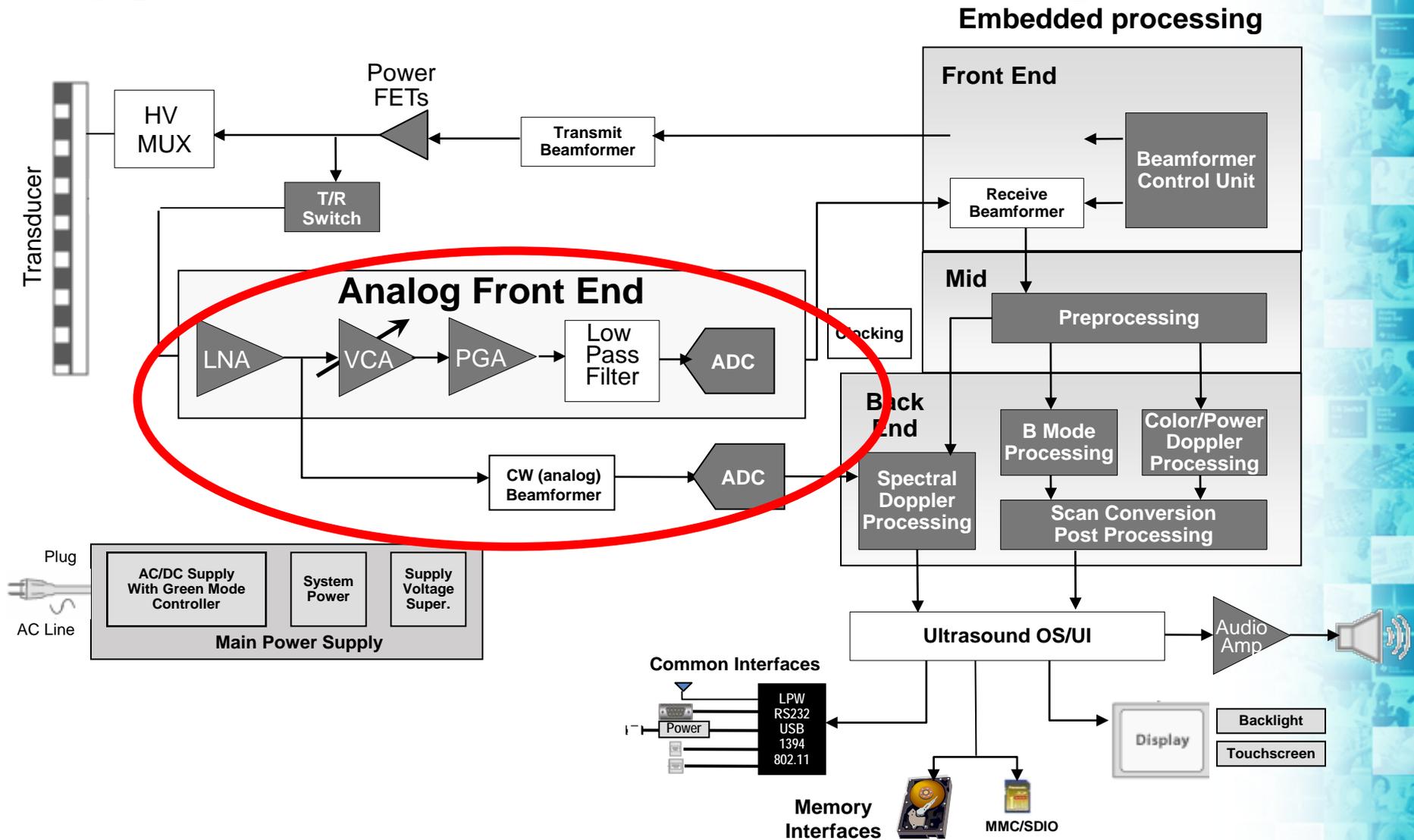
System level benefits for ultrasound
