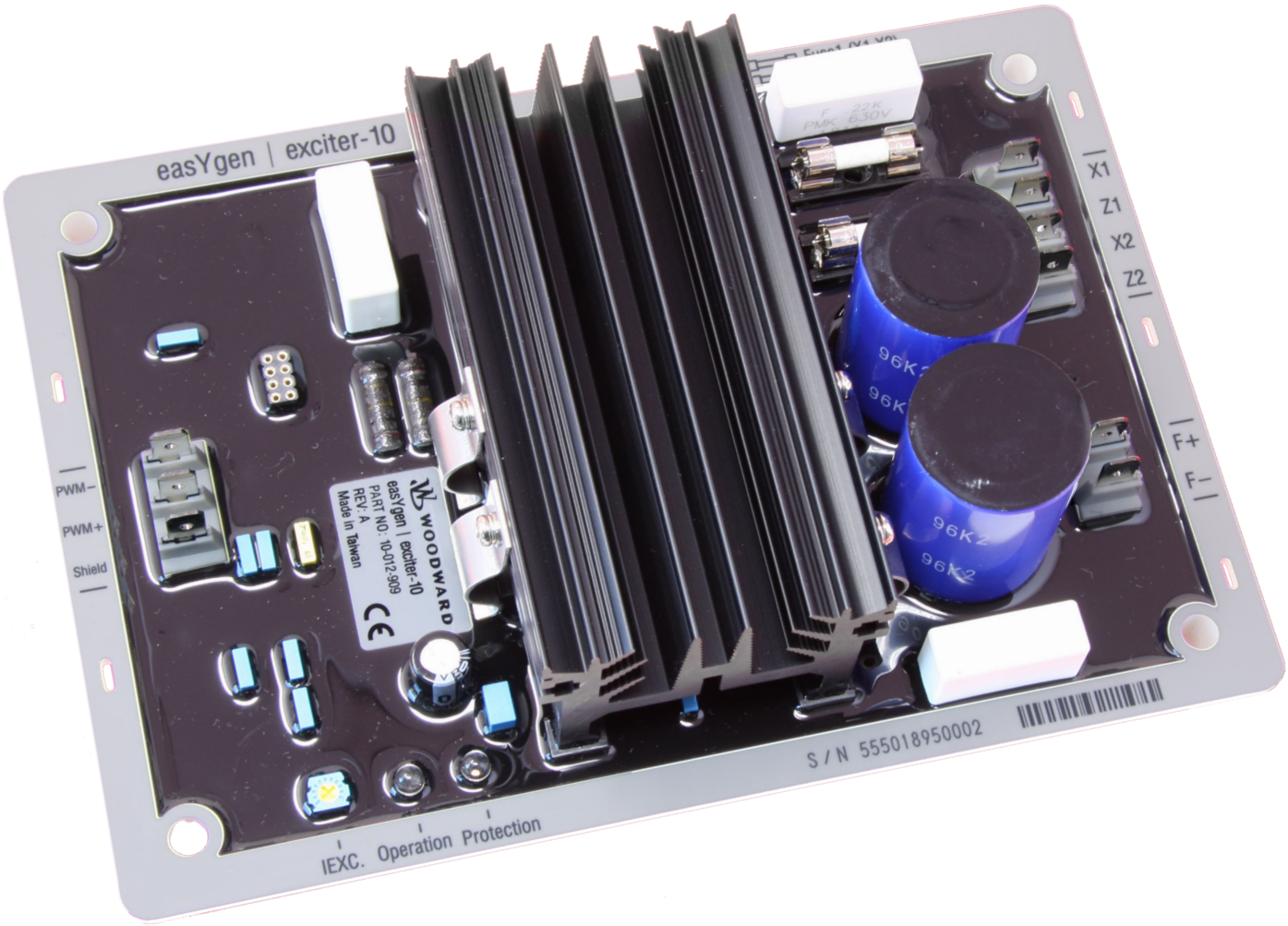
Released

Generator Excitation Driver Module

Technical Manual | easYgen | exciter-10



easYgen Expansion Module

Software Version 1.01

Document ID: B37910, Revision B - Build 50683

Manual (original)

This is no translation but the original Technical Manual in English.

Designed in Germany.

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Brief Overview

General information

The ”easYgen | exciter-10“ (= ”EX-10“) is a generator excitation driver module designed for operation together with the genset control unit ”easYgen 3400/3500XT“ (release 1.16 or higher). The controller function is inherent to the easYgen. The easYgen measures the generator values like voltage, power factor etc. and compares it with the valid set point. According to the deviation, the easYgen controls an ”Excitation command“, which is fed to the ”easYgen | exciter-10“ as a PMW signal. The ”easYgen | exciter-10“ then provides the generator field excitation current according to the PWM signal.

The excitation power supply can be from shunt, auxiliary winding or permanent magnet (PMG) type with either single phase or three phase.

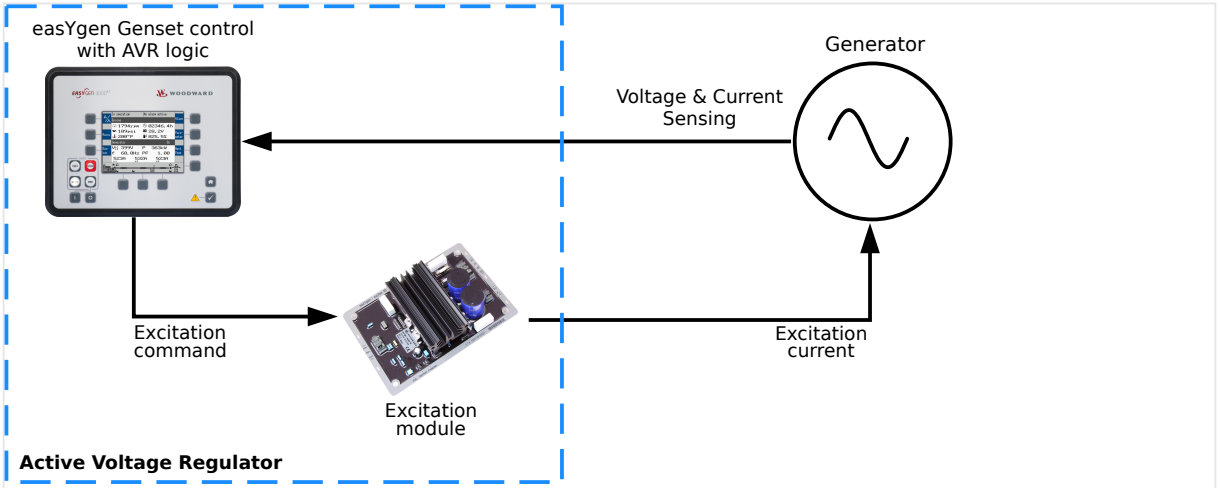


Fig. 1: Overview ”easYgen 3500XT“ with ”easYgen | exciter-10“

The easYgen | exciter-10 is equipped with temperature protection, to prevent failure and damage caused by overheating. In occurrence of overheating, the exciter will shut-down until normal operating temperature is reached then automatically restarts operation

Features:

In conjunction with easYgen-3400/3500XT genset controls, the active voltage regulator system offers:

- Automatic Voltage Regulation (AVR)
- Soft start functionality
- Under frequency regulation (Volt/Hz) defined by a configurable 5-point characteristic and activated by LogicsManager
- Line drop compensation via AnalogManager
- Power factor and kvar control
- Voltage droop compensation
- Fault Ride Through (FRT) support
- Setpoint configuration and AVR status overview on the easYgen screen and on Woodward ToolKit Service Tool

Protection:

- Current limitation – limit can be adjusted via a potentiometer (IEXC.)
- Over-temperature protection – as the heat sink temperature crosses a threshold ”EX-10“ output shuts-off
- Short-circuit protection – when transient current output exceeds a threshold, the ”EX-10 decreases“ the excitation output to below 0.2A until shutdown

Scope of delivery

The following parts are included in the scope of delivery. Please check prior to the installation that all parts are present.

