New Product Update

Multiprotocol, Functionality and Benefits of an integrated RS-232 and RS-485 Solution

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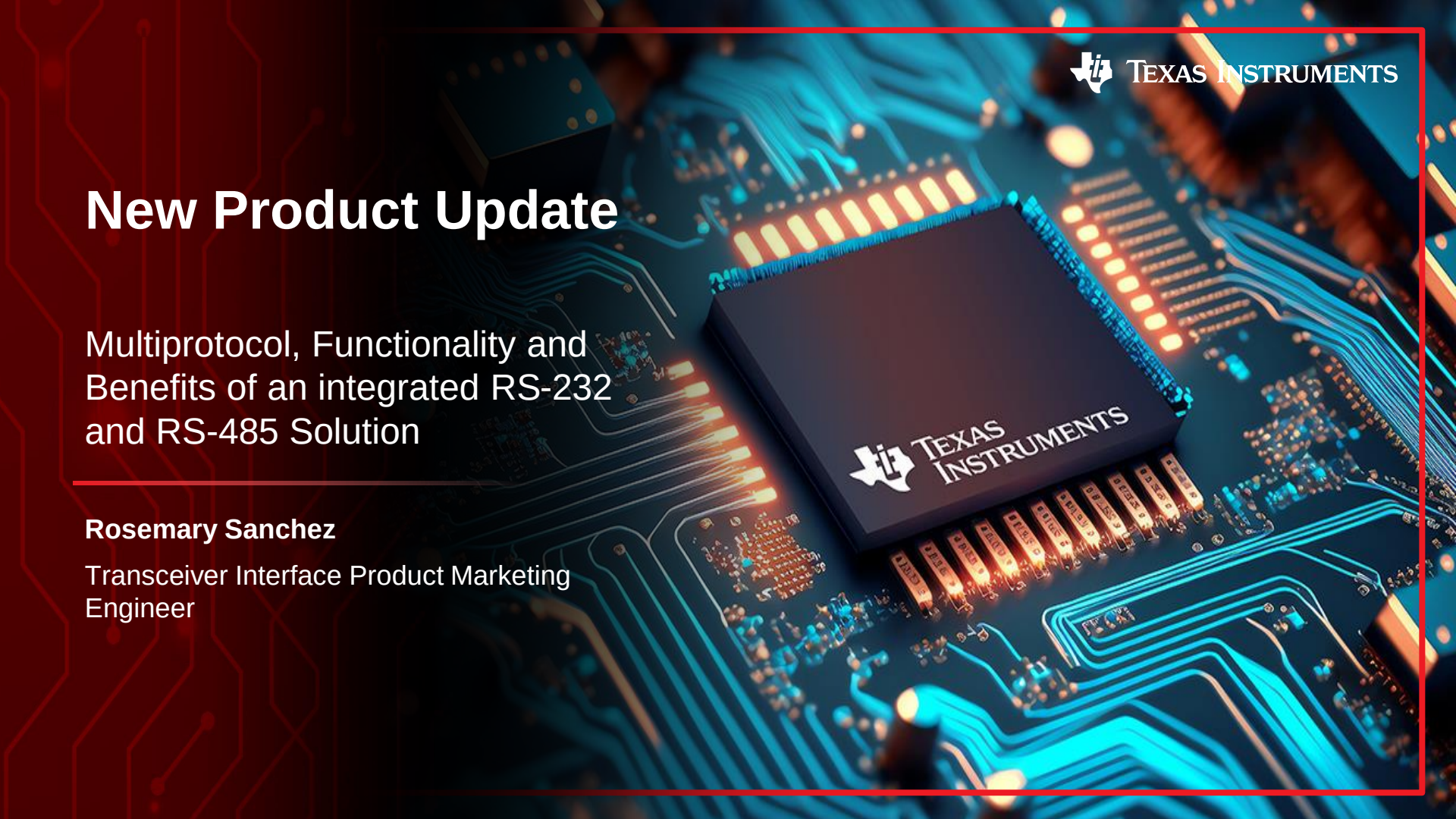


