



Conformance Test for Slave Devices

Version 1.04 (October 2002)

Project: SERCOS interface Conformance Test
Document Type: Specification
File: Conformance Test for Slave Devices (V1.04)

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Abbreviations

addr.	Address
AT	Drive (amplifier) telegram
CP	Communication phase
H	Hex
IDN	Ident number
IGS	Interests Group SERCOS interface e.V.
Mbit/s	Megabit per second
MDT	Master data telegram
MST	Master synchronization telegram
ppm	Parts per million

1 Introduction

As from April 2001, the Institute for Control Engineering of Machine Tools and Manufacturing Units (ISW) of the University of Stuttgart is authorized by the Interests Group SERCOS interface e.V. (IGS) to carry out Conformance Tests on SERCOS Devices according to the International Standard IEC/EN 61491. The aim of the Conformance Test is to ensure the compatibility and interoperability of SERCOS Devices from different vendors in multi-vendor environments. If a SERCOS Device passes the Conformance Test, a certificate can be applied for from the IGS. If any changes are made to the SERCOS Device's hardware or software, then the SERCOS Device must be retested. The Conformance Test Environment for SERCOS Slave Devices (see Fig. 1) comprises of the Slave Conformizer (a SERCOS Master Emulator) running on a standard PC with an enhanced SERCOS interface card, an optical analyzer and a digital oscilloscope. For companies interested in performing their own tests, the Slave Conformizer together with a passive PCI-SERCOS interface card can be ordered from the IGS (Landhausstrasse 20, 70190 Stuttgart, Germany).

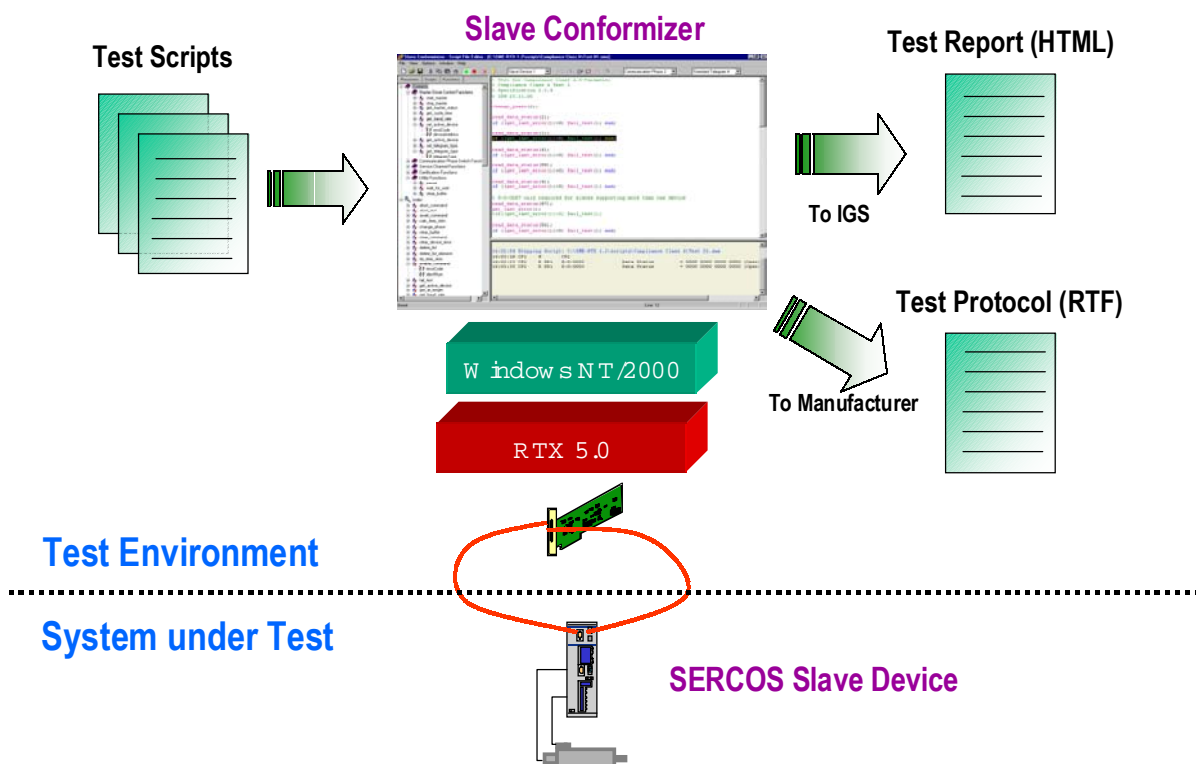


Fig. 1: Conformance Test Environment for SERCOS Slave Devices

The following sections in this document describe the test procedure, requirements and methods for SERCOS Slave Devices.