Fig. 2: Dimension ”easYgen 3500XT“ with ”easYgen | exciter-10“

The following parts are included in the covering box. Please check prior to the installation that all parts are present:

- exciter-10 module
- »Installation Procedure Supplement« paper with links to the latest edition of Technical Documentation and software for download:⟹▷ B37912_ISP_exciter-10_A
- Screw kit installation material

For the wiring 9 flat plug receptacles 6.35 mm (0.25") are needed which are not included.

QR Code

To get access to the complete product documentation, please scan this QR code or use the following link: ⟹ http://wwdmanuals.com/easygenexciter-10.

Table of Contents

1 General information

1.1 Revision History

Rev.	Date	Editor	Changes
B	2020-12	BL	**Corrections/Repairs** • Threshold of overtemperature changed. Refer to "Temperature (Over-temperature) Protection" • Manual updated according to UL and CE maximum continuous field current.
A	2020-08	BL	**First release**

1.2 Depiction Of Notes And Instructions

Safety instructions

Safety instructions are marked with symbols in these instructions. The safety instructions are always introduced by signal words that express the extent of the danger.

DANGER!

This combination of symbol and signal word indicates an immediately-dangerous situation that could cause death or severe injuries if not avoided.

WARNING!

This combination of symbol and signal word indicates a possibly-dangerous situation that could cause death or severe injuries if it is not avoided.

CAUTION!

This combination of symbol and signal word indicates a possibly-dangerous situation that could cause slight injuries if it is not avoided.

NOTICE!

This combination of symbol and signal word indicates a possibly-dangerous situation that could cause property and environmental damage if it is not avoided.

Tips and recommendations

This symbol indicates useful tips and recommendations as well as information for efficient and trouble-free operation.

Additional markings

To emphasize instructions, results, lists, references, and other elements, the following markings are used in these instructions:

Marking	Explanation
⚙	Start of a procedure list
>	Prerequisite for a procedure list
▷	Step-by-step instructions
▶	Results of action steps
	References to sections of these instructions and to other relevant documents
•	Listing without fixed sequence
☼	Example
»Buttons«	Operating elements (e.g. buttons, switches), display elements (e.g. signal lamps)
»Display«	Screen elements (e.g. buttons, programming of function keys)
[Screen xx / Screen xy / Screen xz] ...	Menu path. The following information and setting refer to a page on HMI screen or ToolKit located as described here.
	Some parameters/settings/screens are available only either in ToolKit **or** in HMI/display.

Dimensions in Figures

All dimensions shown with no units specified are in **mm**.

1.2.1 Copyright And Disclaimer

Disclaimer

All information and instructions in this manual have been provided under due consideration of applicable guidelines and regulations, the current and known state of the art, as well as our many years of in-house experience. Woodward assumes no liability for any damages due to:

- Failure to comply with the instructions in this manual
- Improper use / misuse
- Willful operation by non-authorized persons
- Unauthorized conversions or non-approved technical modifications
- Use of non-approved spare parts

The originator is solely liable for the full extent for damages caused by such conduct. The obligations agreed-upon in the delivery contract, the general terms and conditions, the manufacturer’s delivery conditions, and the statutory regulations valid at the time the contract was concluded, apply.

Copyright

1.2.2 Service And Warranty

Our Customer Service is available for technical information.

For regional support, please refer to: ⟹ http://www.woodward.com/Support_pgd.aspx.

In addition, our employees are constantly interested in new information and experiences that arise from usage and could be valuable for the improvement of our products.

Warranty terms

Please enquire about the terms of warranty from your nearest Woodward representative.

For our contact search webpage please go to: ⟹ http://www.woodward.com/Directory.aspx

1.3 Special Tools

- Torque screwdriver

  A torque-screwdriver allow fastening of screws to a precisely specified torque.

- Crimping tool for the flat plug receptacles

2 Installation

NOTICE!

Malfunctions due to literal use of example values

All technical data and ratings indicated in this chapter are merely listed as examples. Literal use of these values does not take into account all actual specifications of the control unit as delivered.

- For definite values please refer to chapter “5 Technical Data”.

NOTICE!

Recommended mounting position

The easYgen | exciter-10 shall be mounted in such a way that optimal convection through the heat sink is ensured.

DANGER!

To avoid damages in case of a voltage control loop failure ensure that the engine will stop immediately and GCB is opened immediately e.g. by including the “Ready for operation relay” of the easYgen.

Make sure that the various generator monitoring functions e.g. overvoltage, undervoltage, overfrequency, underfrequency, power factor etc. are set correctly.

Additionally it is strongly recommended to use a MPU for speed monitoring if no speed governor is installed.

2.1 Mount unit

The module must be fixed with 4 screws. The torque must be 1.1-1.3 Nm.

Take care for sufficient air convection. For good heat dissipation we recommend landscape orientation.

