

EVK1P5 EXPANSION BOARD

Stackable I/O & Peripheral Learning Shield for the 1P5 Main Board (Gowin GW1N-UV1P5QN48XF)

The **EVK1P5 Expansion Board** is a stackable expansion board designed to plug directly onto the 1P5 main board's 48-pin interface connector (U4). The 1P5 main board carries a Gowin **GW1N-UV1P5QN48XF** FPGA (QFN48, 7x7mm). EVK1P5 packs a rich set of onboard peripherals -- buttons, buzzer, addressable RGB LEDs, a 4-digit 7-segment display, I2C EEPROM, a configurable GreenPAK mixed-signal IC, direct FPGA I/O breakout headers, and a Grove-compatible connector -- into a single board, letting students and hobbyists exercise real FPGA I/O, timing, and communication-protocol design without any extra breadboard wiring. Every pin table in this datasheet is cross-checked directly against the EVK1P5 schematic net list (EVK_1P5.xml) and the 1P5 main board's own chip pinout and header schematics (image/pin_chip_1p5.png, image/1p5_header.png) -- not estimated from silkscreen.

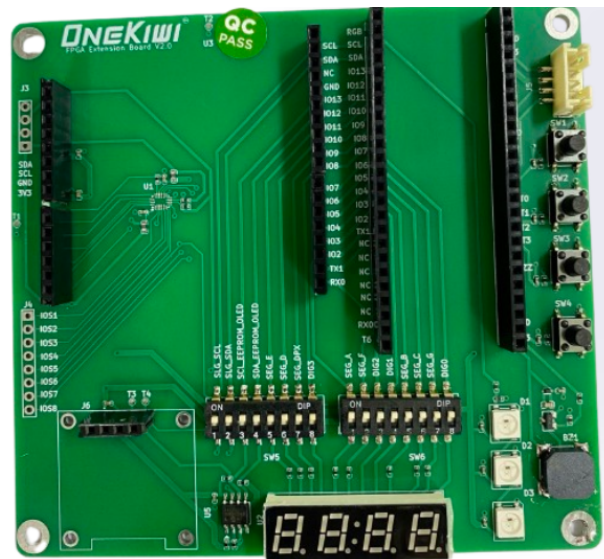


Figure 01. EVK1P5 expansion board -- top view (stacks directly onto the 1P5 main board).

1P5 Main Board Orientation

The 1P5 main board plugs vertically into EVK1P5's center Arduino-style header, as shown below. **Note: the 1P5 board's USB-JTAG port must face up** (top of the stack) when seated -- this is the port used for programming/debug. Its USB-UART console port ends up facing down, near the 7-segment display. Seating the small board the wrong way round will misalign its pins with the header.

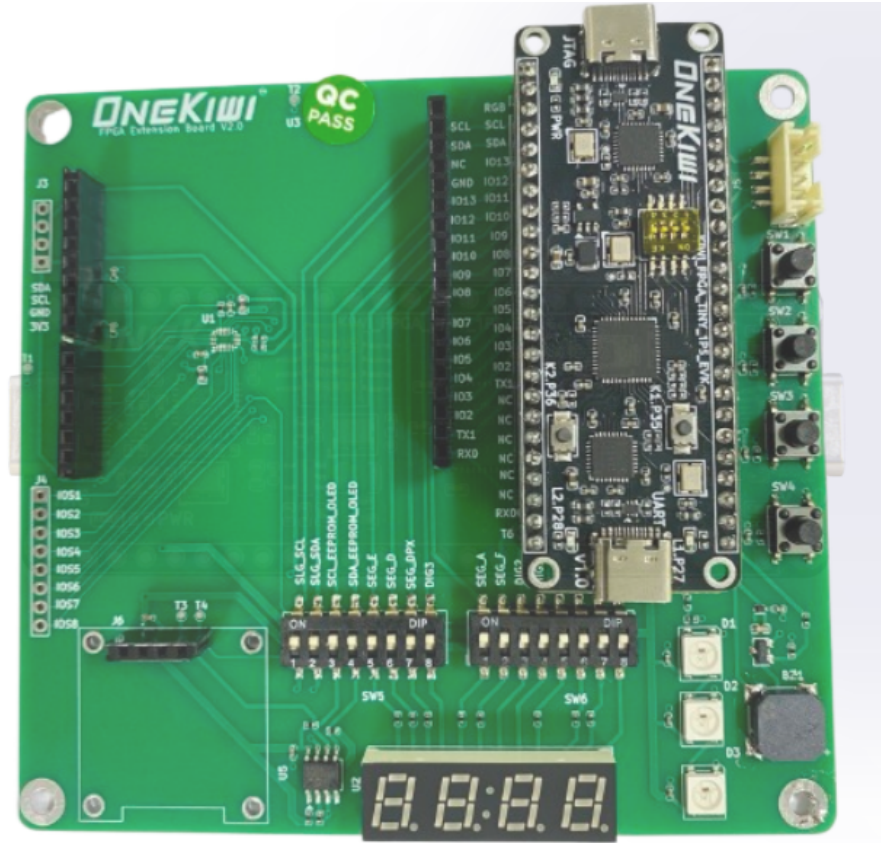


Figure 01b. 1P5 main board seated on EVK1P5 -- USB-JTAG port faces up.

Onboard Module Summary

Module	Function
Main Board Interface (U4)	48-pin connector mating to the 1P5 main board: power, Arduino-style GPIO (IO2-IO13), RX0, I2C, RGB, buttons, buzzer, Grove; 21 positions reserved/NC for main-board JTAG/DONE/SPI use.
Direct I/O Breakout Headers	Two tall pin headers duplicating a subset of U4 (RGB, SCL, SDA, IO2-IO13, RX0) for quick jumper-wire access.
GreenPAK IC (U1, SLG46826V)	Configurable mixed-signal IC: IO0/IO2-IO8 exposed as IOS1-IOS8 (header J4); IO1/IO10-IO14 wired to Arduino A5/A0-A4 as analog comparator inputs.
User Buttons (SW1-SW4)	4x tactile push-buttons, pulled up to 3.3V, Active LOW (BUT0-BUT3), direct to U4 pins 38-41.
Buzzer (BZ1)	Passive piezo buzzer driven through an NPN transistor stage, Active HIGH control, from U4 pin 43.
RGB LED Chain (D1-D3)	3x daisy-chained WS2812B addressable RGB LEDs on a single data line (U4 pin 1).
7-Segment Display (U2)	4-digit multiplexed display (segments SEG_A-G/DPX, digit-select DIG0-3 = CC1-CC4), signals gated onto Arduino D2-D13/SCL/SDA via SW5/SW6.
I2C EEPROM (U5, 24LC08)	8-Kbit I2C serial EEPROM; A0/A2/WP tied to GND; bus shared with the OLED connector (J6).
OLED Connector (J6)	4-pin JST-PH I2C header for an external OLED module; shares the EEPROM_SCL/EEPROM_SDA bus with U5.
Grove Connector (J5)	4-pin generic Grove connector (grove_1/grove_2) wired straight to U4 pins 36-37, no local peripheral.
Config DIP Switches (SW5, SW6)	Two 8-position DIP banks; each bit bridges one onboard peripheral signal to one specific Arduino-header/IO pin -- see full pairing table.