2 Test Procedure

Orders for Conformance Tests must be made in writing to the SERCOS interface Test Laboratory (ISW, University of Stuttgart, Seidenstrasse 36, 70174 Stuttgart, Germany). After an order has been placed, a date for the Conformance Test can be arranged. The duration of a Conformance Test for a SERCOS Slave Device is typically one day, assuming that all requirements listed in Section 3 are met. On completion of the Conformance Test, a Test Report will be sent to the IGS. The customer will receive a copy of this report and a detailed Test Protocol of the test results. If the SERCOS Device passes the Conformance Test, a certificate confirming the conformance of this Device with the International Standard IEC/EN 61491 can be applied for in writing from the IGS (Landhausstrasse 20, 70190 Stuttgart, Germany). This certificate is only valid for devices with same catalog number. Any changes made to the hardware or software will invalidate this certificate and the device must be retested. An inheritance certificate may however be applied for identical devices with differing power stages.

3 Test Requirements

In order to carry out the Conformance Test, the following requirements have to be met. A checklist listing all the information required for a Slave Device Conformance Test is provided in Appendix A and must be completed and sent by the customer to the ISW at least 7 days before test begin. A qualified and experienced contact person must also be named who can assist with technical problems encountered during testing of the Slave Device.

3.1 Slave Device Requirements

The SERCOS Slave Device to be tested, including all cable connections, manuals and documentation must arrive at ISW at least 7 days before the test begin. These requirements include:

- ✳ reference manuals for all the electrical and mechanical components (including a detailed description of the SERCOS interface),
- ✳ a power supply,
- ✳ all cable and connectors required for operation.

3.2 Asic Programming Requirements

The following information regarding the electrical components and asic programming of the Slave Device must also be provided:

- ✱ asic type¹,
- ✱ frequency stability of the oscillator²,
- ✱ receiver circuit,
- ✱ type of the optical receiver,
- ✱ programming of control bit POLRXD (control register address 1H.7) and REGMODE (addr. 1H.5)³,
- ✱ programming of the SERCOS interface specific functions,
- ✱ programming of control bits RXDNRZ (addr. 1H.12) and PRESYNC (addr. 1H.8) ⁴.

This information is used during the Conformance Test to check that the optical circuitry and asic setting have been correctly implemented.

3.3 Physical Test Requirements

In order to test the physical behavior of the Slave Device's hardware , the Slave Device must allow the following optical test modes to be selected:

- ✱ continuous light test,
- ✱ zero bit stream test,
- ✱ normal operation.

3.4 Logical Test Requirements

In order to perform the logical tests, it is necessary that the Slave Device is not password protected and that the following information is provided:

- ✱ maximum selectable device address (e.g. 99 or 255),
- ✱ maximum supported baud rate⁵ (2, 4, 8 or 16 Mbit/s),
- ✱ supported telegram types⁶ (IDN S-0-0015),

¹ SERCON 410B or SERCON 816.

² Must be less than 100 ppm.

³ Their values depend on the receiver used.

⁴ These registers must be set to certain values in order for the asic to operate correctly according to the SERCOS interface specification.

⁵ All tests will be performed with the highest supported baud rate.

⁶ It should not be possible to select non-supported telegram types.

- ✱ supported operation modes¹,
- ✱ all operation mode bit combinations that are supported by IDN S-0-0032,
- ✱ minimum supported communication cycle time² (IDN S-0-0002),
- ✱ minimum cycle time and the granularity (see IEC/EN 61491, annex D).

3.5 Required SERCOS interface Ident Numbers

In order to command a correct phase upshift for the Slave Device to be tested, the Slave Conformizer must be able to read from and write to a minimum set of system parameters (see Tables 1 and 2). The logical tests can only be carried out if all of the following system parameters are supported.

Ident Number	Name
S-0-0003	Shortest AT Transmission Starting Time (t_{1MIN})
S-0-0004	Transmit/Receive Transition Time (t_{ATMT})
S-0-0005	Minimum Feedback Processing Time (t_5)
S-0-0087 ³	Transmit to Transmit Recovery Time (t_{ATAT})
S-0-0088	Receive to Receive Recovery Time (t_{Mtsy})
S-0-0185 ⁴	Length of Configurable Data Record in the AT
S-0-0186 ⁴	Length of Configurable Data Record in the MDT
S-0-0187 ⁴	List of Configurable Data in AT
S-0-0188 ⁴	List of Configurable Data in MDT

Table 1: Minimum Set of Readable Ident Numbers

Ident Number	Name
S-0-0001	NC-Cycle Time (t_{Ncyc})
S-0-0002	Communication Cycle Time (t_{Scyc})
S-0-0006	AT Transmission Starting Time (t_i)

¹ It should not be possible to select non-supported operation modes.

² All logical tests will be performed with the minimum supported communication cycle time down to 1000 μ s in CP0-2 and 500 μ s in CP3-4.

³ Only required for Slave Device's supporting more than device address simultaneously.

⁴ Only required if IDN S-0-0015 supports telegram type 7.

S-0-0007	Feedback Acquisition Capture Time (t_4)
S-0-0008	Command Value Valid (t_3)
S-0-0009	Position of Data Record in MDT
S-0-0010	Length of MDT
S-0-0015	Telegram Type Parameter
S-0-0016 ¹	Configuration List of AT
S-0-0024 ¹	Configuration List of MDT
S-0-0032	Primary Operation Mode
S-0-0089	MDT Transmission Starting time (t_2)

Table 2: Minimum Set of Writeable Ident Numbers

4 Test Methods

The Conformance Test consists of a physical and a logical part.

