IO moduls TTLAI, TTLADO, ENDAT, CAN and DANI

1. DATA FIELDS

SpeedSetValue

(NC → Unit) Data type: int32 Speed reference signal.

31	30	29	28	27	26	25	24
SSV_31	SSV_30	SSV_29	SSV_28	SSV_27	SSV_26	SSV_25	SSV_24
23	22	21	20	19	18	17	16
SSV_23	SSV_22	SSV_21	SSV_20	SSV_19	SSV_18	SSV_17	SSV_16
15	14	13	12	11	10	9	8
SSV_15	SSV_14	SSV_13	SSV_12	SSV_11	SSV_10	SSV_9	SSV_8
7	6	5	4	3	2	1	0
SSV_7	SSV_6	SSV_5	SSV_4	SSV_3	SSV_2	SSV_1	SSV_0

ControlDword

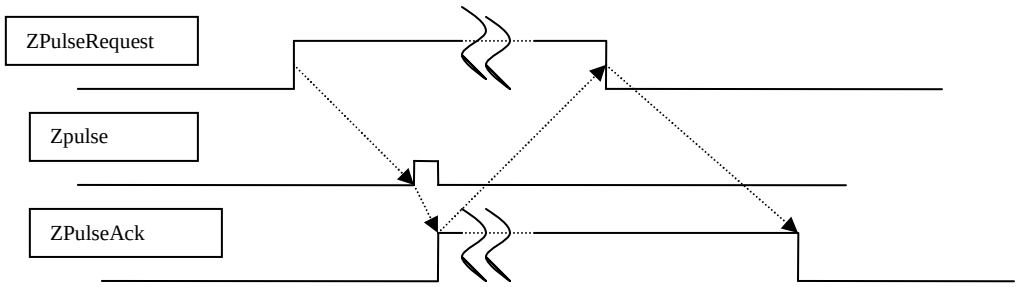
Data type: int32 Control codes.

(NC → Unit)

31	30	29	28	27	26	25	24
TCN_15	TCN_14	TCN_13	TCN_12	TCN_11	TCN_10	TCN_9	TCN_8
23	22	21	20	19	18	17	16
TCN_7	TCN_6	TCN_5	TCN_4	TCN_3	TCN_2	TCN_1	TCN_0
15	14	13	12	11	10	9	8
				ZPulseRequest		ErrorClear	
7	6	5	4	3	2	1	0

ErrorClear. Clear errors
ErrorClear=1 clears the ErrorDword servo drive errors in case of ErrClearAck =0 of the StatusDword.

ZpulseRequest. Start searching zero pulse in case of incremental encoder. (Grid)
This control bit starts searching for zero pulse of incremental encoder. The measuring system of servo drive indicates by ZPulseAck flag bit if found zero pulse. This also means that position (or angular position) of zero pulse is available yet and it can be read. Actual position of zero pulse is written automatically in upper word of ActPos when found any other additional zero pulses independently from state of ZpulseRequest and ZpulseAck.
Short description: Starting zero pulse search for ZpulseRequest=1. If zero pulse found then measuring system indicates this event by ZpulseAck=1 value. At this time position of zero pulse is found in upper 12 bits. The control writes ZpulseRequest=0 as answer-back signal for availability of the position of zero pulse. As a result of ZpulseRequest=0, value of ZpulseAck will be also 0. On the following figure there is the method of taking home point. It is also written in: ZPulseAck



TCN15-TCN0
Two's complement form of the signed integer for tacho signal of the ECAT-TACHO units.

ActPos
Actual Position (Unit → NC) Data type: int64. Measured position.

63	62	61	60	59	58	57	56
POS_63	POS_62	POS_61	POS_60	POS_59	POS_58	POS_57	POS_56
55	54	53	52	51	50	49	48
POS_55	POS_54	POS_53	POS_52	POS_51	POS_50	POS_49	POS_48
47	46	45	44	43	42	41	40
POS_47	POS_46	POS_45	POS_44	POS_43	POS_42	POS_41	POS_40
39	38	37	36	35	34	33	32
POS_39	POS_38	POS_37	POS_36	POS_35	POS_34	POS_33	POS_32
31	30	29	28	27	26	25	24
POS_31	POS_30	POS_29	POS_28	POS_27	POS_26	POS_25	POS_24
23	22	21	20	19	18	17	16
POS_23	POS_22	POS_21	POS_20	POS_19	POS_18	POS_17	POS_16
15	14	13	12	11	10	9	8
POS_15	POS_14	POS_13	POS_12	POS_11	POS_10	POS_9	POS_8
7	6	5	4	3	2	1	0
POS_7	POS_6	POS_5	POS_4	POS_3	POS_2	POS_1	POS_0

ActPOS indicates position on the whole 64 bits for absolute encoders.
In case of incremental encoders the lower 32 bits (POS_31-POS_0) indicates the actual position while the upper 32 bits (POS_63-POS_32) shows the position of the zero pulse. Both values are unsigned integers.

