

MR-J3-□A-RJ158 + MR-J3-T04 (EtherCAT Servo) Trouble Shooting Guideline (Document for oversea sales office)

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1. EtherCAT related alarms and counteraction

EtherCAT communication with MR-J3-A-RJ158 related alarms and counter actions are shown in the below table.

AL name	AL No. - detail-bit	Content	Cause	Action
Home position Setting error	26-0	Position is out of in-position range, at 1 s after home setting (C_CR, C_CR2) or 10 s after homing (hm).	In-position, control gain, the acceleration /deceleration time constant or torque limit setting is out of range of.	Re-check the settings of, In-position range (PA10, Position window (6067h)), control gain (PB07,PB08)、 acceleration /deceleration time constant (Homing acceleration (609Ah)), torque limit settings (PA11,PA12,PC35,Positive torque limit value(60E0h), Negative torque limit value (60E1h)).
			C_CR, C_CR_2 is executed during position control mode.	After the update of a position command is stopped, execute C_CR and C_CR_2.
			If motor axis is rotated by an external force	Re-check the motor set up.
	26-1	Model speed command is not 0 [r/min], at 1 s after home setting (C_CR, C_CR2) or 10 s after homing (hm).	(same as 26-0)	(same as 26-0)
26-2	Home position set during servo off.	Dog signal turned on during servo off.	After Controlword=000Fh is set and make servo-on, proceed the homing.	
26-3	—	—	—	

	26-4	Before Z-phase is passed, the C_CR2 bit turned on.	Z-phase position is unknown because Z-phase was not passed, yet.	Re-check the driving pattern. Once the Z-phase is passed, C_CR2 turns on. ---> Refer to the EtherCAT specification chapter 8.11.4.
Receive error 1	34-0	Continuous irregularity of the incremental counter (After 6-7ms continuous irregularity, Alarm will occur)	Irregular synchronization	Re-check the synchronous setting of the controller and the amplifier ---> Refer to the EtherCAT specification chapter 8.2.3 * If network structure is changed by broken cable etc during PDO communication, all axis have possibility to have receiving failure due to inappropriate communication timing.
			Irregular PDO communication	Re-check the controller and the amplifier PDO communication cycle setting.
			Improper setting of PDO mapping	Re-check the setting of controller and the amplifier PDO mapping
			The incremental counter value, transmitted by the controller is improper.	Re-check the controller's process Specification) Incremental counter is 1 plus last time value at every cycle of PDO communication.
	34-1	Intermittent irregularity of the incremental counter (more than 102 irregular counts in 1024ms)	(same as 34-0)	(same as 34-0)
	34-2	Continuous RxPDO data corrupt (6-7ms continuousness alarms detection)	During the same PDO cycle, Controlword and Controlword2 value is read twice. But the result is different.	The amplifier's data bus access is improper. Re-check the connection between the amplifier and the option unit. Counter measure noise impact.
	34-3	Intermittent RxPDO data corrupt (more than 102 irregular counts in 1024ms)	(same as 34-2)	(same as 34-2)

Command frequency alarm	35-0	—	—	—
	35-1	Irregular F Δ T command frequency	When the motor maximum rotation speed's frequency is more than 2.4 times and inputted by the command refresh cycle time's sampling with more than 10 counts, it can be only detected during servo on.	The command position mismatches the current position. Re-check the driving pattern *Before servo on or MSTOP cancel, set current position to command position.
Receive error 2	36-0	PDO reception is continuously irregular. (RxPDO data does not arrived with regular timing.) (6-7ms continuousness alarms detection)	Disconnection/improper connection of EtherCAT cable.	Re-check the EtherCAT cable connection. Change the cable.
			Interferences caused by noise.	Counter measure noise impact.
			PDO communication failure	Improper controller communication process timing. The communication conflict between controller and amplifier occurred. Re-check the PDO communication cycle setting of the controller and the amplifier.
	36-1	intermittent irregular PDO reception. (RxPDO data does not arrived with regular timing) (more than 102 irregular counts in 1024ms)	Wrong reception caused by noise.	Counter measure noise impact.
			PDO communication failure	Improper controller communication process timing. The communication conflict between controller and amplifier occurred. Re-check the PDO communication cycle setting of the controller and the amplifier.
			Irregular Synchronization	Re-check the synchronization setting of the controller and the amplifier.