4.1 Physical Part

4.1.1 Transmission Power

The optical transmission power is measured using the optical test mode continuous light. The transmission power must be within the specified limits (see IEC/EN 61491, 5.3.1).

4.1.2 Optical Curve Shape

The zero bit stream is measured at high and low attenuation. The curve shape must be within the specified optical signal envelope for the zero bit stream (see IEC/EN 61491, 5.4.1/5.4.2).

¹ Only required if IDN S-0-0015 supports Telegram Type 7.

4.2 Logical Part

4.2.1 Drive Identification

4.2.1.1 Slave Device Behavior in CP₁

The MDT telegrams are sent by the Slave Conformizer to the Slave Device with addresses ranging from 0 to 255. The Slave Device is only allowed to respond if it receives a MDT with its own device address. The Slave Device's must respond within 10 communication cycles.

4.2.1.2 Slave Device Behavior in CP₂

- a) In CP₂, the Slave Device is only allowed to respond, if it was recognized during CP₁ and has received a MDT with its own Device address in the previous communication cycle.
- b) If the Slave Device address is set to 0 or 255, the Device is not allowed to respond to MDTs with either these or any other addresses.

4.2.2 Service Channel

All Service Channel tests are performed in CP₂, CP₃ and CP₄ with a Service Channel length of 2 bytes. A handshake timeout (a handshake taking longer than 10 communication cycles) is not allowed to occur when testing the Service Channel.

4.2.2.1 Data Block Element 0

The Slave Conformizer closes the Service Channel by writing to the element 0. If the Slave Conformizer then tries to read or write one of the following elements, the Slave Device must respond with the error message "Service channel not open" (0x0001) in the service INFO field of the AT.

4.2.2.2 Data Block Element 1 (Ident Number)

The Slave Conformizer opens the Service Channel by transmitting an existing Ident number. The Slave Device has to respond with the message "No error in service channel" (0x0000).

4.2.2.3 Data Block Element 2 (Name)

- a) The Slave Conformizer tries to read the name of an existing Ident number. Either:
 - i. no error is allowed to occur or
 - ii. the Slave Device must set the "Error bit" (bit 2) in the AT drive status word and respond with the error code "No name" (0x2001) in the Service INFO field of the AT.
- b) The Slave Conformizer also tries to write to this element. Again either:

- i. no error is allowed to occur or
- ii. the Slave Device must set the “Error bit” (bit 2) in the AT drive status word and respond with one of the following error codes in the service INFO field of the AT:
 - “No name” (0x2001)
 - “Name is write-protected at this time” (0x2005)
 - “Name can not be changed (read only)” (0x2004)

4.2.2.4 Data Block Element 3 (Attribute)

- a) The Slave Conformizer tries to read the attribute of an existing Ident number. No error is allowed to occur.
- b) If the Slave Conformizer tries to write to this element, the Slave Device must set the “Error bit” (bit 2) in the AT drive status word and respond with one of the following error codes in the service INFO field of the AT:
 - “Attribute is write-protected at this time” (0x3005)
 - “Attribute can not be changed (read only)” (0x3004)

4.2.2.5 Data Block Element 4 (Unit)

- a) The Slave Conformizer tries to read the unit of an existing Ident number. Either:
 - i. no error is allowed to occur or
 - ii. the Slave Device must set the “Error bit” (bit 2) in the AT drive status word and respond the error code “No unit” (0x4001) in the Service INFO field of the AT.
- b) The Slave Conformizer also tries to write to this element. Again either:
 - i. no error is allowed to occur or
 - ii. the Slave Device must set the “Error bit” (bit 2) in the AT drive status word and respond with one of the following error codes in the service INFO field of the AT:
 - “No unit” (0x4001)
 - “Unit is write-protected at this time” (0x4005)
 - “Unit can not be changed (read only)” (0x4004)

4.2.2.6 Data Block Element 5 (Minimum Input Value)

- a) The Slave Conformizer reads the minimum input value of an existing Ident number. Either

- i. no error is allowed occur or
 - ii. the Slave Device must set the “Error bit” (bit 2) in the AT drive status word and respond the error code “No minimum input value” (0x5001) in the Service INFO field of the AT.
- b) The Slave Conformizer tries to write to this element. Again either:
- i. no error is allowed occur or
 - ii. the Slave Device must set the “Error bit” (bit 2) in the AT drive status word and respond with one of the following error codes in the service INFO field of the AT:
 - “No minimum input value” (0x5001)
 - “Minimum input value is write-protected at this time” (0x5005)
 - “Minimum input value can not be changed (read only)” (0x5004)

4.2.2.7 Data Block Element 6 (Maximum Input Value)

- a) The Slave Conformizer reads the maximum input value of an existing Ident number. Either :
- i. no error is allowed to occur or
 - ii. the Slave Device must set the “Error bit” (bit 2) in the AT drive status word and respond the error code “No maximum input value” (0x6001) in the Service INFO field of the AT.
- b) The Slave Conformizer tries to write to this element. Again either:
- i. no error is allowed to occur or
 - ii. the Slave Device must set the “Error bit” (bit 2) in the AT drive status word and respond with one of the following error codes in the service INFO field of the AT:
 - “No maximum input value” (0x6001)
 - “Maximum input value is write-protected at this time” (0x6005)
 - “Maximum input value can not be changed (read only)” (0x6004)

4.2.2.8 Data Block Element 7 (Operation data)

- a) The operation data of existing Ident numbers of fixed length¹ as well as of existing Ident numbers of variable length² are read by the Slave Conformizer. No errors are allowed to occur.

