Product Overview

High Speed Amplifiers for In-Vitro Diagnostics (IVD) Analog Front End

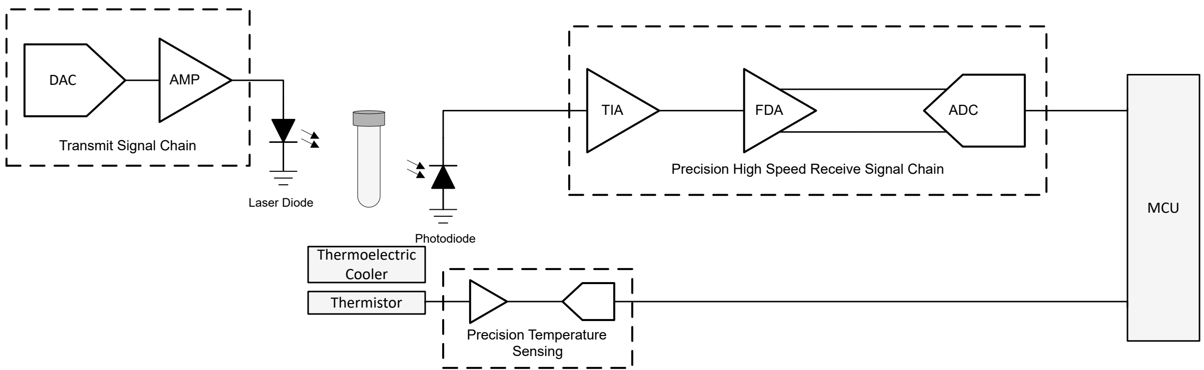

Figure 1. In-Vitro Diagnostics Transmit and Receive Block Diagram

Design Considerations

Modern in-vitro diagnostics (IVD) systems are testing systems designed to analyze biological samples from a patient to determine a wide range of conditions, diseases, and ailments. IVD systems are commonly found in both research and clinical applications. The above block diagram and following considerations outline important components and specifications to maximize IVD design performance.

What are the Key Specifications for Amplifiers in IVD?

- Laser driver (AMP)
  - High output current: Drive and maintain high laser drive bias threshold from mA to A range of output current with a single device. This allows for one design to be used in a wide range of IVD applications, and maintains laser output drive.
  - Simplified and steady control: Single pin current control enables the output current to be adjusted using a digital-to-analog converter (DAC) or auto power control loop, allowing for a steady and consistent laser output.
  - Size: An integrated small form factor reduces the design size by reducing the number of discrete external components, allowing for a smaller PCB and system size.
- Transimpedance amplifier (TIA)
  - Low input bias current: Allows for very small current measurements, which expands the minimum detectable signal and captures the subtle variations being measured during an IVD test.
  - Large gain-bandwidth product: Maintain circuit stability across large total capacitance values while supporting a wide system bandwidth.
  - Low noise: Detect low-magnitude signals and maintain the accuracy of the measurements.
- Fully differential amplifier (FDA)
  - Wide bandwidth: Match ADC sampling rate for accurate signal reproduction and capture of real-time fluctuations from the sample.
  - Rail to rail output: Wide output voltage swing to provide necessary dynamic range and cover the full-scale range of the ADC without clipping or distortion.
  - Low noise: IVD systems require minimal noise effect to maintain accuracy of the measurements.

For more information about ADC selection within an IVD system, see Precision ADCs for In-Vitro Diagnostics.

Recommended Devices

Table 1. Laser Driver Amplifier (AMP)

Parameter	LMH13000
Power Supply (V)	3 - 5.5
Rise Time (typ) (ns)	1
Continuous Output Current (max) (A)	1
Pulsed Output current (max) (A)	5
Pulsed Train Speed (typ) (MHz)	250
Control Interface	LVDS, TTL, CMOS Logic
Features	Thermal Shutdown, Power-Down, Low and High Output Current Modes

Table 2. Transimpedance Amplifiers (TIA)

Parameter	OPA607	OPA810	OPA814	OPA818
Supply Voltage Range	2.2 - 5.5	4.75 - 27	6 - 12.6	6 - 13
Gain Bandwidth Product (MHz)	50	70	250	2700
Quiescent Current, I_Q (typ) (mA)	0.9	3.7	16	27.7
Slew Rate (typ) (V/µs)	24	200	750	1400
Rail-to-Rail	In to V-, Out	In, Out	No	No
Input Bias Current, I_{BIAS} (max) (pA)	10	20	20	25
Input Offset Voltage, V_{OS} (max) (mV)	0.6	0.5	0.25	1.25
Offset Voltage Drift (typ) (µV/°C)	0.3	2.5	1	3
Voltage Noise at Flatband (typ) (nV/√Hz)	3.8	6.3	5.3	2.2
Operating Temperature Range (°C)	-40 to 125	-40 to 125	-40 to 85	-40 to 125
Channel Count Variants	Dual - OPA2607	Dual - OPA2810	---	

Table 3. Fully Differential Amplifiers (FDA)

Parameter	THS4561	THS4551	THS4541
Supply Voltage Range	2.85 - 12.6	2.7 - 5.4	2.7 - 5.4
Gain Bandwidth Product (MHz)	60	135	850
Quiescent Current, I_Q (typ) (mA)	0.78	1.35	10.1
Slew Rate (typ) (V/µs)	230	220	1500
Rail-to-Rail	In to V-, Out	In to V-, Out	In to V-, Out
Input Offset Voltage, V_{OS} (max) (mV)	0.25	0.175	0.45
Offset Voltage Drift (typ) (µV/°C)	0.5	0.45	0.5
Voltage Noise at Flatband (typ) (nV/√Hz)	4	3.3	2.2
Operating Temperature Range (°C)	-40 to 125	-40 to 125	-40 to 125

Table 4. Precision Analog to Digital Converters (ADC)

Parameter	ADS127L11	ADS9219	ADS7066
Resolution (Bits)	24	18	16
Sampling Rate (max) (kSPS)	400	2000	250
Channel Count	1	2	8
Interface Type	SPI	Serial LVDS	SPI
SNR (dB)	110	94	86
Power Consumption (typ) (mW)	18.6	360	4
Architecture	Delta-Sigma	SAR	SAR

Learn More

- *High Speed ADCs and Amplifiers for Flow Cytometry applications*
- *Precision ADCs for In-Vitro Diagnostics*
- *Maximizing the dynamic range of analog front ends having a transimpedance amplifier*
- *Photodiode amplifier circuitry from the analog engineer's circuit*
- *Driving High-Speed Analog-to-Digital Converters: Circuit Topologies and System-Level Parameters*
- *Simplify antialiasing filters with ADS9218*
- *Pairing high speed JFET amplifiers with Hi-Z DAQ systems*
- *ADC Drivers wtih Fully Differential Input ADCs*
- *TI E2E™ Amplifiers Support Forum*