High-Speed Network Servo

MINAS A6N

RTEX Realtime Express

April 1st, 2022

Panasonic Industry Co., Ltd.

NEW

Communication MAX **16,000** *times/s* **!**

In order from left, size A, B, C, D, E and F.

Panasonic INDUSTRY

Features

Concept

Ultimate High-Performance !

Drive

- Velocity fc = 3.2 kHz
- Canceling
  Load Disturbance
- Reducing Resonance
  by Model Reference

Motor

- Precise 23 bit (8 Mp/r)
  Absolute Encoder
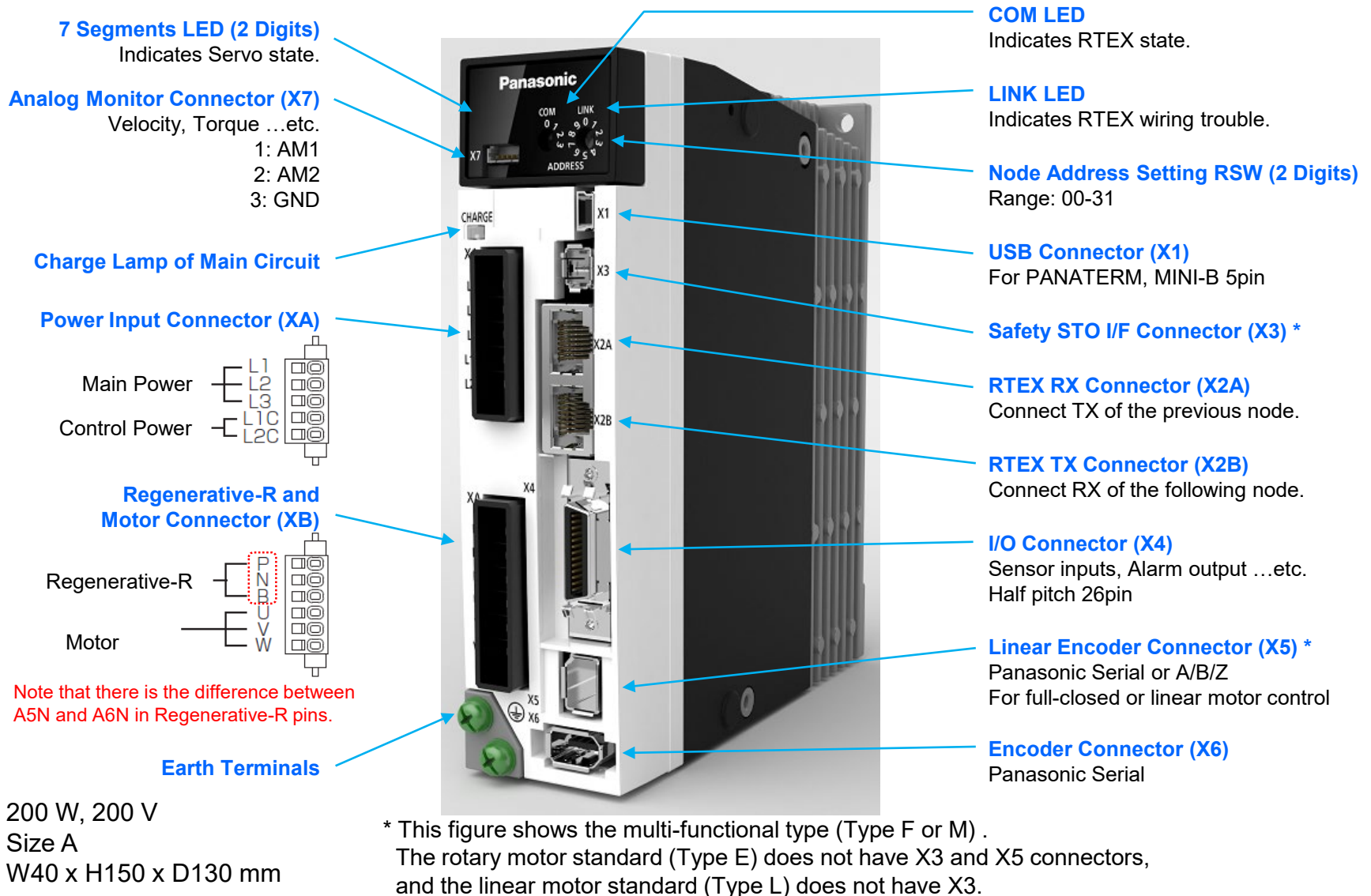- 30 % Compact Size *
- More Toughness
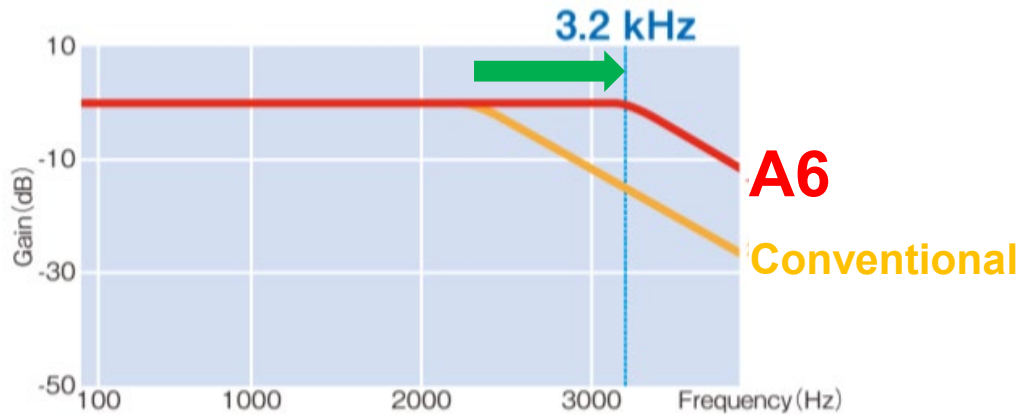 Rotor Structure

* For middle or high inertia type

+

RTEX
Realtime Express

*100 Mbps
Full-duplex*

- Period min 0.0625 ms
- Precise Pos. Comparing
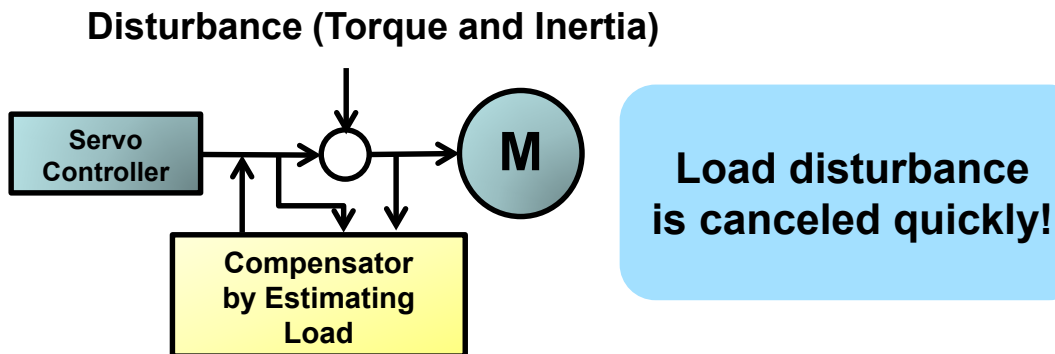- Continuous Rotating Func.
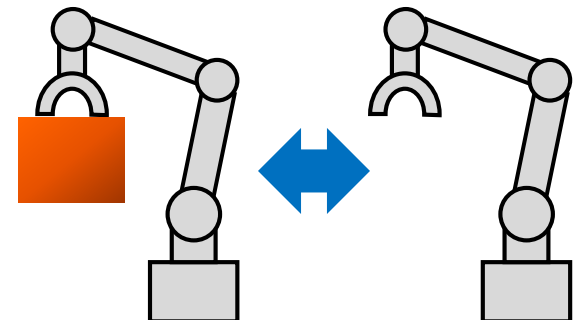 for Absolute Encoder

Drive Appearance

7 Segments LED (2 Digits)
Indicates Servo state.

Analog Monitor Connector (X7)
Velocity, Torque …etc.
1: AM1
2: AM2
3: GND

Charge Lamp of Main Circuit

Power Input Connector (XA)

Main Power — L1 / L2 / L3
Control Power — L1C / L2C

Regenerative-R and Motor Connector (XB)

Regenerative-R — P / N / R / B
Motor — U / V / W

Note that there is the difference between A5N and A6N in Regenerative-R pins.

Earth Terminals

200 W, 200 V
Size A
W40 x H150 x D130 mm

COM LED
Indicates RTEX state.

LINK LED
Indicates RTEX wiring trouble.

Node Address Setting RSW (2 Digits)
Range: 00-31

USB Connector (X1)
For PANATERM, MINI-B 5pin

Safety STO I/F Connector (X3) *

RTEX RX Connector (X2A)
Connect TX of the previous node.

RTEX TX Connector (X2B)
Connect RX of the following node.

I/O Connector (X4)
Sensor inputs, Alarm output …etc.
Half pitch 26pin

Linear Encoder Connector (X5) *
Panasonic Serial or A/B/Z
For full-closed or linear motor control

Encoder Connector (X6)
Panasonic Serial

* This figure shows the multi-functional type (Type F or M) .
  The rotary motor standard (Type E) does not have X3 and X5 connectors,
  and the linear motor standard (Type L) does not have X3.

Panasonic **INDUSTRY**

Drive Features

Velocity Response

3.2 kHz

A6
Conventional

40 % UP!

Canceling Load Disturbance

Even if load changed, stability is kept!

Disturbance (Torque and Inertia)

Servo Controller

M

Compensator by Estimating Load

Load disturbance is canceled quickly!

Panasonic INDUSTRY

Motor Features

High Inertia **MHMF**
200 W

**Weight 760 g
20 %
Light!**

67.5 mm

交流伺服马达
珠海松下马达有限公司
中国广东省珠海市南屏
科技工业园屏东3路3号
原产地：中国
(合格)
10

**30 %
Shorter!**

MHMF Type
Max Speed: 6500 r/min (400 W or less)
Max Torque: 350 % (1 kW or less)

23 bit Absolute Encoder
+
More Precise Position (1 kW or more)

Torque

Expanded
Operatable Area

16 % UP

350 %

30 % UP

6500 r/min
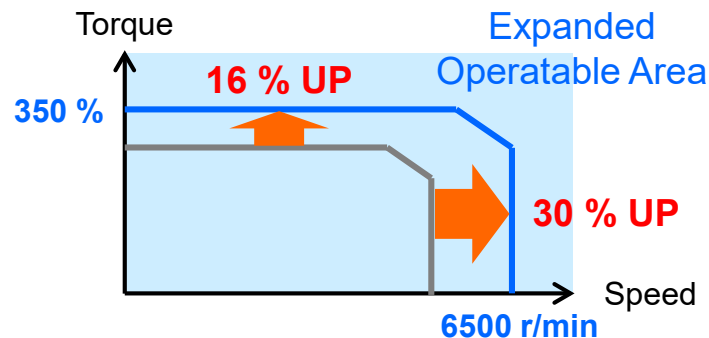
Speed

Conventional
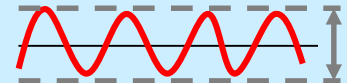
Speed

Disturbance 1/5

New A6

Speed
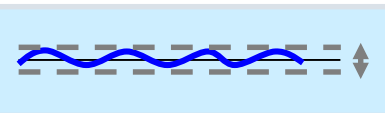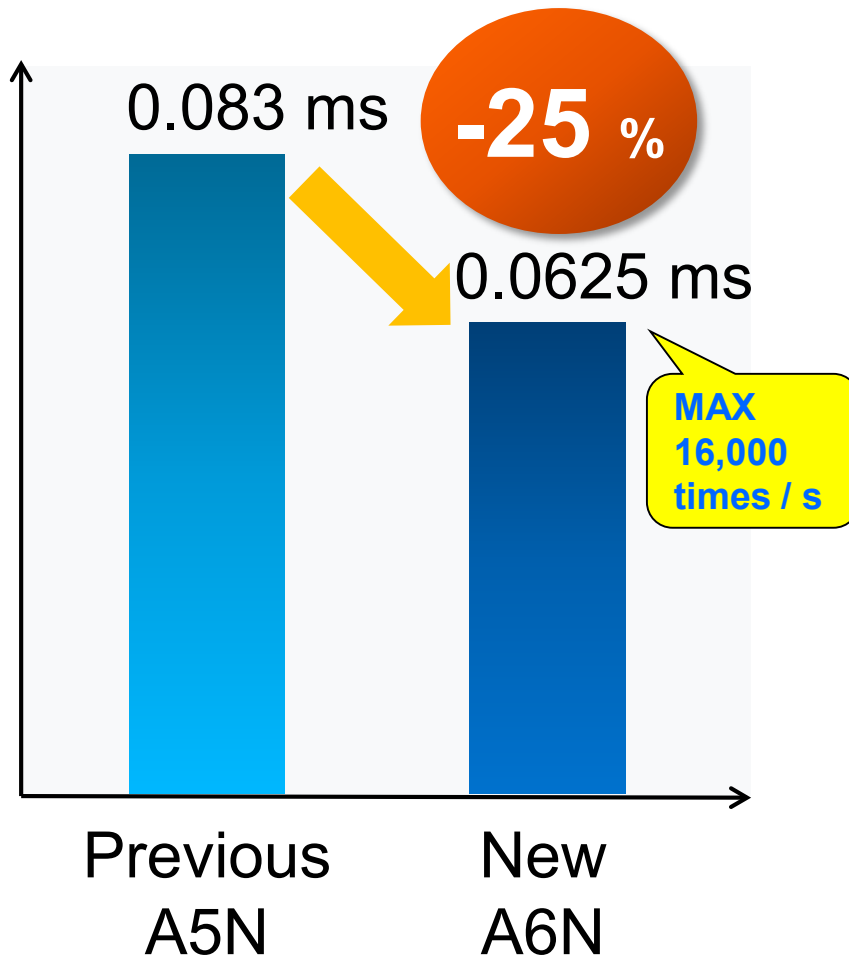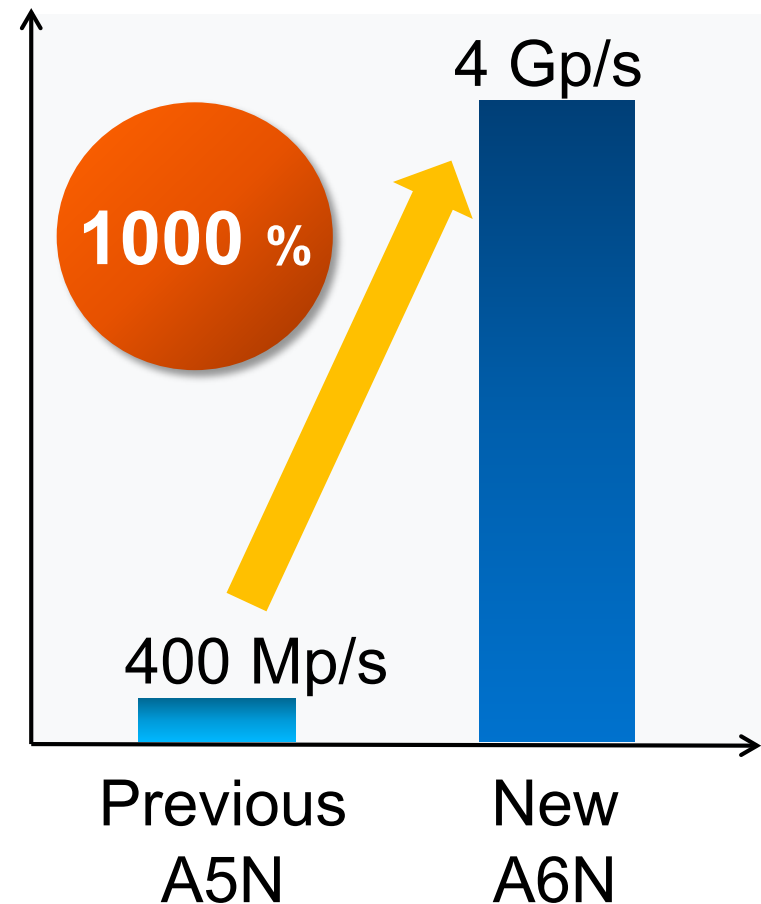
Network Features

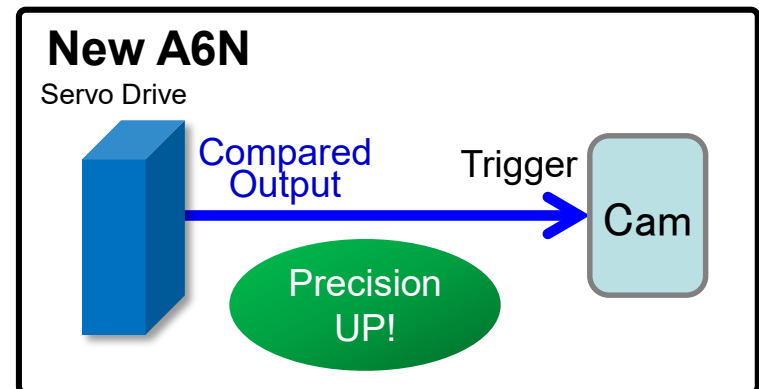# New Function: Precise Position Comparing

At preset positon, drive outputs a pulse.

e.g. Camera

Motor

Position Comparing Value

Actual Position

Compared Output

Pulse for Shutter Trigger

Previous A5N

Servo Drive

Pulse Counter

Trigger

Cam

Encoder A/B phase

New A6N

Servo Drive

Compared Output

Trigger

Cam

Precision UP!

Panasonic INDUSTRY
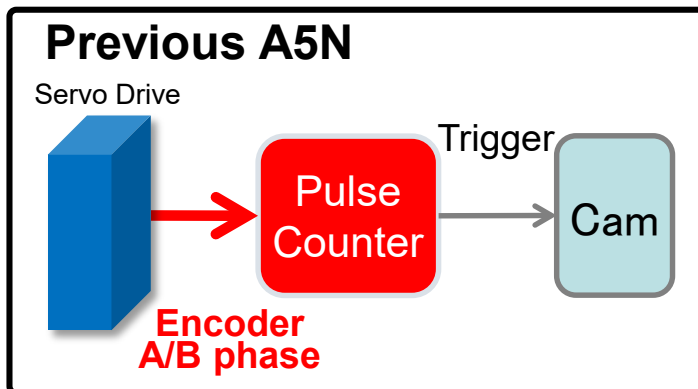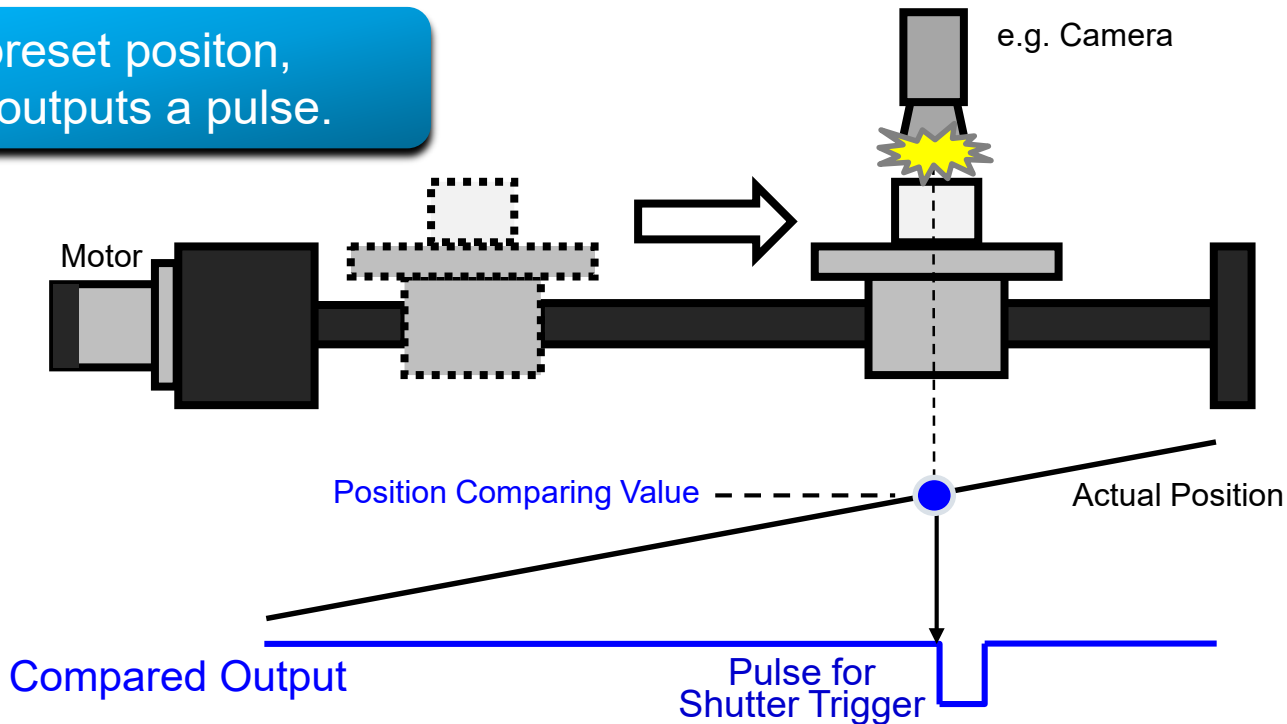
New Function: Continuous Rotating Absolute Encoder
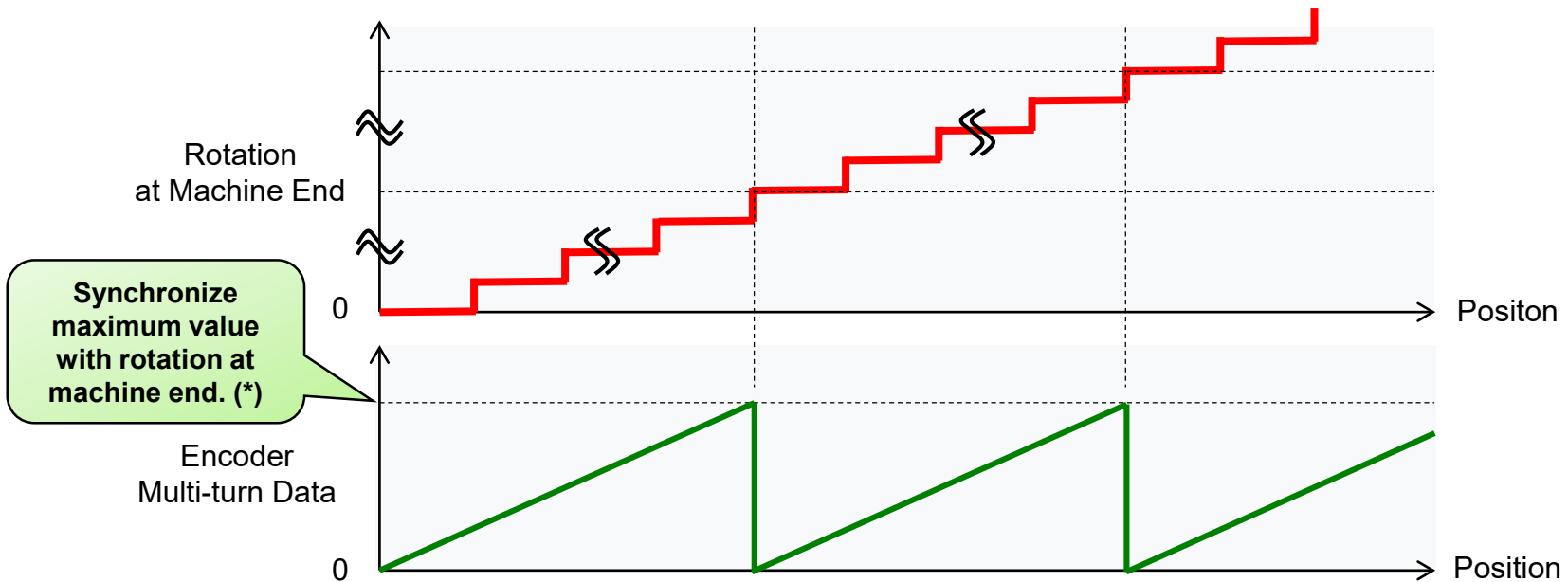
Maximum value can be set freely. (*)

Angle of machine end can be calculated with multi-turn data.

23-bit Absolute Encoder

Reduction Mechanism

Machine End such as turn table

Rotating Infinitely in One Direction

Rotation at Machine End

Position

Synchronize maximum value with rotation at machine end. (*)

Encoder Multi-turn Data

0

0

Position

* This setting has some limitations, so it is not quite free.
  At wrap-around position of multi-turn data, actual positon feed-backed to the host controller with RTEX also shows wrap-around.
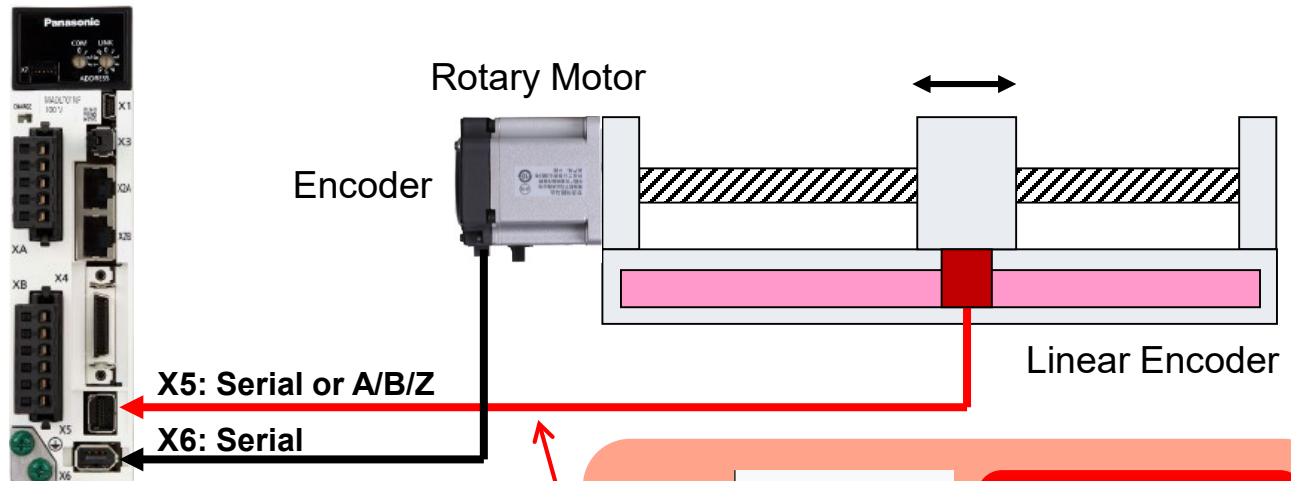
Linear Encoder I/F

High-resolution serial linear encoder can be connected to drive directly.
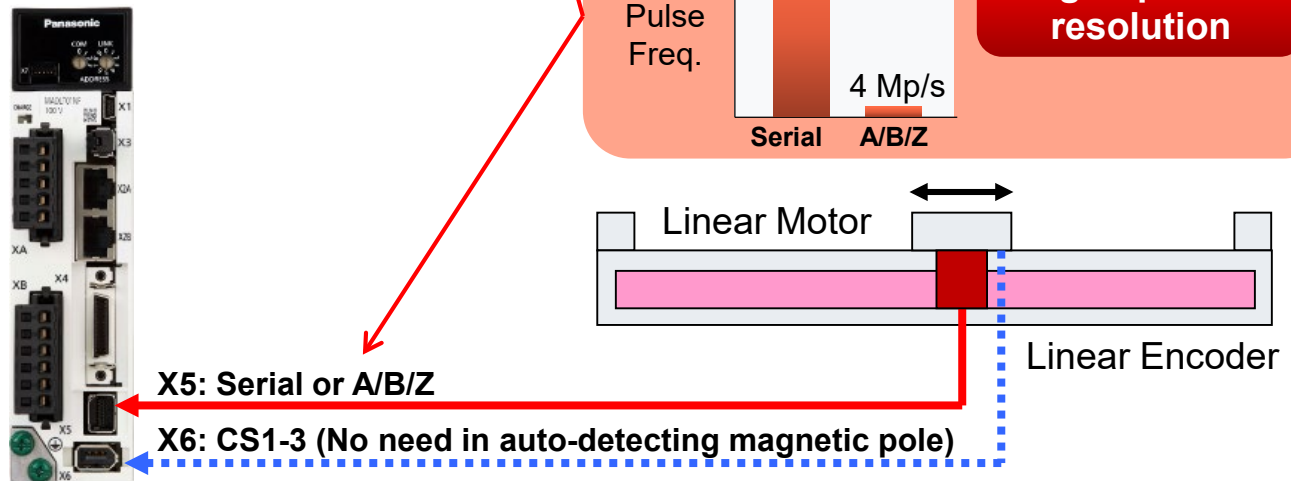
Full-closed Control

Type F

Note 1:
Full-closed control is only for profile or cyclic position mode.

