Electromechanics made by Parker

# Motion control

**Parker**

ENGINEERING YOUR SUCCESS.

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**Application examples**

# Parker Hannifin

## Strong group of companies world-wide

Strong partners are needed in the automation industry. This applies above all for suppliers of high-quality control technology. High potential for development, worldwide sales and service as well as a globally organized company structure – this is what Parker guarantees. Approx. 60,000 employees in over 250 productions sites realize a turnover of about $10 Billion per year.

„Think global, act local" is one of the basic principles of our group of companies. A variety of medium-sized companies form the pillars of the worldwide organization. This structure ensures a close relation the local markets and, above all, to the customers. Come to one of the Parker group companies. We understand you. Parker Hannifin's international company structure enables us to provide excellent support around the world. This represents a basic success factor in times of increasing globalization, especially for manufacturers of complex automation systems.

**Europe**

| | |
|---|---|
| Belgium | Poland |
| Denmark | Portugal |
| Germany | Austria |
| Great Britain | Romania |
| France | Sweden |
| Greece | Slovenia |
| Ireland | Spain |
| Iceland | Turkey |
| Italy | Czech Republic |
| Lithuania | Hungary |
| Moldavia | Cyprus |
| Netherlands | Switzerland |

# Control technology from Parker Hannifin

Modern machines feature high flexibility and productivity. Automation solutions from Parker Hannifin offer the basis for the implementation of state-of-the-art machine concepts. The consequent integration of international standards provides OEMs with the freedom to concentrate entirely on the technological process.

**Motion control plays an increasingly central role in this development.**

## The Parker control technology comes up to your greatest expectations ...

Compax3H *power*PL*m*C-C1x

Compax3S *power*PL*m*C-C1x

- integrated -
into the Compax3 servo drive

C3 *power*PL*m*C-E20

- standalone -
without servo drive

- Basis for the implementation of modular machine concepts

- Windows® based standard tools for programming, start-up and diagnostics

- Minimisation of the wiring overhead by reduction of the interface diversity

- Maximum functionality and flexibility

- Optimised space requirements due to minimised components and state-of-the-art installation concept

- Realisation of safe machine concepts

- Basis for the realisation of hybrid machine concepts – electromechanics, hydraulics and pneumatics

## Technology controller with integrated motion PLC - Compax3 *power*PL*m*C-C1x

Main fields of application

- More than two axes for motion automation
- High degree of system integration (e.g. via Ethernet)
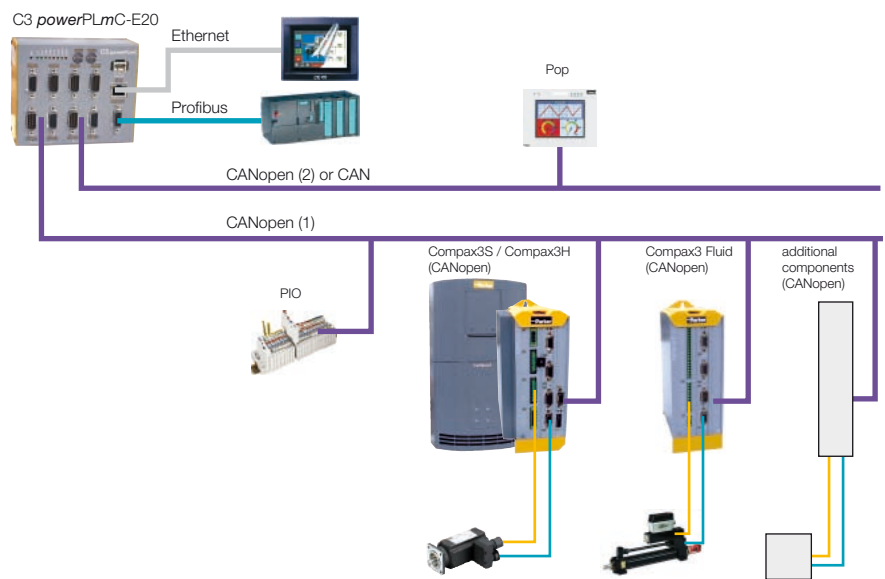- Integration of complex devices for machine visualisation and operation
- Connection to a wide number of digital and analog inputs
- Integration of pneumatic and hydraulic automation devices

Compax3S / Compax3H *power*PL*m*C-C13T11

PIO

Pop

CANopen

Compax3S / Compax3H (CANopen)

Compax3 Fluid (CANopen)

additional components (CANopen)

