

APPLICATION NOTE

Connecting an easYgen-3200XT via ModbusTCP master to a HighPROTEC Protection relay to visualize relay's data on easYgen's HMI





Introduction

This application note describes the procedure how to setup a Modbus master data link between easYgen-3000XT and HighPROTEC protection relays

About easYgen Modbus master Tool:

Download: <u>https://wss.woodward.com/manuals/PGC/easYgen-3000XT_series/SW_Tools/ModbusMasterMapper</u> Configures multiple Modbus masters on a EG-3000XT, starting firmware version 2.10

System Requirements: Pentium® PC, 32 MB of RAM, Windows® 2000, XP, Vista, 7 or greater

About Woodward Toolkit:

Download: https://wss.woodward.com/manuals/PGC/SW_Tools/ToolKit

Microsoft Windows® 10, 8.1, 7, Vista (32- & 64-bit) Microsoft .NET Framework 4.6.2 1GHz or faster x86 or x64 processor, 1GB of RAM Minimum 1024 by 768 pixel screen resolution Appropriate communication hardware (e.g. Serial Port, CAN adapter, Ethernet) IXXAT or Kvaser CAN adapter and driver as appropriate ToolKit requires that the Microsoft .NET Framework be installed. The ToolKit installation will attempt to install the .NET Framework from the Internet; but you can also obtain the .NET Framework Redistributable package from the link below.

About HighPROTEC SmartView

Download: <u>https://docs.segelectronics.de/library/smart_view/</u>

SAFETY MESSAGES

Important Definitions

The types of messages shown below serve the safety of life and limb as well as for the appropriate operating life of the device.



DANGER! indicates an immediately dangerous situation that will result in death or serious injury if it is not avoided.

DANGER

WARNING

WARNING! indicates a hazardous situation that can result in death or serious injury if it is not avoided.

CAUTION

CAUTION! indicates a possibly hazardous situation that can result in minor or moderate injuries if it is not avoided.

NOTICE

NOTICE! is used to address practices not related to personal injury.

PREREQUISITES

This Application Note demonstrates the settings that have to be made at the HighPROTEC and at the Modbus-Master of the easYgen.

WARNUNG

Read this Application Note and all other documents that are required for a safe installation, operation and maintenance of the products. All safety aspects and messages and all national standards – if applicable – must be followed.

Failure to follow instructions can cause personal injury and/or property damage.

Any unauthorized modifications to or use of this equipment outside its specified mechanical, electrical, or other operating limits may cause personal injury and/or property damage, including damage to the equipment.

Any such unauthorized modifications: (1) constitute "misuse" and/or "negligence" within the meaning of the product warranty thereby excluding warranty coverage for any resulting damage, and (2) invalidate product certifications or listings.

HINWEIS

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GENERAL INFORMATION

easYgen-3000XT Modbus master mapper ↔ HighPROTEC:

As of version 2.10, easYgen devices support being operated as a Modbus/TCP-Master. With this functionality they can communicate with up to 5 external devices.

Woodward makes available the software tool "ModbusMasterMapper". It is compatible with Windows 7 or higher, and it can be used to create a setup file for any easYgen-XT device (as of SW version 2.10-0). With this setup file, the easYgen-XT can communicate via Modbus/TCP with several slave devices, i.e. it can read or write data.

The user defines the devices to be accessed, the type of data transfer and the Modbus address ranges to be transferred.

The ModbusMasterMapper generates an SCP file that can be uploaded to an easYgen-XT via the software "Toolkit".

This way the easYgen-XT can be configured in a way such that measurement values are transferred from the HighPROTEC (slave) onto the easYgen-XT (master).

The Modbus function codes 3 and 4 are supported. It is possible to read different values from a device, such as currents, voltages and temperatures.

These read values can be scaled freely and stored in 99 available slots for analog data or 99 Boolean values. The easYgen application can use these data in various ways via AnalogManager and LogicsManager.

The easYgen-XT offers a function for communication diagnosis, so that the user can check easily which external devices are available for communication.

Additionally, easYgen-XT has two special user-defined screens available for display. Each of these two screens can display up to 9 analog measurement values.

