Motor Control Solution—Servo Control

Application Introduction

For motor control solutions, Analog Devices offers a complete product portfolio including data converters, amplifiers, embedded processors, *i*Coupler® digital isolators, and power management devices. Enhanced performance and system integration enable innovative design topologies, which add value and help differentiate our customers' servo control systems. Servo drive solutions are associated with attaining the highest performance and accuracy of a motion system. In most cases the end solution is a CNC, motion control system, or robot system that operates with high precision and where control of absolute position, along with optimum torque alignment, is required. Analog Devices offers a complete solution covering all key components in the signal chain.

System Design Considerations and Major Challenges

- High precision current and voltage detection to support the speed and torque control performance. Servo control needs 12-bit ADC performance and multiple input channels. ADI has a full family to support different customer needs.

- Position detection performance is the key for servo control. Optical encoders and resolvers are often used to achieve that. Increased demand for motor control and efficiency is shifting technologies from analog to digital.

- For applications where safety and protection are priorities, isolation technology is used on signal isolation and gate drive. ADI's *i*Coupler digital isolator products provide technologies for high voltage safety isolation.

- High performance processor, like DSPs, used to implement vector control and sensorless control.

- For industrial applications, designers are "future proofed" by the long-term availability and reliability of ADI products.

- The industry's trend is to change from standard induction machines to permanent magnet motors, which means system designers need to introduce higher efficiency and flexible algorithms for IM motor and PMSM motor.

- High performance, real-time industry control networks enable better synchronization of multiple motors.

ADI Solution Value Proposition

For industrial designers building motor-based systems who are trying to achieve substantially lower power consumption and high efficiency, ADI provides components and full signal chain integration to enable rapid design of these systems. ADI demonstrates differentiation in the areas of feedback and sensing, isolation, power management, interfaces, embedded processing, and communications, where ADI products offer best-in-class performance and quality while enabling a low overall system cost. ADI's broad technology mix, including world class isolation, processors, converters, and mixed-signal front ends, equips design engineers with compelling technologies to cover today's and future needs for any motor control solution.

System Block Diagram and Signal Chain
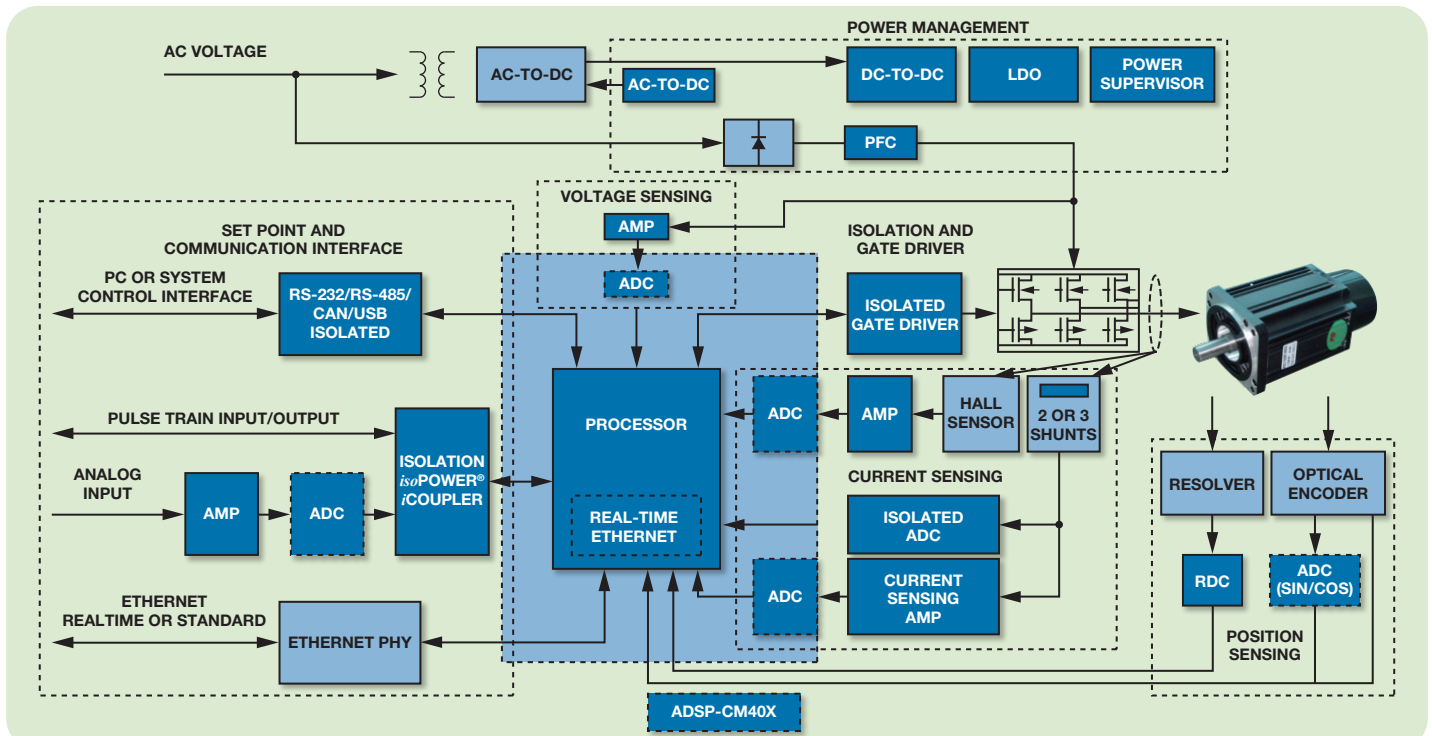
Notes: The signal chains above are representative of a servo control network application system. The technical requirements of the blocks vary, but the products listed in the table are representative of ADI solutions that meet some of those requirements.

