Industrial Communication Solutions Guide

Texas Instruments

Industrial Automation Solutions

www.ti.com/automation

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Industrial communication
Overview

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In today's industrial automation market new technology brings many opportunities for industrial system developers to successfully address ever-evolving challenges.

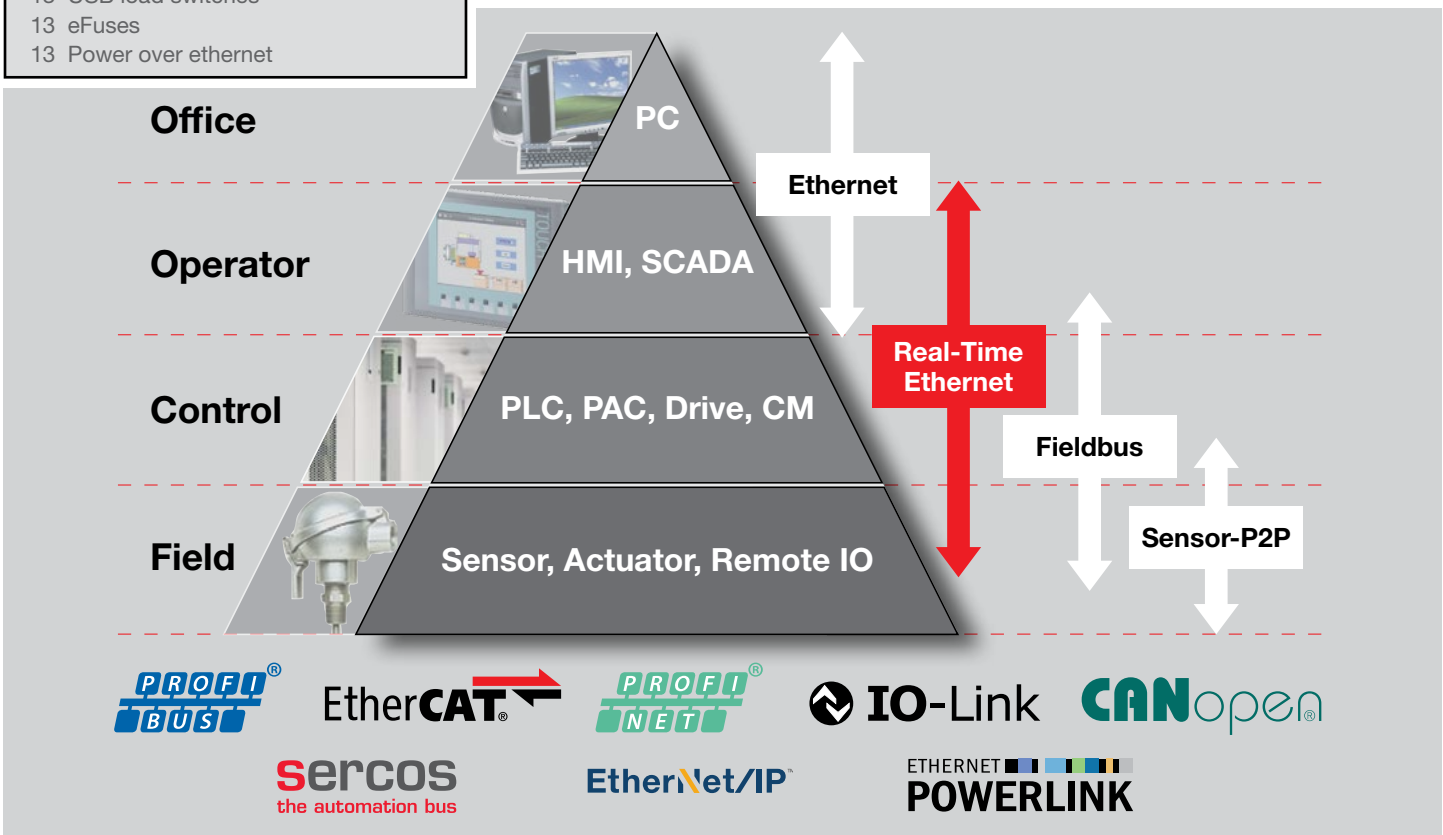
Automation systems require cutting-edge technologies to meet stringent customer requirements for high reliability and harsh environment in mission-critical environments for applications ranging from programmable logic controllers and industrial computers to human machine interface, industrial peripherals and factory communication.

Texas Instruments has a strategic commitment to the factory automation industry with an extensive portfolio and a long product life supply, as well as a strong local-based support.

- Dedicated system solutions
- Development tools
- Close partnership with the industrial ecosystem
- Strong portfolio with industrial feature set:
  - Low power efficiency
  - Long product life supply policy
  - Innovative technology
  - Flexibility and future-proof product roadmap
  - Safety-relevant protocols (IEC 61508, SIL)

In the past industrial automation applications were implemented using a variety of external components, making yesterday's solutions very complex, expensive and nonflexible to evolve as standards also evolve.

The Sitara™ AM335x processors from TI are the industry's first low-power ARM® Cortex®-A8 devices to incorporate multiple industrial communication protocols on a single chip. The six pin-to-pin and software-compatible devices in this generation of processors, along with industrial hardware development tools, software and analog components provide a total industrial system solution. Using this solution, developers can get to market faster with their industrial automation designs, including input/output (I/O) devices, human machine interface (HMI) and programmable logic controllers (PLCs).



Industrial communication

Overview (continued)

30 percent BOM reduction

The unique PRU-ICSS (programmable industrial communication sub system) integrated in Sitara AM335x processors eliminates the need for an external ASIC or FPGA to reduce system complexity and save on bill of materials (BOM) costs by more than 30 percent. The Sitara AM335x processors also include other key industrial peripherals on-chip for additional BOM savings, including CAN, ADC, USB + PHY and two-port gigabit Ethernet with IEEE 1588 to enable fast network connectivity and rapid data throughput, as well as connection to sensors, actuators and motor control.

Scalability

Designers can take advantage of the pin-to-pin and software compatibility of the Sitara AM335x processors and design several end equipments with the devices that best fit their industrial automation need, such as:

- **Drives and I/O-level devices:** Specifically targeted to enable sensors, actuators, motor drives, communications modules and gateways needing industrial slave communications, the AM3357 and AM3356 processors offer a low-performance solution. These two devices do not require an external memory or an operating system making the system solution simple and compact.
- **Industrial PLC applications:** Offering high-performance of up to 1 GHz, the AM3357 and AM3359 processors are well-suited for high-performance PLC applications that need to control various I/O devices in an automation system such as electric motors, pneumatic or hydraulic cylinders, magnetic relay solenoids and more.
- **HMI products:** Perfect for designing HMI products, the AM3354, AM3358 and AM3359 processors offer an on-chip 3D graphics accelerator, which combined with the integrated touch-screen controller, enables rich and intuitive graphical user touch-screen interfaces. For HMI applications not requiring integrated industrial communications, the AM3354 and AM3352 processors offer low-cost options.

Industrial hardware and software tools

Accompanying the Sitara AM335x processors is an industrial hardware development tool to enable customers to easily incorporate industrial communication standards in their industrial automation products.

AM3359 Industrial Communications Engine (ICE)

The TMDSICE3359 is a development platform targeted for systems that specifically focus on the industrial communications capabilities of the Sitara AM335x processors.