Rotary Motor

Encoder

Linear Encoder

X5: Serial or A/B/Z

X6: Serial

Max. Pulse Freq.

4 Gp/s

4 Mp/s

Serial   A/B/Z

Serial is more High-speed & resolution

Linear Motor Drive (Specific)

Type L, M

Linear Motor

Linear Encoder

X5: Serial or A/B/Z

X6: CS1-3 (No need in auto-detecting magnetic pole)

Note 2: Linear motor and linear encoder are partner products.

Serial Communication Linear Encoder

	Manufacturer	Model	Resolution [um]	Max Speed [m/s]
Incremental	Magnescale	SL700 + PL101RP/RHP	0.1	10
		SL710 + PL101RP/RHP	0.1	10
		SQ10 + PQ11	0.05 to 1	3
		SR75 / 85	0.01 to 1	3.3
		BF1	0.001 / 0.01	1.8
	Renishaw	TONIC	0.001 to 5	6.48 @1um
		ATOM	0.001 to 10	6.48 @1um
	Sankyo	PSLH041 + PSLG	0.1	6
Absolute	Heidenhain	LIC 2197P / 9P	0.05 / 0.1	10
		LIC 4193P / 5P / 7P / 9P	0.001 / 0.005 / 0.01	4 / 10 / 10
		LC 195P / 495P	0.001 / 0.01	3
	Magnescale	SR77 / 87	0.01 to 1	3.3
	Mitutoyo	AT573-SC/H	0.05	2.5
		ST700	0.1	5
		ST1300	0.001 / 0.01	4
	Renishaw	RESOLUTE	0.001 / 0.05 / 0.1	4 / 100 / 100
	Fagor	S2AP / SV2AP / G2AP	0.01 / 0.05	3
		LAP	0.05	2

Note: Because of restriction which is pulse frequency max. 4 Gp/s in the servo drive, the resolution and max. speed may be different from linear encoder specifications.

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Compliance

Compliant with various standards in each country.
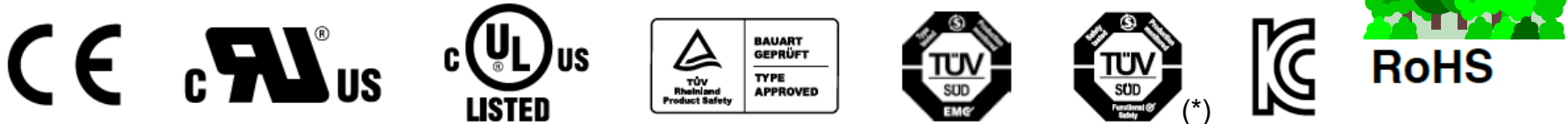
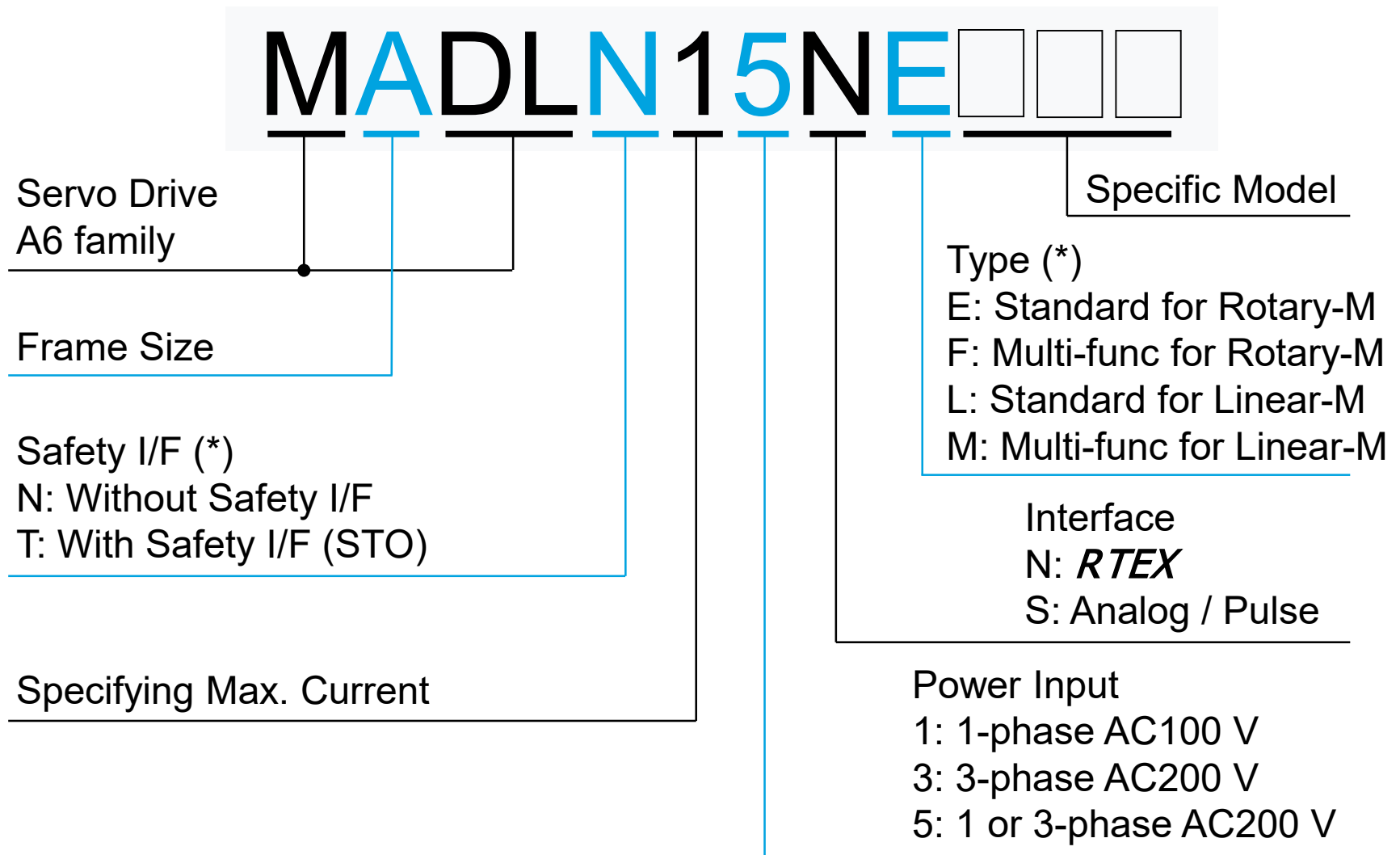|		Drive	Motor
Europe EC Directive	EMC Directive	EN55011 EN61000-6-2 EN61000-6-4 EN61800-3	
	Low Voltage Directive	EN61800-5-1 EN50178	EN60034-1 EN60034-5
	Machinery Directive Functional Safety (*)	ISO13849-1 (PL e, Cat. 3) EN61508 (SIL 3) EN62061 (SILCL 3) EN61800-5-2 (SIL 3, STO) IEC61326-3-1 IEC60240-1	
UL		UL508C (File #E164620)	UL1004-1, 6 (File #E327868)
CSA		C22.2 #14	C22.2 #100-04
KC		KN11 KN61000-4-2, 3, 4, 5, 6, 8, 11	
SEMI		F47 (For control power input)	

* For Type F, M

Lineup

Model Nomenclature

MADLN15NE☐☐☐

**Servo Drive
A6 family**

Frame Size

Safety I/F (*)
N: Without Safety I/F
T: With Safety I/F (STO)

Specifying Max. Current

Specific Model

Type (*)
E: Standard for Rotary-M
F: Multi-func for Rotary-M
L: Standard for Linear-M
M: Multi-func for Linear-M

Interface
N: *RTEX*
S: Analog / Pulse

Power Input
1: 1-phase AC100 V
3: 3-phase AC200 V
5: 1 or 3-phase AC200 V

* The combination has the following limitation:
  Standard type (Type E, L) is without safety I/F, and multi-functional type (Type F, M) is with safety I/F.

Lineup

Motor Rated Output [W]

Drive Power	50	100	200	400	750	1k	1.5k	2k	3k	4k-5k
1-phase AC 100-120 V	A	A	B	C						
	MADLN 01NE	MADLN 11NE	MBDLN 21NE	MCDLN 31NE						
1 or 3-phase AC 200-240 V	A		A	B	C	D	D			
	MADLN 05NE		MADLN 15NE	MBDLN 25NE	MCDLN 35NE	MDDLN 45NE	MDDLN 55NE			
3-phase AC 200-230 V								E	F	F
								MEDLN 83NE	MFDLN A3NE	MFDLN B3NE

Upper: Frame size
Lower: Typical model No. in standard type (Type E only shown).
　　　　Depending on combination with motor, make sure of the brochure because of exceptions.
　　　　(exception) 1 kW MSMF102　corresponds with MDDLN55NE.

Points Changed from A5N to A6N

Comparison between A5N and A6N for Rotary Motor

	Previous A5N		New A6N	
	Standard (D1)	**Multiple (21)**	**Standard (E)**	**Multiple (F)**
Velocity Response	2.3 kHz		3.2 kHz	
Canceling Load Disturbance	-		✓	
2DOF Control & Reducing Resonance	Good		Excellent	
Encoder	Incremental 20 bit Absolute 17 bit		Absolute 23 bit Usable as incremental	
Com. Period [ms]	1 / 0.5 / 0.166 / 0.083		2 / 1 / 0.5 / 0.25 / 0.125 / 0.0625	
Pos. Comparing	-		✓	
Infinitely Absolute	-		✓	
Full-closed Control	✓	✓	-	✓
Safe Torque Off (STO)	-	PL d, SIL 2 Works as an alarm.	-	PL e, SIL 3 Different from alarm.
Analog Monitor X7 Con. / Update	6-pin, Molex 53014-0610 T = 0.5 ms		5-pin, Molex 53398-8605 T = 0.125 ms	

Note: After replacing A5N by A6N, gain tuning is needed again.
Even if setting the same gain as A5N, the same motion cannot be shown because of enhanced response.

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Changed Parameters

	Changed or Added Parameters
Absolute Encoder	Pr0.15 Pr6.88
Gain Tuning	Pr2.24 - 26 Pr4.32 Pr5.23 - 24 Pr6.60 - 76
RTEX	Pr7.20 Pr7.41 Pr7.91 Pr7.95 - 98
Others	Pr7.93

Note: Except for parameters manufacturer uses.

Two-Degree-Of-Freedom (2DOF) control is enabled as the factory default setting.
When using torque command, change it to disable because 2DOF is not supported.

	A5N	A6N
2DOF Pr6.47 bit0 Default	Disable 0	Enable 1

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When host controller distinguish A6N from A4N or A5N, model number should be used.

<Model#> **MADLN15NE**

The 4th character

	A4N	A5N	A6N
The 4th character	D	H	L

To read the model number of the drive, use system ID command (x2h).
When command type code = 120h (or 12h) and index = 0,
the response byte15 shows the 4th character of the model number.

RTEX

About the RTEX

Advanced Network to realize high-precise real-time performance for Servo Control

Concept

High Performance & Low Cost

Simple

High Reliability

Easy Development

RTEX
Realtime Express

Panasonic INDUSTRY

System Structure

Internet

Ring Topology

Real-time Information of Devices

Master

Host Controller

HMI

Parameter Setting & Real-time Monitoring *

RTEX Realtime Express

CAT5e STP

MAX 100 m inter-node cable

Slave

Servo A6N

Up to 32-slave

Stepper Drive or Inverter

IN   OUT

Linear Motor

Partners provide various devices except servo.

* Depends on a host controller specification

High-Efficiency Ring Topology

Simple data flow effects High-Efficiency & Reliability.

LINE

RING (RTEX)

Master   Slave

Master   Slave

1 **2** **3** **4**

1 **2** **3** **4**

7 **6** **5**

8

5
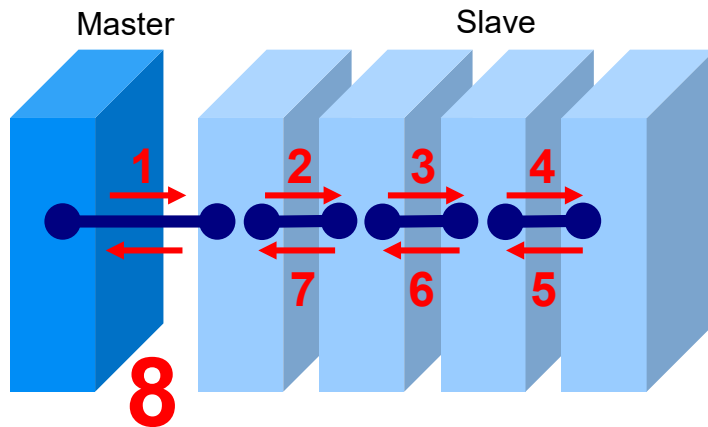
Bi-directional

Simple One-way

Going via many nodes causes low efficiency.
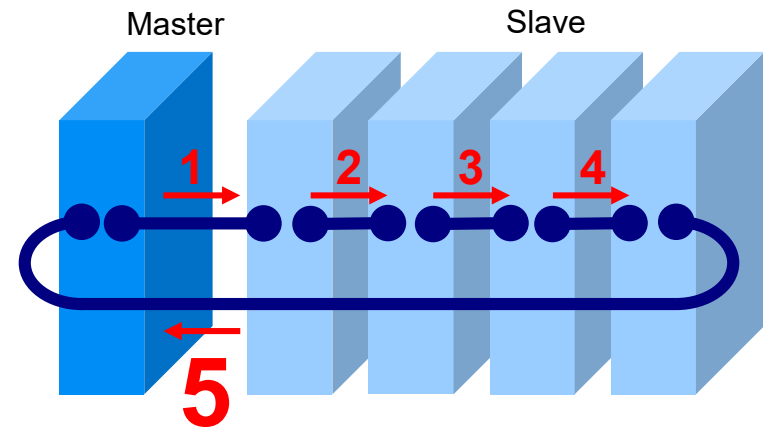
Additional benefit:
With using only one pair signal in a cable, there is no cross-talk which sometimes causes troubles in high-speed communication.

Partners provide various devices.

All-in-One Motion I/F

Control Mode

Profile Position (PP)	Cyclic Position (CP)	Cyclic Velocity (CV)	Cyclic Torque (CT)
1xh	2xh	3xh	4xh

RTEX Command Code

Target Pos. Cmd. **Pos. Cmd.** **Vel. Cmd.** **Trq. Cmd.**

A6N

Motion Profile Generator

Pos. Ctrl.

Vel. Ctrl.

Trq. Ctrl.

M

Enc.

Target Vel.

Acc.

Dec.

Linear Enc.
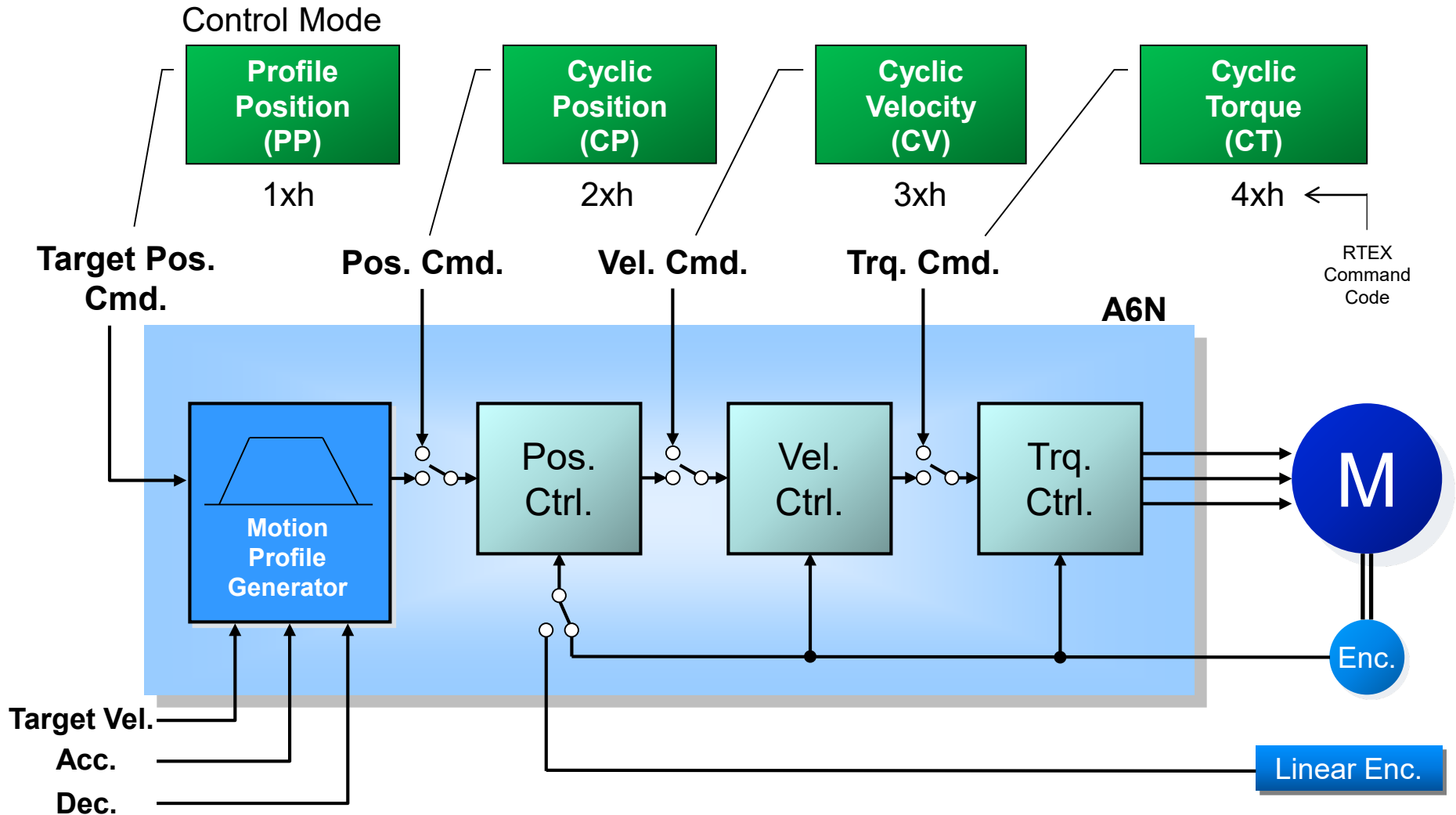
Note: Profile Position is applicable to only "Point to Point (PTP)" control.

Combination of Period, Axes and Modes

Update Period	Com. Period	Max. # of Axes (*)		Available Mode	Full-closed control
		16-byte Mode	32-byte Mode		
4.000 ms	2.000 ms	32	16	PP, CP, CV, CT	✓
2.000 ms	2.000 ms	32	16	PP, CP, CV, CT	✓
2.000 ms	1.000 ms	32	16	PP, CP, CV, CT	✓
1.000 ms	1.000 ms	32	16	PP, CP, CV, CT	✓
1.000 ms	0.500 ms	32	16	PP, CP, CV, CT	✓
0.500 ms	0.500 ms	32	16	PP, CP, CV, CT	✓
0.500 ms	0.250 ms	16	-	PP, CP, CV, CT	
0.250 ms	0.250 ms	16	-	PP, CP, CV, CT	
0.250 ms	0.125 ms	8	-	CP, CV, CT	
0.125 ms	0.125 ms	8	-	CP, CV, CT	
0.125 ms	0.0625 ms	4	-	CP, CV, CT	

Extended

Previous

Typical

Extended

Com. Period: Frame transmitting period
Update Period: Data inside the frame updating period

* If some devices except servo is also connected on RTEX, this number is decreased.

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Update and Communication Period

Shorter communication period makes quick response.

1:1

Update Period

time

n   n+1   n+2

Controller Calculation

Data Exchange

Com. Period

n   n+1   n+2

Communication Frame

Servo Data Exchange

Command Flow   n   Response Flow   n+1   n+2

Data Exchange: Data reading and writing to com. IC

Responded Quickly

1:1/2

Update Period

n   n+1   n+2

Controller Calculation

Com. Period

n   n   n+1   n+1   n+2   n+2

Communication Frame

Servo Data Exchange

n   n   n+1   n+1   n+2   n+2
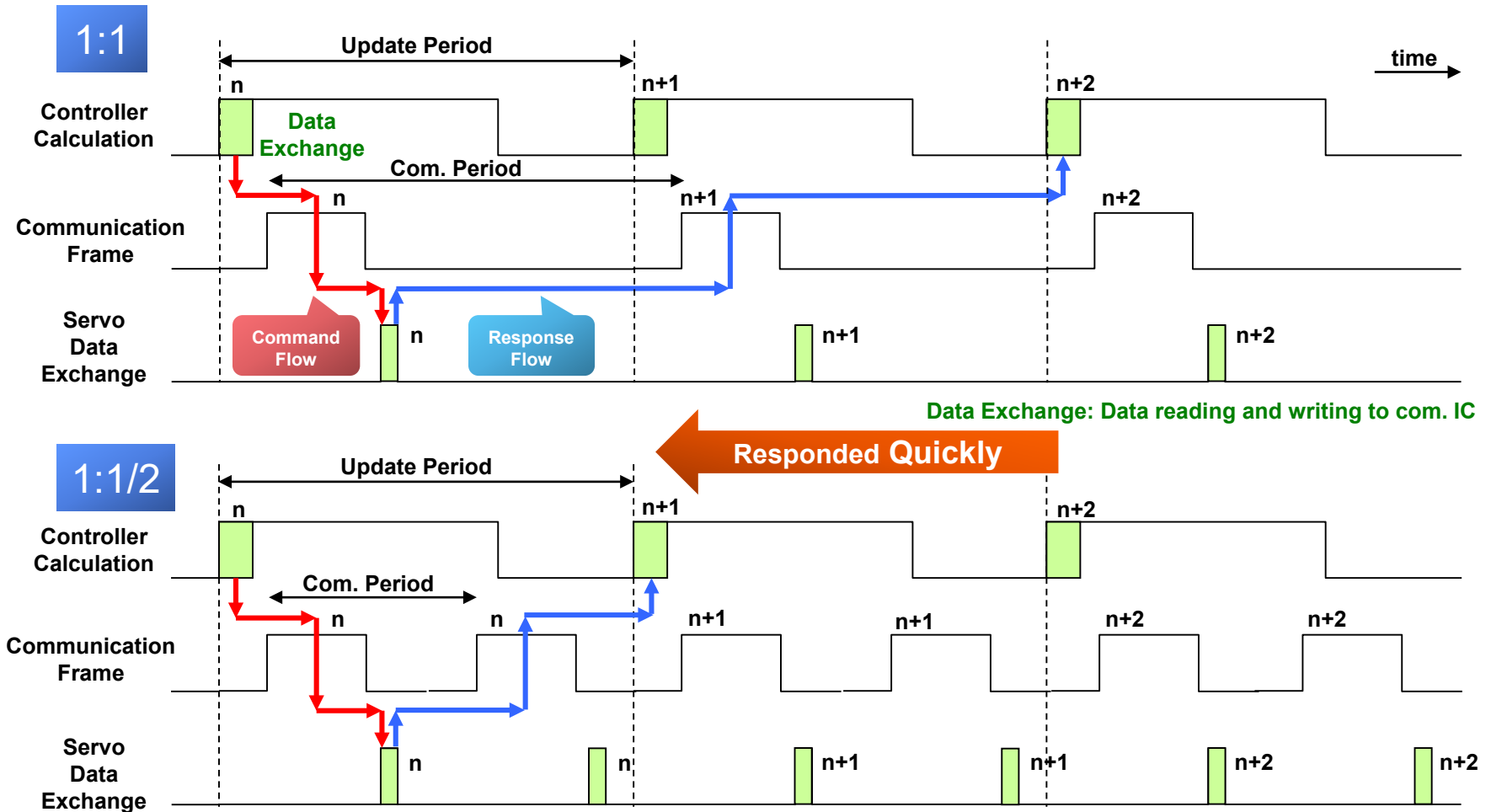
Note: The same command is transmitted two times. If previous command has communication error, the subsequent one is used in servo.

Shorter Update Period

More precisely on high-speed CP control in micro circular interpolation such as laser machine and LCD dispenser.

