SCD6000 RTU Architectural Overview

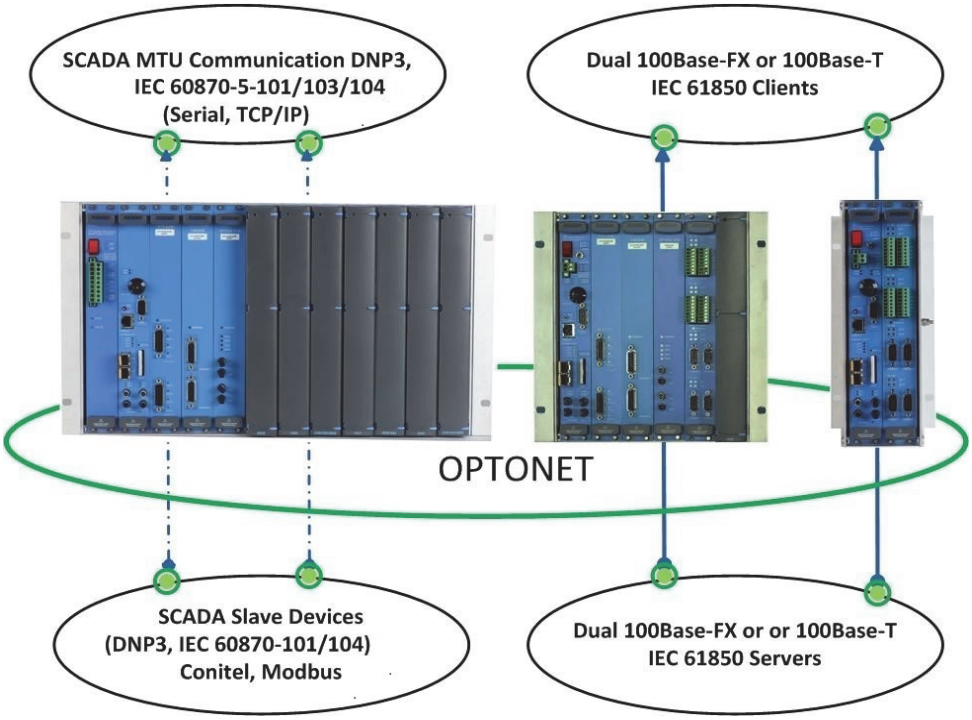

Figure 1. SCD6000 Architecture

SCD6000 OVERVIEW

The SCD6000 modules inherit the functionality of the modular Foxboro SCD5200. The SCD6000 architecture allows a full spectrum of configurations ranging from small single device stations to distributed input/output systems with redundant (duplicated and path diverse) communications networks.

The CPU used in an SCD6000 Controller provides more dynamic RAM for a higher concentration of IEC 61850, Modbus, IEC 101, IEC 103, IEC 104, DNP3, Conitel, and Intelligent Electronic Devices (IEDs). The SCD6000 supports both half and full duplex Ethernet communications.

The SCD6000 has dual 100 Mbps fixed SFP ports to support either 100Base-FX or 100Base-T and provide a cost-effective and versatile optical and wired Ethernet interface.

As shown in Figure 1, the architecture provides continuous support for OptoNet. Backward compatibility of the OptoNet is maintained with the Foxboro Remote Terminal Unit RTU50/ RTU50 SVX/SCD5200.

The CPU module supports these features:

- Specialized communications
- Local networking
- Application processing
- Integration of station devices and meters

The SCD6000 Main Processor module can be used as a plug-in replacement for the existing SCD5200 CPU module installed base with a regenerated configuration file. RTU50 SVX is the variant of SCD6000 used with the RTU50 card file. This allows older RTU50/SCD5200 card files to be mixed with the newer SCD6000 card.

The RTU's real time clock is synchronized to either a local GPS clock or from the master station as part of the protocols synchronizing the master station's clock. Time synchronization is extended across the Electrobus as additional signals to the Industry Standard Architecture (ISA) bus. The intelligent input modules use the real-time clock to time stamp the changes of all status inputs.

