SYSTEM BASED DATA ACQUISITION, PROCESS CONTROL AND COMMUNICATION

NEW
MAX2*box* and CAN*box*

OPENING UP INCREDIBLE POSSIBILITIES

MAX Modules and Carrier Systems

MAX6*pci*, MAX9*pci*, MAX5*dip*, MAX8*dip*, MAX2*box*, CAN*box*

SORCUS

"Dumb" or Intelligent: It's All Down to the Modules

MAX6*pci* and MAX9*pci* are carrier boards for MAX modules. They can operate as "dumb" or intelligent cards in any PC equipped with a PCI slot. Because MAX Modules are simply plugged in to comply with input/output requirements, the boards are immediately ready for use as "dumb" I/O cards. In addition, plug-in MAX modules with CPU enable computing power to be simply adapted to the requirements of the project.

MAX6*pci* and MAX9*pci* carrier boards merely convert PCI access to X-Bus access. The X-Bus – the local bus on the carrier board – has the function of interconnecting the MAX modules. By providing some special features, the high-speed X-Bus is particularly suitable for high-speed measurement and control applications.

MAX6*pci* and MAX9*pci* As "Dumb" Cards

These cards' capacity to take up to 6 or 9 I/O plug-in modules respectively enables ultra-low-cost solutions to be devised for simpler applications. Unlike intelligent solutions, here processing speed and realtime features only depend on the PC and its operating system; software-related differences from intelligent boards are also minimal. Libraries and module device drivers are supplied for the carrier board and all modules (see Page 13) so that the cards are easily integrated into the user's PC program, supporting PC operating systems Windows (XP, NT, 2000, 98, ME) and Linux. Any number of MAX6*pci* and MAX9*pci* carrier cards can be installed in a single PC.

MAX6*pci* and MAX9*pci* As Intelligent Cards

When enhanced computing power and realtime capability are needed, plugging an additional MAX module with CPU onto the carrier board transforms a "dumb" card into an intelligent PCI card. All CPU modules comprise full-scale computers with RAM, Flash and a variety of interfaces such as X-MAX-1 or X-MAX-E with 100 MHz 486, or X-MAX-400 with 400 MHz Intel XScale-CPU (ARM), 32 MByte RAM and 32 MByte Flash. The card can thus operate independently of the PC to allow genuine parallel processing, or several of these CPU modules can even be plugged onto a single carrier board for parallel operation. The local X-Bus always enables multiprocessing.

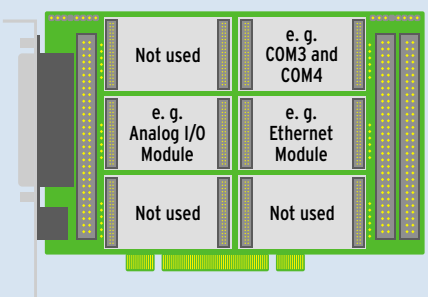
Process I/O Modules

Plug-in modules can be used to adapt the carrier boards to any measurement and control tasks. About 80 types are currently available, including analog and digital inputs and outputs (with 12 up to 24 bit resolution, also galvanically isolated), sample/hold and filter modules, counters, period measurement, incremental encoders and SSI interface, etc. This means, for example, that up to 180 analog inputs or 342 digital inputs/outputs can be provided by a single PCI card. Modules can be accessed by both PC and a CPU module on the card – a process which operates with identical calls from all CPUs.

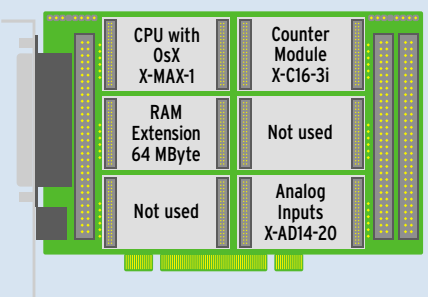
First, a channel is opened with its desired properties, e.g. analog input with input type and range. The channel can now be accessed at any time, including simultaneous accesses by several CPUs and the PC, without the need of special precautions.

Communication Modules

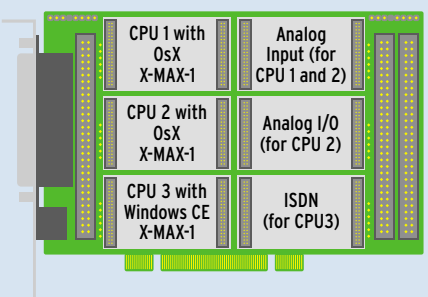
Like process I/O modules, communication interfaces can also be plugged onto the carrier boards – either simple serial interfaces (UARTs), e.g. 2, 4 or 8 x RS-232 per module, RS-422, RS-485 or 20 mA, or Ethernet 10/100 and fieldbus modules with CAN or PROFIBUS protocol, etc. This means, for example, that 72 serial RS-232/-422/-485 interfaces can be realized on a single PCI card, all of which can also be accessed from the PC as COM interfaces. Modules with analog modem and ISDN connection are also available.



MAX6 for simple measurement and communication tasks



MAX6 as intelligent PC card, e. g. for preprocessing of realtime data



MAX6 as multiprocessor system

Software for Standard Applications

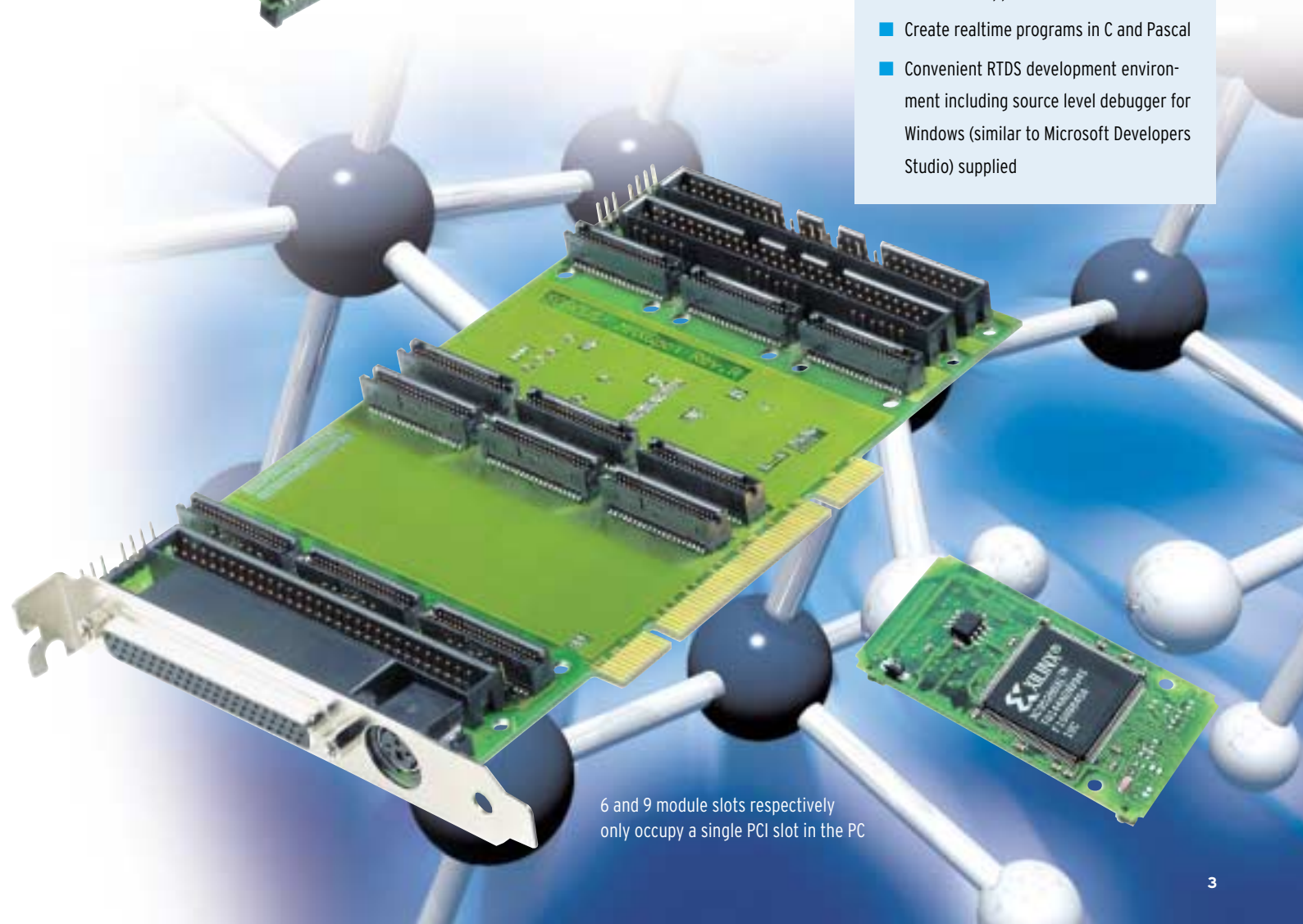
Standard programs for data acquisition, test facility and quality control include ARGUS, DIAdem, and LabVIEW. SORCUS supplies free drivers for all these programs that do not require programming, only configuration of the measurement task.

