

HGM series parallel controller application collection

SMARTGEN (ZHENGZHOU) TECHNOLOGY CO., LTD.



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Chinese trademark



English trademark

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Date	Version	Note
2021-03-18	1.0	Original release.

Table 1 Software Version



Table 2 Symbol Instruction

	Symbol	Instruction
Δ	NOTE	Highlights an essential element of a procedure to ensure correctness.
A	CAUTION	Indicates a procedure or practice, which, if not strictly observed, could result in damage or destruction of equipment.
۲	WARNING	Indicates a procedure or practice, which could result in injury to personnel or loss of life if not followed correctly.



Preface

With the development of genset control technology and the continuous improvement of field application requirements, the application of multi-set parallel connection and grid connection is becoming more and more normalized, diversified and complicated.

Smartgen parallel controller has been used for more than ten years, and has accumulated rich experience by solving on-site problems of various applications. In order to facilitate communication and sharing with users and peers, General Manager Cui Wenfeng of Smartgen Technology proposed to organize some of the data accumulated in our daily work into a book and present it to everyone.

This book has made a detailed introduction to multi-set "island parallel connection", "Mains peak lopping", "AMF mode" and high voltage parallel connection.

There may be some description errors in this book. Experts are welcome to correct them so that we can modify them in time. The book will be updated continuously according to your raised questions and expanded applications of the products, and your valuable suggestions are highly appreciated.

The parallel controllers in all the examples are Smartgen products, so this book can also be used as a reference book for the products.

This book is suitable for OEM manufacturers, genset rental company, special applications and other related genset operators who have an electrical foundation.

This book introduces various parallel schemes involved in the current power generation industry in detail and it is divided into five parts:

- —Parallel scheme: including case introduction, corresponding parallel application method, how to set up, and realized functions.
- Parameter settings: including detailed descriptions of specific settings for different parallel modes.
- ——Debugging guide: including precautions before debugging, preparations, debugging steps, problem analysis, etc.
- ——GOV/AVR/ECU settings: including the GOV wiring application diagram, the AVR wiring application diagram, and the ECU wiring application diagram.
- ——Summarize: Summary about all related products covered in this book.



"Book in hand, plan in mind" is the value embodiment of this book, and "self-taught without a teacher make progress together" is the ultimate goal of writing this book.

This book was compiled and compiled by Zhou Zhitian, a product application engineer of Smartgen Technology. The people who participated in the compilation are: Cui Wenfeng, Wang Xiangqian, Wang Lei, Song Yaojun, Yao Guanbao, Gao Songwei, Zhang Zhibing and Wang Man, etc.

Thank you for your contributions to this book.

Smartgen Technology is committed to the mission of "making control smarter"; its vision is to create a century of Smartgen and to be the most trusted brand of partners. Share the experience with users, and Smartgen Technology will make progress together with everyone and create brilliance together.



1 Parallel scheme

1.1 Start on demand applications

1.1.1 Parallel operation between two same power units

This solution is suitable for parallel applications where two gensets of same power are turned on as demand. The controller can choose HGM9510 or HGM9510N.

Applications include: factories, hospitals, supermarkets, etc.

Example 1: Two ECU units with rated power of 320kW and the AVR is SX440. One of the genset is powered on first, and then the other genset is started/stopped according to the load.



Fig. 1 Application diagram of two units with same power



Table 3 Parameter settings

Setting	Sotting parameters	Setti	ngs	Romark
item	Setting parameters	Unit 1	Unit 2	Remark
	Engine Type	Refer to< <u>Para</u>	meter Setting	
Engine	Rated speed	1500	/min	
Setting	Crank disconnect condition	Gen frequency + speed		
	AC power system	3 Phase	4 Wire	
	Gen rated voltage (rated voltage)	230)V	
	Gen rated frequency (rated frequency)	501	Ηz	
	Current transformer ratio	600)/5	Current transformer ratio> Full load rated current
Generator Setting	Full load rated current (rated current)	576A		Full load rated current =rated power ×1.8
	Full load rated active power (rated active power)	320kW		
	Full load rated reactive power (rated reactive power)	240kvar		Set according to the power factor of 0.8
Input port	Digital input port 1	Remote Start	(on demand)	
setting	Digital input port 4	Gen Clo	se input	
Output port	Digital output port 5	Gen Ope	n output	
settings	Digital output port 6	Gen Clos	e output	
	The number of multi-set communication	2		
	Start options	Start on	demand	
Sync settings	Scheduled on Load Percentage (Maximum load percentage at startup)	80%		1. Scheduled on power = full-load active power of N units which currently connected in parallel × scheduled on load percentage
				r



Setting	Sotting parameters	Setti	ings	Domark
item	Setting parameters	Unit 1	Unit 2	Kelliaik
				 2. Scheduled on Load Percentage = Scheduled on power /full-load active power of N units which currently connected in parallel Note: "N" indicates the number of paralleled units. In this example N=1. 1. Scheduled stop power =
	Scheduled Stop Load Percentage (Minimum load percentage for stop)	40%		full-load active power of N units which currently connected in parallel × $\frac{(N-1)}{N}$ ×scheduled stop load percentage 2. Scheduled stop Load Percentage = Scheduled stop power /full-load active power of N units which currently connected in paralle × $\frac{N}{(N-1)}$ \bigwedge Note: "1" in the formula represents the unit with the lowest priority among the parallel units; "N" represents the number of parallel units. In this example N=2. \bigwedge Note: Scheduled stop power refers to the load power.
Synchroniz	Multi-set communication	1	2	
ed	Module run priority	1		
calibration				
	GUV/AVK	GOV: (SW1	: 5; 5002: 2)	Refer to <hgm9500 controller<="" td=""></hgm9500>



Setting	Setting parameters	Sett	ings	Remark
item		Unit 1	Unit 2	
		AVR: (SW1: 0; SW2: 2)		GOV/AVR Parameters setting

After the above parameter settings are completed, the controller is in auto mode, when the remote start input is active, unit 1 will start with load first, if the current load power is greater than the scheduled start power of 256kW, unit 2 will start in parallel, and the two units will share the current load power equally.

If the current load power is less than the scheduled stop power of 128kW, the load of unit 2 is transferred to unit 1, then unit 2 unloaded and stop, and unit 1 is loaded.



Fig. 2 Parallel start/stop curve of two units

1.1.2 Two units with different power in parallel

This solution is suitable for parallel application where two different power generator sets are turned on according to demand. HGM9510 or HGM9510N can be selected.

Example 2: Two non-ECU units combined with 500kW and 400kW which GOV is EFC3044196 and AVR is SX440, one of the genset is powered on first and loaded, then another unit will be start/stop according to the load.



Part 1 Parallel scheme



Fig. 3 Application diagram of two units with different power

Table 4 Related parameter settings

Setting	Setting parameters	Settings		Remark
item		Unit 1	Unit 2	
	Engine Type	Non ECU unit		
		Set according to the		Four-pole motor:
Engino	Number of engine teeth	result which caculated		$EngineTeeth - \left(\frac{Speed}{SetTeeth}\right) \times \frac{SetTeeth}{SetTeeth}$
Setting		by the engine teeth		60 <i>Frequency</i>
octang		formula.		ANote: "60" means 60 seconds.
	Rated speed	1500r/min		
	Crank disconnect	Gen frequency + speed		





Setting	Setting parameters	Settings		Pomark
item		Unit 1	Unit 2	Keinark
	condition			
	AC power system	3 Phase 4 Wire		
	Gen rated voltage	230V		
	(rated voltage)			
	Gen rated frequency	50Hz		
	(rated frequency)			
Generator Setting	current transformer ratio	1000/5	800/5	Current transformer ratio> Full load rated current
	(rated current)	900A	720A	Full load rated current =rated power × 1.8
	(rated active power)	500kW	400kW	
	(rated reactive power)	380kvar	300kvar	Set according to the power factor of 0.8
lonut nort	Digital input part 1	Remote Start (on demand)		
input port	Digital input port 1			
setting	Digital input port 4	Gen Close input		
Output port	Digital output port 5	Gen Ope	n output	
settings	Digital output port 6	Gen Clos	e output	
	The number of multi-set	2		
	communication			
	Start options	Start on demand		
				1. Scheduled on power = full-load
				active power of N units which currently
				connected in parallel ×scheduled on
				load percentage
Sync	Scheduled on Load			2. Scheduled on Load Percentage =
settings	Percentage	80	%	Scheduled on power /full-load active
				power of N units which currently
	percentage at startup)			connected in parallel
				ANote: "N" indicates the number
				of paralleled units. In this example
				N=1.
	Scheduled Stop Load	10	0/_	1. Scheduled stop power = full-load
	Percentage			active power of N units which currently





Setting	Setting parameters	Settings		Bomark
item		Unit 1	Unit 2	Keinark
	(Minimum load			connected in parallel×
	percentage for stop)			$\frac{\langle N-1 \rangle}{N}$ ×scheduled stop load
				percentage
				2. Scheduled stop Load Percentage =
				Scheduled stop power /full-load active
				power of N units which currently
				connected in parallel $\times \frac{N}{(N-1)}$
				▲ Note: "1" in the formula
				represents the unit with the lowest
				priority to be stopped among the
				parallel units; "N" represents the
				number of parallel units. In this
				example N=2.
				A Note: Scheduled stop power
				refers to the load power.
	Multi-set communication	1	2	
.	(MSC) ID	I	2	
Synchronize	Module run priority	1	2	
d calibration	GOV/AVR	GOV:(SW1: 5; SW2: 2)		Refer to < <u>HGM9500 controller</u>
	GUVAVA	AVR:(SW1:	0; SW2: 2)	GOV/AVR parameter setting>

If all above parameter settings are completed and the controller is in auto mode, when the remote start input is active, unit 1 will start with load first. If the total current load power is greater than 400kW, the unit 2 will be start and the two units will divide the current load equally.

If the current load power is less than the scheduled stop power of 180kW, the load of unit 2 is transferred to unit 1, then unit 2 unloaded and stop, and unit 1 is loaded.

Note: The "Scheduled start load percentage" and "Scheduled stop load percentage" of all units can be set as the same value or different values; when the power of the units is different, if change "Module Running Priority", it is recommended to reset the two percentages, otherwise the desired result may not be obtained.

1.1.3 Parallel connection of multi-sets with same power



This solution is suitable for parallel application where multiple sets with same power are turned on according to demand. HGM9510 or HGM9510N can be selected.

Example 3: Four ECU units combined with 300kW each which AVR is SX440, one of the genset is powered on first and loaded, then other 3 units will be start/stop according to the load.



Fig. 4 Application diagram of multi-sets with same power

Setting	Sotting parameters		Sett	ings		Romark
item	Setting parameters	Unit 1	Unit 2	Unit 3	Unit 4	Kennark
Engine	Engine Type	Refer	to< <u>Paran</u> <u>EFI </u>	<u>neter Set</u> <u>Jnit</u> >		
Setting	Rated speed		1500	r/min		
	Crank disconnect condition	Gen fr	equency ·	+ rotating		
	AC power system		3 Phase	e 4 Wire		
Generator	Gen rated voltage (rated voltage)		23	0V		
Setting	Gen rated frequency (rated frequency)		50	Hz		
	current transformer ratio		60	0/5		Current transformer

Table 5 Parameter settings of 4 gensets with same power



Setting	Sotting paramotors	Settings				Remark	
item	Setting parameters	Unit 1	Unit 2	Unit 3	Unit 4	Remark	
			•			ratio> Full load rated	
					current		
	Full load rated current					Full load rated current	
	(rated current)		54	0A		=rated power ×1.8	
	Full load rated active power		300)k\N/			
	(rated active power)		000				
	Full load rated reactive					Set according to the	
	power		228	kvar		power factor of 0.8	
	(rated reactive power)						
Input port	Digital input port 1	Ren	note Star	t (on dem	and)		
setting	Digital input port 4		Gen Clo	ose input			
Output port	Digital output port 5		Gen Ope	en output			
settings	Digital output port 6		Gen Clo	se output			
	The number of multi-set			4			
	communication			•			
	Start options		Start on	demand			
Sync settings	Scheduled on Load Percentage (Maximum load percentage at startup)		80	0%		 Scheduled on power full-load active power of N units which currently connected in parallel × scheduled on load percentage Scheduled on Load Percentage = Scheduled on power /full-load active power of N units which currently connected in parallel Note: "N" indicates the number of paralleled units. In this example, N=1 when the second unit 	
						is scheduled on, N=2	





Setting	Cotting poromotors	Settings				Pomork	
item	Setting parameters	Unit 1	Unit 2	Unit 3	Unit 4	Remark	
Setting item	Setting parameters	Unit 1	Sett Unit 2	Unit 3	Unit 4	Remarkwhen the third unit is scheduled on, and N=3 when the fourth unit is scheduled on.1. Scheduled stop power= full-load active power of N units which currently connected in parallel × $(N-1)$ N ×scheduled stop 	
	for stop)					unit with the lowest priority to be stopped among the parallel units; "N" represents the number of parallel	
						units. In this example, N=4 when the fourth unit is scheduled stop, N=3 when the third unit is scheduled stop, and N=2 when the second unit is scheduled stop.	





Setting	Setting narameters		Set	ings		Romark
item	Setting parameters	Unit 1	Unit 2	Unit 3	Unit 4	Keinark
				I	-	stop power refers to
						the load power.
						A Note: When there
						are several parallel
						units, it is
						recommended to
						reduce the scheduled
						stop load percentage
						to avoid frequent start
						and stop of units.
Synchroniz	Multi-set communication (MSC) ID	1	2	3	4	
ed	Module run priority	1	2	3	4	
calibration		GC	DV: (SW1	l: 5; SW2	Refer to < <u>HGM9500</u>	
Calibration	GOV/AVR	A۱	/R: (SW1	: 0; SW2	<u>controller GOV/AVR</u> parameter setting>	

If all above parameter settings are completed and the controller is in auto mode, when the remote start input is active, unit 1 will start with load first. If the current load power is greater than 240kW, the unit 2 will be start and the two units will divide the current load equally. If the current load power is greater than 480kW, the unit 3 will be start and the three units will divide the current load equally. If the current load power is greater than 480kW, the unit 3 will be start and the three units will divide the current load equally. If the current load power is greater than 480kW, the unit 3 will be start and the three units will divide the current load equally. If the current load power is greater than 720kW, the unit 4 will be start and the four units will divide the current load equally.

If the current load power is less than 360kW, the unit 4 will be stopped and the three units will divide the current load equally. If the current load power is less than 240kW, the unit 3 will be stopped and the two units will divide the current load equally. If the current load power is less than 120kW, the unit 2 will be stopped and the two units the unit 1 take load.

1.1.4 Multiple units with different power in parallel

This solution is suitable for parallel applications where multiple generator sets with different powers are turned on according to demand. HGM9510 or HGM9510N can be selected.

Example 4: There are four units which unit 1 and unit 2 are ECU units with 600kW of each while Unit 3 and Unit 4 are non-ECU units with 400kW of each. The GOV of non-ECU units is ESD5500 and the AVR



of 4 units are SX440, one of the genset is powered on first and loaded, then other 3 units will be start/stop according to the load.



Fig. 5 Application diagram of multi-sets with different power

Table 6 Parameter settings of 4 gensets with different power

Setting	Setting parameters		Set	tings		Remark
item		Unit 1	Unit 2	Unit 3 Unit 4		Kennark
		Refer				
		to< <u>Parameter</u>		Non EC	llunit	
	Engine Type	Setting of EFI		Non ECO unit		
		<u>Unit</u> >				
				Set acc	ording to	Four-pole motor:
Engine				the resu	It which	EngineTeeth = $\left(\frac{Speed}{60} \times \frac{SetTeeth}{Frequency}\right) \times 2$
Setting	Number of engine teeth			caculate	ed by the	(00 Prequency)
				engine teeth formula.		ANote: "60" means 60
						seconds.
	Rated speed	1500r/min				
	Crank disconnect	Con fr		+ rotating	n speed	
	condition	Gen II	equency	+ rotating speed		





Setting	Sotting parameters	Settings			Pomark	
item	Setting parameters	Unit 1	Unit 2	Unit 3	Unit 4	Remark
	AC power system		3 Phas	e 4 Wire		
	Gen rated voltage		23	30V		
	(rated voltage)		20			
	Gen rated frequency		50)Hz		
	(rated frequency)					
	current transformer	120)0/5	75	0/5	Current transformer ratio>
Conorator	ratio					Full load rated current
Sotting	Full load rated current	100		70		Full load rated current =rated
Setting	(rated current)	100	30A	12	20A	power×1.8
	Full load rated active					
	power	600)kW	400	0kW	
	(rated active power)					
	Full load rated reactive					Set according to the power
	power	450	450kvar	300kvar	factor of 0.8	
	(rated active power)					
Input port	Digital input port 1	Remote Start (on demand)				
setting	Digital input port 4	Gen Close input				
Output port	Digital output port 5	Gen Open output				
settings	Digital output port 6		Gen Clo	se output	t	
	The number of multi-set			4		
	communication					
	Start options		Start on	demand		
						1. Scheduled on power =
						full-load active power of N
						units which currently
Sync						connected in parallel ×
settings	Scheduled on Load					scheduled on load percentage
ootango	Percentage		8	0%		2. Scheduled on Load
	(Maximum load			• / •		Percentage = Scheduled on
	percentage at startup)					power /full-load active power
						of N units which currently
						connected in parallel
						A Note: "N" indicates the
						number of paralleled units.









