



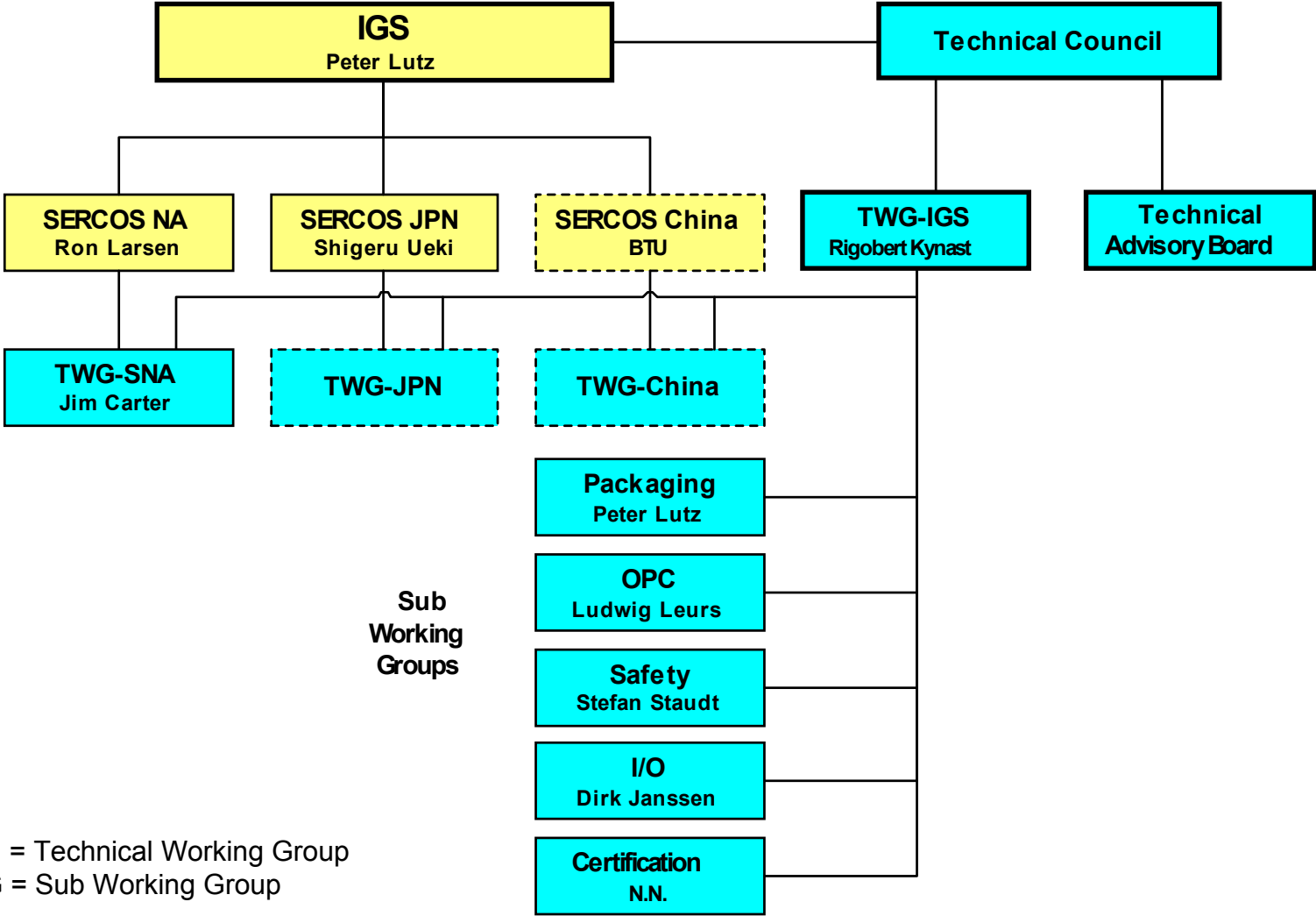
SERCOS interface

presented by

Rigobert Kynast

(Chairman of SERCOS Technical Working Group)

Organization of Technical Working Groups (2002)



TWG = Technical Working Group
 SWG = Sub Working Group

SERCOS Booth - HMI 2002

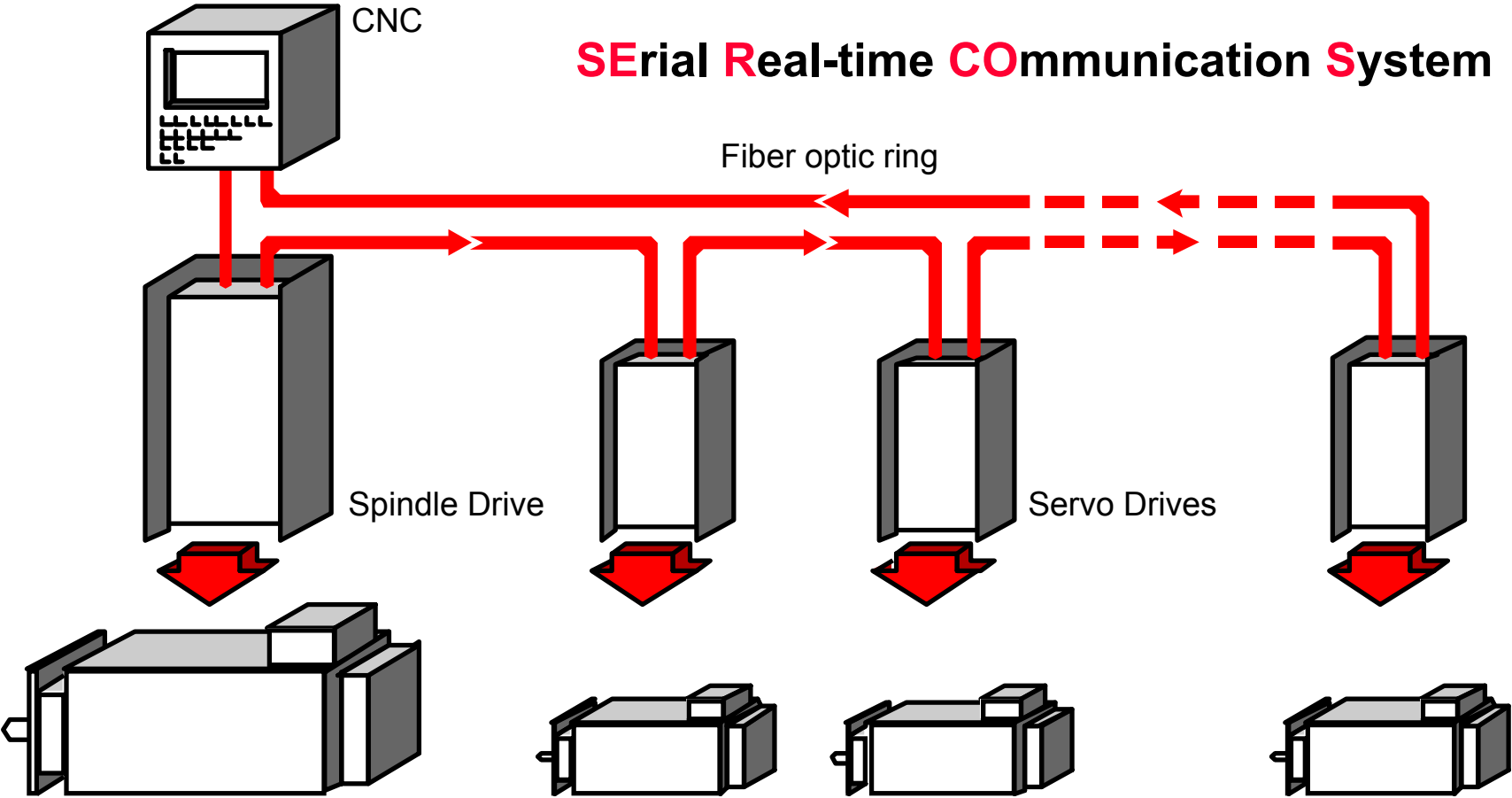


SERCOS Advantage 3

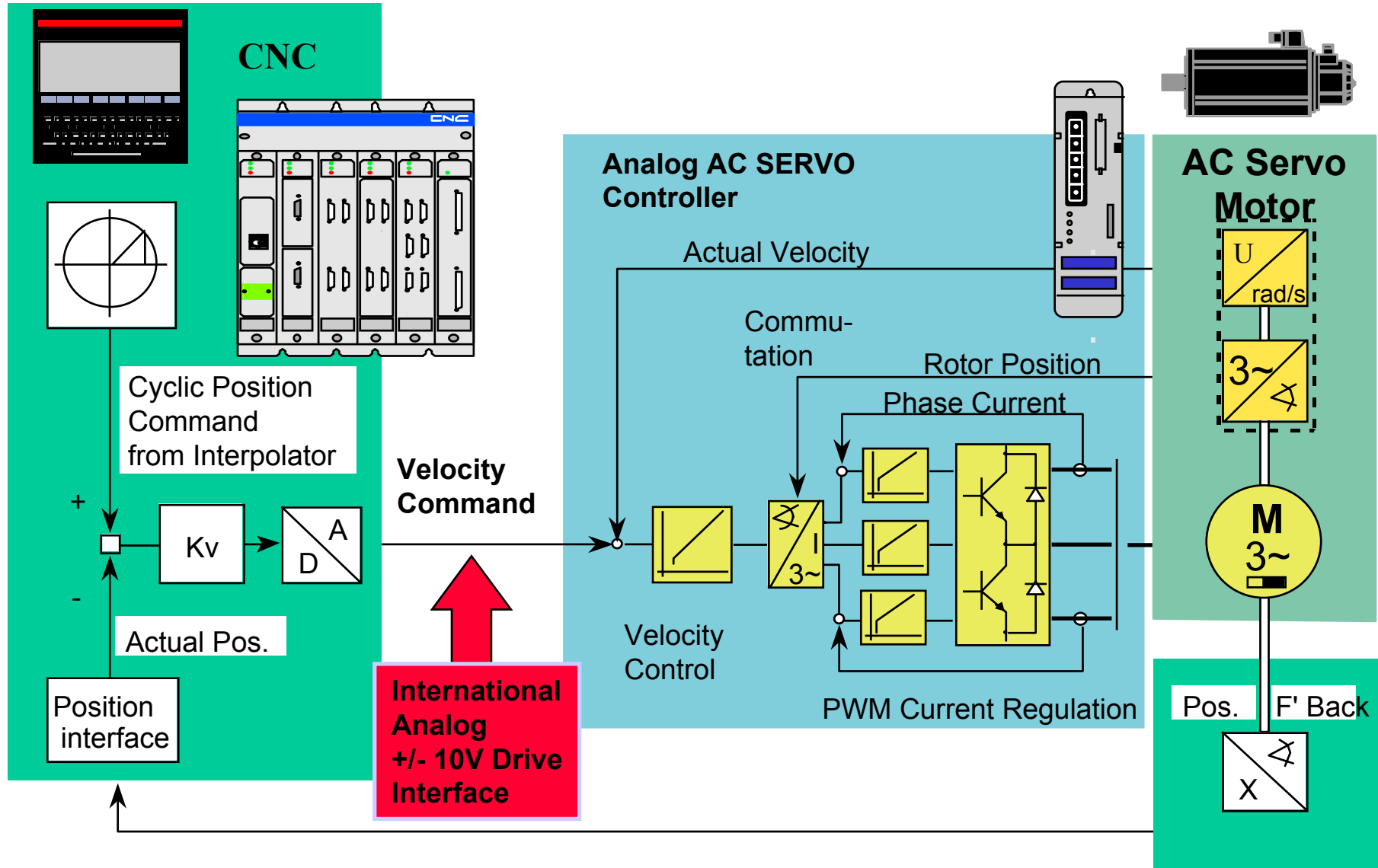


Serial data link for real-time communication between controls and drives

Serial Real-time COmmunication System



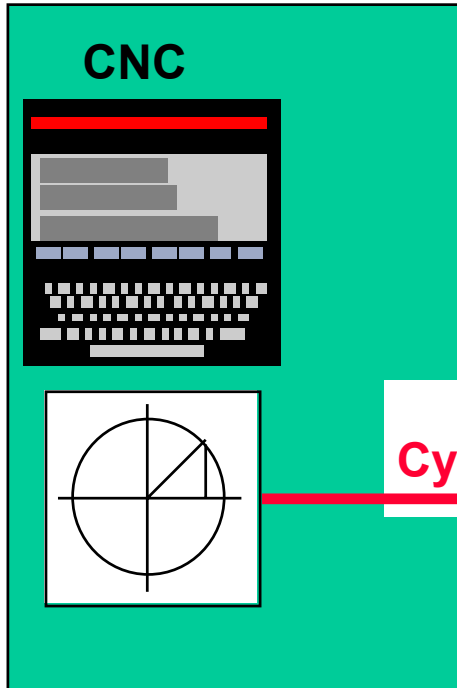
Conventional CNC with Analog AC SERVO Drive