Y

Ideal Trace

Command Position

Pre-vious

Y

New A6N

X

X
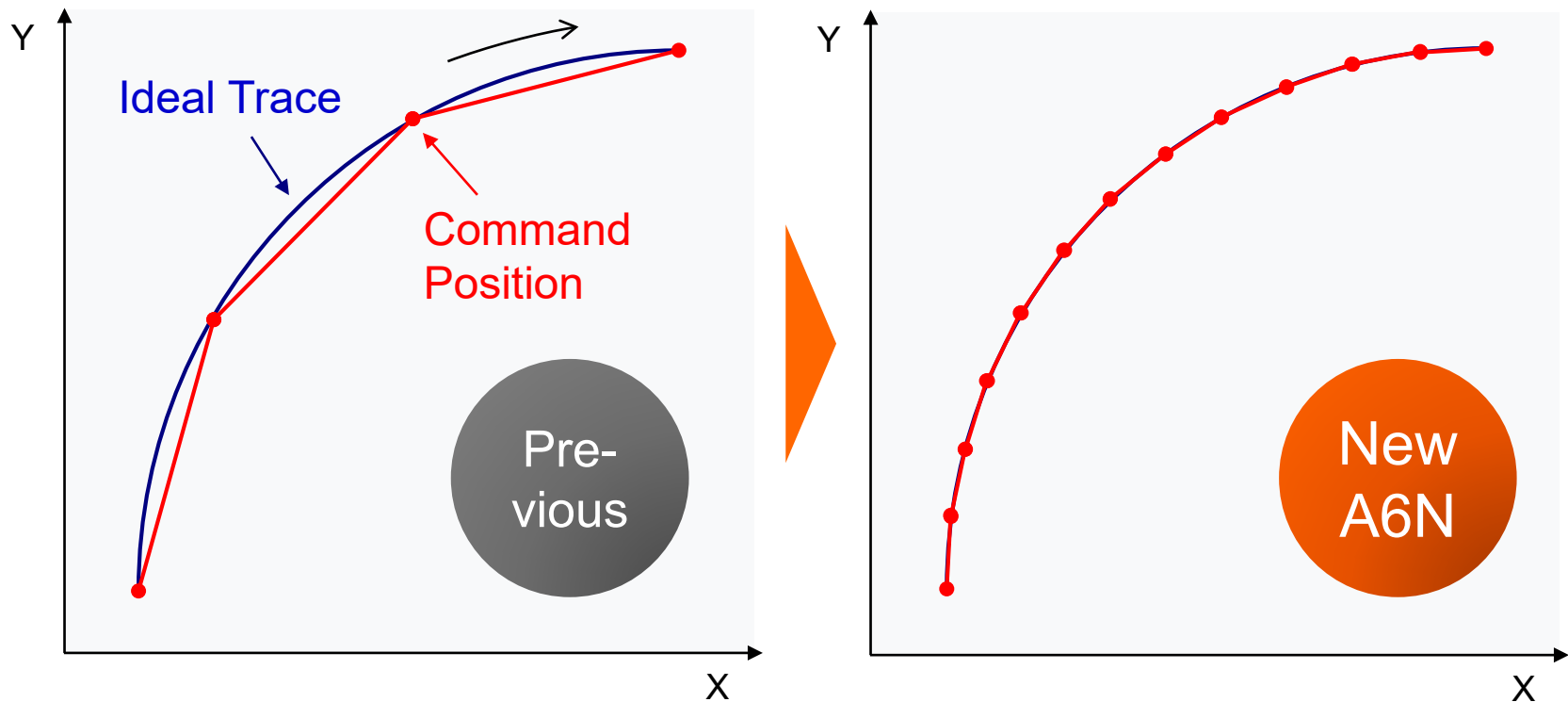
Increased the number of points per distance makes command position more smooth in addition to new high-resolution encoder.

Monitoring Item Examples

- Drive Model No.
- Drive Serial No.
- Firmware Version
- Motor Model No.
- Motor Serial No.

- Alarm Code (History)
- Warning Code

- Parameters

Host Controller

Servo A6N

RTEX
Realtime Express

- Actual Position
- Actual Velocity
- Torque
- Position Error
- Encoder Resolution
- Commanded Position
- Latched Position
- Commanded Velocity
- Re-Generative Ratio
- Over-Load Ratio
- Inertia Ratio
- Rotor Mechanical Angle
- Rotor Electrical Angle
- Absolute Multi-turn Data
- P-N Voltage
- RTEX Com. Error Count
- Encoder Com. Error Count
- X4 Connector I/O

- Power-ON Time
- Drive Temperature
- Encoder Temperature
- Relay Switch Times
- Fan ON Time
- Fan Life Time
- Capacitor Life Time

Panasonic INDUSTRY
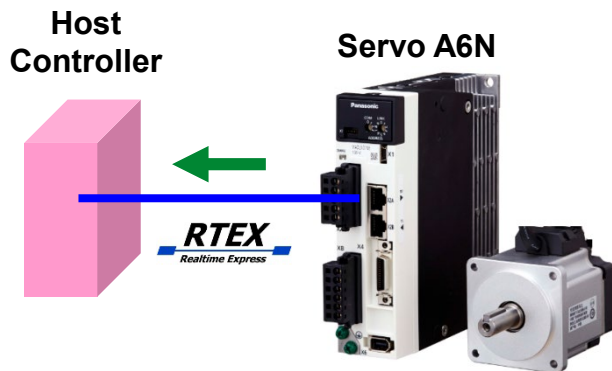
Precise Position Latch

After the encoder position is latched at trigger input,
it is sent to the host controller with RTEX.

Servo A6N

Host Controller

More detail timing
than update period

Latched Position

RTEX
Realtime Express

Encoder

Latch Trigger

At the trigger timing,
the encoder position
is latched precisely.

2ch available for trigger inputs
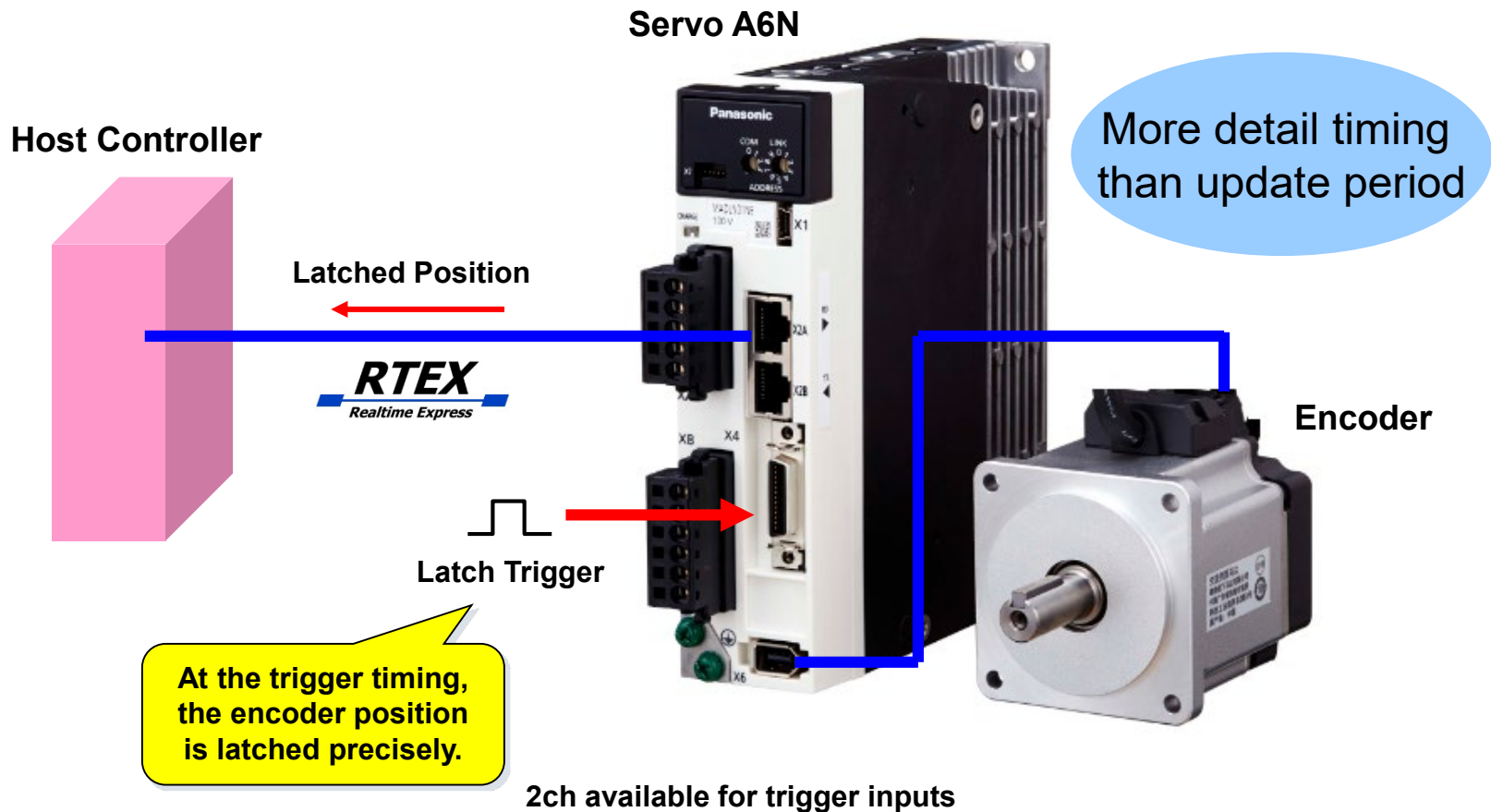
Feed-Forwards from Host Controller

High-resolution feed-forward from host controller
is effective for both high-response and low-vibration.

Host Controller

Servo A6N

Motion
Profile
Generator

Trq. FF

Vel. FF

Pos. CMD

RTEX
Realtime Express

Pos. Ctrl.		Vel. Ctrl.		Trq. Ctrl.
	+ +		+ +	

M

Enc
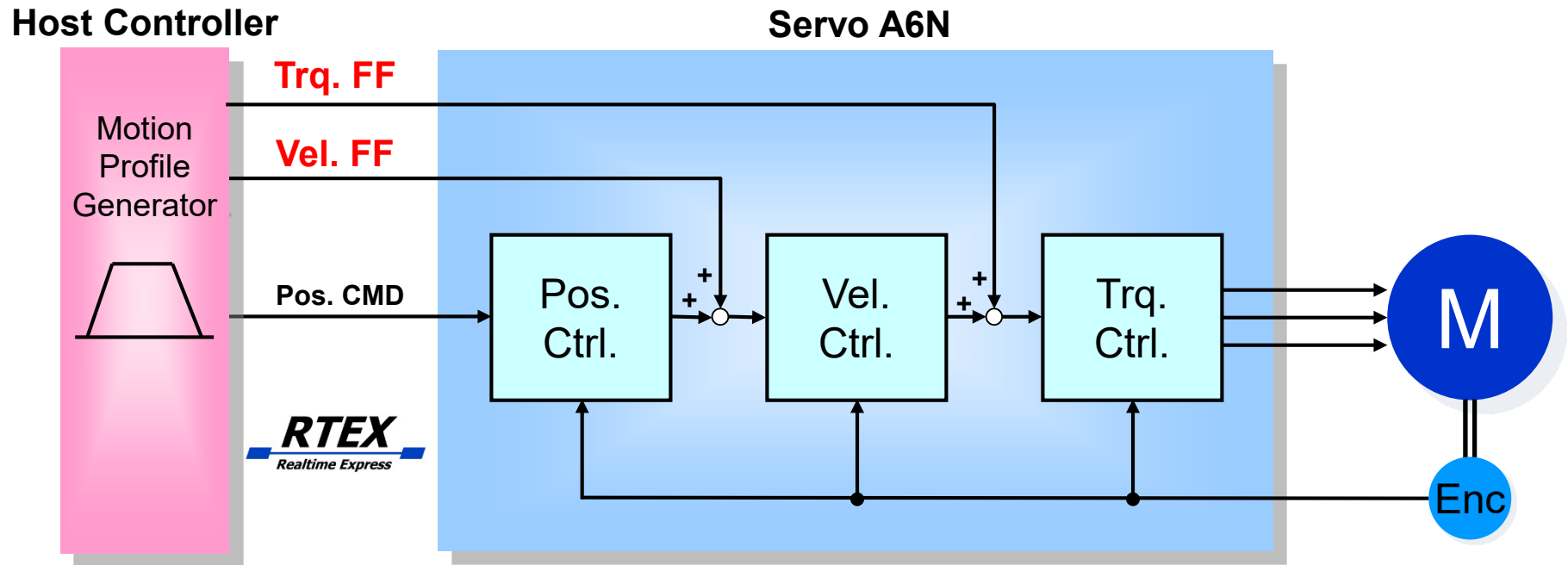
Notes:
- In 16-byte mode, either velocity or torque FF available.
- Torque FF is also useful for torque compensation in "Stick Motion" of circular interpolation.

RTEX Overview

Difference from Ethernet

Upper layer optimized for servo control

Lower Risk of Virus

Ethernet

e.g. HTTP SMTP FTP	e.g. DNS
TCP	UDP
IP	
IEEE802.3 or Ethernet Frame	
100BASE-TX	

Too large over-head

RTEX

Real-time Control Application

Real-time

ASIC control

Real-time Frame

100BASE-TX

Physical Layer is the same.
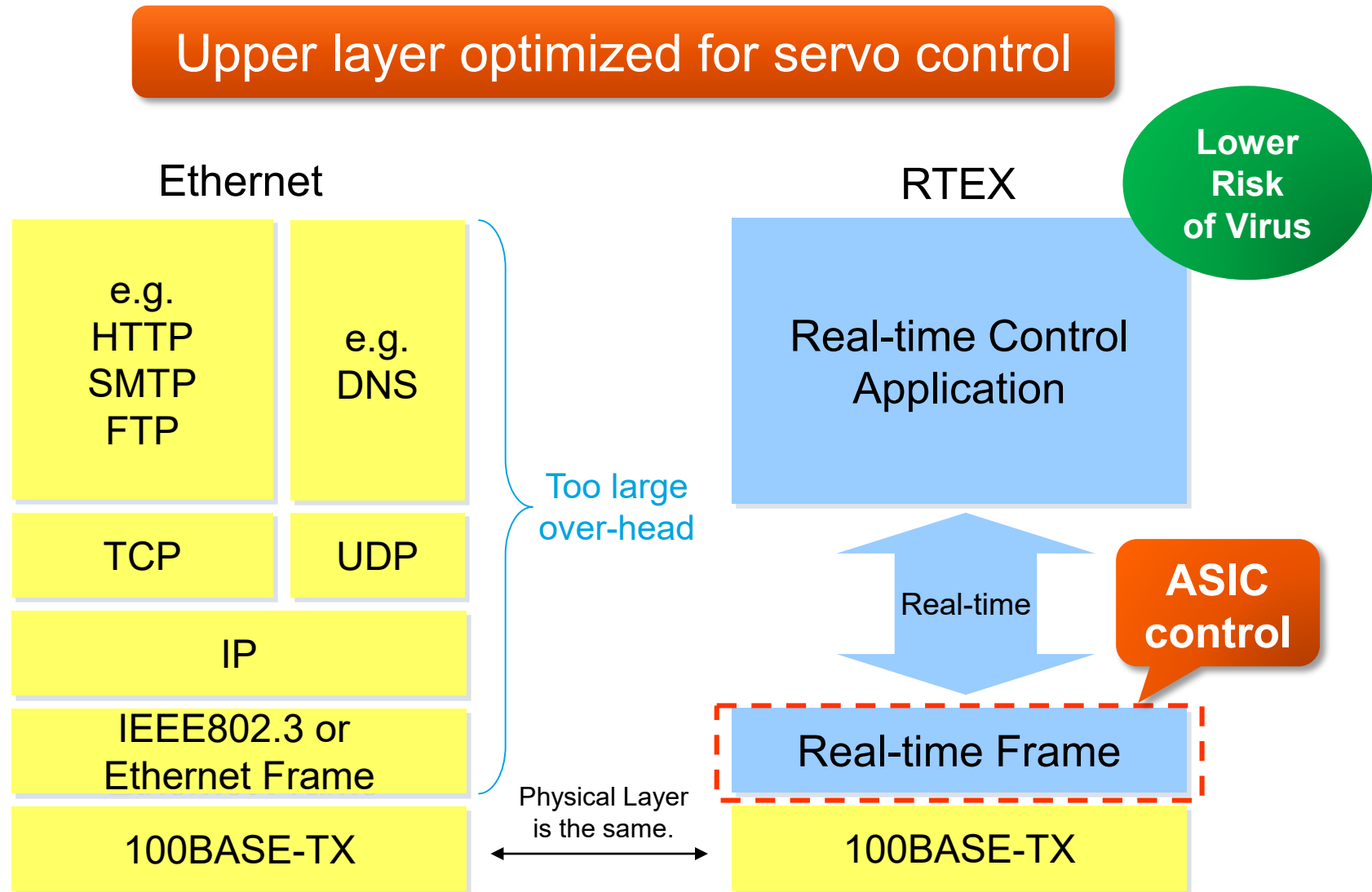
Note: Ethernet is a registered trademark of Xerox corporation.

Panasonic INDUSTRY

Efficient Frame

Simplified frame to realize high-speed real-time control

Ethernet

| Preamble, SFD (8-byte) | Ethernet Header (14-byte) | IP Header (20-byte) | TCP Header (20-byte) | Data |

62-byte

RTEX

| | RTEX Header | Data |

Too long header, inefficiency

Short header suitable for real-time ctrl.
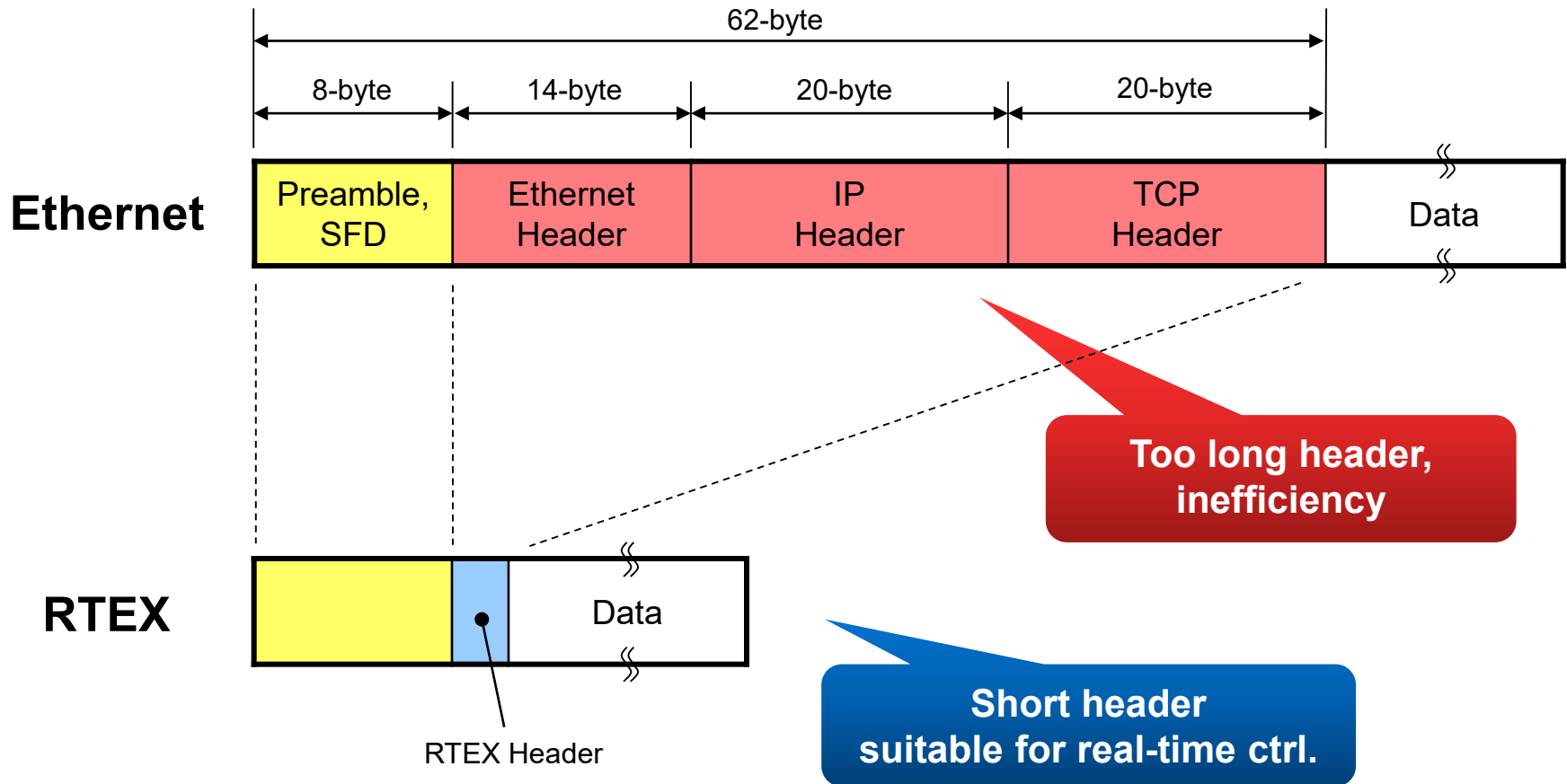
CP Control Needs Isochronous

PTP

Point To Point

CP

Continuous Path

Circular Interpolation

Linear Interpolation

An example of the same speed for both X and Y.

Isochronous is important.
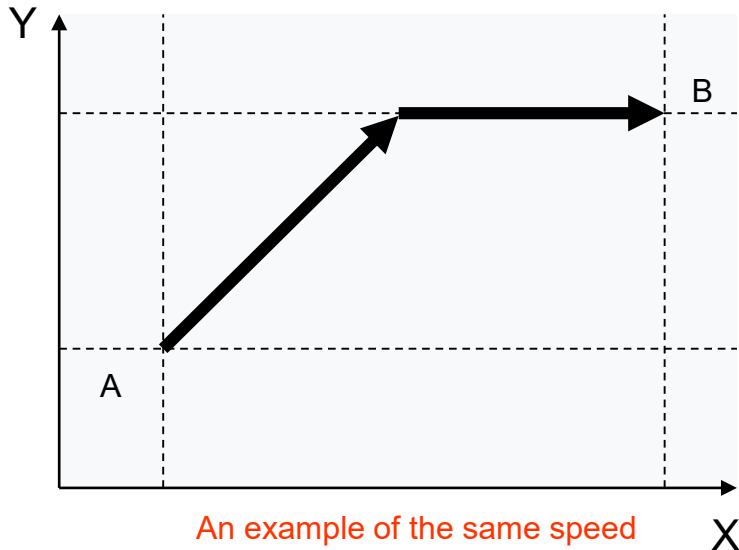
- Separately positioning
- Not corresponding Start/Stop timing between X and Y.
  (Only target position is important.)

- Synchronized positioning
- Corresponding Start/Stop timing
  (Route is important as well.)

e.g.) Semiconductor Machine

e.g.) Machine Tool, Robot

Note: CP control depends on a controller specification, and cannot perform with solely servo drive.

At the same time, commands reflected in all servos.

Time

Frame Receiving Timing XINTRX | Servo Control Reflection Timing XSYNC

Master | **Slave**

Host Controller
TX
RX

RX **Command** Servo Drive Axis #1
TX

RX **Command** Servo Drive Axis #2
TX

RX **Command** Servo Drive Axis #3
TX

RX **Command** Servo Drive Axis #4
TX

Although receiving timings are different among the axes, the command reflection timings are controlled to be the same.

Com. IC controls it automatically.

XINTRX and XSYNC are timing signals communication IC generates.

Isochronous Accuracy

Servo calculation start signals (XSYNC) inside each drive.

Axis #1

Axis #2

Axis #3

Axis #4

High Precision!

Jitter: +/- 70 ns
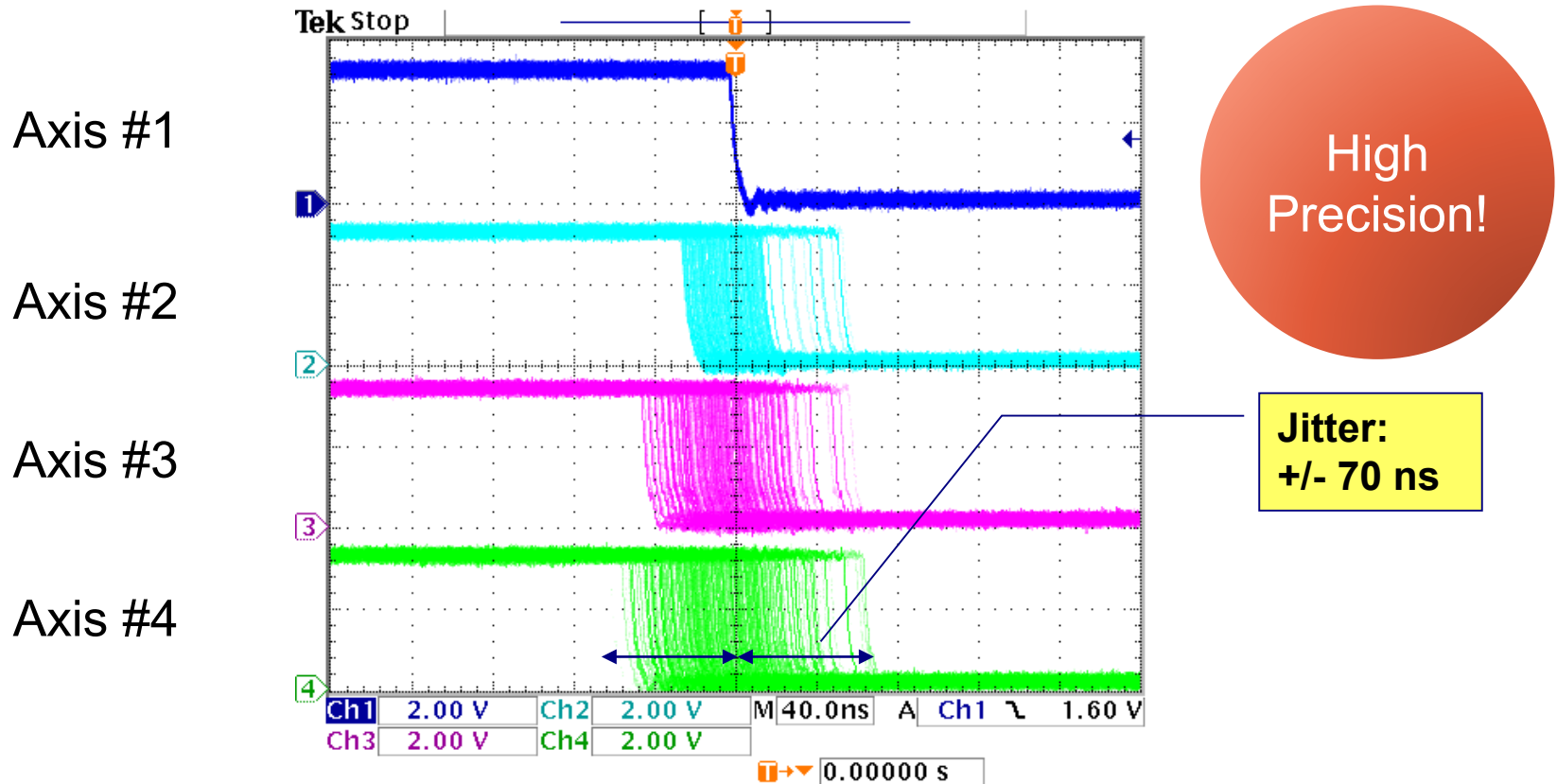
Note: Generally, the jitter less than 1 us is ideal.