The AM335x processors integrate the PRU-ICSS that has been architected to implement the real-time communication technologies used in a broad range of industrial automation equipment. It enables low footprint designs with minimal external components and with best-in-class low-power performance. Learn more at **www.ti.com/tool/tmdsice3359**

Designers can also utilize the previously announced AM335x EVM. Free, production-ready, certified system solution software for industrial automation protocols, including industrial design-specific demos, applications notes and videos make development easy. Software resources required for physical and data link layer implementations of many industrial communications standards are available as well as software frameworks for SYS/BIOS™ real-time kernel and applications stacks for industrial

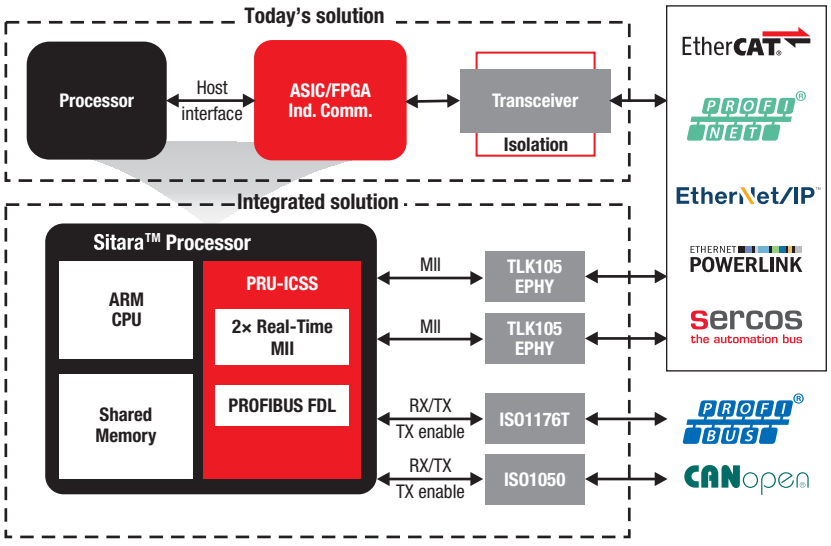
Industrial Communications Engine available for $179 USD

communication standards, allowing customers to focus on differentiating application level aspects of their system.

TI offers the ability to complete an entire industrial system design with TI analog ICs, including industrial Ethernet and isolated CAN transceivers, motor drivers, temperature sensors and power management devices, plus wireless connectivity options to complement the AM335x processors.

The AM437x Industrial Development Kit (IDK) is an application development platform for evaluating the industrial communication and control capabilities of Sitara AM4379 and AM4377 processors for industrial applications.

The AM4379 and AM4377 processors are ideal for industrial communications, industrial control, and industrial drives applications. The AM437x processors integrate a quad-core programmable real-time unit (PRU) that has been architected to implement the real-time communication technologies used in a broad range of industrial automation equipment. It enables low foot print designs with minimal external components and with best in class low power performance. Learn more at **www.ti.com/tool/tmdxidk437x**



Industrial ethernet protocols designs

Name	Description	Key Features
EtherCAT® communications development platform	Targeted for EtherCAT slave communications, this development platform (TIDEP0001) allows designers to implement real-time EtherCAT communications standards in a broad range of industrial automation equipment. It enables low footprint designs in applications such as industrial automation, factory automation or industrial communication with minimal external components and with best-in-class low-power performance.	• EtherCAT conformance tested by EtherCAT Technology Group (ETG) • Free EtherCAT Slave Stack Code (SSC) from Beckhoff available; requires ETG membership (free of charge) and valid EtherCAT Vendor ID • Free board support package and industrial software development kit from TI • Support other industrial communications with the same hardware (e.g., PROFIBUS®, PROFINET®, Ethernet/IP™ and more) • Production ready development platform sub-system which includes schematics, BOM, user guides, application notes, white paper, software, demos and more
PROFIBUS communications development platform	Targeted for PROFIBUS slave communications, this development platform (TIDEP0002) allows designers to implement PROFIBUS communications standards in a broad range of industrial automation equipment. It enables low footprint designs in applications such as industrial automation, factory automation or industrial communication with minimal external components and with best-in-class low-power performance.	• AM335x ARM® Cortex®-A8 processor-based design enables 40% system BOM savings by eliminating external ASIC/FPGA • Access to other peripherals and interfaces for a scalable HMI, PLC and I/O solution • PROFIBUS slave certified by Siemens authorized test labs • Pre-tested protocol stack for evaluation • Free board support package and industrial software development kit from TI • Support other industrial communications with the same hardware (e.g., EtherCAT, Profinet, Ethernet/IP and more) • Production ready development platform sub-system includes schematics, BOM, user guides, application notes, white paper, software, demos and more
PROFINET communications development platform	Targeted for PROFINET slave communications, this development platform (TIDEP0008) allows designers to implement PROFINET communications standards in a broad range of industrial automation equipment. It enables low foot print designs in applications such as industrial automation, factory automation or industrial communication with minimal external components and with best in class low power performance.	• AM335x ARM Cortex-A8 processor-based design enables 30% system BOM savings by eliminating external ASIC/FPGA • PROFINET IO Device for conformance classes A and B certified by COMDEC • High performance PROFINET cut-through switch supports 250us cycle time with 8 real-time connections. • Very robust PROFINET switch with 4 priority queues per port and content filter passing Netload class 3. • Free board support package and industrial software development kit from TI • Support other industrial communications with the same hardware (e.g., EtherCAT, PROFIBUS, Ethernet/IP and more) • Production Ready development platform sub-system which includes schematics, BOM, user guides, application notes, white paper, software, demos and more
Certified Profinet IRT V2.3 device with 1 GHz ARM application processor reference design	Certified hardware and software components for Profinet IRT V2.3 device applications. This design (TIDEP0029) integrates Industrial Ethernet Phys, Profinet IRT switch, Profinet IRT stack and application example in one package. Profinet is the leading Industrial Ethernet standard used by many Industrial segments and end-equipment which require real-time deterministic exchange of IO data and additional bandwidth for service and diagnostics.	• Profinet Conformance Class A/B/C • 250 us cycle time • 1 step time synchronization (PTCP) • 8 consumer and provider protocol machines • MRP – Media Redundancy Protocol • Integrated with Molex Profinet stack • Integrated with Interniche SNMP stack
Ethernet/IP communications development platform	Targeted for Ethernet/IP slave communications, this development platform (TIDEP0003)allows designers to mplement Ethernet/IP communications standards in a broad range of industrial automation equipment. It enables low foot print designs in applications such as industrial automation, factory automation or industrial communication with minimal external components and with best in class low power performance.	• AM335x ARM Cortex-A8 processor-based design enables 30% system BOM savings by eliminating external ASIC/FPGA • Access to other peripherals and interfaces for a scalable HMI, PLC and I/O solution • Free board support package and industrial software development kit from TI • Support other industrial communications with the same hardware (e.g., EtherCAT, PROFIBUS, PROFINET and more) • Production Ready development platform sub-system which includes schematics, BOM, user guides, application notes, white paper, software, demos and more
Powerlink on TI Sitara™ processors	The TIDEP0028 Ethernet Powerlink development platform combines the AM335x Sitara processor family from Texas Instruments (TI) and the Powerlink open media access control (MAC) layer into a single system-on-chip (SoC) solution. Targeted for Ethernet Powerlink slave communications, the TIDEP0028 allows designers to implement the real-time Powerlink communication standard for a broad range of industrial automation equipment. The design is based on the TMDSICE3359 industrial communications engine (ICE).	• Ethernet Powerlink conformance tested • Ethernet Powerlink firmware for PRU-ICSS with openMAC compliant register interface • Board support package and industrial software development kit available from TI and 3rd party • Development platform includes schematics, BOM, user guides, application notes, white paper, software, demos and more • Supports other industrial communications with the same hardware (e.g., EtherCAT, PROFINET, Ethernet/IP and more)
Sercos III communications development platform	The TIDEP0010 Sercos III communication development platform combines the AM335x Sitara processor family from Texas Instruments (TI) and the Sercos III media access control (MAC) layer into a single system-on-chip (SoC) solution. Targeted for Sercos III slave communications, the TIDEP0010 allows designers to implement the real-time Sercos III communication standard for a broad range of industrial automation equipment. The design is based on the TMDSICE3359 Industrial Communications Engine (ICE).	• Sercos III conformance tested • Sercos III firmware for PRU-ICSS with Sercos MAC compliant register interface • Board support package and industrial software development kit available from TI and 3rd party • Development platform which includes schematics, BOM, user guides, application notes, white paper, software, demos and more • Supports other industrial communications with the same hardware (e.g., EtherCAT, PROFINET, Ethernet/IP and more)