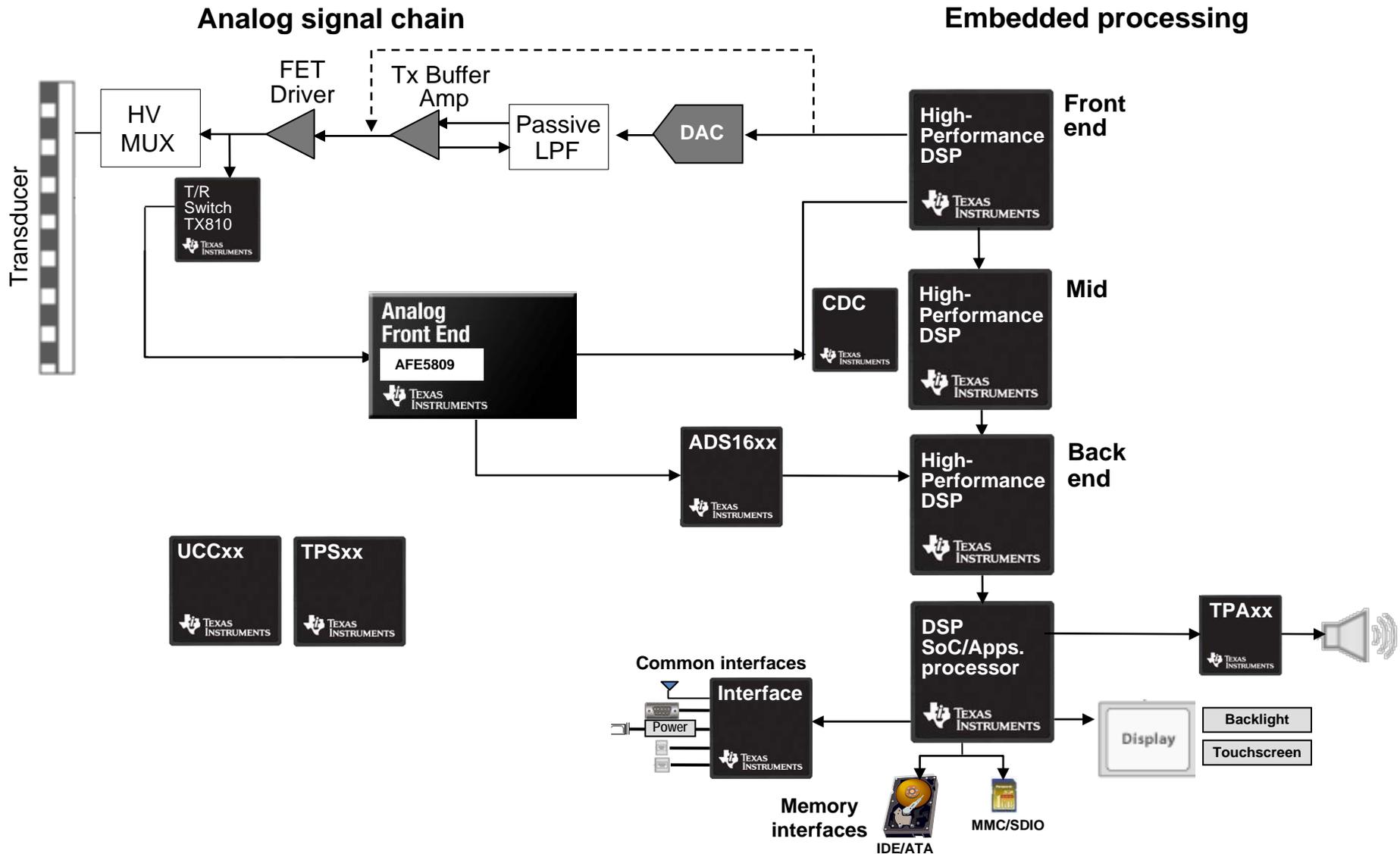
AFE5809:
AFE with Passive CW Mixer & Digital I/Q Demod