DEVICE VARIANTS (EXAMPLE)

easYgen-3200XT

For this kind of application one needs a generator control device of type easYgen-XT (with a recent firmware version, 2.10-0 or higher).

	easYg	en-3000XT	Series			
ERSYGEN 3000 ^{*1} Model	3100XT	320	0XT			
Package	P1	P1	P1-LT			
Measuring T	<u>.</u>					
Generator voltage (3-nhase/4-wire)						
Generator current (3x true r m s.)						
Mains voltage (3-phase/4-wire)		~				
Mains or ground current (1x true r m s : Mains or ground current selectable)						
Bushar voltage (1-phase/2-wire)						
Control	<u> </u>	[Í			
Breaker control logic (open and closed transition <100 ms.) Elev Apa ²⁸	1	2				
Automatic Manual Stop and test operating modes		~				
Mains narallel multiple-unit operation (up to 32 units)		~				
AMF (auto mains failure) and stand-by operation		~				
Solar and diesel support		✓				
Critical mode operation		×				
GCB and MCB synchronization (±slipping / phase matching)		✓				
Import / export control (kW and kvar)		~				
Load-dependent start/stop		~				
n/f, V, P, Q, and PF control via analog input or interface		×				
Load/var sharing for up to 32 gensets		×				
Freely configurable PID controllers		3				
HMI						
Color Display with Softkey operation DynamicsLCD TM	-		(
Start/stop logic for diesel / gas engines						
Counters for operating hours / starts / maintenance / active/reactive energy		 ✓ 				
Configuration via PC (serial connection and ToolKit software (included))		✓				
Event recorder entries with real time clock (battery backup)		1000				
Operating Temperature	-40 to 70 °C	-20 to 70 °C	-40 to 70 °C			
Protection Equivalent ANSI#	-	[
Generator: voltage / frequency 59 / 27 / 810 / 81U						
Generator: overload, reverse/reduced power 32 / 32R / 32F						
Generator: Synch Check 25						
Generator: unbalanced load 46						
Generator: instantaneous overcurrent 50						
Generator: time-overcurrent (IEC 255 compliant) 51 / 51 V						
Generator: ground fault (measured ground current) 50G						
Generator: power factor 55		×				
Generator: Pole slip monitor 78 PS						
Engine: overspeed / underspeed 12 / 14						
Engine: speed / frequency mismatch						
Engine: D+ auxiliary excitation failure						
Engine: Cylinder temperature						
Mains: voltage / frequency / synch check 59 / 27 / 810 / 81U / 25						
Mains: phase shift / rotation field / ROCOF (df/dt) 78						
I/Os						
Speed input: magnetic / switching; Pickup		~				
Discrete alarm inputs (configurable)		12 (10)				
Discrete outputs, configurable LogicsManager ⁷⁸		max. 12				
External discrete inputs / outputs via CANopen		32/32				
Analog inputs ^{#1} configurable FlexIn [™]		3				
Analog outputs: +/- 10V, +/- 20mA, PWM; configurable		2				
External analog inputs / outputs via CANopen		16/4				
Display and evaluation of J1939 analog values, "supported SPNs"		100				
CAN bus communication interfaces #2,#3 FlexCAN**		2				
Ethernet Modbus TCP Slave Interface #3		1				
USB Senai Internace DS 495 Modhus DTU Slave interface		4				
No-400 Moubus NTO Slave Interface		-				
Listings/Approvals						
UL / CUL Listing (61010 ,6200), VDE, EAC, VDE-AR-N 4105/ 4110						
CSA (USA and Canada)		~				
LK, ABS Marine						
GE Marked						
Part Numbers						
Front panel mounting with display #		8440-2082	8440-2083			
Cabinet back mounting w/o display	8440-2081	•				
Spare connector kit	8923-2318	8923-2318	8923-2318			

In the following we use an **easYgen 3200XT-P1** as an example.

HighPROTEC

Select a HighPROTEC that meets your protection needs. For the Modbus Master application described here, it is important to select a device with TCP/IP interface.

Every HighPROTEC device with Ethernet/TCP/IP also makes the Modbus TCP protocol available.

In the following we will use a HighPROTEC MCDGV4-2A0ACA as an example.

