SMART4-Base

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Table of Contents

8.1 Basic Concept of the SMART4 8-5

8.1.1 BASE/EXTENSION CONCEPT 8-5
8.1.2 ON BOARD I/O CONCEPT 8-7
8.1.3 POWER SUPPLY 8-7

8.2 Main Features 8-7

8.2.1 KEY FUNCTIONS 8-7
8.2.2 SPECIFICATIONS 8-8

8.3 SMART4-Base 8-9

8.3.1 SYSTEM PARAMETERS 8-9
8.3.2 BOARD OVERVIEW 8-9

8.4 SMART4-Base versus SMART2-Base 8-10

8.4.1 FUNCTIONAL DESCRIPTION 8-10

8.5 SMART4-Base Interfaces 8-11

8.5.1 SMC INTERFACE (SMART4-BASE ONLY) 8-11
8.5.2 SM INTERFACE 8-11
8.5.3 SPI EXTENSION INTERFACE 8-11

8.6 Configuration 8-12

8.6.1 RS CONFIGURATION 8-12

8.7 Pinouts 8-13

8.7.1 SMC SOCKET PINOUT (SLOT “A”) 8-13
8.7.2 SM SOCKET PINOUT (SLOT “B”) 8-14
8.7.3 POWER SUPPLY SOCKET PINOUT 8-14
8.7.4 RJ45 RS-232 PINOUT 8-15
8.7.5 DSUB-9 RS PINOUT 8-16
8.7.6 SM MODULE SCREW TERMINALS 8-17

8.7.7 I/O'S SCREW TERMINALS 8-17
8.7.8 SPI EXTENSION OUT CONNECTOR 8-17

8 SMART4

SMART4 was designee to extend functionality SMART family. Based on one design, it was possible to reach two different functionalities:

SMART4-Base:

- main carrier containing the SM2-CPU
- I/O module

SMART4-Ext:

- SMART2 extension carrier containing any SM-I/O module
- I/O module

8.1 Basic Concept of the SMART4

8.1.1 Base/Extension Concept

Due to the enhanced modularity concept of SMART2, SMART4 was developed as a basic unit to be used in two different ways, depending what components was mounted on the board. Generally speaking, in a SMART2 system there must be one SMART4-Base unit carrying a CPU module. This unit becomes the intelligent main unit of the system, into which up to one other SM modules may be fitted to provide additional I/O and related functions.

In addition, other SMART4-Ext units may be installed as extensions of the main unit, each capable of housing one additional SM modules per unit with supplementary tasks. The maximum number of extension units envisaged in a system is four. Thus, a system may comprise a maximum of SMART4-Base + 4 x SMART4-Ext carrier units.

Note:

In a system, only SMART4-Base unit may be provided with a CPU module. All other possible SMART4-Ext units must be without such a module, in order to avoid controller conflicts with the first base unit.

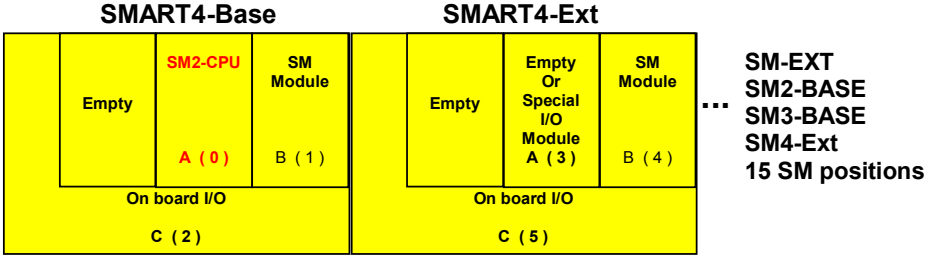


Figure 8 - 1 Typical SMART4 system

Legend:

- **SMART4-Base used as a main controller unit;**
- **SMART4-Ext used as an extension unit.**

Terminology

The SMART4 slots are numbered and lettered in the following way:

- *"0" to "14":* absolute numbering of all possible slots in a system, where:
  - "0" is the system's CPU carrier slot
  - "1" I/O slots of the main system unit;
  - "2" I/O's on the main system unit;
  - "3" to "5", "6" to "8", "9" to "11" and "12" to "14" are I/O slots and I/O's on board of possible extension units.
- *"A" to "C":* relative numbering (lettering) of each single unit, independent of whether the unit is used as a main unit or an extension unit.

8.1.2 On board I/O Concept

In order to save space and to increase price efficiency of the SMART2 family, SMART4 units was designed with integrated I/O's on board. It is planed that SMART3/SMART4 it will be family of base modules with few combination of I/O's on board but only standard I/O's.

(Index 0xB4) - As a second member of family was designed 32 digital isolated inputs and 16 digital output.

8.1.3 Power Supply

In order to save space, reduce the price of the system, the DC/DC power supply is integrated on-board (like SMART-BASE) but only SMART4-Base have integrated PSU unit.

8.2 Main Features

8.2.1 Key Functions

The SMART4 key functions/features are as follows:

- Carrier unit for CPU, fieldbus, power supply and I/O modules;
- I/O's on board (ID = 0xB4 ⇒ 32 inputs, 16 digital outputs);
- One design, two units:
  - SMART4-Base main
  - SMART4-Ext extension carrier;
- Compatible with SMART I/O and SMART2 modules;
- 50% system space saved with 56 digital I/O's compared to SMART I/O and 25% compared to SMART2-BASE;
- With possibility to drive over 200 I/O's.

8.2.2 Specifications

Table 8-1: SMART4-Base Technical Specifications

SMART4	Specifications
Number of Slots	1 SM slots; first slot includes controller/fieldbus option
SM Slot Configuration: • Screw Terminal Pins per Slot • I/O's per Slot	 Max. 14 pins per slot Max. 8 I/O's per slot
I/O Current/Voltage on SM module	Max. 3 A/max. 125 V AC (as on SMART2)
Controller	MC68HC705C8A
Controller Data: • Speed • Firmware	 4 MHz PEP SMART2 Firmware, Ed. 2.0 of 23 Jun 97
SMART4-Base Interfaces	• 1 SMART I/O-compatible Extension Output
Interface Speed	• Max. 2 MHz serial, SPI-based • Max. 100 µs parallel access
Power Consumption	250 – 350 mA at 5 V DC (carrier unit only)
On board Power supply	• Input voltage 18-36 VDc • 10W • Isolation 1kV
Temperature: • Industrial • Extended	 0°C to +70°C -40°C to +85°C
Isolation: • System • Between groups • Surge voltage	 2.5 kV 0.5 kV 1,5 kV
Operating Humidity	0% to 95%, non-condensing
on board I/O's Software ID ID = 0xB4	 • 32 isolated digital inputs • 16 isolated digital outputs

Note:

Real number of I/O's in the „SMART" systems is depending from Power balance: the first what DC/DC is used and the second 15W is the absolute maximum for system (3A at 5V).

