

February 2015

ECOsine® active Harmonic Filters

Manual Expert Parameters (V07)

SCHAFFNER
energy efficiency and reliability



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Revision: **7** (February 2015)

The most current edition of these instructions (PDF format) can be obtained from your contact of the Schaffner organization.

Other technical documentation of our products is also available in the download area of our website www.schaffner.com

Valid for firmware version:

From V02.08.19 on

(For firmware version, see parameter P010)

Meaning of firmware version number:

V XX.xx.xx – hardware release, downwards incompatible

V xx.XX.xx – function version

V xx.xx.XX – small compatible changes

Document name:

Manual Expert Parameter Rev07.pdf

Version history

Revision	Date	Description
07	February 2015	New parameter P557
06	October 2013	New parameter P556 New factory setting P505
05	February 2011	New function P554, P178, P179 resonance detection
04	December 2010	New functions in P536
03	August 2010	New functions for version 02.07.xx P535, 536, 537, 544, 551, 552, 553
02	June 2009	New parameter 538
01	February 2008	New parameters P506, 507, 539, 544 - 549

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1 General Safety Instructions

1.1 Intended use

The ECOsine® active harmonic filter is used for active compensation of reactive power and harmonic content and for load balancing.

Please ensure that no compensation systems, which are not detuned, are connected to the same grid. Otherwise interactions between ECOsine® active and these compensation systems may occur.



DANGER

Dangerous voltage

Risk of death due to short circuits and electric shock if the active filter is opened improperly. The discharge time of the intermediate circuit after disconnecting from the mains can be more than 5 minutes.

All interventions involving opening the device cover or removing or installing the connection cable may only be performed by qualified personnel.



WARNING

High-frequency interferences

In a residential environment, high-frequency interferences could occur, which necessitate interference suppression.

Note

Please note that there are additional manuals for some product variants. For the latest versions of these manuals go to www.schaffner.com


It particularly applies to types FN3420-100/120-400-3-GL, please observe the special EMC-Filter Manual for these types (ECOsine EMC Filters for Applications with GL)

1.2 Personnel qualification

Installation of the ECOSine® active filter, inspections for proper operation, and certain troubleshooting measures may only be performed by qualified personnel. All other measures may be performed by people who have read these instructions.

1.3 Environmental conditions / Exclusion of warranty

This document classifies groups of environmental parameters and their severities to which ECOsine® active harmonic filters are subjected when mounted for stationary use at weather protected locations under use conditions, including periods of erection work, down time, maintenance and repair. The lifetime of electronic equipment is depending on the environmental conditions they are exposed to. Especially in harsh environments lifetime is reduced due to the corrosiveness of the atmospheric environment. Generally corrosion in micro or power electronics depends on several variants such as the package type, materials involved, assembly processes, moisture, inorganic and organic contaminants, atmospheric pollutants, temperature, thermal stress and electrical bias. To increase the lifetime Schaffner provides all ECOsine® active filters with the ability to work within pollution degree 2 (PD2) and does use coated PCB's according to IEC61721-3-3. Schaffner standard PCB construction complies with class 3C2. Please carefully read the provided information and check if your application fulfills the required specifications as **Schaffner expressly points out that the manufacturer's warranty shall lapse with immediate effect if ECOsine® active harmonic filters are transported, stored, installed or operated outside their published specifications.**

<p>Important</p> 	<p>ECOsine® active harmonic filters (AHF) listed below are IP20 or IP54 devices to be installed in an environment in compliance with the requirements named in this document.</p> <p>All AHF must be installed in a clean, dry location, e.g. in sufficiently ventilated or air conditioned electric cabinets or closed electric rooms. Contaminants such as oils, liquids, corrosive vapors, abrasive debris, dust and aggressive gases must be kept out of the filter enclosure.</p> <p>WARNING: Conductive dust may cause damage to ECOsine® active harmonic filters. Ensure that installation site of ECOsine® active is free of conductive dust.</p>
<p>Products</p>	<p>FN3420 series, 3-wire filters, models 30...300A FN3430 series, 4-wire filters, models 30...300A</p>
<p>Overvoltage class (EN50178)</p>	<p>ECOsine® active are designed according to EN 50178 overvoltage class III</p>

