Servo Drive MINAS-A4N with Realtime Express (RTEX)

Panasonic Corporation
Overview
Realtime Express (RTEX)

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

Concept

High Performance & Low Cost

Simple

High Reliability

Easy Development
Features of RTEX

- **Real-time communication** based on 100BASE-TX
- **100Mbps Full duplex**
- **0.5ms cycle** with up to **32 axes** (*1)
- **Max. 60m length** inter-node cable
- **All axes fully synchronization** (*2) for interpolation
- **Parameter setting and monitoring**
- **Less wiring**
- **Low cost system** using shielded twisted pair cable
- **High noise immunity** (IEC61000-4-4 compliant)

*1: Depends on a controller specification.
*2: This sync algorithm is a patent.
System Structure

Upper Network (almost Ethernet)

Host Controller

NC

A4N Servos

Up to 32 axes

STP: Shielded Twisted Pair cable

Low system cost

Ring topology without HUB

Max. 60m inter-node

Parameter Setting & Monitoring (*)

*: Depends on a controller specification

STP: Shilded Twisted Pair cable
Less Wiring at Multi-Axes

Pulse I/F

RTEX

NC
Servo
Servo
Servo
Servo

NC
Servo
Servo
Servo
Servo

Bundle of Many Wires

Reduced trouble with wiring

Simple!

High benefit in distributed placing
Less Wiring at Single-Axis

**Pulse I/F**

Many wires

**RTEX**

Simple!

Sensors are connected to Servo

Drive should be placed near the motor.
Ultra High-Speed

Ten Times Fast!

Conventional

RTEX

100Mbps

10Mbps
Using Low-Cost Cable

Cable Cost Ratio

Mass Distributed on the Market

Conventional (e.g. RS485)  RTEX STP for Ethernet

Note: An example of 1m length.
Simple Ring Topology

RS485 (LINE)

Bi-directional

Termination Resistor

A Trouble

RTEX (RING)

Simple One-way (*)

High Efficiency & Reliability by Simple Data Flow

*: No cross-talk.

NC Servos NC Servos

RS485 (LINE)

Bi-directional

Termination Resistor

A Trouble

RTEX (RING)

Simple One-way (*)

High Efficiency & Reliability by Simple Data Flow

*: No cross-talk.
Features of RTEX
## Difference from Ethernet

### Upper layer optimized for servo control

<table>
<thead>
<tr>
<th>Ethernet</th>
<th>RTEX</th>
</tr>
</thead>
<tbody>
<tr>
<td>e.g. HTTP, SMTP, FTP</td>
<td>Real-time Control Application</td>
</tr>
<tr>
<td>TCP</td>
<td></td>
</tr>
<tr>
<td>IP</td>
<td></td>
</tr>
<tr>
<td>IEEE802.3 or Ethernet Frame</td>
<td>Unique Real-time Frame</td>
</tr>
<tr>
<td>100BASE-TX</td>
<td>100BASE-TX</td>
</tr>
</tbody>
</table>

- **Too large over-head**
- **Using ASIC**

- **The same about Physical Layer**

**Note:** Ethernet is a registered trademark of Xerox corporation.
Efficient Frame

Simplified frame to realize high-speed real-time control

Ethernet

<table>
<thead>
<tr>
<th>Preamble, SFD</th>
<th>Ethernet Header</th>
<th>IP Header</th>
<th>TCP Header</th>
<th>Data</th>
</tr>
</thead>
</table>

8 byte | 14 byte | 20 byte | 20 byte | 62 byte

RTEX

Data

RTEX Header

Too long header, inefficiency

Short header suitable for real-time control
Real-time Communication

Fast and High Resolution
Motion Command

- Command position
- Servo on/off
- Parameter setting

In conventional pulse-interface, command resolution cannot be increased due to frequency limitation.

Parameter Setting
and Monitoring

- Actual position
- Sensor signals
- Details of alarm
- Various monitors

“Visualization”

High-density information links between controller and servos.
Isochronous among Axes

- Separately positioning
- Not corresponding Start/Stop timing between X and Y

- Synchronized positioning
- Corresponding Start/Stop timing

Note: CP control depends on a controller specification, and does not perform with only servo drive.
Isochronous transmission

At the same time, commands are reflected in all servo drives.

