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DYNAMIXEL Protocol 2.0

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1. Introduction

- DYNAMIXEL Protocol 2.0 supported devices: MX-28, MX-64, MX-106, X Series (2X Series included), PRO Series, P Series.
- DYNAMIXEL Protocol 2.0 supported controllers: CM-50, CM-150, CM-200, OpenCM7.0, OpenCM9.04, CM-550, OpenCR
- Other: 2.0 protocol from R+ Smart app, DYNAMIXEL Wizard 2.0

TIP : See DYNAMIXEL Protocol [Compatibility Table](#).

NOTE: MX(2.0) is a special firmware for the DYNAMIXEL MX series supporting the DYNAMIXEL Protocol 2.0. The MX(2.0) firmware can be upgraded from the Protocol 1.0 by using the [Firmware Recovery](#) in DYNAMIXEL Wizard 2.0.

2. Instruction Packet

Instruction Packet is the command packet sent to the Device.

Header 1	Header 2	Header 3	Reserved	Packet ID	Length 1	Length 2	Instruction	Param	Param	Param	CRC 1	CRC 2
0xFF	0xFF	0xFD	0x00	ID	Len_L	Len_H	Instruction	Param 1	...	Param N	CRC_L	CRC_H

2. 1. Header

The field that indicates the start of the Packet

2. 2. Reserved

Uses 0x00 (Note that Reserved does not use 0xFD). The Reserved functions the same as [Header](#).



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See the next image of a table of the [Packet Details](#) of [the DYNAMIXEL Wizard 2.0](#), which shows that the Reserved (0x00) are included in the Header field.

Header				ID	Length		Inst	Param			CRC	
FF	FF	FD	00	01	06	00	03	40	00	01	DB	66

A table of Packet Details of DYNAMIXEL Wizard 2.0

2. 3. Packet ID

The field that indicates an ID of the device that should receive the Instruction Packet and process it

1. Range : 0 ~ 252 (0x00 ~ 0xFC), which is a total of 253 numbers that can be used
2. Broadcast ID : 254 (0xFE), which makes all connected devices execute the Instruction Packet

WARNING: Be sure that Broadcast ID(254 (0xFE)) return [Status Packet](#) for [Ping](#), [Sync Read](#) and [Bulk Read](#) only, other [Instruction] aside from [Ping](#), [Sync Read](#) and [Bulk Read](#) will not return Status Packet to Broadcast ID.

2. 4. Length

The field that indicates the length of packet field.

1. Devided into low and high bytes in the [Instruction Packet](#)
2. The Length indicates the Byte size of Instruction, Parameters and CRC fields
 - $\text{Length} = \text{the number of Parameters} + 3$
 - [Status Packet](#) includes 1 byte length ERROR field's data.

2. 5. Instruction

The field that defines the type of commands.

Value	Instructions	Description
0x01	Ping	Instruction that checks whether the Packet has arrived to a device with the same ID as Packet ID
0x02	Read	Instruction to read data from the Device
0x03	Write	Instruction to write data on the Device



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Value	Instructions	Description
0x04	Reg Write	Instruction that registers the Instruction Packet to a standby status; Packet is later executed through the Action command
0x05	Action	Instruction that executes the Packet that was registered beforehand using Reg Write
0x06	Factory Reset	Instruction that resets the Control Table to its initial factory default settings
0x08	Reboot	Instruction to reboot the Device
0x10	Clear	Instruction to reset certain information
0x20	Control Table Backup	Instruction to store current Control Table status data to a Backup area or to restore EEPROM data.
0x55	Status(Return)	Return packet for the Instruction Packet
0x82	Sync Read	For multiple devices, Instruction to read data from the same Address with the same length at once
0x83	Sync Write	For multiple devices, Instruction to write data on the same Address with the same length at once
0x8A	Fast Sync Read	For multiple devices, Instruction to read data from the same Address with the same length at once
0x92	Bulk Read	For multiple devices, Instruction to read data from different Addresses with different lengths at once
0x93	Bulk Write	For multiple devices, Instruction to write data on different Addresses with different lengths at once
0x9A	Fast Bulk Read	For multiple devices, Instruction to read data from different Addresses with different lengths at once

2. 6. Parameters

1. As the auxiliary data field for Instruction, its purpose is different for each Instruction.
2. Method of expressing negative number data : This is different for each product, so please refer to the e-manual of the corresponding product.

2. 7. CRC

16bit CRC field which checks if the Packet has been damaged during communication.

1. Devided into low and high bytes in the [Instruction Packet](#)
2. Range of CRC calculation: From Header (FF FF FD 00) to Parameteres before CRC field in [Instruction](#)

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Packet

3. Calculating CRC and examples: [CRC Calculation](#)

3. Status Packet

Status Packet is the response packet transmitted from the device to a main controller. Note that it has the same construction as the Instruction Packet except the ERROR field is added.

Header 1	Header 2	Header 3	Reserved	Packet ID	Length 1	Length 2	Instruction	ERR	PARAM	PARAM	PARAM	CRC 1	CRC 2
0xFF	0xFF	0xFD	0x00	ID	Len_L	Len_H	Instruction	Error	Param 1	...	Param N	CRC_L	CRC_H

3. 1. Instruction

Instruction of the Status Packet is designated to 0x55 (Status)

3. 2. Error

The field that indicates the processing result of Instruction Packet

Bit 7 Bit 6 ~ Bit 0

Alert Error Number

- Alert : When there is some hard ware issue with the Device, this field is set as 1. Checking the Hardware error status value of the [Control Table](#) can indicate the cause of the problem.
- Error Number : When there has been an Error in the processing of the Instruction Packet.