8.3 SMART4-Base

8.3.1 System Parameters

Table 8-2: SMART4-Base System Parameters

SMART4-BASE	System Parameters
Number of Carrier Units	Max. 1 SMART4-Base units in a system
Number of SM Slots	Max. 1, and additional 1 CPU slot
Number of I/O's:	max. 280 (with 5 x 48 I/O's per base and 5 x 8 I/O's per SM slot typically)
Power Supply: • Voltage • Power	 24 V DC (18-36 VDC) 10W
Mounting	Modular DIN rail or wall mounting

8.3.2 Board Overview

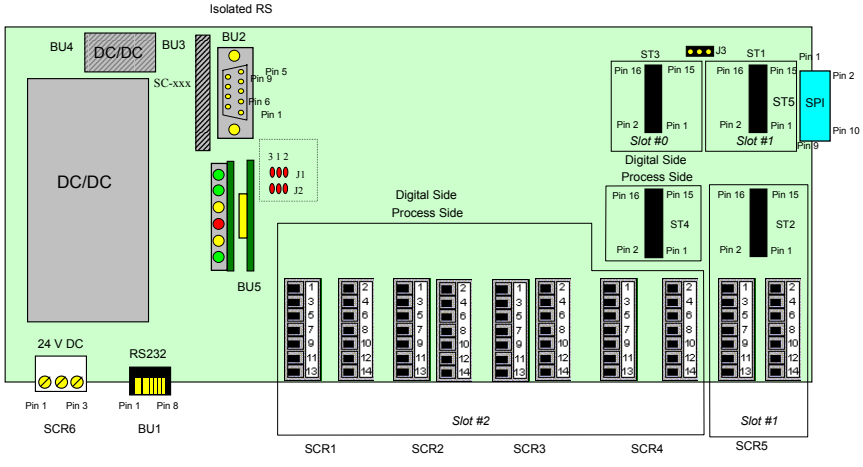


Figure 8 - 2 SMART4-Base schematic board layout front view

PEP Advantage

Connector ST3 of a SMART4-Base unit (slot "0") is provided with 20 pins, ST1 connector of the board with 16. Pins 1, 2, 19 and 20 of ST1 are used by the CPU

8.4 SMART4-Base versus SMART2-Base

SMART4-Base direct member of the SMART2 family, SMART4 are build on the same components and structure as SMART2-Base with on board I/O's added as slot 'C' (instead of the third SM module).

SMART4-Base = SMART2-Base + Inputs + Outputs + PSU

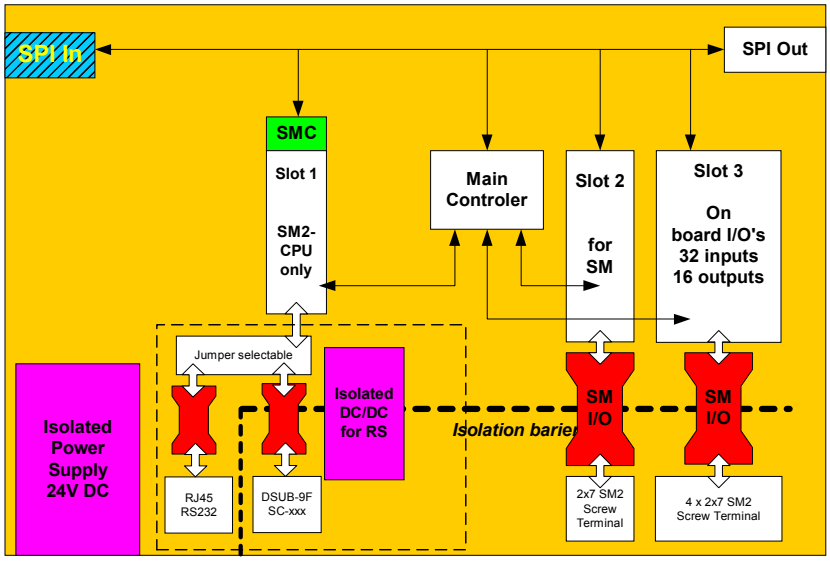
logically SMART4-Base = SMART-Base

Behind the idea of SMART4-Base is following concept:

- build cheaper system per I/O
- build more compressive system
- add new wind in SMART family

8.4.1 Functional Description

Figure 8 - 3 SMART4-Base Function Block Diagram



Legend:

SMART4 / SM2 Module / SMART4 I/O flow

SMART4 internal flow

SMC Via ST1 pins 1, 2, 19, 20 on SMART4-Base used as a controller main unit

SM SMART I/O or SMART2 module/module port (see chapter 10.4.1 and 10.4.2)

SPI SPI master and slave interface (see chapter 10.4.3)

8.5 SMART4-Base Interfaces

On the SMART4, no matter whether it is used as a "SMART2" main controller or extension unit, we will find 3 different types of interfaces. These are the SMC, SM and SPI Extension interfaces. The +24V DC supply will also be described in the following chapters, although it is not strictly an input/output function.

8.5.1 SMC Interface (SMART4-Base only)

With the SMART4-Base SMC port an intelligent SMART2 module may be installed to control the complete SMART2 system.

8.5.2 SM Interface

Except for the SMC extension described in chapter 10.4.1, the SMART4 port "B" are defined as standard SM socket interfaces consisting of two separated standard 8-pin rows, while port "C" is reserved as on board I/O's.



PEP Advantage

Strictly speaking, the SM interface should be named "SM/SM2" interface, since both SMART I/O and SMART2 modules are supported indiscriminately. However, for the sake of simplicity, this interface is called "SM" interface throughout this manual.

8.5.3 SPI Extension Interface

The SPI Bus OUT connector is a standard right-angle 2x5-pin connector placed on the right side of the SMART4 units, with I/O functions towards the subsequent extension unit ("n+1"). If compared to the interfaces of the existing SMART-EXT extension unit, the SMART4 SPI extension interfaces do not differ in any functional way. Furthermore, they are fully software compatible with the SMART-EXT extension unit. All signals needed and software protocols are available as before.

8.6 Configuration

At power-up or after a “Reset” condition, the system firmware starts with a default setting of all parallel ports. This default is naturally the input mode for each I/O point. Together with the pull-ups this means a logic high level for each I/O pin.

This state remains stable, until the user starts to configure the I/O registers by software. All on-board outputs (relays) are switched off and can be activated only when software initialisation is finished.

8.6.1 RS configuration

There are two solder jumpers on bottom side of base board using them you can choose to use:

- RJ45 connector with RS-232 not isolated directly from SM2-CPU

  J1 (1-2), J2 (1-2) (default setting)

- DSUB-9 connector with isolated RS interface with possibility to choose RS standard (232/422/485) by adding the SC-Piggyback.

  J1 (3-1), J2 (3-1)

8.7 Pinouts

8.7.1 SMC Socket Pinout (Slot "A")

Table 8-3: SMART4-Base SMC Socket – Digital Side (ST3)

Pin 1	*CM*	***Pin 2***	*_SCS*
Pin 3	D0	**Pin 4**	D1
Pin 5	D2	**Pin 6**	D3
Pin 7	D4	**Pin 8**	D5
Pin 9	D6	**Pin 10**	D7
Pin 11	System GND	**Pin 12**	Serial RxD
Pin 13	System VCC	**Pin 14**	Serial RxD / TxD
Pin 15	_CS Slot	**Pin 16**	Serial CLKw
Pin 17	Reset	**Pin 18**	SLOT "A" _Interrupt
Pin 19	*SCLK*	***Pin 20***	*STXD*

Italics: SMC extension of a regular SM socket.

