

SIEMENS

SIMATIC Technology

High-Speed Boolean Processor FM 352-5



High-Speed Boolean Processor FM 352-5

Overview

Technical Features

Applications

Operation

FPGA

Configuration

Migration

Logistics

Internet

Ultra fast processing

- 1 μ sec cycle time

Module designed for applications

- With highest processing speed requirements
- With shortest reaction/response time requirements
- Where no jitter is allowed
- Which cannot be met by ordinary S7-CPU's

For use in S7-300, ET 200M systems

Typical applications

- Quality control
- Tool/machine protection
- Manufacturing of pieces with high throughput

High-Speed
Boolean Processor
FM 352-5



Highlights

Overview

Technical Features

Applications

Operation

FPGA

Configuration

Migration

Logistics

Internet

Top speed and large memory

- Shortest response time, 1 μ s
- Memory, approx. 800 binary logic operations feasible
- Data backup to economical Micro Memory Card for module exchange without a programming device

Simple and fast communication

- 16 Byte data port (e.g. for setting process values)

Easiest to program

- Use of STEP 7 LAD/FBD
- No new programming language required

Highlights

Overview

Technical Features

Applications

Operation

FPGA

Configuration

Migration

Logistics

Internet

Comprehensive functions

- And, Or, XOr, Shift, Rotate
- Timer, Counter, Compare
- Pulse Generator, Frequency measurement, Period measurement
- Divider, Shift Register, FIFO, LIFO
- Math-Functions: Add, Sub, Mult, Div, Abs
- For 16-bit and 32-bit values

Integrated I/O

- 12 fast inputs
- 8 fast outputs
- Incremental 5 V (RS 422), 24 V (HTL) encoder
- Absolute SSI encoder (master, subscriber)

Stand-alone mode feasible

- Without higher-level CPU

Hardware

Overview

Technical Features

Applications

Operation

FPGA

Configuration

Migration

Logistics

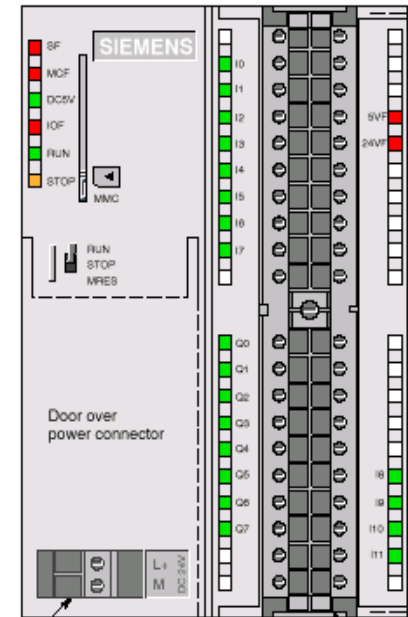
Internet

High execution speed is achieved by a FPGA*

Adaptation to the application is done by a user program

Onboard resources to surround the “bottle neck” system bus

- 12 DI/24 V
 - Assignable input delay (0 to 1600 μ s)
 - Standard inputs
- 8 DO/24 V/0.5 A
 - Sinking type (NPN) or
 - Sourcing type
- 1 encoder input for position dependent responses
 - Incremental 5 V (RS 422)
 - Incremental 24 V (HTL)
 - SSI sensor



