



# US085 Precision Industrial Temperature Control

June 2020

# Precision Industrial Temperature Control

- **Overview**

Industrial control processes often require accurate temperature monitoring and control. By using the 32-bit RX23E-A microcontroller (MCU) with a precision analog front end, this system provides accurate temperature measurements with a minimal number of components.

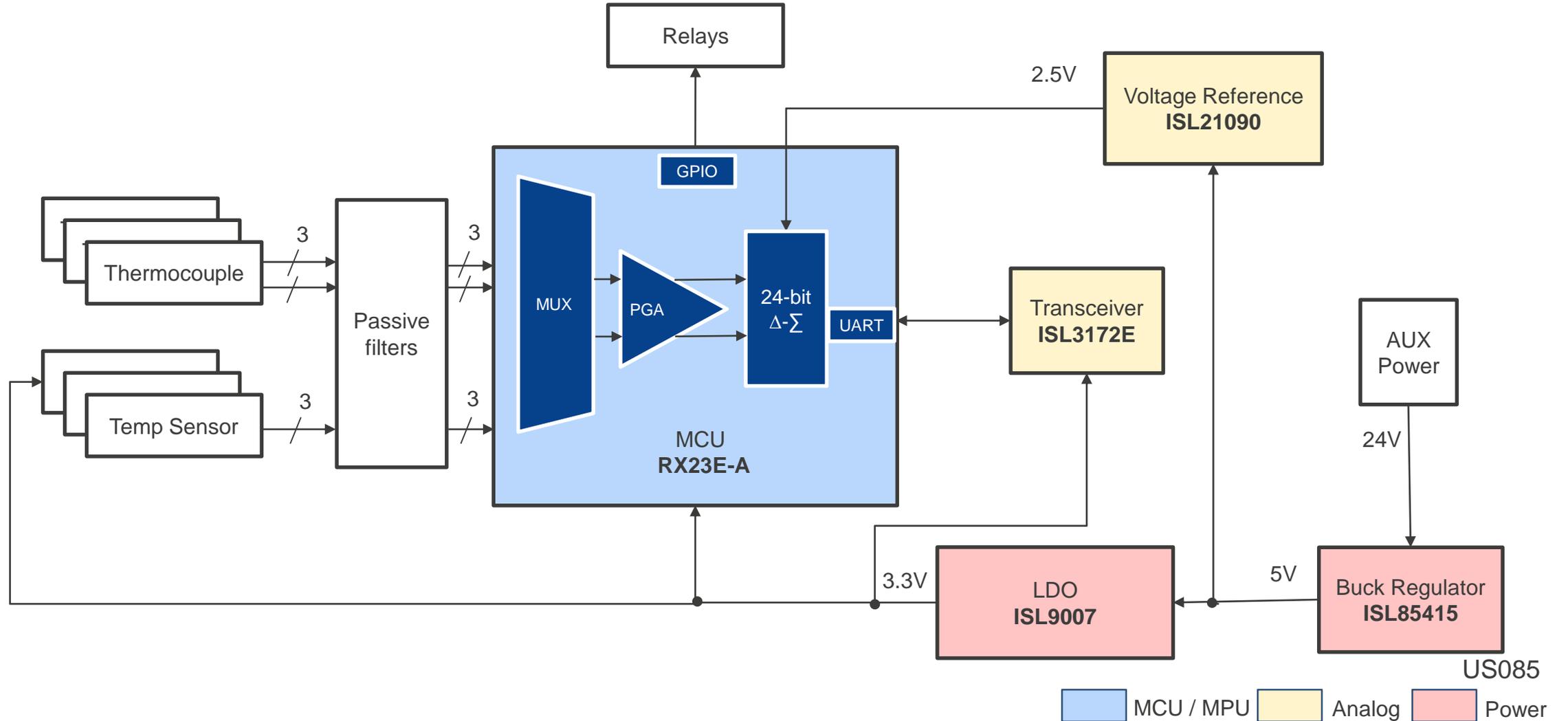
- **System Benefits**

- Highly integrated MCU with 24-bit Delta-Sigma ADC allowing for minimal components
- RS-485 transceiver with high electrostatic discharge (ESD) protection for robust industrial interfaces
- Low noise power component selection