FPGA & Header Physical-Constraint Reference

Every "FPGA Pin" number quoted later in this datasheet is a physical QFN48 package pin on the 1P5 main board's **GW1N-UV1P5QN48XF**, derived by chaining three schematic sources: (1) EVK1P5's own U4 connector net list, (2) the 1P5 main board's J1/J2 header schematic, and (3) the 1P5 main board's chip pinout. The two boards mate so that **U4 pin N (1-24) = main-board J1 pin N**, and **U4 pin N (25-48) = main-board J2 pin (N-24)** -- confirmed directly against the silkscreen notes on the EVK1P5 schematic (28-31=JTAG, 34/35=JTAG_SEL_N/RECONFIG_N, 44=DONE, 45/46=GWU2U, 17-22=SPI/SCL/SDA), which line up exactly with J2's JTAG/DONE block and J1's SPI/I2C block below.

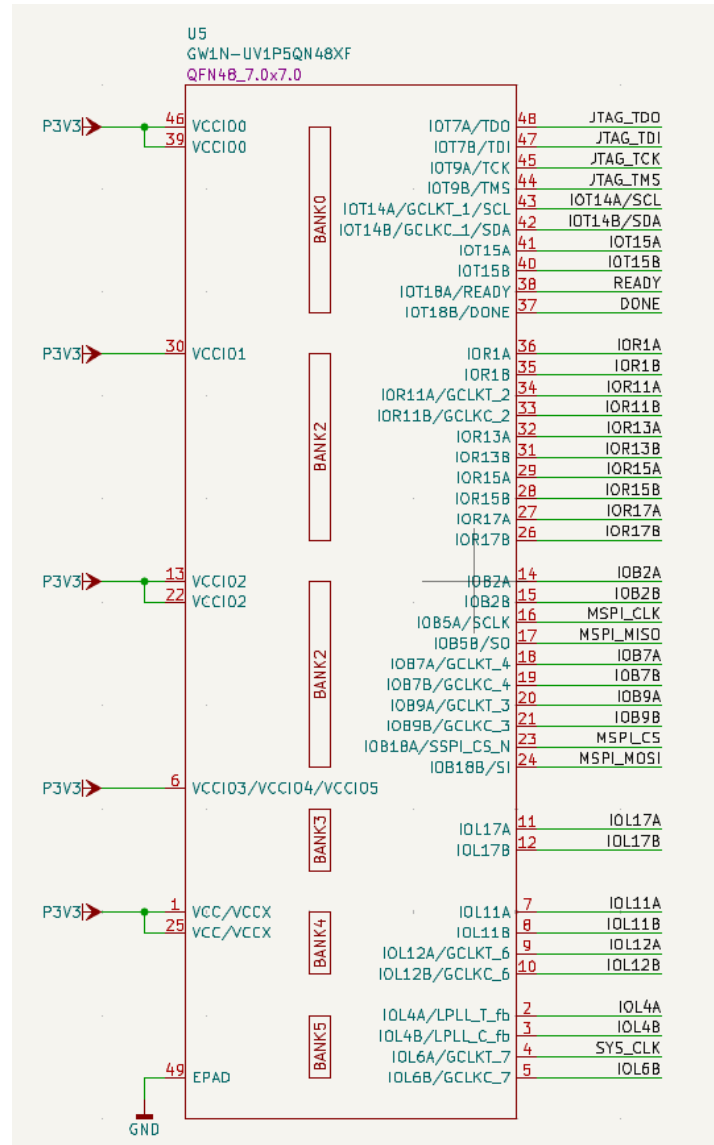


Figure A. GW1N-UV1P5QN48XF chip pinout and I/O bank voltages (all banks are 3.3V/LVCMOS33).