* Field Programmable Gate Array

System integration

Overview

Technical Features

Applications

Operation

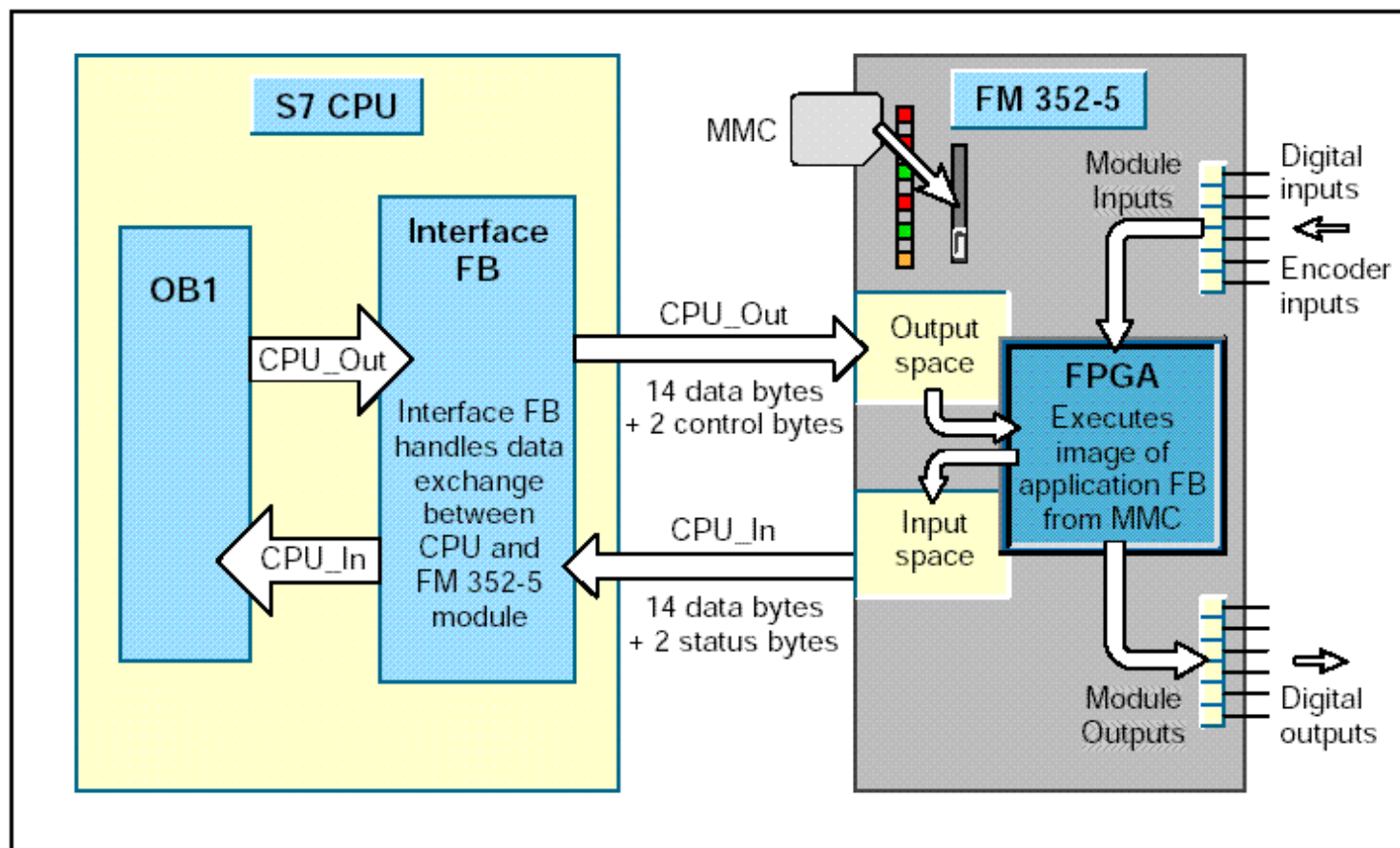
FPGA

Configuration

Migration

Logistics

Internet



Programming and Interfacing

Overview

Technical Features

Applications

Operation

FPGA

Configuration

Migration

Logistics

Internet

Program development

- By using the Standard STEP 7 LAD or FBD editor
- Available instruction set is a subset of the S7-300 instruction set:
 - Binary logic operations, comparator, timer, counter, move
 - Shift register, pulse width modulator, binary divider
 - Math-Functions: Add, Sub, Mult, Div, Abs
- S7-CPU's can be used for testing the program logic
- Program is stored on a Micro Memory Card

Interface to the Master Control

- Fast 16 Byte Data Port
- To S7-CPU, PROFIBUS Master (e.g. for writing/reading of variables)

Technical Key Features

Overview

Technical Features

Applications

Operation

FPGA

Configuration

Migration

Logistics

Internet

Data overview

- Cycle time 1 μ s
- Instruction set And, Or, XOr, =, S/R, Timer, Counter, Divider, Compare, Move, Shift Register, Pulse Generator, Add, Sub, Mult, Div, Abs
- Number of operations Approximately 800 (for straight binary logic operations)
- Data interface 16 I/O Bytes – Peripheral backplane bus (14 data Bytes, 2 status Bytes)
- Digital Inputs 9 + 3 (only available when no 24 V incremental encoder is used)
- Digital Outputs 8, 24 V, 0.5A
- Interrupts 8 hardware interrupts (OB40), diagnostic interrupts (OB82)
- Encoder 1 incremental 24 V, 5 V or 1 absolute, SSI (master, subscriber)

Instruction set

Overview

Technical Features

Applications

Operation

FPGA

Configuration

Migration

Logistics

Internet

Logical operations

- AND, OR, XOR, Shift, Rotate
- Flip-flop, edge detection, complement

Timer, Counter, Binary scaler, Compare

Mathematical functions

- Add, Subtract, Multiply, Divide, Absolute value

Register

- Shift register, FIFO, LIFO

Pulse generator

Measurement

- Period measurement, frequency measurement

Format converter

- Bit – Word - Doubleword

Fields of Application

Overview

Technical
Features

Applications

Operation

FPGA

Configuration

Migration

Logistics

Internet

Fast response speed applications

- For example, for equipment automation with high clock-pulse rates (cigarette manufacturing, packaging industry, etc.)

