

Smart Star (SR9000)

Modular C-Programmable Control System

User's Manual

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1. INTRODUCTION

Chapter 1 introduces the Smart Star embedded control system and describes the features associated with the backplane chassis and the CPU Card. The Tool Kit containing the hardware essentials to begin using the Smart Star is described, and the software highlights are presented.

The Smart Star is a modular and expandable embedded control system whose configuration of Digital I/O, A/D Converter, D/A Converter, and Relay Cards can be tailored to a large variety of demanding real-time control and data acquisition applications.

The typical Smart Star system consists of a rugged backplane with a built-in voltage regulator, a CPU Card, and one or more I/O cards. The CPU Card plugs into a designated slot on the backplane chassis, which has additional slots available for any combination of I/O cards. A high-performance Rabbit 2000 microprocessor on the CPU Card operates at 22.1 MHz to provide fast data processing.

1.1 Features

- C-programmable to create a custom user interface
- Flexible functionality—modular configuration allows interchanging or replacing individual I/O cards
- Expandable—up to 168 I/O ports
- Choice of two backplanes—with either 3 or 7 slots for I/O cards
- Choice of CPU cards—with or without one RJ-45 10/100-compatible Ethernet port with 10Base-T Ethernet interface
- RS-232 and RS-485 serial ports allow networking to other Smart Star units, single-board computers, or enterprise computing centers
- 128K SRAM and 512K flash memory, optional 512K SRAM
- Real-time clock
- Watchdog supervisor
- Backup battery
- Optional backlit 122 × 32 graphic display/keypad module
- RabbitLink Ethernet gateway available for remote download/debug, Web serving, and e-mail

Table 1 lists the backplanes, CPU cards, and the I/O cards that are available for the Smart Star control system. Appendix A provides detailed specifications for the Smart Star backplanes and the CPU cards.

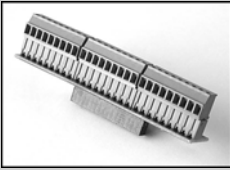
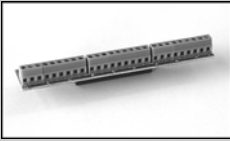
Table 1. Smart Star Backplanes and Cards

Card	Model	Features	
Backplane	SR9010	7 I/O card slots, 1 CPU card slot, header connections for optional LCD/keypad module	
	SR9050	3 I/O card slots, 1 CPU card slot, header connections for optional LCD/keypad module	
CPU	SR9150	Full-featured CPU card <i>with</i> RJ-45 Ethernet port	
	SR9160	Full-featured CPU card <i>without</i> RJ-45 Ethernet port	
I/O Cards	Digital I/O	SR9200	16 digital inputs, 8 digital sinking outputs
		SR9210	8 digital inputs, 16 digital sinking outputs
		SR9220	8 digital inputs, 8 digital sinking outputs
		SR9205	16 digital inputs, 8 digital sourcing outputs
		SR9215	8 digital inputs, 16 digital sourcing outputs
		SR9225	8 digital inputs, 8 digital sourcing outputs
	A/D Converter	SR9300	12-bit A/D converter, 11 channels, 0 V – 10 V
		SR9310	12-bit A/D converter, 11 channels, -10 V – +10 V
		SR9320	12-bit A/D converter, 11 channels, 4 mA – 20 mA
	D/A Converter	SR9400	12-bit D/A converter, 8 channels, 0 V – 10 V
		SR9410	12-bit D/A converter, 8 channels, -10 V – +10 V
		SR9420	12-bit D/A converter, 8 channels, 4 mA – 20 mA
	Relay	SR9500	5 SPST relays and 1 SPDT relay, each protected with onboard snubbers
		SR9510	8 SPDT relays (no snubbers)

1.2 User Connections

Connections to the I/O cards are made via a ribbon cable connector or optional field wiring terminals that are either pluggable or have screw terminals. Three different Field Wiring Terminals (FWTs) are available. Table 2 lists the I/O cards and the Rabbit Semiconductor part numbers for the corresponding FWTs.