Parameter error	37-0	The parameter setting value is out of range.	Wrong parameter Value is written, due to a servo amplifier failure.	Change the servo amplifier.
			Wrong setting of Parameter No. PA02. The regenerative option was selected, which is not possible.	Select the correct Value in parameter No.PA02.
			The No. of EEP-ROM writing exceeds 100,000 times.	Replace the servo amplifier.
	37-1	Wrong parameter combination.	When incremental counter error detection is valid at asynchronous mode, amplifier is started.	Set to synchronous mode (Po02=□□□0h). Or cancel the incremental counter error detection function (PO03=***0h).
Operation error	61-0	The operational state is missed during runtime.	During operation (Operational state) AL state change request was received from the controller (excluding the Operational state).	After the operation starts, changes are prohibited excluding Operational state. When the operation is ended, follow the power supply shut off sequence (Refer to product specifications 4.4). After FSA "state ready to switch on" is valid and AL state "Safe Operational" is changed, AL.34, 36, 61, 74 will not occur. Than the AI state can be changed.
	61-1	Switching to operational state after power supply shut off sequence.	After switching to "Safe operational state" at power supply shut off sequence, receiving again the change request to "Operational state".	After the power supply shut off sequence is done and the operation starts again, cycle power the amplifier.

Option card error	74-0	Option unit is not correctly detected during start up.	Improper connection of option unit.	Re-check whether the option unit is installed correctly.
			Option unit is defect.	Replace the option unit.
	74-1	netX starting failure (Detection during start up)	Improper connection of option unit.	Re-check whether the option unit is installed correctly.
			Option unit (netX) is defect	Replace the option unit.
	74-2	netX RUN status failure (Detection after start up)	Improper connection of option unit.	Re-check whether the option unit is installed correctly.
			Option unit (netX) is defect	Replace the option unit.
	74-3	The CPU<-->netX watchdog failure. (Detection after start up)	netX is out of control or freeze	Counter measure noise impact. □ When CPU is out of control, the RxPDO command is invalid.
			Improper connection of option unit.	Re-check whether the option unit is installed correctly.
			Option unit (netX) is defect	Replace the option unit.
	74-4	The netX access failure.	Improper connection of option unit.	Re-check whether the option unit is installed correctly.
			Option unit (netX) is defect	Replace the option unit.
	Synchronization error	76-0	Synchronization failure during PDO communication (Only detected during synchronous mode)	Improper Synchronization
Irregular EtherCAT communication				Counter measure noise impact. Re-check the EtherCAT cable connection.
Interferences caused by noise.				Counter measure noise impact.
Improper connection of option unit.				Re-check whether the option unit is installed correctly.
Option unit (netX) is defect				Replace the option unit.

	76-1	SYNC1 signal cycle failure (detection after synchronization is established)	Improper Synchronization	Re-check the synchronization setting of the controller and the amplifier.
			Improper EtherCAT communication	Re-check the EtherCAT cable connection. Counter measure noise impact.
			Interferences caused by noise.	Counter measure noise impact.
			Improper connection of option unit.	Re-check whether the option unit is installed correctly.
			Option unit (netX) is defect	Replace the option unit.
	76-2	Mismatch of the CPU, FPGA, ASIC timing counter.	Interferences caused by noise.	Counter measure noise impact.
			Improper connection of option unit.	Re-check whether the option unit is installed correctly.
			Option unit (netX) is defect	Replace the option unit.
Home position return incomplete	90-0	Homing was interrupted.	The deceleration to the creep speed was not proceeded.	Re-check the home position return speed/creep speed/dog signal settings and the limit switch settings.
			LSN was reached during Homing method-1	
			LSP was reached during Homing method-17	
	90-1	—	—	—
	90-2	—	—	—
90-3	Unsupported home position method selection.	As for the "Homing method (6098h)" do not set other values than 0, -1, -17, or 35, otherwise homing can not be proceeded.	After setting 0 -1,-17 or 35 for the "Homing method", homing can start (Controlword bit4=1) * When Homing method=0 and Homing started AL90 will not occur, but Statusword bit13=1 is set (Homing error).	