US085



# Precision Industrial Temperature Control





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Device Category	P/N	Key Features
MCU	RX23E-A R5F523Exxxxx	32-MHz, 32-bit MCU with built-in analog front end and 24-bit delta-sigma ADCs
Power	ISL85415	Wide VIN 500mA Synchronous Buck Regulator
	ISL9007	High Current LDO with Low IQ and High PSRR
Analog	ISL21090BFB825Z-TK	Ultra low noise, high DC accuracy precision voltage reference with wide input voltage range. $1.9\mu\text{V}_{\text{P-P}}$ 0.1Hz to 10Hz noise with an initial voltage accuracy of 0.02% and 7ppm/°C.
	ISL3172E	$\pm 15\text{kV}$ IEC ESD protected, 3.3V, half-duplex, 250kbps RS-485/RS-422 transceiver.

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# RX23E-A – Analog front end mounted 32-bit MCU

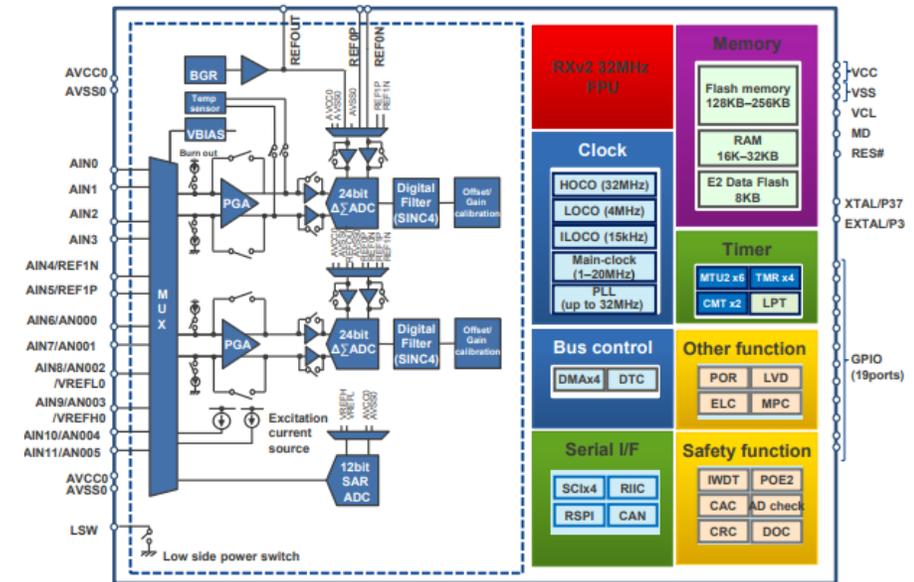
## 32 MHz RX v2 Core with 2 low-noise and low-drift 24-bit delta-sigma A/D converters

### Analog Front End Features

- Max. operating frequency: 32MHz
- Dual 24-bit delta sigma A/D converters: Up to 23-bit effective resolution, Programmable data rate 7.6 sps to 15,625 ksp/s
- PGA: Rail-to-rail analog input, Gain 1 to 128, Offset drift 10 nV/°C, Gain drift 1 ppm/°C
- Voltage Reference: Low drift 4ppm/°C with good temperature stability
- Excitation Current Source: Matched programmable current source

### MCU Functions

- CPU: 32-bit RXv2 (64 DMIPS @ 32 MHz), DSP/FPU for digital signal processing
- Up to 256KB Flash, 32KB RAM, 8KB Data Flash (1M write/erase cycles)
- Interface: SPI x 1 ch, UART x 4 ch, I2C x 1 ch, CAN x 1 ch



System Block



RTK0ESXB10C00001BJ RX23E-A Evaluation Kits

Part #	ROM (Kbytes)	RAM (Kbytes)	Temp.(°C)	Package
<a href="#">R5F523T5ADFM</a>	128	12	-40 to 85	LFQFP64/0.50
R5F523T3ADFD	64	12	-40 to 85	LQFP52/0.65
R5F523T5AGFM	128	12	-40 to 105	LFQFP64/0.50
R5F523T3AGFL	64	12	-40 to 105	LFQFP48/0.50

# ISL85415 – 0.5A Regulator with Integrated High Side FET

## Support 3V-40V Input Voltage Range for Buck Output

### Wide Working Range

- Power input voltage range from 3V to 36V
- The device provides an easy-to-use high-efficiency, low BOM-count solution for a variety of applications.
- Up to 0.5A load over full temperature range