StatusDword

SSW
StatusDWord Data type: int32.
(Unit → NC)

31	30	29	28	27	26	25	24
VN_15	VN_14	VN_13	VN_12	VN_11	VN_10	VN_9	VN_8
23	22	21	20	19	18	17	16
VN_7	VN_6	VN_5	VN_4	VN_3	VN_2	VN_1	VN_0
5	14	13	12	11	10	9	8
7	6	5	4	3	2	1	0
			ErrClearAck	ZPulseAck	Abs/Incr		

Abs/Incr. Absolute or incremental encoder.
If **Abs/Incr=0** then the unit transmits data of position (**ActPos**) from EnDat absolute encoder. (The position is in 64 bit format)
If **Abs/Incr=1** then the unit transmits data of position (**ActPos**) from incremental encoder. (The position is in 32 bit format)

ZpulseAck.

Zero pulse was found after start searching for zero pulse (Grid).
This flag bit turns into 1 if the first zero pulse was found after start searching for zero pulse (ZpulseRequest) in case of incremental encoder. The measuring system of servo drive indicates (via ZPulseAck flag bit) that the zero pulse was found. This also means that the position of zero pulse ActPos is valid and it can be read.

ErrClearAck. Locking of the error clear
This bit turns into 1 when ControlDword ErrClear bit =1 and remains in this status while the ControlDword ErrClear bit will not turn ito „0".
That means it locks the error clear.

VN_15-VN_0 Version number of the softvare in the unit in hexadecimal form.

ErrorDword

SEW
Error Dword (DubleWord)
(Unit → NC)

31	30	29	28	27	26	25	24
23	22	21	20	19	18	17	16
	ECatWatchDog						
15	14	13	12	11	10	9	8
7	6	5	4	3	2	1	0
				r		**EncoderErr**	**UnitErrors**

UnitErrors. Consolidated errors.
This flag bit is produced as a result of summarisation of errors of the unit. If this bit is **„1”**, then the cause of the errors will be shown by another flag bits.

EncoderErr. Encoder Error. An error occured at the encoder.

ECatWatchDog. EtherCat slave unit WatchDog Timeout error.

TimeStamp
Data type: Uint16. Timestamp
(Unit → NC)

15	14	13	12	11	10	9	8
MSGC_15	MSGC_14	MSGC_13	MSGC_12	MSGC_11	MSGC_10	MSGC_9	MSGC_8
7	6	5	4	3	2	1	0
MSGC_7	MSGC_6	MSGC_5	MSGC_4	MSGC_3	MSGC_2	MSGC_1	MSGC_0

Generally this is the elapsed time between the latching of the previous and the current values of the position.in microseconds.. For the incremental encoders this is the elapsed time between the current and the previous encoder impulses of the current position in microseconds.

Message Code
Data type: int32. This code refers to the content of **Message Data**.
(Unit → NC)

31	30	29	28	27	26	25	24
MSGC_31	MSGC_30	MSGC_29	MSGC_28	MSGC_27	MSGC_26	MSGC_25	MSGC_24
23	22	21	20	19	18	17	16
MSGC_23	MSGC_22	MSGC_21	MSGC_20	MSGC_19	MSGC_18	MSGC_17	MSGC_16
15	14	13	12	11	10	9	8
MSGC_15	MSGC_14	MSGC_13	MSGC_12	MSGC_11	MSGC_10	MSGC_9	MSGC_8
7	6	5	4	3	2	1	0
MSGC_7	MSGC_6	MSGC_5	MSGC_4	MSGC_3	MSGC_2	MSGC_1	MSGC_0

Message Data
Data type: float32.
(Unit → NC)

31	30	29	28	27	26	25	24
MSGD_31	**MSGD_30**	**MSGD_29**	**MSGD_28**	**MSGD_27**	**MSGD_26**	**MSGD_25**	**MSGD_24**
23	22	21	20	19	18	17	16
MSGD_23	**MSGD_22**	**MSGD_21**	**MSGD_20**	**MSGD_19**	**MSGD_18**	**MSGD_17**	**MSGD_16**
15	14	13	12	11	10	9	8
MSGD_15	**MSGD_14**	**MSGD_13**	**MSGD_12**	**MSGD_11**	**MSGD_10**	**MSGD_9**	**MSGD_8**
7	6	5	4	3	2	1	0
MSGD_7	**MSGD_6**	**MSGD_5**	**MSGD_4**	**MSGD_3**	**MSGD_2**	**MSGD_1**	**MsgD_0**

EcatControlWord

Data type: Uint16.

(NC→ Unit)

15	14	13	12	11	10	9	8
ECW 15	ECW 14	ECW 13	ECW 12	ECW 11	ECW 10	ECW 9	ECW 8
7	6	5	4	3	2	1	0
ECW 7	ECW 6	ECW 5	ECW 4	ECW 3	ECW 2	ECW 1	ECW_0

Analogxx

Data type: int16.