Ethernet

Profibus
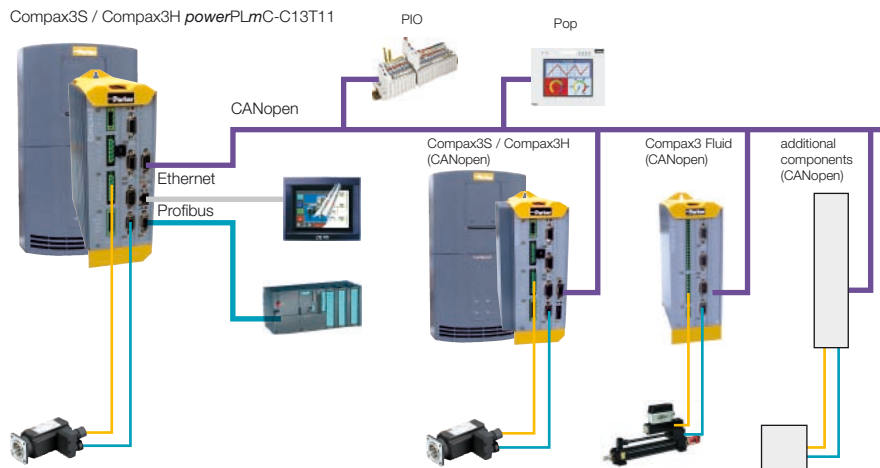
## Motion PLC with technology functions - C3 *power*PL*m*C-E20
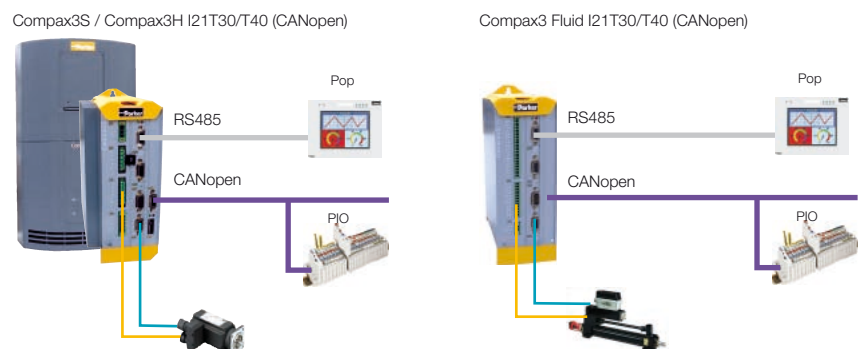
Main fields of application

- Similar to Compax3 *power*PL*m*C-C1x
- High proportion of PLC typical tasks
- Integration of additional automation components via a second CAN bus.
- Basis for the realisation of hybrid machine concepts – electromechanics, hydraulics and pneumatics

C3 *power*PL*m*C-E20

Ethernet

Profibus

Pop

CANopen (2) or CAN

CANopen (1)

PIO

Compax3S / Compax3H (CANopen)

Compax3 Fluid (CANopen)

additional components (CANopen)

## Technology controller - Compax3 T30 / T40

Main fields of application

- Machines or machine modules with one or two servo axes
- Applications requiring a high degree of flexibility with respect to sequence control
- Optional connection of upgrading devices for the operation and monitoring as well as external I/Os

Compax3S / Compax3H I21T30/T40 (CANopen)

Pop

RS485

CANopen

PIO

Compax3 Fluid I21T30/T40 (CANopen)

Pop

RS485

CANopen

PIO

# Multi-axis motion control with C3 *powerPLmC*

## C3 ServoManager

IEC61131-3

PLCopen

Data handling

Visualisation

Communication
(Process control)

Access to all system components

Project handling

Communication

Actuator system

Net Working

Drive Interface

IEC61131-3

PLCopen

CamDesigner

Optimisation
Setup
Diagnostics / Analysis / Maintenance
Oscilloscope

MotorManager
Motor library
Hydraulics Manager
Valve library

Dimensioning tools

**PC - Software**

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Compax3H *powerPLmC*-C1x
Compax3S *powerPLmC*-C1x
- integrated -
into the Compax3 servo drive

C3 *powerPLmC*-E20
- standalone -
without servo drive

### Visualisation / HMI
• Pop

### decentralised I/O extensions
• PIO

**CANopen**

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#### Electric

Servo drives

Stepper

AC/DC-Drives

Function

Performance

#### Pneumatic

Function

Performance

#### Hydraulic

Function

Performance

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Servo motors
Stepper motors
AC motors
Direct drives
Handling actuators
Precision actuators

Cylinders
Grippers
Rotary modules
Rotary drives
Linear drives

Motors
Cylinders
Valves
Pumps

# Com**pax3** *power*PL*m*C-C1x integrated and C3 *power*PL*m*C-E20 standalone

Compax3 powerPLmC is a control system for combined PLC, motion and visualization tasks. CANopen combines the bus components with the CANopen master „Compax3 powerPLmC". The power range of commands based IEC61131-3 is available for control tasks. Programming via „CoDeSys" high-power programming system via Ethernet. The implementation of multi-axis motion tasks are supported by PLCopen function modules.