Home position setting warnings	96-0	(same as AL.26)	(same as AL.26)	(same as AL.26)
	96-1	(same as AL.26)	(same as AL.26)	(same as AL.26)
	96-2	(same as AL.26)	(same as AL.26)	(same as AL.26)
	96-3	(same as AL.26)	(same as AL.26)	(same as AL.26)
	96-4	(same as AL.26)	(same as AL.26)	(same as AL.26)
Main circuit off warning	E9-0	Servo on command is sent during the contactor off.	“Enable operation” command is used during the main circuit is off.	Turn on the main circuit’s power supply.
	E9-1	Voltage drop at the main circuit’s converter	During servo on the voltage of the main circuit converter has decreased while the motor is rotating by 50 rpm or less.	
	E9-2	Ready on command during voltage drop.	“Switch on” command during voltage drop at the main circuit’s converter.	
	E9-3	—	—	—

Note: “—” means that this bit is not assigned at MR-J3-□A-RJ158 + MR-J3-T04.

2. Point of EtherCAT Packet Analysis

EtherCAT packet analysis during communication is helpful for factor analysis of operation failure due to PDO communication or synchronization setting error etc. In this chapter, we explain the point of EtherCAT packet analysis which use Wireshark (Ethernet packet capturing freeware).

* Precondition: Controller has basic function including PDO communication, and can send/receive at least EtherCAT packet.

This packet analysis is useful for the following case.

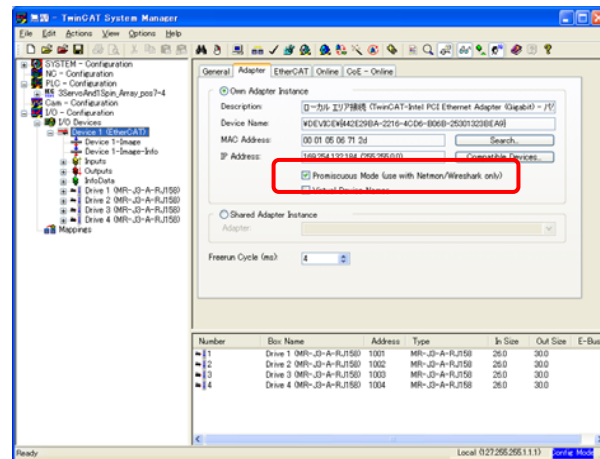
Received/sent PDO data some portion is incorrect.

Hope to know which side has failure, controller command incorrect or amplifier malfunction.

Sometimes sending/receiving PDO lose out. (No update the received/sent data. Data is drop out. etc)

