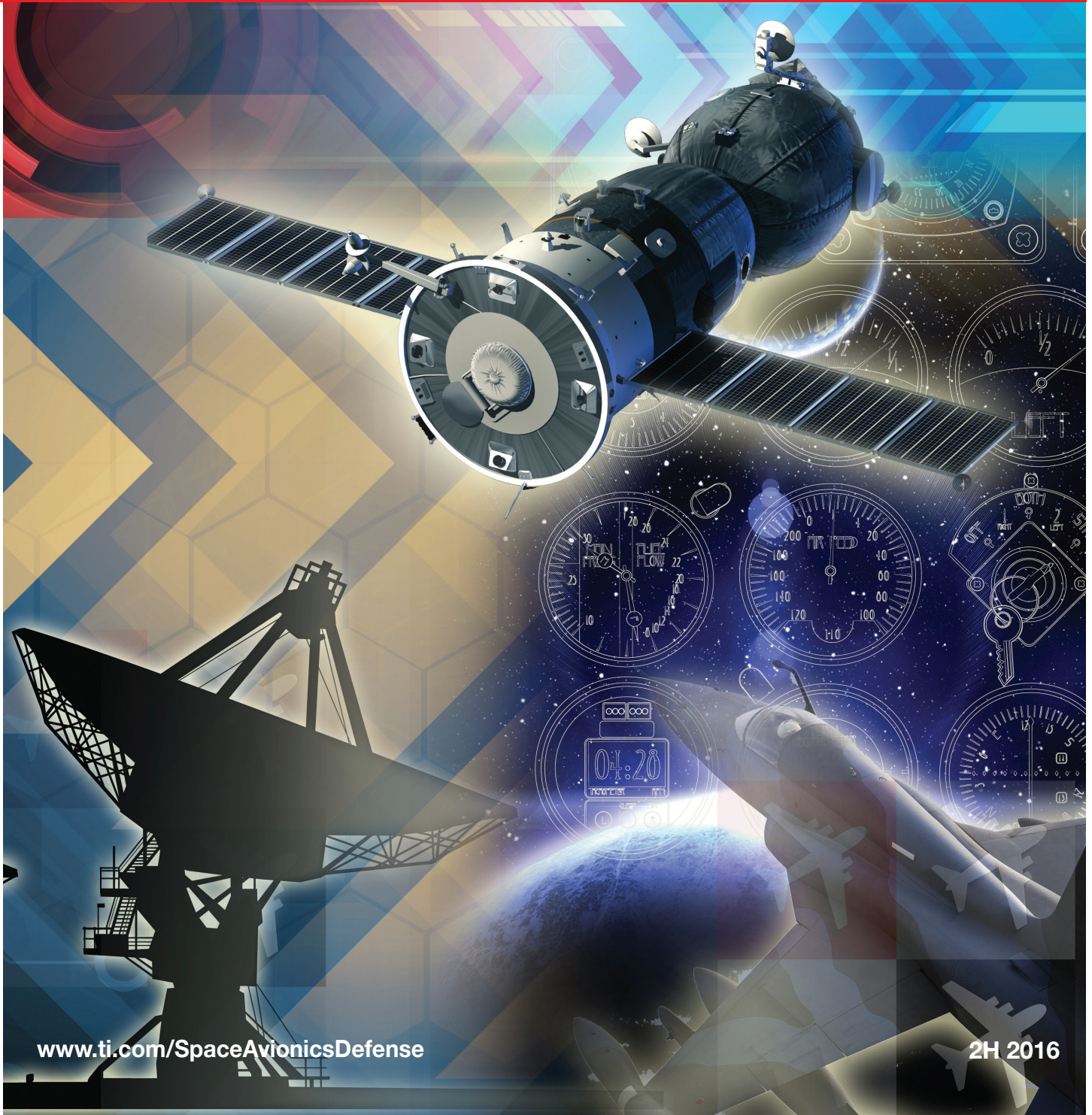


TI Components for Space, Avionics and Defense



www.ti.com/SpaceAvionicsDefense

2H 2016

TI Components for Space, Avionics and Defense

Table of Contents and Introduction

Introduction

The following guide outlines TI's latest components for space, avionics and defense, along with a high-level overview of TI's commitment to this segment.

TI's Broad COTS Portfolio

For more than 80 years, customers have counted on the industry's broadest portfolio of analog and embedded processing products to address challenging or extreme environments. TI's commercial off-the-shelf (COTS) components offer various benefits, including: extended industrial temperature performance, pin-to-pin compatibility among several product families and lower BOM costs for those applications that require it. With a vast selection of data converters, power components, digital signal processors, logic, op amps, memory, clocking and interface offerings, TI aims to be a one-stop shop for space, avionics and defense customers.

Table of Contents

TI Components for Space, Avionics and Defense

2 Introduction

TI Enhanced Products (EP)

3 Ruggedized Plastic Devices

Space Products

4 Components for Extreme Environments

High-Speed Signal Chain

5 High-Speed Analog-to-Digital Converters (ADCs)

6 High-Speed Digital-to-Analog Converters (DACs)

7 High-Speed Amplifiers

8 Clocks and PLLs/Synthesizers

9 High-Speed TI Designs

Precision Signal Conditioning and Monitoring

10 Precision Amplifiers

11 Voltage References

12 Precision Analog-to-Digital Converters (ADCs)

13 Precision Digital-to-Analog Converters (DACs)

14 Precision TI Designs

Power Management

15 Low-dropout Linear Regulators (LDOs)

16 Linear Regulators

17 Power Modules

18 Power TI Designs

Processors

19 COTS Multicore Processors for Mission Critical Customers

20 COTS Multicore Processors Featured Devices

21 Hardware Solutions for Multicore Processors

22 Software Solutions for Multicore Processors

Accelerating today's mission-critical designs, preparing for tomorrow's.

Look for **COTS** under a featured device to find the commercial-off-the-shelf solution for your application.



TI Enhanced Products (EP)

Ruggedized Plastic Devices

Enhanced Products

TI's Enhanced Products (EP) portfolio consists of more than 750 commercial off-the-shelf (COTS) products that span the board to create your solution for harsh environment applications. These products offer variety and design flexibility while still meeting avionic, defense and industrial standards for operating in environments where high quality and long service life are a requirement. Designers for any rugged operating environments and long service life application fields can benefit from this extensive portfolio. In addition, though these are products designed for harsh environments, more than 90% are EAR99 and can be sold with no restrictions anywhere in the world.

Key Benefits

- Extended temperature performance (typically -55°C to +125°C or customer specified)
- No pure tin used in device
- Au bond wire used exclusively
- Long product life cycles
- Fabrication, Assembly, Test, and Material Set controlled baseline
- DLA Vendor Items Drawings (VID or V62) part numbers eliminate need for source-controlled drawings
- Extended 180-day product change notification (PCN)
- Extended 250-hour HAST testing
- Product traceability through reliability reports

Enhanced Products (EP) Minimum Qualification Requirements

Description	Condition	Sample Size	Test Method
Electromigration	Maximum Recommended Operating Conditions	N/A	Per TI Design Rules
Wire Bond Life	Maximum Recommended Operating Conditions	N/A	Per TI Design Rules
Electrical Characterization	TI Data Sheet	50 units/lot	N/A
Electrostatic Discharge Sensitivity	HBM MM	3 units/voltage	EIA/JESD22-A114 EIA/JESD22-A115
Latch-up	Per Technology	5/0 units/lot	EIA/JESD78
Physical Dimensions	TI Data Sheet	5/0	EIA/JESD22- B100
Thermal Impedance	Theta-JA on board	Per Pin-Package	EIA/JESD51
Bias Life Test	125°C / 1000 hours or equivalent	116/0	JESD22-A108*
Biased Humidity	85°C / 85% / 1000 hours or 130°C / 85% / 96 hours	77/0	JESD22-A101* JESD22-A110
HAST	121 °C @ 2 atmospheres absolute for 96 hours	77/0	JESD22-A102*
Temperature Cycle	-65 °C to +150 °C non-biased for 1,000 cycles	77/0	JESD22-A104*
Solder Heat	260 °C for 10 seconds	22/0	JESD22-B106
Resistance to Solvents	Ink symbol only	12/0	JESD22-B107
Solderability	Condition A (steam age for 8 hours)	22/0	ANSI/J-STD-002-92
Flammability	Method A / Method B	5/0	UL-1964
Bond Strength	—	76/0 wires	ASTM F-459
Die Shear	—	5/0	TM 2019
High Temp Storage	150 °C / 1,000 hours	45/0	JESD22-A103-A*
Moisture Sensitivity	Surface Mount Only	12/0	J-STD-020-A*

* Precondition performed

EP Versus Upscreening

TI's EP portfolio offers an alternative to third party upscreening for designers who need higher reliability components. TI's EP line eliminates the following issues with upscreening:

- Yield loss and damage caused by electrical overstress and handling
- Mechanical damage, which causes moisture issues
- Burn-in, which can cause lead finish degradation
- Lack of support by IC manufacturers
- Few upscreening test facilities have the ability to test complex parts
- No access to TI's wafer processing history by third parties

Qualification

- Qualification data reviewed and audited for accuracy and compliance
- Reliability and electromigration monitoring performed at maximum recommended operating conditions in the targeted package
- Certified test programs and test hardware
- Electrical characterization performed across specified temperature range
- Package performance confirmed over extended temperatures (some mold compounds are not suitable for extended temperatures)
- Qualification and reliability reports



Click on image to see the guide.

For a complete list of TI enhanced products, see www.ti.com/ep

Look for **Enhanced Product** under a featured device to find the ruggedized plastic for your application

Look for **QMLQ** rated products under a featured device to find the ceramic solution for your application

Components for Extreme Environments

Texas Instruments offers the largest selection of leading edge radiation hardened and assured products for space flight. With a proven legacy of 45+ years in the space market supporting countless space programs both domestically and internationally, TI is a trusted partner. We focus on radiation assurance and best in class SWaP (Size, Weight, and Power) to enable leading edge designs. The breadth of TI's space portfolio provides a full signal chain solution. The portfolio includes the smallest rad hard point-of-load power solutions, fastest discrete SerDes, and some of the world's highest performance data converters.

TI offers radiation-tolerant, hermetically packaged components highlighted in each of the red blocks below.

High-Speed Signal Chain

High-Speed Analog-to-Digital Converters (ADCs)

TI is the industry's leading innovator in gigasample per second (GSPS) ADCs, providing the highest performance to meet your toughest requirements. TI brings RF sampling with high sample rates, wide bandwidth, high dynamic range and integrated digital down-converters to defense and aerospace applications. By leading the charge in to the JESD204B interface standard and providing education material around RF sampling architectures, TI provides the necessary reference designs and training seminars to reduce the board size of the latest radars, electronic signal intelligence, software defined radios, and electronic warfare designs.

