MANUFACTURER DOCUMENT PACKAGE

Manufacturer's Manual

Selected official pages for procurement and maintenance review

PRODUCT BRAND

Siemens

PRODUCT MODEL

6ES7331-7NF10-0AB0

Eight-Channel Analog Input Module. Relevant section pages: 264, 265, 266, 267, 268, 269, 270, 271, 272, 273. Adjacent model text on shared pages is outside this product reference.

OFFICIAL SOURCE

S7-300 Module data; 05/2022, A5E00105505-AK

Siemens original documentation and product reference

AMIKON PRODUCT SUPPORT

+86-18020776786 INFO@AMIKON.CN

AMIKONG.COM

Amikon Limited prepared this independent reference package. Selected manufacturer pages follow with their original content and pagination visible.

SIEMENS

SIMATIC

S7-300
S7-300 Module data

Equipment Manual

General technical data 1

Power supply modules 2

Digital modules 3

Principles of analog value processing 4

Principles of analog modules 5

Analog modules 6

Other signal modules 7

Interface modules 8

Parameter sets of signal modules A

Diagnostics data of signal modules B

Dimensional drawings C

Spare parts and accessories for S7-300 modules D

Directive on handling Electrostatic-Sensitive Devices (ESD) E

Service & support F

Safety-relevant symbols G

Continued on next page

05/2022
A5E00105505-AK

S7-300
S7-300 Module data

Equipment Manual

Legal information

Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

⚠ DANGER

indicates that death or severe personal injury **will** result if proper precautions are not taken.

⚠ WARNING

indicates that death or severe personal injury **may** result if proper precautions are not taken.

⚠ CAUTION

indicates that minor personal injury can result if proper precautions are not taken.

NOTICE

indicates that property damage can result if proper precautions are not taken.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

Proper use of Siemens products

Note the following:

⚠ WARNING

Siemens products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Siemens. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be complied with. The information in the relevant documentation must be observed.

Trademarks

All names identified by ® are registered trademarks of Siemens AG. The remaining trademarks in this publication may be trademarks whose use by third parties for their own purposes could violate the rights of the owner.

Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

Siemens AG
Digital Industries
Postfach 48 48
90026 NÜRNBERG
GERMANY

A5E00105505-AK
Ⓟ 05/2022 Subject to change

Copyright © Siemens AG 2001 - 2022.
All rights reserved

Properties

- 8 inputs in 4 channel groups
- Programmable measurement type at each channel group
  - Voltage
  - Current
- Programmable resolution for each channel group (15 bits + sign)
- Any measuring range selection per channel group
- Programmable diagnostics and diagnostic interrupt
- Programmable limit value monitoring for 8 channels
- Programmable hardware interrupt when limit is exceeded
- Programmable hardware interrupt at end of cycle
- High-speed update of measured values at up to 4 channels
- Electrical isolation to the CPU
- Supports parameter reassignment in RUN

