

CEDIO_A

5-apr-2011.
Embedded software version 1.

1. Main features

The device is based on unified digital input/output board (CEDIO) and customized by embedded software. CEDIO_A is intended for using as general purpose input/output register in control systems of accelerators.

The device includes:

- 16-bits output register with power outputs;
- 16-bits input TTL register;
- CANBUS interface for interaction with control computer;
- On-board micro-controller.

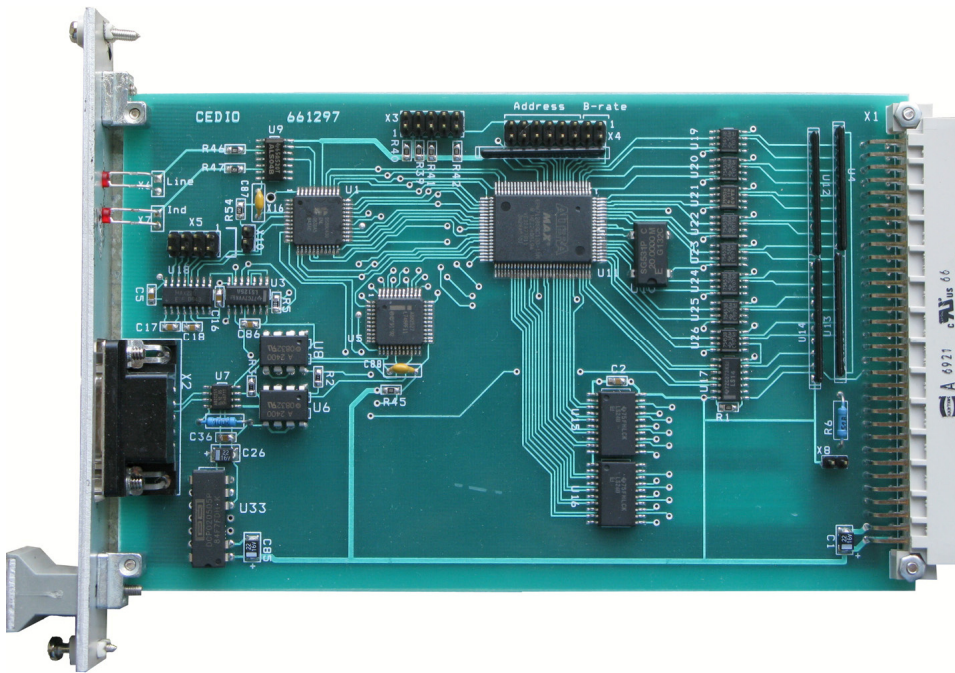


Photo of CEDIO.

The device is intended to be embedded in power supply racks. The device requires for proper operation the only power supply with voltage +5V ($\pm 5\%$).

2. Specifications (main parameters):

1. Channels of output register – 16.
2. Maximal voltage for output register e - 30 V.
3. Maximal current for output register - 300 mA.
4. Channels of input register – 16.
5. Voltage for input register- TTL levels or contact with “ground”.
6. Duration of RDR – 3-5 uS.
7. Duration of WRR – 0,5-1,5 uS.
8. Duration of INT – >500 nS.
9. CANbus transceiver is galvanically isolated from network and it is in compliance with ISO 11898-24V (chip PCA82C251).
10. Voltage between transmission line and device- 1000V.
11. Baud rates- 1000, 500, 250, 125 Kbaud (may be chosen by jumpers).
12. Voltage of power supply- +5V, $\pm 5\%$.
13. Power supply current- <0,9 A (typical value- 0.6A). Power supply must provide starting current > 1,0 A.
14. Size of device - 3U * 160 mm.

3. External connections

The device CEDIO is implemented as eurocard 3U*160. A front panel of the device contains a network connector (DB-9M) and two LEDs. One LED is blinking during processing CANbus messages. The second LED using depend on embedded software version. Connection with external signals carry out by rear connector.