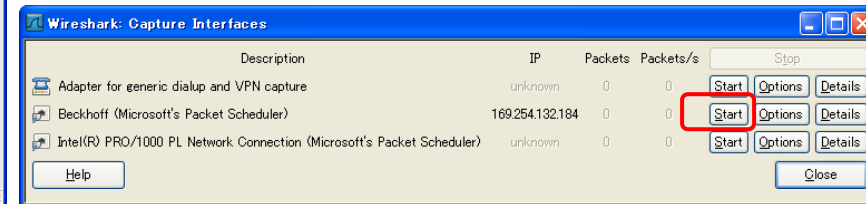
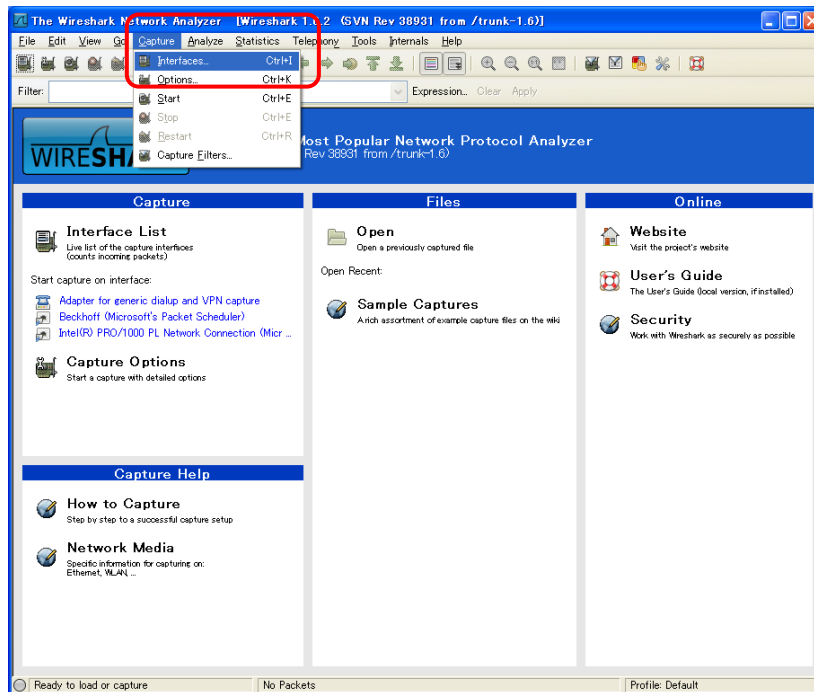
2.1 Notice to use Wireshark

In order to get packet by Wireshark, please make sure to select “Promiscuous Mode” in TwinCAT System Manager.

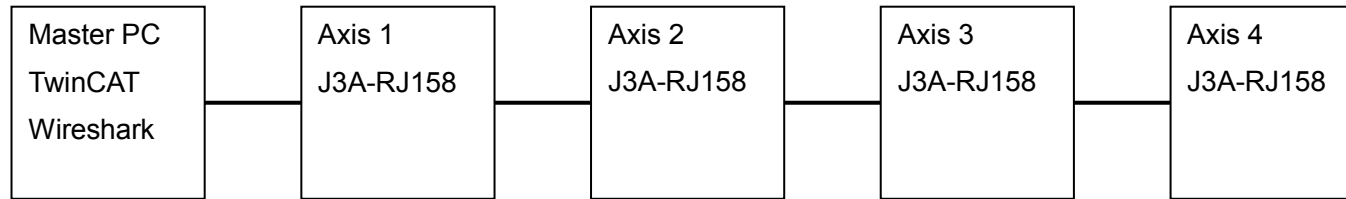


Before start capture, please select “[Capture] – [Interfaces].” Then, please select the Network interface for the target log data.

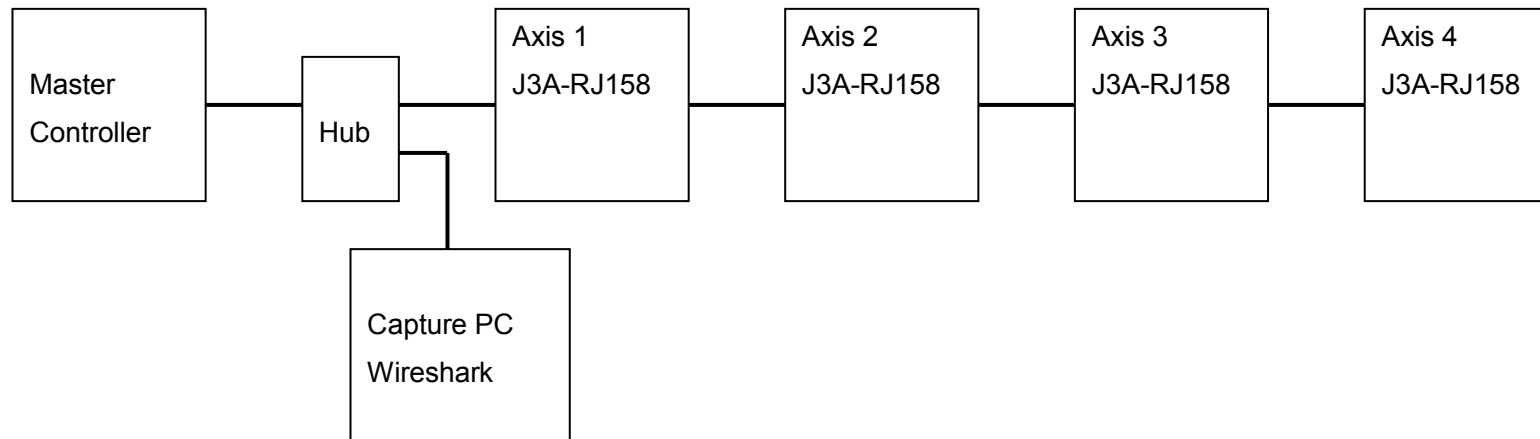
Right bottom window is example in case of Beckhoff LAN card is used for EtherCAT communication at PC which has Beckhoff FC9011 LAN card and Intel embedded LAN adapter.