High Speed ADC

Part Number	Description	Rating	Resolution (Bits)	Sample Rate (max) (SPS)	# Input Channels	SNR (dB)	SFDR (dB)	Power Consumption (Typ) (mW)	Interface	Analog Input BW (MHz)
ADC12D1600QML-SP	12-Bit, Single or Dual, 3200/1600/800 MSPS RF Sampling ADC	QMLV	12	3.2 GSPS	2	58.5	70.3	3880	Parallel LVDS, Serial SPI	2800
ADC12J1600	12-Bit, 1.6 GSPS RF sampling ADC with JESD204B interface	COTS	12	1.6 GSPS	1	55	70	1600	JESD204B	3300
ADC12J2700	12-Bit, 2.7 GSPS RF sampling ADC with JESD204B interface	COTS	12	2.7 GSPS	1	55	71	1800	JESD204B	3300
ADC12J4000	12-Bit, 4.0 GSPS RF sampling ADC with JESD204B interface	COTS	12	4 GSPS	1	55	71	2000	JESD204B	3300
ADC32RF45	Dual Channel 14-bit 3.0 GSPS Analog to Digital Converter	COTS	14	3 GSPS	2	61.5	75	6400	JESD204B	3200
ADS54J40	Dual-Channel, 14-Bit, 1.0-GSPS ADC	COTS	14	1 GSPS	2	69	86	1300	JESD204B	1200
ADS54J60	Dual Channel 16-bit 1.0 GSPS ADC	COTS	16	1 GSPS	2	70	86	1330	JESD204B	1200
ADS54J20	Dual-Channel, 12-Bit, 1.0-GSPS ADC	COTS	12	1 GSPS	2	67.8	84	1350	JESD204B	1200
ADS54J42	Dual-Channel, 14-Bit, 625-MSPS Analog-to-Digital Converter	COTS	14	625 MSPS	2	71	85	970	JESD204B	1200
ADS54J54	Quad Channel 14-Bit 500 MSPS ADC	COTS	14	500 MSPS	4	65.8	85	875	JESD204B	900
ADS54J66	Quad-Channel, 14-Bit, 500-MSPS ADC with Integrated DDC	COTS	14	500 MSPS	4	70.8	89	650	JESD204B	900
ADS54J69	Dual-Channel, 16-Bit, 500-MSPS ADC	COTS	16	500 MSPS	2	73	91	1350	JESD204B	1200
ADC14X250	14-Bit 250 MSPS Single Channel ADC	COTS	14	250 MSPS	1	71.1	93	584	JESD204B	800

TI offers various resources to accelerate high-speed designs. Together with **TI's Data Converter Learning Center**, the following materials are aimed at helping engineers who are focused on mission-critical projects:

- Training materials: High-speed signal chain university, www.ti.com/hsscu
- Clocking Optimization for RF Sampling Analog-to-Digital Converters, www.ti.com/lit/pdf/snua291
- Advanced JESD204B training video series, JESD204B multi-device synchronization: Breaking down the requirements, www.ti.com/lit/slyt628

Learn more about high-speed ADC solutions at: www.ti.com/gigasampleadc

High-Speed Signal Chain

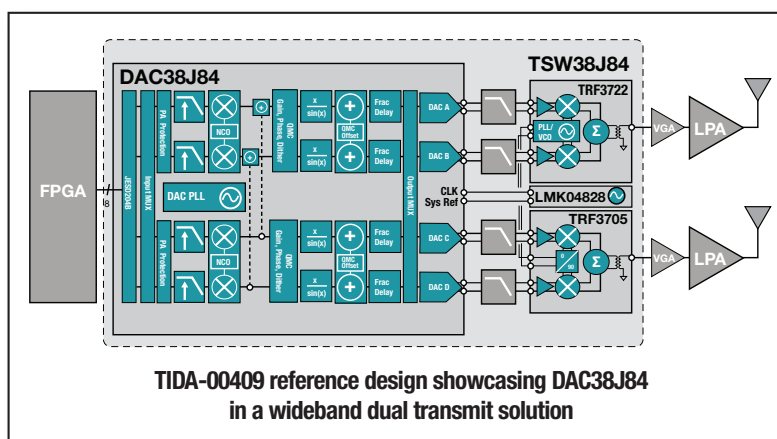
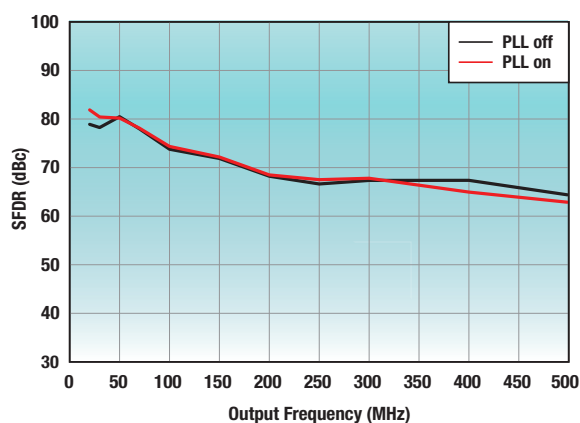
High-Speed Digital-to-Analog Converters (DACs)

TI's broad portfolio ranges from industry-standard communication DACs to ultra-high-speed and wide bandwidth DACs with advanced digital features and lowest power consumption bringing the highest performance to applications such as radar, software defined radios (SDR) and electronic warfare.

High Speed DAC

Part Number	Description	Rating	Resolution (Bits)	Sample / Update Rate (MSPS)	DAC: Channels	SNR (dB)	SFDR (dB)	IMD3 (dBc)	Power Consumption (Typ) (mW)	Interface
DAC39J84	Quad-Channel, 16-Bit, 2.8 GSPS, DAC	COTS	16	2800	4	–	68	76	1619	JESD204B
DAC5670-SP	14-Bit, 2.4 GSPS DAC	QMLV	14	2400	1	60	55	70	2000	Parallel LVDS
DAC34SH84	Quad-Channel, 16-Bit, 1.5 GSPS DAC	COTS	16	1500	4	–	80	86	1448	Parallel LVDS
DAC3484	4-channel 16-bit 1.25GSPS Digital-to-Analog Converter	COTS	16	1250	4	–	82	81	1200	Parallel LVDS
DAC5687-EP	Enhanced Product 16-Bit 500 Mps 2X-8X Interpolating Dual-Channel DAC	Enhanced Product	16	500	2	75	80	79	1410	Parallel CMOS

DAC39J84 SFDR vs output frequency over clocking options



Learn more about high-speed DAC solutions at: www.ti.com/highspeeddac

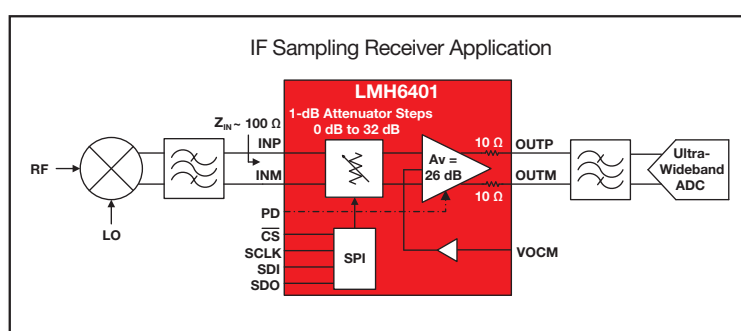
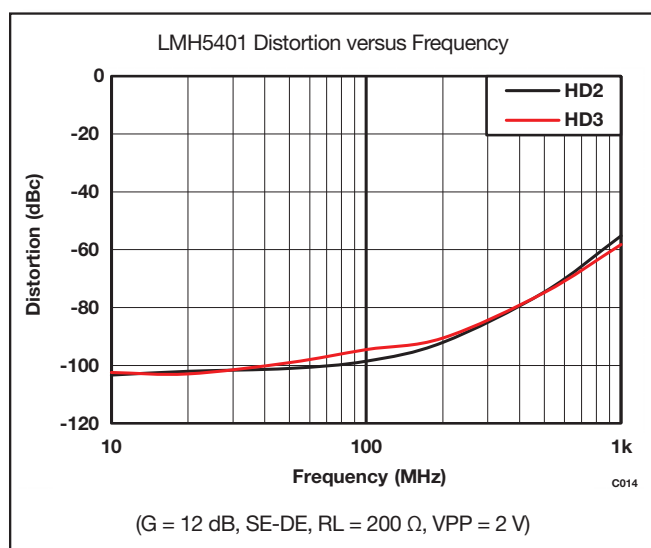
High-Speed Signal Chain

High-Speed Amplifiers

TI offers the industry's most comprehensive high speed amplifier portfolio with the widest bandwidth and best in class distortion, precision and power consumption across a broad range of supply voltages. Our industry leading FDA's, DVGA's, TIA's and general purpose amplifiers coupled with the reliability and longevity of our parts makes TI the ideal supplier of high speed amplifiers.

High Speed Amplifiers

Part Number	Description	Rating	Architecture	Number of Channels (#)	Total Supply Voltage (Min) (+5V=5, +/-5V=10)	Total Supply Voltage (Max) (+5V=5, +/-5V=10)	BW @ Acl (MHz)
THS4541	High-Speed Differential I/O Amplifier	COTS	Fully Differential, Voltage FB	1	2.7	5.4	620
THS4524-EP	Enhanced Product very low power quad channel rail-to-rail output fully differential amp	Enhanced Product	Fully Differential, Voltage FB	4	2.5	5.5	145
OPA365-EP	Enhanced Product 2.2V, 50MHz, Low-Noise, Single-Supply Rail-to-Rail Op Amp	Enhanced Product	Voltage FB, CMOS	1	2.2	5.5	50
LMH6522	High Performance Quad DVGA	COTS	Digitally Controlled Variable Gain Amplifier (DVGA)	4	4.75	5.25	–
LMH6521	High Performance Dual DVGA	COTS	Digitally Controlled Variable Gain Amplifier (DVGA)	2	4.75	5.25	
THS4524	Very low power quad channel rail-to-rail output fully differential amplifier	COTS	Fully Differential, Voltage FB	4	2.5	5.5	145
LMH5401	8GHz Ultra Wideband Fully Differential Amplifier	COTS	Fully Differential, Voltage FB, Bipolar	1	3.15	5.25	6200
LMH3401	7-GHz, Ultra-Wideband, Fully Differential Amplifier	COTS	Fully Differential, Voltage FB, Bipolar	1	3.15	5	7000
LMH6401	5 GHz Ultra Wideband Digital Variable Gain Amplifier	COTS	Digitally Controlled Variable Gain Amplifier (DVGA)	1	4	5.25	5000



Find out whether your RF/IR signal chain should consider using a **fully differential amplifier (FDA)** or **balun to drive high speed ADCs** in this new blog post.

Read more at: www.ti.com/highspeedamp

High-Speed Signal Chain

Clocks and PLLs/Synthesizers

JESD204B interface

The JESD204B serial interface standard for data converters provides board area, FPGA/ASIC pin-count and latency improvements over traditional LVDS and CMOS interfaces. TI's JESD204B ADCs, DACs, clock ICs and development tools enable quick evaluation, design and implementation of designs utilizing the JESD204B interface.