Error Number	Error	Description
0x01	Result Fail	Failed to process the sent Instruction Packet
0x02	Instruction Error	Undefined Instruction has been used Action has been used without Reg Write
0x03	CRC Error	CRC of the sent Packet does not match

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Error Number	Error	Description
0x04	Data Range Error	Data to be written in the corresponding Address is outside the range of the minimum/maximum value
0x05	Data Length Error	Attempt to write Data that is shorter than the data length of the corresponding Address (ex: when you attempt to only use 2 bytes of a item that has been defined as 4 bytes)
0x06	Data Limit Error	Data to be written in the corresponding Address is outside of the Limit value
0x07	Access Error	Attempt to write a value in an Address that is Read Only or has not been defined Attempt to read a value in an Address that is Write Only or has not been defined Attempt to write a value in the ROM domain while in a state of Torque Enable(ROM Lock)

3. 3. Parameters

1. As the auxiliary data field for Instruction, its purpose is different for each Instruction.
2. Method of expressing negative number data : This is different for each product, so please refer to the e-manual of the corresponding product

3. 4. Response Policy

1. Broadcast ID(254 (0xFE)) is responded to [Ping](#), [Sync Read](#) and [Bulk Read](#) only. For instance, Broadcast ID is not responded to [Sync Write](#) and [Bulk Write](#) Instruction.
2. A response to Instruction can be determined depending on a value of Status Return Level in [Control Table](#). For more details, see the selectable value from Status Return Level in Control Table of the DYNAMIXEL in use.

4. Packet Process

4. 1. Processing Order of Transmission

1. Generate basic form of Packet and afterwards Byte Stuffing(0xFD)
 - Inspection range : Everything within the Instruction field to the Parameter field (not the CRC)
 - Processing method : When the pattern "0xFF 0xFF 0xFD" appears, add Byte Stuffing (0xFD) (If "0xFF 0xFF 0xFD" already exists, add a 0xFD to change it to "0xFF 0xFF 0xFD 0xFD")

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2. Length : Modify to Length with Byte Stuffing applied
3. CRC : Calculate CRC with Byte Stuffing applied

4. 2. Processing Order of Reception

1. Search for Header(0xFF 0xFF 0xFD) : Ignore the Byte Stuffing("0xFF 0xFF 0xFD 0xFD").
2. Packet ID : If Packet ID is valid, receive additional transmission the size of Length
3. CRC : Calculate with the received Packet with Byte Stuffing included, and once CRC is matched then remove Byte Stuffing

5. Instruction Details

Note that given examples use the following abbreviation to provide clear information.

- Header : H
- Reserved: RSRV
- Length: LEN
- Instruction: INST
- Error: ERR
- Param: P

5. 1. Ping (0x01)

5. 1. 1. Description

- Instruction to check the existence of a Device and basic information
- Regardless of the Status Return Level of the Device, the [Status Packet](#) is always sent to Ping Instruction.
- When the Packet ID field is 0xFE(Broadcast ID) : All devices send their Status Packet according to their arranged order.

5. 1. 2. Packet Parameters

NOTE : Status Packet is received from each Device.



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Status Packet	Description
Parameter 1	Model Number LSB
Parameter 2	Model Number MSB
Parameter 3	Version of Firmware

5. 1. 3. Example 1

5. 1. 3. 1. Conditions

- ID1(XM430-W210) : For Model Number 1030(0x0406), Version of Firmware 38(0x26)
- Instruction Packet ID : 1

5. 1. 3. 2. Ping Instruction Packet

H1	H2	H3	RSRV	Packet ID	LEN1	LEN2	INST	CRC 1	CRC 2
0xFF	0xFF	0xFD	0x00	0x01	0x03	0x00	0x01	0x19	0x4E

5. 1. 3. 3. ID 1 Status Packet

H1	H2	H3	RSRV	Packet ID	LEN1	LEN2	INST	ERR	P1	P2	P3	CRC 1	CRC 2
0xFF	0xFF	0xFD	0x00	0x01	0x07	0x00	0x55	0x00	0x06	0x04	0x26	0x65	0x5D

5. 1. 4. Example 2

5. 1. 4. 1. Conditions

- ID1(XM430-W210) : For Model Number 1030(0x0406), Version of Firmware 38(0x26)
- ID2(XM430-W210) : For Model Number 1030(0x0406), Version of Firmware 38(0x26)
- Instruction Packet ID : 254(Broadcast ID)

5. 1. 4. 2. Ping Instruction Packet

H1	H2	H3	RSRV	Packet ID	LEN1	LEN2	INST	CRC 1	CRC 2
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5. 2. Read (0x02)

H1	H2	H3	RSRV	Packet ID	LEN1	LEN2	INST	CRC 1	CRC 2
0xFF	0xFF	0xFD	0x00	0xFE	0x03	0x00	0x01	0x31	0x42

5. 1. 4. 3. ID 1 Status Packet

H1	H2	H3	RSRV	Packet ID	LEN1	LEN2	INST	ERR	P1	P2	P3	CRC 1	CRC 2
0xFF	0xFF	0xFD	0x00	0x01	0x07	0x00	0x55	0x00	0x06	0x04	0x26	0x65	0x5D

5. 1. 4. 4. ID 2 Status Packet

H1	H2	H3	RSRV	Packet ID	LEN1	LEN2	INST	ERR	P1	P2	P3	CRC 1	CRC 2
0xFF	0xFF	0xFD	0x00	0x02	0x07	0x00	0x55	0x00	0x06	0x04	0x26	0x6F	0x6D

5. 2. Read (0x02)

5. 2. 1. Description

- Instruction to read a value from [Control Table](#)
- Method of expressing negative number data : This is different for each product, so please refer to the e-manual of the corresponding product
- Read Instruction does not respond to Broadcast ID(254 (0xFE))

NOTE: If requesting the response for the excess range of its Control Table, the Status packet will fill [Access Error](#) in its error field, and return the packet with no parameters.