Generator Protection											
MCDGV4						-2	#	#	#	#	#
Housing	Display	DigitalIn puts	Binaryou tputrelay s	Analogin puts / Outputs	Interf.for ext.RTD Box						
B2	LCD, 128x 128pixel	16	11	0/0	ئد		A				
B2	LCD, 128x 128pixel	8	11	2/2	ئد		в				
B2	LCD, 128x 128pixel	24	11	0/0	ئد		С				
B2	LCD, 128x 128pixel	16	16	0/0	ند		D				
Hardware	variant 2										
Phase Current 5 A/1 A, Ground Current 5 A/1 A 0											
Phase Current 5 A/1 A, Sensitive Ground Current 5 A/1 A 1											
Housing a	nd mountin	g									
Housing sui	itable for doc	or mounting							Α		
Housing sui	itable for 190	Frack mounti	ng						в		
Communic	ation proto	col (°)									
Without pro				PE / torminal						A	
Modbus TC	P DNP3 0 TC	P/UDP_IEC60	870-5-104	Ethernet 100	MB / R.45					C	
Profbus-DP	optic fber	/ ST connect	or							D	
Profbus-DP	RS485 / D-	SUB								Е	
Modbus RT	U, IEC60870-	5-103, DNP3	.0 RTU optic	c fber / ST co	onnector					F	
Modbus RT	U, IEC60870-	5-103, DNP3	.0 RTU <i>R</i> S48	35 / D-SUB						G	
IEC61850, N	Modbus TCP,	DNP3.0 TCP/	UDP, IEC608	70-5-104 <i>Et</i>	hernet 100M	1B / F	RJ45			н	
IEC60870-5	-103, Modbu	s RTU, DNP3	.0 RTU <i>R</i> S48	35 / terminal	S				r Ś	ī	
Modbus TC	P, DNP3.0 TC	P/UDP, IEC60	870-5-104	Ethernet 100) MB/RJ45				ŝ		

Generator Protection						
MCDGV4	-2	#	#	#	#	#
IEC61850, Modbus TCP, DNP3.0 TCP/UDP, IEC60870-5-104 Optical Ethernet 100MB / LC duplex connector					K	
Modbus TCP, DNP3.0 TCP/UDP, IEC60870-5-104 Optical Ethernet 100MB / LC duplex connector					L	
IEC60870-5-103, Modbus RTU, DNP3.0 RTU <i>RS485 / terminals</i>				ŗ	т	
IEC61850, Modbus TCP, DNP3.0 TCP/UDP, IEC60870-5-104 Ethernet 100 M	ИВ /	RJ45		ŝ		
Harsh Environment Option						
None						Α
Conformal Coating						в
Available menu languages						
English (USA) / German / Spanish / Russian / Polish / Portuguese (BR) / Free	nch /	Ron	nani	an		
Miscellaneous Functions						

Control functions for up to 6 switchgears and logic up to 80 equations.IRIG-B interface for time synchronization.



SETTINGS

HighPROTEC MCDGV4-2A0ACA

The setting and operating software *Smart view* can be downloaded here: <u>http://docs.segelectronics.de/smart_view</u>

Launch *Smart view* and select the menu item [Device planning]. There you can double-click the parameter *»Scada . Protocol«* and set it to "Modbus TCP".