Table 8-4: SMART4-BASE SMC Socket – Process Side

ST2	SCR5	ST2	SCR5
Pin 1	Battery GND (*)	**Pin 2**	Battery GND (*)
Pin 3	NC	**Pin 4**	TxD
Pin 5	NC	**Pin 6**	RxD
Pin 7	Battery +3.6V (*)	**Pin 8**	RTS
Pin 9	NC	**Pin 10**	CTS
Pin 11	NC	**Pin 12**	System GND
Pin 13	NC	**Pin 14**	NC
Pin 15	System +5V Vcc	**Pin 16**	System +5V Vcc

(*) off the board battery backup.

BATTERY ON BOARD connection via socket additional battery in BU5 slot

- supply voltage min. 3V DC,
- please note: that CPU board for this function has to be little modified, so please order this service accordingly.

8.7.2 SM Socket Pinout (slot “B”)

Table 8-5: SMART4 SM Socket – Digital Side (ST1)

Pin 1	P1	**Pin 2**	P2
Pin 3	P3	**Pin 4**	P4
Pin 5	P5	**Pin 6**	P6
Pin 7	P7	**Pin 8**	P8
Pin 9	System GND	**Pin 10**	Serial RxD
Pin 11	System VCC	**Pin 12**	Serial TxD
Pin 13	_CS Slot	**Pin 14**	Serial CLK
Pin 15	_Reset	**Pin 16**	Slot _Interrupt

Table 8-6: SMART4 SM Socket – Process Side

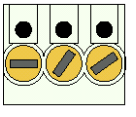
ST4	SCR6	ST4	SCR6
Pin 1	Screw Term. 13	**Pin 2**	Screw Terminal 13
Pin 3	Screw Term. 1	**Pin 4**	Screw Terminal 2
Pin 5	Screw Term. 3	**Pin 6**	Screw Terminal 4
Pin 7	Screw Term. 5	**Pin 8**	Screw Terminal 6
Pin 9	Screw Term. 7	**Pin 10**	Screw Terminal 8
Pin 11	Screw Term. 9	**Pin 12**	Screw Terminal 10
Pin 13	Screw Term. 11	**Pin 14**	Screw Terminal 12
Pin 15	Screw Term. 14	**Pin 16**	Screw Terminal 14

8.7.3 Power Supply Socket Pinout

Table 8-7: SMART4-Base – SCR6

Pin 1	Shield
Pin 3	GND
Pin 5	+24V

Pin 1 *Pin 3*



8.7.4 RJ45 RS-232 pinout

Connection is an subset of SMART I/O RJ45 connector

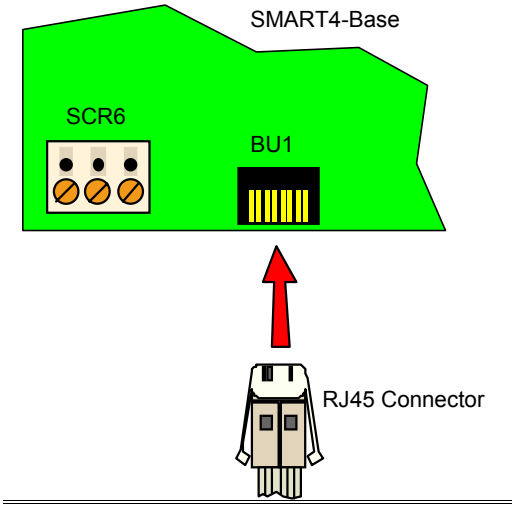


Table 8-8: SMART4-Base – BU1

Pin 1	NC
Pin 2	NC
Pin 3	GND
Pin 4	TxD
Pin 5	RxD
Pin 6	NC
Pin 7	NC
Pin 8	NC

8.7.5 DSUB-9 RS pinout

Connection is 100% compatible with upper port on IUC processor

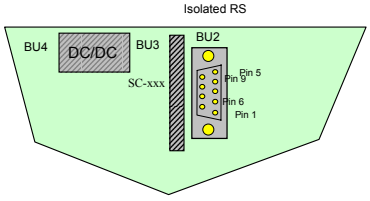


Table 8-9: SMART4-Base – BU2 – with SC-Piggyback

	SC-232	SC-485	SC-422 SC-422E
Pin 1			Tx+
Pin 2	RxD		
Pin 3	TxD	D+	
Pin 4			Rx+
Pin 5	GND		
Pin 6			Rx-
Pin 7	RTS		
Pin 8	CTS	D-	
Pin 9			Tx-

8.7.6 SM Module Screw Terminals

Both SMART3-BASE screw terminals consists of a double-row terminal board having a pin-to-pin distance of 5.00 mm and providing 14 free connections per I/O slot. The two 7-terminal rows of each connector are separated as shown in chapter 8.2.4, “Board overview”. The terminal pinout depends on the type of SM modules, and the pinout of the relevant module(s) should be looked up in the appropriate section of this manual.



Note:

The seven-pole terminal blocks you may have been using already with SMART2-BASE are different in size and, therefore, cannot be used on the SMART3-BASE. If on SMART3-BASE are mounted removable screw terminals it are compatible with SMART-BASE and SMART-EXT.

8.7.7 I/O’s Screw Terminals

The on-board I/O screw terminals and their functions are described separately in next chapter.

8.7.8 SPI Extension OUT Connector

Table 8-10: SMART4-BASE SPI Extension Connectors

Pin 1:	System GND	**Pin 2:**	Serial RxD
Pin 3:	System GND	**Pin 4:**	Serial TxD
Pin 5:	Serial Ext. _Select	**Pin 6:**	Serial CLK
Pin 7:	System VCC	**Pin 8:**	_Reset
Pin 9:	System VCC	**Pin 10:**	Extension _Interrupt

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SMART4-Base
On board I/O's
(Software Index 0xB4)

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Table of Contents

9.1 SMART4-Base board overview 9-5

9.2 Digital inputs..... 9-6

9.2.1 INTRODUCTION 9-6

9.2.2 FUNCTIONAL DESCRIPTION 9-6

9.2.3 PINOUTS 9-7

9.2.4 SOFTWARE.....9-8

9.3 Digital outputs 9-9

9.3.1 INTRODUCTION 9-9

9.3.2 FUNCTIONAL DESCRIPTION 9-9

9.3.3 PINOUTS 9-10

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9 SMART4 (Index 0xB4) on board I/O's

