

## Application Note "Error management"

### DES 50/5, DES 70/10 Firmware version 1051h or higher

#### Introduction

The DES (**D**igital **E**C **S**ervo amplifier) is a very efficient digital servo amplifier with sinusoidal current commutation for the perfect control of EC (**E**lectronic **C**ommutation) motors. The sinusoidal commutation causes minimal torque ripple and low motor noise. The motor chokes integrated in the DES extend the operating range of the DES to motors with very low inductance.

The EC motors must be equipped with 3 Hall sensors (bipolar hall effect latches, 120° electrical) and a digital 3 channel encoder (recommended with line driver A,A\,B,B\,I,I).

The controller, the monitoring and the complete control algorithms are implemented in a very fast digital signal processor. As with classical, conventional automatic controllers, easy trimming and adjustment of the servo amplifier is possible with just a few potentiometers.

As an alternative, configuration and commanding is also possible by means of a PC or PLC (CAN or RS232). This is particularly favourable with series application, as all adjustments and parameters can be set fast, reproducible and numerical.

The set value specification can be made conventionally with an analogue input (0 ... 5 V or  $\pm 10$  V), or digitally via the RS232 or CAN bus interfaces.

#### Objectives

This application note clarifies the Error management of the maxon servo amplifiers DES 50/5 and 70/10 with **Firmware version 1051h or higher**.

#### Required Tool

maxon motor DES Graphical User Interface GUI Version 1.10 or higher

Freely available at <http://www.maxonmotor.com> category «Service», subdirectory «Downloads», Order number 205679 or 228597.

#### References

maxon motor DES Communication Guide

Freely available at <http://www.maxonmotor.com> category «Service», subdirectory «Downloads», Order number 205679 or 228597.

**Initialisation phase (Errors 0 to 3)**

During the initialisation phase the rotor position will be detected by a special sequence. It calculates an initial angle from the pattern of the hall sensors and gets a more exact position due the edge of hall sensor 3 during the first 2 turns. Then it observes the index pulse of the encoder to get the reference angle for each rotor turn.

**Error 0** **Hall Sensor Error**

- Meaning:** Hall Sensor Error
- Caused by:**
- \* Wrong wiring of the hall sensors or the hall sensor supply voltage.
  - \* Damaged hall sensors of the motor.
- Remark:**
- \* Error 0 can only occur during the initialisation procedure after power on.
- Clear Error by:**
- \* This error requires a hardware reset! Switch off and on the power supply!
- Figure:** see figure Error 3

**Error 1** **Index Processing Error**

- Meaning:** Index Processing Error
- Caused by:**
- \* Encoder without or with none working index channel.
  - \* Too low setting of system parameter 'Encoder Resolution'.
  - \* To high input frequency of encoder signals.
  - \* Wrong wiring of encoder signals.
- Remark:**
- \* The index pulse of the encoder was not found within two turns.
- Clear Error by:**
- \* This error requires a hardware reset! Switch off and on the power supply!
- Figure:** see figure Error 3

**Error 2** **Wrong setting of encoder resolution**

- Meaning:** Wrong setting of encoder resolution
- Caused by:**
- \* The setting of the system parameter 'Encoder Resolution' is wrong.
- Remark:**
- \* Error 2 can only occur during the initialisation procedure after power on.
- Clear Error by:**
- \* This error requires a hardware reset! Switch off and on the power supply!
- Figure:** see figure Error 3