¹ 2 or 4 bytes

² 1-, 2- or 4-byte data strings

- b) The operation data of non-write-protected Ident numbers¹ of fixed length² as well as of variable length³ are also written to. No errors are allowed to occur.
- c) The Slave Conformizer also tries to write to the operation data of write-protected Ident numbers³. The Slave Device must set the “Error bit” (bit 2) in the AT drive status word and respond with one of the following error codes in the service INFO field of the AT:
 - “Data is write-protected at this time” (0x7005)
 - “Date can not be changed (read only)” (0x7004)
- d) The operation data of an Ident number with a maximum and minimum input value is written with a value within the range of valid values. No errors are allowed to occur.
- e) The operation data of an Ident number with a maximum and minimum input value is written with a value below the range of values. The Slave Device must set the “Error bit” (bit 2) in the AT drive status word and respond with the error code “Operation data is smaller than the minimum input value” (0x7006) in the service INFO field of the AT.
- f) The operation data of an Ident number with a maximum and minimum input value is written with a value above the range of values. The Slave Device must set the “Error bit” (bit 2) in the AT drive status word and respond with the error code “Operation data is greater than the maximum input value” (0x7007) in the service INFO field of the AT.
- g) The operation data of an Ident number is transmitted too short. The Slave Device must set the “Error bit” (bit 2) in the AT drive status word and respond with the error code “Operation data transmitted too short” (0x7002) in the service INFO field in the AT.
- h) The operation data of an Ident number is transmitted too long. The Slave Device must set the “Error bit” (bit 2) in the AT drive status word and respond with the error code “Operation data transmitted too long” (0x7003) in the service INFO field in the AT.

4.2.3 Procedure Command Handling

4.2.3.1 Reset Class 1 Diagnostics (IDN S-0-0099)

- a) The Slave Conformizer sets, enables and clears the command “Reset Class 1 Diagnostics” in CP₂, CP₃ and CP₄. The correct behavior of the procedure command change bit (bit 5) in the drive status word and of the procedure command acknowledgment (bit 8..0) of the data status are checked. In CP₂ the command S-0-0099 must reset all bits in “Class 1 Diagnostics” (IDN S-0-0011) and the “Drive Shut-Down Error in C1d bit” (bit 13) in the drive status word.

¹ According to attribute (data block element 3) bits 30..28.

² 2- or 4-bytes

³ 1-, 2- or 4-byte data strings

- b) The Slave Conformizer sets and enables the command “Reset Class 1 Diagnostics” in CP₂, CP₃ and CP₄ and switches to CP₀. The Slave Device then has to clear the command and reset the procedure command change bit (bit 5) in the drive status word and reset the procedure command acknowledgment (bit 8..0) of the data status. In CP₂ the Slave Conformizer checks, if the command has been cleared correctly.

4.2.3.2 CP₃ transition check (IDN S-0-0127)

- a) The Slave Conformizer sets, enables and clears the procedure commands CP₃ transition check) in CP₂. The correct behavior of the procedure command change bit (bit 5) in the AT drive status word and of the procedure command acknowledgment (bit 8..0) of the data status are checked. If no error occurs, it must not be possible to switch the Slave Device to CP₃.
- b) The Slave Conformizer sets, enables and clears the procedure commands CP₃ transition check in CP₃ and CP₄. The Slave Device must either:
- i. set the “Error bit” (bit 2) in the AT drive status word and respond with one of the following error codes in the service INFO field of the AT:
 - “Data is write-protected at this time” (0x7005)
 - “Date can not be changed (read only)” (0x7004)
 - ii. or set bit 3 “Command execution not possible” of the procedure command acknowledgement (bits 8..0 of the data status).
- c) The Slave Conformizer sets and enables the CP₃ transition check in CP₂ and switches to CP₀. The Slave Device then has to clear the command and reset the procedure command change bit (bit 5) in the AT drive status word and reset the procedure command acknowledgment (bit 8..0) of the data status. In CP₂ the Slave Conformizer checks, if the command has been cleared correctly.
- d) The Slave Conformizer sets, enables and clears the procedure commands CP₃ transition check in CP₂. Then the Slave Conformizer writes data to an IDN, required for a phase upshift to CP₃ (e.g. Control unit cycle time t_{Ncyc} , IDN S-0-0001). The Slave Device must either:
- i. signal with one of the specified error codes in the service INFO field in the AT that this IDN is now write protected or not changeable or
 - ii. if this IDN is not write-protected, must not be able to switch to the next phase and generate the error phase switch without ready acknowledge (see 4.2.8) or
 - iii. if the IDN is writeable and the Slave Conformizer writes the CP₃ transition check the second time in CP₂, the Slave Device is not allowed to signal an error and must be able to switch to CP₃.