9.1 SMART4-Base board overview

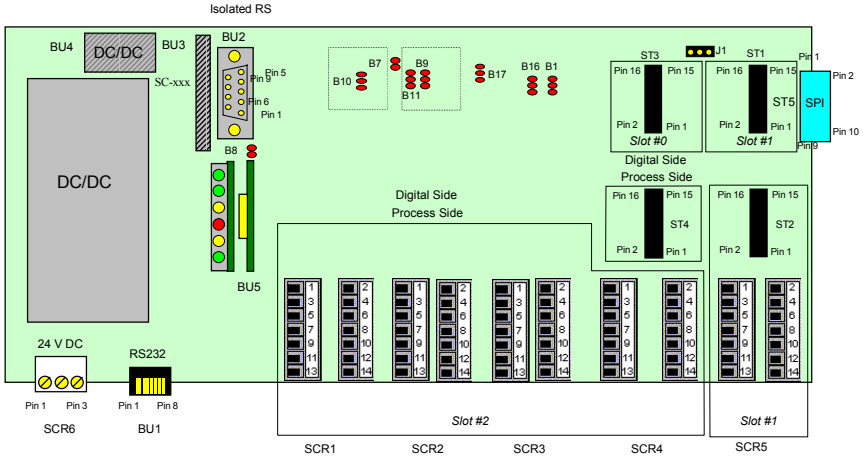


Figure 9 - 1 SMART4-Base board overview

Table 9-1: Connectors description

SCR1	digital inputs 1 to 8	digital outputs 1 to 4
SCR2	digital inputs 9 to 16	digital outputs 5 to 8
SCR3	digital inputs 17 to 24	digital outputs 8 to 12
SCR4	digital inputs 25 to 32	digital outputs 13 to 16
SCR5	SM style screw terminal (Slot 1)	
SCR6	Power connector	
ST5	SPI output to next extension module	
ST6	Not connected	
BU1	RS232 for second RS from the SM2-CPU non isolated	
BU2	Isolated RS configured by SC-xxx piggyback for second RS from the SM2-CPU non isolated	
BU3*	SC-xxx piggyback socket	
BU4*	DC/DC socket for isolated RS	
BU5	Socket for battery backup for SM2-CPU	

* - SC-xxx piggyback and DC/DC are mounted optionally by customer if isolated RS on BU2 is needed

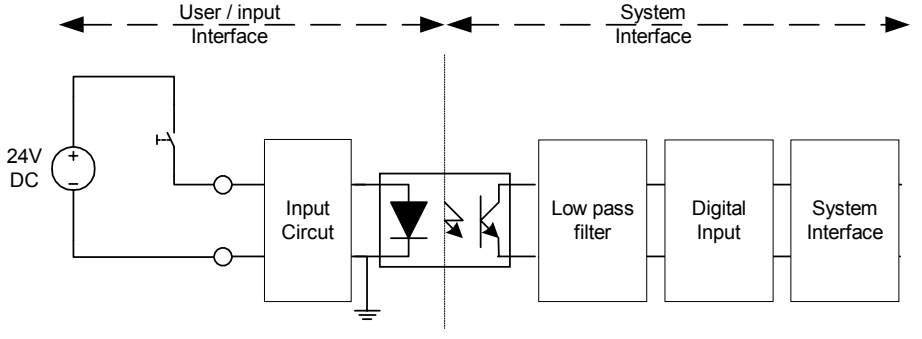
9.2 Digital inputs

9.2.1 Introduction

The SMART4-Base provides 32 optoisolated 24V DC digital inputs arranged in 4 groups with respect to the ground connections. The maximum input switching frequency is set to 200Hz with the system registering a logical ‘1’ when the input exceeds 19V. Logical ‘0’ is returned when the input falls below 9V. A low-pass filter restricts signals exceeding the filter limit and registers a logical ‘0’ with the system.

9.2.2 Functional Description

Figure 9 - 2 SMART4-Base Input Schematic Diagram



The input signal drives the Schmitt gate providing noise and transient states elimination. With the given resistor divider the input voltage of more than 19 V is treated as logical „1” (or „ON”) and the input voltage below 9 V is treated as logical „0” (or „OFF”). The capacitor together with the series resistor forms low-pass filter further reducing input noise

9.2.3 Pinouts

Screw Terminal Pinouts

The following shows the pinout/signal relationship for the inputs and outputs when connected to a particular screw terminal block.

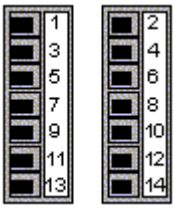


Table 9-2: SCR1 connector

Pin 1	+24 V DC	Pin 2	GND
Pin 3	Input 1	Pin 6	Input 2
Pin 5	Input 3	Pin 6	Input 4
Pin 7	Input 5	Pin 8	Input 6
Pin 9	Input 7	Pin 10	Input 8
Pin 11	Output 1	Pin 12	Output 2
Pin 13	Output 3	Pin 14	Output 4

Table 9-3: SCR2 connector

Pin 1	+24 V DC	Pin 2	GND
Pin 3	Input 9	Pin 6	Input 10
Pin 5	Input 11	Pin 6	Input 12
Pin 7	Input 13	Pin 8	Input 14
Pin 9	Input 15	Pin 10	Input 16
Pin 11	Output 5	Pin 12	Output 6
Pin 13	Output 7	Pin 14	Output 8

Table 9-4: SCR3 connector

Pin 1	+24 V DC	Pin 2	GND
Pin 3	Input 17	Pin 6	Input 18
Pin 5	Input 19	Pin 6	Input 20
Pin 7	Input 21	Pin 8	Input 22
Pin 9	Input 23	Pin 10	Input 24
Pin 11	Output 9	Pin 12	Output 10
Pin 13	Output 11	Pin 14	Output 12

Table 9-5: SCR4 connector

Pin 1	+24 V DC	Pin 2	GND
Pin 3	Input 25	Pin 6	Input 26
Pin 5	Input 27	Pin 6	Input 28
Pin 7	Input 29	Pin 8	Input 30
Pin 9	Input 31	Pin 10	Input 32
Pin 11	Output 13	Pin 12	Output 14
Pin 13	Output 15	Pin 14	Output 16

9.2.4 Software

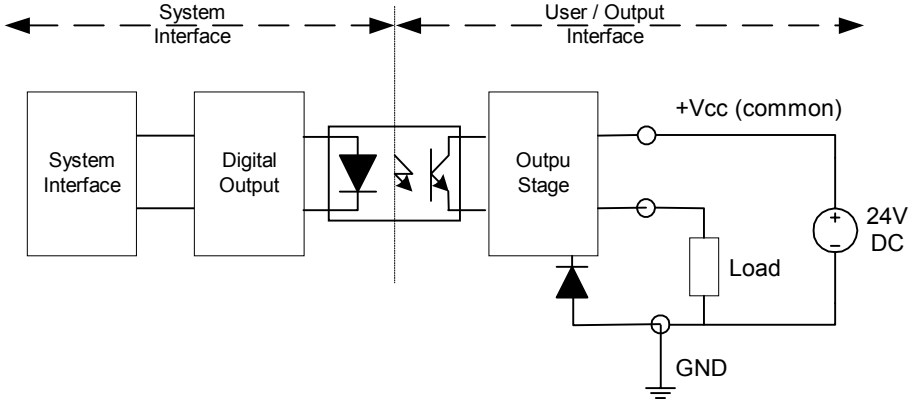
9.3 Digital outputs

9.3.1 Introduction

The SMART4-Base provides sixteen optoisolated 24V DC (typ.) digital outputs arranged in 4 independent groups. The maximum output switching frequency is limited to 1 kHz (square wave) with the in the ON state when the system issues a logical '0'. The maximum continuous output supply current is limited to 500mA (resistive loads) and provision has been made to cater for inductive loads.

9.3.2 Functional Description

Figure 9 - 3 SMART4-Base digital output



The driving output device is a Darlington transistor pair protected against inductive loads by an additional clamp diode. Furthermore, because each output stage requires three terminals to remain independent and only few such terminals are available, the common Vcc and GND lines have been grouped. Hence, each group of outputs is coupled to one Vcc line and to each group of Vcc lines is one ground.

