

Smart Factory

ARROW FAE

Oliver Wang



Agenda

- ▶ **Smart Factory Introduce**

- ▶ **Smart Sensing in Factory**

 - Water Quality Analysis- Electrochemical & Optical solution

 - Gas Detection

 - CbM (Condition-based Monitoring)

- ▶ **Smart Factory Interface**

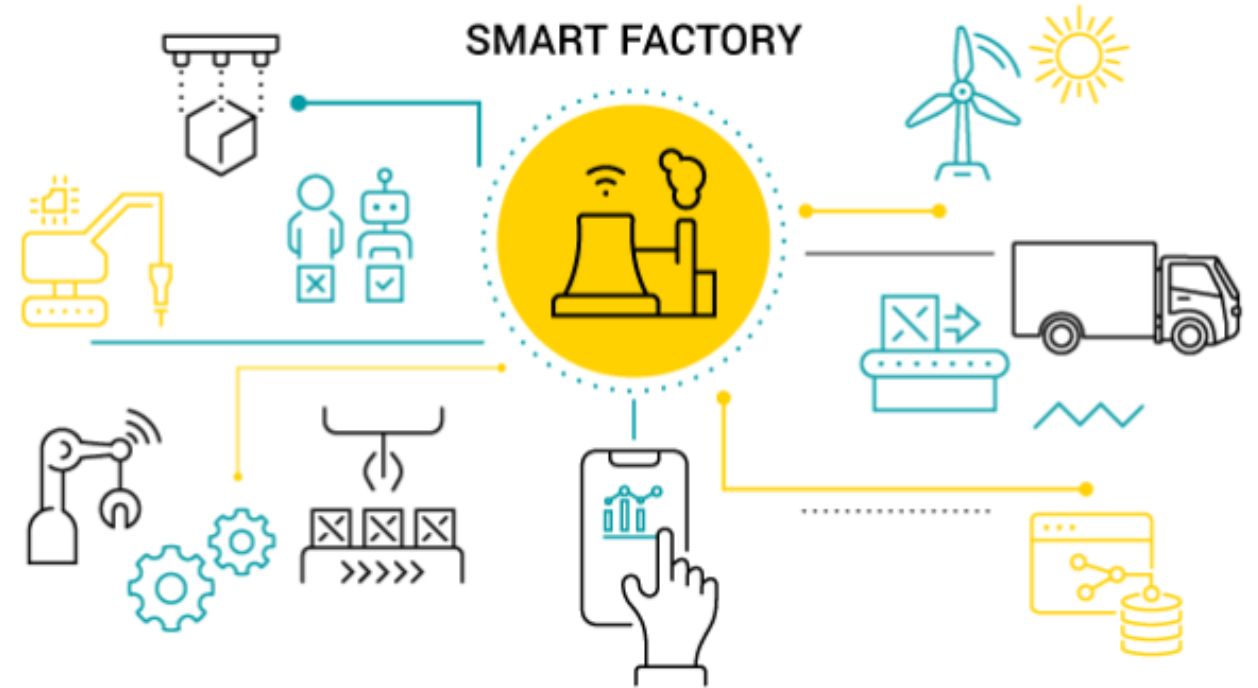
 - Dust_SmartMesh

 - 10BASE-T1L

Smart Factories Need Smart Machines

Smart Factories

Industry 4.0 Smart Factories will be increasingly flexible and adaptable, enabled by more autonomous intelligent machines.



- ▶ Environment
- ▶ Process monitoring
- ▶ Materials quality
- ▶ Early failure detection
- ▶ Safety



Making Electrochemical Sensors Intelligent



Water Quality and Liquid Analysis



Environmental Air Quality



Industrial Gas Sensing

Vision: Fully Integrated, Easy to Use, Plug 'n' Play Sensors

“Analyte In, Measurement Out”

Smart Sensor



ADUCM355

Signal Conditioning
and Data Conversion

Digital
Processing and
Control

Memory/
FIFO

Embedded Compensation, Calibration, Data Fusion,
Diagnostics/Prognostics/Extended Life

I²C/SPI/UART..



Smart interrupts

Reliable measurements in real-world conditions

Temperature Humidity Contaminants
Handling EMC

Water Quality Analysis

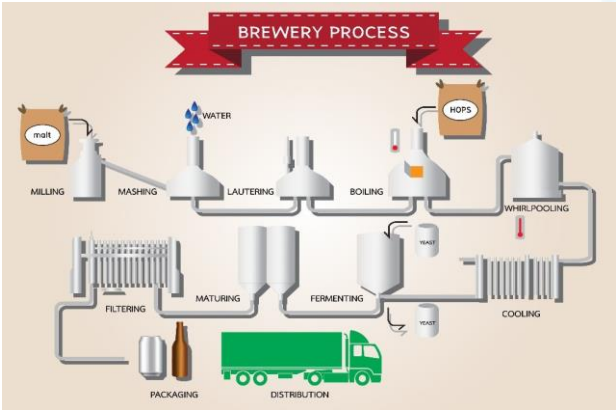


Liquid Analysis Applications

Vital Measurements For:

- ▶ Environmental management
- ▶ Health & safety
- ▶ Process monitoring
- ▶ Materials quality
- ▶ Plant operation
- ▶ Water treatment & conditioning
- ▶ Regulatory standards

Food & Beverage



Environment, Agriculture, Aquaculture



Materials & Manufacturing Processes



Lab Analysis



Medical & Pharma



Pools & Water Sources



Utilities & Power



Water Analysis- Electrochemical

Electrochemical: Ions Transport Charge

Long proven sensor technology without reagents

Colorimetric / Titrimetric

Nephelometric /
Turbidimetric

Luminescence, Absorbance,
Fluorescence

Electrochemical

Microbiological

Trace Analysis /
Lab Methods

Advantages

Most common indicators

Low power

High resolution

Linear output

Economical

Disadvantages

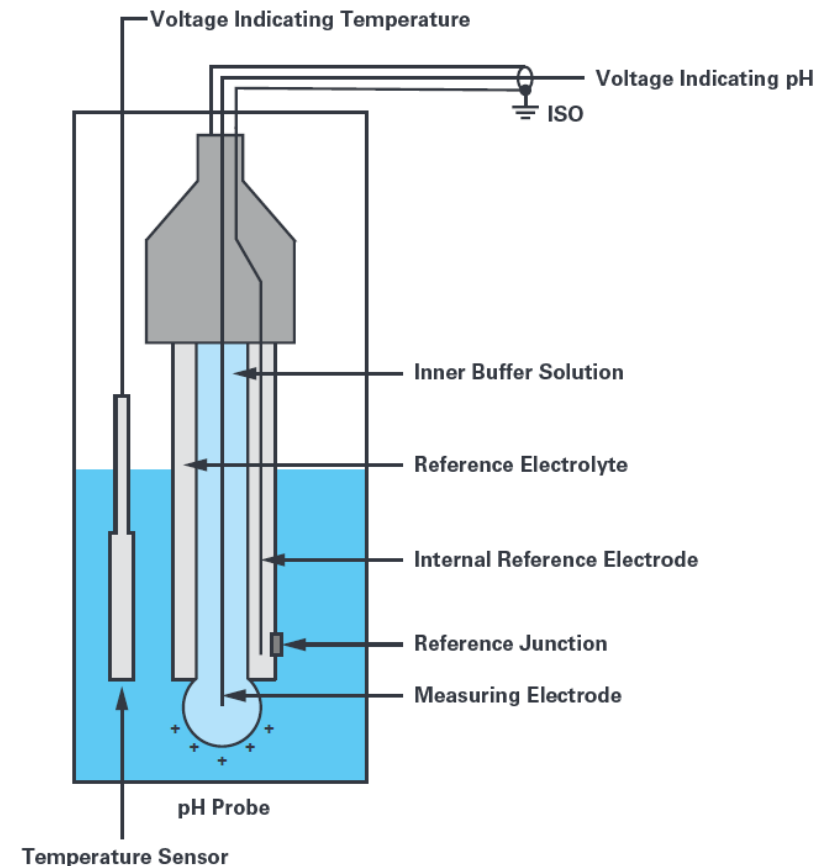
Sensor fouling, aging
& maintenance

Calibration

Environment
compensation

Drift over life

Nernst equation:
$$E = a - \frac{2.303 R (T + 273.1)}{nF} \times (pH - pH_{ISO})$$



pH

Oxidation-
Reduction Potential
(ORP)

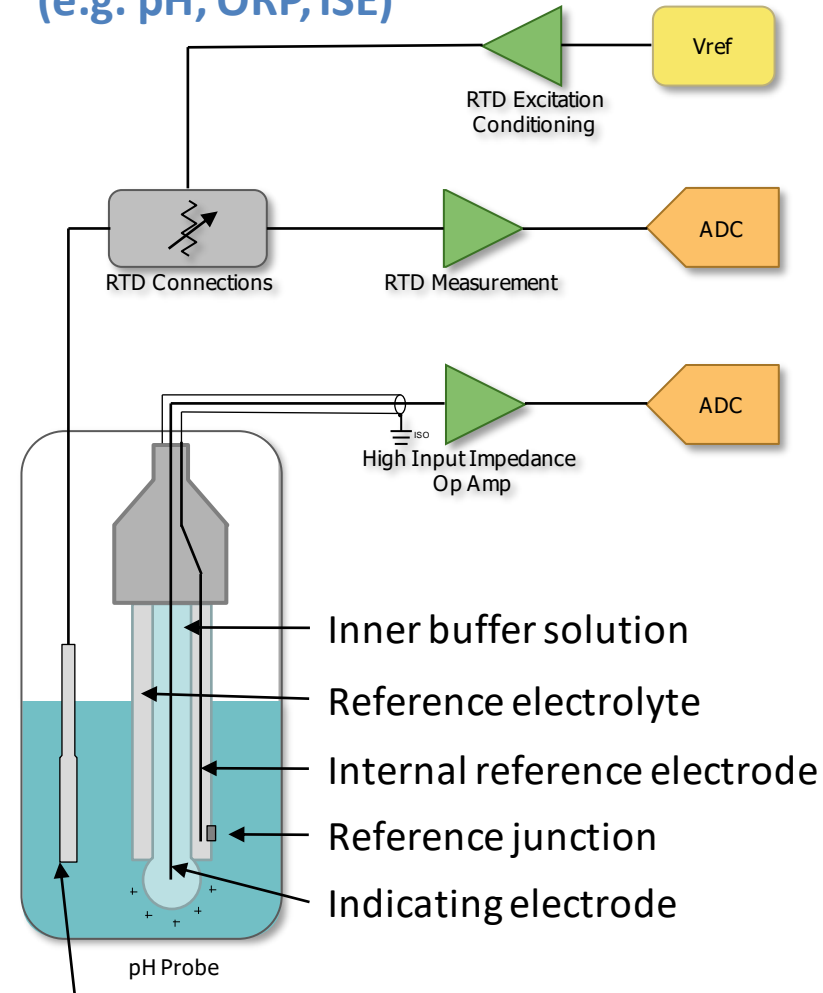
Conductivity

Ion Selective
Electrodes
(ISE)

Dissolved Oxygen
(DO)

Electrochemical Liquid Sensors – Basic Principles & Operation

Potential Sensors (e.g. pH, ORP, ISE)

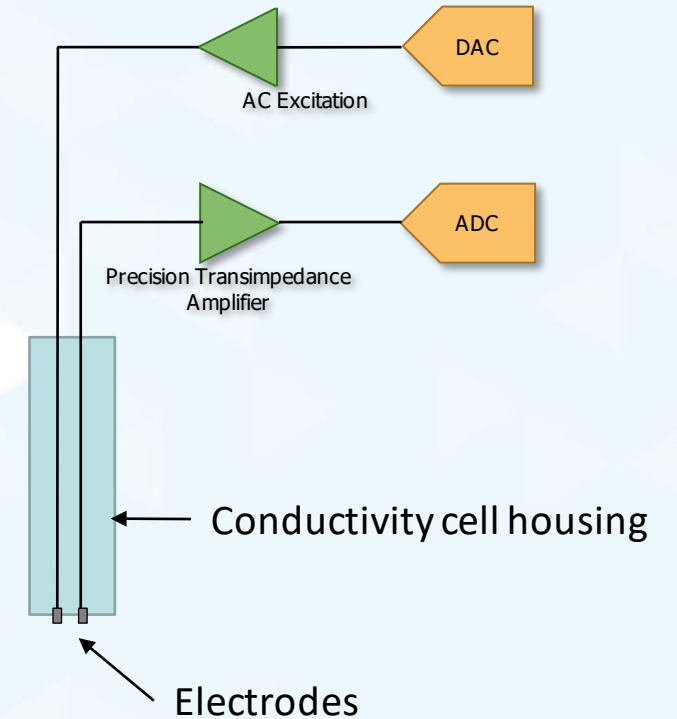


Temperature sensor

Proper Operation Requires:

- Routine calibration against a standard buffer solution
- Clean sensing surface
- Operation within specified sensor range
- Temperature compensation
- Precision, low noise, low drift measurement electronics

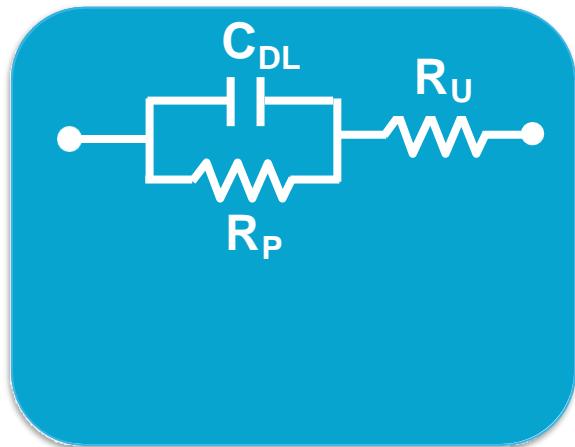
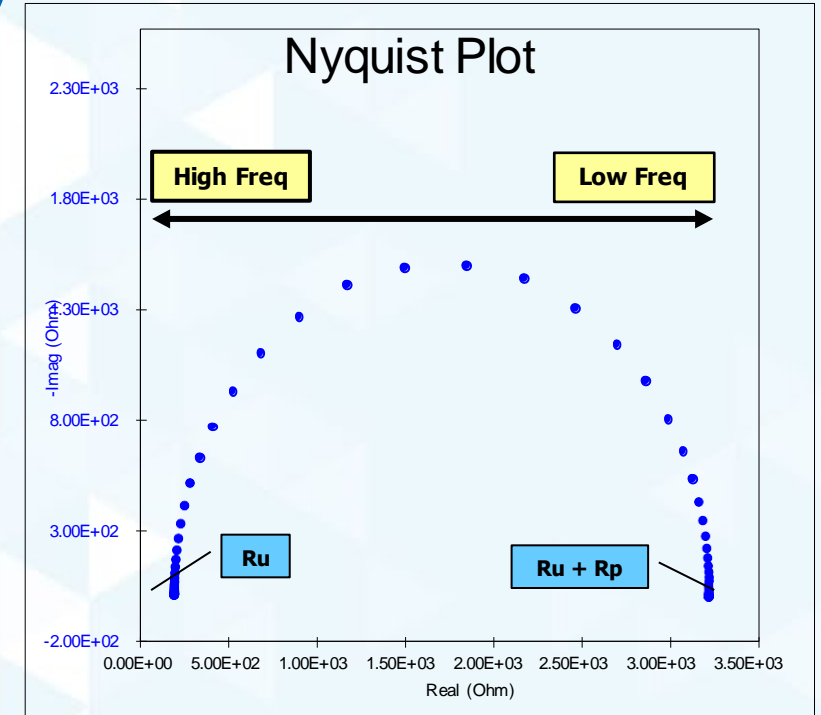
Impedance or Current Sensors (e.g. Conductivity, DO)