CNC Axis with Digital Intelligent Drive

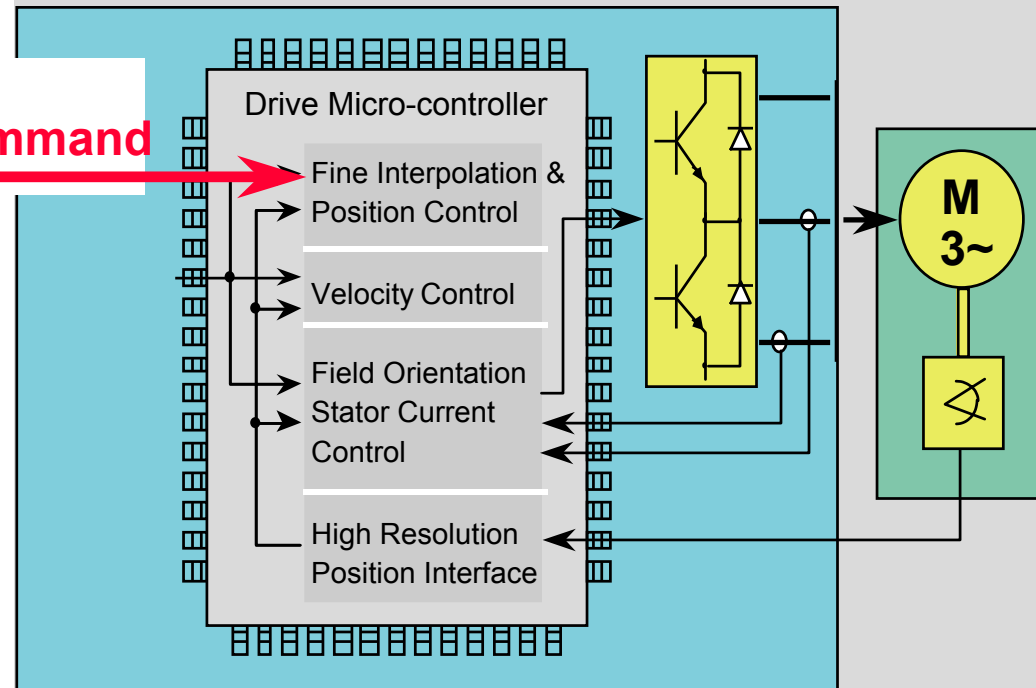


- ◆ Complete Drive Control Loop in Fast Micro-controller
- ◆ Quantum Leap in Precision and Useable Speed due to Lagless Position Control with 0.25 ms Cycle Time
- ◆ Reduction in Feedback & Control Requirements
- ◆ Encapsulated Drive-Functionality guarantees Precision using non-influential Position Command Interface to the Control

