

Smart Dual-Core UART Serial Bridge

YD-RP2040 User Manual & Technical Reference

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The **Smart Dual-Core UART Serial Bridge** is an open-source hardware utility powered by the Raspberry Pi RP2040 microcontroller. Designed specifically for embedded platform diagnostics, router recovery, and bootloader interfacing, it combines hardware UART bridging, real-time OLED terminal output, automated bootloader signal injection, and dynamic visual diagnostics into a compact, low-cost tool.

Technical Specifications & Hardware Notes

- **Target Microcontroller:** YD-RP2040 / Raspberry Pi RP2040 (Dual-Core ARM Cortex-M0+)
- **Primary Core Allocation:**
 - **Core 0:** OLED display rendering, WS2812 RGB LED engine, system UI timing.
 - **Core 1:** High-speed UART pass-through, line signature pattern matching, hardware user key handler.
- **Supported Baud Rates:** 9600, 19200, 38400, 57600, 115200 (Default), 230400, 460800, 921600.
- **Display Output:** 128x64 SSD1306 OLED (Software I2C mode).

IMPORTANT HARDWARE SETUP NOTES:

- **RGB Solder Bridge Requirement:** To enable the onboard WS2812 RGB LED functionality on the YD-RP2040 board, you **must solder the RGB jumper pad bridge** located on the topside of the module connecting the RP2040 GPIO (GP23) to the RGB LED data pin.
- **Modular/Optional Peripherals:** Neither the OLED display nor the WS2812 RGB LED is strictly required for core operation. The firmware functions as a fully operational USB-to-TTL serial adapter and console automation tool without them—all host commands, boot-interrupt sequences, and serial passthrough features remain 100% accessible via your PC terminal emulator.

Hardware Pin Mapping

Hardware Function	GPIO Pin	Physical Connection / Notes
OLED Ground (GND)	GND	System Ground (Connect to OLED GND pin)
OLED VCC Power	GP6	Supplies boosted 3.3V power (12mA drive strength)
OLED SCL	GP7	Software I2C Clock
OLED SDA	GP8	Software I2C Data
Target Ground (GND)	GND	Common Ground Reference (Connect to Target GND pin)
Target Hardware TX	GP16	RP2040 UART0 TX → Connect to Target RX
Target Hardware RX	GP17	RP2040 UART0 RX ← Connect to Target TX
Onboard RGB LED	GP23	WS2812 Addressable NeoPixel (Requires solder bridge)
USR Key Button	GP24	Physical tactile switch (Active LOW)
Blue Activity LED	GP25	System activity / heartbeat indicator

Visual Diagnostic LED Engine

The onboard WS2812 NeoPixel (GP23) and Blue LED (GP25) provide instant physical feedback on system status, target signatures, and communication state:

- **Solid Green:** Receiving data from target device (Target → Host RX).

- **Solid Red:** Transmitting data to target device (Host → Target TX).
- **Solid Yellow:** Simultaneous full-duplex traffic (TX and RX active at the same time).
- **Flash Solid Blue (400ms):** Target platform signature successfully auto-identified (Broadcom, Qualcomm, or MediaTek).
- **Rainbow Spectrum Cycle:** Active TFTP recovery mode triggered via line string detection.
- **Blue LED (GP25):** Flashes on UART activity or pulses during recovery modes.

Automatic Router Identification

Core 1 actively monitors incoming UART text buffers to automatically recognize connected target platforms during bootup. When a matching target architecture is detected, the platform short code appears in the bottom right corner of the OLED screen:

- **BCM** : Automatically recognizes Broadcom CFE platforms.
- **QCA** : Automatically recognizes Qualcomm / Atheros U-Boot platforms.
- **MTK** : Automatically recognizes MediaTek / Ralink U-Boot platforms.

Physical USR Button Controls

The onboard user key on **GP24** provides quick hardware actions tailored to the target platform architecture:

1. **Short Tap (< 400 ms):** Sends platform-specific break sequences to halt the boot process.
2. **Press-and-Hold (≥ 400 ms):** Executes platform-specific recovery and boot interruption sequences, including placing supported devices directly into TFTP mode.

Host Serial Command Set (**...RP** Suffix)

You can issue host control commands over the USB terminal connection at any time. To prevent accidental triggering during regular terminal passthrough, commands use a mandatory **RP** suffix (e.g., **STATUSRP**).

Note: System commands are case-insensitive and stripped automatically before standard serial transmission.

Command Reference Table

Command	Full Syntax Example	Description
BAUDRP	BAUDRP 115200	Dynamically updates the hardware UART baud rate. Valid options: 9600 , 19200 , 38400 , 57600 , 115200 , 230400 , 460800 , 921600 .
BREAKRP	BREAKRP	Holds the physical TX line LOW for 250 milliseconds to send a hardware break signal for interrupting bootloaders.
STOPRP / HALTRP	STOPRP	Automatically triggers the target platform's architecture-specific boot-stop sequence (equivalent to tapping the physical USR button).
TFTPRP	TFTPRP	Executes platform-specific commands to place CFE/U-Boot devices directly into TFTP server mode.
INVERTRP	INVERTRP	Toggles inverse display mode (black-on-white vs. white-on-black) on the SSD1306 OLED screen.
HEXRP	HEXRP	Toggles real-time ASCII text vs. raw Hexadecimal view mode on the OLED terminal screen.
CLSRP / CLEARRP	CLSRP	Clears the OLED character grid buffer and resets the cursor position.
STATUSRP / INFORP	STATUSRP	Prints target architecture type, active baud rate, USB host status, and display configuration to the console.

Command	Full Syntax Example	Description
LOGRP / STATSRP	LOGRP	Displays total lifetime byte counts transferred across RX (Router → Host) and TX (Host → Router) lines.
UPTIMERP	UPTIMERP	Outputs current system running uptime in [UP] DDd HH:MM:SS format.
FREERP / RAMRP	FREERP	Calculates and displays free available system SRAM on the RP2040.
REBOOTRP / RESETRP	REBOOTRP	Triggers hardware watchdog reset to reboot the RP2040 bridge.
BOOTLOADERRP	BOOTLOADERRP	Forces the RP2040 into USB BOOTSEL mode for firmware updates without opening the case.