Applications with a minimum of jitter

Applications that for performance reasons can no longer be accomplished using a standard PLC

Speed Measurement

Overview

Technical
Features

Applications

Operation

FPGA

Configuration

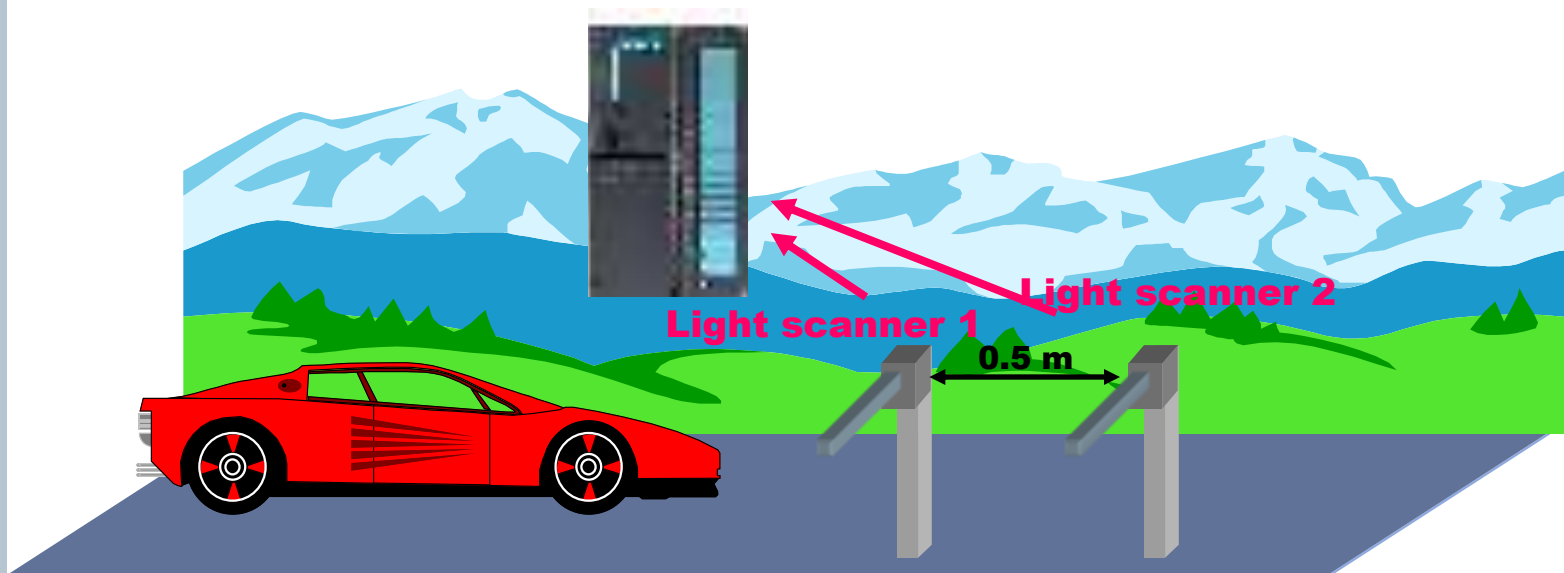
Migration

Logistics

Internet

Objective

- Determine vehicle speeds of up to 300 km/hr using two photoelectric barriers
- Accuracy $<0.1\%$ ($<5 \mu\text{s}$)



Solution for example Speed Measurement

Overview

Technical
Features

Applications

Operation

FPGA

Configuration

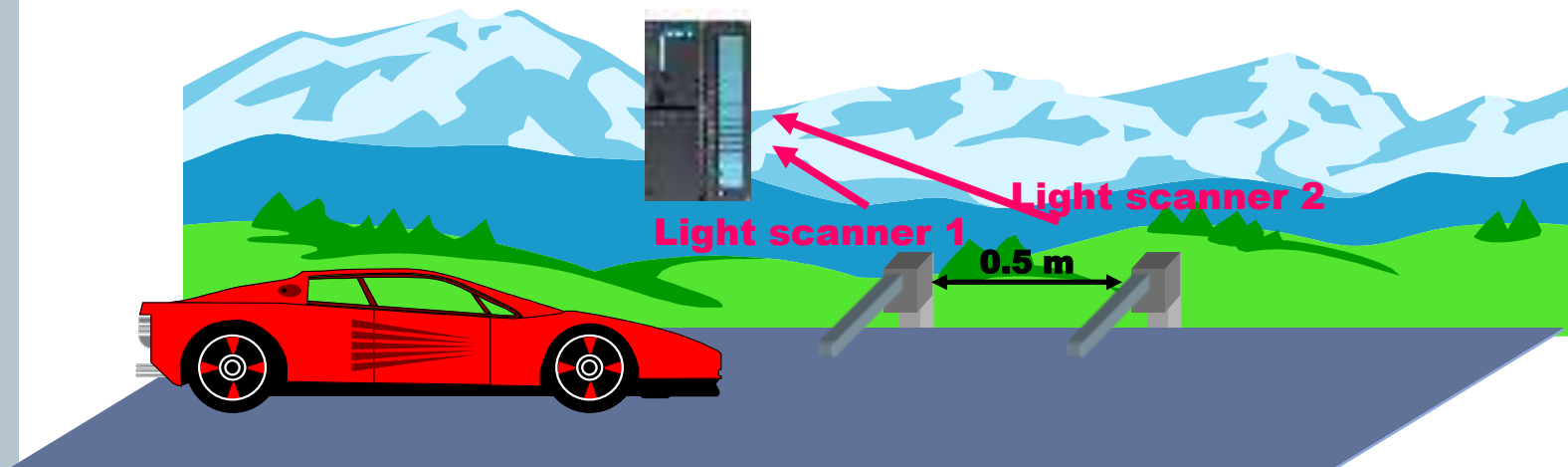
Migration

Logistics

Internet

How speed measurement is accomplished:

- An internal base frequency of 500 kHz is generated
- A detection by the first light scanner triggers a counter with the generated base frequency
- A detection by the second light scanner stops the counter
- The count can be read and be converted into speed



Hardening Parts

Overview

Technical Features

Applications

Operation

FPGA

Configuration

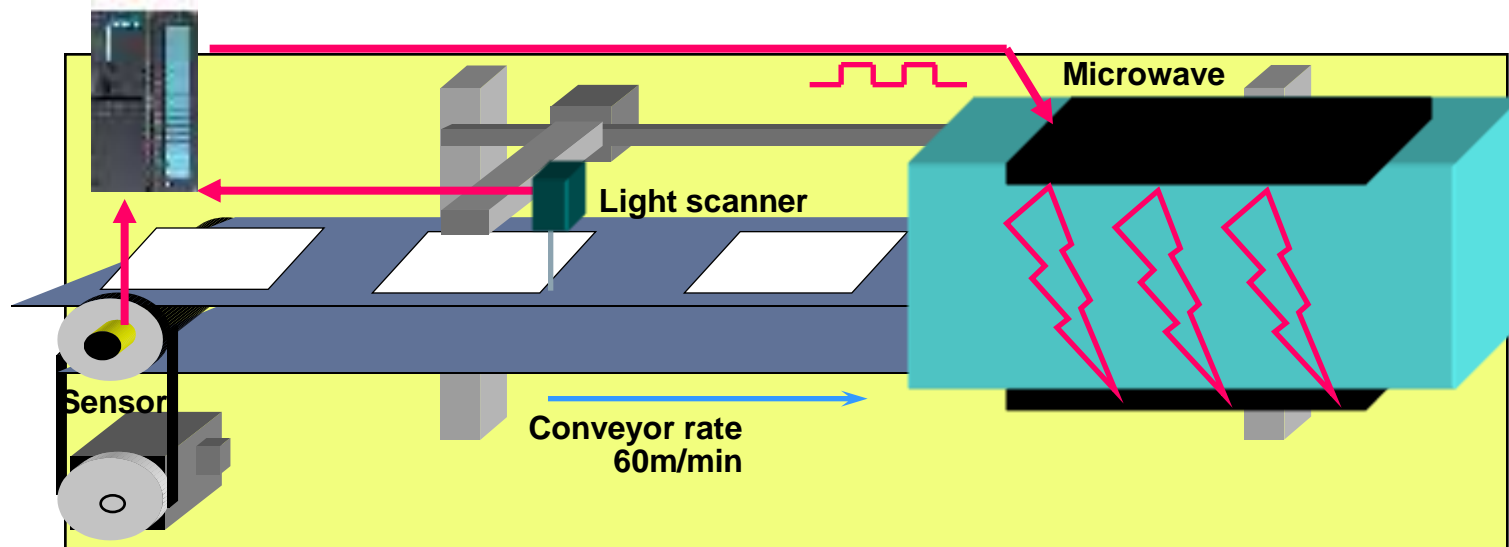
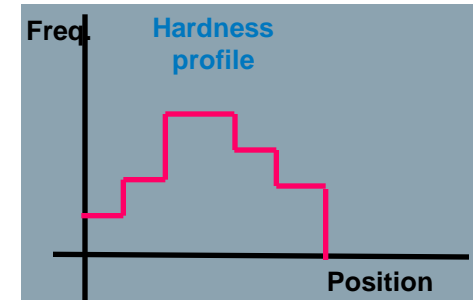
Migration

Logistics

Internet

Objective

- Measure length of parts (pass/fail 0.1 mm)
- Sense edges and start the hardening program when the offset position is reached
- Set microwave frequency depending on position (10 kHz to 50 kHz)



Solution for example Hardening Parts

Overview

Technical
Features

Applications

Operation

FPGA

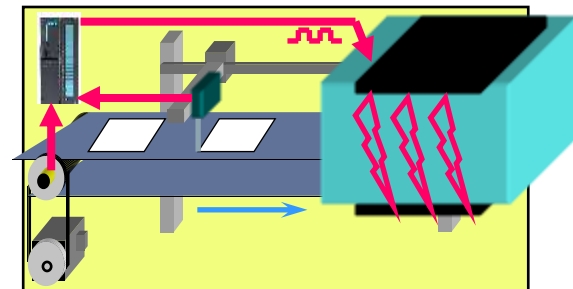
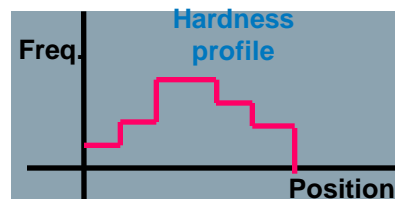
Configuration

Migration

Logistics

Internet

1. Measure length of parts (pass/fail 0.1 mm)
 - Sense the starting value and final value of the parts
 - Calculate the difference \Rightarrow length
2. Sense edges and start the hardening program when the offset position is reached
 - Sense the starting value of the parts
 - Compare for “Actual value $>$ edge position + offset position”
3. Set microwave frequency depending on position
 - Compare the switching positions
 - Output frequencies directly via the integrated function “Clock pulse generator”