Features

- 8 CH AFE with LNA, VCAT, PGA, LPF, ADC, CW Mixer and integrated:
    - **Digital I/Q demodulator**
    - Continuous wave Doppler (CWD)
- 14 bit ADC w/ **77 dBFS SNR**.
- Selectable power/noise combo's to optimize system
    - 158mW/ch at **0.75nV/rtHz**, 65MSPS
    - 99mW/ch at 1.1nV/rtHz, 40MSPS
   - 80mW/ch at CW Mode
- Package: 15 mm x 9 mm, 135-BGA

Benefits

- Complete AFE for Ultrasound and Ultrasonic systems
- Lowers interface rate, cost of FPGA
- Measures blood flow velocity in Spectral Doppler systems
- Best in-class noise levels for crisp image qualities.
- Ability to fine-tune power consumption for portable systems

Applications

- Ultrasound Imaging
- Non-destructive Testing
- Sonar
- Military Radar

Samples: Now
EVM: Now
Production: Released!

Analog signal chain

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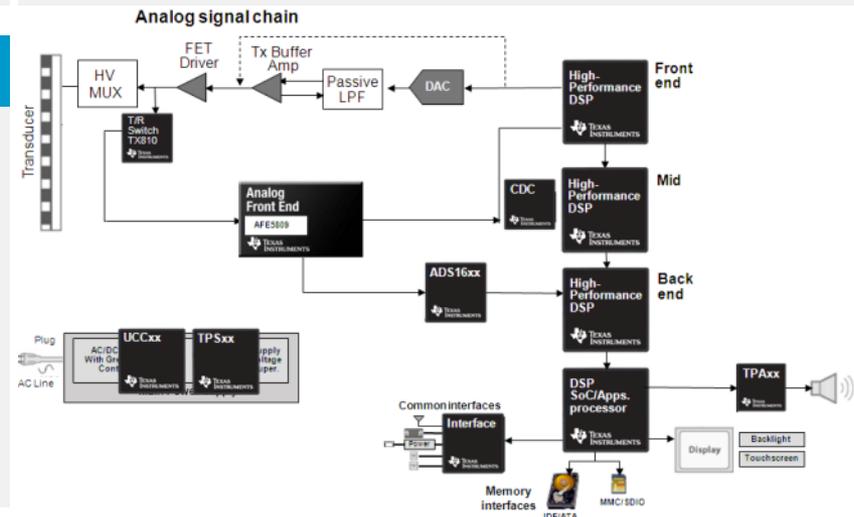
Why is the AFE5809 so great?