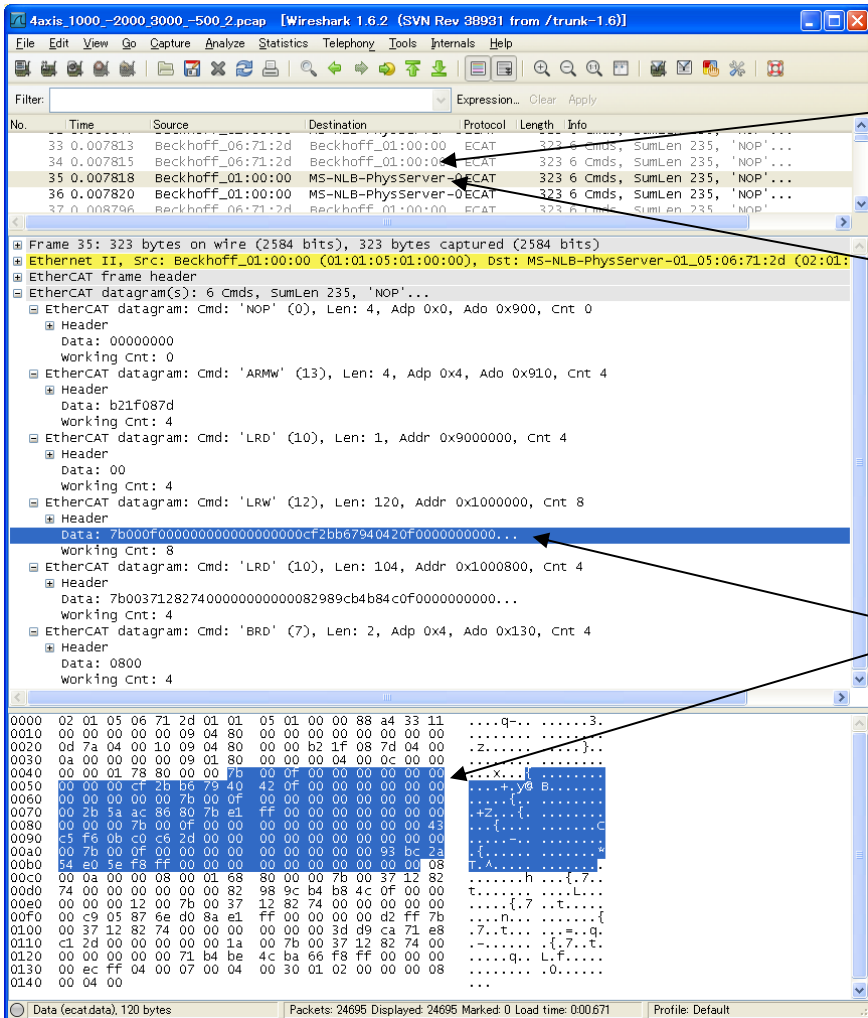
From this page, here is capture example in case of 4 axes servo with PC which has TwinCAT and Wireshark.