5. 2. 2. Packet Parameters

Instruction Packet	Description
Parameter 1	Low-order byte from the starting address
Parameter 2	High-order byte from the starting address
Parameter 3	Low-order byte from the data length (X)



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Instruction Packet	Description
Parameter 4	High-order byte from the data length (X)

Status Packet	Description
Parameter 1	First Byte
Parameter 2	Second Byte
...	...
Parameter X	X-th Byte

5. 2. 3. Example

5. 2. 3. 1. Conditions

- ID1(XM430-W210) : Present Position(132, 0x0084, 4[byte]) = 166(0x000000A6)

5. 2. 3. 2. Read Instruction Packet

H1	H2	H3	RSRV	Packet ID	LEN1	LEN2	INST	P1	P2	P3	P4	CRC 1	CRC 2
0xFF	0xFF	0xFD	0x00	0x01	0x07	0x00	0x02	0x84	0x00	0x04	0x00	0x1D	0x15

5. 2. 3. 3. ID 1 Status Packet

H1	H2	H3	RSRV	Packet ID	LEN1	LEN2	INST	ERR	P1	P2	P3	P4	CRC 1	CRC 2
0xFF	0xFF	0xFD	0x00	0x01	0x08	0x00	0x55	0x00	0xA6	0x00	0x00	0x00	0x8C	0xC0

5. 3. Write (0x03)

5. 3. 1. Description

- Instruction to write a value on the [Control Table](#)
- Method of expressing negative number data : This is different for each product, so please refer to the e-manual of the corresponding product



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5. 1. Ping (0x01)

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5. 3. 2. Packet Parameters

Instruction Packet	Description
Parameter 1	Low-order byte from the starting address
Parameter 2	High-order byte from the starting address
Parameter 2+1	First Byte
Parameter 2+2	Second Byte
...	...
Parameter 2+X	X-th Byte

5. 3. 3. Example

5. 3. 3. 1. Conditions

- ID1(XM430-W210) : Write 512(0x00000200) to Goal Position(116, 0x0074, 4[byte])

5. 3. 3. 2. Write Instruction Packet

H1	H2	H3	RSRV	Packet ID	LEN1	LEN2	INST	P1	P2	P3	P4	P5	P6	CRC 1	CRC 2
0xFF	0xFF	0xFD	0x00	0x01	0x09	0x00	0x03	0x74	0x00	0x00	0x02	0x00	0x00	0xCA	0x89

5. 3. 3. 3. ID 1 Status Packet

H1	H2	H3	RSRV	Packet ID	LEN1	LEN2	INST	ERR	CRC 1	CRC 2
0xFF	0xFF	0xFD	0x00	0x01	0x04	0x00	0x55	0x00	0xA1	0x0C

5. 4. Reg Write (0x04)

5. 4. 1. Description

- Instruction that is similar to Write Instruction, but has an improved synchronization characteristic
- Write Instruction is executed immediately when an Instruction Packet is received.



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5. Instruction Details

5. 1. Ping (0x01)

5. 2. Read (0x02)

- By using Reg Write and [Action](#) Instruction, one can operate multiple devices simultaneously.
- Reg Write Instruction registers the Instruction Packet to a standby status, and sets Control table Registered Instruction to '1'.
- When an Action Instruction is received, the registered Packet is executed, and sets [Control Table](#) Registered Instruction to '0'.

5. 4. 2. Packet Parameters

Instruction Packet		Description
Parameter 1	Low-order byte from the starting address	
Parameter 2	High-order byte from the starting address	
Parameter 2+1	First Byte	
Parameter 2+2	Second Byte	
...	...	
Parameter 2+X	X-th Byte	

5. 4. 3. Example

5. 4. 3. 1. Condition

- ID1(XM430-W210) : Write 200(0x000000C8) to Goal Velocity(104, 0x0068, 4[byte])

5. 4. 3. 2. Reg Write Instruction Packet

H1	H2	H3	RSRV	Packet ID	LEN1	LEN2	INST	P1	P2	P3	P4	P5	P6	CRC 1	CRC 2
0xFF	0xFF	0xFD	0x00	0x01	0x09	0x00	0x04	0x68	0x00	0xC8	0x00	0x00	0x00	0xAE	0x8E

5. 4. 3. 3. ID 1 Status Packet

H1	H2	H3	RSRV	Packet ID	LEN1	LEN2	INST	ERR	CRC 1	CRC 2
0xFF	0xFF	0xFD	0x00	0x01	0x04	0x00	0x55	0x00	0xA1	0x0C



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5. 5. Action (0x05)

5. 5. 1. Description

- Instruction that executes the Packet that has been registered using Reg Write Instruction
- When controlling multiple devices using Write Instruction, there will be a difference in the time of execution between the first device that receives the Packet and the last device that receives the Packet.
- By using Reg Write and Action Instruction, one can operate multiple devices simultaneously.

5. 5. 2. Example

5. 5. 2. 1. Condition

- ID1(XM430-W210) : Instruction has been already registered by the Reg Write Instruction.

5. 5. 2. 2. Action Instruction Packet

H1	H2	H3	RSRV	Packet ID	LEN1	LEN2	INST	CRC 1	CRC 2
0xFF	0xFF	0xFD	0x00	0x01	0x03	0x00	0x05	0x02	0xCE

5. 5. 2. 3. ID 1 Status Packet

H1	H2	H3	RSRV	Packet ID	LEN1	LEN2	INST	ERR	CRC 1	CRC 2
0xFF	0xFF	0xFD	0x00	0x01	0x04	0x00	0x55	0x00	0xA1	0x0C

5. 6. Factory Reset (0x06)

5. 6. 1. Description

- Instruction that resets the Control Table to its initial factory default settings.
- When Factory Reset (0x06) Instruction is performed, a device is rebooted and the LED blinks four times in a row.
- In case of when **Packet ID** is a Broadcast ID `0xFE` and **Option** is Reset All `0xFF`, Factory Reset Instruction(0x06) will **NOT** be activated.



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5. 1. Ping (0x01)

5. 2. Read (0x02)

- This feature is applied from MX(2.0) FW42, X-series FW42 or above.