File Device Edit View Settings Tools Window Help	Device planning		×
	Module . Name	Value	^
	delta phi - 78V. Mode		Apply
Shortcuts 👲 Data from Device	Se Intertripping . Mode		
	P - 32R . Mode		Edit
S but	🖉 Q - 32 . Mode		
	HVBT[11-59, Mode		Lancel
Operation OP Drvice Data	HVBT[2] - 59 . Mode		Help
	LVBT[1] - 27 . Mode		Trop
	LVRT[2] - 27, Mode		
A le Protection Para	VG[1] - 27A, 59N A , Mode		
Device planning >	VG[11 · 27A, 59N A , Superv. only	no	
Logics	VG[2] 27A 59N A Mode		
> ⋥ Service	VG[2] - 27A, 59N A, Superv. only	no	
	A V012[11 - 47 . Mode		
Device Para	@ V012[2] - 47 Mode		
	V012[3] - 47 Mode		
3É~ 50/50	& V012[4] - 47 . Mode		
$\mathbf{pc} \rightarrow \mathbf{p}$	@ V012[5] - 47 Mode		
Field Para	@ V012[6] 47 Mode		
	@ ff11-81 Mode	fr	
(EECO)	@ f[2]-81_Mode	b	
	@ f[3]-81_Mode		
Protection Para	G f[4] - 81 Mode		
	G# [[5] - 81 Mode		
	@ [[6] 81 Mode		
	@ POS(11-32-37 Mode		
Control	A POS[1] - 32, 37 Mode	-	
	A POS[2] - 32, 37 Mode		
	@ POS[4] 32, 37 Mode		
	@ POSI51-32-37 Mode		
Logics	@ POSI61, 32, 37, Mode		
	@ PE[1], 55 Mode		
	Gr PEI21.55 Mode		
	St DastV/ Mode		
Service	BeCon[1] Mode	-	
Since	A ReCon[2] Mode		
	General Mode		
	GLAP 79 Made		
	Gi Suno, 25 Mode		
	GI SOTE Mode		
	G CLPU Mode		
	Gr EuDI11 Mode		
	Ga Everal Made		
	Gr EvP[2] Mode		
	Ga EuPIAL Mode		
	CALCE FOR COPE M		
	Cor - Subr, ozor . Mode		
	Garte col Mode	•	
	GLOD H		
	Ga Curte Made		
	SysA. Mode		
	Syslog Mode		
	Scada . Protocol	Modbus TCP	
	IRIG-B . Mode	•	
	AN SNLP Mode	1120	



Enter the menu branch [Device Para] and set »TCP/IP config« to a valid IP address (with subnet mask and gateway).

File Device Edit	View Settings Tools Window Help	3		
	2 ₮ ₮ ⊖ ₿ ⊘			
Shortcuts	🛨 Data from Device			
روان المعالم ا Operation	 ✓ I MCDGV4 > Su Operation + M Device planning ✓ Price Para 		TCP/IP Device Configuration Activate TCP/IP on the device TCP/IP Properties	×
Device planning	> - Digital Inputs > - Binary Outputs > - E Einary Outputs > - E Einary Outputs		IP address:	192 . 168 . 178 . 100
Ŷ	Acknowledge	6	Subnet mask:	255 . 255 . 252 . 0
Device Para			Default gateway:	10 . 25 . 16 . 1
Field Para	> -		Ethernet Properties: Speed:	100 MBit/s
E.E.T.O	Advanced Settings		Duplex mode: Link:	Full Duplex Up
	> 12 Field Para		MAC address:	00-12-8c-00-91-65
Control	> 😨 Control > 🔯 Logics		V Access Level:	Supervisor-Lv3 Cancel
-211-	> "etz: Service			

Enter [Device Para / Modbus / TCP] and set the »Unit ID«.

In the following we will use the example setting »Unit ID« = 1.

(Note that this requires the same setting Modbus-ID = 1 within the Modbus-Master-settings of the easYgen-XT, see Error! Reference source not found. on page Error! Bookmark not defined..)



File Device Edit	View Settings Tools Window Help		
	2 ₮ ₮ ⊖ 母 ?		
Shortcuts	🛨 Data from Device	🐼 Device Para/Modbus/Communication/General Settings 🛛 🐼 Device Para/Modb	us/Communication/TCP
Operation	 ✓ Im MCDGV4 > Im Device planning ✓ Im Device Para > Im Measurem Display 	Value Details	×
Device planning	 > E Digital Inputs > E Binary Outputs > E LEDs 	Unit ID:	Previous
B	Acknowledge	Range of Values: 1 255	🕑 Next
Device Para	> \bigcirc Security > \bigcirc Recorders > \bigcirc TCP/IP	The Unit Identifier is used for routing. This parameter is to be set, if a Modbus RTU and a Modbus TCP network should be coupled.	
©©© Protection Para	 ✓ - → Communication → → General Settings → → Config Registers → ○ Config Data Ohi 	Contraction of the second seco	
Control	> 12 Time	OK	Help
Logics Service	> v∰ Protection Para > v∰ Control > v∰ Cogics > s₩ Logics		

easYgen / Modbus-Master

The software ModbusMasterMapper can be downloaded here:

https://wss.woodward.com/manuals/PGC/easYgen-3000XT_series/SW_Tools/ModbusMasterMapper