<p>Storage environmental specifications (IEC 60721-3-1, EN50178)</p>	<p>Climate conditions for storage class 1K3:</p> <ul style="list-style-type: none"> • Temperature range: -25°C to +55°C • Relative humidity: < 95%, no condensation • Atmospheric pressure: 70KPa to 106KPa 																																										
<p>Transportation environmental specifications (IEC 60721-3-2, EN50178)</p>	<p>Climate conditions for transport class 2K3:</p> <ul style="list-style-type: none"> • Temperature range: -25°C to +70°C • Relative humidity: < 95%, no condensation • Atmospheric pressure: 70KPa to 106KPa 																																										
<p>Operation environmental specifications (IEC 60721-3-3, EN50178)</p>	<p>Climate conditions for operation class 3K3:</p> <ul style="list-style-type: none"> • Temperature range: 0°C to +40°C • Relative humidity: < 95%, no condensation • Atmospheric pressure: 70KPa to 106KPa 																																										
<p>Degree of pollution (IEC 61010, EN50178)</p>	<p>Pollution conditions for operation class PD2</p>																																										
<p>Corrosive levels (IEC 60721-3-3)</p>	<p>Corrosive levels for storage, transport and operation Class 3C2⁽³⁾:</p> <ul style="list-style-type: none"> • Applies to locations with normal levels of contaminants, experienced in urban areas with industrial activities • Levels: <table border="1" data-bbox="533 1227 1353 1765"> <thead> <tr> <th rowspan="2">Environmental parameter</th> <th rowspan="2">Units⁽¹⁾</th> <th colspan="2">Class 3C2⁽²⁾</th> </tr> <tr> <th>Mean value</th> <th>Max value</th> </tr> </thead> <tbody> <tr> <td>Sea salt</td> <td></td> <td colspan="2">Salt mist</td> </tr> <tr> <td>Sulphur dioxide</td> <td>ppm cm³/m³</td> <td>0.3 0.11</td> <td>1.0 0.37</td> </tr> <tr> <td>Hydrogen sulphide</td> <td>ppm cm³/m³</td> <td>0.1 0.071</td> <td>0.5 0.36</td> </tr> <tr> <td>Chlorine</td> <td>ppm cm³/m³</td> <td>0.1 0.034</td> <td>0.3 0.1</td> </tr> <tr> <td>Hydrogen chloride</td> <td>ppm cm³/m³</td> <td>0.1 0.066</td> <td>0.5 0.33</td> </tr> <tr> <td>Hydrogen fluoride</td> <td>ppm cm³/m³</td> <td>0.01 0.012</td> <td>0.03 0.036</td> </tr> <tr> <td>Ammonia</td> <td>ppm cm³/m³</td> <td>1.0 1.4</td> <td>3.0 4.2</td> </tr> <tr> <td>Ozone</td> <td>ppm cm³/m³</td> <td>0.05 0.025</td> <td>0.1 0.05</td> </tr> <tr> <td>Nitrogen oxides</td> <td>ppm cm³/m³</td> <td>0.5 0.26</td> <td>1.0 0.52</td> </tr> </tbody> </table> <p>⁽¹⁾The values given in cm³/m³ have been calculated from the values given in mg/m³ and refer to a temperature of 20 °C and a pressure of 101,3 kPa. The table uses rounded values.</p> <p>⁽²⁾Mean values are expected long-term values. Maximum values are limit or peak values, occurring over a period of time of not more than 30 min per day.</p> <p>⁽³⁾IEC 60721-3-3 is only applied to the coated PCB covered areas and not the entire device. The unprotected areas, such as connections, terminations and exposed magnetics, may not survive these exposure levels over time.</p>	Environmental parameter	Units ⁽¹⁾	Class 3C2 ⁽²⁾		Mean value	Max value	Sea salt		Salt mist		Sulphur dioxide	ppm cm ³ /m ³	0.3 0.11	1.0 0.37	Hydrogen sulphide	ppm cm ³ /m ³	0.1 0.071	0.5 0.36	Chlorine	ppm cm ³ /m ³	0.1 0.034	0.3 0.1	Hydrogen chloride	ppm cm ³ /m ³	0.1 0.066	0.5 0.33	Hydrogen fluoride	ppm cm ³ /m ³	0.01 0.012	0.03 0.036	Ammonia	ppm cm ³ /m ³	1.0 1.4	3.0 4.2	Ozone	ppm cm ³ /m ³	0.05 0.025	0.1 0.05	Nitrogen oxides	ppm cm ³ /m ³	0.5 0.26	1.0 0.52
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2 Introduction