Individual Software

The cards and all modules can easily be integrated into the user's own software by using the drivers and program libraries supplied. This can be done with PC programs and with programs running on a CPU module when the card is used as an intelligent subsystem. The cards and all modules are supplied with libraries, drivers and a full development environment including remote debugging.

Special Features of MAX6*pci* and MAX9*pci*

- Non-intelligent PCI carrier cards
- Upgradable to intelligent cards by plugin of several CPU modules, e.g. X-MAX-1, X-MAX-E or X-MAX-400
- 6 and 9 slots respectively for MAX modules
- Multiprocessor capability with up to 8 CPU modules
- As intelligent card, operates in parallel to the PC's CPU
- Drivers for Windows (XP, NT, 2000, 98, ME) and Linux supplied
- Create realtime programs in C and Pascal
- Convenient RTDS development environment including source level debugger for Windows (similar to Microsoft Developers Studio) supplied



6 and 9 module slots respectively only occupy a single PCI slot in the PC

Decentralized Intelligence and Customer Specific Boards

MAX5*dip* and MAX8*dip*

MAX5*dip* and MAX8*dip* are decentralized, intelligent I/O systems for DIN rail mounting. They can operate stand-alone or as slaves with a variety of field bus systems. The main difference between them is the number of slots for I/O modules. All I/O lines of the modules (40 per module) are available on screw terminals, which provides a total of 120 process I/O signals for MAX5*dip* and 240 for MAX8*dip* respectively.

MAX5*dip*: Decentralized intelligent peripheral

MAX8*dip*: Connectors for several communication interfaces on-board

CPU Modules and Host Connection

In addition, both offer 2 slots for a CPU and a communication module for connecting to other computers via serial, CAN, PROFIBUS, Ethernet or USB.

Scalable Computing Output

If a CPU module is equipped with the communication interface required, it can also take over this function. This leaves the resulting slot free to be used for another CPU module to increase the real time resp. computing power. X-bus systems are always capable of working as a multiprocessor system.

Remote Diagnosis, Remote Maintenance and Standby

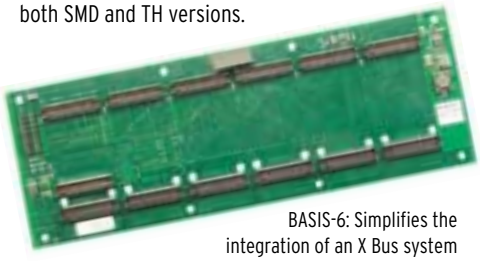
The X-56K-FU modem module can be used with both MAX5*dip* and MAX8*dip*. In addition, MAX8*dip* can switch into standby mode, in which it is reactivated by a call via the modem and then restarts the programs previously stored in the flash.

Custom Carrier Boards

SORCUS also designs and manufactures carrier boards according to customers' specifications (see table on next page).

BASiS-6

This carrier board for 6 MAX modules is designed to simplify building your own X-Bus system. It is plugged onto a custom made printed circuit board which only has to provide the required external connectors.
A low cost 2-layer printed circuit board is sufficient in most cases. Of course, some project specific electronics, e.g. level converter, improved surge protection etc., can be integrated on this board. In addition, some circuitry might be required to derive the power supply voltage/s from system voltages if these voltages are not directly available. All MAX modules can be used on BASiS-6. The BASiS-6 connectors on the custom board are available as both SMD and TH versions.



BASIS-6: Simplifies the integration of an X Bus system

BASiS-6 Features

- 6 slots for MAX modules
- Can be used with all MAX modules
- All module I/O signals available on customer circuit board
- Additional 10 GPIOs
- LED on-board
- X-Bus type configurable as standard or GTL+
- 5V power supply (optional +3.3V and +/-12V)
- Dimensions 220 x 80 mm

MAX2*box*:
Stand-alone device for 2 resp. 3 MAX modules

MAX2*box* und MAX3*box*

Each of these stand-alone boxes provides an X-Bus system that can be equipped with a CPU module and 1 resp. 2 I/O modules. The 40 I/O pins of each I/O module are brought out via 44-pin HD-Sub connector/s. Screw terminals and other connectors can be used with corresponding adapters. The MAX2*box* additionally includes a CF card slot, e.g. for a Flash card, microdrive, or WLAN card. All MAX modules can be used with both boxes. The external power supply voltage range covers 6..60V DC.

MAX2*box* and MAX3*box** Features

- 2 resp. 3 Slots for MAX modules: CPU and 1 resp. 2 I/O modules
- HD-Sub 44 connector/s for the I/O pins
- LAN 10/100, RS-232 and USB-OTG interface
- **MAX2*box*:** CF card slot for Flash, HDD or WLAN/Bluetooth
- **MAX3*box*:** MMC/SD card slot
- WLAN/Bluetooth module internally (optional)
- Can be used with all MAX modules
- LEDs for Power, LAN resp. WLAN/BT
- Power supply 6...60 V DC (incl. 42 V)
- Dimensions (W x H x D)
  MAX2*box*: 85 x 36 x 125 mm
  MAX3*box*: 105 x 36 x 149 mm
- Operating temperature: 0..70°C (opt. -40...85°C)
- Tabletop, DIN rail or screw mounted
- Adapter from HD-Sub 44 to screw terminals available

*Preliminary information

CAN*box*:
Dual CAN to WLAN Converter

CAN*box*

This all-in-one stand-alone box is a special MAX2*box* design. Fully equipped with all hardware, it includes two isolated CAN interfaces, a CPU module and a WLAN/Bluetooth module.
The CAN*box* transmits and receives telegrams from the 2 CAN buses to a PDA, a laptop or an access point via WLAN (optional: Bluetooth). Instead of WLAN, data can also be transceived via an on-board wired 10/100 Ethernet interface. An RS-232 interface is also provided.
The CAN*box* is supplied with configuration software and libraries that enable the CAN*box* to be controlled by user programs under Windows. Libraries are largely compatible with the Vector CANcardX resp. XL, a PCMCIA card with CAN interface.
The CAN*box* has a power supply range of 6..60V DC.

