

Signal Chain

Texas Instruments
2013

Home



EE



Signal Chain



Power



Technology



Locations



Webench



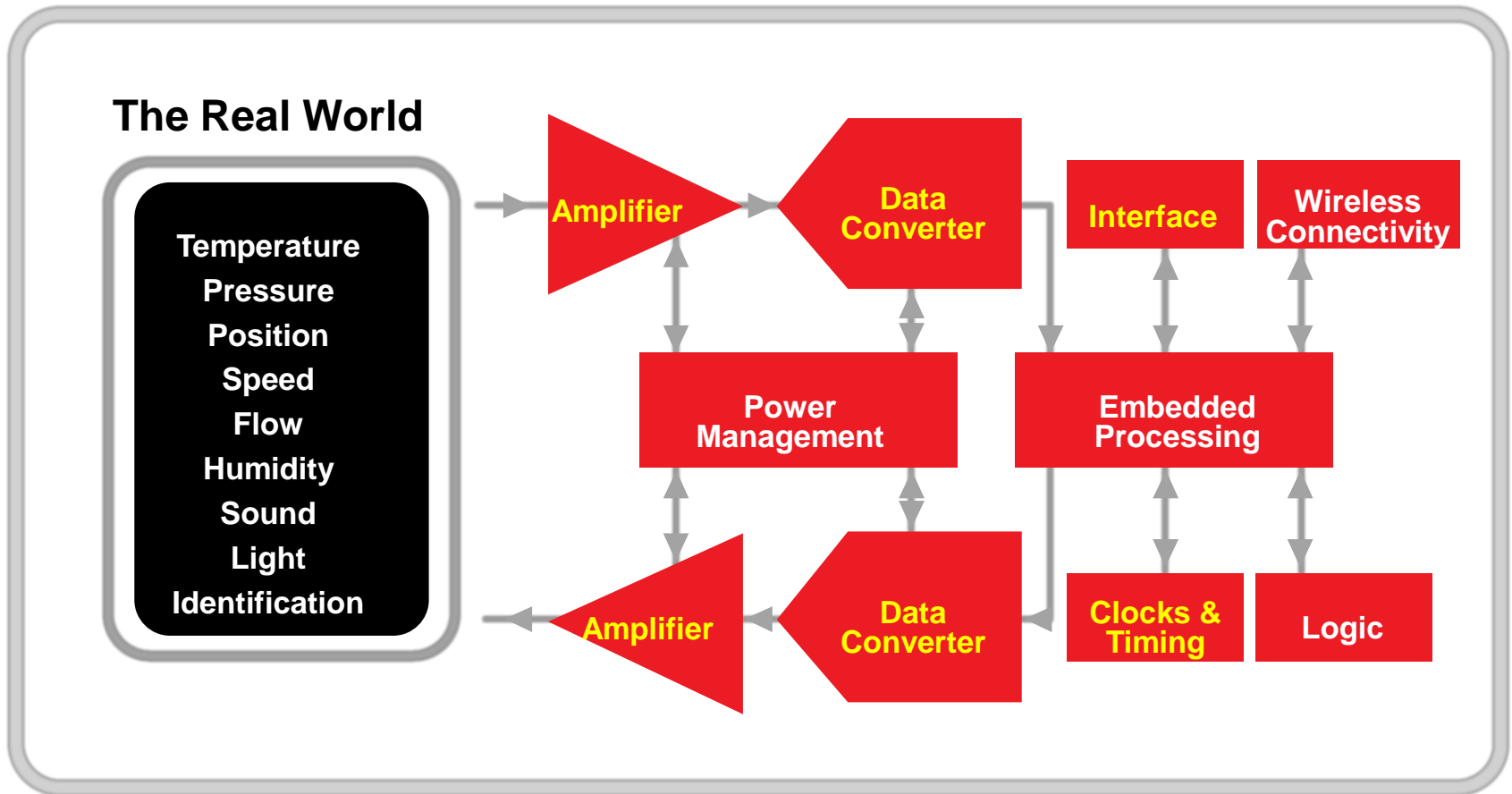
Investments



Org Chart



with our complete solutions across the board



Amplifier at a glance...