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

Signals to start servo calculation inside each drive

Axis 1

Axis 2

Axis 3

Axis 4

Note: Generally, jitter less than 1us is ideal.

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

Jitter: +/- 70ns
Fully Synchronization

With a unique algorithm (patented), NC is synchronized with all servo controls (position, velocity, current, PWM).

Improvement of sync precision among axes!

<table>
<thead>
<tr>
<th>Servo Control</th>
<th>Pulse I/F</th>
<th>RTEX</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Async.</td>
<td>All Axes Sync</td>
</tr>
</tbody>
</table>

Suitable for precise synchronizing such as a gantry as well as CP control.
Position command with 0.5ms com. cycle

Shorter delay of transmission makes high servo performance.

NC

Motion Profile Generator

Servo

Position Control

Velocity Control

Torque Control

M

Enc

Target Position

Command Position

Command Velocity

Command Torque

Position command with 0.5ms com. cycle

Motion Profile Generator
Interface Data

1ms or 0.5ms (Selectable with parameter)

Absolute (not incremental) value must be used.
Default polarity: + → CCW, - → CW
Shorter Update Period

More Precisely on High-speed CP control

Micro circular interpolation (e.g. Dispenser)

Conventional
T = 2ms

RTEX
T = 0.5ms (*)

*: Data update period depends on controller specification, and is either 1ms or 0.5ms.
Shorter Transmission-Time

Conventional System

RTEX

<table>
<thead>
<tr>
<th>Proportion to # of axes</th>
<th>4axes</th>
<th>8axes</th>
<th>16axes</th>
<th>32axes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>38us</td>
<td>75us</td>
<td>150us</td>
<td>300us</td>
</tr>
</tbody>
</table>

Command Generation in NC

Communication

Command Reflection in Servo Calculation

Constant

TA > TB

Note: The above shows a case when the data update is done with the same period as the communication.
Error Correction

Error corrected at going through nodes.

Strong Noise Immunity

Note: Because of limitations of the error correct ability, there is a case where it cannot restore broken data.

Effective in many nodes system
## Specifications of RTEX

<table>
<thead>
<tr>
<th>Item</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Speed</strong></td>
<td>100Mbps</td>
</tr>
<tr>
<td><strong>Physical Layer</strong></td>
<td>100BASE-TX full duplex (by IEEE 802.3u)</td>
</tr>
<tr>
<td><strong>Cable</strong></td>
<td>Shielded Twisted Pair (TIA/EIA-568B CAT5e or more)</td>
</tr>
<tr>
<td><strong>Topology</strong></td>
<td>Ring</td>
</tr>
<tr>
<td><strong>Isolation</strong></td>
<td>Pulse Transformer with common-mode choke</td>
</tr>
<tr>
<td><strong>Connector</strong></td>
<td>RJ45</td>
</tr>
<tr>
<td><strong>Cable Length</strong></td>
<td>Inter-node: Max. 60m, Total: Max. 200m</td>
</tr>
<tr>
<td><strong>Noise Immunity</strong></td>
<td>2.5kV over, IEC61000-4-4 compliant</td>
</tr>
<tr>
<td><strong>Com. Cycle (*)</strong></td>
<td>0.5ms (data update: 1ms or 0.5ms)</td>
</tr>
<tr>
<td><strong>Number of Axes (</strong>)</td>
<td>Up to 32</td>
</tr>
<tr>
<td><strong>Motion Interface (*)</strong></td>
<td>Position Command</td>
</tr>
</tbody>
</table>

*Note: For standard model of A4N  ** Note: Depending on specification of host controller
Collaboration

Products except servo are provided by partners.
Features of Servo
Features of A4 (Base of A4N)

- 1000Hz velocity response
- Advanced real-time automatic gain-tuning
- Vibration reduction control
Compact

Previous Model

A4N

Volume 1/2

Unit: mm

Note: Comparison with B series (200W, 200V)
Setting Tools (Optional)

Setup Software
“PANATERM”
DV0P4460

Parameter Setting
Monitoring
Wave Form
Freq. Analyzing
etc.