4.2.3.3 CP₄ transition check (IDN S-0-0128)

- a) The Slave Conformizer sets, enables and clears the procedure commands CP₄ transition check in CP₃. The correct behavior of the procedure command change bit (bit 5) in the drive status word and of the procedure command acknowledgment (bit 8..0) of the data status are checked. If no error occurs, the Slave Device must be able to switch to CP₄.
- b) The Slave Conformizer sets, enables and clears the procedure commands CP₄ transition check in CP₂ and CP₄. The Slave Device must either:
 - i. signal with one of the specified error codes in the service INFO field in the AT that the data is write-protected or not changeable or
 - ii. signal an error in the procedure command acknowledgment (bit 8..0) of the data status.
- c) The Slave Conformizer sets and enables the CP₄ transition check in CP₃ and switches to CP₀. The slave device then has to clear the command and reset the procedure command change bit (bit 5) in the drive status word and reset the procedure command acknowledgment (bit 8..0) of the data status. In CP₂ the Slave Conformizer checks, if the command has been cleared correctly.
- d) The Slave Conformizer sets, enables and clears the procedure commands CP₄ transition check in CP₃. The Slave Conformizer then writes data to an IDN, that is required for the phase upshift to CP₄. The Slave Device must either:
 - i. signal with one of the specified error codes in the service INFO field in the AT that this IDN is now write-protected or
 - ii. generate the error "phase switch without ready acknowledge" (see 4.2.8), if the Slave Conformizer tries to change to CP₄ without rewriting "CP₄ Transition Check" or
 - iii. change to CP₄ without signaling any errors, if the Slave Conformizer does rewrite the "CP₄ Transition Check" command.

4.2.4 Compliance Class A

All compliance class A tests are performed in CP₂, CP₃ and CP₄.

4.2.4.1 Data Block Element 1

The Slave Conformizer opens the Service Channel for all Ident numbers listed in compliance class A by writing to data block element 1 (see IEC/EN 61491, annex D). No error is allowed to occur.

4.2.4.2 Required Data Block Elements 3 and 7

- a) The Slave Conformizer reads the attribute and the operation data of all Ident numbers listed in compliance class A (see IEC/EN 61491, annex D). No errors are allowed to occur.
- b) The Slave Conformizer tries to write the operation data of all Ident numbers in compliance class A in order to test the write-protection as described in Section 4.2.2.
- c) The correct description of the Ident number's attribute is also checked (e.g. commands must be signified with bit 19 being set).

4.2.4.3 Optional Data Block Elements 2, 4 and 5

- a) If it is specified, that an Ident number listed in compliance class A must have these elements, then the Slave Conformizer reads these elements. No error may occur.
- b) If the Ident number has minimum input values and maximum input values, the Slave Conformizer tries to write data values above and below the valid range of values as described in Section 4.2.2.

4.2.5 Telegram Types

4.2.5.1 Standard Telegrams (Telegram Types 0 to 6)

- a) The Slave Conformizer selects all standard telegrams by writing to the Telegram type parameter (IDN S-0-0015). If the standard telegram type is supported, then the AT length in CP₄ is checked. If the standard telegram type is not supported, then the Slave Device must either:
 - i. set the "Error bit" (bit 2) in the AT drive status word and respond with one of the following error codes in the service INFO field of the AT:
 - "Data is write-protected at this time" (0x7005)
 - "Date can not be changed (read only)" (0x7004)
 - "Invalid Date (e.g. invalid bit combination)" (0x7008)
 - ii. or set bit 3 "Command execution not possible" of the procedure command acknowledgement (bits 8..0 of the data status) when the Slave Conformizer writes to command "CP₃ Transition Check" (IDN S-0-0127).

4.2.5.2 Application Telegram (Telegram Type 7)

- a) If the application telegram is supported, by using the information contained in the following IDNs:
 - "Length of Configurable Data Record in the AT" (IDN S-0-0185),

- “Length of Configurable Data Record in the MDT” (IDN S-0-0186),
- “List of Configurable Data in AT” (IDN S-0-0187),
- “List of Configurable Data in MDT” (IDN S-0-0188),

different combinations are configured by writing to the IDNs:

- “Configuration list of AT” (IDN S-0-0016) and
- “Configuration list of MDT” (IDN S-0-0024)

The length of the MDT and AT telegrams is checked for each configuration. No errors are allowed to occur.

- b) If the Slave Conformizer tries to write an IDN that is not in the “List of configurable data in the AT” (IDN S-0-0187) or in the “List of configurable data in the MDT “(IDN S-0-0188), the Slave Device must either:
 - signal with one of the specified error codes in the service INFO field in the AT that the data is invalid or
 - signal an error when the Slave Conformizer writes the command CP₃ transition check (IDN S-0-0127).
- c) If the Slave Conformizer tries to configure an AT longer than the “Length of the configurable data record in the AT” (IDN S-0-0185) or a MDT longer than the “Length of the configurable data record in the MDT” (IDN S-0-0186), the Slave Device must either:
 - signal with one of the specified error codes in the service INFO field in the AT, that the data is invalid or
 - must signal an error, when the Slave Conformizer writes the command “CP₃ transition check” (IDN S-0-0127).