9.3.3 Pinouts

Screw Terminal Pinouts

The following shows the pinout/signal relationship for the inputs and outputs when connected to a particular screw terminal block.

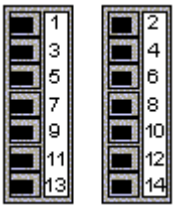


Table 9-6: SCR1 connector

Pin 1	+24 V DC	Pin 2	GND
Pin 3	Input 1	Pin 6	Input 2
Pin 5	Input 3	Pin 6	Input 4
Pin 7	Input 5	Pin 8	Input 6
Pin 9	Input 7	Pin 10	Input 8
Pin 11	Output 1	Pin 12	Output 2
Pin 13	Output 3	Pin 14	Output 4

Table 9-7: SCR2 connector

Pin 1	+24 V DC	Pin 2	GND
Pin 3	Input 9	Pin 6	Input 10
Pin 5	Input 11	Pin 6	Input 12
Pin 7	Input 13	Pin 8	Input 14
Pin 9	Input 15	Pin 10	Input 16
Pin 11	Output 5	Pin 12	Output 6
Pin 13	Output 7	Pin 14	Output 8

Table 9-8: SCR3 connector

Pin 1	+24 V DC	Pin 2	GND
Pin 3	Input 17	Pin 6	Input 18
Pin 5	Input 19	Pin 6	Input 20
Pin 7	Input 21	Pin 8	Input 22
Pin 9	Input 23	Pin 10	Input 24
Pin 11	Output 9	Pin 12	Output 10
Pin 13	Output 11	Pin 14	Output 12

Table 9-9: SCR4 connector

Pin 1	+24 V DC	Pin 2	GND
Pin 3	Input 25	Pin 6	Input 26
Pin 5	Input 27	Pin 6	Input 28
Pin 7	Input 29	Pin 8	Input 30
Pin 9	Input 31	Pin 10	Input 32
Pin 11	Output 13	Pin 12	Output 14
Pin 13	Output 15	Pin 14	Output 16

SMART4-Ext

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Table of Contents

10.1 Basic Concept of the SMART4 10-5

10.1.1 BASE/EXTENSION CONCEPT 10-5
10.1.2 ON BOARD I/O CONCEPT 10-7

10.2 Main Features 10-7

10.2.1 KEY FUNCTIONS 10-7
10.2.2 SPECIFICATIONS 10-8

10.3 SMART4-Ext 10-9

10.3.1 SYSTEM PARAMETERS 10-9
10.3.2 BOARD OVERVIEW 10-9

10.4 SMART4-Ext versus SMART2-Base 10-10

10.4.1 FUNCTIONAL DESCRIPTION 10-10

10.5 SMART4-Ext Interfaces 10-11

10.5.1 SM INTERFACE 10-11
10.5.2 SPI EXTENSION INTERFACE 10-11

10.6 Pinouts 10-12

10.6.1 SM SOCKET PINOUT (SLOT "B") 10-12
10.6.2 SM MODULE SCREW TERMINALS 10-12
10.6.3 I/O'S SCREW TERMINALS 10-13
10.6.4 SPI EXTENSION IN AND OUT CONNECTORS 10-13

10.7 Compatibility with SMART I/O Systems 10-14

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10 SMART4

SMART4 was designee to extend functionality SMART family. Based on one design, it was possible to reach two different functionalities:

SMART4-Base:

- main carrier containing the SM2-CPU
- I/O module

SMART4-Ext:

- SMART2 extension carrier containing any SM-I/O module
- I/O module

10.1 Basic Concept of the SMART4

10.1.1 Base/Extension Concept

Due to the enhanced modularity concept of SMART2, SMART4 was developed as a basic unit to be used in two different ways, depending what components was mounted on the board. Generally speaking, in a SMART2 system there must be one SMART4-Base unit carrying a CPU module. This unit becomes the intelligent main unit of the system, into which up to one other SM modules may be fitted to provide additional I/O and related functions.

In addition, other SMART4-Ext units may be installed as extensions of the main unit, each capable of housing one additional SM modules per unit with supplementary tasks. The maximum number of extension units envisaged in a system is four. Thus, a system may comprise a maximum of SMART4-Base + 4 x SMART4-Ext carrier units.

Note:

In a system, only SMART4-Base unit may be provided with a CPU module. All other possible SMART4-Ext units must be without such a module, in order to avoid controller conflicts with the first base unit.

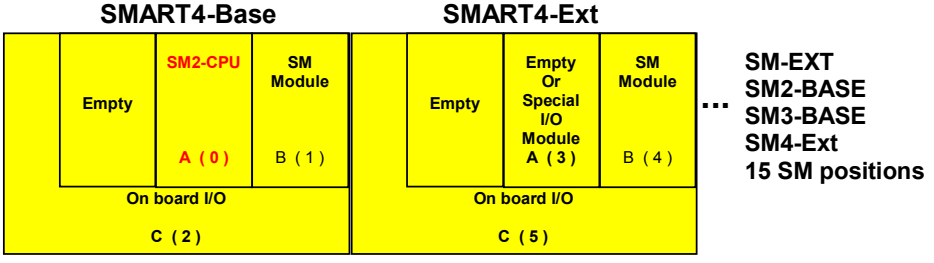


Figure 10 - 1 Typical SMART4 system

Legend:

.. **SMART4-Base used as a main controller unit;**

: **SMART4-Ext used as an extension unit.**

Terminology

The SMART4 slots are numbered and lettered in the following way:

- *"0" to "14":* absolute numbering of all possible slots in a system, where:
  - "0" is the system's CPU carrier slot
  - "1" I/O slots of the main system unit;
  - "2" I/O's on the main system unit;
  - "3" to "5", "6" to "8", "9" to "11" and "12" to "14" are I/O slots and I/O's on board of possible extension units.
- *"A" to "C":* relative numbering (lettering) of each single unit, independent of whether the unit is used as a main unit or an extension unit.

10.1.2 On board I/O Concept

In order to save space and to increase price efficiency of the SMART2 family, SMART4 units was designed with integrated I/O's on board. It is planed that SMART3/SMART4 it will be family of base modules with few combination of I/O's on board but only standard I/O's.

(Index 0xB4) - As a second member of family was designed 32 digital isolated inputs and 16 digital output.

10.2 Main Features

10.2.1 Key Functions

The SMART4-Ext key functions/features are as follows:

- I/O's on board (ID = 0xB4 ⇒ 32 inputs, 16 digital outputs);
- One design, two units:
  - SMART4-Base main
  - SMART4-Ext extension carrier;
- Compatible with SMART I/O and SMART2 modules;
- 50% system space saved with 56 digital I/O's compared to SMART I/O and 25% compared to SMART2-BASE;
- With possibility to drive over 200 I/O's.

