

SEMI E54.12-0701^E (Reapproved 1106) SPECIFICATION FOR SENSOR/ACTUATOR NETWORK COMMUNICATIONS FOR CC-LINK

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^E This standard was editorially modified in September 2001 to correct a typographical error and the omission of a required disclaimer. § 2.3 was added and changes were made to § 7.6.2.6.

NOTICE: This document is no longer published with the SEMI E54 suite of standards. It is published and sold separately.

1 Purpose

1.1 This specification is part of the SEMI Sensor/Actuator Network (SAN) suite of standards and defines a specific communications protocol based on the CC-Link standard. This Network Communication Standard (NCS) taken together with the SEMI Sensor/Actuator Network standard suite and the CC-Link standard completely and unambiguously defines an open standard providing an industry specific solution to off-the-shelf interoperability of networked devices in semiconductor manufacturing equipment.

1.2 CC-Link is a vendor independent, open device level network standard. Vendor independence and openness are guaranteed by the CC-Link Partner Association.

2 Scope

2.1 This document specifies a SAN communications standard based on the CC-Link specification that is in compliance with SEMI E54.1. As such, it specifies the protocol, services and behavior that compliant intelligent devices must support in order to interchange information over this SAN in a method compatible with SEMI E39.

2.2 In conjunction with a SEMI standard SAN Common Device Model (CDM) specification and one or more SEMI standard Specific Device Model (SDM) specifications (e.g., for a mass flow controller), this Network Communication Standard (NCS) with the related CC-Link standard describe the data structures, interactions and behavior that are characteristic of the various devices on the network. This composite model forms a complete interoperability standard for communications among intelligent sensors, actuators and controllers in semiconductor manufacturing equipment.

NOTICE: This standard does not purport to address safety issues, if any, associated with its use. It is the responsibility of the users of this standard to establish appropriate safety and health practices and determine the applicability of regulatory or other limitations prior to use.

3 Limitations

3.1 This document specifies a semiconductor equipment SAN based solely on CC-Link; thus, a complete specification of this standard necessarily includes the CC-Link specifications. There are other semiconductor equipment SAN communications options. The specifications for these options are not included here.

3.2 The specifications within are strictly enhancements that provide additional capabilities over and above those currently required by CC-Link. Included throughout this document, primarily in § 6, is information paraphrased from the CC-Link specifications—such as: protocol structure, capabilities, options and limitations. This information is provided here for reference only and is not intended to provide specification definitions. In all such areas, refer to the CC-Link specification documents for information. This document is limited to describing enhancements or limitations to the CC-Link specification that are imposed by this standard.

3.3 A complete specification of the conformance testing procedure shall include the CC-Link protocol conformance testing specification. Conformance testing shall also include enhancements and limitations to the CC-Link specification required by this standard.

4 Referenced Standards and Documents

4.1 SEMI Standards

SEMI E39 — Object Services Standard: Concepts, Behavior and Services

SEMI E54.1 — Sensor/Actuator Network Common Device Model

SEMI E54.3 — Specification for Sensor/Actuator Network Specific Device Model for Mass Flow Device

4.2 ISO Standard¹

7498 OSI — Basic Reference Model for Open Systems Interconnection

4.3 CC-Link Partner Association²

CC-Link Specification, Version 1.11 (or later)

NOTICE: Unless otherwise indicated, all documents cited shall be the latest published versions.

5 Terminology

5.1 Abbreviations and Acronyms

5.1.1 CDM — Common Device Model

5.1.2 NCS — Network Communication Standard

5.1.3 OSI — Basic Reference Model for Open Systems Interconnection (ISO 7498)

5.1.4 SAN — Sensor/Actuator Network

5.1.5 SDM — Specific Device Model

5.2 Definitions from Sensor/Actuator Network Common Device Model (SEMI E54.1)

5.2.1 Attribute

5.2.2 Behavior

5.2.3 Byte

5.2.4 Common Device Model

5.2.5 Device

5.2.6 Device Manager (DM) Object

5.2.7 Device Model

5.2.8 Instance

5.2.9 Network Communication Standard

5.2.10 Object

5.2.11 Sensor, Actuator and Controller (SAC) Object

5.2.12 Service

5.2.13 Specific Device Model

5.2.14 State Diagram

1 International Organization for Standardization, ISO Central Secretariat, 1 rue de Varembe, Case postale 56, CH-1211 Geneva 20, Switzerland. Telephone: 41.22.749.01.11; Fax: 41.22.733.34.30; <http://www.iso.ch>

2 CC-Link Partner Association; <http://www.cc-link.org>

5.3 Definitions

5.3.1 *broadcast polling method* — polling to each station and the data communication are executed by the same packet, and the data is transmitted to all of the stations in this method.

5.3.2 *cyclic transmission* — function to transmit the data from master station to all stations periodically, then for each station to transmit the response data to master station.

5.3.3 *intelligent device station* — station which can send cyclic transmission and transient transmission to master station.

5.3.4 *local station* — station which can send cyclic transmission and transient transmission to master station and other local stations.

5.3.5 *master station* — station that controls all stations on CC-Link. One (and only one) master station per system is required.

5.3.6 *profiles* — Application Object Model specifications.

5.3.7 *remote device station* — station that handles bit data and word data.

5.3.8 *remote I/O station* — station that handles only bit data.

5.3.9 *remote station* — generic name of remote I/O station and remote device station.

5.3.10 *slave station* — generic name of station other than master station.

5.3.11 *station* — equipment which can be connected with CC-Link and is assigned a station number of 0–64.

5.3.12 *transient transmission* — function to transmit the non-periodic data generated in master station, local station, and intelligent device station.

6 Communication Protocol High Level Structure

6.1 Message transfer is organized in cycles. A message cycle mainly consists of a request-frame followed by a corresponding acknowledge/response-frame of the addressed station.

6.2 A brief description of the CC-Link protocol as it relates to the ISO 7498 OSI model follows in the sections below. For protocol efficiency, CC-Link does not define layers 3–6.

NOTE 1: The information contained in this section is for reference only. It in no way represents specifications for CC-Link. See related documentation for these specifications.

6.3 *Physical Layer – Layer 1* — the Physical Layer conforms to the EIA RS-485 standard. See the CC-Link standard for more information.

6.4 *Data Link Layer – Layer 2* — the Data Link Layer conforms to the HDLC standard. See the CC-Link standard for more information.

6.5 *Application Layer – Layer 7* — the Application Layer defines services and protocols for Network Management, Cyclic Transmission and Non-Cyclic Transmission (or Transient Transmission). Also, Application Object Models are specified as “Profiles”. See the CC-Link standard for more information.

6.6 Version 1.11 of the CC-Link Standard introduces two methods for request/response messaging.

6.7 Devices that support the CC-Link Transient Transmission capability use this method, together with a messaging protocol to transmit Service Requests and Responses.

6.8 Devices that do not support the Transient Transmission capability use the Cyclic Transmission method. A protocol is defined for changing the context of the cyclic data from I/O to a messaging protocol for Service Requests and Responses.

6.9 See the CC-Link standard for more information.