5. 6. 2. Parameters

Instruction Packet	Description
Parameter 1	0xFF : Reset all
	0x01 : Reset all except ID
	0x02 : Reset all except ID and Baudrate

5. 6. 3. Example

5. 6. 3. 1. Conditions

- ID1(XM430-W210) : Apply reset with option 0x01(Reset all except ID)

5. 6. 3. 2. Factory Reset Instruction Packet

H1	H2	H3	RSRV	Packet ID	LEN1	LEN2	INST	P1	CRC 1	CRC 2
0xFF	0xFF	0xFD	0x00	0x01	0x04	0x00	0x06	0x01	0xA1	0xE6

5. 6. 3. 3. ID 1 Status Packet

H1	H2	H3	RSRV	Packet ID	LEN1	LEN2	INST	ERR	CRC 1	CRC 2
0xFF	0xFF	0xFD	0x00	0x01	0x04	0x00	0x55	0x00	0xA1	0x0C

5. 7. Reboot (0x08)

5. 7. 1. Description

- Instruction to reboot the device

5. 7. 2. Example

5. 7. 2. 1. Conditions

- ID1(XM430-W210)



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5. 7. 2. 2. Reboot Instruction Packet

H1	H2	H3	RSRV	Packet ID	LEN1	LEN2	INST	CRC 1	CRC 2
0xFF	0xFF	0xFD	0x00	0x01	0x03	0x00	0x08	0x2F	0x4E

5. 7. 2. 3. ID 1 Status Packet

H1	H2	H3	RSRV	Packet ID	LEN1	LEN2	INST	ERR	CRC 1	CRC 2
0xFF	0xFF	0xFD	0x00	0x01	0x04	0x00	0x55	0x00	0xA1	0x0C

5. 8. Clear (0x10)

5. 8. 1. Description

- This instruction resets certain information of DYNAMIXEL
- Applied Products : MX with DYNAMIXEL Protocol 2.0 (Firmware v42 or above), DYNAMIXEL-X series (Firmware v42 or above)

5. 8. 2. Parameters

P1	P2 ~ P5	Description
0x01	Fixed Values (0x44 0x58 0x4C 0x22)	Reset the Present Position value to an absolute value within one rotation (0-4095). The Clear instruction can only be applied when DYNAMIXEL is stopped. Note that if DYNAMIXEL is in motion and the Clear Instruction packet is sent, Result Fail (0x01) will be sent via the Error field of the Status Packet.
0x02	-	Reserved
...	-	Reserved
0xFF	-	Reserved

5. 8. 3. Example

5. 8. 3. 1. Conditions

- ID1(XM430-W210) : Resets multi turn revolution information

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5. 8. 3. 2. Clear Instruction Packet

H1	H2	H3	RSRV	Packet ID	LEN1	LEN2	INST	P1	P2	P3	P4	P5	CRC 1	CRC 2
0xFF	0xFF	0xFD	0x00	0x01	0x08	0x00	0x10	0x01	0x44	0x58	0x4C	0x22	0xB1	0xDC

5. 8. 3. 3. ID 1 Status Packet

H1	H2	H3	RSRV	Packet ID	LEN1	LEN2	INST	ERR	CRC 1	CRC 2
0xFF	0xFF	0xFD	0x00	0x01	0x04	0x00	0x55	0x00	0xA1	0x0C

5. 9. Control Table Backup (0x20)

5. 9. 1. Description

- Instruction to store current [Control Table](#) status data to a Backup area, or to restore EEPROM data.
- The Control Table Backup works properly only if **Torque Enable** in RAM area is set as '0' (Torque Off status). If the Torque Enable is set as '1' (Torque On), Status Packet with [Result Fail](#) will be returned.
- The Control Table Backup is available from FW45 (for X430, X540 series), FW46 (for X330 series) and FW12 (for P series).
- XL-320 is not supported.
- Available items in Control Table for data backup:
 - All Data in EERPOM
 - Velocity P.I Gains
 - Position P.I.D Gains
 - Feedforward 1st & 2nd Gains
 - Profile Acceleration
 - Profile Velocity
 - Indirect Addresses (Except DYNAMIXEL-P Series)

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DYNAMIXEL Protocol 2.0

1. Introduction

2. Instruction Packet

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2. 1. Header

2. 2. Reserved

2. 3. Packet ID

2. 4. Length

2. 5. Instruction

2. 6. Parameters

2. 7. CRC

3. Status Packet

▼

3. 1. Instruction

3. 2. Error

3. 3. Parameters

3. 4. Response Policy

4. Packet Process

5. Instruction Details

▼

5. 1. Ping (0x01)

5. 2. Read (0x02)

Note

- See [Backup and Restore](#) for more details.
- RAM area can be restored by configuring the **Startup Configuration(60)** address. Refer to the [Restoring RAM Area](#) for more information.

5. 9. 2. Parameters

P1	P2 ~ P5	Description
0x01	Fixed Values (0x43 0x54 0x52 0x4C)	Store current Control Table status data to a Backup area
0x02	Fixed Values (0x43 0x54 0x52 0x4C)	Restore EEPROM data from Backup area. After processing packets, DYNAMIXEL reboots itself
0x03	-	Reserved
...	-	Reserved
0xFF	-	Reserved

5. 9. 3. Example

5. 9. 3. 1. Example 1 Conditions

- ID 1(XC330-T288) : Backup the Control Table.

5. 9. 3. 2. Control Table Backup Packet

H1	H2	H3	RSRV	Packet ID	LEN1	LEN2	INST	P1	P2	P3	P4	P5	CRC1	CRC2
0xFF	0xFF	0xFD	0x00	0x01	0x08	0x00	0x20	0x01	0x43	0x54	0x52	0x4C	0x16	0xF5

5. 9. 3. 3. ID1 Status Packet

H1	H2	H3	RSRV	Packet ID	LEN1	LEN2	INST	ERR	CRC1	CRC2
0xFF	0xFF	0xFD	0x00	0x01	0x04	0x00	0x55	0x00	0xA1	0x0C



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DYNAMIXEL Protocol 2.0

1. Introduction

2. Instruction Packet

2. 1. Header

2. 2. Reserved

2. 3. Packet ID

2. 4. Length

2. 5. Instruction

2. 6. Parameters

2. 7. CRC

3. Status Packet

3. 1. Instruction

3. 2. Error

3. 3. Parameters

3. 4. Response Policy

4. Packet Process

5. Instruction Details

5. 1. Ping (0x01)

5. 2. Read (0x02)

5. 9. 3. 4. Example 2 Conditions

- ID1(XC330-T288) : Restoring EEPROM data
- DYNAMIXEL will be rebooted after a successful restoration.