(Unit→ NC) This value supplied by converter A/D

15	14	13	12	11	10	9	8
A 15	A 14	A13	A12	A 11	A 10	A 9	A 8
7	6	5	4	3	2	1	0
A 7	A 6	A 5	A 4	A 3	A 2	A 1	A_0

EcatStatusWord

Data type: Uint16.

(Unit→ NC)

15	14	13	12	11	10	9	8
ESW 15	ESW 14	ESW 13	ESW 12	ESW 11	ESW 10	ESW 9	ESW 8
7	6	5	4	3	2	1	0
ESW 7	ESW 6	ESW 5	ESW 4	ESW 3	ESW 2	ESW 1	ESW_0

2. IO moduls TTLAI and TTLADO

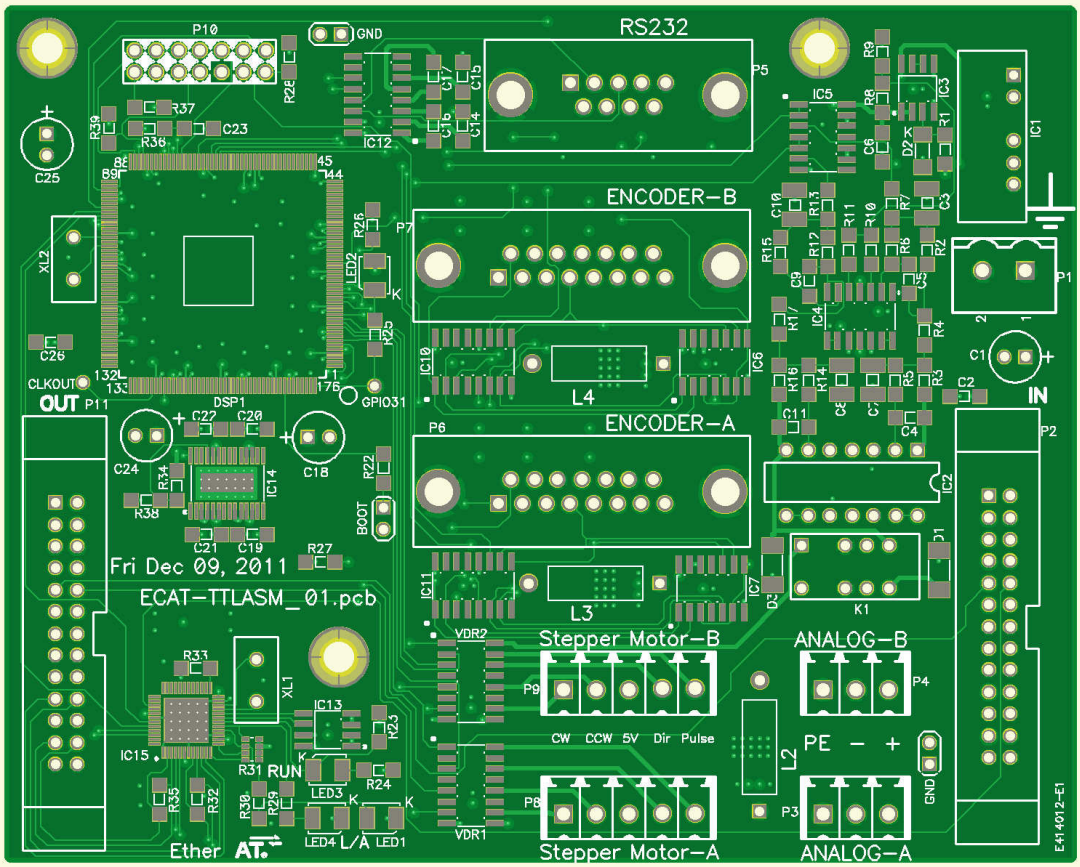


Fig. 1. Unassembled PCB ECAT-TTLASM_01 (TTLAI and TTLADO)

2.1. TTLAI module

Name in the XML	Name of PCB	Label	Software
TTLAI	ECAT-TTLASM_01	ECAT-TACHO 1.2	ECAT-TACHO1.2
0x11/0x02 17/2	ECAT-TTLASM_02		

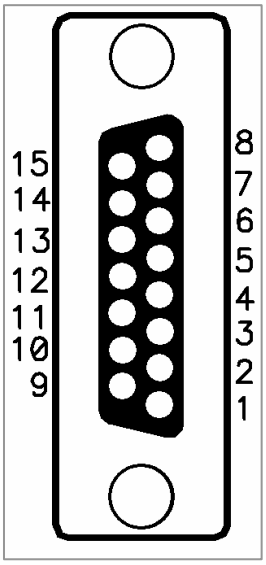
Connectors:
P1- Signal grounding connector.
Mating connector: MSTB 2,5/2-ST-5,08 (Phoenix Contact)
Both pins of the connector have the same potential on the PCB.
This pin should be connected in case of noise problems only. Otherwise it can be leaved unconnected (safety grounding is unnecessary due to low voltage). Overall noise protection can be improved by connection of this pin in case of the noise problems in the another EtherCAT units. Sometimes the connection of this pin can cause noise (in case of noise groinding network). This pin can be connected to the safety grounding if there is no separate signal groiunding in the system.

