Introduction

General

A CPU is an intelligent module. Your controlling programs are executed here. You are able to select one of three CPUs, depending on the performance required from your system. The higher the performance of the CPU, the more user memory is available.

The CPUs 21x are intended for small to medium applications and have an integrated 24V power supply. The CPUs contain a standard processor with internal program memory for the storage of user-programs. In addition, every CPU 21x is equipped with a socket for a memory module, which is located on the front.

Every CPU has an MPI-interface and is instruction set compatible with STEP®7 from Siemens. The CPU series 214...216 have similar performance as the Siemens STEP®7 CPU series.

This series of CPUs provides access to the peripheral modules of the System 200V. You may query sensors and control actuators by means of standardized commands and programs. The unit can address a maximum of 32 modules. You may parameterize the CPU via the integrated MPI-interface.

Products

The VIPA CPUs 21x are available in three different performance categories with 8 versions each:

- **CPU 21x** PLC-CPU
- **CPU 21x-2BT02** PLC-CPU with Ethernet interface with H1 / TCP-IP
- **CPU 21x-2BT10** PLC-CPU with Ethernet interface with TCP-IP
- **CPU 21xDP** PLC-CPU with PROFIBUS slave
- **CPU 21xDPM** PLC-CPU with PROFIBUS master
- **CPU 21xSER-1** PLC-CPU with 1 serial interface
- **CPU 21xSER-2** PLC-CPU with 2 serial interfaces
- **CPU 21xCAN** PLC-CPU with CANopen master

In all three performance categories, the CPUs 21x are available as CPU 214, 215 and 216. Within these three performance categories, the CPUs are visually on the same lines. With rising number the scope of performance of a CPU 21x is increasing.



Note!

The remainder of this description refers to all CPUs of the VIPA CPU 21x family!

Mode of operation of a CPU

General

A CPU supports the following modes of operation:

- cyclic processing
- timer processing
- alarm controlled processing
- priority based processing

Cyclic processing

Cyclic processing represents the major portion of all the processes that are executed in the CPU. Identical sequences of operations are repeated in a never ending cycle.

Timer processing

Where a process requires control signals at constant intervals you can initiate certain operations based upon a **timer**, e.g. not critical monitoring functions at one-second intervals.

Alarm controlled operation

If a process signal requires a quick response you would allocate this signal to an **alarm controlled** procedure. An alarm may activate a procedure in your program.

Priority based processing

The above processes are handled by the CPU in accordance with their **priority**. Since a timer or an alarm event requires a quick reaction the CPU will interrupt the cyclic processing when these high-priority events occur to react to the event. Cyclic processing will resume once the reaction has been processed. This means that cyclic processing has the lowest priority.

CPU 21x programs

The program that is present in every CPU is divided as follows:

- System routine
- User program

System routine

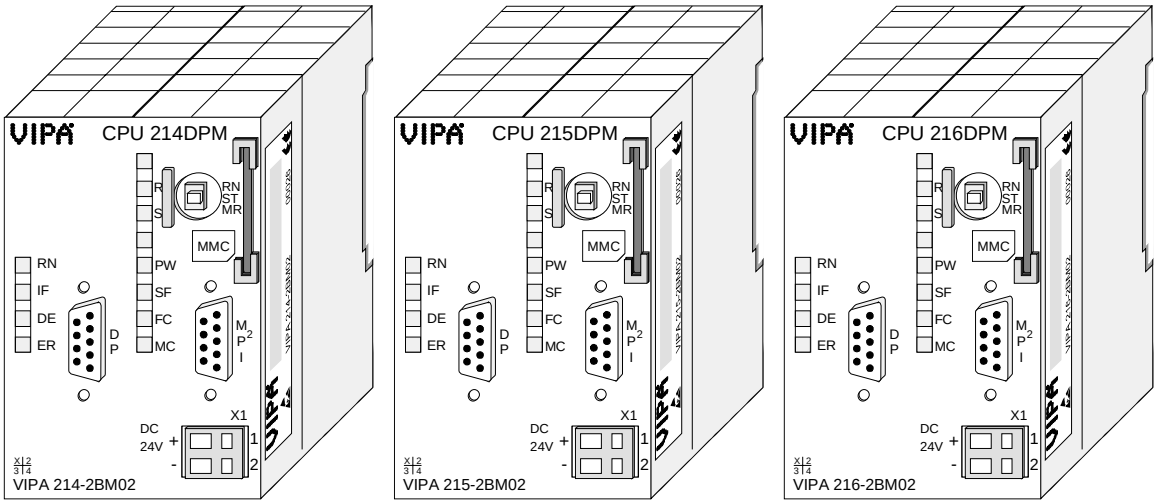
The system routine organizes all those functions and procedures of the CPU that are not related to a specific control application.