5. 9. 3. 5. Control Table EEPROM Restoring Packet

H1	H2	H3	RSRV	Packet ID	LEN1	LEN2	INST	P1	P2	P3	P4	P5	CRC1	CRC2
0xFF	0xFF	0xFD	0x00	0x01	0x08	0x00	0x20	0x02	0x43	0x54	0x52	0x4C	0x92	0xF5

5. 9. 3. 6. ID1 Status Packet

H1	H2	H3	RSRV	Packet ID	LEN1	LEN2	INST	ERR	CRC1	CRC2
0xFF	0xFF	0xFD	0x00	0x01	0x04	0x00	0x55	0x00	0xA1	0x0C

5. 10. Sync Read (0x82)

5. 10. 1. Description

- Instruction to read data from multiple devices simultaneously using one Instruction Packet
- The Address and Data Length of the data must all be the same.
- If the Address of the data is not continual, an Indirect Address can be used.
- [Status Packet](#) will be returned in order, according to input ID in the [Instruction Packet](#).
- Packet ID field : 0xFE (Broadcast ID)

5. 10. 2. Parameters

Instruction Packet	Description
Parameter 1	Low-order byte from the starting address
Parameter 2	High-order byte from the starting address
Parameter 3	Low-order byte from the data length(X)
Parameter 4	High-order byte from the data length(X)



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DYNAMIXEL Protocol 2.0

1. Introduction

2. Instruction Packet

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2. 1. Header

2. 2. Reserved

2. 3. Packet ID

2. 4. Length

2. 5. Instruction

2. 6. Parameters

2. 7. CRC

3. Status Packet

▼

3. 1. Instruction

3. 2. Error

3. 3. Parameters

3. 4. Response Policy

4. Packet Process

5. Instruction Details

▼

5. 1. Ping (0x01)

5. 2. Read (0x02)

Instruction Packet	Description
Parameter 4+1	ID of the 1st Device
Parameter 4+2	ID of the 2nd Device
...	...
Parameter 4+X	ID of the X-th Device

Status Packet	Description
Parameter 1	Frist Byte
Parameter 2	Second Byte
...	...
Parameter X	X-th Byte

NOTE : Each device individually returns Status Packet for Sync Read instruction.

5. 10. 3. Example

5. 10. 3. 1. Conditions

- ID1(XM430-W210) : Present Position(132, 0x0084, 4[byte]) = 166(0x000000A6)
- ID2(XM430-W210) : Present Position(132, 0x0084, 4[byte]) = 2,079(0x0000081F)

5. 10. 3. 2. Sync Read Instruction Packet

H1	H2	H3	RSRV	Packet ID	LEN1	LEN2	INST	P1	P2	P3	P4	P5	P6	CRC 1	CRC 2
0xFF	0xFF	0xFD	0x00	0xFE	0x09	0x00	0x82	0x84	0x00	0x04	0x00	0x01	0x02	0xCE	0xFA

5. 10. 3. 3. ID 1 Status Packet

H1	H2	H3	RSRV	Packet ID	LEN1	LEN2	INST	ERR	P1	P2	P3	P4	CRC 1	CRC 2
0xFF	0xFF	0xFD	0x00	0x01	0x08	0x00	0x55	0x00	0xA6	0x00	0x00	0x00	0x8C	0xC0

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DYNAMIXEL Protocol 2.0

1. Introduction

2. Instruction Packet

2. 1. Header

2. 2. Reserved

2. 3. Packet ID

2. 4. Length

2. 5. Instruction

2. 6. Parameters

2. 7. CRC

3. Status Packet

3. 1. Instruction

3. 2. Error

3. 3. Parameters

3. 4. Response Policy

4. Packet Process

5. Instruction Details

5. 1. Ping (0x01)

5. 2. Read (0x02)

5. 10. 3. 4. ID 2 Status Packet

H1	H2	H3	RSRV	Packet ID	LEN1	LEN2	INST	ERR	P1	P2	P3	P4	CRC 1	CRC 2
0xFF	0xFF	0xFD	0x00	0x02	0x08	0x00	0x55	0x00	0x1F	0x08	0x00	0x00	0xBA	0xBE

5. 11. Sync Write (0x83)

5. 11. 1. Description

- Instruction to control multiple devices simultaneously using one Instruction Packet
- The Address and Data Length of the data must all be the same.
- If the Address of the data is not continual, an Indirect Address can be used.
- Packet ID field : 0xFE (Broadcast ID)

5. 11. 2. Parameters

Instruction Packet	Description
Parameter 1	Low-order byte from the starting address
Parameter 2	High-order byte from the starting address
Parameter 3	Low-order byte from the data length(X)
Parameter 4	High-order byte from the data length(X)
Parameter 5	[1st Device] ID
Parameter 5+1	[1st Device] 1st Byte
Parameter 5+2	[1st Device] 2nd Byte
...	[1st Device]...
Parameter 5+X	[1st Device] X-th Byte
Parameter 6	[2nd Device] ID
Parameter 6+1	[2nd Device] 1st Byte
Parameter 6+2	[2nd Device] 2nd Byte

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DYNAMIXEL Protocol 2.0

1. Introduction

2. Instruction Packet

2. 1. Header

2. 2. Reserved

2. 3. Packet ID

2. 4. Length

2. 5. Instruction

2. 6. Parameters

2. 7. CRC

3. Status Packet

3. 1. Instruction

3. 2. Error

3. 3. Parameters

3. 4. Response Policy

4. Packet Process

5. Instruction Details

5. 1. Ping (0x01)

5. 2. Read (0x02)

Instruction Packet	Description
...	[2nd Device]...
Parameter 6+X	[2nd Device] X-th Byte
...	...

