

3GBit/s Digital Automotive Pixel Link Transmitter

INAP375T INAP375R

The INAP375T/R is the next generation high speed digital serial link for DISPLAY and CAMERA applications. It enables a DC-balanced, AC coupled low latency, point-to-point link over shielded twisted pair (STP) copper cables. Its scalable physical layer provides bandwidth of up to 3 GBit/s at lowest EMI.

The INAP375T/R devices are based on the Advanced APIX2 technology, a packet oriented link technology allowing transmission of Video, Audio and Data simultaneously. In addition 100Mbit Ethernet network architectures can be implemented.

INAP375T/R supports popular Automotive displays with video resolutions up to 1600x600 pixels, 24 bit colour depth and refresh rates of up to 100Hz. Video Interface handle 1 or 2 independent Video streams, with configurable input interfaces such as parallel RGB (1x24Bit or 2x10Bit) or 2xLVDS (4 lanes + clock, OpenLDI). Software adjustable driver characteristics, selectable interfaces and configurable operating modes allow maximum transmission distances of up to 12m at lowest power consumption.

In addition to the Video transmission the INAP375T/R provides completely independent Full Duplex Communication channels to implement SPI or I²C Interfaces over the link. Using the internal AShell protocol, data transfers are protected by error detection and retransmission mechanisms. Additionally, the link is optimized to carry low latency GPIO signals for reset or synchronization purposes. The inbuilt audio path allows synchronous transmission of up to 4 stereo audio channels, with highly precise clock regeneration at the receiver for high-end rear-seat entertainment applications.

Applications:

- Central Information Displays
- Round View Camera Systems
- Head up Displays
- Cluster Displays
- Rear-Seat Entertainment Systems
- Stereo Camera Systems
- Rear View Camera Systems
- Sensor Fusion Systems
- Automotive Driver Assistance

Features:

- Full backwards compatibility to INAP125T/R
- 500 MBit/s, 1000 MBit/s and 3000 MBit/s sustained downstream link bandwidth for video datarates up to 2500 MBit/s
- 187.5 MBit/s and 62.5 MBit/s upstream link bandwidth
- Supports 2 independent video streams
- Configurable video interface
 - Parallel RGB (10,12,18,24 Bit)
 - openLDI compliant LVDS interface
 - Single Channel (18, 24 Bit)
 - Dual Channel (18, 24 Bit)
 - Bulk Data Mode (10, 16 Bit + 2 frame)
- Video resolutions up to
 - 1280x1024x24 Bit
 - 1600x600x24 Bit
 - 1920x1080x18 Bit
- Configurable full duplex communication channel for up to 2 receivers
- SPI data interfaces
- I²C Master interface
- Media Independent Interface (MII) for Ethernet support
- GPIOs for direct signalling and camera synchronization support
- Embedded AShell
- I²S Audio interface
 - supports 16/24/32 Bit word length
 - 44.1/48/96 or 192 kHz sampling
 - TDM support for up to 8 channels
- Diagnostic Features:
 - Self test
 - Embedded diagnostics
- Up to 12m distance at 3 GBit/s

Package:

- 100 pin LQFP

Temperature/Quality:

- -40°C to +105°C
- AEC-Q100

1.0 Introduction

The APIX2 link transmits uncompressed pixel data with a resolution-independent link data rate of up to 3Gbit/s over one single pair of STP copper cable. The INAP375T offers 2 independent video channel inputs, either supplied through parallel RGB interfaces or OpenLDI compliant LVDS links. In addition to the pixel data, audio data as well as bidirectional communication or control data can be transmitted. The communication data are protected using the built-in AShell protocol, offering highly robust data transmission over the high speed link by error detection and retransmission mechanisms.

The link supports distances of up to 12 meters (3 GBit/s mode) and up to 30 meters (500 MBit/s mode) depending on the physical layer settings and the cable characteristics.

Optimized for low EMI, the APIX2 link is dedicated for point-to-point applications within vehicles. The on-chip I²S interface allows transparent real-time transmission of multiple digital audio streams for rear-seat entertainment applications. Especially for camera applications, the INAP375T offers an I²C master implementation, for direct communication to 1 or 2 camera sensors.