Diagnostics

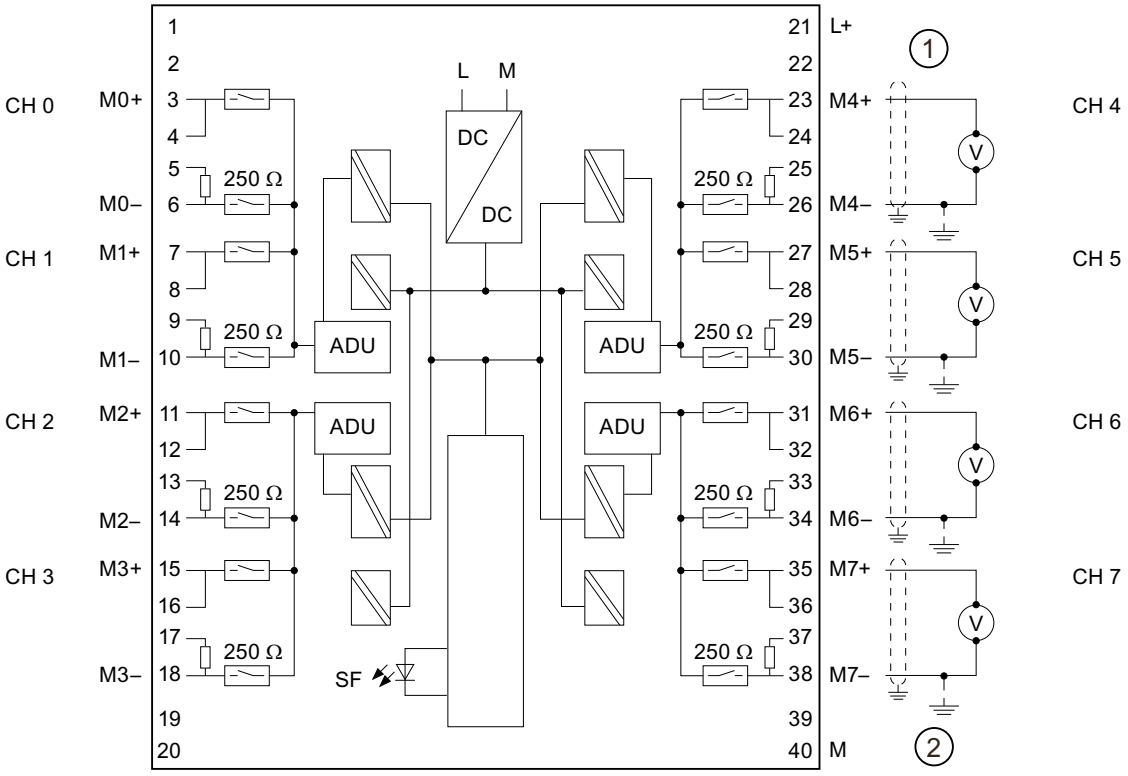
For information on diagnostic messages at the "group diagnostics" parameter, refer to the table *Diagnostic messages of analog input modules*.

Terminal assignment

The diagrams below show various wiring options

Wiring: Voltage and current measurement

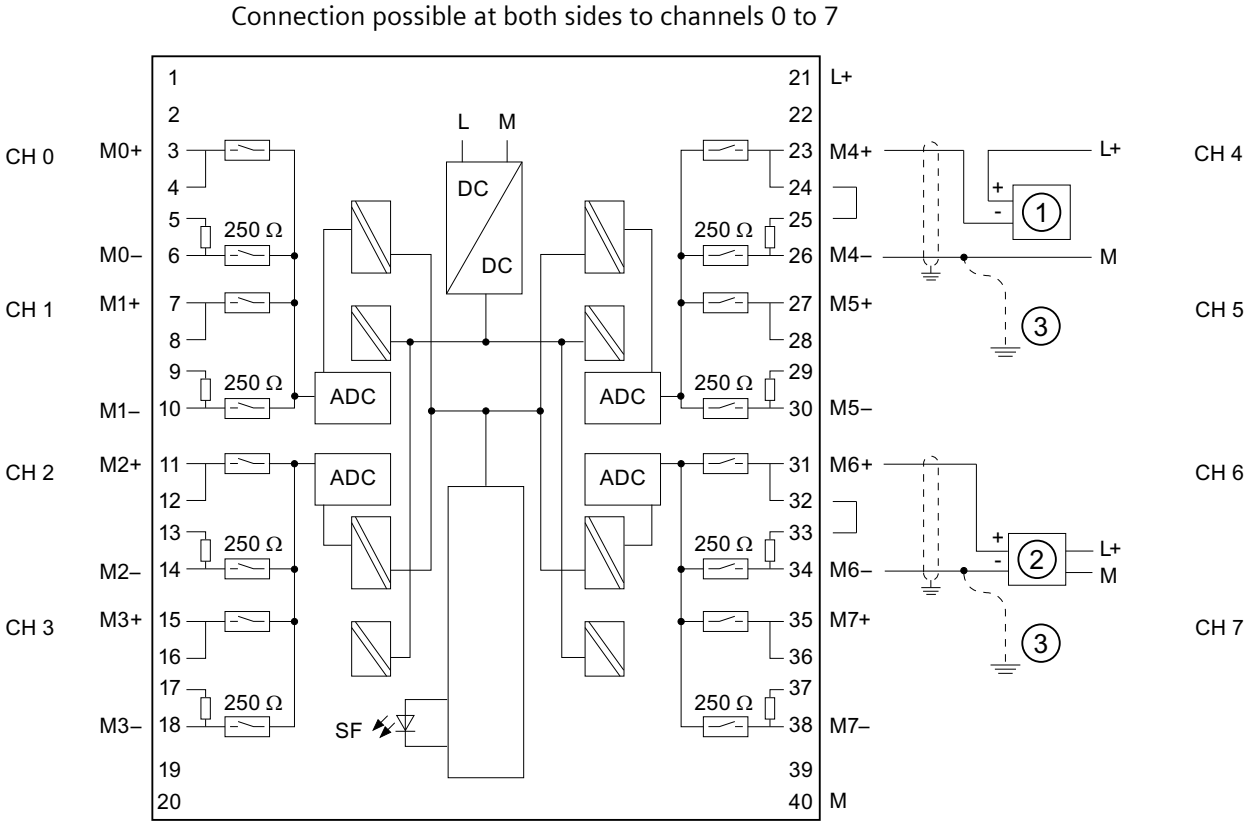
Connection possible at both sides to channels 0 to 7