What it is: Complete 8 ch front end integrating all of the components of a typical Ultrasound Receiver.
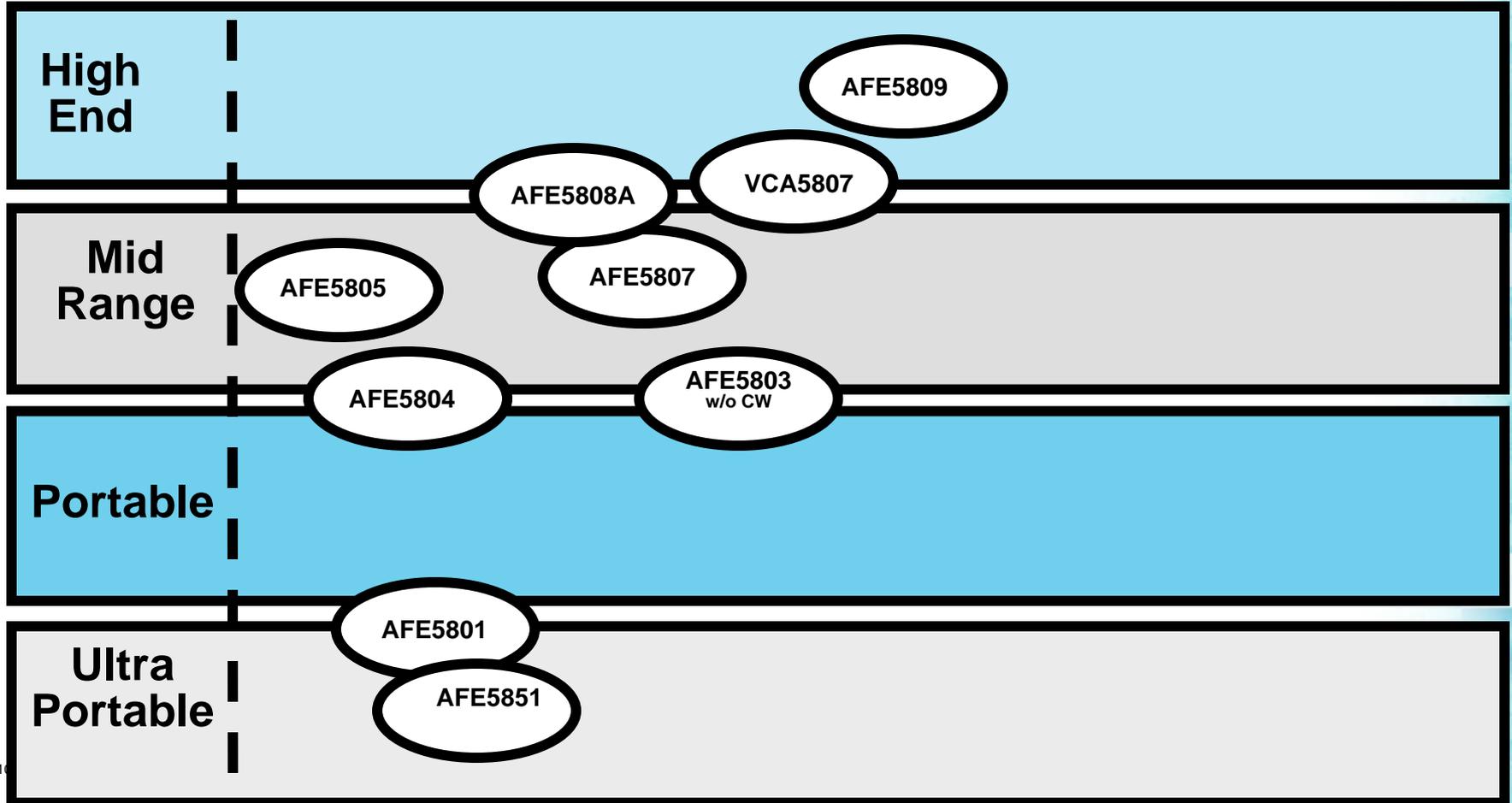
Features and Benefits:

- Complete front end solution = easier design and lowered BOM cost
- Digital I/Q demodulation = reduced FPGA processing requirements
- Lowest noise and lowest power = highest image quality at lowest power