If Wireshark can not be installed to master controller, alternative idea is to install Wireshark into other PC which is connected to system via hub. (This is inappropriate method for strict timing investigation, because there is a hub in communication path.)



Reading Instruction of EtherCAT Packet (RxPDO)



Downstream packet
(Master ----> slave)

Upstream packet
(Slave ----> master)

Select RxPDO data

Case of 4 axis.
Using a default setting of PDO mapping.

This log data are in case of "RxPDO is sent by LRW command, and TxPDO is sent by LRD command.

Downstream packet: Only command data (RxPDO) is inserted. TxPDO data area has zero.

Upstream packet: Command ((RxPDO) and F/B(TxPDO) are inserted.

```

0000 02 01 05 06 71 2d 01 01 05 01 00 00 88 a4 33 11
0010 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0020 0d 7a 04 08 7d 04 00 00 00 00 00 00 00 00 00
0030 0a 00 00 00 00 09 01 80 00 00 00 04 00 0c 00 00
0040 00 00 01 78 80 00 00 7b 00 0f 00 00 00 00 00 00
0050 00 00 00 cf 2b b6 79 40 42 0f 00 00 00 00 00 00
0060 00 00 00 00 00 7b 00 0f 00 00 00 00 00 00 00 00
0070 00 2b 5a ac 86 80 7b e1 ff 00 00 00 00 00 00 00
0080 00 00 00 7b 00 0f 00 00 00 00 00 00 00 00 43
0090 c5 f6 0b c0 c6 2d 00 00 00 00 00 00 00 00 00 00
00a0 00 7b 00 0f 00 00 00 00 00 00 00 00 93 bc 2a
00b0 54 e0 5e f8 ff 00 00 00 00 00 00 00 00 00 00 08
00c0 00 0a 00 00 00 01 68 80 00 00 7b 00 37 12 82
00d0 74 00 00 00 00 00 82 98 9c b4 b8 4c 0f 00 00
00e0 00 00 00 12 00 7b 00 37 12 82 74 00 00 00 00 00
00f0 00 c9 05 87 6e d0 8a e1 ff 00 00 00 d2 ff 7b
0100 00 37 12 82 74 00 00 00 00 00 3d d9 ca 71 e8
0110 c1 2d 00 00 00 00 1a 00 7b 00 37 12 82 74 00
0120 00 00 00 00 00 71 b4 be 4c ba 66 f8 ff 00 00 00
0130 00 ec ff 04 00 07 00 04 00 30 01 02 00 00 00 08
0140 00 04 00

```

Zoom-in of RxPDO data

Axis 1
Axis 2
Axis 3
Axis 4

Incremental counter(RxPDO)
Controlword
Controlword2
Target velocity

Main Check Point of RxPDO Data

Object	Command (Axis 4)	Check Point
Incremental counter(RxPDO)	7Bh	"7Bh" is sent to all axis. (Soon before/after is "7Ah" & "7Ch".) --- > Sending data from controller is updated correctly.
Controlword	000Fh	Enable Operation command is sent. ---> Under servo on.
Controlword2	0000h	No selected function
Target velocity	FFF85EE0h	Speed command of -500r/min

* We recommend user to implement incremental counter at controller side, because synchronization failure etc can be detected.

Object data are put with order from first axis to termination axis.
Command data for each axis are put with order of PDO mapping.
However, rear side byte is high digit data due to little endian as object data.
Example) Axis 4's Target velocity FFF85EE0h=-500000 (-500r/min)

When you check RxPDO data, it is possible to confirm if controller side correctly send the command.

Reading Instruction of EtherCAT Packet (TxPDO)

The screenshot shows a Wireshark capture of an EtherCAT packet. The packet list pane at the top shows several ECAT packets. Packet 35 is selected, and its details are shown in the packet details pane. The Ethernet II header shows the source as Beckhoff_01:00:00 and the destination as MS-NLB-PhysServer-01:05:06:71:2d. The EtherCAT frame header shows 6 commands. The packet bytes pane at the bottom shows the raw data of the TxPDO, starting with 0000 02 01 05 06 71 2d 01 01 05 01 00 00 88 a4 33 11.