① Connection for voltage measurement
② Equipotential bonding

Figure 6-3 Wiring and block diagram

Wiring: 2-wire and 4-wire transducer



① 2-wire transducer
② 4-wire transducer
③ Equipotential bonding

Figure 6-4 Wiring and block diagram

Technical specifications

Technical specifications	
Dimensions and weight	
Dimensions W x H x D (mm)	40 x 125 x 117
Weight	ca. 272 g
Module-specific data	
Supports parameter reassignment in RUN	Yes
Response of non-programmed inputs	Return the process value which was valid before configuration
Supports isochronous mode	no
Number of inputs	8
Cable length • shielded	 max. 200 m
Voltages, currents, electrical potentials	
Rated electronics supply voltage L +	24 V DC

Technical specifications	
• Reverse polarity protection	yes
Electrical isolation	
• between channels and the backplane bus • between channels and electronics power supply • between channels in groups of	yes yes yes 2
Isolation test voltage	500 V AC
Current consumption	
• from the backplane bus • from supply voltage L+	max. 100 mA max. 200 mA
Power loss of the module	typ. 3.0 W
Generation of analog values	
Measuring principle	Integrating
Integration/conversion time/resolution (per channel)	
• programmable • Basic conversion time in ms (8-channel mode) • Basic conversion time in ms (4-channel mode) • Resolution, including sign • Interference frequency suppression at frequency f1 in Hz	yes 95/83/72/23 10[1) 4)] 16 bits All[2)]/50/60/400
Measured value smoothing	None / low/ average/ high
Basic execution time of the module, in ms (8-channel-mode)	190/166/144//46
Basic execution time of the module, in ms (4-channel-mode)	10[1)]
Interference frequency suppression, error limits	
Interference frequency suppression at F = n x (f1 1%)(f1 = interference frequency, n = 1, 2, ...)	
• Common mode interference (VCM < AC 60 V) • Series mode interference (peak value of disturbance < rated input range)	> 100 dB > 90 dB [3)]
Crosstalk between inputs	> 100 dB
Operational limit (across entire temperature range, relative to the measurement range end value in the selected input range)	
• Input voltage • Input current	±0.1% ±0.1%
Basic error limit (operational limit at 25 °C, relative to the measurement range end value in the selected input range)	
• Voltage input • Current input	±0.05% ±0.05%
Temperature error (relative to input range)	± 0.005%/K
Linearity error (relative to input range)	±0.01%
Repeat accuracy (in settled state at 25 °C, relative to measurement range end value in the input range)	±0.01%
Status, interrupts, diagnostics	
Interrupts	