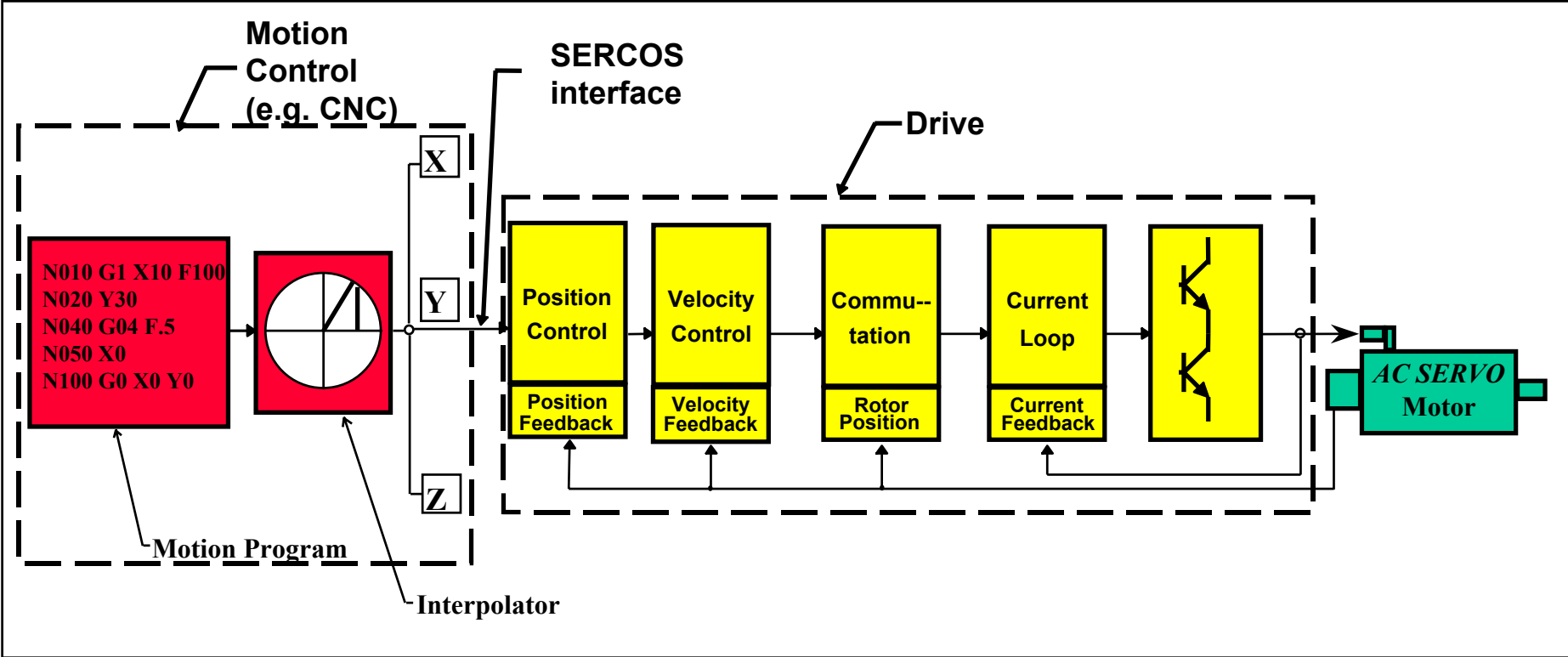


Cyclic Position Command

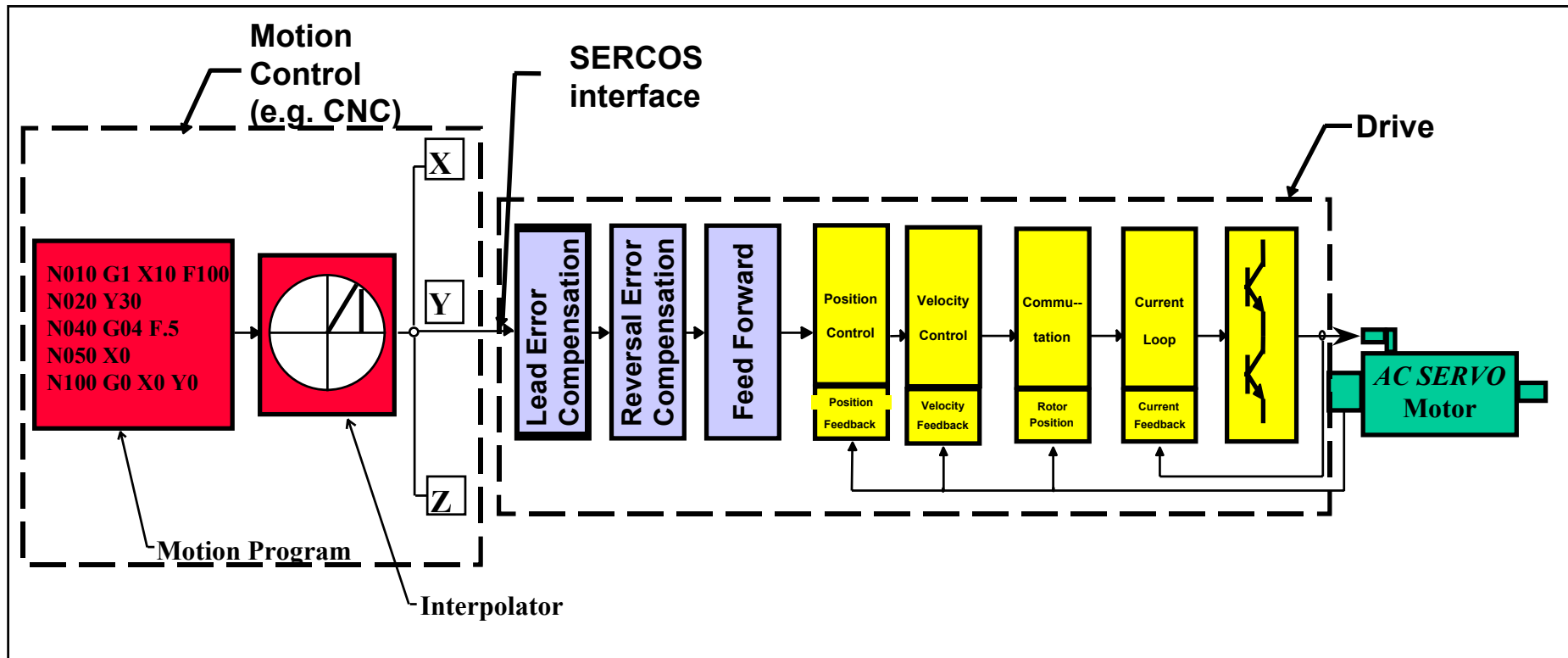
Digital Intelligent Axis



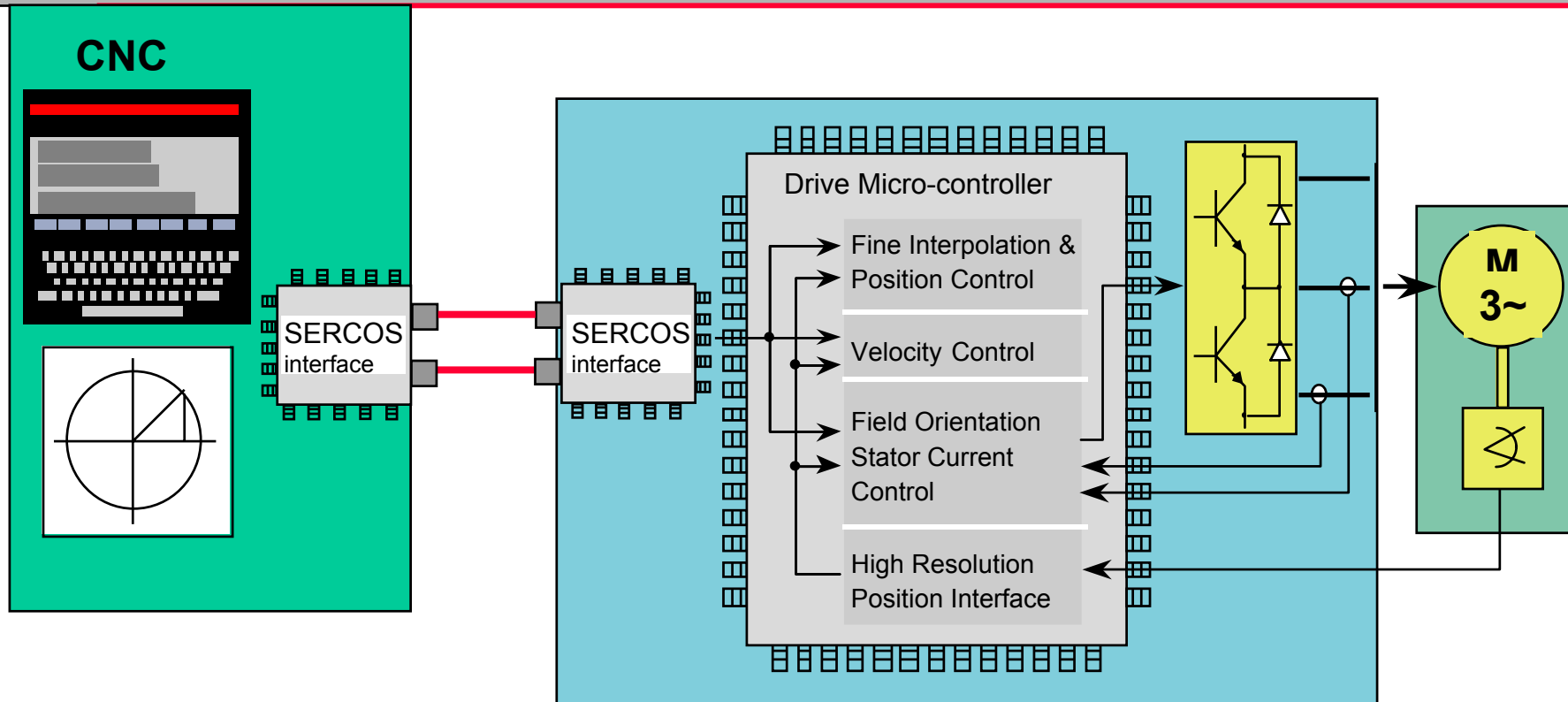
Intelligent SERCOS Drive



Distributed Axis Control

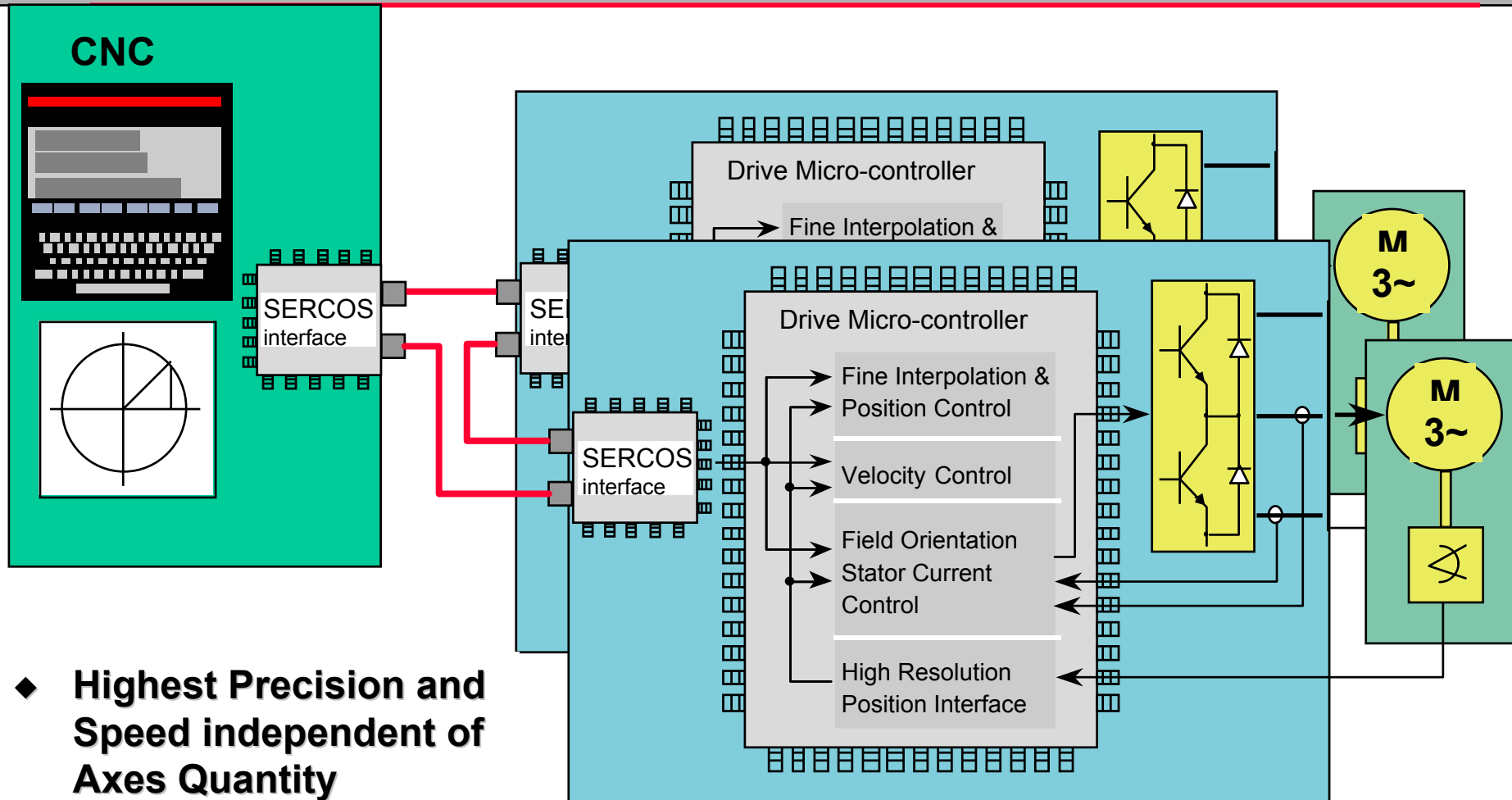


Connection CNC - SERCOS Drive (1)



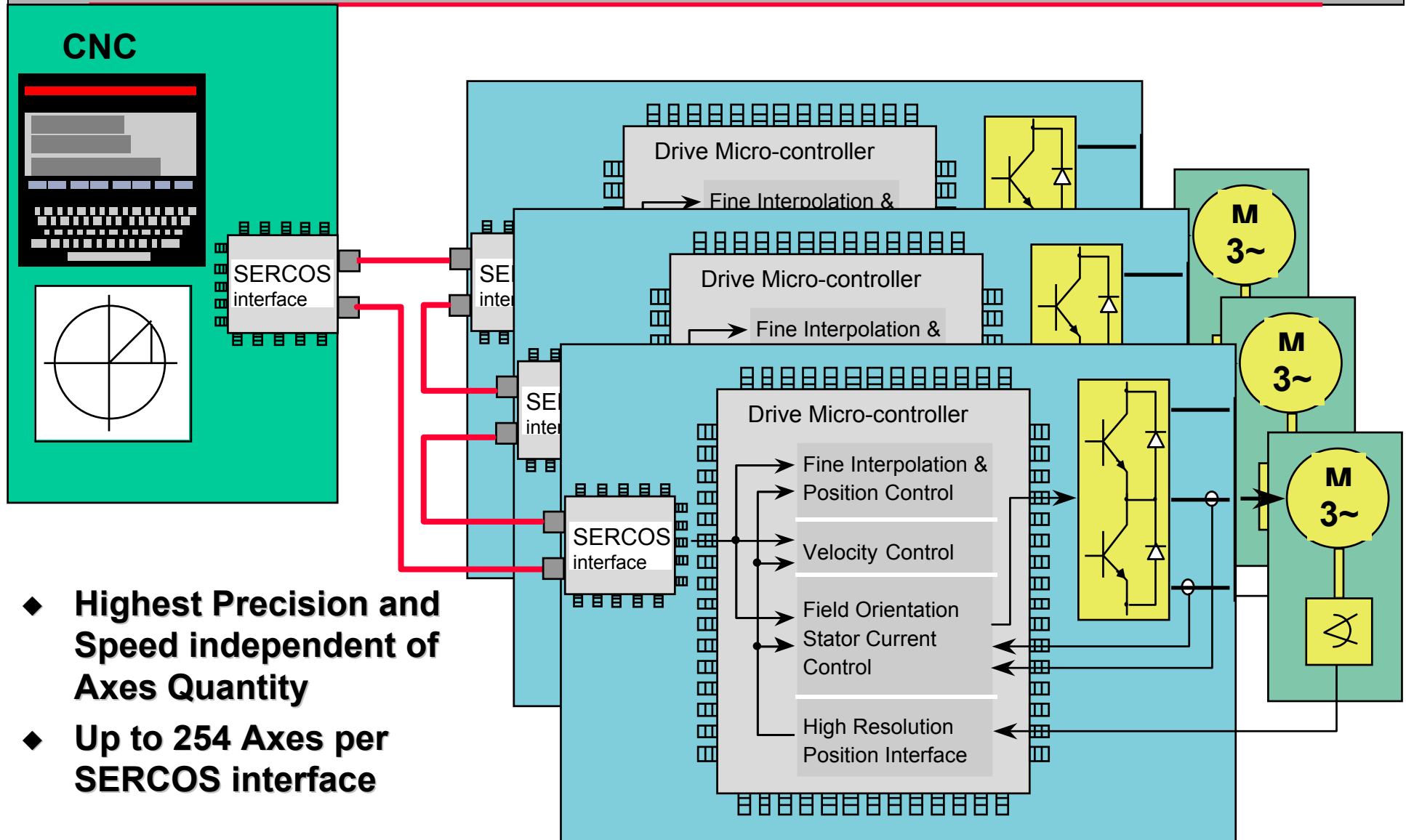
- ◆ **Highest Precision and Speed independent of Axes Quantity**

Connection CNC - SERCOS Drive (2)



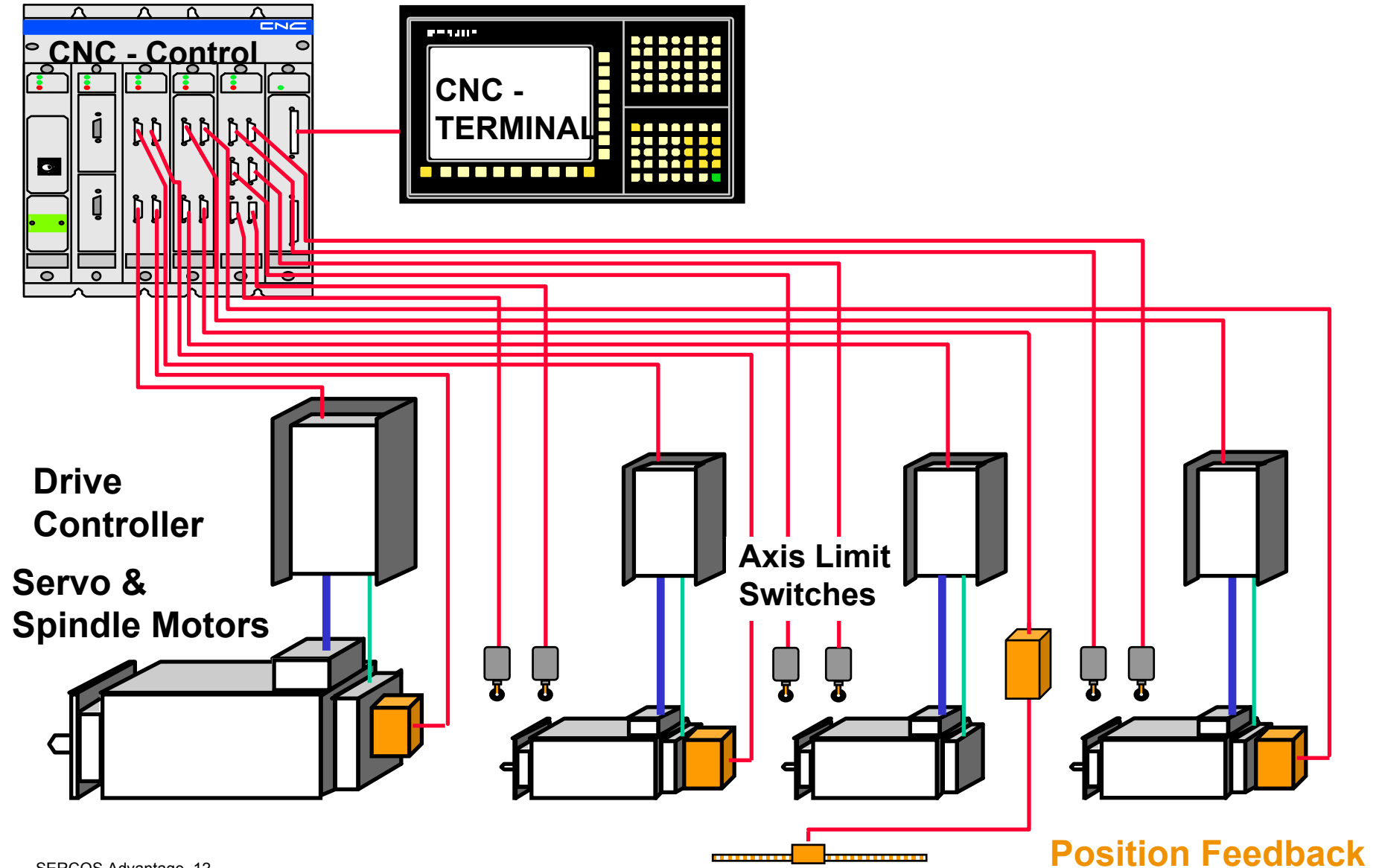
- ◆ Highest Precision and Speed independent of Axes Quantity
- ◆ Up to 254 Axes per SERCOS interface

Connection CNC - SERCOS Drive (3...)

