



Technical Documentation

IIR 4.X - OVERVIEW

Document Number:	L1D_AS410
TI Department	European Wireless Terminal Chipset Business Unit
Version:	1.1
Status:	APPROVED
Date:	March 16, 2006

IMPORTANT NOTICE

Texas Instruments Incorporated and / or its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products, software and services at any time and to discontinue any product, software or service without notice. Customers should obtain the latest relevant information during product design and before placing orders and should verify that such information is current and complete.

All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment. TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI products, software and / or services. To minimize the risks associated with customer products and applications, customers should provide adequate design, testing and operating safeguards.

Any access to and / or use of TI software described in this document is subject to Customers entering into formal license agreements and payment of associated license fees. TI software may solely be used and / or copied subject to and strictly in accordance with all the terms of such license agreements.

Customer acknowledges and agrees that TI products and / or software may be based on or implements industry recognized standards and that certain third party may claim intellectual property rights therein. The supply of products and / or the licensing of software do not convey a license from TI to any third party intellectual property rights and TI expressly disclaims liability for infringement of third party intellectual property rights.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products, software or services are used.

Information published by TI regarding third-party products, software or services does not constitute a license from TI to use such products, software or services or a warranty, endorsement thereof or statement regarding their availability. Use of such information, products, software or services may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

No part of this document may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying and recording, for any purpose without the express written permission of TI.

History

Date of change	Changed by	Approved by	Date of approval	Version	Notes
June 06, 2005	Thierry Le Gall			0.1	(1)
June 06, 2005	Thierry Le Gall	Sébastien Guiriec		1.0	(2)
Oct. 18, 2005	Thierry Le Gall			1.1	(3)

Notes

- (1) Creation.
- (2) Approval.
- (3) Updated (Figure 2.1) and (Figure 2.2).

Glossary

IIR	Infinite Impulse Response
ABB	Analogical Base Band
ASYMFIR	Asymmetric phase Finite Impulse Response Filter
DBB	Digital Base band
FIR	Finite Impulse Response
FTA	Full-Type Agreement
RFR	Receiving Frequency Response
SFR	Sending Frequency Response
SOS	Second Order Section
SYMFIR	Symmetric phase Finite Impulse Response Filter
UE	User Equipment

References

- [1] L1D_AS411-1 – IIR 4.x – API Definition
- [2] 3GPP TS 26.131 – 3rd Generation Partnership Project – Technical Specification Group Services and System Aspects – Terminal Acoustic Characteristics for Telephony – Requirements, v5.2.0, September 2002.

Table of Contents

1	Introduction.....	5
2	IIR Overview	5
3	IIR Use Cases	6
4	IIR Features	7

List of Figures and Tables

Figure 2.1	The IIR 4.x – System Level Overview	5
Figure 2.2	The IIR 4.x – Module Overview.....	5
Figure 3.1	The UE Typical & Equalized RFR vs. 3GPP Mask (Handset)	6
Figure 3.2	The UE Typical & Equalized SFR vs. 3GPP Mask (Handset)	6
Table 4.1	The IIR 4.x – Main Features.....	7

1 Introduction

This document provides an overview of the Equalization Filter generically called Infinite Impulse Response (IIR) module. This document applies to IIR 4.0 and next upgrades IIR 4.x [1].

2 IIR Overview

The primary goal of the IIR 4.x is to equalize the Receiving Frequency Response (RFR) and the Sending Frequency Response (SFR) of the User Equipment (UE) to fit in 3GPP Full-Type Agreement (FTA) tests cases [2] . The equalization filters are commonly implemented in the Digital Base Band (DBB) close to the Analogical Base Band (ABB) (Figure 2.1).