Main dialog window looks like this:



• 4 ModbusMasterMapper				- 🗆	×
Files Help			N.W.	VOODWA	A R D
DEVICE ATEGROUP WRITE READ Connected T	imeout ModbusID IP1 IP2 II	P3 IP4 Port			▲ ▼
					*
Enable LM Bool	Connected LM Not used	Replace	Description		
FALSE Timeout [s] Float AM + 0.0	Nodbus- Int ID 0	Add Add at End	map file	map.mmap	
IP Address IPaddr 0 0 0 0	Port Int 0	Check	Application		
			Package		
			Nelease		

Every new project requires a device description package to be set up.

The package contains settings for all necessary parameters and access points of the device that shall operate as a Modbus Master. Without loading a package the tool is not functional, i.e. all menu items are inactive.

440-2082_G_English_EDS.zip	14.05.2020 13:52	WinZip File	164 KB
💐 8440-2082_G_Multilingual_Package.zip	14.05.2020 13:52	WinZip File	2.907 KB

The package file is also available at the documentation server,

https://wss.woodward.com/manuals/PGC/easYgen-3000XT_series/easYgen-3100XT-3200XT-P1/02_Config_Files_/8440-2082_J

Note: The package file is updated with every firmware release. Make sure to use the package file that matches with your easYgen firmware version.

After a package has been loaded the main dialog window shows menu items for several categories.



🝕 ModbusMas	terMapper										_		×
Files Help										M.	voo	DWA	RD
DEVICE	#	Enable +++ Connected	Timeout	ModbusID	IP1	IP2	IP3	IP4	Port				
 RATEGROUP WRITE 	√ 1	TRUE -	2	1	192	168	178	11	502				
READ													•
													*
													+
Enable LM	Bool		Connec	ted LM N	ot used				De	scription			
TRU	E			not us	ed		J	керіасе		MCDGV4	-2_08Okt	2020	
Timeout [s] Floa	t AM		Modbu	s- Int				Add	ma	p file	map.mm	ар	
+ 2				1	_			Add at End	Ha	ndoff	46141		
IP Address IPac 192	ldr 168 1	78 11	Port	Int 502	- X			Check	Ap	plication	EG3200	XTP1	
			<u> </u>						Pao	ckage	V1.1		
									Rel	lease	2.10-0		
										l			

The "Device" menu defines external devices, to which the easYgen-XT as Modbus Master will connect.

Every line in the list describes a device, and up to 5 devices are supported. In our example shown above the HighPROTEC MCDGV4 has already been defined.

First the IP address (of the Modbus-Master, i.e. of the easYgen-XT) and the Modbus-ID (of the Modbus-Slave, i.e. of the HighPROTEC device) have to be set.

The Modbus-ID (Slave-ID) has to be equal to the HighPROTEC setting, i.e. in our case: = 1.



🝕 ModbusMasterMapper			- 🗆 ×
Files Help		W	WOODWARD
	6	3	
O DEVICE ● RATEGROUP WRITE ● READ	Rate		▲ ▼ *
Rate [s] Float AM + 1		Replace Descriptic Add Add Add at End Handoff Check Applicatic Package Release With which device to communicate Communicate	n V4-2_08Okt2020 map.mmap 46141 xn EG3200XTP1 V1.1 2.10-0 1

The "Rategroup" menu defines groups that collect devices to be connected to by the easYgen-XT. In our case, the MCDGV4 is defined as the sole group member.

Every line in the list describes such a communication group.

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- The buttons move the position of an entry in the list.
- This button deletes an entry from the list.
- This button adds a new group.
- A click onto a line selects the respective group, and its settings are shown in the editing panel underneath, where they can be modified.

Replace
Add
Add at End
Check

This button transfers / inserts / checks the settings of the editing panel into the currently selected line of the list.