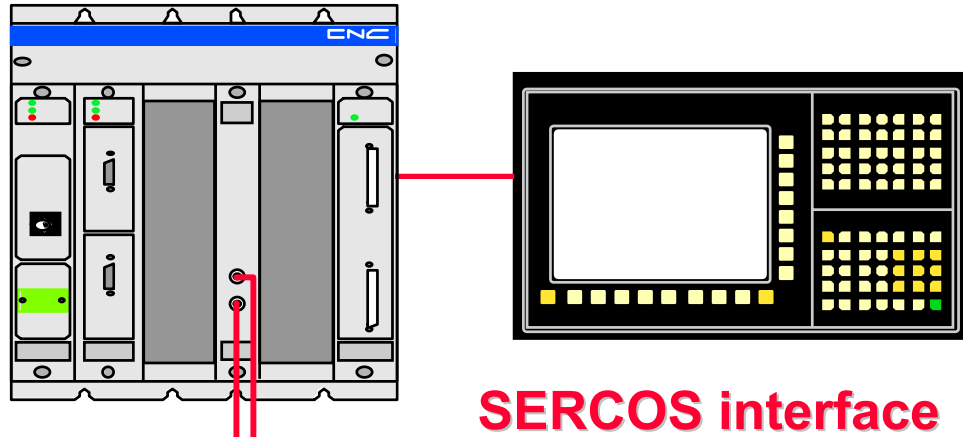


- ◆ Highest Precision and Speed independent of Axes Quantity
- ◆ Up to 254 Axes per SERCOS interface

Conventional CNC-Control and Drive Technology

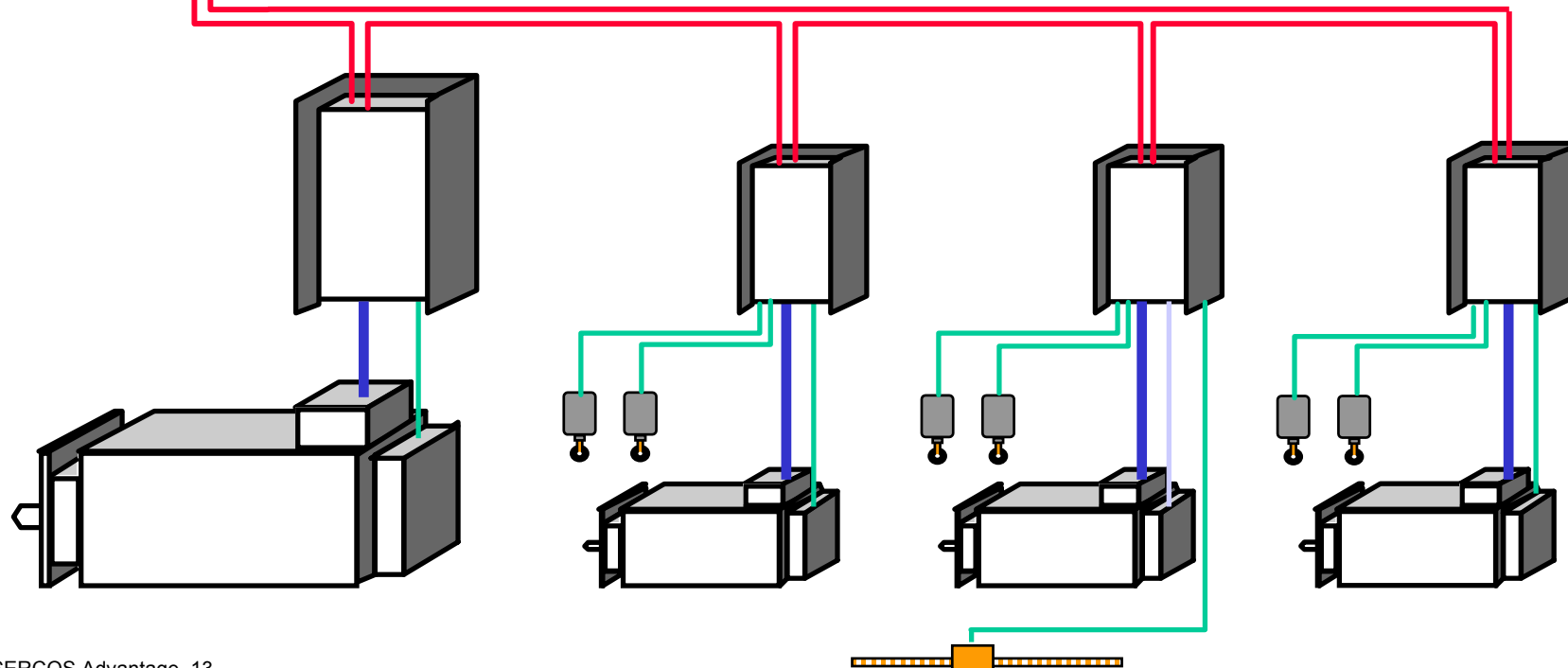


CNC with SERCOS interface

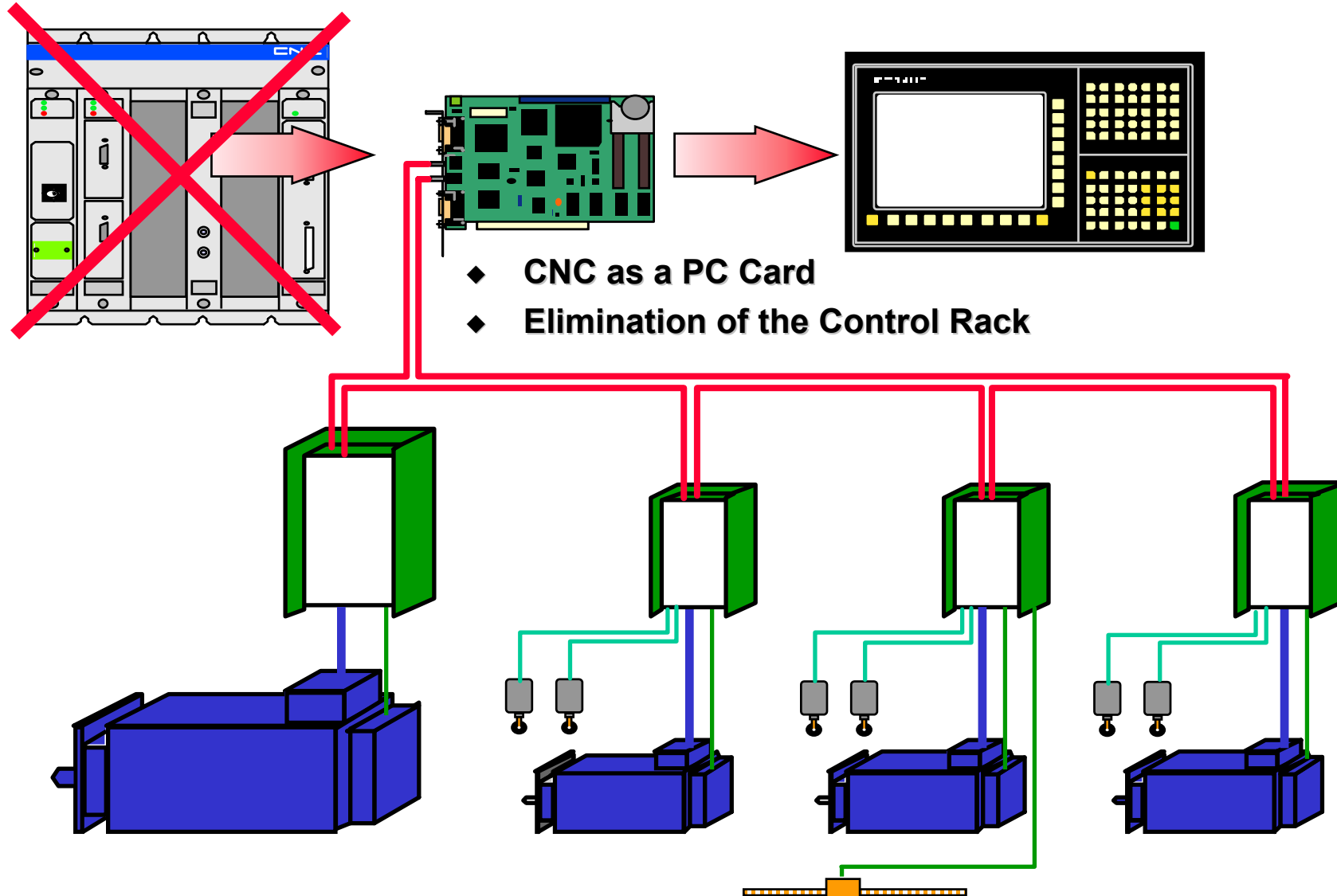


Elimination of:

- ◆ Position Feedback, Cables & Position Interfaces
- ◆ CNC Axis Cards
- ◆ Cabling & Terminations
- ◆ Start-up Requirements