The INAP375T/R devices offer full backwards compatibility to the INAP125T/R devices, by supporting the APIX physical layer as well as offering the downstream and upstream sideband functionality. In addition, existing APIX implementations from other suppliers including AShell can also be connected to the devices.

System Overview

The APIX2 link is built up by the INAP375T transmitter and the INAP375R receiver. The serial link typically requires two shielded twisted pairs of wire, carrying the 3Gbit/s downstream on the one, and 187.5 MBit/s upstream transmissions on the other pair.

The link offers transparent transmission of 2 independent video channels, an audio channel and 2 independent, AShell protected communication channels over 2 pairs of wire. In addition, each device, INAP375T or INAP375R can be configured and monitored by the remote side through an inbuilt configuration channel.

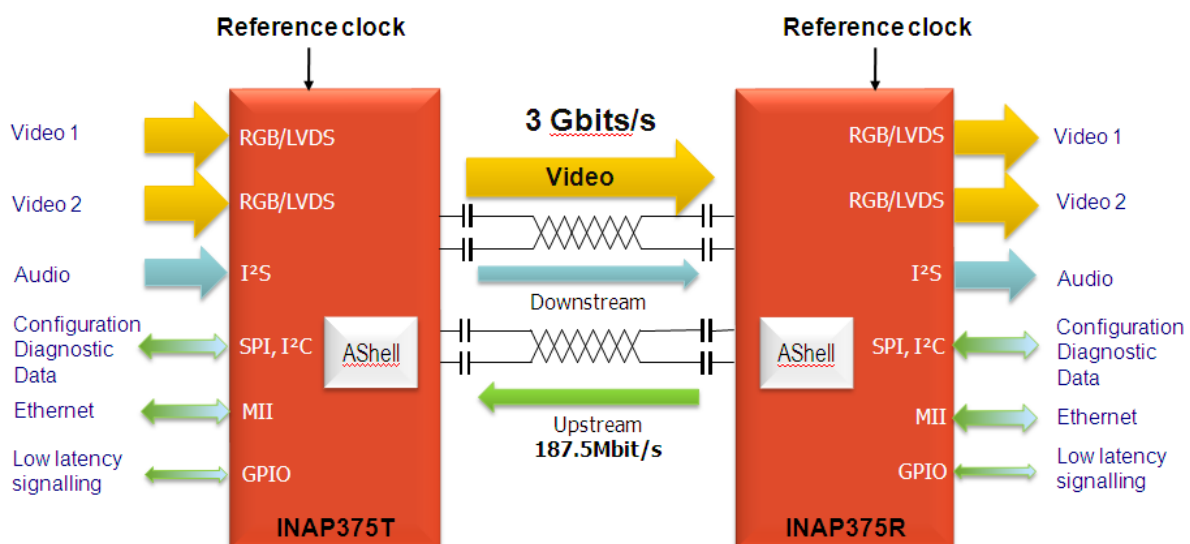


Figure 1: APIX2 system overview

2.0 Functional Description

Video interface

The APIX2 downstream link offers up to 2.6 GBit/s net datarate to transport video, data and configuration information. The video channel is able to transport up to 2 independent video streams, with individual pixel clock and synchronization information. The INAP375T and INAP375R offer a flexible video interface, configurable to either RGB or OpenLDI LVDS inputs and outputs.

The maximum video bandwidth of the APIX2 link is 2.6 Gbit/s, which allows to transmit video resolutions up to 1600x600@100Hz . The video interface allows pixel clock rates of up to 120 MHz for RGB and 80 Mhz for LVDS video information.

Table 1 provides a few examples of supported video resolutions and possible combinations of video streams. The resolutions assume a display refresh rate of 60 Hz, requiring a horizontal blanking of 10% with all pixel control information. The table assumes that all bandwidth is used for video.