CAN*box* Features

- All-in-one device with 2 isolated CAN interfaces (2 x D-Sub-9 connectors)
- Built-in WLAN resp. Bluetooth
- SMA (female) connector for antenna
- LAN 10/100 and RS-232 interface
- Software and libraries included, largely compatible with CANCardXL
- LEDs for power and LAN
- Power supply from 6..60V DC (incl. 42V)
- Operating temperature: -20..70°C
- Tabletop, rail or screw mounted

CAN*box* and PDA
(Personal Digital Assistant):
Teamwork in perfection

Overview of Selected Carrier Boards and Systems

	MAX6pci	MAX5*dip*	MAX8*dip*	MAX2*box*/MAX3*box*	BASiS-6	Customer Specific Carrier Boards
Total number of slots	6	5	8	2 resp. 3	6	Up to 32
Slots for I/O modules	6	3	6	1 resp. 2	5	Up to 32
Number of I/O pins	240	120 + 8	240	40 resp. 80	240	Up to 32 x 40 = 1280
External connectors	HD-Sub-62, Pinheader	Screw terminals	Screw terminals	1 resp. 2 HD-Sub 44	8 slots, 40 pin	On request
Power supply	Via PCI Bus	24 V (18...36 V)	24 V (18...36 V)	6...60 V	5 V (3.3 ± 12)	+3.3 V and ± 12 opt.
Standby operation and Wake-up on ring/LAN	Yes (PC)	–	Yes	–	–	On request
Remote diagnosis and maintenance (prep.)	Yes	Yes	Yes	Yes	–	Yes

Analog and Digital I/O Modules

All analog and digital I/O modules are supplied with module device drivers (MDDs) suitable either for PC programs under Windows and Linux or for realtime programs running on a CPU module under OsX or Win CE.
All modules have a configuration EEPROM in which key information, e. g. initial module settings, can be entered. The appropriate initialization is set after power-on or system reset.

X-AD14-20
X-AD12-20

- 20 analog inputs: programmable as single-ended or 10 differential inputs per channel
- 14 or 12 bit resolution
- Conversion time 400ns or 800ns respectively
- 8 input ranges selectable per channel, from ± 250mV to ± 10V
- Custom ranges per channel possible, e.g. ± 100V, ± 20mV, 0...20mA
- Lowpass filter per channel possible
- New mode with on-board FIFO

X-AD16i-4

- 4 analog differential inputs
- Module galvanically isolated from carrier board
- 16 bit resolution
- Conversion time 5 µs per channel
- 4 input ranges per channel: ± 5V, ± 10V, 0...2.5V and 0...5V

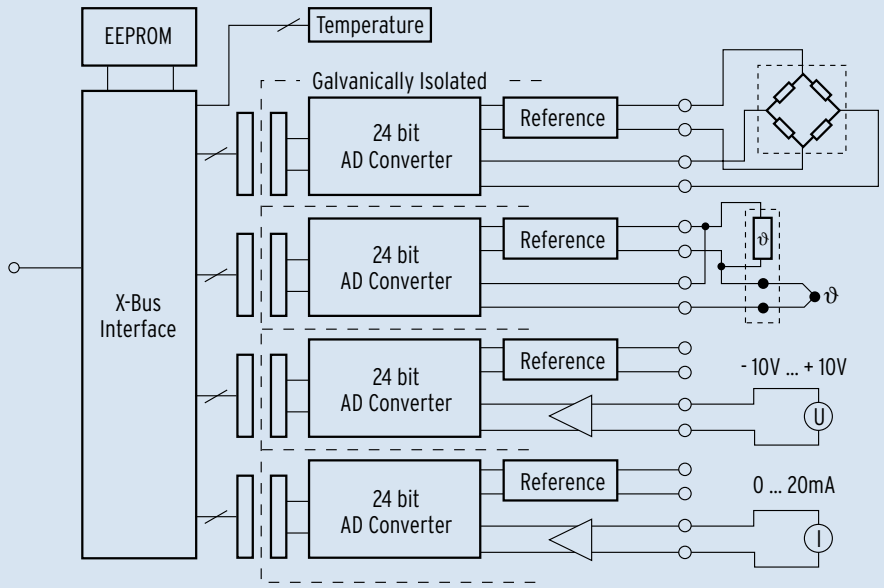
X-SH12-8 NEW

- 8 analog inputs, simultaneously sampled
- 12 bit resolution
- 12 Msps (1 channel)...1.5 Msps (8 channel)
- Local RAM (FIFO) on-board
- Trigger inputs: 1 analog and 1 digital
- 1 analog output, 12 bit resolution

X-5B-1

- Suitable for controlling external 19" multiplexers, e.g. 5Bx02 (for up to 256 individually isolated channels, for Pt100, thermocouple, etc.)
- One analog input and one output, 14 bit resolution
- 14 digital outputs (TTL)

X-AD24-4i



X-AD24-4i NEW

- 4 individually isolated analog differential inputs for direct connection of sensors
- 24 bit sigma-delta converter per channel
- 1 digital output per channel (input optional)
- Available versions (all sensors can be directly connected, mixed versions on request):
  - 4 strain gauges (350 Ω)
  - 4 thermocouples (all types) with cold junction compensation
  - 4 Pt100 temperature sensors
  - 4 ICP sensors incl. 24V/4mA power supply
  - 4 inputs 0...20mA
  - 4 inputs ± 10V
  - 4 highly dynamic bridges (40ksps per channel)

X-MiX-26 NEW

- 4 analog inputs with simultaneous sampling, 14 bit resolution
- Input ranges: ± 10V, optional ± 5V, ± 2.5V or 0...20mA
- 4 analog outputs, can be set simultaneously, 14 bit resolution
- Output ranges: ± 10V, optional ± 5V, ± 2.5V or 0...20mA
- 18 digital inputs and outputs

X-DA16i-4
X-DA14i-4

- 4 analog outputs
- 16 and 14 bit resolution respectively
- Module galvanically isolated from carrier board
- 11 output ranges programmable per channel:
- ± 2.5V, ± 5V, ± 10V, 0...2.5V, 0...5V, 0...10V, 0...-2.5V, 0...-5V, 0...-10V, 0...20 mA, 4...20 mA
- Max. output current ±10 mA or 20 mA resp.
- All channels can be set simultaneously

Analog I/O and Mixed Modules

Module	Ain	Aout	Resolution	Din	Dout	Isolated	Comments
X-AD24-4i	4	–	24 bit	4 *	4 *	Per channel	Sigma-delta, various sensors
X-AD14-20	20	–	14 bit	–	–	No	Custom range per channel
X-AD12-20	20	–	12 bit	–	–	No	Custom range per channel
X-AD16i-4	4	–	16 bit	–	–	Module	4 input ranges per channel
X-SH12-8	8	1	12 bit	1	1	No	Simultaneous sampling
X-MiX-26	4	4	14 bit each	18 *	18 *	No	Simultaneous sampling
X-5B-1	1	1	14 Bit each	–	14	No	For 5B signal conditioner panels
X-DA16i-4	–	4	16 bit	1	–	Module	Uout- and Iout versions
X-DA14i-4	–	4	14 bit	1	–	Module	Uout- and Iout versions
X-TEST-1	40 *	40 *	16 bit	40 *	40 *	No	Test module for all MAX modules, stackable

* max. possible number of channels, depends on assembly version resp. software configuration