The number of axes: 4
Cable length inter-node: 0.3 m

Fully Synchronization

NC in host controller is synchronized with all servo controls (position, velocity, current) by a unique patented algorithm.

Improvement of sync precision among axes!

	Pulse	RTEX
Servo Ctrl.	Async.	**All Axes Sync**

X2

X1
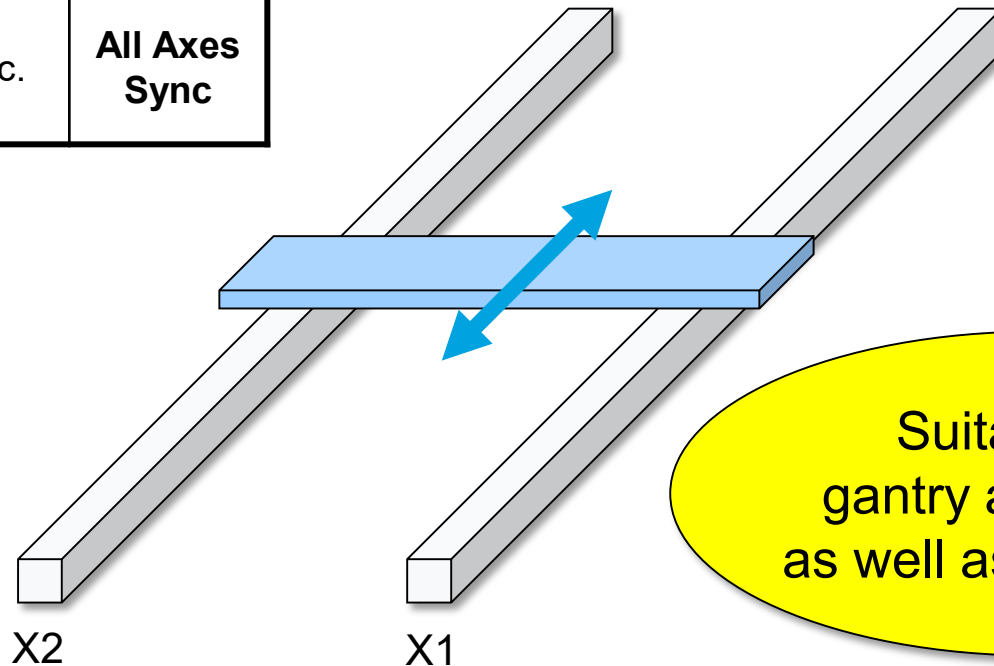
Suitable for
gantry application
as well as CP control.

Difference between Pulse and RTEX

Pulse

Host Controller (an example)

Motion Profile Gen.

Position Data

CPU → Pulse IC

INT

Timer

Servo

Pulse → Counter → Position Data → CPU

INT

Latch

Timer

Async.
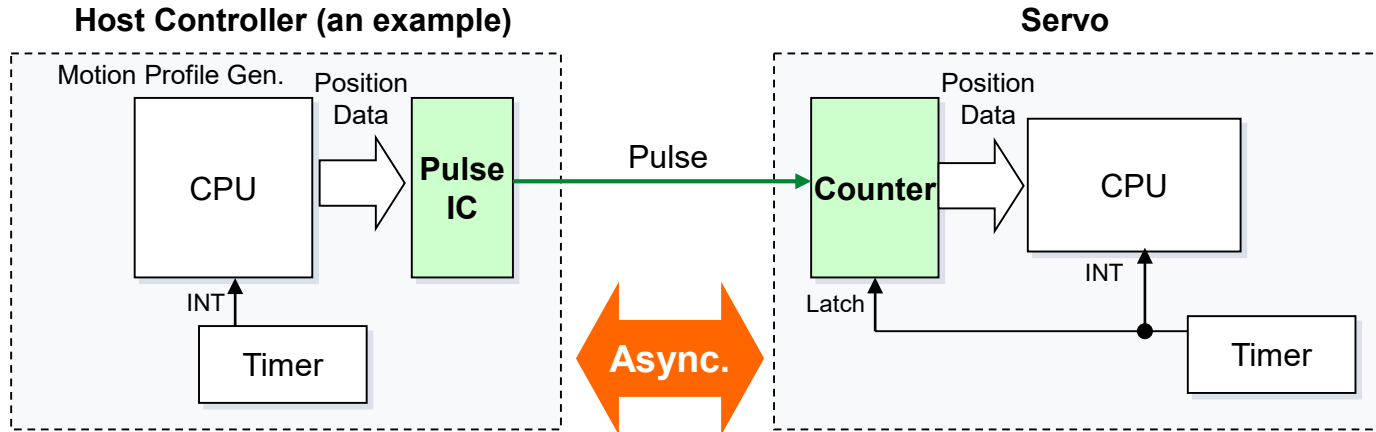
As each servo makes sampling independently, data reflected timings are different among the axes.

RTEX

Host Controller (an example)

Motion Profile Gen.

Position Data

CPU → Com. IC

INT

Timer

Transmit

Servo

Position Data → Com. IC → Position Data → CPU

INT

The same Timing

Sync.

Timer
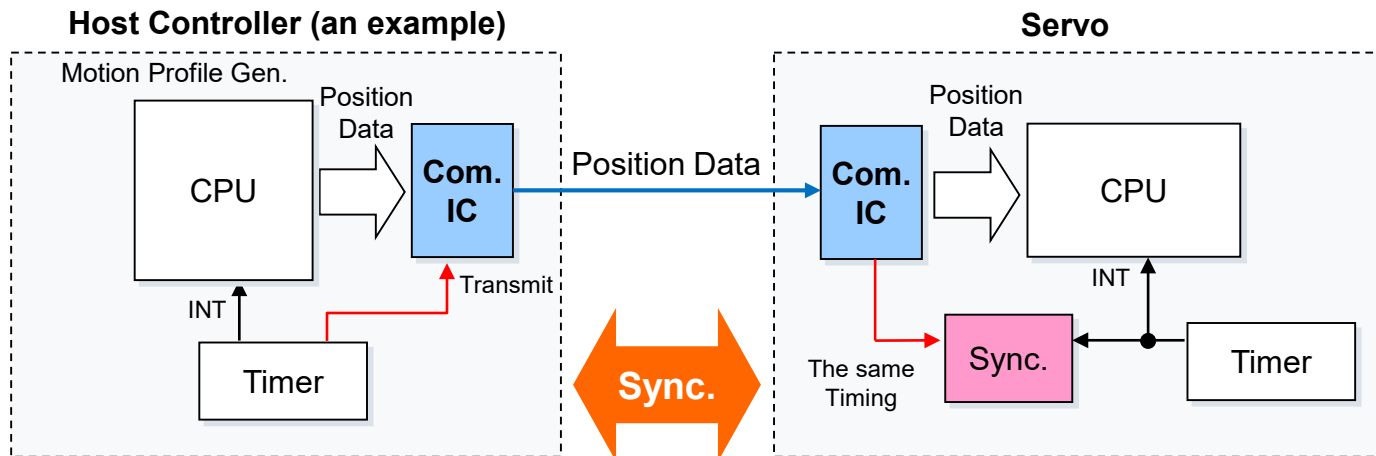
Sync.

As synchronized with communication, data is reflected at the same time in all axes.

Cyclic Position Command

Velocity

Pulse

Position Command
(*)

RTEX

Position Command
[pulse]

Time

Time

Time

Integrate

Differentiate

Command update period
(NC calculation period)

Position is absolute.
To prevent positioning error when data lost by communication error.

*Note.
In pulse I/F, the pulse frequency represents the product of position resolution and velocity. Since the frequency has the limitation of approximately 8 Mpulse/s by practical transmission, it determines the maximum resolution.
To get higher resolution of position command, network is necessary.

Less Wiring

Pulse

At least these wires necessary

Host Controller		Servo Drive		M	Slider

S-ON
PULS
SIGN
CLR
OZ
ALM

NOT · Home · POT
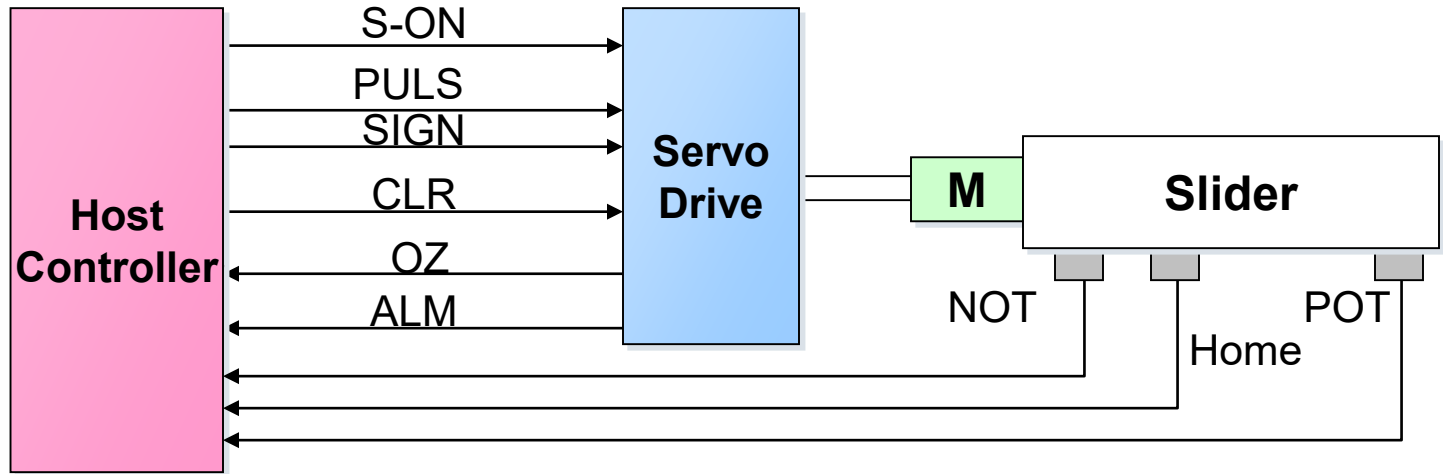
RTEX

Simple!

Wiring Trouble Reduced

RTEX Realtime Express

It is more effective that drive is placed near motor.

Without increasing wires, many information can be transmitted.

Host Controller — Servo Drive — M — Slider

NOT · Home · POT

Sensors are tied to servo.
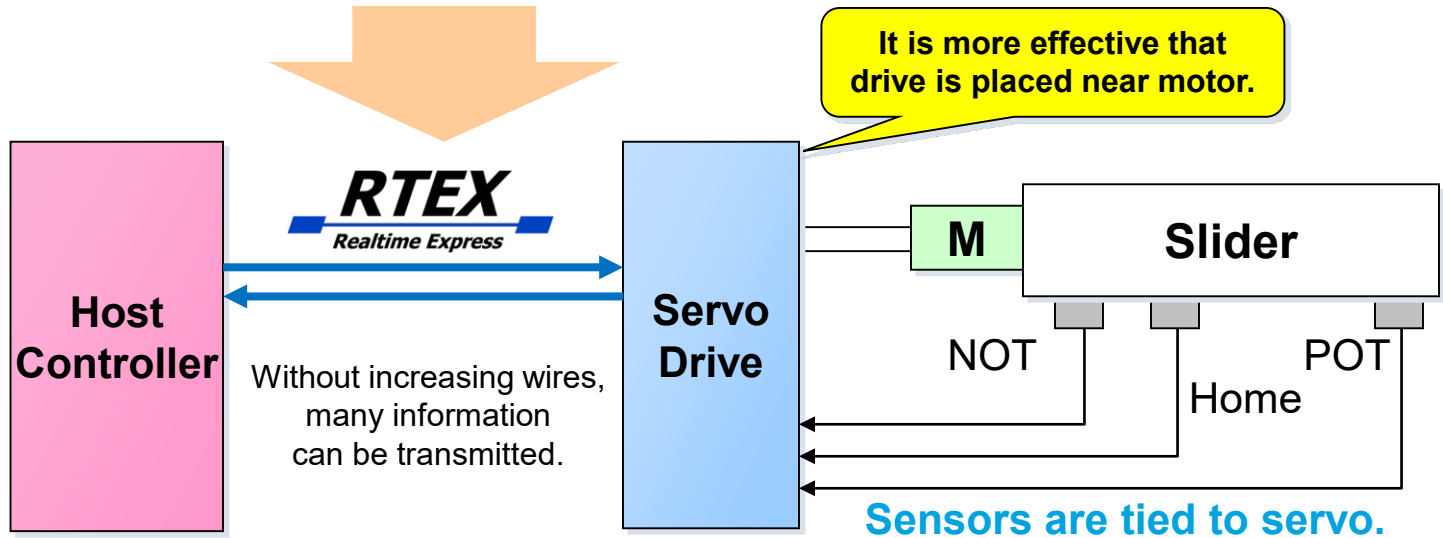
Error Correction

Error corrected at going through each node.

▶ Strong Noise Immunity

Master
Slave

Data Broken

TX → RX

Error Corrected

RX ← TX

Restored

RX

TX

Since error is not accumulated, it is effective in many nodes system.

Data Broken

RX

Error Corrected

TX

Restored

RX

TX

In normal communication, when data broken, correct data cannot be transmitted until next cycle.
In RTEX, the error correction keeps real-time performance in such a situation.
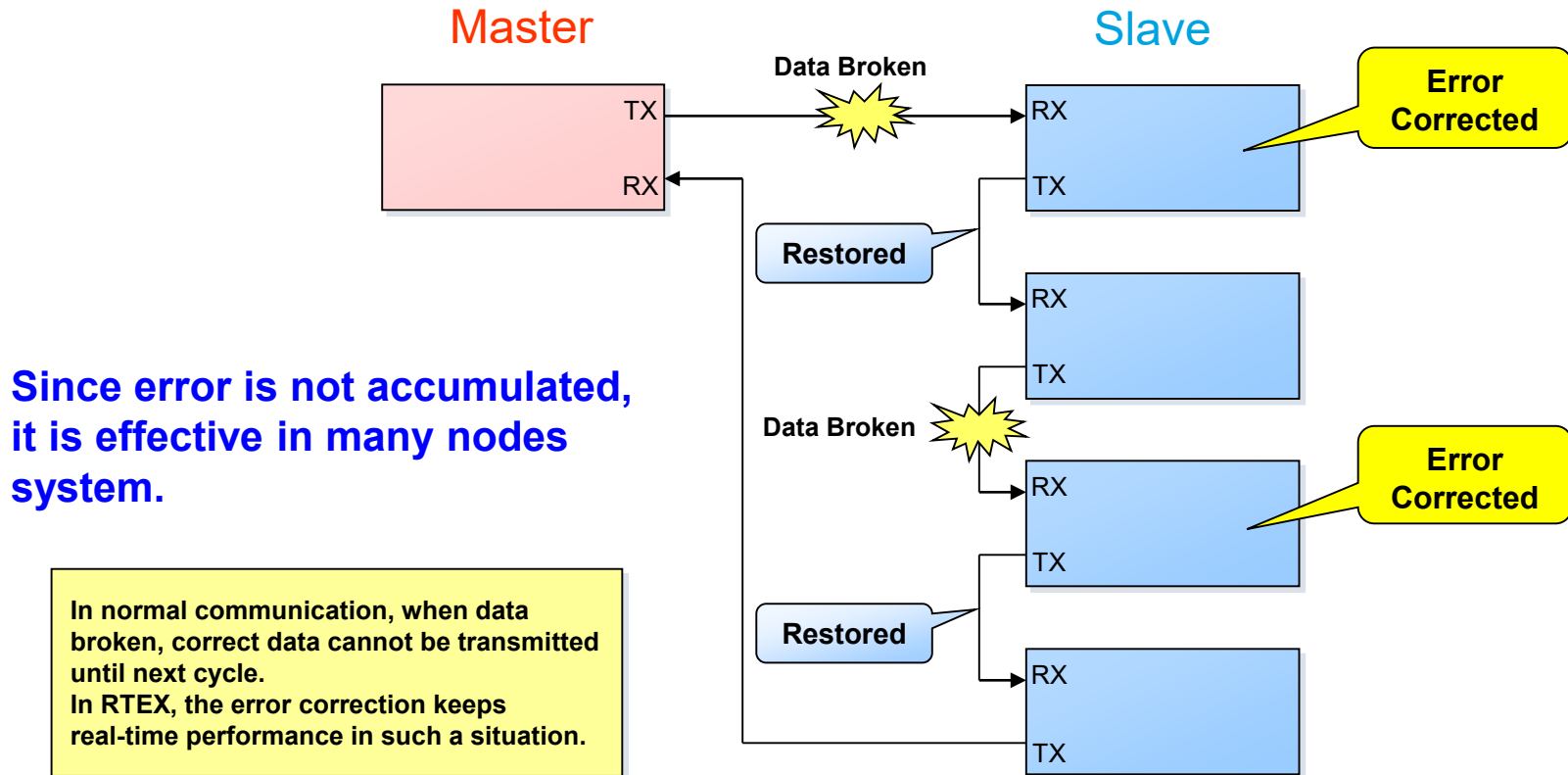
Note: The error correct ability has limitations, so there is a case where it cannot restore broken data.

RTEX Specifications

Item	Specifications
Speed	100 Mbps
Physical Layer	100BASE-TX Full-duplex by IEEE 802.3u
Cable	Shielded Twisted Pair by TIA/EIA-568B CAT5e
Topology	Ring
Isolation	Pulse Transformer with common-mode choke
Connector	8-pin RJ45 by IEC 60603-7
Cable Length	Inter-node: Max. 100 m, Total: Max. 200 m
Noise Immunity	2.5 kV over, IEC 61000-4-4 Level4 compliant
Com. Period *	2 to 0.0625 ms
Update Period *	4 to 0.125 ms
Number of Axes *	Up to 32
Motion Interface *	Profile Position, Cyclic Position / Velocity / Torque

* Depending on host controller specification.

Test Operation

System Example
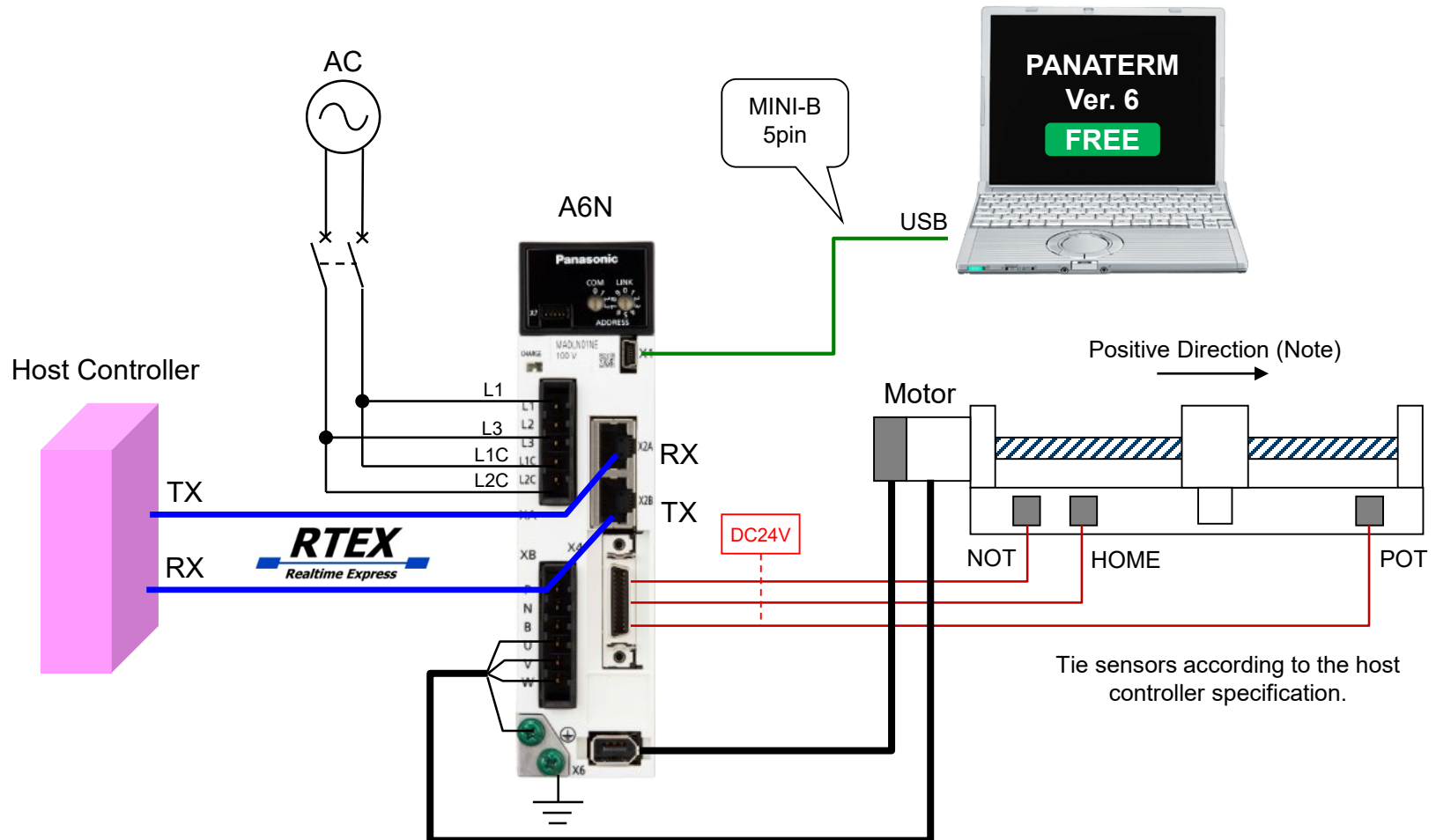
Note: With Pr0.00, it is defined.

Servo Settings

Parameter settings are depend on host controller specification.
At least the followings must be set.

Part	Item
Front Panel	Node Address
Pr0.00	Positive Direction
Pr0.01	Control Mode
Pr0.08 - 0.10	Electronic Gear
Pr0.15	Absolute Encoder
Pr4.00 - 4.12	I/O Assignment (If necessary)
Pr5.04	Limit Inputs
Pr7.20 - 7.21	Com. and Update Period
Pr7.22	16-byte/32-byte Mode Selection
Pr7.23	Response Byte3 Structure
Pr7.25	RTEX Speed Unit

Notes:
1. In some host controller, parameters are automatically set with RTEX.
2. After setting parameters, write them into EEPROM and turn power off and on.

Operation

After making sure of correct wiring, power ON.
(Turning-on sequence depends on controller spec.)

When both LINK and COM LED indicate green,
RTEX communication is established.

According to host controller specification,
Servo-ON and Start.

Gain tuning with PANATERM.

Front Panel

7-segment LED

COM LED (Red / Green)

LINK LED (Green)

Node Address Setting Rotary Switch Range: 00 - 31

Pin #1

Analog Monitor Connector
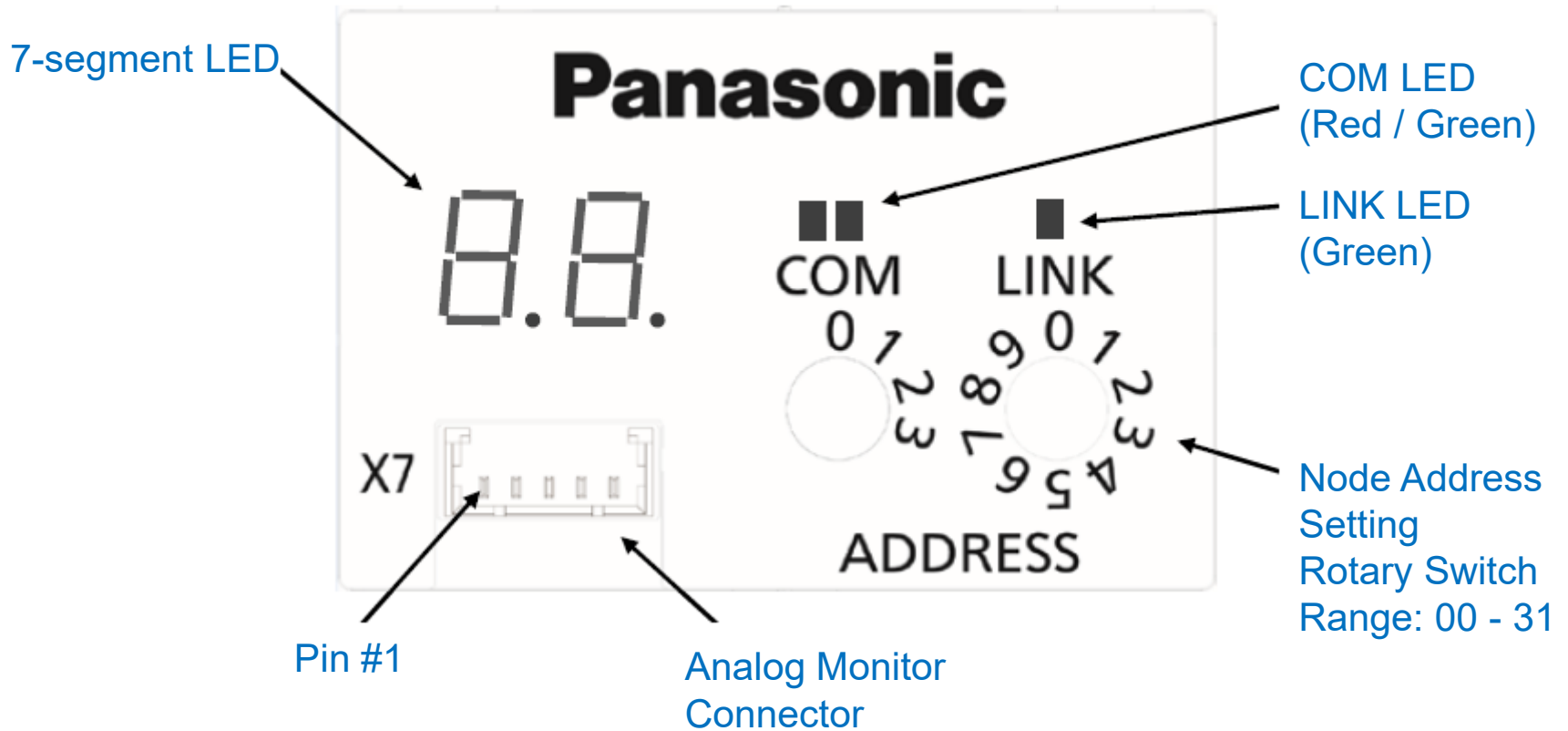
LINK / COM LED

LINK

		RTEX State
OFF	⬛	Not Link Cause: - Wiring problem between my RX and previous TX. - Power-OFF of previous node.
Solid Green	🟩	Good

Note: During reset, Green is indicated.