Technical specifications	
• Hardware interrupt when limit value is exceeded • Hardware interrupt at end of cycle • Diagnostic interrupt	Programmable channels 0 to 7 programmable programmable
Diagnostic functions	programmable
• Group error display • Reading diagnostic information	red LED (SF) supported
Encoder selection data	
Input range (rated values) / input impedance	
• Voltage	± 5 V / 2 MΩ 1 V to 5 V / 2 MΩ ± 10 V / 2 MΩ
• Current	0 mA to 20 mA / 250 Ω 4 mA to 20 mA / 250 Ω ± 20 mA / 250 Ω
Maximum voltage at voltage input (destruction limit)	35 V continuous; 75 V for max. duration of 1 s (duty factor 1:20)
Maximum current at current input (destruction limit)	40 mA
Wiring of the signal transmitters	using a 40pin front connector
• for voltage measurement • for current measurement as 2-wire transducer as 4-wire transducer	supported possible, with separate transducer supply supported
[1] Interference frequency for 4-channel mode is "All" [2] Interference frequencies 50/60/400 Hz are designated as "All" [3] The series mode rejection in 8-channel mode is reduced as follows: 50 Hz > 70 db 60 Hz > 70 db 400 Hz > 80 dB 50/60/400 Hz > 90 dB [4] In 4-channel mode, the converted value settles to 100% within 80 ms. The value determined in this process is returned at intervals of max. 10 ms.	

Reassigning parameters in RUN

If you reassign parameters in RUN, the following special characteristic applies.

SF LED is lit:

If a diagnostics was pending prior to reconfiguration, the SF LEDs (on CPU, IM or module) may be lit even though diagnostics is no longer pending and the module is operating correctly.

Solution:

- Only assign new parameters if no diagnostics is pending, or
- unplug module and plug it in again.

6.4.1 Measurement types and measuring ranges

Introduction

The measurement type and range is configured at the "measuring type" parameter in *STEP 7*.

Table 6-9 Measurement types and ranges

Selected type of measurement	Output range
Voltage V:	± 5 V, from 1 V to 5 V, ± 10 V
Current (4-wire transducer) 4DMU	0 mA to 20 mA 4 mA to 20 mA ± 20 mA

Channel groups

The channels of SM 331; AI 8 x 16 bits are arranged in four groups of two channels. You always assign parameters to a group. The interrupt limits form the exception.
The table below shows the relevant configuration of channel groups. The channel group number is required to program SFC parameters in the user program.

Table 6-10 Assignment of SM 331; AI 8 x 16 Bit channels to channel groups

Channels ...	...form one channel group each
Channel 0	Channel group 0
Channel 1	
Channel 2	Channel group 1
Channel 3	
Channel 4	Channel group 2
Channel 5	
Channel 6	Channel group 3
Channel 7	

6.4.2 Programmable parameters

Introduction

For information on programming analog modules, refer to the chapter Programming analog modules (Page 244).

Parameter

Table 6-11 Overview of parameters of SM 331; AI 8 x 16 Bit

Parameters	Range of values	Defaults	Parameter type	Scope
Enable • Process interrupt when limit value is exceeded • Process interrupt at end of cycle • Diagnostics interrupt	 yes/no yes/no yes/no	 no no no	 dynamic dynamic dynamic	Module

Parameters	Range of values	Defaults	Parameter type	Scope
Process interrupt trigger • High limit • Low limit	 32511 to -32512 -32512 to 32511	 - -	 dynamic dynamic	 Channel Channel
Diagnostics • Group diagnostics • Line continuity check	 yes/no yes/no	 no no	 static	 Channel Channel
Measurement • Module operating mode • Noise suppression	 • 8 channels • 4 channels 50 Hz 60 Hz 400 Hz 50/60/400 Hz	 yes no 50/60/400 Hz	 dynamic	 Module Channel group
• Smoothing	• none • weak • medium • strong	none	dynamic	Channel group
• Measurement type	• Measuring range:		dynamic	Channel group
disabled				
Voltage	• ± 5 V • 1 V to 5 V • ± 10 V	± 10 V		
Current (4-wire transducer)	• 0 mA to 20 mA • 4 mA to 20 mA • ± 20 mA	4 mA to 20 mA		

See also

Diagnostics messages of analog input modules (Page 246)
Programming analog modules (Page 244)

6.4.3 Additional information for SM 331; AI 8 x 16 Bit

Modes of operation

Operating modes of SM 331; AI 8 x 16 Bit:

- 8-channel mode
- 4-channel mode

8-channel operating mode

In this mode, the module changes between the two channels of each group. Since the module contains four analog/digital converters (ADC), all four ADCs convert simultaneously for channels 0, 2, 4 and 6. After converting the channels with the even numbers, all ADCs simultaneously convert for the channels with the odd numbers 1, 3, 5 and 7 (see the figure below).