CYBERSECURITY FEATURES

SCD6000 provides dedicated features that help improve the cybersecurity posture of the product, including:

- Achilles Level 2 certified by Wurldtech
- System Use Notification
- Trusted Hosts with online configuration
- DNP3 SAv2 and DNP3 SAv5 using Asymmetric and Symmetric methods
- Encryption of Diagnostic Tool Access
- Role based access for RTV connectivity

The SCD6000 can be password-protected on any TCP/IP or serial port to restrict end user access. Passwords can be assigned for individual users and common roles such as Maintainer, Browser, and Superuser.

SCD6000 DISTRIBUTED BUILDING BLOCK OPTIONS

The SCD6000 architecture provides a series of building blocks that can be tailored to suit your control and communication needs. This section briefly describes various ways these building blocks can be interconnected to obtain the best solution for your needs. These options are:

- Electrobus Expansion
- OptoNet Expansion
- DCIU Integration
- IED Integration – Embedded and user defined protocols
- Communication Integration

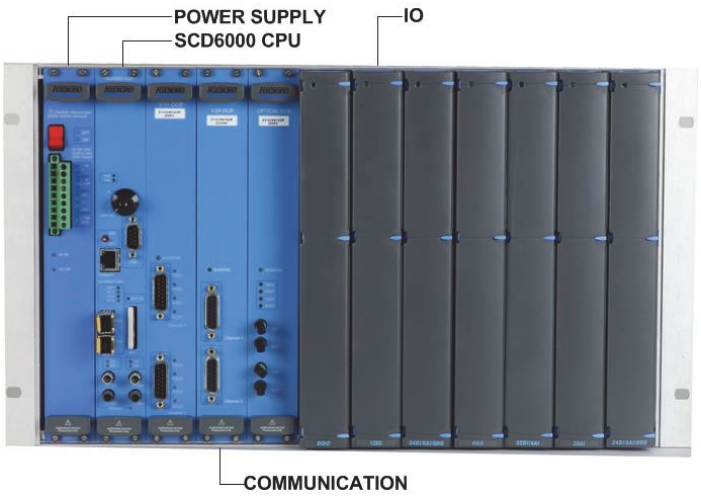

Figure 2. SCD6000 Main File

SCD6000 Main File

As shown in Figure 2, the SCD6000 Main File is a modular unit, consisting of the following subsystems:

- Power Supply module
- CPU module
- Communications module

The SCD6000 can be configured as an independent RTU, monitoring and controlling a remote plant via a variety of communication interfaces. The RTU can be as simple as a main file of electronics, can include extended I/O modules using Electrobus for a maximum of up to four chassis, or can be configured as part of an OptoNet network.

SCD6000 Card File Variations

The SCD6000 is provided with a passive high speed backplane that makes it possible to provide a number of formats with varying number of I/O slots. The SCD6000 supports four standard file variations:

- 10-slot I/O Card File
- 5-slot I/O Card File
- 3-slot I/O Card File
- 1-slot I/O Card File

Each variation allows one CPU. The most popular card format for the SCD6000 is a 19" rack file, which includes a wide range power supply, a COE variant of the CPU module (CPU, OptoNet, and Ethernet), and space to accommodate up to 10 standard width I/O modules.

You can use OptoNet cables to interconnect each card file to allow a scalable solution involving multiple computing nodes. Use the 5-slot card file to accommodate higher module densities. In this case, a COPE variant of the CPU module (CPU, OptoNet, Power supply, and Ethernet) supplies backplane power, which avoids the need for a separate wide range power supply. Use this card file for smaller spaces where a 19" card file solution might not be feasible.

Card File Power Supply

In smaller file formats (up to 5 I/O modules), the COPE's integral 40W wide input voltage supply powers the system.

Optional Power Supply (SY-0399131R)

A standalone power supply module is required to power the I/O modules and provide the field supply in the 10-slot I/O module file formats. These power supplies operate from 19.2 to 148VDC.