Digital I/O Modules

Module	Din	Dout	Isolated	Interrupt	Comments
X-DIO-40	38 *	38 *	No	12	3 timer/counter, crystal oscillator, TTL
X-CPLD-38	38 *	38 *	No	38 *	User-programmable CPLD, crystal oscillator
X-C16-3i	12	8	Per channel	12	3 multifunctional counters, 13 modes each
X-SSI-2	2	2	No	Yes	2 SSI channels for sensors
X-SSI-2/M	2	–	No	Yes	2 SSI channels for monitoring mode
X-REL-8i	–	8	Per channel	Yes, WD	Watchdog, stackable
X-OPT-200i	20	–	Per channel	Yes	Process or logic level
X-OPT-164i	16	4	Per channel	Yes	Process or logic level, watchdog
X-OPT-128i	12	8	Per channel	Yes	Process or logic level, watchdog
X-OPT-812i	8	12	Per channel	Yes	Process or logic level, watchdog
X-OPT-416i	4	16	Per channel	Yes	Process or logic level, watchdog
X-OPT-020i	–	20	Per channel	Yes	Version for 80 mA/100 V available

* max. number of channels, depends on software configuration resp. FPGA design

X-CPLD-38

- 38 digital I/O pins, logic level
- Function programmable by gate array (Xilinx CPLD 95288XL)
- CPLD function can be created and modified by customer
- Free development software (VHDL, Abel)
- In-system-programmable (Flash)
- 1 control LED on-board
- On-board timer 8254 and crystal oscillator
- Programmable interrupt line

X-SSI-2
X-SSI-2/M

- Connection of sensors with synchronous serial interface (SSI)
- 2 channels for sensors resp. for monitoring 2 SSI communication channels
- Programmable transmission rate
- Gray or binary coding programmable
- Programmable number of data bits (2...32)

X-C16-3i

- 3 independent counter channels, 10 MHz max. counting rate
- 16 bit per channel, cascadable
- 13 operation modes selectable per channel, including counter, incremental encoder interface, pulse width, frequency, period and speed measurement
- Programmable reference frequencies on board
- 12 opto-isolated inputs and 8 outputs
- Various interrupt options

X-OPT-io (with i + o = 20)

- i = Number of isolated inputs (0, 4, 8, 12, 16 or 20)
- o = Number of isolated outputs (20, 16, 12, 8, 4, or 0)
- Configurable interrupt lines
- All inputs can be sampled simultaneously
- Input range selectable for logic or process interface
- Open Collector outputs
- Watchdog timer
- Version /P with 80 mA and 100 V outputs available

X-REL-8i

- 8 relay output channels
- Each channel 1 x SPDT and 1 x SPST n.o. resp. n.c.
- 100 V/1 Ampere per output
- Watchdog timer

X-LCD-1

Communication Modules

X-COM-8i

- 8 asynchronous serial interfaces
- Each channel galvanically isolated
- Selectable as RS-232 (incl. RTS/CTS), RS-422 or RS-485
- PC-compatible UARTs with 64 byte FIFO per channel and direction
- Baud rates up to 1 MBaud RS-232 or 3 MBaud RS-422/-485

X-COM-4

- 4 asynchronous serial interfaces
- 2 channels configurable as RS-232 (incl. RTS/CTS), RS-422 or RS-485
- 2 channels RS-232 each with 6 modem control lines
- PC-compatible UARTs
- Baud rates up to 460 KBaud
- 16 resp. 64 byte FIFO per channel and direction

X-CAN-2i

- 2 independent CAN channels
- Each channel galvanically isolated from CAN-BUS
- Up to 1 Mbit/s transmission rate
- Full CAN functionality
- Supports CAN specification 2.0 A and 2.0 B (11 and 29 bit identifier)
- BUS termination controlled by software
- Supplied with fault-tolerant resp. high speed ISO 11898 CAN interface

X-DPS-2i

- 2 independent PROFIBUS slaves
- Each channel galvanically isolated, RS-485
- Compatible with IEC 61158 standard
- Automatic Baud rate recognition up to 12 Mbit/s
- Dual ported RAM interface

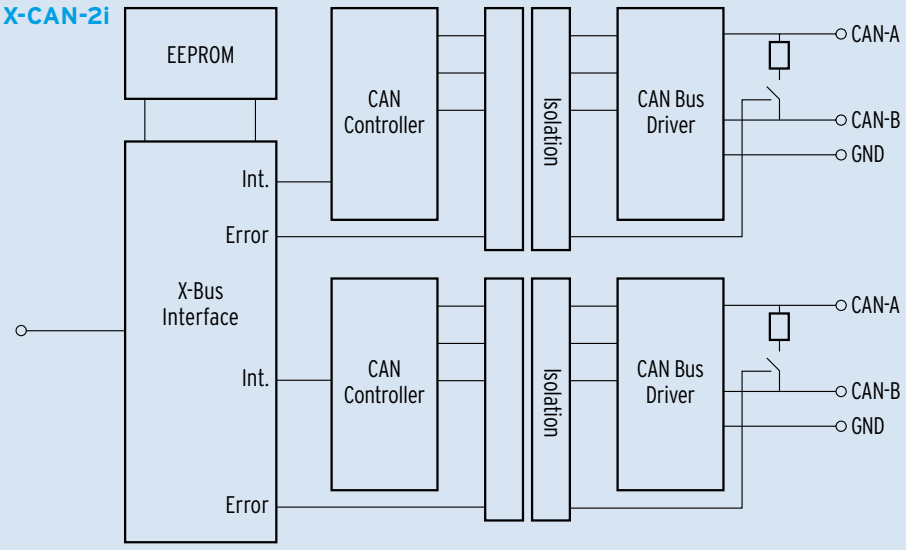
X-DPM-1i NEW

- PROFIBUS master/slave with on-board CPU
- Compatible with IEC 61158 standard
- Baud rates from 9.6 K to 12 Mbit/s
- RS-485 galvanically isolated
- 16 KByte dual ported RAM interface

Communication Modules

Module	Channel	Protocol	I/O Level	Isolated	Comments
X-COM-8i	8	async	RS-232 or -422/-485	Per channel	PC-compatible UARTs
X-COM-4	4	async	2xRS-232 + 2xRS-232/ -422/-485	No	PC-compatible UARTs
X-SCC-2	2	async/sync	RS-232/-422/-485	No	With ESCC, DPLLs
X-DPM-1i	1	PROFIBUS	RS-485	Yes	Master and slave
X-DPS-2i	2	PROFIBUS	RS-485	Per channel	Slaves
X-CAN-2i	2	CAN	CAN	Per channel	High-speed or fault-tolerant
X-56K-FU	1	Modem	Analog	Yes	56K modem, UART
X-ETH-4c	1 + 4	IEEE 802.3	10 BaseT + RS-xxx	(Yes)	Ethernet isolated
X-ETH-10	1	IEEE 802.3	10 BaseT	Yes	Magnetics on-board
X-ETH-100	1	IEEE 802.3	100 BaseTx	Yes	10/100 Mbps, Magnetics on-board

X-CAN-2i



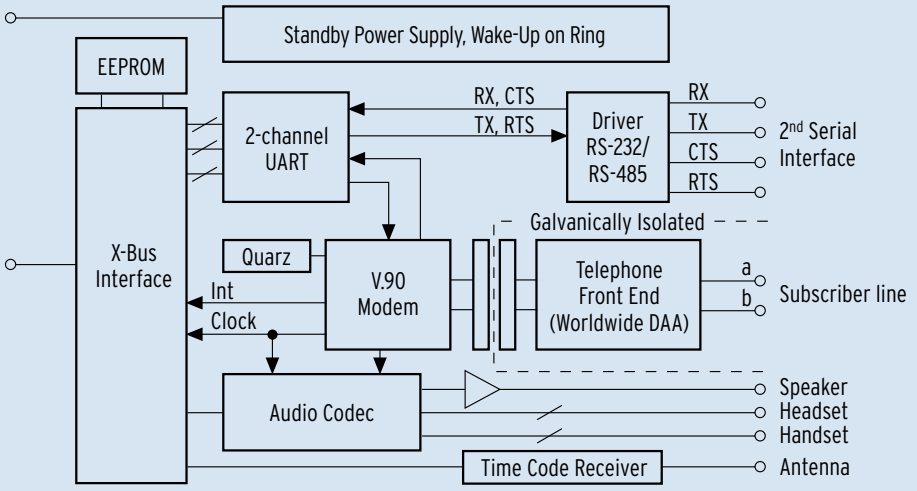
X-ETH-10
X-ETH-100

- 10/100 Mbps Ethernet resp.
- 10 BaseT resp. 100 BaseTX
- Magnetics on-board
- Incl. TCP/IP for OsX and Windows CE