#1 in amplifier market share with 23.8%

Low Power

INA333

**Lowest Input Bias
Zero Drift In-Amp**
0.2nA Ib, 75µA

LPV521

**Industry's lowest power
RRIO Op-Amp**

OPA2835

**Lowest Power >50MHz
Bandwidth VFB Amp**
250uA, 59MHz GBW

OPA333

**Lowest Power
Zero Drift Op Amp**
25µA, RFI filtering

OPA378

**Lowest Noise/Power
Zero-Drift Op Amp**
20nV/rtHz, 100µA

Precision Input

INA282

**Highest Accuracy / High Voltage
Current Shunt**
-14V to 80V, 20uV Offset

LME49990

Ultra low-distortion
0.00001% THD+N @ 110MHz

LMP7721

**Industry's lowest
bias current**
(3 fA) Amplifier

OPA140

High Precision 11MHz JFET
120uVVos, 1µV/°C drift,
11MHz GBW

OPA211

Lowest Noise Bipolar Amp
1.1nV/rtHz, 36V

OPA320

1pA Ibias Precision Amplifier
for Sensor Signal Conditioning
(20MHz, 1.8-5.5V)

Wide Bandwidth

LMH6554

**Ultra Linear Differential
ADC Driver**
2.8 GHz BW, flat to 830 MHz

LMH6629

**Highest Performance
Low-Noise**
Op-Amp : 0.69nV/rtHz, 900 MHz BW

OPA2673

**Dual Wideband High
Output Current**
Slew Rate: 3000 V/µs
BW: 340MHz

OPA365

**Widest GBW RRIO
Zero-Crossover CMOS Op Amp**
50MHz, 16-Bit Performance

THS4521

Lowest Power Fully Differential
Quiescent current 1.14 mA/ch
RRO, 145MHz BW

THS770006

**Highest Linearity
ADC Driver**
1.8 GHz Bandwidth
50dB OIP3, 107Mhz IMD3 @ 100MHz

Industrial Amplifiers

DRV8402

**Highest Power
Integrated Driver**
5A RMS / 12A peak Per Bridge

OPA564

**Ideal for OFDM Power Line
Communications**
1.5A Out, 24V, 17MHz

OPA653

Industry's fastest FET Input
2675V/µs Slew Rate
500MHz Bandwidth

OPA836

**Single-ended and
Pseudo differential ADC Driver**
4.6nV/rtHz, 205MHz BW for 1mA Iq

THS3095

Power-Down Capability
Iq 500 µA



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OPAx333: OPA333 / OPA2333

Lowest Noise | Zero-Drift | Op Amp

Features

- Low Offset Voltage 10 μV (max)
- Offset Voltage Drift 0.05 $\mu\text{V}/^{\circ}\text{C}$ (max)
- Very Low Noise 55nV/ $\sqrt{\text{Hz}}$ @ 1kHz
- Ultra-Low I_{Q} 25 μA (max)
- GBW 350 kHz
- Supply Voltage 1.8 V to 5.5 V
- Rail-to-Rail Input and Output
- EMI Input Filter

Applications

- Battery Powered Instruments
- Temperature Measurement
- Precision Strain Gages
- Precision Sensor Applications
- Medical Instrumentation
- Handheld Test Equipment

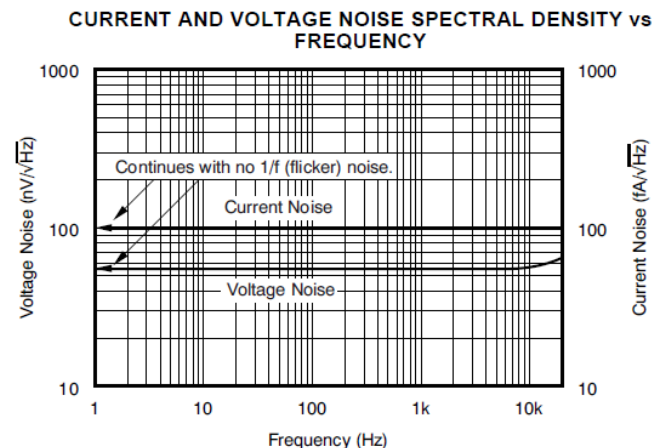
Package Options:

Single: SOIC-8, SON-8, VSSOP-8

Dual: SC70-5, SOT23-5, SOIC-8

Benefits

- 30% Lower Drift than the nearest competitor
- Low offset and drift removes need for calibration
- Lowest Noise among the competition enabling high gain without distortion
- 1.8V Supply and low Quiescent Current make this ideal for portable applications
- RRIO Increases Dynamic Range
- Minimizes EMI induced offset errors
 - Competition doesn't have No zero drift with EMI filtering!