10.2.2 Specifications

Table 10-1: SMART4-Ext Technical Specifications

SMART4	Specifications
Number of Slots	1 SM slots; first slot includes controller/fieldbus option
SM Slot Configuration: • Screw Terminal Pins per Slot • I/O's per Slot	 Max. 14 pins per slot Max. 8 I/O's per slot
I/O Current/Voltage on SM module	Max. 3 A/max. 125 V AC (as on SMART2)
Controller	MC68HC705C8A
Controller Data: • Speed • Firmware	 4 MHz PEP SMART2 Firmware, Ed. 2.0 of 23 Jun 97
SMART4-Ext Interfaces	• 1 SMART I/O-compatible Extension Input • 1 SMART I/O-compatible Extension Output
Interface Speed	• Max. 2 MHz serial, SPI-based • Max. 100 µs parallel access
Power Consumption	250 - 350 mA at 5 V DC (carrier unit only)
Temperature: • Industrial • Extended	 0°C to +70°C -40°C to +85°C
Isolation: • System • Between groups • Surge voltage	 2.5 kV 0.5 kV 1,5 kV
Operating Humidity	0% to 95%, non-condensing
on board I/O's Software ID ID = 0xB4	 • 32 isolated digital inputs • 16 isolated digital outputs

Note:

Real number of I/O's in the „SMART" systems is depending from Power balance: the first what DC/DC is used and the second 15W is the absolute maximum for system (3A at 5V).

10.3 SMART4-Ext

10.3.1 System Parameters

Table 10-2: SMART4-Ext System Parameters

SMART4-Ext	System Parameters
Number of Carrier Units	Max. 4 SMART4-Ext units in a system
Number of SM Slots	Max. 1
Number of I/O's:	max. 280 (with 5 x 48 I/O's per base and 5 x 8 I/O's per SM slot typically)
Power Supply:	(5V) Extension connector cable
Mounting	Modular DIN rail or wall mounting

10.3.2 Board Overview

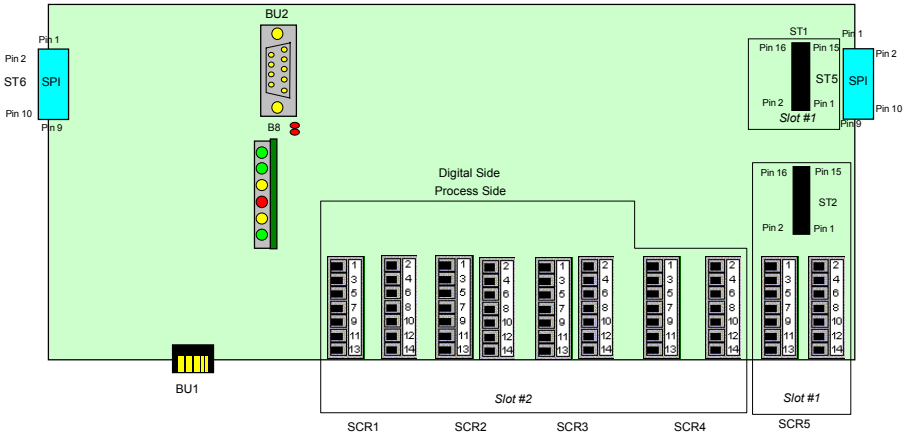


Figure 10 - 2 SMART4-Ext schematic board layout — front view

PEP Advantage

SMART4-Ext is the sub set of SMART4-Base taking to live "One design – two units"

10.4 SMART4-Ext versus SMART2-Base

SMART4–Ext are direct member of the SMART2 family, SMART4-Ext are builds on same components and structure as SMART2-Base with on board I/O's added as slot 'C' (instead of the third SM module).

SMART4-Ext = SMART2-Base + Inputs + Outputs

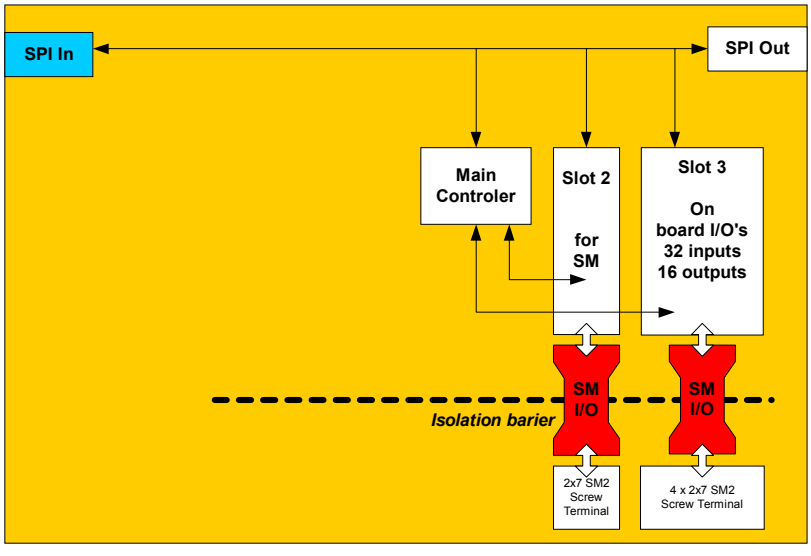
logically SMART4-Ext = SMART-Ext

Behind the idea of SMART4-Ext is following concept:

- use full SMART4-Base design
- remove all not used components to build cheaper system per I/O
- build more compressive system

10.4.1 Functional Description

Figure 10 - 3 SMART4-Ext functional block diagram



Legend:

⇔ SMART4 / SM2 Module / SMART4 I/O flow

→ SMART4 internal flow

SM SMART I/O or SMART2 module/module port (see chapter 10.4.1 and 10.4.2)

SPI SPI master and slave interface (see chapter 10.4.3)

10.5 SMART4-Ext Interfaces

On the SMART4, no matter whether it is used as a “SMART2” main controller or extension unit, we will find 3 different types of interfaces. These are the SMC, SM and SPI Extension interfaces. The +24V DC supply will also be described in the following chapters, although it is not strictly an input/output function.

10.5.1 SM Interface

Except for the SMC extension described in chapter 10.4.1, the SMART4 port “B” are defined as standard SM socket interfaces consisting of two separated standard 8-pin rows, while port “C” is reserved as on board I/O’s.



PEP Advantage

Strictly speaking, the SM interface should be named “SM/SM2” interface, since both SMART I/O and SMART2 modules are supported indiscriminately. However, for the sake of simplicity, this interface is called “SM” interface throughout this manual.

10.5.2 SPI Extension Interface

The SPI Bus IN socket is placed on the left side of the SMART4-Ext. It is vertically mounted 2x5-pin connector, with I/O functions towards the logically preceding extension unit (“n-1”) or, if preceded by a main controller unit, to the main controller unit.

The SPI Bus OUT connector is a standard right-angle 2x5-pin connector placed on the right side of the SMART4 units, with I/O functions towards the subsequent extension unit (“n+1”). If compared to the interfaces of the existing SMART-EXT extension unit, the SMART4 SPI extension interfaces do not differ in any functional way. Furthermore, they are fully software compatible with the SMART-EXT extension unit. All signals needed and software protocols are available as before.