Sensor Diagnostics

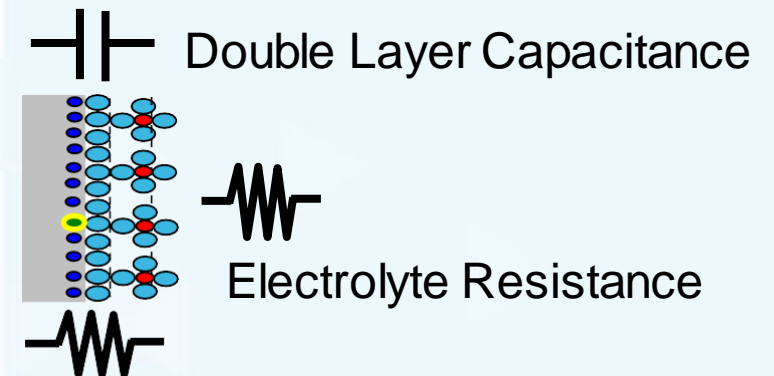
Electrochemical Impedance Spectroscopy (EIS)

- ▶ Applying ac signal sweep on sensor electrodes
 - Detects aging of sensor's electrolyte
 - Diagnoses charge transfer between electrodes
- ▶ Good correlation between impedance and sensitivity
- ▶ On-chip EIS enables long term drift compensation, end-of-life prognostics, and other smart sensor features

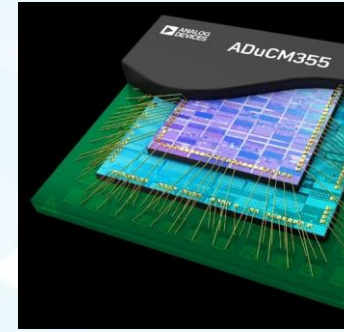


Other large signal EC techniques:

- ▶ Voltammetry (for example, CV, square wave)
- ▶ Chronoamperometry



CN0428 – A Programmable Electrochemical Liquid Analysis Reference Platform Featuring ADUCM355



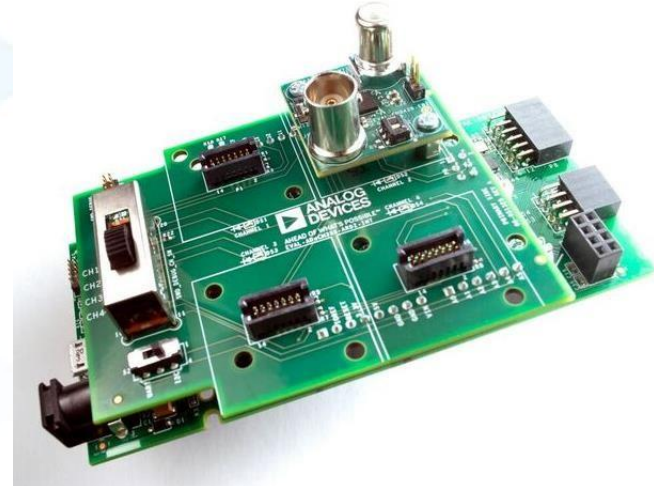
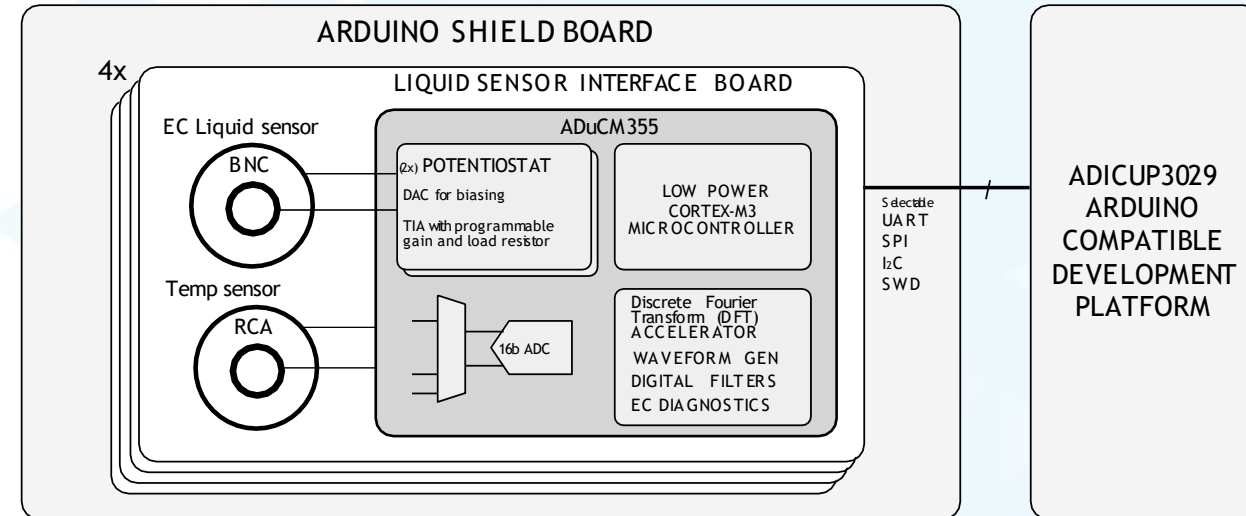
Water quality solution enables platformization in low power, small footprint designs

- ▶ Sensor health analysis made possible through integrated measurement & diagnostic functions
- ▶ Very low power, integrated measurement platform adaptable to probe form factor
 - Measures pH, Conductivity, ISE, ORP
- ▶ Programmable liquid analysis daughter boards
 - AFE and measurement pre-processing with ADuCM355
 - Integrated compensation (ATC)

Hardware, software and documentation

- ▶ Based on ADICUP3029 development platform
- ▶ Software examples available on analog.com
- ▶ [Circuit Note](#) and user guide

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www.analog.com/cn0428

Water Analysis- Optical

Optical: Ubiquitous, Non-Contact Sensing

Wide range of sensing applications & measurement techniques, yet requires clearly defined optical path

Colorimetric / Titrimetric

Nephelometric /
Turbidimetric

Luminescence, Absorbance,
Fluorescence

Electrochemical

Microbiological

Trace Analysis /
Lab Methods

Advantages

- Non-destructive, Non-contact sensing
- High precision
- Low drift
- Low calibration
- Standard methods
- Less maintenance

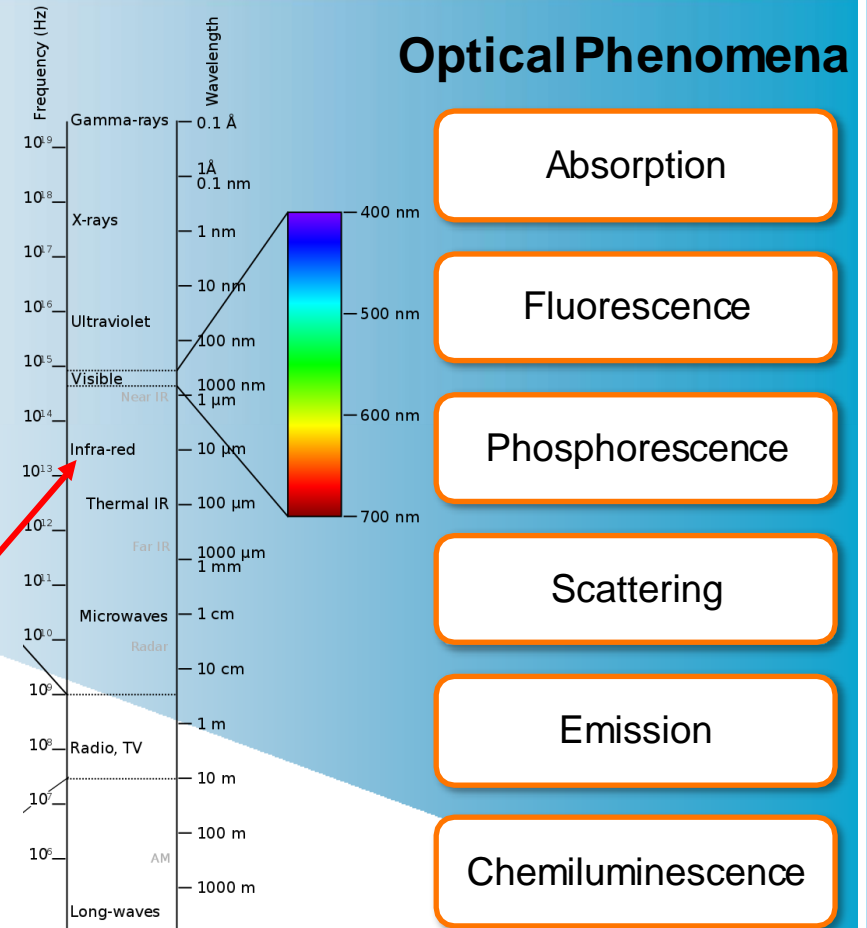
Disadvantages

- Challenging optics
- Path obstruction, sensor fouling
- Environment compensation
- Reagents may be required

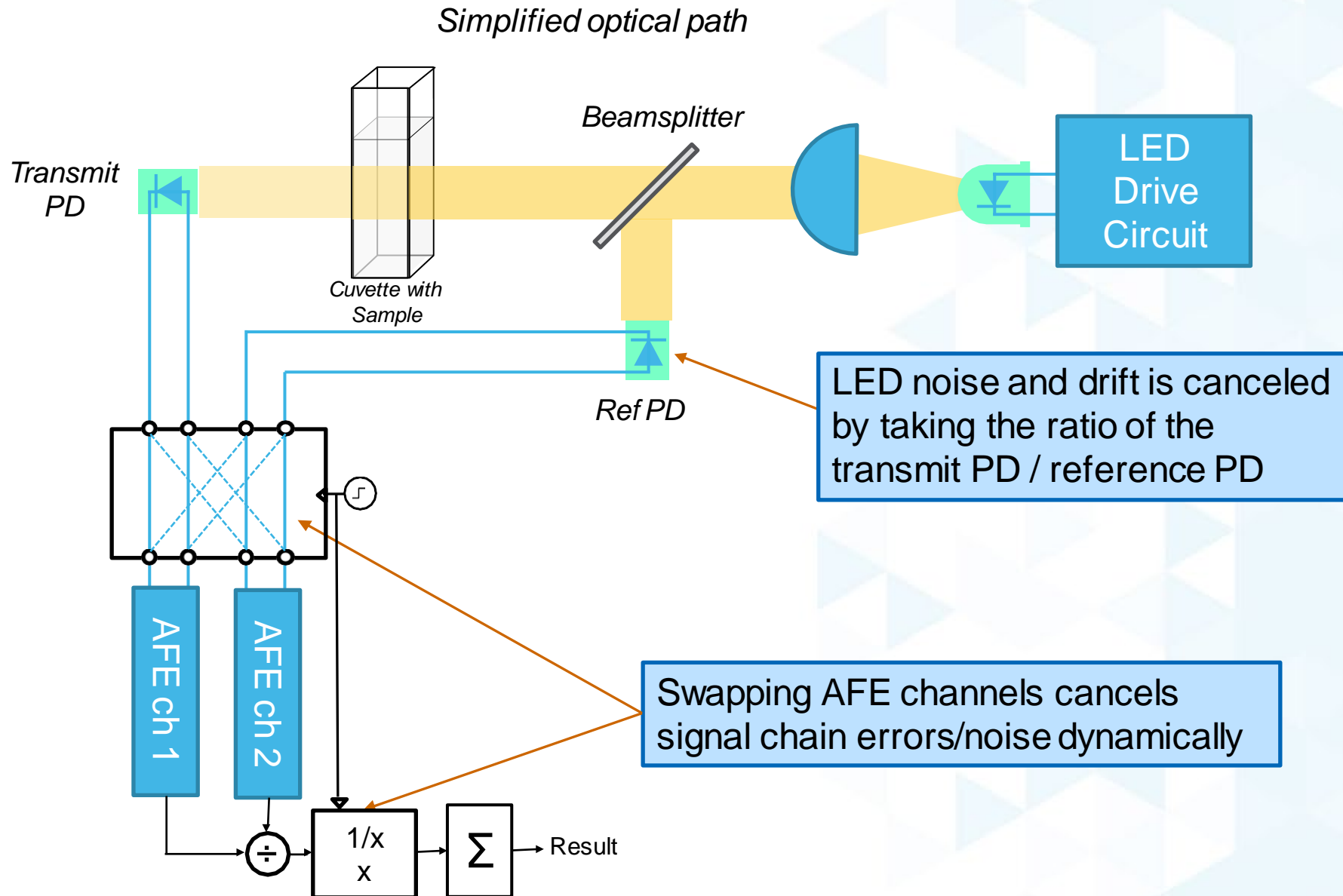
Example parameters

- Turbidity
- Total organic carbon
- Total suspended solids
- Dissolved O₂
- Bio/chemical O₂ demand
- Many ions
 - NO₂, NO₃
 - Chlorine
 - Ammonia

Note: Most liquid measurements done in UV, visible range, since water absorbs strongly in IR band



