

Model

# CJ1W-CTS21-E

Synchronous Serial Interface (SSI) Unit

## INSTRUCTION SHEET (NJ-series Controllers)

Thank you for purchasing an OMRON product. Read this instruction sheet thoroughly and familiarise yourself with the functions and characteristics of the product before using it. To ensure safe and correct use of this Unit, also read the Operation and Programming Manuals for your NJ-series Controller system.

Keep this instruction sheet for future reference.

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**⚠ DANGER** Do not attempt to take the Unit apart and do not touch any internal parts while the power is being supplied. Doing either of these may result in electrical shock, and serious or fatal injury.

**⚠ Caution** Leave the protective label on top of the Unit as long as the Unit is not mounted and wired completely, in order to prevent wire clippings or other materials from getting inside the Unit. When the mounting and wiring has been completed, the label must be removed to allow air circulation and heat radiation.

### Nomenclature

#### Unit status LED indicators

- RUN (green)
- ERC (red)
- ERH (red)
- CH1, CH2 (green)

#### Machine number rotary switches

#### Removable Terminal Block

- Connections for SSI-encoders
- Connection for power supply SSI-encoders

#### Terminal Block latch

- Slide down to remove
- Slide up to lock



### Quick Start

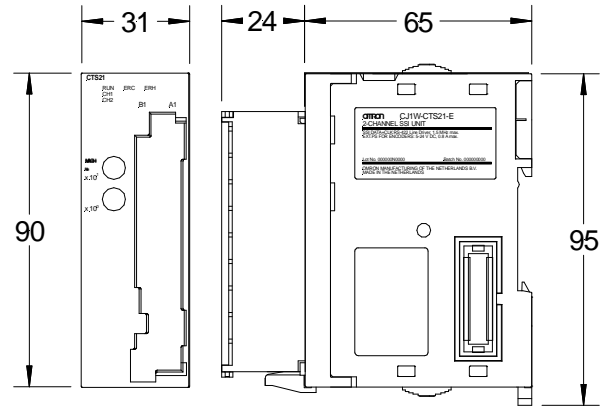
1. Set all configuration device variables to 0. The Unit is now configured as follows: 400kHz clock frequency, 24 bit Gray-coded and a 40µs monoflop time, for both SSI channels.
2. Set Machine Number.
3. Mount and wire the Unit, the two SSI encoders and the encoders power supply.
4. Turn power on.
5. Create I/O Table.
6. Both green CH1 and CH2 indicators should now turn on.
7. The encoder data can now be read from operational device variables \*\_Ch1\_SSIDat and \*\_Ch2\_SSIDat.

**Note:** If you only want to connect one SSI encoder, the other SSI channel has to be disabled. See section *Configuration Device Variables for CJ-series Units* for further details.

### Unit specifications

Unit type	CJ1 Special I/O Unit
Applicable PLC models	CJ/NJ-series PLCs
Storage temperature	-20 to +75 °C
Ambient temperature	0 to +55 °C
Ambient humidity	10 to 90 % (non-condensing)
EMC compliance	EN 50081-2, EN 61131-2
Current consumption	300 mA (5VDC via bus connection)
Weight	200 g (typical)
Number of words allocated	<ul style="list-style-type: none"> <li>• 20 Operation Words</li> <li>• 30 Configuration Words</li> </ul>

### Dimensions



### LED Indicators

Name	Color	State	Unit status
RUN	green	On	Normal operation
		Off	Initialisation error
ERC	red	On	Unit error (check *_ErrCode1/*_ErrCode2)
		Off	Unit has no errors
ERH	red	On	NJ CPU Unit error
		Off	NJ CPU Unit has no errors

Name	Color	State	Counter channel status
CH1, CH2	green	On	Channel configured and is communicating without errors
		Off	Channel is not configured or a communication error has occurred

### Machine Number Switch

Name	Function
MACHINE No.	Sets the Machine Number (00 – 94).
x10 <sup>1</sup> ○	<ul style="list-style-type: none"> <li>• Setting Machine Numbers 95-99 will generate an error.</li> <li>• Make sure each Machine Number is used only once per NJ CPU.</li> <li>• The next higher Machine Number should not be used on any unit, as it would cause a CIO-data overlap</li> <li>• Be sure to turn off the power to the Unit before setting the Machine Number.</li> </ul>
x10 <sup>0</sup> ○	

## Terminal Block layout

Use the following table to make connections directly to the screw terminals block:

Item	Description Row B	Terminal no.	Description Row A
SSI DATA CH1	DATA1 -	B1	
		A1	DATA1 +
SSI Clock CH1	CLOCK1 -	B2	
		A2	CLOCK1 +
SSI Power Supply OUT CH1	0V_ENC_PS <sup>1</sup>	B3	
		A3	+_ENC_PS <sup>2</sup>
	N.C.	B4	
		A4	N.C.
SSI DATA CH2	DATA2 -	B5	
		A5	DATA2 +
SSI Clock CH2	CLOCK2 -	B6	
		A6	CLOCK2 +
SSI Power Supply OUT CH2	0V_ENC_PS <sup>1</sup>	B7	
		A7	+_ENC_PS <sup>2</sup>
	N.C.	B8	
		A8	N.C.
Encoder Power Supply Input	0V_ENC_PS <sup>1</sup>	B9	
		A9	+_ENC_PS <sup>2</sup>

<sup>(1)</sup>/<sup>(2)</sup>: All these pins are internally connected.

## Notes:

- Electrical isolation is provided for each data input line. Electrical isolation is not provided for the outgoing clock lines. The encoder power supply can be connected to the unit's connector.
- The power supply should match the encoder's specifications.
- Use shielded twisted pair, 2x2x0.25mm<sup>2</sup> (+ optional 2x0.5mm<sup>2</sup> for PS).
- The shield must be connected to the SSI encoder and to the frame-ground near the PLC-system.
- Recommended maximum cable length by selected clock frequency:
  - 100 kHz: < 400 m
  - 300 kHz: < 100 m
  - 200 kHz: < 200 m
  - 400 kHz: < 50 m.

## Communication Errors

During normal operation, the SSI Unit can detect three kinds of communication errors (see section *Error Processing*). At the occurrence of a communication error on channel 1(2):

- the corresponding error code is set in device variables \*\_ErrCode1 and \*\_ErrCode2
- the corresponding error code is stored inside the SSI Unit
- the Global Error device variable \*\_GblErr is turned ON
- the ERC LED indicator is turned ON
- the corresponding CH1(2) LED indicator is turned OFF

This status will remain, even if during the next SSI-communication no error is detected by the SSI Unit. In this case only the valid SSI data received device variable \*\_Ch1(2)\_ValidDatRcvSta will be turned ON indicating that for the current SSI data, no communication error was detected.

To clear the above error status, the clear all errors device variable \*\_ClrAllErr has to be turned ON.

The following table describes the possible statuses of the SSI Unit after proper initialisation:

ERC LED / Global error bit	CH LED	New Valid SSI data received bit	Status
Off	On	On	The channel SSI data can be used; no error has occurred.
Off	On	Off	No new channel SSI data has been received since last cyclic refresh; no error has occurred.
Off	Off	Off	Channel is not configured for SSI communication (see Configuration Device Variables).
On	Off	On	The channel SSI data can be used; a communication error has occurred earlier*.
On	Off	Off	The channel SSI data cannot be used; a communication error has occurred*.
On	On	On	The channel SSI data can be used; a non-communication error has occurred*.
On	On	Off	No new channel SSI data has been received since last cyclic refresh; a non-communication error has occurred*.

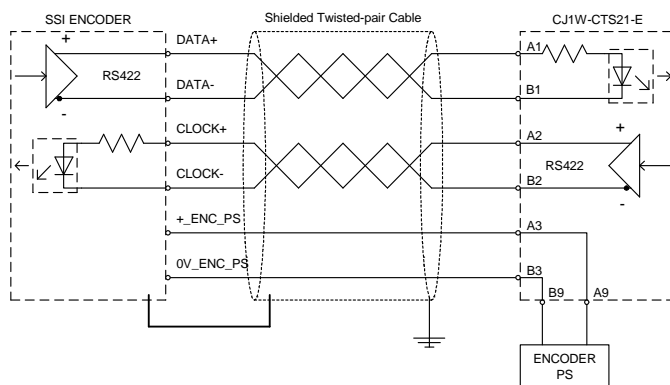
\* See *Error Processing* section for countermeasures.

## SSI Communication

Item	Specification
CLK lines	Non-isolated differential line driver, RS422 compliant
DATA lines	Electrically isolated differential line receiver, RS422 compliant
Number of data-bits	9 to 31 (default: 24)
Value coding	Gray/Binary/Tannenbaum/Raw (default Gray)
Clock frequency	100kHz to 1.5 MHz (default 400 kHz)
Monoflop time	10µs to 99,990 µs (default: 40 µs)
Sample rate	Approx. 2500 Samples/sec with 2 encoders connected (with default settings)

Default: All DM-settings are 0000

## SSI Circuitry



## Noise Prevention

The symptoms of picking up noise are random jumps in the SSI data values read (\*\_Ch1\_SSIDat, \*\_Ch2\_SSIDat). For applications that expect a continuous change of SSI data values, the user program can identify noise by detecting an unexpected large change in the SSI data values or data values outside the expected range.