## PLC-Logic + Motion Control + Visualisation = *power*PL*m*C

Compax3 *power*PL*m*C-C1x
- integrated -
into the Compax3 servo drive

C3 *power*PL*m*C-E20
- standalone -
without servo drive

- 32 Bit - RISC - Processor:
  - <100µs für 1000 IL commands
- CANopen:
  - Multi-axis communication
- Drive Interface:
  - Simple integration of the servo axes
- Ethernet:
  - Programming interface,
  - Remote diagnostics via Internet/Intranet,
  - Process visualisation,
  - System integration
- Programmable according to IEC61131-3 / PLCopen
- CoDeSys development tool
- PLC functionality
  - 4 real-time task types: free running, cyclical, event-triggered (internal or external events)
  - Debugging, Single Step, Watch function, Log
- PLC extensions from Parker:
  - POP: Parker Operator Panel (MMI) - from the 4-line display to the colour touchscreen
  - PIO: Parker digital and analogue inputs/outputs - modular extensions

## Additional features

### Motion Control
- Ready-made PLCopen compliant Motion Control function modules allow users to create programs effectively
- Drive Interface
  - Integrating a servo axis without field-bus knowledge
  - shortest transmission times due to internal cache memory; only modified data is transmitted

### PLC functionality
- Online program change
- Simulation, online trace, break-points
- Watchdog Timer
- Minimum IEC task time: 1ms

### Project management
- Saving and archiving an entire project (source file) including symbols and comments to make service calls easier, because there is no need for any project data on the device itself.

- Creating and protecting user-specific libraries that can be reused as tested sections of programs
- Various user levels make it possible to lock sections of the program with passwords
- 5 IEC languages plus CFC can be selected
- Data import / export

### File handling
- The servo drive can generate files (e.g. for error protocols, recipes, machine parameters)
- Files are available via the FTP server on a drive in C3 powerPLmC and can be downloaded onto a PC.
- Error messages can be assigned to an error string by means of the error number and then stored together with the time of day (from an integrated clock)
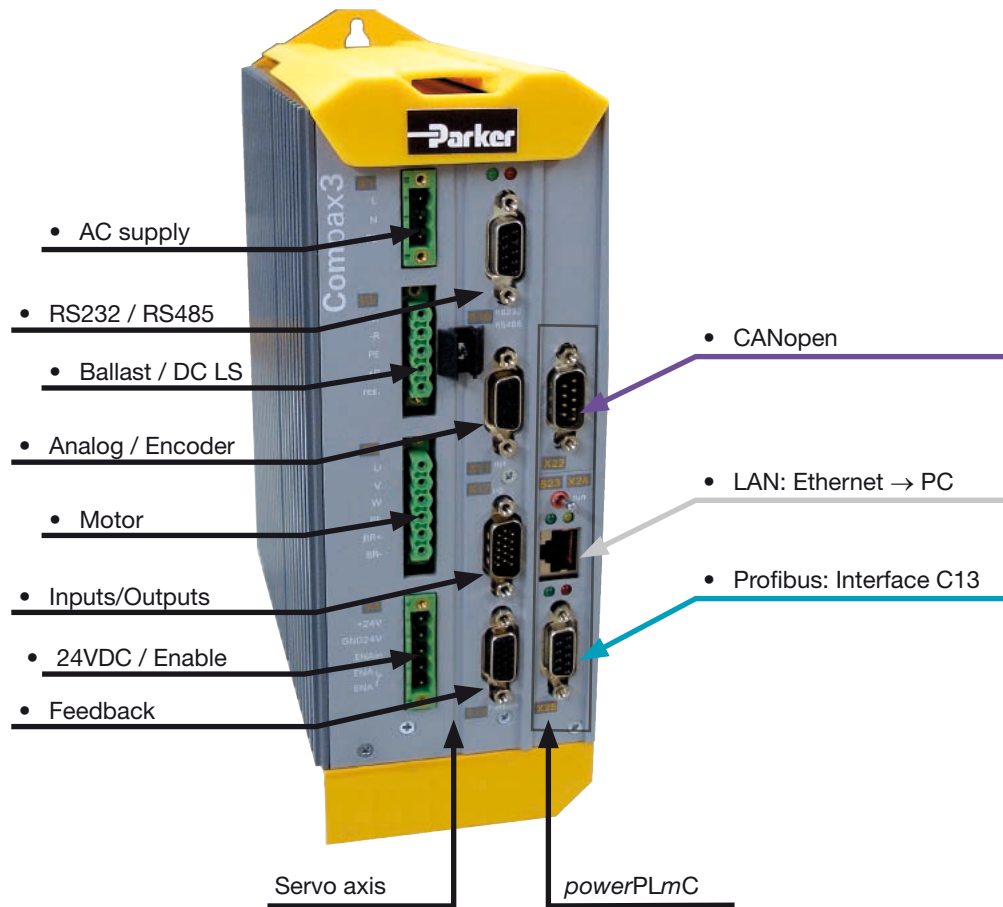
### Networking control systems
- Multiple control systems can be networked together via Ethernet
- Exchanging information via network variables

