

Model

CJ1W-CTS21-E

Synchronous Serial Interface (SSI) Unit

INSTRUCTION SHEET

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 following Operation Manual (Cat. No. W393-E1): SYSMAC CJ1 Series Programmable Controllers.



Keep this instruction sheet for future reference.

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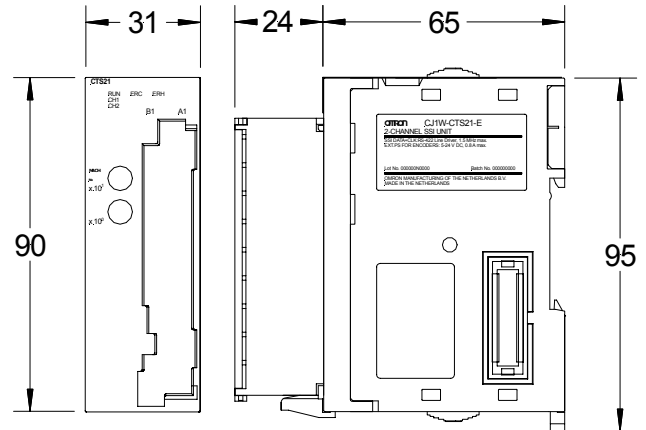
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Note: If you only want to connect one SSI encoder, the other SSI channel has to be disabled in DM m+20, see section *Configuring the Unit via DM* for further details.

Unit specifications

Unit type	CJ1 Special I/O Unit
Applicable PLC models	CJ1-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 (5V via busconnection)
Weight	200 g (typical)
Number of words allocated	<ul style="list-style-type: none"> 20 CIO-words. First word allocated = CIO2,000 + (Nx10) 30 DM-words. First word allocated = D20,000 + (Nx100)

Dimensions



⚠ 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 indicators

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

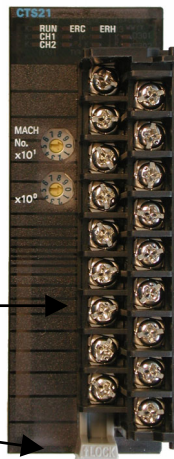
Machine number rotary switches

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 DM-settings 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 CIO n+10/11 and CIO n+15/16.

LED Indicators

Name	Colour	State	Unit status
RUN	green	On	Normal operation
		Off	Initialisation error
ERC	red	On	Unit error (check CIO n+6, n+7)
		Off	Unit has no errors
ERH	red	On	CJ1-CPU Unit error
		Off	CJ1-CPU Unit has no errors

Name	Colour	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).
$x10^1$ ○	<ul style="list-style-type: none"> • Setting Machine Numbers 95-99 will generate an error. • Make sure each Machine Number is used only once per CJ1-CPU. • The next higher Machine Number should not be used on any unit, as it would cause a CIO-data overlap • Be sure to turn off the power to the Unit before setting the Machine Number.
$x10^0$ ○	

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 ¹	B3	
		A3	+_ENC_PS ²
	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 ¹	B7	
		A7	+_ENC_PS ²
	N.C.	B8	
		A8	N.C.
Encoder Power Supply Input	0V_ENC_PS ¹	B9	
		A9	+_ENC_PS ²

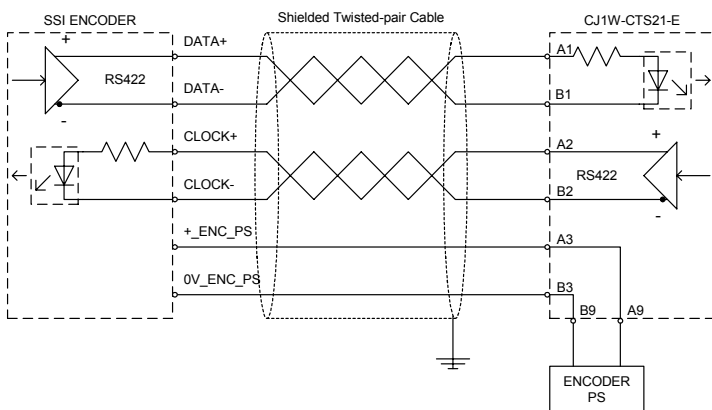
(¹)(²): All these pins are internally connected.

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 1.5MHz (default 400kHz)
Monoflop time	10µs to 99,990µs (default: 40µs)
Sample rate	Approx. 2500 Samples/sec with 2 encoders connected (with default settings)

Default: All DM-settings are 0000

SSI Circuitry



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 encoders specifications.
- Use shielded twisted pair, 2x2x0.25mm² (+ optional 2x0.5mm² for PS).
- The shield must be connected to the SSI encoder and to the frame-ground near the PLC-system.
- The SSI protocol has no mechanism to reject noise. See section *Noise Prevention* for more information.
- Recommended maximum cable length by selected clock frequency:
 - 100kHz: < 400m
 - 300kHz: < 100m
 - 200kHz: < 200m
 - 400kHz: < 50m.

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 CIO n+6, n+7
- the corresponding error code is stored inside the SSI Unit
- the Global Error Indication bit in CIO (n+8, bit 00) is set
- the ERC-LED is turned on
- the corresponding CH1(2)-LED 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 "New valid SSI data received" bit in CIO will be set, indicating that for the current SSI data in CIO no communication error was detected.

To clear the above error status, the "Clear Error" bit in CIO has to be set.