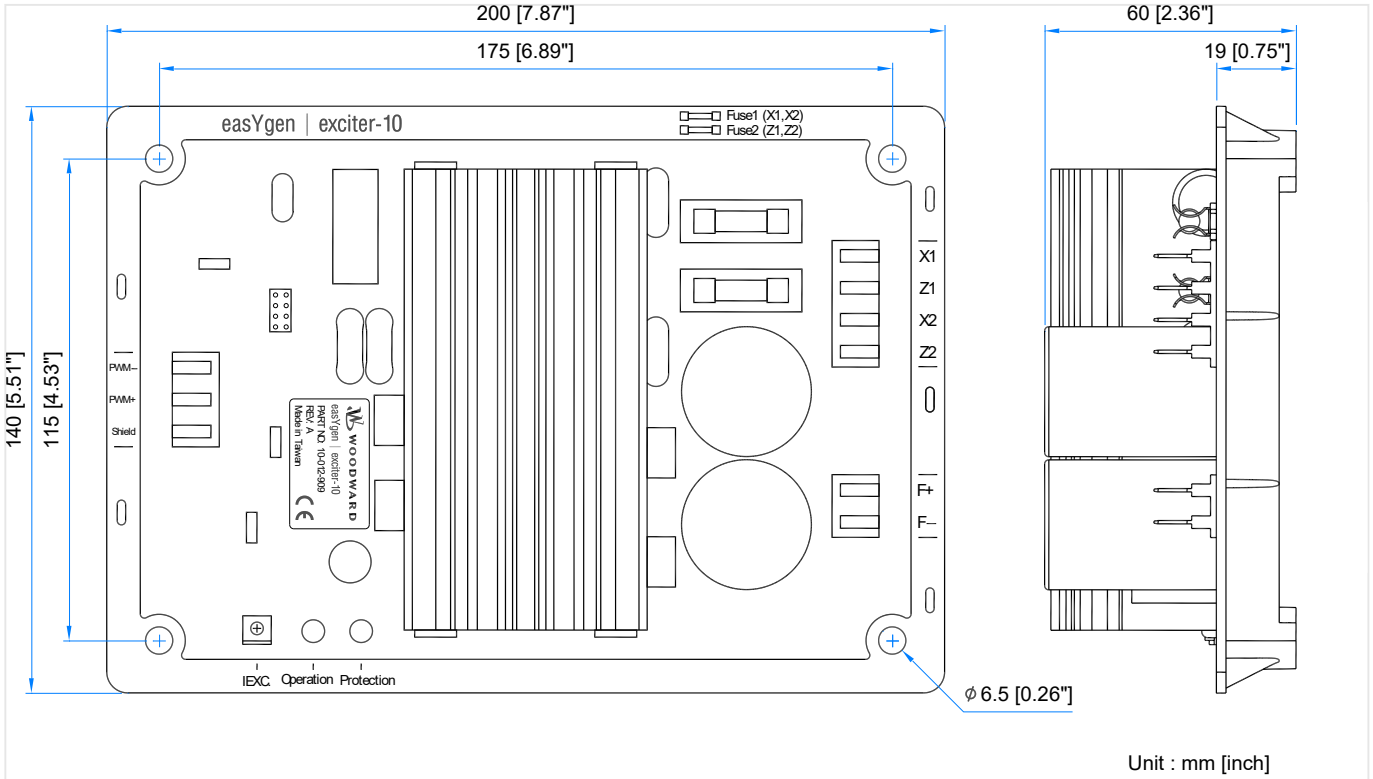


Fig. 3: Dimension ”easYgen 3500XT“ with ”easYgen | exciter-10“

2.2 Setup Connections

Wire sizes

Field wiring shall be made with use of cables which have temperature rating not less than 90 °C.

AWG	mm²	AWG	mm²	AWG	mm²	AWG	mm²	AWG	mm²	AWG	mm²
30	0.05	21	0.38	14	2.5	4	25	3/0	95	600MCM	300
28	0.08	20	0.5	12	4	2	35	4/0	120	750MCM	400
26	0.14	18	0.75	10	6	1	50	300MCM	150	1000MCM	500
24	0.25	17	1.0	8	10	1/0	55	350MCM	185		
22	0.34	16	1.5	6	16	2/0	70	500MCM	240		

Table 1: Conversion chart - wire sizes

Terminal allocation and function

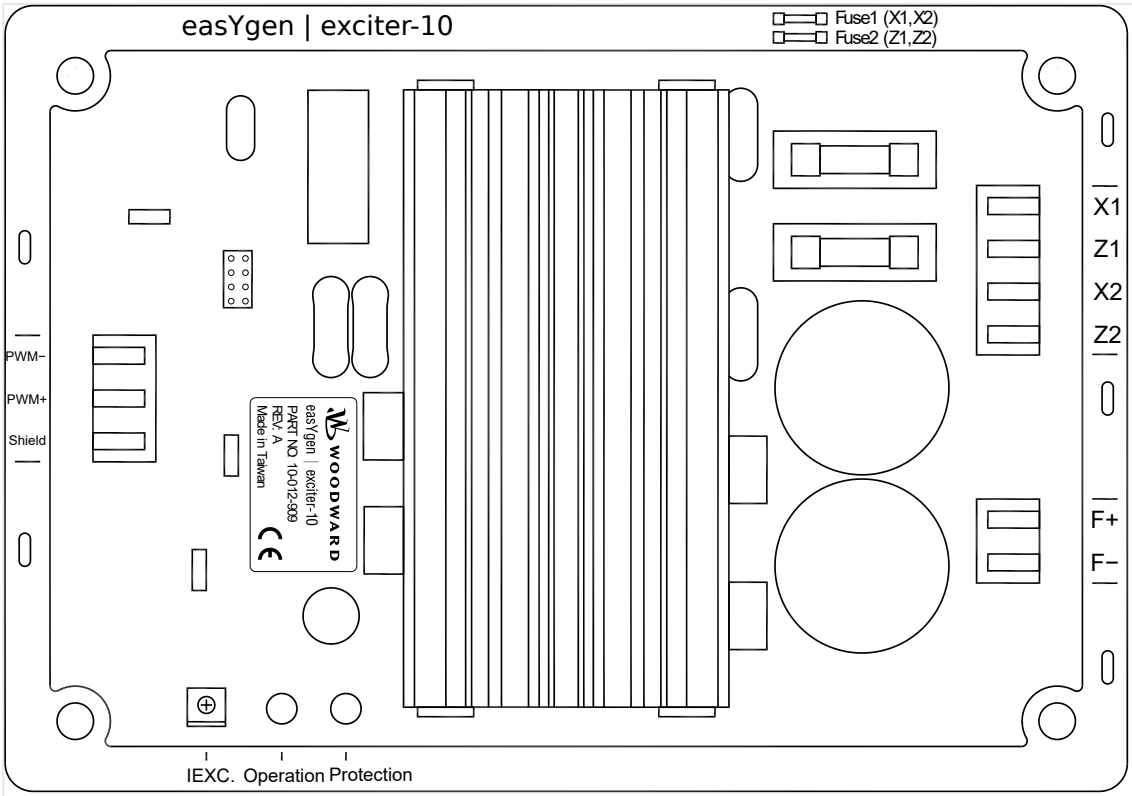


Fig. 4: Terminals "easYgen | exciter 10"

The 9 terminals are designed as flat plugs 6.35 mm (0.25"). Therefore the wiring must be done with 9 flat plug receptacles.

Terminal label	Function	Notes
X1, X2, Z1, Z2	Power supply: -PMG input, -Shunt input or -Auxilary winding input	40 ... 250 Vac, 40 ... 500 Hz **Note for Shunt and Auxiliary winding supply:** If the build up voltage is below 20Vac, a reliable start up of the start voltage cannot be guaranteed.
F+	Field excitation positive output	
F−	Field excitation negative output	
PWM−	PWM negative input	500 Hz PWM duty cycle 0 ... 100% Pulse Voltage 5 ... 20 Vdc, < 20 mA (5 Vdc recommended) If the easYgen is configured to use analog output 2 for AVR, this

Terminal label	Function	Notes
		terminal must be connected to terminal 20 of the easYgen.
PWM+	PWM positive input	If the easYgen is configured to use analog output 2 for AVR, this terminal must be connected to terminal 19 of the easYgen.
Shield	Shield	Connect to the common Protective Earth (PE)

2.2.1 Wiring ”easYgen | exciter-10“ / ”easYgen“

The figure below shows a typical wiring between the ”easYgen | exciter-10“ and the ”easYgen“. In this example analog output 2 of the easYgen is configured for AVR. (Power supply is PMG in this example.)