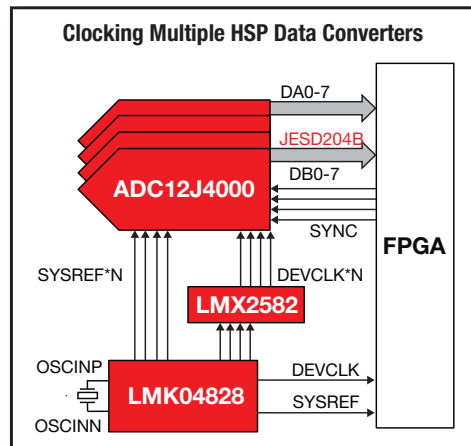
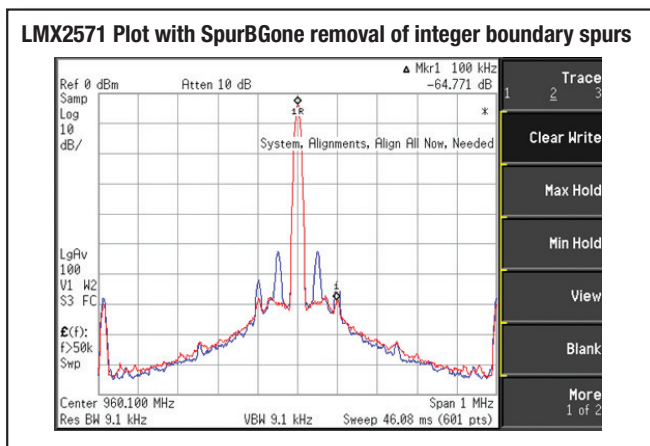
For more information on TI's JESD204B supported products, please visit the TI JESD204B landing page at: www.ti.com/jesd204b

Clocks

Part Number	Description	Rating	SubFamily	No. of Outputs	Output Level	Output Frequency (Min) (MHz)	Output Frequency (Max) (MHz)
LMK04826	Ultra Low Jitter Synthesizer and Jitter Cleaner	COTS	Dual / Cascaded PLL	15	HSDS, LCPECL, LVCMOS, LVDS, LVPECL	0.225	2505
LMK04828	Ultra Low Jitter Synthesizer and Jitter Cleaner	COTS	Dual / Cascaded PLL	15	HSDS, LCPECL, LVCMOS, LVDS, LVPECL	0.289	3080
LMK04816	Three Input Low Power, Low Noise Clock Jitter Cleaner with Dual Loop PLLs	COTS	Dual / Cascaded PLL	12	LVCMOS, LVDS, LVPECL	0.22	2600
CDCM7005-SP	3.3-V High Performance Rad-Tolerant Class V, Clock Synchronizer And Jitter Cleaner	QMLV	Single-Loop PLL	5	LVCMOS, LVPECL	0	1500
CDCM7005	High Performance, Low Phase Noise, Low Skew Clock Synchronizer that Synchronizes Ref Clock to VCXO	COTS	Single-Loop PLL	5	LVCMOS, LVPECL	0	1500
LMK03806	Ultra-low jitter clock generator with 14 outputs	COTS	Clock Generator	14	LVCMOS, LVDS, LVPECL	0/25	1300

PLL / Synthesizers

Part Number	Description	Rating	Output Frequency (Min) (MHz)	Output Frequency (Max) (MHz)	Normalized PLL Phase Noise (dBc/Hz)	VCO Phase Noise (Nom) (dBc/Hz)	1/f Noise (10 kHz offset at 1 GHz carrier) (dBc/Hz)	Special Features
LMX2582	High Performance, Wideband PLLatinum RF Synthesizer	COTS	20	5500	-231	-129	-126	Integer-Boundary Spurs (IBS) removal, Phase adjustment, Wideband
LMX2592	Wideband Frequency Synthesizer with Integrated VCO	COTS	20	9800	-231	-129	-126	Integer-Boundary Spurs (IBS) removal, Phase adjustment, Wideband
LMX2571	LMX2571 Low Power Synthesizer with FSK Modulation	COTS	10	1344	-231	-115	-124	FSK modulation, Integer-Boundary Spurs (IBS) removal, Wideband
LMX2492	500MHz to 14GHz Wideband, Low Noise Fractional N PLL with Ramp/Chirp Generation	COTS	500	14000	-227	—	-120	Flexible ramp generation, Wideband



Learn more about clocking solutions at: www.ti.com/clocks

TI's catalog of broadband RF products feature high-linearity, low-noise solutions with EVMs and reference designs available.

Design Number	Description	
TIDA-01163 Multi-band RF Sampling Receiver Reference Design	The reference design showcases the ADC32RF80 dual channel, 14-bit, 3-GSPS RF sampling receiver. - Digital down converter with decimation solution - Low noise, high dynamic range RF sampling receiver solution - Low-phase noise clocking solution for RF sampling ADC	
TIDA-00467 Synchronizing Multiple JESD204B ADCs for Emitter Position Location Reference Design	TIDA-00467 offers a reference design to estimate the position of emitters using the amplitude and phase shift data of a signal derived from an array of spatially distributed sensors. - Reference design made from TI JESD204B ADC and clock conditioner - Design guide highlights how multiple ADCs with JESD204B interface can be synchronized to be phase aligned	
TIDA-00814 RF Sampling S-Band Radar Receiver Reference Design	A direct RF sampling receiver approach to a radar system operating in S-band is demonstrated using the ADC32RF45, 3-GSPS, 14-bit analog to digital converter (ADC). - Supports greater than 1-GHz instantaneous signal bandwidth - Receiver based on the ASR-11 air traffic control radar specifications	
TIDA-00996 Synchronized Multi-Transmitter Reference Design: Method of Time-Aligning Multiple DAC3xJ8x in JESD204B	This design showcases two DAC38J84 DACs in synchronization and facilitates the design of a multiple-antenna transmitter system.	
TIDA-00823 16-Bit 1-GSPS Digitizer Reference Design with AC and DC Coupled Fixed Gain Amplifier	This reference design discusses the use and performance of the LMH3401 ultra-wideband, fixed-gain high-speed amplifier to drive the ADS54J60 high-speed analog-to-digital converter (ADC). Different options for common-mode voltages, power supplies and interfaces are discussed and measured, including AC-coupling and DC-coupling, to meet the requirements of a variety of applications.	

Precision Signal Conditioning and Monitoring

Precision Amplifiers

TI offers catalog precision amplifiers, featuring low-noise, zero-drift and low input bias current for sensor signal conditioning and accurate system monitoring.

Op-Amps

Part Number	Description	Rating	# of Channels	Total Supply Voltage (Min)	Total Supply Voltage (Max)	GBW (Typ) (MHz)	Vos @ 25C (Max) (mV)	CMRR (Typ) (dB)
OPA140	11MHz, Single Supply, Low Noise, Precision, Rail-to-Rail Output, JFET Amplifier	COTS	1	4.5	36	11	0.12	140
OPA191	Low-Power, Precision, 36-V, e-trim CMOS Amplifier	COTS	1	4.5	36	2.5	0.025	140
OPA192	High Voltage, Rail-to-Rail Input/Output, Precision Op Amps, E-Trim(TM) Series	COTS	1	4.5	36	10	0.025	120
OPA197	36-V, Precision, Rail-to-Rail Input Output, Low Offset Voltage Op Amp	COTS	1	4.5	36	10	0.25	140
OPA2192	36-V, Precision, RRIO, Low Offset Voltage, Low Input Bias Current Op Amp with e-trim	COTS	2	4.5	36	10	0.025	120
OPA2211-EP	1.1nV/rHz Noise, Low Power, Precision Operational Amplifier	Enhanced Product	2	4.5	36	45	0.175	120
OPA4192	Low-Noise, Low Quiescent Current, 36V RRI/O Precision Op Amps, E-Trim(TM) Series	COTS	4	4.5	36	10	0.025	120
OPA4277	High Precision Operational Amplifiers	COTS	4	4	36	1	0.05	140
OPA4277-EP	Enhanced Products High Precision Operational Amplifiers	Enhanced Product	4	4	36	1	0.065	140
OPA625	High Bandwidth, High Precision, Low Noise & Distortion Amplifier SAR ADC Driver with Power Scaling	COTS	1	2.7	5.5	80	0.1	117

Instrumentation Amplifiers

Part Number	Description	Rating	# of Channels	Vs (Min) (V)	Vs (Max) (V)	IB (+/-) (Max) (nA)	CMRR (Min) (dB)	Non-Linearity (+/-) (Max) (%)
INA129-EP	Enhanced Product Precision, Low Power Instrumentation Amplifiers	Enhanced Product	1	4.5	36	5	120	0.002
INA826	Precision, 200-µA Supply Current, 36-V Supply Instrumentation Amplifier	COTS	1	2.7	36	65	120	0.0005
INA827	Precision, G>5, 200uA, 2.7-V to 36-V Supply Instrumentation Amplifier	COTS	1	2.7	36	65	110	0.0005

Difference Amplifiers

Part Number	Description	Rating	Number of Channels (#)	Vs (Min) (V)	Vs (Max) (V)	IQ (Max) (mA)	CMRR (Min) (dB)	Non-Linearity (+/-) (Max) (%)
INA149	High Common Mode Voltage Difference Amplifier	COTS	1	4	36	0.9	90	0.001
INA149-EP	Enhanced Product High Common Mode Voltage Difference Amplifier	Enhanced Product	1	2	18	0.9	84	0.001
INA159-EP	Enhanced Product Precision, Gain of 0.2 Level Translation Difference Amplifier	Enhanced Product	2	1.8	5.5	1.5	80	0.005

TI Precision Labs is the electronics industry's first comprehensive online classroom for analog engineers. The on-demand curriculum pairs theory and applied lab exercises to deepen the technical expertise of experienced engineers and accelerate the development of those early in their career. Watch any of the 40, free hands-on trainings and lab videos, covering analog amplifier design considerations with online course work at training.ti.com/ti-precision-labs-op-amps

Learn more about our precision amplifier portfolio at: www.ti.com/precisionamp

Precision Signal Conditioning and Monitoring

Voltage References

With more than 40 years of supply history, TI offers a broad portfolio of precision voltage references featuring low temperature coefficient, high initial accuracy and excellent long-term stability performance. Rely on TI's voltage reference solutions to support mission-critical applications requiring extended operating temperature ranges, robust materials and standard qualifications.