User program

This consists of all the functions that are required for the processing of a specific control application. The operating modules provide the interfaces to the system routines.

CPU 21xDPM Identical to CPU 21x, additionally with:

- Integrated PROFIBUS-DP master
- Status-LEDs for PROFIBUS status and diagnostics



Order data CPU 21xDPM

Type	Order number	Description
CPU 214DPM	VIPA 214-2BM02	PLC CPU 214 with PROFIBUS-DP master and 48/80KB of work/load memory
CPU 215DPM	VIPA 215-2BM02	PLC CPU 215 with PROFIBUS-DP master and 96/144KB of work/load memory
CPU 216DPM	VIPA 216-2BM02	PLC CPU 216 with PROFIBUS-DP master and 128/192KB of work/load memory

Components

CPU 21x

The components of the CPU 21x that are described here are components of all the CPUs presented in this manual.

LEDs

The CPUs 21x have a number of LEDs that are used to diagnose bus conditions and to display the status of a program. The table below describes the diagnostic LEDs and the according colors.

These LEDs are part of every CPU in this manual.

Name	Color	Description
PW	green	Indicates CPU power on.
R	green	CPU status is RUN.
S	yellow	CPU status is STOP.
SF	red	Is turned on if a system error is detected (hardware defect)
FC	yellow	Is turned on when variables are forced (fixed).
MC	yellow	This LED blinks when the MMC is accessed.

Function selector RN/ST/MR

You can select the operating mode STOP (ST) and RUN (RN) by means of the function selector. The CPU automatically executes the operating mode START-UP when the mode changes from STOP to RUN.

You may issue an overall reset by placing the switch in the Memory Reset (MR) position.

MMC slot memory card

You may install a VIPA MMC memory card in this slot as external storage device (Order No.: VIPA 953-0KX10).

The access to the MMC takes always place after an overall reset.

Power supply

The CPU has an internal power supply. This is connected to an external supply voltage via two terminals located on the front of the unit.

The power supply requires DC 24V (20,4 ... 28,8V). In addition to the electronic circuitry of the CPU this supply voltage is used for the modules connected to the backplane bus.

The electronic circuitry of the CPU is not dc-insulated from the supply voltage. The power supply is protected against reverse polarity and short circuits.



Note!

Please ensure that the polarity of the supply voltage is correct.

Battery backup for clock and RAM

A rechargeable battery is installed on every CPU 21x to safeguard the contents of the RAM when power is removed. This battery is also used to buffer the internal clock.

The rechargeable battery is maintained by a charging circuit that receives its power from the internal power supply and that maintain the clock and RAM for a max. period of 30 days.



Attention!

The CPU will operate only if the battery is healthy.

The CPU will STOP when the battery is faulty. In this case the CPU should be checked. Please contact VIPA!

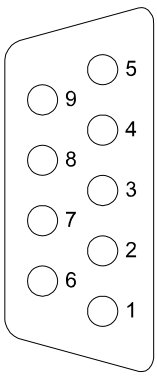
MP²I interface

The MPI unit provides the link for the data transfer between the CPU and the PC. Via bus communication you are able to exchange programs and data between different CPUs that are linked over MPI.

For a serial exchange between the partners you normally need a special MPI-converter. But now you are also able to use the VIPA "Green Cable" (Order-No. VIPA 950-0KB00), which allows you to establish a serial peer-to-peer connection over the MPI interface.

Please regard the "Hints for the deployment of the MPI interface" in chapter "Deployment CPU 21x".

The pin assignment of the MP²I jack is as follows:



9pin jack

Pin	Assignment
1	reserved (must not be connected)
2	M24V
3	RxD/TxD-P (Line B)
4	RTS
5	M5V
6	P5V
7	P24V
8	RxD/TxD-N (Line A)
9	n.c.