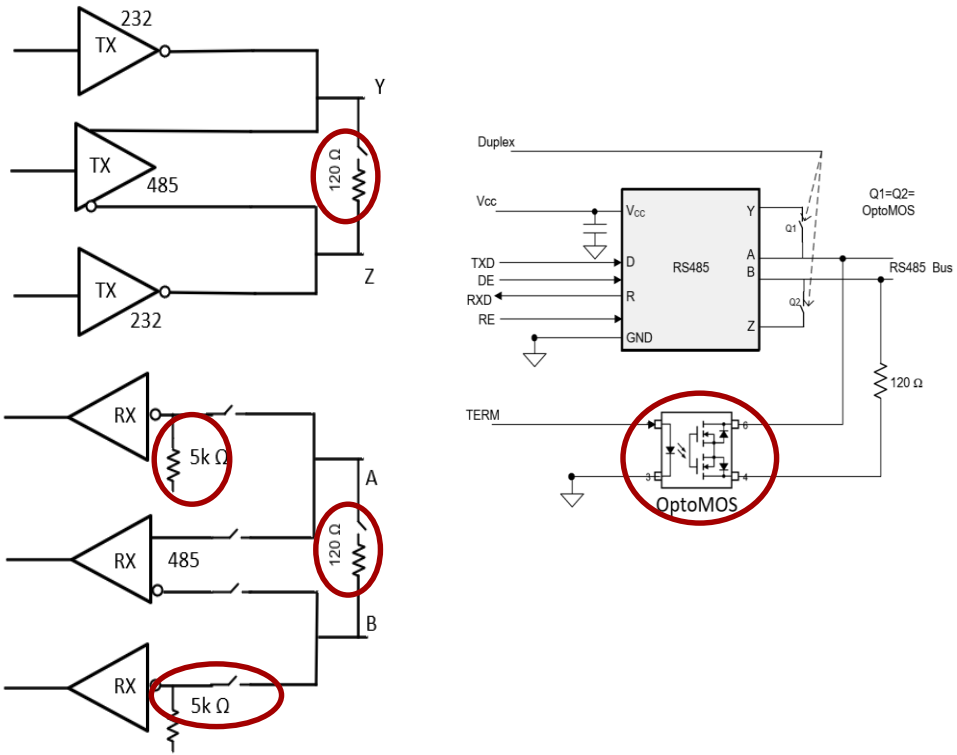
Agenda

- Advantages of multiprotocol implementation versus discrete implementation of RS-232, RS-485, RS-422
- Functionality and features of TI’s multiprotocol family
- Applications for multiprotocol

RS-232 and RS-485 interfaces

- RS-485 and RS-232 are referred to as “COM ports” in the industry
- Since RS-485 mechanical is not defined, RS-232 connector (DB9) is often used
- DB9 connector is bulky, multiple COM ports on a PCB; huge traction in the industry for RS-485 & RS-232 on the same connector
- Same port for short distance point-to-point data download/debug port AND can be used for long distance multi-drop network communication

Discrete solution implementation for shared connector RS232/RS485 interface



- Opto-MOS needed to switch ON/OFF 120 ohm differential termination
- Opto-MOS need to switch between half and full duplex
- RX will additionally need switches to enable/disable to nullify 5kohm, RS232 Rx input impedance in case of operating in RS485 mode
- Result, tricky implementation with lot of discrete components

Example discrete implementation of 2T2R RS232 + 1T1R RS485

Multiprotocol transceivers roadmap

THVD44X1 multiprotocol transceiver family

Released

Dual-protocol RS-232 /RS-485 transceivers with IEC ESD

Features

- Operates with 3-V to 5.5-V VCC supply
- 1.65-5.5 V logic supply (VL pin)
- Meets or exceeds the requirements of TIA/EIA-485-A standards and TIA/EIA-232-F
- RS232:
  - 10V output (max, with no load), 9V typ 3k load→at 5Vcc
  - Selectable data rates: 250 kbps, 1 Mbps
- RS485:
  - Half or full-duplex configuration
  - Selectable data rates: 500 kbps, 20 Mbps
  - Integrated 120-ohm termination and receiver fail-safe operation
- Robust ESD Protection on bus pins
  - ±16 kV HBM
  - ±15 kV IEC 61000-4-2 air-gap discharge
  - ±8 kV IEC 61000-4-2 contact discharge
  - Shutdown mode and loopback modes
- Operational Temperature Range: -40C to 125C

