USB-QUAD08

Eight-channel Quadrature Encoder Input Device

Specifications

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MEASUREMENT COMPUTING™

USB-QUAD08 Specifications

All specifications are subject to change without notice.
Typical for 25 °C unless otherwise specified.
Specifications in *italic text* are guaranteed by design.

Counter

Table 1. Counter specifications

Parameter	Specification
Counter type	FPGA
Counters	8 (quadrature or normal)
Counter input modes	Quadrature (x1, x2, x4)/Totalize, Pulse width, Period
Mode options	Non-Recycle, Range Limit, Clear on Read, Modulo-N, Up/Down, Decrement
Index options	Latch, Clear|Reload, Decrement, Gate; mode dependent.
Resolution	16, 32 or 48-bit counters
Quadrature mode input frequency	10/5/2.5 MHz, max, in x1/x2/x4
Normal mode input frequency	10 MHz, max
De-bounce times	16 steps from 500 ns to 25 ms; positive or negative edge sensitive; glitch detect mode or de-bounce mode; software-selectable.
Time-base and accuracy	48 MHz (24 MHz – 30 ppm with a 2xDLL (delay locked loop))
Counter read pacer	Internal or external scan pacer up to 8 MHz
Period/pulse width resolution	20.83 ns; 208.3 ns; 2.083 µs; or 20.83 µs

Input

Table 2. Input specifications

Parameter	Specification
Receiver type	SN75ALS175 quad differential receiver
Configuration	8 channels. Each channel consists of PhaseA input, PhaseB input and Index input; each input is selectable as single-ended or differential.
	Differential: ▪ PhaseA, PhaseB and Index (+) inputs at the user connector are routed to the (+) inputs of differential receiver. ▪ PhaseA, PhaseB and Index (–) inputs at the user connector are routed to the (–) inputs of the differential receiver.
	Single-ended: ▪ PhaseA, PhaseB and Index (+) inputs at the user connector are routed to the (+) inputs of the differential receiver. ▪ PhaseA, PhaseB and Index (–) inputs at the user connector are left floating. The (–) inputs of the differential receiver are routed to the +3 V reference.
Common mode input voltage range	*±12 V*
Differential input voltage range	*±12 V*
Input sensitivity	*±200 mV*
Input hysteresis	*50 mV, typ*
Input impedance	*12 kΩ, min*
Absolute maximum input voltage	*±14 V, max*
Miscellaneous	▪ *Meets or exceeds ANSI EIA/TIA-422-B, EIA/TIA-423-B, RS-485.* ▪ *Meets ITU recommendations V.10, V.11, X.26, X.27.* ▪ *Designed for multipoint busses on long lines and in noisy environments.*

Digital I/O – Timer outputs – Terminal count outputs

Table 3. Output specifications

Parameter	Specification
Number of I/O	8 independent
Configurable	Timer outputs (DIO6, DIO7 only), Terminal count/Modulo, Input/Output (default)
Input:	
Input characteristics	Weak 10 kΩ resistor pulled-up to 5V with protection diode (+V_{USB} – diode drop).
Input high	*+2.0 V to 42.4 V_{pk} 50 VDC*
Input low	*0 V to 0.8 V*
Output:	
Output characteristics	Open-collector Darlington transistors with CEMF suppression diodes (ULN2803)
Output logic supply	User voltage supply up to 50 VDC (42.4 V_{pk}) for strong drive.
CEMF Supply (CLMP+)	Connect to logic supply positive terminal up to *50 VDC (42.4 V_{pk})*
Output high	*2.0 VDC to 50 VDC (42.4 V_{pk}); dependent upon logic supply.*
Output low	<0.8 V
Output sink current	*500 mA per pin, 2.5 A max. per device* (parallel connections for higher current needs) requires external supply.
Output generation	Counter events or timer outputs (bits 6 and 7); asynchronous generation
Asynchronous throughput	4000 updates/second, typ (tested on Windows XP and Windows Vista32)
Timer outputs:	
Number of channels	Two 16-bit ▪ Timer Output 0 (DIO6) ▪ Timer Output 1 (DIO7)
Effective frequency range	0.01123 Hz to 5 MHz

Trigger and pacer

Table 4. Trigger and pacer specifications

Parameter	Specification
Digital type	Edge/level sensitive; software-selectable.
Trigger types	Start acquisition process
Pacer	Latch counter values for read back
Trigger and pacer inputs	▪ Internal (software) ▪ External
Trigger and pacer input	–0.5 V to 7.0 V
External pacer frequency	8 MHz, max

Indicator LEDs

Table 5. LED specifications

Parameter	Specification
Power LED	Indicates that the device's microcontroller has power and is running.
Status LED	Indicates that the USB is configured; blinks to indicate USB traffic.
Channel LEDs	Indicates that the encoder/counter is receiving a valid signal on any of the inputs.