Setting	Setting parameters		Set	tings		Remark
item	octang parameters	Unit 1	Unit 2	Unit 3	Unit 4	Komark
						several parallel units, it is recommended to reduce the scheduled stop load percentage to avoid frequent start and stop of units.
Synchroniz ed	Multi-set communication (MSC) ID Module run priority	1	2	3	4	
calibration	GOV/AVR	GOV: S	SW1: 5 SW2: 2 SW1: 0; S	GOV: 5W2: 2)	SW1: 0 SW2: 2	Refer to < <u>HGM9500 controller</u> <u>GOV/AVR parameter setting></u>

If all above parameter settings are completed and the controller is in auto mode, when the remote start input is active, unit 1 will start with load first. If the current load power is greater than 480kW, the unit 2 will be start and the two units will divide the current load equally. If the current load power is greater than 960kW, the unit 3 will be start and the three units will divide the current load equally. If the current load power is greater than 960kW, the unit 3 will be start and the three units will divide the current load equally. If the current load power is greater than 960kW, the unit 4 will be start and the four units will divide the current load equally.

If the current load power is less than 600kW, the unit 4 will be stopped and the three units will divide the current load equally. If the current load power is less than 427kW, the unit 3 will be stopped and the two units will divide the current load equally. If the current load power is less than 240kW, the unit 2 will be stopped and the unit 1 take load.

Note: The "Scheduled start load percentage" and "Scheduled stop load percentage" of all units can be set as the same value or different values; when the power of the units is different, if change "Module Running Priority", it is recommended to reset the two percentages, otherwise the desired result may not be obtained.

1.2 Full start application

1.2.1 Multi-set with same power in parallel connection at the same time

This solution is suitable for applications where multi-set with same power are powered on in parallel at the same time. According to the load demand, other units can be stopped/started reasonably, and HGM9510 or HGM9510N can be selected.



Applications include: factories with large loads, large supermarkets, etc.

Example 6: Four ECU units with rated power of 220kW are connected in parallel, and the AVR is SX440. Totally four units are required to loaded at the same time, and then stop/start three low-priority units according to the load demand. The unit with the highest priority keeps running at all time.



Tig. 6 Application diagram of multi-set with same power in parallel connection at the same time

Table 7 Parameter settings	s of 4 gensets with	equal power
----------------------------	---------------------	-------------

Setting	Setting parameters		Sett	ings	Remark	
item	octang parameters	Unit 1	Unit 2	Unit 3	Kemark	
Engine	Engine Type	Refer to <u>EFI Unit</u>	< <u>Parame</u> >	eter Settin	ng of	
Setting	Rated speed		1500	r/min		
Setting	Crank disconnect condition	Gen fre	equency	+ rotating	l speed	
	AC power system		3 Phase			
Generator Setting	Gen rated voltage (rated voltage)		23	0V		
	Gen rated frequency (rated frequency)		50	Hz		



Part 1 Parallel scheme

Setting	Sotting parameters		Sett	ings		Pomark
item	item Unit 1 Unit 2 U		Unit 3	Unit 4	Keinark	
	ourrent transformer ratio		40	0/5	I	Current transformer ratio>
			40	0/5		Full load rated current
						Full load rated current =rated
	Rated rated current		39	6A		power ×1.8
	Full load rated active					
	power		220	0kW		
	(rated active power)					
	Full load rated reactive					Sat according to the newer
	power		165	kvar		factor of 0.9
	(rated reactive power)					
Input port	Digital input port 1	Rem	ote Start	(on dem	and)	
setting	Digital input port 4		Gen Clo	se input		
Output port	Digital output port 5		Gen Ope	en output		
settings	Digital output port 6		Gen Clo	se output		
	The number of multi-set					
	communication		-	+		
	Start options		All pov	wer on		
						Four generator sets are started
					at the same time and	
	full start delay		18	ille.	connected in parallel. After	
	Turi start doldy			.00	180s delay, the three generator	
					sets with lower priority will be	
						stopped according to the load.
Svnc						1. Scheduled on power =
settings						full-load active power of N units
						which currently connected in
						parallel × scheduled on load
	Scheduled on Load					percentage
	Percentage		80)%		2. Scheduled on Load
	(Maximum load					Percentage = Scheduled on
	percentage at startup)					power /full-load active power of
						N units which currently
						connected in parallel
						A Note: "N" indicates the









Setting	Setting parameters		Sett	ings		Romark
item		Unit 1	Unit 2	Unit 3	Unit 4	Kontark
						several parallel units, it is recommended to reduce the scheduled stop load percentage to avoid frequent start and stop of units.
Synchroniz	Multi-set communication (MSC) ID	1	2	3	4	
ed	Module run priority	1	2	3	4	
calibration	GOV/AVR	GC AV	0V: (SW1 R: (SW1	: 5; SW2 : 0; SW2	:: 2) : 2)	Refer to < <u>HGM9500 controller</u> GOV/AVR parameter setting>

If all above parameter settings are completed and the controller is in auto mode, when the remote start input is active, the four units will be powered on at the same time and loaded in parallel. After a delay of 180 seconds, If the current load power is less than 264kW, the unit 4 will be stopped and the three units will divide the current load equally. If the current load power is less than 176kW, the unit 3 will be stopped and the two units will divide the current load equally. If the current load power is less than 264kW, the unit 1 take load.

If the load power is greater than 176kW, the unit 2 will be start and the two units will divide the load equally. If the load power is greater than 352kW, the unit 3 will be start and the three units will divide the load equally. If the load power is greater than 528kW, the unit 4 will be start and the four units will divide the load equally.

1.2.2 Two units with different power in parallel connection at the same time

This solution is suitable for applications where two units with same power are powered on in parallel at the same time. According to the load demand, other units can be stopped/started reasonably, and HGM9510 or HGM9510N can be selected.

Example 5: Two non-ECU units combined with 440kW and 640kW which GOV is ESD5500 and AVR is MX321. The two units start in parallel simultaneously, then another unit will be start/stop according to the load.





Fig. 7 Application diagram of two units with different power in parallel connection at the same time

Table 8 Parameter settings

Setting	Setting parameters	Setti	ngs	Remark
item		Unit 1	Unit 2	
	Engine Type	Non EC	CU unit	
Engine Setting	Number of engine teeth	Set accordi result which by the en formula.	ng to the caculated gine teeth	Four-pole motor: Engine Teeth = $\left(\frac{Speed}{60} \times \frac{SetTeeth}{Frequency}\right) \times 2$ Note: "60" means 60 seconds.
	Rated speed	1500r	/min	
	Crank disconnect	Gen freq	uency +	





Setting	Sotting parameters	Settings		Romark	
item		Unit 1	Unit 2	Kenlark	
	condition	rotating speed			
	AC power system	3 Phase	4 Wire		
	Gen rated voltage	230)\/		
	(rated voltage)	200	, v		
	Gen rated frequency	501	17		
	(rated frequency)	001	12		
Generator	current transformer ratio	800/5 1200/		Current transformer ratio > Full load rated current	
Setting	Full load rated current	7024	11520		
Coung	(rated current)	192A	TISZA		
	Full load rated active				
	power	440kW	640KW		
	(rated active power)				
	Full load rated reactive			Set according to the power factor of	
	power	330kvar	480kvar		
	(rated reactive power)			0.0	
Input port	Digital input port 1	Remote S	Start (on		
settina		dema	and)		
g	Digital input port 4	Gen Close input			
Output port	Digital output port 5	Gen Ope	n output		
settings	Digital output port 6	Gen Clos	e output		
	The number of multi-set	2			
	communication				
	Start options	All power on			
				Two generator sets are started at the	
				same time and connected in parallel.	
	full start delay	180)s	After 180s delay, the other generator	
Sync				sets with lower priority will be stopped	
settings				according to the load.	
				1. Scheduled on power = full-load	
	Scheduled on Load			active power of N units which currently	
	Percentage	809	26	connected in parallel × scheduled on	
	(Maximum load			load percentage	
	percentage at startup)			2. Scheduled on Load Percentage =	
				Scheduled on power /full-load active	





Setting	Sotting parameters	Setti	ngs	Romark	
item	Setting parameters	Unit 1	Unit 2	. Nemark	
				power of N units which currently	
				connected in parallel	
				A Note: "N" indicates the number	
				of paralleled units.	
				In this example N=1	
				1. Scheduled stop power = full-load	
				active power of N units which currently	
				connected in parallel ×	
				$\frac{\langle N-1 \rangle}{N}$ ×scheduled stop load	
	Scheduled Stop Load Percentage (Minimum load percentage for stop)			percentage	
				2. Scheduled stop Load Percentage =	
				Scheduled stop power /full-load active	
				power of N units which currently	
		409	%	connected in parallel $\times \frac{N}{(N-1)}$	
				▲ Note: "1" in the formula	
				represents the unit with the lowest	
				priority to be stopped among the	
				parallel units; "N" represents the	
				number of parallel units.	
				In this example N=2	
				A Note: Scheduled stop power	
				refers to the load power.	
	Multi-set communication	1	2		
Synchronize d calibration	(MSC) ID		2		
	Module run priority	1	2		
		GOV:(SW1:	9; SW2: 2)	Refer to < <u>HGM9500 controller</u>	
	GOVAVIN	AVR:(SW1: 0); SW2: 2)	<u>GOV/AVR parameter setting></u>	

If all above parameter settings are completed and the controller is in auto mode, when the remote start input is active, the two units will be powered on at the same time and loaded in parallel. After a delay of 180 seconds, If the load power is less than 216kW, the unit 2 will be stopped and the unit 1 take load. If the load



power is greater than 352kW, the unit 2 will be start and parallel with unit 1, and the two units will divide the load equally.

1.2.3 Fast parallel connection of multi-set (static parallel connection)

This solution is suitable for fast parallel connection of multi-set. HGM9510N controller is advised.

ANote: The "static parallel connection" function can be selected via a digital input port.

Disconnect all generator excitation and close all generator power supply (generator power supply must select DC control) before start the genset, and then start all generator at the same time. When the speed of all engines reaches the load speed, close the excitation switch and the generator establish the voltage at the same time, and then the parallel connection is completed.

Compared with common parallel connection, the delay for the unit to wait for the synchronization conditions to be met was saved. When the unit fails to meet the output excitation requirments within the set static parallel delay, the unit will exit the static parallel mode and enter into normal parallel mode. The generator open and excitation output, and it will close and parallel again after the synchronization requirments are met.

Example 7: Four ECU units combined with 400kW each which AVR is DVR2000. All four units need to be start in parallel and output to the transformer, and then other 3 units will be start/stop according to the load.





Fig. 8 Application diagram of multi-set with same power in fast parallel connection

Setting	Setting parameters		Setti	ngs	Remark	
item	ootting parameters	Unit 1	Unit 2	Unit 3	Unit 4	Komurk
Engine	Engine Type	Refer to	< <u>Parame</u> <u>Un</u>	<u>ter Settin</u> i <u>t</u> >		
Setting	Rated speed		1500	r/min		
octarig	Crank disconnect condition	Gen fre	equency +	⊦ rotating		
Generator Setting	AC power system		3 Phase	e 4 Wire		
	Gen rated voltage (rated voltage)		230	V		
	Gen rated frequency (rated frequency)		501	Hz		
	current transformer ratio		800)/5		Current transformer ratio> Full load rated current
	Full load rated		72	A	Full load rated current =rated	

Table 9 Parameter settings of four units with same power in fast parallel connection



Setting	Setting parameters		Sett	ings	Pomark	
item		Unit 1	Unit 2	Unit 3	Unit 4	Keillark
	current			1		power ×1.8
	(rated current)					
	Full load rated active					
	power		400	kW		
	(rated active power)					
	Full load rated	300kvar				
	reactive power					Set according to the power
	(rated reactive		500	Kvar		factor of 0.8
	power)					
	Digital input port 1	Ren	note Start	(on dema	and)	
setting	Digital input port 4		Gen Clo	se input		
setting	Digital input port 5	S	Static Par	allel Mode	Э	must be active always
Output port	Digital output port 5		Gen Ope	en output		
	Digital output port 6		Gen Clos	se output		
seungs	Digital output port 7	Gene	rator mag	netizing o	Generator Excitation Control	
	The number of					
	multi-set		2	1		
	communication					
	Start options		All pov	wer on		
	Number of online			1		
	units			1		
					Four generator sets are started	
					at the same time and	
					connected in parallel statically.	
Sync	full start delay		18	0s	After 180s delay, the three	
settings						generator sets with lower
						priority will be stopped
						according to the load.
						When the unit fails to meet the
						output excitation requirments
						within the set static parallel
	Static parallel delay		60)s		delay, the unit will exit the static
					parallel mode and enter into	
						normal parallel mode. The
					generator open and excitation	



Part 1 Parallel scheme

Setting	Setting parameters		Sett	ings	Bemerk	
item		Unit 1	Unit 2	Unit 3	Unit 4	Kemark
	Scheduled on Load Percentage (Maximum load percentage at startup)		80%			output, and it will close and parallel again after the synchronization requirments are met. 1. Scheduled on power = full-load active power of N units which currently connected in parallel * scheduled on load percentage 2. Scheduled on Load Percentage = Scheduled on power /full-load active power of N units which currently connected in parallel Note: "N" indicates the number of paralleled units. In this example, N=1 when the second unit is scheduled on, N=2 when the third unit is scheduled on, and N=3 when
					<pre>the fourth unit is scheduled on. 1. Scheduled stop power =</pre>	
	Scheduled Stop Load Percentage (Minimum load percentage for stop)		40	1%		full-load active power of N units which currently connected in parallel $\times \frac{(N-1)}{N}$ xscheduled stop load percentage 2. Scheduled stop Load Percentage = Scheduled stop power /full-load active power of N units which currently connected in parallel $\times \frac{N}{(N-1)}$





Setting	Setting parameters		Setti	ings	Romark	
item	Oetting parameters	Unit 1	Unit 2	Unit 3	Unit 4	Kentark
						 ▲ Note: "1" in the formula represents the unit with the lowest priority to be stopped among the parallel units; "N" represents the number of parallel units. In this example, N=4 when the fourth unit is scheduled stop, N=3 when the third unit is scheduled stop, and N=2 when the second unit is scheduled stop. ▲ Note: Scheduled stop power refers to the load power. ▲ Note: When there are several parallel units, it is recommended to reduce the scheduled stop load percentage to avoid frequent start and stop of units.
Synchronize	Multi-set communication (MSC) ID	1	2	3	4	
d calibration	Module run priority	1	2	3	4	
	GOV/AVR	GOV: (S AVR: (S	W1: 5; S' W1: 0; S\	W2: 2) W2: 2)	Refer to < <u>HGM9500N controller</u> <u>GOV/AVR parameter setting></u>	

If all above parameter settings are completed and the controller is in auto mode, when static parallel mode and remote start input are both active, all Gen power closed and then four units start simultaneously. When the speed of all engines reaches the load speed, close the excitation switch and the generator establish the voltage at the same time. If the current load power is less than 480kW, the unit 4 will be stopped and the three units will divide the current load equally. If the current load power is less than 320kW, the unit 3 will be stopped


and the two units will divide the current load equally. If the current load power is less than 160kW, the unit 2 will be stopped and the unit 1 take load.

If the load power is greater than 320kW, the unit 2 will be start and parallel with BUS, and the two units will divide the load equally. If the load power is greater than 640kW, the unit 3 will be start and parallel with BUS, and the three units will divide the load equally. If the load power is greater than 960kW, the unit 4 will be start and parallel with BUS, and parallel with BUS, and the four units will divide the load equally.

1.3 Balanced runtime applications

1.3.1 Application Notes for Balanced Runtime

Balance the operating time of all generators so that all units' run time are same. Benefit from this, all the generators can be maintained at one time and the life of the whole generators can be extended. You can choose HGM9510 or HGM9510N controller, while HGM9510N is advised due to its more flexible and more powerful function.

1.3.2 Parallel connection with two same/different power unit

This solution is suitable for parallel applications where two gensets with different power are running according to balanced runtime. HGM9510N can be selected.

Example 8: Two ECU units combined with 580kW and 460kW which AVR is MX321. Before balanced, the accumulative runtime of unit 1 is 190 hours, and that of unit 2 is 170 hours. Unit 2 is started first and unit 1 is started in parallel with unit 2 when the two units have the same runtime, following that unit 2 is soft-unloaded and stopped. The two units are started in a cycle according to the set balanced runtime.



Part 1 Parallel scheme



Fig. 9 Application diagram of balanced runtime parallel of two units with different power

Table 10 Related	parameter settings
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Setting	Setting parameters	Sett	ings	Remark		
item	item		Unit 2			
	Engine Type	Refer to< <u>Parameter</u>				
Engine		Setting of	<u>EFI Unit</u> >			
Setting	Rated speed	1500r/min		1500r/min		
Crank disconnect		Gen frec	luency +			
	condition	rotating	speed			
Generator	AC power system	3 Phase 4 Wire				
Setting	Gen rated voltage	2301/				
	(rated voltage)	(rated voltage)				





Setting	Sotting parameters	Settings		Romark
item	Setting parameters	Unit 1	Unit 2	Kenlark
	Gen rated frequency (rated frequency)	50	Hz	
	current transformer ratio	1200/5	1000/5	Current transformer ratio > Full load rated current
	Full load rated current (rated current)	1044A	828A	Full load rated current =rated power × 1.8
	Full load rated active power (rated active power)	580kW	460kW	
	Full load rated reactive power (rated reactive power)	440kvar	340kvar	Set according to the power factor of 0.8
Input port	Digital input port 1	Remote Start (on demand)		
Setting	Digital input port 4	Gen Close input		
Output port	Digital output port 5	Gen Open output		
settings	Digital output port 6	Gen Close output		
	The number of multi-set communication	2		
	Start options	Start on	demand	
	Balanced runtime	20h		Switch the units when the accumulated running time difference of two units is 20 hours. The number of online units refers to the minimum
Sync settings	Number of online units	1		number of units which running in parallel at the same time. In this example, if it is set to 2, the two units will always run at the same time.
	Scheduled on Load Percentage (Maximum load percentage at startup)	80%		 Scheduled on power = full-load active power of N units which currently connected in parallel × scheduled on load percentage Scheduled on Load Percentage = Scheduled on power /full-load active





Setting	Satting parameters	Sett	ings	Bomark
item	Setting parameters	Unit 1	Unit 2	Keillaik
				power of N units which currently connected in parallel Note: "N" indicates the number of paralleled units. In this example N=1
	Scheduled Stop Load Percentage (Minimum load percentage for stop)	40%		active power of N units which currently connected in parallel × $\frac{(N-1)}{N}$ ×scheduled stop load percentage 2. Scheduled stop Load Percentage = Scheduled stop power /full-load active power of N units which currently connected in parallel × $\frac{N}{(N-1)}$ \bigwedge Note: "1" in the formula represents the unit with the lowest priority to be stopped among the parallel units; "N" represents the number of parallel units. In this example N=2 \bigwedge Note: Scheduled stop power refers to the load power.
Synchroniz ed calibration	Multi-set communication (MSC) ID	1	2	If the "balanced runtime function is enabled, the unit with less runtime has higher priority than the one with more runtime. Otherwise, the unit with smaller module ID has higher priority than the one with larger module ID. The runtime refers to the user's accumulated runtime B.
	Module run priority	1		It balanced runtime function is enabled, all units that need to balance the runtime should be set as same





Setting	Setting parameters	Settings		Remark
item		Unit 1	Unit 2	Kenlark
				priority. The unit with less runtime has
				higher priority while the one with less
				MSC ID has higher priority if the
				runtime is same.
				Note: HGM9510 cannot be set as the
				same priority.
		GOV:		
		SW1: 5; SW	2: 2	Refer to < <u>HGM9500N controller</u>
	GOVIAVIN	AVR:		GOV/AVR parameter setting>
		SW1: 0; SW	2: 2	

If all above parameter settings are completed and the controller is in auto mode, when the remote start input is active, the unit 2 with less accumulated runtime will start first to take load. When the accumulated runtime of unit 2 reaches 190 hours, unit 1 is start and parallel with unit 2, and then unit 2 is unloaded and stopped. The two gensets start/stop circularly automatically according to the set balanced engine runtime of 20 hours (The one with less runtime and smaller module ID has higher priority).