CPU Module

For the technical specifications of the SCD6000 Processor module, see the latest revision of PSS 31H-8K2R. The SCD6000 board supports:

- OptoNet high-speed optical redundant token passing local area network
- Dedicated RJ45 Ethernet diagnostic port for the Foxboro Remote Terminal Viewer (RTV)
- COM2 port RS-232/RS-485 supported protocols
  - DNP3 Master (SAv2 and SAv5)
  - DNP3 Slave (SAv2 and SAv5)
  - DNP3 Slave Dialup (SAv2 and SAv5)
  - Modbus Master
  - Modbus Slave
  - IEC 60870-5-101 Master
  - User Configurable Serial Interface
  - IED Pass-Through/Terminal Server
- Ethernet supported protocols
  - DNP3 Master on TCP/IP (SAv2 and SAv5)
  - DNP3 Slave on TCP/IP (SAv2 and SAv5)
  - DNP3 Master on UDP (SAv2 and SAv5)
  - DNP3 Slave on UDP (SAv2 and SAv5)
  - IEC 60870-5-104 Master
  - IEC 60870-5-104 Slave
  - DNV GL certified IEC 61850 Server and Client
  - DNV GL certified IEC 61850 GOOSE Publisher and Subscriber
  - Modbus/TCP Master
  - Diagnostic Utility over TCP/IP

Input/ Output Assemblies (I/O)

The CPU interfaces with the I/O modules through Electrobus. The range of I/O modules is extensive, covering all aspects of I/O at a wide range of input voltage level. Each I/O processor is intelligent, provides on-board pre-processing, and captures information on the sequence of events. For the technical specifications of the Input and Output Modules, see the latest revision of PSS 31H-8K1R.

Dual Communication Board (DCB)

DCB provides the communication interface between the SCD6000 and the master station. For the complete specifications of the SCD6000 Dual Communication Modules, see the latest revision of PSS 31H-8K4R.

State And Logic Language (SALL)

SALL provides the means to implement individual control and data processing logic for execution on the SCD6000 (see Figure 3). For more details, see the latest revision of the *RTU Programming User's Guide: State and Logic Language (SALL) Reference* (B0780DK).

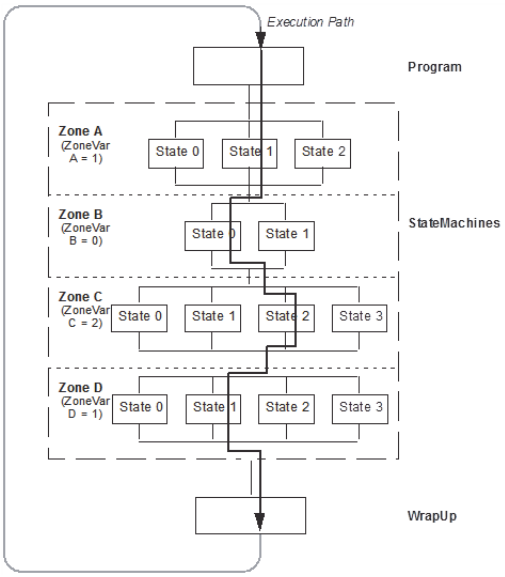

Figure 3. Execution Path of SALL Program

SALL High Level Serial Interface (HLSI)

The High Level Serial Interface (HLSI) allows users of Foxboro remote devices and the RTU50 to define an asynchronous, byte-oriented communications protocol. Using the State And Logic Language (SALL), you can develop applications that communicate with the protocol. The services provided by the High Level Serial Interface are:

Protocol Definition: An offline configuration program, called SALLHLSI.EXE, used to generate a Protocol Definition File

Protocol Support Functions: A set of SALL functions that perform online input and output operations within a SALL task based on the protocol definition (see Figure 4).

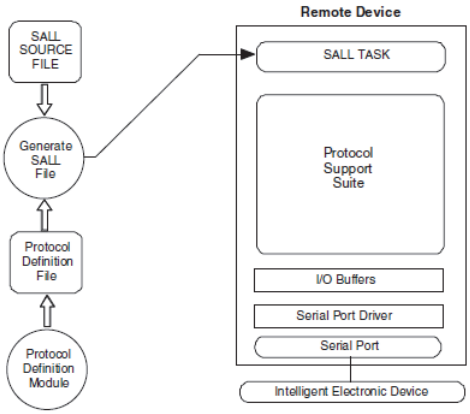

Figure 4. Foxboro Remote Device or RT50 SALL High Level Serial Interface

For more details, see the latest revision of the *SALL High Level Serial Interface User's Guide* (B0780DM).