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OPAx188: OPA188 / OPA2188 / OPA4188

0.03 $\mu\text{V}/^\circ\text{C}$ | 6 μV V_{OS} | 36V | Zero-Drift | Op Amp

Highest-precision,
zero drift,
36V op amp

Features

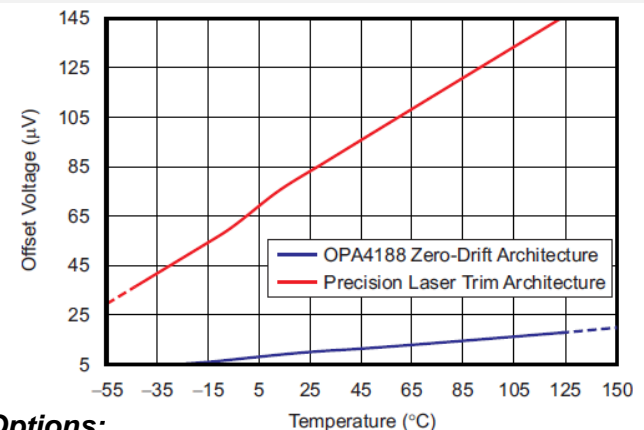
- GBW 2MHz
- Low Quiescent Current 475 μA (max)
- Very Low Offset and Drift
 - Offset Voltage 25 μV (max)
 - Offset Voltage Drift 0.085 $\mu\text{V}/^\circ\text{C}$ max
- CMRR, PSRR, A_{OL} 130dB (min)
- Noise Voltage 8.8nV/ $\sqrt{\text{Hz}}$ at 1kHz
- Noise voltage at 0.1Hz to 10Hz 0.25 μVpp
- Supply Range +4.0V to +36V or $\pm 2\text{V}$ to $\pm 18\text{V}$
- Rail-to-Rail Output
- EMI/RFI Filtered Inputs
- Input Common Mode Range Extending from Negative Rail to within 1.5V of the Positive Rail

Applications

- Electronic Weigh Scales
- Bridge Amplifier
- Strain Gauge
- Automated Test Equipment
- Transducer amplifier
- Medical Instrumentation
- Resistor Thermal Detector

Benefits

- Improved high accuracy and stability
- Allows for high sensitivity, high resolution systems
- Flexibility in design, enabling low power 5V single supply operation
 - Nearest competitor part's minimum input range is at 1.5V from negative rail, thus no single supply operation is possible
- OPAx188 will have 68% less error caused by input bias current than the nearest competition



Package Options:

Single: SOT23-5, SOIC-8, VSSOP-8

Dual: SOIC-8, VSSOP-8

Quad: TSSOP-14, SOIC-14

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Data Converter at a glance...

<http://dataconverter.ti.com>

#2 in overall data converter market share with 22%

Low Power

ADC08D1520

3.0 GSPS at only 1.6 W
8-bit ADC for data acquisition

ADS1115

16-bit ADC
Internal Reference
Integrated Oscillator
and Programmable
Comparator @ 0.5mW