5. 11. 3. Example

5. 11. 3. 1. Conditions

- ID1(XM430-W210) : Write 150(0x00000096) to Goal Position(116, 0x0074, 4[byte])
- ID2(XM430-W210) : Write 170(0x000000AA) to Goal Position(116, 0x0074, 4[byte])

5. 11. 3. 2. Sync Write Instruction Packet

H1	H2	H3	RSRV	Packet ID	LEN1	LEN2	INST	P1	P2	P3	P4
0xFF	0xFF	0xFD	0x00	0xFE	0x11	0x00	0x83	0x74	0x00	0x04	0x00

P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	CRC 1	CRC 2
0x01	0x96	0x00	0x00	0x00	0x02	0xAA	0x00	0x00	0x00	0x82	0x87

5. 12. Fast Sync Read (0x8A)

5. 12. 1. Description

- Enhanced Instruction for faster communication compared to [Sync Read](#)
- One Status Packet is structured and returned for all DYNAMIXELs if using Fast Sync Read Instruction regardless of number of DYNAMIXELs chained, as if one DYNAMIXEL returns [Status Packet](#).
- Instruction Packet is formatted in the same way as Sync Read

Note: [DYNAMIXEL Tips | EEPROM and RAM Data Restoring Using Backup Function](#)

5. 12. 2. Parameter



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DYNAMIXEL Protocol 2.0

1. Introduction

2. Instruction Packet

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2. 1. Header

2. 2. Reserved

2. 3. Packet ID

2. 4. Length

2. 5. Instruction

2. 6. Parameters

2. 7. CRC

3. Status Packet

▼

3. 1. Instruction

3. 2. Error

3. 3. Parameters

3. 4. Response Policy

4. Packet Process

5. Instruction Details

▼

5. 1. Ping (0x01)

5. 2. Read (0x02)

Instruction Packet	Description
Parameter 1	Low-order byte from the starting address
Parameter 2	High-order byte from the starting address
Parameter 3	Low-order byte from the data length(X)
Parameter 4	High-order byte from the data length(X)
Parameter 4+1	<div>1st Device</div> ID
Parameter 4+2	<div>2nd Device</div> ID
...	...
Parameter 4+n	<div>Nnd Device</div> ID

Status Packet	Description
Parameter 1	<div>1st Device</div> ID
Parameter 2	<div>1st Device</div> First Byte
Parameter 3	<div>1st Device</div> Second Byte
...	...
Parameter X	<div>1st Device</div> X-th Byte
Parameter X+1	<div>1st Device</div> Low-order byte from CRC
Parameter X+2	<div>1st Device</div> High-order byte from CRC
Parameter X+3	<div>2nd Device</div> Error
Parameter X+4	<div>2nd Device</div> ID
Parameter X+4+1	<div>2nd Device</div> First Byte
Parameter X+4+2	<div>2nd Device</div> Second Byte
...	...
Parameter 2X+4	<div>2nd Device</div> X-th Byte



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1. Introduction

2. Instruction Packet

2. 1. Header
2. 2. Reserved
2. 3. Packet ID
2. 4. Length
2. 5. Instruction
2. 6. Parameters
2. 7. CRC

3. Status Packet

3. 1. Instruction
3. 2. Error
3. 3. Parameters
3. 4. Response Policy

4. Packet Process

5. Instruction Details

5. 1. Ping (0x01)
5. 2. Read (0x02)

Status Packet	Description
Parameter 2X+4+1	2nd Device Low-order byte from CRC
Parameter 2X+4+2	2nd Device High-order byte from CRC
...	...
Parameter nX+4	Nnd Device X-th Byte

Note: CRC values are used for internal calculation in DYNAMIXEL to confirm packet integrity between DYNAMIXELs. You can let the main controller check CRC only at the end of Status Packet.

Note: Each device respectively returns a particular part of Status Packet in response to Fast Sync Read Instruction. For more details, see Example below.

Note: Fast Sync Read Status Packet does not perform Byte Stuffing(0xFD) process.

5. 12. 3. Example

5. 12. 3. 1. Example Description

- ID3(XC330-T288) : Present Position(132, 0x0084, 4[byte]) = 166(0x000000A6)
- ID7(XC330-T288) : Present Position(132, 0x0084, 4[byte]) = 2,079(0x0000081F)
- ID4(XC330-T288) : Present Position(132, 0x0084, 4[byte]) = 1,023(0x000003FF)

5. 12. 3. 2. Fast Sync Read Instruction Packet

H1	H2	H3	RSRV	Packet ID	LEN1	LEN2	INST	P1	P2	P3	P4	P5	P6	P7	CRC1	CRC2
0xFF	0xFF	0xFD	0x00	0xFE	0x0A	0x00	0x8A	0x84	0x00	0x04	0x00	0x03	0x07	0x04	0x20	0xF2

5. 12. 3. 3. ID 3 Status Packet

H1	H2	H3	RSRV	Packet ID	LEN1	LEN2	INST	ERR	ID1	D1	D2	D3	D4	CRC1	CRC2
----	----	----	------	-----------	------	------	------	-----	-----	----	----	----	----	------	------



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1. Introduction

2. Instruction Packet

2. 1. Header

2. 2. Reserved

2. 3. Packet ID

2. 4. Length

2. 5. Instruction

2. 6. Parameters

2. 7. CRC

3. Status Packet

3. 1. Instruction

3. 2. Error

3. 3. Parameters

3. 4. Response Policy

4. Packet Process

5. Instruction Details

5. 1. Ping (0x01)

5. 2. Read (0x02)

H1	H2	H3	RSRV	Packet ID	LEN1	LEN2	INST	ERR	ID1	D1	D2	D3	D4	CRC1	CRC2
0xFF	0xFF	0xFD	0x00	0xFE	0x19	0x00	0x55	0x00	0x03	0xA6	0x00	0x00	0x00	0x84	0x08

5. 12. 3. 4. ID 7 Status Packet

ERR	ID2	D1	D2	D3	D4	CRC1	CRC2
0x00	0x07	0x1F	0x08	0x00	0x00	0x16	0xCA

5. 12. 3. 5. ID 4 Status Packet

ERR	ID3	D1	D2	D3	D4	CRC1	CRC2
0x00	0x04	0xFF	0x03	0x00	0x00	0xD1	0x9E

5. 13. Bulk Read (0x92)

5. 13. 1. Description

- Similar to Sync Read, this is an Instruction to read data from multiple devices simultaneously using one Instruction Packet
- This Instruction can be used even if the Address and Data Length of the data for each device are not all the same.
- The same ID cannot be used multiple times in the Parameter. In other words, it can only read once from each individual device.
- [Status Packet](#) will be returned in order, according to input ID in the [Instruction Packet](#).
- If the Address of the data is not continual, an Indirect Address can be used.
- Packet ID field : 0xFE (Broadcast ID)

5. 13. 2. Parameters

Instruction Packet	Description
Parameter 1	[1st Device] ID
Parameter 2	[1st Device] Low-order byte from the starting address