### High Efficiency and Performance (low board space)

- Synchronous operation for high efficiency
- No compensation required
- Integrated High-side and Low-side NMOS devices
- Selectable PFM or forced PWM mode at light loads
- Internal fixed (500kHz) or adjustable switching frequency 300kHz to 2MHz

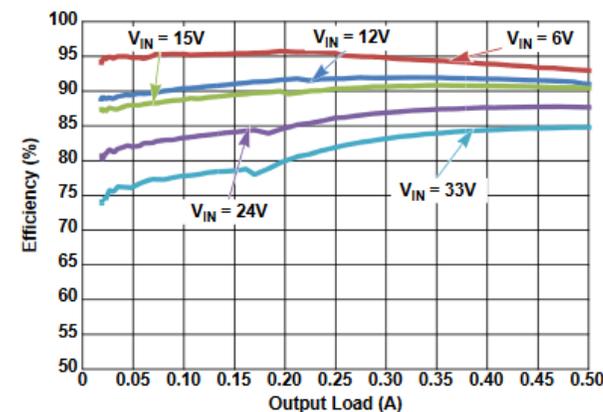
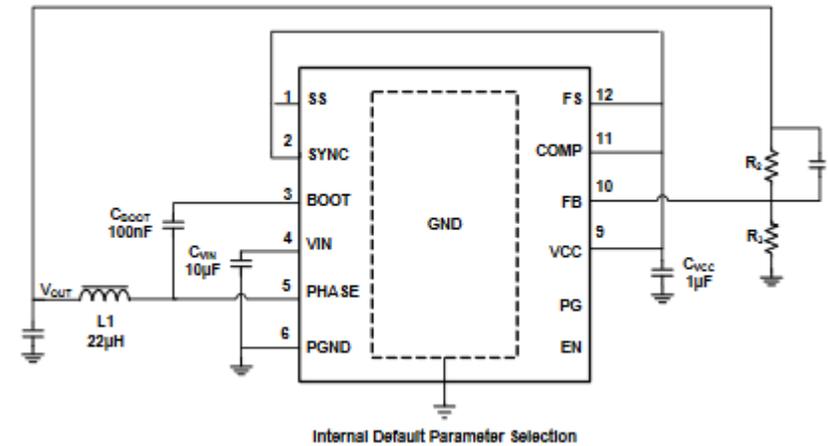


Figure 6. Efficiency vs Load, PFM,  $V_{OUT} = 5V$



FIGURE 1. FRONT OF EVALUATION BOARD ISL85415DEMO2Z

Part #	$V_{IN}$ Range(V)	Temp.(°C)	Package
<a href="#">ISL85415FRZ</a>	3 to 36	-40 to 125	12 Ld DFN 4x3

# ISL9007 – $V_{IN}$ 2.3V to 6.5V/400mA LDO

## High Current LDO with Low $I_Q$ and High PSSR

### High Performance

- Excellent load regulation: <0.1% voltage change across full range of load current
- Very high PSRR: 75dB @ 1kHz

### Wide Input Voltage and Stable Output Voltage

- $\pm 1.8\%$   $V_{OUT}$  accuracy over all operating conditions
- Wide input voltage capability: 2.3V to 6.5V
- Low output noise: typically 30 $\mu$ VRMS @ 100 $\mu$ A (2.5V)

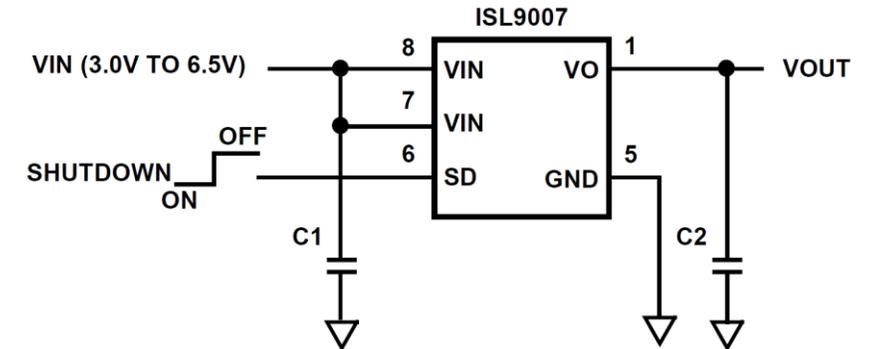
### High Efficiency

- Very low quiescent current: 50 $\mu$ A
- Low dropout voltage: typically 200mV @ 300mA
- Low output noise: typically 30 $\mu$ VRMS @ 100 $\mu$ A (2.5V)
- Shutdown pin turns off LDO for 1 $\mu$ A (max) standby current