**Error 3**

**Hall Sensor 3 not found**

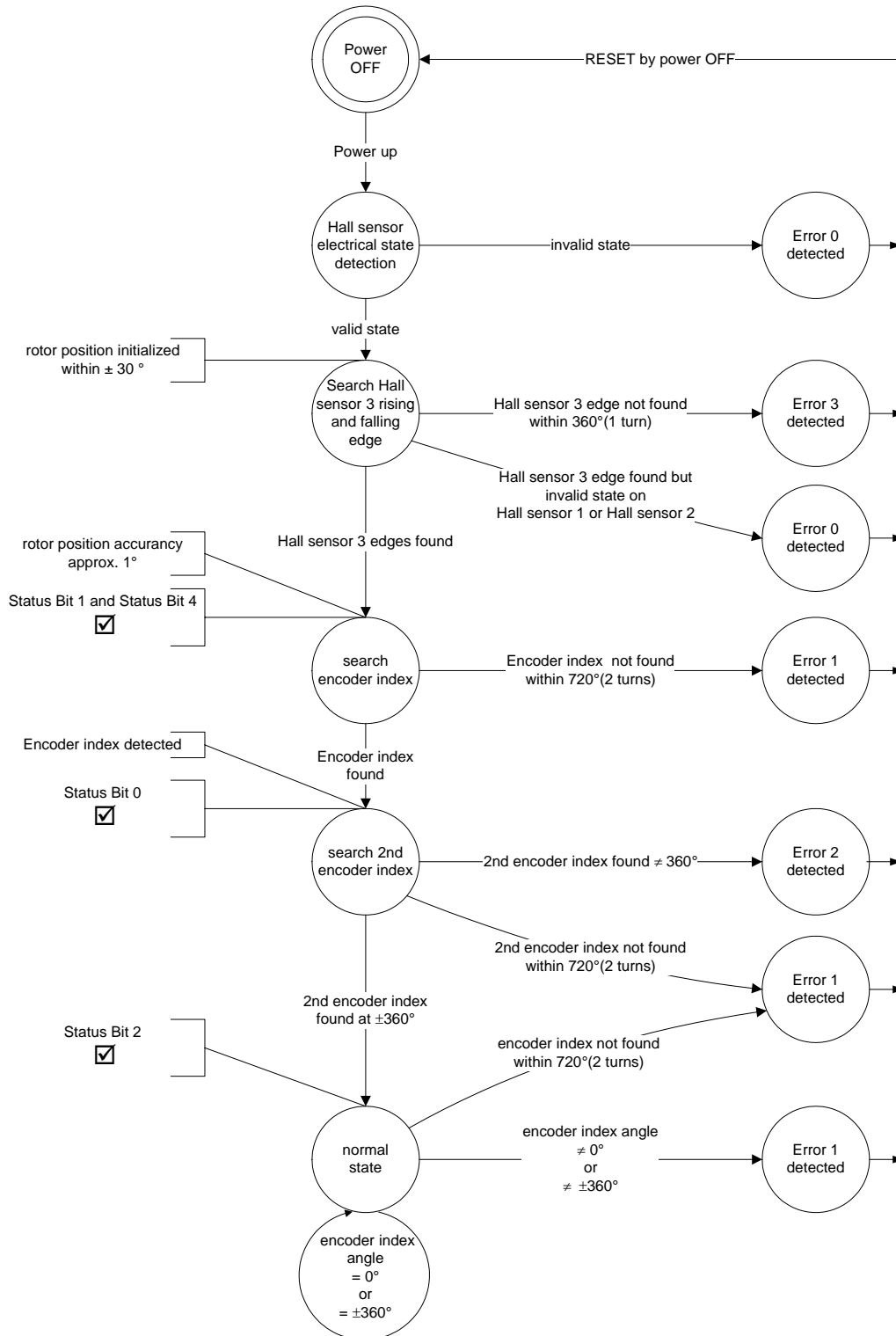
**Meaning:** Hall Sensor 3 not found

**Caused by:** \* Wrong wiring or defect hall sensor 3.  
\* Too low setting of system parameter 'Encoder Resolution'.

**Remark:** \* Error 3 can only occur during the initialisation procedure after power on.

**Clear Error by:** \* This error requires a hardware reset! Switch off and on the power supply!

**Figure:**



Running phase (Errors 4 to 15)