Table 2. Guide to FWT Selection

FWT Description	I/O Cards	Rabbit Semiconductor Part Number	
		Pluggable Terminals	Screw Terminals
			
FWT27	Digital I/O Relay (SR9510)	101-0420	101-0514
FWT18	A/D Converter D/A Converter	101-0421	101-0515
FWT18R	Relay (SR9500)	101-0422	101-0516

NOTE: Appendix A, “Field Wiring Terminals,” provides further information on FWTs, including their dimensions.

1.3 Optional Add-Ons

The LCD/keypad module is the only available optional add-on. Further details on the LCD/keypad module are provided in Appendix B.

Visit our [Web site](#) for up-to-date information about additional add-ons and features as they become available. The Web site also has the latest revision of this user’s manual.

1.4 Development and Evaluation Tools

1.4.1 Tool Kit

The Tool Kit has the hardware essentials that you need to create and use your own Smart Star control system.

The items in the Tool Kit and their use are as follows:

- *Smart Star (SR9000) Getting Started* instructions.
- *Dynamic C* CD-ROM, with complete product documentation on disk.
- Programming cable, used to connect your PC serial port to the Smart Star CPU Card to write and debug C programs that run on the Smart Star control system.
- FWT27 pluggable field wiring terminal.
- Screwdriver.
- DC power supply, used to power the backplane, which in turn supplies power to the CPU card and the I/O cards. The DC power supply accepts an AC input of 100 V to 240 V at up to 0.6 A, and delivers a DC output up to 1.1 A at 24 V.
- *Rabbit 2000 Processor Easy Reference* poster.
- Registration card.

1.4.2 Software

The Smart Star control system is programmed using Rabbit Semiconductor's Dynamic C. A compatible version is included on the Tool Kit CD-ROM.

Rabbit Semiconductor also offers add-on Dynamic C modules containing the popular μ C/OS-II real-time operating system, as well as PPP, Advanced Encryption Standard (AES), and other select libraries. In addition to the Web-based technical support included at no extra charge, a one-year telephone-based technical support module is also available for purchase. Visit our Web site at www.rabbit.com or contact your Rabbit Semiconductor sales representative or authorized distributor for further information.

1.5 CE Compliance

Equipment is generally divided into two classes.

CLASS A	CLASS B
Digital equipment meant for light industrial use	Digital equipment meant for home use
Less restrictive emissions requirement: less than 40 dB $\mu\text{V}/\text{m}$ at 10 m (40 dB relative to 1 $\mu\text{V}/\text{m}$) or 300 $\mu\text{V}/\text{m}$	More restrictive emissions requirement: 30 dB $\mu\text{V}/\text{m}$ at 10 m or 100 $\mu\text{V}/\text{m}$

These limits apply over the range of 30–230 MHz. The limits are 7 dB higher for frequencies above 230 MHz. Although the test range goes to 1 GHz, the emissions from Rabbit-based systems at frequencies above 300 MHz are generally well below background noise levels.

The CPU card, I/O cards, and backplane in the Smart Star embedded control system have been tested and were found to be in conformity with the following applicable immunity and emission standards as described in Table 3.

Table 3. CE Compliance of Smart Star Backplanes and Cards

Card	Model	Description		Used for CE Compliance Testing	
Backplane	SR9010	7 I/O card slots, 1 CPU card slot, header connections for optional LCD/keypad module*	Full-featured	×	
	SR9050	3 I/O card slots, 1 CPU card slot, header connections for optional LCD/keypad module*	Sub-version		
CPU	SR9150	22.1 MHz CPU card <i>with</i> Ethernet	Full-featured	×	
	SR9160	22.1 MHz CPU card <i>without</i> Ethernet	Sub-version		
I/O Cards	Digital I/O	SR9200	16 inputs, 8 sinking outputs	Full-featured	×
		SR9205	16 inputs, 8 sourcing outputs	Full-featured	×
		SR9210	8 inputs, 16 sinking outputs	Sub-version	
		SR9220	8 inputs, 8 sinking outputs	Sub-version	
	A/D Converter	SR9300	Eleven 12-bit analog inputs (0–10 V)	Sub-version	
		SR9310	Eleven 12-bit analog inputs (± 10 V)	Full-featured	×
		SR9320	Eleven 12-bit analog inputs (4–20 mA)	Sub-version	
	Relay	SR9500	5 SPST relays and 1 SPDT relay, each protected with onboard snubbers	Full-featured	×
		SR9510	8 SPDT relays (no snubbers)	Full-featured	×