ADS4249

**Lowest Power 14-bit
250MSPS ADC**
260mW, lowest by 30%
72.8 dB SNR, 86 dBc SFDR

ADS7924

Ultra Low Power
ADC Monitoring Solution
12b,4-ch, 4uW/ch @ 1kSPS

DAC161P997

Single Wire Process Automation

16-Bit ADC
4-20mA

DAC34842

Lowest Power 1.25GSPS DAC
4-channel, full feature Tx DAC
Only 250mW/ channel

DAC7678

Low Power Octal
8/10/12 bit, I2C in 4x4 QFN
Only 0.28 mW/channel

AFE7070

**Integrated NCO, DAC, IQ Modulator
and LVDS output option**
325 mW, 800MHz LVDS output
7x7mm 48-pin QFN package

High Performance

ADC12D1800RF

**Industry's Largest Range
Of Nyquist Sampling**
3.6 GSPS interleaved
1.8 GSPS Dual ADC

ADS1282

Highest Accuracy D/S ADC
32-Bit Resolution w/ on-chip PGA

ADS1675

Highest Bandwidth D/S ADC
24-Bit/ 4MSPS
2MHz Input Bandwidth
116 dB SFDR

ADS5493

Highest SFDR 16-bit ADC
16-bit, 130MSPS
97dBc SFDR @ 90MHz

ADS8486

Lowest Drift 18-Bit ADC
18b fully-differential
1.25MSPS @ 10mW

DAC3283

3G/LTE DAC
16-bit, 800MSPS
ACLR: 81dBc @ 153.6MHz

AFE7225

Transmit/Receive for SDR
Dual125MSPS ADCs
Dual 250MSPS DACs

LMP91000

Chemical Sensing ADCs

Low Power Solution
2.7V to 5.5 V



Data Converters

ADS1298

Measurement ADCs

Complete Front End for Biopotential
(ECG) Measurement

High Integration

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 **TEXAS
INSTRUMENTS**

ADS8556

16-Bit | 630/450kSPS | 6ch Simultaneous Sampling SAR w/ Bipolar Inputs

Features

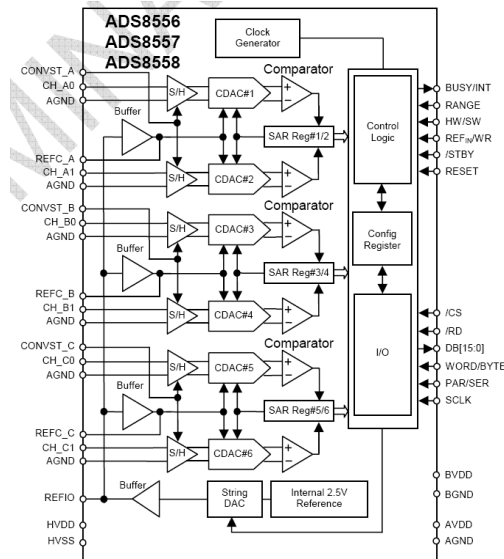
- Best In Class AC/DC Performance
 - 16-Bit, 3 LSB MAX INL
 - 91.5db SNR (typ)
- True bipolar inputs with software selectable input ranges up to $\pm 12V$ and Selectable parallel or serial interface
- Pin Compatible 14 -/12-Bit Versions
- LQFP-64 Package pin compatible with AD7656
 - Only 122mW @ 250kSPS

Applications

- Power quality and automation
- Protection relays
- Closed loop servo control
- Robotics

Benefits

- Excellent performance and external conversion clock for synchronization of multiple devices enables flexible and expandable systems
- Allows easy connectivity to a wide range of inputs , sensors, and host processors
- Allows for an easy upgrade / downgrade path for future designs
- Improved second source to ADI device with >2x faster sampling rate and 3.5db better SNR



ADS1298R

Complete Integrated Analog Front End for ECG Applications

Features

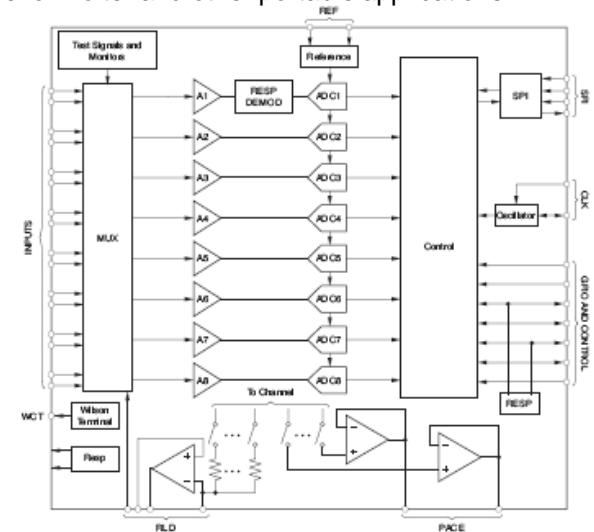
- Fully Integrated **ECG** Solution
 - 8 Low Noise **Programmable Amps**
 - 8 high resolution **ADC's**
 - Test Signals, RLD Amp, Oscillator, Reference
- Outstanding Performance
 - Noise: **5 μ V p-p** (150Hz BW, G=6)
 - CMRR : **105dB** with G = 6
- **Continuous Lead Off** detect option
- Integrated Respiration Impedance Measurement Circuitry
- Pace Detect Channel Select (HW / SW)
- Low Power
 - **0.75mW/Channel** (typ)
 - Multiple **Power Down** Configurations
 - **Standby (STBY)** Mode Uses 2mW

Benefits

- **95% less PCB space necessary for 8-channel solution over discrete implementation!**
- Meets or exceed IEC & AAMI performance requirements.
- Provides immediate notification if electrode becomes disconnected.
- Reduces BOM cost and consumes negligible power compared to discrete impedance measurement solution
- Insures correct measurement even if external pacer is present.
- **95% less power than discrete solutions!** Power down and standby options lengthen battery life for Holter and other portable applications.