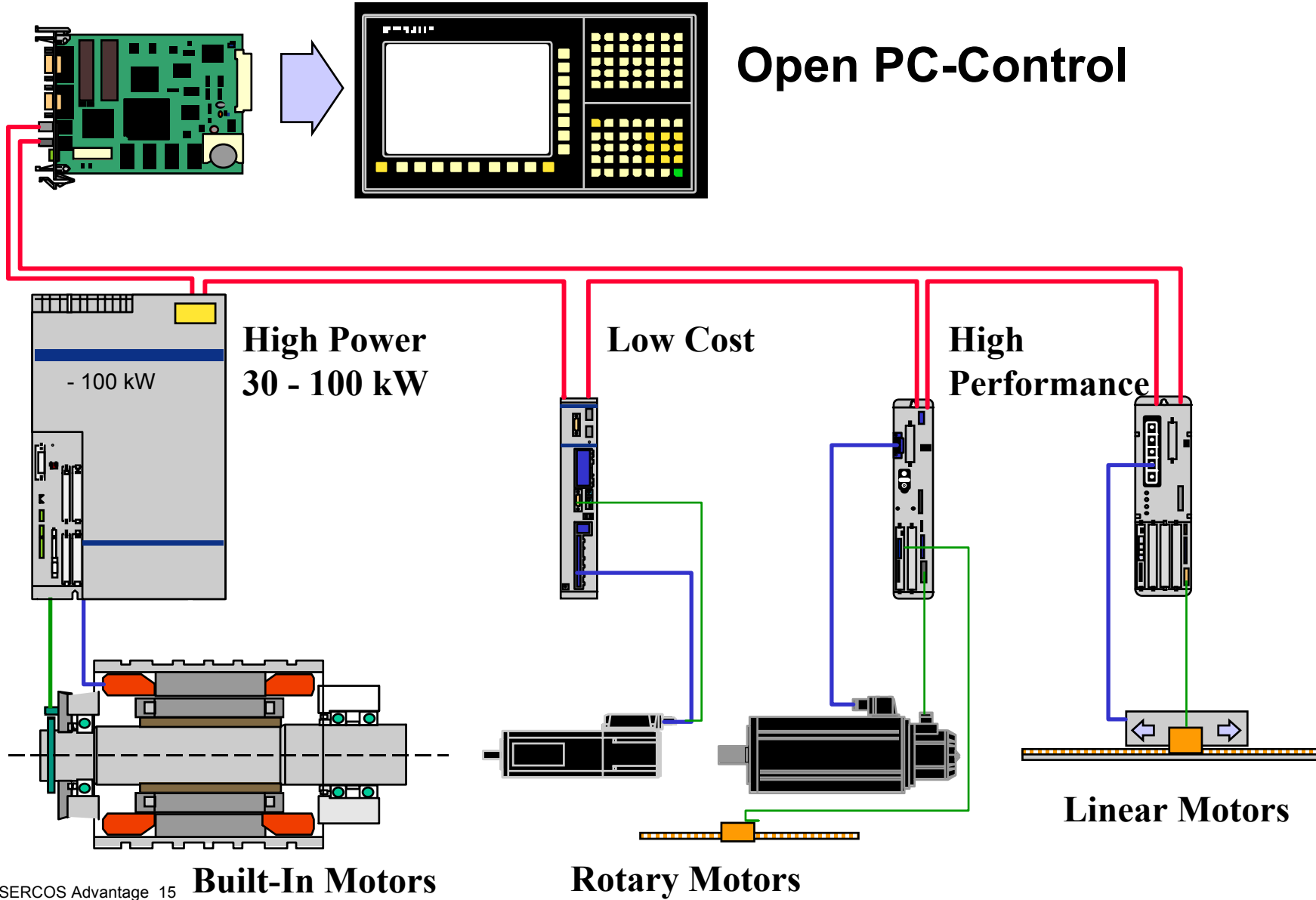
PC-Control with SERCOS interface



Drive Technology independent

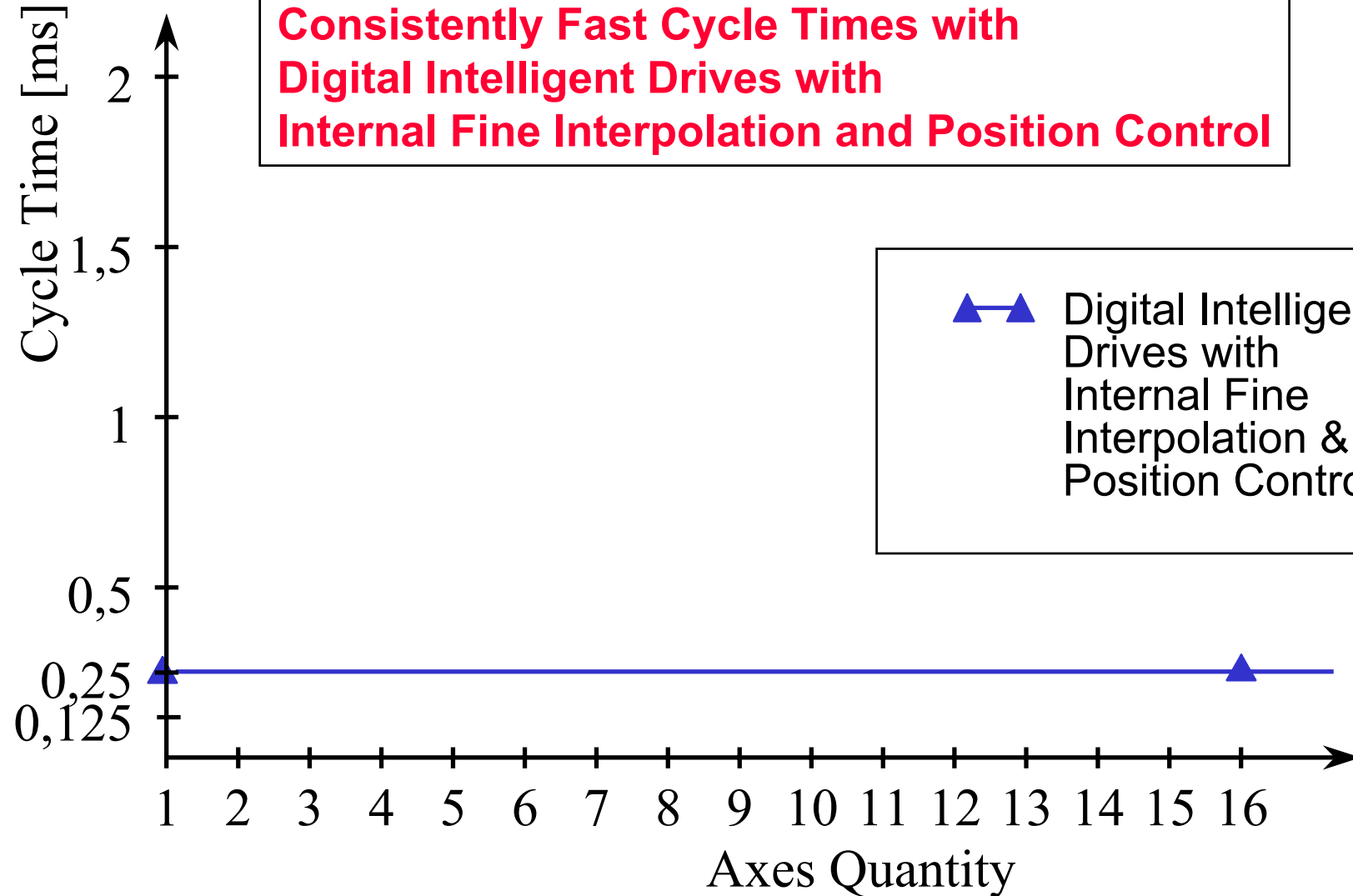


Open PC-Control

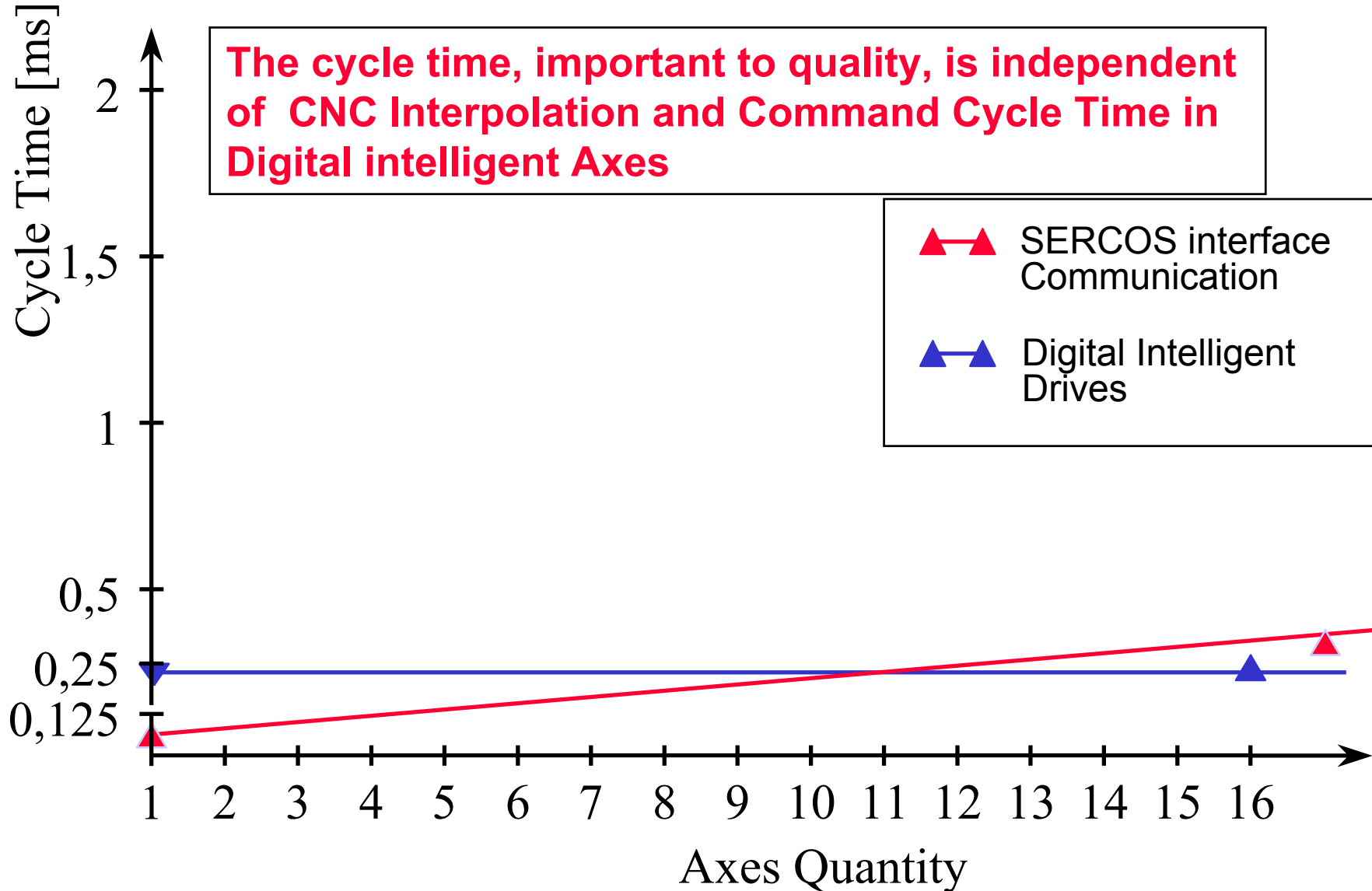


Comparisons

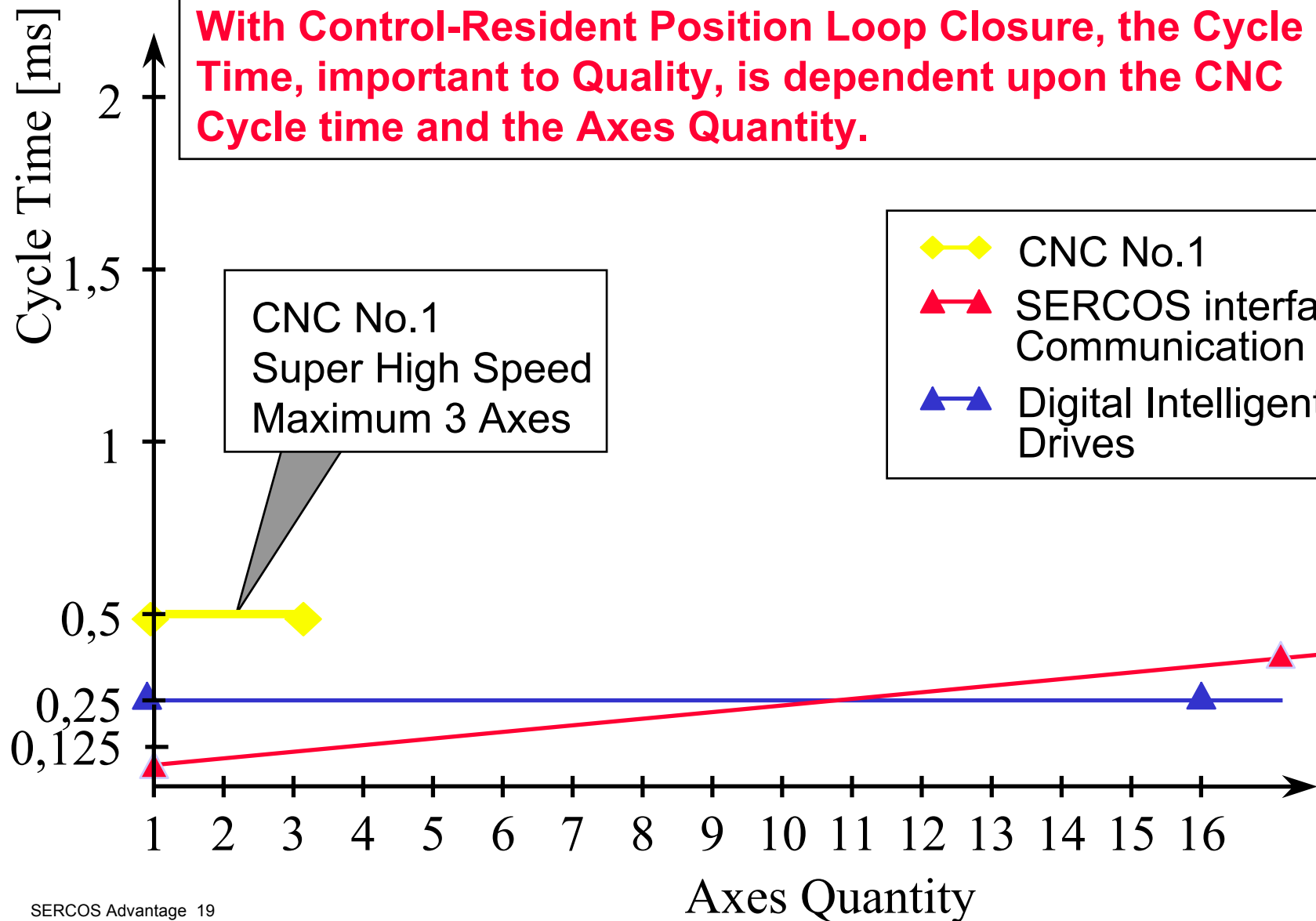
Performance SERCOS interface Drive with Position Control