4.2.6 Error Handling

4.2.6.1 Repeater Function

The Slave Conformizer sends MSTs, the slave device must work as a repeater and close the ring.

4.2.6.2 Slave Device Response in CP₁ and CP₂

- a) The Slave Conformizer sends MDTs with the Slave Device’s address. The Slave Device must respond by sending an AT within 10 communication cycles.
- b) If the Slave Conformizer stops sending MDTs, the Slave Device is not allowed to send ATs.
- c) In case of MDT failures the Slave Device is not allowed to react in any way.

- d) In the case of MST failures, the Slave Device is not allowed to react in any other way than incrementing the MST error counter (IDN S-0-0028).

4.2.6.3 MST Failure Reaction in CP₃

- a) In the case of one MST failure, the MST error counter (IDN S-0-0028) must be increased by the Slave Device. The “MST failure” bit (bit 3) in the Interface status (IDN S-0-0014) is not allowed to be set.
- b) If two successive MST failures occur, the Slave Device must switch to CP₀. The “MST failure” bit (bit 3) in the Interface status (IDN S-0-0014) and the “Communication error” bit (bit 12) in the Class 1 diagnostics (IDN S-0-0011) must be set.

4.2.6.4 MDT Failure Reaction in CP₃

In case of MST failures, the MDT error counter (IDN S-0-0029) must be increased by the Slave Device. No further reactions are allowed to occur.

4.2.6.5 MST Failure Reaction in CP₄

- a) The MST error counter (IDN S-0-0028) must be increased after a MST failure by the Slave Device. The “MST failure” bit (bit 3) in the Interface status (IDN S-0-0014) must not be set.
- b) If two successive MST failures occur, then the Slave Device must switch to CP₀ and the “MST failure” bit (bit 3) in the Interface status (IDN S-0-0014) and the “Communication error” bit (bit 12) in the Class 1 diagnostics (IDN S-0-0011) must be set.

4.2.6.6 MDT Failure Reaction in CP₄

- a) In case of a MDT failure the MDT error counter (IDN S-0-0029) must be increased. The “MDT failure” bit (bit 4) in the Interface status is not to be set.
- b) If two successive MDT failures occur, the Slave Device must switch to CP₀ and the “MDT failure” bit (bit 4) in the Interface status (IDN S-0-0014) and the “Communication error” bit (bit 12) in the Class 1 diagnostics (IDN S-0-0011) must be set.

4.2.7 Time Slot Measurement

4.2.7.1 Slave Device Time Slot in CP₁ and CP₂

The Slave Conformizer emulator sends MDTs at 500µs and 700µs. The time at which the slave device sends ATs is measured. This response time must be within a range from 100µs up to 300µs.

4.2.7.2 Slave Device Time Slot in CP₃ and CP₄

- a) The Slave Conformizer sends MDTs within the jitter window. The Slave Device must not respond with an error. The time at which the Slave Device sends ATs is measured. This response time must be within the specified jitter window.
- b) If the Slave Conformizer sends MDTs at a time outside of the jitter window, the slave must recognize a telegram failure and react as described in section 4.2.6.

4.2.8 Phase Switch

4.2.8.1 Correct Phase Upshift

The Slave Conformizer commands a correct phase upshift. The Slave Device has to perform this phase upshift without generating an error.

4.2.8.2 Incorrect Phase Upshift

The Slave Conformizer commands a phase upshift in the wrong order (e.g. CP₀, CP₁ then CP₃). The Slave Device must switch to CP₀ and set the “Communication error” bit (bit 12) in Class 1 diagnostics (IDN S-0-0011). The “Error during phase upshift (invalid sequence)” bit (bit 6) in the Interface status (IDN S-0-0014) must also be set.

4.2.8.3 Invalid Phase Shift

The Slave Conformizer commands a phase switch to an invalid phase (e. g. CP₈). The Slave Device must switch to CP₀ and set the “Communication error” bit (bit 12) in Class 1 diagnostics (IDN S-0-0011). The “Invalid phase” bit (bit 5) in the Interface status (IDN S-0-0014) must also be set.

4.2.8.4 Incorrect Phase Downshift

The Slave Conformizer commands a wrong phase downshift (not to CP₀). The Slave Device must switch to CP₀ and set the “Communication error” bit (bit 12) in Class 1 diagnostics (IDN S-0-0011). The “Error during phase downshift (not to CP₀)” bit (bit 7) in The Interface status (IDN S-0-0014) must also be set.

4.2.8.5 Phase Switch without Transition Check

- a) The Slave Conformizer commands a phase shift from CP₂ to CP₃ without writing the command CP₃ transition check (IDN S-0-0127). The Slave Device must set the “Communication error” bit (bit 12) in Class 1 diagnostics (IDN S-0-0011). The “Phase switching without ready acknowledge” bit (bit 8) in the Interface status (IDN S-0-0014) must also be set.