Intrinsic Database Functions (IDF)

IDF provides a range of embedded functions that can be applied to RTU database points (Source Points) to produce new database points (Result Points). IDF manipulates previously specified Analog and Digital Inputs (Source Points) to produce Analog and Digital values (Result Points). This allows several kinds of calculations to be implemented within the RTU configuration without requiring the user to create application programs using SALL. For more details, see the latest revision of the *Intrinsic Database Functions User's Guide* (B0780DR).

Foxboro RTU Station

Foxboro RTU Station is a configuration tool for the Foxboro remote devices and RTU50 that run under the Microsoft Windows® operating system. Foxboro RTU Station is graphical and mouse-based, permitting browsing and editing of configurations in a windows environment.

Foxboro RTU Station supports configuration of hardware and protocols. For more details, see the latest revision of the *RTU Station User's Guide* (B0780DQ).

Foxboro RTU Connect Secure

Foxboro RTU Connect Secure is a configuration tool for Foxboro remote devices and RTU50 used to create the security configuration file. The security configuration file provides a password-based authentication mechanism to help prevent unauthorized access to the RTU through the RTV. For more details, see the latest revision of the ***RTU Connect Secure User's Guide (B0780DP***).

Foxboro Remote Terminal Viewer (RTV)

Foxboro Remote Terminal Viewer (RTV) is a diagnostic and remote file management tool. It helps provide authenticated and authorized access to the Foxboro remote devices and RTU50 from different locations.

RTV connects to multiple RTU controllers through a Graphical User Interface (GUI) and presents a real-time view of the operation of each RTU. RTV communication interfaces include serial connection for local access and a dial-up modem or TCP/IP for both local and wide area networks.

RTV also allows you to connect using the File Transfer Protocol. RTV uploads, downloads, and displays device configurations, including firmware and calculations. Several windows of the RTV are dynamically updated with input, output, and calculation data. Other windows display information on dynamic communications and raw communication packets, and provide communication diagnostics. For more details, see the latest revision of the ***Remote Terminal Viewer (RTV) User's Guide (B0780DY)***.

Electrobus Expansion

The SCD6000 Main File, which is the first chassis of the RTU, is the module that contains the configuration data for all individual I/O slots, includes the database and logic definition. To expand the SCD6000 main file to include additional I/O cards, expansion files are added to the main file using Electrobus I/O expansion modules. This extends the backplane of the RTU up to a maximum of four chassis to hold a maximum of 31 I/O modules. Each additional unit is electrically connected to the SCD6000 Main File through an Electrobus I/O expansion module (see Figure 5). In order to support the migration there are several ways to use expansions in a SCADA system solution. For more details, see the latest revision of the RTU50/SCD5200 to *SCD6000 Migration Guide (B0780FA)*.

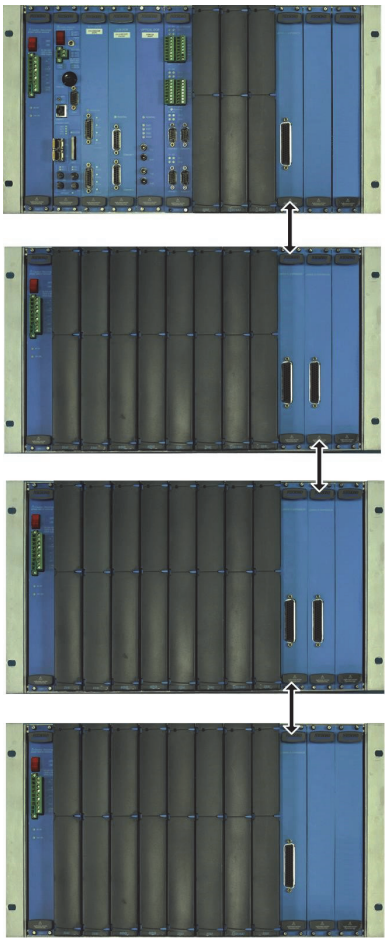

Figure 5. Electrobus Expansion

OptoNet Distribution of Control Logic

Local logic within each processor can seamlessly access data and controls from any node on the OptoNet LAN (see Figure 6), through the use of a "global database". OptoNet allows optimization of:

- **Logic**: Distributed to match the plant configuration
- **Distributed I/O**: To minimize cabling
- **Performance**: Locating processing power where it is needed
- **Availability**: No single point of a detected failure affects the total plant performance

- **Flexibility**: Full peer-to-peer access to database and logic
- **Maintainability**: All modules are maintained from one location

OptoNet is a ring topology optical network. Each RTU on the network has a processor, power supply, and OptoNet Interface that completely supports peer-to-peer communication between all nodes on the network. The protocol helps ensure secure, time deterministic delivery of the data across the OptoNet for up to 63 nodes on the network.