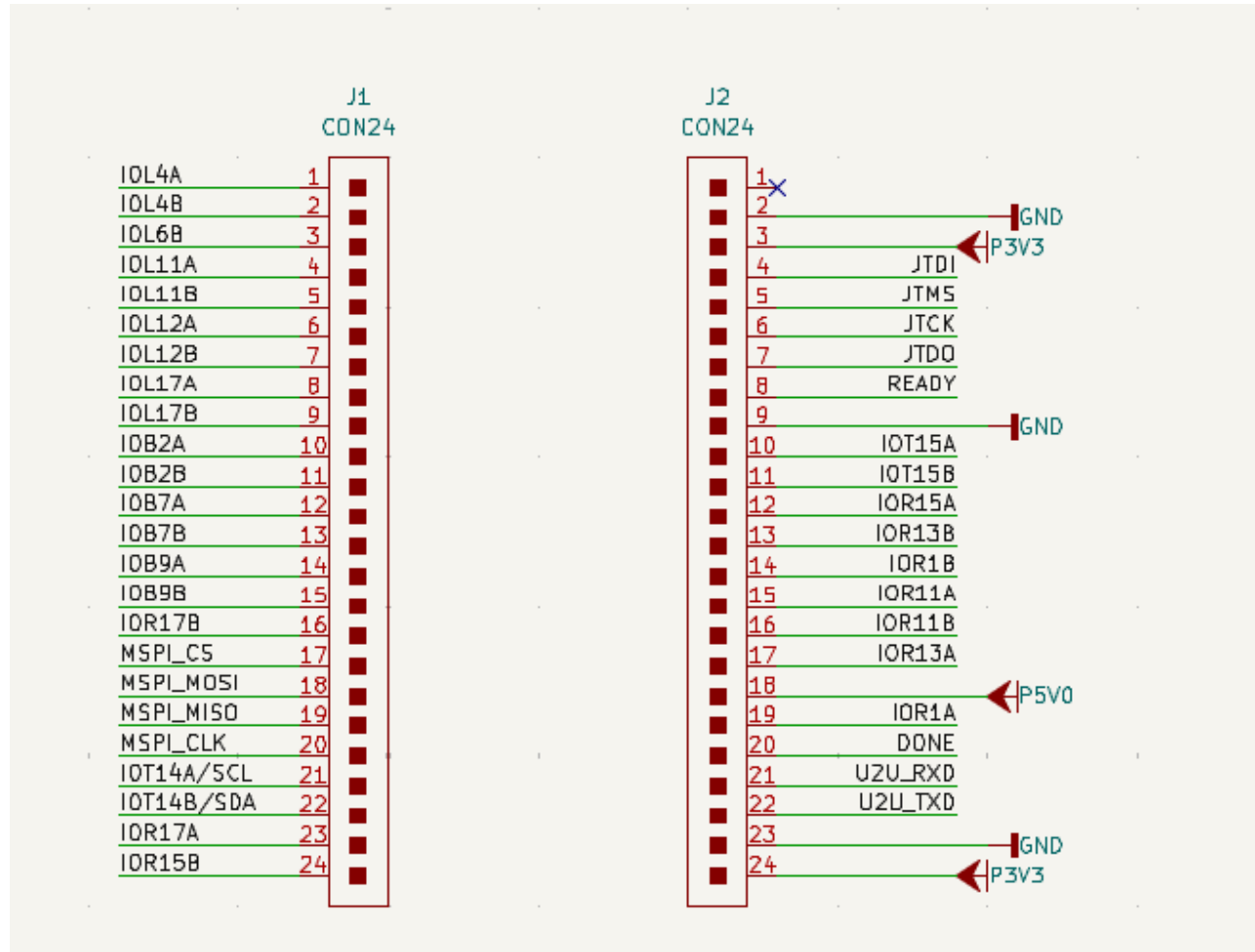


Figure B. 1P5 main board's J1/J2 expansion header (48 pins total), the connector EVK1P5 plugs onto.

Note on shared debug-UART pins: per the main board's own schematic, chip pins 33/34 (IOR11B/IOR11A) are bridged via 0Ω resistors R25/R24 to the onboard GWU2X USB-UART debug channel (U2U_TXD/U2U_RXD). These are the same physical pins EVK1P5 uses for **BUT2/BUT1** -- avoid relying on those two buttons while the debug console is actively in use.

Main Board Interface Connector (U4) -- Full Pin Table

The table below is the verified pin-by-pin net list of connector U4, with each signal's real FPGA physical-constraint pin and I/O voltage looked up via Figures A/B above. 21 positions are physically **not populated** on EVK1P5 -- their FPGA pin is still listed for reference, since the main board uses them internally (JTAG, DONE, RECONFIG_N, GWU2U, SPI/I2C).

Pin	Signal	FPGA Pin	Voltage	Description
1	RGB	2	3V3	RGB LED chain data output (also on direct breakout header)
2	IO_SCL	3	3V3	Arduino-header I2C clock; shared onto SLG_SCL/EEPROM_SCL via SW5
3	IO_SDA	5	3V3	Arduino-header I2C data; shared onto SLG_SDA/EEPROM_SDA via SW5
4	IO13	7	3V3	Arduino D13; shared with EEPROM_SDA via SW5 bit 4
5	IO12	8	3V3	Arduino D12; shared with EEPROM_SCL via SW5 bit 3
6	IO11	9	3V3	Arduino D11; shared with SEG_E via SW5 bit 5
7	IO10	10	3V3	Arduino D10; shared with SEG_D via SW5 bit 6
8	IO9	11	3V3	Arduino D9; shared with SEG_DPX via SW5 bit 7
9	IO8	12	3V3	Arduino D8; shared with DIG3 via SW5 bit 8
10	IO7	14	3V3	Arduino D7; shared with DIG0 via SW6 bit 8
11	IO6	15	3V3	Arduino D6; shared with SEG_G via SW6 bit 7
12	IO5	18	3V3	Arduino D5; shared with SEG_C via SW6 bit 6
13	IO4	19	3V3	Arduino D4; shared with SEG_B via SW6 bit 5
14	IO3	20	3V3	Arduino D3; shared with DIG1 via SW6 bit 4
15	IO2	21	3V3	Arduino D2; shared with SEG_A via SW6 bit 1
16	IOS5	26	3V3	GreenPAK U1 IO5 / J4 pin 5; also Arduino D1(TX)
17	NC	--	--	Not populated -- main board MSPI_CS (SPI flash chip-select)
18	NC	--	--	Not populated -- main board MSPI_MOSI (SPI flash data out)
19	NC	--	--	Not populated -- main board MSPI_MISO (SPI flash data in)
20	NC	--	--	Not populated -- main board MSPI_CLK (SPI flash clock)
21	NC	--	--	Not populated -- main board I2C SCL (IOT14A)
22	NC	--	--	Not populated -- main board I2C SDA (IOT14B)
23	RX0	27	3V3	Arduino D0 (RX); shared with SEG_F via SW6 bit 2
24	IOS6	28	3V3	GreenPAK U1 IO6 / J4 pin 6; shared with DIG2 via SW6 bit 3
25	NC	--	--	Not populated -- reserved (main-board J2 pin 1, not connected there either)
26	GND	--	GND	Ground reference
27	+3V3	--	+3V3	3.3V power from main board
28	NC	--	--	Not populated -- main board JTAG TDI
29	NC	--	--	Not populated -- main board JTAG TMS
30	NC	--	--	Not populated -- main board JTAG TCK
31	NC	--	--	Not populated -- main board JTAG TDO

Pin	Signal	FPGA Pin	Voltage	Description
32	NC	--	--	Not populated -- main board READY status
33	GND	--	GND	Ground reference
34	NC	--	--	Not populated -- main board JTAG_SEL_N (user-assigned function on IOT15A)
35	NC	--	--	Not populated -- main board RECONFIG_N (user-assigned function on IOT15B)
36	grove_1	29	3V3	Grove connector J5, pin 3
37	grove_2	31	3V3	Grove connector J5, pin 4
38	BUT0	35	3V3	User button SW1, Active LOW
39	BUT1	34	3V3	User button SW2, Active LOW (also main-board GWU2X U2U_RXD via R24)
40	BUT2	33	3V3	User button SW3, Active LOW (also main-board GWU2X U2U_TXD via R25)
41	BUT3	32	3V3	User button SW4, Active LOW
42	+5V	--	+5V	5V power from main board
43	BUZZER	36	3V3	Buzzer driver input, Active HIGH
44	NC	--	--	Not populated -- main board DONE status
45	NC	--	--	Not populated -- main board GWU2X debug UART RXD (not an FPGA pin)
46	NC	--	--	Not populated -- main board GWU2X debug UART TXD (not an FPGA pin)
47	GND	--	GND	Ground reference
48	+3V3	--	+3V3	3.3V power from main board