Applications

- **Medical Instrumentation (ECG and EEG) including:**
 - **Patient monitoring: Holter, event, stress, and vital signs ECG; AED; fetal ECG**
 - **Bispectral index (BIS), Sleep study monitor**
- **High-Precision, Simultaneous, Multichannel Signal Acquisition**



Packages: 64-ball BGA

AMC1200 Q-100

4kV_{PEAK} Isolated Amplifier

AMC1200B

4.25kV_{PEAK} Isolated Amplifier

Features

- Certified Galvanic Isolation Barrier
 - 4kV (**4.25kV**) peak Basic isolation
 - UL1777 and IEC60747-5-2 approved
 - 1.2kV_{peak} continuous working voltage
- $\pm 250\text{mV}$ input voltage range
- Pin-to-pin performance upgrade for HCPL7800 & HCPL7840
- Specified Temperature range: -40 to 105°C

Benefits

- Galvanic barrier provides EMI immunity and robust isolation barrier lifetime
- Optimized for direct connection to shunt resistors or other low voltage level signal sources
- Over 90% more linear, 80% less gain drift, at 50% of the power
- Extended industrial range offers additional 20°C of fully specified performance

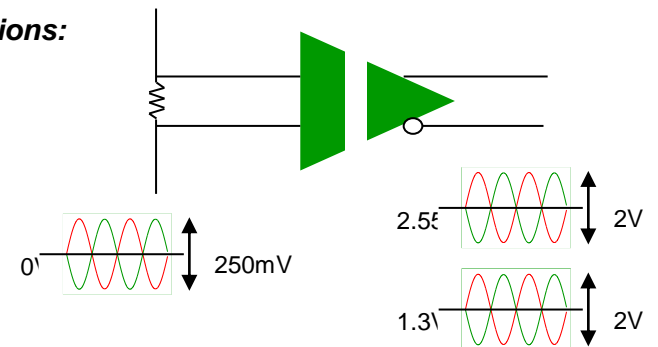
Applications

Shunt-based Current measurement in:

- Motor Control
- Green Energy
- Frequency Inverter Applications
- Uninterruptible Power Supplies



Packaging options:
SO-8, SOP-8



AMC1200 EVM Available

Interface at a glance...

#1 in interface market share with 23%

12 new interface products introduced in 2011

Consumer/Computing

DS80PCI1xxx

Industry's lowest power and longest reach
PCI Express Redrivers

SN75DP126

Dual-Mode DisplayPort

DisplayPort 1:2 Redriver Switch with Integrated TMDS Translator

SN75LVDS83C

Industry's lowest power
flat panel LVDS transmitter for portable solutions

TUSB7340

Industry's first
Certified 4-port SuperSpeed USB Host

TUSB8040

SuperSpeed
4-port USB Hub

XIO2001

Industry's highest performance, smallest footprint
PCI to PCI Express bridge

Industrial

ISO1050

Industry's first
Isolated CAN transceiver

ISO1176T

Proven reliability
RS485 Transceiver with integrated transformer driver

ISO764xFM

Longest lifetime
High speed and low power 4-Channel Isolators

SN65HVD17xx

70V Fault Protection, Low Power, and *Widest Common Mode* Range RS-485 Xcvr

SN65HVS882

Industry's first
8-channel, 34V digital-input serializer

TLK110

Best in Class
Deterministic channel latency Industrial ethernet 10/100 PHY

TL16C75xC

Industry's best combination
of low voltage support and wide pkg variety

General Interfaces

TPD1E10B09

Most versatile
General Purpose ESD Solution

TPD12S015/15A/16

Industry's first
Complete HDMI Companion chips w/ DC-DC or load switch

TPD4E001/101

Low-capacitance
4-Channel +/-15-kV ESD Protection Array for High-Speed Data Interfaces

TS3A225E

Autonomous
Audio Switch with Headset Type Detection

TXS0104E

4-Bit Bidirectional
Voltage-Level Translator for Open-Drain and Push-Pull Applications

SN74AVC2T45/245

Dual-bit dual-supply
bus transceiver with configurable voltage translation and 3-state outputs

Communications/Networking

SN65LVCP408

Superior
Signal integrity performance 8x8 4.25 Gbps Crosspoint Switch

TLK10002

Industry's only discrete
2 Ch Up to 10Gbps Wide data range SerDes

TLK1102E

Longest reach
dual cable equalizer for 11.3Gbps

TLK3134

Industry's only
Combo of SERDES, Adaptive EQ Rx and ref clk jitter cleaner for 4x3.75Gbps

TLK6002

Widest Frequency
Dual-channel transceiver 0.47G-6.25Gbps



DS90UH925/6

FPD-Link III Ser & Des
720p 24b Color with HDCP

DS92LX2121/2

Channel-Link III Ser & Des
1.05 Gbps data + full-duplex control

LMH0376

3G SDI Re-Clocker
only 90mW

LMH0394

SDI Adaptive EQ
3 Gbps, SMPTE compliant

Video Transport

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SN65HVD888 RS485 Transceiver