### Visualisation
- Integrated into the local programming system
  - Monitoring of machine or system states
  - Debugging
  - Diagnosis
- With integrated access to web server via standard browser
- OPC interface for integrating Windows-based visualisation programs such as InteractX, WinCC, Intouch, Protool
- Remote diagnostics
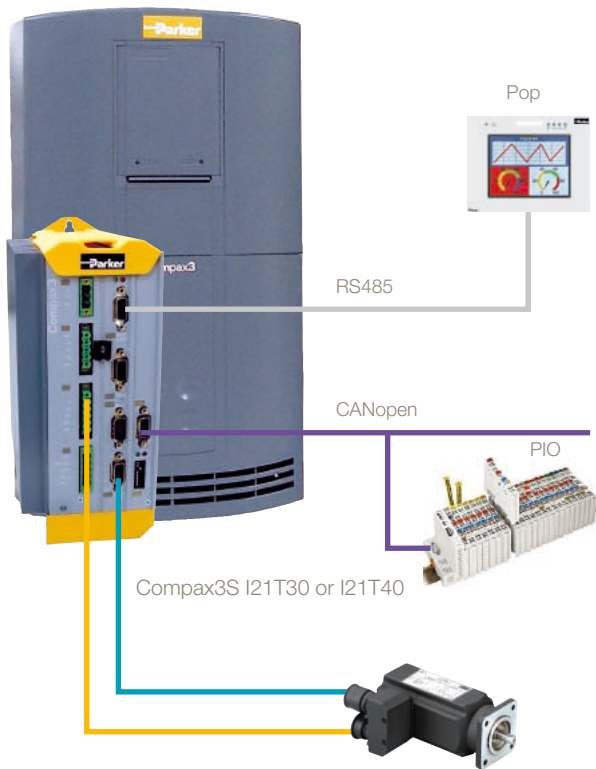
## Compax3 *power**PL*m**C**-C13 integrated

- AC supply
- RS232 / RS485
- Ballast / DC LS
- Analog / Encoder
- Motor
- Inputs/Outputs
- 24VDC / Enable
- Feedback

- CANopen
- LAN: Ethernet → PC
- Profibus: Interface C13

Servo axis

*power*PL*m*C

## C3 *power**PL**m**C**-E20 standalone

- Status LEDs & Reset
- Hex-decode switch

- 2x RS232
- RS232 / RS485 / RS422

- CAN Bus 1 (in / out)
- CAN Bus 2 (in / out)

- 24VDC supply

- Ethernet → PC

- Profibus

# Technical data

| | | Compax3 *power*PL*m*C-C1x | C3*power*PL*m*C-E20 | Compax3 T30 / T40 |
|---|---|---|---|---|
| **General data** | **Platform** | 32Bit RISC Processor 200MHz | | 24Bit Signal processor |
| | **Boot FLASH / Program memory FLASH** | 1 Mbyte / 4MBytes | 64MB Compact Flash | |
| | **Data memory SDRAM / Data memory non volatile** | 16MB / 32kB (Retain) | | 64kB / 18Byte (Retain) |
| | **Real-time clock** | Yes, buffered | | No |
| | **Operating system / supply** | Real-time Multitasking / 24V DC | | Singletasking |

| | | | | |
|---|---|---|---|---|
| **Control properties** | **Processing time** | <100µs for 1000 IL lines | | 2ms for 1000 IL lines |
| | **Real-time tasks** | free-running cyclical Event-triggered, internal / external events | | cyclical |
| | **Minimum cycle time** | typical 1ms | | |
| | **Online program change** | Yes | | No |
| | **Watchdog timer** | Yes | | Yes |
| | **Data exchange in distributed systems (network variables)** | Yes | | No |

| | | | | |
|---|---|---|---|---|
| **Programming and Debugging** | **Programming system** | CoDeSyS | | |
| | **Programming languages** | IL, KOP, FUP, ST, AS, CFC | | |
| | **Protocol** | IEC61131-3 | | |
| | **Import PLC programs** | Siemens Import | | |
| | **PLCopen - Motion Control modules** | Yes | | |
| | **Debug, Single Step, Watch function** | Yes | | Yes (kein Single Step) |
| | **Simulation, Online Trace** | Yes | | Yes |
| | **Breakpoints** | Yes (Source level debugging) | | Yes |
| | **Source Code Download** | Yes | | Yes |
| | **Writing, reading, forcing variables** | Yes | | Yes (no forcing) |
| | **Program management** | File System, FTP | | No |
| | **Programming interface** | Fast Ethernet | | RS232 |

| | | | | |
|---|---|---|---|---|
| **Visualisation** | **Locally in the programming system** | Yes | | No |
| | **Web Server** | Yes | | No |
| | **OPC Server** | Yes | | No |

| | | | | |
|---|---|---|---|---|
| **Interfaces** | **general** | RS232/RS485 | 2x RS232 2x RS232/RS485 | RS232/RS485 |
| | **Fieldbusses (standard)** | CANopen Master Ethernet 10/100 | 2 x CANopen Master Ethernet 10/100 | CANopen Master for the connection of PIOs (Input/ output modules) |
| | **Fieldbusses (optional)** | Profibus DP Slave HEDA: Real-time data bus | Profibus DP Slave | HEDA: Real-time data bus |
| | **Digital and analaogue Inputs/Outputs Option** | any | any (depending on the number of axes) | 24 digital / 4 analogue |
| | **Encoder output** | Yes, up to 16384/rev | no | Yes, up to 16384/rev |