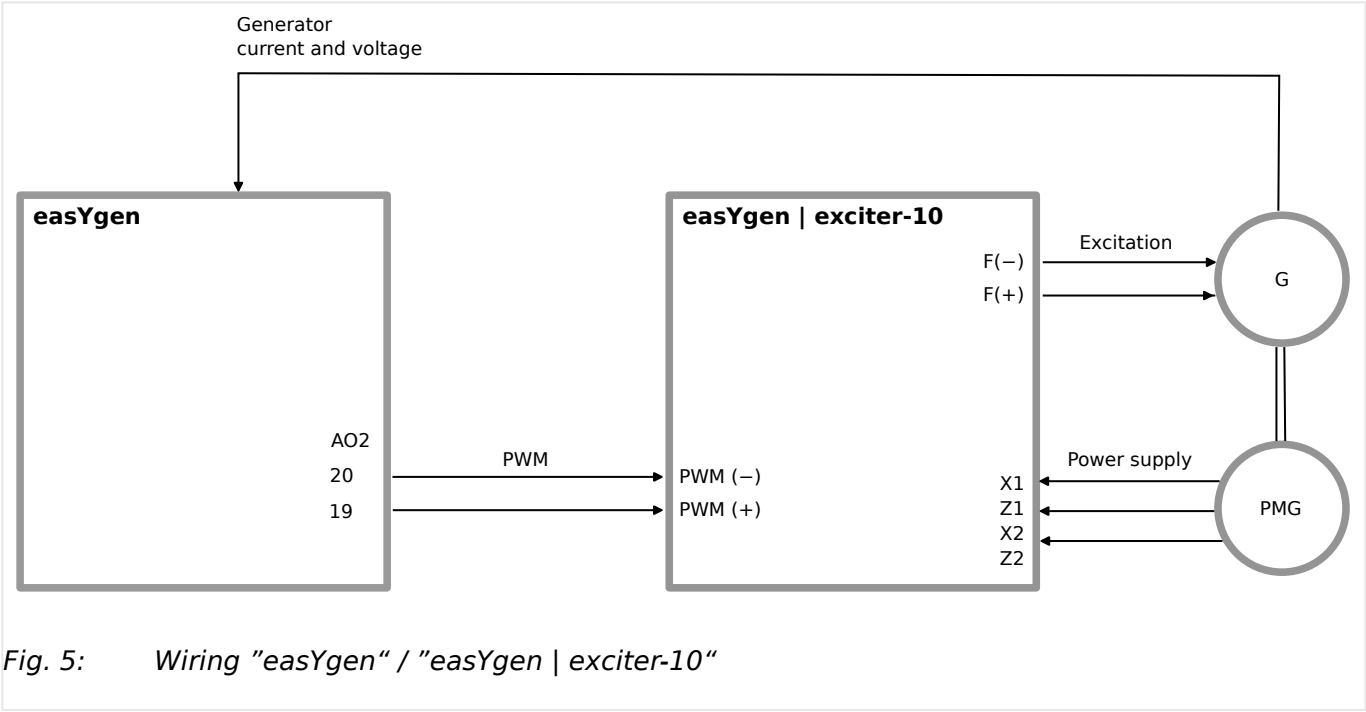


Fig. 5: Wiring ”easYgen“ / ”easYgen | exciter-10“

2.2.2 PMG power supply

The figure below shows the wiring for ”PMG“ power supply.

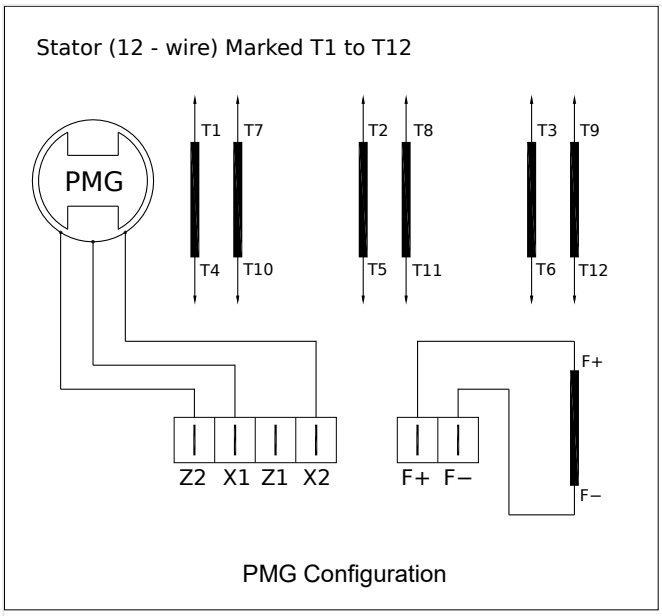


Fig. 6: Wiring for ”PMG“ power supply

2.2.3 Shunt power supply

If the build up voltage is below 20Vac, a reliable start up of the start voltage cannot be guaranteed.

The figure below shows the wiring for ”Shunt“ power supply.

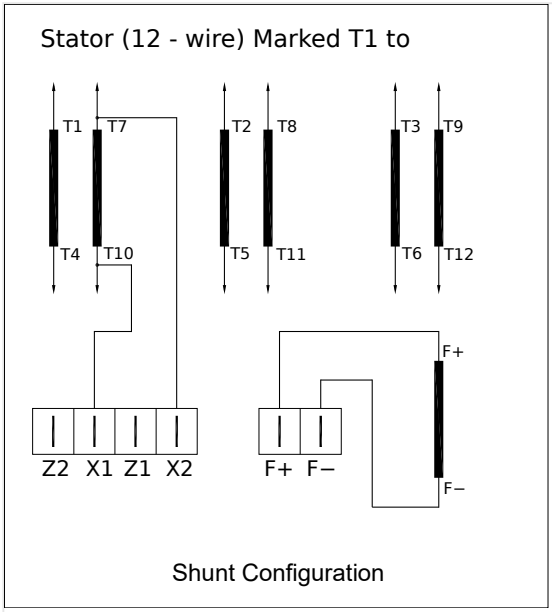


Fig. 7: Wiring for ”Shunt“ power supply

2.2.4 Auxiliary winding power supply

If the build up voltage is below 20Vac, a reliable start up of the start voltage cannot be guaranteed.

The figure below shows the wiring for ”Auxiliary Winding“ power supply.

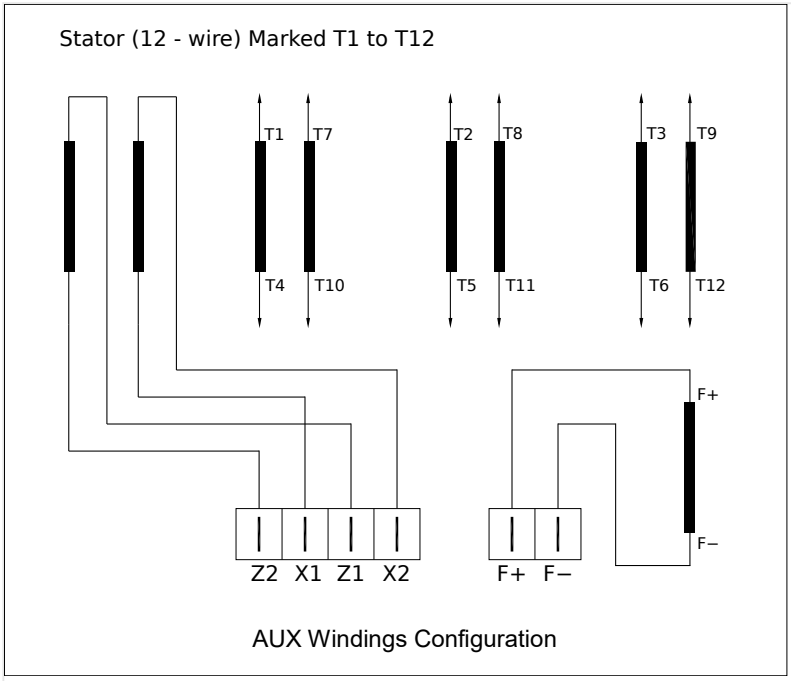


Fig. 8: Wiring for ”Auxiliary Winding“ power supply

3 Configuration

General information

Since the ”easYgen | exciter-10“ itself has no controller function, the configuration is done via the easYgen in which the controller function is integrated.