Power

Table 6. Power specifications

Parameter	Condition	Specification
V_{USB} (+5V) (Note 1)	▪ Connected to self-powered hub ▪ Connected to externally-powered root port hub	4.5 V to 5.25 V 480 mA max; 225 mA typ
V_{USER} (+5V) current	4.5 V to 5.25 V; 20 mA max	
Encoder supply	External supply of 1.5 A @ 5 VDC fused up to 42.4 V_{pk} (50 V_{DC}) @ 2 A Protection diodes (30BQ060, 0.5V_{max} drop) protecting against reverse polarity.	
Encoder supply fuse	0452002. - Littelfuse 2A NANO2® Slo-Blo® Subminiature Surface Mount Fuse	

Note 1: "Self-powered hub" refers to a USB hub with an external power supply. Self-powered hubs allow a connected USB device to draw up to 500 mA. "Root port hubs" reside in the PC USB host Controller. The USB port(s) on your PC are root port hubs. All externally-powered root port hubs (desktop PC) provide up to 500 mA of current for a USB device. Battery-powered root port hubs provide 100 mA or 500 mA, depending upon the manufacturer. A laptop PC that is not connected to an external power adapter is an example of a battery-powered root port hub. If your laptop PC is constrained to the 100 mA max, use a self-powered hub.

Environmental

Table 7. Environmental specifications

Parameter	Specification
Operating temperature range	0 °C to 60 °C
Storage temperature range	–40 °C to 85 °C
Humidity	0% to 90% non-condensing

Mechanical

Table 8. Mechanical specifications

Parameter	Specification
Dimensions (L × W × H)	245 × 146 × 50 mm (9.6 × 5.7 × 2.0 in.)

USB specifications

Table 9. USB specifications

Parameter	Specification
Device type	USB 2.0 high-speed mode (480 Mbps) if available (recommended), otherwise, USB 1.1 full-speed mode (12 Mbps)
Device compatibility	USB 2.0 (recommended) or USB 1.1
USB cable type	*A-B cable, UL type AWM 2725 or equivalent. (min 24 AWG VBUS/GND, min 28 AWG D+/D–)*
USB cable length	3 meters, max (9.84 feet)

I/O connectors

Table 10. I/O Connector specifications

Parameter	Specification
Connector type	▪ Screw terminals: 10 banks; detachable ▪ 37-pin D type: J12(external) and J50 (internal)
Wire gauge range for screw terminals	16 AWG to 28 AWG
Compatible cable with the 37-pin connectors	C37F-4X9F-1M C37FF-x C37FFS-x
Compatible accessory products with the 37-pin connectors	SCB-37 CIO-MINI37 CIO-MINI37/DST CIO-MINI37-VERT CIO-MINI37-VERTDST CIO-TERMINAL

