

Enhancing Connectivity with MaxLinear XR21xxx USB-UART Bridges

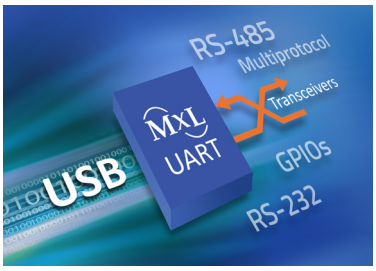
WHITE PAPER

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OS Support

- MacOS
- Windows
- Linux/Android
- Custom drivers

Applications

- Data center server/switch
- Point of sale (POS) systems
- Serial port expander
- Embedded connectivity
- RS-232 debug port replacement
- Wearables (IoT)

Introduction

MaxLinear's USB-UART bridges are designed to provide compact, high-performance UART connectivity via USB ports, making them ideal for space-constrained environments. These bridges offer robust functionality and are engineered to deliver fast and reliable data transmission. With their enhanced features and streamlined connectivity, MaxLinear's solutions stand out as efficient and versatile options for adding UART capabilities to any USB system.

Product Overview

The XR21B1411, XR21B1420, XR21B1422, XR21B1424, XR21V1410, XR21V1412, and XR21V1414 devices (XR21xxx family) are enhanced UARTs with a USB interface. The USB interface is fully compliant with full-speed USB 2.0 specification that supports 12Mbps USB data transfer rate. The USB interface also supports USB suspend, resume, and remote wake-up operations. Different device series support supply voltage ranging from 3.3V to 5V. The XR21xxx family operates from a 48MHz internal clock so no external crystal/oscillator is required. For specific device, the internal clock can be programmed to 6MHz, 12MHz, or 24MHz based on customer's need. With the fractional baud rate generator, any baud rate up to 12Mbps can be accurately generated using the internal clock. The large Tx FIFO and Rx FIFO, up to 512 bytes each, help to optimize the overall data throughput for various applications. The *Automatic Transceiver Direction Control* feature simplifies both the hardware and software for half-duplex RS-485 applications. If required, the multidrop (9-bit) mode with automatic half-duplex transceiver control further simplifies typical multidrop RS-485 applications. Depending on the actual device series, either XR21B1411 or XR21B142x, Vendor ID, Product ID, bus-powered mode, self-powered mode, remote wake-up support or maximum power consumption values, as well as some other configurations can be programmed using the on-board OTP through the USBD+/USBD- pins, if needed.

Custom and standard software drivers for MacOS, Windows, and Linux/Android are supported for the XR21xxx family. All MaxLinear's custom Windows drivers are certified to the Microsoft WHQL standard to ensure compatibility and reliable performance. The custom MacOS driver supports up-to-date operating systems (Sequoia).

Key features of MaxLinear's USB-UART bridges include:

- Support for custom Windows drivers certified to the Microsoft WHQL/HCK standards, ensuring reliable performance and compatibility.
- Flexible GPIO configuration for enhanced integration and control.
- Plug and play, fully compatible with standard drivers across multiple operating systems, including MacOS, Windows, Linux, and Android.
- Compact design, ideal for embedded, consumer, and industrial applications where board space is limited.

Technical Specifications

MaxLinear's USB-UART bridges are engineered for high performance and flexibility. Key technical specifications include:

- Supports up to ±15kV HBM ESD on USBD+/USBD-
- USB 2.0 compliant interface
  - Supports 12Mbps USB full-speed data rate
  - Supports USB suspend, resume and remote wake-up operations
- Enhanced UART features
  - Data rates up to 12Mbps
  - Fractional baud rate generator
  - Up to 512 bytes Tx FIFO
  - Up to 512 bytes Rx FIFO
  - Can support 5, 6, 7, 8, or 9 data bits (may vary between device series)
  - Can support 1, 1.5, or 2 stop bits (may vary between device series)
  - Odd, even, mark, space, or no parity
  - Automatic hardware (RTS/CTS or DTR/DSR) flow control
  - Automatic software (Xon/Xoff) flow control
  - Multidrop mode
  - Auto RS-485 transceiver direction control
  - Half-duplex modes
  - Supports up to 10 selectable GPIO or Modem I/O
- Internal 48MHz clock (with clock divisors programmable down to 6MHz for specific device)
- 3.3V or 5V power supply
- QFN, TQFP, LQFP package
- Virtual COM port drivers
  - MacOS
  - Windows
  - Linux/Android

Software Driver Support

MaxLinear's USB-UART bridges offer comprehensive support for all major operating systems—including MacOS, Windows, Linux/Android—paired with customized driver integration to align with vendor-specific feature requirements and deployment needs. Full control over device behavior through standard and custom drivers (upon request) delivers the flexibility and the ability to optimize performance.