The ring network also supports the distribution of automation functions across the network, allowing control functions to be configured to match the plant topology for high availability solutions. In addition, the protocol communication is maintained independent to the processor in each node and is not affected by a single processor or a detected network interface failure.

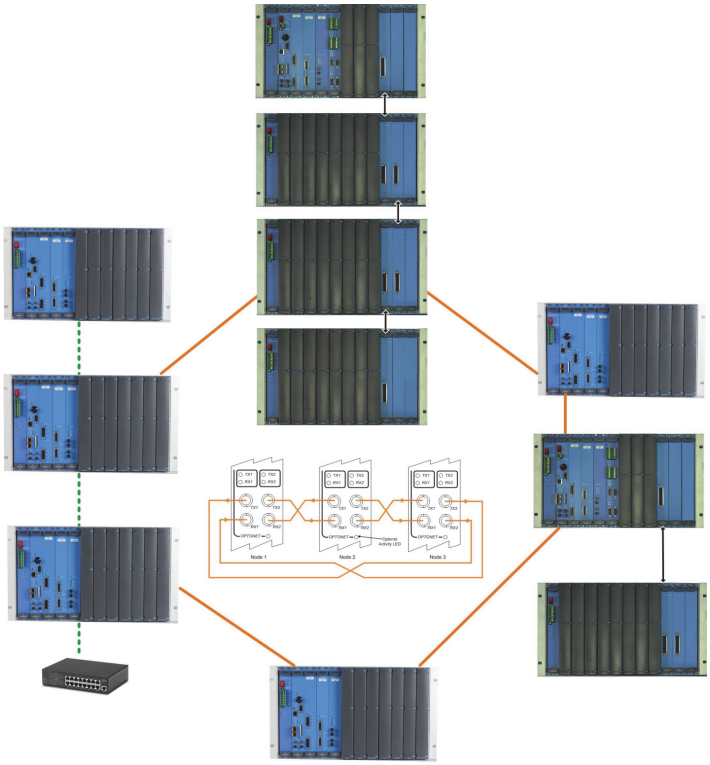

Figure 6. OptoNet Expansion

DCIU Integration

An optional implementation of the communications capability for the SCD6000 includes the Data and Control Interface Unit (DCIU). This function allows an RTU to scan and control other RTUs. The RTU is then able to use any of the communications interfaces to link to other RTUs or master stations (for example, store, data concentrate, and forward operation).

The database of the DCIU RTU contains all the points resident in the scanned RTUs. Therefore State And Logic Language (SALL) logic can implement

control strategies that include remote RTUs. This is useful for providing local control strategies independent of the master station and communications links.

IED Integration

Each processor in a SCD6000 main file has an RS-232 interface available for local Intelligent Electronic Device (IED). The SALL language supports a configurable protocol link via this port using the IED's native protocol. The data acquired forms part of the RTU's database and is available for all the RTU's functions. Several protocols are already implemented via this port as detailed in PSS 31S-2M15, Foxboro SCD6000 and RTU50 SVX State And Logic Language (SALL). Optionally, additional ports are available with the Multi-Channel Serial Interface Module, which can be located in any I/O slot. SALL HLSI can be used to integrate the IEDs.

Communications Integration

Communication interfaces are used to communicate to multiple master stations using multiple protocols.

Each communications interface card is a dual ported card supporting two topologies. It is configurable as either a primary and backup channel, or as two independent channels connected to two master stations. Communications interfaces can be located in any slot of any of the main files of an OptoNet configuration. Given that each node has access to the total database of the network, all data is available for transmission via any node with a communications interface.

Figure 7 shows the SCD6000 controller environment, which consists of a central real-time database that is kept up-to-date by a variety of independent processes.