TI Designs

Industrial ethernet protocol designs (continued) / encoder feedback protocols

Industrial ethernet protocols designs

Name	Description	Key Features
Sercos III Slave for AM437x – communication development platform sercos the automation bus	The TIDEP0039 Sercos III Slave For AM437x Communication Development Platform Reference Design combines the AM437x Sitara processor family from Texas Instruments (TI) and the Sercos III media access control (MAC) layer into a single system-on-chip (SoC) solution. Targeted for Sercos III slave communications, the TIDEP0039 allows designers to implement the real-time Sercos III communication standard for a broad range of industrial automation equipment. The design is based on the TMDXIDK437X industrial development kit (IDK).	• Sercos III conformance tested • Sercos III firmware for PRU-ICSS with Sercos MAC compliant register interface • Board support package and industrial development kit available from TI and 3rd party • Development platform includes schematic, BOM, user guides, application notes, white paper, software, demos and more • Supports other industrial Ethernet communication standards with the same hardware (e.g. EtherCAT, PROFINET, Ethernet/IP and more)
Multi-protocol industrial ethernet detection with PRU-ICSS	Industrial ethernet for industrial automation exist in more than 30 industrial standards. Some of the well-established real-time Ethernet protocols, like EtherCAT, EtherNet/IP, PROFINET, Sercos III and Powerlink require dedicated MAC hardware support in terms of FPGA or ASICs. The programmable real-time unit inside the Industrial Communication Subsystem (PRU-ICSS), which exists as HW block inside the Sitara processors family, replaces FPGA or ASICS by a single chip solution. A firmware in the PRU-ICSS detects the type of industrial Ethernet protocol and loads the appropriate industrial application during run-time into the Sitara processor. The TIDEP0032 reference design describes the multi-protocol industrial Ethernet protocol detection firmware for PRU-ICSS.	• High speed/frequency with high precision for accurate PTO control and synchronization • Implementation without external ASIC or FPGA • Implementation on PRU-ICSS with Sitara processor • Contains PRU-ICSS firmware in source code and can get adoptable by customer • Easy evaluation with TMDSICE3359 industrial communication engine (ICE) EVM

Encoder feedback protocols designs

Name	Description	Key Features
BiSS interface BiSS INTERFACE	Impelementation of BiSS-C Master protocol on industrial communication sub-system (PRU-ICSS). The TIDEP0022 reference design provides full documentation and source code for programmable realtime unit (PRU).	• BiSS-C master protocol running on ICSS • Interface speed of 1, 2, 5 and 10 MHz • 8x oversampled input capture • Line delay compensation with filtered sample point • Debouncing filter on oversampled input • Variable frame format with crc check • Command (CDS/CDM/CRC) interface • Supports up to 100 m cable • Runs on AM335x and AM437x with ICSS
EnDat 2.2 system reference design EnDat 2.2	TIDEP0050 implements the EnDat 2.2 master protocol stack and hardware interface solution based on the HEIDENHAIN EnDat 2.2 standard for position or rotary encoders. The design is composed of the EnDat 2.2 master protocol stack, half-duplex communications using RS485 transceivers and the line termination implemented on the Sitara™ AM437x industrial development kit. This design is fully tested to meet the HEIDENHAIN EnDat 2.2 standard. Along with EnDat position feedback, the AM437x IDK is also able to support industrial communications and motor drive as described in the AM437x Single-Chip Motor-Control Design Guide.	• Enables developers to use EnDat 2.2 encoder interlaces to implement low footprint, low-power single-chip solutions in applications such as industrial automation and factory automation • EnDat 2.2 interface is technical standard for direct drive technology thanks to its high resolution, short cycle times, commutation information, long line length support and encoder diagnostics • EnDat 2.2 digital technology, simple connection technology and simple voltage supply requirements reduces overall system cost • Based on Sitara AM437x Processor which supports single chip motor control applications and other embedded control and communications applications • Production ready development platform sub-system includes schematics, BOM, user guide, benchmarks, software, demos and more • Free board support package and industrial software development kit from TI • Sitara AM437x supports a number of industrial communications standards including EtherCAT, PROFINET, PROFIBUS™, Ethernet/IP™, Powerlink and Sercos
HIPERFACE DSL® master protocol HIPERFACE DSL®	TIDEP0035 reference design: • HIPERFACE DSL® master protocol with register compatible interface to existing FPGA IP core • Programmable approach using ICSS_L concurrently with DS filter and Industrial Ethernet (Single Chip Drive) • Internal and external sync pulse sources • Supports cable length of up to 100 meter • Line delay compensation • 8x oversampling with sample edge detection • Line diagnostics – quality monitor	• HIPERFACE DSL® allows to remove motor feedback cable • Integrated with Single Chip Drive solution • Replaces external FPGA • On chip time synchronization with motor application • 225 MHz design supports minimum sync pulse jitter

TI Designs

Encoder feedback transceiver / industrial ethernet reference designs

Encoder feedback transceiver reference designs

Name	Description	Key Features
Interface to a 5 V BiSS position encoder reference design	The TIDA-00175 implements a hardware interface solution based on the BiSS standard for position or rotary encoders. It supports both BiSS point-to-point and BiSS bus configurations.The building blocks include the power supply for a 5 V BiSS encoder – with innovative smart e-Fuse technology – and robust full-duplex RS485 transceivers, including line termination and EMC protection. An auxiliary power supply and logic level interface with adjustable I/O voltage level is provided to connect to subsequent MCUs and MPUs that would run the BiSS (or SSI) master protocol stack. This design is fully tested to meet EMC immunity requirements for ESD, fast transient burst and surge according to IEC61800-3.	• 3.3 V RS-485 full-duplex transceivers with IEC-ESD meets BiSS clock frequency (10Mhz) • Design meets EMC immunity requirements for ESD, fast transient burst and surge according to IEC61800-3 • Wide input (15-30 VDC) high-efficiency (>85%) DCDC power supply for 5 V BiSS (or SSI) encoders with 350 mA, lowest-ripple (<20 mVpp) output • Protected power supply with innovative eFuse technology with inrush current limitation and protection against over-current, over- and under-voltage and disconnect in case of fault. • Option to shut down encoder power supply in case of fault or to save power when no encoder is connected. • 3.3 V interface with level shifter to also support 2.5 V or 1.8 V I/O interface to processors to run the BiSS (or SSI) Master
Reference design for an interface to a position encoder with EnDat 2.2	The TIDA-00172 implements a hardware interface solution based on the HEIDENHAIN EnDat 2.2 standard for position or rotary encoders. The building blocks include the power supply for the encoder – with innovative smart e-Fuse technology - and robust half-duplex RS485 transceivers, including line termination and EMC protection. An auxiliary power supply and logic level interface with adjustable I/O voltage level is provided to connect to subsequent MCUs and MPUs that would run the EnDat 2.2 Master protocol stack. This design is fully tested to meet EMC immunity requirements for ESD, fast transient burst and surge according to IEC61800-3.	• Design meets EMC immunity requirements for ESD, fast transient burst and surge according to IEC61800-3 • High-speed RS-485 transceivers robust to 15kV ESD immunity • Wide input (15-30 VDC) high-efficiency (>85%) DCDC power supply configurable from 3.6 V to 14 V (defaulted to 8 V) with 200 mA, low-ripple (<20 mVpp) output • Protected power supply with innovative eFuse technology to protect against over-current, over-power, over- and under-voltage and disconnect in case of fault • Option to shut down encoder power supply in case of fault or to save power when no encoder is connected • Level shifter to support 3.3 V, 2.5V or 1.8 V I/O interface to processors like Sitara AM4x for EnDat 2.2 Master
Two-wire interface to a HIPERFACE DSL® encoder reference design	The TIDA-00177 reference design is an EMC compliant industrial interface to a two-wire HIPERFACE DSL® encoder. Applications include industrial servo drives. The design features a 3.3 V supply RS485 transceiver and line termination and coupling for encoder power over RS485 as per HIPERFACE DSL® specification. The design has been tested up to 100 m cable length with an integrated cable, where the encoder's two-wire twisted pair was integrated in the same motor cable. The encoder connector output is protected against over-voltage and short circuit to prevent damage to an encoder or during a cable short. The design features an industrial compliant 24 V input with wide range from 18-36 V. A 3.3 V I/O connector with logic signals for easy interface to a host processor with HIPERFACE DSL® master IP core is made available.	• Two-wire interface to a HIPERFACE DSL® encoder. Supports HIPERFACE DSL® 9.375 MBaud transfer rate with power over RS485, cable length up to 100 m • 3.3 V supply half-duplex RS485 transceiver with 12kV IEC-ESD and 4kV EFT • Wide input (18-36 V) non-isolated power supply with configurable output voltage 7 V -12 V, default 10.5 V, 250 mA (3.5 A peak) compliant to HIPERFACE DSL® specification • OV, UV and precise over-current limit with short-circuit protection leveraging TI eFuse technology with fault indicator • Logic interface (3.3 V I/O) to host processor like Sitara for the HIPERFACE DSL® master • Designed to meet EMC immunity for ESD, fast transient burst, and surge with levels according to IEC61800-3