Optical Liquid Sensing – Basic Principles & Operation



Application tip:
LED drift in power output and wavelength with temperature (including self-heating). Use ratiometric measurement to cancel intensity errors and optical filters for wavelength shift

Integrated Photometric Front End

ADPD4100/ADPD4101 Multimodal Sensor Front End with Maximized Design Flexibility

Features and Specifications

- ▶ Fully integrated AFE, ADC, LED driver, and timing core
- ▶ Multimodal analog front end
 - **Simultaneous sampling** with dual channel capability
 - 8 input channels with multiple operation modes
 - 12 programmable time slots for synchronized sensor measurements
 - Flexible input multiplexing to support differential and single-ended sensor measurements
- ▶ Eight LED drivers, four of which can be driven simultaneously
 - 400 mA total LED drive current
- ▶ Power dissipation $< 50 \mu W$ (combined LED/AFE power)
- ▶ **SNR of transmit and receive signal chain: > 100 dB**
- ▶ On-chip digital filtering
- ▶ Best-in-class ambient light rejection: 60 dB up to 1 kHz
- ▶ Flexible sampling rate from 0.004 Hz to 9 kHz using internal oscillators

Part Number	Interface	PD Inputs	LED Drivers	Package
ADPD4100BCBZR7	I ² C	8	8	35-ball WLCSP
ADPD4101BCBZR7	SPI	8	8	33-ball WLCSP

FUNCTIONAL BLOCK DIAGRAM

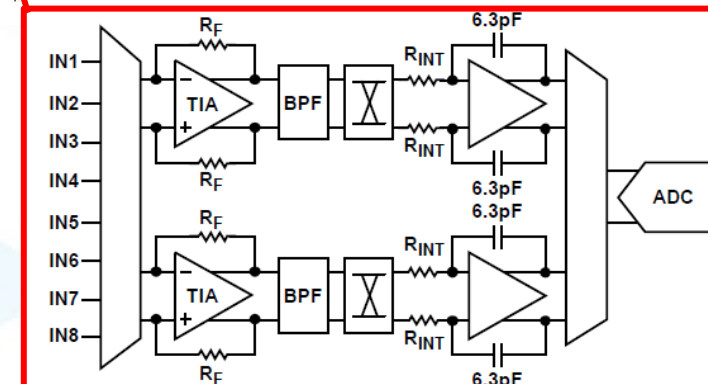
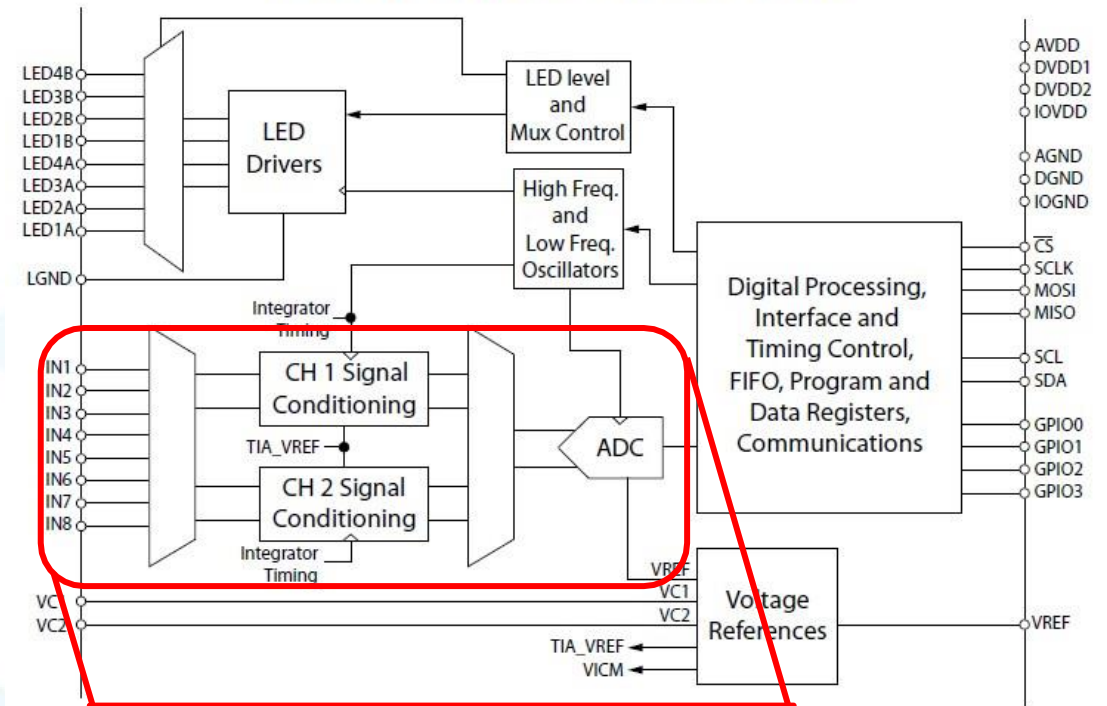


Figure 16. Analog Signal Path Block Diagram



CN0503 – A Multi-Parameter Optical Liquid Analysis Reference Platform Featuring ADPD4101

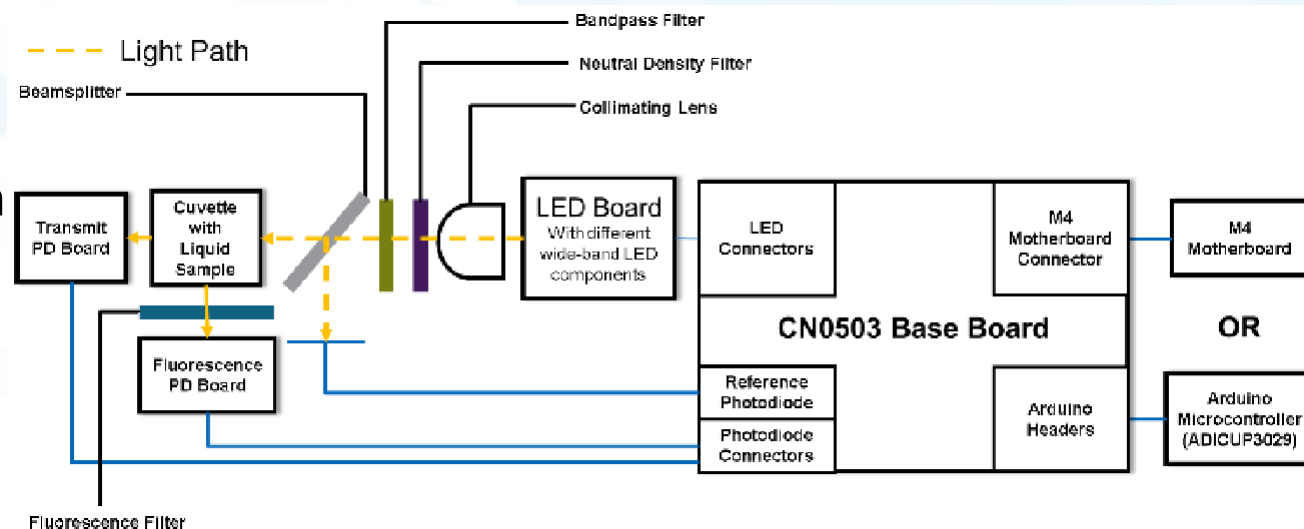
Highly configurable design for optical platform development

- ▶ Measures colorimetry/absorbance, fluorescence, turbidity
- ▶ Programmable AFE board with swappable PD & LED boards
 - 365nm – 630nm options included
- ▶ Single photometric front-end IC drives multiple measurement channels
 - 4x pass-through channels
 - 2x 90° scattering channels



Hardware, software and documentation

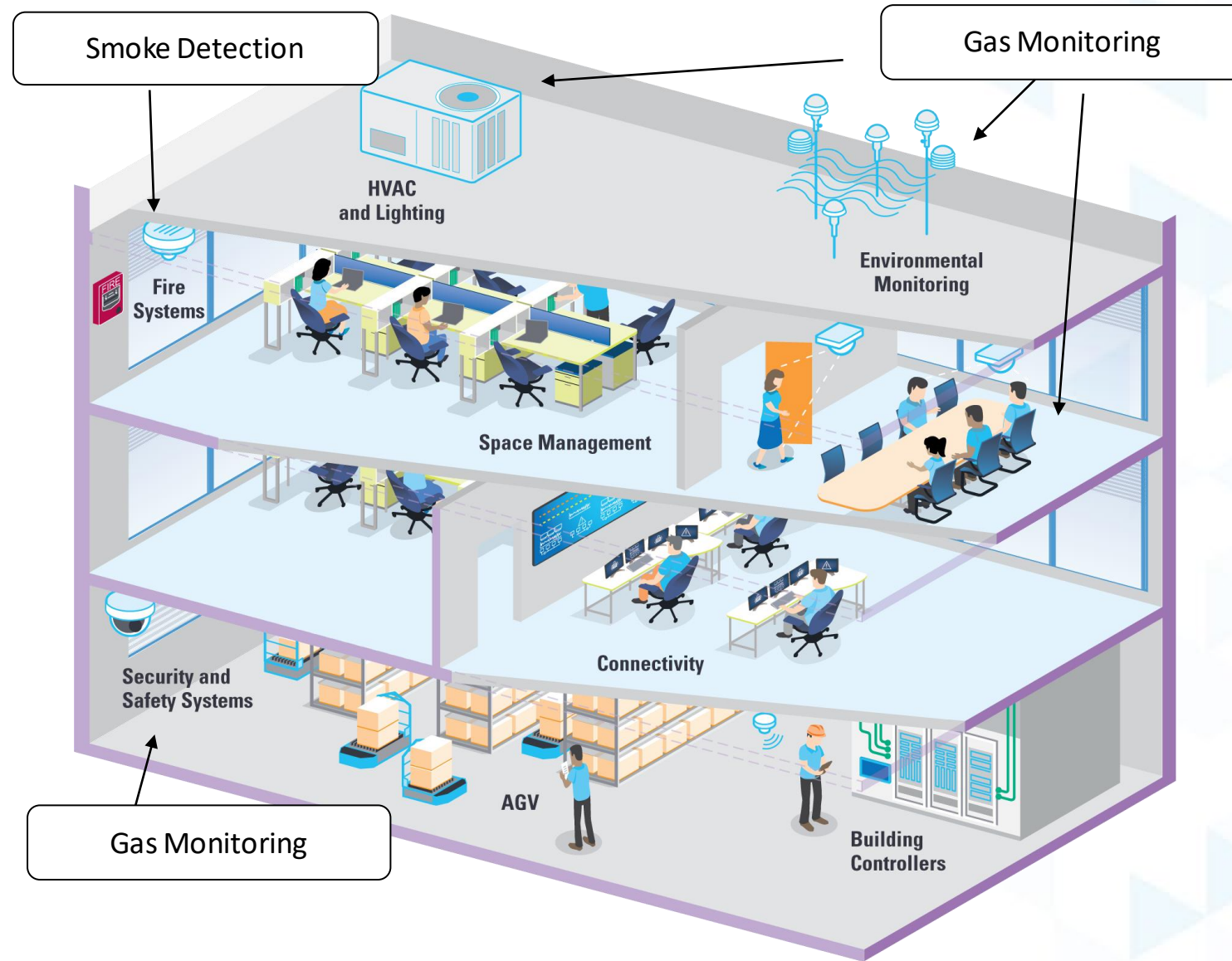
- ▶ Interfaces to ADICUP3029 development platform
- ▶ Firmware, Python scripts and GUI available on analog.com
- ▶ Circuit Note, user's guide, all mechanical & electrical design files



Gas detection



Building Automation Systems



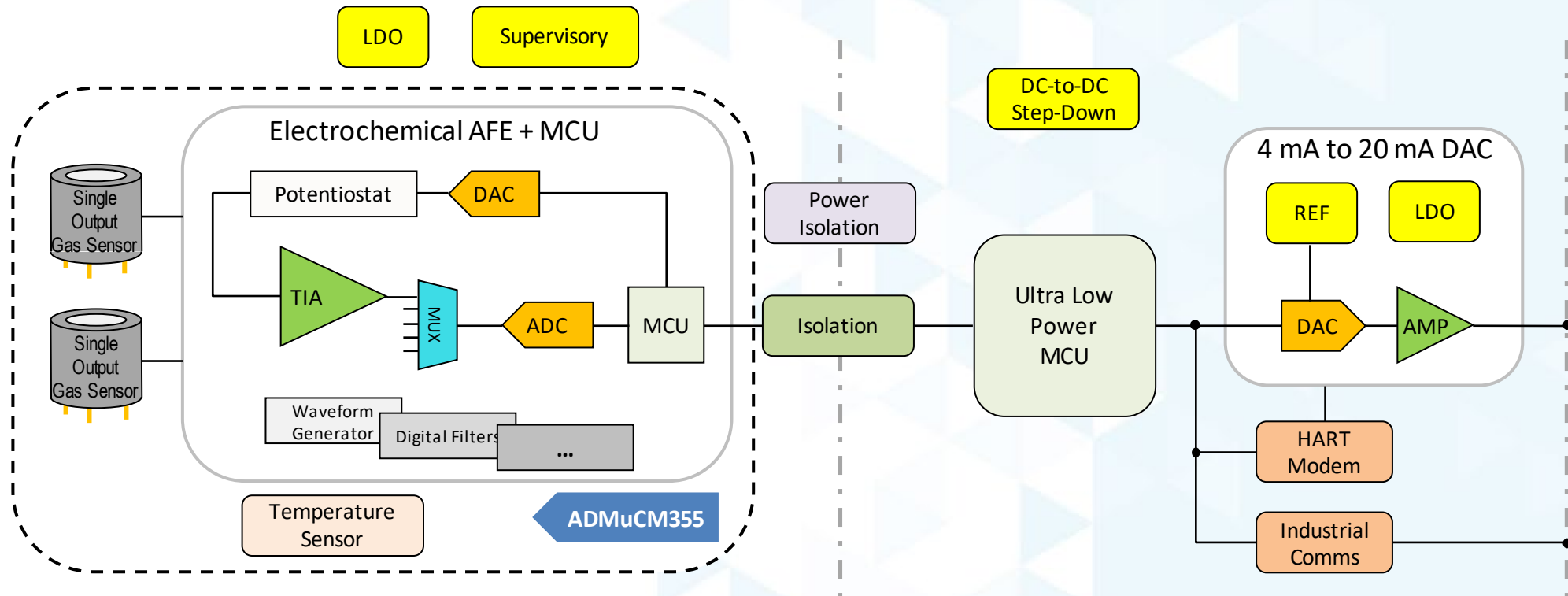
Building automation systems that enable automated decision making to provide greater efficiencies in the following areas:

- ▶ Energy consumption
- ▶ Operational efficiency
- ▶ Space utilization
- ▶ Building automation
- ▶ Sustainability
- ▶ Well-being of workers

Gas Sensing Technologies



Fixed Gas Sensing



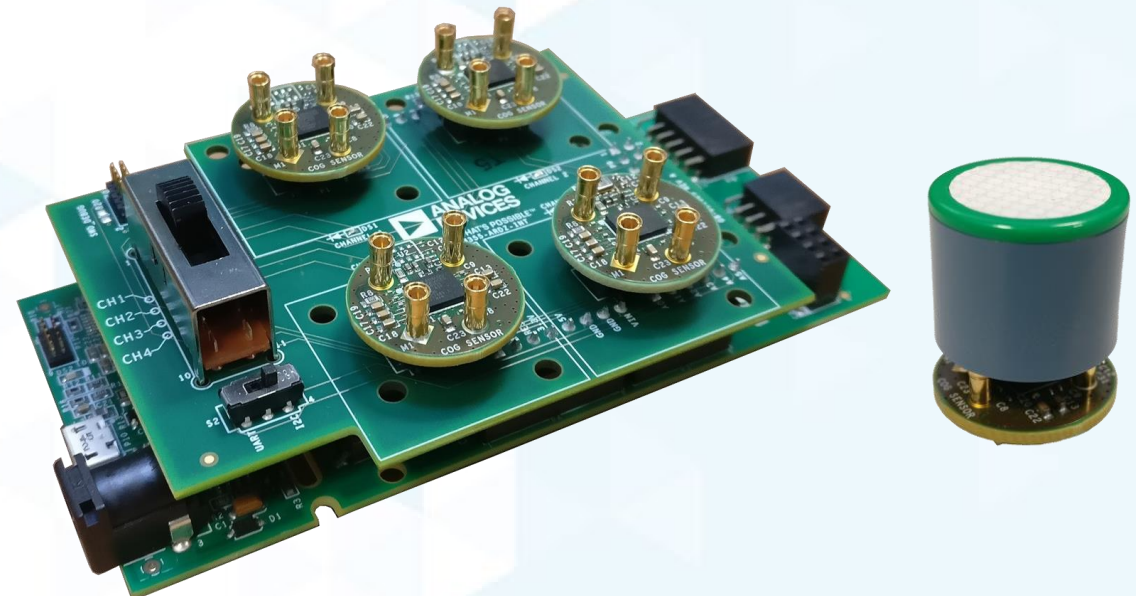
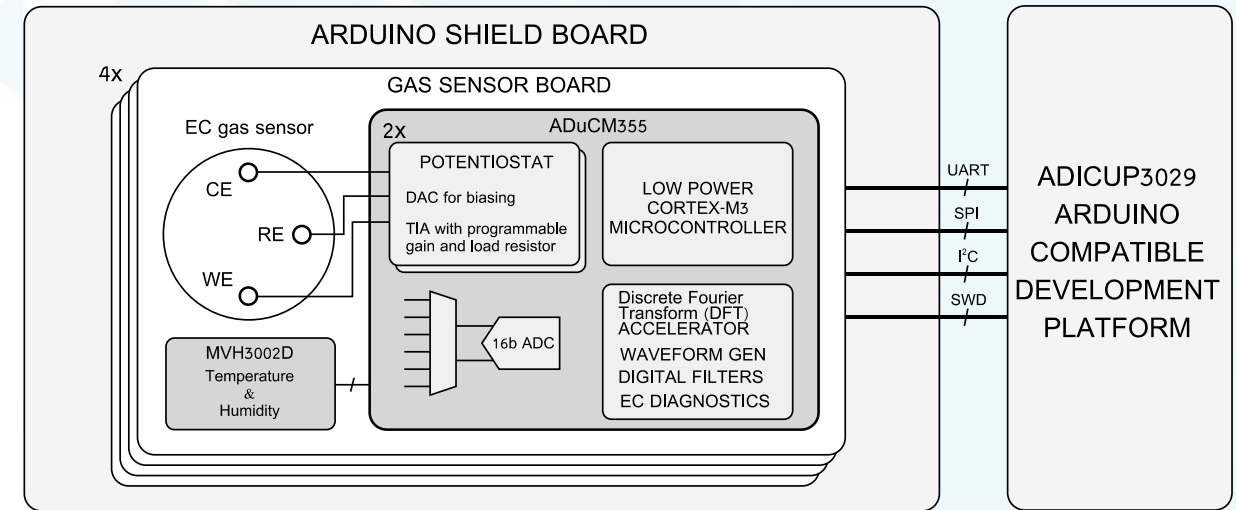
- **Function:** loop-powered gas sensing device measuring an electrochemical gas sensor

- **Solution:** fully integrated electrochemical front end enabling sensor diagnostics, temperature compensation, and industrial connectivity

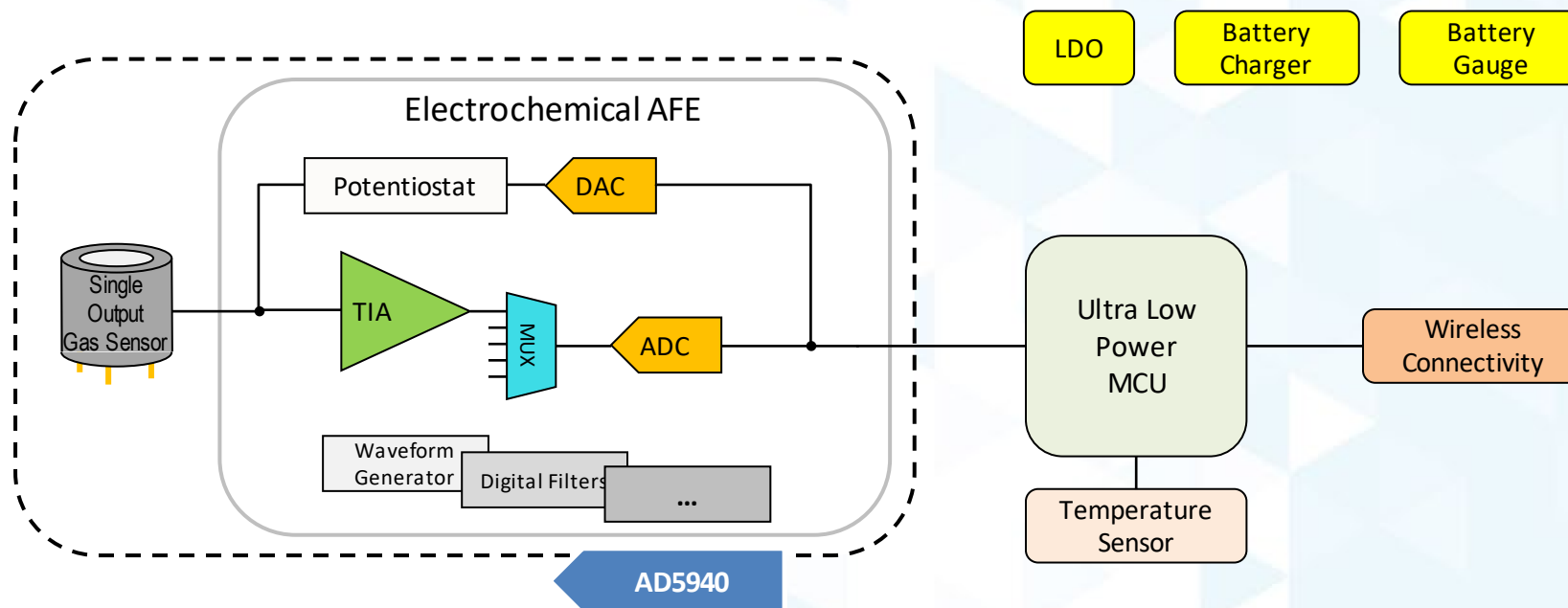


Circuits from the Lab[®] Reference Design: CN-0429

- ▶ Based on ADICUP3029 development platform
 - Arduino compatible
 - USB interface (virtual COM port)
- ▶ Arduino gas sensing shield
 - Measure any four EC gas sensors (in 4-series form factor)
 - Programmable gas sensing daughter boards
 - AFE and signal processing with ADuCM355
 - On-board temperature and humidity sensor
- ▶ Hardware, software, and documentation
 - Serial terminal is used to display the data
 - Software examples available on analog.com
 - [Circuit note](#)
 - CftL user guide
 - Released December 2018



Portable Gas Sensing Device 2



- **Function:** Battery powered, wirelessly connected gas sensing device measuring 4 standard single output electrochemical gas sensors

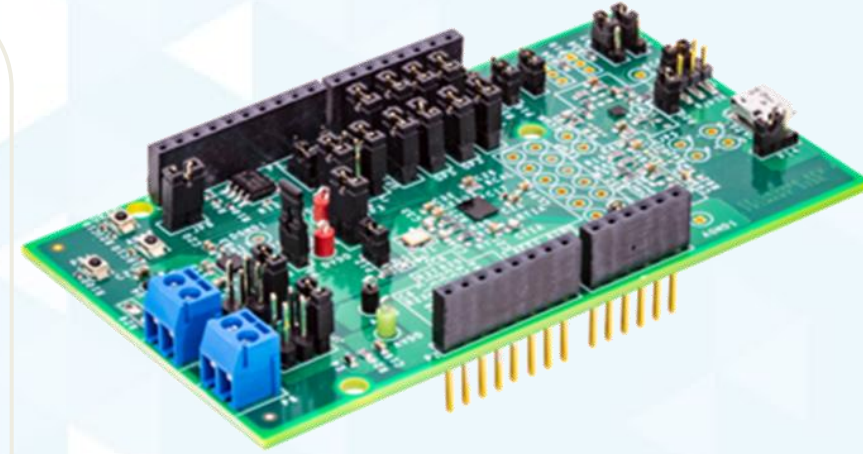
- **Solution:** Fully integrated ultra low power electrochemical front end enabling sensor diagnostics, temperature compensation, and wireless connectivity



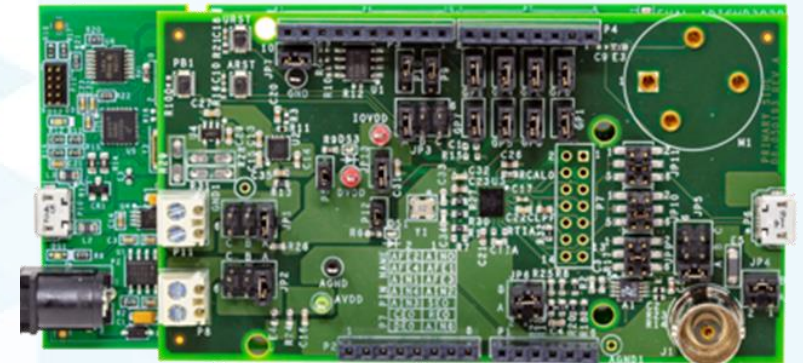
AD5940/AD5941: Online Resources



- ▶ [Data sheet](#)
- ▶ **Evaluation boards**
 - [EVAL-AD5940BIOZ](#) (Bioelectric evaluation board)
 - [EVAL-AD5940ELCZ](#) (Electrochemical evaluation board)
- ▶ **Companion products**
 - [AD8233](#) (ECG AFE)
 - [ADPD1080](#) (Photometric AFE)
- ▶ **Application notes:** [AN-1563](#), [AN-1557](#)
- ▶ **Press release:** [ADI Announces New Impedance and Potentiostat AFE](#)
- ▶ [EngineerZone®](#)
- ▶ [Marketing slide deck](#) and [signal chains](#) at Hyperion
- ▶ **Videos:**
 - [Smart Bracelet for Heart Rate, Impedance, and Motion Sensing](#)
 - [Intelligent Automotive In-Cabin Sensing](#)
- ▶ **Tech article:** [Jack of All Trades in Impedance Measurement](#)
- ▶ **Product home page:** [AD5940](#)



EVAL-AD5940BIOZ



EVAL-AD5940ELCZ



CbM-(Condition-based Monitoring)



Industrial CbM

Enabling asset monitoring solutions that deliver actionable insights



- Manufacturing
- Water & Wastewater Treatment
- Food and Beverage
- Paper and Pulp
- Metal and Mining
- Energy
- Oil and Gas Installations

Why is there a need for CbM?