### Excellent Safety

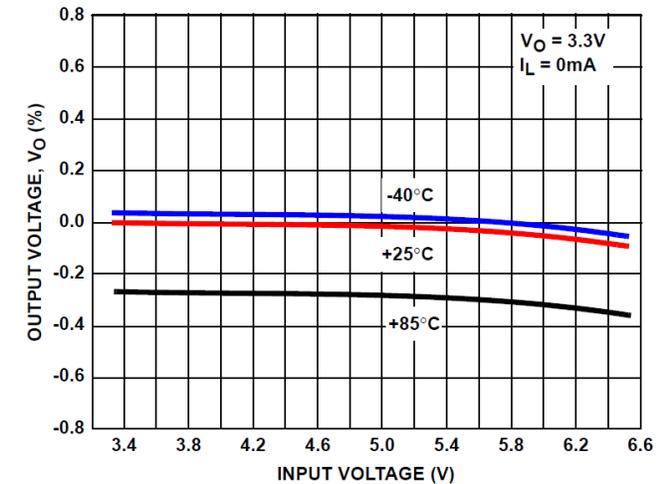
- Current limit and overheat protection
- Soft-start to limit input current surge during enable

Part #	Vout (V)	Temp.(°C)	Package
<a href="#">ISL9007IUNZ</a>	3.3	-40 to +85	8Ld MSOP
ISL9007IUKZ	2.85	-40 to +85	8Ld MSOP
ISL9007IUJZ	2.8	-40 to +85	8Ld MSOP
ISL9007IUFZ	2.5	-40 to +85	8Ld MSOP
ISL9007IUCZ	1.8	-40 to +85	8Ld MSOP



C<sub>1</sub>, C<sub>2</sub>: 1 $\mu$ F X5R CERAMIC CAPACITOR

Typical Application Circuit



Output Voltage vs Input Voltage(3.3V Output)

# ISL21090 – Ultra Low Noise, Precision Voltage Reference

High DC accuracy precision voltage reference with wide input voltage range

## Wide Output Voltages, High Precision

- Reference output voltages: 0. 1.25V, 2.5V, 5.0V and 7.5V
- ISL21090-12:  $\pm 0.03\%$ , ISL21090-25:  $\pm 0.02\%$ , ISL21090-50:  $\pm 0.025\%$ , ISL21090-75:  $\pm 0.035\%$

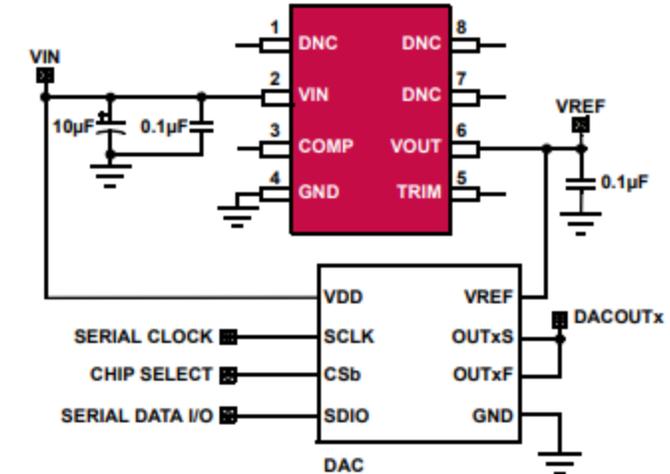
## Flexible Supply Voltage

- Operates from a single 2.0V to 8V supply (minimum and maximum voltage is dependent on voltage option)
- Operating temperature range:  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$

## Output features

- Output voltage noise (0.1Hz to 10Hz):  $1.0\mu\text{V}_{\text{P-P}}$  typ (1.25V option)
- Supply current :  $750\mu\text{A}$  (1.25V option)