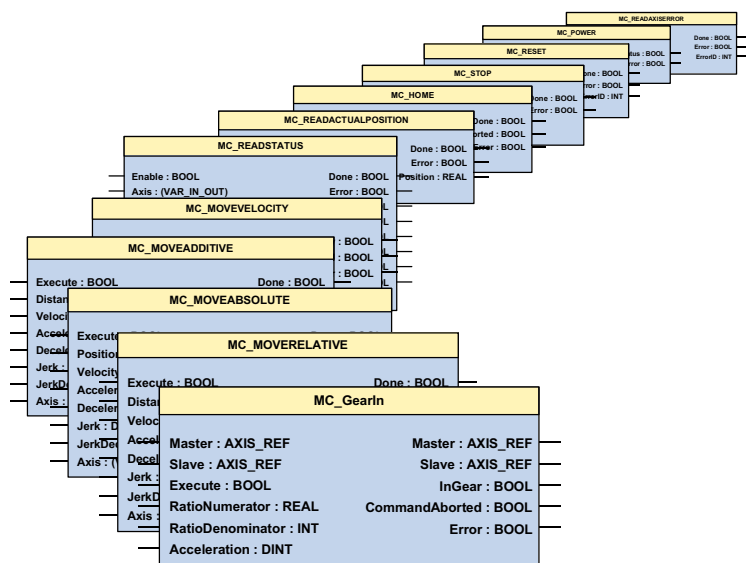# Single axis motion control with Compax3 T30/T40

Compax3H I21T30 or I21T40

Pop

RS485

CANopen

PIO

Compax3S I21T30 or I21T40

Compax3 Fluid I21T30/T40 (CANopen)

Pop

RS485

CANopen

PIO
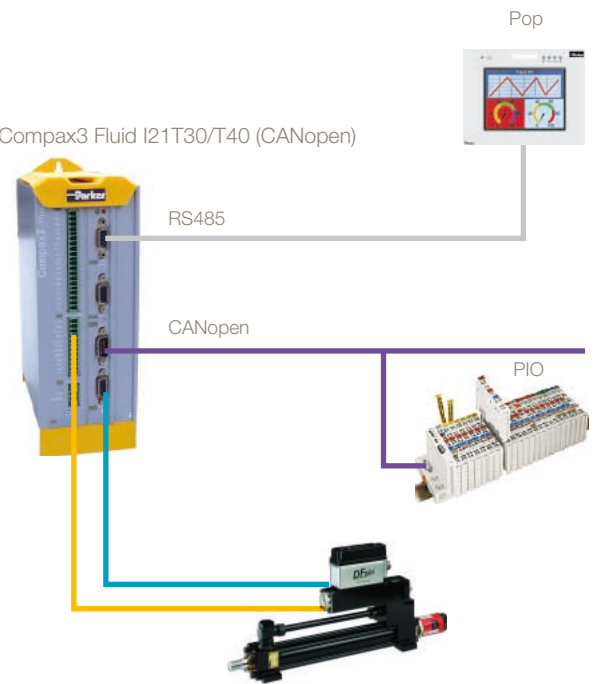
# The Compax3 I21T30 servo drive

## Function range T30

- Programmable based on IEC61131-3
- Programming system: CoDeSys
- Up to 5000 instructions
- 500 16bit variables / 150 32bit variables
- Recipe table with 288 variables
- 3x16-bit retain variables / 3x32-bit retain variables
- PLCOpen function modules:
  - Positioning: absolute, relative, additive, endless
  - Machine Zero / Homing Mode Settings
  - Stop, energizing the power stage, Quit
  - Position, device status, reading axis error
  - Electronic gearbox (MC_GearIn)
- IEC61131-3-standard modules:
  - Up to 8 timers (TON, TOF, TP)
  - Triggers (R_TRIG, F_TRIG)
  - Flip-flops (RS, SR)
  - Counters (CTU, CTD, CTUD)
- Device-specific function modules:
  - C3_Input: generates an input process image
  - C3_Output: generates an output process image
  - C3_ReadArray: access to recipe table
- Inputs/outputs:
  - 8 digital inputs (24V level)
  - 4 digital outputs (24V level)
  - 2 analog inputs (14bits)
  - Optional addition of 12 inputs/outputs

**MC_READAXISERROR**

Done : BOOL
Error : BOOL
ErrorID : INT

**MC_POWER**

**MC_RESET**

**MC_STOP**

**MC_HOME**

**MC_READACTUALPOSITION**

**MC_READSTATUS**

Enable : BOOL      Done : BOOL
Axis : (VAR_IN_OUT)    Error : BOOL

**MC_MOVEVELOCITY**

**MC_MOVEADDITIVE**

Execute : BOOL      Done : BOOL
Distan
Velocit
Accel
Decel
Jerk :
JerkD
Axis :