Industrial ethernet reference designs

Name	Description	Key Features
AM3359 industrial communications engine TMDSICE3359	The AM3359 industrial communications engine (ICE) is a development platform targeted for systems that specifically focus on the industrial communications capabilities of the Sitara™ AM335x ARM® Cortex™-A8 processors. The AM335x ARM Cortex-A8 processors integrate the programmable real-time unit (PRU) that has been architected to implement the real-time communication technologies used in a broad range of industrial automation equipment. It enables low footprint designs with minimal external components and with best-in-class-low-power performance.	• Option of controlling the Ethernet ports from PRU or from 2-port GbE switch • On-board OLED display • DDR3 memory • Support for larger NOR Flash upto 32 Mb • Industrial communication modules • Industrial communication interfaces for sensors and input/output (I/O) systems • Industrial communication gateways • Industrial drives with integrated communications • Motor feedback systems
AM437x Industrial Development Kit (IDK)	The AM437x industrial development kit (IDK) is an application development platform for evaluating the industrial communication and control capabilities of Sitara AM4379 and AM4377 processors for industrial applications. The AM4379 and AM4377 processors are ideal for industrial communications, industrial control and industrial drives applications. The AM437x processors integrate a quad-core programmable real-time unit (PRU) that has been architected to implement the real-time communication technologies used in a broad range of industrial automation equipment. It enables low footprint designs with minimal external components and with best-in-class-low-power performance.	• AM4379 ARM Cortex-A9 • 1GB DDR3 • QSPI-NOR flash • Discrete power solution • Industrial communication interfaces • EnDat connectivity for motor feedback control • On-board 2 Mp camera
EMI/EMC compliant industrial temp dual port gigabit ethernet reference design	The TIDA-00204 allows for performance evaluation of two industrial grade DP83867IR gigabit Ethernet PHYs and Sitara host processors with integrated Ethernet MAC and switch. It was developed to meet industrial requirements for EMI and EMC. The application firmware implements a driver for the PHY, UDP and TCP/IP stack and HTTP web server examples. The host processor is configured to boot the pre-installed firmware from the on-board SD-card. A USB virtual COM port offers optional access to the PHY registers. A JTAG interface allows for firmware development.	• EMI- and EMC-compliant design with wide input voltage range (17-60 V) using two DP83867IR gigabit Ethernet PHYs and AM3359 Sitara processor to work in harsh industrial environments • Exceeds CISPR 11 / EN55011 class A radiated emission requirement by >4.6 dB • Sitara AM3359 firmware, including UDP and TCP/IP stack and HTTP web server examples, boots from on-board SD-Card allowing easy standalone operation • Access to DP83867IR registers via USB virtual COM port allows for custom specific PHY configurations, like RGMII delay mode • Hardware support for class A radiated emission requirements allows IEEE1588 PTP implementation

TI Designs

Industrial ethernet reference designs (continued) / fieldbus reference designs

Industrial ethernet reference designs

Name	Description	Key Features
EN55011 compliant, industrial temperature, 10/100 Mbps Ethernet PHY brick reference design	This Ethernet PHY brick reference design (TIDA-00207) enables Texas Instruments' customers to quickly design systems and release them to market, using TI industrial Ethernet PHY transceiver devices, fully compliant to EN5501 class A EMI requirements. A 50 pin interface is provided to interface with the 32 Bit Cortex M4 processor based controller board. The board is designed in a small form factor (2 inches x 3 inches) making it easy to fit into existing products.	• Meets EN55011 class A radiated emission requirements • Low power consumption = 264 mW • DP83848K Ethernet PHY configured for MII interface • Programmable LED support for link and activity • External isolation transformer with common-mode choke on PHY side for improved EMI and EMC performance • HBM ESD protection on RD± and TD± of 4k V
Compact CAN-to-ethernet converter using 32-bit ARM Cortex-M4F MCU reference design	The TIDA-00203 design demonstrates a small form-factor controller access network (CAN)-to-Ethernet converter using the TM4C129XNCZAD 32-bit ARM; Cortex;-M4F MCU. Supporting 10/100 Base-T compliant with IEEE 802.3 standard, this reference design is useful for industrial drives monitoring and control, as well as supervisory control and data acquisition (SCADA) systems. The same hardware can be used as a CAN-to-Ethernet gateway or bridge with simple changes in the firmware. The gateway application is useful for monitoring remote CAN networks over Ethernet, while the bridge application is useful for coupling CAN networks via the the internet or local area netowork (LAN).	• Fully integrated 10/100 Ethernet MAC and PHY with advanced IEEE 1588 precision time protocol (PTP) hardware and both media independent interface (MII) and reduced MII (RMII) support provides a compact Ethernet solution. • Onboard non-isolated controller area network (CAN) and RS-485 PHYs provides easy interface to a variaety of fieldbus solutions. Provisional connection allows high efficiency isolated CAN & Profibus interface • JTAG connector for easy programming • Expansion connectors provide access to communication, analog-to-digital converters (ADCs), and general purpose input and output (GPIO) interfaces for maximum flexibility • 50-pin SDCC connector provided for easy interface to the MII and RMII Ethernet PHY for use with other controllers

Fieldbus reference designs

Name	Description	Key Features
MSP430 HART protocol + modem in a single chip transmitter reference design	The HART protocol and HART modem solution is run in a single chip on the MSP430 microcontroller. This reference design provides a full HART and 4-20 mA field transmitter solution interfaced to an RTD temperature sensor.	• Single chip HART protocol and modem solution • Full field transmitter system solution • Ultra low power solution
Turnkey IO-link sensor transmitter IO-Link	The TIDA-00188 offers a rapid prototyping platform for IO-Link sensor transmitters. Thanks to its modular design, different sections can be easily cut away to allow fast and simple interfacing of any analog or digital sensor. The system is programmed with a fully validated IO-Link stack leveraging the fully validated IO-Link PHY. It comes by default with: a switch emulating a digital input, 2 LEDs for status indications and a potentiometer emulating an RTD (read by a 24-bit front-end). All this fitting in a 6 mm wide PCB compatible with the industry standard M12 connector.	• RTD performance: maximum measured error: 0.17°C (-200°C to 850°C) • IO-LINK v1.1 connectivity out of the box (TMG stack, PHY and M12 connector) • Easy connection of in-house sensor to the PCB • Designed to meet IEC 61000-4-2, IEC 61000-4-4, IEC 61000-4-5 and IEC 60255-5 standards

IO-link sensor transmitter booster pack
IO-Link
	The TIDA-00339 offers a rapid prototyping platform for IO-Link sensor transmitters. Thanks to its design it can be connected to TI's LaunchPad / BoosterPack ecosystem on which the fully validated IO-Link stack is implemented. The system has easy access to all interface and status signals. The different optional settings make the TI Design flexible to adjust for several use cases. With the ability to connect sensor front-ends, the design can be used either as an evaluation platform of the IO-Link interface or as an entire sensor transmitter system. With the industry standard M12 connector, the sub-system can be quickly connected to an IO-Link master system.	• IO-Link v1.1 and v1.0 connectivity out of the box (TMG stack, PHY and M12 connector)
		• Simple interfacing of sensors
		• Designed to meet:
		  • IEC 61000-4-2
		  • IEC 61000-4-4
		  • IEC 61000-4-5
		  • IEC 60255-5