X-ETH-4C

- 10 Mbps Ethernet + 4 async. serial interfaces
- Ethernet: 10 BaseT (magnetics on-board) incl. TCP/IP for OsX and Windows CE
- Async.: 2 channels configurable as: RS-232 (with RTS/CTS), RS-422 or RS-485
- 2 RS-232 channels each with 6 modem control lines
- 16 or 64 byte FIFO per channel and direction

X-56K-FU



X-SCC-2

- 2 universal serial interfaces
- Operation modes: async, sync, SDLC, HDLC, etc.
- Serial chip 85230 (= ESCC)
- Each channel with Baud rate generator, DPLL and FIFO
- Physical interface programmable as RS-232, RS-485 or RS-422

X-56K-FU NEW

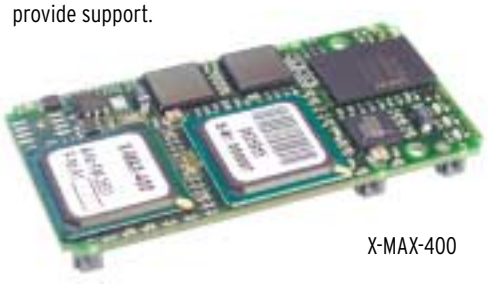
- 56K analog modem (V.90)
- Controlled by AT-compatible instruction set
- Wake-up on ring, if carrier board provides this feature
- Codec on-board
- Time-code receiver (e. g. for DCF)
- Additional RS-232/-422/-485 interface

CPU Modules

All CPU modules comprise a complete computer with CPU, RAM, Flash and various interfaces. They are optimized for very low power consumption, maximum computing power and reliable operation in industrial environments. All CPU modules are suitable not only for use on SORCUS standard carrier boards, but also in many custom designs including portables. Many interfaces can be deactivated to save power. In addition, the CPU clock can also be lowered via software command and increased at any time as needed. All CPU modules provide an X-Bus interface for communication with other modules including other CPU modules.

The two CPU modules, X-MAX-1 and X-MAX-E, are equipped with a 100 MHz 486 CPU, and the new X-MAX-400 with an Intel 400 MHz XScale CPU with ARM architecture (PXA255). This CPU module delivers a computing power of about ten times that of the x86 modules, yet its power consumption is lower and it provides even more on-board interfaces. Further properties are given in the table below and the product data sheets.

The Flash ROM of all CPU modules contains either the SORCUS realtime multitasking operating system OsX for up to 1024 tasks, or a Microsoft Windows CE image. Some realtime programs are supplied, e. g. for data acquisition, PID controllers, function generators and FFT. Serial communication protocols such as 3964/R are also available. In addition, realtime programs can easily be written for a CPU module and stored in the Flash. The program can then be started automatically after power-on or system reset. A powerful development environment, libraries and sample programs provide support.

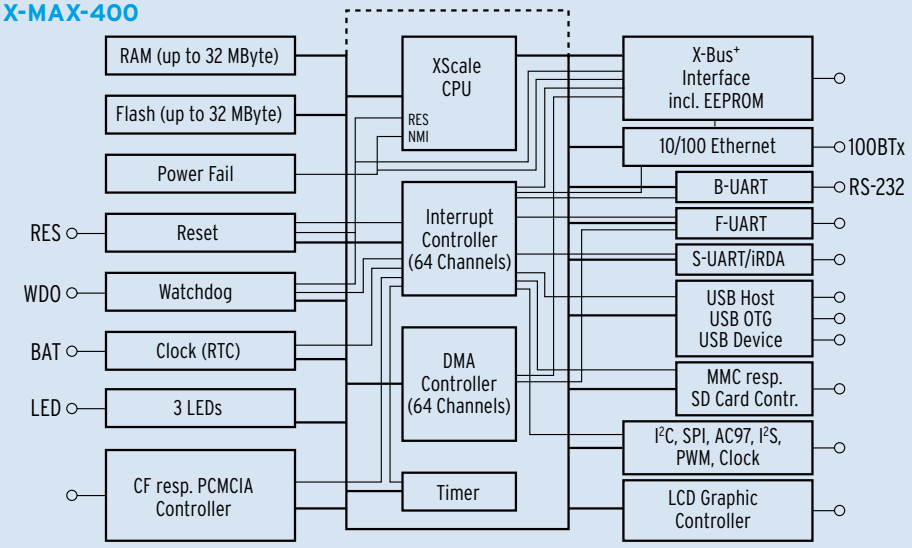


X-MAX-400

CPU, Display Interface, and Memory Extension Modules

Module	CPU/Clock	RAM	Flash	Interfaces
X-MAX-400	XScale, 400 MHz	32 Mbyte	32 MByte	3xUART, LCD, PCMCIA, RTC, 100BaseTx, USB, I²C, SPI, MMC/SD, CF, AC97, etc.
X-MAX-1	486, 100 MHz	16 Mbyte	16 MByte	RS-232, EPP, LCD, PCMCIA, Keyboard, RTC
X-MAX-E	486, 100 MHz	8 Mbyte	16 MByte	Same as X-MAX-1 + 10BaseT, seriell = RS-232/-422/-485
X-LCD-1	–	–	–	TFT interface incl. backlight inverter and touch screen interface

X-MAX-400



X-MAX-400 (see data sheet)

- CPU module with 400 MHz XScale PXA255 (including thumb and DSP instructions)
- Up to 32 MByte RAM
- Up to 32 MByte Flash-ROM
- Ethernet 10/100 incl. magnetics on-board
- USB Host, USB OTG and USB Device
- 3 UARTs: 1 x RS-232, 2 x logic interface, iRDA (SIR and F)
- RTC, backup with external battery
- Graphic interface for TFT/DSTN-Displays (up to 640x480 resolution, 16 bit color)
- CF- resp. PCMCIA controller for 2 cards
- MMC resp. SD card controller for 2 cards
- Audio interface AC97 and I²S
- I²C, SPI, watchdog, timers, 3 LEDs
- Dimensions only 29 x 58 x 8 mm
- 3.3 V power supply
- Real time operating system OsX or WIN CE on-board

The "Blue Line" Series: Rugged Modules and Carrier Systems for Tough Industrial Environments

This range of MAX modules has the following special features:

Features of "Blue Line" Modules

1. Available for many bus systems for design-in: X-Bus, UART, I²C, SPI, C51, etc.
2. Operating temperature: -40 ... +85°C
3. Guarantee of delivery: at least 10 years for pin and functional compatible modules if SORCUS drivers and libraries are used
4. Programming and remote maintenance can be performed in-system
5. High speed X-Bus: GTL+ up to 100 MHz
6. Low power

A special feature of this module series is that it can be configured for a wide variety of serial and parallel bus interfaces, enabling the modules to be designed-in like components into a system.
For example, if a "Blue Line" module is configured for SPI, it can be simply controlled via 2 or 3 I/O pins of a microcontroller. Many modern microcontrollers and DSPs provide these interfaces. Parallel bus systems, e. g. for the popular C51 microcontroller, can also be connected. In addition, custom bus adaptations can be made.