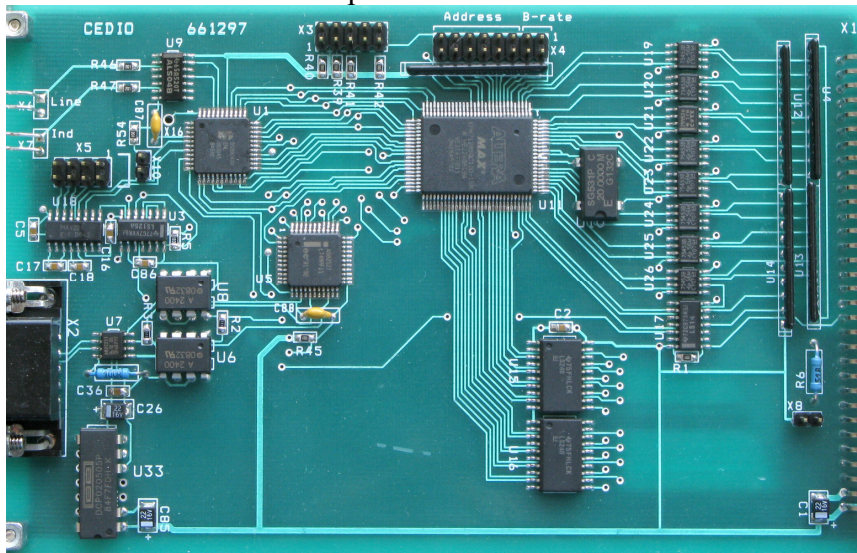
3.1. Jumpers

The device CEDIO has jumper X* and set of jumpers- X4.

X8 is intended for using internal power supply (+5 V) instead of external for powering load of output register (see description of output register).

X4 includes 8 jumpers. 6 jumpers define number (address) of device in network (this number is used to compose identifier of messages) and 2 jumpers define baud rate.

Jumper location is shown on board photo.



Destination of jumpers in X4 group.

Designation	Location	Destination
X4-7	Upper	N5- included in device number (most significant bit)
X4-6	...	N4- included in device number
X4-5	...	N3- included in device number
X4-4	...	N2- included in device number
X4-3	...	N1- included in device number
X4-2	...	N0- included in device number (least significant bit)
X4-1	...	BR1- defines baud rate
X4-0	Lower	BR0- defines baud rate

Jumpers N5...N0 defines logical number (address) of device which is used to compose message identifier for CANbus network (for more detail see PROTOCOL part of this description). An installed jumper should be interpreted as logical 0 and absence of jumper should be interpreted as logical 1.

Don't use addresses 34, 3C, 3D, 3E и 3F (hexadecimal).

Baude rate coding.

BR1	BR0	Baud rate
Connected	Connected	1000 Kbit/sec
Connected	Disconnected	500 Kbit/sec
Disconnected	Connected	250 Kbit/sec
Disconnected	Disconnected	125 Kbit/sec

NOTES:

1. CANbus is bus with multiple accesses and incorrect baud rate setting may affects on transfer messages of other devices up to impossibility of access to the device.
2. In network may exist concurrently devices with identical numbers (addresses). Formally it is permissibly, but actually it does cause a lot of problem. Connecting to network devices with identical numbers is strictly not recommended.

3.2 Front panel



A front panel includes:

Line LED

Ind LED

CANbus connector

Line LED is blinking during processing CANbus messages by onboard processor.

Ind LED is on in CHANGE DETECTOR mode..

After power-on the device blinks by all LEDs a few times. Then the processor indicates version of device. Version CEDIO_A is marked by single flash of **Ind LED**. Both LEDs are blinking during “bus-off recovery” procedure also.

CANbus connector (DB-9M) is intended for connection to media. Pin designations follow below in table.

2	CAN-L	One wire in pair
3	GND	Shield of cable
7	CAN-H	One wire in pair

Shielded twisted pair is used as media. According to the ISO 11898-2 it should has nominal impedance 120 Ohm. Line termination has to be provided by termination resistors of 120 Ohm located at both ends of the line.

3.3 Main connector

There is DIN41612 connector for connecting with input and output signals.