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ANALOG DEVICES

Current Sensing	Voltage Sensing	Position Sensing	Set Point
Isolated ADC AD7400A/AD7401A/AD7403 Amp AD8418/AD8417/AD8212 ADC AD7266/AD7367	ADC AD7266/AD7352/AD7356/AD7903 Isolated ADC AD7400A/AD7401A	RDC AD2S1205/AD2S1210 Amp AD8662 Encoder ADC AD7266/AD7264/AD7903	Amp AD8676/AD8221/AD8226/ADA4096-2 ADC AD7680/AD7663/AD7606-4

Processor	Isolation and Gate Drive	Communication Interface	Power Management
ADSP-CM408/ADSP-CM403	Isolation ADuM1411/ADuM1311 Gate Drive ADuM4223/ADuM3223 DC-to-DC ADuM5000	RS-232 ADM3251E RS-485 ADM2486E/ADM2483E/ADM2587E CAN ADM3053 USB ADuM4160	uPMU ADP5034/ADP211x Supervisor ADM6339/ADM13307 AC-to-DC ADP1051 PFC ADP1047

Key Product Technologies

| Part Number	Description	Key Features	Benefits
Amplifier			
AD8418	High voltage, high resolution current shunt amplifier	Bidirectional, zero-drift, initial gain of 20 V/V, high common-mode voltage range −2 V to +70 V typical, CMRR 86 dB dc to 10 kHz	Supports high voltage, excellent ac and dc performance
ADC			
AD7266	Simultaneous, 12-bit SAR ADC	Dual, 12-bit, 3-channel ADC, throughput rate: 2 MSPS, 70 dB SNR at 50 kHz input frequency, accurate on-chip reference: 2.5 V ±0.2% maximum @ 25°C, 20 ppm/°C maximum, dual conversion with read 437.5 ns, 32 MHz SCLK	Multichannel, simultaneous and SAR ADC
AD7403	Isolated Σ-Δ modulator	20 MHz clock rate, second-order modulator, 16-bits no missing codes, ±2 LSB INL typical at 16-bits, 1.5 μV/°C typical offset drift, on-board digital isolation	Isolation, high accuracy ADC
AD2S1210	Resolver-to-digital converter	3125 rps maximum tracking rate (10-bit resolution), ±2.5 arc minutes of accuracy, 10-bit/12-bit/14-bit/16-bit resolution, set by user, parallel and serial 10-bit to 16-bit data ports	High accuracy
Processor			
ADSP-CM408F	ARM® Cortex™-M4	240 MHz ARM Cortex-M4, 384 kB SRAM, and 2 MB flash memory, dual 16-bit SAR ADCs, and 14-bits of accuracy, 2.6 MSPS, integrated sinc filters	240 MHz M4 core and high performance ADC and sinc filters
Isolation			
ADuM3223	Gate drive	High frequency operation: 1 MHz, high-side and low-side isolation: 560 V peak and 700 V peak for differential input, −40°C to +125°C	High-side and low-side isolation, high temperature operation: −40°C to +125°C
Interface			
ADM2587E	Isolated RS-485/RS-422 transceiver	Half or full duplex, 500 kbps, 5 V or 3.3 V operation	RS-485 with integrated isolated dc-to-dc converter, ±15 kV ESD protection
Power Management			
ADP1047	Digital power factor correction controller	Flexible, single phase, digital power factor correction (PFC) controller, true rms ac power metering, enhanced dynamic response, switching frequency spread spectrum for improved EMI	Digital controller and true rms ac power metering
ADP5034	Multi output dc-to-dc regulator	Dual 1.2 A bucks and dual 300 mA LDOs in LFCSP, up to 96% buck power efficiency	4-channels output PMU, single part power chain solution