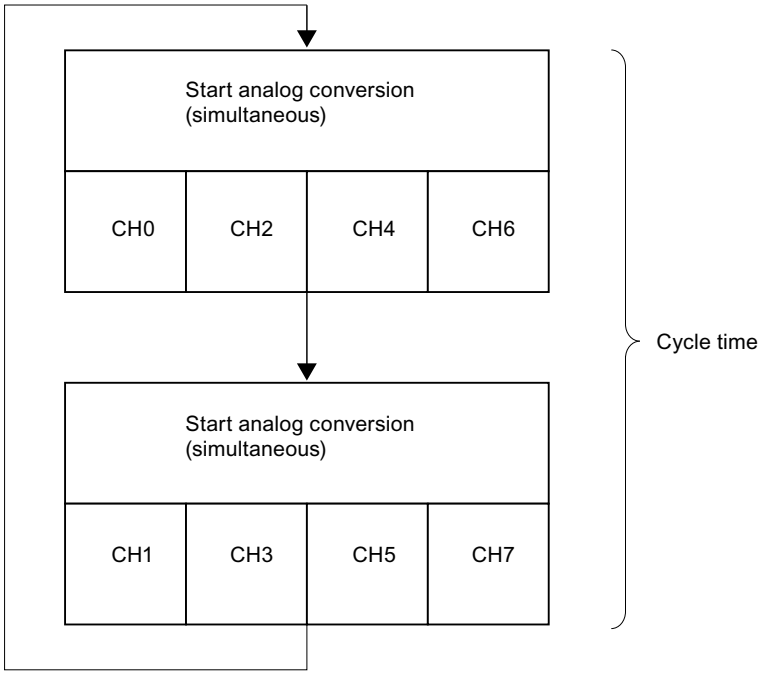


Figure 6-5 8-channel mode cycle time

Cycle time of module in 8-channel mode

The channel conversion time is based on the programmed noise suppression. The channel conversion time is 76 ms, including communication time, at a set interference frequency of 50 Hz. The channel conversion time is 65 ms when you set an interference frequency of 60 Hz. You can reduce channel conversion times to 16 ms by setting an interference frequency of 400 Hz. When you set 50, 60 and 400 Hz , the channel conversion time amounts to 88 ms. The module then has to switch to a different channel of the group by means of the OptoMOS relay. Opto-MOS relays require 7 ms for switching and settling. The following table shows this relationship.

Table 6-12 Cycle times in 8-channel mode

Interference frequency (Hz)	Channel cycle time (ms)	Module cycle time (all channels)
50	83	166
60	72	144
400	23	46
50/60/400	95	190

4-channel operating mode

In this mode, the module does not change between the channels of the groups. The four ADCs of the module simultaneously convert the channels 0, 2, 4 and 6.

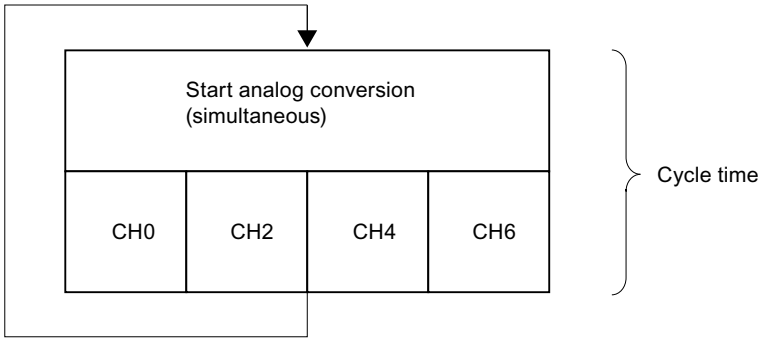


Figure 6-6 4-channel mode cycle time

Module cycle time

The converted value settles to 100% within 80 ms and is updated every 10 ms when 4-channel mode is set. The channel and module cycle times are always identical, because the module does not change between the channels of a group: 10 ms.
Channel conversion time = channel cycle time = module cycle time = 10 ms

Unused channels

Set the "disabled" value at the "measuring method" parameter for unused channels. This setting reduces module cycle times.