2.1 Functions of the active filter

The ECOSine® active filter enables:

- Reduction of the current THD
- Reduction of the harmonic current content
- Compensation of reactive power and an improvement of the power factor $\cos \varphi$, inductive and capacitive
- Display of mains current and voltage
- Load balancing

2.2 Principle of operation

The ac mains current, which is drawn by a non-linear load, is measured by ECOsine® active either directly or indirectly via external current transformers. The harmonic content and reactive power components are detected and processed in a digital control structure. The active filter continually generates a compensating current that offsets the harmonic content and reactive current in the load, so the ac mains only has to provide the minimum fundamental in phase current.

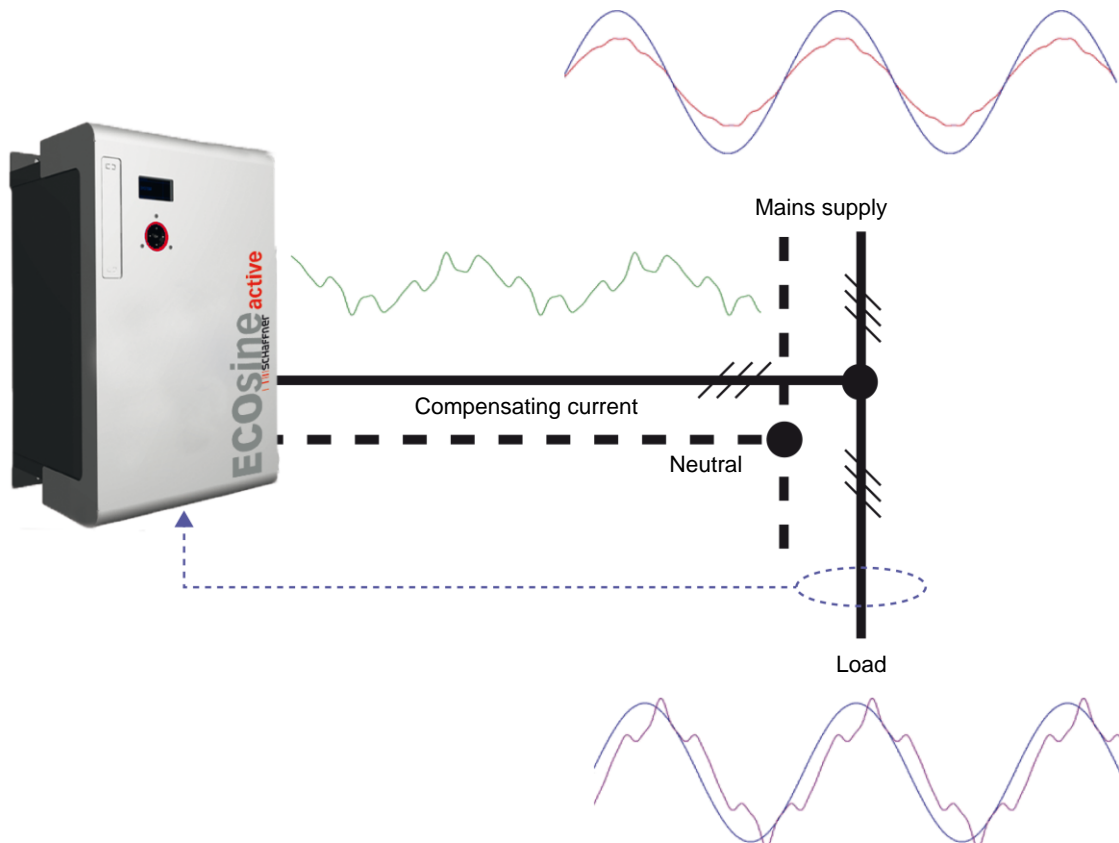


Fig. 1: Principle of operation of the ECOsine® active filter

The active filter instantly adapts to all changes in the load and the systems harmonic content spectrum, in order to be able to optimally respond at any time.