CPU 21xDPM

In addition to the components described in the section on the CPU 21x the CPU 21xDPM module is provided with 4 more LEDs and a PROFIBUS interface.

LEDs

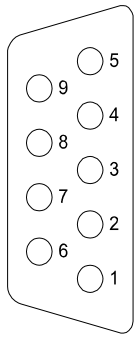
The LEDs are located in the left half of the front panel and they are used for diagnostic purposes. The following table shows the color and the significance of these LEDs.

Name	Color	Description
RN	green	DP-Master-RUN On: Master status is RUN. The slaves are being accessed and the outputs are 0 ("clear" state). On with DE: Master status is "operate". and is communicating with the slaves.
IF	red	Initialization error On: Error in PROFIBUS configuration
DE	yellow	DE (Data exchange) On: Indicates PROFIBUS communication activity.
ER	red	Error On: Slave has failed

PROFIBUS interface

The CPU 21xDPM is connected to the PROFIBUS system by means of a 9pin jack. The pin assignment of this interface is as shown:

9pin PROFIBUS D-type jack:



Pin	Assignment
1	Shield
2	n.c.
3	RxD/TxD-P (Line B)
4	RTS
5	M5V
6	P5V
7	n.c.
8	RxD/TxD-N (Line A)
9	n.c.

Note!

Refer to the chapter "Deployment of the CPU 21xDPM" for details on the PROFIBUS master.

CPU 21xDPM

Electrical Data	VIPA 214-2BM02 ... VIPA 216-2BM02
Power supply	DC 24V (20.4 ... 28.8V)
Current consumption	max. 1.5A
Dissipation power	max. 5W
Potential separation	≥ 500V AC to fieldbus
Status monitoring (LEDs)	like CPU 21x additionally with LEDs for the PROFIBUS section
Adapters/interfaces	like CPU 21x additionally with 9pin D-type jack (PROFIBUS)
PROFIBUS interface	
Connector	9pin D-type jack
Network topology	Linear bus, active bus termination at both ends
Medium	Screened and drilled twisted pair cable. Depending on environment screening may be omitted.
Transfer rate	9.6kbit/s up to 12Mbit/s
Overall length	100m at 12 Mbit/s without repeater, up to 1000m with repeater
max. no. of stations	32 stations on every segment without repeater. Expandable to 126 stations with repeater.
Combination with peripheral modules	
max. number of slaves	125
max. number of input bytes	1024
max. number of output bytes	1024
Dimensions and Weight	
Dimensions (WxHxD) in mm	50.8x76x80
Weight	150g

CPU 21xDP

Electrical data	VIPA 214-2BP02 ... VIPA 216-2BP02
Power supply	DC 24V (20.4 ... 28.8V)
Current consumption	max. 1.5A
Dissipation power	max. 5W
Potential separation	≥ 500V AC to fieldbus
Status indicator (LEDs)	like CPU 21x additionally with LEDs for the PROFIBUS section
Adapters/interfaces	like CPU 21x additionally with 9pin D-type jack (PROFIBUS)
PROFIBUS interface	
Connector	9pin D-type jack
Network topology	Linear bus, active bus termination at both ends
Medium	Screened and drilled twisted pair cable. Depending on environment screening may be omitted.
Transfer rate	9.6kbit/s up to 12Mbit/s
Overall length	100m at 12 Mbit/s without repeater, up to 1000m with repeater
max. no. of stations	32 stations on every segment without repeater. Expandable to 126 stations with repeater.
Dimensions and weight	
Dimensions (WxHxD) in mm	50.8x76x80
Weight	150g

V-bus cycle vs. DP cycle

To guarantee a simultaneous data transfer the V-bus cycle time should always be same or lower than the DP cycle time.

In the delivered GSD you'll find the parameter **min_slave_interval = 3ms**.

Thus guarantees that the PROFIBUS data on the V-bus is updated latest every 3 ms. Though you are allowed to execute one data exchange with the slave every 3 ms.

Data consistency

Data is referred to as being consistent, if it has the same logical contents. Data that belongs together is: the high- and low-byte of an analog value (word consistency) and the control and the status byte with the respective parameter word required to access the registers.

The data consistency during the interaction between the peripherals and the controller is only guaranteed for 1 byte. That is, the bits of one byte are acquired together and they are transmitted together. Byte-wise consistency is sufficient for the processing of digital signals.