During balanced runtime, if the load power is greater than the scheduled start percentage set value of the running unit, the other unit will start and take load in parallel; if the load power is less than the scheduled stop percentage, the unit with less runtime will be unloaded and stopped. The two gensets start/stop circularly automatically according to the set balanced engine runtime of 20 hours (The one with less runtime and smaller module ID has higher priority).

1.3.3 Multisets in parallel with the same power

This solution is suitable for parallel applications where multiple gensets with same power are running according to balanced runtime. HGM9510N can be selected and multi-sets can be balanced in group.

Example 9: Four ECU units combined with 520kW each which AVR is MX321.The cumulative runtime of unit 1 is 20 hours, and that of unit 2 is 30 hours while unit 3 is 40 hours and unit 4 is 55 hours. Then, the runtime of the four units can be balanced alternately from less to more according to the accumulative runtime.





Fig. 10 Application diagram of balanced runtime parallel of multi-set with same power

Table IT Parameter Settings of Dalanced fundine parametor four units with same power	Table 11 Parameter settings of	balanced runtime parallel of four units with same power
--	--------------------------------	---

Setting	Setting parameters	Settings				Romark
item	Oetting parameters	Unit 1 Unit 2 Unit 3 Unit 4				Keinark
Engino	Engine Type	Refer	to< <u>Paran</u> <u>EFI l</u>	neter Set <u>Jnit</u> >	ting of	
Setting		1500	r/min			
	Gen fre	equency -	+ rotating	speed		
	AC power system	3 Phase 4 Wire				
	Gen rated voltage (rated voltage)		230V			
Generator	Gen rated frequency (rated frequency)	50Hz				
Setting	current transformer ratio	1000/5		0/5		
	Full load rated current (rated current)	936A				
	Full load rated active		520	kW		



Part 1 Parallel scheme

Setting	Sotting parameters	Settings				Pomark
item	Setting parameters	Unit 1	Unit 2	Unit 3	Unit 4	Remark
	power (rated active power)		I	I		
	Full load rated reactive		000			Set according to the power
	power (rated reactive power)	390kvar				factor of 0.8
Input port	Digital input port 1	Rem	ote Start	(on dem	and)	
setting	Digital input port 4		Gen Clo	se input		
Output port	Digital output port 5		Gen Ope	en output		
settings	Digital output port 6		Gen Clos	se output		
	The number of multi-set communication	4				
	Start options		Start on	demand		
	Balanced runtime		10)h		
	Number of online units	2				The number of online units refers to the minimum number of units which running in parallel at the same time. In this example, if it is set to 2, the two units will always run at the same time.
Sync settings	Scheduled on Load Percentage (Maximum load percentage at startup)		80	%		 1. Scheduled on power = full-load active power of N units which currently connected in parallel × scheduled on load percentage 2. Scheduled on Load Percentage = Scheduled on power /full-load active power of N units which currently connected in parallel Note: "N" indicates the number of paralleled units. In this example, N=1 when the second unit is scheduled on, N=2 when the third unit is





Setting	Sotting parameters		Sett	ings		Bomork
item	Setting parameters	Unit 1 Unit 2 Unit 3 Unit 4				Remark
				I	L	scheduled on, and N=3 when
						the fourth unit is scheduled
						on.
						1. Scheduled stop power =
						full-load active power of N units
						which currently connected in
						parallel × $\frac{(N-1)}{N}$ ×scheduled
						stop load percentage
						2. Scheduled stop Load
						Percentage = Scheduled stop
						power /full-load active power of
	Scheduled Stop Load Percentage (Minimum load					N units which currently
		40%				connected in parallel $\times \frac{N}{(N-1)}$
	percentage for stop)					A Note: "1" in the formula
						represents the unit with the
						lowest priority to be stopped
						among the parallel units; "N"
						represents the number of
						parallel units.
						ANote: Scheduled stop
						power refers to the load
						power.
						If balanced runtime function is
						enabled, all units that need to
	Multi-set communication	1	2	3	4	balance the runtime should be
Synchroniz	(MSC) ID			-		set as same priority. The unit
od						with less runtime has higher
calibration						priority while the one with less
						MSC ID has higher priority if
	Module run priority	1	2	3	4	the runtime is same.
						Note: HGM9510 cannot be set
						as the same priority.





Setting	Setting parameters	Settings				Remark
item		Unit 1	Unit 2	Unit 3	Unit 4	Roman
	GOV/AVR	GC AV)V: (SW1 /R: (SW1	: 5; SW2 : 0; SW2:	: 2) : 2)	Refer to < <u>HGM9500N</u> controller GOV/AVR parameter <u>setting></u>

If all above parameter settings are completed and the controller is in auto mode, when the remote start input is active, unit 1 and unit 2 are scheduled start and stop according to the load power. Only when the load power is greater than the set value of scheduled start percentage, unit 3 will start first (generator with less accumulated runtime). When the accumulated runtime of unit 3 reaches 55 hours, unit 4 will be started and parallel, and then unit 3 unloaded and stopped. As long as the load power is greater than the set value of scheduled start 9 power is greater than the set value of scheduled and stopped. As long as the load power is greater than the set value of scheduled start percentage of units 1 and 2, unit 3 and 4 will start/stop circularly automatically, that is, only the unit 3 and unit 4 balance the runtime while unit 1 and 2 will not participate.

1.4 Application of Genet/mains parallel connection

1.4.1 Gen control mode (constant power mode)

This solution is suitable for a genset parallel with mains, and the genset is mainly on-load. HGM9510 and HGM9510N controllers can be selected. The applications include: biogas power generation, landfill gas power generation and gas power generation, etc.

Example 12: An ECU unit with a rated power of 680kW, and the AVR is MX321. The unit is parallel with mains, and the HGM9510 controller is selected.





Fig. 11 Application diagram of single mains parallel with single Gen (Gen control)

Table 1	12	Parameter	settings
---------	----	-----------	----------

Setting item	Setting parameters	Settings	Remark
	Mains power supply system	3 Phase 4 Wire	
Mains	Mains voltage	230V	
	Mains frequency	50Hz	
settings	Mains Split Setting	Enable: Frequency Change Rate, Vector Shift Mains undervoltage, mains overvoltage	



Setting item	Setting parameters	Settings	Remark
		Mains under-frequency,	
		mains over-frequency	
		Refer to <parameter setting<="" td=""><td></td></parameter>	
Engine	Engine Type	<u>of EFI Unit</u> >	
Sotting	Rated speed	1500r/min	
Setting	Crank disconnect	Gen frequency + rotating	
	condition	speed	
	AC power system	3 Phase 4 Wire	
	Gen rated voltage	2201/	
	(rated voltage)	230 V	
	Gen rated		
	frequency	50Hz	
	(rated frequency)		
	current transformer	4500/5	Current transformer ratio > Full load
Generator Setting	ratio	1500/5	rated current
	Full load rated		Full load rated current =rated power
	current	1224A	×1.8
		6001/11	
		OOUKVV	
			Sat apparding to the newer factor of
	(rated reactive	510kvar	
			0.0
	Digital input port 1	Remote Start (on demand)	
Input port	Digital input port 1	Gen Close input	
setting	Digital input port 5	Mains parallel mode	
	Digital niput port 5		
sottings	Digital output port 6		
settings	Settings Digital output port 6 Gen Close output		
Sync sottings		1	
Sync settings	communication	I	
	Multi-sot		
Synchronized	communication	1	
calibration		I	





Setting item	Setting parameters	Settings	Remark
	Module run priority	1	
	load mode	Gen control mode	
	Active power output	100% (680kW)	Active power output can be set according to site requirements.
	reactive power	100% (510kvar)	Reactive power output can be set
	output		according to site requirements.
	GOV/AVR	GOV: (SW1: 5; SW2: 2)	Refer to < <u>HGM9500 controller</u>
		AVR: (SW1: 0; SW2: 2)	GOV/AVR parameter setting>

If all above parameter settings are completed and the controller is in auto mode, when the remote start input is active, the genset starts with load, and the genset works in the constant power output mode (the set active/reactive power value is the maximum output active/reactive power of the genset.).

1.4.2 Mains control mode (mains peak)

This solution is suitable for a genset parallel with mains, and the mains is loaded with constant power, while the extra load is borne by the genset. Can choose HGM9520 or HGM9520N controller. This solution is often used in situations where the mains capacity is insufficient.

Example 13: An ECU unit with a rated power of 650kW, and the AVR is MX321. The single unit is parallel with mains. Use HGM9520 controller.

A current transformer is needed on the mains and 3 current transformers is needed on Gens.





Fig. 12 Application diagram of single mains parallel with single Gen---Mains control mode (mains

peak)

Table 13 Parameter settings

Setting item	Setting parameters	Settings	Remark
	Mains power	3 Phase / Wire	
	supply system	51 Hase 4 Wile	
	Mains voltage	230V	
	Mains frequency	50Hz	
	Mains current	1200/5	
	transformer	1200/0	
	full load active	200kW	
Mains	power	20000	
settings	full load reactive	150kvar	
	power		
		Frequency Change Rate,	
		Vector Shift	
	Mains Split Setting	Mains undervoltage, mains	Fully enabled or partially enabled
		overvoltage	according to specific requirements.
		Mains under-frequency,	
		mains over-frequency	
	Engine Type	Refer to< <u>Parameter Setting</u>	
Engine		of EFI Unit>	
Setting	Rated speed	1500r/min	
	Crank disconnect	Gen frequency + rotating	
	condition	speed	
	AC power system	3 Phase 4 Wire	
	(rated voltage)	230V	
	Gen rated		
	frequency	50Hz	
Generator Setting	(rated frequency)		
	current transformer	1200/5	
	Full load rated		
	current	11704	Full load rated current =rated power \times
	(rated current)		1.8
	,		



Cotting item	Setting	Settings	Remark		
Setting item	parameters				
	Full load rated				
	active power	650KM			
	(rated active	OSOKVV			
	power)				
	Full load rated				
	reactive power	185kvar	Set according to the power factor of 0.8		
	(rated reactive	4056741	Set according to the power lactor of 0.0		
	power)				
	Digital input port 1	Remote Start (on demand)			
setting	Digital input port 4	Gen Close input			
setting	Digital input port 8	Mains Close input			
	Digital output port 5	Gen Open output			
Output port	Digital output port 6	Gen Close output			
settings	Digital output port 3	Mains Close output			
	Digital output port 4	Mains Open output			
	The number of				
Sync settings	multi-set	1			
	communication				
	Multi-set				
	communication	1			
	(MSC) ID				
	Module run priority	1			
	load mode	Mains control mode			
Synchronized	Active power output	100% (200k\\\)	Mains active power output can be set		
calibration	(mains)		according to site requirements.		
	reactive power		Mains reactive power output can be set		
	output	100% (150kvar)	according to site requirements.		
	(mains)				
		GOV: (SW1: 5; SW2: 2)	Refer to < <u>HGM9500 controller</u>		
	GOV/AVR	AVR: (SW1: 0; SW2: 2)	GOV/AVR parameter setting>		

If all above parameter settings are completed and the controller is in auto mode, when the remote start input is active, the mains take load first. If the current load power is greater than the mains output active power of 200kW, the unit will be turned on and parallel with mains, and the generator will bear the excess load power, if the load power is less than the mains output active power of 200KW, the genset will be unloaded and stopped.



1.4.3 Mains control mode (Gen peak)

This solution is suitable for a genset parallel with mains, and the mains is loaded with constant power, while the extra load is borne by the genset. Can choose HGM9520 or HGM9520N controller. This solution is often used in situations where the mains capacity is limited.

Example 13: An ECU unit with a rated power of 650kW, and the AVR is MX321. The single unit is parallel with mains. Use HGM9520 controller. A current transformer is needed on the mains and 3 current transformers is needed on Gens.



Fig. 13 Application diagram of single mains parallel with single Gen---Mains control mode (Gen peak)

Table 14 Parameter settings

Setting item	Setting parameters	Settings	Remark
	Mains power	3 Phase 4 Wire	
	supply system		
	Mains voltage	230V	
Mains	Mains frequency	50Hz	
settings	Mains current	600/5	
	transformer		
	full load active	300kW	
	power		



Part 1 Parallel scheme

Setting item	Setting parameters	Settings	Remark		
	full load reactive power	222kvar			
		Frequency Change Rate,			
	Mains Split Setting	Mains undervoltage, mains	Fully enabled or partially enabled		
		overvoitage	according to specific requirements.		
		mains over-frequency,			
		Refer to <parameter setting<="" td=""><td></td></parameter>			
	Engine Type	of EFI Unit>			
Engine	Rated speed	1500r/min			
Setting	Crank disconnect	Gen frequency + rotating			
	condition	speed			
	AC power system	3 Phase 4 Wire			
	Gen rated voltage	230\/			
	(rated voltage)	2001			
	Gen rated				
	frequency	50Hz			
	(rated frequency)				
	current transformer	1200/5			
	ratio				
Generator	Full load rated		Full load rated current =rated power \times		
Setting	current	1170A	18		
	(rated current)		1.0		
	Full load rated				
	active power	650kW			
	Full load rated				
	reactive nower				
	(rated reactive	485kvar	Set according to the power factor of 0.8		
	power)				
	Digital input port 1	Remote Start (on demand)			
Input port	Digital input port 4	Gen Close input			
setting	Digital input port 8	Mains Close input			



Setting item	Setting parameters	Settings	Remark
	Digital output port 5	Gen Open output	
Output port	Digital output port 6	Gen Close output	
settings	Digital output port 3	Mains Close output	
	Digital output port 4	Mains Open output	
	The number of	1	
Sync settings	multi-set		
	communication		
	Multi-set	1	
	communication		
	(MSC) ID		
	Module run priority	1	
	load mode	Mains control mode	
Synchronized	Active power output	10% (30kW)	Mains active power output can be set
calibration	(mains)	1070 (0000)	according to site requirements.
	reactive power		Mains reactive power output can be set
	output	10% (22kvar)	according to site requirements.
	(mains)		
		GOV: (SW1: 5; SW2: 2)	Refer to < <u>HGM9500 controller</u>
	GUV/AVK	AVR: (SW1: 0; SW2: 2)	GOV/AVR parameter setting>

If all above parameter settings are completed and the controller is in auto mode, when the remote start input is active, the mains take load first. If the current load power is greater than the mains output active power of 30kW, the unit will be turned on and parallel with mains, and the generator will bear the excess load power, if the load power is less than the mains output active power of 30kW, the genset will be unloaded and stopped.

1.4.4 Busbar mode of single mains parallel with multi Gens

This solution is suitable for one way mains parallel with multiple gensets. HGM9510 or HGM9510N controller + HGM9560 controller is advised.

Example 14: Four Gas ECU units with rated power of 500kW and the AVR is SX440. Totally four units are required to parallel first, and then Gen Bus parallel with Mains to take load.

Note: According to the requirements, 4 pcs HGM9510 controllers, 1pc HGM9560 controller, 4pcs 1000A generator switches, 1pc 1000A mains switch, and 1pc 3200A load output switch are required. The busbar current of HGM9560 needs to be detected, so a current transformer on the busbar side and three current transformers on the mains side are required.