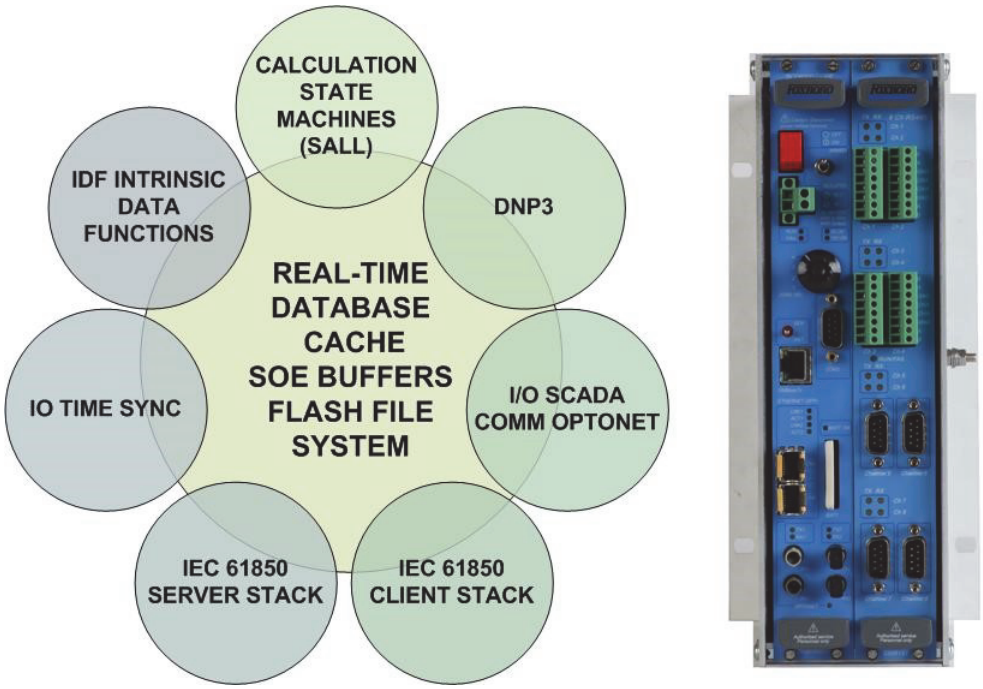

Figure 7. Real-Time Database and Environment

The embedded operating system executive supports these processes:

- **Intrinsic Data Functions (IDF)**: Event-driven preconfigured functionality is very fast and often used for implicit conversions of I/O information
- **Calculations**: Up to 3 calculation tasks can be programmed. Each task is written as a State Machine or a Procedural Logic using the dedicated State And Logic Language [SALL]
- **IEC 61850 Client Stack**: A separate stack process is maintained to allow the IEC 61850 Client services to operate
- **IEC 61850 Server Stack**: A separate stack process is maintained to allow the IEC 61850 Server services to operate
- **IO/COMMS/OptoNet**: The Electrobus interface supports the I/O and Communications modules and the OptoNet functionality supports the transparent transmission of the real-time database from node to node
- **I/O Time Sync**: The real-time clock on each processor is used to synchronize the clocks on all intelligent I/O modules

The real-time database accepts incoming data and records changes in any of the change-driven protocol stacks with a time-based comparison. The real-time database is supported by a flash-based file system during start-up and run-time.

A complete set of diagnostic interfaces allows both remote and local diagnostic tools to establish a connection with the unit at any time. The on-board flash file workspace allows multiple files to be downloaded and used as current, past, or future running configurations. The diagnostic interface allows the SCD6000 to be reset remotely and re-started with a new or test configuration.

The Foxboro SCD6000 controller has the ability to update online parameters for communication protocols, which avoids restart of the RTU if certain parameters such as delays and timeouts are changed.

Control Points now have the last five control events with Request Time, Operate Time, Value, and CE Flag.