2.3 About these instructions

The following symbols, terms and designations are used in these operating and installation instructions:





	Description
NOTICE	Notice Follow these instructions to avoid damages to the unit.
 CAUTION	Caution Follow these instructions to avoid damages to the unit or injuries of personnel.
 WARNING	Warning Follow these instructions to avoid situations which may cause severe or deadly injuries.
 DANGER	Danger Follow these instructions to avoid situations which may cause severe or deadly injuries.
 DANGER	Dangerous voltage Follow these instructions to avoid situations which cause severe or deadly injuries due to dangerous electrical voltage.
NOTE Note text	Note Please observe these notes..
⇒ 1. 2.	Operation steps Complete the operation described (multiple steps are numbered, arrow indicates a single step).

Table 1: Use of symbols, terms, and designations

2.4 Type plate

I I III SCHAFFNER
FN3430-30-400-4
 ACTIVE HARMONIC FILTER

Nominal operating voltage	380...415V
Operating frequency	50/60Hz
Compensation current	30A
Ambient temperature	0 to +40°C
Refer to user manual	

1234567 88 YYWWP 810162

123456700001

Type code
Serial number
 WO 1234567 + S/N 00001

Part number
Date of manufacture (year (yy) + calendar week (ww))
WO number

2.5 Type code

The type designations of all ECOsine® active have the following structure:
FN34TT-AAA-VVV-W-CC

Variable	Description
TT	Type: 20 – 3-wire device 30 – 4-wire device
AAA	Rated current
VVV	Rated voltage
W	Number of compensated conductors
CC	Certificates and variants (optional)

Table 2: Type code

3 Welcome

3.1 About this manual

This manual is meant to provide comprehensive information on expert parameters of the ECOsine® active harmonic filter series. The issues discussed in this guide cover the necessary theoretical conceptions as well as practical aspects of working with ECOsine® active expert parameters. The guide will familiarize you with the way expert parameters are used to change default settings of the filters.

3.2 Who should read this guide

The primary audiences for this book are experts responsible for administering ECOsine® active harmonic filters. To fully understand the guide, you should have some basic computer system and at least a good level of power quality habits. Attending Schaffner International training courses prior to work with expert parameters is strongly considered necessary.



CAUTION

Caution

Expert parameters should only be changed by trained and skilled personnel to avoid damages to the unit or injuries of personnel.



WARNING

Warning

Changing of expert parameters may cause malfunction of device.

3.3 Get training

Do you need training? Schaffner can offer training courses comprised of lecture and hands-on workshops designed to introduce you to the fundamental concepts of power quality, ECOsine® harmonic filters and AHF Viewer® software including expert parameters (if needed).

We also offer customized training courses designed to meet your specific needs. Please contact your local Schaffner sales office or Schaffner representative to discuss how we can help you achieve success in your power quality efforts.

3.4 Contact us

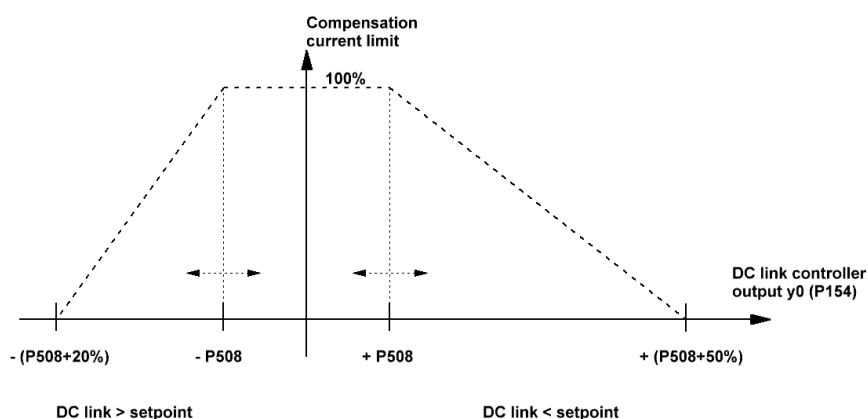
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Corporate URL: www.schaffner.com
Corporate E-mail: info@schaffner.com