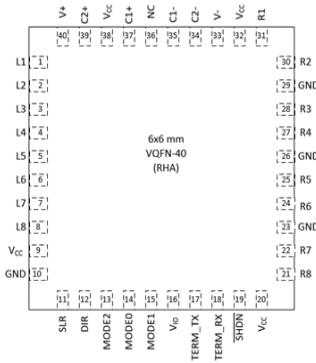
Applications

- Industrial PC
- Point-of-Sale
- Barcode scanner
- HVAC controls
- Process control
- Building security

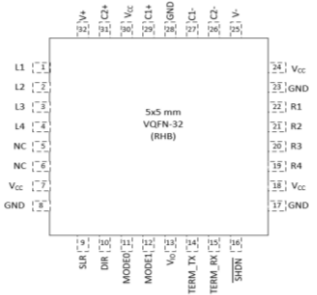
Configuration & package comparison

	THVD4431	THVD4421	THVD4411
# of RS-232 transceiver	3T/5R	2T/2R	1T/1R
# of RS-485 transceiver	1T/1R	1T/1R	1T/1R
Package	VQFN40	VQFN32	VQFN24

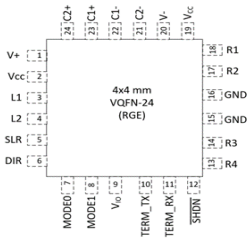
THVD4431
VQFN-40, 6mmx6mm



THVD4421
VQFN-32, 5mmx5mm



THVD4411
VQFN-24, 4mmx4mm



*1:3 scale factor

THVD44X1

Dual-protocol RS-232 /RS-485 Transceivers with IEC ESD

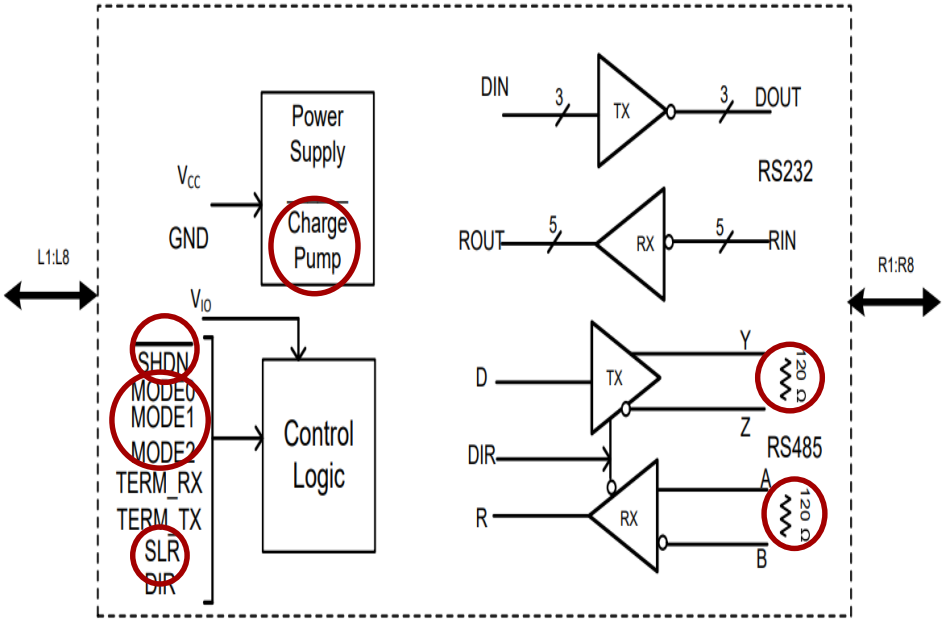
Features

Discovery questions

Pricing, availability, resources

- Eliminates external resistors/switching relays by integrating termination
- Integrated system level ESD protection
- QFN package option for space constrained applications
- Convenient layout with all connector-side pins on the same side