The best way to prevent noise is by proper wiring the unit as described in the *SSI Circuitry* section.

An alternative could be to use an SSI encoder equipped with parity.

## ■ Configuration Device Variables for CJ-series Units

Device Variable	Name (Type)	Function
<b>General</b>		
*_StartUpDelayCfg Offset = 07	Additional SSI-communication Start-up Delay (UINT)	Additional SSI-communication start-up delay **: 0 = 2000 ms delay 1 = 1050 ms delay 2 = 500 ms delay 3 = no delay Valid Range: 0 to 3 Read/Write Access Type
<b>SSI Channel 1 ***</b>		
*_Ch1_SSIbaudrateCfg Offset = 10 (channel 1) or 20 (channel 2)	SSI Baudrate (UINT)	SSI baudrate: 0 = 400 kHz 1 = 100 kHz 2 = 200 kHz 3 = 300 kHz 4 = 400 kHz 5 = 500 kHz 6 = 1 MHz 7 = 1.5 MHz 65535 = No encoder connected (the rest of settings is not processed) Valid Range: 0 to 7 or 65535 Read/Write Access Type
*_Ch1_ValCodeCfg Offset = 11 (channel 1) or 21 (Channel 2)	Value Coding (UINT)	Value coding: 0 = Gray code 1 = Binary 2 = Raw SSI data only (settings for leading/trailing bits, optional SSI encoder status bits, and parity are not processed) Valid Range: 0 to 2 Read/Write Access Type
*_Ch1_ResolutionCfg Offset = 12 (channel 1) or 22 (channel 2)	Encoder Resolution (WORD)	Encoder resolution: Number of data bits: [9..31] (in BCD), 0 means value = 24 bits Valid Range: 16#0000, 0009 to 0031 Read/Write Access Type
*_Ch1_LeadingBitSzCfg Offset = 13 (channel 1) or 23 (channel 2)	Leading Bits (WORD)	Leading bits ****: Number of bits preceding encoder data: [0..31] (in BCD) $\Sigma m+12..13 \leq 31$ Valid Range: 16#0000 to 0031 Read/Write Access Type
*_Ch1_TrailingBitSzCfg Offset = 14 (channel 1) or 24 (channel 2)	Trailing Bits (WORD)	Trailing bits ****: Number of bits following encoder data: [0..31] (in BCD) $\Sigma m+12..14 \leq 31$ Valid Range: 16#0000 to 0031 Read/Write Access Type
*_Ch1_SSIStatusBitSzCfg Offset = 15 (channel 1) or 25 (channel 2)	SSI Encoder Status Bits (WORD)	Optional SSI encoder status bits (see *_Ch1_SSISta): Number of bits succeeding trailing bits: [0..8] $\Sigma m+12..15 \leq 31$ Valid Range: 16#0000 to 0008 Read/Write Access Type
*_Ch1_ParityChkCfg Offset = 16 (channel 1) or 26 (channel 2)	Parity Check (USINT)	Parity check: 0 = no parity check 1 = check for even parity 2 = check for odd parity Parity is calculated over all bits received. Valid Range: 0 to 2 Read/Write Access Type
*_Ch1_MonoflopTimeCfg Offset = 17 (channel 1) or 27 (channel 2)	Mono-flop Time (WORD)	Mono-flop time: check if the data line is high after the mono-flop time has expired. Set in tens of microseconds (BCD). Valid Range: 16#0000 to 9999 Read/Write Access Type
<b>SSI Channel 2 ***</b>		
Use *_Ch2 in place of *_Ch1	---	Same as SSI channel 1

\*\* This delay is additional to the PLC-system start-up time.

\*\*\* Refer to the operation manual of the SSI encoder for proper configuration of the SSI Unit's channels.

\*\*\*\* Trailing and leading bits are to be used for connecting Tannenbaum coded SSI-encoders. E.g. for a 24-bit Tannenbaum encoder with 10 multi-turn and 10 single turn-bits and 1 status bit, centred around bit 12/13, the leading bits have to be set to 2 and the trailing bits to 2.