Direct FPGA I/O Breakout Headers

Two tall single-row pin headers run down the middle of the board. They duplicate a subset of the U4 signals above for quick jumper-wire access (probing, external wiring, logic analyzer hookup) without unplugging the shield. Silkscreen labels read, top to bottom:

Pin Labels (top -> bottom)	Description
RGB, SCL, SDA, NC	= U4 pins 1, 2, 3 -- RGB LED data line and the shared Arduino I2C pair
IO13, GND, IO12, IO11, IO10, IO9	= U4 pins 4-8 -- general-purpose Arduino I/O pins with an interleaved ground
IO8, IO7, IO6, IO5, IO4, IO3	= U4 pins 9-14 -- general-purpose Arduino I/O pins
IO2, NC, NC, NC, RX0, NC	= U4 pins 15 and 23 -- general I/O and the UART Rx line

System Block Diagram

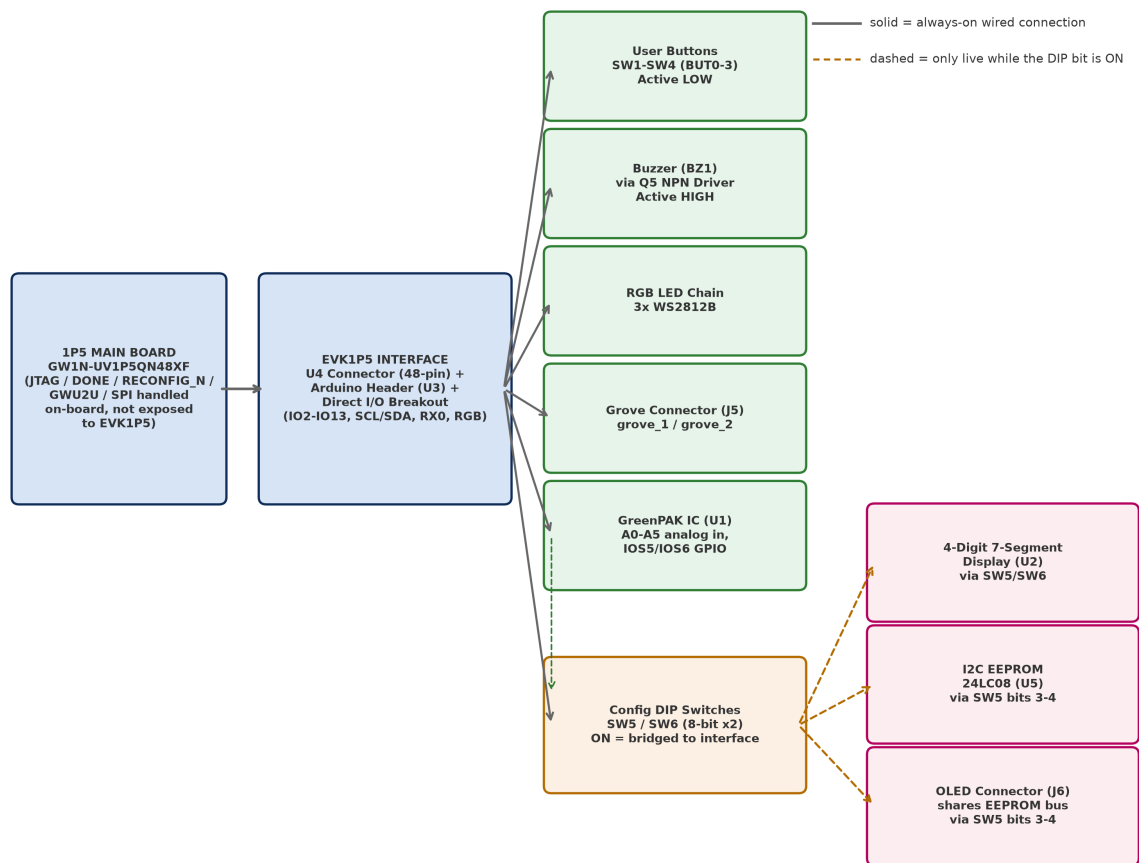


Figure 02. EVK1P5 onboard module block diagram.

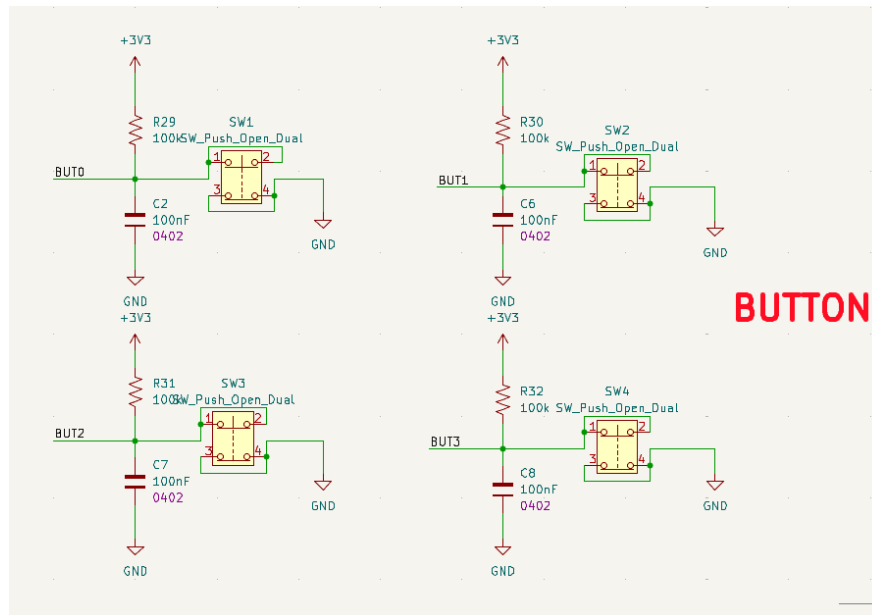
Onboard Peripheral Modules

GreenPAK Mixed-Signal IC (U1, SLG46826V)

A field-configurable 20-pin mixed-signal IC. Its I2C configuration bus (SLG_SCL/SLG_SDA, pins 8/9) is broken out on header J3 and can be bridged onto the Arduino SCL/SDA pins via SW5 bits 1-2. Six of its GPIOs (IO0, IO2-IO8 minus IO9) are exposed as the IOS1-IO8 group on header J4; five more (IO1, IO10-IO14) are wired directly to the Arduino analog pins A5, A0-A4 for use as analog comparator inputs. Note that IOS1-4/7/8 and A0-A5 terminate on the GreenPAK only -- they do **not** reach the 1P5 FPGA directly ("FPGA Pin" = N/A), unlike IOS5/IOS6 which also ride out to U4.