Handy Console
DV0P4420

Parameter Setting
Monitoring
Jogging
etc.

Connect with RS232(X4)

Alternative
## Full-Closed Control

High precision full-closed control system

![Diagram of full-closed control system with encoder and Linea Encoder connections]

### Connectable Linea Encoder

<table>
<thead>
<tr>
<th>Mitsutoyo</th>
<th>Sony Manufacturing Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>AT573A</td>
<td>SR75 / SR85</td>
</tr>
<tr>
<td>ST771A / ST773A</td>
<td>SR77 / SR87</td>
</tr>
<tr>
<td></td>
<td>SL710 + PL101-RP</td>
</tr>
<tr>
<td><strong>Type</strong></td>
<td><strong>Incremental (*)</strong></td>
</tr>
<tr>
<td>Absolute</td>
<td>Absolute</td>
</tr>
<tr>
<td>Resolution</td>
<td></td>
</tr>
<tr>
<td>0.05um</td>
<td>0.5um / 0.1um</td>
</tr>
<tr>
<td>0.05 to 1um</td>
<td>0.05 to 1um</td>
</tr>
<tr>
<td>0.1um</td>
<td></td>
</tr>
</tbody>
</table>

*Note: For incremental, the special model of servo is needed.*
Special servo drive for linear motor can be provided.

Notes:
- Panasonic do not provide linear motor.
- The linear encoder is the same as for full-closed control.
- Because of limitations of servo drive, the combination of resolution and max. speed are as follows:
  - max 2m/s at 0.05um
  - max 5m/s at 0.5um
Compliance

- UL, cUL
- TUV
- CE

<table>
<thead>
<tr>
<th>EMC Directive</th>
<th>EN55011</th>
<th>Terminal Disturbance Voltage</th>
<th>group 1, class A</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Radiated Electric Field Strength</td>
<td>group 1, class A</td>
<td></td>
</tr>
<tr>
<td>IEC61000-4-2</td>
<td>Electrostatic Discharge</td>
<td>8kV</td>
<td></td>
</tr>
<tr>
<td>IEC61000-4-3</td>
<td>Radiated Susceptibility</td>
<td>10V/m</td>
<td></td>
</tr>
<tr>
<td>IEC61000-4-4</td>
<td>EFT/Burst</td>
<td>2kV</td>
<td></td>
</tr>
<tr>
<td>IEC61000-4-5</td>
<td>Surge</td>
<td>2kV</td>
<td></td>
</tr>
<tr>
<td>IEC61000-4-6</td>
<td>Conductive Susceptibility</td>
<td>150kHz-80MHz, 10V</td>
<td></td>
</tr>
<tr>
<td>IEC61000-4-11</td>
<td>Voltage Dips</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- RoHS
Appearance

Analog monitor pins

X1: Power supply

<table>
<thead>
<tr>
<th>pin</th>
<th>L1</th>
<th>L2C</th>
</tr>
</thead>
</table>

X2: Motor connector

<table>
<thead>
<tr>
<th>pin</th>
<th>RB1</th>
<th>RB2</th>
<th>U</th>
<th>V</th>
<th>W</th>
</tr>
</thead>
</table>

Earth terminal

X3: Com. connector (RJ45)

X4: RS232 (MINI-DIN 8pins)

X5: Sensors connector (Half pitch 36pins)

X6: Encoder connector (6pins)

X7: Linear encoder connector (6pins)
Front Panel

Servo ON

- 7segments LED
- Address Setting RSW
- LINK Status (Green)
- Com. Status (Green / Red)

Servo OFF

Note: If alarm, the error code is indicated on 7segments LED with blinking.
Appearance of Size A to D

