IPD series, theory of operation

Purpose

This document shall highlight areas of the design in IPD1200 and IPD2400 to allow for better service.

Abstract

The document contains information on a number of the printed circuit boards in the Lab.gruppen IPD-series. It does not contain any information regarding the SP10A10D and A11D boards since they are considered to be "old designs".

History

Owner: FRKIH

Rev.	Created By	Approved By	Date	Comment
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Rev.	Revision number (0,1…X)
Create by	Author's name or initials
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ADIC – Analog Digital Input Control

The ADIC board holds:

- 2 balanced, analog inputs with associated link connectors
- 1 stereo digital input (AES) with associated link connector
- 1 Ethernet port for control and monitoring (10Mbit)
- 1 DSP board (DSPB), containing all firmware for the amplifier
- Fan control
- Connections to:
    - 2 output amplifier modules (AMP I/F)
    - Power supply unit (PSU I/F)
    - User interface

1. Analog inputs – A/D converter

The operational amplifier U12 acts as high impedance input buffers. These buffers are used to improve real world common mode rejection performance.

U2 is the actual balanced receiver. As seen in the schematic, U12 and U2 use VCOM1 resp. VCOM2 as reference as opposed to ground. This arrangement is adopted to shift the incoming audio signal to suit the single ended inputs of the A/D converter, U2k.

VCOM1 and VCOM2 are created by resistive voltage dividers (R110k/R111k and R100k/R101k) and decoupled by large electrolytic capacitors.

Without input signal, the input pins of the A/D converter shall have a ground reference voltage of around 2,5VDC (5V_A / 2).

The A/D converter is a four channel device. To improve noise performance, we have chosen to use two inputs in parallel per channel in this design.

The digital side of the A/D converter is connected to the on board DSP module (DSPB).

The components G1 – G6 are patterns in the PCB foil that acts like ESD suppressors (spark gaps).

U3p is a voltage regulator that creates the voltage supply for the A/D converter.

2. D/A converter – Analog outputs

The D/A converter used in this design is in fact a codec with 2 inputs and 6 outputs where the inputs are unused and the first two output channels are used to drive the amplifier modules in the IPD series.

The components around U3A and U3B form a low pass filter that supresses HF noise coming from the D/A converter. These operational amplifiers also add gain to the audio signal to match the input level of the amplifier modules.

U3C and U3D are configured as inverting amplifiers to supply the negative version of the output signal (as the cold output in an electronically balanced output stage).

U7 is a low noise linear voltage regulator that supplies the D/A chip.

3. AES/EBU

The AES input signal is fed to an RS485 transceiver. R20/R21 and R302/R303 are termination resistors.

C21 decouples any DC voltage present on the AES input before it is sent to U28. U28 supplies the DSP-module with the AES stream. The digital audio stream is also directly resent to the AES output connector (CN3), via the transceiver.

C301 and C300 forms an output low pass filter together with R300 – R303. This filter improves EMI performance and it also reduces potential ringing in long AES cables of poor quality.

G7-G8, G11 and G12 are ESD suppressor spark gaps in the PCB layout.

4. General

U401 and U402 are configured as analog muxes that collects analog data from various temperature sensors (PSU and amplifiers). The muxed data is sent to an A/D converter (U400) which is connected to the DSP module via an I2C interface.

U403 is a serial to parallel converter which is used to select the active analog mux channel.

P1M and P2M are pin header connectors that connect the DSP module to the ADIC board.

J1E is an Ethernet connector with integrated magnetics and LED´s. Apart from LED drive resistors and termination resistors/capacitors, the rest of the Ethernet interface is located on the DSP module.

U1 is the main 3,3VDC down converter for the digital electronics on the board.

U1fA, Q1f and the components surrounding those components form the fan drive circuit. The fan speed is controlled by means of a PWM signal directly from the DSP module.

U1dA and associated components is a monitoring circuit that holds the output amplifiers muted if voltage supplies are outside of nominal working voltage. This prevents clicks and pops on the speaker outputs during start up and shut down of the amplifier.

DSPB – Digital Signal Processor, type B

This is the processing unit of the IPD series amplifiers. It contains the actual DSP´s, memory and physical layer of the Ethernet interface.

This board will not be serviced.

MIAO2 – Mains Input Output 2 channels

This board holds the mains input connector as well as the speaker output connectors.

P409 is the mains input IEC-connector. Capacitors C426, C427 and C428 is a part of the mains input EMI filter.
P407, P408, P410 and P411 connect mains voltage to the mains inputs of the SP10A10D´s used in the system (2 pcs in IPD2400 and 1pcs in IPD1200).

The triac, Q13, is the main part of a speaker output DC protection circuit. R71, R73-R76 and C31-34 forms a low pass filter that will send any DC to the discretely designed diac (formed around Q14 and Q15). When this DC voltage reaches above approx. 10-15Vdc, it will trig the gate of the triac which will short the amplifier output terminals. This will protect the connected speaker.
The DC crowbar circuit is duplicated for the other channel.

P2, P102 and P401 are the actual speaker output connectors.

SCBA – Secondary Capacitor Bank type A (IPD2400 only)

This board is mainly an interface board that connects the outputs of the two separate power supply units in an IPD2400. It also carries signals between the input board (ADIC) and the two SP10A10D´s.

C1-C8 are used as a combined energy storage for both power supplies.

U2 and associated components combines the NTC temperature resistors located in the two power supplies on the SP10A10D boards. Whit this setup the hotter of the two NTC´s will be used to signal current PSU temperature to the ADIC board.

U1 and Q1 and the components around form the second fan drive circuit in the IPD2400. This, secondary fan drive circuit senses the voltage to the first fan and reproduces that to drive the second fan. The power for the second fan is taken separately from the SP10A10D that is not supplying power to the ADIC board.

UID2 – User Interface Display 2 channels

The UID2 board contains all front panel functions. This board will not be serviced.