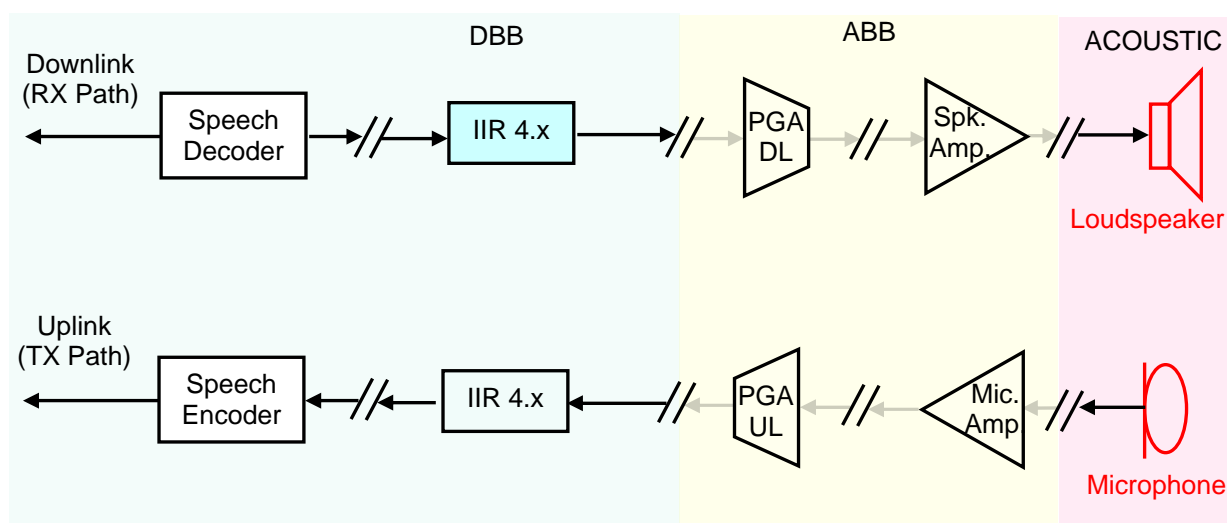


Figure 2.1 The IIR 4.x – System Level Overview

The IIR 4.x equalization filter is based on Finite Impulse Response (FIR) and IIR filters implemented through a stream of Second Order Sections (SOS) also called biquads. The IIR 4.x enables symmetric (SYM) or asymmetric (ASYM) phase FIR with 40-taps maximal length and a maximum of 6 bi-quads IIR. The IIR 4.x allows maximal flexibility so that FIR and SOS can be involved independently or jointly. FIR could be processed before SOS or inverse (Figure 2.2).

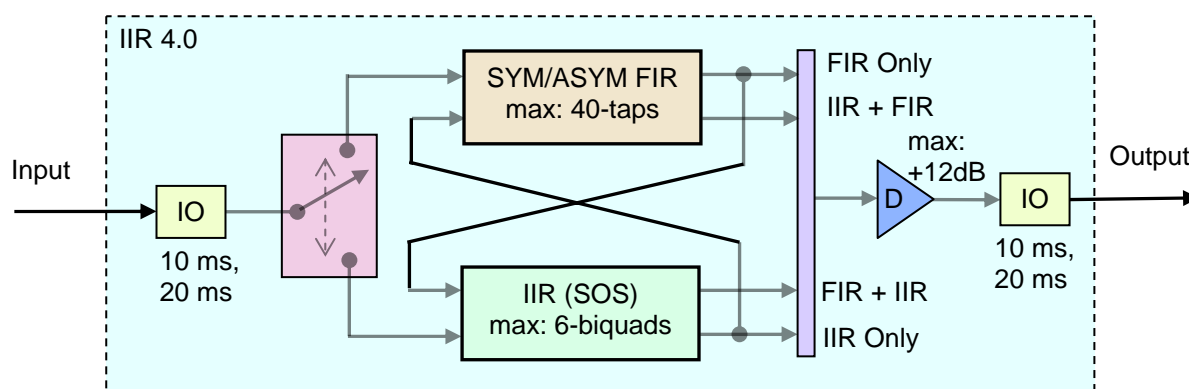


Figure 2.2 The IIR 4.x – Module Overview

3 IIR Use Cases

The equalization filter IIR 4.x can be use in the receiving direction (RX path) to equalize the loudspeaker frequency response and in the sending direction (TX path) to equalize the microphone frequency response. IIR 4.x supports Handset-Headset, Handheld-Handsfree, Desktop & Vehicle-Handsfree uses cases as defined in [1](Chapter 5). Below are presented some results in handset mode (Figure 3.1), (Figure 3.2).