P2.P11- EtherCAT input and output.
Mating connector: 26-pin ribbon cable connector.
This is for the EtherCAT data sream and for supply voltage of the unit.

P3,P4- Analog output connectors
Mating connector: MC 1,5/3-ST-3,81 (Phoenix Contact)
Provides analog output signal +/-10V.
Wiring according to the PCB printing.
Recommended cable: twisted and shielded pair.
The screening should be connected to the terminal labeled PE. (However in very disturbed environment recommended to connect it directly to the signal ground.)

P6,P7 – Encoder connectors
Mating connector: 15 pin D-Sub male connector
It receives signals of the incremental TTL encoder according to the following wiring:

1: Signal **A**
2: Ground of the supply (**GND**)
3: Signal $\overline{B}$
4: Signal **C**
5: Positive supply voltage (**5V**)
6:
7:
8:
9: Signal $\overline{\mathbf{A}}$
10: Signal **B**
11: Ground of the supply (**GND**)
12: Signal $\overline{C}$
13:
14 Positive supply voltage (**5V**)
15:
screening: connector housing



P8,P9 are inactive

P5,P10 for service purposes

Used data fields and bits

SpeedSetValue
Used bits are: SSV_23 – SSV_8 (16 bits)
Two's complement form of the signed integer.
ControlDword
ErrorClear
ZpulseRequest
TCN15-TCN0

ActPos
lower 32 bits of the current position (POS_31-POS_0)
upper 32 bits of the position of the zero pulse (POS_63-POS_32)
StatusDword
Abs/Incr
ZpulseAck
ErrClearAck
VN_15-VN_0
ErrorDword
UnitErrors
EncoderErr
EcatWatchDog
TimeStamp

Operation:
This unit can handle two drives, receives signals of two TTL encoders and has two active analog outputs (the stepper motor outputs are not active).

If write zeros to the upper *ControlDword* (TCN15-TCN0), it gives to the *Analog* connector a voltage proportional to the basic analog signal received via data field *SpeedSetValue*

If the unit will be used for the analog DC drives having only tacho signal input but the motor has TTL incremantal encoder, then an integer number should be written to the upper ControlDword (TCN15-TCN0) via PLC. The integer number should be calculated as following:
(pulse number of the encoder * 4)*(maximal rpm of the motor/60) /5000 * -1. This is the maximal number of received encoder pulses during one cicle (200us).
This way the output analog reference signal of the unit will be compensated with the tacho signal (which is proportional to the rpm). For this reason the tacho input of the drive should be closed or left open.
(Generally the potentiometer „Ref in Gain" should be set to the maximum and the drive should be controlled via potentiometer „Loop Gain".
Experience has shown that certain DC drives can not be properly adjusted if they receive reference signal compensated by the tacho signal. In this case the analog reference signal should be provided by one of the channels e.g. *ANALOG-A.* Incremental TTL encoder should be connected to the input of the another channel e.g. *ENCODER-B*. Data field *SpeedSetValue* of this channel should be filled with zeros and to the upper ControlDword should be written the integer calculated above. This way the tacho signal (proportional to the rpm) appears on the connector *ANALOG-B*. This connector should be wired to the tacho input of the drive (avoid the positive feedback).

2.2. TTLADO module

Name in the XML	Name of PCB	Label	Software
ECAT-TTLADO	ECAT-TTLASM_01	ECAT-TTL_ADO 1.2	ECAT-TTLADO 1.2
0x14/0x02 20/2	ECAT-TTLASM_02		

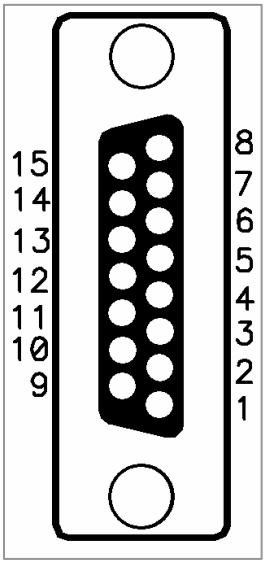
Connectors:
P1- Signal ground connector
Mating connector: MSTB 2,5/2-ST-5,08 (Phoenix Contact)
Both pins of the connector have the same potential on the PCB.
This pin should be connected in case of noise problems only. Otherwise it can be leaved unconnected (safety grounding is unnecessary due to low voltage). Overall noise protection can be improved by connection of this pin in case of the noise problems in the another EtherCAT units. Sometimes the connection of this pin can cause noise (in case of noise groinding network). This pin can be connected to the safety grounding if there is no separate signal groiunding in the system.