Screw terminal connectors

Table 11. Differential mode pinout

Signal name	Terminal description	Signal name	Terminal description
ENC+	Encoder power output (Note 2)	GND	Ground
0PHA+	Counter 0 Phase A high	1INDX–	Counter 1 Phase A high
0PHA–	Counter 0 Phase A low	1INDX+	Counter 1 Phase A low
0PHB+	Counter 0 Phase B high	1PHB–	Counter 1 Phase B high
0PHB–	Counter 0 Phase B low	1PHB+	Counter 1 Phase B low
0INDX+	Counter 0 Index high	1PHA–	Counter 1 Index high
0INDX–	Counter 0 Index low	1PHA+	Counter 1 Index low
GND	Ground	ENC+	Encoder power output (Note 2)
ENC+	Encoder power output (Note 2)	GND	Ground
2PHA+	Counter 2 Phase A high	3INDX–	Counter 3 Phase A high
2PHA–	Counter 2 Phase A low	3INDX+	Counter 3 Phase A low
2PHB+	Counter 2 Phase B high	3PHB–	Counter 3 Phase B high
2PHB–	Counter 2 Phase B low	3PHB+	Counter 3 Phase B low
2INDX+	Counter 2 Index high	3PHA–	Counter 3 Index high
2INDX–	Counter 2 Index low	3PHA+	Counter 3 Index low
GND	Ground	ENC+	Encoder power output (Note 2)
ENC+	Encoder power output (Note 2)	GND	Ground
4PHA+	Counter 4 Phase A high	5INDX–	Counter 5 Phase A high
4PHA–	Counter 4 Phase A low	5INDX+	Counter 5 Phase A low
4PHB+	Counter 4 Phase B high	5PHB–	Counter 5 Phase B high
4PHB–	Counter 4 Phase B low	5PHB+	Counter 5 Phase B low
4INDX+	Counter 4 Index high	5PHA–	Counter 5 Index high
4INDX–	Counter 4 Index low	5PHA+	Counter 5 Index low
GND	Ground	ENC+	Encoder power output (Note 2)
ENC+	Encoder power output (Note 2)	GND	Ground
6PHA+	Counter 6 Phase A high	7INDX–	Counter 7 Phase A high
6PHA–	Counter 6 Phase A low	7INDX+	Counter 7 Phase A low
6PHB+	Counter 6 Phase B high	7PHB–	Counter 7 Phase B high
6PHB–	Counter 6 Phase B low	7PHB+	Counter 7 Phase B low
6INDX+	Counter 6 Index high	7PHA–	Counter 7 Index high
6INDX–	Counter 6 Index low	7PHA+	Counter 7 Index low
GND	Ground	ENC+	Encoder power output (Note 2)
+5V	Power output	+5V	Power output
XTRIG	External trigger input	CLMP+	CEMF protection for DIO (Note 5)
XPCR	External pacer input	ENC+ IN	Encoder power input(Note 2)
GND	Ground	GND	Ground
DIO0	DIO channel 0	DIO1	DIO channel 1
DIO2	DIO channel 2	DIO3	DIO channel 3
DIO4	DIO channel 4	DIO5	DIO channel 5
DIO6*	DIO channel 6 (Note 3)	DIO7*	DIO channel 7 (Note 4)

Note 2: External supply when operating in encoder mode. ENC+ IN is passed to all ENC+ lines with optional protection diodes to prevent reverse connection.

Note 3: DIO6 can also function as Timer Output 0.

Note 4: DIO7 can also function as Timer Output 1.

Note 5: CEMF protection to the DIO supply; it is not a source.

Table 12. Single-ended mode pinout

Signal name	Terminal description	Signal name	Terminal description
ENC+	Encoder power output (Note 6)	GND	Ground
0PHA+	Counter 0 Phase A	1INDX–	Floating (Note 7)
0PHA–	Floating (Note 7)	1INDX+	Counter 1 Phase A
0PHB+	Counter 0 Phase B	1PHB–	Floating (Note 7)
0PHB–	Floating (Note 7)	1PHB+	Counter 1 Phase B
0INDX+	Counter 0 Index	1PHA–	Floating (Note 7)
0INDX–	Floating (Note 7)	1PHA+	Counter 1 Index
GND	Ground	ENC+	Encoder power output (Note 6)
ENC+	Encoder power output (Note 6)	GND	Ground
2PHA+	Counter 2 Phase A	3INDX–	Floating (Note 7)
2PHA–	Floating (Note 7)	3INDX+	Counter 3 Phase A
2PHB+	Counter 2 Phase B	3PHB–	Floating (Note 7)
2PHB–	Floating (Note 7)	3PHB+	Counter 3 Phase B
2INDX+	Counter 2 Index	3PHA–	Floating (Note 7)
2INDX–	Floating (Note 7)	3PHA+	Counter 3 Index
GND	Ground	ENC+	Encoder power output (Note 6)
ENC+	Encoder power output (Note 6)	GND	Ground
4PHA+	Counter 4 Phase A	5INDX–	Floating (Note 7)
4PHA–	Floating (Note 7)	5INDX+	Counter 5 Phase A
4PHB+	Counter 4 Phase B	5PHB–	Floating (Note 7)
4PHB–	Floating (Note 7)	5PHB+	Counter 5 Phase B
4INDX+	Counter 4 Index	5PHA–	Floating (Note 7)
4INDX–	Floating (Note 7)	5PHA+	Counter 5 Index
GND	Ground	ENC+	Encoder power output (Note 6)
ENC+	Encoder power output (Note 6)	GND	Ground
6PHA+	Counter 6 Phase A	7INDX–	Floating (Note 7)
6PHA–	Floating (Note 7)	7INDX+	Counter 7 Phase A
6PHB+	Counter 6 Phase B	7PHB–	Floating (Note 7)
6PHB–	Floating (Note 7)	7PHB+	Counter 7 Phase B
6INDX+	Counter 6 Index	7PHA–	Floating (Note 7)
6INDX–	Floating (Note 7)	7PHA+	Counter 7 Index low
GND	Ground	ENC+	Encoder power output (Note 6)
+5V	Power output	+5V	Power output
XTRIG	External trigger input	CLMP+	CEMF protection for DIO (Note 10)
XPCR	External pacer input	ENC+ IN	Encoder power input (Note 6)
GND	Ground	GND	Ground
DIO0	DIO channel 0	DIO1	DIO channel 1
DIO2	DIO channel 2	DIO3	DIO channel 3
DIO4	DIO channel 4	DIO5	DIO channel 5
DIO6*	DIO channel 6 (Note 8)	DIO7*	DIO channel 7 (Note 9)