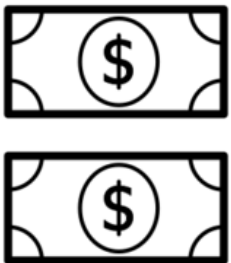
Reduced
maintenance
breakdowns



Reduced
unplanned
failures and
downtime



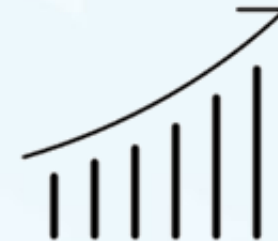
Increased
machinery
life



Reduced
maintenance
costs



Reduced mean
time to repair



Increased
productivity

Analog Devices Broad Market CbM Offerings



**Sensing
Modalities**



**Data
Acquisition**



**Edge
Processing**



**Wired/Wireless
Connectivity**



**Power
Management**

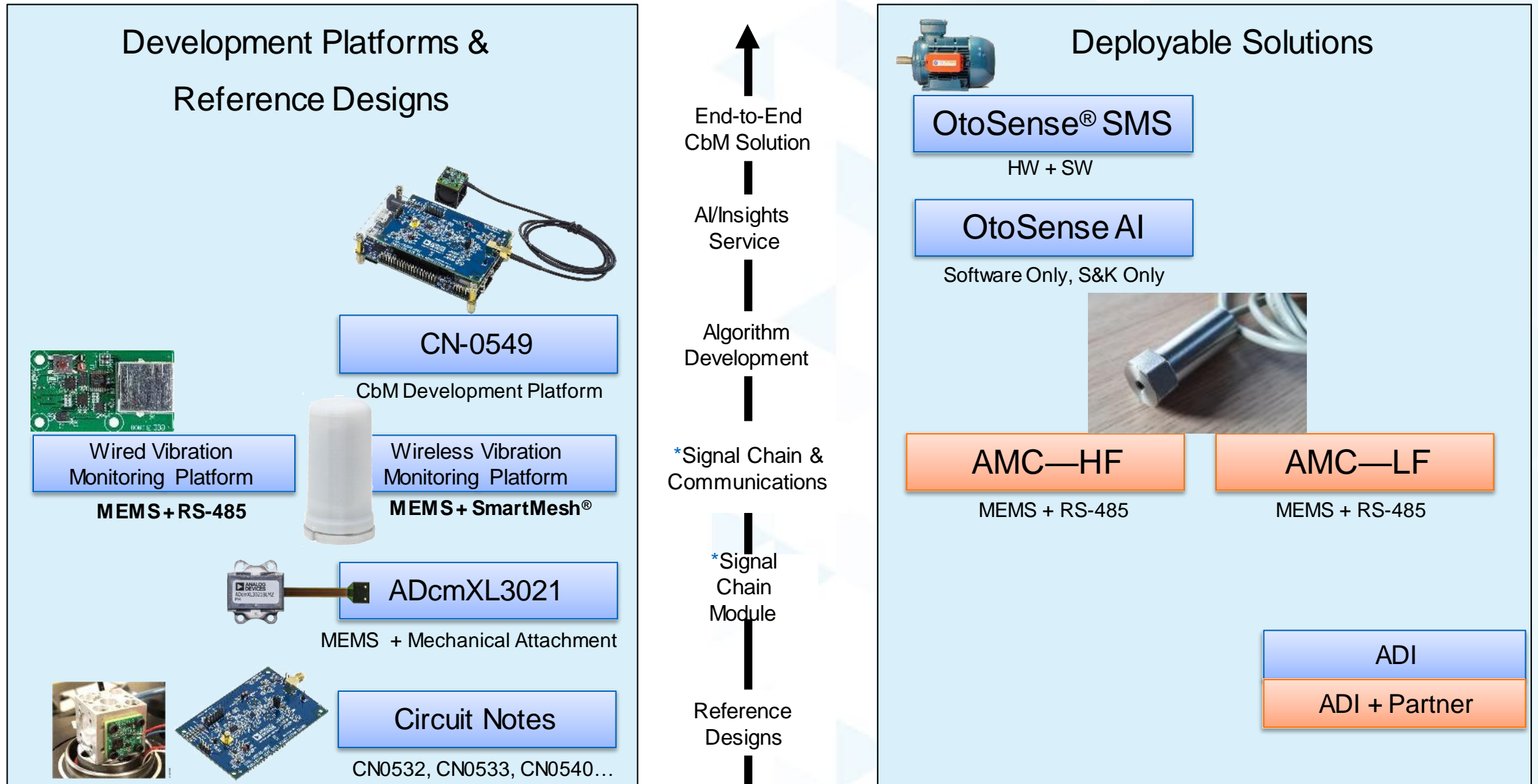


**Asset Monitoring
Solutions**

Industrial CbM Platform Solutions

*Accelerate our customers CbM developments
with system level solutions*

ADI's CbM Development Platforms and Deployable Solutions



Robust, Low Power Wireless Mesh, Vibration Monitoring Platform

EV-CBM-VOYAGER3-1Z

ADXL356

Low Noise, Low Power,
3-Axis MEMS

AD7685

Low Power
16-Bit, 250 kSPS ADC

ADuCM4050

Ultra Low Power
ARM® Cortex®-M4F MCU

LTP5901

Robust, Low Power
SmartMesh® 802.15.4e



Accelerate wireless CbM deployments with complete, system-level solutions

Signal Chains and Reference Designs: CN-0532

High Performance, Cost-Effective, MEMS-Based PZT Sensor Replacement Sensors

ADI sensor and signal chain technologies enable piezoelectric vibration sensor replacement solutions by providing validated reference designs to convert ADI MEMS sensor outputs to a compatible IEPE interface for easier integration into existing sensing and data acquisition solutions.



Potential for single and multi-axis vibration measurement
Bandwidths greater than 10 kHz



Optimized signal chain for IEPE interface
Enables quicker deployment into existing DAQ systems



Robust, IEPE communications interface
Enables quicker deployment into existing industrial DAQ systems



Accelerates time to market
HW design files available for development

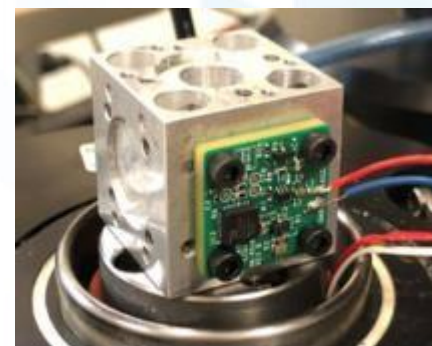
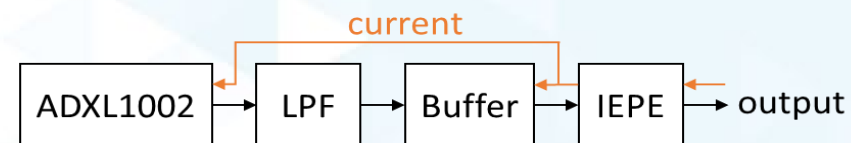
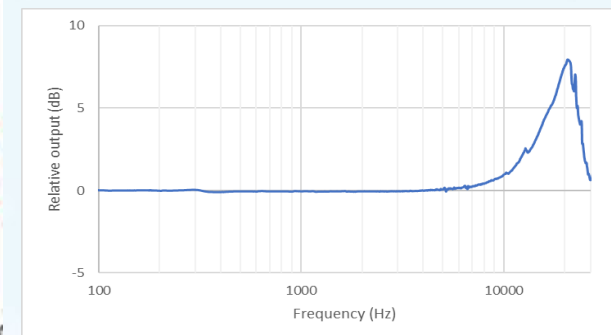


Figure 3. Vibration measurement test setup. EVAL-CFTL0614 board attached to shaker table using an aluminum block.



Signal Chains and Reference Designs: CN-0540

High Performance, Wide Bandwidth, Precision Data Acquisition for IEPE Sensors

ADI sensor and signal chain technologies enable fast prototyping of vibration sensor data acquisition solutions by providing validated reference designs for precision data acquisition designs that interface directly to wide bandwidth IEPE sensor outputs.



Potential for single and multi-axis vibration measurement
Bandwidths greater than 10 kHz



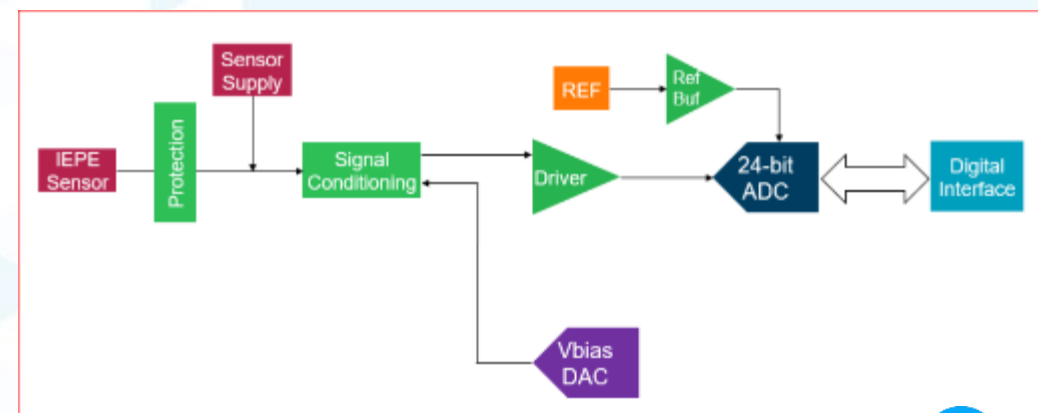
Precision data acquisition design
Optimal component choice ensures measurement fidelity



Optimized signal chain for IEPE sensors
Enables precision, low noise, wide bandwidth acquisition profiles



Accelerates time to market
HW design files available for development



DUST_SmartMesh



Wireless Landscape

Different Technologies for Different Purposes

LPWAN (LoRa, SigFox)

- Very low data rates (ideally few pkts / day)
- Long range radio link, star topology
- Questionable reliability, Questionable Security

Consumer WSN (e.g. ZigBee, Google Thread)

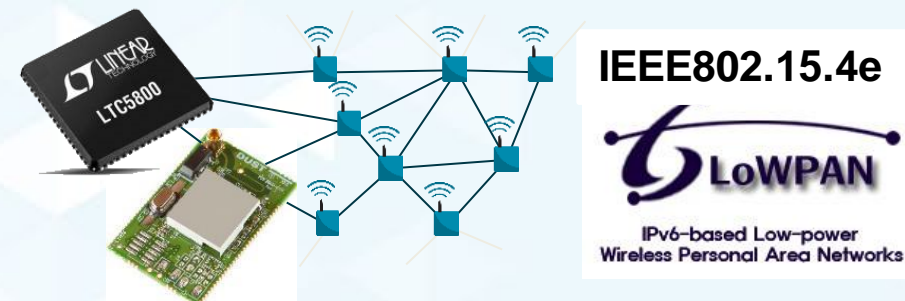
- Wireless Mesh
- Emphasis on Low-cost BOM, simple network implementation
- Problems with scale and tough Environments

SmartMesh

- Field Proven for Industrial IoT applications
- >99.999% Data Reliability
- > 10 Year Battery Life, without Sacrificing Availability or Reliability

ADI IP Wireless Mesh Networking Protocol Solution

- ▶ **2.4 GHz multihop wireless mesh networking solution**
- ▶ **Established industrial grade solution**
 - IEEE 802.15.4e standards based
- ▶ **Complete wireless networking solution**
 - LTC5800 SoC with embedded protocol software and reference design
 - Pre certified surface mount pcb (castellated) with embedded software



Key Benefits

- ▶ **Ultralow power consumption delivering >10 year battery life**
- ▶ **High reliability, robustness, and immunity to interference**
 - Maintains network integrity, avoiding data loss in industrial environments
- ▶ **Scalability for networks to work in different configurations**

Industrial Process



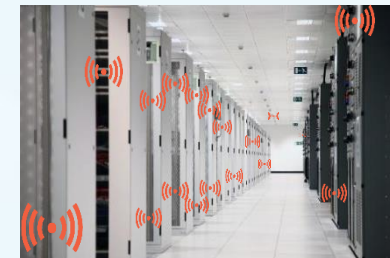
Condition-Based Monitoring



Transportation



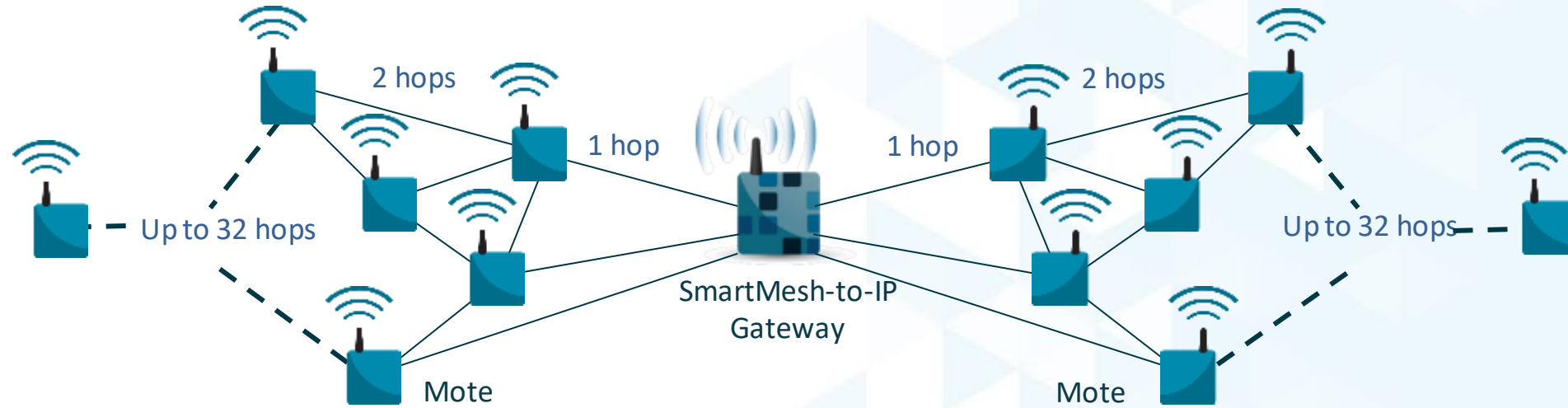
Data Center Monitoring



~100m indoors
~300m outdoors



SmartMesh Network Size and Capacity



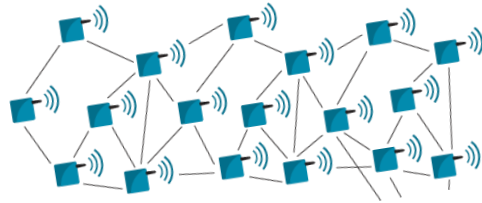
- 90 Bytes of user data per packet
- 36 packets/second/gateway aggregate traffic
- Up to 32 'hops' from gateway to cover long spans (64 hops end-to-end)
- SmartMesh Manager SW schedules, optimizes and performs network management functions: Embedded Manager or Vmanager
- Typical Routing Node: <50 μ A at 3.6 V
- 4.5 mA to receive a packet
- 9.7 mA to transmit at 8 dBm

ADI SmartMesh IP—Network Managers

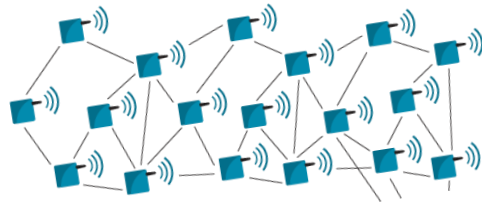
Network Management Options for Network Scaling

Embedded Manager

- ▶ “Manager-on-Chip”—radio and NW software runs on LTC5800-IPM microprocessor
- ▶ Each gateway supports up to 100 nodes/network