P2.P11- EtherCAT input and output connector
Mating connector: 26-pin ribbon cable connector.
This is for the EtherCAT data sream and for supply voltage of the unit.

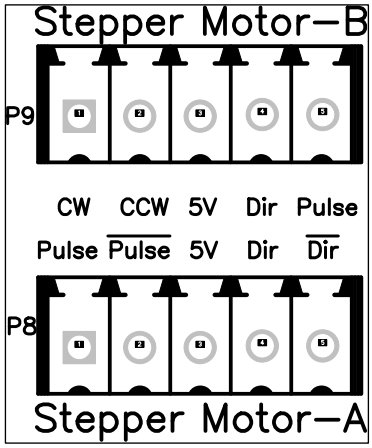
P3,P4- Analog output connectors
Mating connector: MC 1,5/3-ST-3,81 (Phoenix Contact)
Provides analog output signal +/-10V.
Wiring according to the PCB printing.
Recommended cable: twisted and shielded pair.
The screening should be connected to the terminal labeled PE. (However in very disturbed environment recommended to connect it directly to the signal ground.)

P6,P7 – Encoder connectors
Mating connector: 15 pin D-Sub male connector
It receives signals of the incremental TTL encoder according to the following wiring:

1: Signal **A**
2: Ground of the supply (**GND**)
3: Signal $\overline{B}$
4: Signal **C**
5: Positive supply voltage (**5V**)
6:
7:
8:
9: Signal $\overline{\mathbf{A}}$
10: Signal **B**
11: Ground of the supply (**GND**)
12: Signal $\overline{C}$ jel
13:
14 Positive supply voltage (**5V**)
15:
screening: connector housing



P8,P9 Frequency output



Mating connector: MC 1,5/5-ST-3,81 (Phoenix Contact)
It provides output and direction of rotation signals and their inverted values.
Wiring according to the sign on the bottom (Pulse $\overline{\text{Pulse}}$ 5V Dir $\overline{\text{Dir}}$)
(Outputs are open-collector types, so a pull-up resistor should be connected between the output and 5V - normally 6k8.)
The maximum output frequency is:200kHz

P5,P10 For service purposes

Used data fields and bits

SpeedSetValue
Used bits are: SSV_23 – SSV_4 (20 bit)
Two's complement form of the signed integer.
ControlDword
ErrorClear
ZpulseRequest

ActPos
lower 32 bits of the current position (POS_31-POS_0)
upper 32 bits of the position of the zero pulse (POS_63-POS_32)
StatusDword
Abs/Incr
ZpulseAck
ErrClearAck
VN_15-VN_0
ErrorDword
UnitErrors
EncoderErr
EcatWatchDog
TimeStamp

Operation:
This unit can receive 2 channels of TTL encoder. It has two channels for analog output and two channels for frequency output, that means four reference signals can be handled via data fields.