* No CE compliance testing was done with the LCD/keypad module connected to a Smart Star embedded control system. A system consisting of Smart Star boards and an LCD/keypad module therefore *cannot* be considered to be CE-compliant.

The sub-versions of the boards are also CE-compliant. All boards that are CE-compliant have the CE mark.



Several Smart Star boards are not yet CE-compliant. These boards are listed in Table 4.

Table 4. Smart Star Backplanes and Cards Not CE-Compliant

Card	Model	Description	Comments
Backplane	SR9000	7 I/O card slots, 1 CPU card slot	Legacy product
CPU	SR9100	25.8 MHz CPU card	Legacy product
D/A Converter	SR9400	Eight analog outputs (0–10 V)	Passed emissions tests, immunity tests pending
	SR9410	Eight analog outputs (± 10 V)	
	SR9420	Eight analog outputs (4–20 mA)	

Immunity

The CE-compliant Smart Star boards meet the following EN55024/1998 immunity standards.

- EN61000-4-3 (Radiated Immunity)
- EN61000-4-4 (EFT)
- EN61000-4-6 (Conducted Immunity)

Additional shielding or filtering may be required for a heavy industrial environment.

Emissions

The CE-compliant Smart Star boards meet the following emission standards when used with a Smart Star embedded control system that contains a Rev. C or higher version of the Rabbit 2000 microprocessor with its spectrum spreader turned on and set to the normal mode. This microprocessor is used in all Smart Star CPU boards that carry the CE mark.

- EN55022:1998 Class A
- FCC Part 15 Class A

NOTE: The Smart Star embedded control system satisfied the Class A limits but not the Class B limits. Such equipment need not be restricted in its sale, but the following warning must be included in the instructions for its use.

Warning

This is a class A product. In a domestic environment this product may cause radio interference, in which case the user may be required to take adequate measures.

Additional shielding or filtering may be needed to meet Class B emissions standards.

1.5.1 Design Guidelines

Note the following requirements for incorporating a Smart Star embedded control system into your application to comply with CE requirements.

General

- The power supply provided with the Tool Kit is for development purposes only. It is the customer's responsibility to provide a CE-compliant power supply for the end-product application.
- When connecting the Smart Star embedded control system to outdoor cables, the customer is responsible for providing CE-approved surge/lighting protection.
- Rabbit Semiconductor recommends placing digital I/O or analog cables that are 3 m or longer in a metal conduit to assist in maintaining CE compliance and to conform to good cable design practices.
- When installing or servicing the Smart Star embedded control system, it is the responsibility of the end-user to use proper ESD precautions to prevent ESD damage to the Smart Star.

Safety

- All inputs and outputs to and from the Smart Star embedded control system must not be connected to voltages exceeding SELV levels (42.4 V AC peak, or 60 V DC).
- The lithium backup battery circuit on the CPU card in the Smart Star embedded control system has been designed to protect the battery from hazardous conditions such as reverse charging and excessive current flows. Do not disable the safety features of the design.

1.5.2 Interfacing the Smart Star to Other Devices

Since Smart Star embedded control systems are designed to be connected to other devices, good EMC practices should be followed to ensure compliance. CE compliance is ultimately the responsibility of the integrator. Additional information, tips, and technical assistance are available from your authorized Rabbit Semiconductor distributor, and are also available on our Web site at www.rabbit.com.