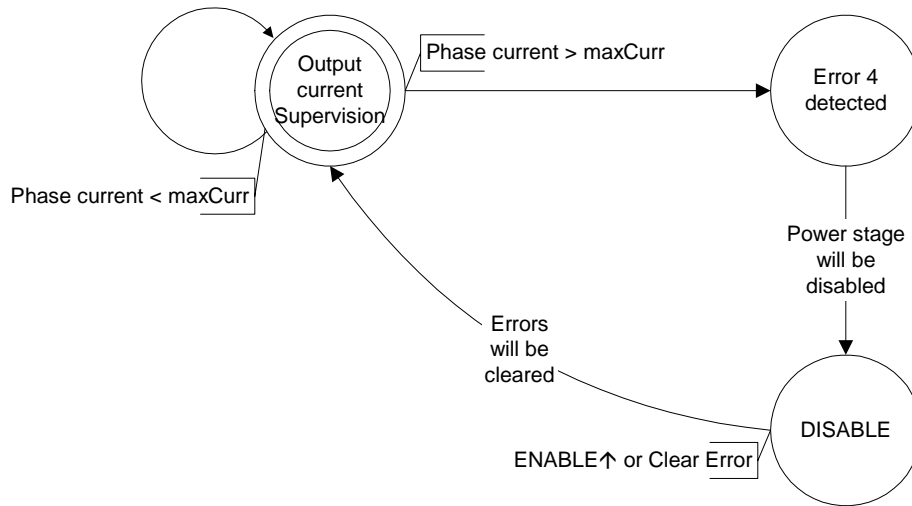
**Error 4** **Over Current Error**

**Meaning:** Over Current Error

- Caused by:**
- \* Short circuit at motor windings.
  - \* Regulation loop gain is too high.
  - \* System parameter 'Acceleration' too high.
  - \* Damaged power stage.
  - \* Overtemperature of power stage . (only on DES 70/10 Hardware version 4101h!)

- Clear Error by:**
- \* Send a 'ClearError' command via a communication port.
  - \* Set 'Enable' level from low to high (  $\_ \uparrow \_$  ).
  - \* Switch off and on the power supply.

**Figure:**



**Error 5**

**Over Voltage Error**

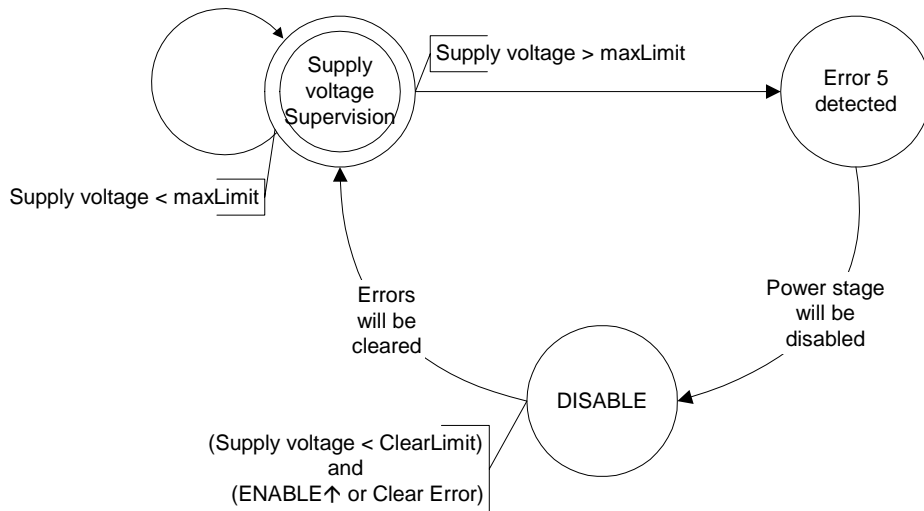
**Meaning:** Over Voltage Error

**Caused by:** \* The power supply voltage is too high.  
\* Too high voltage during deceleration mode (4Q).

**Remark:** \* Once reached the limit, the voltage has to decrease to the lower hysteresis limit otherwise the Error 5 can't be cleared

**Clear Error by:** \* Send a 'ClearError' command via a communication port.  
\* Set 'Enable' level from low to high ( \_↑ \_).  
\* Switch off and on the power supply.