3. IO moduls ENDAT and TTLCAN

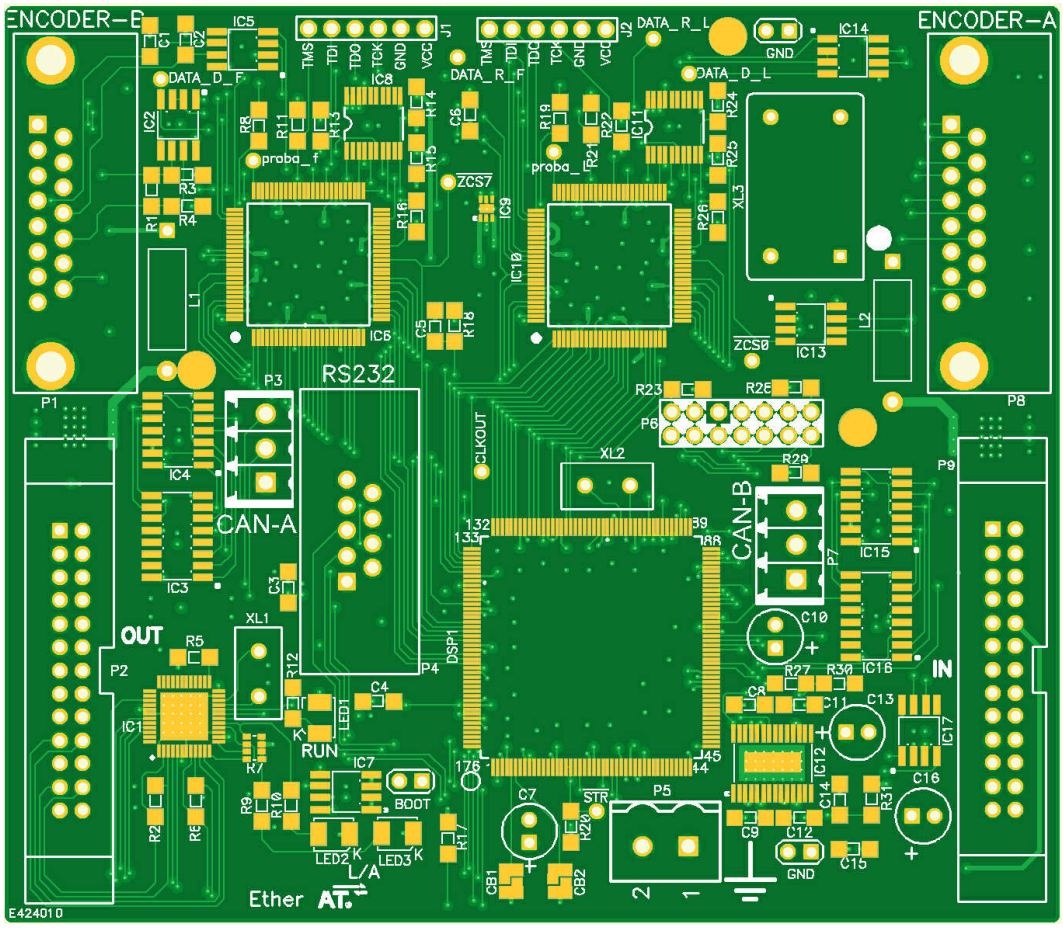


Fig. 2. Unassembled PCB ECAT-ENDAT_00 (ENDAT and TTLCAN)

3.1. ENDAT module

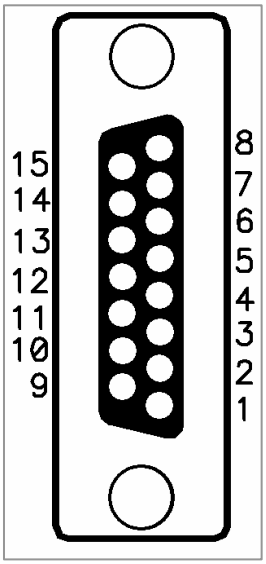
Name in the XML	Name of PCB	Label	Software
ECAT-ENDAT	ECAT-ENDAT_00	ECAT-ENDAT 1.4	ECAT-ENDAT 1.4
0x13/0x02 19/2	ECAT-ENDAT_01		

Connectors:
P5- Signal ground connector
Mating connector: MSTB 2,5/2-ST-5,08 (Phoenix Contact)
Both pins of the connector have the same potential on the PCB.
This pin should be connected in case of noise problems only. Otherwise it can be leaved unconnected (safety grounding is unnecessary due to low voltage). Overall noise protection can be improved by connection of this pin in case of the noise problems in the another EtherCAT units. Sometimes the connection of this pin can cause noise (in case of noise groinding network). This pin can be connected to the safety grounding if there is no separate signal groiunding in the system.

P2.P9- EtherCAT input and output connector
Mating connector: 26-pin ribbon cable connector.
This is for the EtherCAT data sream and for supply voltage of the unit.

P1,P8 – Encoder connectors
Mating connector: 15 pin D-Sub male connector
It receives signals of the incremental TTL encoder according to the following wiring:

1:
2: Ground of the supply (**GND**)
3:
4: **C**lock
5: Positive supply voltage (**5V**)
6:
7:
8:
9:
10:
11: Ground of the supply (**GND**)
12: $\overline{\text{Clock}}$
13: $\overline{\text{Data}}$
14 Positive supply voltage (**5V**)
15: Data
screening: connector housing



P3,P7 Inactive

P4,P6,J1,J2 For service purposes

Used data fields and bits

ControlDword
ErrorClear

ActPos
The full 64-bit field shows the position

StatusDword
Abs/Incr
ErrClearAck
VN_15-VN_0

ErrorDword
UnitErrors
EncoderErr
EcatWatchDog

TimeStamp

Operation:
This unit is suitable for two encoders EnDat 2.2.

3.2. TTLCAN module

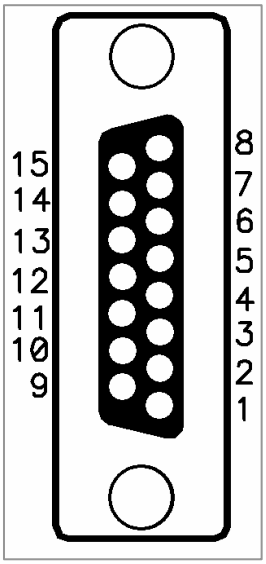
Name in the XML	Name of PCB	Label	Software
ECAT-CAN	ECAT-ENDAT_00	ECAT-CAN 1.5	ECAT-CAN 1.5
0x12/0x03 18/3	ECAT-ENDAT_01		

Connectors:
P5- Signal ground connector
Mating connector: MSTB 2,5/2-ST-5,08 (Phoenix Contact)
Both pins of the connector have the same potential on the PCB.
This pin should be connected in case of noise problems only. Otherwise it can be leaved unconnected (safety grounding is unnecessary due to low voltage). Overall noise protection can be improved by connection of this pin in case of the noise problems in the another EtherCAT units. Sometimes the connection of this pin can cause noise (in case of noise groinding network). This pin can be connected to the safety grounding if there is no separate signal groiunding in the system.