250kbps w/ automatic polarity correction

Features

- 5V supply voltage with 10% tolerance
- IEC ESD protection
- **Automatic polarity correction**
- $> \pm 13V$ survivability on bus pins
- Low quiescent supply current ($< 800 \mu A$)
- Extended industrial temperature range
- 5V-tolerant D, DE, RE inputs

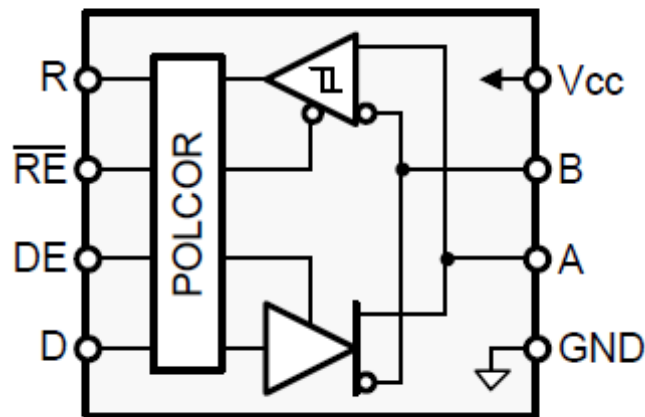
Benefits

- Low power, fewer supplies
- Reliable in high noise environments
- Prevents system failure in case of mis-wiring
- Survive shorts to wide range of voltages
- Power savings
- Eliminate cooling fans, ease system design
- Compatible with 5V controllers

Applications

- E-Metering Networks
- Industrial Automation
- HVAC Systems
- DMX512-Networks
- Process Control
- Battery-Powered Applications

BLOCK DIAGRAM



Confidential – NDA Restrictions

ISO1050 DUB / DW

4kV / 7kV Isolated - 5V CAN

Features

- Industry's first Isolated CAN transceiver
- Meets or Exceeds ISO 11898
- Isolated CAN with **Ultra low loop time**
- **Very Low EME** (Electro-Magnetic Emissions)
- **CMTI** > 25 kV/ μ s
- Silicon Integrated **SiO₂ Insulation**
 - 4kVpk / 2.5kVrms – DUB
 - 7kVpk / 5kVrms – DW
 - 6.1mm and 8.3mm Clearance packages
 - UL1577 ; IEC ; CSA Approval Pending

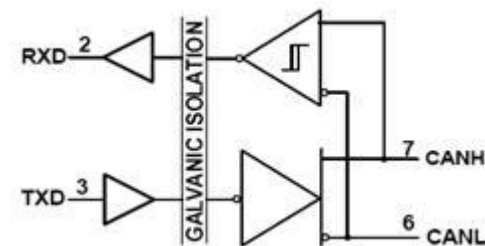
Applications

- **Medical – ISO1050DW**
- Motor Control
- Industrial Automation
- DeviceNet™ Data Buses
- SAE J1939 Standard Data Bus Interface
- ISO 11783 Standard Data Bus Interface
- NMEA 2000 Standard Data Bus Interface

Benefits

- Reduce Components and Board Space - 30%
- Meets DeviceNet and CAN timing requirements
- High Speed Isolation allows longer buses – 34%
- Reduces interference with other devices
- **Proven Reliability of SiO₂ Insulation**, Stable over Time, Temperature & Moisture
 - **Life Span > 25 years @ 105°C**

Part #	Isolation	Temp (C)	Package
ISO1050DUB	4kVpk/2.5kVrms	-55 to 105	SOP-8
ISO1050DW	7kVpk/5kVrms	-55 to 105	SOIC-16



Compatible with 75+ TI Processors with CAN controllers : C2000, TMS470 ARM, LM3Sxxxx ARM3 Cortex - M3, OMAP3505/3517

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TEXAS INSTRUMENTS



TI Confidential – NDA Restrictions

Clocks at a glance...