**MC_MOVEABSOLUTE**

Execute
Position
Velocity
Acceler
Deceler
Jerk : D
JerkDe
Axis : (

**MC_MOVERELATIVE**

Execute : BOOL    Done : BOOL
Distan
Veloc
Accel
Decel
Jerk :
JerkDe
Axis :

**MC_GearIn**

Master : AXIS_REF     Master : AXIS_REF
Slave : AXIS_REF      Slave : AXIS_REF
Execute : BOOL       InGear : BOOL
RatioNumerator : REAL   CommandAborted : BOOL
RatioDenominator : INT     Error : BOOL
Acceleration : DINT

# The **Com**pax**3** I21T40 servo drive

## Complementary technology function T40:

Compax3 T40 is able to simulate mechanical cams and cam switching mechanisms electronically.
The T40 electronic cam was especially designed for:

- the packaging machine industry,
- all applications where a mechanical cam is to be replaced by a flexible, cyclic electronic solution

This helps to realize discontinuous material supply, flying knife and similar drive applications with distributed drive performance.
Compax3 T40 supports both real and virtual master movements. In addition, the user can switch to other cam profiles or cam segments on the fly. Programming is made in the well-

known IEC61131-3 environment. With the aid of the cam function modules and the CamDesigner, cam applications can be easily implemented.

## Function range T40

- T30 Technology Functions completely integrated and available
- Master position acquisition
- Mark synchronization
- 10 000 24 bit interpolation points
- Cam switching mechanism

- Coupling and decoupling functions
- Cam profiles
- Cam memory
- Cam creation with the CamDesigner
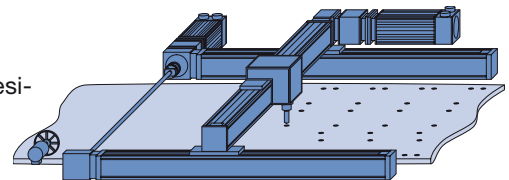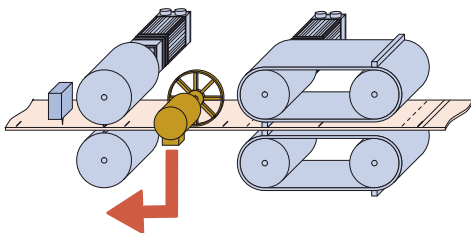
| Device: C3 | Current A$_{RMS}$ | | Mains voltage | Power |
|---|---|---|---|---|
| | I$_{cont}$ | I$_{peak}$(<5s) | | kVA |
| S025V2 | 2.5 | 5.5 | 1 * | 1.0 |
| S063V2 | 6.3 | 12.6 | 230/240VAC | 2.5 |
| S100V2 | 10.0 | 20.0 | 3 * | 4.0 |
| S150V2 | 15.0 | 30.0 | 230/240VAC | 6.0 |
| S015V4 | 1.5 | 4.5 | | 1.25 |
| S038V4 | 3.8 | 9.0 | | 3.1 |
| S075V4 | 7.5 | 15.0 | 3 * | 6.2 |
| S150V4 | 15.0 | 30.0 | 400/480VAC | 11.5 |
| S300V4 | 30.0 | 60.0 | | 25.0 |
| H050V4 | 50 | 75 | | 35 |
| H090V4 | 90 | 135 | 3 * | 70 |
| H125V4 | 125 | 187.5 | 400/480VAC | 91 |
| H155V4 | 155 | 232.5 | | 109 |

## The **Com**pax**3** servo drive

Compax3 is an intelligent servo drive with a modular structure enabling it to be used in a wide range of industrial applications.
The use of industrial standards minimises development overheads for the user.

### Technical data

- enclosed housing
- Direct mains operation
- Power range of 1kW ... 110kW
- Modular design for the implementation of individual requirements

- 8 digital inputs, 4 digital outputs
- RS232 / RS485 - interfaces
- 2 analogue inputs (+/-10V, 14 bits)
- 2 analogue outputs (+/-10V, 8 bits)
- Encoder input or output
- CE-conformity, UL, cUL
- Certified safety technology integrated (EN954-1 Cat.3)
- Position acquisition at the motor shaft via most of the available feedback systems
- Different fieldbusses
- HEDA real-time bus for inter-axis coupling

### Software

- Fast and simple setup with the „Compax3 ServoManager"

# Advantages offered by international standards

## IEC61131-3

**IEC61131-3 is the only company- and product independent programming language with world-wide support for industrial automation devices.**

**IEC61131-3 includes graphical and textual programming languages:**

- Instruction list
- Structured text
- Ladder diagram
- Sequential function chart
- Function block diagram



Program development in IL

- Integrated standards offer:
  - a trusted programming environment
  - standardized programming

- Integrated standards reduce:
  - the overhead of development
  - maintenance costs
  - software upkeep
  - training overhead

- Integrated standards increase:
  - productivity
  - software quality
  - concentration on core competence

Instruction list (IL):

```
LD        A
ANDN      B
ST        C
```

Structured text:

```
C := A AND NOT B
```
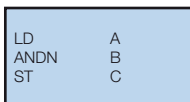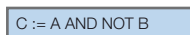
Contact plan:



Function block:
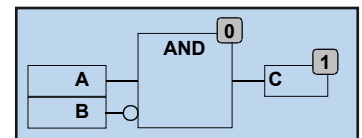


## Function modules based on PLCopen
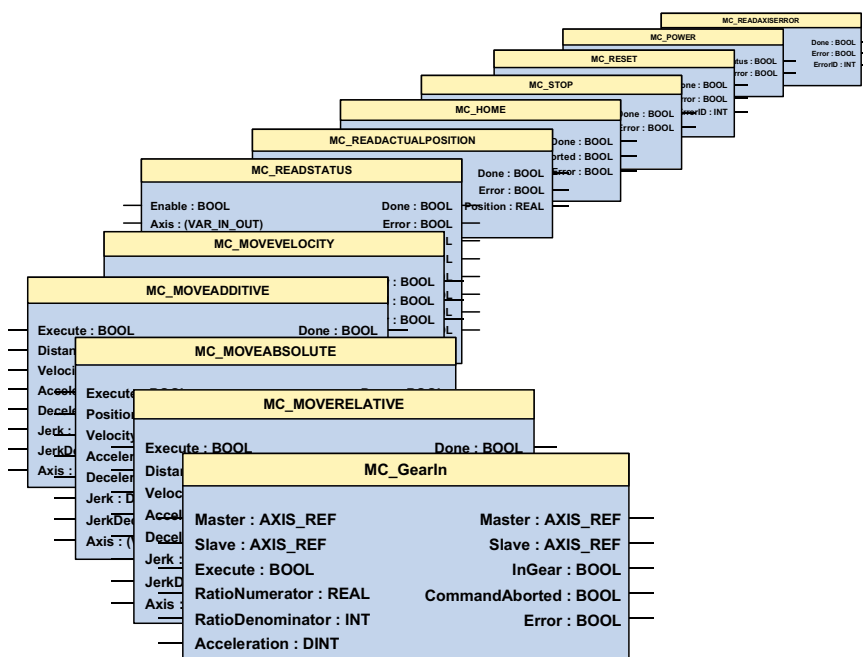




### Function modules according to PLCopen

**PLCopen is a product- and company-independent organisation that plays a significant role in supporting the IEC61131-3 programming language. Its specific tasks also include defining basic processes relevant to motion. The PLCopen organization consists of both users and manufacturers of automation components.
Parker Hannifin is an active member of the "Motion Control" task force. This represents a great advantage to users of Parker drive technology, since they are constantly able to profit directly from the latest developments in PLCopen.**

# CoDeSys

**CoDeSys professional development tool**
**CoDeSys is a development environment for programming that saves a significant amount of time as applications are created.**

- One of the most powerful development environments available, established world-wide
- Universal programming platform for various devices
- Complete offline simulation
- Visual elements
- Library management for user-defined applications
- Context-sensitive help wizard
- Data exchange between devices from different manufacturers
- Complete online functionality
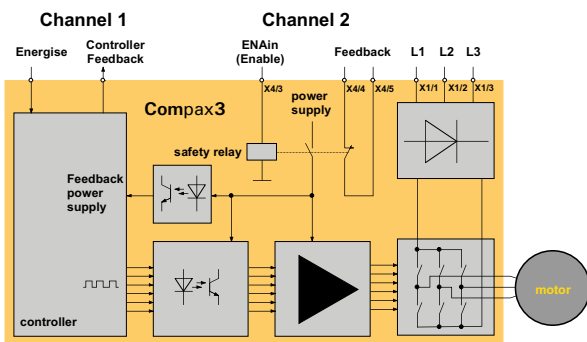- Sophisticated technological features
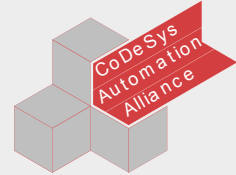




Visualisation with Compax3 powerPLmC and CoDeSys
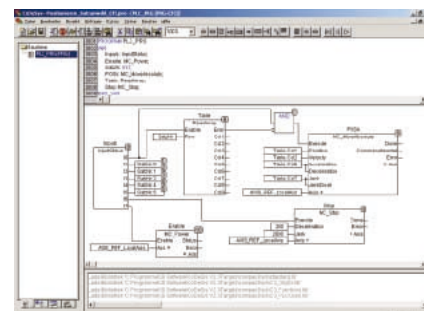


Program development in CFC

# Safety technology

Principle circuit diagram



Circuitry example for C3 powerPLmC - multi-axis application



**Principle:**

To ensure safe protection against a motor starting up unexpectedly, the flow of current to the motor and thus to the power output stage must be prevented.