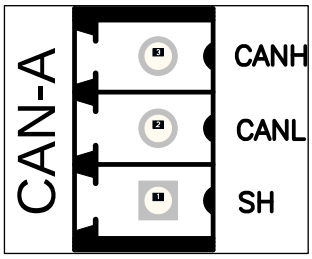
P2.P9- EtherCAT input and output connectors
Mating connector: 26-pin ribbon cable connector.
This is for the EtherCAT data sream and for supply voltage of the unit.

P1,P8 – Encoder connectors
Mating connector: 15 pin D-Sub male connector
It receives signals of the incremental TTL encoder according to the following wiring:

1: Signal **A**
2: Ground of the supply (**GND**)
3: Signal $\overline{B}$
4: Signal **C**
5: Positive supply voltage (**5V**)
6:
7:
8:
9: Signal $\overline{\mathbf{A}}$
10: Signal **B**
11: Ground of the supply (**GND**)
12: Signal $\overline{C}$ jel
13:
14 Positive supply voltage (**5V**)
15:
screening: connector housing



P3,P7 CAN connector



Mating connector: MC 1,5/3-ST-3,81 (Phoenix Contact)
Recommended wire: twisted and shielded pair with 120 Ohm terminating resistor between CANH and CANL.
Screening should be connected to the pin SH. (However in very disturbed environment recommended to connect it directly to the signal ground.)

P4,P6,J1,J2 For service purposes

Used data fields and bits

SpeedSetValue
Used bits are: SSV_23 – SSV_0 (24 bit)
Two's complement form of the signed integer.
ControlDword
ErrorClear
ZpulseRequest

ActPos
lower 32 bits of the current position (POS_31-POS_0)
upper 32 bits of the position of the zero pulse (POS_63-POS_32)
StatusDword
Abs/Incr
ZpulseAck
ErrClearAck
VN_15-VN_0
ErrorDword
UnitErrors
EncoderErr
EcatWatchDog
TimeStamp
Message Code
Only code „2" is valid
Message Data
Relative current of the motor (I/In) %, shown as 32 bit floating point number.

This unit is suitable for receieving 2 channel TTL encoder and CAN input and output.
It can be used for Servoamplifires produced by NCT kft (DA..-D, DS..-D).
CAN connectors are sending and receiving data by two CAN addresses (labelled „1" and „2").
Communication with servoamplifiers can be handled by both („CAN-A" and „CAN-B") connectors on both adresses.
(Important: field „CAN Auto Answer" should contain number „2" in both parameter tables of the drives).