U1 Pin	Pin Function	Net	FPGA Pin	Notes
2	IO0	IOS1	N/A	GPIO, breakout J4 pin 1 (GreenPAK-local only)
4	IO2	IOS2	N/A	GPIO, breakout J4 pin 2 (GreenPAK-local only)
5	IO3	IOS3	N/A	GPIO, breakout J4 pin 3 (GreenPAK-local only)
6	IO4	IOS4	N/A	GPIO, breakout J4 pin 4 (GreenPAK-local only)
7	IO5	IOS5	26	GPIO, breakout J4 pin 5 / U4 pin 16 / Arduino D1(TX)
10	IO6	IOS6	28	GPIO, breakout J4 pin 6 / U4 pin 24, gated with DIG2 via SW6 bit 3
12	IO7	IOS7	N/A	GPIO, breakout J4 pin 7 (GreenPAK-local only)
13	IO8	IOS8	N/A	GPIO, breakout J4 pin 8 (GreenPAK-local only)
15	IO9	(unused)	N/A	Not connected
3	IO1	A5	N/A	Analog comparator input, Arduino A5 (GreenPAK-local only)
16	IO10	A0	N/A	Analog comparator input, Arduino A0 (GreenPAK-local only)
17	IO11	A1	N/A	Analog comparator input, Arduino A1 (GreenPAK-local only)
18	IO12	A2	N/A	Analog comparator input, Arduino A2 (GreenPAK-local only)
19	IO13	A3	N/A	Analog comparator input, Arduino A3 (GreenPAK-local only)
20	IO14	A4	N/A	Analog comparator input, Arduino A4 (GreenPAK-local only)
8	SCL	SLG_SCL	3 (when SW5-1 ON)	I2C config bus, breakout J3 pin 3
9	SDA	SLG_SDA	5 (when SW5-2 ON)	I2C config bus, breakout J3 pin 4
1, 14	VDD, VDD2	+3V3	--	Power
11	GND	GND	--	Ground

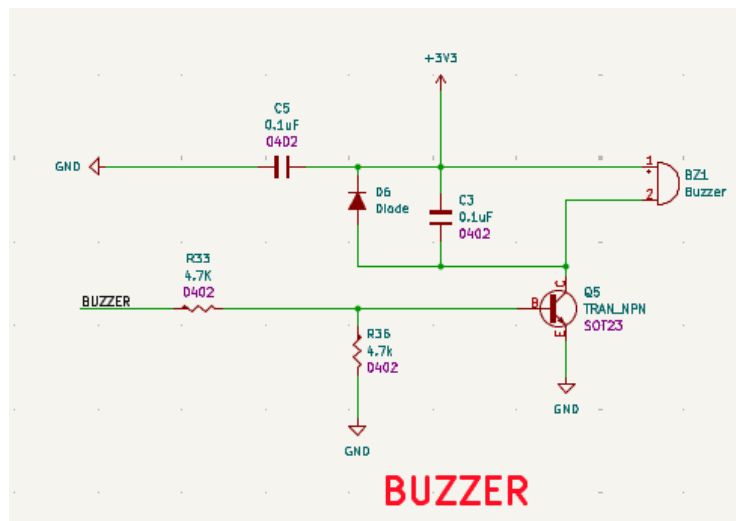
User Buttons (SW1-SW4)



Four tactile push-buttons, each pulled up to 3.3V through a 100kΩ resistor (R29-R32) with a 100nF debounce/decoupling capacitor. Pressing a button pulls its line to GND, so all four buttons are **Active LOW** -- the same convention as the main 1P5 board's onboard buttons.

Designator	Net	Connector Pin	FPGA Pin	Voltage	Active State	Bias Network
SW1	BUT0	U4 pin 38	35	3V3	Active LOW	R29 100kΩ + C2 100nF
SW2	BUT1	U4 pin 39	34	3V3	Active LOW	R30 100kΩ + C6 100nF
SW3	BUT2	U4 pin 40	33	3V3	Active LOW	R31 100kΩ + C7 100nF
SW4	BUT3	U4 pin 41	32	3V3	Active LOW	R32 100kΩ + C8 100nF

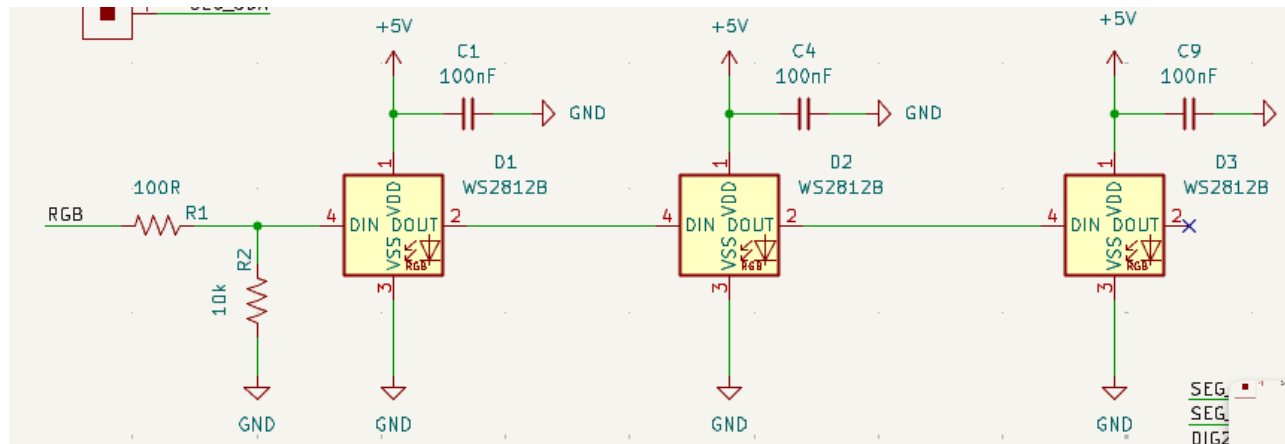
Buzzer (BZ1)



A passive piezo buzzer driven through an NPN transistor stage (Q5, SOT-23) from the single-ended **BUZZER** control signal, with flyback diode D6 protecting the transistor and R36 pulling the transistor base to GND when idle. BZ1's positive terminal ties to +3V3; driving BUZZER to **Logic HIGH** turns Q5 on and energizes the buzzer. Toggle it at an audible frequency (e.g., ~2 kHz) from FPGA logic to produce a tone. Component datasheet: lsc.com/datasheet/C94599.pdf.