A

B

C

D

A to C: Fan less
D or more: With built-in fan

W 40
H 150
D 132

W 55
H 150
D 132

W 65
H 150
D 172

W 85
H 150
D 172

Unit: mm
## Lineup

<table>
<thead>
<tr>
<th>Power Input of Drive</th>
<th>50W</th>
<th>100W</th>
<th>200W</th>
<th>400W</th>
<th>750W</th>
<th>1kW</th>
<th>1.5kW</th>
<th>2kW</th>
<th>3kW</th>
<th>4kW</th>
<th>5kW</th>
<th>7.5kW</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Phase AC 100-115V</td>
<td>A</td>
<td>A</td>
<td>B</td>
<td>C</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>MADD T1105N</td>
<td>MADD T1107N</td>
<td>MBDD T2110N</td>
<td>MCDD T3120N</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Phase AC 200-240V</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>MADD T1205N</td>
<td>MADD T1207N</td>
<td>MBDD T2210N</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 or 3 Phase AC 200-240V</td>
<td>C</td>
<td>D</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>MCDD T3520N</td>
<td>MDDD T5540N</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Phase AC 200-230V</td>
<td>E</td>
<td>F</td>
<td>F</td>
<td>G</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>MEDD T7364N</td>
<td>MFDD TA390N</td>
<td>MFDD TB3A2N</td>
<td>MGDD TC3B4N</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Upper: Frame size
Lower: Typical model No.  (Depending on combination with motor )
Structure of Model No.

**MADDT1207N**

- Servo Drive: A4 family
- Interface type: N: RTEX
- Frame Size:
  - A: Size A
  - B: Size B
  - C: Size C
  - D: Size D
  - E: Size E
  - F: Size F
- Power Input:
  - 1: 1-Phase AC100V
  - 2: 1-Phase AC200V
  - 3: 3-Phase AC200V
  - 5: 1 or 3-Phase AC200V
- Specifying Max. Current
Wiring
Power Supply and Motor

Put the circuit that makes main power turn off at alarm.

Put AC reactor if necessary.

For noise immunity, make the back of chassis tightly contact earthed metal frame. The surface of the metal frame must have conductivity.

Notes:
*1) The above figure shows an example of the frame size A or B. For the other size, refer to the specifications.
*2) The Battery is for absolute encoder. It is normally installed on encoder cable, or alternatively can be also connected to X5 connector.

Connect regenerative resistor, if necessary.

To reduce EMI, install a ferrite core DV0P1460. (ZCAT3035-1330 by TDK)
Daisy Chain of Power

Using dual connector, Daisy Chain is possible.

Specifications of connector:

<table>
<thead>
<tr>
<th>Description</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Manufacturer</strong></td>
<td>J.S.T. Mfg.</td>
</tr>
<tr>
<td><strong>Model No.</strong></td>
<td>4pole (for A, B size): 04JFAT-SAXGSA-C 5pole (for C, D size): 05JFAT-SAXGSA-C</td>
</tr>
<tr>
<td>Wire Size</td>
<td>AWG#14 to #18</td>
</tr>
<tr>
<td>Remark</td>
<td>This is not an accessory of the drive, so it is provided by yourself.</td>
</tr>
</tbody>
</table>
Sensor Inputs

DC12 to 24V +/-10%

CW Limit

CCW Limit

HOME

External Servo-ON (or general purpose input)

Emergency Stop

Servo Drive A4N

<table>
<thead>
<tr>
<th>Sensor Input</th>
<th>Pin Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>I-COM</td>
<td>1</td>
</tr>
<tr>
<td>CWL</td>
<td>20</td>
</tr>
<tr>
<td>CCWL</td>
<td>19</td>
</tr>
<tr>
<td>HOME</td>
<td>21</td>
</tr>
<tr>
<td>EX-SON / EX-IN4</td>
<td>23</td>
</tr>
<tr>
<td>EMG-STOP</td>
<td>2</td>
</tr>
</tbody>
</table>

Specifications:

- Normally Closed
- Normally Open
- Changeable polarity with parameter
- Mask-able with parameter

Note: 

- External Servo-ON (or general purpose input) can be used as Servo-ON (or general purpose input).
- Emergency Stop is normally closed and can be masked with parameter.
General Purpose Inputs

Note:
Host controller can monitor a state of EX-INs via RTEX.
These inputs do not influence servo control in the drive.
Sensor Input Example 1

Proximity-Sensor by SUNX
GX-F12 (NPN transistor output)

GX-F12A: Normally Open
GX-F12B: Normally Closed
Sensor Input Example 2

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

Note:
If “L” pin is open, ON during shade.
If “L” pin is tied to “+” pin, ON during light.
Relay Control Outputs