Connectivity Block Diagram

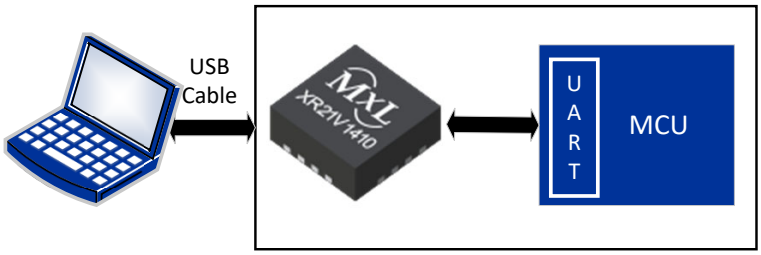


Figure 1: USB Console (Debug) Port

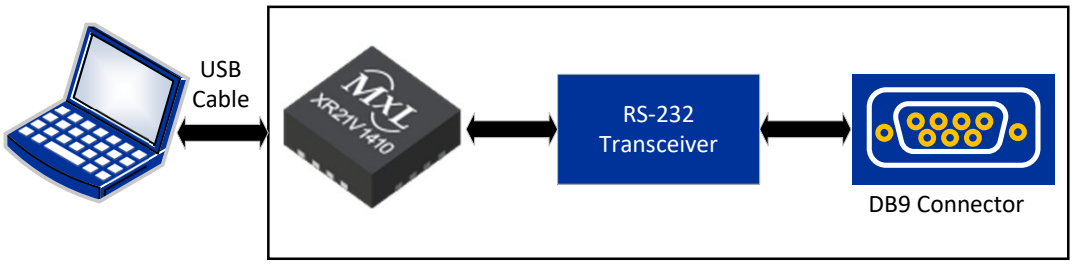


Figure 2: USB to RS-232 Dongle

Performance Metrics

MaxLinear's USB-UART products offer high-performance hardware and software solutions with twice the throughput of competitors at a higher data rate.

Programmable power modes and the overall design reduce power consumption on the device and on various user applications.

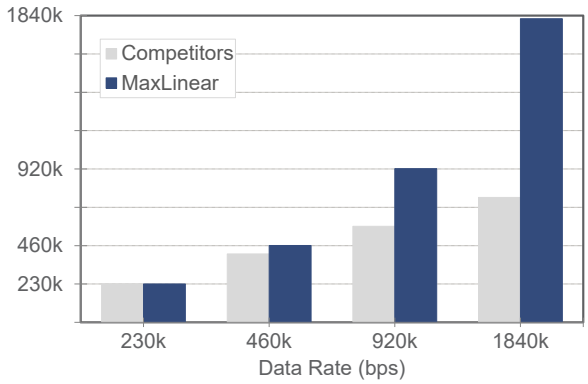


Figure 3: USB-UART Data Throughput vs. Competitors

Product Offering

Part Number	CPU Interface	UARTs	Max Data Rate (Mbps)	Tx/Rx FIFO (Bytes)	Auto RS-485 Half-Duplex Control	Multidrop (9-bit) Mode	IrDA Sup	Supply Voltage Range V_{CC} (V)	Max UART/ GPIO Input Voltage (V)	Max UART/ GPIO Output Voltage (V)	Temp Range (°C)	Package
XR21B1411	USB 2.0 FS	1	12	128/384	■	■		4.4 to 5.25	3.6	1.6 to 3.6	-40 to 85	QFN-16
XR21B1420	USB 2.0 FS	1	12	512/512	■	■	■	3.0 to 3.6 4.4 to 5.25	5.5	3.6	-40 to 85	QFN-28
XR21B1421*	USB 2.0 FS	1	12	512/512	■	■	■	3.0 to 3.6 4.4 to 5.25	5.5	1.6 to 3.6	-40 to 85	QFN-24 QFN-28
XR21B1422	USB 2.0 FS	2	12	512/512	■	■	■	3.0 to 3.6 4.4 to 5.25	5.5	1.6 to 3.6	-40 to 85	QFN-40
XR21B1424	USB 2.0 FS	4	12	512/512	■	■	■	2.97 to 3.63	5.5	1.6 to 3.6	-40 to 85	LQFP-64
XR21V1410	USB 2.0 FS	1	12	128/384	■	■		2.97 to 3.63	5.5	V_{CC}	-40 to 85	QFN-16
XR21V1412	USB 2.0 FS	2	12	128/384	■	■		2.97 to 3.63	5.5	V_{CC}	-40 to 85	QFN-32
XR21V1414	USB 2.0 FS	4	12	128/384	■	■		2.97 to 3.63	5.5	V_{CC}	-40 to 85	TQFP-48

* This is a USB HID device.

Conclusion

MaxLinear's USB-UART bridges offer a compact design, robust performance, and extremely flexible integration options, making it an ideal solution for industrial and embedded applications. With support for standard operating systems (MacOS, Windows, and Linux/Android), industry-leading ESD protections, advanced UART and GPIO configurations, these bridges offer performance, flexibility, and vendor-specific customizations needed to meet today's connectivity challenges.

References

- *XR21V1410 Data Sheet*.
- *XR21B1411 Data Sheet* (255DS).
- *XR21B1420 Data Sheet* (271DS).
- *MaxLinear Serial Transceiver & Bridges Brochure* (001BR).

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