#3 in timing market share with 8.0%
3 new clock products introduced in 2011

Clock Generation

CDCE(L)9xx

Highly flexible / programmable
Up to 230MHz
Up to 4-PLL, 9 Outputs
Spread-Spectrum

CDCS502

SSC-capable for EMI Reduction
Up to 108MHz
Clock Driver / Multiplier
Replaces 1 XO

CDCM6100x

Highly versatile, ultra-low jitter
frequency synthesizers

LMK04808

Industry's lowest phase noise
Jitter Cleaner & Clock Generator
125 fs jitter, 1536 MHz and over

Oscillator ICs

CDCM7005

High Performance
Low Phase Noise
Low Skew
Clock synchronizer

LMK0480x

Industry's Lowest Noise and Jitter
Clock Conditioner

LMK03806

Ultra-Low Jitter
Clock generator with 14 outputs

Distribution PLL Buffers

CDCVF2505

Spectrum Compatibility and Power-Down Mode
PLL Clock Driver for Synchronous DRAM and General Purpose Apps

CDCVF855

Differential, zero-delay
Up to 220MHz
PLL Clock Driver
5 Outputs
Spread-Spectrum

CDCVF2510A

Phase-Lock Loop Clock Driver
3.3V with Power Down Mode

Distribution Fan Out Buffers

CDCLVC1310

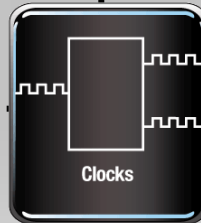
Highly Flexible LVCMOS buffer
Ultra Low additive Jitter (30fs typ)
Flexible Power Supply range
Up to 10 Outputs
Universal Inputs

LMK00301

Highly Flexible Universal buffer
Low Jitter (<100fs)
Flexible Power Supply Range
Low Skew

CDCLVP12xx / 21xx

Ultra-low additive jitter
Low Skew
Up to 2000MHz
Up to 16 Outputs
LVPECL Driver Family



Audio and Sensing at a glance...

#1 in audio market share with 18%

30 new audio products introduced in 2011 with 150 new sensor products from NSC acquisition

Speaker Power Amplifiers

LM48520

Boosted Stereo Class D Audio Power Amplifier with Output Speaker Protection and **Spreadspectrum**

TAS5630B

Class-D PurePath™
600W Mono/300W Stereo Amplifier

TAS5721

15W Stereo I2S Audio Amplifier with Headphone with Audio Processing and 2.1 Support

TPA2025D1

Boosted class-D speaker amp With **Battery Tracking**

TPA3118

30W Stereo Class D Amplifier with no Heatsink
4.5V~26V support/ and 1.2 MHz switching

Audio Converters

LM48901

Quad Channel **Spatial Array**

PCM1794

Industry's Highest Performance
132dB Stereo DAC

PCM4222

Industry's Highest Performance
124dB SNR Stereo ADC

PCM5102

High Performance
112dB Stereo DAC with 2Vrms line driver

TLV320AIC325x

Ultra Low power
Mobile Codecs w/miniDSP

TLV320AIC3262

High Integration
Mobile Codec w/miniDSP

Small Signal Amplifiers

DRV632

2VRMS line driver with **Directpath Technology**

OPA1602/1604

High Performance
Dual and Quad Bipolar-Input Audio Op-amps

TPA6136A2

25-mW DirectPath™
Stereo Headphone Amplifier with Pop Suppression

DIX9211

216KHz
Transceiver

PCM2912A

Plug and Play
USB Audio Codec

SRC4392

Integrated 24-bit perfect Sample rate converter
216kHz S/PDIF RX/TX

Sensing

INA282-6

Best Combination
High accuracy and high CMVR

LM57

High Accuracy
Programmable Temperature Switch

INA3221

Industry's First
Triple channel Current Shunt Monitor

TMP112

Industry Leading
Temperature accuracy

Audio Interface



Audio

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TI's Wide Package Portfolio

Thermally Enhanced BGAs

MicroStar Ultra Thin™ Land Grid Array Chip Scale Pkg (u*UT LGA)

MicroStar Jr™ Chip Scale Pkg (u*JR BGA)

MicroStar BGA™ Chip Scale Tape BGA (u*BGA)

Fine pitch BGA (nFBGA)

Analog Mirror Packages

Most Popular Packaging Options

QFN

WCSP

TO236

TO46

TO92

TO3

TO220

Transistor Outline (TO)

Mini Small Outline Pkg (MSOP)

Small Outline Transistor (SOT223)

Shrink Small Outline Pkg (SSOP)

Thin Shrink Small Outline Pkg (TSSOP)

Small Outline Integrated Circuit (SOIC)

Thin Quad Flatpack (TQFP)

Heat Sink Thin Quad Flatpack (HTQFP)

PowerPad Small Outline Pkg (HSOP)

Plastic Dual-In-Line Pkg (PDIP)

Ceramic Quad Flat Pack (CQFP)

Power Module (TO-PMOD)

Heat Slug Small Outline Integrated Circuit

Surface Mount Header (DDPak)

Power Small Outline Pkg (PSOP3)