All "Blue Line" modules are X-Bus compatible and can be combined with all other MAX modules as desired.

The following modules and carrier systems are available as "Blue Line" modules:

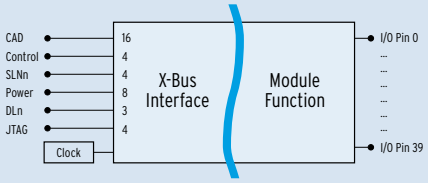
X-MAX-400	CPU-module with 400 MHz Intel X-Scale processor, 32 MByte RAM, 32 MByte Flash, LCD controller, Ethernet 10/100, USB, CF/PCMCIA, 3 x UART, iRDA, etc.
X-AD24-4i	4 channel sensor interface, 24-Bit sigma-delta converter per channel, individually isolated
X-AD14-20	20 analog inputs, 14 bit resolution
X-DA16i-4	4 analog outputs, 16 bit, isolated
X-DPS-2i	2 PROFIBUS slave channels, individually isolated
X-CAN-2i	2 CAN channels, individually isolated
X-COM-8i	8 asynchronous serial interfaces, individually isolated, RS-232 or RS-422/-485 version
X-33K-FU	Analog modem with time coded receiver and serial interface (RS-232/-422/-485)
X-SSI-2	2 SSI interfaces (Sync. Serial Interface)
X-OPT-io	20 opto-coupled inputs and/or outputs, individually isolated
X-ETH-100	Ethernet 10/100 Mpbs, incl. magnetics
MAX5*dip*	Carrier system for 5 MAX modules, 120 screw terminals, DIN rail mounting
MAX8*dip*	Carrier system for 8 MAX modules, 240 screw terminals, DIN rail mounting
CAN*box*	CAN to WLAN or Bluetooth in stand-alone box, 2 x CAN, LAN, RS-232, 6...60V DC
MAX2*box*	Stand-alone box for CPU and I/O modules, LAN, USB-OTG, RS-232 and CF card slot

Further modules and carrier systems will be added to the "Blue Line" series, e. g.

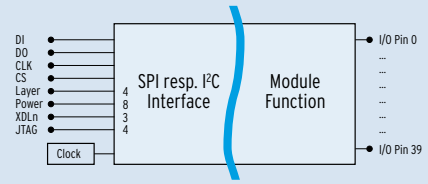
X-DPM-1i	PROFIBUS master/slave, 1 channel isolated
MAX9*pci*	PCI carrier board for 9 MAX modules
MAX3*box*	Stand-alone box for CPU and 2 I/O modules, LAN, USB-OTG, RS-232, CF module for WLAN/Bluetooth, MMC/SD card slot

MAX2*box*

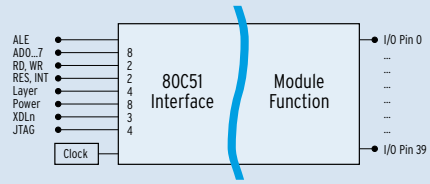
X-Bus



SPI resp. I²C



Microcontroller, e. g. 80C51



From Windows to Linux: Programming for A Host of Applications

Programmers need to distinguish between PC applications for "dumb" cards, PC applications for intelligent boards and so-called realtime programs running on one of the CPU modules.

PC Programming for "Dumb" and Intelligent Cards

The SORCUS PC libraries provide users with a convenient interface to communicate with the PCI cards and other carrier boards and systems. They are available for a variety of programming languages (C, Pascal, BASIC) and operating systems (Windows and Linux). Any number of cards can be served from a library. Library function calls are the same for "dumb" and intelligent cards. Communication between PC and card is handled solely by the library, freeing users from attending to details. Libraries handle the following tasks:

- Card configuration
- Loading realtime programs onto a CPU module
- Data exchange between card and PC
- Error processing
- Interrupt processing
- Access to channels via MDDs

Operating Systems, Programming Languages and Complete Packages for Measurement and Process Control Supported

Windows XP, NT, 2000, 98 and ME

- Microsoft Visual C (from Version 4.0)
- Borland C (from Version 5.0)
- Borland Delphi (from Version 2.0)
- Microsoft Visual Basic (from Version 4.0)

Linux

- Kernel 2.4 and 2.6
- GNU C

Complete Software Packages

- ARGUS Drivers
- LabVIEW and DIAdem Drivers

Scope of Delivery

All libraries and drivers are supplied with each board. Current versions are also available free of charge on the Internet: **www.sorcus.com** The operating systems and compilers supported are included in the list above. If the compiler and/or version you use is not mentioned, please contact SORCUS.

Portability

Libraries have the same scope of functions for different PC operating systems, so that a PC application program can easily be ported from one operating system to another.

The Libraries

Windows XP, NT, 2000, 98 and ME

The Windows library comprises two parts: a device driver that handles communication with the card, and a DLL, which supplies users with the library functions. A DLL interface is available in C, Delphi and Visual Basic.

Linux

A device driver and library are available for Linux. The driver is provided as a kernel module and can be integrated into the system while running. The library supplies all functions to communicate with the card from C and C++ programs.

X-AD24-4i

Programming I/O Devices

Module Device Driver (MDD)

Module device drivers (MDDs) are used to program I/O devices on all MAX modules, e. g. enabling timers to be set, analog inputs to be read etc. A module device driver is not an integral part of the application program in operation, but is a high-speed realtime program or kernel mode device driver on the CPU in question (PC or MAX module with CPU) that processes access to all devices provided by that module. In general, one MDD is used per module and CPU. If a second CPU needs to access the same module, this CPU also requires an MDD. Simultaneous accesses by either CPU are handled by the MDDs.

Module device drivers are based on a channel-oriented setup. The user "opens" a channel to a device, e.g. an analog input, and sets some channel-specific parameters describing the channel's properties. These parameters are held in a so-called channel parameter structure (CPS). Devices can be used by multiple applications simultaneously or assigned exclusively to a specific channel.

When a channel is opened, the driver checks the plausibility of the channel parameter structure and whether the devices can be accessed, returning a handle in response. This handle is required for later access to the device (e.g. reading the analog value). Access to all devices can only be done via this standard interface. This allows the hardware to be replaced without software modifications, which is a great advantage for long term systems: if some hardware components are no longer available, they can easily be replaced by a functional identical module and an update of the MDD. In addition, the format of the input and output data is standardized.

X-MAX-400

Using MDDs

The libraries provide functions for using MDDs for both realtime programming and PC programs.

Procedure:

1. Opening a channel (with parameters) returns a handle (required only once when a program is started)
2. The handle allows a channel resp. the device to be accessed
3. Close channel (when program is terminated)

Module device drivers also offer a host of useful properties. For example, each channel can be given a unique name such as "Valve 19" or "Cylinder 6". The resolution, range and physical unit of a channel can be accessed at any time. All properties and features of an MDD can be read by any application.

A channel that is no longer needed can be closed, freeing up the storage space it had previously occupied.

Further benefits of module device drivers are their multitasking and multiprocessor capabilities. The whole device management, administration and all accesses are performed by only one unit - the module driver itself - eliminating the danger of the unauthorized simultaneous use of a device by multiple applications.