AFE5809 with Demodulator
1 of 8 Channels
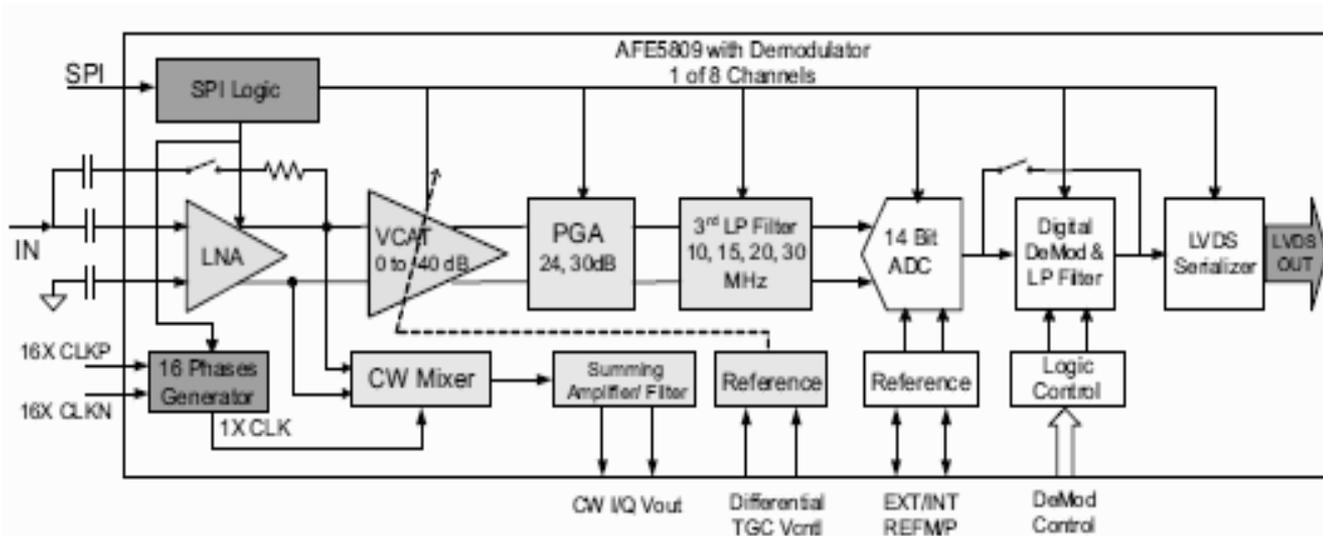
AFE58xx Family for Ultrasound Rx

Production   Sampling   Future

High End

AFE5809

AFE5808A   VCA5807

Mid Range

AFE5805   AFE5807

AFE5804   AFE5803 w/o CW

Portable

Ultra Portable

AFE5801

AFE5851

AFE58xx Family for Ultrasound Rx

	AFE5809	AFE5808A	AFE5807	AFE5805	AFE5804	AFE5801	AFE5851
Channels	8						16
Integration	LNA+VCA+LPF+ADC+ CW + digital demod	LNA+VCA+LPF+ADC+ CW		LNA+VCA+LPF+ADC		VCA+LPF+ADC	
Power	99mW/Ch @ 40 MSPS	101 mW/Ch @ 40 MSPS	88 mW/Ch @ 40 MSPS	122 mW/Ch @ 40 MSPS	101 mW/Ch @ 40 MSPS	58 mW/Ch @ 50 MSPS	39 mW/Ch @ 32.5 MSPS
Noise	0.75 nV/rtHz	0.75 nV/rtHz	1.1 nV/rtHz	0.85 nV/rtHz	1.23 nV/rtHz	5.0 nV/rtHz (without LNA)	5.0 nV/rtHz (without LNA)
ADC SNR	77dBFS	77dBFS	70dBFS	70dBFS	69dBFS	66dBFS	66dBFS
Price	$87 ea. @ 1ku	$58 ea. @ 1ku	$54 ea. @ 1ku	$44.70 ea. @ 1ku	$44.70 ea. @ 1ku	$40 ea. @ 1ku	$72 ea. @ 1ku
Package	135-pin, 15*9 mm	135-pin, 15*9 mm	135-pin, 15*9 mm	135-pin, 15*9 mm	135-pin, 15*9 mm	64-pin, 9*9mm	64-pin, 9*9mm

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Summary

- Complete 8 ch front end integrating all of the components of a typical Ultrasound Receiver.

- Features and Benefits include
  - Complete front end solution = easier design and lowered BOM cost
  - Digital I/Q demodulation = reduced FPGA processing requirements
  - Lowest noise and lowest power = highest image quality at lowest power

- To learn more or order samples or evaluation module please visit www.ti.com/product/AFE5809