Note 6: External supply when operating in encoder mode. ENC+ IN is passed to all ENC+ lines with optional protection diodes to prevent reverse connection.

Note 7: In single-ended mode, the PhaseA, PhaseB and Index (–) inputs at the user connector are left floating. The (–) inputs of the differential receiver are routed to +3 V reference.

Note 8: DIO6 can also function as Timer Output 0.

Note 9: DIO7 can also function as Timer Output 1.

Note 10: CEMF protection to the DIO supply; it is not a source.

37-pin connectors

J12

Table 13. Differential mode pinout

Pin	Signal name	Pin description	Pin	Signal name	Pin description
1	0PHA –	Counter 0 Phase A low	20	0PHA+	Counter 0 Phase A high
2	ENC+	Encoder power output	21	0PHB+	Counter 0 Phase B high
3	0PHB–	Counter 0 Phase B low	22	GND	Ground
4	ENC+	Encoder power output	23	0INDX+	Counter 0 Index high
5	0INDX–	Counter 0 Index low	24	2INDX–	Counter 2 Index low
6	NC	No connection	25	2PHA+	Counter 2 Phase A high
7	2PHA–	Counter 2 Phase A low	26	2PHB+	Counter 2 Phase B high
8	ENC+	Encoder power output	27	GND	Ground
9	2PHB–	Counter 2 Phase B low	28	2INDX+	Counter 2 Index high
10	ENC+	Encoder power output	29	3INDX–	Counter 3 Index low
11	3PHA–	Counter 3 Phase A low	30	3PHA+	Counter 3 Phase A high
12	ENC+	Encoder power output	31	3PHB+	Counter 3 Phase B high
13	3PHB–	Counter 3 Phase B low	32	GND	Ground
14	ENC+	Encoder power output	33	3INDX+	Counter 3 Index high
15	1PHA–	Counter 1 Phase A low	34	1PHA+	Counter 1 Phase A high
16	ENC+	Encoder power output	35	1PHB+	Counter 1 Phase B high
17	1PHB–	Counter 1 Phase B low	36	GND	Ground
18	ENC+	Encoder power output	37	1INDX+	Counter 1 Index high
19	1INDX–	Counter 1 Index low			

Table 14. Single-ended mode pinout

Pin	Signal name	Pin description	Pin	Signal name	Pin description
1	0PHA –	Floating (Note 11)	20	0PHA+	Counter 0 Phase A
2	ENC+	Encoder power output	21	0PHB+	Counter 0 Phase B
3	0PHB–	Floating (Note 11)	22	GND	Ground
4	ENC+	Encoder power output	23	0INDX+	Counter 0 Index
5	0INDX–	Floating (Note 11)	24	2INDX–	Floating (Note 11)
6	NC	No connection	25	2PHA+	Counter 2 Phase A
7	2PHA–	Floating (Note 11)	26	2PHB+	Counter 2 Phase B
8	ENC+	Encoder power output	27	GND	Ground
9	2PHB–	Floating (Note 11)	28	2INDX+	Counter 2 Index
10	ENC+	Encoder power output	29	3INDX–	Floating (Note 11)
11	3PHA–	Floating (Note 11)	30	3PHA+	Counter 3 Phase A
12	ENC+	Encoder power output	31	3PHB+	Counter 3 Phase B
13	3PHB–	Floating (Note 11)	32	GND	Ground
14	ENC+	Encoder power output	33	3INDX+	Counter 3 Index high
15	1PHA–	Floating (Note 11)	34	1PHA+	Counter 1 Phase A
16	ENC+	Encoder power output	35	1PHB+	Counter 1 Phase B
17	1PHB–	Floating (Note 11)	36	GND	Ground
18	ENC+	Encoder power output	37	1INDX+	Counter 1 Index
19	1INDX–	Floating (Note 11)			