X1					
OU T0	33	C 1	A1	1	IN0
OU T1	34	C 2	A2	2	IN1
OU T2	35	C 3	A3	3	IN2
OU T3	36	C 4	A4	4	IN3
OU T4	37	C 5	A5	5	IN4
OU T5	38	C 6	A6	6	IN5
OU T6	39	C 7	A7	7	IN6
OU T7	40	C 8	A8	8	IN7
OU T8	41	C 9	A9	9	IN8
OU T9	42	C 10	A10	10	IN9
OU T10	43	C 11	A11	11	IN10
OU T11	44	C 12	A12	12	IN11
OU T12	45	C 13	A13	13	IN12
OU T13	46	C 14	A14	14	IN13
OU T14	47	C 15	A15	15	IN14
OU T15	48	C 16	A16	16	IN15
RDR	49	C 17	A17	17	
WRR	50	C 18	A18	18	
INT	51	C 19	A19	19	
VE	52	C 20	A20	20	VE
	53	C 21	A21	21	
	54	C 22	A22	22	
	55	C 23	A23	23	
	56	C 24	A24	24	
	57	C 25	A25	25	
	58	C 26	A26	26	
	59	C 27	A27	27	
	60	C 28	A28	28	
	61	C 29	A29	29	
	62	C 30	A30	30	
	63	C 31	A31	31	
VCC	64	C 32	A32	32	VCC

The main connector provides for user register inputs, outputs, special signals and pins for powering device. The device uses the only external power supply +5B (5%). For powering device one should use pins 31, 32, 63 and 64.

Output register is implemented on power logical elements with open collector and can control by electromechanical relay. Keep in mind that output register has not protection circuitry and if load has inductance (relay, for example) user must add diode to remove spike. Register outputs with VE (external voltage) by pull-up resistor 10 KOhm. If register will be used as TTL register then pin VE can be connected with internal power supply (+5 V) by X8 jumper.

Zero in output register corresponds to disconnected output (no output current).

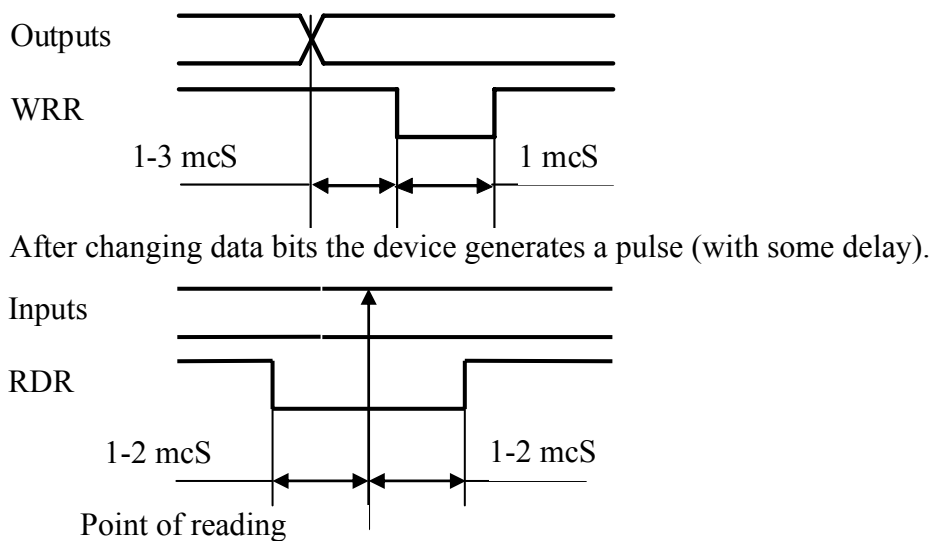
Input register is intended for TTL levels. Each input is connected with power supply by pull-up resistor (10 KOhm). It may be used for reading mechanical contact state, accordingly. Disconnected input is interpreted by device as logical zero.

For more convenience there are additional signals (WRR, RDR, INT) with TTL levels.

4. Basics of operations for CEDIO_A

CEDIO_A is intended for interfacing with external digital device without connection with computer but having parallel dataway. In addition CEDIO_A can control different devices having discrete input/outputs. Output register can drive electromagnetic relay and input register can read state of mechanical contacts. Input and output pins can be connected together and work as bidirectional databus.

For interfacing CEDIO_A with external device can be user additional signals: WRR (Write to Register) and RDR (Read from Register). They are ordinary TTL outputs. Below are shown timing diagrams with these signals.



Processor set LOW at RDR pin, then read both bytes and set HIGH at RDR pin.