Net	Connector Pin	FPGA Pin	Voltage	Active State	Drive
BUZZER	U4 pin 43	36	3V3	Active HIGH	Via Q5 NPN (R33 base series, R36 pull-down)

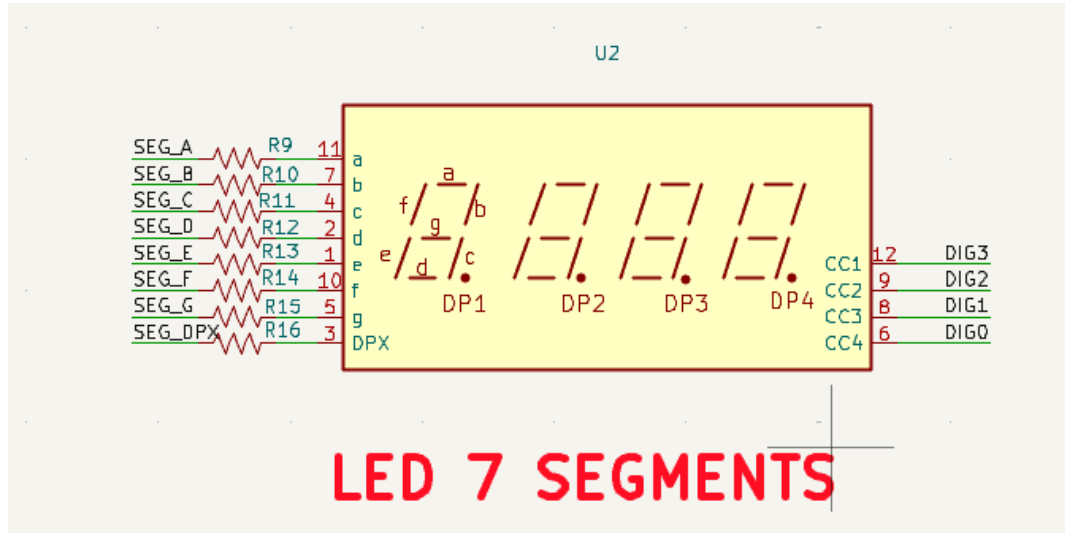
RGB LED Chain (D1-D3, WS2812B)



Three WS2812B addressable RGB LEDs are daisy-chained (DOUT of D1 → DIN of D2 → DIN of D3) and driven from a single connector pin (**RGB**) through a 100Ω series resistor (R1). Each LED is individually addressable via the WS2812B single-wire NZR timing protocol; no separate clock line is required. The chain is powered from 5V with a common GND reference. Component datasheet: lsc.com/datasheet/C114587.pdf.

Net	Connector Pin	FPGA Pin	Voltage	Direction	Protocol
RGB	U4 pin 1	2	3V3	Digital Output	WS2812B single-wire NZR, via R1 100Ω

4-Digit 7-Segment Display (U2)



A multiplexed 4-digit 7-segment display. Segment lines SEG_A-SEG_G and the decimal point SEG_DPX (each through its own series resistor R9-R16) are shared across all four digits; the CC1-CC4 common pins (driven by DIG3-DIG0) select which digit is currently active. FPGA logic must scan through DIG0-DIG3 fast enough (e.g., >100 Hz per-digit refresh) to avoid visible flicker. None of these 12 lines connect to U4 directly -- all of them are gated onto specific Arduino header pins (D2-D13, SCL/SDA, or RX0) through DIP switches SW5/SW6; the FPGA pin below is only live while that switch bit is ON.

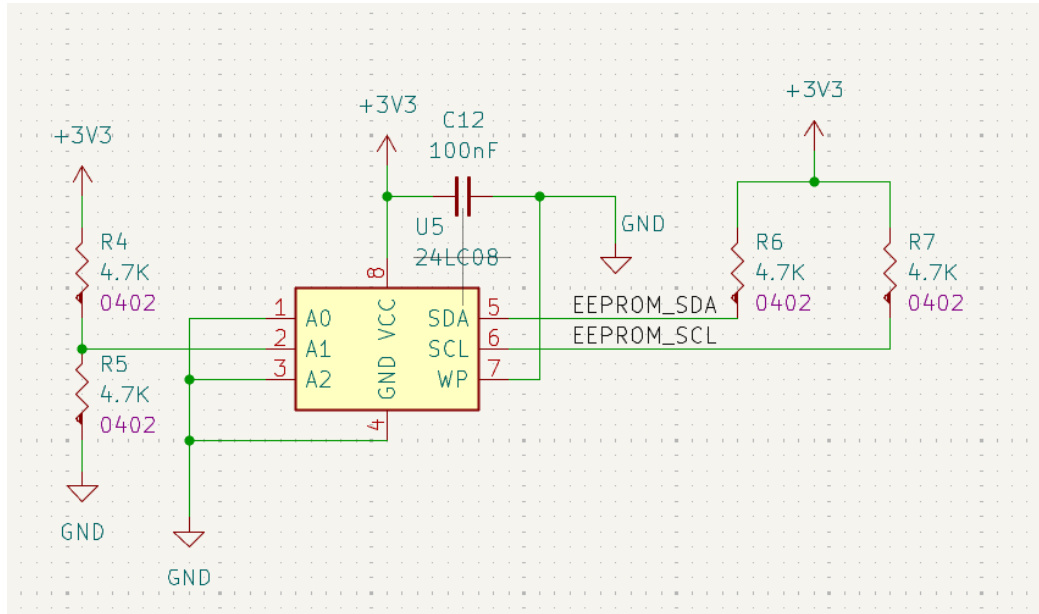
U2 Pin	Pin Function	Series R	Routed Via	FPGA Pin	Voltage
11	a (SEG_A)	R9	SW6 bit 1 ↔ Arduino D2	21	3V3
7	b (SEG_B)	R10	SW6 bit 5 ↔ Arduino D4	19	3V3
4	c (SEG_C)	R11	SW6 bit 6 ↔ Arduino D5	18	3V3
2	d (SEG_D)	R12	SW5 bit 6 ↔ Arduino D10	10	3V3
1	e (SEG_E)	R13	SW5 bit 5 ↔ Arduino D11	9	3V3
10	f (SEG_F)	R14	SW6 bit 2 ↔ Arduino D0/RX	27	3V3
5	g (SEG_G)	R15	SW6 bit 7 ↔ Arduino D6	15	3V3
3	dp (SEG_DPX)	R16	SW5 bit 7 ↔ Arduino D9	11	3V3
12	CC1 (DIG3)	--	SW5 bit 8 ↔ Arduino D8	12	3V3
9	CC2 (DIG2)	--	SW6 bit 3 ↔ GreenPAK IOS6	28	3V3
8	CC3 (DIG1)	--	SW6 bit 4 ↔ Arduino D3	20	3V3
6	CC4 (DIG0)	--	SW6 bit 8 ↔ Arduino D7	14	3V3