The easYgen can be configured via the PC tool ToolKit or, depending on the model, via the HMI.

Only the current limitation adjustment must be done via the potentiometer ”IEXC.“ at the exciter itself. Take care to adjust this potentiometer according to the excitation current of the generator. Refer to chapter operation: “4.1 Current limitation (”IEXC.“)”)

3.1 Configuration via easYgen

This document contains only two screenshots of important AVR parameters.

For detailed description of the configuration refer to the easYgen manuals. (Chapters: ”Voltage Control“, ”AVR FRT Adjustments”)

⟹ EG3500XTP1

⟹ EG3500XTP2

Also make sure that the various generator monitoring functions e.g. overvoltage, undervoltage, overfrequency, underfrequency, power factor etc. are set correctly. (easYgen manuals chapter ”Configure Generator Monitoring“)

For operation with ”easYgen | exciter-10“ parameter 5607 Voltage control must be configured to ”AVR“ like in the screenshot below:

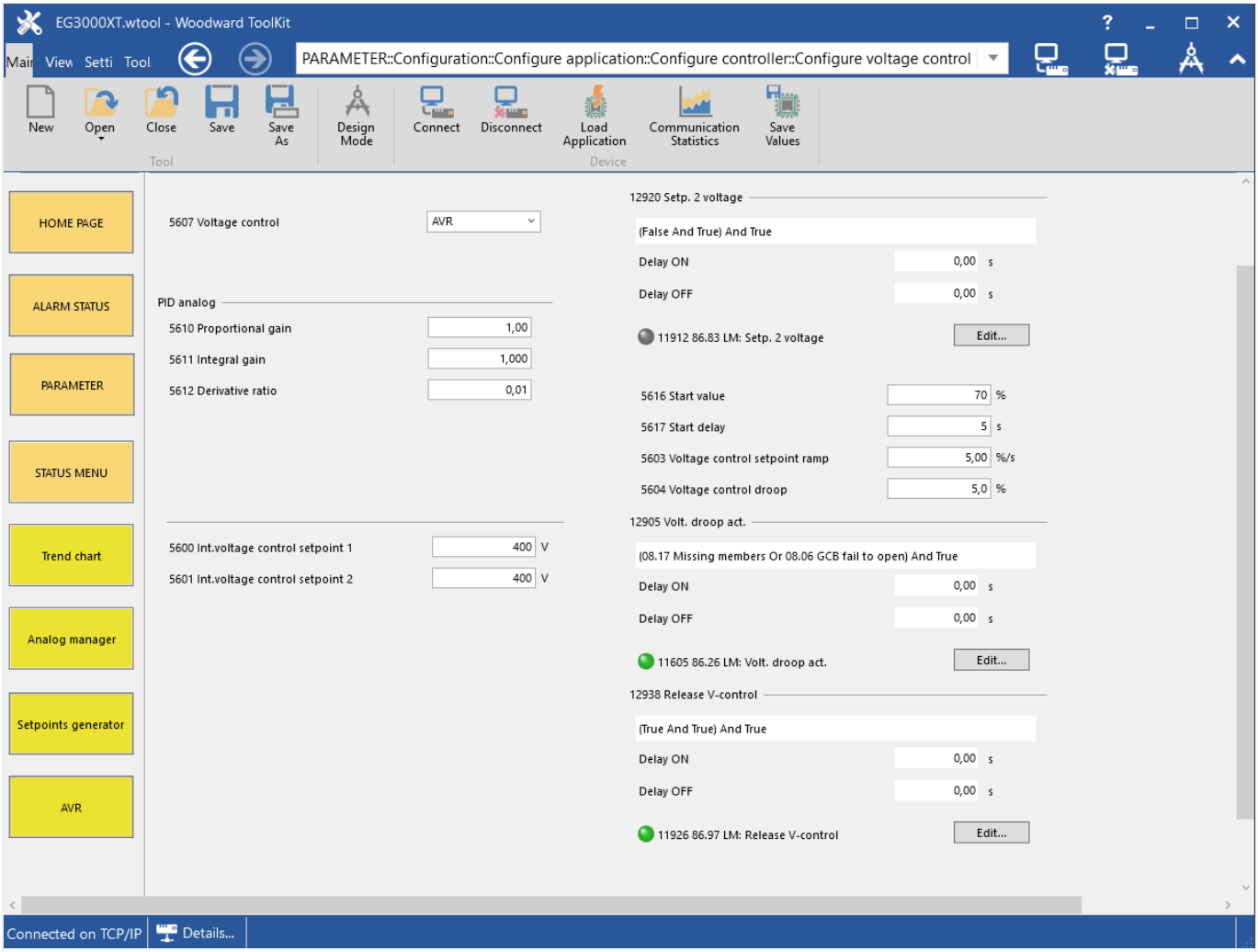


Fig. 9: Main configuration sheet for "Voltage control" of ToolKit

If you click on the AVR button in the lower left corner you will get to the AVR page below. There are some indications of actual values and the parameters for:

- Voltage filter time
- Start behavior
- V(f) characteristic

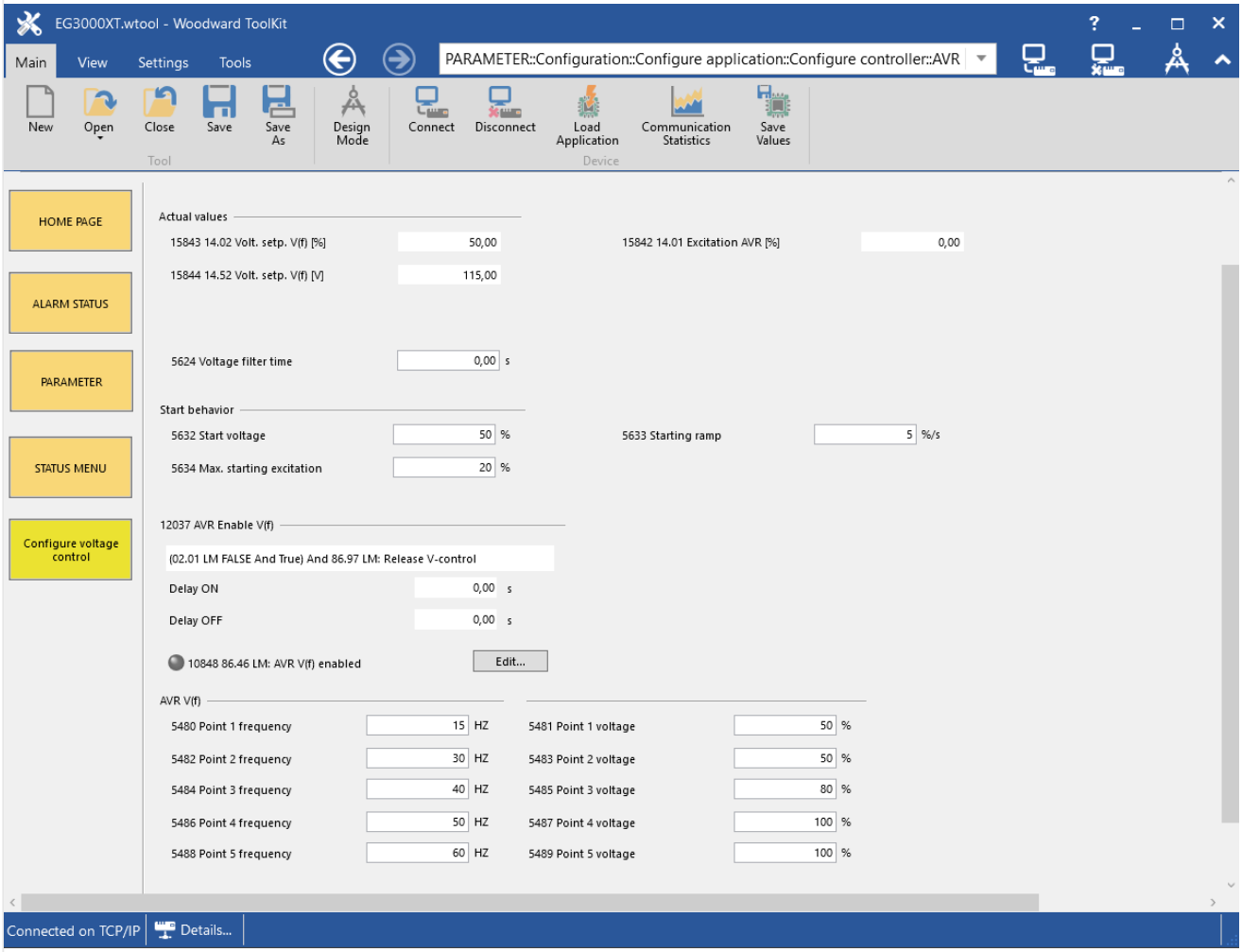


Fig. 10: Configuration sheet for AVR ”easYgen | exciter 10“ of ToolKit

Usually analogue output 2 is used to control the exciter. The following screenshot shows an example of how to configure AO2.

Note: The hardware and source level settings influence the excitation range and control behaviour.

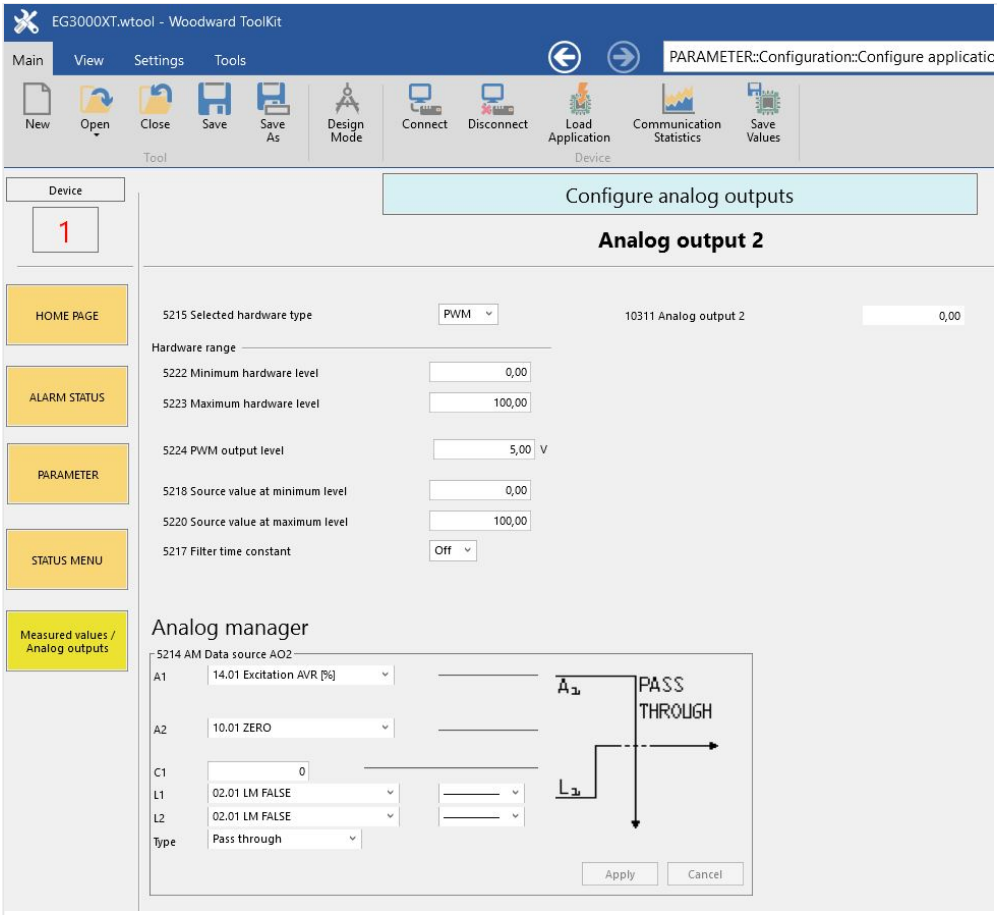


Fig. 11: Configuration Analog Output 2 for AVR operation

4 Operation

4.1 Current limitation (”IEXC.“)

The exciter is built-in with Current Limiting Adjustment potentiometer ”IEXC.“ (I Excitation). Basically, the Exciter-10 decreases the field current if the field current exceeds the limit adjusted by the ”IEXC“ potentiometer for more than 10 s. During commissioning the potentiometer must be adjusted due to the application.

If current limitation is activated and exceeded 10 seconds, the green LED is turned off and red LED begins to flicker twice per second (2 Hz).

For the adjustment the following dependencies are important:

- The actual trigger current and the resulting limited current depend on the supply voltage and the PWM.
- The higher the supply voltage, the higher the limited current.

If current limiting is desired, the potentiometer setting must be determined empirically because of the above-mentioned dependencies. Basically, the adjusted limit should be higher than the expected continuous excitation current.

The figure below shows an example of the current limitation depending on the potentiometer position (min. to max.). The upper line shows the excitation current before the limitation becomes active and the line below the resulting limited current after 10 s. (In this example the supply voltage is 116 Vac, the PWM is 70%.)

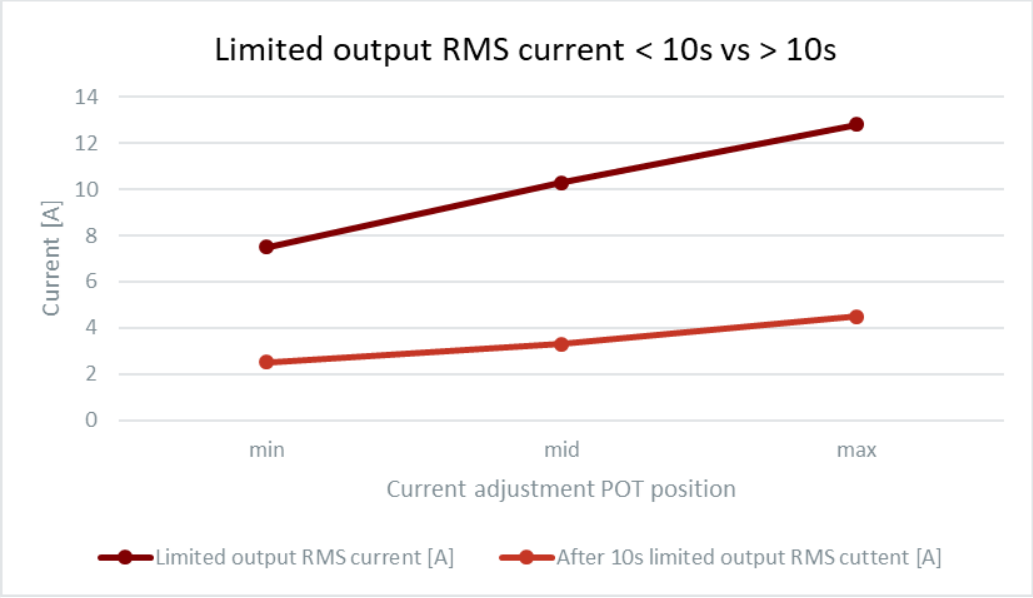


Fig. 12: Example of current adjustment

4.2 LED Status Indicators

The LEDs show the following operating states:

- Normal operation:

Under normal operation the green LED ”Operation“ is illuminated and the red LED ”Protection“ is turned off.