Proximity and temperature multi-variable transmitter with IO-link reference design IO-Link	The TIDA-00341 offers a rapid prototyping platform for a Hall-sensing proximity sensor and temperature sensing multi-variable field transmitter with IO-Link. Thanks to its IO-Link interface, the sensor can be used as a multi-variable sensor for proximity sensing and for temperature sensing. TIDA-00341 comes by default with an integrated Hall-sensor, a switch and 2 LEDs for status indications. This entire design fits in a 6 mm wide PCB compatible with the industry standard M12 connector.	• Hall-effect latch proximity sensor with IO-Link interface • Ambient temperature sensing • IO-LINK v1.1 connectivity out of the box (TMG stack, PHY and M12 connector) • Designed to meet IEC 61000-4-2, IEC 61000-4-4, IEC 61000-4-5 and IEC 60255-5 standards
Hall sensor proximity sensor w/fixed threshold and temperature sensing over IO-link reference design IO-Link	The TIDA-00340 offers a rapid prototyping platform for a magnetic-field proximity sensor with IO-Link. Thanks to its IO-Link interface the sensor can be used as a multi-variable sensor for proximity sensing and for temperature sensing.TIDA-00340 comes by default with an integrated Hall-sensor, a switch and 2 LED for status indications. All this fits in a 6 mm wide PCB compatible with the industry standard M12 connector.	• Hall-effect latch proximity sensor with IO-Link interface • Ambient temperature sensing • IO-LINK v1.1 connectivity out of the box (TMG stack, PHY and M12 connector) • Designed to meet IEC 61000-4-2, IEC 61000-4-4, IEC 61000-4-5 and IEC 60255-5 standards

Industrial protocol support

	Microprocessor						Microcontroller					
	AM1810	AM335x	AM437x		AM5xxx[1]		MSP430	MSP432	C2000	Tiva C	RM4x	TMS570
	PRUSS	ICSS #1	ICSS #1	ICSS #2	ICSS #1	ICSS #2						
Industrial ethernet												
ProfiNet™ RT/IRT v2.3	-	X	X	-	X	X	-	-	-	-	-	-
Ethernet I/P™	-	X	X	-	X	X	-	-	-	-	-	-
EtherCAT™ Slave	-	X	X	-	X	X	-	-	X[2]	-	-	-
Powerlink	-	X	X	-	X	X	-	-	-	-	-	-
Sercos III	-	X	X	-	X	X	-	-	-	-	-	-
Position encoder feedback												
EnDat 2.2	-	-	X	X	X	X	-	-	X	-	X	X
HIPERFACE DSL	-	-	X	X	X	X	-	-	-	-	-	-
BiSS-C	-	X	X	X	X	X	-	-	X	-	-	
SinCos	-	-	X	X	X	X	-	X	X	X	X	X
Industrial fieldbus												
CANOpen	-	X	X	X	X	X	-	-	X	X	X	X
Profibus™ Slave DP	X	X	X	X	X	X	-	-	-	-	-	-
Profibus Master DP	-	X	X	X	X	X	-	-	-	-	-	-
HART (4-20 mA)	-	-	-	-	-	-	X	-	-	-	-	-
IO-Link Slave	-	-	-	-	-	-	X	-	-	-	-	-

(1) Each ICSS can run any protocol listed below. Hence, any combination of protocols possible. (2) Over external ET1100

Microcontrollers

Part Number	Description	Core	Communication Interface	Analog I/O	End Equipment
MSP MCUs	16- and 32-bit mixed-signal processors designed for ultra-low-power sensing applications, including those operating on a current loop; portfolio features up to 48 MHz, 512 KB non-volatile memory (Flash/FRAM), 64 KB SRAM and smart analog and digital peripherals	MSP430™/ ARM® Cortex™-M4	I²C, SPI, UART, USB, IrDA	24-bit SD ADCs, 14-bit SAR ADCs, DACs, op amps, comparators, LCD	Sensor transmitters, metering solutions, current loop controllers
C2000™	C2000 32-bit real-time MCU optimized for processing, sensing and actuation to improve closed loop performance	Proprietary	UART, I²C, SPI, USB	ADC, DAC	I/O modules & communication modules
TM4C	Industrial grade 10/100/1000 Ethernet physical layer transceiver	ARM Cortex-M4	UART, I²C, SPI, CAN, Ethernet, USB	ADC, DAC	I/O modules & communication modules
RM4x	RM4x ARM Cortex-R4-based microcontroller for safety-critical applications up to 220 MHz and 3 MB Flash	ARM Cortex-R4	UART, I²C, SPI, CAN, Ethernet, USB	ADC, DAC	Safety
TMS570	TMS570 ARM Cortex-R4F-based microcontroller for safety-critical applications up to 160 MHz and 2 MB Flash	ARM Cortex-R4	UART, I²C, SPI, CAN, Ethernet, USB	ADC, DAC	Safety

Microprocessors

Part Number	Description	Core	Communication Interface	Analog I/O	End Equipment
Sitara™ AM335x	Sitara™ processors with ARM® Cortex™-A8 core and integrated industrial communications support	ARM® Cortex™ - A8	USB, UART,I²C, SPI, Industrial Ethernet	ADC	Communication module PLC controller (CPU)
Sitara AM4xxx	Sitara processors with ARM Cortex-A9 core with integrated industrial communications support	ARM Cortex - A9	USB, UART, I²C, SPI, Industrial Ethernet	12-bit SAR ADC0 12-bit SAR ADC1	Motor control PLC controller (CPU)
Sitara AM5xxx	Sitara processors with ARM Cortex-A15 core with integrated industrial communications support and DSP acceleration for analytics processing	ARM Cortex - A15	USB, UART, I²C, SPI, Industrial Ethernet	PMIC	PLC controller (CPU)
66AK2L06	High-performance DSP+ARM SoC with integrated digital front end (DFE) and JESD204B	ARM Cortex-A15 and C66x DSP	UART, I²C, SPI, Ethernet, USB, JESD204B	DFE	Communication modules PLC controller (CPU)

Ethernet physical layer transceiver (PHY)

Part Number	Description	Interface	Cable Length (m)	LED (#)	Supply Voltage (V)	Data Rate (Mbps)	JTAG 1149.1	Port Count	Special Features	Operating Temperature Range (°C)	Pin/Package	Price* (US$)
DP83848I	Industrial temperature 10/100 Ethernet physical layer transceiver in QFP packaging	MII/RMII/SNI	150	3	3.3	10/100	Yes	Single	25 MHz clock out, EMI mitigation circuitry, industry gold standard	–40 to 85	QFP-48	2.20
DP83848K	Industrial temperature 10/100 Ethernet physical layer transceiver in QFN packaging	MII/RMII	137	2	3.3	10/100	Yes	Single	EMI mitigation circuitry, industry gold standard	–40 to 85	QFN-40	0.95
DP83867IRPAP	Industrial grade QFP packaging 10/100/1000 Ethernet physical layer transceiver	RGMII/GMII/MII	130	4	2.5, 1.1	10/100/1000	Yes	Single	Cable diagnostics, IEEE 1588 start of frame detect, wake on LAN, integrated termination resistors	–40 to 85	QFP-64	6.40
DP83867IRRGZ	Industrial grade 10/100/1000 Ethernet physical layer transceiver	RGMII	130	4	2.5, 1.0	10/100/1000	Yes	Single	Cable Diagnostics, IEEE 1588 start of frame detect, wake on LAN, integrated termination resistors	–40 to 85	QFN-48	6.40
DP83867IS	Industrial grade with SGMII 10/100/1000 Ethernet physical layer transceiver	SGMII RGMII	130	4	2.5, 1.0	10/100/1000	Yes	Single	Cable Diagnostics, IEEE 1588 start of frame detect, wake on LAN, integrated termination resistors	–40 to 85	QFN-48	7.27
DP83867E	Extended temperature grade with SGMII 10/100/1000 Ethernet physical layer transceiver	SGMII RGMII	130	4	2.5, 1.0	10/100/1000	Yes	Single	Cable Diagnostics, IEEE 1588 start of frame detect, wake on LAN, integrated termination resistors	–40 to 105	QFN-48	8.36