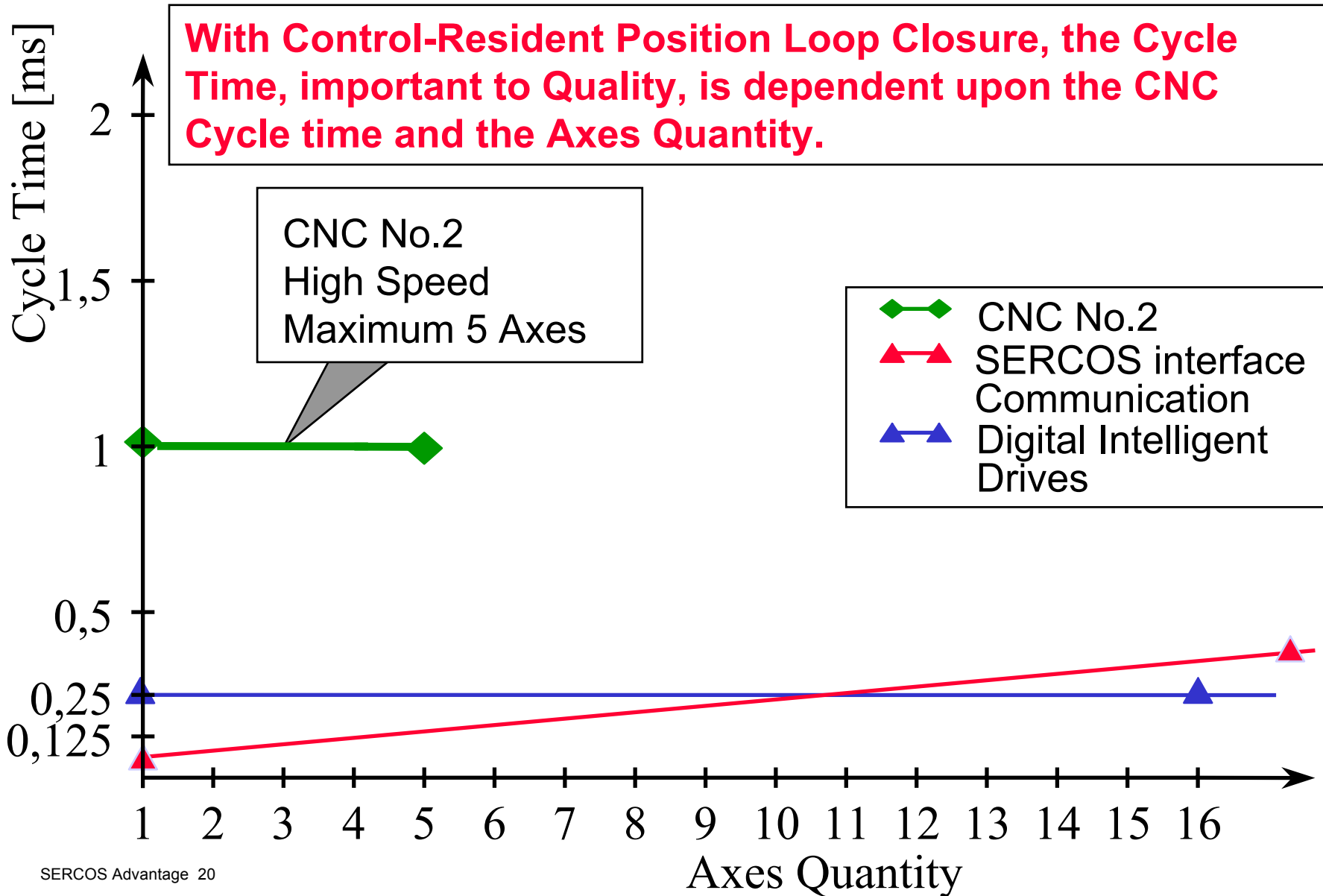
Performance SERCOS interface Communication



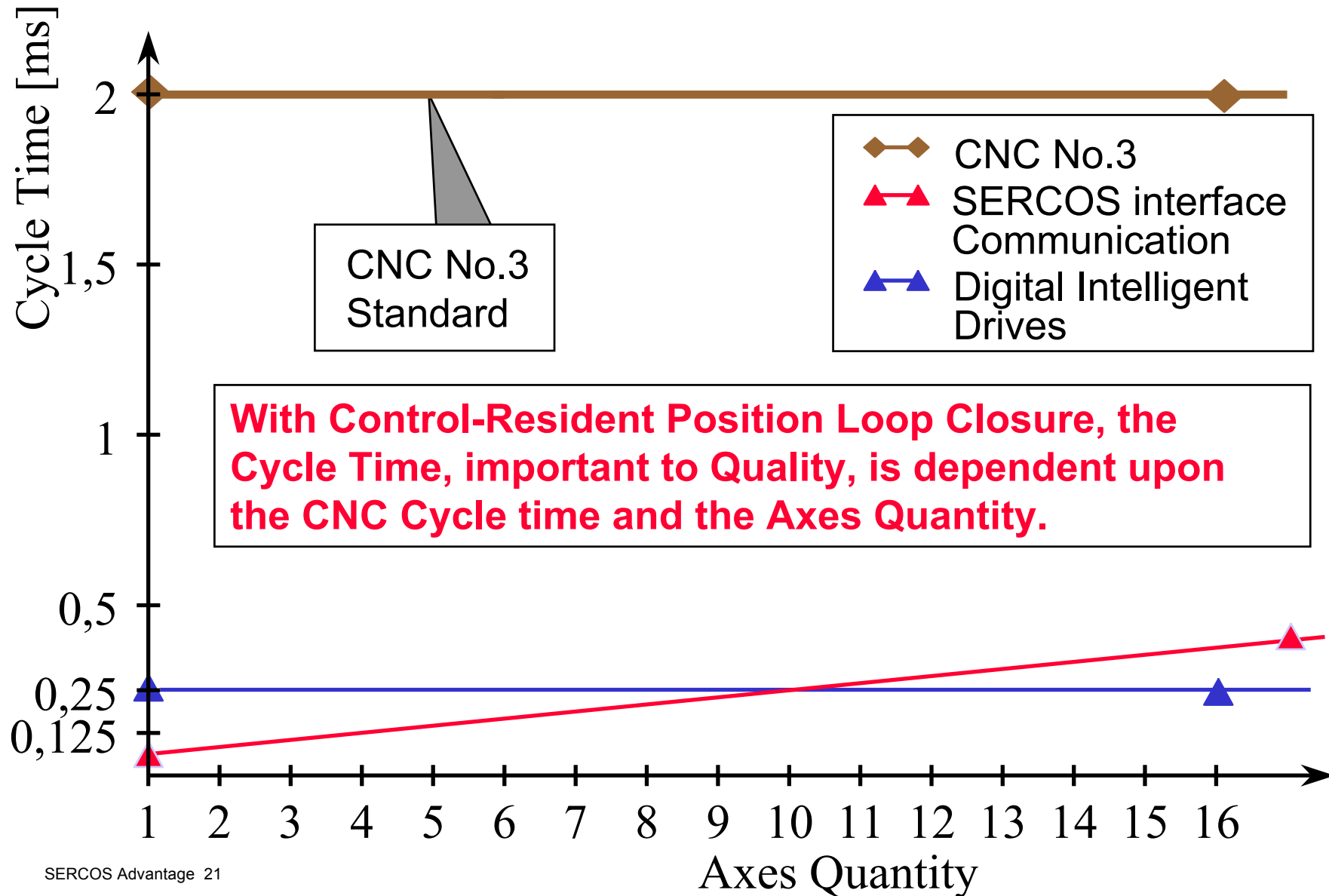
Performance Comparison (CNC No.1)



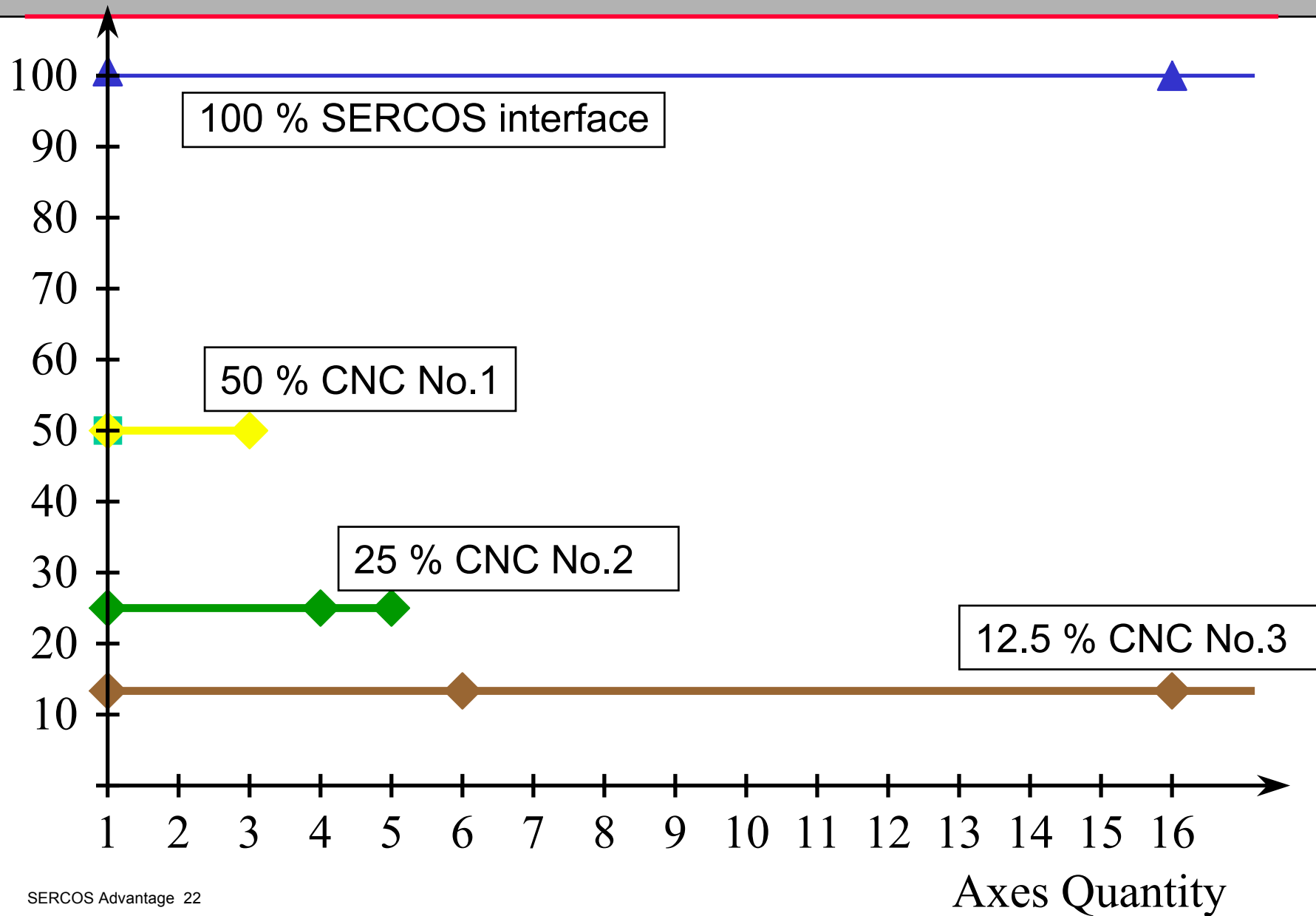
Performance Comparison (CNC No.2)



Performance Comparison (CNC No.3)



Performance Capability (4000 Cycles per Second = 100 %)