Fig.14 Application diagram of single mains parallel with multi Gens

Table	15	Parameter	settings
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Setting item	Setting parameters		Setti	ngs		Romark
Setting item	Setting parameters	Unit 1	Unit 2	Unit 3	Unit 4	Itemark
HGM9510	Engine Type	Refer to< <u>Parameter Setting of EFI</u> <u>Unit</u> >				
Engine	Rated speed		1500	r/min		
Setting	Crank disconnect condition	Gen fre	equency +	⊦ rotating	speed	
	AC power system		3 Phase	e 4 Wire		
	Gen rated voltage (rated voltage)		230)V		
HGM9510	Gen rated frequency (rated frequency)		501	Hz		
Generator Setting	current transformer ratio		100	0/5		
	Full load rated		90(٦A		Full load rated current =rated
	(rated current)		500	57 (power ×1.8
	Full load rated active power	500kW				



Sotting itom	Setting parameters	Settings				Pomark
Setting item		Unit 1	Unit 2	Unit 3	Unit 4	
	(rated active power)					
	Full load rated					
	reactive power		380	kvar		Set according to the power
	(rated reactive		000	itter i		factor of 0.8
	power)					
HGM9510						
Input port	Digital input port 4		Gen Clo	se input		
setting						
HGM9510	Digital output port 5		Gen Ope	en output		
Output port	Digital output port 6		Gen Clos	se output		
settings				•		
	The number of					
	multi-set	4				
	communication					
						1. Start all gensets when the
	Start options				HGM9560 is in the busbar	
		All power on				control mode.
		(start on demand)			2. Start on demand When the	
						HGM9560 is in the mains
						control mode.
						1. Scheduled on power =
						full-load active power of N units
HGM9510						which currently connected in
Sync settings						parallel × scheduled on load
						percentage
	Scheduled on Load					2. Scheduled on Load
	Percentage		80	1%		Percentage = Scheduled on
	(Maximum load		00	//0		power /full-load active power of
	nercentage at start)					N units which currently
	poroonago aroany					connected in parallel
						A Note: "N" indicates the
					number of paralleled units.	
						In this example, N=1 when
						the second unit is scheduled
						on, N=2 when the third unit is







Sotting itom	Setting parameters		Setti	ngs	Remark	
Setting item		Unit 1	Unit 2	Unit 3	Unit 4	Remark
						percentage to avoid frequent
						start and stop of units.
	Multi-set					
	communication	1	2	3	4	
	(MSC) ID					
	Module run priority	1	2	3	4	
HGM9510	Active newer output		1000/ //		I	Active power output can be set
Synchronized	Active power output		100% (5	συσκνν)		according to site requirements.
calibration	reactive newer					Reactive power output can be
	reactive power		100% (3	80kvar)		set according to site
	output					requirements
		GC	V: (SW1:	5; SW2	: 2)	Refer to < <u>HGM9500 controller</u>
	GOV/AVR	AV	R: (SW1:	0; SW2:	2)	GOV/AVR parameter setting>
	Mains power supply		3 Phase	4 Wire		
	system					
	Mains voltage		230)V		
	Mains frequency		501	Ηz		
	Mains current		200	0/5		
	transformer					
HGM9560	full load active power		1000)kW		
Mains	full load reactive	700/0407				
settings	power	/ bukvar				
		Enable:				
		Frequen	cy Chang	ge Rate, '	Vector	
		Shift				
	Mains Split Setting	Mains u	lains undervoltage, mains			
		overvolta	age			
		Mains u	nder-freq	uency, m	ains	
		over-free	quency			
	AC power mode		3 Pha	se 4 Wire	9	
	busbar rated voltage		2	30V		
Ruchar	Busbar rated	<u> </u>	E	оц-		
Dusbai	frequency		5			
seungs	Current Transformer		4(000/5		
	Full load rated active		20	00kW		



Sotting itom	Sotting paramotors	Settings		Pomark		
octang tern	Setting parameters	Unit 1	Unit 2	Unit 3	Unit 4	κειιακ
	power					
	Full load rated		15	26kvar		
	reactive power		152	LORVAI		
HGM9560	Digital input port 1	Remot	e power o	on (on de	mand)	
Input port	Digital input port 4	Bus	bar close	status in	iput	
setting	Digital input port 8		Mains Clo	ose input		
	Digital output port 5	Ν	Aains Clo	se outpu	t	
	Digital output port 6	E	Busbar clo	ose outpu	t	
settings	Digital output port 7	Ν	Mains Op	en outpu	t	
settings	Digital output port 8	E	Busbar op	en outpu	t	
	The number of					Pofors to the number of
	multi-set	4				
Syna sottings	communication					communication module.
Sync settings	Minimum number of	1				
	starting units					
	Multi-machine		1			
	communication ID					
	Module run priority	1				
						1. It is mains peak lopping
					mode if the mains control mode	
					is selected. that is, the mains	
						take load mainly, and when the
						mains is out of range or the
Numerica d	load mode	Busbar Control Mode			mains is abnormal, the busbar	
Synchronized						take load.
calibration						2. If busbar control mode is
						selected, it is constant power
						mode. Busbar constant power
						output.
						In mains mode, active power
	Active power output		100% (2	UUUKVV)		output is 100% (1000kW)
	reactive power	<u> </u>	1000/ (1)	526kvor)		In mains mode, reactive power
	output		10070 (1	JZURVAI)		output is 100% (760kvar)

If all above parameter settings are completed:

-----If the mains is closed and loaded, when the HGM9560 is selected as the busbar control mode,



while the HGM9510 and HGM9560 controllers are in auto mode, and when the HGM9560 remote start input is valid, all four units are turned on and connected in parallel. After the busbar is closed, it is parallel with mains and loaded. The maximum load power of the busbar is 2000KW.

When the HGM9510 and HGM9560 controllers are in auto mode, and the HGM9560 selects as mains control mode, then the mains switch is closed first with load. If the current load power is less than or equal to 1000KW, the mains takes load. If 1000KW < current load power \leq 1400kW, when HGM9560 remote start (on demand) is active, unit 1 is closed and connected in parallel with mains, and the generator busbar is loaded with load power below 400kW; if 1000KW < current load power When \leq 1800kW, unit 2 is closed and connected in parallel with mains, and the generator busbar is loaded with load power below 800kW; if 1000KW < current load power \leq 2200kW, unit 3 is closed and connected in parallel with mains, and the generator busbar is loaded in parallel with mains, and the generator busbar is closed and connected in parallel with mains, and the generator busbar is closed and connected in parallel with mains, and the generator busbar is loaded with load power \leq 3000kW, unit 4 is closed and connected in parallel with mains, and the generator busbar is loaded with mains, and the generator busbar is loaded with load power \leq 3000kW, unit 4 is closed and connected in parallel with mains, and the generator busbar is loaded with load power \leq 3000kW.

- ——If the current load power is less than 1600kW, unit 4 is unloaded and stopped, and the generator busbar is loaded with load power below 600kW; if the current load power is less than 1400kW, unit 3 is unloaded and stopped, and the generator busbar is loaded with load power below 400kW; if the current load power When it is less than 1200kW, unit 2 is unloaded and stopped, the power generation busbar is loaded with load power below 200kW. If the current total load power is lower than the mains active output power of 1000kW, after unit 1 is unloaded, the busbar is opened, then the unit 1 is turned off and the mains is loaded.
- ——When HGM9560 and HGM9510 both in AUTO mode, and "Load Mode" select as "Bus", if Mains fail, Mains breaker will open and Generator start to take the load. The Bus largest loading power is 2000KW.
- ——When controller in AUTO mode, and "Load Mode" select as "Mains", If Mains fail, Gen 1 start and close breaker, Bus breaker close, and the Gen Busbar take the load; If the current load is greater than scheduled power 800kW,Gen 2 starts and synchronizes with busbar to equally share the load; If the current load is greater than scheduled power 800kW,Gen 3 starts and synchronizes with busbar to equally share the load; If the current load is greater than scheduled power 800kW,Gen 3 starts and synchronizes with busbar to equally share the load; If the current load is greater than scheduled power 800kW,Gen 3 starts and synchronizes with busbar to equally share the load; If the current load is greater than scheduled power 800kW,Gen 3 starts and synchronizes with busbar to equally share the load; If the current load is greater than scheduled power 800kW,Gen 3 starts and synchronizes with busbar to equally share the load; If the current load is greater than scheduled power 800kW,Gen 3 starts and synchronizes with busbar to equally share the load; If the current load is greater than scheduled power 800kW,Gen 3 starts and synchronizes with busbar to equally share the load; If the current load is greater than scheduled power 800kW,Gen 3 starts and synchronizes with busbar to equally share the load; If the current load is greater than scheduled power 800kW,Gen 3 starts and synchronizes with busbar to equally share the load; If the current load is greater than scheduled power 800kW,Gen 3 starts and synchronizes with busbar to equally share the load; If the current load is greater than scheduled power 800kW,Gen 3 starts and synchronizes with busbar to equally share the load; If the current load is greater than scheduled power 800kW,Gen 3 starts and synchronizes with busbar to equal busbar



1200kW,Gen 4 starts and synchronizes with busbar to equally share the load; If the current load is greater than 2000kW, HGM9560 sends over power shutdown alarm, and four gensets shutdown. If the current load is lower than 600kW, Gen 4 unloads and shutdown, and Gen busbar shares the load. If the current load is lower than 400kW, Gen 3 unloads and shutdown, and Gen busbar shares the load. If the current load is lower than 200kW, Gen 2 unloads and shutdown, and Gen busbar shares the load. If the current load is lower than 200kW, Gen 2 unloads and shutdown, and Gen busbar shares the load.

—When controller in AUTO mode, and "Load Mode" select as "Mains", When Mains is normal, Mains and generators will anti-synchronize, and after synchronizing is completed, controller will start/stop gensets according to the scheduled power.

A Note: During Mains fail and before GCB close, there is no power for load; During Manis normal and Mains supply completed, there is continuous power for load.

1.4.5 Multi Mains and Multi Gens Synchronizing Mode

This solution suits for muti Mains and multi generators synchronization, users can select HGM9510/HGM9510N + HGM9560 controllers. Applications include: factories, hospitals, etc.

Example 15:Three 700kW gas EFI gensets with SX440 AVR, there are three channels of Mains and three channels of loads. Normally, Mains is loaded when Mains normal and generator is loaded when the Mains has failure.

A Note: As requirement, customers need to prepare 3xHGM9510 and 3xHGM9560 controllers, 3x1500A breakers for generators, 3x1500A breakers for Mains, and 3x3000A breakers for Busbar synchronized with Mains. Since the busbar current needs to be detected on the HGM9560, a current transformer is needed to add on the busbar.

When multiple channels of Mains in the system, multiple HGM9560 controllers control the start/stop of HGM9510 controllers dispatching gensets through MSC communication to supply power for multiple channels of load.

HGM9560 and HGM9510 work in AUTO mode.

——When "Starting Option" choose "Start Sets as Load Require".



- When there's one channel Mains fails, the HGM9560 of this channel detects voltage fault and initiates start signals to multiple HGM9510 controllers via MSC communication, and then genset with high-priority is powered on and loaded.
- 2) When multiple channels of Mains fail, and the busbar power reaches the scheduled start-up power, HGM9510 will start the remaining gensets in synchronization to supply power to multiple loads according to the order of priority from high to low.
- 3) When one channel of Mains back to normal, after the HGM9560 of this channel detects normal voltage from this Mains, it will control Mains anti-synchronized with generators busbar, and then close MCB and open the busbar breaker. HGM9560 sends a stop signal to HGM9510 through MSC communication, and the genset with the lowest priority stops.
- 4) When multiple channels of Mains back to normal, after the HGM9560 of each channel detects normal voltage from this Mains, HGM9560 controllers will control each Mains synchronized with busbar one by one, and then close MCBs to loaded and open the busbar breakers. Each HGM9560 sends a shutdown signal to HGM9510 through MSC communication, and multiple gensets are shut down in order of priority from low to high.

——When HGM9510 "Starting Option" choose "Start All Sets Initially".

- When one Mains or multiple Mains fail, after the HGM9560 controller detect Mains voltage fault, it will initiate start signals to multiple HGM9510 controllers via MSC communication to start all gensets running in synchronization and loaded.
- 2) When one channel of Mains back to normal, after the HGM9560 of this channel detects normal voltage from this Mains, it will control Mains anti-synchronized with generators busbar, and then close MCB and open the busbar breaker. Multiple gensets continue o work normally.
- 3) When every channel of Mains back to normal, after the HGM9560 of each channel detects normal voltage from each Mains, it will control related Mains anti-synchronized with generators busbar, and then close MCB and open the busbar breaker. Each HGM9560 sends a shutdown signal to HGM9510 through MSC communication, and multiple gensets are shut down in order of priority from low to high.

HGM9560 priority can be divided into status priority and module priority. If status priorities are different, then the HGM9560 priority is up to the status priorities; If status priorities are same, then the HGM9560 priority is up to the module priority;







The module priority can be set by users, while the status priority cannot be set.

Fig.15 Multiple Mains and Multiple Generators Synchronizing Application

Table 16 Multiple Mains and Multiple Generators Synchronizing Application Parameters

ltoms	Parameters	S	etting Val	ues	Romark
items		Gen1	Gen2	Gen3	Kemark
		Refer to	< <u>Paramet</u>	er Setting	
HGM9510		<u>of EFI Unit</u> >		<u>t</u> >	
Engine	Rated speed		1500r/mi	n	
Settings	Crank disconnect	Gen frequency + Speed		+ Speed	
	conditions			opeed	
HGM9510	AC system	3	Phase 4 V	Vire	





Itomo	Parametere	Setting Values			Bomark
items	Farameters	Gen1	Gen1 Gen2 Gen3	Gen3	Kellidik
Generator	Gen rated voltage		230\/		
Settings	(rated voltage)		2001		
	Gen rated frequency		50Hz		
	(rated frequency)		00112		
	CT primary		150/5		CT select > full load rating current
	Full load rating current		10001		Full load rating current=rated
	(rated current)		1260A		power × 1.8
	Full kW rating		700kW		
	(rated active power)		, contr		
	Full Kvar rating		520kvar		based on power factor 0.8
	(rated reactive power)		ozonvar		
HGM9510 Digital Inputs Settings	Digital input port 4	Genera	itor closed	auxiliary	
HGM9510	Relay output 5	Op	oen gen ou	Itput	
Relay Outputs Settings	Relay output 6	Clo	ose gen ou	ıtput	
	MSC number		3		
HGM9510 Sync Settings	Starting options	Star (star	t sets as re t all sets ir	equire nitially)	 Start sets as require:Start gensets based on each channel of load when Mains fail; When Mains return, gensets will stop based on load. Start all sets initially: All gensets start when Mains fail, and when all Mains return gensets will stop.
	Calling for more sets (maximum load percentage when to start genset)		80%		Power(when calling for more sets)=full loading power of N synchronizing gensets ×







Itoms	Paramotors	S	etting Val	ues	Romark
items	Farameters	Gen1	Gen2	Gen3	
					for No.3 genset to stop, N=3. if calling for No.2 genset to stop, N=2. if calling for No.1 genset to start, N=1. Note: power when calling less gensets is means loading power. Note: when too many gensets running in synchronization, we suggest to reduce the calling for less units percentage to avoid gensets start/stop frequently.
	MSC ID	1	2	3	
	Module priority	1	2	3	
HGM9510 Sync.	Active power output	100%(700kW)			Users can set active power output according to the site requirements.
Calibration	Reactive power output	10	0%(520k	var)	
	GOV/AVR	GOV:(SW1:5; SW2:2) AVR:(SW1:0; SW2:2)			Refer to < <u>HGM9500</u> controller GOV/AVR parameter setting>
	Mains AC system	3P4W			
	Mains voltage		230V		
	Mains frequency		50Hz		
HGM9560	Mains CT primary		1500/5		
Mains	Full load kW power		700kW		
Settings	Full load kvar power		520kvar		
	Mains decoupling setting	Enable: R.O.C.C Mains ur over volt	9.F, Vector nder voltag age, Main	r shift, ge, Mains ns under	



Itoms	Parameters	Se	etting Val	ues	Pomark
items		Gen1	Gen2	Gen3	. Keillaik
		frequenc	y, Mains d	over	
		frequenc	у		
	AC system		3P4W		
	Bus voltage		230V		
Bus	Bus frequency		50Hz		
Settings	Bus CT primary		1500/5		
	Bus full load kW power	700kW			
	Bus full load kvar power		520kvar		
HGM9560	Digital input port 4	Bus	closed au	xiliary	
Input Settings	Digital input port 8	Mains closed auxiliary		uxiliary	
	Relay output 5	Relay output 5Close mains outputRelay output 6Close Bus output		output	
Output	Relay output 6			utput	
settings	Relay output 7	Open Mains output			
Journa	Relay output 8	Open Bus output			
HGM9560 Sync	MSC No.	3			Refers to the number of gensets in communication.
Settings	Minimum number of sets	1			
HGM9560	MSC ID	1	2	3	
Sync. Calibration	Module priority	1	2	3	

If above settings completed, HGM9560 and HGM9510 controllers in AUTO mode, three channels of Mains will supply three channels of load when Mains normal.

——When HGM9510 "Starting Option" choose "Start Sets as Load Require".

- 1) If either Mains fails, the corresponding MCB will open, Genset 1 will start and the corresponding Bus breaker will close. If current load power < 560kw, Gen 1 will take the load. If any one of the current load power > 560kW or any two channels of Mains fail and 560kW < current load power ≤ 1120kW, Gen 2 will start and synchronize with Gen1 to share the load with Gen2. If any two channels of current load power > 1120kW or three channels of Mains fail and 1120kW<current load power ≤ 2100kW,Gen 3 will start and synchronize with Bus to share the load with Gen2 and Gen1.
- 2) When three channels of load are all powered by Gens, if any one channel of Mains return, the corresponding Mains will anti-synchronize with Gens and take the load from the Gen, and the



corresponding Bus breaker will open. If the current load power > 560kW, three Gens will share the load. If 280kw < current load power \leq 560kW, Gen3 will open breaker and stop. If either channel of other two Mains returns, the corresponding Mains will anti-synchronize with Gens and take the load from the Gen, and the corresponding Bus breaker will open. If current load power \leq 280kW, Gen2 will open breaker and stop. If all three channels of Mains return, the last channel of Mains will anti-synchronize with Gens and take the load from the Gen, and the corresponding Bus breaker will open, and Gen1 will open breaker and stop.

——When HGM9510 "Starting Option" choose "Start All Sets Initially".

- 1) If Mains fail, all gensets will run in synchronization and take the load.
- If one or two channels of Mains return, the corresponding Mains will anti-synchronize with the Gen Bus, MCB will close and related Bus breaker will open. Three gensets keep running normally.
- 3) If all three channels of Mains return, the corresponding Mains will anti-synchronize with the Gen Bus, MCB will close and related Bus breaker will open. And then three gensets will stop in order of priority from low to high.