Voltage References

Part Number	Description	Rating	Sub Family	Vin (Min) (V)	Vin (Max) (V)	VO (V)	Initial Accuracy (Max) (%)	Temp Coeff (Max) (ppm/ degree C)
REF5020 / 30 / 40 / 50	Low Noise, Very Low Drift, Precision Voltage Reference	COTS	Series Voltage Reference	2.7 / 3.2 / 4.3 / 5.2	18	2.048 / 3 / 4.096 / 5	0.05, 0.1	3
REF5020 / 25 / 40 / 50-EP	Enhanced Product Low-Noise, Very Low Drift, Precision Voltage Reference	Enhanced Product	Series Voltage Reference	2.7 / 2.7 / 4.3 / 5.2	18	2.048 / 2.5 / 4.096 / 5	0.05, 0.1	3
LM136-2.5-N	Voltage Reference Diode	COTS	Shunt Voltage Reference	–	–	2.5	1	90
LM136-5.0	5.0V Reference Diode	COTS	Shunt Voltage Reference	–	–	5	1	90
LM136-5.0QML	5.0V Reference Diode	QMLQ	Shunt Voltage Reference	–	–	5	1	Adjustable
LM136-5.0QML-SP	5.0V Reference Diode	QMLV	Shunt Voltage Reference	–	–	5	1	Adjustable
LM136A-2.5QML	2.5V Reference Diode	QMLQ	Shunt Voltage Reference	–	–	2.5	1	Adjustable
LM136A-2.5QML-SP	2.5V Reference Diode	QMLV	Shunt Voltage Reference	–	–	2.5	1	Adjustable
LM136A-5.0QML	5.0V Reference Diode	QMLQ	Shunt Voltage Reference	–	–	5	1	Adjustable
LM185-1.2-N	Micropower Voltage Reference Diode	COTS	Shunt Voltage Reference	–	–	1.2	1	30
LM185-1.2QML	Micropower Voltage Reference Diode	QMLQ	Shunt Voltage Reference	–	–	1.2	1	30
LM185-1.2QML-SP	Micropower Voltage Reference Diode	QMLV	Shunt Voltage Reference	–	–	1.2	1	30
LM185-2.5QML	Micropower Voltage Reference Diode	QMLQ	Shunt Voltage Reference	–	–	2.5	0.8	30
LM185-2.5QML-SP	Micropower Voltage Reference Diode	QMLV	Shunt Voltage Reference	–	–	2.5	0.8	30
LM185-ADJ	Adjustable Micropower Voltage Reference	COTS	Shunt Voltage Reference	–	–	1.24	1, 2	30
LM185QML	Adjustable Micropower Voltage Reference	QMLQ	Shunt Voltage Reference	–	–	1.24	1	50
LM4050-N	Precision Micropower Shunt Voltage Reference	COTS	Shunt Voltage Reference	–	–	2.048, 2.5, 4.096, 5, 8.192, 10	0.1, 0.2, 0.5	50
LM4050QML-SP	Precision Micropower Shunt Voltage Reference	QMLV	Shunt Voltage Reference	–	–	2.5, 5	0.1	15
TL1431	Precision Adjustable (Programmable) Shunt Reference	COTS	Shunt Voltage Reference	–	–	2.5 to 36	0.4	114
TL1431-EP	Enhanced Product Precision Adjustable (Programmable) Shunt Reference	Enhanced Product	Shunt Voltage Reference	–	–	2.5 to 36	0.4	114
TL1431-SP	Precision Adjustable (Programmable) Shunt Reference	QMLV	Shunt Voltage Reference	–	–	2.5 to 36	0.4	114
TL1431M	Precision Adjustable (Programmable) Shunt Reference	QMLQ	Shunt Voltage Reference	–	–	2.5 to 36	0.4	114

Learn more at: www.ti.com/vref

Precision Signal Conditioning and Monitoring

Precision Analog-to-Digital Converters (ADCs)

TI's broad precision successive approximation register (SAR) and delta-sigma analog-to-digital converters (ADCs) operate at sampling rates less than 10 MSPS and with 12-bit to 32-bit resolution. Our industry-leading portfolio provides pinpoint precision for the most demanding designs; high integration to slash design time, board space and system cost; and the lowest power to reduce power consumption and extend battery life.

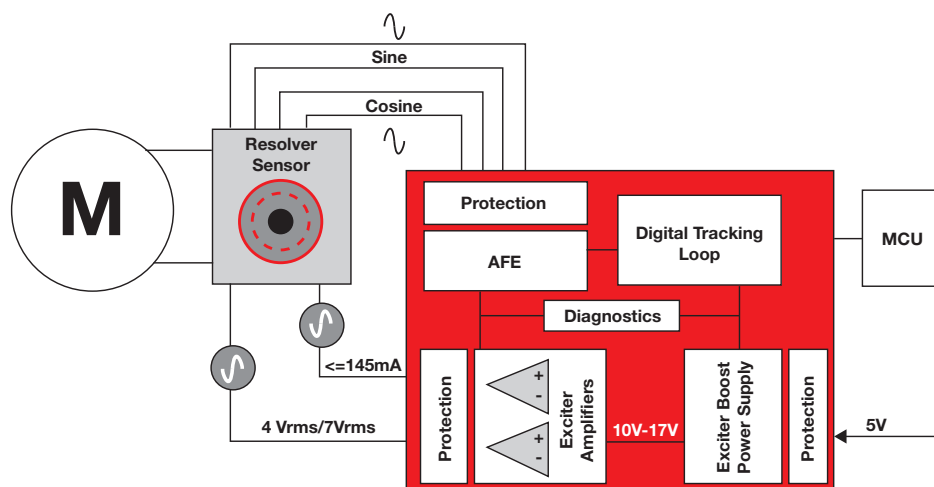
Precision ADCs

Part Number	Description	Rating	Resolution (Bits)	Sample Rate (max) (SPS)	# Input Channels	Multi-Channel Configuration	Input Range (Min) (V)	Input Range (Max) (V)	Integrated Features	Architecture
ADS1282-SP	High Resolution Analog-to-Digital Converter	QMLV	31	4kSPS	2	Multiplexed	0.5Vref/PGA		PGA	Delta-Sigma
ADS1278-EP	Enhanced Product Octal, 144kHz, Simultaneous Sampling 24-Bit Delta Sigma ADC	Enhanced Product	24	144kSPS	8	Simultaneous Sampling	0	5.25	Daisy-Chainable	Delta-Sigma
ADS1278	Octal, 144kHz, Simultaneous Sampling 24-Bit Delta Sigma ADC	COTS	24	144kSPS	8	Simultaneous Sampling	0	5.25	Daisy-Chainable	Delta-Sigma
ADS8698	18-bit SAR ADC, 8 channels, 500 kSPS, and bipolar inputs off +5V supply	COTS	18	500kSPS	8	Multiplexed	-10.24	10.24	Daisy-Chainable, Oscillator, Over-Voltage Protection, PGA	SAR
ADS8344	16-Bit, 8-Channel Serial Output Sampling Analog-to-Digital Converter	COTS	16	100kSPS	8	Multiplexed	0	5.25	–	SAR
ADS8688	SAR ADC with 16 bits, 8 channels, 500 kSPS, and bipolar inputs off +5V supply	COTS	16	500kSPS	8	Multiplexed	-10.24	10.24	Daisy-Chainable, Oscillator, Over-Voltage Protection, PGA	
ADS8568	16-Bit, 8-Channel, Simultaneous Sampling, Bipolar Input ADC	COTS	16	500kSPS	8	Simultaneous Sampling	-12	12	Daisy-Chainable, Oscillator	SAR
ADS8548	14-Bit, 8-Channel, Simultaneous Sampling, Bipolar Input ADC	COTS	14	600kSPS	8	Simultaneous Sampling	-12	12	Daisy-Chainable, Oscillator	SAR

For more information on PGA411-Q1, see www.ti.com/product/PGA411-Q1

Resolver Sensing Solution Based on TI's PGA411-Q1

- +/- 10.56 arc min or +/- 2.64 arc min maximum angular accuracy
- Integrated exciter amplifier (10-20 kHz) with short protection and integrated exciter boost power supply
- Built-in-Self-Test for functional safety enables better latent fault coverage



Learn more about TI's precision ADC portfolio at: www.ti.com/precisionadc

Precision Signal Conditioning and Monitoring

Precision Digital-to-Analog Converters (DACs)

TI's precision DAC portfolio includes several, highly integrated solutions to bias a LDMOS, GaN or GaAs power amplifier (PA) in an RF application. Monitoring the performance of your PA will allow you to improve the overall efficiency of the transmission system, maximize output power and achieve highest linearity.

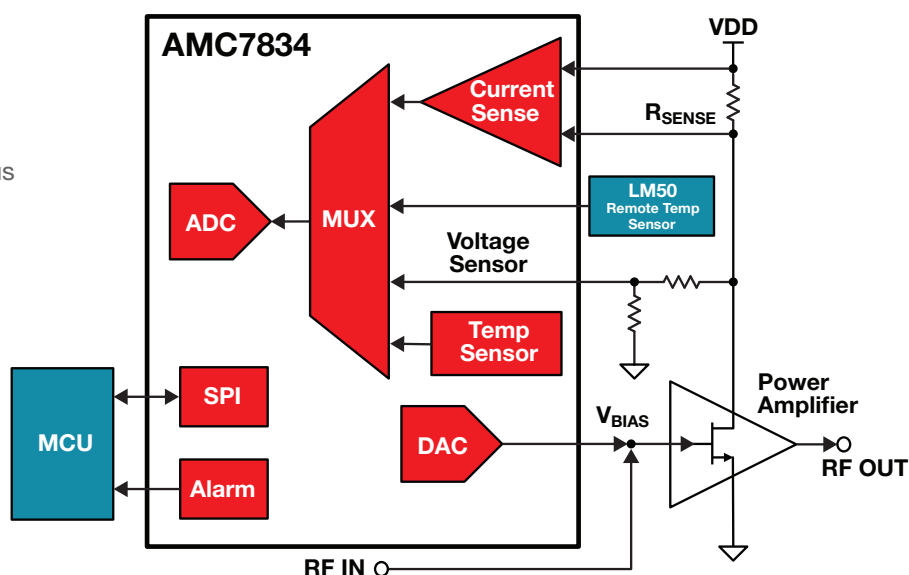
Precision DACs

Part Number	Description	Rating	Resolution (Bits)	DAC Outputs	DAC Output Range (V)	ADC Inputs	Temp Sensing	Current Sensing	Interface
AMC7812	Integrated, Multichannel ADC and DAC for Analog Monitoring & Control	COTS	12	12	0 to 5	16	Local + 2 Remote	No	SPI, I2C
AMC7823	Integrated, Multichannel ADC and DAC for Analog Monitoring & Control	COTS	12	8	0 to 5 -5 to 0 -4 to 1	8	Local	No	SPI
AMC7832	12-Bit High Density Analog Monitor and Control (AMC) Solution	COTS	12	12	0 to 5 0 to 12.5	17	Local	No	SPI
AMC7836	High-Density, 12-Bit Analog Monitor and Control Solution, Bipolar DAC	COTS	12	16	0 to 5 0 to 10 -10 to 0	21	Local	No	SPI
AMC7834	Integrated Power-Amplifier Monitor and Control System	COTS	12	8	0 to 5 0 to 10 -5 to 0 -10 to 0	4	Local + 2 Remote	4 current sensors 4 to 60	SPI

RF Power Amp Biasing Using

AMC7834

- Eight monotonic 12-bit DACs with programmable ranges
- Integrated current sensors enable calibration on-the-fly and autonomous drain current control
- Flexible DAC output ranges enables biasing for LDMOS, GaAs and GaN transistor technologies



Learn more about TI's precision DAC portfolio at: www.ti.com/precisiondac

The Precision TI Designs library is a collection of board and sub-system level circuits designed to help engineers quickly evaluate and customize their systems while expanding their analog knowledge base. Three levels of designs are offered — Reference, Verified and CeRTified — providing a combination of theory, methodology, simulation, tested results and design files from the desks of our analog experts.