- b) The Slave Conformizer commands a phase shift from CP₃ to CP₄ without writing the command CP₄ transition check (IDN S-0-0128). The Slave Device must set the “Communication error” bit (bit 12) in Class 1 diagnostics (IDN S-0-0011). The “Phase switching without ready acknowledge” bit (bit 8) in the Interface status (IDN S-0-0014) must also be set.

4.2.9 Compliance Class B (Basic)

4.2.9.1 Data Block Element 1

The Slave Conformizer opens the Service Channel for all Ident numbers listed in compliance class B (basic) by writing to data block element 1 (see IEC/EN 61491, annex D). No error is allowed to occur.

4.2.9.2 Required Data Block Elements 3 and 7

- a) The Slave Conformizer reads the attribute and the operation data of all Ident numbers listed in compliance class B (basic) (see IEC/EN 61491, annex D). No errors are allowed to occur.
- b) The Slave Conformizer tries to write the operation data of all Ident numbers in compliance class B (basic) in order to test the write-protection as described in Section 4.2.2.
- c) The correct description of the Ident number’s attribute is also checked (e.g. commands must be signified with bit 19 being set).

4.2.9.3 Optional Data Block Elements 2, 4 and 5

- a) If it is specified, that an Ident number listed in compliance class B (basic) must have these elements, then the Slave Conformizer reads these elements. No error may occur.
- b) If the Ident number has minimum input values and maximum input values, the Slave Conformizer tries to write data values above and below the valid range of values as described in Section 4.2.2.

4.2.10 Compliance Class B (Torque control)

The test in compliance class B (torque control) are done with telegram type 1 and operation mode torque control.

4.2.10.1 Data Block Element 1

The Slave Conformizer opens the Service Channel for all Ident numbers listed in compliance class B (torque control) by writing to data block element 1 (see IEC/EN 61491, annex D). No error is allowed to occur.

4.2.10.2 Required Data Block Elements 3 and 7

- a) The Slave Conformizer reads the attribute and the operation data of all Ident numbers listed in compliance class B (torque control) (see IEC/EN 61491, annex D). No errors are allowed to occur.
- b) The Slave Conformizer tries to write the operation data of all Ident numbers in compliance class B (torque control) in order to test the write-protection as described in Section 4.2.2.
- c) The correct description of the Ident number's attribute is also checked (e.g. commands must be signified with bit 19 being set).

4.2.10.3 Optional Data Block Elements 2, 4 and 5

- a) If it is specified, that an Ident number listed in compliance class B (torque control) must have these elements, then the Slave Conformizer reads these elements. No error may occur.
- b) If the Ident number has minimum input values and maximum input values, the Slave Conformizer tries to write data values above and below the valid range of values as described in Section 4.2.2.

4.2.10.4 Master Control Word and Drive Status Word

- a) The Slave Conformizer commands a correct start up of the drive by setting the bits 15, 14 and 13 in the master control word. The drive must set the bits 14 and 15 in the drive status word according to the specification (see IEC/EN 61491, "Starting/stopping functions").
- b) The Slave Conformizer commands a correct shut down of the drive by setting the bits 15, 14 and 13 in the master control word. The drive must set and reset the bits 14 and 15 in the drive status word according to the specification (see IEC/EN 61491, "Starting/stopping functions").

4.2.10.5 Bit 4 and bit 3 in “Class 3 diagnostics”(IDN S-0-0013)

- a) The Slave Conformizer commands a Torque command value (IDN S-0-0080) smaller than the “Bipolar torque limit value” (IDN S-0-0092). If the drive reaches the value, Bit 4 in “Class 3 diagnostics”(IDN S-0-0013) must be set to 0.
- b) The Slave Conformizer commands a Torque command value (IDN S-0-0080) greater than the “Bipolar torque limit value” (IDN S-0-0092). If the drive reaches the value, Bit 4 in “Class 3 diagnostics”(IDN S-0-0013) must be set to 1.
- c) The Slave Conformizer commands a Torque command value (IDN S-0-0080) smaller than the “Torque treshold value” (IDN S-0-0126). If the drive reaches the value, Bit 3 in “Class 3 diagnostics”(IDN S-0-0013) must be set to 0.
- d) The Slave Conformizer commands a Torque command value (IDN S-0-0080) greater than the “Torque treshold value” (IDN S-0-0126). If the drive reaches the value, Bit 3 in “Class 3 diagnostics”(IDN S-0-0013) must be set to 1.

4.2.11 Compliance Class B (Velocity Control)

The test in compliance class B (velocity control) are done with telegram type 2 and operation mode velocity control.

4.2.11.1 Data Block Element 1

The Slave Conformizer opens the Service Channel for all Ident numbers listed in compliance class B (velocity control) by writing to data block element 1 (see IEC/EN 61491, annex D). No error is allowed to occur.

4.2.11.2 Required Data Block Elements 3 and 7

- a) The Slave Conformizer reads the attribute and the operation data of all Ident numbers listed in compliance class B (velocity control) (see IEC/EN 61491, annex D). No errors are allowed to occur.
- b) The Slave Conformizer tries to write the operation data of all Ident numbers in compliance class B (velocity control) in order to test the write-protection as described in Section 4.2.2.
- c) The correct description of the Ident number’s attribute is also checked (e.g. commands must be signified with bit 19 being set).