4 Controller Gains

4.1 Parameter P500 to P534

Par. No.	Designation	Factory setting	Description
500	Kp	0.5 (ECOsine® active 30-xxx-x) 0.5 (ECOsine® active 50-xxx-x) 0.5 (ECOsine® active 60-xxx-x) 0.4 (ECOsine® active 100-xxx-x) 0.4 (ECOsine® active 120-xxx-x) 0.25 (ECOsine® active 200-xxx-x) 0.25 (ECOsine® active 250-xxx-x) 0.25 (ECOsine® active 300-xxx-x)	Current controller gain (recommended range 0.2 ... 0.5, reduce in case of detected resonances or oscillations, e.g. when “ error 12 control unstable ” occurs)
501	Ki_1_reactPow	0.0010	Controller gain fundamental harmonic
502	Ki_1_DC	0.0010	Controller gain fundamental harmonic
503	Ki_1_N	0.0010	Controller gain fundamental harmonic
504	Kp_DC	1.5	DC-Bus controller gain (recommended range 0.5 ... 3, effects recharging of DC link capacitors) Decrease value: harmonics caused by recharging DC link will be reduced, used in case of very small load current changes Increase value: recharging of DC link will get higher priority and will be done faster, used in case of instable DC link or DC link overvoltage due to very fast or huge load current changes Adjustment of P547 and/or P549 might be an additional option
505	DC link Tn	70ms	DC link controller time constant Factory setting for former FW versions: V02.06.20 - V02.08.16 → P505 = 50ms Up to V02.06.19 → P505 = -0.999375
506	Gain DClk sym	0	Gain of internal DC-link voltage symmetric controller
507	DClk_sym_Tn	20ms	DC link sym controller time constant Factory setting from former FW versions: Up to V02.06.19 → DC-link sym controller factor-factory setting – 0.99844
508	DClk smoothing	20%	Automatic current reduction, if DC controller deviation is to large



511	Ki_3	0.001	Controller gain for harmonic 3 (recommended range 0.001 ... 0.003, no adjustments required)
512	Ki_5	0.001	Controller gain for harmonic 5
513	Ki_7	0.001	Controller gain for harmonic 7
514	Ki_9	0.001	Controller gain for harmonic 9
515	Ki_11	0.001	Controller gain for harmonic 11
516	Ki_13	0.001	Controller gain for harmonic 13
517	Ki_15	0.001	Controller gain for harmonic 15
518	Ki_17	0.001	Controller gain for harmonic 17
519	Ki_19	0.001	Controller gain for harmonic 19
520	Ki_21	0.001	Controller gain for harmonic 21
521	Ki_23	0.001	Controller gain for harmonic 23
522	Ki_25	0.001	Controller gain for harmonic 25
523	Ki_27	0.001	Controller gain for harmonic 27
524	Ki_29	0.001	Controller gain for harmonic 29
525	Ki_31	0.001	Controller gain for harmonic 31
526	Ki_33	0.001	Controller gain for harmonic 33
527	Ki_35	0.001	Controller gain for harmonic 35
528	Ki_37	0.001	Controller gain for harmonic 37
529	Ki_39	0.001	Controller gain for harmonic 39
530	Ki_41	0.001	Controller gain for harmonic 41
531	Ki_43	0.001	Controller gain for harmonic 43
532	Ki_45	0.001	Controller gain for harmonic 45
533	Ki_47	0.001	Controller gain for harmonic 47
534	Ki_49	0.001	Controller gain for harmonic 49

Table 3: Controller gains (parameter P500 to P534)

5 Special Expert Parameters

5.1 Parameter P535 to P556

Par. No.	Designation	Factory setting	Description
535	Band pass h5 h7	OFF	<p>Enables a band pass filter to filter out 5th and 7th harmonic even from set point</p> <p>0 = OFF (default setting, no set point filtering)</p> <p>1 = ON (setting for special applications with high content of 5th and 7th harmonic but with no or very low compensation of this harmonics)</p> <p>see also P551</p>
537	Resonance level	120V	<p>Level of harmonics voltage resonance detection</p> <p>Suggested range 50V... 200V, measured value displayed in P184</p> <p>If limit exceeds → harmonic controllers will be switched off step by step → status message “reduced operation”</p> <p>If limit exceeding still appears → error 11 resonance, ECOsine® active will be stopped (no restart)</p>
538	CT offset compensation	OFF	<p>Starts an offset compensation of the external CT one times when changing value from OFF to ON, the values are sampled and frozen</p> <p>the measured values of CT secondary site in mA are displayed in P16,17,18</p> <p>best results come, when load current is off while starting offset compensation</p>
539	Rated current	100%	<p>Rated current in % (0...100%)</p> <p>Reduction of rated current, indication in P002</p> <p>In case of parallel working filters P320 need to be adjusted, too</p>
540	No. of current transformers	1 = 3 CT	<p>Number of external current transformers</p> <p>0 = 2 (L1, L2), only for 3wire devices</p> <p>1 = 3 (L1, L2, L3) – default value</p> <p>possible, accuracy will be less</p>
541	Test harm.ampl.	-	Only for service, do not change
542	Test harm. number	-	Only for service, do not change
543	Test react. current magn.	-	Only for service, do not change
544	Direct line angle	OFF	<p>Use of direct line angle</p> <p>0 = OFF (standard applications, default value → internal PLL for line angle is used)</p> <p>1 = ON (typical for generator applications with unstable</p>