10.6 Pinouts

10.6.1 SM Socket Pinout (slot "B")

Table 10-3: SMART4 SM Socket – Digital Side (ST1)

Pin 1	P1	**Pin 2**	P2
Pin 3	P3	**Pin 4**	P4
Pin 5	P5	**Pin 6**	P6
Pin 7	P7	**Pin 8**	P8
Pin 9	System GND	**Pin 10**	Serial RxD
Pin 11	System VCC	**Pin 12**	Serial TxD
Pin 13	_CS Slot	**Pin 14**	Serial CLK
Pin 15	_Reset	**Pin 16**	Slot _Interrupt

Table 10-4: SMART4 SM Socket – Process Side

ST4	SCR6	ST4	SCR6
Pin 1	Screw Term. 13	**Pin 2**	Screw Terminal 13
Pin 3	Screw Term. 1	**Pin 4**	Screw Terminal 2
Pin 5	Screw Term. 3	**Pin 6**	Screw Terminal 4
Pin 7	Screw Term. 5	**Pin 8**	Screw Terminal 6
Pin 9	Screw Term. 7	**Pin 10**	Screw Terminal 8
Pin 11	Screw Term. 9	**Pin 12**	Screw Terminal 10
Pin 13	Screw Term. 11	**Pin 14**	Screw Terminal 12
Pin 15	Screw Term. 14	**Pin 16**	Screw Terminal 14

10.6.2 SM Module Screw Terminals

Screw terminals consists of a double-row terminal board having a pin-to-pin distance of 5.00 mm and providing 14 free connections per I/O slot. The two 7-terminal rows of each connector are separated as shown in chapter 8.2.4, "Board overview". The terminal pinout depends on the type of SM modules, and the pinout of the relevant module(s) should be looked up in the appropriate section of this manual.

10.6.3 I/O's Screw Terminals

The on-board I/O screw terminals and their functions are described separately in next chapter.

10.6.4 SPI Extension IN and OUT Connectors

Table 10-5: SMART4-Ext SPI Extension Connectors

Pin 1:	System GND	**Pin 2:**	Serial RxD
Pin 3:	System GND	**Pin 4:**	Serial TxD
Pin 5:	Serial Ext. _Select	**Pin 6:**	Serial CLK
Pin 7:	System VCC	**Pin 8:**	_Reset
Pin 9:	System VCC	**Pin 10:**	Extension _Interrupt

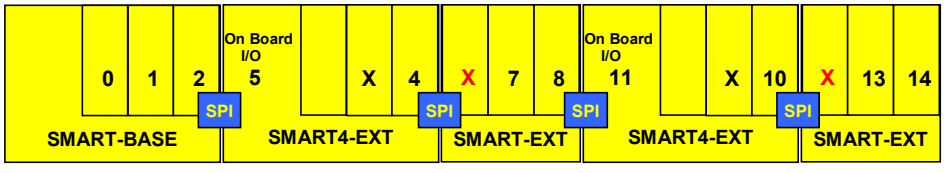
10.7 Compatibility with SMART I/O Systems

The SMART4-Ext and SMART-EXT units can be used together as extensions in a single SMART I/O system.

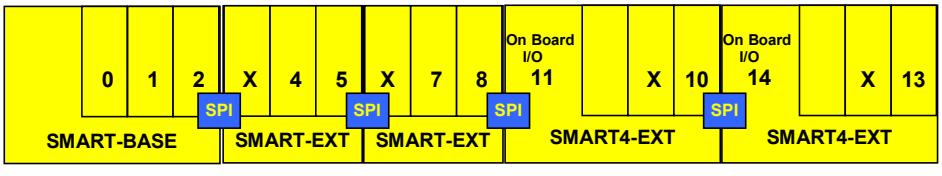
There is only one point that should be taken into consideration. The SMART-EXT slot identification numbers may start only with odd numbers. The reason for this is the fact that there are some combinations which should not be used. The following example shows how to correctly configure a mixed system:

Figure 10 - 4 : SMART4 in a SMART I/O System

WRONG CONFIGURATION.



RIGHT CONFIGURATION.



Case 1: Although the system is not configured very well, it will work without any problems with the SMART2 library. However, older systems may have problems finding the maximum number of slots, since the SMART I/O slot count maximum is 11.

Case 2: Correct arrangement. There are no missing slot numbers which may confuse the system in the process of slot count identification.

Note:

The functions of SMART4 and SMART2 are nearly identical. The only difference is that SMART3-BASE slot #2 has a fixed function of on-board I/O's.

SMART4-Ext
On board I/O's
(Software Index 0xB4)

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Table of Contents

11.1 SMART4-Ext board overview 11-5

11.2 Digital inputs..... 11-6

11.2.1 INTRODUCTION.....11-6
11.2.2 FUNCTIONAL DESCRIPTION.....11-6
11.2.3 PINOUTS.....11-7
11.2.4 SOFTWARE 11-8

11.3 Digital outputs 11-9

11.3.1 INTRODUCTION.....11-9
11.3.2 FUNCTIONAL DESCRIPTION.....11-9
11.3.3 PINOUTS.....11-10

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11 SMART4-Ext (Index 0xB4) on board I/O's

11.1 SMART4-Ext board overview

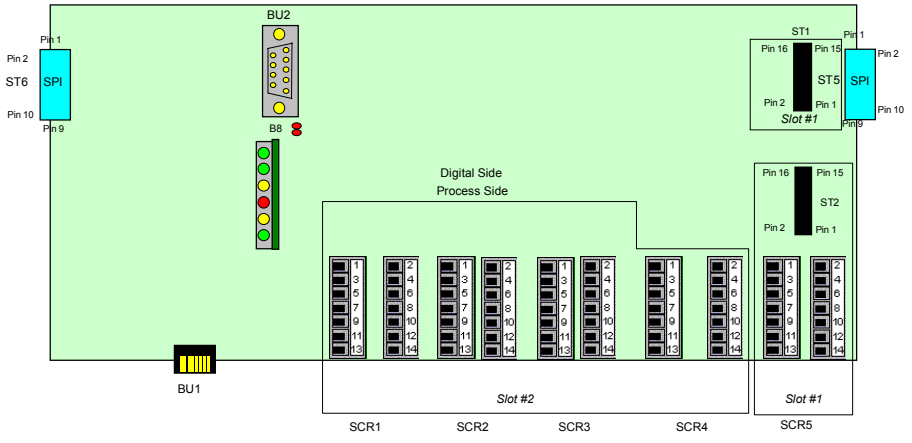


Figure 11 - 1 SMART4-Ext board overview

Table 11-1: Connectors description

SCR1	digital inputs 1 to 8	digital outputs 1 to 4
SCR2	digital inputs 9 to 16	digital outputs 5 to 8
SCR3	digital inputs 17 to 24	digital outputs 8 to 12
SCR4	digital inputs 25 to 32	digital outputs 13 to 16
SCR5	SM style screw terminal (Slot 1)	
ST5	SPI output to next extension module	
ST6	SPI input from the master module	
BU1	Not connected	
BU2	Not connected	

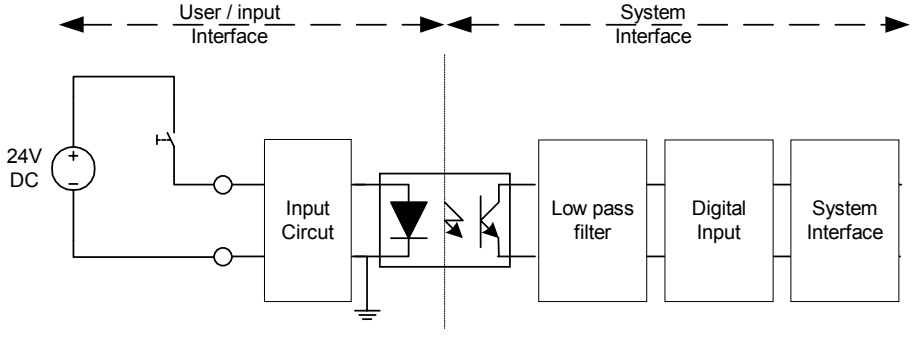
11.2 Digital inputs

11.2.1 Introduction

The SMART4 provides 32 optoisolated 24V DC digital inputs arranged in 4 groups with respect to the ground connections. The maximum input switching frequency is set to 200Hz with the system registering a logical ‘1’ when the input exceeds 19V. Logical ‘0’ is returned when the input falls below 9V. A low-pass filter restricts signals exceeding the filter limit and registers a logical ‘0’ with the system.