Video Stream 1	Video Stream 2
1280x1024, 24 Bit	320x240, 24 Bit
1600x600, 24 Bit	800x600, 24 Bit
1600x600, 24 Bit	1280x480, 18 Bit
1280x720, 24 Bit	800x600, 24 Bit
1280x720, 24 Bit	1280x480, 18 Bit
1280x1024, 18 Bit	1024x768, 18 Bit
1600x600, 18 Bit	1600x600, 18 Bit

Table 1: Video resolution and combination examples

Data Communication

The INAP375T/R offers full-duplex, video independent data communication of up to 160MBit/s over the high speed serial link. All data transfers are protected by the integrated AShell protocol, using CRC error detection and optional retransmission mechanisms.

The INAP375T/R supports various interfaces to handle the data traffic.

- SPI Master interface
- SPI Slave interface
- I²C Master Interface

The interfaces can be configured to different combinations, depending on the application requirements for data throughput and interfaces.

Networking Support

The INAP375T/R features a fully compliant Media Independent interface (MII) for high speed, full-duplex data communication through the APIX2 link. This enables to interface directly to 100MBit/s Ethernet Media Access Controllers.

AShell - APIX Automotive Shell

The APIX Automotive Shell called “AShell” is an abstraction layer for the data communication. Already offered for INAP125T/R and implemented in APIX1 based solutions, the AShell allows a secure and error free data exchange on the bi-directional full duplex communication channels of the APIX link.

Apart from the error control functions, the AShell is more or less a wrapper layer, providing the following services to the data communication

- transmission and reception of application data ensuring data integrity
- supply of information about transmission link status as well as simple errors
- link and error statistics

Audio Channel

The INAP375T offers the transmission of real-time digital audio data over the 3 GBit/s downstream link. The high speed link acts as gateway for all bit clock, frame clock (left/right clock), master clock and data information, with support of up to eight 32 Bit audio channels (4 times stereo). All clocks are regenerated at the INAP375R based on a highly precise local PLL, to ensure best audio quality.

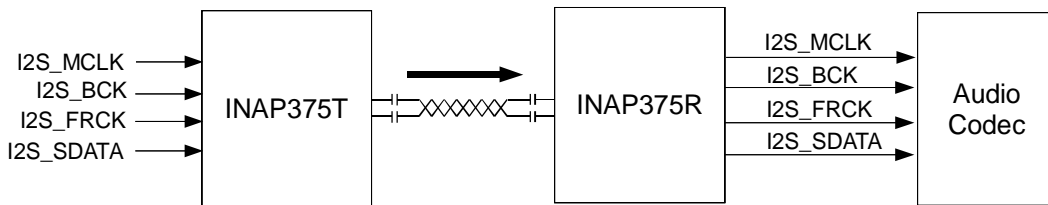


Figure 1: Audio interface

GPIO Transmission

In addition to the protected data communication over the SPI interfaces, the INAP375T/R allows to sample or provide GPIO states at two general purpose inputs/outputs GPIO0 and GPIO1. These IOs can be configured as input or output. Configured as input, the pins are asynchronously sampled and directly transferred to the receiver with lowest delay, e.g. as required for synchronization pulses for camera sensors.

Configured as output, the signals reflect the GPIO state sampled at the remote device.

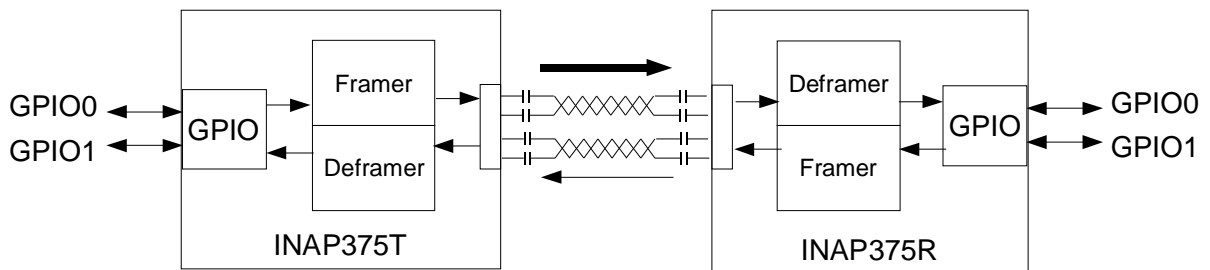


Figure 2: Direct GPIO transmission

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