A Note: After Mains fail but before GCB closed, there is no power supply for load; and from Mains return and Mains loaded, there is uninterrupted power for the load.

1.4.6 Load Mode: Takeover Application

This application is suitable for one generator synchronized running with Mains, load can be transferred from Mains and Gen. Customers can choose HGM9520 or HGM9520N controller. Application scenarios include: harbors, inshore/offshore, entry/exit the port, and planned power outages.

Example 16: 1x750kW EFI generator, AVR model is SX440, when the controller receives the switch signal between the Mains and the generator, the generator and the mains can automatically switch to be loaded.

• Note: Controller must connect to Mains CT if customers choose the Load Mode of HGM9520 to realize the generator and Mains automatically switch to be loaded based on the requirement.





Fig.16 Takeover Load Mode Application Diagram

Table 17 Takeover Load Mode Parameters Se	ettings
---	---------

Items	Parameters	Setting Values	Remark
	AC system	3P4W	
	Voltage	230V	
	Frequency	50Hz	
	CT primary	1200/5	
	Full load rating	600kW	
Mains	Load kvar rating	443kvar	
Settings		Enable:	
	Mains decoupling	R.O.C.O.F, Vector Shift,	
		Mains Under Voltage, Mains	
		Over Voltage, Mains Under	
		Frequency, Mains Over	
		Frequency	
	Engine type	Refer to< <u>Parameter Setting</u>	
Engine		<u>of EFI Unit</u> >	
Settings	Rated speed	1500r/min	
	Crank disconnect	Frequency + Speed	



Items	Parameters	Setting Values	Remark
	conditions		
	AC system	3P4W	
	Rated voltage	230V	
	Rated frequency	50Hz	
Conorator	CT primary	1500/5	CT selection>full loading rated current
Settings	Full load rating	1350 \	Full load rating=rated powerx1.8
Counigo	(rated current)	1330A	
	Full kW rating	75041	
	(rated kW power)	70000	
	Full kvar rating	555kvar	Setting based on PE 0.8
	(rated kvar power)	JJJKVAI	
Digital	Digital input 1	Remote start (island mode)	
Inputs	Digital input 4	Generator closed auxiliary	
Settings	Digital input 8	Mains closed auxiliary	
Bolov	Relay output 5	Open gen output	
	Relay output 6	Close gen output	
Settings	Relay output 3	Close Mains output	
Counigo	Relay output 4	Open Mains output	
Sync. Settings	MSC number	1	
Churs e	Load mode	Load takeover mode	
Sync.		GOV:(SW1:5; SW2:2)	Refer to < <u>HGM9500 controller</u>
Calibration	GUV/AVK	AVR:(SW1:0; SW2:2)	GOV/AVR parameter setting>

After above parameters set completely, and controller is in Auto mode:

- —When generator needs to supply to the load, activate "Remote start (island mode)", generator will start and synchronize with Mains, and all the load will transfer from Mains to generator, and then MCB will open. All the load are powered from generator.
- —When Mains needs to supply to the load, deactivate "Remote start (island mode)", Mains will anti-synchronize with generator, and all the load will transfer from generator to Mains, and then GCB will open and stop.

1.4.7 The application of "Load Control Mode"



This project is suitable for one generator (this generator is considered as Mains) synchronized with one generator equipped with HGM9520 control system to share the load in proportion.

Example 17: There are two EFI gensets, the rated power of genset 1 is 640kW; and genset 2 equipped with HGM9520 control system is 720kW. Both gensets AVR is SX440. A synchronizing controller is used to evenly share the load between two gensets.

Note: Choose the "Load Mode" of HGM9520 based on the requirement to realize use one synchronizing controller to share the load proportionally between two gensets. HGM9520 will control circuit close/open, and not control the genset start or stop. In this mode, Mains parameters are configured as generator parameters in ASM control system. One CT needs to be installed in the end of ASM generator and connect with HGM9520 current sampling terminals (terminal 53, terminal 54).



Fig. 17 Load Control Mode Application Diagram

Table 18 Parameters Settings of Load Control Mode Application

Items	Parameters	Settings	Remark
	AC system	3P4W	
	Voltage	230V	
Mains	Frequency	50Hz	ASM control system parameters
Settings	CT primary	1200/5	Admitter system parameters
	Full load rating	640kW	
	Load kvar rating	475kvar	



Items	Parameters	Settings	Remark
	Engine type	Refer to< <u>Parameter Setting of</u>	
Engine		<u>EFI Unit</u> >	
Settings	Rated speed	1500r/min	
Cettings	Crank disconnect	Frequency + Speed	
	conditions		
	AC system	3P4W	
	Rated voltage	230V	
	Rated frequency	50Hz	
		1500/5	CT selection > full loading rated
Conorator	Crpnnary	1500/5	current
Sottings	Full load rating	10001	Full load rating=rated power × 1.9
Settings	(rated current)	1296A	Fuilload failing-failed power × 1.0
	Full kW rating	700144	
	(rated kW power)	720KVV	
	Full kvar rating	E2Elavor	
	(rated kvar power)	555KVAI	Setting based on PP 0.6
Digital	Digital input 1	Remote start(Start Sets as	
Inputs		Load Require)	
Settings	Digital input 4	Generator closed auxiliary	
Relay	Relay output 5	Open gen output	
Outputs	Relay output 6	Close gen output	
Settings	5 1 -		
Sync.	MSC number	1	
Settings			
	Load mode	Load Control Mode	
	Active power	40%(Mains: 40%; Gen: 60%)	Mains is ASM genset parameters
Sync.	output		
Calibration	Reactive power	40%(Mains: 40%; Gen: 60%)	Mains is ASM genset parameters
	output	, , , , , , , , , , , , , , , , , , , ,	
	GOV/AVR	GOV:(SW1:5; SW2:2)	Refer to < <u>HGM9500 controller</u>
		AVR:(SW1:0; SW2:2)	<u>GOV/AVR parameter setting</u> >

After above settings completed:

If the current loading power is 800kW, and Gen 1 is running with load, when HGM9520 is in AUTO mode and remote start is active, Gen 2 will start and synchronize with Gen 1. The current loading power will be distributed proportionally according to the active power output setting, with



Gen 1 carrying 320kW and Gen 2 carrying 480kW.

- —If the current loading power 1300kW, Gen 1 synchronizes with Gen 2 loaded together. The current loading power will be distributed proportionally according to the active power output setting, with Gen 1 carrying 520kW and Gen 2 carrying 780kW.
- —If the loading power is bellow 640kW, the remote start input signal will be disconnected, and the load will transfer from Gen 2 to Gen 1, and then Gen 2 will be stopped.

A Caution: If the load is above the rated power of each generator, don not disconnect the remote start input signal to avoid generator overload shutdown.

1.4.8 AMF control mode application

This application is suitable for after one generator synchronize with Mains, the load will transfer from Mains and generator. In this case, HGM9520 or HGM9520N can be chose to applicate in plant, school, supermarket etc.

Example 18, one EFI 900kW generator with SX440 AVR, when Mains is faulty, generator will take the load; when Mains return, Mains will take the load and generator will stop automatically.

A Note: Choose AMF control mode of HGM9520 based on the requirement to realize Mains or Gen to take the load. CT needs to be connected to the Mains side, and set the current transformer ratio, full load active power and full load reactive power according to the load condition.




Fig.18 AMF control mode application

Table 19 AMF control mode application related parameters settings

Items	Parameters	Setting Values	Remark
	AC system	3P4W	
	Voltage	230V	
	Frequency	50Hz	
	CT primary	1500/5	
	Full load rating	800kW	
Mains	Load kvar rating	600kvar	
Settings	Mains decoupling	Enable:	
		R.O.C.O.F, Vector Shift,	
		Mains Under Voltage, Mains	
		Over Voltage, Mains Under	
		Frequency, Mains Over	
		Frequency	
Engine	Engine type	Refer to< <u>Parameter Setting</u>	
Settings		<u>of EFI Unit</u> >	
Coungs	Rated speed	1500r/min	



SmartGen ideas for power

Items	Parameters	Setting Values	Remark
	Crank disconnect conditions	Frequency + Speed	
	AC system	3P4W	
Generator Settings	Rated voltage	230V	
	Rated frequency	50Hz	
	CT primary	2000/5	CT selection > full loading rated current
	Full load rating (rated current)	1620A	Full load rating=rated power × 1.8
	Full kW rating (rated kW power)	900kW	
	Full kvar rating (rated kvar power)	760kvar	Setting based on PF 0.8
Digital	Digital input 4	Generator closed auxiliary	
Inputs Settings	Digital input 8	Mains closed auxiliary	
Relay	Relay output 5	Open gen output	
Outputs Settings	Relay output 6	Close gen output	
	Relay output 3	Close Mains output	
	Relay output 4	Open Mains output	
Sync. Settings	MSC number	1	
Sync.	GOV/AVR	GOV: (SW1: 5; SW2: 2)	Refer to < <u>HGM9500 controller</u>
Calibration		AVR: (SW1: 0; SW2: 2)	GOV/AVR parameter setting>

After above settings completed, controller is in AUTO mode, if Mains is faulty, MCB will open, Gen will take the load. If Mains is return, Mains will anti-synchronize with Gen and load will transfer from Gen to Mains, GCB will open, and then generator will stop.

A Note: Load has no power supply after Mains faulty and before GCB close; load has continuous power from Mains return and Mains loaded.

1.4.9 Island Mode Application

The application is same as "Take Over" mode.

1.5 Economic Fuel Consumption Synchronization Application



1.5.1 Description of the economic fuel consumption synchronization application

Enable the economic fuel consumption to realize this function. Configure the same economic fuel consumption data for all gensets, including enable economic fuel consumption, economic fuel consumption percentage, and economic fuel consumption exchange rate.

Scheduling principle:

- ——The priority is to select minimum synchronizing gensets, when the one generator can meet with the requirements, the second genset will not start, and likewise.
- ——The second priority is to meet the economic fuel consumption percentage. The load percentage of the selected solution should not be greater than and closest to the economic fuel consumption percentage.
- ——When choose the better solution, the total rated power difference before and after exchange should greater than economic fuel consumption exchange rate.
- ——When enable the economic fuel consumption, the parameters including Call for more sets percentage, Call for less sets percentage, Call for more sets active power, Call for less sets active power, MSC number etc. are still work.
- Economic fuel consumption scheduling and balance time scheduling cannot work at the same time. When economic fuel consumption scheduling enabled, balance time scheduling will not work anymore.

1.5.2 Two gensets with different capacities running in synchronization

This solution selected with HGM9510N is suitable for two gensets with different power running in synchronization.

Example 11: Two EFI gensets, Gen 1 rated power is 300kW, Gen 2 rated power is 360kW, both two AVRs are MX321, and gensets are running in a fuel-efficient manner.



Part 1 Parallel scheme



Fig.19 Two different power gensets synchronization diagram

Items	Paramotors	Setting V	Values	Pomark
	T didificters	Gen 1	Gen 2	- Keinark
	Engine type	Refer to <p< td=""><td>arameter</td><td></td></p<>	arameter	
Engine Settings		Setting of t	<u>=FI Unit</u> >	
	Rated speed	1500r/	/min	
	Crank disconnect	Frequency	+ Sneed	
	conditions	rioquonoy	opood	
Generator	AC system	3P4	W	
Settings	Rated voltage	230	IV	
eetinge	Rated frequency	50H	lz	

Table 20 Two different power gensets synchronization related parameter settings



Itoms	Daramotors	Setting '	Values	Pomark	
items	Gen 1 Gen 2		Keniark		
	CT primary	600/5	750/5	CT selection>full loading rated current	
	Full load rating (rated current)	540A	648A	Full load rating=rated power × 1.8	
	Full kW rating (rated kW power)	300kW	360kW		
	Full kvar rating (rated kvar power)	222kvar	270kvar	Setting based on PF 0.8	
Digital Inputs	Digital input 1	Remote start(Start Sets as Load Require)			
Settings	Digital input 4	Generator clos	sed auxiliary		
Relay	Relay output 5	Open ger	n output		
Outputs Settings	Relay output 6	Close gen output			
	MSC number	2			
	Starting option	Start sets as	load require		
	Sets on Bus	1		The number of sets on bus means the minimum synchronizing gensets . If setting as 2, Gen1 and Gen2 will keep running in synchronization.	
Sync.	Economy Fuel (%)	75%			
Settings	Economy Sawp(W)	50k	W		
	Call More Sets(%) (the maximum load percentage when to start the genset)	75%		 Call more sets power = full load kW of current running genset×call more sets (%) call more sets (%)=Call more sets power/ full load kW of current running genset 	
0.00	(MSC)ID	1	2		
Sync.	Module Priority	1	2		
Calibration	GOV/AVR	GOV: SW1: 5; SW2: 2		Refer to < <u>HGM9500N controller</u>	





ltems	Parameters	Setting Values		Remark
nomo		Gen 1	Gen 2	Komurk
		AVR: SW1: 0; SW2: 2		GOV/AVR parameter setting>

After above parameters set completely, the controller is in Auto Mode, remote start is active:

- a) Gen 1 starts and takes the load.
- b) When load power is 150kW, 50% of Gen 1 rated power, which is below economical fuel consumption 75%, Gen 1 will continue to take the load.
- c) When the load power is above 225kW, and greater than 75% of the rated power of Gen1 (the percentage of economic fuel consumption setting limit), the optimal solution is as follows: Gen2 running in synchronization. Gen 1 rated power is 300kW, the optimal solution rated power is 360kW, since exchange power (300kW+50kW<360kW) is not less than 50kW, Gen 2 will start to synchronize running and take the load, Gen 1 will soft unloading and top.</p>
- d) When the load power is above 270kW, and is greater than 75% of the rated power of Gen2 (the percentage of economic fuel consumption setting limit), the optimal solution is as follows: Gen2 +Gen1. The rated power of the original solution is 360kW, and the optimal solution rated power is 660kW, since exchange power (360kW+50kW < 300kW+360kW) is not less than 50kW, Gen1 and Gen2 will running in synchronization to share the load.</p>

Note 1: we strongly suggest to configure the economical fuel consumption percentage and the calling for more sets percentage as the same limit.

Note 2: calling for more sets percentage is prior to exchange power conditions.

In this example, if configure the economical fuel consumption percentage as 75%, call for more sets set as 80%, exchange power set as 70kW(>360kW-300kW), operation procedure is as follows:

Gen1 start to take the load.

When the load power is 150kW, which is 50% of Gen1 rated power and is less than setting economical consumption 75%, Gen1 will continue to take the load.

When the load power is above 225kW, and is greater than 75% of Gen1 rated power (the percentage of economic fuel consumption setting limit), the optimal solution is Gen2. However, since the rated power of Gen2(360kW) minus the rated power Gen1(300kW) is less than the exchange power of 70kW, the switching condition is not satisfied, so Gen1 continues to take the load.



When the load power is above 240kW, the optimal solution is still Gen2(the load power is less than 75% of Gen2 rated power, 270kW). However, since the load power is greater than the 80% calling for more sets rate of Gen1, which cause the exchange power condition limit invalid, and the Gen2 is powered on and running in synchronization to take the load, and then the Gen1 is soft-unloaded and shut down.

When the load power is above 270kW, and is greater than 75% of Gen2 rated power (the percentage of economic fuel consumption setting limit), the optimal solution is Gen2 + Gen1. Since the rated power of Gen2(360kW) plus 70kW (equal to 430kW) is greater than the exchange power of 70kW(360kW+70kW< 360kW+300kW), which is meet the switching condition, so Gen1 and Gen2 will take the load together.

When the load power is below 270kW, it is lower than $360kW \times 75\%(270kW)$, the percentage of economic fuel consumption setting limit), and meet the switching condition(660kW-360kW > 70kW). The optimal solution is Gen2, and Gen1 will soft-unload and shutdown.

When the load power is below 225kW, it is lower than $300kW \times 75\%(225kW)$, the percentage of economic fuel consumption setting limit), and cannot meet the switching condition 70kW(360kW-300kW < 70kW). Thus, Gen2 continues to take the load.

Gen2 is loaded until remote start signal is invalid.

1.5.3 Multi different capacities gensets running in synchronization.

This solution is suitable for multi different capacities gensets synchronized running in "Economical fuel consumption" mode, and use HGM9510N controllers.

Example 10: 4 EFI gensets, rated power of Gen1 is 100kW, Gen2 is 200kW, Gen 3 is 360kW, and Gen4 is 360kW. The AVR model of these four gensets is MX321, and gensets are taking load based on economical fuel consumption mode.