Where the length of the data exceeds a single byte, e.g. analog values, the data consistency must be expanded. PROFIBUS guarantees consistency for the required length of data. Please ensure that you use the correct method to read consistent data from the PROFIBUS master into your PLC.

For additional information please refer to the manual on your PROFIBUS master as well as the one for the interface module.

Restrictions

If a high-level master fails, this is not recognized automatically by the CPU. You should always pass along a control byte to indicate the presence of the master thereby identifying valid master data.

The example at the end of this chapter also explains the use of the control byte.

Diagnosis

There is a wide range of diagnosis functions under PROFIBUS-DP to allow a fast error localization. The diagnosis data are broadcasted by the bus system and summarized at the master.

Transfer medium

As transfer medium PROFIBUS uses an isolated twisted-pair cable based upon the RS485 interface or a duplex photo cable. The transfer rate is for both methods max. 12Mbaud.

Electrical system over RS485

The RS485-interface is working with voltage differences. Though it is less irritable from failures than a voltage or a current interface. You are able to configure the network as well linear as in a tree structure. Your VIPA PROFIBUS coupler includes a 9pin slot where you connect the PROFIBUS coupler into the PROFIBUS network as a slave.

The bus structure under RS485 allows an easy connection resp. disconnection of stations as well as starting the system step by step. Later expansions don't have any influence on stations that are already integrated. The system realizes automatically if one partner had a fail down or is new in the network.

Optical system via fiber optic (FO)

The optical waveguide system uses monochromatically light impulses. The optical waveguide is totally independent from disturbing voltage from other machines. An optical waveguide system is built up linear. Every module has to be connected with two links: one input link and one back. You don't need to terminate the last module.

For the structure is a linear one, connecting and disconnecting stations is not free of consequences.

Addressing

Every partner of the PROFIBUS network has to identify itself with a certain address. This address may be existing only one time in the bus system and has a value between 0 and 125.

At the CPU 21xDP you choose the address via your software tool.

GSD-file

To configure the slave connections in your own configuration tool, you've got all the information about your VIPA modules in form of an electronic data sheet file.

Structure and content of this file are dictated by the PROFIBUS User Organization (PNO) and can be seen there.

Install this file in your configuration tool. Look for more information at the next pages "CPU 21xDP configuration" or in the manual of the according tool.

CPU 21xDP configuration

Overview

In contrast to the VIPA PROFIBUS slave IM 253DP, the PROFIBUS coupler in the CPU 21xDP is an "intelligent coupler".

The "intelligent coupler" processes data that is available from an input or an output area of the CPU. This area and an area for status and diagnostic data are fixed via the CPU 21xDP properties. Separate memory areas are used for input and for output data. Those areas are to handle with your PLC program.

Due to the system, the address areas occupied by the coupler are not displayed in the hardware configurator from Siemens. For the directly plugged-in System 200V modules are also included in the periphery address range, there may occur address overlappings during the automatic address allocation.



Note!

For configuring the CPU and the PROFIBUS-DP master a thorough knowledge of the Siemens SIMATIC manager and the hardware configurator from Siemens is required!

Possibility of configuration in the Siemens SIMATIC manager

The address allocation and the parameterization of the directly plugged-in System 200V modules takes place via the Siemens SIMATIC manager in form of a virtual PROFIBUS system.

For the PROFIBUS interface is software standardized, VIPA is able to guarantee the availability of the complete functions of the System 200V modules by including the GSD-file vipa_21x.gsd in the manager.

Steps of the CPU 21xDP configuration

To be compatible with the Siemens SIMATIC manager, you have to execute the following steps:

- Project the CPU 315-2DP with DP master system (address 2).
- Add the PROFIBUS slave "VIPA_CPU21x" from the VIPA_21x.gsd with address 1.
- Include the CPU type 21xDP at the 1st slot of the slave system.
- Adjust the PROFIBUS parameters of the CPU 21xDP.
- Include directly plugged-in periphery modules at the following slots.
- Transfer project via MPI into the CPU 21xDP

Steps of the master configuration

- Project CPU with DP master system (address 2).
- Add the PROFIBUS slave "VIPA_CPU2xxDP" from the VIPA04D5.gsd.
- Set the PROFIBUS in- and output ranges starting with the 1st slot. Please regard that the length settings at the slave must be congruent to the Byte settings in the master!