📲 ModbusMa	asterMapper								-		×
Files Help								₩.	voo	DWA	RD
								\searrow			
	Leng Devi	ce# Rate# Addr.	Туре	Endianness	FC	Scale	Source		Comr	ment	
RATEGROUP WRITE											
READ											+
											{
											۲A ۲ Z
Device-	t Rate-	Int	Modbus-	Int	Datatype	Type	Replace	Description			
number 0	number	Endianness	address	U *v+v	L		Add	MCDGV4	-2_08Ok	t2020	_
code 16	Endian- ness	littleEndian	Factor/ offset	*: + 1.0	+: + 0.	D	Check	map file	map.mm	lah	
Source In	dex Float AM Bit	ield					 CHECK	Handoff	46141		
+ (0.0			_				Application	EG3200	XTP1	
Comment Str	ring							Package	V1.1		
								Release	2.10-0		
1											

The "Write" menu defines a Modbus command to be transmitted. The easYgen-XT periodically sends a Modbus-command 16 "write multiple" to transfer data to the MCDGV4.

The lines can be grouped, so that they get transmitted within one command. The list is always displayed sorted as follows:

- 1. Device,
- 2. Rate,
- 3. Modbus address.

📲 Modbu	ısMas	terMa	pper												- 🗆	×
Files Help														woodw	ARD	
O DEVICE RATEGRO WRITE READ			Leng	g Device	# Rate# Addr.		Туре	Endianness	FC	Scale			Target		Comment ^	^
	DUP	~	1	1	1	20128	FLOAT	bigEndian	4	*1.0+0.0	A:54.01			SpW	/ Frequenz	2
		 ✓ 	1	1	1	20130	FLOAT	bigEndian	4	*1.0+0.0	A:54.02			SpW	/ U12	+
		1	1	1	1	20132	FLOAT	bigEndian bigEndian bigEndian	4 4 4	*1.0+0.0 *1.0+0.0 *1.0+0.0	A:54.03 A:54.04 A:54.05	2		SpW SpW SpW	7 U23 7 U31 7 U1	
		✓	1	1	1	20134	FLOAT									{
		1	1	1	1	20136	FLOAT									- A
		1	1	1	1	20138	FLOAT	bigEndian	4	*1.0+0.0	A:54.06			SpW	/ U2	۲Ż
		1	1	1	1	20140	FLOAT	bigEndian	4	*1.0+0.0	A:54.07			SpW U3		
		1	1	1	1	20232	FLOAT	bigEndian	4	*1.0+0.0	A:54.10			SfW	Netz IL1	
		2	/ 1 1		1	1 20224	FLOAT	bigEndian		*10.00	A-54 11			CAN	Note II 2	~
																_
	_		~		_				v—							
Device- Int number 1		nt		ate-	Int		Modbus-	Int	Datatype Type				Replace	Description		
				number			address	20128						MCDGV4-2_08Okt2020		
Function-	FC	FC 4		ndian-	Endia	nness	Factor/	*x+y			1		Add	map file	map.mmap	
code	4			ness		dian	offset	*: + 1.0	+: + 0.0		J		Check	Handoff	46141	
Target	Inde	exW A	M Bit	tfield												
Ĺ	503	03 Remote control 1 v												Application	EG3200XTP1	
Comment	Strin	ng							Package	V1.1						
	SpV	SpW Frequenz										Release	2 10-0			
														nereuse	2.10-0	
1																



The "Read" menu allows for defining a Modbus read command.

The easYgen-XT periodically sends a Modbus-command 3 "read" to get data from the MCDGV4.

The functionality of the Modbus addresses, as defined within the MCDGV4, i.e. the assignment of Modbus addresses to MCDGV4 parameters, is listed in a separate document, the MCDGV4 Modbus Datapoint List. This document is available here:

https://docs.segelectronics.de/library/HighPROTEC/MCDGV4-2/04_SCADA_Communication/Modbus/

The lines can be grouped, so that the data get transmitted within one command. The list is always displayed sorted as follows:

- 1. Device,
- 2. Rate,

•

•

- 3. Modbus address.
 - This button deletes an entry from the list.
 - This button adds a new line (i.e. a new analog value).
 - This button ungroups all groups within the whole list.
 - This button collects the selected lines in a new group. This is only possible if the lines to be grouped have the same Modbus-ID and the same Baud rate.



— This button transfers / inserts / checks the settings of the editing panel into the currently selected line of the list.



After all, the easYgen periodically reads measurement values from the HighPROTEC and displays them.



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