Fig. 20 multi different capacities gensets synchronized in "economical fuel consumption" mode diagram

Table 21 Four different capacities gensets synchronized in "economical fuel consumption" parameter

ltoms	Parameters		Setting	Remark		
	T urumotoro	Gen1	Gen2	Gen3	Gen4	Kontark
Engine Settings	Engine type	Refer	to< <u>Parame</u> <u>Ur</u>	eter Setting <u>nit</u> >	of EFI	
	Rated speed		1500)r/min		
	Crank disconnect conditions		Frequenc			
	AC system		3P			
	Rated voltage		23			
Generator	Rated frequency		50			
Settings	CT primary	250/5	400/5	630/5	630/5	
	Full load rating (rated current)	180A	360A	648A		
	Full kW rating	100kW	200kW	360kW	360kW	



ltoms	Paramotors	Setting Values				Romark		
items	T drumeters	Gen1	Gen2	Gen3	Gen4	Kentark		
	(rated kW power)							
	Full kvar rating	75kvar	150kvar	270kvar	270kvar	Setting based on PE 0.8		
	(rated kvar power)	ronvar	Tookvar	270100	270100			
Digital	Digital input 1	Rem	ote start(S					
Inputs			Red					
Settings	Digital input 4	G	enerator cl	osed auxili	ary			
Relay	Relay output 5		Mains ope	en auxiliary	1			
Outputs Settings	Relay output 6		Mains clos	ed auxiliar	у			
	MSC number			4				
	Starting option	S	tart sets a	s load requ	ire			
						The number of sets on		
						bus means the minimum		
	Sets on Bus		1			synchronizing gensets .		
						If setting as 4, all		
						gensets will start and		
						running.		
	Economy Fuel (%)		7	5%				
	Economy Sawp(W)		50)kW				
						1. Call more sets power		
				= full load kW of current				
Sync.						N synchronizing gensets		
Settings						×call more sets (%)		
						2. call more sets		
						(%)=call more sets		
	Call More Sets(%)					power/ full loading power		
	(the maximum load		7	5%		of N synchronizing		
	percentage when					gensets.		
	to start the genset)					A Note: "N" means		
						the number of		
						synchronized gensets.		
						In this example, when		
						N=1, the Gen2 will		
						start, when N=2, the		
						Gen3 will start, and		



ltems	Parameters		Setting	Remark		
nomo	i di	Gen1	Gen2	Gen3	Gen4	
						when N=3, the Gen4
				will start.		
	(MSC)ID	1	2	3	4	
Sync.	Module Priority	1	2	3	4	
Calibration		0		Refer to < <u>HGM9500N</u>		
	GOV/AVR		1/R·(SW)	controller GOV/AVR		
			τοιτ. (Ο νν	1. 0, 3002.	<i>~</i>)	parameter setting>

After above parameters completed, controller is in AUTO mode, and when remote start input is active:

- a) Gen1 starts and takes the load.
- b) When load power is above 75kW, and is greater than 75% of the Gen1 rated power (the percentage of economic fuel consumption setting limit), the optimal solution is Gen2. Gen1 rated power is 100kW, and Gen2 rated power is 200kW, since the exchange power (100kW+50kW<200kW) is not lower than 50kW, the Gen2 starts and runs in synchronization to take the load, and Gen1 soft unloads and stops.</p>
- c) When the load power is above 150kW, and is greater than 75% of the Gen2 rated power (the percentage of economic fuel consumption setting limit), the optimal solution is Gen3(Gen3 has a higher priority than Gen4). Gen2 rated power is 200kW, and Gen3 rated power is 360kW, since the exchange power (200kW+50kW < 360kW) is not lower than 50kW, the Gen3 starts and runs in synchronization to take the load, and Gen2 soft unloads and stops.</p>
- d) When the load power is above 270kW, and is greater than 75% of the Gen3 rated power (the percentage of economic fuel consumption setting limit), the optimal solution is Gen3+Gen1. Gen3 rated power is 360kW, and Gen1 rated power is 100kW, since the exchange power (100kW+360kW> 360kW+50kW) is not lower than 50kW, the Gen1 starts and runs in synchronization with Gen3 to share the load.
- e) When the load power is above 345kW, the optimal solution is Gen3 and Gen2 run in synchronization and share the load, and Gen1 soft unloads and stops.
- f) When the load power is above 420kW, the optimal solution is Gen3 and Gen4 run in synchronization and share the load, and Gen2 soft unloads and stops.
- g) When the load power is above 540kW, the optimal solution is Gen3, Gen4 and Gen1 run in synchronization and share the load.



- h) When the load power is above 615kW, the optimal solution is Gen3, Gen4 and Gen2 run in synchronization and share the load, and Gen1 soft unloads and stops.
- When the load power is above 690kW, the optimal solution is all the gensets start and share the load.
 Note 1: we strongly suggest to configure the economical fuel consumption percentage and the calling for more sets percentage as the same limit.

Note 2: calling for more sets percentage is prior to exchange power conditions.

1.6 Other Modes Application

1.6.1 Power Management Mode

This solution is suitable for transformation of multiple non-synchronous gensets, adding HGM9510 or HGM9510N to achieve multiple gensets running in synchronization and power sharing. Application occasions: transformation of multiple single start genset to synchronization.

Example 20: There are four 360kW EFI gensets with SX440 AVR, and transform these four gensets to realize synchronous running and evenly share the load without changing the original control system.

Use the power management mode of four HGM9510 controllers to realize the power distribution based on the requirement.

A Note:

Application abstract of power management:

- HGM9510 configurable relay output(passive contact) can be set as fuel output, which is connect to remote start input REM and E of the genset controller.
- HGM9510 crank disconnect conditions select as "Frequency".
- HGM9510 input port is configured as "Emergency Stop", and expand a DC24V replay, and its normally open contact connects with the HGM6110N input port(external shutdown alarm input) to realize emergency shutdown in two places.
- Connect the passive contact of the configurable output port of the genset controller to the configurable input port (user-defined as shutdown alarm input)of the HGM9510 to realize that if there's shutdown alarm in two places, genset can shut down.
- HGM9510 configurable input port configured as "Power Management Mode", open to activate.



- HGM9510 wring connection: B+, B-, FUEL, EMERGENCY STOP, CLOSE GEN OUTPUT, OPEN GEN OUTPUT, GOV, AVR, MSC, SPEED, GENERATOR CLOSED AUXILIARY, SHUTDOWN ALARM INPUT, SAMPLING VOLTAGE, SAMPLING BUSBARM SAMPLING CURRENT.
- Wring connection of the controller besides of the genset: B+, B-, FUEL, CRANK, WATER TEMPERATURE, OIL PRESSURE, SPEED, SAMPLING VOLTAGE, SAMPLING CURRENT, SHUTDOWN ALARM OUTPUT, EXTERNAL SHUTDOWN ALARM INPUT, REMOTE START INPUT, IDLING CONTROL OUTPUT.
- Configure water temperature and oil pressure sensor curves as "Not Used".
- There is no need to configure the "Cooling Time" and "Stop Idle Time", but the "Fail to Stop Delay" should be greater than or equal to the sum of the "Cooling Time" + " Idle Stopping Time" of the side controller, so that to avoid HGM9510 displays shutdown failure. There is no need to set "Start Idle Time" of HGM9510, and the "Warming Up time" should greater than that of the side controller.



Fig. 21 Power management application diagram



|--|

Itomo	Setting Values			Pomark		
items	Parameters	Gen1	Gen2	Gen3	Gen4	Remark
	Engine type	Refer	to< <u>Paran</u> <u>EFI (</u>	neter Set <u>Jnit</u> >		
Engine	Rated speed		1500	r/min		
Settings	Crank disconnect conditions		Frequ	iency		
	AC system		3P4	4W		
Generator Settings	Rated voltage		23	0V		
	Rated frequency		50	Hz		
	CT primary		75	0/5		CT primary selection>full load rated current
	Full load rating (rated current)	648A				Full load rated current=rated power×1.8
	Full kW rating (rated kW power)	360kW				
	Full kvar rating (rated kvar power)	274kvar				Setting based on PF 0.8
	Disital insult 1	Rem	ote start	Start Set		
	Digital input 1	Load Require)				
Digital Inputs Settings	Digital input 2	User-defined		Setting as "Alarm Stop" input, close to activate, alarm shutdown, always active, and then connect to the passive normally open contact of the controller on the genset, and configure it as "Alarm Stop" output.		
	Digital input 4	(Gen close	e auxiliar	y	
	Digital input 5	Pow	er manag	gement n	node	Open to activate
Relay Outputs Settings	Relay output 3	Power management mode Emergency stop output		A DC24V relay needs to be expanded, and its normally open contact connects with the genset controller input port(external shutdown		



Itomo	Daramotoro	Setting Values		Pomark		
items	Faranieters	Gen1	Gen2	Gen3	Gen4	Reindik
			1		alarm input) to realize emergency shutdown in two places.	
	Relay output 4		Fuel rela	ay output	A DC24V relay needs to be expanded if using active fuel output. Connect the passive normally open contact with the remote start signal of the genset controller.	
	Relay output 5		Open ge	en output		
	Relay output 6		Close ge	en output		
	MSC number	4				
	Starting option	Start sets as load require				
Sync. Settings	Calling for More Sets(%) (the maximum load percentage when to start the genset)	80%				 Call more sets power = full load kW of current N synchronizing gensets× call more sets (%) call more sets (%)=call more sets power/ full loading power of N synchronizing gensets. Note: "N" means the number of synchronized gensets. In this example, when N=1, the Gen2 will start, when N=2, the Gen3 will start, and when N=3, the Gen4 will start.
	Calling for less sets(the maximum load percentage when to stop the genset)	40%			1. Call less sets power = full load kW of current N synchronizing gensets $x\frac{(N-1)}{N}$ × call less sets (%)	



Itome	Paramotors		Setting	Values	Pomark	
nems	Farameters	Gen1	Gen2	Gen3	Gen4	- Kellidik
						2.Call less sets (%)=Call
						less sets power/ full load kW
						of current N synchronizing
						gensets $x \frac{N}{(N-1)}$
						A Note: "1" in the
						formula means the genset
						with the lowest priority
						that will be called for
						stopped; "N" means the
						number of synchronized
						gensets.
						In this example, when N=4,
						the Gen4 will stop, when
						N=3, the Gen3 will stop,
						and when N=2, the Gen2
						will stop.
						A Note: calling for less
						sets power means the load
						power.
						A Note: if there are
						many genset running in
						synchronization, it is
						recommended to reduce
						the percentage of calling
						for less sets to avoid
						frequent start and
						shutdown of gensets.
	(MSC)ID	1	2	3	4	
Sync.	Module Priority	1	2	3	4	
Calibration		GO	V: (SW ²	1: 5; SW2	2: 2)	Refer to < <u>HGM9500</u>
	GOV/AVR AVR (SW1: 0; SW2: 2)				, 2: 2)	controller GOV/AVR
AVR: (5VV1: 0; 5VV2: 2)				parameter setting>		

After above parameters configured completely, HGM9510 works in auto mode, and power management mode is active, when the remote start input signal is active, fuel relay of HGM9510 will output. The passive



normally open contact of the relay is used to control the remote start of the side controller (in auto mode), and the Gen1 starts with load. If the current load power≥power when calling for more sets 288kW, Gen2 will start and synchronize with the Busbar to share the load.

If the current load power \geq calling for more sets power 576kW, Gen3 will start and synchronize with the busbar, and three gensets will share the current load power evenly; if the current load power \geq calling for more sets power 864kW, Gen4 will start and synchronize with the busbar, and four gensets will share the current load power evenly.

If the current load power < calling for less sets power 432kW, Gen4 will stop, and three gensets will share the load power evenly; if the current load power < calling for less sets power 288kW, Gen3 will stop, and two gensets will share the load power evenly; if the current load power < call for less sets power 144kW, Gen2 will stop, and only one genset will take the load.

A Note:

- The first HGM9510 is added with Mains failure start signal (remote start relay), and the start signal of the remaining HGM9510 controllers are synchronized, when the genset side controller manually start, HGM9510 should in auto mode; when the HGM9510 start (no matter in auto or manual mode), genset side controller should in auto mode, or both controllers are in auto mode.
- After power management mode is active, HGM9510 doesnllers are in auto mode. 510 stagenset warmed up in high speed, HGM9510 enters high speed delay.
- When there is an output breaker connected with genset side controller, the breaker should be in the closed state.

Note: when the genset side controller has a long distance with the synchronized controller, a remote start relay needs to be expanded.

1.6.2 Busbar synchronization

This solution is suitable for applications where multiple gensets can be loaded in groups or by a single genset. HGM9510 controller or HGM9510N+HGM9580 controllers can be selected, and applications are: factories, buildings, etc.

Example 21: Four 350kW EIF gensets with SX440 AVR, and the busbar divided into two groups(one group include two gensets), and start/stop the other three gensets according to the load requirement.



A Note: chose 4 × HGM9510 synchronize controller and 1 × HGM9580 bus-bus synchronize

controller based on the requirement.



Fig. 22 Bus-Bus synchronization diagram

Table 23 Bus-Bus synchronization parameters settings

ltems	Parameters		Setting	Values	Remark		
homo	T urumotoro	Gen1	Gen2	Gen3	Gen4	Kontark	
HGM9510	Engine type	Refer	Refer to< <u>Parameter Setting of</u> <u>EFI Unit</u> >				
Engine Settings	Rated speed		1500)r/min			
	Crank disconnect conditions	F	requenc	y + Spee			
HGM9510	AC system		3P	4W			
Generator Settings	Rated voltage	230V					
	Rated frequency		50)Hz			



ltoms	Paramotors	Setting Values			Romark	
items	T arameters	Gen1	Gen2	Gen3	Gen4	Kennark
	CT primary		75	0/5	L	CT primary selection $>$
	Crpinary		10	0/0	full load rated current	
						Full load rated
	Full load rating		63	80A		current=rated power×
	(rated current)					1.8
	Full kW rating					
	(rated kW power)		350	JkW		
	Full kvar rating		000	Maran		Catting based on DE 0.0
	(rated kvar power)		260	kvar		Setting based on PF 0.8
HGM9510	Digital input 1	Rem	ote start	(Start Se	ets as	
Digital Inputs	Digital Input 1		Load F	Require)		
Settings	Digital input 4	(Gen clos	e auxiliai	у	
HGM9510	Relay output 5		Open ge	en output	t	
Relay Outputs	Relay output 6		Close g	en outpu	t	
Settings						
	MSC number	4				
	Starting option	Sta	rt sets as	s load red	quire	
						1. Call more sets power
						= full load kW of current
						N synchronizing gensets
						× call more sets (%)
						2. call more sets
						(%)=call more sets
HGM9510	Calling for More					power/ full load kW of
Svnc. Settings	Sets(%)					current N synchronizing
	(the maximum load		80	0%		gensets.
	percentage when					A Note: "N" means
	to start the genset)					the number of
						synchronized gensets.
						In this example, when
						N=1, the Gen2 will
						start, when N=2, the
						Gen3 will start, and
						when N=3, the Gen4



Itoms	Baramotors	Setting Values				Pomark
Items	Falameters	Gen1	Gen2	Gen3	Gen4	Remark
						will start.
						1. Call less sets power =
						full load kW of current N
						synchronizing gensets
						$x \frac{(N-1)}{N} \times call less sets$
						(%)
						2.Call less sets (%)=Call
						less sets power/ full load
						kW of current N
						synchronizing gensets
						$X_{(N-1)}^{N}$
						A Note: "1" in the
						formula means the
						genset with the lowest
	Calling for less					priority that will be
	sets(the maximum					called for stopped;
	load percentage		4	0%		"N" means the number
	when to stop the					of synchronized
	genset)					gensels.
						N=4 the Gen4 will
						ston when N=3 the
						Gen3 will stop, and
						when N=2. the Gen2
						will stop.
						A Note: calling for
						less sets power means
						the load power.
						A Note: if there are
						many genset running
						in synchronization, it is
						recommended to
						reduce the percentage



Itoms	Paramotors		Setting	y Values	Pomark	
items	r al allieter 5	Gen1	Gen2	Gen3	Gen4	
					1	of calling for less sets
						to avoid frequent start
						and shutdown of
						gensets.
	(MSC)ID	1	2	3	4	
HGM9510	Module Priority	1	2	3	4	
Sync Calibration		GO	V·(SW	1· 5· SW	2.2)	Refer to < <u>HGM9500</u>
	GOV/AVR		R·(SW)	1. 0. SW	2·2)	controller GOV/AVR
		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	11. (011	1. 0, 000	parameter setting>	
HGM9580	AC System	3D4/W				
Bus Settings			01			
HGM9580	Digital input 1	Re	mote Cl	ose On-l	oad	
Digital Inputs	Digital input 4	В	us Close	ed Auxilia	ary	
HGM9580	Relay output 5		Open B	us Outpu	t	
Relay Outputs	Relay output 6		Close B	us Outpu	ıt	
	MSC Number			2		
Sync Settings	Control Prior		Βι	ıs 1		
	MSC1/2 Level		Same	e Level		
HGM9580 Sync Calibration	MSC ID			1		

If above parameters set completely, before close bus tie breaker, the two sections of busbars are independent, and each section of busbars independently performs power sharing and gensets scheduling; after close bus tie breaker, the two sections of the busbar equally share the power, and no genset scheduling is performed, and the four gensets are manually turned on/off.

There are 4 units of HGM9510 controllers used in this project, when remote start input is active, and HGM9580 under manual mode, Gen1 will start and supply power for the load1; if the current power of load1 ≥calling for more set power 280kW, Gen2 will start and synchronize with Gen1, and two gensets will share the load1 evenly; and Gen3 will start and supply power for Load2; if the current power of load2 ≥calling for more set power 280kW, Gen4 will start and synchronize with Gen3, and two gensets will share the load2 evenly; If either channel of load power ≥80% of the corresponding busbar power, the bus tie breaker need to be closed manually through HGM9580, and four gensets will share the current load evenly.



If the current power of the load < calling for less sets power 420kW, Gen4 will unload and stop, and the left three gensets will share the load evenly; if the current power of the load < calling for less sets power 280kW, Gen3 will unload and stop, and the two gensets of the first segment busbar share the current load power equally; if the current power of the load < calling for less sets power 140kW, Gen2 will unload and stop, and Gen1 will take the load.

A Note: Theoretically, unlimited gensets can synchronize running through the HGM9580 controllers, it is can be realized according to the method of adding HGM9580 controller to control the multi-gensets grouping.





1.6.3 EFI/Non-EFI gensets synchronization

This solution is suitable for EFI gensets synchronized with non-EFI genset under "Start Sets Under Load Require". HGM9510 or HGM9510N controllers can be selected, and applicate to occasions when EFI gensets and non-EFI gensets running in synchronization.

Example 22: There are two gensets need running in synchronization, Gen1 is 880kW EFI genset, and Gen2 is 880kW non-EFI genset, AVR model is SX440, and non-EFI genset GOV model is ESD5500. One genset needs to start and take on load firstly, and then another genset needs to start/stop based on the load requirement.