Example: Reading of Analog Inputs of X-AD14-20 Module

```
/* Create channel parameter structure for X-AD14-20 */
CPS_XAD1420 rcXAD1420;
/* Create handle for channel */
MAXCHLHND hChannel;
/* Array for data */
LONG values [20];
/* Size of data block */
USHORT size;
MAX_ERROR result;
/* Set channel parameters:
- Inputs 0 to 19, exclusive to this channel
- Single-ended, range ±10 V
- Read inputs directly */
rcXAD1420.usDevice = DEVICE_AIN_SE; // Single ended
rcXAD1420.usIndexFirst = 0; // from 0
rcXAD1420.usIndexLast = 19; // to 19
rcXAD1420.usFlags = _CP_EXCLUSIVE; // open exclusively
rcXAD1420.usReadMode = IO_MODE_DIRECT; // Access type: direct
rcXAD1420.usRange = RANGE_BIP_10V; // Range : ±10 V
rcXAD1420.usSettleTime = 60; // 60 ns Settle time
/* Open channel */
if (max_open_channel (hDriver, sizeof (rcXAD1420), &rcXAD1420,
NULL, 0, &hChannel) == ERR_OK)
{
  /* Channel opened */
  size = 20 * sizeof (LONG);
  /* Read inputs: 20 * 2 bytes */
  result = max_read_channel_block (hChannel, &size, values);
  if (result == ERR_OK)
  {
  /* Evaluation */
  ...
  }
  /* Close channel */
  max_close_channel (&hchannel);
```

Genuine Parallel Processing and Realtime Programming

Realtime Programming

Having time-critical tasks run on a CPU module permits genuine parallel processing to PC. Without this parallel processing, data acquisition and real time processing is in many cases nearly impossible, particularly when using modern PC operating systems such as Linux or Windows. Several tasks like data acquisition, control loops and communication protocols can run on the CPU module completely independent of the PC, allowing the PC to focus on other less time critical tasks such as visualization and storing the data.

The OsX multitasking operating system on the CPU module enables up to 1024 processes (tasks) to run simultaneously on a single module. Realtime programs – the programs that run as tasks on a CPU module – are easy to program by users themselves. Software developers can utilize Borland standard compilers (PASCAL or C++) or GNU C. In addition, the RTDS development environment with integrated source level debugger is supplied for realtime programs.

The development of a realtime program with RTDS follows these three steps:

1. Enter and compile a realtime program
2. Transfer program into the RAM of a CPU module.
3. Test and debug the realtime program using the SORCUS RTDS realtime debugger.

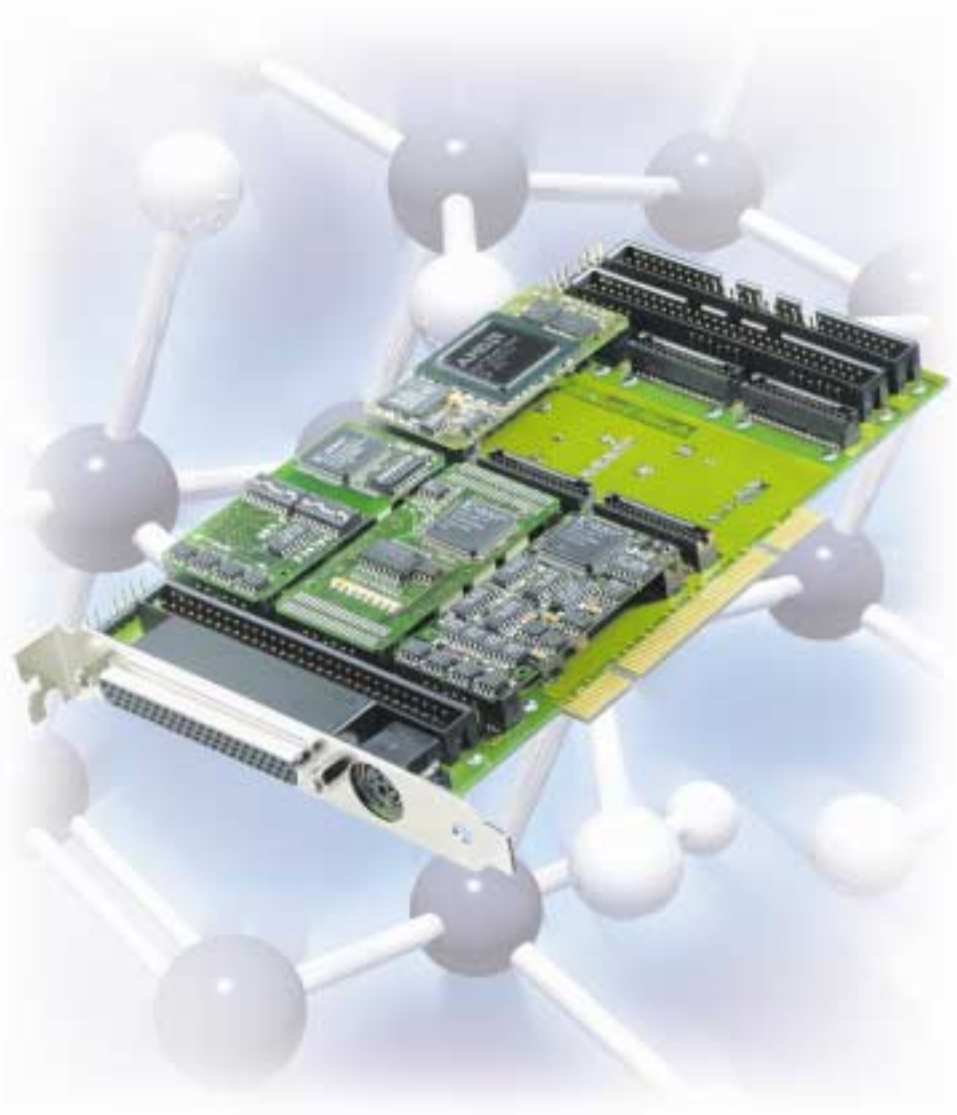
Realtime program structure is similar to that of a Windows DLL. Individual task procedures can be called up later by other tasks on the same CPU module, by another CPU module or by the PC, e.g. to start a communication protocol, read acquired data from buffer, etc. In addition to task procedures, each program comprises a parameter and a data area. The parameter area generally contains user-definable configuration and other parameters, e.g. status of a task resp. program, sample rate, number of channels, Baud rate etc.

The data area can be used to store acquired data. As with the task procedures, other tasks on the same CPU module, other CPU modules or the PC can easily access these parameters and data. Libraries and module device drivers (MDDs) are available to call the various I/O functions and system routines. To transfer the compiled realtime program into the RAM or Flash of a CPU module either the SORCUS PC utility program SNW32 can be used or the PC libraries can be used in an own PC application program.

The SORCUS RTDS debugger supplied can be used to test and debug the realtime program at source level like a PC program.

Of course, features such as breakpoints, watch variables etc. are included.

Realtime programs can be stored in the Flash of a CPU module together with instruction sequences, enabling the programs to load and start automatically during booting.



ARGUS: Software Package for Measurement, Testing and Monitoring under Windows

ARGUS is a realtime-capable standard software for data acquisition, testing, controlling and monitoring applications. It was designed specifically for use with "dumb" and intelligent carrier cards. It can be used under Windows XP, 2000, NT, 98 and ME without limitations. ARGUS enables all data to be supplied to all users online and offline network-wide, with intelligent preprocessing on request.

No-Compromise Convenience

A single mouseclick, and users can scroll, zoom, evaluate or print out data from ongoing measurements while measurement continues in the background. In addition, the display screen, like scaling, diagrams, subdivisions and display types can be changed while the real time tasks are continuously running.
For setup, maintenance and service, ARGUS also offers the option via teleservice for Internet/ISDN or modem.