supply frequency, causing status message “**P20 = line synchronization**” → direct line angle is used without filtering)

2 = filtered (typical for applications with commutation notches in line voltage, causing status message “**P20 = line synchronization**” → line angle is filtered exactly with 50/60Hz filter)

545	Line angle offset	- 5°		Tuning of line angle offset (tuning of phase shift for reactive current compensation e.g. due to long supply cables) recommended range: - 10° ... 0°
546	H-limit	ON		only for service, do not change
547	Cut-off frequency set point	BW 10 Hz		Cut off frequency of set point filter recommended range: Butterworth BW 5... 40 Hz decrease value: harmonic compensation might be better for operation without significant load changes increase value: compensation for very fast or huge load changes (like welding applications) might be better, stabilizes DC link control in that cases see also P504 and P549
548	Overload capability	142%		Overload capability in % Reduction of overload capability, indication in P003
549	DC link set point	480V ECOsine® active 30-200-3 50-200-3 100-200-3 120-200-3 570V ECOsine® active 30-200-4 60-200-4 750V ECOsine® active 300-480-3-UL 780V ECOsine® active 30-480-3		Set point for DC link control Recommended range (ECOsine® active 3-wire): 0... 30V below factory setting Recommended range (ECOsine® active 4-wire): 0... 20V below factory setting used if DC link voltage becomes too high (error “4 DC link high”) also see P504 and P547

		50-480-3	
		120-480-3	
	820V	ECOsine® active	
		30-400-4	
		60-400-4	
		100-400-4	
		100-480-3	
		120-400-4	
		200-480-3	
		200-400-4	
		250-480-3	
		250-400-4	
		300-480-3	
		300-400-4	
	1200V	ECOsine® active	
		200-690-3	

550	Boot mode	-	Only for service
551	Band pass factor	7	enables a detuning of band pass filter of 7 th harmonic, see function of P535 useful to filter out special frequency in set point signal, e.g. 11 th harmonic if different from 7 → the 7 th harmonic will not be filtered out
552	Limit proportional-controller output	40V (ECOsine® active 30/50 3-wire) 40V (ECOsine® active 30/60A 4-wire) 50V (ECOsine® active 100/120A) 75V (ECOsine® active 200-300A)	Level for limitation of internal proportional controller output, suggested range 10V... 200V, measured value displayed in P185, maximum latched value displayed in P187 if limits exceed → error “12 control unstable”, decrease of P500 could be an option, check grid situation

553	Limit notch filter current	<p>200A (ECOsine® active 30/50 3-wire) 50A (ECOsine® active 30/60A 4-wire) 50A (ECOsine® active 100/120A) 75A (ECOsine® active 200-300A ECOsine® active)</p>	<p>Level for max. internal notch filter current 40A ... 200A, default value depends on type of ECOsine® active, measured value is displayed in P186) if limits exceed → error “13 notch filter”</p>
554	THDu limit ratio	300%	<p>Ratio of maximum allowed increase of THDu caused by operation of the active filter (resonance detection function)</p> <p>P178 reference value of THDu, sampled from switching ON the ECOsine® active P179 limit of THDu during operation of active filter (P179 = P178 * P554) → if limit exceeds → error 14 THDu resonance, ECOsine® active will be stopped (no restart)</p>
556	Max IGBT DC offset	40%	<p>Limit of max. DC offset in output current (% of nominal device current) if limits exceed → error “17 IGBT DC error” or “error 18 IGBT CTRL error” check correct working and compensation of ECOsine® active, if compensation result is ok increase of P556 in steps of 10% could be an option otherwise an internal hardware problem could be present</p>
557	Max IGBT Temp	Only for internal testing and engineering purposes	

Table 4: Special expert parameters (parameter P535 to P556)

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