Design Number	Description	
TIDA-00493 Voltage & Current (Power) Measurement AFE for mV Output Sensor Interface to SAR ADC Reference Design	TIDA-00493 TI design is a fixed gain amplifier stage for measuring low amplitude voltage and current inputs accurately over a wide dynamic range using SAR ADC for power measurement applications. Low-amplitude AC voltage from voltage dividers, current transformers or split core current sensors with a 333-mV output can be accurately measured.	
TIPD115 Data Acquisition Optimized for Lowest Distortion, Lowest Noise, 18-bit, 1MSPs Reference Design	This TI Verified Design is a high-performance data acquisition system (DAQ) using an 18-bit SAR ADC, ADS8881 at a throughput of 1 MSPS. This design has been optimized to provide the lowest noise and distortion solution for a full-scale input sinewave of 10 KHz. This leads to a maximum possible value for Effective Number of Bits (ENOB) at a total power consumption of less than 50 mW.	
TIDA-00209 Isolated Current Shunt and Voltage Measurement Reference Design for Motor Drives Using AM437x	This reference design uses the AMC130x reinforced isolated delta-sigma modulators along with AM437x Sitara™ ARM® Cortex® -A9 Processor, which implements Sinc filters on PRU-ICSS. The design provides an ability to evaluate the performance of these measurements: three motor currents, three inverter voltages, and the DC Link voltage.	

Power Management

LDOs

TI's low noise LDO portfolio will help reduce the flicker noise and reject ripple generated from switching power supplies. Using TI low noise LDOs can help improve SNR performance for your sensitive signal intelligence (SIGINT) systems. The use of new space FPGAs, ASICs and ADCs with multiple voltage rails in satellites has led to the need for an increase in point-of-load (POL) solutions in every design, causing a functionality vs. size trade-off. TI has developed several of the industry's smallest solutions, many at 50% of the size of competition, to enable our space customers to fit these POL components into designs without sacrificing product functionality.

Low Noise LDO

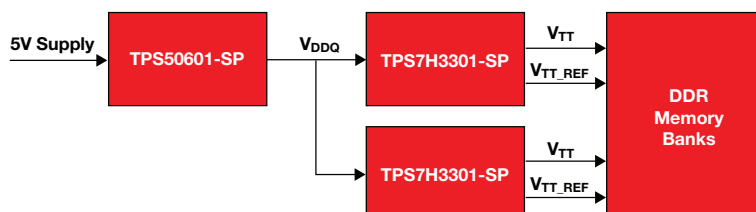
Part Number	Description	Rating	Iout (Max) (A)	Vin (V)	Vout (V)	PSRR @ 100 kHz (dB)	Output noise voltage (μVRMS)
TPS7A85	High-Current (4 A), High-Accuracy (1%), Low-Noise (4.4 μVRMS), LDO Voltage Regulator	COTS	4	1.1 to 6.5	0.8 to 5	25	4.4
TPS7A84	High-Current (3 A), High-Accuracy (1%), Low-Noise (4.4 μVRMS), LDO Voltage Regulator	COTS	3	1.1 to 6.5	0.8 to 5	25	4.4
TPS7A47	36-V, 1-A, 4.17-μVRMS, RF LDO Voltage Regulator	COTS	1	3 to 36	1.4 to 34	60	4.17
TPS7H1101-SP	1.5 -7V Input, 3 Amp, Ultra Low Dropout Regulator	QMLV	3	1.5 to 7	0.8 to 6.8	25	20.33
TPS7A8300	2A, Low-Dropout Voltage Regulator for High Speed Communication Systems	COTS	2	1.1 to 6.5	0.8 to 5	40	6
TPS7A33	Vin -3V to -36V, -1A, Ultra-Low Noise, High PSRR, Low-Dropout Linear Regulator	COTS	1	-36 to -3	-33 to -1.2	64	16

Wide VIN LDO

Part Number	Description	Rating	Iout (Max) (A)	Vin (V)	Vout (V)	Additional Features
TPS7A4001-EP	100V Input Voltage, 50mA Single Output Low Dropout Linear Regulator	Enhanced Product	0.05	7 to 100	1.2 to 90	Enable, Overcurrent Protection, Thermal Shutdown
TPS7A4501-SP	Wide Vin Low-Dropout Voltage Regulator	QMLV	1.5	2.3 to 20	1.21 to 20	Enable, Overcurrent Protection, Reverse Current Protection, Thermal Shutdown
TPS7A3001-EP	Enhanced Product Vin -3V to -36V, -200mA, Ultra-Low Noise, High PSRR, Low-Dropout Linear Regulator	Enhanced Product	0.2	-36 to -3	-33 to -1.2	Enable, Overcurrent Protection, Soft Start, Thermal Shutdown, Fast Transient Response
TPS7A49	Vin 3V to 36V, 150mA, Ultra-Low Noise, High PSRR, Low-Dropout Linear Regulator	COTS	0.15	3 to 36	1.2 to 33	Enable, Fast Transient Response, Overcurrent Protection, Soft Start, Thermal Shutdown
TPS7A30	Vin -3V to -36V, -200mA, Ultra-Low Noise, High PSRR, Low-Dropout Linear Regulator	COTS	0.2	-36 to -3	-33 to -1.2	Enable, Fast Transient Response, Overcurrent Protection, Soft Start, Thermal Shutdown
TPS54120	Low-Noise 1A Power Supply with Integrated DC-DC Converter and Low-Dropout Regulator	COTS	0.8 to 6	1	4.5 to 17	Enable, Power Good, Synchronous Rectification
TPS54122	Dual Output, High Efficiency 3A Switcher + 3A Low Noise LDO	COTS	0.8 to 4.5	3	2.95 to 6	Enable, Power Good

DDR Termination Regulators

Part Number	Description	Rating	DDR Memory Type	Control Mode	Vin (Min) (V)	Vin (Max) (V)	Iq (Typ) (mA)	Output
TPS51200	3A Sink/Source DDR Termination Regulator w/ VTTREF Buffered Reference for DDR2, DDR3, DDR3L and DDR4	COTS	DDR, DDR2, DDR3, DDR3L, DDR4, LPDDR2, LPDDR3	D-CAP, S3, S4/S5	1.1	3.5	0.5	VREF, VTT
TPS51216-EP	Enhanced Product Complete DDR2, DDR3 and DDR3L Memory Power Solution Synchronous Buck Controller	Enhanced Product	DDR, DDR2, DDR3, DDR3L, LPDDR2, LPDDR3	D-CAP, S4/S5	3	28	0.6	VDDQ, VREF, VTT
TPS7H3301-SP	Radiation Hardened 3Amp Sink/Source DDR Termination Regulator w/ Built-in VREF	QMLV	DDR, DDR2, DDR3, DDR3L, DDR4, LPDDR2, LPDDR3	S3, S4/S5	0.9	3.5	18	VREF, VTT
TPS51200-EP	Enhanced Product 3A Sink/Source DDR Termination Regulator w/ VTTREF Buffered Reference for DDR2, DDR3, DDR3L and DDR4	Enhanced Product	DDR, DDR2, DDR3, DDR3L, DDR4, LPDDR2, LPDDR3	D-CAP, S3, S4/S5	1.1	3.5	0.5	VREF, VTT



Learn more about TI's complete LDO portfolio at: www.ti.com/lldo

Power Management

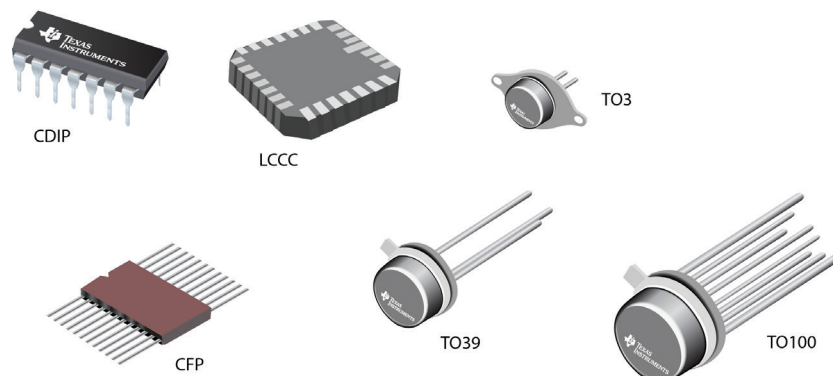
Linear Regulators

TI's broad portfolio of wide V_{IN} voltage regulators going up to ± 60 V and 7 A of peak current have a number of package and die options to help your mission critical designs.

Wide V_{IN} Linear Regulators

Part Number	Description	Rating	I _{out} (Max) (A)	V _{in} (V)	V _{out} (V)	Operating Temperature Range (C)
LM1085	3A Low Dropout Positive Regulators	COTS	3	2.6 to 29	1.25 to 27.5	-40 to 125
LM1086	1.5A Low Dropout Positive Regulators	COTS	1.5	2.6 to 29	1.25 to 27.5	-40 to 125
LM117	3-Terminal Adjustable Regulator	COTS	5	4.2 to 40	1.25 to 37	-55 to 150
LM117HV	3-Terminal Adjustable Regulator	COTS	1.5	4.2 to 60	1.25 to 57	-55 to 125
LM117HVQML	3-Terminal Adjustable Regulator	QMLQ	1.5	4.2 to 60	1.25 to 57	-55 to 125
LM117HVQML-SP	3-Terminal Adjustable Regulator	QMLV	1.5	4.2 to 60	1.25 to 57	-55 to 125
LM117JAN	3-Terminal Adjustable Regulator	QMLQ	1.5	4.2 to 40	1.25 to 37	-55 to 125
LM117JAN-SP	3-Terminal Adjustable Regulator	QMLV	1.5	4.2 to 40	1.25 to 37	—
LM117QML	3-Terminal Adjustable Regulator	QMLQ	1.5	4.2 to 40	1.25 to 37	-55 to 125
LM117QML-SP	3-Terminal Adjustable Regulator	QMLV	1.5	4.2 to 40	1.25 to 37	-55 to 125
LM137	3-Terminal Adjustable Negative Regulator	COTS	1.5	-40 to -4.2	-37 to -1.2	-55 to 150
LM137HVQML	3-Terminal Adjustable Negative Regulator (High Voltage)	QMLQ	1.5	-50 to -4.2	-47 to -1.2	-55 to 150
LM137JAN	3-Terminal Adjustable Negative Regulator	QMLQ	1.5	-40 to -4.2	-37 to -1.2	-55 to 150
LM137JAN-SP	3-Terminal Adjustable Negative Regulator	QMLV	1.5	-40 to -4.2	-37 to -1.2	-55 to 150
LM137QML	3-Terminal Adjustable Negative Regulator	QMLQ	1.5	-40 to -4.2	-37 to -1.2	-55 to 125
LM137QML-SP	3-Terminal Adjustable Negative Regulator	QMLV	1.5	-40 to -4.2	-37 to -1.2	-55 to 125
LM138	5 Amp Adjustable Regulator	COTS	5	4.2 to 40	1.24 to 32	-55 to 125
LM2940QML	1A Low Dropout Regulator	QMLQ	1	0 to 26	5 to 15	-55 to 125
LM2940QML-SP	1A Low Dropout Regulator	QMLV	1	0 to 26	5 to 15	-55 to 125
LM723	Voltage Regulator	COTS	0.15	9.5 to 40	2 to 37	-55 to 150
LM723JAN-SP	Voltage Regulator	QMLV	0.15	9.5 to 40	2 to 37	-55 to 125
LM723QML	Voltage Regulator	QMLQ	0.15	9.5 to 40	2 to 37	-55 to 125

Package Designators



Learn more about linear regulator solutions at: www.ti.com/ldo

Power Management

Power Modules

Leverage the industry's most comprehensive catalog power module portfolio to find the solution that best fits your defense or aerospace design.