Component Specification (per note.txt)

Property	Value
Pin count	12
Digit size	0.28 inch
Digits	4
Common terminal	Common Anode
LED color	Red
Face color	Black
Segments	7
Character W x H	4.5mm x 7mm
Mounting	Through-hole
Outline dimensions	32 x 10 x 5.8mm
Luminous intensity	54 mcd
Power	65mW
Operating temperature	-40 ~ 85°C
Forward current	20mA
Forward voltage	2V

I2C Peripherals & Expansion Connectors

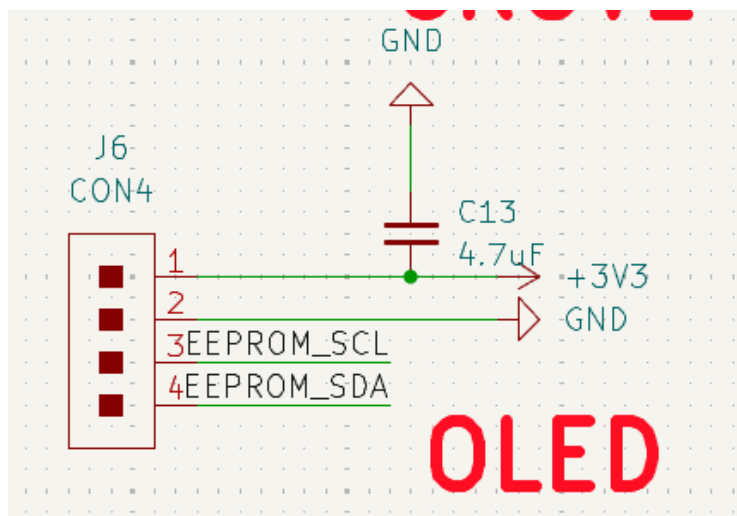
I2C EEPROM (U5, 24LC08)



An 8-Kbit I2C serial EEPROM for non-volatile storage experiments (e.g., saving calibration data or a counter across power cycles). Address pins A0 and A2 are tied to GND, WP is tied to GND (write-protection disabled by default), and the bus (EEPROM_SCL/EEPROM_SDA) is pulled up 4.7kΩ via R7/R6. Manufacturer datasheet (Microchip 24LC08): ww1.microchip.com/downloads/en/DeviceDoc/21710K.pdf.

U5 Pin	Pin Function	Net	FPGA Pin	Voltage	Notes
6	SCL	EEPROM_SCL	7	3V3	R7 4.7kΩ pull-up; = J6 pin 3; = IO13 (SW5 bit 3 ON)
5	SDA	EEPROM_SDA	8	3V3	R6 4.7kΩ pull-up; = J6 pin 4; = IO12 (SW5 bit 4 ON)
1	A0	GND	--	GND	Address bit, tied low
2	A1	-- (floating)	--	--	Not connected
3	A2	GND	--	GND	Address bit, tied low
7	WP	GND	--	GND	Write-protect disabled
8	VCC	+3V3	--	+3V3	Power
4	GND	GND	--	GND	Ground

OLED Connector (J6)



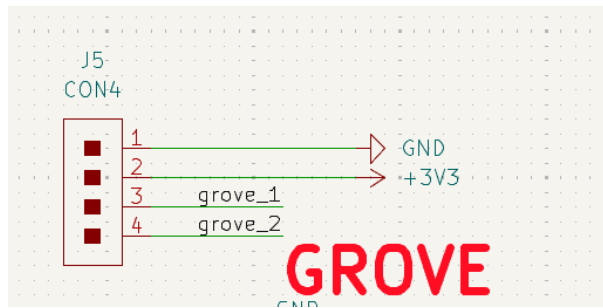
A 4-pin vertical JST-PH header (footprint JST_B4B-PH-SM4) for an external I2C OLED module (e.g. SSD1306 0.96" 128x64). **Pin order, pin 1 to pin 4 (pin 1 marked by the square silkscreen pad):**

Pin	Net	FPGA Pin	Voltage	Notes
1	+3V3	--	+3V3	Power
2	GND	--	GND	Ground
3	EEPROM_SCL	7	3V3	I2C clock -- same bus as EEPROM U5; = IO13 (SW5 bit 3 ON)
4	EEPROM_SDA	8	3V3	I2C data -- same bus as EEPROM U5; = IO12 (SW5 bit 4 ON)

Component Specification (per note.txt)

Property	Value
Diagonal size	0.96 inch
Display area	26 x 19mm
Driver IC	SSD1306
Matrix type	Passive
Resolution	128 x 64 px
Display color	Blue
Interface	I2C
Overall size	30 x 28 x 4mm
Operating temperature	-30 ~ 70°C
Operating voltage	3.3 ~ 5VDC

Grove Connector (J5)



A second 4-pin JST-PH Grove connector for generic analog/digital sensor modules, wired straight through to U4 pins 36-37 (no local onboard peripheral). Pin order, pin 1 to pin 4:

Pin	Net	FPGA Pin	Voltage	Notes
1	GND	--	GND	Ground
2	+3V3	--	+3V3	Power
3	grove_1	29	3V3	= U4 pin 36
4	grove_2	31	3V3	= U4 pin 37

Shared I2C Bus Notice: The OLED connector (J6) and the onboard EEPROM (U5) sit on the **same physical I2C bus** (EEPROM_SCL/EEPROM_SDA), separate from the GreenPAK's own I2C bus (SLG_SCL/SLG_SDA, broken out on J3). Do not plug in an external OLED at an I2C address that conflicts with the EEPROM's address (A0/A2 tied low) -- confirm addresses before combining devices on the same bus.