COM

		RTEX State
OFF	⬛	INITIAL
Blinking Green	🟩⬛	CONFIGURATION
Solid Green	🟩	RUNNING (Cyclic Transmission) *
Blinking Red	🟥⬛	Drive has detected a clearable alarm for RTEX.
Solid Red	🟥	Drive has detected an unclearble alarm for RTEX, and needs reset.

* If setting Pr7.23 bit4 to 1, it is Flashing Green in RUNNING state when servo control is not synchronized with communication yet.

Panasonic INDUSTRY

7-segment LED

Normal

Servo Ready and RTEX established / Not Ready or Not established

Servo ON / Servo OFF

Note:
At power-on, node address is displayed for a moment before this indication.

Alarm / Cleared

Waring / Cleared

Alarm

Main Code   **Sub Code**

All segments blinking

Warning

Warning Code (2s)   **Normal (4s)**

Only right dot blinking
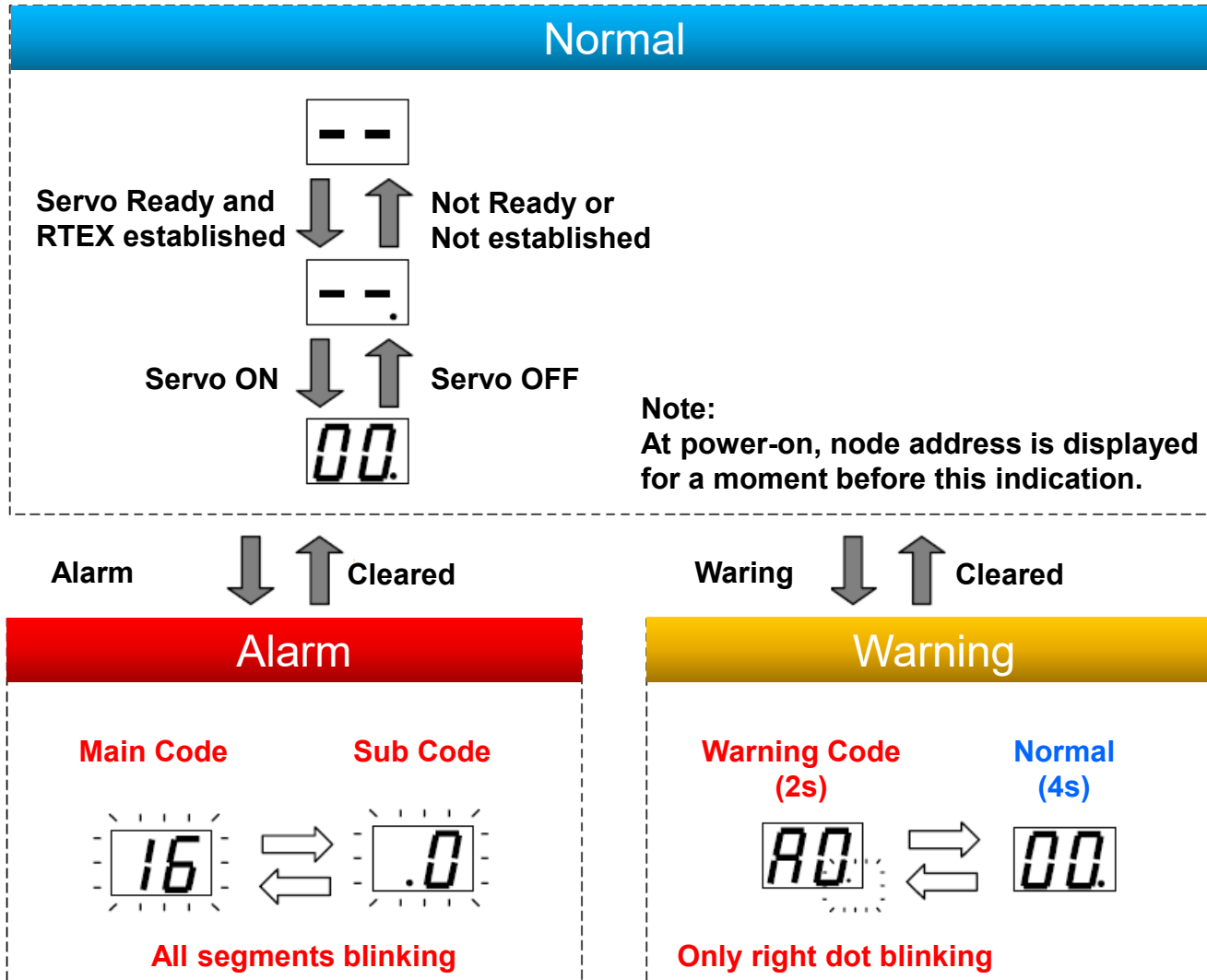
Parameter Setting

Download PANATERM from the following web site:
https://industrial.panasonic.com/ww/products/motors-compressors/fa-motors/ac-servo-motors/minas-a5-panaterm

Positive Direction

With Pr0.00, define positive direction.

Pr0.00 *	Title	Rotational direction setup			Related control mode	P	S	T	F
	Range	0 to 1	Unit	—	Default	1			

Setup the relationship between the direction of command and direction of motor rotation.

0: Motor turns CW in response to positive direction command (CW when viewed from load side shaft end)

1: Motor turns CCW in response to positive direction command (CCW when viewed from load side shaft end)

Positive direction (CCW) — Negative direction (CW)

Default

| Setup value	Command direction	Motor rotational direction	Positive direction drive inhibit input	Negative direction drive inhibit input
0	Positive direction	CW	Valid	—
	Negative direction	CCW	—	Valid
1	Positive direction	CCW	Valid	—
	Negative direction	CW	—	Valid

Control Mode

In the standard type (Type E), set Pr0.01 to 0.
The multi-functional type (Type F) supports full-closed control as well.

	Semi-Closed	Full-Closed
Pr0.01	0	6

A6N type F

Full-Closed Control

Motor

Rotary Encoder

Linear Encoder

X5: Serial or A/B/Z

X6: Serial
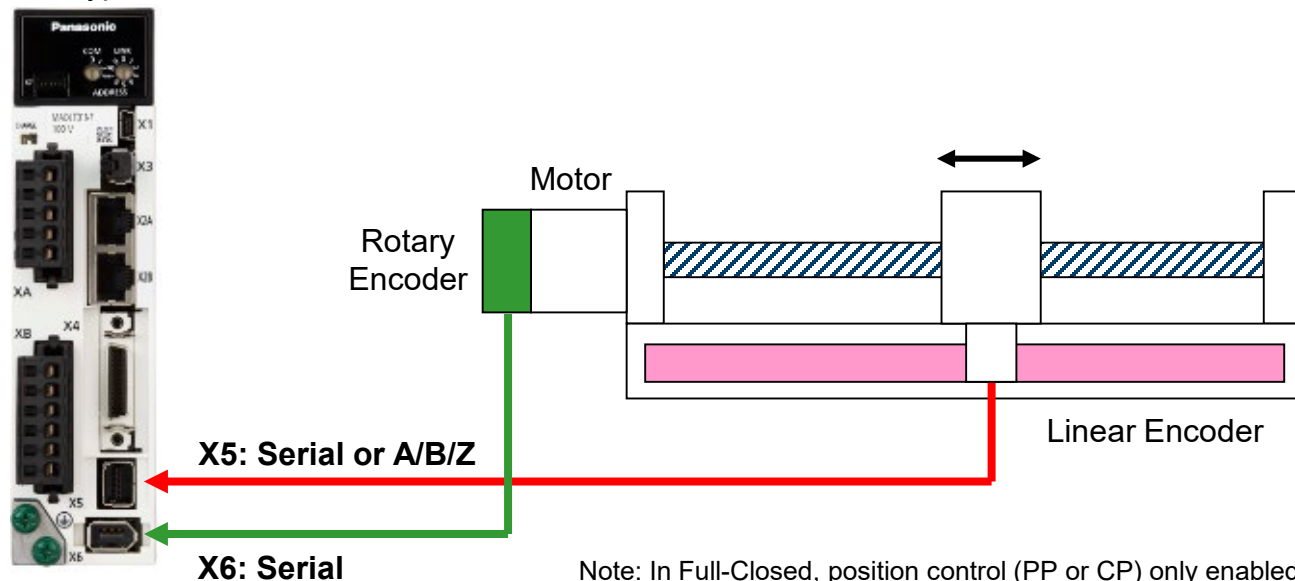
Note: In Full-Closed, position control (PP or CP) only enabled.

Electronic Gear

e.g.) When commanding as 10000 pulse/r (A4N incremental equivalent),
   then set the followings:

Pr0.08 = 0, Pr0.09 = 0, Pr0.10 = 10000

Pr0.08	Pr0.09	Pr0.10	Command division/multiplication operation
0	0	0 to 1073741824	Command pulse input → [Encoder resolution / [Pr0.10 setup value]] → Positional command. * When Pr0.09 is set to 0, this operation is processed according to setup value of Pr0.10.
	1 to 1073741824	1 to 1073741824	Command pulse input → [[Pr0.09 setting] / [Pr0.10 setting]] → Positional command. * When Pr0.09≠0, this operation is processed according to setup value of Pr0.09 and Pr0.10.

In addition, adjust the FIR filter (Pr2.23) to smooth out the position command.

Multiplication makes stepwise. → Pos. cmd. FIR filter → Smooth!
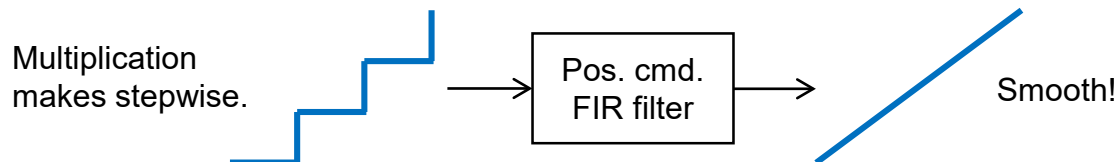
Absolute Encoder Setting

With Pr0.15, set an application for 23-bit absolute encoder.

Pr0.15	Absolute encoder setup	Range	Unit	Default	Related control mode
		0 to 4	—	1	P S T

Value	Description	Battery
0	Using as absolute system.	Necessary
1	Using as incremental system.	Unnecessary
2	Using as absolute system. Ignores multi-turn count overflow.	Necessary
3	Using as single-turn absolute system. Multi-turn is not used.	Unnecessary
4	Using as absolute system. Pr6.88 is set as maximum value of multi-turn data. Wrap-around as follows: - When multi-turn data is at upper limit, positive rotation changes the data to zero. - When multi-turn data is at zero, negative rotation changes the value to the upper limit.	Necessary

Note: Setting value 4 is for the infinitely rotatable absolute function.

Panasonic INDUSTRY

IN-signals Assignment

Default settings:

	X4 Name	X4 Pin #	Setting Value (hex)	Setting Signal	Setting Logic
Pr4.00	SI1	5	00323232h	SI-MON5	Normally Open
Pr4.01	SI2	7	00818181h	POT	Normally Closed
Pr4.02	SI3	8	00828282h	NOT	Normally Closed
Pr4.03	SI4	9	002E2E2Eh	SI-MON1	Normally Open
Pr4.04	SI5	10	00222222h	HOME	Normally Open
Pr4.05	SI6	11	00212121h	EXT2	Normally Open
Pr4.06	SI7	12	002B2B2Bh	EXT3	Normally Open
Pr4.07	SI8	13	00313131h	SI-MON4	Normally Open

Note: If homing with edge of HOME, POT or NOT, the assignment must be HOME:SI5, POT:SI6 and NOT:SI7. If not so, alarm occurs.

OUT-signals Assignment

Default settings:

	X4 Name	X4 Pin #	Setting Value (hex)	Setting Signal	Remark
Pr4.10	SO1+ SO1-	1 2	00030303h	BRK-OFF	If changing to EX-OUT2, set to 00111111h.
Pr4.11	SO2+ SO2-	25 26	00101010h	EX-OUT1	
Pr4.12	SO3+ SO3-	3 4	00010101h	ALM	Normally Closed

Panasonic INDUSTRY

Limit Operation

With setting Pr5.04 to 1, limit input operation by servo should be disabled because such a operation is normally done by host controller.
Even if disabled, limit inputs status can be monitored via RTEX with Pr7.23 setting.

Pr5.04 *	Title	Over-travel inhibit input setup			Related control mode	P	S	T	F
	Range	0 to 2	Unit	—	Default	1			

Set up the operation of the run-inhibition (POT, NOT) inputs.

Setup value	Operation
0	POT → Inhibit positive direction travel NOT → Inhibit negative direction travel
1	Disable POT, NOT
2	POT or NOT input activates Err38.0 Run-inhibition input protection.

Communication and Update Period

Since setting way is changed from A5N and A4N, new Pr7.91 is added.
To keep the compatibility, previous Pr7.20 can be used as well.

No.	Attr.	Name	Range	Unit	Description
7.20	R	RTEX Communication Period (Old)	-1 to 12	-	-1: Using Pr7.91 3: 0.5 ms 6: 1 ms Else: Do not set.
7.21	R	RTEX Ratio of Command Update Period	1 to 2	-	Command Update / Communication Period
7.91	R	RTEX Communication Period (New)	0 to 2000000	ns	62500 125000 250000 500000 1000000 2000000 Else: Do not set. It causes Err93.5.

Communication and Update Period (Cont.)

Update Period [ms]	Com. Period [ms]	Parameter Setting Value			Remark
		Pr7.20	Pr7.21	Pr7.91	
4.000	2.000	-1	2	2000000	
2.000	2.000	-1	1	2000000	
2.000	1.000	-1	2	1000000	
1.000	1.000	-1	1	1000000	Pr7.20 = 6, Pr7.21 = 1 also allowed.
1.000	0.500	-1	2	500000	Pr7.20 = 3, Pr7.21 = 2 also allowed.
0.500	0.500	-1	1	500000	Pr7.20 = 3, Pr7.21 = 1 also allowed.
0.500	0.250	-1	2	250000	
0.250	0.250	-1	1	250000	
0.250	0.125	-1	2	125000	
0.125	0.125	-1	1	125000	
0.125	0.0625	-1	2	62500	

Default Setting ⬅

16-byte/32-byte Mode

Pr7.22

It depends on host controller specifications.

Title	Unit	Range	Size [byte]	Function / Contents	Attribute	Related control mode
RTEX function extended setup 1	—	-32768 −32767	2	bit 0: Set up RTEX communication data size 0: 16-byte mode, 1: 32-byte mode bit 1: Specifies synchronization mode among multiple axes using TMG_CNT. 0: Semi-synchronization among axes, 1: Full synchronization among axes. bit 2: For manufacturer's use. Always set to 0. bit3: unused. Always set to 0. bit4: A setup of the external scale position information monitoring facility at the semi-closed control 0: Invalid 1: Valid *When communication period is below 0.1666 [ms] or less, does not correspond. (except for NOP) *Full-close control is not related to a setup of this bit, external scale position information can be monitored. ·Set up the RTEX communication cycle properly according to the specifications of the host device. If the parameter is not proper, the operation is not be guaranteed.	R	All

Panasonic INDUSTRY

RTEX Response byte3

Setting for external input status from X4 connector.

Response byte3:

Byte	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
3	SI-MON5 /E-STOP	SI-MON4 /EX-SON	SI-MON3 /EXT3	SI-MON2 /EXT2	SI-MON1 /EXT1	HOME	POT /NOT	NOT /POT

With Pr4.00 to 4.07, set the correspondence to X4 connector inputs.

	Name	Range	Description
Pr7.23	RTEX Functional Expansion 2	-32768 to 32767	bit2: In POT/NOT disabled (Pr5.04=1), its status response activation. 　　0: Status enabled 　　1: Status disabled (Always 0) bit3: Arrangement of POT/NOT status. 　　0: POT is bit1, NOT is bit0 　　1: NOT is bit1, POT is bit0 bit6: Logic of POT/NOT status. 　　0: Positive logic, Active is 1 　　1: Negative logic, Active is 0

Select according to the controller specification.

Limit Sensors Wiring

A4N

Regardless of parameter setting, physical layout decides wiring.

CW direction →

X5 Connector

CCWL   CWL
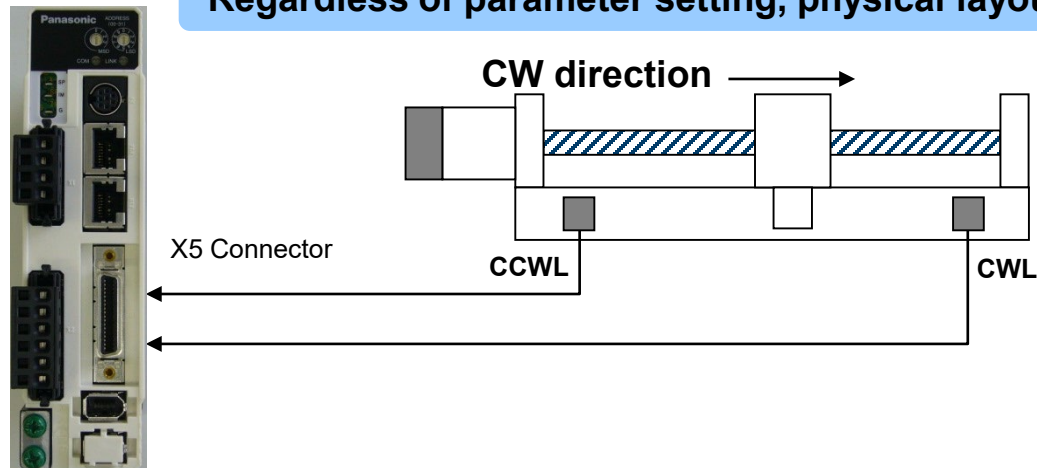
A5N / A6N

According to parameter setting, wiring is changed.

Positive direction (Note) →

X4 Connector

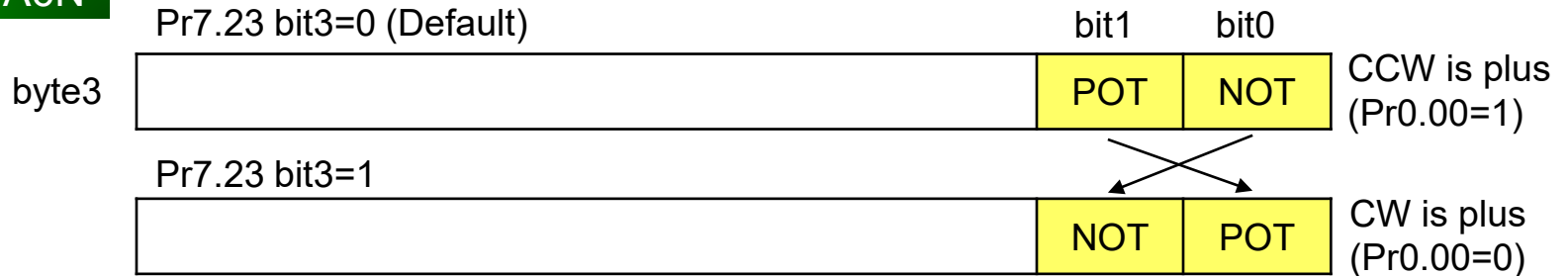NOT   POT
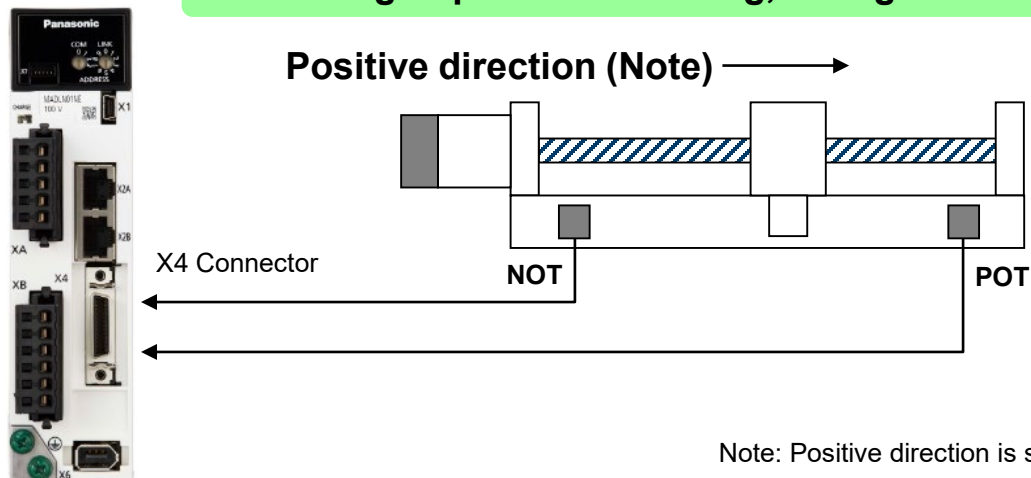
Note: Positive direction is set with Pr0.00.

RTEX Response Bit Layout for Limit Flags

Even if A4N is used in default setting for bit layout of limit flags,
the default parameter must be changed in A5N or A6N when using CW is plus.

A4N

Default | | bit1 | bit0

byte3

| | | CCWL | CWL |

A5N / A6N

Pr7.23 bit3=0 (Default) | | bit1 | bit0

byte3

| | | POT | NOT | CCW is plus (Pr0.00=1)

Pr7.23 bit3=1

| | | NOT | POT | CW is plus (Pr0.00=0)
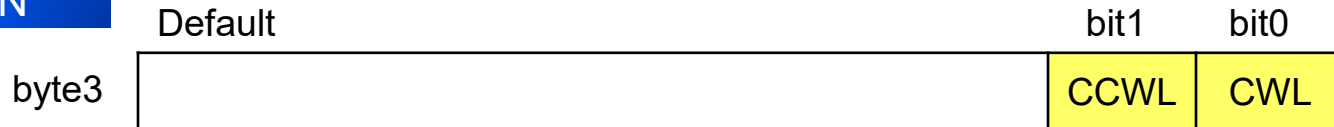
Parameters:

	A4N	A5N / A6N
Positive Direction	Pr43	Pr0.00
Bit layout of Limit Flags	Pr43	Pr7.23, bit3

RTEX Devices Development

RTEX Circuit Example

100BASE-TX Physical Layer + ASIC

PHY   ASIC   CPU

RTEX Circuit

Pulse Transformer   RJ45   Status LED
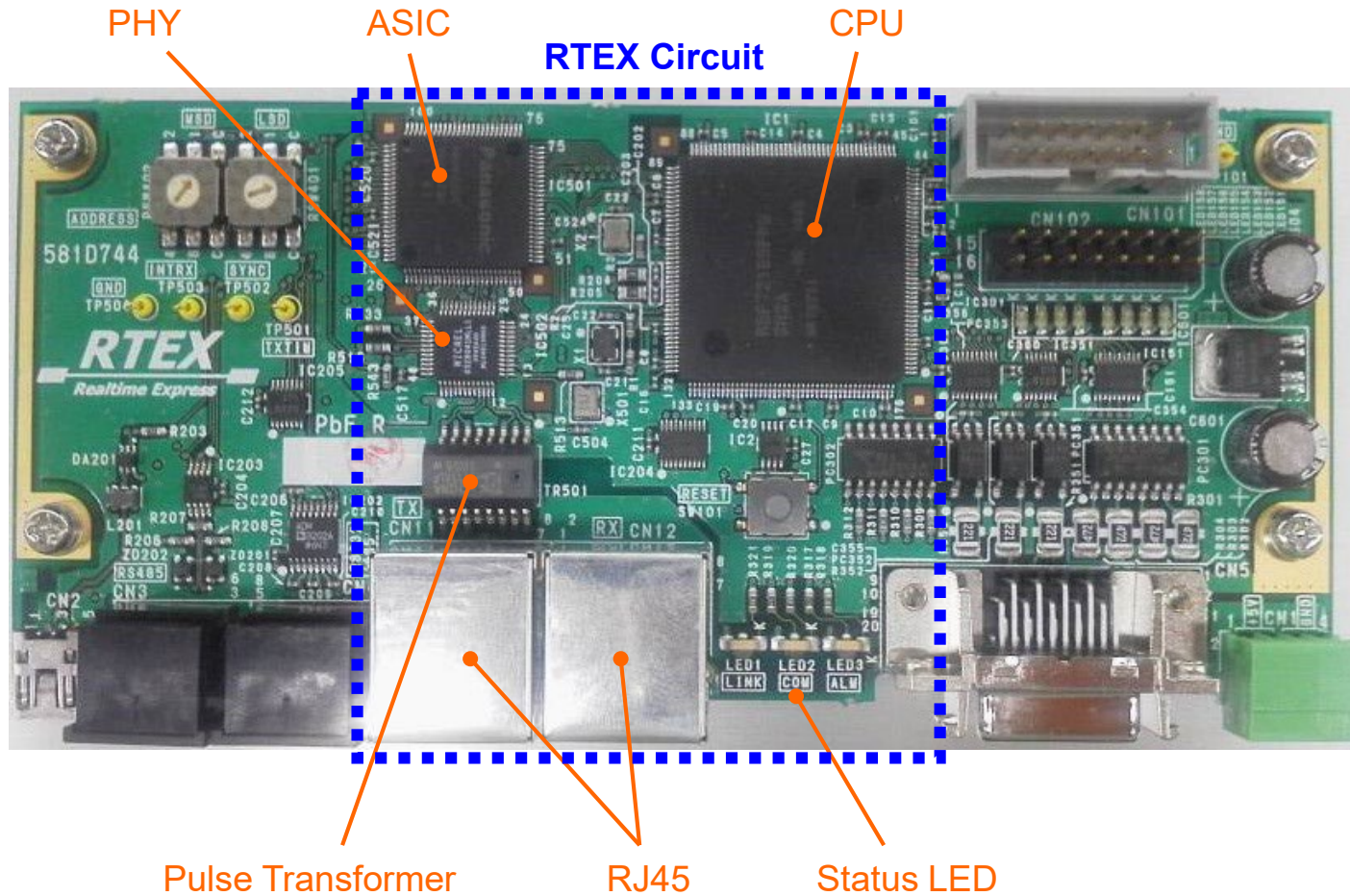
RTEX Technical Documents:
https://industrial.panasonic.com/ww/products/motors-compressors/fa-motors/ac-servo-motors/a5n_rtex/rtex

Communication ASIC "MNM1221"

If you develop RTEX products, the ASIC is provided.