- Current Limitation:

  If current limitation is activated and exceeded 10 seconds, the green LED is turned off and red LED begins to flicker twice per second (2 Hz).

- Short-circuit Protection:

  Green LED is turned off and red LED begins to flicker 5 times per second (5Hz).

- Temperature Protection:

  Green LED is turned off and red LED is illuminated until protection is deactivated.

4.3 Protection

Short-circuit Protection

If transient current output greater than 180 A is detected, the system will determine it as a short-circuit output and immediately decrease the excitation output to below 0.2 A until shutdown. The Green LED is turned off and red LED begins to flicker 5 times per second (5Hz).

Temperature (Over-temperature) Protection

If temperature at the heat sink reaches 130°C the excitation output is immediately shut-off, until the temperature falls under 105°C then resumes excitation output. Temperature measurement tolerance: +/- 3°C. If temperature protection is triggered, the green LED is turned off and red LED is illuminated until protection is deactivated.

PWM signal monitoring

When the initial voltage is established, the Exciter-10 will first check whether the PWM signal changes between high and low. If yes, the excitation output current is according to the PWM signal. If the initial power supply is established and the PWM signal is constantly at high level (PWM = 100%), the Exciter-10 will not drive the output current. In this case it is assumed, that the controller which provides the PWM is not working correctly.

The Exciter-10 changes to normally operation if the PWM signal changes between high and low (PWM has decreased).

DANGER!

To avoid damages in case of a voltage control loop failure ensure that the engine will stop immediately and GCB is opened immediately e.g. by including the “Ready for operation relay” of the easYgen.

Make sure that the various generator monitoring functions e.g. overvoltage, undervoltage, overfrequency, underfrequency, power factor etc. are set correctly.

Additionally it is strongly recommended to use a MPU for speed monitoring if no speed governor is installed.

5 Technical Data

5.1 Product label

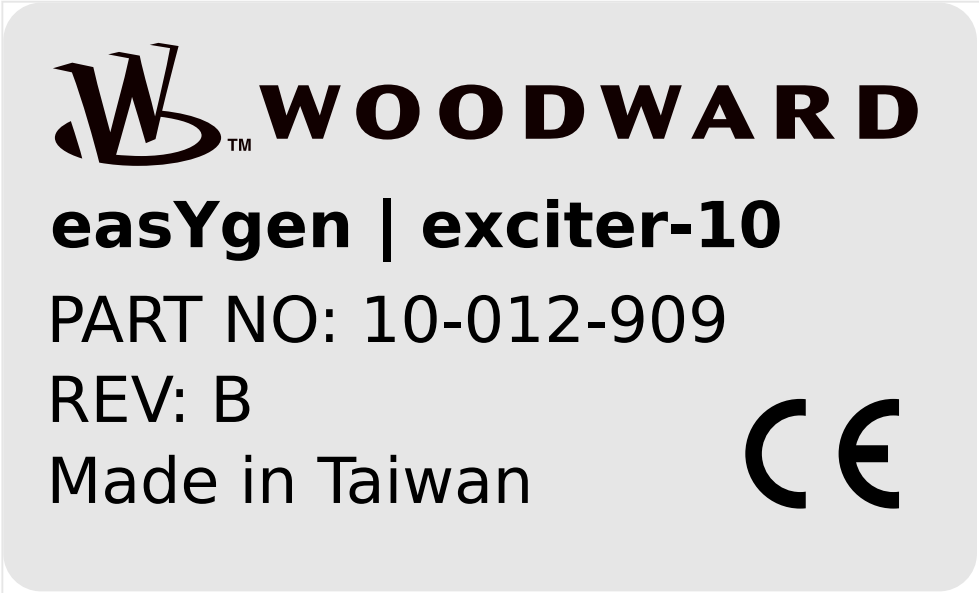
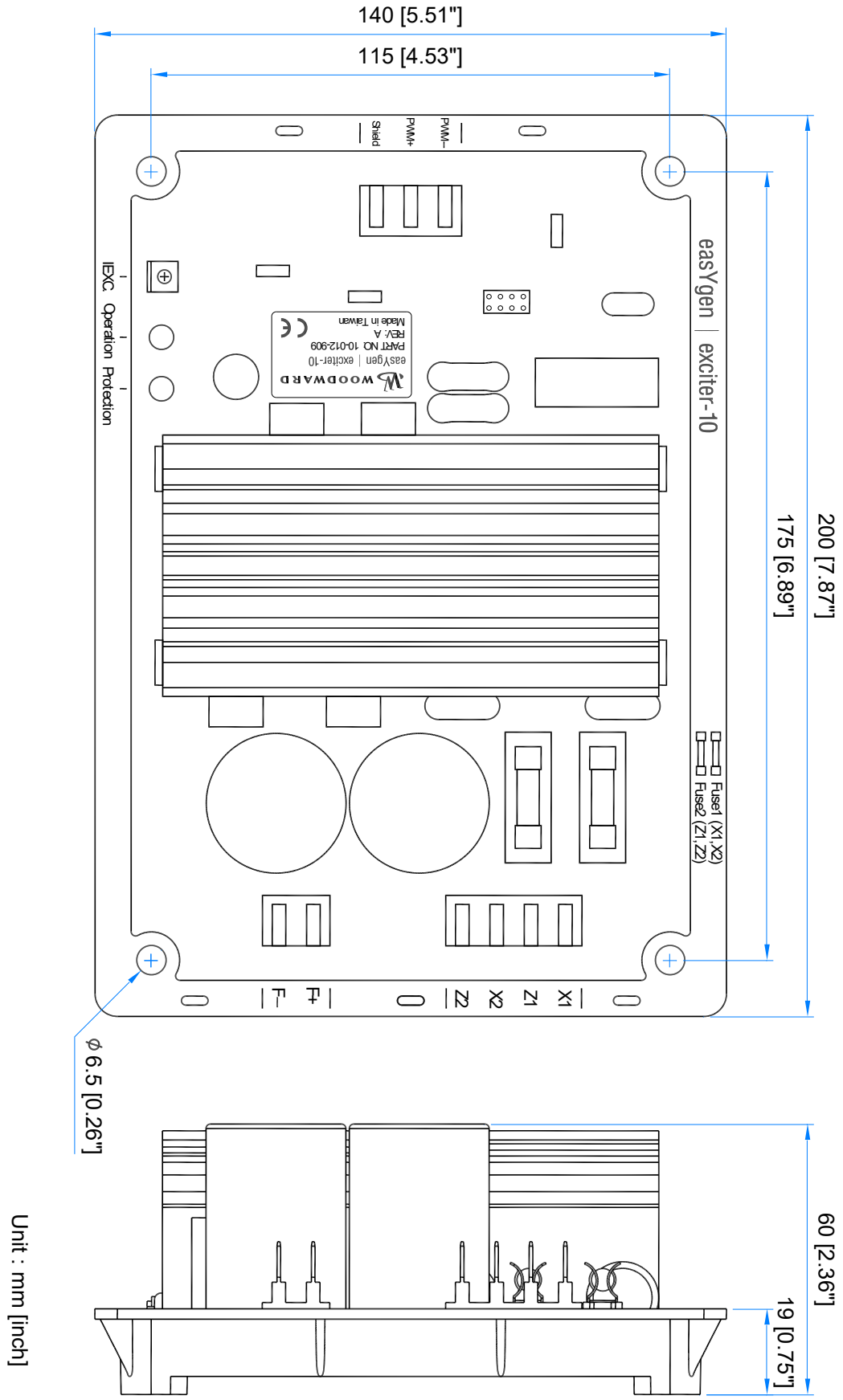


Fig. 13: Product label (for reference only)

The serial number is for this device not part of the product label but printed on the housing.