Fig. 24 Synchronization application diagram of two EFI/non-EFI genset gensets with same capacity

Table 24 Parameters of synchronization application of two EFI/non-EFI genset gensets with same

capacity

ltems	Parameters	Setting	Values	Remark
nomo	i uluilotoro	Gen1	Gen2	Komunk
Engine Settings	Engine type	Refer to< <u>Parameter</u> <u>Setting of EFI</u> <u>Unit</u> >	Non-EFI genset	
	Flywheel teeth		Set based on the calculation result of the	Four-pole motor: Engine teeth=



Itoms	Paramotors	Setting	Values	Romark
items	Farameters	Gen1	Gen2	
			formula of the number of the engine flywheel teeth	$\left(\frac{\text{current speed}}{60} \times \frac{\text{preset teeth}}{\text{current frequency}}\right) \times 2$ Note: "60" means 60s.
	Rated speed	1500	r/min	
	Crank disconnect conditions	Frequency	/ + Speed	
	AC system	3P4	4W	
	Rated voltage	23	VO	
	Rated frequency	50	Hz	
Concreter	CT primary	200	0/5	CT primary selection>full load rated current
Settings	Full load rating (rated current)	158	34A	Full load rated current=rated power×1.8
	Full kW rating (rated kW power)	880	kW	
	Full kvar rating (rated kvar power)	670	<var< td=""><td>Setting based on PF 0.8</td></var<>	Setting based on PF 0.8
Digital Inputs	Digital input 1	Remote start(Sta Req	art Sets as Load uire)	
Settings	Digital input 4	Gen close	e auxiliary	
Relay	Relay output 5	Open ge	n output	
Outputs Settings	Relay output 6	Close ge	n output	
	MSC number	2	2	
	Starting option	Start sets as	load require	
Sync. Settings	Calling for More Sets(%) (the maximum load percentage when to start the genset)	80	%	 Call more sets power = full load kW of current N synchronizing gensets × call more sets (%) call more sets (%)=call more sets power/ full load kW of current N synchronizing gensets



Part 1 Parallel scheme

ltome	Paramotors	Setting	Values	Bomark
nems	Falameters	Gen1	Gen2	
	Calling for less sets(the maximum load percentage when to stop the genset)	40	9%	▲ Note: "N" means the number of synchronized gensets.In this example, N=1.1. Call less sets power = full load kW of current N synchronizing gensets $x^{(N-1)}$ ×call less sets (%)2.Call less sets (%)=Call less sets power/ full load kW of current N synchronizing gensets $x^{(N-1)}$ ▲ Note: "1" in the formula means the genset with the lowest priority that will be called for stopped; "N" means the number of
	(MSC)ID	1	2	
	Module Priority	1	2	
Sync. Calibration	GOV/AVR	GOV: SW1: 5 SW2: 2	GOV: SW1: 9 SW2: 2	Refer to < <u>HGM9500</u> <u>controller GOV/AVR</u>
		AVR. (SVV1: 0; S	vvZ.Z)	parameter setting-

After above parameters set completely, when the controller in auto mode, and remote start signal is active,



Gen1 will start and take load. If the current load power is greater than calling for more sets power 704kW, Gen2 will start and synchronized with Gen1 to share the load evenly. If the current load power is lower than calling for less set power 352kW, Gen2 will take of load and stop.

1.6.4 Black start

This solution is suitable for when a single genset starts, close generator output is active at the same time, the control switch is closed, and the generator switch selects the DC power switch. HGM9510 or HGM9510N controller can be selected to use in applications including power plants, factories, etc.

A Note: Users can select one digital input port as "Black Start Input" function.

Example 23: There is one unit of 1200kW EFI genset with DVR2000E generator voltage regulator, before starting the genset, the generator switch is closed first, and supply power to the transformer.





Fig. 25 Black start application diagram

Table 25 Black start parameters settings

Items	Parameters	Setting Values	Remark
Engine	Engine type Rated speed	Refer to< <u>Parameter Setting</u> <u>of EFI Unit</u> > 1500r/min	
Cettings	Crank disconnect conditions	Frequency + Speed	
Generator	AC system	3P4W	
Settings	Settings Rated voltage 230V		
eetinge	Rated frequency	50Hz	





Items	Parameters	Setting Values	Remark
		2500/5	CT primary selection > full load
	CT primary	2300/5	rated current
	Full load rating	04004	Full load rated current=rated
	(rated current)	2160A	power×1.8
	Full kW rating	1200k\//	
	(rated kW power)	120000	
	Full kvar rating	888kvar	Setting based on PE 0.8
	(rated kvar power)	COORVAI	
	Digital input 1	Remote start(Start Sets as	
	Digital input i	Load Require)	
Digital	Digital input 4	Gen close auxiliary	
Inputs			Always active. (HGM9510 PC
Settings	Digital input 5		software has no this option, users
e e unige		Black start input	can select this option from
			controller screen; HGM9510N PC
			software has this option.)
Relay	Relay output 5	Open gen output	
Outputs	Relay output 6	Close gen output	
Settings	i tolay calpat c	elece gen earpar	
Sync.	MSC number	1	
Settings			
	MSC ID	1	
Sync.	Module Priority	1	
Calibration	GOV/AVR	GOV: (SW1: 9; SW2: 2)	Refer to < <u>HGM9500N controller</u>
		AVR: (SW1: 0; SW2: 2)	GOV/AVR parameter setting>

After above parameters set completely, when the controller in auto mode, and black start input is active, remote start input is active, the controller will close generator switch and generator starts up, and supply power to the transformer. When the remote start input is deactivated, generator switch will open and generator will top.

1.6.5 Central monitoring (HMU15) application

This solution is suitable for remote monitoring of up to 6xHGM9510 controllers to realize automatic start/stop gensets, data measurement, alarm display, switch closing and opening, and "four remote" functions. HGM9510 or HGM9510N controller can be selected to use in applications including power plants, centralized control center, etc.

Example 24: There are 6×600kW EFI gensets with AVR SX440 need to be monitored remotely, uses







can select HMU15 or HGM9510 to start/stop gensets, or close/open switch.

Fig. 26 Application diagram of six gensets of the same power in synchronization + centralized monitoring

Table 26 Parameters settings of six gensets of the same power in synchronization + centralized

monitoring

			S	etting	Valu	es		Remark
Items	Parameters	Gen	Gen	Gen	Gen	Gen	Gen	
		1	2	3	4	5	6	
HGM9510								
Module	Module address	1	2	3	4	5	6	
Settings								
	Engine type	Re	Refer to< <u>Parameter Setting of</u>					
HGM9510				<u>EFI</u>	<u>Unit</u> >			
Engine	Rated speed			1500)r/min			
Settings	Crank disconnect		Ero	auene	v + Si	hood		
	conditions		110	quene	y i Ol	Jeeu		
HGM9510	AC system		3P4W					
Generator	Rated voltage		230V					
Settings	Rated frequency			50	Hz			





	Setting Values						Remark
Parameters	Gen	Gen	Gen	Gen	Gen	Gen	
	1	2	3	4	5	6	
CT primary		1200/5					CT primary selection>full
C i pinnary							load rated current
Full load rating	10001						Full load rated
(rated current)		1080A					current=rated power×1.8
Full kW rating			600)k/W			
(rated kW power)			000				
Full kvar rating			450	kvar			Setting based on PE 0.8
(rated kvar power)			100	Real			
Digital input 1	Rem	note s	tart(St	art Se	ets as	Load	
			Req	uire)			
Digital input 4		Ge	n clos	e auxi	liary		
Relay output 5		0	pen ge	en out	put		
Relay output 6	Close gen output				put		
MSC number				6			
Starting option	5	Start s	ets as	load	requir	e	
Calling for More Sets(%) (the maximum load percentage when to start the genset)			80)%			 Call more sets power = full load kW of current N synchronizing gensets × call more sets (%) call more sets (%)=call more sets power/ full load kW of current N synchronizing gensets. ▲ Note: "N" means the number of synchronized gensets. In this example, when N=1, the Gen2 will start, when N=2, the Gen3 will start, and when N=3, the
	CT primary Full load rating (rated current) Full kW rating (rated kW power) Full kvar rating (rated kvar power) Digital input 1 Digital input 4 Relay output 5 Relay output 6 MSC number Starting option Calling for More Sets(%) (the maximum load percentage when to start the genset)	Parameters Gen 1 1 CT primary 1 Full load rating (rated current) 1 Full kW rating (rated kW power) 1 Full kW rating (rated kwar power) 1 Digital input 1 Rem Digital input 4 1 Relay output 5 1 Relay output 6 1 MSC number 2 Starting option 3 Calling for More Sets(%) 4 (the maximum load percentage when to start the genset) 4	Parameters Gen Gen Gen 1 2 CT primary	ParametersGenGenGenGen123CT primary120Full load rating (rated current)100Full kW rating (rated kW power)600Full kW rating (rated kvar power)600Digital input 1Remote start(St Relay output 5Digital input 4Gen closeRelay output 5Open genMSC numberClose genStarting optionStart sets asCalling for More Sets(%)80percentage when to start the genset)80	ParametersGenGenGenGenGenGen1234CT primary1200/5Full load rating (rated current)1080AFull kW rating (rated kW power)600kWFull kVar rating (rated kvar power)450kvarDigital input 1Remote start(Start Sec Require)Digital input 2Open gen outRelay output 5Open gen outMSC number6Starting optionStart sets as loadCalling for More Sets(%) (the maximum load percentage when to start the genset)80%	ParametersGenGenGenGenGenGenGenGen12345CT primary1200/5Full load rating (rated current)1080AFull kW rating (rated kW power)600kWFull kwar rating (rated kvar power)600kWFull kvar rating (rated kvar power)450kvarDigital input 1Remote start(Start Sets as Require)Digital input 4Gen close auxillaryRelay output 5Open gen outputMSC number6Starting optionStart sets as load requine)Calling for More Sets(%) (the maximum load percentage when to start the genset)80%	ParametersGenGenGenGenGenGenGenGenGen123456CT primary1200/51080A1080AFull load rating (rated current)1080A600kWFull kW rating (rated kW power)600kW450kvarFull kvar rating (rated kvar power)450kvarDigital input 1Remote start(Start Sets as Load Require)Digital input 2Open concertainal Open gen outputRelay output 5Open gen outputMSC number6Starting optionStart sets as load requireCalling for More Sets(%) (the maximum load percentage when to start the genset)80%





		Setting Values					Remark	
Items	Parameters	Gen	Gen	Gen	Gen	Gen	Gen	
		1	2	3	4	5	6	
								1. Call less sets power = full
								load kW of current N
								synchronizing gensets
								$\times \frac{(N-1)}{N} \times \text{call less sets (%)}$
								2.Call less sets (%)=Call
								less sets power/ full load
								kW of current N
								synchronizing gensets \times
								$\frac{N}{(N-1)}$
								A Note: "1" in the
								formula means the genset
								with the lowest priority
								that will be called for
	Calling for less							stopped; "N" means the
	sets(the maximum							number of synchronized
	load percentage			4()%			gensets.
	when to stop the							In this example, when
	genset)							N=4, the Gen4 will stop,
								when N=3, the Gen3 will
								stop, and when N=2, the
								Gen2 will stop.
								ANote: calling for less
								sets power means the
								load power.
								A Note: if there are
								many genset running in
								synchronization, it is
								recommended to reduce
								the percentage of calling
								for less sets to avoid
								frequent start and
								shutdown of gensets.





			S	etting	y Valu	es	Remark	
Items	Parameters	Gen	Gen	Gen	Gen	Gen	Gen	
		1	2	3	4	5	6	
	(MSC)ID	1	2	3	4	5	6	
HGM9510 Sync. Calibration	Module Priority	1	2	3	4	5	6	
	GOV/AVR	GOV:(SW1:5; SW2:2) AVR:(SW1:0; SW2:2)						Refer to < <u>HGM9500</u> <u>controller GOV/AVR</u> <u>parameter setting</u> >
HMU15	MSC number				6			
System Settings	Genset Power			60	OkW	Configured from the front panel ofHMU15		

Note: HMU15 communicates with HGM9510 via RS485 port, one end of the communication cable is DB9 connects to HMU15, and the other end of the cable has six wires (two groups of RS485 ports). One group of RS485 connects with three units of HGM9510 controller (COM address set as 1, 3, 5), and the other group of RS485 connects with the other three units of HGM9510 controller (COM address set as 2, 4, 6).

After above parameters set completely, when controller is in the auto mode and the remote start input is active, Gen1 will start. If the current load power is greater than the calling for more sets power 480kW, Gen2 will start and synchronize with Gen1 to share the load evenly; If the current load power is greater than the calling for more sets power 960kW, Gen3 will start and synchronize with the Bus and three gensets will share the load evenly; If the current load power is greater than the calling for more sets power 960kW, Gen3 will start and synchronize with the Bus and three gensets will share the load evenly; If the current load power is greater than the calling for more sets power 1440kW, Gen4 will start and synchronize with the Bus and four gensets will share the load evenly; If the current load power is greater than the calling for more sets power is greater than the calling for more sets power is greater than the calling for more sets power is greater than the calling for more sets power is greater than the calling for more sets power is greater than the calling for more sets power is greater than the calling for more sets power 2400kW, Gen6 will start and synchronize with the Bus and five gensets will share the load evenly; If the current load power is greater than the calling for more sets power 2400kW, Gen6 will start and synchronize with the Bus and six gensets will share the load evenly;

If the current load power is less than the calling for less sets power 1200kW, Gen6 will unload and stop, and five gensets will share the load evenly; If the current load power is less than the calling for less sets power 960kW, Gen5 will unload and stop, and four gensets will share the load evenly; If the current load power is less than the calling for less sets power 720kW, Gen4 will unload and stop, and three gensets will share the load evenly; If the current load power is less than the calling for less sets power 720kW, Gen4 will unload and stop, and three gensets will share the load evenly; If the current load power is less than the calling for less sets power 480kW, Gen3 will unload and stop, and two gensets will share the load evenly; If the current load power is less than the calling for less sets power 240kW, Gen2 will unload and stop, and only one genset takes the load.





Fig. 27 Synchronized Six gensets start and stop curve

1.6.6 High voltage gensets running in synchronization

This solution is suitable for multiple high-voltage gensets running in synchronization. HGM9510 or HGM9510N controller can be selected to use in applications including factories, power plants, etc.

Example 25: There are four 1000kW high-voltage gensets with rated voltage 10.5kV, and engine voltage regulating board is DVR2000. One genset needs to be started and take the load firstly and the other three gensets will start/stop based on the load requirement.

This application needs to install voltage transformers on the busbar and generator side for controller voltage sampling.







Fig. 28 Application diagram of multiple high-voltage gensets running in synchronizatio

Table 27 Application Related Parameter	Configuration of Four Hig	h Voltage Gensets v	with Same Power
Table 21 Application Related Parameter	Configuration of Four my	n vollage Gensels v	with Same Fower

			Set v	alue		
Items	Parameters	Gen	Gen	Gen	Gen	Remarks
		1	2	3	4	
Engine	Engine Type	Re <u>Se</u>	fer to< <u>F</u> tting of	Parame EFI Ur	eter hit>	
Setting	Rated Speed		1500	r/min		
	Crank Disconnect	Fre	equency	/ + Eng	ine	
			Spe	eed		
	AC System		3P3	3W		
	Gen Rated Voltage		105	00\/		
	(Rated Voltage)		100	000		
Conorator	Gen Rated Frequency		50	H7		
Setting	(Rated Frequency)		50	112		
	Voltago Transformor		Prima	ry: 1050	V0C	
	voltage mansionner	Secondary: 100V				
	СТ		10(7/5		CT Selection $>$ Full Load Rated
		100/5				Current



	Full Load Rated		· · · · · · · · · · · · · · · · · · ·
	Current	69A	満報 敬定 电 加 = $\left($
	(Rated Current)		
	Full Load Rated		
	Active Power	1000-100	
	(Rated Active	TUUUKVV	
	Power)		
	Full Load Rated		
	Reactive Power	740kvar	Set according to PE=0.8
	(Rated Reactive	740KVal	
	Power)		
Innute	Digital Input 1	Remote start (on	
Setting		demand).	
Setting	Digital Input 4	Gen close status input	
Outputs	Digital Output 5	Open Gen Output	
Setting	Digital Output 6	Close Gen Output	
	Num. On MSC Bus	4	
-	Starting Option	Start Sets as Load	
		Requires	
Sync Setting	Call More sets (%) (Startup Max. load percentage)	80%	 startup=Full load active power of current N sets in parallel × Schedule startup load percentage 2. Schedule startup load percentage=Schedule power at startup / Full load active power of current N sets in parallel ▲ Note: "N" indicates the number of parallel sets. In this case, second set is scheduled to start N=1, third set is scheduled to start N=2, and fourth set is scheduled to start N=2
	Call Less sets (%) (Max. load	40%	1. Schedule power at shutdown=Full load active power



					of current N sets in	
	shutdown)					parallel× $\frac{(N-1)}{N}$ ×Schedule
						shutdown load percentage
						2. Schedule shutdown load
						percentage=Schedule power at
						shutdown / Full load active power
						of current N sets in
						parallel×- <u>N</u> (N-1)
						A Note: "1" in the Formula
						indicates the set with the
						lowest priority to shut down in
						the parallel sets; "N" indicates
						the number of parallel sets.
						In this case, fourth set is
						scheduled to shut down N=4,
						third set is scheduled to shut
						down N=3, and second set is
						scheduled to shut down N=2.
						A Note: Power refers to load
						power during scheduling
						shutdown.
						A Note: When there are
						many parallel sets, it is
						recommended to reduce the
						schedule shutdown load
						percentage to avoid frequent
						startup and shutdown of sets.
	MSC ID	1	2	3	4	
Sync	Module Priority	1	2	3	4	
Calibration	GOV/AVR	GOV:	(SW1:9	; SW2	:2)	Refer to < <u>HGM9500 controller</u>
		AVR:(SW1:0	; SW2:	2)	GOV/AVR parameter setting>

The above parameter setting is completed, the controller is in Auto mode, when the remote start input is valid, set 1 will start with load, if the current load power is greater than the rated power of set 1 by 800kW, set 2 will start in parallel with the bus, and the two sets will share the current load power equally. If the current load power is greater than 1600kW at the time of scheduled start-up, set 3 will start in parallel with the bus, and the time of scheduled start-up, set 3 will start in parallel with the bus, and the time of scheduled start-up, set 3 will start in parallel with the bus, and the time of scheduled start-up, set 3 will start in parallel with the bus, and the time of scheduled start-up, set 3 will start in parallel with the bus, and the time of scheduled start-up, set 3 will start in parallel with the bus, and the time of scheduled start-up, set 3 will start in parallel with the bus, and the time of scheduled start-up, set 3 will start in parallel with the bus, and the time of scheduled power is greater than 2400kW at the time of scheduled power is greater than 2400kW at the time of scheduled power is greater than 2400kW at the time of scheduled power is greater than 2400kW at the time of scheduled power is greater than 2400kW at the time of scheduled power is greater than 2400kW at the time of scheduled power is greater than 2400kW at the time of scheduled power is greater than 2400kW at the time of scheduled power is greater than 2400kW at the time of scheduled power is greater than 2400kW at the time of scheduled power is greater than 2400kW at the time of scheduled power is greater than 2400kW at the time of scheduled power is greater than 2400kW at the time of scheduled power is greater than 2400kW at the time of scheduled power is greater than 2400kW at the time of scheduled power is greater than 2400kW at the time of scheduled power is greater than 2400kW at the time of scheduled power is greater than 2400kW at the time of scheduled power is greater than 2400kW at the time of sche



scheduled start-up, set 4 will start in parallel with the bus, and the four sets share the current load power equally.