Simple Protocol & Easy Development

Ref. Schematics, Example Codes, …etc. Available

	Specifications
Ordering No.	**DV0P444-9**
Packing Quantities	90 pcs
Power Supply Voltage	3.3 V
Consumption	Max. 100 mA (For reference)
Operating Ambient Temp	-40 to +85 degree C
Package	LQFP 100 pin 14 x 14 mm Lead Pitch 0.5 mm
RoHS	Compliant
Operating Mode	Master / Slave

Notes:
- You are subject to limitation that you must not compete with Panasonic products.
- For further information, please contact us.

RTEX Monitoring Tool

"Log Reader" is to readout own communication data logged on memory inside the drive. As another tool, a partner Cosmo Techs provides "RTEX Analyzer".
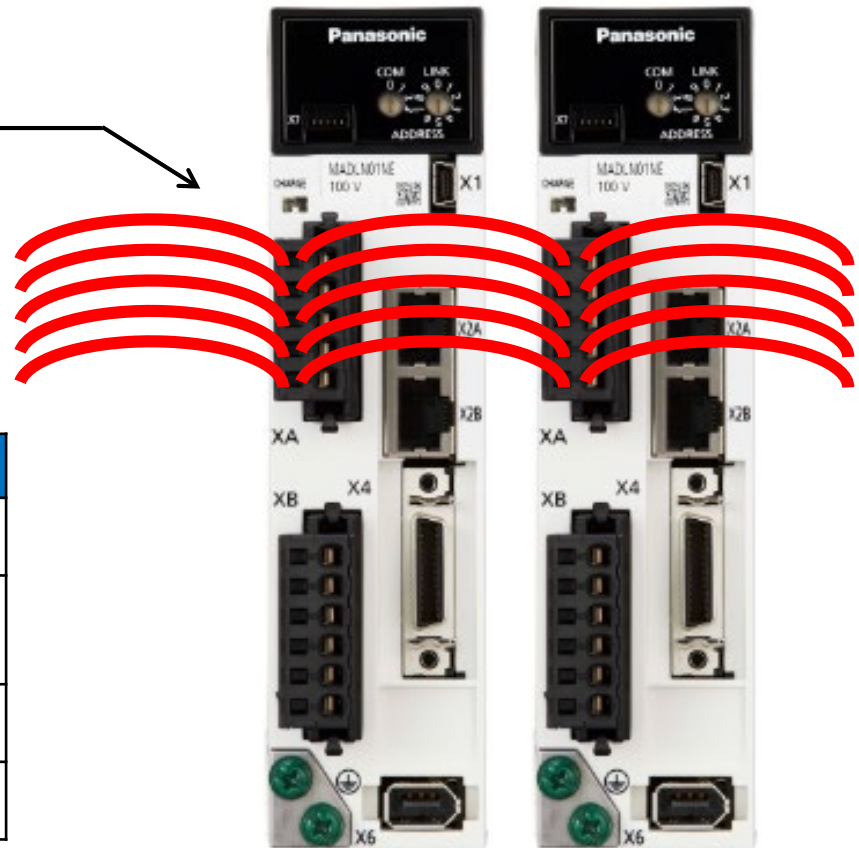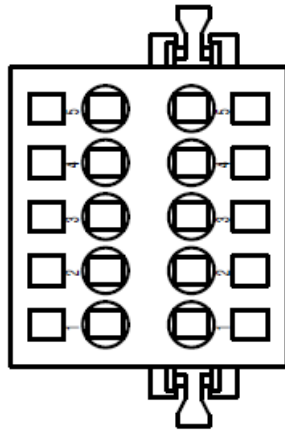

Servo Drive

Log Reader
FREE
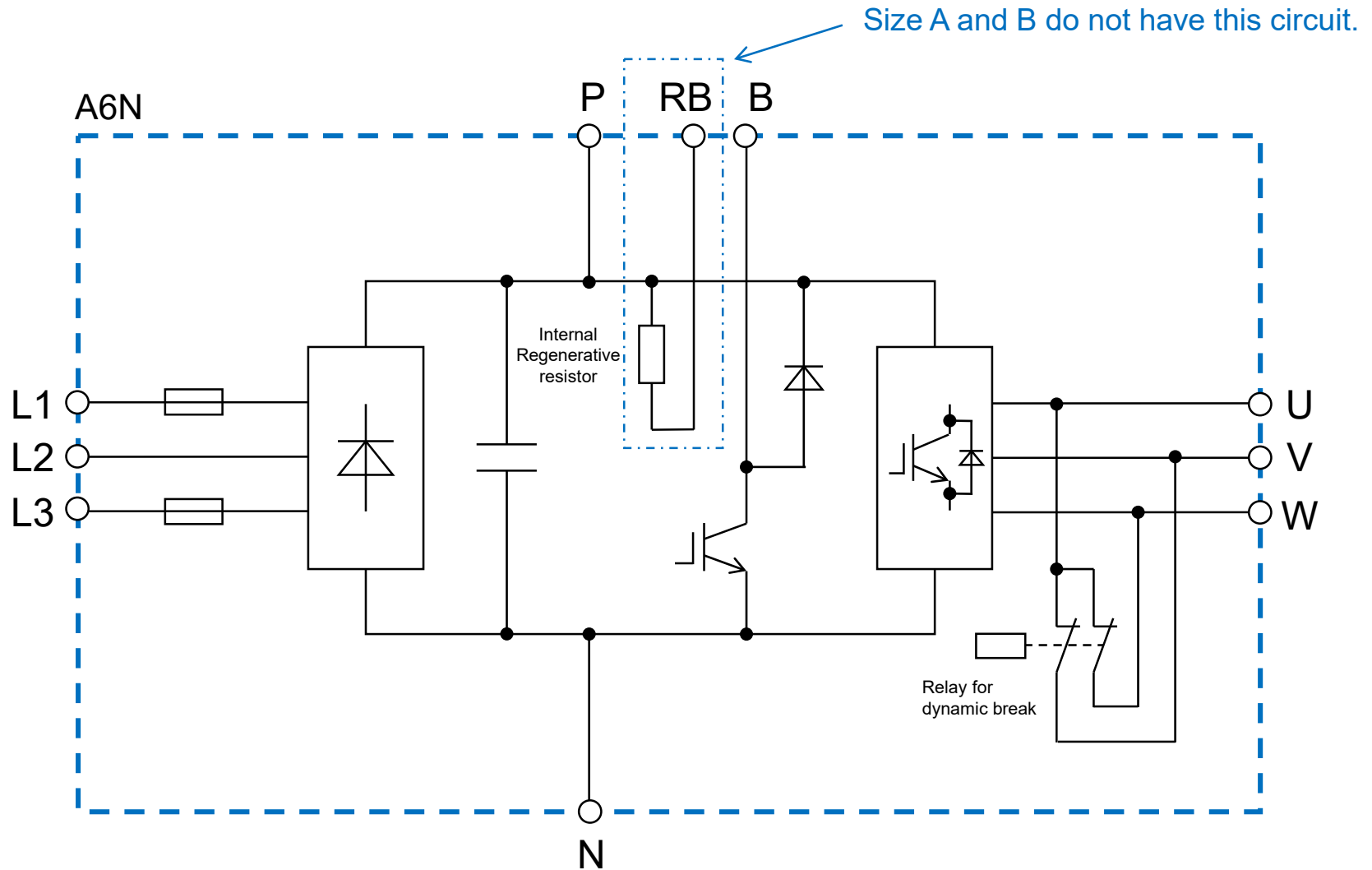
Host Controller

USB

RTEX

Note: Other axis data cannot be readout.
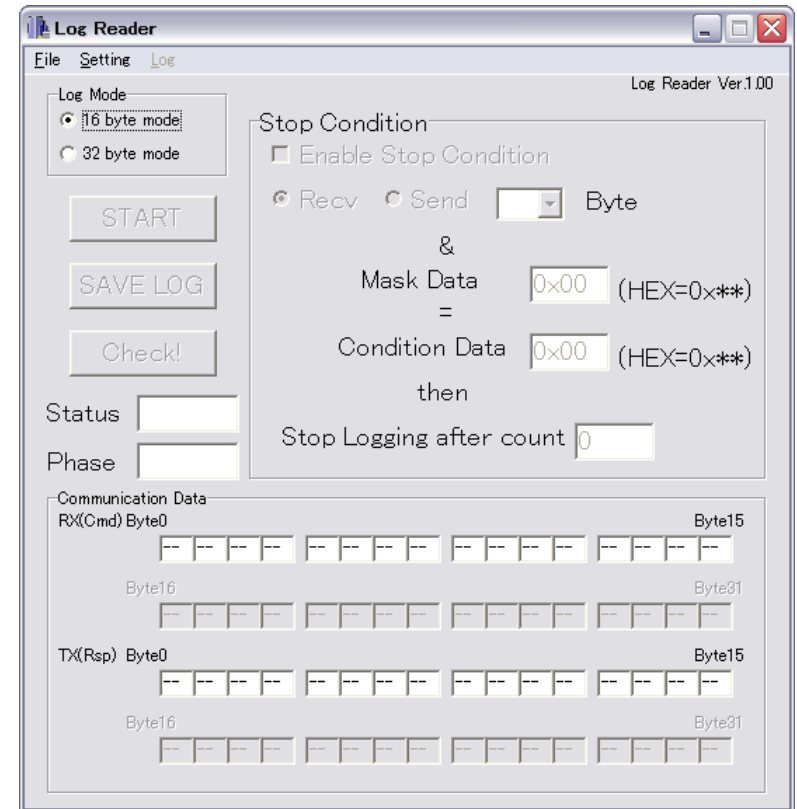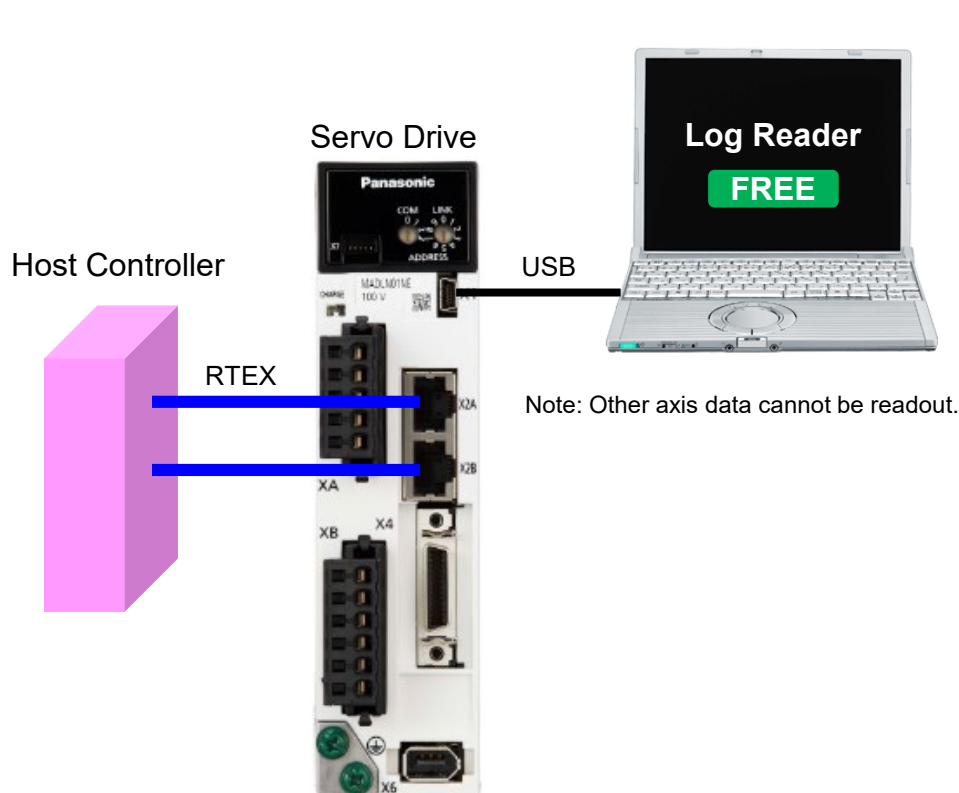
Wiring

Power Supply and Motor

In single-phase case, connect L1 and L3.

Put circuit that makes main power turn off at alarm.

This is different from A5N.

Connect a regenerative resistor, if necessary.

A6N

XB
- P
- N
- B
- U — 3 — Red
- V — 2 — White
- W — 1 — Black

6
5
4

AC   MCCB   MC   XA

Noise Filter

- 5 — L1 — Main Power
- 4 — L2
- 3 — L3
- 2 — L1C — Control Power
- 1 — L2C

Green / Yellow

If necessary, put an AC reactor.

Motor

Encoder

Shield

X4
- 14 — BTP-I
- *2
- 15 — BTN-I

X6
- E5V — 1
- E0V — 2
- BTP-O — 3
- BTN-O — 4
- PS — 5
- $\overline{PS}$ — 6
- Shell

*2

Cable side connector:
Molex 55100-0670

Notes:
*1. This figure shows an example of the size A or B.
   For the other size, refer to the specifications.

*2. The battery is used for absolute encoder system.
   It is normally installed on the encoder cable,
   or alternatively can be also tied to X4 connector.

Using the dual-type connector, the power line can be daisy chain.

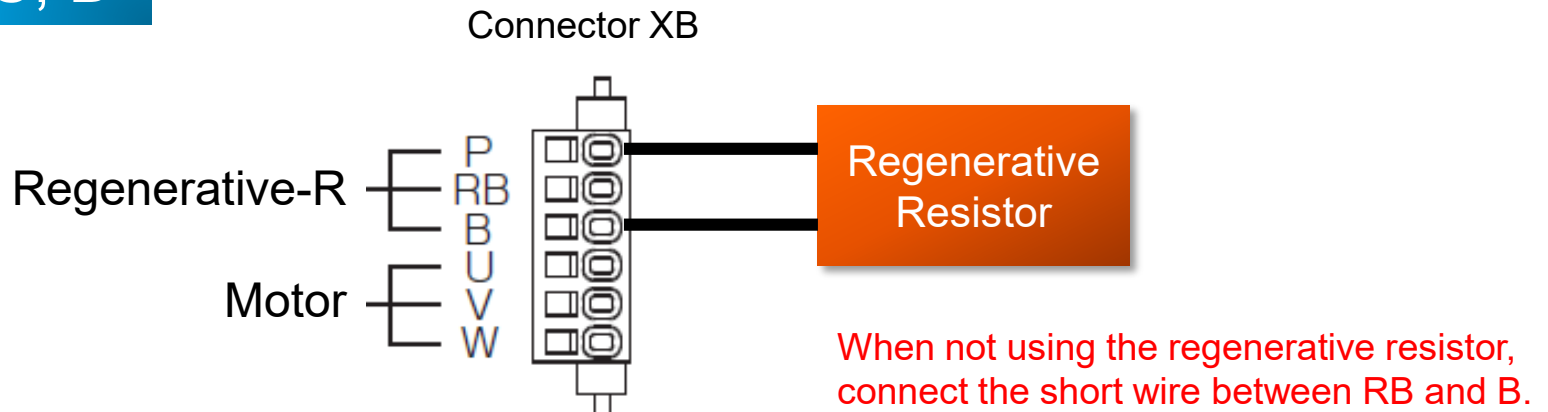|	Description
Option #	DV0PM20033
Manufacturer #	JST 05JFAT-SAXGSA-C
Applicable Wire	AWG #18 - 14
Rated Current	11.25 A @AWG #14

Main Circuit Block Diagram

Size A and B do not have this circuit.

A6N

P   RB   B

L1

L2

L3

Internal Regenerative resistor

U

V

W

Relay for dynamic break

N

Regenerative Resistor (Size A-D)

Size A, B
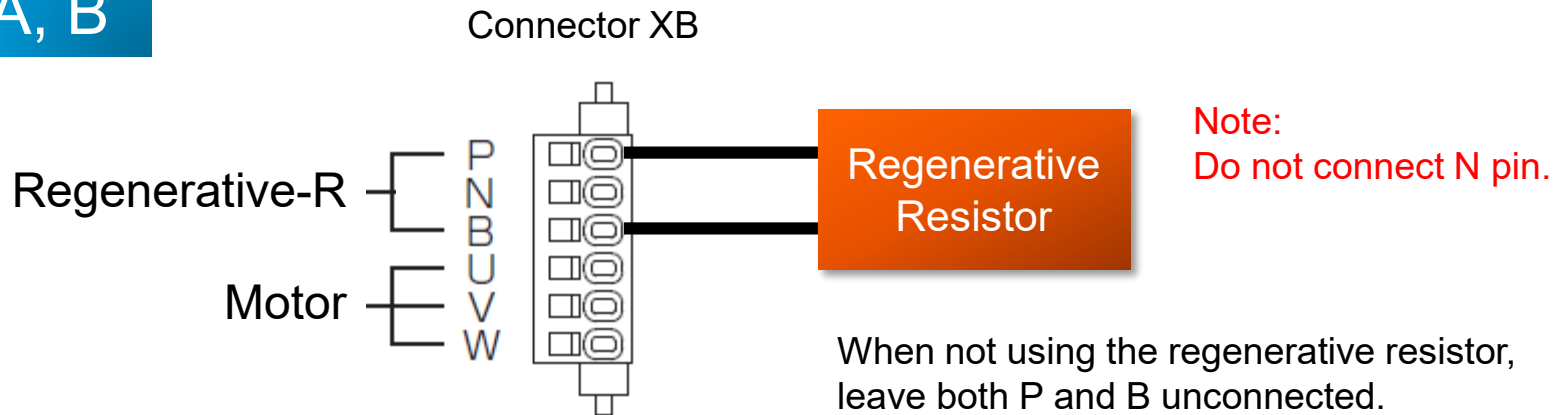
Connector XB

Regenerative-R
- P
- N
- B

Motor
- U
- V
- W

Regenerative Resistor

Note:
Do not connect N pin.

When not using the regenerative resistor, leave both P and B unconnected.

Size C, D

Connector XB

Regenerative-R
- P
- RB
- B

Motor
- U
- V
- W

Regenerative Resistor

When not using the regenerative resistor, connect the short wire between RB and B.

Note: In all sizes, put a circuit that makes main power OFF when a built-in thermal protector activates in the regenerative resistor.

Regenerative Resistor (Size E, F)

Size E
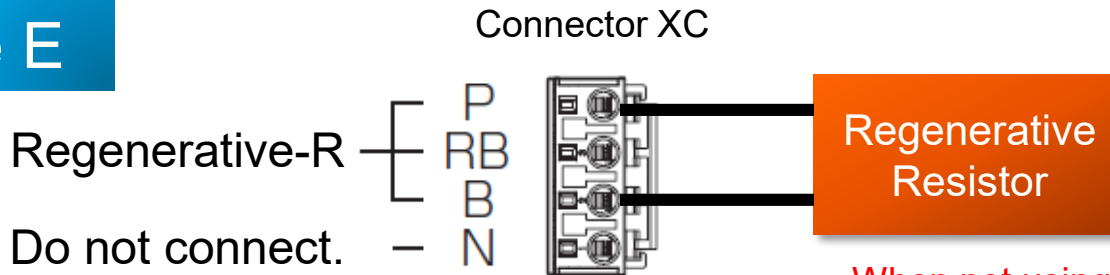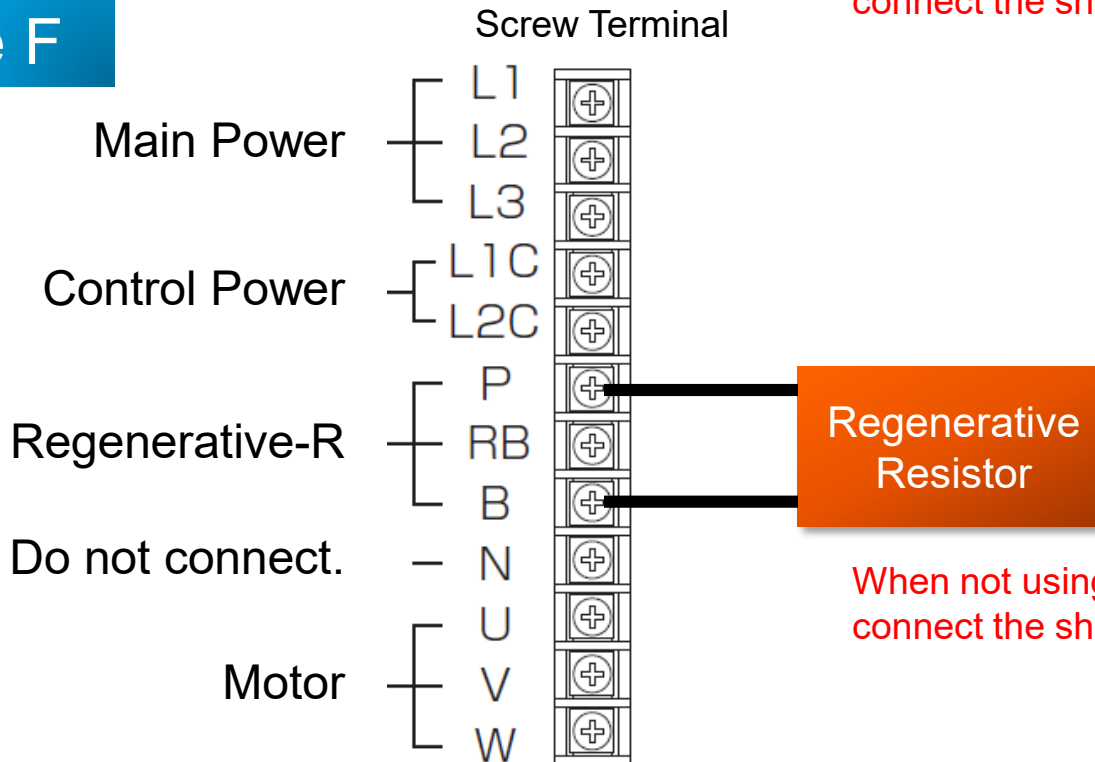
Connector XC

Regenerative-R ⎰ P
　　　　　　　 ⎱ RB
　　　　　　　 　 B

Do not connect. — N

Regenerative Resistor

When not using the regenerative resistor, connect the short wire between RB and B.

Size F

Screw Terminal

Main Power ⎰ L1
　　　　　　 ⎱ L2
　　　　　　 　 L3

Control Power ⎰ L1C
　　　　　　　 ⎱ L2C

Regenerative-R ⎰ P
　　　　　　　 ⎱ RB
　　　　　　　 　 B

Do not connect. — N

Motor ⎰ U
　　　 ⎱ V
　　　 　 W

Regenerative Resistor

When not using the regenerative resistor, connect the short bar between RB and B.

Note: In all sizes, put a circuit that makes main power OFF when a built-in thermal protector activates in the regenerative resistor.

Counter-measures for Noise

Reducing PWM Noise Radiated from Drive

Stable Frame Ground

Install a ferrite core on motor cable U, V and W.

Ferrite Core: **ZCAT3035-1330 by TDK (DV0P1460)**

U
V
W

Motor Cable

E
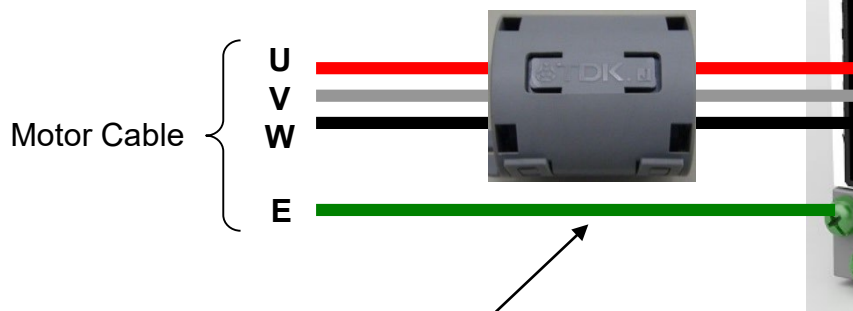
Do not install it on E.

Make the back of chassis tightly contact earthed metal frame. Surface of the metal frame must be kept conductive.

Sensor Inputs
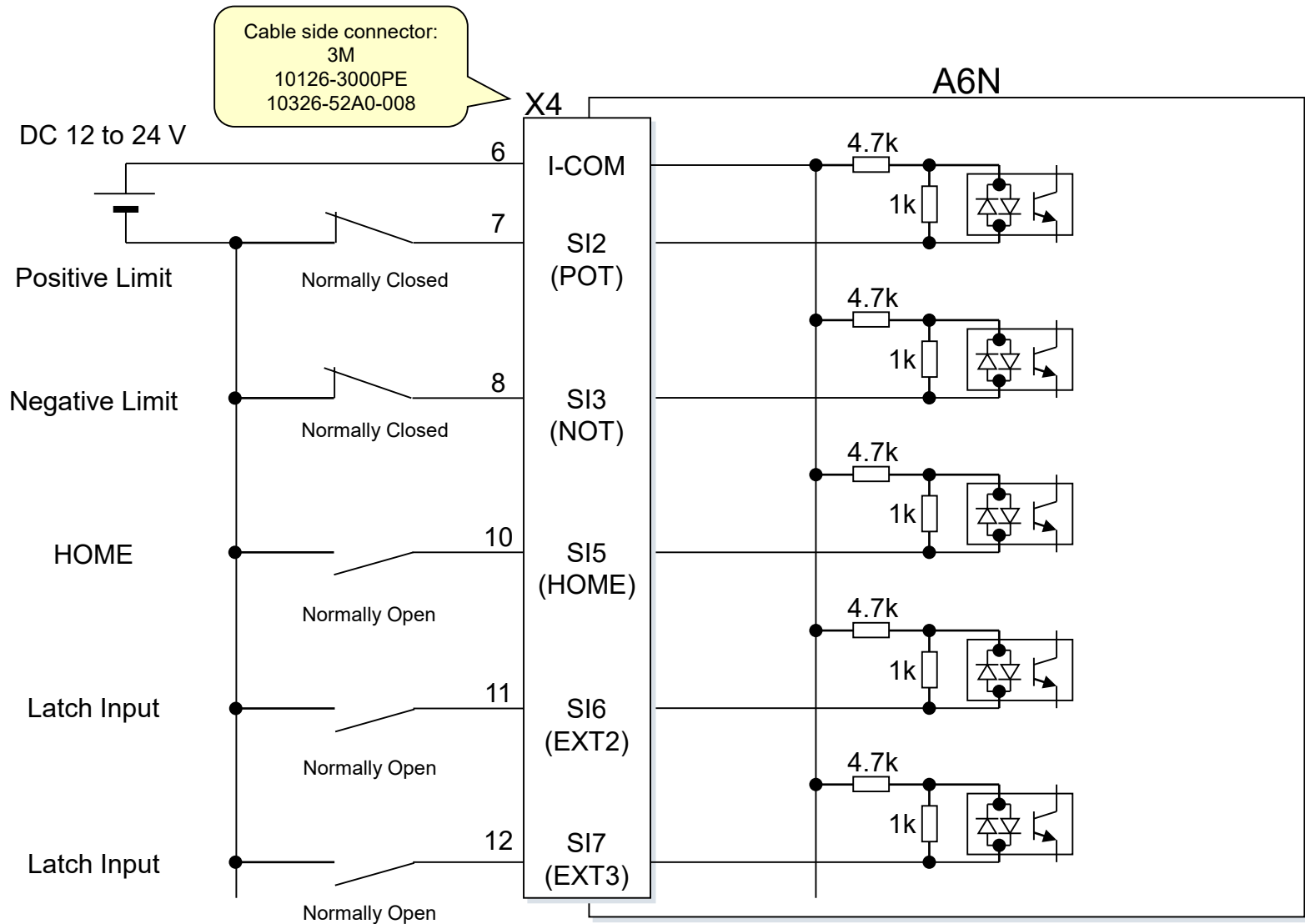
() shows default setting.