As certain programmed inputs may remain unused due to the channel group configuration in 8-channel mode, make allowances for the special features of these inputs outlined below to activate the diagnostics functions at the channels being used:

- **Measuring range 1 V to 5 V:** wire the used input and unused input of the same channel group in parallel.
- **Current measurement, 4 to 20 mA:** Connect unused input in series to the input of the same channel group. A shunt resistor must be connected for each programmed and unused channel.
- **Other measuring ranges:** Short-circuit the plus and minus inputs of the channel.

Line continuity check

The wire break test is available for the voltage measuring range 1 to 5 V and the current measuring range 4 to 20 mA.

When there is a configured measuring range of 1 to 5 V or 4 to 20 mA and the wire break test is **activated**, the analog input module reports a wire break in the diagnostics when underflow (-32768) is reached.

- The module also triggers a diagnostic interrupt if this function is enabled in the program.
- A wire break can only be signaled by means of the lit SF LED and the diagnostic bytes must be evaluated in the user program if diagnostic interrupts are disabled.

Under the following circumstances, wire-break detection can take up to 2 s:

- If a wire break occurs during voltage measurement.
- If a wire break occurs on the front-connector jumpers from shunt (250 Ω) to the inputs during current measurement.

The measured value can go through the entire valid value range during the wire break detection.

When there are configured measuring ranges ± 10 V, ± 5 V, 1 to 5 V or 4 to 20 mA, the wire break test is **not activated** and a diagnostic interrupt is enabled, the module triggers a diagnostic interrupt when the underflow is reached. The module detect the underflow when the input signal is below 0.296 V or 1.185 mA.

Overflow, underflow and hardware interrupt limits

The limits in diagnostics response to overflow and underflow in certain measuring ranges differ compared to the listed ranges starting at the chapter*Analog value representation for analog input channels* of the manual. In certain situations the numerical methods of the module software used to evaluate the process variables do not return values up to 32511.

Do not set any hardware interrupt limits higher than the lowest possible overflow or underflow response limits. End of cycle interrupt starting at the chapter *Analog value representation for analog input channels*.

End of cycle interrupt

You can synchronize a process with the conversion cycle of the module by enabling the end of cycle interrupt. The interrupt is set when enabled channels have been converted.

The table below shows the contents of the 4 bytes of additional OB40 information during process or end of cycle interrupts.

Content of the 4 bytes of additional information		27	26	25	24	23	2^2	2^1	2^0	Byte
Special analog flags	2 bits per channel to identify the range									
	High limit exceeded at channel	7	6	5	4	3	2	1	0	0
	Low limit exceeded at channel	7	6	5	4	3	2	1	0	1
	End of cycle event						X			2
	Free bit									3

Operation of the module on the ET 200M Distributed IO devices

Operation of SM 331; AI 8 x 16 Bit on ET 200M requires one of the following IM 153 x:

- IM 153-1; as of 6ES7153-1AA03-0XB0, E 01
- IM 153-2; as of 6ES7153-2AA02-0XB0; E 05
- IM 153-2; as of 6ES7153-2AB01-0XB0; E 04

Programming restrictions when operating SM 331; AI 8 x 16 Bit on PROFIBUS masters which only support DPV0

Certain parameters are not supported when operating an electrically isolated SM 331; AI 8 16 Bit analog input module on an ET200M PROFIBUS slave system in combination with a PROFIBUS master which is not an S7 master. Non-S7 masters do not support hardware interrupts. All parameters associated with these functions are disabled for this reason. This includes hardware interrupt enable, hardware restrictions and end the enabling of cycle interrupts. All other parameters are allowed.