CPU MODULES

Part Number	Description
SY-60399001R	SCD6000 CPU OptoNet Power Supply Ethernet (COPE) Module (RoHS)
SY-60399002R	SCD6000 CPU OptoNet Ethernet (COE) Module (RoHS)

POWER SUPPLY

Part Number	Description
SY-0399131	Wide Input Range Power Supply Module (needed for 2003098)
SY-0399131R	Wide Input Range Power Supply Module (needed for 2003098) (RoHS)

I/O FILES

Part Number	Description
SY-2003092	2x5 I/O slot file (RoHS)
SY-2003098	Ten I/O slot card file (RoHS)
SY-2003100	Five I/O slot card file (RoHS)
SY-2003102	Three I/O slot card file (RoHS)
SY-2003104	One I/O slot card file (RoHS)
SY-2003107	3x3 I/O slot file (RoHS)
SY-60399004R[(a)]	Electrobus Upper I/O Expansion Module
SY-60399005R[(a)]	Electrobus Lower I/O Expansion Module
SY-6500175R	Electrobus I/O Expansion 50 PIN DSUB Cable

(a) These modules support SCD6000 firmware version SY-1101207_F or later.

I/O ASSEMBLIES

Part Number	Description
SY-0399160R	32 Digital Input (24V to 129V) 4 Analog Input (1kV isolated) Module
SY-0399222R	4 Isolated AI and 32 DI Input Board (Deep Wiring Channel) Module
SY-0399085R	20 Analog Input (1kV isolated) Module
SY-0399084R	4 Analog Output Module
SY-0399086R	12 Digital (Relay) Output Module
SY-0399087R	12 Magnetically Latched Relay Output Module
SY-0399136R	8 x 10 Amp Digital (Relay) Output Module
SY-0399089R	24 Digital Input (24V)/6 Analog Input/6 Pilot Relay Output Module
SY-0399096R	24 Digital Input (48V)/6 Analog Input/6 Pilot Relay Output Module
SY-0399097R	24 Digital Input (129V)/6 Analog Input/6 Pilot Relay Output Module
SY-0399088R	24 Digital Input (24V)/6 Analog Input/8 Mini-Pilot Relay Output Module
SY-0399094R	24 Digital Input (48V)/6 Analog Input/8 Mini-Pilot Relay Output Module
SY-0399095R	24 Digital Input (129V)/6 Analog Input/8 Mini-Pilot Relay Output Module
SY-0399140R	IOM 3 CT 4 PT Transducer - 1 Amp CT
SY-0399142R	IOM 3 CT 4 PT Transducer - 5 Amp CT

DUAL COMMUNICATION BOARDS

Part Number	Description
SY-0399192R	Dual Communications Module V.28 CONITEL C2020/ C2025 (Master and Slave)
SY-0399194R[a]	Dual Communications Module V.28 DNP3
SY-0399122R[a]	Dual Communications Module Optical DNP3
SY-0399196R	Dual Communications Module V.28 IEC 60870-5-101
SY-0399127R	Dual Communications Module Optical IEC 60870-5-103
SY-0399163R[a]	64K Dual Communications Module V.11 DNP3
SY-0399224R[a]	64K Dual Communications Module V.11 DNP3 Master/Slave (ignores DCD)
SY-0399225R[b]	Communications Module V.11 DNP3 Master/Slave RoHS Type 2
SY-0399226R[b]	Communications Module V.28 DNP3 Master/Slave RoHS Type 2
SY-0399227R[b]	Communications Module Glass Optical DNP3 Master/Slave RoHS Type 2

(a) These modules do not support SCD6000 software part number SY-1101207 Revision D or later.
(b) These modules support SCD6000 software part number SY-1101207 Revision D or later.

ASSOCIATED PRODUCT SPECIFICATION SHEETS

Part Number	Description
PSS 31H-8K1R	SCD6000 Input/Output Modules
PSS 31H-8K2	SCD6000 CPU OptoNet Power Supply Ethernet (COPE) Module / SCD6000 CPU OptoNet Ethernet (COE) Module
PSS 31H-8K3R	SCD6000 Wide Range Input Power Supply Module
PSS 31H-8K4R	SCD6000 Wide Range Input Power Supply Module (RoHS)
PSS 31H-8K5R	SCD6000 8 Channel Serial Module
PSS_31H-8C8R	Foxboro Remote Terminal Unit (RTU) 3 Phase Digital Transducer Module
PSS 31S-2M11	Foxboro RTU Station
PSS 31S-2M12	Foxboro RTU Connect Secure
PSS 31S-2M15	SCD6000 State And Logic Language (SALL)

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