Applications

Mechanical Precision

Position Gain & Position Loop Update Time



Maximum Gain as a Function of Position Loop Update Time

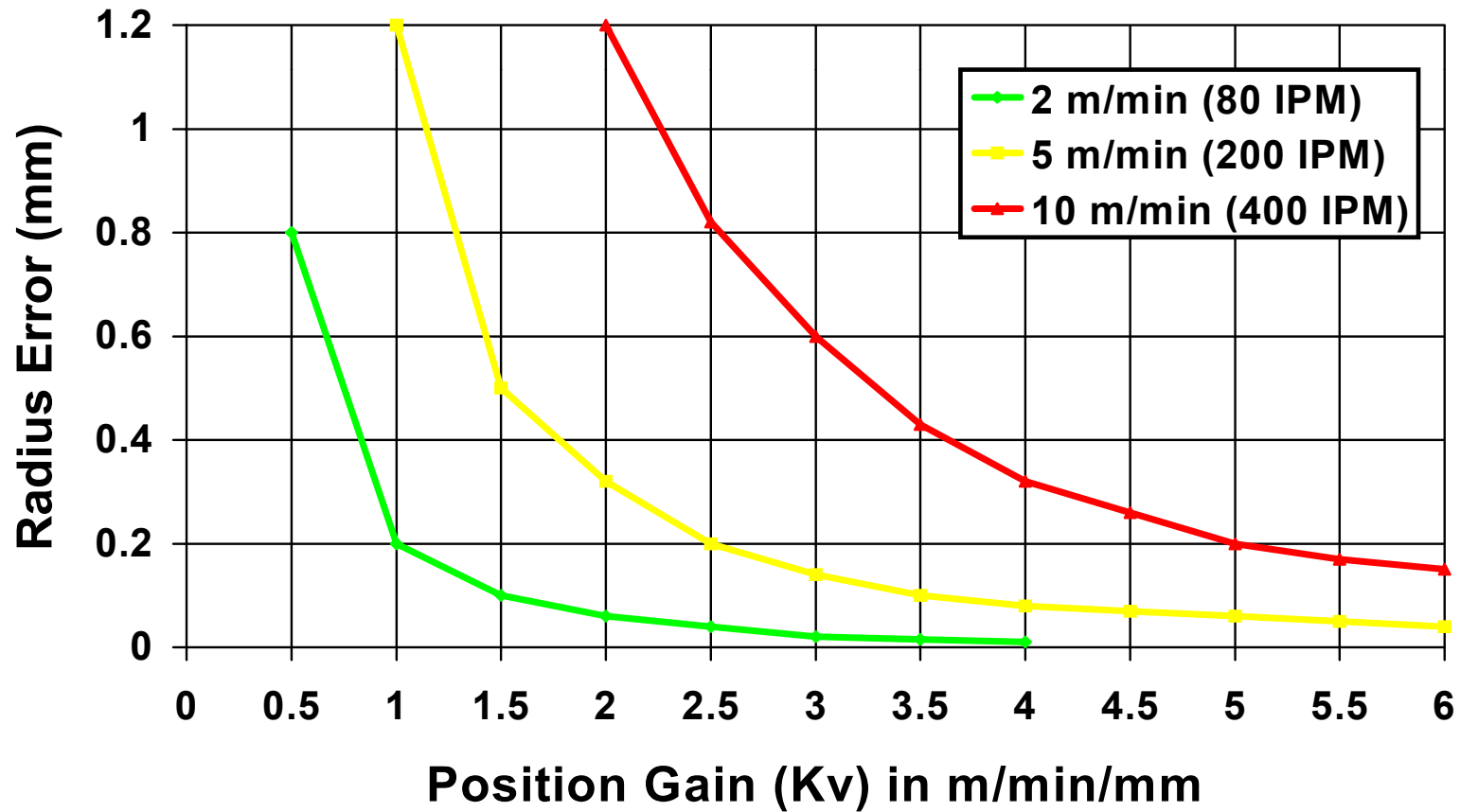
Position Loop Update Time	Maximum KV (m/min/mm)
10 ms	2
5 ms	4
2 ms	10
1 ms	20
0.25 ms	80

Mechanical Precision

Position Gain & Contour Error



Contour Error as a Function of Position Gain For a Radius of 10 mm (0.4")



Mechanical Precision Field Example



EX-CELL-●

- 20 m/min (800 IPM) path speed
- 16 mm \varnothing tool
- XY Circular Interpolation
- 68 mm (2.5") \varnothing circle
- 4 μ m (0.00015") Error
as measured on part

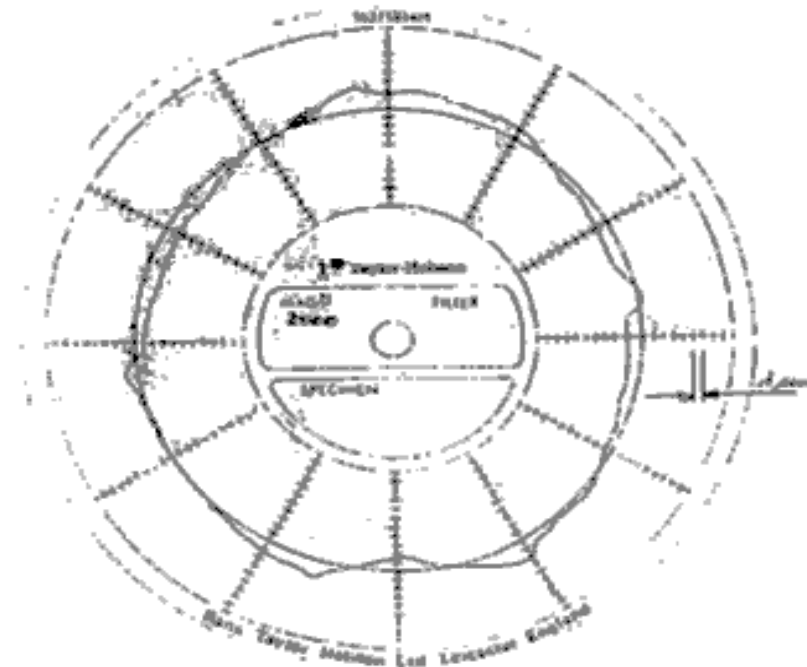
6.9.1993
180 010_3

REC 240 CIRCULARFRÄSEN

INTERPOLATION VON X- UND Y-ACHSE

DREHZAHL n : 24 000 1/min
VORSCHUB v_c : 20 m/min
FRÄSER : FRD; 4-Schneider

-----> FORMFEHLER 4 μ m !



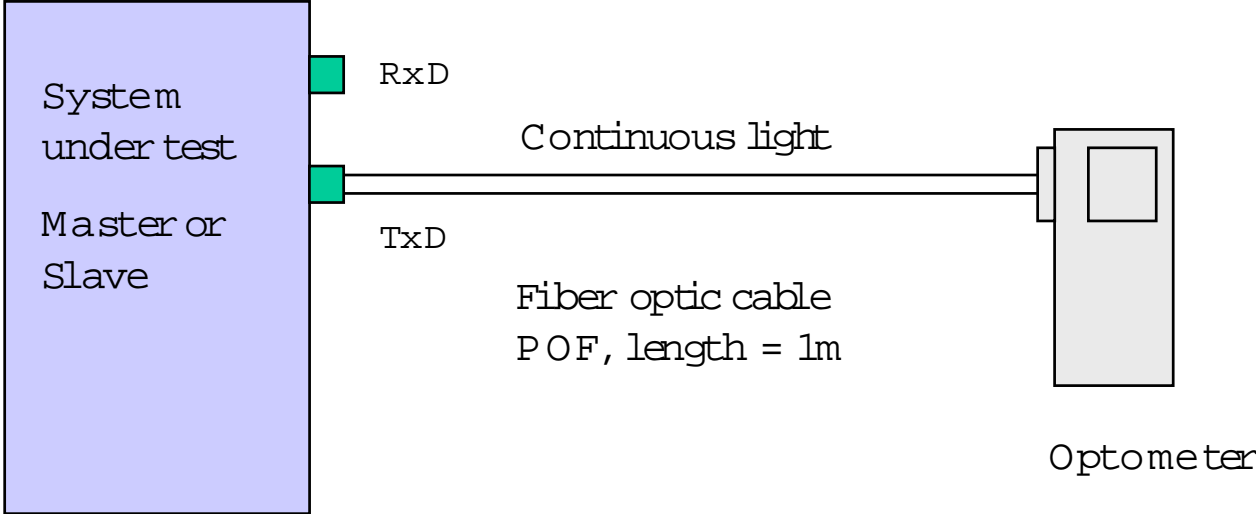


***From Low-Cost to High-End
The Intelligent Digital Drive Interface***

Certification

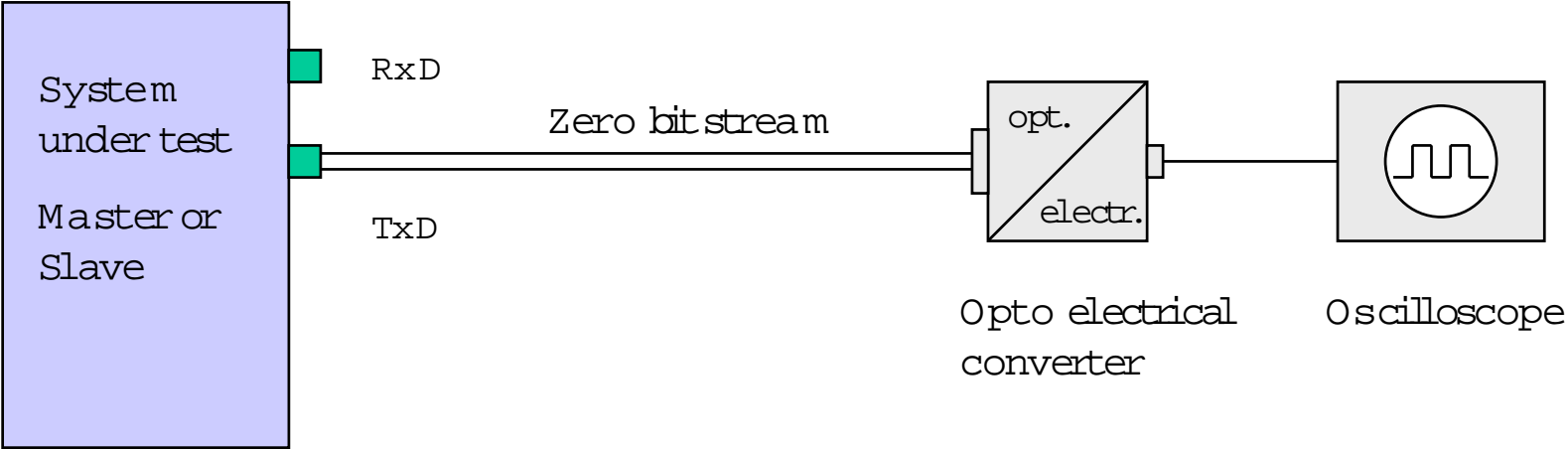
Certification

Optical output power



Certification

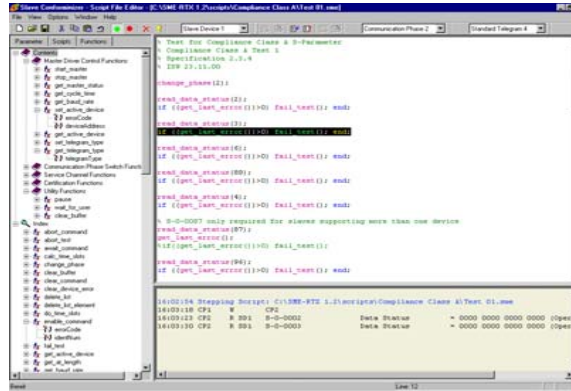
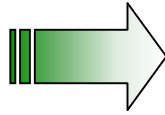
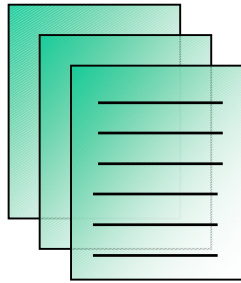
Optical output signal



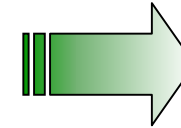
Certification (Conformizer) Slave Conformance Test



Test Scripts



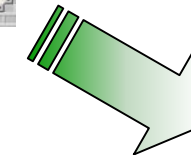
Test Report (HTML)



To IGS



Test Protocol (RTF)