4.2.11.3 Optional Data Block Elements 2, 4 and 5

- a) If it is specified, that an Ident number listed in compliance class B (velocity control) must have these elements, then the Slave Conformizer reads these elements. No error may occur.
- b) If the Ident number has minimum input values and maximum input values, the Slave Conformizer tries to write data values above and below the valid range of values as described in Section 4.2.2.

4.2.11.4 Master Control Word and Drive Status Word

- a) The Slave Conformizer commands a correct start up of the drive by setting the bits 15, 14 and 13 in the master control word. The drive must set the bits 14 and 15 in the drive status word according to the specification (see IEC/EN 61491, "Starting/stopping functions").
- b) The Slave Conformizer commands a correct shut down of the drive by setting the bits 15, 14 and 13 in the master control word. The drive must set and reset the bits 14 and 15 in the drive status word according to the specification (see IEC/EN 61491, "Starting/stopping functions").

4.2.11.5 Bits 0,1,2 and 5 in "Class 3 diagnostics"(IDN S-0-0013)

- a) The Slave Conformizer commands a velocity command value (IDN S-0-0036) smaller than the "Bipolar velocity limit value" (IDN S-0-0091). If the drive reaches the command value, Bit 5 in "Class 3 diagnostics"(IDN S-0-0013) must be set to 0.
- b) The Slave Conformizer commands a velocity command value (IDN S-0-0036) greater than the "Bipolar velocity limit value" (IDN S-0-0091). If the drive reaches the command value, Bit 5 in "Class 3 diagnostics"(IDN S-0-0013) must be set to 1.
- c) The Slave Conformizer commands a velocity command value (IDN S-0-0036) smaller than the "Velocity threshold (n_x)" (IDN S-0-0125). If the drive reaches the command value, Bit 2 in "Class 3 diagnostics"(IDN S-0-0013) must be set to 1.
- d) The Slave Conformizer commands a velocity command value (IDN S-0-0036) greater than the "Velocity threshold (n_x)" (IDN S-0-0125). If the drive reaches the command value, Bit 2 in "Class 3 diagnostics"(IDN S-0-0013) must be set to 0.
- e) The Slave Conformizer commands a velocity command value (IDN S-0-0036) within the "Stillstand window" (IDN S-0-0124). If the drive reaches the command value, Bit 1 in "Class 3 diagnostics"(IDN S-0-0013) must be set to 1.
- f) The Slave Conformizer commands a velocity command value (IDN S-0-0036) outside of the "Stillstand window" (IDN S-0-0124). If the drive reaches the command value, Bit 1 in "Class 3 diagnostics"(IDN S-0-0013) must be set to 0.

- g) The Slave Conformizer commands a velocity command value (IDN S-0-0036). If the drive reaches a velocity with a difference off command and feedback value within the "Velocity window" (IDN S-0-0157) , Bit 0 in "Class 3 diagnostics"(IDN S-0-0013) must be set to 1.

4.2.12 Compliance Class B (Position Control)

The test in compliance class B (position control) are done with telegram type 6 and operation mode position control.

4.2.12.1 Data Block Element 1

The Slave Conformizer opens the Service Channel for all Ident numbers listed in compliance class B (position control) by writing to data block element 1 (see IEC/EN 61491, annex D). No error is allowed to occur.

4.2.12.2 Required Data Block Elements 3 and 7

- a) The Slave Conformizer reads the attribute and the operation data of all Ident numbers listed in compliance class B (position control) (see IEC/EN 61491, annex D). No errors are allowed to occur.
- b) The Slave Conformizer tries to write the operation data of all Ident numbers in compliance class B (position Control) in order to test the write-protection as described in Section 4.2.2.
- c) The correct description of the Ident number's attribute is also checked (e.g. commands must be signified with bit 19 being set).

4.2.12.3 Optional Data Block Elements 2, 4 and 5

- a) If it is specified, that an Ident number listed in compliance class B (position control) must have these elements, then the Slave Conformizer reads these elements. No error may occur.
- b) If the Ident number has minimum input values and maximum input values, the Slave Conformizer tries to write data values above and below the valid range of values as described in Section 4.2.2.

4.2.12.4 Master Control Word and Drive Status Word

- a) The Slave Conformizer commands a correct start up of the drive by setting the bits 15, 14 and 13 in the master control word. The drive must set the bits 14 and 15 in the drive status word according to the specification (see IEC/EN 61491, "Starting/stopping functions").

- b) The Slave Conformizer commands a correct shut down of the drive by setting the bits 15, 14 and 13 in the master control word. The drive must set and reset the bits 14 and 15 in the drive status word according to the specification (see IEC/EN 61491, "Starting/stopping functions").

4.2.12.5 Bits 6 in "Class 3 diagnostics"(IDN S-0-0013)

- a) The Slave Conformizer commands a Position command value (IDN S-0-0041). If the drive reaches a position with a difference off command and feedback positions smaller than the "Position window" (IDN S-0-0057). Bit 6 in "Class 3 diagnostics"(IDN S-0-0013) must be set to 1.

5 References

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