4. IO modul DANI

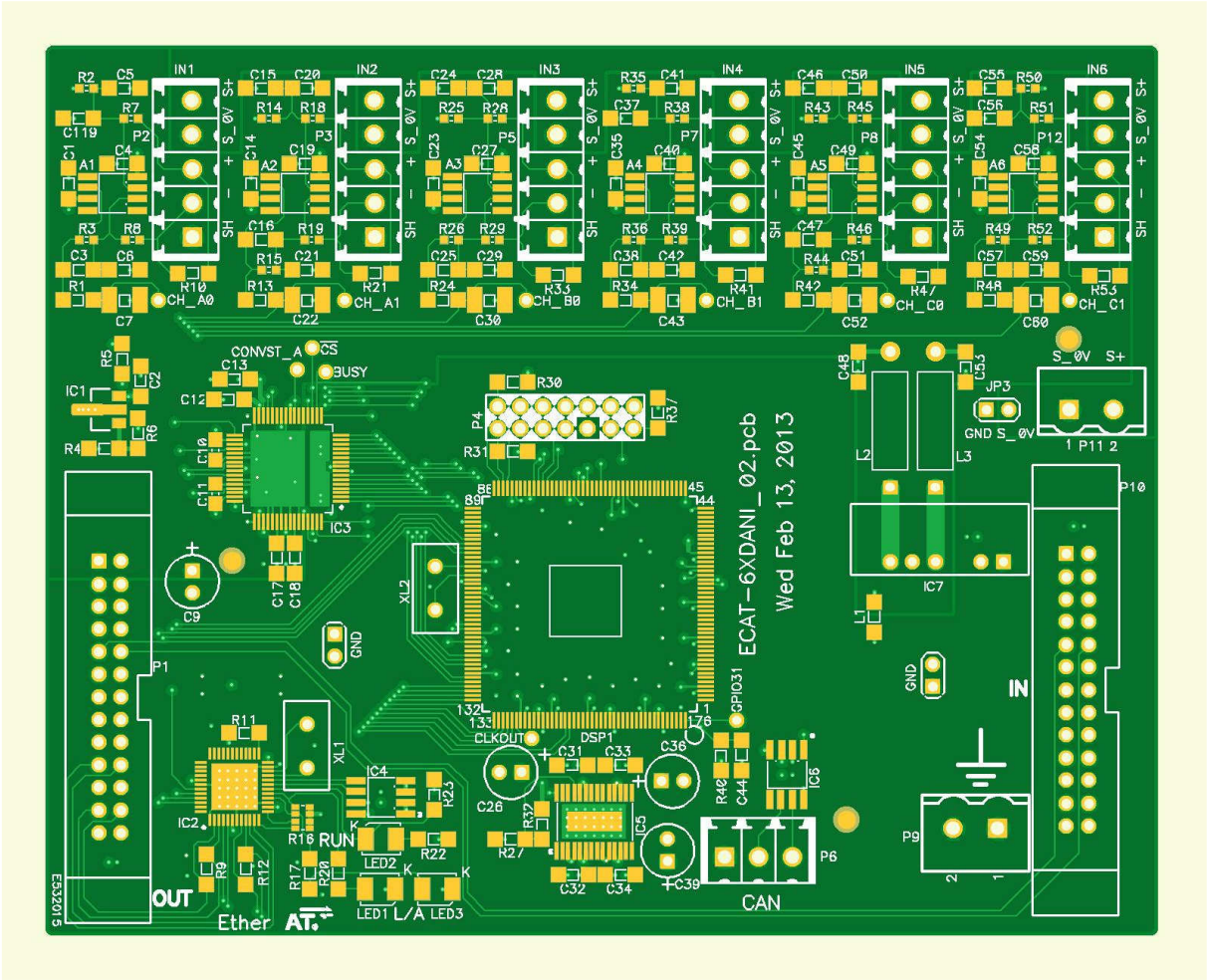


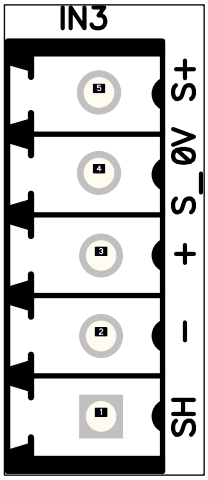
Fig. 3. Unassembled PCB ECAT-6XDANI_02 (DANI)

Name in XML	Name of PCB	Label	Software
DANI	ECAT-6XDANI_01	ECAT-6XDANI 16bit 1.3	ECAT-6XDANI_16bit_1.3
0x10/0x00 16/0	ECAT-6XDANI_02		

Connectors:
P9- Signal ground connector
Mating connector: MSTB 2,5/2-ST-5,08 (Phoenix Contact)
Both pins of the connector have the same potential on the PCB.
This pin should be connected in case of noise problems only. Otherwise it can be leaved unconnected (safety grounding is unnecessary due to low voltage). Overall noise protection can be improved by connection of this pin in case of the noise problems in the another EtherCAT units. Sometimes the connection of this pin can cause noise (in case of noise groinding network). This pin can be connected to the safety grounding if there is no separate signal groiunding in the system.

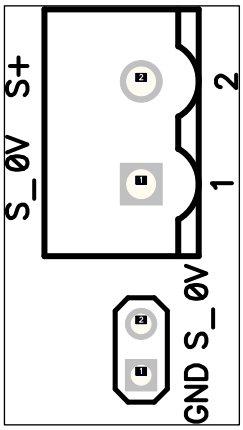
P1.P10- EtherCAT input and output connectors
Mating connector: 26-pin ribbon cable connector.
This is for the EtherCAT data sream and for supply voltage of the unit.

P2,P3,P5,P7,P8,P12 Analog input connectors



Mating connector: MC 1,5/5-ST-3,81 (Phoenix Contact)
Receives input analog signal +/-10V.
Wiring according to the PCB printing. (S_0V, S+ provide supply voltage for measuring system)
For the analog signals (+ -) a twisted and shielded pair wire is recommended.
Screening should be connected to the pin SH. (However in very disturbed environment recommended to connect it directly to the signal ground.)

P11 Supply voltage connection for the measuring system



Mating connector: MSTB 2,5/2-ST-5,08 (Phoenix Contact)
This connector is for the supply voltage required by the measuring system.
This supply voltage appears ont he points of the PCB with the same label.
Shortening the jumper JP3 you can connect the 0 V of the supply voltage to the inside GND of the unit.
The maximal voltage is: 48V

P6 inactive

P7 for service purposes

Used data fields and bits

EcatControlWord
Analogxx
EcatStatusWord

Operation:

Signals of the six analog connectors (+/-10V) received by differential amplifiers.
Digital values of these amplifiers are sent to the CNC.
The strong noise signals are stored int he data field EcatStatusWord.
If this number is big enough, that means the noise protection of the system should be improved. The maximum frequency handled by the unit is 1 kHz.