Operation of the FM 352-5

Overview

Technical
Features

Applications

Operation

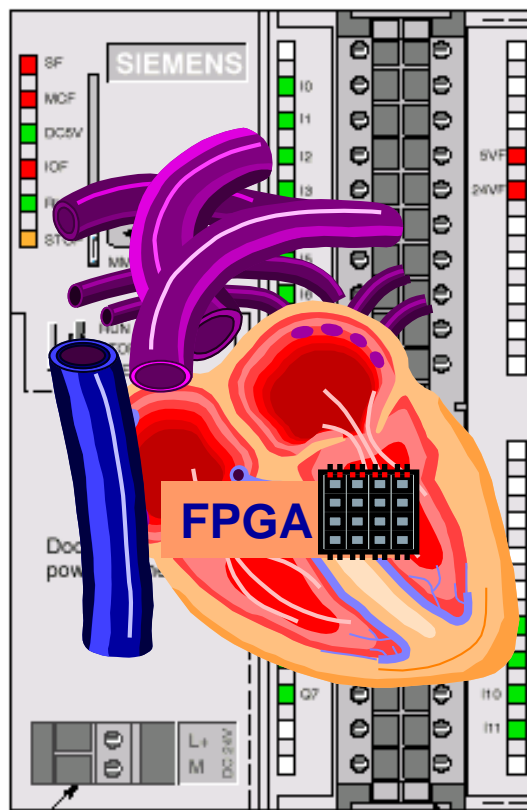
FPGA

Configuration

Migration

Logistics

Internet



The heart of the FM 352-5 is a
FPGA (Field Programmable
Gate Array)

What is an FPGA?

Overview

Technical
Features

Applications

Operation

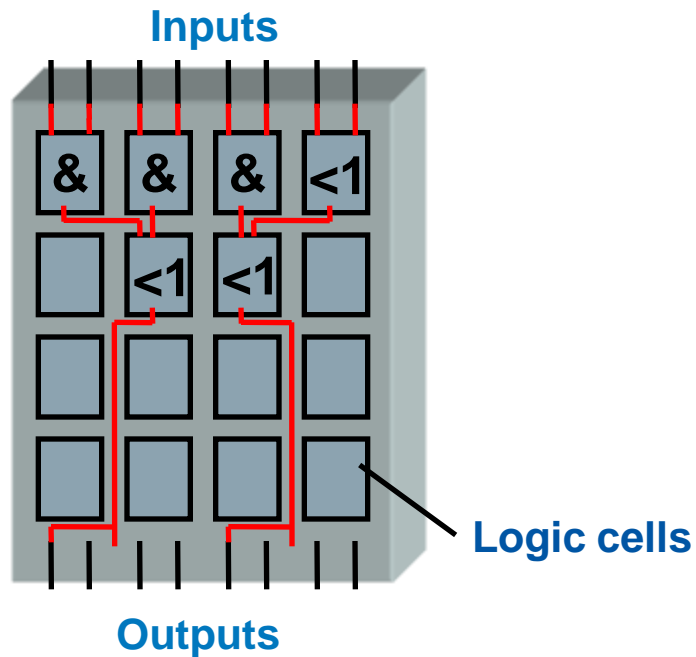
FPGA

Configuration

Migration

Logistics

Internet



An FPGA (Field Programmable Gate Array) is basically composed of a number of inputs, outputs, and slices (logic cells)

By means of programming, the logic cells can be assigned a function (AND, OR, S/R, etc.)

Complex functionalities can be achieved by connecting these logic cells and functions

What is an FPGA?

Overview

Technical
Features

Applications

Operation

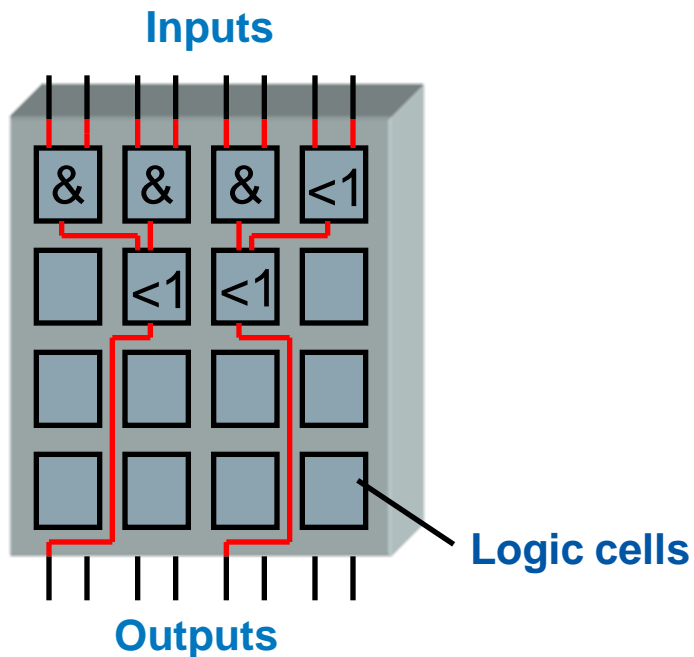
FPGA

Configuration

Migration

Logistics

Internet



Ultimately the program will become part of the hardware structure in the form of connected logic cells in the FPGA