Package on Substrate (POS)

Ceramic Dual-In-Line Package (CDIP)

Ceramic Pin Grid Array (CPGA)

MicroSiP™

Power Modules

Power Packages

Flip-Chip

Miniature Plastic Packages

SOT-23

SC-70

Multi-Row QFN

Flip-Chip QFN

Multi-Die QFN

Stacked-Die QFN

2 Dies + 2 Passives

ESV

Small Outline No Leads (SON)

LLGA

MicroStar BGA™ (U*BGA)

2 Stacked Dies + 6 Passives

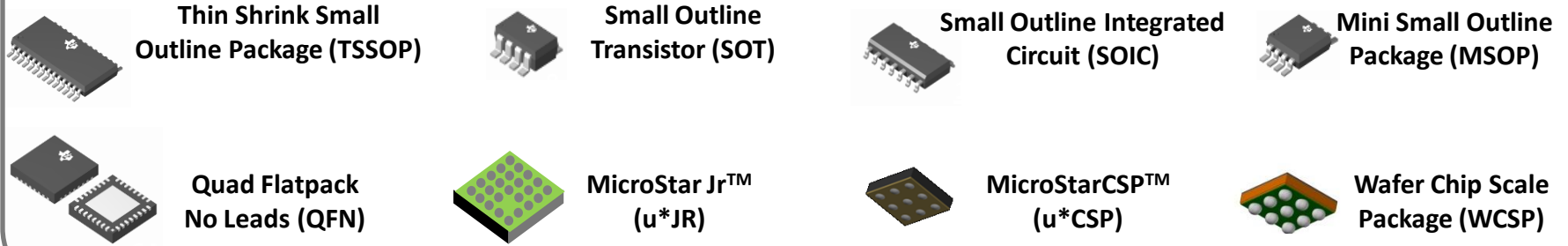
Chip-on-Lead QFN

Stacked Passives

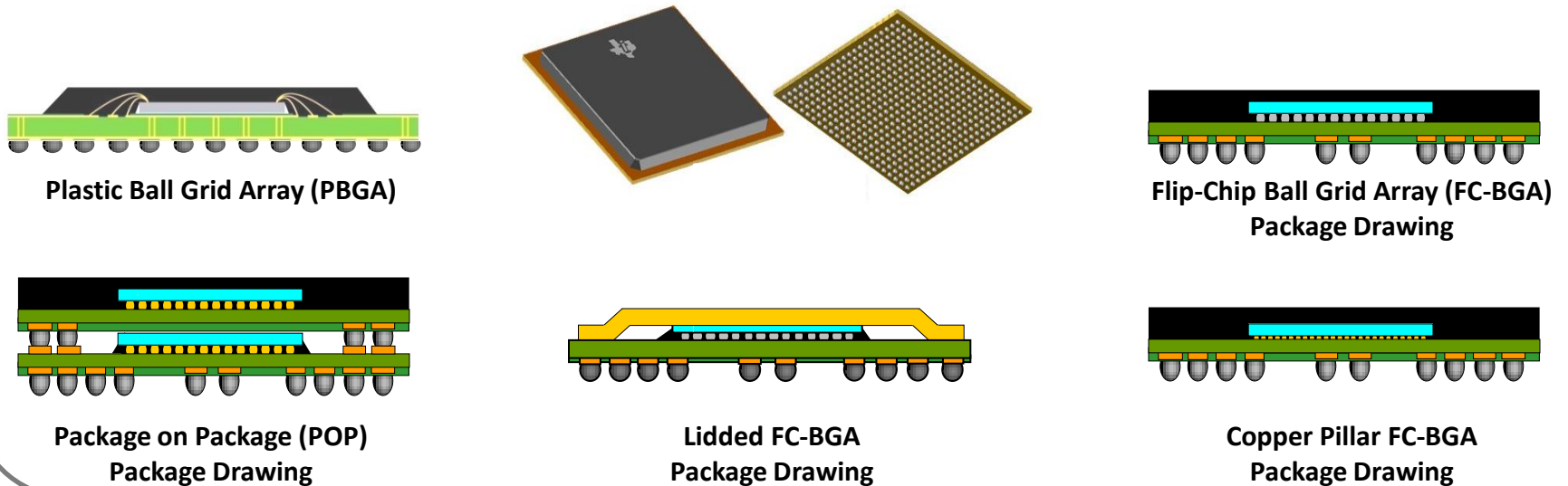
An LDO stacked on a Passive

TI Package Examples

Small Pin-Count Packages



Large Pin-Count Packages



And More...



Thank You!