11.2.2 Functional Description

Figure 11 - 2 SMART4-Ext Input Schematic Diagram



The input signal drives the Schmitt gate providing noise and transient states elimination. With the given resistor divider the input voltage of more than 19 V is treated as logical „1” (or „ON”) and the input voltage below 9 V is treated as logical „0” (or „OFF”). The capacitor together with the series resistor forms low-pass filter further reducing input noise

11.2.3 Pinouts

Screw Terminal Pinouts

The following shows the pinout/signal relationship for the inputs and outputs when connected to a particular screw terminal block.

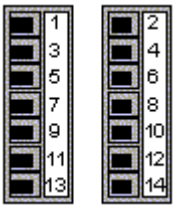


Table 11-2: SCR1 connector

Pin 1	+24 V DC	Pin 2	GND
Pin 3	Input 1	Pin 6	Input 2
Pin 5	Input 3	Pin 6	Input 4
Pin 7	Input 5	Pin 8	Input 6
Pin 9	Input 7	Pin 10	Input 8
Pin 11	Output 1	Pin 12	Output 2
Pin 13	Output 3	Pin 14	Output 4

Table 11-3: SCR2 connector

Pin 1	+24 V DC	Pin 2	GND
Pin 3	Input 9	Pin 6	Input 10
Pin 5	Input 11	Pin 6	Input 12
Pin 7	Input 13	Pin 8	Input 14
Pin 9	Input 15	Pin 10	Input 16
Pin 11	Output 5	Pin 12	Output 6
Pin 13	Output 7	Pin 14	Output 8

Table 11-4: SCR3 connector

Pin 1	+24 V DC	Pin 2	GND
Pin 3	Input 17	Pin 6	Input 18
Pin 5	Input 19	Pin 6	Input 20
Pin 7	Input 21	Pin 8	Input 22
Pin 9	Input 23	Pin 10	Input 24
Pin 11	Output 9	Pin 12	Output 10
Pin 13	Output 11	Pin 14	Output 12

Table 11-5: SCR4 connector

Pin 1	+24 V DC	Pin 2	GND
Pin 3	Input 25	Pin 6	Input 26
Pin 5	Input 27	Pin 6	Input 28
Pin 7	Input 29	Pin 8	Input 30
Pin 9	Input 31	Pin 10	Input 32
Pin 11	Output 13	Pin 12	Output 14
Pin 13	Output 15	Pin 14	Output 16

11.2.4 Software

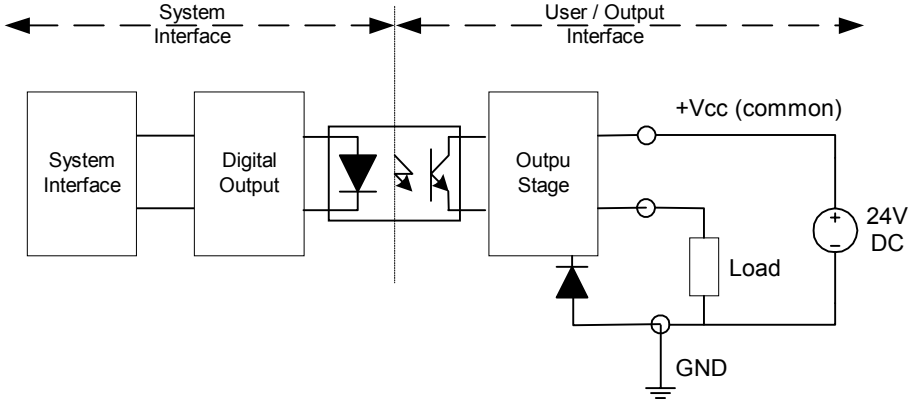
11.3 Digital outputs

11.3.1 Introduction

The SMART4-Ext provides sixteen optoisolated 24V DC (typ.) digital outputs arranged in 4 independent groups. The maximum output switching frequency is limited to 1 kHz (square wave) with the in the ON state when the system issues a logical '0'. The maximum continuous output supply current is limited to 500mA (resistive loads) and provision has been made to cater for inductive loads.

11.3.2 Functional Description

Figure 11 - 3 SMART4-Ext digital output



The driving output device is a Darlington transistor pair protected against inductive loads by an additional clamp diode. Furthermore, because each output stage requires three terminals to remain independent and only few such terminals are available, the common Vcc and GND lines have been grouped. Hence, each group of outputs is coupled to one Vcc line and to each group of Vcc lines is one ground.

11.3.3 Pinouts

Screw Terminal Pinouts

The following shows the pinout/signal relationship for the inputs and outputs when connected to a particular screw terminal block.

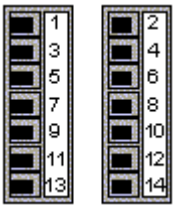


Table 11-6: SCR1 connector

Pin 1	+24 V DC	Pin 2	GND
Pin 3	Input 1	Pin 6	Input 2
Pin 5	Input 3	Pin 6	Input 4
Pin 7	Input 5	Pin 8	Input 6
Pin 9	Input 7	Pin 10	Input 8
Pin 11	Output 1	Pin 12	Output 2
Pin 13	Output 3	Pin 14	Output 4

Table 11-7: SCR2 connector

Pin 1	+24 V DC	Pin 2	GND
Pin 3	Input 9	Pin 6	Input 10
Pin 5	Input 11	Pin 6	Input 12
Pin 7	Input 13	Pin 8	Input 14
Pin 9	Input 15	Pin 10	Input 16
Pin 11	Output 5	Pin 12	Output 6
Pin 13	Output 7	Pin 14	Output 8

Table 11-8: SCR3 connector

Pin 1	+24 V DC	Pin 2	GND
Pin 3	Input 17	Pin 6	Input 18
Pin 5	Input 19	Pin 6	Input 20
Pin 7	Input 21	Pin 8	Input 22
Pin 9	Input 23	Pin 10	Input 24
Pin 11	Output 9	Pin 12	Output 10
Pin 13	Output 11	Pin 14	Output 12

Table 11-9: SCR4 connector

Pin 1	+24 V DC	Pin 2	GND
Pin 3	Input 25	Pin 6	Input 26
Pin 5	Input 27	Pin 6	Input 28
Pin 7	Input 29	Pin 8	Input 30
Pin 9	Input 31	Pin 10	Input 32
Pin 11	Output 13	Pin 12	Output 14
Pin 13	Output 15	Pin 14	Output 16