Ruggedized Power Modules

Extended temperature (EXT) family of power modules

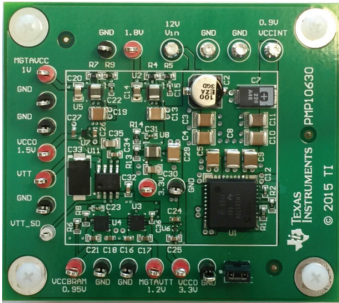
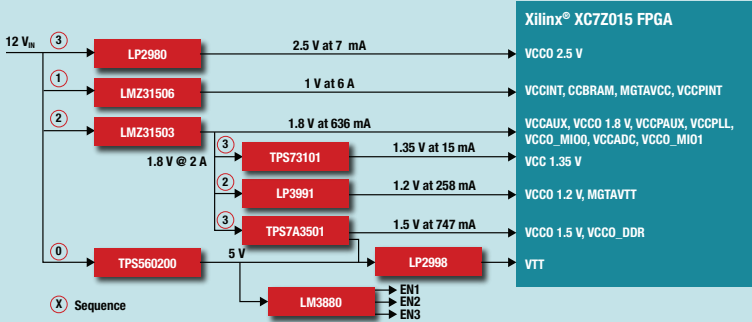
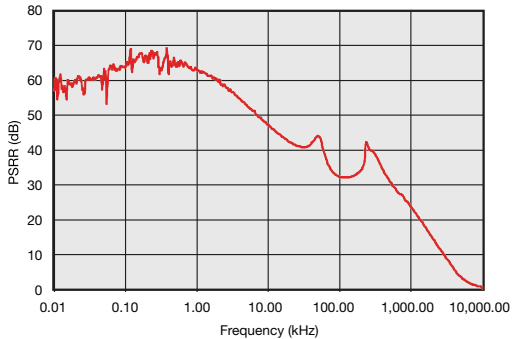
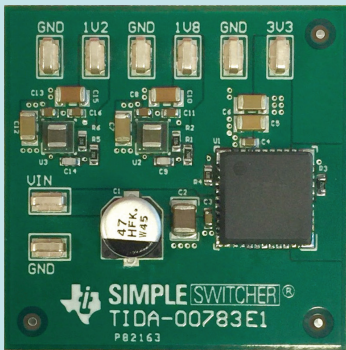
The SIMPLE SWITCHER® EXT power modules provide excellent performance in the most extreme conditions

- Supports max input voltage ranges from 5.5 to 42 V and output currents up to 5 A
- Compliant to vibration standard MIL-STD-883 method 2007.2 condition A
- Compliant to drop standard MIL-STD-883 method 2002.3 condition B
- Passes 10 V/m radiated immunity EMI test standard EN61000 4-3
- IC junction temperature range: -55 to +125°C

Part Number	Description	Vin (Max) (V)	Vin (Min) (V)	Iout (Max) (A)	Vout (Min) (V)	Vout (Max) (V)	Package Type	Special Features
Wide VIN Power Modules								
LMZ34202	SIMPLE SWITCHER, 4.5V to 42V, 2A Step-Down Voltage Regulator	42	4.5	2	2.5	7.5	QFN	EMI Tested, Enable, Frequency Synchronization, Light Load Efficiency, Power Good, Remote Sense
LMZ36002	SIMPLE SWITCHER® 4.5V to 60V, 2A Step-Down Power Module in QFN Package	60	4.5	2	2.5	7.5	QFN	EMI Tested, Enable, Frequency Synchronization, Light Load Efficiency, Power Good, Remote Sense
LMZ14203EXT	3A SIMPLE SWITCHER Power Module with 42V Maximum Input Voltage	42	6	3	0.8	6	Leaded	EMI Tested, Enable, Tracking, -55 to 125°C Temp Range, MIL-STD-883 drop and vibration
LMZ23610	10A SIMPLE SWITCHER® Power Module with 36V Maximum Input Voltage	36	6	10	0.8	6	Leaded	Current Sharing, EMI Tested, Enable, Frequency Synchronization, Tracking
LMZ14203	SIMPLE SWITCHER® 6V to 42V, 3A Power Module	42	6	3	0.8	6	Leaded	EMI Tested, Enable, Tracking
LMZ34002	SIMPLE SWITCHER® 4.5V to 40V, 2A Negative Output Power Module	40	4.5	2	-3	-17	QFN	EMI Tested, Negative Output, Remote Sense
Point of Load (POL) Power Modules								
TPS82130	3-A 17V Step-down Converter Module with Integrated Inductor	17	3	3	0.9	5	MicroSiP (LGA)	Enable, Light Load Efficiency, Power Good, Tracking
TPS82084	2-A, High-Efficiency Step-Down Converter Module with Integrated Inductor	6	2.5	2	0.8	6	MicroSiP (LGA)	Enable, Light Load Efficiency, Output Discharge, Power Good
TPS82085	3A, High-Efficiency Step-Down Converter Module with Integrated Inductor	6	2.5	3	0.8	6	MicroSiP (LGA)	Enable, Light Load Efficiency, Output Discharge, Power Good
LMZ20501	SIMPLE SWITCHER® 2.7V to 5.5V, 1A High Density Nano Module	5.5	2.7	1	0.8	3.6	MicroSiP (LGA)	EMI Tested, Enable, Light Load Efficiency, Power Good
LMZ21701	SIMPLE SWITCHER® 3V to 17V, 1A High Density Nano Module	17	3	1	0.9	6	MicroSiP (LGA)	EMI Tested, Enable, Light Load Efficiency, Power Good
LMZ31530	SIMPLE SWITCHER® 3V to 14.5V, 30A Power Module in Small QFN Package	14.5	3	30	0.6	3.6	QFN	EMI Tested, Enable, Light Load Efficiency, Power Good, Remote Sense
LMZ31710	SIMPLE SWITCHER® 2.95V to 17V, 10A Power Module with Current Sharing	17	2.95	10	0.6	5.5	QFN	Current Sharing, EMI Tested, Frequency Synchronization, Power Good, Remote Sense, Tracking, Light Load Efficiency
LMZ30606	SIMPLE SWITCHER® 2.95V to 6V, 6A Power Module in Small QFN Package	6	2.95	6	0.8	3.6	QFN	EMI Tested, Enable, Frequency Synchronization, Power Good, Remote Sense, Tracking
LMZ22010	10A SIMPLE SWITCHER® Power Module with 20V Maximum Input Voltage	20	6	10	0.8	6	Leaded	Current Sharing, EMI Tested, Enable, Frequency Synchronization, Tracking
LMZ12003EXT	3A SIMPLE SWITCHER Power Module with 20V Maximum Input Voltage	20	4.5	3	0.8	6	Leaded	EMI Tested, Enable, Tracking, MIL-STD-883 drop and vibration
LMZ12002EXT	2A SIMPLE SWITCHER Power Module with 20V Maximum Input Voltage	20	4.5	2	0.8	6	Leaded	EMI Tested, Enable, Tracking, MIL-STD-883 drop and vibration
LMZ12001EXT	1A SIMPLE SWITCHER Power Module with 20V Maximum Input Voltage	20	4.5	1	0.8	6	Leaded	EMI Tested, Enable, Tracking, MIL-STD-883 drop and vibration
LMZ10505EXT	5A SIMPLE SWITCHER Power Module with 5.5V Maximum Input Voltage	5.5	2.95	5	0.8	5	Leaded	Enable, MIL-STD-883 drop and vibration
LMZ10504EXT	4A, SIMPLE SWITCHER Power Module with 5.5V Maximum Input Voltage	5.5	2.95	4	0.8	5	Leaded	Enable, MIL-STD-883 drop and vibration
LMZ10503EXT	3A SIMPLE SWITCHER Power Module with 5.5V Maximum Input Voltage	5.5	2.95	3	0.8	5	Leaded	Enable, MIL-STD-883 drop and vibration

Learn more about TI's power module solutions at: www.ti.com/modules

TI provides a board portfolio of power management reference designs created to improve the size, weight and power (SWaP) of your next system. From low noise, high PSRR designs to noise sensitive RF components to complete solutions for the latest FPGA, our TI Designs will help move your designs to production faster. You can even use the power reference design parametric search to look for the design that matches your power needs.

Design Number	Description	
PMP10630 Xilinx Kintex UltraScale XCKU040 FPGA Power Solution, 6W Reference Designs	This design uses an optimal combination of SIMPLE SWITCHER® modules and LDOs to provide all the necessary voltage rails for the XCKU040 FPGA in a small solution size of 36 x 43 mm (1.4 x 1.7 inch). - Simple and flexible power sequencing with LM3880 - Provide DDR3 termination power with LP2998	
PMP10601 Xilinx® Zynq® 7000 Series (XC7Z015) Reference Design	As part of the extensive TI Design Library, PMP10601 offers all the power supply rails necessary to power Xilinx Zynq 7000 series (XC7Z015) FPGA. - Design optimized to support a 12-V input - On board power-up and power-down sequencing - Supports DDR3 memory device	
TIDA-00270 Current-Sharing Dual-LDO Reference Design	TIDA-00270 offers a power-supply topology capable of sourcing 6 A via two LDOs operating in parallel for high-current, low-noise applications. - Includes soft-start procedure for monotonic startup - Allows better thermal dissipation for air flow restricted environment - Achieves ≥ 40 dB PSRR at 6 A ($0.8 V_{out}$)	 TIDA-00270 V_{IN} PSRR vs frequency (V_{OUT}: 3.3 V, I_{OUT}: 6 A)
TIDA-00783 Space Optimized Wide Vin Triple-Output Power Module Reference Design	The TIDA-00783 reference design is a triple output wide Vin power module design. It provides 3.3V, 1.8V and 1.2V output, at 6W total power.	