To Manufacturer

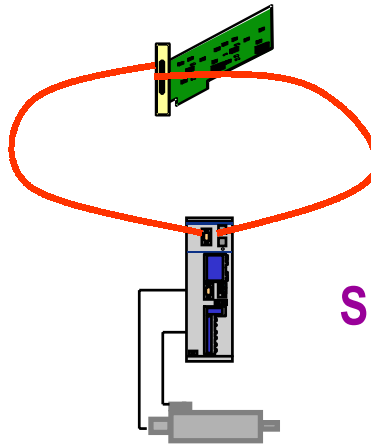


Windows NT/2000

RTX 5.0

Test Environment

System under Test

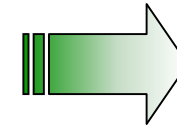
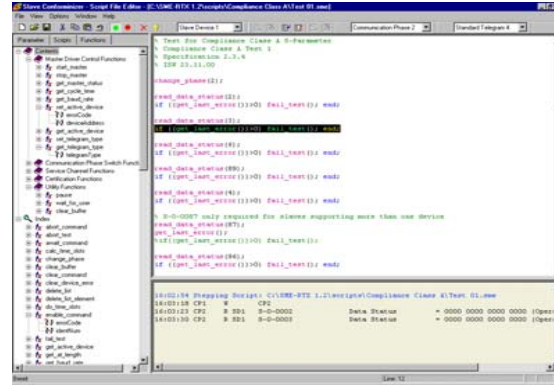
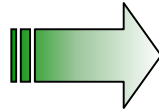
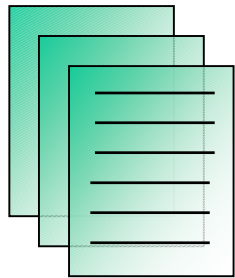


SERCOS Slave Device

Certification (Conformizer) Master Conformance Test

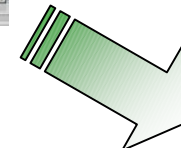


Test Scripts



To IGS

Test Report (HTML)

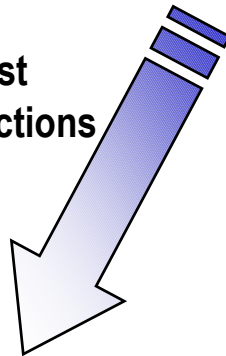


To Manufacturer

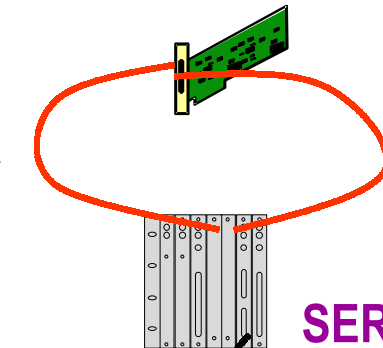
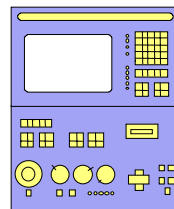
Test Protocol (RTF)



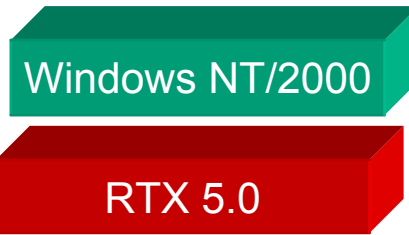
Test Instructions



CNC-Engineer



SERCOS Master Device



Test Environment

System under Test

Certification Master & Slave Conformizer



```

% Test for Compliance Class A S-Parameter
% Compliance Class A Test 1
% Specification 2.3.4
% ISW 23.11.00

change_phase(2);

read_data_status(2);
if ((get_last_error())>0) fail_test(); end;

read_data_status(3);
if ((get_last_error())>0) fail_test(); end;

read_data_status(6);
    
```

The screenshot shows a script editor with a file explorer on the left containing folders like 'Master Driver Control Functions', 'Communication Phase Switch Functions', and 'Service Channel Functions'. The script contains test logic for compliance class A S-Parameter.

Describe logical tests using a **Script Language** with over 80 functions

File Name	Test Name	Result	Number of
Command Handling/Test 01.sme	Test for command S-0-0099	Passed	0
Command Handling/Test 02.sme	Test for command S-0-0127 and S-0-0128	Passed	0
Drive Identification/Test 01.sme	Test slave addresses 0:255 in CP 1 and 2		
Drive Identification/Test 02.sme	Test slave addresses 0:255 only in CP 2		
Drive Identification/Test 03.sme	Test slave address 0 in CP 1 and 2		
Phase Switch/Test 08.sme	Test correct phase down switch from CP 4		
Phase Switch/Test 09.sme	Test correct phase down switch from CP 3		
Phase Switch/Test 10.sme	Test correct phase down switch from CP 2		
Phase Switch/Test 11.sme	Test correct phase down switch from CP 1		
Phase Switch/Test 12.sme	Test incorrect phase down switch from CP 4 to CP 1		
Phase Switch/Test 13.sme	Test incorrect phase down switch from CP 4 to CP 2		
Phase Switch/Test 14.sme	Test incorrect phase down switch from CP 4 to CP 3		
Phase Switch/Test 15.sme	Test incorrect phase down switch from CP 3 to CP 1		
Phase Switch/Test 16.sme	Test incorrect phase down switch from CP 3 to CP 2		
Phase Switch/Test 17.sme	Test incorrect phase down switch from CP 2 to CP 1		

Build test scenarios and view the results using the **Batch Test Overview**

```

change_phase(2)
do_time_slots()

is_command(128)
read_attribute(128)

read_list(16)
read_list_length(17)

read_max(1)
read_min(1)

write_max(1,2000)
    
```

15:40:19	CP2	W	SD1	S-0-0001	Data	= 2000
15:40:19	CP2	W	SD1	S-0-0002	Data	= 2000
15:40:19	CP2	W	SD1	S-0-0006	Data	= 150
15:40:20	CP2	W	SD1	S-0-0008	Data	= 1910
15:40:20	CP2	W	SD1	S-0-0008	Data	= 1965
15:40:20	CP2	W	SD1	S-0-0089	Data	= 1687
15:40:27	CP2	R	SD1	S-0-0001	Data	= 2000
15:40:33	CP2	R	SD1	S-0-0002	Name	= SERCOS-Zykluszeit (TSycs)
15:41:03	CP2	R	SD1	S-0-0128	Attribute	= 00000000 DC
15:41:15	CP2	R	SD1	S-0-0016	Data[1]	= S-0-0051
15:41:31	List	S-0-0017	has a current length of 199 elements			
15:41:52	CP2	R	SD1	S-0-0001	Max	= 65000
15:41:57	CP2	R	SD1	S-0-0001	Min	= 250
15:42:21	CP2	W	SD1	S-0-0001	Max	= 0x6004 (Max)

Access script functions directly using the **Command Shell**

Check the detailed **Protocol**

- System Requirements**
- Windows NT/2000
 - RTX 5.0

Capability Characteristics

Data Throughput (Examples)

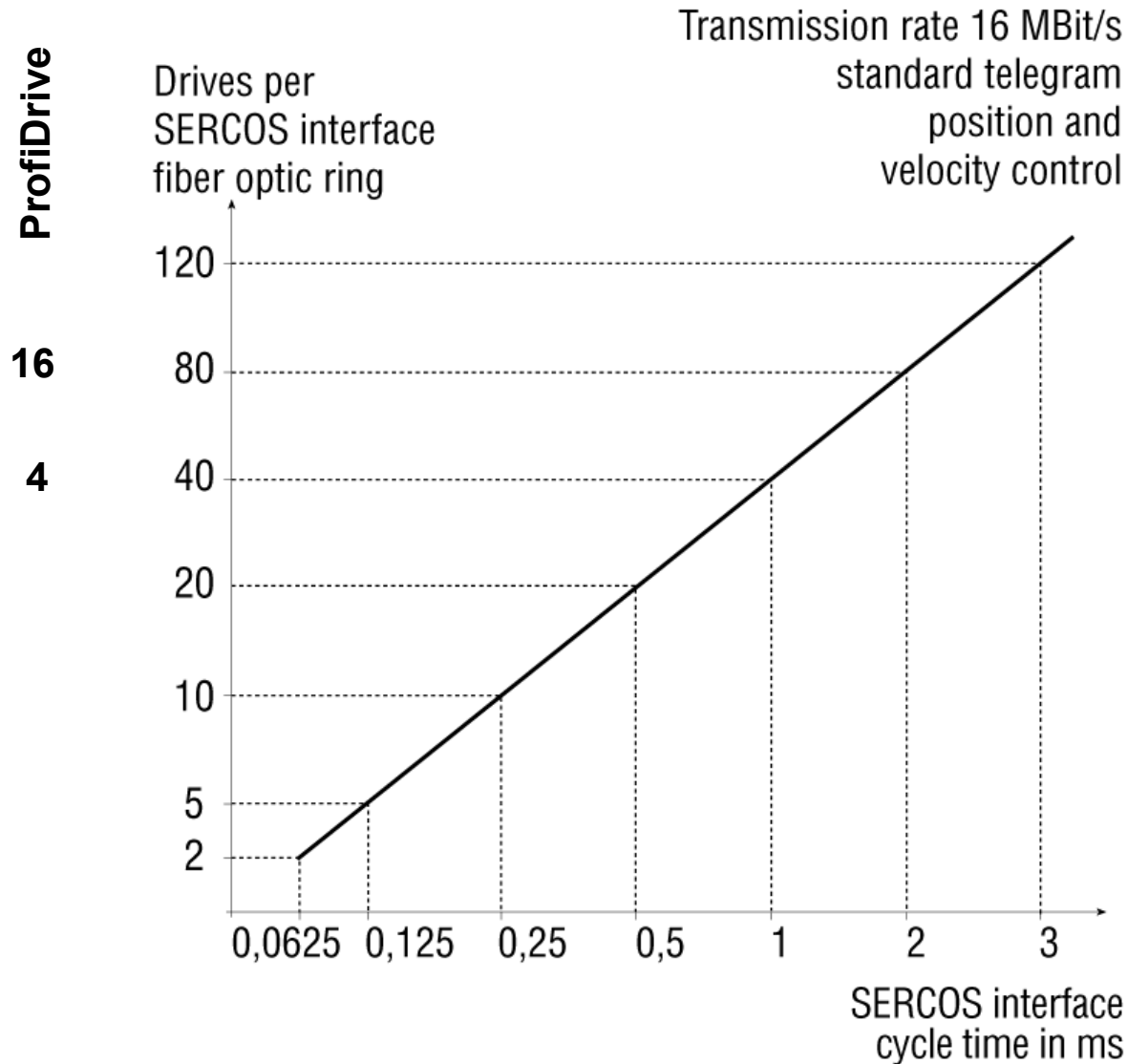


Cycle time	Data per drive (MDT & AT)	Transmission rate	Number of drives	Data rate (non-cyclic data)
1) 2 ms	32 Byte	2 Mbit/s	8	8 kbit/s (2 Byte)
2) 1 ms	32 Byte	4 Mbit/s	8	16 kbit/s (2 Byte)
3) 1 ms	36 Byte	8 Mbit/s	15	32 kbit/s (4 Byte)
4) 0,5 ms	36 Byte	16 Mbit/s	14	128 kbit/s (8 Byte)
5) 2 ms	StandardTelegram 2, 3, 4	16 Mbit/s	120	8 kbit/s (2 Byte)

MST time	MDT time	AT time	Jitter time
1) 30µs	640µs	8 * 100 = 800µs	10 * 14µs = 140µs
2) 15µs	320µs	8 * 50 = 400µs	10 * 14µs = 140µs
3) 8µs	330µs	15 * 28 = 420µs	17 * 2µs = 34µs
4) 4µs	155µs	14 * 14 = 196µs	16 * 2µs = 32µs
5) 4 µs	579µs	120 * 8 = 960µs	122 * 2µs = 244µs

	Telegrams	Safety Time	Spare Time	Bus-Load
❑ 1)	1470µs	140µs	390µs	73,5%
❑ 2)	735µs	140µs	125µs	73,5%
❑ 3)	758µs	34µs	208µs	75,8%
❑ 4)	355µs	32µs	113µs	71,0%
❑ 5)	1543µs	244µs	213µs	77,1%

Drives per SERCOS interface fiber optic ring





SANYO DENKI CO., LTD.



AUTOMATION TECHNOLOGY GROUP



IEC 61491
EN 61491

SERCOS interface



INDUSTRIAL & ROBOTIC CONTROLS

SIEMENS



Thank You for Your Attention



PRÄZISION



matec Maschinenbau GmbH



DMS Dersch Mikrosystem GmbH



contaves antriebstechnik