Industrial interface transceivers

Part Number	Description	Bus Fault Voltage (V)	ICC (Max) (mA)	Number of Nodes	Date	Duplex	ESD	Supply Voltage(s) (V)	Special Features	Operating Temperature Range (°C)	Pin/Package	Price* (US$)
DS75176BT	5 V, multipoint RS-485/RS-422 transceivers	–10 to 15	55	32	10 Mbps	Half	+500V HBM	+4.75 to +5.25	Industry standard	–40 to 85	8/SOIC, 8/PDIP	0.52
DS485	5 V, low power, half-duplex RS-485/RS-	–14 to 14	0.9	32	2.5 Mbps	Half	+2kV HBM	+4.75 to +5.25	Low power (Typical ICC = 200uA)	–40 to 85	8/SOIC, 8/PDIP	0.87
SN65HVD77	3.3 V, full-duplex RS-485, 12 kV IEC ESD, 50 Mbps data rate, no enables	–13 to 16.5	1.1	96	50 Mbps	Full	±30-kV HBM protection ±12-kV IEC61000-4-2 Contact Discharge ±4-kV IEC61000-4-4 Fast Transient Burst	3.3	High ESD Low power	–40 to 125	8SOIC 8MSOP	1.9
SN65HVD78	3.3 V, half-duplex RS-485, 12 kV IEC ESD, 50 Mbps data rate		.95	200	50 Mbps	Half	±15 kV HBM Protection ±12 kV IEC 61000-4-2 Contact Discharge ±4 kV IEC 61000-4-4 Fast Transient Burst	3.3	High ESD Low power	–40 to 125	8SOIC 8SON 8VSSO	1.0
SN65HVD1176	PROFIBUS® RS-485 transceiver	–9 to 14	6	160	40 Mbps	Half	±10-kV HBM	5	Low bus capacitance Exceeds PROFIBUS requirements of 2.1 V with voltage at 54 V	–40 to 85	8SOIC	1.54
SN65HVD255	CAN transceiver with fast loop times for highly loaded networks	–27 to 40	85	167	1 Mbps		High speed, turbo short prop delay, silent mode	4.5 to 5.5	Meets the Requirements of ISO11898-2	-40 to 125	8SOIC	0.50
SN65HVD256	CAN transceiver With Fast Loop Times for Highly Loaded Networks	–27 to 40	85	167	1 Mbps		High speed, turbo short prop delay, RXD I/O supply	4.5 to 5.5 2.8 to 5.5	Meets the Requirements of ISO11898-2	-40 to 125	8SOIC	0.50
TRS3253E7	RS-232 transceiver with 1.8 V logic supply and IEC-ESD protection		1		1 Mbps		±8 kV IEC 61000-4-2 air-gap discharge, ±8 kV IEC 61000-4-2 contact discharge, ±15 kV human body model	3 to 5.5	Logic supply pin with 1.8 support	–40 to 85	32/VQFN	1.12

**Suggested resale price in U.S. dollars in quantities of 1,000.*

*New products are listed in **bold red**.*

Isolated industrial interface

Part Number	Description	Integrated Transformer Driver	Duplex	Isolation Rating (kVrms)	VCC1 (Min) (V)	VCC1 (Max) (V)	VCC2 (Min) (V)	VCC2 (Max) (V)	Data Rate (Mbps)	Number of Nodes	ESD (kV)	Fail Safe	Operating Temperature Range (°C)	Pin/Package	Price* (US$)
ISO1176	Isolated PROFIBUS® RS-485 transceiver	No	Half	2.5	3.15	5.5	4.75	5.25	40	256	16	Idle, open and short	–40 to 85	16/SOIC	3.00
ISO1176T	Isolated PROFIBUS transceiver with integrated transformer driver	Yes	Half	2.5	3	5.5	4.75	5.25	40	256	10	Idle, open and short	–40 to 85	16/SOIC	3.30
ISO1050	Isolated 5 V CAN transceivers	No	Half	2.5, 5	3	5.5	4.75	5.25	1		4	Idle, open and short	–55 to 105	16/SOIC, 8/SOP	1.55

Interface

Digital isolators / window comparator

Digital isolators

Part Number	Description	Isolation Rating (kVrms)	Peak Isolation Rating (Vpk)	Working Voltage (Vpk)	Forward / Reverse Channels	Speed (Max) (Mbps)	VCC (Min) (V)	VCC (Max) (V)	Default Output	Propagation Delay (Typ) (ns)	Operating Temperature Range (°C)	Pin/Package	Price* (US$)
ISO7321FC/C	Robust EMC, low power, dual-channel 1/1 digital isolator, fail-safe high	3000	6000	566	1/1	25	3.3	5	High	31	-40 to 125	8/SOIC	1.05
ISO7341FC/C	Robust EMC, low power, quad-channel 3/1 digital isolator, fail-safe high	3000	6000	1414	3/1	25	3	5.5	FC= Low C= High	31	-40 to 125	16/SOIC	1.80
ISO7141FCC	4242-VPK small-footprint and low-power 3/1 quad-channel digital isolator with fail-safe output low	2500	4000	560	3 / 1	50	2.7	5	Low	23	–40 to 125	16/SSOP	1.90

Window comparator

Part Number	Description	Vs (Min) (V)	Vs (Max) (V)	t_{RESP} Low-to-High (µs)	Vos (Offset Voltage @ 25°C) (Max) (mV)	Iq per Channel (Max) (mA)	Output Type	Input Bias Current (±) (Max) (nA)	Number of Channels	Special Features	Rail-Rail	Operating Temperature Range (°C)	Pin/ Package	Price* (US$)
TPS3701	36 V window comparator with internal ref for over- and undervoltage detection	1.8	36	28	5.5	0.011	Open drain	25	1	Hysteresis, internal reference	In	–40 to 125	6/SOT	0.89

Clocking

Clock generators and XO replacement / clock fanout

Clock generators and XO replacement

Part Number	Number of Outputs	Output Levels	Max Output Frequency in MHz	VCC Core (V)	VCC Out (V)	Programmability	Dividers	Jitter RMS	Operating Temperature Range (°C)	Pin/Package	Price* (US$)
CDCE(L)913	3	LVCMOS	230	1.8	3.3/2.5/1.8	I2C, EEPROM, pin	Fractional and integer	> 1ps	-40 to 85	14/TSSOP	1.6
CDCEL824	4	LVCMOS	201	1.8	1.8	I2C, EEPROM, pin	Fractional and integer	> 1ps	-40 to 85	16/TSSOP	1.85
CDCE(L)925	5	LVCMOS	230	1.8	3.3/2.5/1.8	I2C, EEPROM, pin	Fractional and integer	> 1ps	-40 to 85	16/TSSOP	1.93
CDCE906	6	LVCMOS	167	1.8	3.3	I2C, EEPROM, pin	Fractional and integer	> 1ps	-40 to 85	20/TSSOP	2.2
CDCE(L)937	7	LVCMOS	230	1.8	3.3/2.5/1.8	I2C, EEPROM, pin	Fractional and integer	> 1ps	-40 to 85	20/TSSOP	2.14
CDCE(L)949	9	LVCMOS	230	1.8	3.3/2.5/1.8	I2C, EEPROM, pin	Fractional and integer	> 1ps	-40 to 85	24/TSSOP	2.35
CDCM6208	8	CML, HCSL, LVCMOS, LVDS, LVPECL	800	3.3/2.5/1.8	3.3/2.5/1.8	I2C, SPI, EEPROM, pin	Fractional and integer	265 fs	-40 to 85	48/VQFN	5.2
CDCE62002/5	2/5	LVPECL, LVDS, LVCMOS	1175	3.3	3.3	SPI, EEPROM	integer	500 fs	-40 to 85	32 or 48/ VQFN	6.60 to 7.5
CDCM9102	2	HCSL	100	3.3	3.3	uWire, pin	integer	500 fs	-40 to 85	32/VQFN	2.25
LMK03328	8	CML, HCSL, LVCMOS, LVDS, LVPECL	1000	3.3	3.3/2.5/1.8	I2C, EEPROM, pin	Fractional and integer	100 fs	-40 to 85	48/WQFN	10