Processors

COTS Multicore Processors for Mission Critical Customers

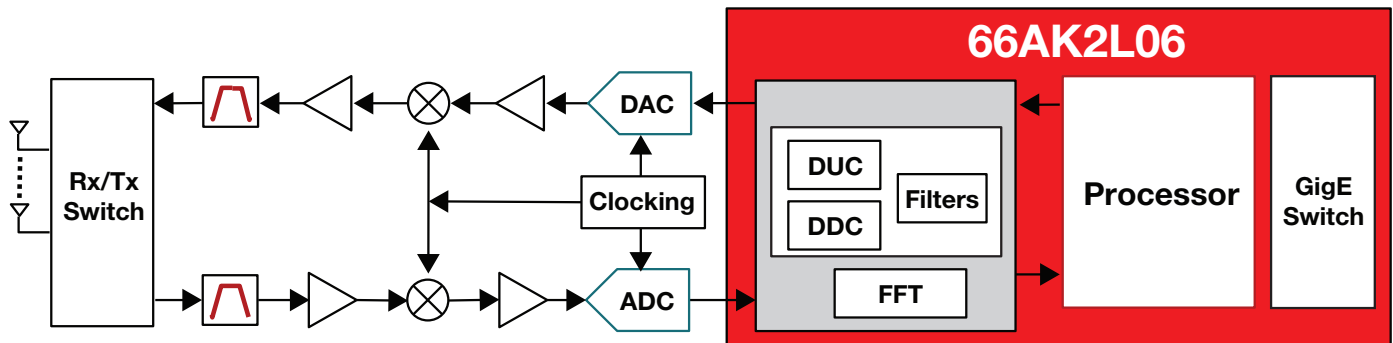
Architecture Highlights

KeyStone Architecture

- Great fit for radar systems, electronic warfare, software-defined radio and avionics applications with devices ranging from single core DSPs, up to devices such as a quad-core ARM® Cortex®-A15 or an ARM + DSP device with 12 cores
- TI devices using the KeyStone architecture deliver full processing entitlement, meaning every processing element is able to process at nearly its full capacity all of the time. The KeyStone architecture is the basis for DSP-only, ARM-only, and ARM + DSP device families, providing a common platform for multiple processing solutions
- Scalable platforms allow for software design reuse
- Integrated high-throughput I/O — such as on-chip 1 Gb/10 Gb Ethernet switches, PCIe gen 2, and SRIO — support data-intensive applications
- TI's HyperLink interface offers up to 50 Gbps connection to another TI KeyStone architecture or an FPGA
- High performance in a constrained power budget, up to 16 GFLOPS/W, and available extended temperature ranges meet SWaP requirements
- On-chip memories have error-correction code (ECC); the DDR3 interfaces support ECC-capable memory
- Secure boot and other security features available on some devices
- Linux and TI-RTOS kernel are available from TI, commercial RTOS offerings from Wind River and Green Hills are available for ARM-only and ARM + DSP devices

C66x DSP Core

- Software compatible with previous-generation C67x and C64x DSP cores
- Includes SIMD support for floating point operations



66AK2L06 DFE

DDC / DUC

- 368Msps TX and 368Msps RX
- Up to 48 channels and 4 streams
- 18-24 bit data path

Filter

- Programmable FIR Filter: 18-bit data path and coefficients, up to 399 Taps
- CIC & Farrow Filter

FFT

- Programmable FFT Coprocessors
- Up to 8192pts, > 84db SNR, 35GFLOPS @ 8Kpts
- 2x 1024pt in 2.1us

Additional Features

Real to complex converter, front end AGC, NCO/mixer, signal generator, power measurements, IQ Imbalance Comp

Learn more about TIDEP0060: Optimized Radar System Reference Design
Using a DSP+ARM SoC at www.ti.com/tool/TIDEP0060

Processors

COTS Multicore Processors Featured Devices

DSP

Part Number	Description	ARM CPU	ARM MHz (Max.)	DSP Cores	DSP MHz (Max.)	EMAC	PCI/PCle	Hardware Accelerators
66AK2E02	Multicore DSP+ARM KeyStone II System-on-Chip (SoC)	1 ARM Cortex-A15	1250, 1400	1 C66x	1250, 1400	8-Port 1Gb Switch, 2-Port 10Gb Switch	4 PCIe Gen2	–
66AK2E05	Multicore DSP+ARM KeyStone II System-on-Chip (SoC)	4 ARM Cortex-A15	1250, 1400	1 C66x	1250, 1400	8-Port 1Gb Switch, 2-Port 10Gb Switch	4 PCIe Gen2	–
66AK2G02	Multicore DSP+ARM KeyStone II System-on-Chip (SoC)	1 ARM Cortex-A15	600	1 C66x	600	1-port 1Gb	PCIe Gen2	Security Acceleration, PRU-ICSS
66AK2H06	Multicore DSP+ARM KeyStone II System-on-Chip (SoC)	2 ARM Cortex-A15	1200, 1400	4 C66x	1200	4-port 1Gb Switch	2 PCIe Gen2	Packet Accelerator, Security Accelerator
66AK2H12	Multicore DSP+ARM KeyStone II System-on-Chip (SoC)	4 ARM Cortex-A15	1200, 1400	8 C66x	1200	4-port 1Gb Switch	2 PCIe Gen2	Packet Accelerator, Security Accelerator
66AK2H14	Multicore DSP+ARM KeyStone II System-on-Chip (SoC)	4 ARM Cortex-A15	1200, 1400	8 C66x	1200	4-port 1Gb Switch	2 PCIe Gen2	Packet Accelerator, Security Accelerator
66AK2L06	Multicore DSP+ARM KeyStone II System-on-Chip (SoC)	2 ARM Cortex-A15	1200	4 C66x	1200	4-Port 1Gb Switch	2 PCIe Gen2	FFT Coprocessor, Digital Front End
TMS320C6671	Fixed and Floating-Point Digital Signal Processor	–	–	1 C66x	1000, 1250	2-Port 1Gb Switch	2 PCIe Gen2	–
TMS320C6672	Multicore Fixed and Floating-Point Digital Signal Processor	–	–	2 C66x	1000, 1250, 1500	2-Port 1Gb Switch	2 PCIe Gen2	–
TMS320C6674	Multicore Fixed and Floating-Point Digital Signal Processor	–	–	4 C66x	1000, 1250	2-Port 1Gb Switch	2 PCIe Gen2	–
TMS320C6678	Multicore Fixed and Floating-Point Digital Signal Processor	–	–	8 C66x	1000, 1250	2-Port 1Gb Switch	2 PCIe Gen2	–

Sitara™ Processors

Part Number	Description	ARM CPU	ARM MHz (Max.)	EMAC	PCI/PCle	Serial I/O	Co-Processor(s)
AM5K2E04	Multicore ARM KeyStone II System-on-Chip (SoC)	4 ARM Cortex-A15	1250, 1400	8-Port 1Gb Switch	4 PCIe Gen2	Hyperlink, I2C, SPI, TSIP, UART, USB	–
AM5K2E02	Multicore ARM KeyStone II System-on-Chip (SoC)	2 ARM Cortex-A15	1250, 1400	8-Port 1Gb Switch	4 PCIe Gen2	Hyperlink, I2C, SPI, TSIP, UART, USB	–
AM5728	Sitara Processor	2 ARM Cortex-A15	1500	10/100/1000, 2-Port 1Gb Switch	2 PCIe Gen 2	CAN, I2C, SPI, UART, USB	2 ARM Cortex-M4, 4 PRU-ICSS
AM5726	Sitara Processor	2 ARM Cortex-A15	1500	10/100/1000, 2-Port 1Gb Switch	2 PCIe Gen 2	CAN, I2C, SPI, UART, USB	2 ARM Cortex-M4, 4 PRU-ICSS
AM5718	Sitara Processor	1 ARM Cortex-A15	1500	10/100/1000, 2-Port 1Gb Switch	2 PCIe	CAN, I2C, SPI, UART, USB	2 ARM Cortex-M4, 4 PRU-ICSS
AM5716	Sitara Processor	1 ARM Cortex-A15	500, 1500	10/100/1000, 2-Port 1Gb Switch	2 PCIe	CAN, I2C, SPI, UART, USB	2 ARM Cortex-M4, 4 PRU-ICSS
AM3359	Sitara Processor	1 ARM Cortex-A8	800	2-Port 1Gb Switch	–	CAN, I2C, SPI, UART, USB	2 PRU-ICSS
AM3358-EP	AM3358 Sitara™ Processors	1 ARM Cortex-A8	800	2-Port 1Gb Switch	–	CAN, I2C, SPI, UART, USB	2 PRU-ICSS
AM3357	Sitara Processor	1 ARM Cortex-A8	300, 600, 800	2-Port 1Gb Switch	–	CAN, I2C, SPI, UART, USB	2 PRU-ICSS
AM3356	Sitara Processor	1 ARM Cortex-A8	300, 600, 800	2-Port 1Gb Switch	–	CAN, I2C, SPI, UART, USB	2 PRU-ICSS
AM3354	Sitara Processor	1 ARM Cortex-A8	600, 800, 1000	2-Port 1Gb Switch	–	CAN, I2C, SPI, UART, USB	–
AM3352	Sitara Processor	1 ARM Cortex-A8	300, 600, 800, 1000	2-Port 1Gb Switch	–	CAN, I2C, SPI, UART, USB	–
AM3351	Sitara Processor	1 ARM Cortex-A8	300, 600	10/100/1000	–	I2C, SPI, UART, USB	–

Processors

Hardware Solutions for Multicore Processors

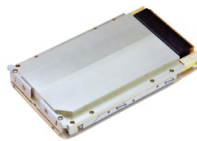
Hardware Ecosystem

TI has also worked together with several 3rd party board manufacturers to develop off-the-shelf solutions. Click on any of the links below to gather more information on the design.

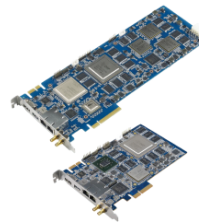


Comm (i) Agility

AMC-2C6678
2x6678+FPGA AMC card



VPX-D16A4
66AK2H12 + C6678 3U
Open VPX



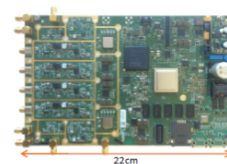
Full line of AMC and PCIe
cards in various sizes with
various processor counts.



VF360 3U Open VPX
Module



D.Module2.C6657
C6657 Module



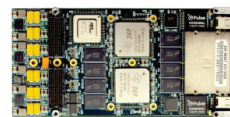
Small Cell / SDR Products for
Military/Aviation/Public Safety



Ittiam
Defense and
Industrial-specialized
Video networking



PDAK2H
66AK2H12 + 2x C6788
AMC



XMC-8320
2x C6670 XMC Card



FMC667
C6678 FMC Card

Processors

Software Solutions for Multicore Processors

TI's software offerings enable multicore performance with single core simplicity.