**Figure:**



**Error 6** **Over Speed Error**

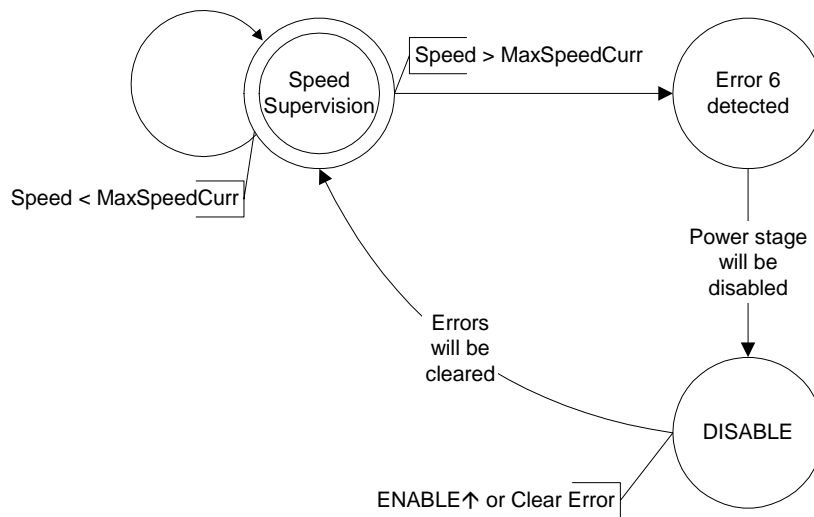
**Meaning:** Over Speed Error

**Caused by:** \* The speed in current control mode is higher then 'MaxSpeedCurr'.

**Remark:** \* Parameter 'MaxSpeedCurr' is set to 30'000rpm by default.  
 \* Within Firmware Version 1051 and higher the Over Speed Error is replaced by speed limitation in current mode.

**Clear Error by:** \* Send a 'ClearError' command via a communication port.  
 \* Set 'Enable' level from low to high (  $\_ \uparrow \_$  ).  
 \* Switch off and on the power supply.

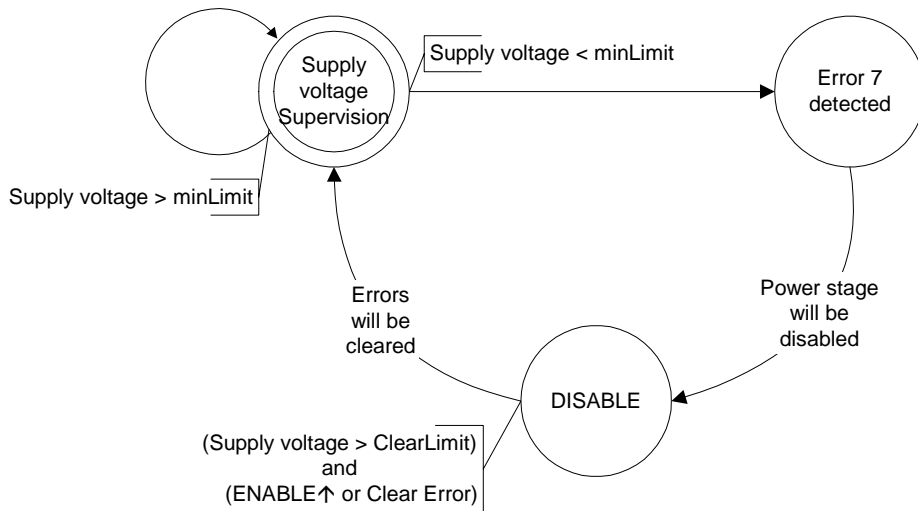
**Figure:**



**Error 7** **Supply voltage too low for operation**

- Meaning:** The supply voltage is too low for operation
- Caused by:**
- \* The voltage is too low.
  - \* The power supply can't supply the acceleration current.
- Remark:**
- \* Once reached the limit, the voltage has to rise to the higher hysteresis limit otherwise the Error 7 can't be cleared
- Clear Error by:**
- \* Send a 'ClearError' command via a communication port.
  - \* Set 'Enable' level from low to high (  $\_ \uparrow \_$  ).
  - \* Switch off and on the power supply.