This hardware structure enables all program components to be executed in parallel

As a result, very fast and constant response times are attainable

Comparison of Program Execution between an FPGA and a PLC

Overview

Technical Features

Applications

Operation

FPGA

Configuration

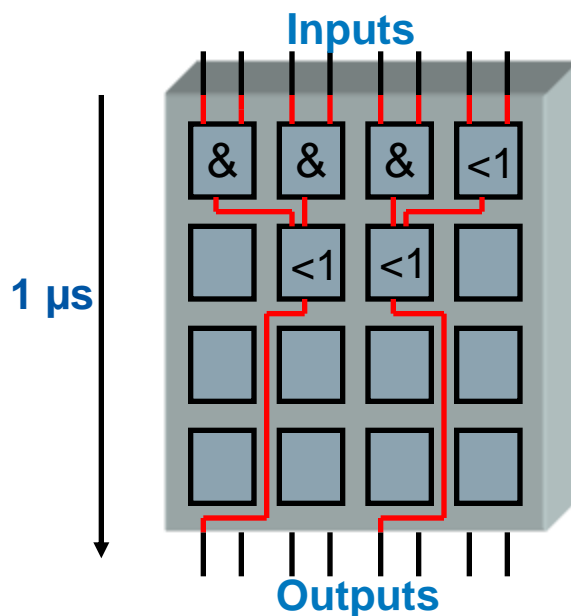
Migration

Logistics

Internet

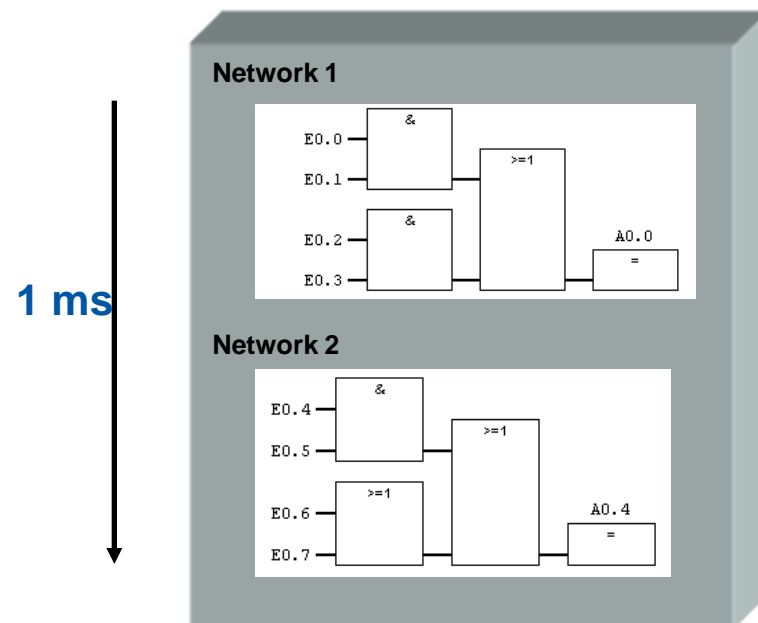
FPGA

Parallel execution



SPS

Sequential Execution



Modes of operation

Overview

Technical Features

Applications

Operation

FPGA

Configuration

Migration

Logistics

Internet

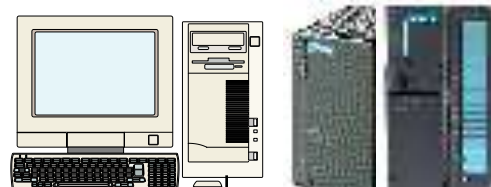
Central with S7-300 CPU

(CPU314 and up)



Distributed operation with IM 153 as Normslave on any PROFIBUS-Master

(IM153-1 and up)