Multiprotocol features



THVD4431 Block diagram

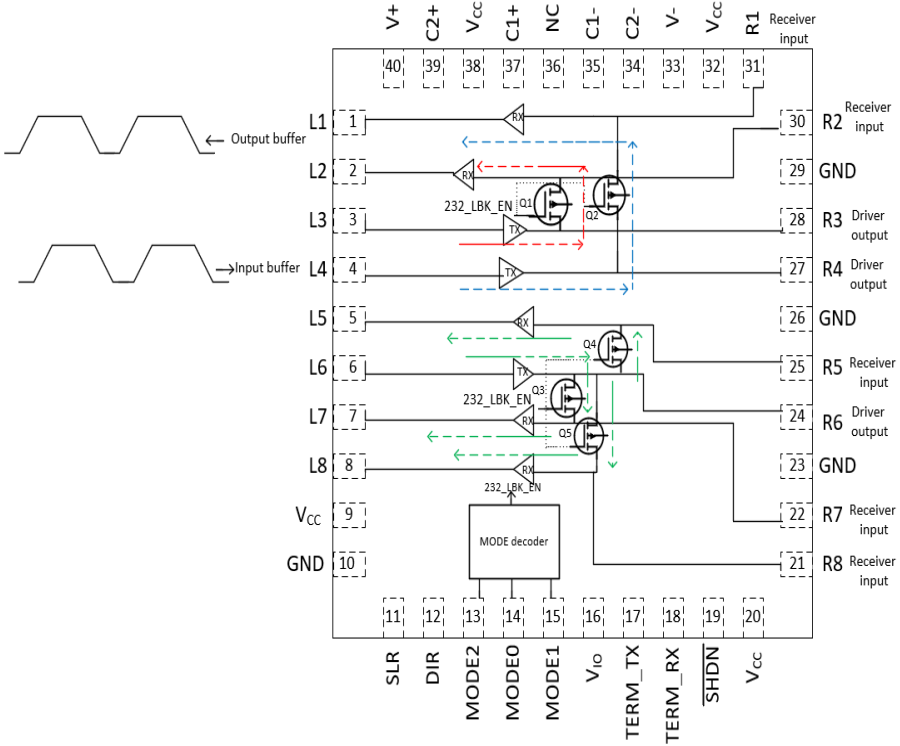
- Integrated 120-ohm switchable termination
- Integrated high-efficiency low-noise charge pump
- Slew rate control
- Ample configuration options
- Integrated protection features

Loopback feature for RS-232

- Mode enables checking short on cables and/or connector for diagnostics
- MCU on logic side normally does not have any feedback on whether data transmitted from logic side reaches destination node.
- With this feature, we enable connecting driver output to receiver input so that pattern sent via logic input is received back on logic output
- This enables checking device level integrity for full path: logic input → driver output → receiver input → logic output
  - R1 or R2 or R3 or R4 or R5 or R6 or R7 or R8 short to GND are detectable

MODE2, MODE1,MODE0: X00
(RS232 Loopback Mode)

RS232 loopback mode
L4 reflects on R4 and R1 and L1 (Q2)
L3 reflects on R3 and R2 and L2 (Q1)
L6 reflects on R5, R6,R7, R8, L5, L7, L8 (Q3, Q4, Q5)



*Similar function exists in RS-485 mode as well.

THVD44X1

Dual-protocol RS-232 /RS-485 Transceivers with IEC ESD

Features

Discovery questions

Pricing, availability, resources

- Are RS-232 and RS-485 used in your design?
- How many transmitters/receivers are needed?
- What speed data rate is needed?
- Are both protocols being used at the same time?

THVD44X1

Dual-protocol RS-232 /RS-485 Transceivers with IEC ESD

Features

Discovery questions

Pricing, availability, resources

The below pricing and product availability information was pulled on May 22, 2024. Please check the product folder here for the latest information:

- **Pricing 1Ku:** 1Ku pricing is $3.50 for the THVD4431
- **Product info:**
  - Full production samples: Now
  - Evaluation Boards: THVD4431, THVD4421, THVD4411
  - Datasheet: THVD4431, THVD4421, THVD4411
  - Software: PSpice for TI

Additional resources:

- White Paper: THVD44xx: Multiprotocol Transceivers With Advanced Integration and Flexibility Enable Diverse Applications
- Application note: XR34350 and SP339E/B to THVD4431 System Rollover Guide
- Support: (E2E)
- RS-485 Precision Labs
- RS-232 Glossary and Selection Guide

Example applications / Use cases

	Application area #1 Industrial	Application area #2 Enterprise Systems
Example Applications/End Equipment's	• Industrial PC, Single Board Computer • Payment, Desktop POS • PLCS, DCS & PAC, CPU (PLC Controller)	• End Point, Multifunction Printer • Server Motherboard, Rack Server Motherboard
Key Market Differentiators	• Interface with external devices • Robustness against harsh environments • Communication versatility • Small form factor	• Connecting with microcontrollers • Logic level support to interface to 1.8V MCU • Flow through layout

Competitive assessment

Parameter	THVD4431	Comp #1	Comment
Vio	1.65V to 5.5V	Not supported	TI is future proof with low level logic support to 1.8V MCU
Operating ambient temperature	-40 to 125C	-40 to 85C	TI supports higher ambient temperature enabling smaller PCB's/end systems
Integrated 120ohm termination resistor RS-485 mode	On driver and receiver terminals	Only on receiver terminals	TI device has more flexibility for RS-485 network placement as individual termination can be turned on/off
Supply current RS232 mode no load (max)	5mA	30mA	TI has much lower current consumption
RS-485 receiver threshold voltage (min)	-200mV	-250mV	TI meets RS485 standard hard limit on RS-232 receiver threshold
Diagnostic loopback for RS-232 & RS-485	Supported	Only RS-232	Full path diagnostic loopback supported to detect cable and connector short
RS-232 output voltage swing @ 5Vcc- variation with cap load or data rate	Regulated	Unregulated	TI's RS232 output will be regulated across data rate and varying cap load
Max data rate RS-485 mode	20Mbps	10Mbps	TI can support higher data rate in RS-485 mode

Parameter	THVD4431	Comp #2	Comment
Package	40-QFN (6mm*6mm)	40-QFN (5mm*5mm)	TI is pinout and footprint compatible to competition. Comp has different pinout and footprint
Vio	1.65V to 5.5V	Not supported	TI is future proof with log level logic support to 1.8V MCU
Operating ambient temperature	-40 to 125C	-40 to 85C	TI supports higher ambient temperature enabling smaller PCB's/end systems
Integrated 120ohm termination resistor RS-485 mode	On driver and receiver terminals	Only on receiver terminals	TI device has more flexibility for RS-485 network placement as individual termination can be turned on/off
Flow through layout	Yes	No	All left side pins in THVD4431 are MCU logic pins, right side are bus (connector) side pins enabling clean layout
Supply current RS232 mode no load (max)	5mA	30mA	TI has much lower current consumption
RS-485 receiver threshold voltage (min)	-200mV	-250mV	TI meets RS485 standard hard limit on RS-232 receiver threshold
Diagnostic loopback for RS-232 & RS-485	Supported	Not supported	Full path diagnostic loopback supported to detect cable and connector short
RS-232 output voltage swing @ 5Vcc- variation with cap load or data rate	Regulated	Unregulated	TI's RS232 output will be regulated across data rate and varying cap load
Max data rate RS-485 mode	20Mbps	10Mbps	TI can support higher data rate in RS-485 mode

Getting started

You can start evaluating this device leveraging the following:

Content type	Content title	Link to content or more details
Product folder	THVD4431, THVD4421, THVD4411	https://www.ti.com/product/THVD4431 https://www.ti.com/product/THVD4421 https://www.ti.com/product/THVD4411
Application note	XR34350 and SP339E/B to THVD4431 System Rollover Guide	https://www.ti.com/lit/an/slla637/slla637.pdf
White paper	THVD44xx: Multiprotocol Transceivers With Advanced Integration and Flexibility Enable Diverse Applications	https://www.ti.com/lit/wp/slla635/slla635.pdf
Development tool or evaluation kit	THVD4431, THVD4421 and THVD4411 EVM	https://www.ti.com/tool/THVD4431EVM https://www.ti.com/tool/THVD4421EVM https://www.ti.com/tool/THVD4411EVM

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