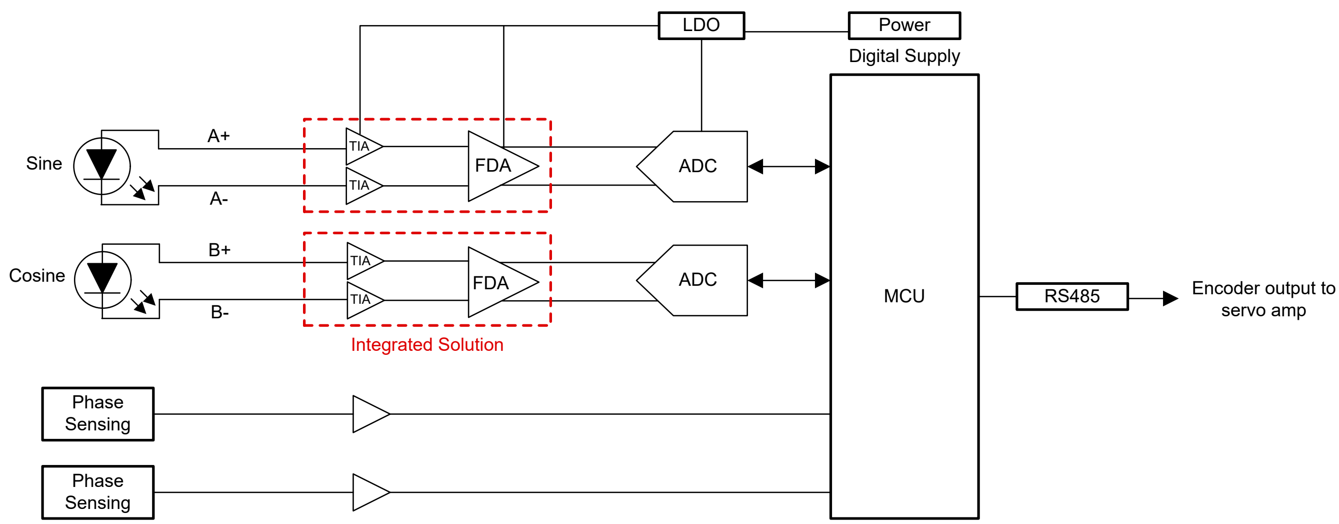
Product Overview

High Speed Amplifiers for Motor Encoders and Position Sensing



Example: Optical Motor Encoder Block Diagram with Discrete and Integrated Solutions

What are the Key Specifications for Transimpedance Amplifiers (TIA) in Motor Encoders?

- Gain-Bandwidth Product: The signal-chain bandwidth required by the encoder is determined by the resolution (periods per revolution) and speed (revolutions per minute). The wider the signal-chain bandwidth, the larger the gain-bandwidth product needed to maintain linearity across a wide range of gain values.
- Offset Voltage and Input Bias Current: A higher precision amplifier improves total dynamic range received from the output of the photodiode. The smaller the output current value that is detectable from the photodiode, the more precise the motor encoder positioning.
- Voltage Noise and Total Harmonic Distortion: Lower noise and distortion performance amplifiers enable maximum performance of the selected ADC. For more information on ADC selection, see *Precision ADCs for Motor Encoders and Position Sensing*.
- Size: Encoders are typically located on a PCB mounted on the motor; therefore, a small form factor amplifier is required.

What are the Key Specifications for Fully Differential Amplifiers (TIA) in Motor Encoders?

- Fully Differential Architecture: A fully-differential amplifier allows the input signal to be converted into a differential signal if using a single ended transimpedance amplifier in an optical path, or remain a fully-differential signal while setting the output common mode voltage if a TIA is not required.
- High Gain-Bandwidth Product: Add additional gain and active filtering onto the amplifier while maintaining signal-chain bandwidth linearity.
- Low Offset Voltage and Drift: Improve precision performance for minimal DC shift impact on the system.
- Rail to Rail Output: Maximize the full scale range available on the output to maintain signal integrity.

Need additional assistance? Ask our engineers a question on the TI E2E™ Amplifiers Support Forum.

Recommended Discrete Components

Table 1. Transimpedance Amplifier (TIA)

Parameter	OPA607	OPA836	OPA814
Supply Voltage Range (V)	2.2 - 5.5	2.5 - 5.5	6 - 12.6
Gain Bandwidth Product (MHz)	50	118	250
Quiescent Current, I_Q (typ) (mA)	0.9	1	16
Slew Rate (typ) (V/µs)	24	560	750
Rail-to-Rail	In to V-, Out	In to V-, Out	No
Input Offset Voltage, V_{OS} (max) (mV)	0.6	0.4	0.25
Offset Voltage Drift (typ) (µV/ºC)	0.3	1.1	1
Voltage Noise at Flatband (typ) (nV/√Hz)	3.8	4.6	5.3
Operating Temperature Range (ºC)	-40 to 125	-40 to 125	-40 to 85
Channel Count Variants	OPA2607	OPA2836	---

Table 2. Fully Differential Amplifier (FDA)

Parameter	THS4531A	THS4561	THS4551
Supply Voltage Range (V)	2.5 - 5.5	2.85 - 12.6	2.7 - 5.4
Gain Bandwidth Product (MHz)	27	60	135
Quiescent Current, I_Q (typ) (mA)	0.25	0.78	1.35
Slew Rate (typ) (V/µs)	220	230	220
Rail-to-Rail	In to V-, Out	In to V-, Out	In to V-, Out
Input Offset Voltage, V_{OS} (max) (mV)	00.4	0.25	0.175
Offset Voltage Drift (typ) (µV/ºC)	3	0.5	0.45
Voltage Noise at Flatband (typ) (nV/√Hz)	10	4	3.3
Operating Temperature Range (ºC)	-40 to 125	-40 to 125	-40 to 125

Recommended Integrated Components

Table 3. Integrated Differential TIA + ADC Driver

Parameter	THS4567
Supply Voltage Range (V)	3.3 -6
Gain Bandwidth Product (MHz)	220
Quiescent Current, I_Q (typ) (mA)	2
Slew Rate (typ) (V/µs)	500
Rail-to-Rail	Out
Input Bias Current, I_{BIAS} (max) (pV)	750
Input Offset Voltage, V_{OS} (max) (mV)	10
Offset Voltage Drift (typ) (µV/ºC)	1
Voltage Noise at Flatband (typ) (nV/√Hz)	4.2
Operating Temperature Range (ºC)	-40 to 125
Features	Independent input and output common mode control, shutdown

Learn More

- *Interface to Sin/Cos Encoders with High-Resolution Position Interpolation Reference Design*
- *Interface to a Sin/Cos Encoder with Sitara AM437x Reference Design*
- *Interface to a HIPERFACE Position Encoder Reference Design*
- *Dual-channel data acquisition reference design for optical encoders, 12 bits, 1MSPS*
- *Current sensing with <1µs settling for 1-, 2-, & 3-Shunt FOC in 3-Phase Inverter Reference Design*
- *Improving response time and accuracy in autonomous robots with wideband SAR-ADCs*
- *Maximizing signal chain distortion performance using high speed amplifiers*
- *Transimpedance amplifier circuit design calculator*

Key Applications

- *Servo drive position sensor*
- *Servo drive position feedback*
- *AC drive position feedback*
- *Linear motor position sensor*

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265