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DYNAMIXEL Protocol 2.0

1. Introduction

2. Instruction Packet

▼

2. 1. Header

2. 2. Reserved

2. 3. Packet ID

2. 4. Length

2. 5. Instruction

2. 6. Parameters

2. 7. CRC

3. Status Packet

▼

3. 1. Instruction

3. 2. Error

3. 3. Parameters

3. 4. Response Policy

4. Packet Process

5. Instruction Details

▼

5. 1. Ping (0x01)

5. 2. Read (0x02)

Instruction Packet	Description
Parameter 3	[1st Device] High-order byte from the starting address
Parameter 4	[1st Device] Low-order byte from the data
Parameter 5	[1st Device] High-order byte from the data
Parameter 6	[2nd Device] ID
Parameter 7	[2nd Device] Low-order byte from the starting address
Parameter 8	[2nd Device] High-order byte from the starting address
Parameter 9	[2nd Device] Low-order byte from the data
Parameter 10	[2nd Device] High-order byte from the data
...	...

Status Packet	Description
Parameter 1	1st Byte
Parameter 2	2nd Byte
...	...
Parameter X	X-th Byte

NOTE : Each device individually returns Status Packet for Bulk Read instruction. See the Example below for more details.

5. 13. 3. Example

5. 13. 3. 1. Condition

- ID1(XM430-W210) : Present Voltage(144, 0x0090, 2[byte]) = 119(0x0077)
- ID2(XM430-W210) : Present Temperature(146, 0x0092, 1[byte]) = 36(0x24)

5. 13. 3. 2. Bulk Read Instruction Packet



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DYNAMIXEL Protocol 2.0

1. Introduction

2. Instruction Packet

2. 1. Header

2. 2. Reserved

2. 3. Packet ID

2. 4. Length

2. 5. Instruction

2. 6. Parameters

2. 7. CRC

3. Status Packet

3. 1. Instruction

3. 2. Error

3. 3. Parameters

3. 4. Response Policy

4. Packet Process

5. Instruction Details

5. 1. Ping (0x01)

5. 2. Read (0x02)

H1	H2	H3	RSRV	Packet ID	LEN1	LEN2	INST	P1	P2	P3	P4	P5
0xFF	0xFF	0xFD	0x00	0xFE	0x0D	0x00	0x92	0x01	0x90	0x00	0x02	0x00

P6	P7	P8	P9	P10	CRC 1	CRC 2
0x02	0x92	0x00	0x01	0x00	0x1A	0x05

5. 13. 3. 3. ID 1 Status Packet

H1	H2	H3	RSRV	Packet ID	LEN1	LEN2	INST	ERR	P1	P2	CRC 1	CRC 2
0xFF	0xFF	0xFD	0x00	0x01	0x06	0x00	0x55	0x00	0x77	0x00	0xC3	0x69

5. 13. 3. 4. ID 2 Status Packet

H1	H2	H3	RSRV	Packet ID	LEN1	LEN2	INST	ERR	P1	CRC 1	CRC 2
0xFF	0xFF	0xFD	0x00	0x02	0x05	0x00	0x55	0x00	0x24	0x8B	0xA9

5. 14. Bulk Write (0x93)

5. 14. 1. Description

- Similar to Sync Write, this is an Instruction to control multiple devices simultaneously using one Instruction Packet
- This Instruction can be used even if the Address and Data Length of the data for each device are not all the same.
- The same ID cannot be used multiple times in the Parameter. In other words, it can only write once for each individual device.
- If the Address of the data is not continual, an Indirect Address can be used.
- Packet ID field : 0xFE (Broadcast ID)

5. 14. 2. Parameters

Instruction Packet	Description
--------------------	-------------



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DYNAMIXEL Protocol 2.0

1. Introduction

2. Instruction Packet

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2. 1. Header

2. 2. Reserved

2. 3. Packet ID

2. 4. Length

2. 5. Instruction

2. 6. Parameters

2. 7. CRC

3. Status Packet

▼

3. 1. Instruction

3. 2. Error

3. 3. Parameters

3. 4. Response Policy

4. Packet Process

5. Instruction Details

▼

5. 1. Ping (0x01)

5. 2. Read (0x02)

Instruction Packet	Description
Parameter 1	[1st Device] ID
Parameter 2	[1st Device] Low-order byte from the starting address
Parameter 3	[1st Device] High-order byte from the starting address
Parameter 4	[1st Device] Low-order byte from the data length(X)
Parameter 5	[1st Device] High-order byte from the data length(X)
Parameter 5+1	[1st Device] 1st Byte
Parameter 5+2	[1st Device] 2nd Byte
...	...
Parameter 5+X	[1st Device] X-th Byte
Parameter 6+X	[2nd Device] ID
Parameter 7+X	[2nd Device] Low-order byte from the starting address
Parameter 8+X	[2nd Device] High-order byte from the starting address
Parameter 9+X	[2nd Device] Low-order byte from the data length(X)
Parameter 10+X	[2nd Device] High-order byte from the data length(X)
Parameter 10+X+1	[2nd Device] 1st Byte
Parameter 10+X+2	[2nd Device] 2nd Byte
...	...
Parameter 10+X+Y	[2nd Device] Y-th Byte
...	...

5. 14. 3. Example

5. 14. 3. 1. Condition



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DYNAMIXEL Protocol 2.0

1. Introduction

2. Instruction Packet

2. 1. Header

2. 2. Reserved

2. 3. Packet ID

2. 4. Length

2. 5. Instruction

2. 6. Parameters

2. 7. CRC

3. Status Packet

3. 1. Instruction

3. 2. Error

3. 3. Parameters

3. 4. Response Policy

4. Packet Process

5. Instruction Details

5. 1. Ping (0x01)

5. 2. Read (0x02)

- ID1(XM430-W210) : Set Max Voltage Limit(32, 0x0020, 2[byte]) to 160(0x00A0)
- ID2(XM430-W210) : Set Temperature Limit(31, 0x001F, 1[byte]) to 80(0x50)