Part #	Vref (V)	V <sub>OUT</sub> Option(V)
ISL21090BFB812Z-TK	1.25	8Ld 5x4mm SOIC
ISL21090BFB825Z-TK	2.5	8Ld 5x4mm SOIC
ISL21090BFB850Z-TK	5.0	8Ld 5x4mm SOIC
ISL21090BFB875Z-TK	7.5	8Ld 5x4mm SOIC



Typical Application Diagram



ISL2109025EV1Z Evaluation Board

# ISL317xE—High ESD Protected RS-485/RS-422 Transceivers

## ±15kV, 3.3V, Full Fail-Safe, High Speed or Slew Rate Limited

### High ESD Performance

- ±15kV comply with IEC61000
- ESD protection on RS-485 I/O pins
- Class 3 HBM level on all other pins (ISL3179E): >7kV

### High Performance and Low Power

- High data rates: up to 20Mbps
- True 1/8 unit load allows up to 256 devices on the bus
- 7V to +12V common-mode input/output voltage range
- Low quiescent supply current: 800µA (Max)
- Ultra low shutdown supply current: 10nA

### Protection Function and Small Package

- Current limiting and thermal shutdown for driver overload protection
- Tiny MSOP packages consume 50% less board space

Part #	Half/Full Duplex	Data rate (Mbps)	Hot Plug	Package
<a href="#">ISL3170EIUZ</a>	Full	0.25	Yes	10 Ld MSOP
ISL3172EIBZ	Half	0.25	Yes	8 Ld SOIC
ISL3174EIUZ	Full	0.5	No	8 Ld MSOP
ISL3175EIUZ	Half	0.5	Yes	8 Ld MSOP
ISL3176EIBZ	Full	20	Yes	14 Ld SOIC
ISL3178EIUZ	Half	20	Yes	Ld MSOP

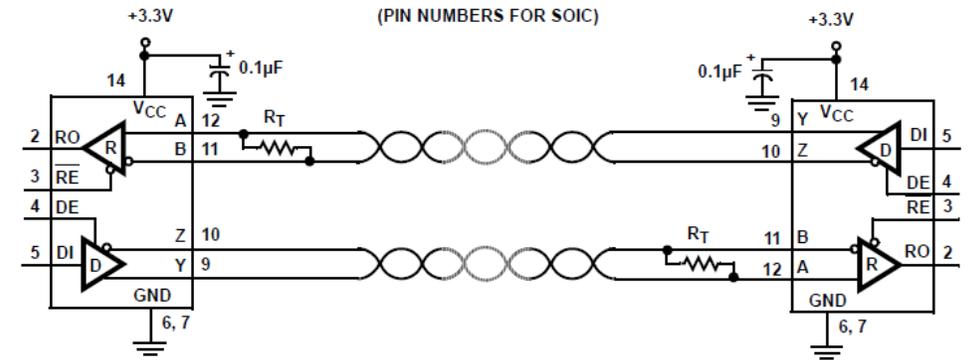
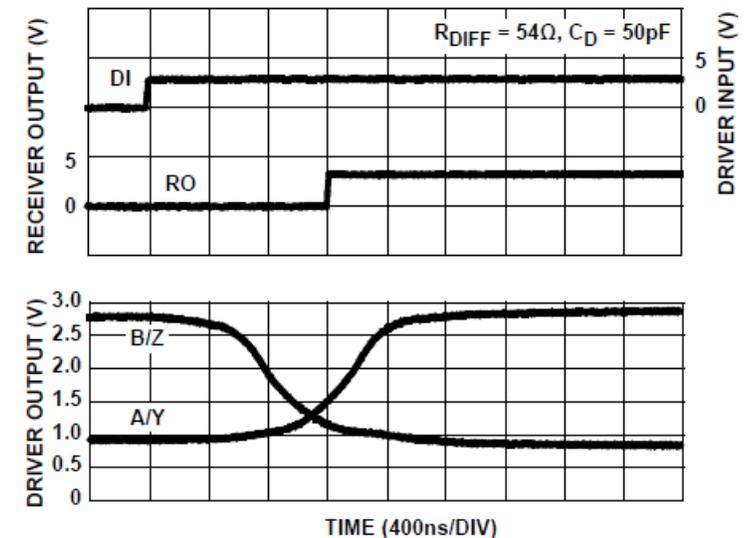


FIGURE 3. ISL3170E, ISL3173E, ISL3176E

### Typical System Block



Driver and Receive Waveforms, Low to High

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