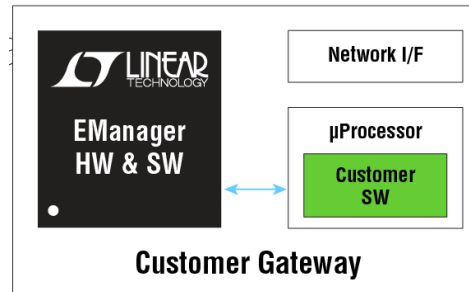


<100 motes in network 1

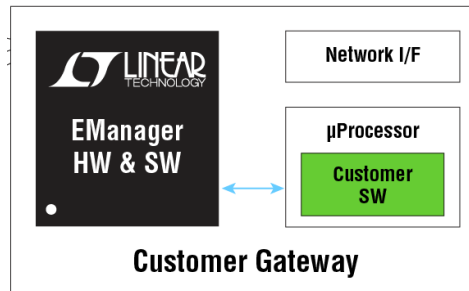


100 to <200 motes in network 2

..... Incremental 100 mote networks



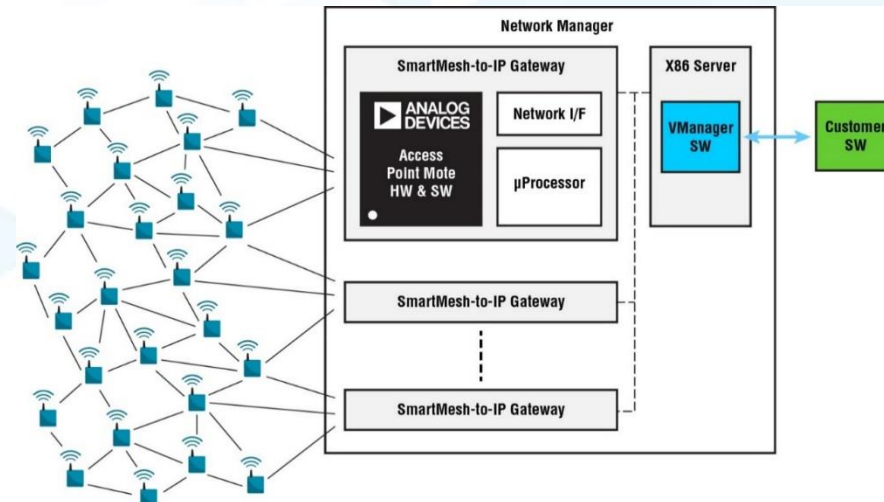
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2

VManager

- ▶ Consolidated network manager coordinating multiple gateways
- ▶ Up to 165 gateways accessing a single mesh network
- ▶ Each gateway supports the data bandwidth for up to 300 motes (1 pkt/8 sec per node)
- ▶ For use in multi-floor buildings, multi building campuses, etc.
- ▶ Ease of commissioning/installation (single network)
- ▶ Enables redundant gateway access to network



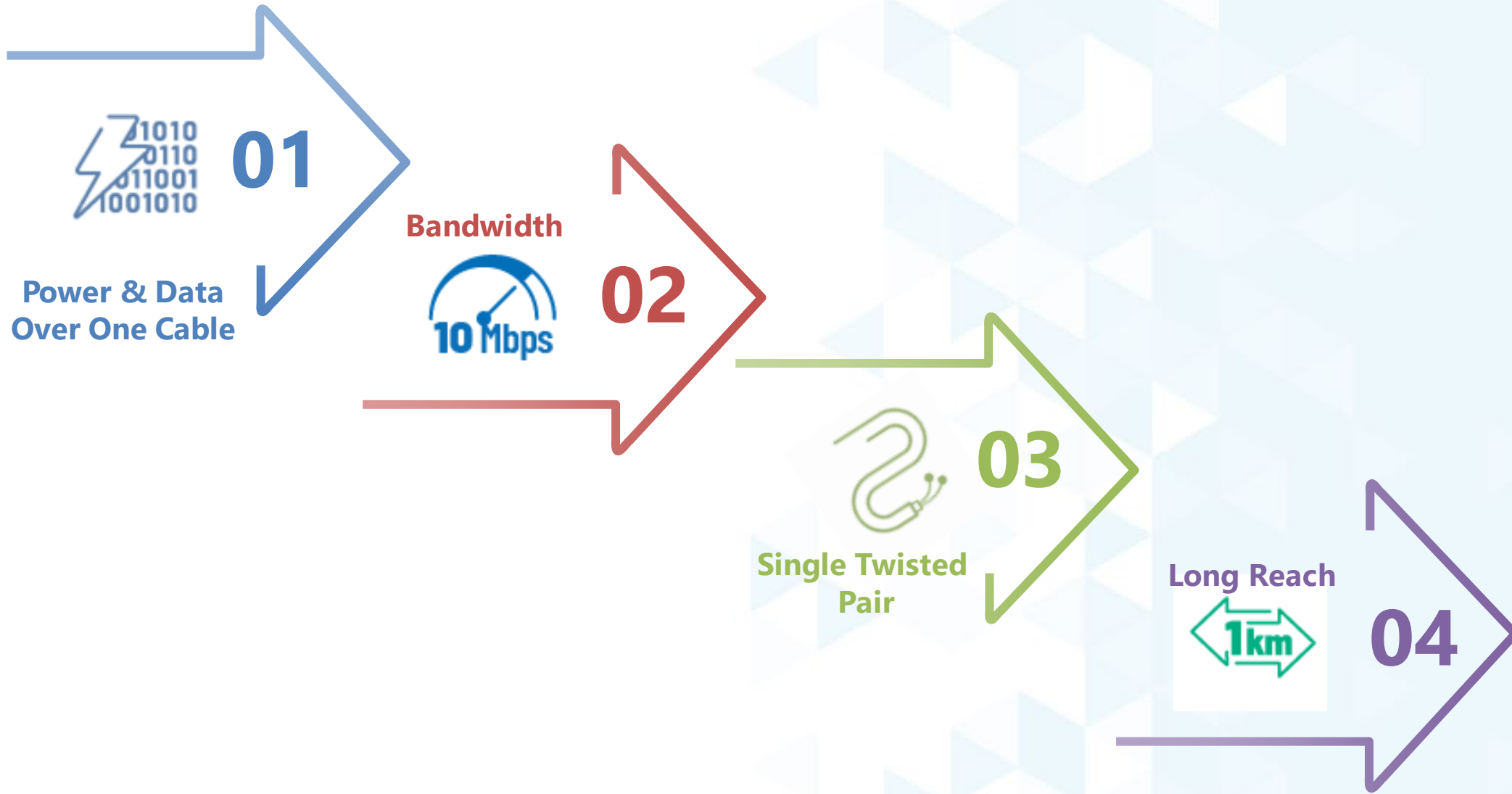
<(300× No. of Gateway managers) motes



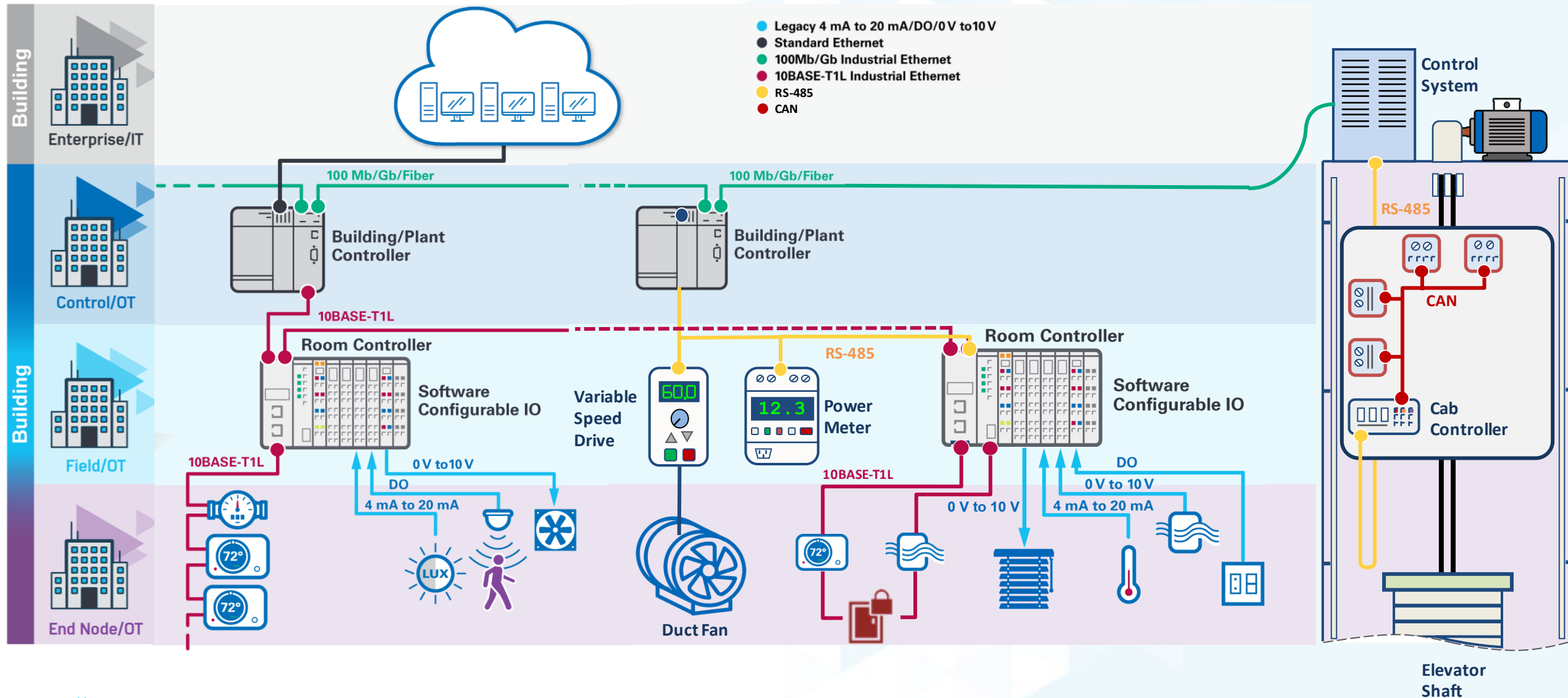
10BASE-T1L

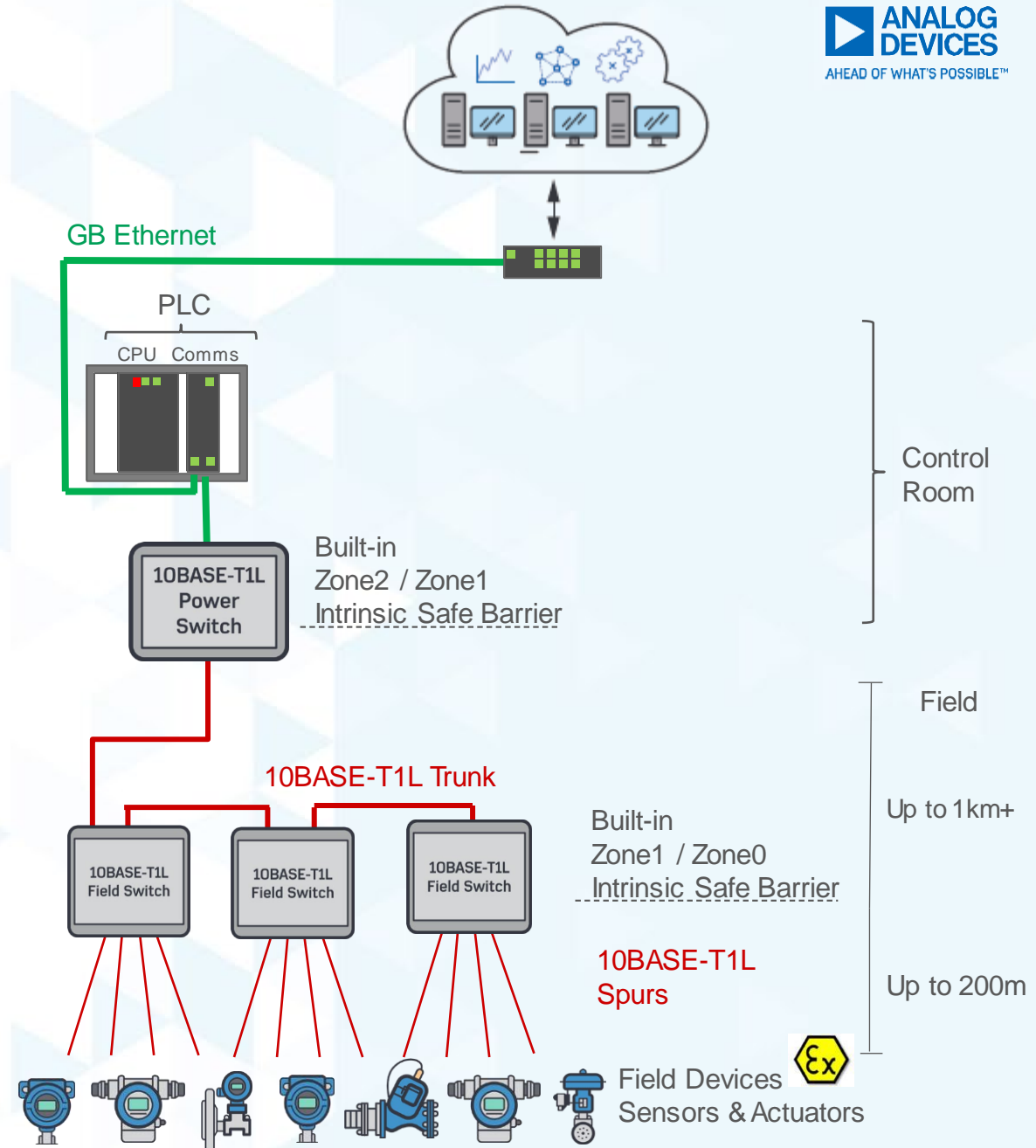
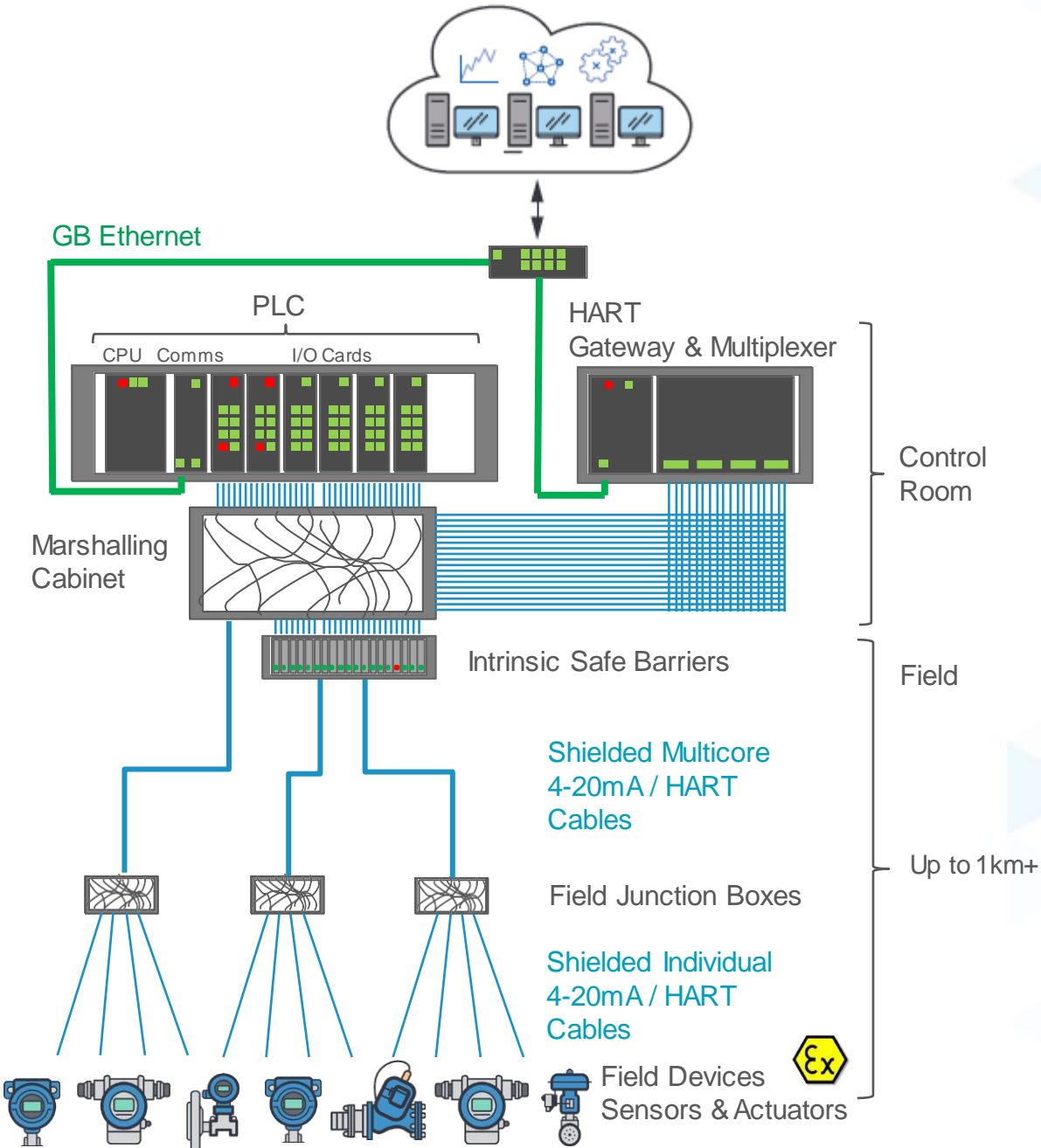