**Figure:**



**Error 8**

**Angle detection error**

**Meaning:** Angle detection error

**Caused by:**

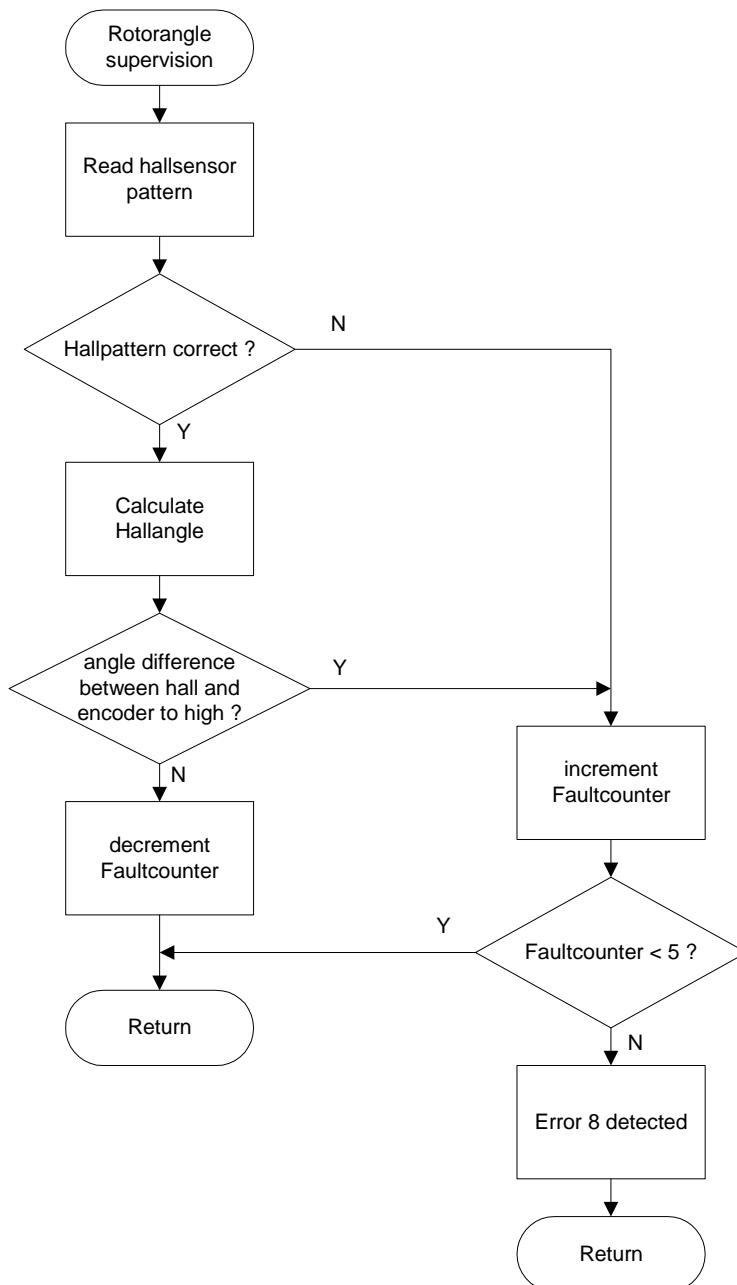
- \* Wrong wiring of Hall sensors or defect Hall sensors.
- \* Wrong wiring of encoder or defect encoder.
- \* Wrong setting of system parameter 'Encoder Resolution'.

**Remark:** \* In addition to the rotor position detection there is a continuous rotor angle supervision also (even during initialisation phase). For this the hall sensor signals will be observed and the rotor angle will be calculated from there pattern. If the hall sensor pattern is invalid or the angle differs to much from the angle calculated from encoder a Error 8 is set. For multi pole motors a higher angle difference is allowed as for two pole motors.