MCSDK Highlights

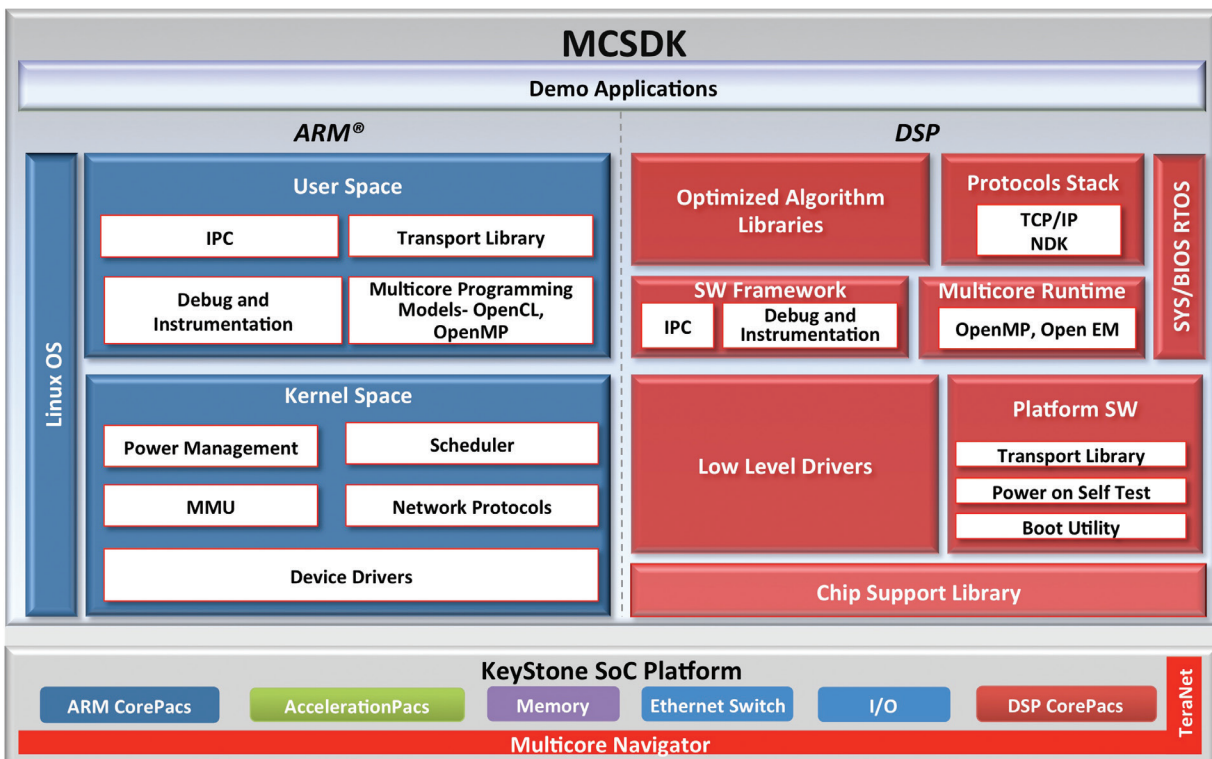
The Multicore Software Development Kit (MCSDK) provides foundational software and highly-optimized bundles of platform-specific drivers to enable development on TI's KeyStone multicore devices. Used along with TI's Code Composer Studio™ IDE, it encapsulates a collection of software elements and tools which enable straightforward customer application development and accelerate customer time to market by focusing on ease of use and performance. Available for free on the TI website, all software in the MCSDK is in source form along with pre-built libraries.

Included in the MCSDK:

- TI-RTOS kernel real-time embedded operating system for DSP cores
- Linux high-level operating system for ARM® cores, including SMP mode for multicore ARM devices
- DSP chip support libraries, ARM + DSP device drivers, and basic platform utilities
- Interprocessor communication models
- System-on-Chip (SoC) resource management
- Optimized application-specific and application non-specific algorithm libraries
- OpenMP™, the de facto industry standard for shared memory parallel programming, which allows users to implement multithreading algorithms on high-performance multicore devices
- OpenCL™, an open industry-standard framework for writing programs that run on a combination of ARM + DSP processors
- OpenEM, a centralized runtime system for event scheduling, which enables load balancing across all system resources
- MPI for cluster based calculations across multiple KeyStone architecture devices
- Trace, debug and instrumentation
- Bootloaders and boot utilities, power-on self-test
- Latest toolchain (ARM Linaro, DSP TI CodeGen)
- Demos and examples

OS Offerings

- TI-RTOS kernel provided for DSP development
- TI open-source Linux kernel provided with drivers on YoctoProject.org
- Third party operating systems available soon for KeyStone II devices:
 - Green Hills® INTEGRITY® RTOS
 - Wind River® VxWorks® RTOS
 - Wind River Linux



TI MCSDK for KeyStone II devices.

Processors

Software Solutions for Multicore Processors (Continued)

Development Tools

Code Composer Studio™, the best in class Eclipse™-based IDE, is provided at no cost with any of the KeyStone device evaluation kits (EVMs). Code Composer Studio is a common development tool for all TI processors and can be used for development on both the ARM® and DSP cores of KeyStone multicore processors. Code Composer Studio offers advanced debug features which include:

- Visibility into CPU Trace and System Trace: Allows identification of application hotspots and performance bottlenecks, bandwidth and latency analysis, interconnect and traffic monitoring
- Visibility into application and RTOS: Allows identification of thread and CPU load, OS object status, and correlation of information from various cores
- Trace: Provides a detailed, historical account of code execution, timing and accesses
- Debug Server Scripting: Allows automation of debugger functionality and is useful for performing regression testing

Third Party Ecosystem

A strong third party software ecosystem complements the tools and libraries provided by TI's MCSDK and Code Composer Studio™

- Third party plug-ins for Code Composer Studio
 - 3L's Diamond tool-suite and model provides an automated development flow and enables development to scale smoothly as cores per SoC and multicore SoCs per system increase.
 - CriticalBlue's Prism provides multicore analysis and exploration tools to evaluate parallelization strategies of existing software applications.
 - ENEA's Optima includes overview and management tools for multicore systems, profiling tools showing resource usage and debug tools that track execution of application and operating system events.
 - Polycore's Poly-Platform™ consists of productivity tools and run-time communications software that provide a programming model for applications to scale from one to many cores.

- Integretek's HyperLink IP core enables HyperLink connectivity between TI's KeyStone multicore processors and FPGAs from Xilinx® and Altera® using an industry standard AXI interface.
- nCore's Lithium Suite for KeyStone II processors is a set of tools, libraries and drivers that combine an optimized Linux kernel with HPC-oriented packages such as OpenMP, OpenMPI, BLAS, PAPI Performance Layer and more.
- RunTime Computing's VSI/Pro®, a VSIPL-compliant optimized library, provides highly efficient and portable computational middleware for signal and image processing applications.

For More Information

To learn more about the COTS DSP, ARM® and ARM + DSP products, please visit: ti.com/multicore

TI E2E Community

e2e.ti.com

TI Processors Wiki

processors.wiki.ti.com

TI Training Videos

training.ti.com

Third Party Partners: Software



INTEGRITY RTOS

Hypervisor, Certified OS if needed

WIND RIVER

VxWorks RTOS, Wind River Linux
Hypervisor, Certified OS if needed



CIM virtualization software
& SigRAD



Gedae development environment



HyperLink FPGA IP block for
Altera and Xilinx FPGAs



nCore Lithium Suite



Defense and Industrial-
specialized Video
networking



mi!SmallCellPHY – 4G PHY
Layer Software for SDR



3G/4G PHY Layer
Software for SDR



3G/4G Stack for SDR

TI Worldwide Technical Support

Internet

TI Semiconductor Product Information Center Home Page

support.ti.com

TI E2E™ Community Home Page

e2e.ti.com

Product Information Centers

Americas Phone +1(512) 434-1560

Brazil Phone 0800-891-2616

Mexico Phone 0800-670-7544

Fax +1(972) 927-6377
Internet/Email support.ti.com/sc/pic/americas.htm

Europe, Middle East, and Africa

Phone

European Free Call 00800-ASK-TEXAS
(00800 275 83927)
International +49 (0) 8161 80 2121
Russian Support +7 (4) 95 98 10 701

Note: The European Free Call (Toll Free) number is not active in all countries. If you have technical difficulty calling the free call number, please use the international number above.

Fax +49 (0) 8161 80 2045
Internet www.ti.com/asktexas
Direct Email asktexas@ti.com

Japan

Phone Domestic 0120-92-3326
Fax International +81-3-3344-5317
Domestic 0120-81-0036
Internet/Email International support.ti.com/sc/pic/japan.htm
Domestic www.tij.co.jp/pic

Asia

Phone

International +91-80-41381665
Domestic Toll-Free Number

Note: Toll-free numbers do not support mobile and IP phones.

Australia 1-800-999-084
China 800-820-8682
Hong Kong 800-96-5941
India 1-800-425-7888
Indonesia 001-803-8861-1006
Korea 080-551-2804
Malaysia 1-800-80-3973
New Zealand 0800-446-934
Philippines 1-800-765-7404
Singapore 800-886-1028
Taiwan 0800-006800
Thailand 001-800-886-0010

Fax +8621-23073686
Email tiasia@ti.com or ti-china@ti.com
Internet support.ti.com/sc/pic/asia.htm

Important Notice: The products and services of Texas Instruments Incorporated and its subsidiaries described herein are sold subject to TI's standard terms and conditions of sale. Customers are advised to obtain the most current and complete information about TI products and services before placing orders. TI assumes no liability for applications assistance, customer's applications or product designs, software performance, or infringement of patents. The publication of information regarding any other company's products or services does not constitute TI's approval, warranty or endorsement thereof.

A021014

The platform bar, E2E, Sitara and Code Composer Studio are trademarks and SIMPLE SWITCHER is a registered mark of Texas Instruments. All other trademarks are the property of their respective owners.



IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products

Audio	www.ti.com/audio
Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
DLP® Products	www.dlp.com
DSP	dsp.ti.com
Clocks and Timers	www.ti.com/clocks
Interface	interface.ti.com
Logic	logic.ti.com
Power Mgmt	power.ti.com
Microcontrollers	microcontroller.ti.com
RFID	www.ti-rfid.com
OMAP Applications Processors	www.ti.com/omap
Wireless Connectivity	www.ti.com/wirelessconnectivity

Applications

Automotive and Transportation	www.ti.com/automotive
Communications and Telecom	www.ti.com/communications
Computers and Peripherals	www.ti.com/computers
Consumer Electronics	www.ti.com/consumer-apps
Energy and Lighting	www.ti.com/energy
Industrial	www.ti.com/industrial
Medical	www.ti.com/medical
Security	www.ti.com/security
Space, Avionics and Defense	www.ti.com/space-avionics-defense
Video and Imaging	www.ti.com/video

TI E2E Community

e2e.ti.com