Open to All

ARGUS is not an isolated solution, but features integrated interfaces, supporting almost all standard interfaces such as OPC, ActiveX, SMS, e-Mail, Ethernet, ODBC. Custom modifications can be implemented easily via the ARGUS-API (DLL).

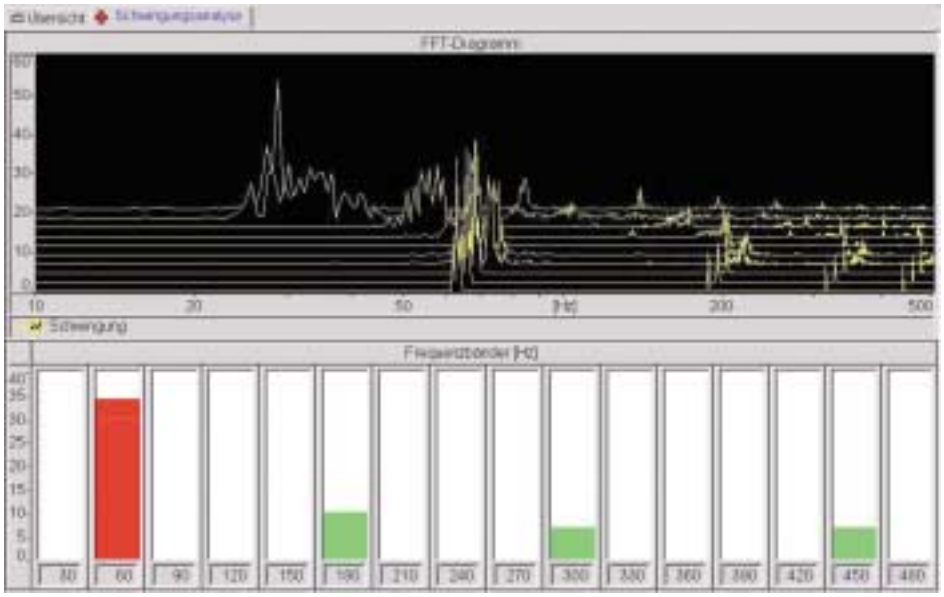
Realtime for Windows

The only secure solution for realtime requirements under Windows and Linux is to put all time-critical tasks onto a realtime-capable subsystem with its own processor. ARGUS consistently utilizes this method by running PC-independent realtime programs on the intelligent carrier cards resp. boards.
The realtime programs perform high-speed measurement, control and communication tasks with clock rates into the high KHz range.

Single Supplier for Hardware and Software

SORCUS also takes care of installation and setup of complete systems including all hardware and software on request. In addition, our team of specialists will design full-scale plant and test bench incorporating all customer specifications – from planning a system, wiring, signal conditioning and network installation right down to final startup.

Monitoring data in a power plant



Data Acquisition

- Several measurements, independently and simultaneously on a PC
- Pre-/post-triggers of all events and conditions
- Event-controlled recording of measurements
- Network-wide availability of all measured data
- Individual sampling rates up to high KHz range

Process Control Tasks

- All control functions in realtime
- PID controllers parameterizable online
- Function generators with sine, square, ramp etc. and simulation data
- Conditional trigger events are freely definable
- Powerful function library for test procedures

Data Analyzing

- Zoom, pan, scroll and other functions
- Broad array of display and scaling options
- Minimum, maximum, average, effective value etc.
- Analysis and inter-channel calculation
- Database supported selection of datasets and time ranges

Documentation

- Freely configurable layouts with page view
- Export to all Office applications
- All standard formats are supported for export of data
- Graphics and text can be imported
- Naming of graphs

MAX Modules

Analog I/O and Mixed Modules

Module	Ain	Aout	Resolution	Din	Dout	Isolated	Comments
X-AD24-4i	4	–	24 bit	4 *	4 *	Per channel	Sigma-delta, various sensors
X-AD14-20	20	–	14 bit	–	–	No	Custom range per channel
X-AD12-20	20	–	12 bit	–	–	No	Custom range per channel
X-AD16i-4	4	–	16 bit	–	–	Module	4 input ranges per channel
X-SH12-8	8	1	12 bit	1	1	No	Simultaneous sampling
X-MiX-26	4	4	14 bit each	18 *	18 *	No	Simultaneous sampling
X-5B-1	1	1	14 Bit each	–	14	No	For 5B signal conditioner panels
X-DA16i-4	–	4	16 bit	1	–	Module	Uout- and Iout versions
X-DA14i-4	–	4	14 bit	1	–	Module	Uout- and Iout versions
X-TEST-1	40 *	40 *	16 bit	40 *	40 *	No	Test module for all MAX modules, stackable

* max. possible number of channels, depends on assembly version resp. software configuration

Digital I/O Modules

Module	Din	Dout	Isolated	Interrupt	Comments
X-DIO-40	38 *	38 *	No	12	3 timer/counter, crystal oscillator, TTL
X-CPLD-38	38 *	38 *	No	38 *	User-programmable CPLD, crystal oscillator
X-C16-3i	12	8	Per channel	12	3 multifunctional counters, 13 modes each
X-SSI-2	2	2	No	Yes	2 SSI channels for sensors
X-SSI-2/M	2	–	No	Yes	2 SSI channels for monitoring mode
X-REL-8i	–	8	Per channel	Yes, WD	Watchdog, stackable
X-OPT-200i	20	–	Per channel	Yes	Process or logic level
X-OPT-164i	16	4	Per channel	Yes	Process or logic level, watchdog
X-OPT-128i	12	8	Per channel	Yes	Process or logic level, watchdog
X-OPT-812i	8	12	Per channel	Yes	Process or logic level, watchdog
X-OPT-416i	4	16	Per channel	Yes	Process or logic level, watchdog
X-OPT-020i	–	20	Per channel	Yes	Version for 80 mA/100 V available

* max. number of channels, depends on software configuration resp. FPGA design

Communication Modules

Module	Channel	Protocol	I/O Level	Isolated	Comments
X-COM-8i	8	async	RS-232 or -422/-485	Per channel	PC-compatible UARTs
X-COM-4	4	async	2xRS-232 + 2xRS-232/ -422/-485	No	PC-compatible UARTs
X-SCC-2	2	async/sync	RS-232/-422/-485	No	With ESCC, DPLLs
X-DPM-1i	1	PROFIBUS	RS-485	Yes	Master and slave
X-DPS-2i	2	PROFIBUS	RS-485	Per channel	Slaves
X-CAN-2i	2	CAN	CAN	Per channel	High-speed or fault-tolerant
X-56K-FU	1	Modem	Analog	Yes	56K modem, UART
X-ETH-4c	1 + 4	IEEE 802.3	10 BaseT + RS-xxx	(Yes)	Ethernet isolated
X-ETH-10	1	IEEE 802.3	10 BaseT	Yes	Magnetics on-board
X-ETH-100	1	IEEE 802.3	100 BaseTx	Yes	10/100 Mbps, Magnetics on-board

CPU and Display Interface Modules

Module	CPU/Clock	RAM	Flash	Interfaces
X-MAX-400	XScale, 400 MHz	32 Mbyte	32 MByte	3xUART, LCD, PCMCIA, RTC, 100BaseTx, USB, I²C, SPI, MMC/SD, CF, AC97, etc.
X-MAX-1	486, 100 MHz	16 Mbyte	16 MByte	RS-232, EPP, LCD, PCMCIA, Keyboard, RTC
X-MAX-E	486, 100 MHz	8 Mbyte	16 MByte	Same as X-MAX-1 + 10BaseT, seriell = RS-232/-422/-485
X-LCD-1	–	–	–	TFT interface incl. backlight inverter and touch screen interface

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