5.2 Mechanical drawing



Outline Drawing

easYgen | exciter-10

5.3 Technical parameters

Item	Content
Operating Voltage	40 ... 250 Vac, 40 ... 500 Hz Single phase or three phase (Shunt, PMG, winding)
Power Consumption	Depends on the operation conditions
Fuse 1 (X1, X2) Fuse 2 (Z1, Z2)	10 A, 250 V, T (slow blow) 10 A, 250 V, T (slow blow)
Input signal	500 Hz PWM duty cycle 0 ... 100% Pulse Voltage 5 ... 20 Vdc, < 20 mA
Output Voltage	In accordance with supply voltage and input PWM signal accuracy 0.5%
Max. Continuous Field Current Output **CE**	6 A (dependent on supply voltage) for details refer to: “5.4 Maximum continuous field current output CE”)
Max. Continuous Field Current Output **UL**	4 A according to UL 6200
Max. Forcing Field Current Output (for 10 s)	10 A
Temperature protection	Excitation shutdown > 130°C (+-3°C) Resume Excitation < 105°C (+-3°C)
Case Dimension	200 mm × 140 mm × 60 mm
Working Conditions	Temp. : (−30 ... 70)°C Humidity: 60 °C, 95% RH, 5 days
Storage Conditions	Temp. : (−55 ... 85)°C
Weight	approx. 0.77 kg

5.4 Maximum continuous field current output CE

The figure below shows the maximum continuous field current depending on the supply voltage at 70°C ambient temperature.

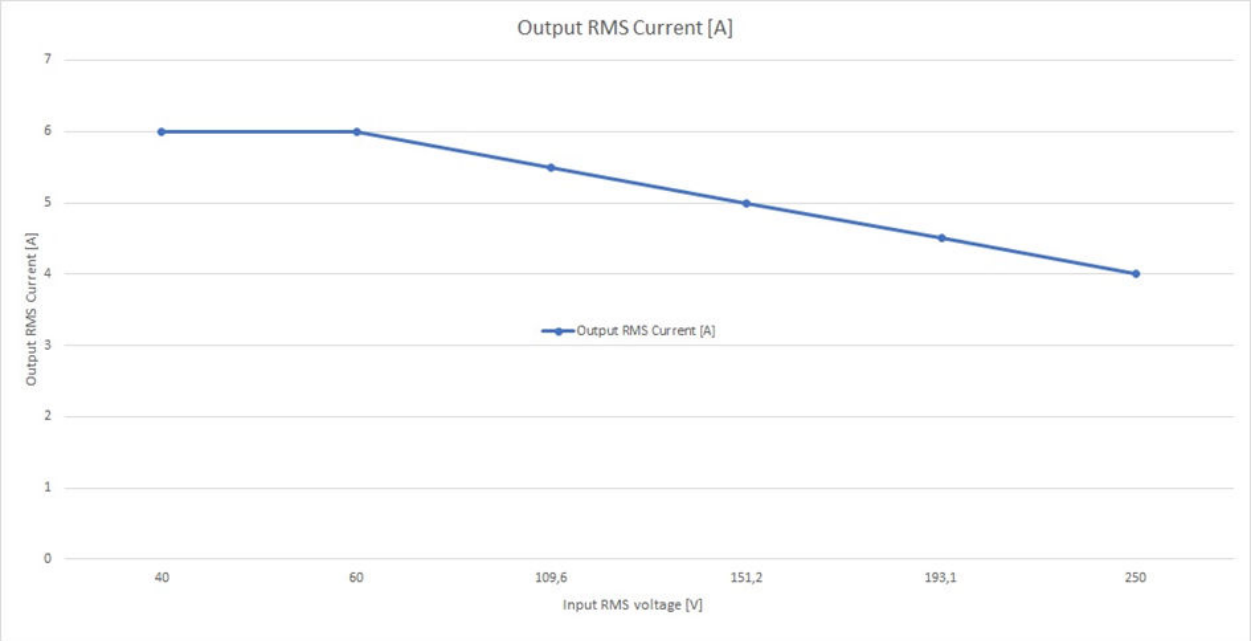


Fig. 14: Maximum continuous field current depending on the supply voltage

5.5 Approvals

UL File No: E335643

CE In conformity with the applicable requirements of the following Standards

- EN 61000-6-2, 2005: Generic Standards - Immunity for Industrial Environments
- EN 61000-6-4, 2007: Generic Standards - Emissions for Industrial Environments
- EN 61010-1, 2010: Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General Requirements

6 Glossary And List Of Abbreviations

AM	AnalogManager
AVR	Automatic Voltage Regulation
BDEW	German community of 1,800 companies represented by the German Association of Energy and Water Industries (Bundesverband der Energie- und Wasserwirtschaft)
SPN	Suspect Parameter Number
FMI	Failure Mode Indicator
OC	Occurrence Count
CB	Circuit Breaker
CL	Code Level
CT	Current Transformer
DI	Discrete Input
DO	Discrete (Relay) Output
ECU	Engine Control Unit
EX-10	easYgen | Exciter-10
GAP	Graphical Application Programming (GAP™)
GCB	Generator Circuit Breaker
GCP	Woodward device series (Genset Control) - not preferred for new design!
GGB	Generator Group Breaker
GOV	(speed) Governor; rpm regulator
HMI	Human Machine Interface e.g., a front panel with display and buttons for interaction
IOP	Islanded Operation in Parallel ("Islanded Parallel Operation")
LM	LogicsManager©
LSG	Woodward device: Load Share Gateway (communication converter)
MFR	Woodward device series (multifunctional relays) - not preferred for new design!
Operation	In (general) operation. State when the genset is running according to the selected mode, all parameters are in allowed values and ranges, and without OPEN requests or alarms. Somehow "waiting for next occurrence".
S/N	Serial Number
PT	Potential (Voltage) Transformer

P/N	Part Number
PLC	Programmable Logic Control
PID	Proportional Integral Derivative controller
PF	Power Factor
N.O.	Normally Open (make) contact
N.C.	Normally Closed (break) contact
NC	Neutral Contactor
MPU	Magnetic Pickup Unit
MOP	Mains Operation in Parallel
MCB	Mains Circuit Breaker
LDSS	Load-Dependent Start/Stop operation
V	Voltage
I	Current
P	Real power
Q	Reactive power
S	Apparent power
Sequencer	A sequencer file is carrying specific settings e.g. to enable communication with and/or control of an expansion module. Such files can be prepared by Woodward.

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