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 in CIO 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 DM m+10/20).
On	Off	On	The channel □ SSI data in CIO can be used; a communication error has occurred earlier*.
On	Off	Off	The channel □ SSI data in CIO cannot be used; a communication error has occurred*.
On	On	On	The channel □ SSI data in CIO 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.

Noise Prevention

The symptoms of picking up noise are random jumps in the SSI data values read (CIO n+10/11 and n+15/16). For applications that expect a continuous change of SSI data values, the PLC application can e.g. 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 Communication* section.

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

■ Configuring the Unit via DM

m = D20000 + (Nx100), with N the Machine Number of the Unit.

DM Word	Bit	Function
General		
m	00-15	Reserved*
m+1	00-15	Reserved*
m+2	00-15	Reserved*
m+3	00-15	Reserved*
m+4	00-15	Reserved*
m+5	00-15	Reserved*
m+6	00-15	Reserved*
m+7	00-15	Additional SSI-communication start-up delay **: 0 = 200ms delay 1 = 1050ms delay 2 = 500ms delay 3 = no delay
m+8 to m+9	00-15	Reserved*
SSI Channel 1 ***		
m+10	00-15	SSI baudrate: 0 = 400kHz 1 = 100kHz 2 = 200kHz 3 = 300kHz 4 = 400kHz 5 = 500kHz 6 = 1MHz 7 = 1.5MHz FFFF = No encoder connected (the rest of settings is not processed)
m+11	00-15	Value coding: 0 = Gray code 1 = Binary 2 = Raw SSI data only (settings m+13..16 are not processed)
m+12	00-15	Encoder resolution: Number of data bits: [9..31] (in BCD), 0 means value = 24 bits
m+13	00-15	Leading bits ****: Number of bits preceding encoder data: [0..31] (in BCD) $\Sigma m+12..13 \leq 31$
m+14	00-15	Trailing bits ****: Number of bits following encoder data: [0..31] (in BCD) $\Sigma m+12..14 \leq 31$
m+15	00-15	Optional SSI encoder status bits (see CIO n+12 bits 00-07): Number of bits succeeding trailing bits: [0..8] $\Sigma m+12..15 \leq 31$
m+16	00-07	Parity check: 0 = no parity check 1 = check for even parity 2 = check for odd parity Parity is calculated over all bits received.
	08-15	Not used
m+17	00-15	Mono-flop time: check if the data line is high after the mono-flop time has expired. Set in tens of microseconds (BCD).
m+18	00-15	Reserved*
m+19	00-15	Reserved*
SSI Channel 2 ***		
m+20 to m+29	00-15	Same as SSI channel 1, see m+10 to m+19

Reserved*: Address should not be used, value must be 0000

** 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.

■ Operating the Unit via CIO

n = CIO2000 + (Nx10), with N the Machine Number of the Unit.

Word (output)	Bit	Function
General		
n	00-15	Reserved*
n+1	00	Read (next) Error (0→1) from error history
	01	Clear all Errors (0→1) from error history
	02-15	Reserved*
n+2	00-15	Reserved*
n+3	00-15	Reserved*
n+4	00-15	Reserved*
n+5	00-15	Reserved*
n+6, n+7	00-15	Error Code (See <i>Error Processing</i> section for details)
n+8	00	Global Error Indication
	01	Reserved*
	02	Unit initialising after restart or power-up
	03-15	Reserved*
n+9	00-15	Reserved*
SSI Channel 1		
n+10, n+11	00-15	Current SSI data
n+12	00-07	Optional SSI encoder status (see DM m+15)
	08	Valid SSI data received since previous I/O-refresh
	09-15	Reserved*
n+13, n+14	00-15	Reserved*
SSI Channel 2		
n+15, n+16	00-15	Current SSI data
n+17	00-07	Optional SSI encoder status (see DM m+25)
	08	Valid SSI data received since previous I/O-refresh
	09-15	Reserved*
n+18, n+19	00-15	Reserved*

Reserved*: Address should not be used, value must be 0000

■ Error Processing

At the occurrence of an error:

- the corresponding error code is transferred to words CIO n+6, n+7
- the corresponding error code is stored inside the SSI Unit
- the Global Error Indication bit in CIO (n+8, bit 00) is set
- the ERC-LED or ERH-LED is turned on

The following errors codes can be reported in CIO n+6, n+7:

n+6	n+7	Description
0300	DM Offset	The DM-setting located at $D20000 + (N \times 100) + \underline{DM\ Offset}$ is Out of Range (N = Machine Number).
0310	DM Offset	The DM-setting located at $D20000 + (N \times 100) + \underline{DM\ Offset}$ is an invalid BCD-code (N = Machine Number). (The range of a valid BCD-code for a digit is 0-9. If one or more digits is within range A - F an invalid BCD-code is specified).

Countermeasure: DM-configuration errors can be cleared by correcting the faulty settings in Data Memory and transferring the new configuration data to the Unit. To transfer the configuration data::

- Turn the power of the CJ1-system ON, or
- Restart the Unit using Restart-Bits A50200 to 50715

n+6	n+7	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.

n+6	n+7	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.

n+6	n+7	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.

n+6	n+7	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 CJ1-PLC settings. 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. On occurrence of an I/O Bus error you can configure the Outputs to keep their last state or to have a predefined state (refer to DM m/m+1)

Countermeasure: Turn ON the power supply again or restart the system. If the error persists then replace the CJ1-CPU.

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Note: Specification subject to change without notice.
Printed in The Netherlands

1634330-1A