Configuration DIP Switches (SW5, SW6)

SW5 and SW6 are each 16-pin DIP packages wired as 8 independent SPST switches. Physically, switch bit N bridges package pin N (peripheral side, matching the top silkscreen label) to package pin (17-N) on the opposite side (Arduino-header / IO side). **ON bridges the two signals into one node; OFF splits them so the onboard peripheral no longer loads the Arduino/main-board pin.** The FPGA Pin column is only live while that bit is ON. This table is the verified pairing extracted from the schematic net list -- each row is one physical switch position:

Switch	Bit	Peripheral-Side Signal	Bridged To (Arduino/IO Side)	FPGA Pin	Voltage
SW5	1	SLG_SCL	IO_SCL (Arduino SCL / U4 pin 2)	3	3V3
SW5	2	SLG_SDA	IO_SDA (Arduino SDA / U4 pin 3)	5	3V3
SW5	3	EEPROM_SCL	IO13 (Arduino D13 / U4 pin 4)	7	3V3
SW5	4	EEPROM_SDA	IO12 (Arduino D12 / U4 pin 5)	8	3V3
SW5	5	SEG_E	IO11 (Arduino D11 / U4 pin 6)	9	3V3
SW5	6	SEG_D	IO10 (Arduino D10 / U4 pin 7)	10	3V3
SW5	7	SEG_DPX	IO9 (Arduino D9 / U4 pin 8)	11	3V3
SW5	8	DIG3	IO8 (Arduino D8 / U4 pin 9)	12	3V3
SW6	1	SEG_A	IO2 (Arduino D2 / U4 pin 15)	21	3V3
SW6	2	SEG_F	RX0 (Arduino D0 / U4 pin 23)	27	3V3
SW6	3	DIG2	IOS6 (GreenPAK U1 IO6 / U4 pin 24)	28	3V3
SW6	4	DIG1	IO3 (Arduino D3 / U4 pin 14)	20	3V3
SW6	5	SEG_B	IO4 (Arduino D4 / U4 pin 13)	19	3V3
SW6	6	SEG_C	IO5 (Arduino D5 / U4 pin 12)	18	3V3
SW6	7	SEG_G	IO6 (Arduino D6 / U4 pin 11)	15	3V3
SW6	8	DIG0	IO7 (Arduino D7 / U4 pin 10)	14	3V3

*Practical consequence: with every bit ON, the 7-segment display and both onboard I2C buses occupy **all** of Arduino D2-D13 plus SCL/SDA. To use the Arduino shield header (or the main FPGA board) for your own signal on any of those pins, flip only that one bit OFF first.*

Expansion Headers J3 / J4

Pin order, pin 1 to pin 4/8, for both direct-breakout headers:

Header	Pin	Net	FPGA Pin	Voltage	Notes
J3	1	+3V3	--	+3V3	Power
J3	2	GND	--	GND	Ground
J3	3	SLG_SCL	3 (SW5-1 ON)	3V3	GreenPAK (U1) I2C clock
J3	4	SLG_SDA	5 (SW5-2 ON)	3V3	GreenPAK (U1) I2C data
J4	1	IOS1	N/A	3V3	= GreenPAK U1 IO0 (GreenPAK-local only)
J4	2	IOS2	N/A	3V3	= GreenPAK U1 IO2 (GreenPAK-local only)
J4	3	IOS3	N/A	3V3	= GreenPAK U1 IO3 (GreenPAK-local only)
J4	4	IOS4	N/A	3V3	= GreenPAK U1 IO4 (GreenPAK-local only)

Header	Pin	Net	FPGA Pin	Voltage	Notes
J4	5	IOS5	26	3V3	= GreenPAK U1 IO5 / U4 pin 16 / Arduino D1
J4	6	IOS6	28	3V3	= GreenPAK U1 IO6 / U4 pin 24, gated with DIG2 via SW6 bit 3
J4	7	IOS7	N/A	3V3	= GreenPAK U1 IO7 (GreenPAK-local only)
J4	8	IOS8	N/A	3V3	= GreenPAK U1 IO8 (GreenPAK-local only)

Full Onboard Signal Reference

Net Name	Associated Module	Direction	Notes
BUT0 - BUT3	User Buttons	Digital Input	Active LOW, U4 pins 38-41
RGB	RGB LED Chain (WS2812B x3)	Digital Output	Single-wire NZR protocol, U4 pin 1
BUZZER	Piezo Buzzer (via Q5)	Digital Output	Active HIGH, U4 pin 43
SEG_A - SEG_G, SEG_DPX	7-Segment Display Segments	Digital Output	Gated onto Arduino D2-D11 via SW5/SW6
DIG0 - DIG3	7-Segment Digit Select	Digital Output	Gated onto Arduino D7/D8/IO5/D3 via SW5/SW6
SLG_SCL, SLG_SDA	GreenPAK IC I2C Bus	Bidirectional (I2C)	Breakout J3; gated onto Arduino SCL/SDA via SW5 bits 1-2
EEPROM_SCL, EEPROM_SDA	24LC08 EEPROM / OLED Connector I2C Bus	Bidirectional (I2C)	Breakout J6; gated onto Arduino D13/D12 via SW5 bits 3-4; 4.7k Ω pull-ups
IOS1 - IOS8	GreenPAK GPIO / J4 Breakout Header	Digital I/O	= GreenPAK U1 IO0, IO2-IO8; not switch-gated
A0 - A5	Arduino Analog Header	Analog Input	Wired directly to GreenPAK U1 IO10-IO14, IO1 (analog comparator inputs)
IO2 - IO13, RX0	Arduino Header / U4 / Direct Breakout	Digital I/O	= U4 pins 15-4 and pin 23; also on the direct I/O breakout headers
grove_1, grove_2	Grove Connector J5	Digital/Analog I/O	= U4 pins 36-37

Quick Connection & First-Test Guide

- Step 1. Power down** both boards, then align EVK1P5's 48-pin connector with the 1P5 main board's expansion header (match pin-1 markings) and stack firmly.
- Step 2. Power up** the 1P5 main board via USB-C as usual -- EVK1P5 draws both 3.3V and 5V directly from the main board; no separate power supply is required.
- Step 3. Set all DIP switches on SW5 and SW6 to ON** for first bring-up, so the 7-segment display and both onboard I2C buses are connected to the FPGA.
- Step 4. Load a simple test design** in GOWIN EDA that maps BUT0-BUT3 to the RGB LED chain, the buzzer, and the 7-segment digit count -- press each button and confirm the corresponding output responds.
- Step 5. Test I2C peripherals one at a time** (GreenPAK, EEPROM, OLED) -- the GreenPAK bus and the EEPROM/OLED bus are separate, but only one OLED/EEPROM device should be active on its shared bus at once.
- Step 6. To free a specific pin for your own circuit**, flip only that bit on SW5/SW6 OFF and wire your signal through the direct I/O breakout header or J3/J4 instead.

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