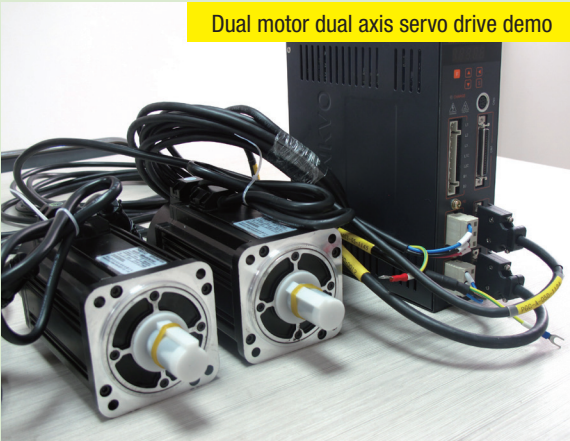## Reference Design and Demo Boards

HV MPC Platform
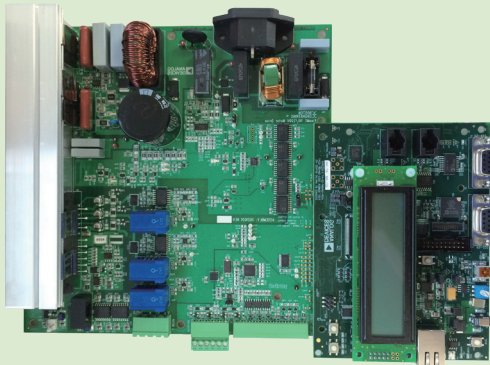
Design by Boston Engineering
www.boston-engineering.com
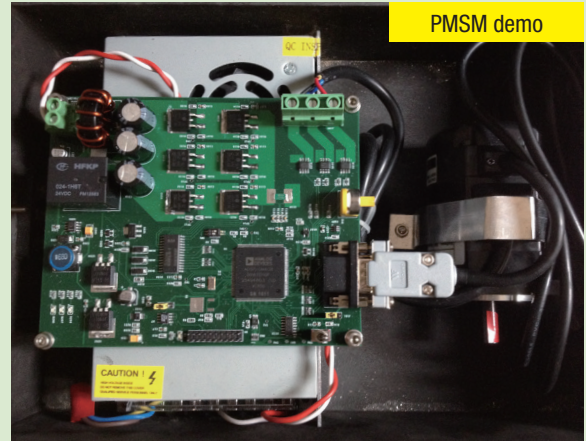

LV MPC Platform
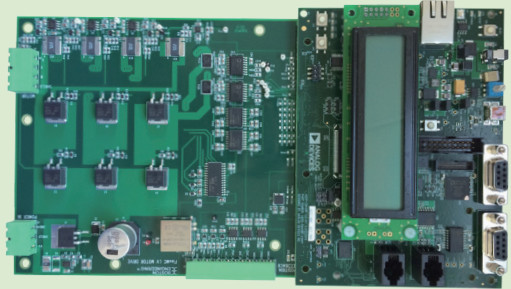
Design by Boston Engineering
www.boston-engineering.com

Dual motor dual axis servo drive demo

Design by third party

PMSM demo

Design by third party

Design Resources

- Matlab® Simulink—complete scalability and flexibility
  - High level system block level development with functional block definition
  - Alignment with functionality of each element—complete flexibility of design flow and structure
- FOC, vector control, sensorless controllers and standard motor control libraries
- Reference design including PCB, SCH, documents, source code examples, and more
- MPC platform and EZ KIT®

Third Party

- Dual motor dual axis servo drive demo

Circuits from the Lab® Reference Circuits for Motor Control

Reference circuits are subsystem level building blocks that have been engineered and tested for quick and easy system integration.

- A novel analog-to-analog isolator using an isolated Σ-Δ modulator, isolated dc-to-dc converter, and active filer (CN0185)—*www.analog.com/CN0185*
- High current driver for the AD2S1210 resolver-to-digital reference signal output (CN0192)—*www.analog.com/CN0192*
- High performance, 10-bit to 16-bit resolver-to-digital converter (CN0276)—*www.analog.com/CN0276*
- High voltage, high precision current sensing with output level shifting using the AD8210 current sense amplifier and the AD8274 difference amplifier (CN0116)—*www.analog.com/CN0116*
- 500 V common-mode voltage current monitor (CN0218)— *www.analog.com/CN0218*
- More reference circuits are available at *www.analog.com/circuits*

More Details Are Available on the ADI Motor Control Website
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Customer Interaction Center

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EngineerZone	*ez.analog.com*
Free Samples	*www.analog.com/sample*

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India – Hyderabad	(91) 40 2781-2699	Vietnam – HCM City	(84) 8 3517-3734
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