Clock fanout buffers

Part Number (Families*)	Number of Outputs	Output Levels	Max Output Frequency in (MHz)	VCC Out (V)	Operating Temperature Range (°C)	Pin/Package	Price* (US$)
CDCLVC11xx	2/4/6/8/10/12	LVCMOS	250	2.5/3.3	-40 to 85	8 to 24/TSSOP	0.90 to 2.60
CDCVLD12xx	4/8/10/12/16	LVDS	800	2.5	-40 to 85	16 to 48/VQFN	2.85 to 5.90
CDCLVP11xx	2/4/8/10	LVPECL	2000 to 3500	2.5/3.3	-40 to 85	16 to 32/VQFN	3.15 to 5.55
CDCV304	4	LVCMOS	200	2.5/3.3	-40 to 85	8/TSSOP	1.2
LMK0010x	5/10	LVCMOS	200	2.5/3.3	-40 to 85	24 or 32/WQFN	2.25 or 2.95
LMK0030x	4/6/10	LVPECL, LVDS, HCSL, LVCMOS	3100	2.5/3.3	-40 to 85	32 or 28/WQFN	3.35 to 5.25
LMK0033x	4/8	HCSL	400	2.5/3.3	-40 to 85	32 or 40/WQFN	1.20 or 1.80
CDCUN1208LP	8	LCMOS, LVDS, HCSL	400	1.8/2.5/3.3		32/VQFN	5

*) 'x' indicates family of devices

DC-DC regulators

Part Number	Description	V_{IN} (Min) (V)	V_{IN} (Max) (V)	V_{OUT} (Min) (V)	V_{OUT} (Max) (V)	I_{OUT} (A)	Topology	Switch Current Limit (Typ) (A)	Iq (Typ) (mA)	Duty Cycle (Max) (%)	Soft Start	Compensation	Special Features	Operating Temperature Range (°C)	Pin/ Package	Price* (US$)
TPS54218/318	2.95 V to 6 V input, 2/3 A synchronous step-down SWIFT™ converter	2.9	6	0.8	4.5	2/3	Buck	2.9/4	0.35	98	Adjustable	External	Enable, frequency synchronization, power good, tracking	–40 to 150	116/WQFN	1.40/1.80
TPS54320	4.5 V to 17 V input, 3 A synchronous step-down SWIFT converter	4.5	17	0.8	15	3	Buck	4.2	0.6	98	Adjustable	Internal	Enable, frequency synchronization, power good, tracking	–40 to 150	14/VQFN	1.50
TPS62175	28 Vin, 0.5 A step-down converter with DCS-Control™	4.75	28	1	6	0.5	Buck, synchronous buck	1	0.022	100	Adjustable	Internal	Enable, light load efficiency, sleep mode, power good	–40 to 85	10/SON	0.70
TPS55340	Integrated, 5 A 40 V wide input range boost/ SEPIC/flyback DC-DC converter	2.9	32	3	38	3	Boost, SEPIC, flyback	6	0.5	90	Adjustable	External	Enable, frequency synchronization, power good	–40 to 125	14/HTSSOP, 16/WQFN	1.85
TPS62150	3 V to 17V input 1A step-down converter with DCS-Control	3	17	0.9	6	1	Buck, synchronous buck	1.7	0.017	100	Adjustable	Internal	Enable, light load efficiency, power good, tracking, voltage margining	–40 to 85	16/QFN	0.98
TPS54360/560	4.5 V to 60 V input 3.5 A / 5 A step-down DC-DC converter with Eco-mode™	4.5	60	0.8	58.8	3.5/5	Buck, inverting buck-boost	5.5/7.5	146	98	No	External	Enable, frequency synchronization, light load efficiency, adjustable UVLO	–40 to 125	8SO PowerPAD	2.30
TPS54062/61	4.7 V to 60 V input, 50 mA / 200 mA synchronous step-down converter	4.5	60	0.8	58	0.050/ 0.200	Buck	0.13/0.35	0.09	98	Fixed	External	Enable, frequency synchronization, light load efficiency	–40 to 125	8/SON, 8/ VSSOP	0.88
TPS54361/561	4.5 V to 60 V input 3.5 A / 5 A step-down DC-DC converter with soft-start and Eco-mode	4.5	60	0.8	59	3.5/5	Buck	5.5/7.5	152	98	Adjustable	External	Enable, frequency synchronization, light load efficiency, power good, tracking, adjustable UVLO	–40 to 125	0.88	3.00
LM5160	65 V, 1.5 A synchronous step-down converter with integrated high-side and low-side MOSFETs.	4.5	65	2	60	1.5	Buck	2.5	2.3	92	Adjustable	No compensation needed	Adjustable UVLO, enable, light load efficiency, pre-bias start-up, synchronous rectification	–40 to 125	12WSON	1.8
LM5017	100 V, 600 mA constant on-time synchronous buck regulator	9	100	1.25	90	0.6	Constant on-time synchronous buck	1.3	1.75	90	External	No compensation needed	Intelligent current limit, primary-side fly-buck regulation	–40 to 125	8/SO PowerPAD, 8/WSON	1.57

**Suggested resale price in U.S. dollars in quantities of 1,000.*

*New products are listed in **bold red***

DDR termination regulators

Part Number	Description	DDR Memory Type	I_{OUT} VTT (Max) (A)	I_{OUT} VTT (Max) (A)	V_{IN} (Max) (V)	Iq (Typ) (mA)	Output	Additional Features	Operating Temp. (°C)	Pin/ Package	Price* (US$)
TPS51200	3 A sink/source DDR termination regulator with VTTREF buffered reference	DDR, DDR2, DDR3, DDR3L, DDR4, LPDDR2, LPDDR3	3	1.1	3.5	0.5	VREF VTT	Enable, power good	–40 to 85	10/VSON	0.75
TPS53317	6 A, low input voltage synchronous step-down SWIFT™ converter	DDR, DDR2, DDR3, DDR3L, DDR4, LPDDR2, LPDDR3	6	1	6	0.32	VTT	Overvoltage, Over-Temperature and Hiccup Undervoltage Protection	–40 to 85	20/VQFN	2.60

Power management

LDO linear regulators / supply voltage supervisor / power management ICs (PMICs)

LDO linear regulators

Part Number	Description	Output Options	I_{OUT} (Max) (A)	V_{IN} (Min) (V)	V_{IN} (Max) (V)	V_{OUT} (Min) (V)	V_{OUT} (Max) (V)	Iq (Typ) (mA)	Vdo (Typ) (mV)	Noise (µVrms)	Additional Features	Operating Temperature Range (°C)	Pin/ Package	Price* (US$)
TPS7A47	36 V, 1 A, 4.17 µVRMS, RF LDO voltage regulator	Adjustable Output	1	3	36	1.4	34	0.58	307	4	Enable, overcurrent protection, soft start, thermal shutdown	–40 to 125	20/QFN	2.10
TPS7A33	Vin -3 V to -36 V, -1 A, ultra-low noise, high PSRR, low-dropout linear regulator	Adjustable Output	1	-36	-3	-33	-1.2	0.21	290	16	Enable, overcurrent protection, soft start, thermal shutdown	–40 to 125	20/QFN, TO-220	2.70
LM2992	Micropower 250 mA low-noise ultra low-dropout regulator	Fixed 1.5V , 1.8 V, 2.5 V, 3.3 V, 5 V	0.25	2.2	16	Fixed outputs	Fixed outputs	0.065	450	30	Enable, overcurrent protection, thermal shutdown	–40 to 125	5/SOT, 6/SON	0.38
TLV1117	Single output LDO, 800 mA, fixed and adj., internal current limit, thermal overload protection	Adjustable Output	0.8	15	2.7	13.7	1.25	0.08	1200	–	Overcurrent protection, thermal shutdown	–40 to 125, 0 to 125	DDPAK/TO-263, SON, SOT-223, TO-220, TO-252	0.18
UA78L05	3/8 pin 100 mA fixed 5 V positive voltage regulator	Fixed Output	0.1	20	7	5	5	3.8	1700	42	Overcurrent protection, thermal shutdown	0 to 125	SOIC, SOT-89, TO-92	0.09
TPS709	30 V, 150 mA, ultra-low Iq low-dropout regulator	Fixed 1.2V, 1.35V, 1.5V, 1.6V, 1.8V, 1.9V, 2.5V, 2.8V, 3.0V, 3.3V, 3.6V, 3.8V, 3.9V, 5.0V, 6.0V	0.15	2.7	30	Fixed outputs	Fixed outputs	0.001	300	–	Reverse current protection, enable, overcurrent protection, thermal shutdown	–40 to 125	5/SOT, 6/SON	0.39
TLV733P	Capacitor-free, 300 mA, low-dropout regulator with foldback current limit	Fixed 1.0V, 1.1V, 1.2V, 1.5V, 1.8V, 2.5V, 2.8V, 2.85V, 3.0V, 3.3V	0.3	1.4	5.5	Fixed outputs	Fixed outputs	0.034	122	–	Enable, stable without output capacitors, foldback overcurrent protection, output discharge, thermal shutdown	–40 to 125	5/SOT, 4/SON	0.17