5. 14. 3. 2. Bulk Write Instruction Packet

H1	H2	H3	RSRV	Packet ID	LEN1	LEN2	INST	P1	P2	P3	P4	P5	P6	P7
0xFF	0xFF	0xFD	0x00	0xFE	0x10	0x00	0x93	0x01	0x20	0x00	0x02	0x00	0xA0	0x00

P8	P9	P10	P11	P12	P13	CRC 1	CRC 2
0x02	0x1F	0x00	0x01	0x00	0x50	0xB7	0x68

5. 15. Fast Bulk Read (0x9A)

5. 15. 1. Description

- Enhanced Instruction for faster communication compared to Bulk Read.
- One Status Packet is structured and returned for all DYNAMIXELs using Fast Bulk Read Instruction regardless of number of DYNAMIXELs chained, as if one DYNAMIXEL returns Status Packet.
- Instruction Packet is formatted in the same way as Bulk Read

Note: [DYNAMIXEL Tips | EEPROM and RAM Data Restoring Using Backup Function](#)

5. 15. 2. Parameters

Instruction Packet	Description
Parameter 1	1st Device ID
Parameter 2	1st Device Low-order byte from the starting address
Parameter 3	1st Device High-order byte from the starting address
Parameter 4	1st Device Low-order byte from the data length(X1)
Parameter 5	1st Device High-order byte from the data length(X1)
Parameter 6	2nd Device ID



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DYNAMIXEL Protocol 2.0

1. Introduction

2. Instruction Packet

▼

2. 1. Header

2. 2. Reserved

2. 3. Packet ID

2. 4. Length

2. 5. Instruction

2. 6. Parameters

2. 7. CRC

3. Status Packet

▼

3. 1. Instruction

3. 2. Error

3. 3. Parameters

3. 4. Response Policy

4. Packet Process

5. Instruction Details

▼

5. 1. Ping (0x01)

5. 2. Read (0x02)

Instruction Packet	Description
Parameter 7	<div>2nd Device</div> Low-order byte from the starting address
Parameter 8	<div>2nd Device</div> High-order byte from the starting address
Parameter 9	<div>2nd Device</div> Low-order byte from the data length(X2)
Parameter 10	<div>2nd Device</div> High-order byte from the data length(X2)

Status Packet	Description
Parameter 1	<div>1st Device</div> ID
Parameter 2	<div>1st Device</div> First Byte
Parameter 3	<div>1st Device</div> Second Byte
...	...
Parameter X1	<div>1st Device</div> X1-th Byte
Parameter X1+1	<div>1st Device</div> Low-order byte from CRC
Parameter X1+2	<div>1st Device</div> High-order byte from CRC
Parameter X1+3	<div>2nd Device</div> Error
Parameter X1+4	<div>2nd Device</div> ID
Parameter X1+4+1	<div>2nd Device</div> First Byte
Parameter X1+4+2	<div>2nd Device</div> Second Byte
...	...
Parameter X1+4+X2	<div>2nd Device</div> X2-th Byte
Parameter X1+4+X2+1	<div>2nd Device</div> Low-order byte from CRC
Parameter X1+4+X2+2	<div>2nd Device</div> High-order byte from CRC
...	...
Parameter X1+4+X2+	<div>Nnd Device</div> Xn-th Byte



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DYNAMIXEL Protocol 2.0

1. Introduction

2. Instruction Packet

2. 1. Header

2. 2. Reserved

2. 3. Packet ID

2. 4. Length

2. 5. Instruction

2. 6. Parameters

2. 7. CRC

3. Status Packet

3. 1. Instruction

3. 2. Error

3. 3. Parameters

3. 4. Response Policy

4. Packet Process

5. Instruction Details

5. 1. Ping (0x01)

5. 2. Read (0x02)

Status Packet	Description
... 4+Xn	

Note: CRC values are used for internal calculation in DYNAMIXEL to confirm packet integrity between DYNAMIXELs. You can let the main controller check CRC only at the end of Status Packet.

Note: Each device respectively returns a particular part of Status Packet in response to Fast Bulk Read Instruction. For more details, see Example below.

Note: Status Packet responded from Fast Bulk Read does not perform Byte Stuffing(0xFD) process.

5. 15. 3. Example

5. 15. 3. 1. Example Description

- ID3(XC330-T288) : Present Position(132, 0x0084, 4[byte]) = 166(0x000000A6)
- ID7(XC330-T288) : Present PWM(124, 0x007C, 2[byte]) = 421(0x01A5)
- ID4(XC330-T288) : Present Temperature(146, 0x0092, 1[byte]) = 31(0x1F)

5. 15. 3. 2. Fast Bulk Read Instruction Packet

H1	H2	H3	RSRV	Packet ID	LEN1	LEN2	INST	P1	P2	P3	P4	P5	P6	P7	P8
0xFF	0xFF	0xFD	0x00	0xFE	0x12	0x00	0x9A	0x03	0x84	0x00	0x04	0x00	0x07	0x7C	0x00
P9	P10	P11	P12	P13	P14	P15	CRC1	CRC2							
0x02	0x00	0x04	0x92	0x00	0x01	0x00	0x20	0xF2							

5. 15. 3. 3. ID 3 Status Packet

H1	H2	H3	RSRV	Packet ID	LEN1	LEN2	INST	ERR	ID1	D1	D2	D3	D4	CRC1	CRC2
0xFF	0xFF	0xFD	0x00	0xFE	0x14	0x00	0x55	0x00	0x03	0xA6	0x00	0x00	0x00	0x67	0xA4



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DYNAMIXEL Protocol 2.0

1. Introduction

2. Instruction Packet

2. 1. Header

2. 2. Reserved

2. 3. Packet ID

2. 4. Length

2. 5. Instruction

2. 6. Parameters

2. 7. CRC

3. Status Packet

3. 1. Instruction

3. 2. Error

3. 3. Parameters

3. 4. Response Policy

4. Packet Process

5. Instruction Details

5. 1. Ping (0x01)

5. 2. Read (0x02)

5. 15. 3. 4. ID 7 Status Packet

ERR	ID2	D1	D2	CRC1	CRC2
0x00	0x07	0xA5	0x01	0x24	0x74

5. 15. 3. 5. ID 4 Status Packet

ERR	ID2	D1	CRC1	CRC2
0x00	0x04	0x1F	0xD9	0xC1