This is accomplished for Compax3 with two measures independent of each other (Channel 1 and 2), without disconnecting the drive from the power supply:
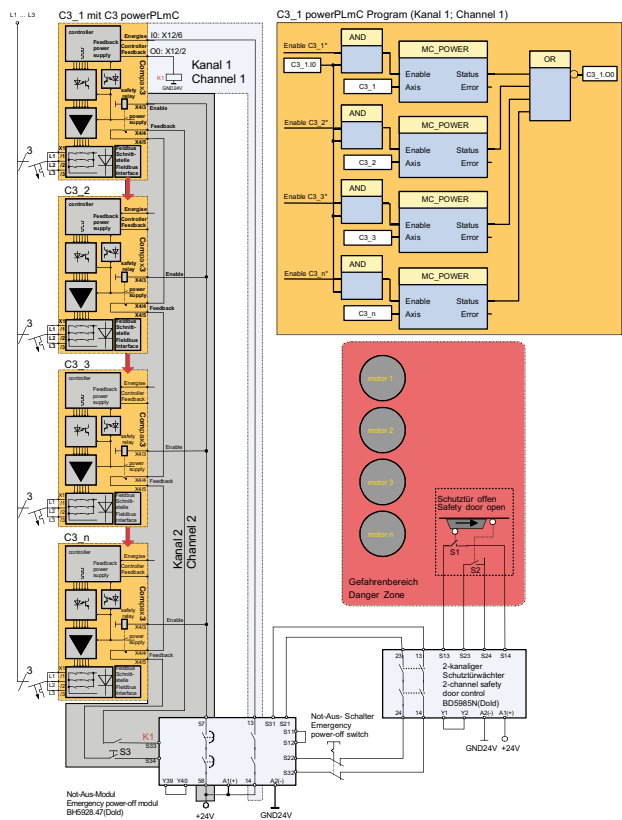
**Channel 1:**

Activation of the power output stage can be disabled in the Compax3 controller by means of a digital input or with a fieldbus interface (depending on the Compax3 device type) (deactivation of the energize input).

**Channel 2:**

The power supply for optocouplers and drivers of power output stage signals is disconnected by a safety relay activated by the enable input „ENAin"(X4/3) and equipped with force-directed contacts. This prevents control signals from being transferred to the power output stage.

**The „Safe Standstill" safety function as defined by EN 954-1 Category 3 is possible if both channels are used.**

# Machine automation with Parker products

## Visualisation/HMI

### Pop: Parker Operator Panel - HMI
- Text / graphic displays
- different sizes
- RS232, RS485, Profibus, CAN-open, DeviceNET, Interbus S

### PowerStation
- Graphic design elements
- Touchscreen monitors up to 18"

## Decentralised I/O extensions

### PIO: Parker Inputs/Outputs
- Digital and analogue inputs and outputs via fieldbus coupler.

## Servo Drives

### Compax3 ServoAxis
- Voltage supply: 1x/3x230VAC or 3x400/480VAC
- Power range: 1... 110kW
- 8 digital inputs / 4 digital outputs

### SLVDN: Servo controller
- Voltage supply: 1/3x230VAC
- Power range: 0.5...15kW

### ViX Servo drive
- Voltage supply: 24...80VDC
- Power range: 250/500W

### Series 638
- Voltage supply: 1x/3x16...240VAC
- Nominal current: 1...6A
- 10 digital inputs / 3 digital outputs

## AC/DC drives

### AC890
- AC drive
- Voltage supply: 400...500VAC
- Power range: 0.75...90kW

### Series 590P/591P
- DC drive
- Voltage supply: 3x110/230VAC, 3x220/500VAC, 3x500/600VAC
- 15...5400A

### Series 690
- AC drive
- Voltage supply: 1x/3x230VAC, 3x380/460VAC, 3x460/500VAC
- Power range: 0.75...1000kW

## Stepper drives

### XL Stepper drive
- Voltage supply: 24...80VDC
- Nominal current: 1.8A, 3.5A, 5.6A

### ViX Stepper drive
- Voltage supply: 24...80VDC
- Nominal current: 2.8A, 5.6A

## Pneumatic drives

### Moduflex
- Adaptable pneumatiacs with modular components.
- Protection class IP65 - IP67

## Hydraulic drives

### Compax3 Fluid
- Voltage supply: 24VDC
- Servo quality in hydraulics
- programmable according to IEC61131-3
- Cam function

## Actuators

### Synchronous servo motors
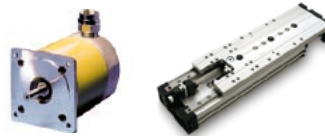- For highly dynamic machines and systems
- 0.2...90Nm

### Precision actuators
- Linear motor tables
- Screw-driven tables
- Rotary tables
- 3 axis systems

### Stepper motors
- 2 Phase hybrid stepper motors
- 0.45...5.4Nm
- NEMA 23/34/ 1-3 Stacks, NEMA 42, 2/3 Stacks

### Components for pneumatic systems
- ISO/VDMA cylinders,
- Grippers
- Rotary modules
- Rotary drives
- Linear drives

### Direct drives
- Kits and complete systems for linear and torque motors

### Components for hydraulic systems
- Motors
- Cylinders
- Valves
- Pumps

### Handling actuators
- Driven by toothed belt, screw or linear motor
- Horizontal or vertical actuators