Supply voltage supervisor

Part Number	Description	# of Supplies Monitored	Threshold Voltages (Typ) (V)	VCC (Min) (V)	VCC (Max) (V)	Iq (Typ) (µA)	Output Driver Type / Reset Output	Reset Threshold Accuracy (%)	Watchdog Timer WDI (s)	Time Delay (ms)	Special Features	Operating Temperature Range(C)	Pin/ Package	Price* (US$)
TPS386000	Quad supply voltage supervisors with programmable delay and watchdog timer	4	0.4	1.8	6.5	12	Active-low, open-drain	1	0.45	20, 300, programmable	Manual reset, negative voltage monitoring, overvoltage sense, programmable delay	–40 to 125	20/QFN	0.95

Power Management ICs (PMICs)

Part Number	Description	Regulated Outputs (#)	MCU/ processor attached	V_{IN} (Min) (V)	V_{IN} (Max) (V)	LDO	Step-Up DC/DC Converter	Step-Down DC/ DC Converter	Iout (Max) (A)	Operating Temperature Range (°C)	Pin/ Package	Price* (US$)
TPS659039	Automotive power management IC (PMIC) for ARM® Cortex®-A15 processor	13	AM572x	3.15	5.5	6	–	7	6	–40 to 85	169NFBGA	–
TPS65917	Power management unit (PMU) for processor	10	DRA72x, TDA3x	3.15	5.5	5	–	5	7	–40 to 105	40WQFN	–
TPS65218	PMIC for ARM Cortex-A8/A9 SoCs and FPGA	7	AM437x AM335x	2.2	5.5	1	1	5	–	–	48HTQFP 48VQFN	3.45
TPS65023	6-channel PMIC with 3DC/DCs, 3 LDOs, I2C interface and DVS	6	DM357x DM644x AM35xx	1.5	6.5	3	–	3	–	–	40WQFN	2.95
TPS650250	Integrated power management IC w/ 3 DC/DCs and 3 LDOs in 5 mm QFN	6	-	2.5	6	3	–	3	1.6	–40 to 85	32 VQFN	2.20
TPS65910A	Integrated power management IC w/ 4 DC/DCs, 8 LDOs and RTC in 6 mm QFN	11		2.7	5.5	9	1	3	1.7	–40 to 85	48 VQFN	3.45
TPS65217	Single-chip PMIC for battery-powered systems for AM335x ZCE/ZCZ, DDR2	7		2.7	5.8	4	–	3	1.2	–40 to 105	48 VQFN	3.45

**Suggested resale price in U.S. dollars in quantities of 1,000*

Power management

Load switches / USB load switches / eFuses / power over ethernet

Load switches

Part Number	Description	V_{IN} (Max) (V)	Imax (A)	Ron (mΩ)	Leakage Current (µA) (Typ)	Channels	Special Features	Operating Temp. (°C)	Pin/ Package	Price* (US$)
TPS22954	5.7 V, 5 A, 14 mΩ load switch with voltage monitoring and quick output discharge	0.7 to 5.7	5	14	34	1	Adjustable rise time, power good, quick output discharge Vbias	–40 to 105	10WSON	0.36
TPS22968	5.5 V, 4 A, 25 mΩ, 2-channel load switch with quick output discharge and adjustable rise time	0.8 to 5.5	4	25	55	2	Adjustable rise time, quick output discharge Vbias	–40 to 85	14WSON	0.36
TPS22960	5.5V, 0.5A, 435mΩ, 2-Channel Load Switch with Quick Output Discharge	1.62 to 5.5	0.5	435	0	2	Quick output discharge	–40 to 85	8SOT-23 8UQFN	0.36

USB load switches

Part Number	Description	V_{IN} (Max) (V)	Imax (A)	Ron (mΩ)	Leakage Current (µA) (Typ)	Channels	Special Features	Operating Temperature Range (C)	Pin/ Package	Price* (US$)
TPS2553	Adjustable, precision, current-limited power-distribution switch	6.5	1.5	85	1	1	Adjustable current limit, reverse input/output voltage protection UL-listed	–40 to 85	6 SOT-23 6SON	0.75
TPS2051B	0.5 A fixed current limit, power-distribution switch	5.5	0.5	70	1	1	Overcurrent flag thermal and short circuit protection UL-listed	–40 to 85	6 SOT-23 8MSOP Power Pad 8SOIC	0.5
TPS2052B	0.5 A fixed current limit, power-distribution switch	5.5	0.5	70	1	2	Overcurrent flag thermal and short circuit protection UL-listed	–40 to 85	8MSOP Power Pad 8SOIC 8SON	0.63

eFuses

Part Number	Description	V_{IN} (Max) (V)	Imax (A)	Ron (mΩ)	Current Limit Accuracy	Channels	Special Features	Operating Temp. (°C)	Pin/ Package	Price* (US$)
TPS25927	18 V, 5 A, 28 mΩ eFuse with BFET driver for reverse current protection	4.5 to 18	5	28	±8%	1	Reverse current protection, thermal shutdown, undervoltage protection	–40 to 85	10VSON	0.55
TPS25921	18 V, 1.6 A, 90 mΩ eFuse with adjustable +/-2% accurate current limit	4.5 to 18	1.6	90.0	±2%	1	Fault reporting, overvoltage protection, undervoltage protection	–40 to 85	8SOIC	0.50
TPS25942	18 V, 5 A, 42 mΩ current limiting power MUX eFuse w/integrated reverse current protection, IMON & PG	2.7 to 18	5	42	±8%	1	Current sense/monitor, fault reporting, overvoltage protection, power good, reverse current protection, thermal shutdown, undervoltage protection	–40 to 85	20WQFN	1.10

Power over ethernet (PoE)

Part Number	Description	PoE Standards Supported	PD Power Level	PoE Inrush Limit (Typ) (mA)	PoE Current Limit (Min) (mA)	UVLO	rDS(on) per FET (Typ) (mΩhms)	Fault Response	Error Amplifier	Auxiliary/ Local Power Support	Auxiliary Power Rails Supported	Duty Cycle (%)	Switching Frequency	Pin/ Package	Price* (US$)
TPS2379	IEEE 802.3at PoE high-power PD interface with external gate driver	802.3at type 2	External circuit	140	850	802.3at type 1/ type 2	420	Auto retry	No	No	N/A		N/A	8/SO PowerPAD	1.00
TPS2378	IEEE 802.3at PoE high-power PD interface with AUX control	802.3at type 2	25 W	140	850	802.3at type 1/ type 2	420	Auto retry	No	Yes	Yes		N/A	8/SO PowerPAD	1.00
TPS23753A	IEEE 802.3-2005 PoE interface and isolated converter controller with enhanced ESD ride-through	802.3at type1	13 W	140	405	Unified	700	Auto retry	No	Programmable	12V-57 V	78	Programmable, synchronizable	14/TSSOP	1.10
TPS23754-1	IEEE 802.3at PoE interface and isolated converter controller	802.3at type1, 2	25 W	140	850	Unified	430	Auto retry	No	Programmable	24V-57 V	78	Programmable, synchronizable	20/HTSSOP	1.25

**Suggested resale price in U.S. dollars in quantities of 1,000.*

Notes

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