General Purpose Inputs
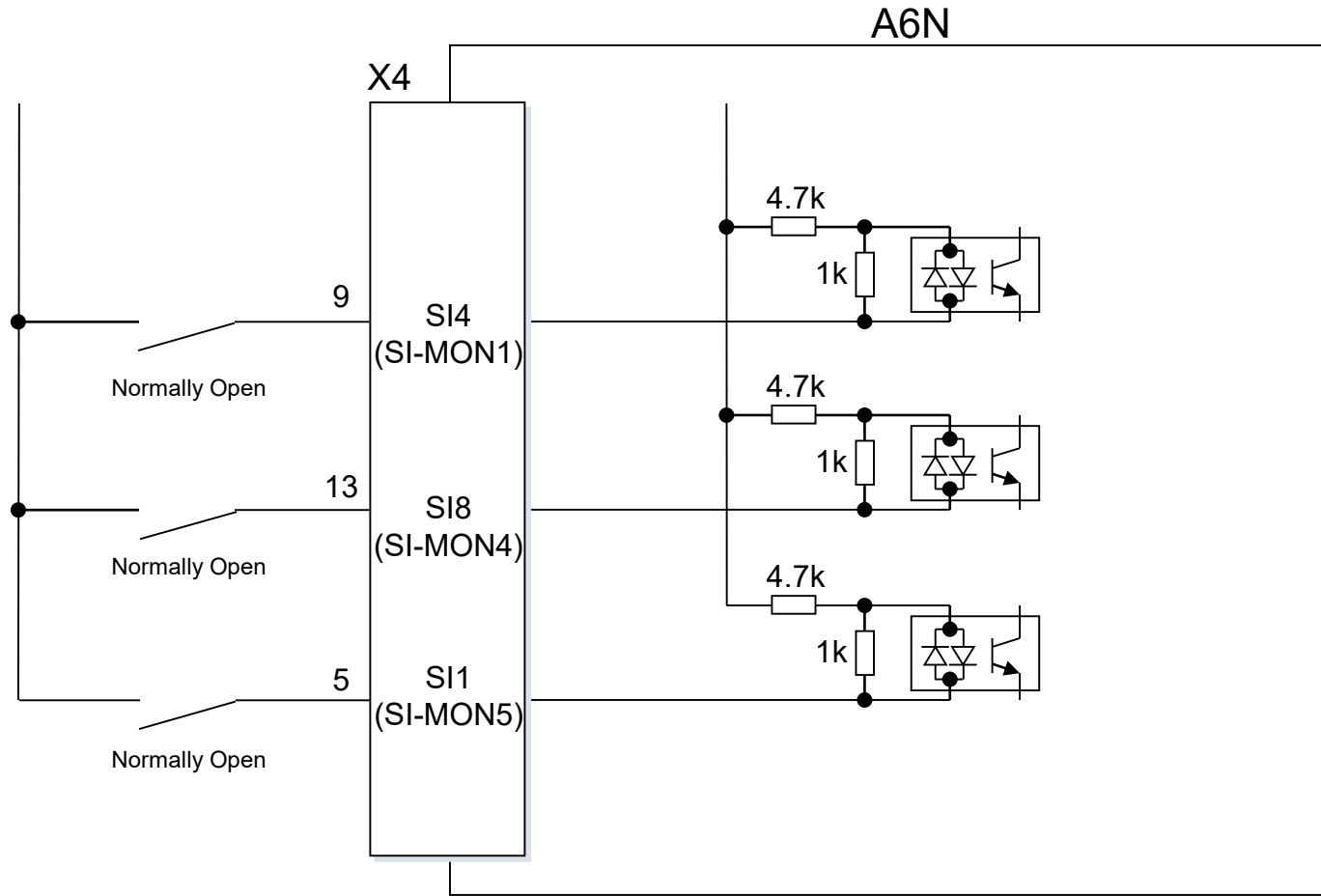
() shows default setting.

Note:
Host controller can monitor states of SI-MONs over RTEX.
These inputs do not influence servo control in the drive.

Sensor Example 1

Panasonic Industrial Devices SUNX

A6N

X4

Photo-sensor PM-25/45/65 (NPN transistor output)

Sensor circuit

- (Brown) +V
- ZD1
- Tr1
- (Black) Output 1
- ZD2
- Tr2
- (White) Output 2
- (Blue) 0 V
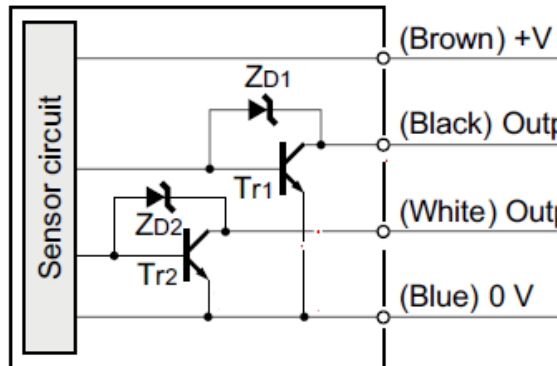
Out1: Normally Closed
Out2: Normally Open

Proximity-sensor GX-F12 (NPN transistor output)

Main Circuit

- D
- +V Brown
- ZD1
- Tr
- Output Black
- ZD2
- 0V Blue
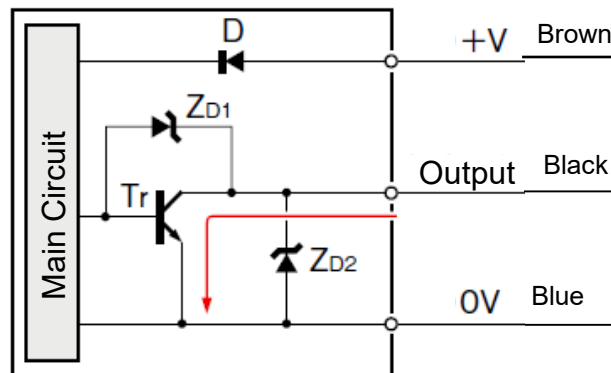
GX-F12A: Normally Open
GX-F12B: Normally Closed

6 I-COM

4.7k

1k

R
4.7k

1k

Vf

Vf = approx. 1.2 V

Vdd
DC 24 V

Ic

$Ic = (Vdd - Vf) / R$

When Vdd is 24 V, Ic is about 5 mA.
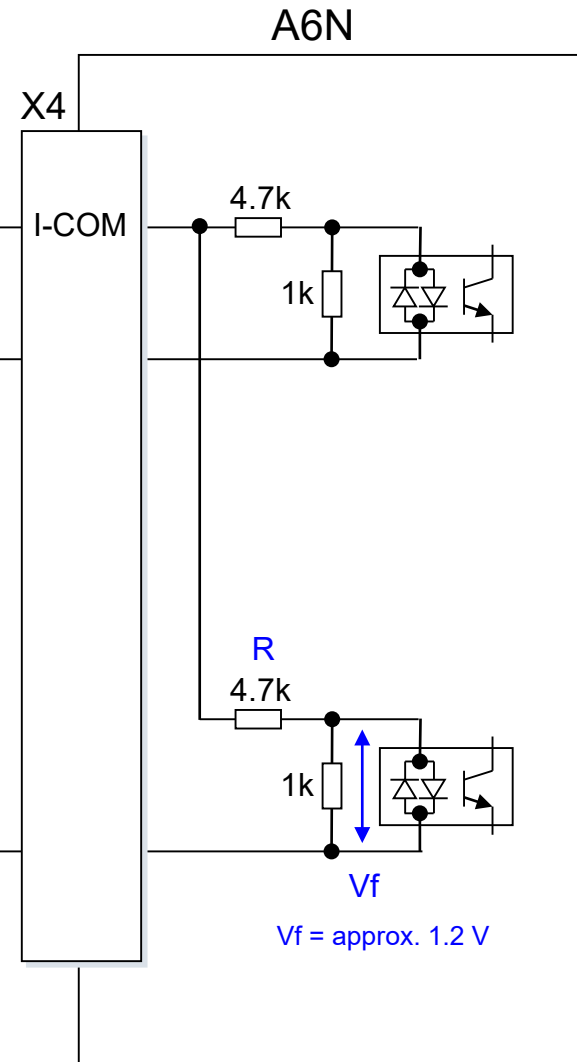
Sensor Example 2

Photo-Sensor by OMRON
EE-SX672A (NPN transistor output)

A6N

X4

6 I-COM

4.7k

1k

DC24V

OUT

Note

Main
Circuit

Note:
 If "L" pin is open, ON during shade.
 If "L" pin is tied to "+" pin, ON during light.

Relay Control Outputs

$Ic = (Vdd - Vce) / R$
$W = Ic^2 \times R$

A6N

DC 12 to 24 V

Vdd

R

For turning main power off

For releasing motor brake

For generic

X4

3 — SO3+ (ALM)

4 — SO3- (ALM-)

1 — SO1+ (BRK-OFF+)

2 — SO1- (BRK-OFF-)

25 — SO2+ (EX-OUT1+)

26 — SO2- (EX-OUT1-)

Ic

Vce (sat) = approx. 1.2 V max
Ic = 50 mA max

10   Vce

During alarm, transistor OFF

10

During release, transistor ON

10

Note:
SO1 can be set to generic EX-OUT.
The generic output does not influence servo control in the drive.

() shows default setting.

Panasonic INDUSTRY

Encoder Emulation Output
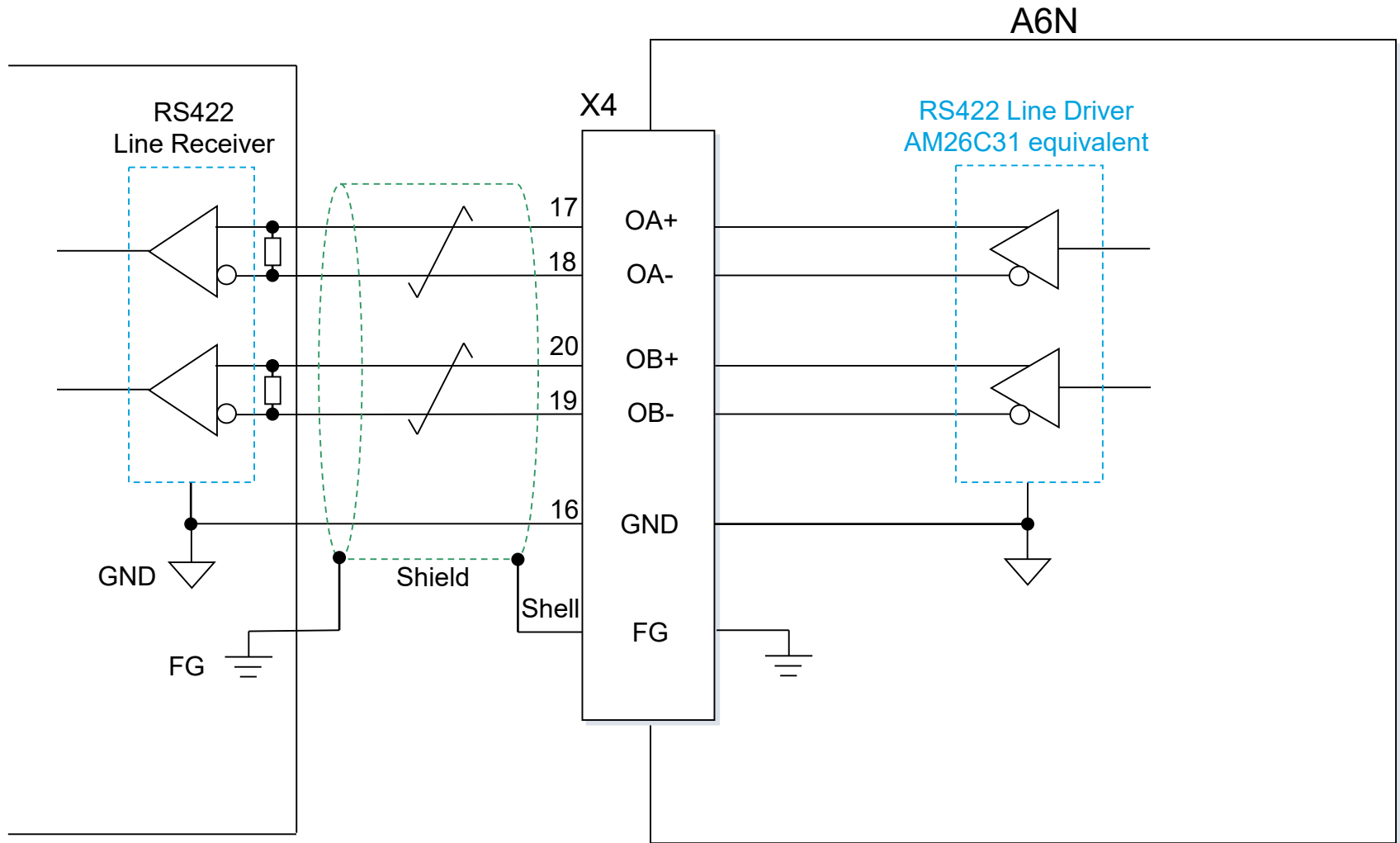
Note: A termination resistor (typ. 330 Ohm) must be put between line-receiver inputs.

Encoder Connectors

X5：MUF-RS10DK-GKXR by JST
\<Type F, L, M\>

No.	Name	Function
1	E5V	Power Supply Out
2	E0V	
3	PS	Panasonic Style Serial Data
4	/PS	
5	EXA	A-phase In
6	/EXA	
7	EXB	B-phase In
8	/EXB	
9	EXZ	Z-phase In
10	/EXZ	
Shell	FG	Frame Ground

Note:
- "In" "Out" are based on a servo drive.
- Cable side connectors
  X5: MUF-PK10K-X (JST)
  X6: 55100-0670 (Molex)

X6：53460-0629 by Molex
\<Type E, F\>

No.	Name	Function
1	E5V	Power Supply Out
2	E0V	
3	BTP	Battery Out for Abs.
4	BTN	
5	PS	Panasonic Style Serial Data
6	/PS	
Shell	FG	Frame Ground

\<Type L, M\>

No.	Name	Function
1	E5V	Power Supply Out
2	E0V	
3	NC	Non Connection
4	CS3	Commutation In
5	CS2	
6	CS1	
Shell	FG	Frame Ground

Linear Encoder Serial
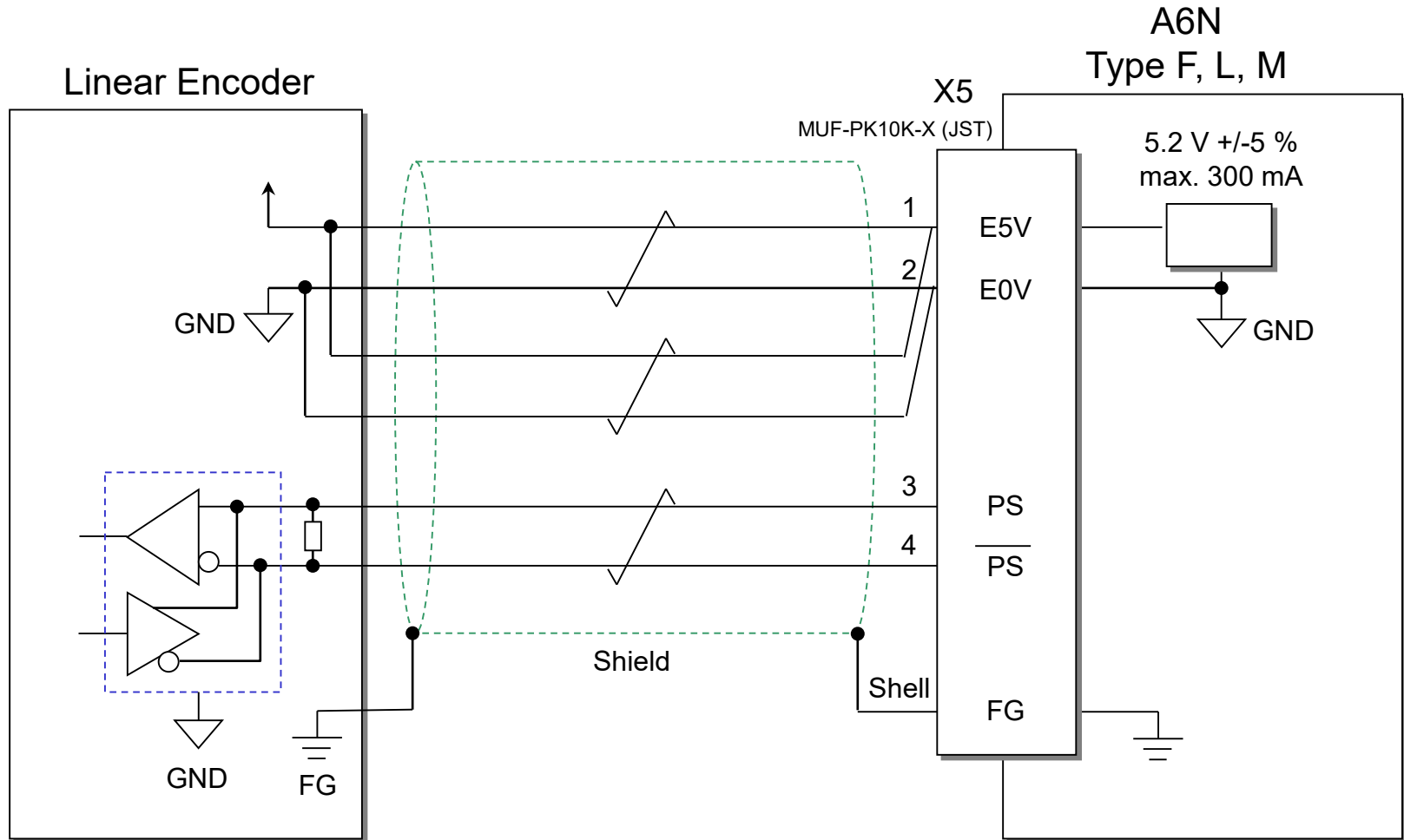
Note: If using an external power supply, E5V(pin#1) must be left unconnected. E0V(pin#2) always must be connected to GND of a linear encoder.
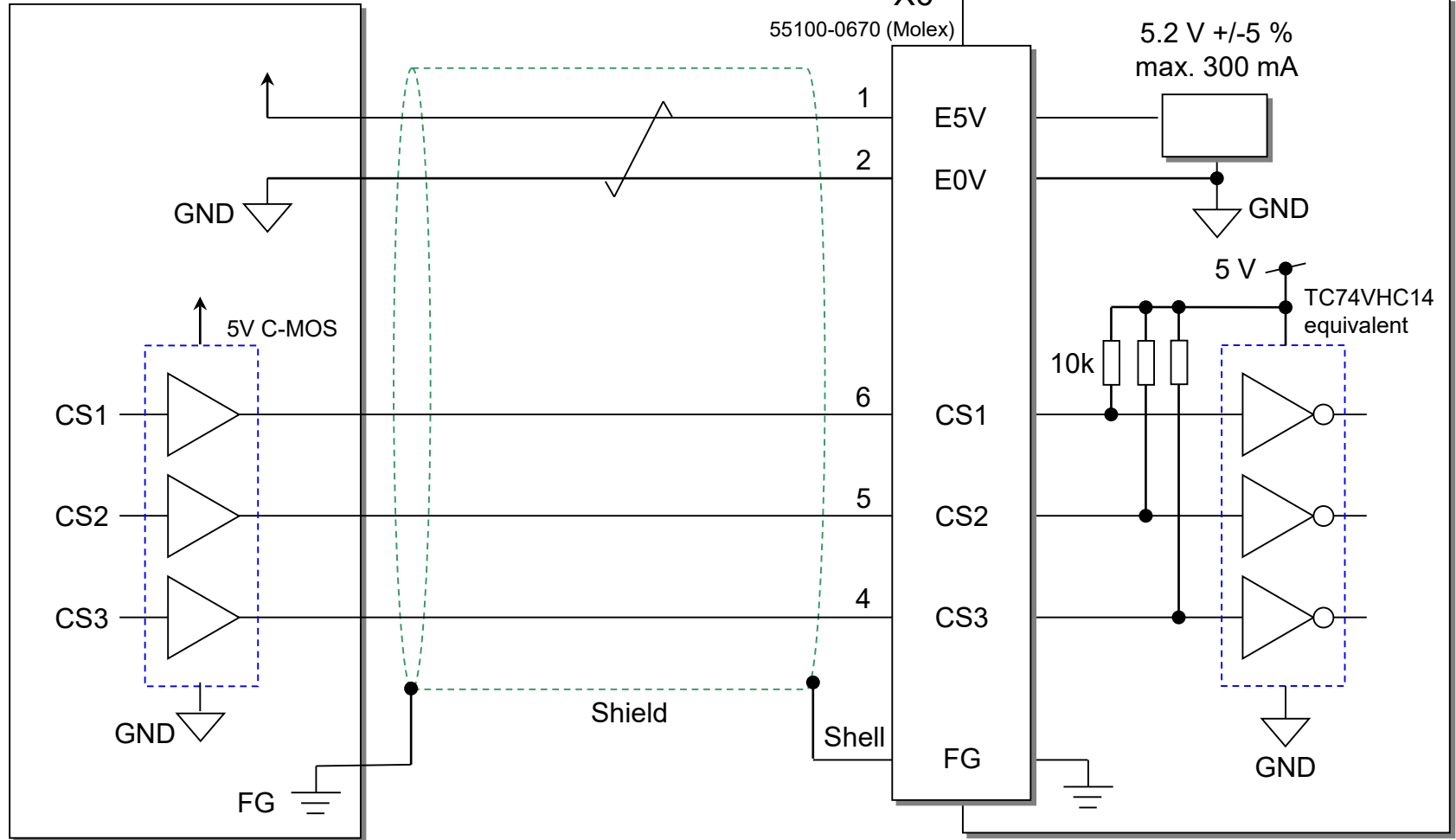
Linear Encoder A/B/Z
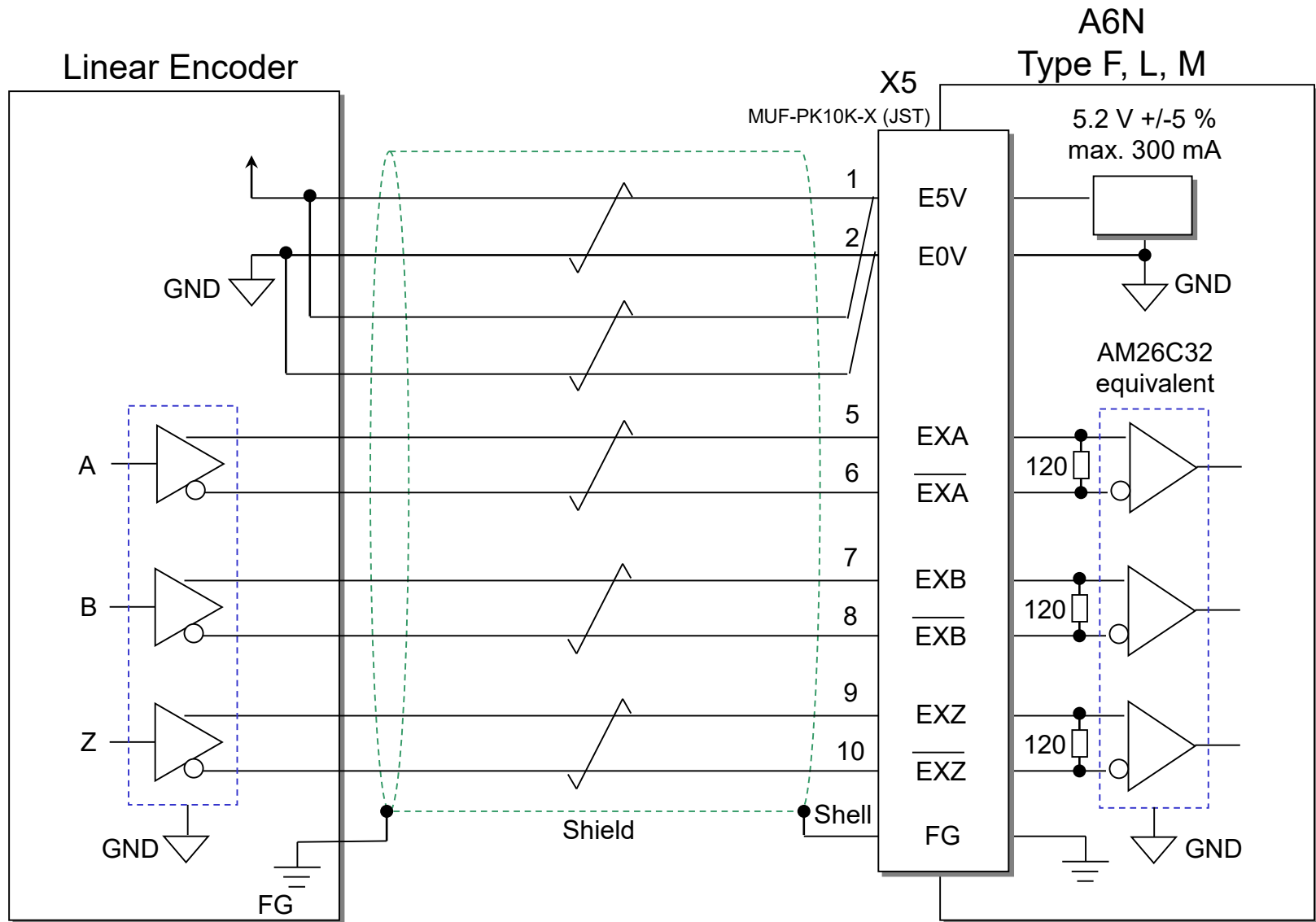
Note: If using an external power supply, E5V(pin#1) must be left unconnected. E0V(pin#2) always must be connected to GND of a linear encoder.
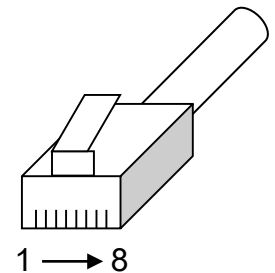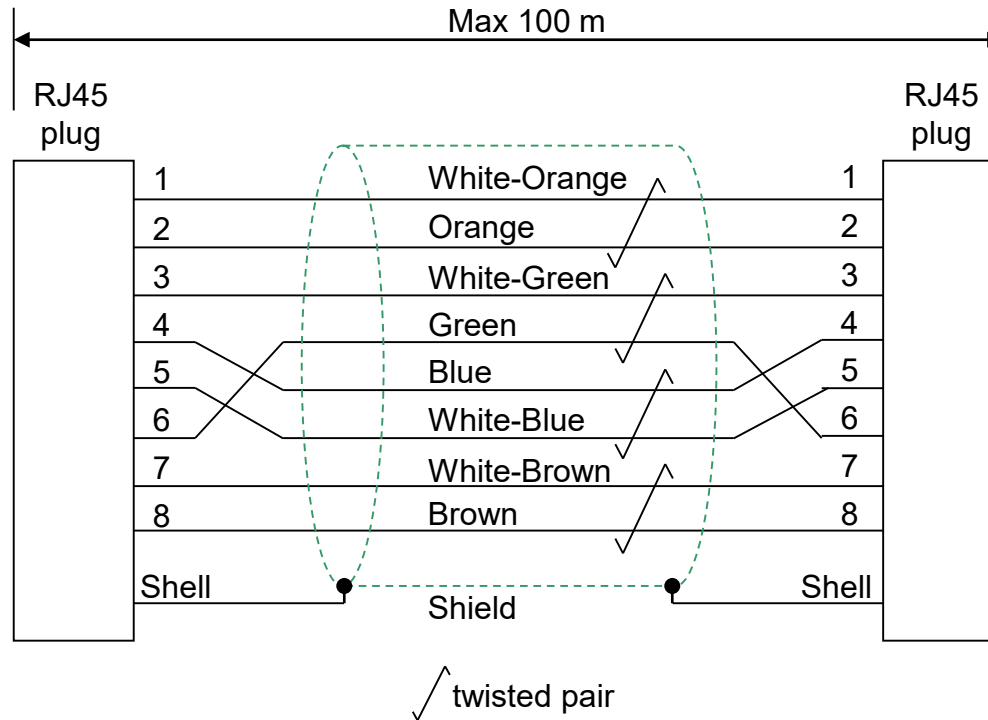
Commutation

Magnetic Pole Detector

A6N
Type L, M

X6
55100-0670 (Molex)

5.2 V +/-5 %
max. 300 mA

Pin	Signal
1	E5V
2	E0V
6	CS1
5	CS2
4	CS3
Shell	FG

5V C-MOS

5 V

TC74VHC14
equivalent

10k

GND

Shield

Note: If using an external power supply, E5V(pin#1) must be left unconnected. E0V(pin#2) always must be connected to GND of a pole detector.