What is 10BASE-T1L (IEEE802.3cg)?



Enabling Seamless Ethernet to the Edge within Building Management Systems





ADIN1100 10BASE-T1L PHY

Sampling Now!

FEATURES

**10BASE-T1L IEEE® Std 802.3cg™ -2019
compliant**

- Supports 1.0 V pk-pk & 2.4 V pk-pk transmit levels

Low power consumption

- 1V pk-pk Dual Supply – **39 mW**
- 1V pk-pk Single Supply – 45 mW
- 2.4V pk-pk Multiple Supplies – **75 mW**
 - Specification for all power options in datasheet

Small package 40-lead (6 mm x 6 mm) LFCSP

Industrial temperature range -40°C to 105°C

*Industry's Lowest Power
10BASE-T1L PHY*



www.analog.com/ADIN1100

ADIN1110 10BASE-T1L MAC PHY

Sampling Now!

FEATURES

10BASE-T1L IEEE® Std 802.3cg™ -2019 compliant

- 1.0 V pk-pk & 2.4 V pk-pk transmit levels
- Master / Slave
- Auto-negotiation

Supports Intrinsic Safe applications

Integrated MAC with SPI interface

IEEE 1588 timestamp support

Single supply 1.8 V or 3.3 V

- Mode dependent, multiple supplies also possible

Ultra-Low power consumption

- 1V pk-pk with Dual Supply – **42 mW**
- 2.4V pk-pk Multiple Supplies – **78 mW**
 - Specification for all power options in datasheet

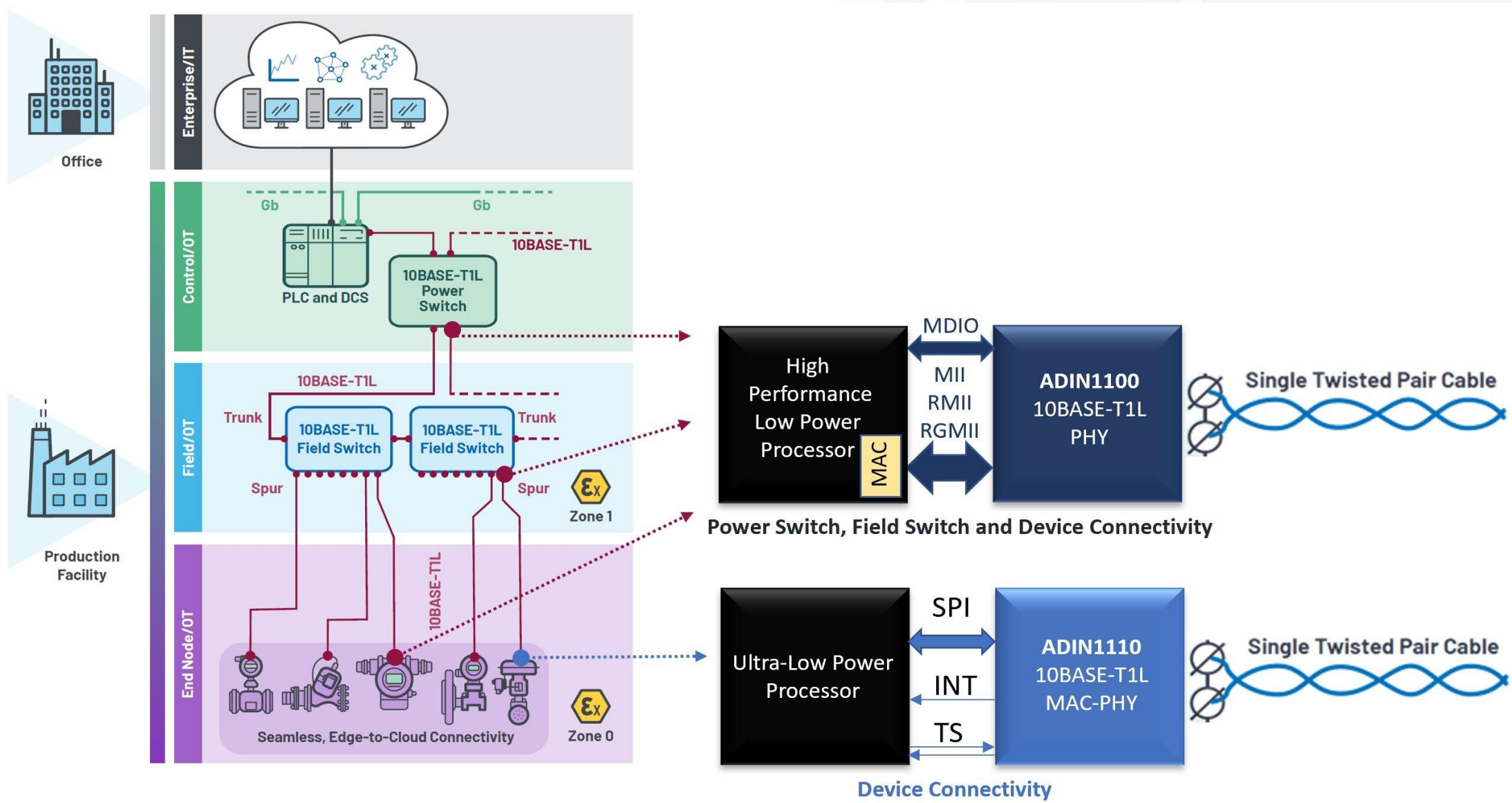
Small package 40-lead LFCSP

Industrial temperature range -40°C to 105°C

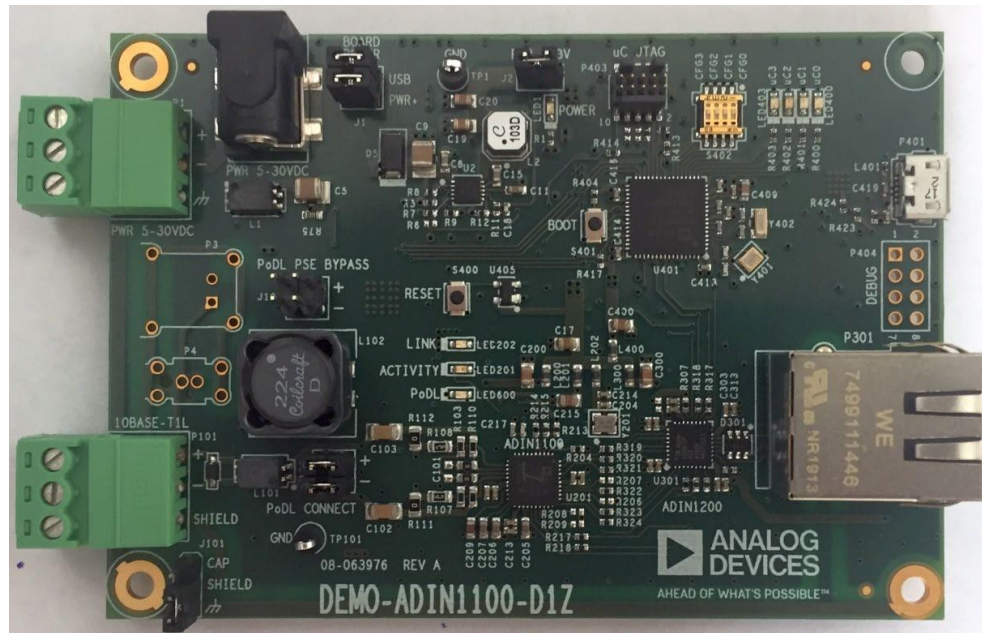
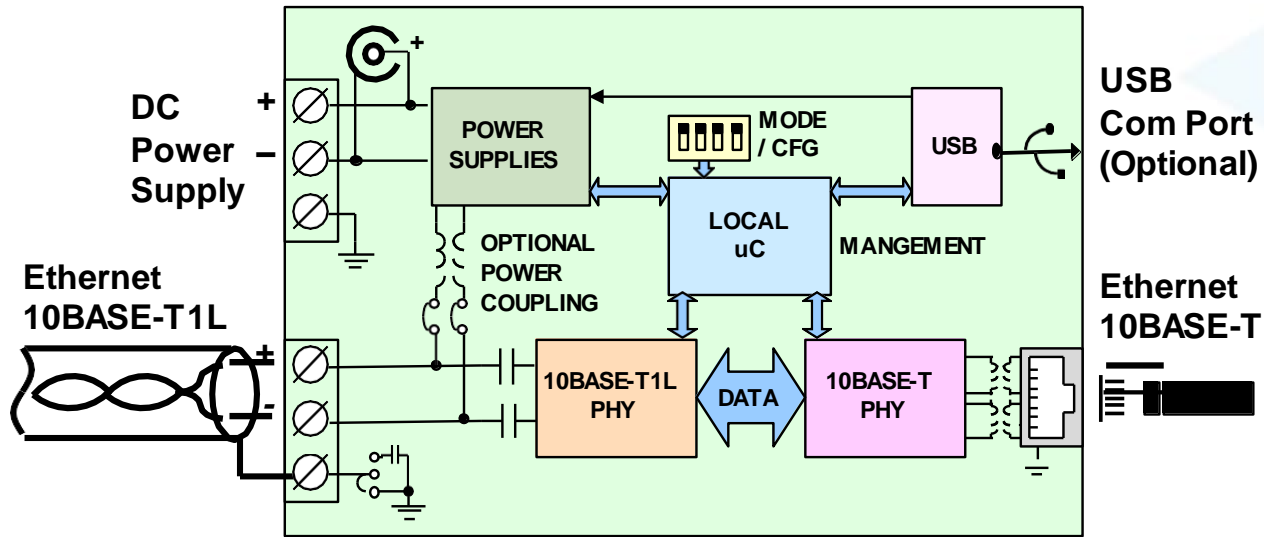
Ultra-Low Power 10BASE-T1L MAC PHY



Process Control – Trunk and Spur Network Topology



10BASE-T1L System Demos / Tools



- ▶ **DEMO-ADIN1100-D1Z**
 - (SAP: DEMO-ADIN1100D1ZU1)
- ▶ Demo hardware for ADIN1100, Robust, Industrial, Low Power 10BASE-T1L Ethernet PHY.
- ▶ The board works as a media converter, converting “standard” 10BASE-T Ethernet to the new 10BASE-T1L standard.
- ▶ The demo can also provide power, from an external power supply, to a device connected over the 10BASE-T1L cable.
- ▶ This demo enables connecting 10BASE-T1L devices to an existing Ethernet network during design, prototyping and evaluation of the 10BASE-T1L technology.