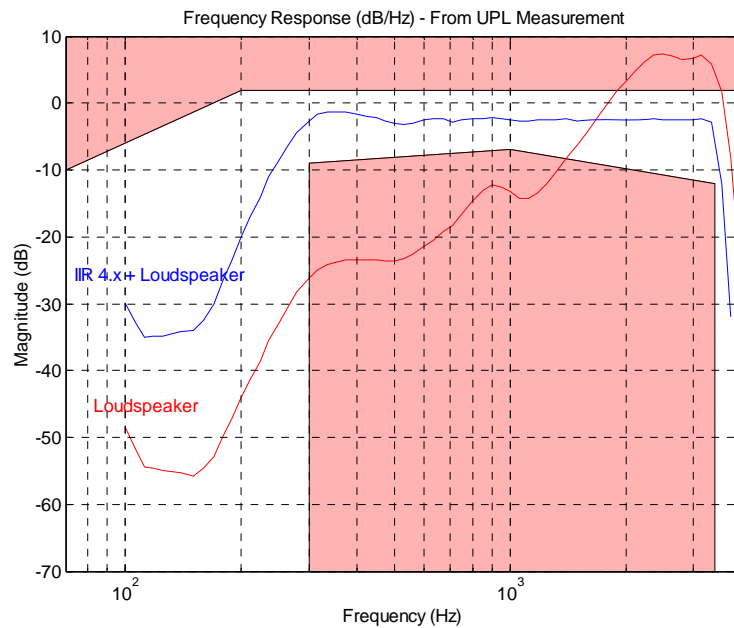


Figure 3.1 The UE Typical & Equalized RFR vs. 3GPP Mask (Handset)

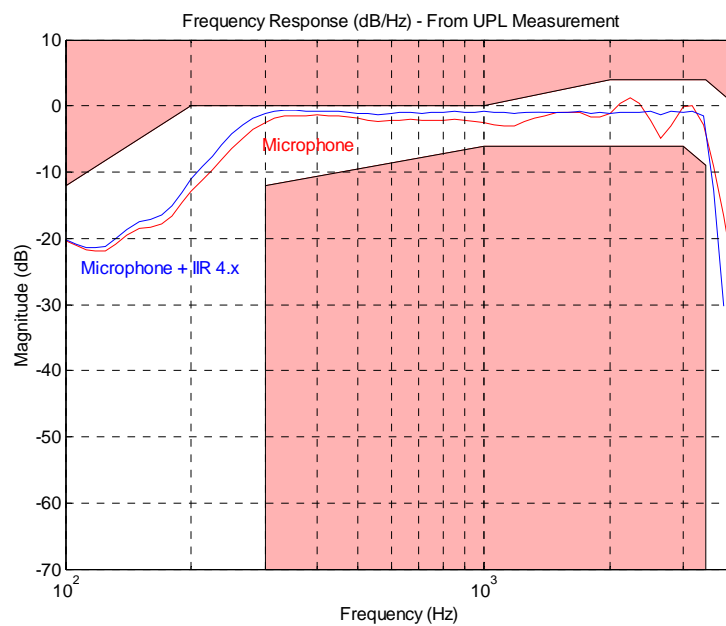


Figure 3.2 The UE Typical & Equalized SFR vs. 3GPP Mask (Handset)

4 IIR Features

The IIR 4.x features are summarized below (Table 4.1).

Features	Values	Comments
Sampling frequency	8000 Hz, 16000 Hz	Compatible WB
IO Digital amplitude	16-bits [-32768; 32767]	16X32-bits Extended Internal Precision
IO Frame duration	10 ms, 20 ms	80, 160, 320 samples
Processing sub-frame duration	10ms	80, 160 samples
Processing delay (max)	2.5ms	SYMFIR 40-taps

Table 4.1 The IIR 4.x – Main Features