Panasonic INDUSTRY

RTEX Cable (4 pairs type)

"Straight" Wiring

Max 100 m

RJ45 plug		RJ45 plug
1	White-Orange	1
2	Orange	2
3	White-Green	3
4	Green	4
5	Blue	5
6	White-Blue	6
7	White-Brown	7
8	Brown	8
Shell	Shield	Shell

1 ➙ 8

/ twisted pair

Notes:
- STP(Shielded Twisted Pair cable) conformed to category 5e must be used.
- Colors of the lead wire are defined by TIA/EIA-568B.
- A pair connected to 3-6pin is used as signal line.
- Unused 3 pairs must be also connected to 1-2, 4-5 and 7-8 as the above figure.

RTEX Cable (2 pairs type)

"Straight" Wiring
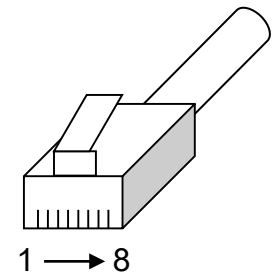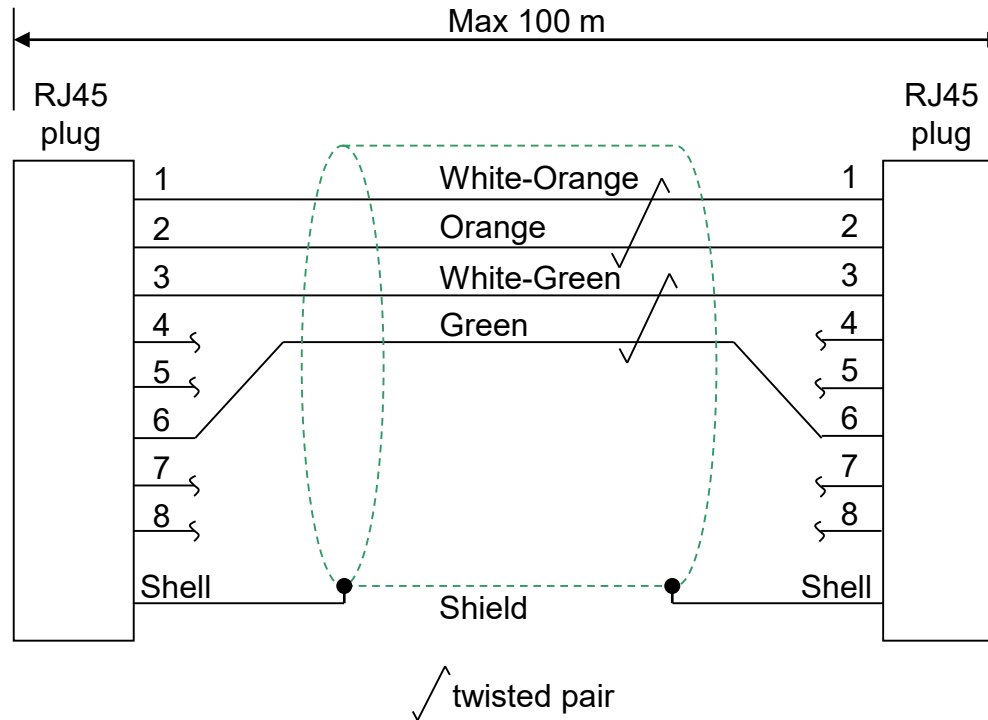
Max 100 m

RJ45 plug

Pin	Wire	Pin
1	White-Orange	1
2	Orange	2
3	White-Green	3
4	Green	4
5		5
6		6
7		7
8		8
Shell	Shield	Shell

RJ45 plug

1 → 8

twisted pair

Notes:
- STP(Shielded Twisted Pair cable) conformed to category 5e must be used.
- Colors of the lead wire are defined by TIA/EIA-568B.
- A pair connected to 3-6pin is used as signal line.
- Unused 3 pairs must be also connected to 1-2 as the above figure.

Analog Monitor

Lead wire side connector:
Housing: Molex 51021-0500
Terminal: Molex 50058-8500
AWG #28 - 32

Pin #1 → 5

e.g. Oscilloscope

A6N

X7

Pin	Signal
1	AM1
2	AM2
3	GND

1 k

1 k
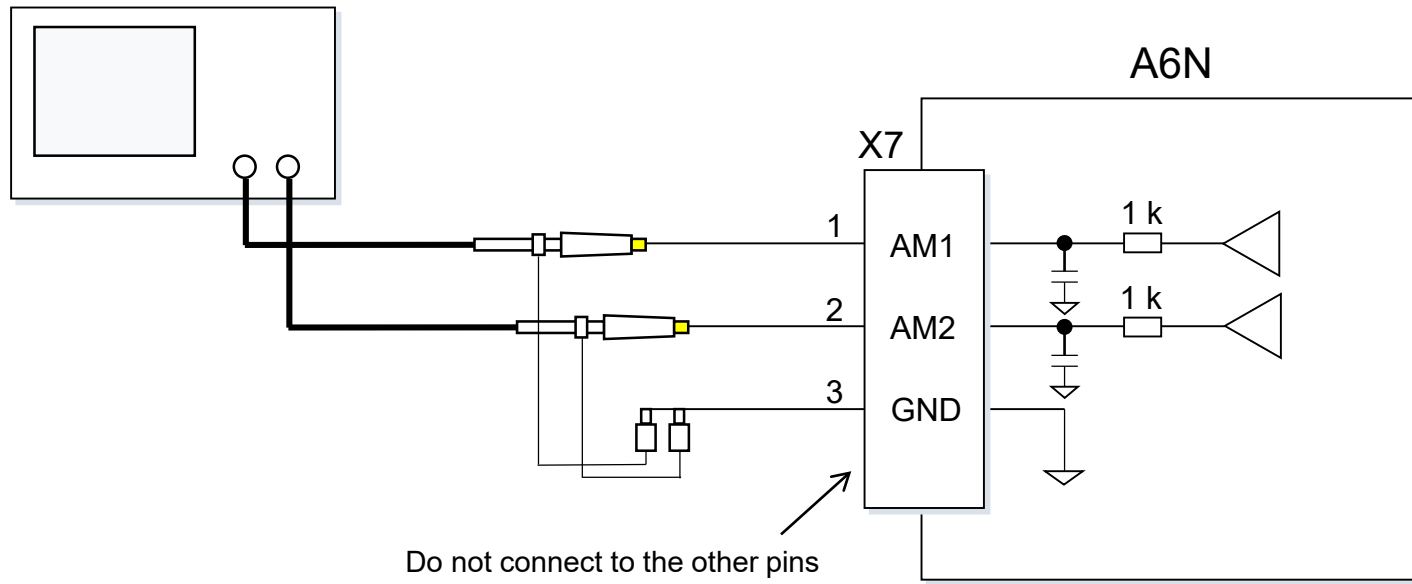
Do not connect to the other pins
that is used for manufacturer.

Safety I/F STO (PL e, SIL 3)

Safe Torque Off (STO) Overview

The safe torque off (STO) function is a safety function that shuts the motor current and turns off motor output torque by turning off the driving signal of the servo driver's internal power transistor,when safety input signal is detected.

When STO function operates, the servo driver turns off the servo ready output signal (S-RDY) and enters safety state,"St" is displayed on the front panel.Also when STO input is off and servo on input is off, it enters servo off status automatically.

Caution ⋯⊹
- STO function differs from MINAS A5 series.
  Unlike A5 series, when STO function is on. Alarm will not be activated.

	A5N	A6N
In STO	Alarm 30.0	Not alarm 7seg. LED "St"
Releasing STO	Alarm Clear	Servo OFF

Connector X3

Signal	Symbol	Pin No.	Contents
Safety input 1	SF1+	4	• Input 1 that triggers STO function. This input turns off the upper arm drive signal of power transistor. • When using the function, connect this pin in a way so that the photocoupler of this input circuit turns off to activate STO function.
	SF1−	3	
Safety input 2	SF2+	6	• Input 2 that triggers STO function. This input turns off the lower arm drive signal of power transistor. • When using the function, connect this pin in a way so that the photocoupler of this input circuit turns off to activate STO function.
	SF2−	5	
EDM output	EDM+	8	Outputs monitor signal that is used to check the safety function. **Caution** ⋯⋰ This output signal is not a safety output.
	EDM−	7	

Viewed from cable

SF2+ SF1+
EDM+ NC*1
```
8 6 4 2
7 5 3 1
```
EDM− NC*1
SF2− SF1−
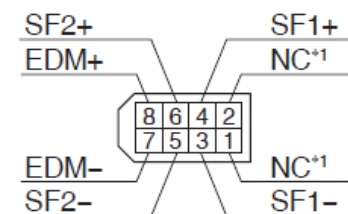
Shell: FG

*1 Do not connect anything to NC pins.

Connector plug:
Tyco Electronics
2201855-1
or
2013595-1

When both safety input 1 and 2 are off, i.e. when STO function of 2 safety input channels are active, the photocoupler in EDM output circuit turns on.

Signal	Symbol	photocoupler logic			
Safety input	SF1	ON	ON	OFF	OFF
	SF2	ON	OFF	ON	OFF
EDM output	EDM	OFF	OFF	OFF	ON

By monitoring the logics (all 4 states) of photocoupler shown in the table above, the external device can determine the status (normal or abnormal) of safety input circuit and EDM output circuit.

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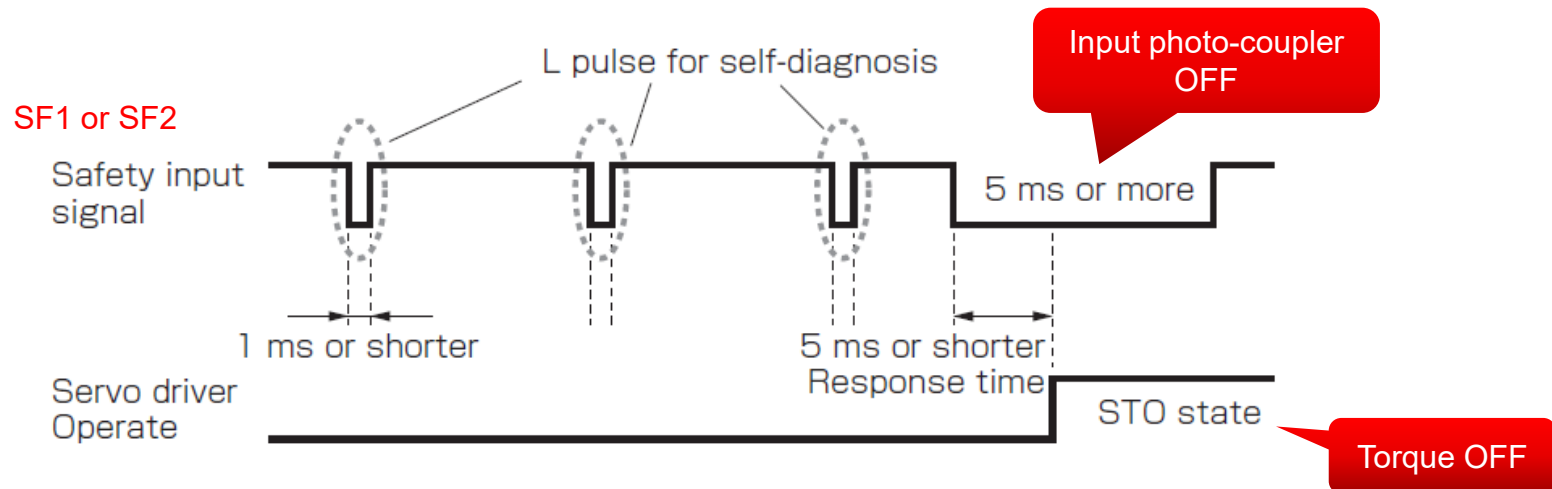# Delay Time

Delay from Input OFF to Torque OFF: Max 5 ms

• **Safety equipment self-diagnosis L pulse**

Safety output signal from the safety controller and safety sensor may include L pulse for self-diagnosis.
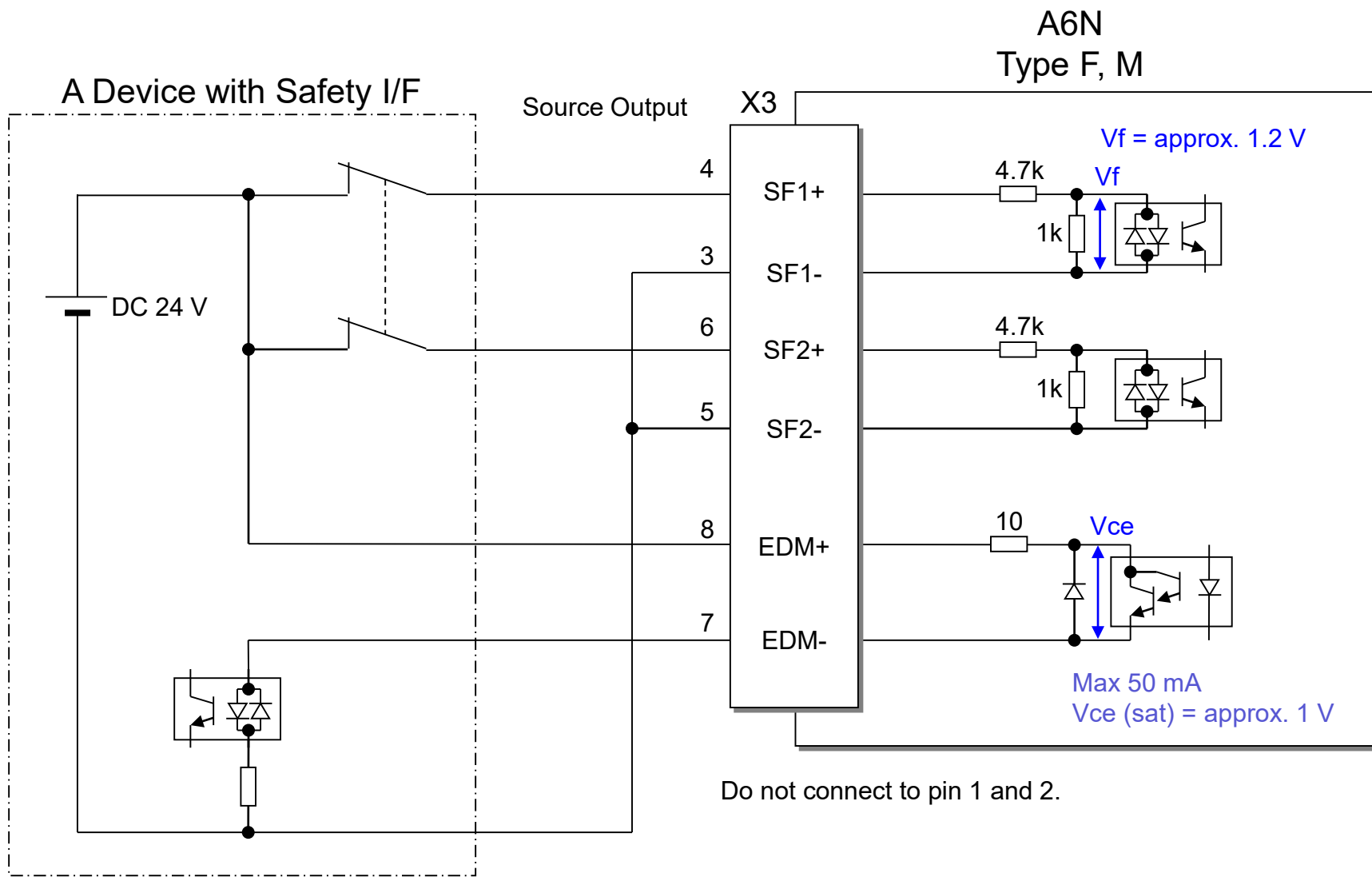
To prevent the L pulse from mis-triggering STO function, the safety input circuit has built-in filter that removes the self-diagnosis L pulse.

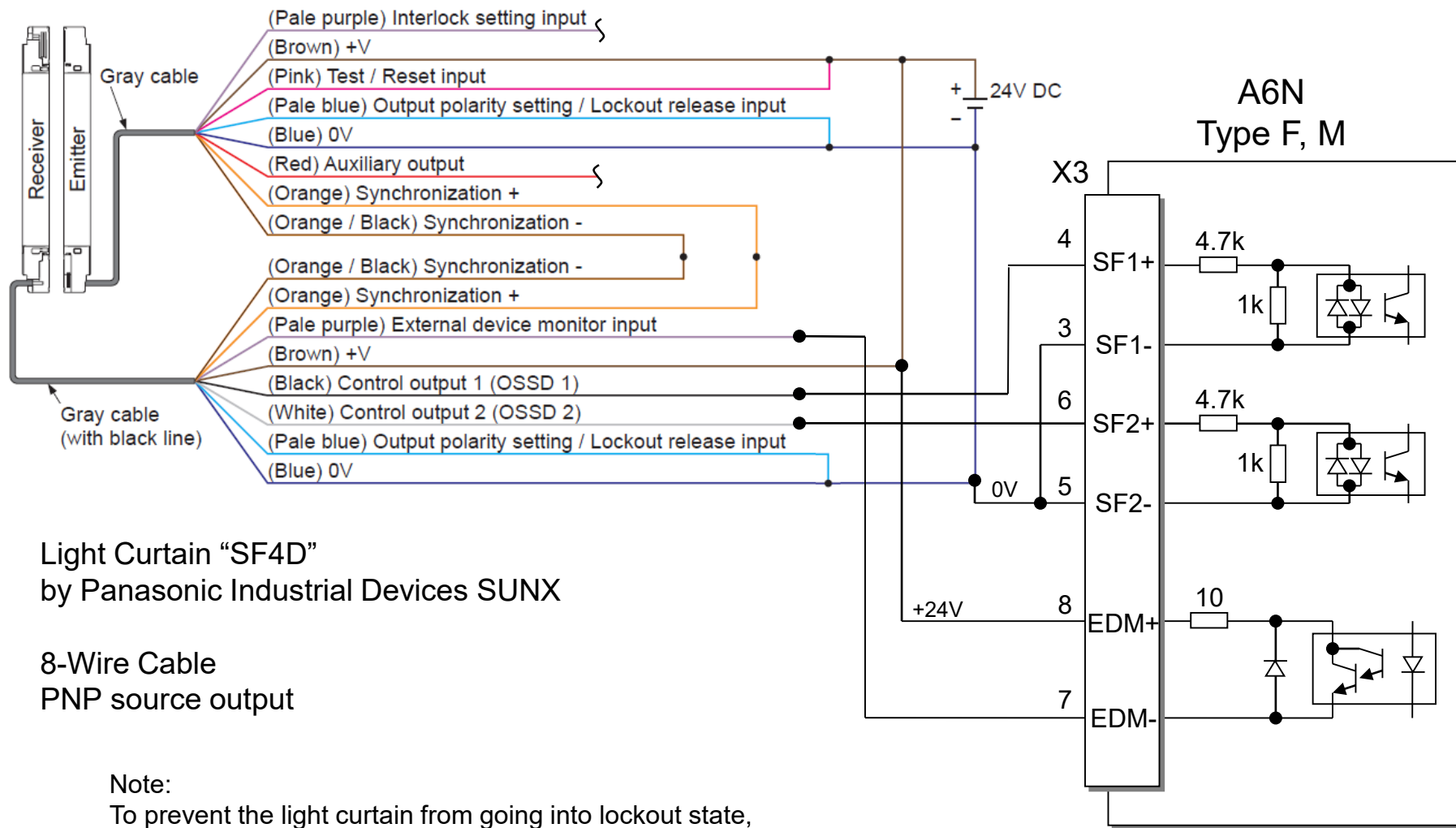Therefore, if the off period of safety input signal less than 1 ms, the safety input circuit does not detect this "off" event.

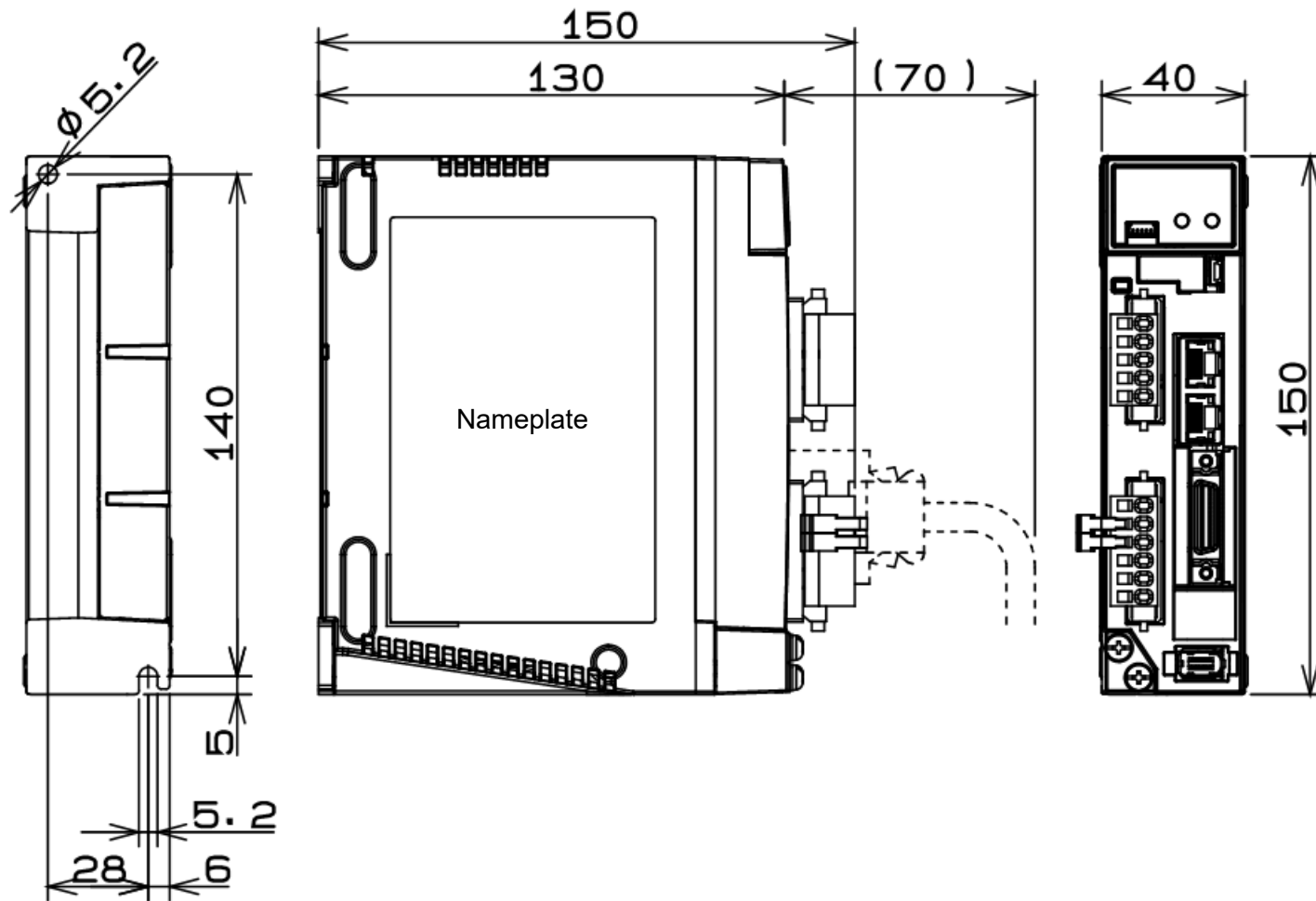To validate this "off" period, turn off the input signal for more than 5 ms.

SF1 or SF2

L pulse for self-diagnosis

Input photo-coupler OFF

Safety input signal

5 ms or more

1 ms or shorter

5 ms or shorter
Response time

Servo driver Operate

STO state

Torque OFF

Wiring

Light Curtain "SF4D"
by Panasonic Industrial Devices SUNX

8-Wire Cable
PNP source output

Note:
To prevent the light curtain from going into lockout state,
before the light curtain power-up, make the servo power-up
and the EDM output works well.

Do not connect to pin 1 and 2.

Dimensions in mm

Size A

Nameplate

Size B

Nameplate

Size C

Nameplate

Size D

Nameplate

Size E

Nameplate

Size F

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