Input register can be used as ordinary input register with reading input pins and transfer this information to computer. But, logically there is another unit based on input register- Change Detector. There is CD_mask register which is cleared on power up. If to set some bit in CD_mask register then microcontroller will check state of corresponding bit in input register and on changing this bit, device will send message in CANbus.

Note.

Period of reading input register is 50-100 usec and fast changing of signal (spikes) can be missed.

INT pin is connected with interrupt input of microcontroller and can be used in future. Software revision 1 doesn't use this line.

5. Protocol (interaction with CANbus) of CEDIO_A

Identifier bit definition.

Identifier bits	ID10...ID08	ID07...ID02	ID01...ID00
Bit field	Field 1	Field 2	Field 3
Destination	Priority	Address	Reserve

Comments to bit distribution:

Field 1 – priority field (type field):

Code 5 – a broadcast message (field 2 is ignored).

Code 6 – ordinary (address) message.

Code 7 – response (reply for type 6 message).

Code 0 is forbidden, other combination is not used (they are reserved for future extensions).

Field 2 – a physical address field. It defined address device (this address is defined by jumpers on-board). Don't use addresses 34, 3C, 3D, 3E and 3F (hexadecimal).

Field 3: User should set zero in this field. The device can send messages with different values in this field.

Any device on receiving address message interprets information by its content. If received message requires a reply, the device sends required information by message with code 6 (response type message). Broadcast messages should be received by all devices simultaneously and required actions should be done in all devices. The device doesn't check size of message except for F4 command (sequential write to file).

Size of transmitted messages is not defined and may be different in different versions of device.

Data interpretation.

Receiving CANbus message device interprets data the following way: the first byte (byte 0) is interpreted as descriptor of message (command) and the following bytes are parameters.

5.1. List of commands (hexadecimal codes).

E8 - request for data from input and output registers

E9 - write to output register

FA – write to CD_mask register

FE - device status request

FF - device attributes request

5.2. Detail description of messages (commands) (all codes are hexadecimal)

Message E8 - request data from registers. This message has not additional information. In reply a device sends a message with output register bytes and input register bytes.

E8	DO0	DO1	DI0	DI1	0	0
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Here:

DO0 – data from output register (bits OUT0-OUT7);

DO1 – data from output register (bits OUT8-OUT15);

DI0 – data from input register (low byte, bits IN0-IN7);
 DI1 – data from input register (high byte, bits IN8-IN15);

Message E9 - write data to output register.

Bytes 1 and 2 contain information to be written into output register (bits OUT0-OUT7 and OUT8-OUT15, respectively).

Message FA – write to CD_mask register.

FA	CD_Mask0	CD_Mask1
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CD_Mask – mask register of Change Detector. Bit b0 corresponds to IN0 pin. Cleared mask bit means ignoring corresponding pin.

On changing pin state (if corresponding mask bit is 1) the device sends to CANbus the following message:

FA	CD_Mask0	Changed0	Inputs0	CD_Mask1	Changed1	Inputs1
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Changed – bits, state of which has been changed since previous message FA to CANbus.

This bit could be changed a few times for elapsed time.

Inputs- state pins of input register (not masked).

Message FE – request device status. It hasn't any parameters. In reply a device sends the following message:

FE	0	CD_Mask0	CD_Mask1
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CD_Mask – mask register of Change Detector.

Message FF - device attribute request. There are not additional parameters. In reply a device sends the following message:

FF	Device Code	HW version	SW version	Reason
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Device Code- device type (for CEDIO_A it is equal 28).

HW version- hardware version of device.

SW version- software version of device.

Reason- reason of sending this message:

- 0 - After power-up.
- 1 - After reset by button on front panel.
- 2 - On request by address message with code FF.
- 3 - On request by broadcast message (who is here?).
- 4 - On restart by Watchdog timer.
- 5 - On busoff recovery.

5.3. GLOBAL messages (broadcasts)

For broadcast messages all devices analyze only field 1 in CANbus identifier. Valid combination is 5. A first byte of date presents a broadcast command. CEAC124 uses the following broadcast commands:

FF- request “Who is here”. On this broadcast request all devices on-line must send into network message with their attributes (and identifier).

7. Software versions for CEDIO_A

Version 2.