Note 11: In single-ended mode, the PhaseA, PhaseB and Index (–) inputs at the user connector are left floating. The (–) inputs of the differential receiver are routed to +3 V reference.

J50

Table 15. Differential mode pinout

Pin	Signal name	Pin description	Pin	Signal name	Pin description
1	4PHA –	Counter 4 Phase A low	20	4PHA+	Counter 4 Phase A high
2	ENC+	Encoder power output	21	4PHB+	Counter 4 Phase B high
3	4PHB–	Counter 4 Phase B low	22	GND	Ground
4	ENC+	Encoder power output	23	4INDX+	Counter 4 Index high
5	4INDX–	Counter 4 Index low	24	6INDX–	Counter 6 Index low
6	NC	No connection	25	6PHA+	Counter 6 Phase A high
7	6PHA–	Counter 6 Phase A low	26	6PHB+	Counter 6 Phase B high
8	ENC+	Encoder power output	27	GND	Ground
9	6PHB–	Counter 6 Phase B low	28	6INDX+	Counter 6 Index high
10	ENC+	Encoder power output	29	7INDX–	Counter 7 Index low
11	7PHA–	Counter 7 Phase A low	30	7PHA+	Counter 7 Phase A high
12	ENC+	Encoder power output	31	7PHB+	Counter 7 Phase B high
13	7PHB–	Counter 7 Phase B low	32	GND	Ground
14	ENC+	Encoder power output	33	7INDX+	Counter 7 Index high
15	5PHA–	Counter 5 Phase A low	34	5PHA+	Counter 5 Phase A high
16	ENC+	Encoder power output	35	5PHB+	Counter 5 Phase B high
17	5PHB–	Counter 5 Phase B low	36	GND	Ground
18	ENC+	Encoder power output	37	5INDX+	Counter 5 Index high
19	5INDX–	Counter 5 Index low			

Table 16. Single-ended mode pinout

Pin	Signal name	Pin description	Pin	Signal name	Pin description
1	4PHA –	Floating (Note 12)	20	4PHA+	Counter 4 Phase A
2	ENC+	Encoder power output	21	4PHB+	Counter 4 Phase B
3	4PHB–	Floating (Note 12)	22	GND	Ground
4	ENC+	Encoder power output	23	4INDX+	Counter 4 Index
5	4INDX–	Floating (Note 12)	24	6INDX–	Floating (Note 12)
6	NC	No connection	25	6PHA+	Counter 6 Phase A
7	6PHA–	Floating (Note 12)	26	6PHB+	Counter 6 Phase B
8	ENC+	Encoder power output	27	GND	Ground
9	6PHB–	Floating (Note 12)	28	6INDX+	Counter 6 Index
10	ENC+	Encoder power output	29	7INDX–	Floating (Note 12)
11	7PHA–	Floating (Note 12)	30	7PHA+	Counter 7 Phase A
12	ENC+	Encoder power output	31	7PHB+	Counter 7 Phase B
13	7PHB–	Floating (Note 12)	32	GND	Ground
14	ENC+	Encoder power output	33	7INDX+	Counter 7 Index
15	5PHA–	Floating (Note 12)	34	5PHA+	Counter 5 Phase A
16	ENC+	Encoder power output	35	5PHB+	Counter 5 Phase B
17	5PHB–	Floating (Note 12)	36	GND	Ground
18	ENC+	Encoder power output	37	5INDX+	Counter 5 Index
19	5INDX–	Floating (Note 12)			

Note 12: In single-ended mode, the PhaseA, PhaseB and Index (–) inputs at the user connector are left floating. The (–) inputs of the differential receiver are routed to +3 V reference.

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