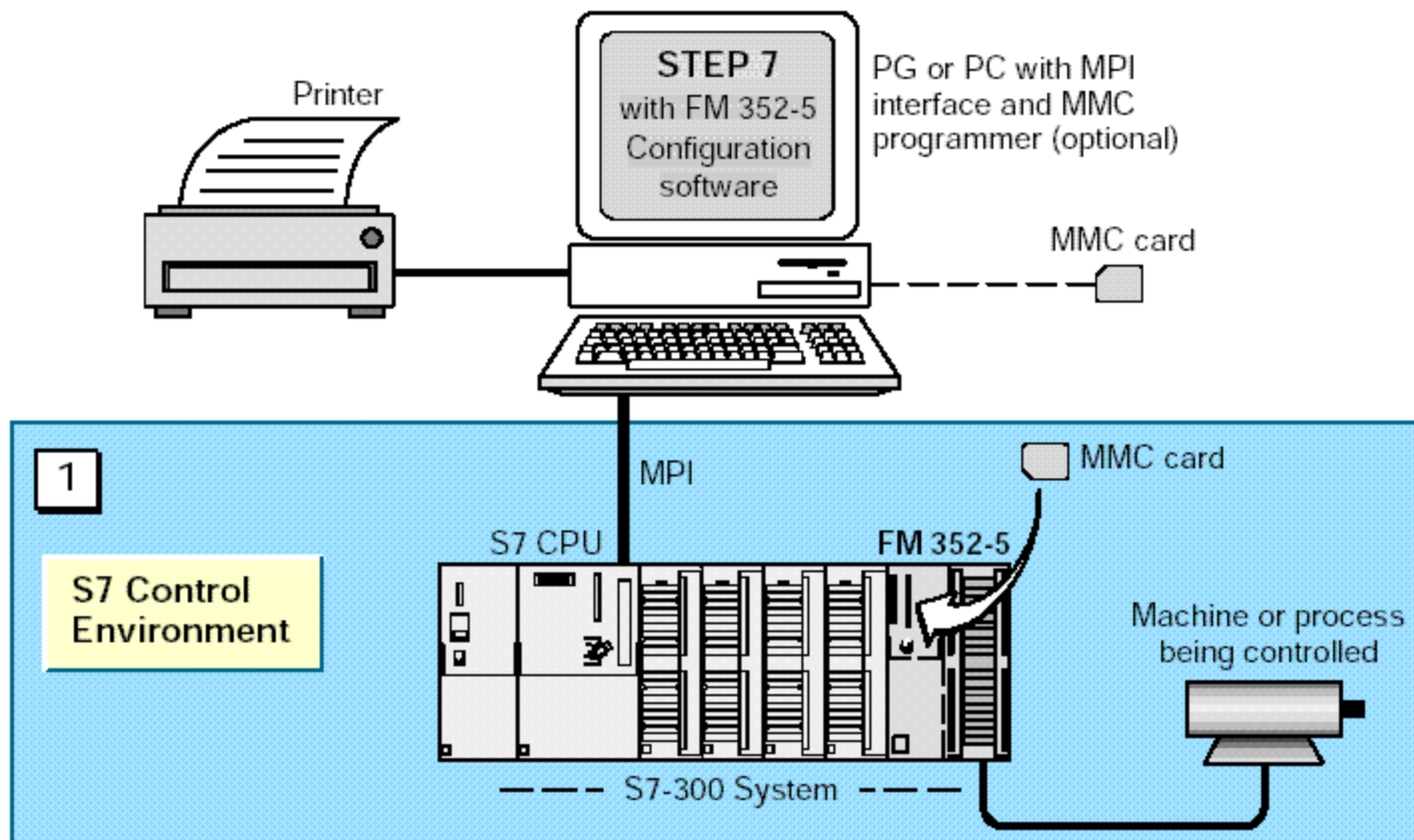


Stand-alone



Program development environment

- Overview
- Technical Features
- Applications
- Operation
- FPGA
- Configuration**
- Migration
- Logistics
- Internet



Configuration Tool

Overview

Technical
Features

Applications

Operation

FPGA

Configuration

Migration

Logistics

Internet

Assigns parameters

Invokes program editor

- The FM program is provided in an optional function block (FB application)

Provides a template for FM 352-5 programs

- for easy and safe program development

Provides interface FB

- for easy and safe data exchange

Generates target code

Generating programs

Is integrated into STEP 7

Comprises an easy to follow guide for program development



Creating and Testing a Program

Overview

Technical
Features

Applications

Operation

FPGA

Configuration

Migration

Logistics

Internet

Using STEP 7 for programming an application

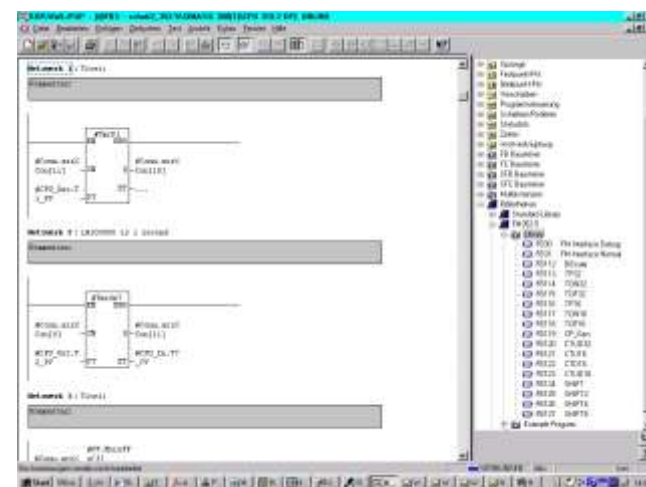
STEP 7 editor (LAD, FBD) for creating a program

Comprehensive instruction set through the use of STEP 7 instructions and additional functions from the FM library

- And, Or, S/R, Timer, Counter, Compare, XOr, Move, Divider, PWM, Shift Register, Add, Sub, Mult, Div, Abs
- Allowable data types: BIT, INT, DINT

STEP 7 online functions for testing a program

Feasible to operate with all “STEP 7 CPUs” (centrally with S7-300, via DP with S7-400, WinAC)