Servo Drive A4N

DC12 to 24V +/-10%

- ALM+ 15
- ALM- 16
- BRK-OFF+ 36
- BRK-OFF- 35

Max 50mA

Note: Vce (sat) = approx. 1.2V

For turning main power off

For releasing motor brake

During alarm, transistor OFF

During release, transistor ON

Max 50mA

X5
General Purpose Outputs

Example of connecting to a relay

DC12 to 24V +/-10%

EX-OUT1+

EX-OUT1-

EX-OUT2+

EX-OUT2-

X5

When the corresponding bit is 1, the transistor ON.

Max 50mA

Max 50mA

Note: Vce (sat) = approx. 1.2V

Note: Host controller can operate the EX-OUTs via RTEX. These outputs do not influence servo control in the drive.
Encoder Signal Outputs

Note: If incremental type of a linear encoder is used, this output is disabled.
Wiring of Com. Cable (4pairs)

“Straight” Wiring

Max 60m

RJ45 plug

1

White-Orange

2

Orange

3

White-Green

4

Green

5

Blue

6

White-Blue

7

White-Brown

8

Brown

Shell

Shield

Shell

√ twisted pair

Notes:
- STP(Shielded Twisted Pair cable) conformed to category 5e or more 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.
Wiring of Com. Cable (2pairs)

“Straight” Wiring

Max 60m

1
2
3
4
5
6
7
8

Yellow
Orange
White-Green
Green
White-Orange

Notes:
- STP (Shielded Twisted Pair cable) conformed to category 5e or more 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.
Trouble of Com. Cable

When “LINK” LED is disappear against power ON of all servos, make sure whether there is the trouble (e.g. breaking down) with a cable connected to RX of the disappearing servo.
Dimensions

(unit: mm)
Size A
Size B
Size F

Panasonic
ideas for life

Mounting bracket (typical position)

Mounting bracket (replaced)

Mounting bracket (typical position)

Mounting bracket (replaced)

Name plate
Options
Cable and Connector

Except for X5 connector, the options are in common with A4. For X5, the followings for A4P should be used.

X5 Cable

1) Model No. DV0P4510

2) Dimensions

<Remarks>
Color designation of the cable
e.g.) Pin-1  Cable color: Orange (Red1) : One red dot on the cable

X5 Connector

1) Model No. DV0P4500

2) Components

<table>
<thead>
<tr>
<th>Title</th>
<th>Part No.</th>
<th>Quantity</th>
<th>Manufacturer</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connector</td>
<td>54306-3611 or 54306-3619 (lead-free)</td>
<td>1</td>
<td>Molex Inc.</td>
<td>For CN X5 (36-pins)</td>
</tr>
<tr>
<td>Connector cover</td>
<td>54331-0361</td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3) Table for wiring

Cable of 2m is connected.

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Color</th>
<th>Pin No.</th>
<th>Color</th>
<th>Pin No.</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Orange (Red1)</td>
<td>13</td>
<td>Gray (Red2)</td>
<td>25</td>
<td>White (Red3)</td>
</tr>
<tr>
<td>2</td>
<td>Orange (Black1)</td>
<td>14</td>
<td>Gray (Black2)</td>
<td>26</td>
<td>White (Black3)</td>
</tr>
<tr>
<td>3</td>
<td>Gray (Red1)</td>
<td>15</td>
<td>White (Red2)</td>
<td>27</td>
<td>Yellow (Red3)</td>
</tr>
<tr>
<td>4</td>
<td>White (Red1)</td>
<td>16</td>
<td>White (Black2)</td>
<td>28</td>
<td>Yellow (Black3)</td>
</tr>
<tr>
<td>5</td>
<td>White (Black1)</td>
<td>17</td>
<td>Yellow (Red2)</td>
<td>29</td>
<td>Pink (Red3)</td>
</tr>
<tr>
<td>6</td>
<td>Gray (Black1)</td>
<td>18</td>
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3) Pin disposition (36 pins) (viewed from the soldering side)
## X5 Pin Configurations

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Note: Do not connect to “Reserved” or “NC”. 