**Clear Error by:**

- \* Send a 'ClearError' command via a communication port.
- \* Set 'Enable' level from low to high (  $\_ \uparrow \_$  ).
- \* Switch off and on the power supply.

**Figure:**





**Error 9** **not defined**

**Meaning:** not defined

**Caused by:**

**Remark:**

**Clear Error by:**

**Figure:**

**Error 10** **not defined**

**Meaning:** not defined

**Caused by:**

**Remark:**

**Clear Error by:**

**Figure:**

**Error 11** **Over temperature error**

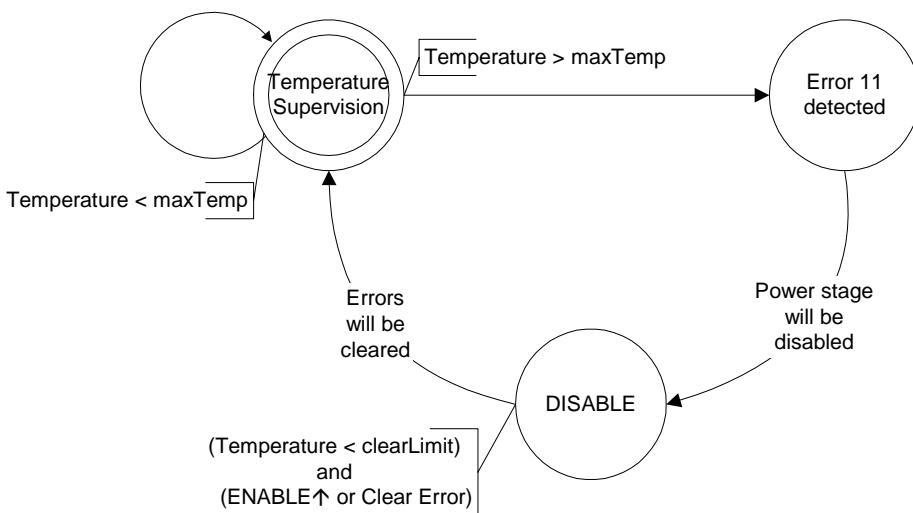
**Meaning:** Over temperature error

**Caused by:** \* The power stage temperature measured on PCB is too high

**Remark:** \* Once reached the limit, the temperature has to decrease to the lower hysteresis limit otherwise the Error 11 can't be cleared  
\* Only released on DES 50/5 Hardware version 4003h or higher.

**Clear Error by:** \* Send a 'ClearError' command via a communication port.  
\* Set 'Enable' level from low to high (↑).  
\* Switch off and on the power supply.