Assigning Parameters and Storing Data

Overview

Technical Features

Applications

Operation

FPGA

Configuration

Migration

Logistics

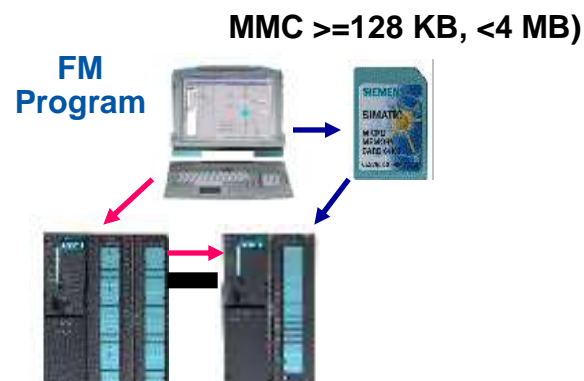
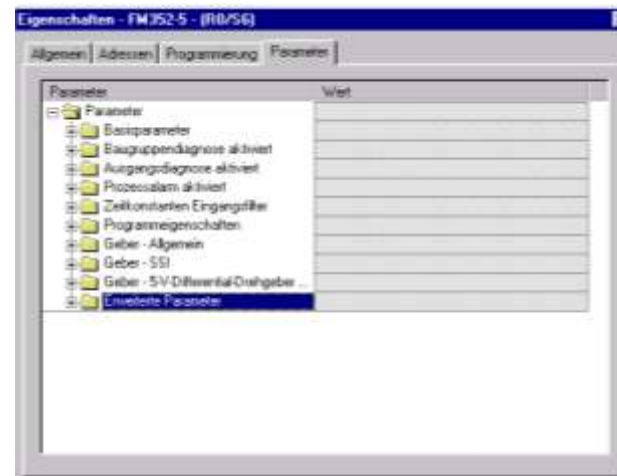
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Assigning Parameters

- Simple setting of module characteristics through the configuration software integrated in HW-Config

Downloading of FM Data by:

- “Indirect downloading” to Micro Memory Card via the S7-CPU (MPI, DP), or
- “Direct downloading” to Micro Memory Card (with programming device)



Migration of S5-IP265 – Differences to FM 352-5

Overview

Technical Features

Applications

Operation

FPGA

Configuration

Migration

Logistics

Internet

- More than five times as fast
- Four additional DI
- Program code can be more than five times the size
- No differences in run time due to “multiphase clocking”
- Connectable SSI sensor included
- Broader interface for the master CPU (16 Bytes DI/DO)
- Simulation by means of a physical S7-CPU or S7-PLCSIM feasible
- Can be used in “stand-alone mode“
- 80 mm wide

Order Information

Overview

Technical
Features

Applications

Operation

FPGA

Configuration

Migration

Logistics

Internet

FM 352-5 product components and accessories:

- Module:
 - outputs switching to m-potential 6ES7352-5AH00-0AE0
 - outputs switching to p-potential 6ES7352-5AH10-0AE0

- Configuration package with manual and software included in delivery of the module

- Micro Memory Card (always necessary)
 - From 128 KB e.g. 6ES7953-8LG00-0AA0

- 40-pin front-panel connector e.g. 6ES7392-1AM00-0AA0

Everything around FM 352-5

www.siemens.com/techno

- Overview
- Technical Features
- Applications
- Operation
- FPGA
- Configuration
- Migration
- Logistics
- Internet

The screenshot shows the Siemens website interface. At the top, the Siemens logo and 'siemens.com' are visible. Below the navigation bar, there are links for 'International', 'Deutsch', 'Site Map | Contact Us', 'Home', 'Products & Solutions', 'News Center', 'e-commerce', and 'Support'. A search bar and 'Login | Register' links are also present. The main content area features a sidebar with a navigation menu for 'SIMATIC Technology' products, including 'Overview', 'System features', 'Design', 'Integrated Functions', 'Loadable Function Blocks', 'Distributed ET 200S function modules', 'Parameterizable function modules', 'Technology controller', and 'User configurable application modules'. The 'User configurable application modules' section is expanded to show 'FM 352-5' as the selected item. The main content area displays the title 'High-Speed Boolean Processor FM 352-5' with the tagline 'Always a tick ahead'. Below this, there is a paragraph describing the product's capabilities: 'Ultra-high-speed binary logic operations and the fastest possible path-dependent switching operations combined with exceptionally little jitter - Those are the strengths of the SIMATIC® FM 352-5 application module.' An image of the FM 352-5 hardware is shown. To the right of the image, there is a text block stating: 'With a cycle time of only 1 μs, it is clearly superior to any conventional PLC CPU. Whether you want to increase the machine cycles, produce products of the highest quality, or prevent machine or tool damage - the FM 352-5 is exactly the right choice.' On the far right, there is a blue callout bubble that says 'Click our Web-site'. Below the main content, there are sections for 'All about Industrial Systems' with a dropdown menu, and 'Further Details' with a list of links including 'Types of Encoders/Cables', 'Brochures & printed material', 'Technical documentations', 'Catalog and online ordering system', 'Tools & Downloads', 'FAQs', 'Newsletter', 'Training', and 'Service'.

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Thank you