Upstream packet (Slave ---> Master)

Select TxPDO data

```

0000 02 01 05 06 71 2d 01 01 05 01 00 00 88 a4 33 11
0010 00 00 00 00 00 08 04 80 00 00 00 00 00 00 00
0020 0d 7a 04 00 00 00 00 00 00 00 00 00 00 00 00
0030 0a 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0040 00 00 01 78 80 00 00 7b 00 0f 00 00 00 00 00
0050 00 00 00 cf 2b b6 79 40 42 0f 00 00 00 00 00
0060 00 00 00 00 00 7b 00 0f 00 00 00 00 00 00 00
0070 00 2b 5a ac 86 80 7b e1 ff 00 00 00 00 00 00
0080 00 00 00 7b 00 0f 00 00 00 00 00 00 00 00 43
0090 c5 f6 0b c0 c6 2d 00 00 00 00 00 00 00 00 00
00a0 00 7b 00 0f 00 00 00 00 00 00 00 00 93 bc 2a
00b0 54 e0 5e f8 ff 00 00 00 00 00 00 00 00 00 08
00c0 00 0a 00 00 08 00 01 68 80 00 00 7b 00 37 12 82
00d0 74 00 00 00 00 00 00 82 98 9c b4 b8 4c 0f 00 00
00e0 00 00 00 12 00 7b 00 37 12 82 74 00 00 00 00 00
00f0 00 c9 05 87 6e d0 8a e1 ff 00 00 00 00 d2 ff 7b
0100 00 37 12 82 74 00 00 00 00 00 00 3d d9 ca 71 e8
0110 c1 2d 00 00 00 00 00 1a 00 7b 00 37 12 82 74 00
0120 00 00 00 00 00 71 b4 be 4c ba 66 T8 TT 00 00 00
0130 00 ec ff 04 00 87 00 04 00 30 01 02 00 00 00 08
0140 00 04 00

```

Zoom-in of TxPDO data

- Axis 1
- Axis 2
- Axis 3
- Axis 4

Incremental counter (TxPDO)

Position actual value

Statusword

Statusword2

Velocity actual value

Object data are put in display with order from first axis to termination axis.
 F/B data of each axis are put with order of PDO mapping. However, rear side byte is high digit data due to little endian.

Example) Axis 4's Velocity actual value FFF866BAh=-497990 (-497.99r/min)

When you check TxPDO data, it is possible to confirm if amplifier side correctly execute the receiving controller command ~ reply F/B.

Main Check Point of TxPDO Data

Object	F/BValue (Axis 4)	Check Point
Incremental counter(TxPDO)	7Bh	All axis sent "7Bh". (Note. 7Ah (Received data in last cycle) +1) ---> It means that all axis received "7Ah" from controller in last cycle, and all axis succeeded to set "7Bh". i.e. Amplifier correctly executed the process from receiving data to setting F/B value with correct timing.
Statusword	1237h	bit14=bit8=bit6=bit3=0, bit5=bit2=bit1=bit0=1 (It means that FSA state is Operation enabled. ---> Under servo-on) bit9 (RM)=1 (Under the operation with complying Controlword.) bit12 (Target velocity ignored)=1 (Under the controlling motor by using Target velocity for speed control loop input)
Statusword2	7482h	bit1(S_SA)=1 (Speed reached) bit7(S_ZPAS)=1 (Z phase has been passed.) bit10(S_MBR)=1 (Electromagnetic brake interlock invalid) bit12(S_LSP)=1 (LSP=ON) bit13(S_LSN)=1 (LSN=ON) bit14(S_SYNC)=1 (Synchronous check flag (1= Synchronization completed between amplifier and option unit)
Position actual value	4CBEB471h	Current position=1287566449 (CYC=4911, ABS=177265, 18bit Encoder using)
Velocity actual value	FFF866BAh	Current speed= -497.99r/min (Under the motor rotating at approx -500r/min)