**Figure:**



**Error 12** **not defined**

**Meaning:** not defined

**Caused by:**

**Remark:**

**Clear Error by:**

**Figure:**

**Error 13** **Parameter out of range**

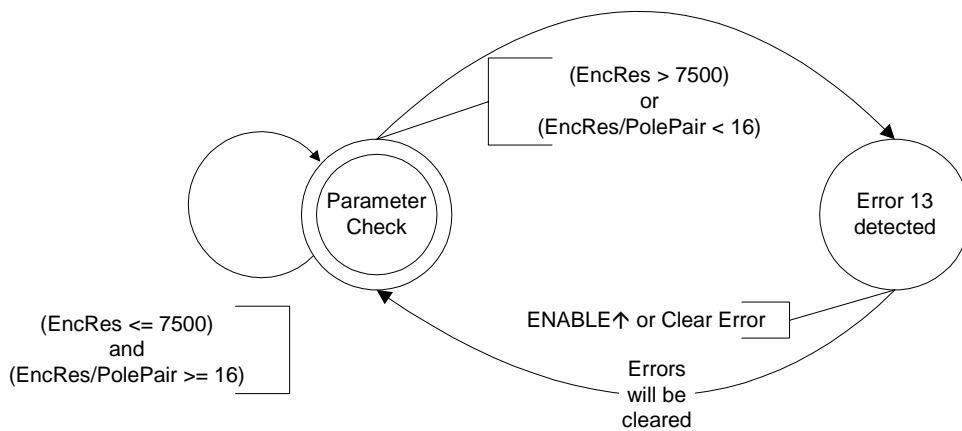
**Meaning:** Parameter out of range

**Caused by:** \* The system parameter 'Encoder resolution' is out of range.

**Remark:** \* The encoder resolution setting has to be less or equal then 7500 counts per revolution.  
 \* The encoder resolution divided by the number of pole pairs must be higher or equal then 16

**Clear Error by:** \* Send a 'ClearError' command via a communication port.  
 \* Set 'Enable' level from low to high (  $\_ \uparrow \_$  ).  
 \* Switch off and on the power supply.

**Figure:**



**Error 14** **not defined**

**Meaning:** not defined

**Caused by:**

**Remark:**

**Clear Error by:**

**Figure:**

<b>Error 15</b>	<b>Error summary</b>
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**Meaning:** Error summary

**Caused by:** \* One or more Errors (0..14) are set.

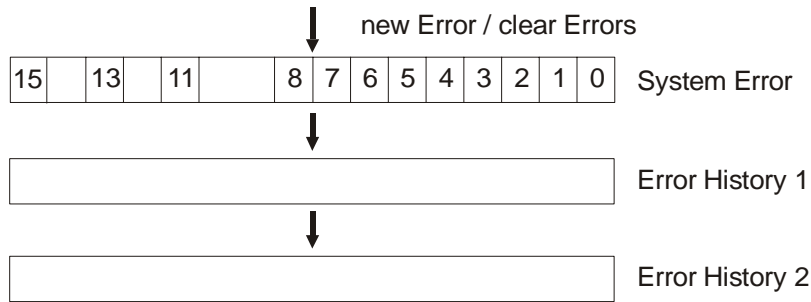
**Remark:**

**Clear Error by:** \* Clearing of occurred Error Bit (0..14)

**Figure:**

### Error register

An extended Error management is implemented in Firmware version 1050h. The detected Errors are represented by the bits of an internal Error word. If a new Error is detected the DES is set to the Error state (with disabling or stopping drive). The Error state register 'System Error' is readable via communication ports. The old value of 'System Error' Register is shifted to 'Error History 1' and its old value to 'Error History 2'.



## Definition of the system operating status

BIT 0:	0: encoder index not found yet 1: encoder index found	
BIT 1:	0: hall sensor edge 1 not found yet 1: hall sensor edge 1 found	
BIT 2:	0: rotor position not found yet 1: rotor position found	
BIT 3:	0: not saving the system parameters in EEPROM 1: saving the system parameters in EEPROM	
BIT 4:	0: hall sensor edge 2 not found yet 1: hall sensor edge 2 found	
BIT 5:	0: measure Vmax/Offset 1: measure Temperature	} only available since HW 4003h and higher
BIT 6:	0: ±10V SetValue 1: 0 ... 5V SetValue	
BIT 7:	0: Max current set to peak current 1: Max. current reduced to continuous current	
BIT 8:	0: in the small current region 1: in the large current region	
BIT 9:	0: no error 1: error	
BIT 10:	0: software disabled 1: software enabled	
BIT 11:	0: not debouncing the enable input 1: debouncing the enable input	
BIT 12:	0: no offset in current circuit detected 1: offsets in current circuit detected	
BIT 13:	0: not braking 1: braking with the maximum setting current	
BIT 14 + 15:	0 + 0 : power stage is disabled 0 + 1 : refresh the power stage 1 + 0 : power stage is enabled 1 + 1 : power stage is enabled	

The system operating status can be monitored using the Graphical User Interface GUI. Open the menu 'Status' and click the menu item 'Read System Status' to see the following dialog.  
(Activate the automatic refresh mode to see the bit states changing during the initialisation.)