## ■ Operation Device Variables for CJ-series Units

Device Variable	Name (Type)	Function
<b>General</b>		
*_RdNxtErr	Read Next Error (BOOL)	Read (next) Error (0→1) from error history. Read next error at the rising edge (from the error list in the SSI Unit). The error code can be read from *_ErrCode1 and *_ErrCode2. Valid Range: 0,1 Read/Write Access Type
*_ClrAllErr	Clear All Errors (BOOL)	Clear all Errors (0→1) from error history. Clear all errors at the rising edge (from the error list in the SSI Unit). Valid Range: 0,1 Read/Write Access Type
*_ErrCode1	Error Code 1 (WORD)	Error Code (See <i>Error Processing</i> section for details) Valid Range: 16#0000 to FFFFFFFF Read Only Access Type
*_ErrCode2	Error Code 2 (WORD)	Read Only Access Type
*_GlbErr	Global Error (BOOL)	Global Error Indication. Indicates that one or more errors have occurred and that their error code(s) are included in the error list of the Unit. Valid Range: 0,1 Read Only Access Type
*_UnitInitSta	Unit Initializing (BOOL)	Unit initialising after restart or power-up. Valid Range: 0,1 Read Only Access Type
<b>SSI Channel 1</b>		
*_Ch1_SSIData	SSI Data (DWORD)	Current SSI data. Valid Range: 16#0000 to FFFFFFFF Read Only Access Type
*_Ch1_SSISta	SSI Encoder Status (UINT)	Optional SSI encoder status (see *_Ch1_SSIStaBitSzCfg) Valid Range: 16#00 to FF Read Only Access Type
*_Ch1_ValidDatRcvSta	Valid SSI Data Received (BOOL)	Valid SSI data received since previous I/O-refresh Valid Range: 0,1 Read Only Access Type
<b>SSI Channel 2</b>		
*_Ch2_SSIData	SSI Data (DWORD)	Current SSI data Valid Range: 16#0000 to FFFFFFFF Read Only Access Type
*_Ch2_SSISta	SSI Encoder Status (UINT)	Optional SSI encoder status (see *_Ch2_SSIStaBitSzCfg) Valid Range: 16#00 to FF Read Only Access Type
*_Ch2_ValidDatRcvSta	Valid SSI Data Received (BOOL)	Valid SSI data received since previous I/O-refresh Valid Range: 0,1 Read Only Access Type

## ■ Error Processing

At the occurrence of an error:

- the corresponding error code is transferred to device variables  
\*\_ErrCode1 and \*\_ErrCode2
- the corresponding error code is stored inside the SSI Unit
- the Global Error device variable \*\_GlbErr is turned ON
- the ERC LED indicator or ERH LED indicator is turned ON

The following errors codes can be reported in device variables  
\*\_ErrCode1 and \*\_ErrCode2

*_ErrCode 1	*_ErrCode2	Description
0300	Offset (see configuration device variable table above)	The setting for the Device Variable is out of range. Use the *_ErrCode2 offset to identify the Device Variable.
0310	Offset (see configuration device variable table above)	The setting for the Device Variable has an invalid BCD-code (The range of a valid BCD-code for a digit is 0-9. If one or more digits are within range A – F, an invalid BCD-code is specified). Use the *_ErrCode2 offset to identify the Device Variable.

Countermeasure: Configuration errors can be cleared by correcting the faulty settings in device variables and transferring the new configuration data to the Unit. To transfer the configuration data:

- Turn the power of the NJ system ON, or
- Restart the Unit

*_ErrCode 1	*_ErrCode2	Description
0490	CH No. 00	Parity error in SSI channel <u>CH No.</u>

Countermeasure: Check if the unit is configured to check for the correct type of parity (even or odd). Check the SSI-encoder.

*_ErrCode 1	*_ErrCode2	Description
0490	CH No. 01	SSI-encoder channel <u>CH No.</u> not ready

Countermeasure: This error appears in case the data line is low right before the communication with the encoder connected to channel CH No. is started. Check the cabling between the unit and the SSI-encoder. Check the SSI-encoder.

*_ErrCode 1	*_ErrCode2	Description
0490	CH No. 02	SSI-encoder channel <u>CH No.</u> time-out

Countermeasure: This error appears in case the data line is and stays low after the mono-flop time has expired on channel CH No. Check if the unit is configured for the correct encoder settings. Check the cabling between the unit and the SSI-encoder. Check the SSI-encoder.

*_ErrCode 1	*_ErrCode2	Description
0002	Time-out in ms (hex)	A cyclic refresh time-out error was generated caused by a PLC system error or you have chosen to disable the Cyclic Refresh of the SSI Unit in the NJ-series CPU Unit. This error will be cleared as soon as Cyclic Refresh or IORF will take place.
000E	0000	An error has occurred on the I/O Bus causing the SSI Unit to be in an undefined state.

Countermeasure: Turn ON the power supply again or restart the system. If the error persists then replace the NJ CPU.

# OMRON

OMRON EUROPE B.V.

Wegalaan 67-69  
NL-2132 JD Hoofddorp  
The Netherlands  
Phone (+31) 23 - 56 81 300  
Fax (+31) 23 - 56 81 388  
Internet: [www.eu.omron.com](http://www.eu.omron.com)

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