2-Port Multiprotocol Real-Time Industrial Ethernet Solutions

Module



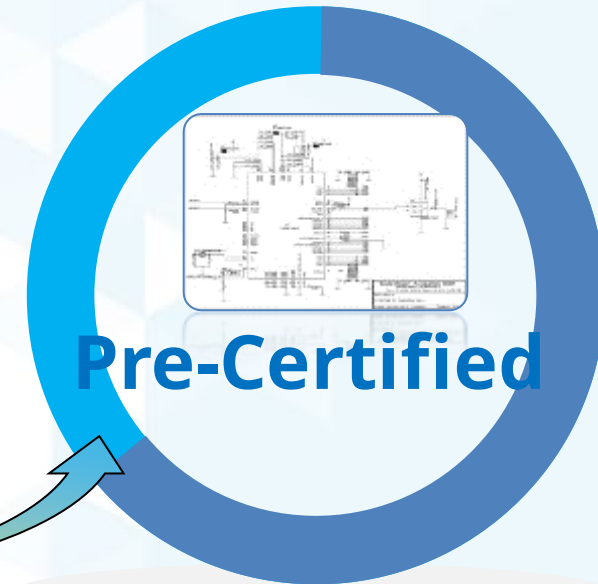
ADIN2299

- Multiprotocol software provided
- Pre-certified solution
- Saves development effort
- Faster time to market

VS

Same Software for Both Solutions

Embedded Reference Design



Pre-Certified

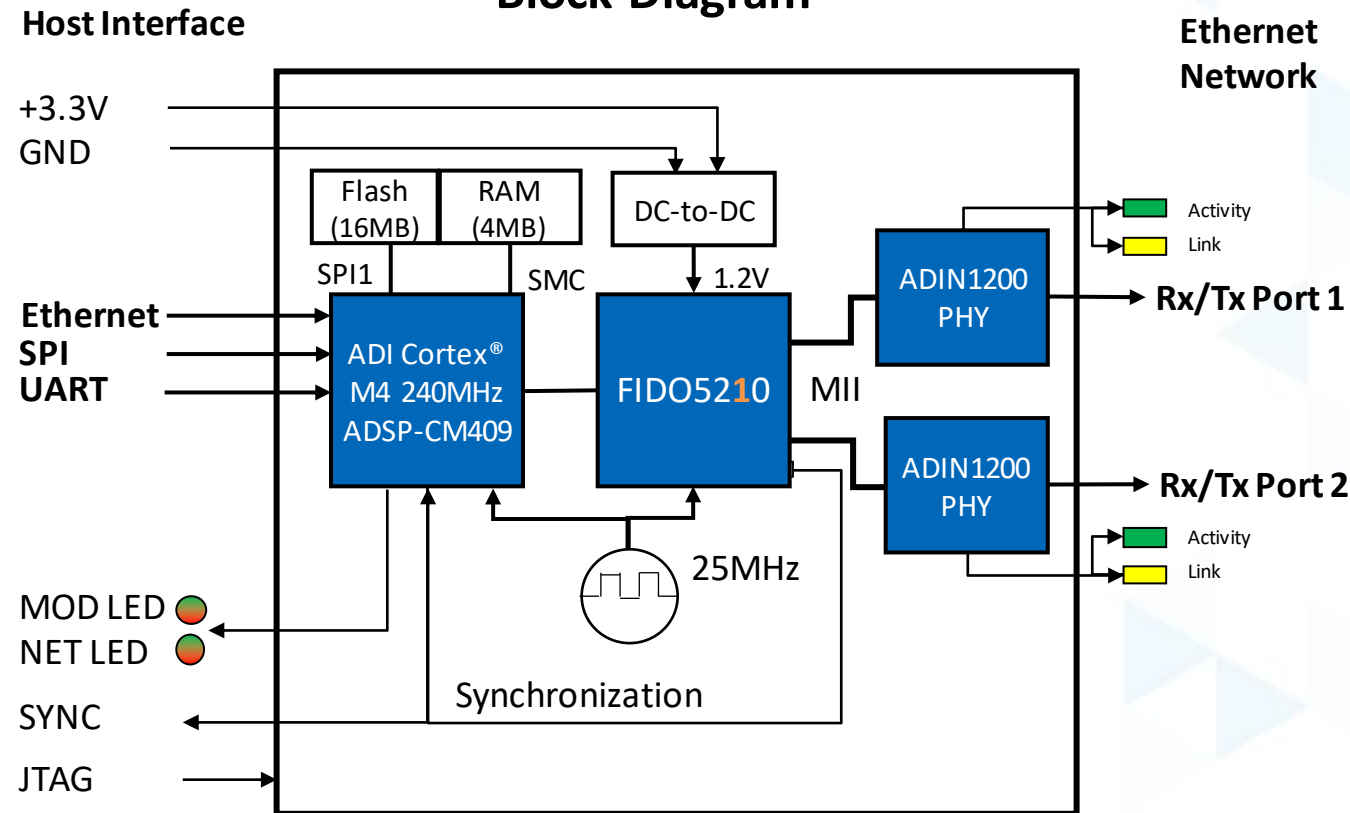
- Complete off-the-shelf, ready to use solution
- Fully tested, reducing development risk

- Enables optimization of board design
- Cost-effective solution for high volume applications



2 Port Multiprotocol Real Time Industrial Ethernet Reference Design

Block Diagram



- “**Design-n-Play**” -

- Purchase BOM Elements
- Verified Schematic supplied
- Layout Recommendations supplied

- Receive **pre-certified network software**

- Common software interface speeds Host Processor integration



EtherNet/IP

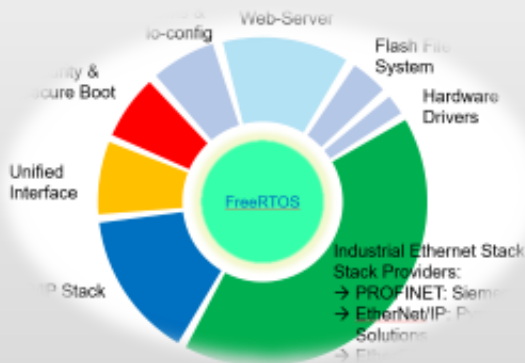




Software Charges

Reducing Development Time and Saving R&D Costs

➤ Charge for Software via Increase in Hardware Price



■ For Reference Design

■ New Fido Model

■ Software only operates on **fido5110 & fido5210**

■ ~\$3 ASP adder over original fido5200/5100 @1K List

■ For ADIN2299

■ List price (ASP) incorporates software fee

➤ No Hidden Extras

- No direct Software Licence Fees
- No Tool Chain Charges
- No Charges for Software Maintenance Updates

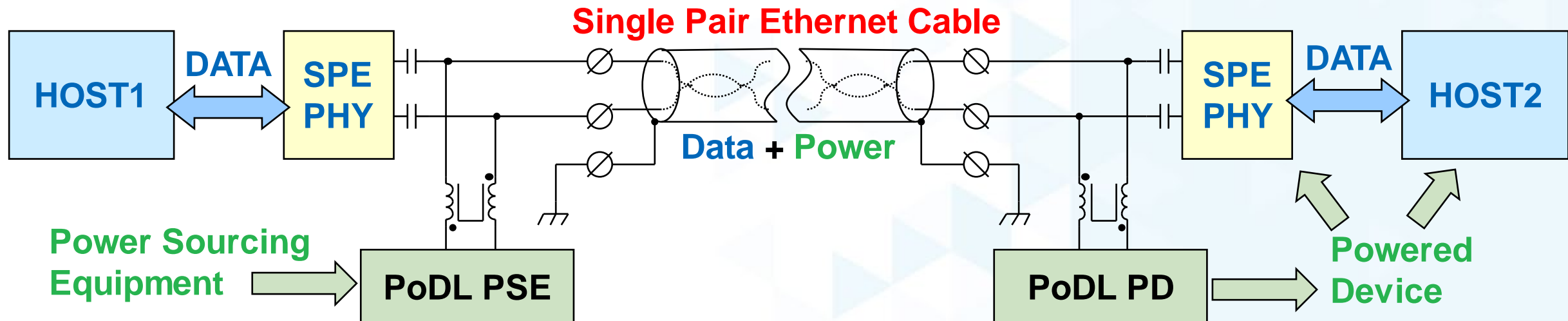
PoDL/SPoE

Power over Data Line (PoDL)/Single Pair PoE (SPoE)

10BASE-T1L: IEEE Std 802.3cg™-2019

Class	10	11	12	13	14	15
$V_{PSE(max)}$ (V)	30	30	30	58	58	58
$V_{PSE_OC(min)}$ (V)	20	20	20	50	50	50
$V_{PSE(min)}$ (V)	20	20	20	50	50	50
$I_{PI(max)}$ (mA)	92	240	632	231	600	1579
$P_{class(min)}$ (W)	1.85	4.8	12.63	11.54	30	79
$V_{PD(min)}$ (V)	14	14	14	35	35	35
$P_{PD(max)}$ (W)	1.23	3.2	8.4	7.7	20	52

- ▶ PoDL - Power over Data Line
 - PoDL is PoE for one-pair Ethernet PHYs
- ▶ PoDL is an industry standard: IEEE Std. 802.3bu
- ▶ IEEE Std. 802.3cg further specifies PoDL for 10Mbps industrial systems
- ▶ Intended for industrial sensors, factory automation, Internet of Things, etc.
 - Safe, fault-tolerant and easy to install
 - Anywhere that both data and power over just two conductors is valuable



Thank you

Q1. How many ADUCM355 related reference designs for Water Quality Analysis?

► A1 –

- [CN-0503](#): Multiple parameter optical water quality measurement platform
- [CN-0428](#): Electrochemical water quality measurement platform
- CN-0411: TDS measurement system for water quality monitoring
- CN-0409: ISO 7027 ratio method turbidity (wider measurement range with ratiometric turbidity)
- CN-0398: Soil moisture and pH measurement system
- CN-0359: Fully automatic high performance conductivity measurement system (highest accuracy)
- CN-0349: Fully Isolated conductivity measurement system
- CN-0326: Isolated low power pH monitor

Other related reference designs (supporting diagnostics):

- CN-0429: Electrochemical gas measurement system with sensor diagnostics
- CN-0510: Electrochemical impedance spectroscopy (EIS) for batteries

Q2. Why CbM can resolve Motor vibration problem?

A2 – Accelerometers are the most commonly used vibration sensor and vibration analysis is the most commonly employed PdM technique mainly used on large rotating equipment such as turbines, pumps, motors and gearboxes. It is possible to completely seal MEMS accelerometers hermetically in ceramic packages and piezo accelerometers in mechanical packages for use in harsh, dirty environments.

Q3 What is ADuCM355 advantage?

A3 – High integration electrochemical SoC, 16-bit, 400 kSPS ADC 、 dual 12-bit DAC 、 input buffers 、 two bias potentiostat and TIA amplifiers 、 high speed TIA for impedance measurements 、 programmable gain amplifier on output.

Q4. How to use the ADuCM355 with 4-lead electrochemical sensors

A4 – The ADuCM355 is designed with dual, independent, low power potentiostats intended to support 2x 3-lead sensors. For a 4-lead sensor with dual working electrodes, the 2nd working electrode needs to be connected to LPTIA of the other channel or else to the HSTIA.

For our gas sensing demos, we support 2x 3-lead sensors or 1x 4-lead(dual WE electrodes) - this is a typical application where the sensor(s) need to be permanently biased.

Q5. What electrochemical measurement for water analysis techniques are supported by the ADuCM355?

A5 – These include Linear Sweep Voltammetry (LSV), Cyclic Voltammetry (CV), Differential Pulse Voltammetry (DPV), Square Wave Voltammetry (SWV), Normal Pulse Voltammetry (NPV), Chronoamperometry (CA), Open Circuit Potentiometry (OCP), Electrochemical Impedance Spectroscopy (EIS) and Pulsed Amperometric Detection(PAD).

Q6. the CN0549 platform allows you to benchmark MEMS vs piezo, can you summarize the advantages of MEMS technologies over piezo?

A6 – MEMS vibration sensors are enabling new and improved CbM capabilities with important improvements over piezoelectric sensors. MEMS vibration and shock sensors advantages over piezo sensors include; significantly smaller form factor, multi-axis measurement, improved performance with low frequency response down to DC for slow rotating equipment, lower power, long-term reliability, integration with signal conditioning and edge processing at the edge and finally lower cost solution allowing CbM on higher volumes, lower cost assets.

Q7 MEMS Sensors- Enable new condition-based monitoring

A7 – ADXL1xx: 1-axis ; ADXL3xx: 3-axis, digital or analog for different Bandwidth and g value, use in Tilt with Vibration 、 Industrial, Balance of Plant 、 Automation, Robotics, CNC, SPM Methodology 、 Transportation Safety, Embedded Bearings, Smaller Hardware.

EX: ADXL354 、 ADXL355 、 ADXL356 、 ADXL357 、 ADXL358 、 ADXL359 、 ADXL371 、 ADXL380 、 ADXL382 、 ADcmXL3021 、 ADXL1001 、 ADXL1002 、 ADXL1003 、 ADXL1004 、 ADXL1005

Q8. Does the Voyager kit include a PC Application / GUI to display vibration data from the wireless mote?

A8 – Yes. The PC side GUI displays network information, as well as acceleration time series and FFT data. There are several useful features included in the GUI, including motor harmonic matching and bearing fault frequencies plotting.

Q9. Is it possible to evaluate a real SmartMESH network with this Voyager evaluation kit?

A9 — The GUI and firmware have been optimized so that a customer can evaluate a real MESH network.

The Voyager kit has been tested for SmartMESH mote hopping. This is where a mote, which is out of range of the network manager, can hop through an in-range mote.

The multiple hops network ensures that out of range motes can stream data to the network manager.

Q10. How can I verify the integrity of a wireless mesh network?

A10 — In order to ensure the integrity of a wireless mesh network, every mote must have at least 3 good neighbors with path stability of 50% or better.

Q11. How long distance does DUST transmit and how many maximum smartmesh nodes?

A11 — Indoor 100m/outdoor 300m distance between nodes, up to 48,000 nodes.

Q12. Does the network assign preferred paths so that duplicate paths are not used for message delivery, and if so is this done dynamically by the motes based on what they know about their neighbors, or handled by the network manager as a configuration process?

A12 — The manager will assign more links to the better quality, closest to manager (“preferred”) path of each mote, so that on average the bulk of transmission attempts will happen on that path. The mote will simply use whichever link comes up next, so the non-preferred path will eventually be used, and could be used frequently if message generation happens to occur right before that link. The manager is constantly evaluating the health of the network and will make link changes as path qualities change.

Q13 – How many devices can I connect in a T1L network?

A13 – T1L is a point-to-point solution but you can configure nodes in a daisy chain topology using a switch. In this configuration the number of nodes you can connect in a network is virtually infinite. In practice, the BW reserved for each communication is the real limit as it determines the performance.

Q14. How far can a transmission line based on ADIN1100 and ADIN1110 go?

A14 – The IEEE802.3cg Standard specified 1km for interoperability. We have tested our solution and can perform reliably up to **1.7km** with auto-negotiation enabled. Most Applications will not know what the Link Partner is (what the other end of the link is connected to), hence customers can only design to the standard which is 1km. Beyond this is not a viable use case in most applications. Cable reach highly dependent on Cable Quality & Environmental Noise conditions.

Q15. ADIN2299 Network Interface Module advantage

A15 – Low Power - < 800mW, Multiprotocol Software, Pre-certification for conformance, Common software interface simplifies integration with host controller, Enables Simple development of Portfolio End Systems