If the current load power is less than 1200kW at the scheduled shutdown, the set 4 will be shut down by soft unloading, and the three units will share the current load power equally; If the current load power is less than 800kW at the scheduled shutdown, the set 3 will be shut down by soft unloading, and the two units will share the current load power equally; If the current load power is less than 400kW at the scheduled shutdown, the set 2 will be shut down by soft unloading and a single unit will be loaded.

1.6.7 High Voltage Parallel (Step-up Transformer)

This solution is suitable for parallel application of multiple low-voltage sets starting on demand. After boosting by transformer, it can supply power to the load. HGM9510 or HGM9510N can be selected. The application occasions include factory, mobile power station, etc.

Example 26: Four EFI sets with rated power of 550kW are in parallel, and the model of the generator AVR is SX440. After the generator is closed, the booster output is boosted to supply power to the load. It is required to start a single set with load first, and start/stop the other three sets according to the load.



Fig.29 Application Diagram of Multiple High Voltage Parallel (Step-up Transformer) with Same Power


Table 28 Application Related Parameter Configuration of Four High Voltage Gensets Parallel (Step-up

Transformer) with Same Power

ltoms	Parameters		Set v	value		Romarks
noms	T drumeters	Gen 1	Gen 2	Gen 3	Gen 4	Kennarko
	Engine Type	Refer	to< <u>Paran</u>	neter Set	ting of	
Engine			<u>EFI Unit</u> >			
Setting	Rated Speed	1500r/min Frequency + Engine Speed				
	Crank Disconnect	Frequency + Engine Speed				
	AC System		3P4	4W		
	Gen Rated Voltage		23	0\/		
	(Rated Voltage)		20	0 0		
	Gen Rated					
	Frequency (Rated		50	Hz		
	Frequency)					
	СТ		100	0/5		CT Selection > Full Load
			100	10/5		Rated Current
Generator	Full Load Rated			Full Load Rated Current=		
Setting	Current	990A			Rated Power×1.8	
	(Rated Current)					
	Full Load Rated					
	Active Power	550kW				
	(Rated Active Power)					
	Full Load Rated					
	Reactive Power		410	kvar		Set according to PE=0.8
	(Rated Reactive					
	Power)					
Inputs	Digital Input 1	Rem	ote start	(on dema	and).	
Setting	Digital Input 14	G	en close s	status inp	out	
Outputs	Digital Output 5		Open Ge	n Output		
Setting	Digital Output 56		Close Ge	en Output		
	Num. On MSC Bus		2	1		
	Starting Option	Start	Sets as L	_oad Req	luires	
Sync						1. Schedule power at
Setting						startup=Full load active
	Call More sets (%)		80	1%		power of current N sets in
						parallel × Schedule startup





Itomo	Baramotoro	Set value			Pomarka	
items	Parameters	Gen 1	Gen 2	Gen 3	Gen 4	Remarks
		Gen 1	Gen 2	Gen 3	Gen 4	load percentage 2. Schedule startup load percentage=Schedule power at startup / Full load active power of current N sets in parallel ▲ Note: "N" indicates the number of parallel sets. In this case, second set is scheduled to start N=1, third set is scheduled to
						start N=2, and fourth set is scheduled to start N=3.
	Call Less sets (%)		40	%		1. Schedule power at shutdown=Full load active power of current N sets in parallel× $\frac{(N-1)}{N}$ × Schedule shutdown load percentage 2. Schedule shutdown load percentage=Schedule power at shutdown / Full load active power of current N sets in parallel× $\frac{N}{(N-1)}$ Note: "1" in the Formula indicates the set with the lowest priority to shut down in the parallel sets; "N" indicates the number of parallel sets. In this case, fourth set is scheduled to shut down N=4, third set is





ltoms	Parameters		Set	value		Romarks
nems	T drumeters	Gen 1	Gen 2	Gen 3	Gen 4	. Itemarka
						N=3, and second set is
						scheduled to shut down
						N=2.
						A Note: Power refers to
						load power during
						scheduling shutdown.
						A When there are many
						parallel sets, it is
						recommended to reduce
						the schedule shutdown
						load percentage to avoid
						frequent startup and
						shutdown of sets.
	MSC ID	1	2	3	4	
Sync	Module Priority	1	2	3	4	
Calibration			:	1.2.2/0/2.	2)	Refer to < <u>HGM9500</u>
Calibration	GOV/AVR		VP.(SW	1.0.9\/2.	∠) 2)	controller GOV/AVR
				1.0,0002.	<u>-</u>)	parameter setting>

The above parameter setting is completed, the controller is in Auto mode, when the remote start input is valid, set 1 will start with load, if the current load power is greater than the rated power of set 1 by 440kW, set 2 will start in parallel with the bus, and the two sets will share the current load power equally. If the current load power is greater than 880kW at the time of scheduled start-up, set 3 will start in parallel with the bus, and the two sets will start up, set 3 will start in parallel with the bus, and the time of scheduled start-up, set 3 will start in parallel with the bus, and the time of scheduled start-up, set 3 will start in parallel with the bus, and the time of scheduled start-up, set 4 will start in parallel with the bus, and the four sets share the current load power equally.

If the current load power is less than 660kW at the scheduled shutdown, the set 4 will be unloaded and shut down, and the three sets will share the current load power equally; If the current load power is less than 440kW at the scheduled shutdown, the set 3 will be unloaded and shut down, and the two sets will share the current load power equally; If the current load power is less than 220kW at the scheduled shutdown, the set 2 will be unloaded and shut down and a single set will be loaded.

1.6.8 Redundant Parallel



This solution is suitable for parallel application of multiple sets starting on demand, and has the function of redundant backup. HGM9530N should be selected. The application occasions include Data center, Bank, etc.

The controller redundancy system consists of two controllers. The two controllers shall be set with the same ID, and the redundant controller should enable the redundant controller in the module setting.

When the redundant controller detects the failure of the main controller (the redundant controller does not receive the data frame sent by the main controller in MSC communication, or the redundant controller receives a valid output signal of the redundant controller sent by the main controller), the redundant controller takes over the control of the set, outputs the effective signal of the redundant controller to the main controller and switches the control signal at the same time.

1.6.9 GOV/AVR Two Control Methods

Method 1: Use electronic potentiometer HEP300.The main controller and the redundant controller output the digital signal to the UP/DOWN input of HEP300, and the analog output of HEP300 is connected to the GOV (AVR). In this way, when the main controller is switched with the redundant controller, the voltage signal output to the GOV (AVR) will not be interrupted, and the set will be smoothly transitioned to the redundant controller.

Method 2: The relay is used to directly switch the GOV and AVR control outputs of both controllers. The circuit of this method is simple, but when the main controller is switched with the redundant controller, the voltage signal output to the governor will be interrupted, which may lead to the fluctuation of some units.

Example 27: Two EFI sets with rated power of 1500kW are in parallel, and the rated voltage is 10.5kv. The model of generator AVR is DVR2000. In addition to normal parallel function, the parallel system shall have redundant function. It is required to start a single set with load first, and start/stop the other set according to the load.







Fig.30 Application Diagram of Two Redundant Parallel Sets

					-			-
Fabla 20) Annligation	Dolotod	Daramatar	Configuration	of Two	Dodundant	Darallal	Coto
	ADDIICATION	Related	ralameter	Connuuration		Regundant	Falallel	JUS

ltems	Parameters	Set value		Remarks
nomo	T urumetere	Gen 1	Gen 2	
Module	Main/Redundant	Main	Main	
Setting		Redundant	Redundant	
	MSC2	MSC2 Enable		
	Engine Type	Refer to<	Parameter	
Engine		Setting of	EFI Unit>	
Setting	Rated Speed	1500r/min		
	Crank Disconnect	Frequency	y + Engine	
		Spe	eed	
	AC System	3P	3W	
	Rated Voltage	105	00V	
Generator	Rated Frequency	50	Hz	
Setting	Voltage	Primary:	10500V	
	Transformer	Seconda	ary: 100V	
	СТ	150/5		CT Selection $>$ Full Load Rated





Itoms	Paramotors	Set	value	Romarks
items	r al allielei 5	Gen 1	Gen 2	
				Current
	Full Load Rated	1(12 4	満裁麵完由流 - (额定功率)→0.8
	Current	IUJA		$\overline{\overline{\mathbf{M}}}$ 初定电加一 $\left(\overline{\overline{\mathbf{M}}}\right)$ · 0.8
	Full Load Rated	1500kW		
	Active Power			
	Full Load Reactive	1140kvar		Set according to PE=0.8
	Power			
	Digital Input 1	Remote	start (on	
Inputs		dem	and).	
Setting	Digital Input 4	Gen close	status input	
	Digital Input 5	Redundar	nt controller	
		Va	alid	
	Digital Output 2	PWM Speed Raise		No need to set this parameter by
				using analog speed regulation
	Digital Output 3	tput 3 PWM Speed Drop		No need to set this parameter by
				using analog speed regulation
Outrouto	Digital Output 4	Redundar		
Outputs	Disital Output 5			
Setting	Digital Output 5	Clean C		
		Close G		No pood to get this peremeter by
	Digital Output 7	PWM Vol	tage Raise	using analog voltage regulation
				No need to set this parameter by
	Digital Output 8	PWM Vo	Itage Drop	using analog voltage regulation
	Num on MSC Bus		2	
		Start Set	s as Load	
	Starting Option	Requires		
			•	1. Schedule power at startup=Full
				load active power of current N sets in
Sync				parallel × Schedule startup load
Setting				nercentage
	Call More Sets(%)	8	0%	2 Schedule startun load
				percentage=Schedule power at
				startup / Full load active power of
				current N sets in parallel





Itoms	Paramotore	Set value		Romarks	
items	Falameters	Gen 1	Gen 2		
				A Note: "N" indicates the	
				number of parallel sets.	
				In this case, N=1.	
				1. Schedule power at shutdown=Full	
				load active power of current N sets in	
				parallel× $\frac{(N-1)}{N}$ × Schedule	
				shutdown load percentage	
				2. Schedule shutdown load	
				percentage=Schedule power at	
				shutdown / Full load active power of	
	Call Less Sets(%)	40%		current N sets in parallel× $\frac{N}{(N-1)}$	
				ANote: "1" in the Formula	
				indicates the set with the lowest	
				priority to shut down in the parallel	
				sets; "N" indicates the number of	
				parallel sets.in this case, N=2.	
				ANote: Power refers to load	
				power during scheduled shutdown.	
	MSC ID	1	2		
	Module Priority	1	2		
	Export Mode(W)	Fixed	Power		
Sync	Analogue Adjust(W)	Ena	able		
Calibration	Export Mode(var)	Fixed	Power		
Calibration	Analogue	En	abla		
	Adjust(var)				
		GOV:(SW	1:5;SW2:2)	Refer to < <u>HGM9500N controller</u>	
	GOVAVIN	AVR:(SW1:0;SW2:2)		GOV/AVR parameter setting>	

The above parameter setting is completed, the main control and redundant controller of the two sets are in Auto mode. When the remote start input is valid, set 1 will start with load, if the current load power is greater than 1200kW at the time of scheduled start-up, set 2 will start in parallel with set 1, and the two sets share the current load power equally. If the current load power is less than 600kW at the scheduled shutdown, set 2 will be unloaded and shut down, and set 1 will be loaded.



During this period, when any redundant controller of the two sets detects that the corresponding main controller is faulty (the redundant controller does not receive the data frame sent by the main controller in the MSC communication, or the redundant controller receives the effective output signal of the redundant controller sent by the main controller), the redundant controller takes over the control of the set, and outputs the effective signal of the redundant controller to the main controller and switches the control signal at the same time.

1.6.10 CCHP (Combined Cooling, Heating and Power)

This solution is suitable for parallel application of multiple generator sets starting on demand, and provides cold and heat supplies at the same time. HGM9530 or HGM9510N can be selected, and the applications are: hotels, field sites, etc.

Example 28: Two gas-fired EFI sets with a rated power of 800kW, and the model of generator AVR is SX440. As a construction site without mains power, the two sets undertake all the power supply tasks. In addition to the parallel power supply function, they also provide heat and cold.



Fig. 31 CCHP Application Diagram of Two Sets with Same Power



Table 30 CCHP Application Related Parameter Configuration of Two Sets with Same Power

ltoms	Paramotors	Set v	alue	Pomarks
nems	F al allieter 5	Gen 1	Gen 2	Nemarks
		Refer to<	<u>Parameter</u>	
		Setting of	<u>EFI Unit</u> >	
Engine Setting	Rated Speed	1500	r/min	
	Crank Disconnect	Frequency	+ Engine	
		Speed		
	AC System	3P4W		
	Gen Rated Voltage	23(אר <i>ו</i>	
	(Rated Voltage)	200	50	
	Gen Rated			
	Frequency (Rated	501	Ηz	
	Frequency)			
	СТ	T 3000/5		CT Selection $>$ Full Load Rated
				Current
Generator	Full Load Rated			Full Load Rated Current= Rated
Sotting	Current	144	0A	Powerx 1.8
Cetting	(Rated Current)			T Ower A 1.0
	Full Load Rated			
	Active Power	800kW		
	(Rated Active			
	Power)			
	Full Load Rated			
	Reactive Power	6001	war	Set according to PE=0.8
	(Rated Reactive	000	(vai	
	Power)			
	Digital Input 1	Remote	start (on	
Inputs Setting		dema	and).	
inputs octaing	Digital Input 14	Gen clos	e status	
		inp	out	
Outputs Setting	Digital Output 5	Open Ge	n Output	
	Digital Output 6	Close Ge	n Output	
Sync	MSC ID	2	2	
Calibration	Starting Option	Start Sets	as Load	
		Requ	uires	





ltoms	Baramotors	Set value		Pomarke
items	Farameters	Gen 1	Gen 2	Keinarks
				1. Schedule power at startup=Full
				load active power of current N sets in
				parallel × Schedule startup load
				percentage
				2. Schedule startup load
	Call More sets (%)	80	%	percentage=Schedule power at
				startup / Full load active power of
				current N sets in parallel
				A Note: "N" indicates the
				number of parallel sets.
				In this case, N=1.
				1. Schedule power at shutdown=Full
				load active power of current N sets in
				parallel× $\frac{(N-1)}{N}$ ×Schedule shutdown
				load percentage
				2. Schedule shutdown load
				percentage=Schedule power at
				shutdown / Full load active power of
				current N sets in parallel× $\frac{N}{N-1}$
	Call Less sets (%)	40	%	A Note: "1" in the Formula
				indicates the set with the lowest
				priority to shut down in the parallel
				sets; "N" indicates the number of
				parallel sets.
				In this case, N=2.
				A Note: Power refers to load
				power during scheduling
				shutdown
	MSC ID	1	2	
Sync	Module Priority	1	2	
Calibration	GOV/AVR	GOV:(SW1	:5;SW2:2)	Refer to < <u>HGM9500 controller</u>
		AVR:(SW1:0;SW2:2)		GOV/AVR parameter setting>



The above parameter setting is completed, the controller is in Auto mode, when the remote start input is valid, set 1 will start with load. If the current load power is greater than 640kW at the time of scheduled start-up, set 2 will start in parallel with set 1, and the two sets will share the current load power equally.

If the current load power is less than 320kW at the scheduled shutdown, the set 2 will be unloaded and shut down, and set 1 will be loaded.

The working principle of CCHP is:

——The power generated by the generator set supplies power to the load.

—By using natural gas, city gas, waste heat from power generation, industrial waste heat, solar energy, biogas and any heat energy that can generate above 80°C is used as power, and lithium bromide is used as refrigerant for heat exchange, to reduce the temperature of air-conditioning circulating water and achieve the purpose of refrigeration.

——When heating, the cylinder liner water can be directly used for circulating heating, and the high exhaust temperature can be dissipated through the water circulation to increase the temperature of the circulating water of the air conditioner, and also realize the heating of the air conditioner.

The set works for a long time, and the cylinder liner water and the water in the cooling water tank circulate to raise the water temperature in the water tank, so as to provide hot water supply other than drinking, which can be used for bathing, washing clothes and other purposes.



Fig. 32 Structural Application Diagram of CCHP



2 Parameters setting

2.1 Engine Setting

Engine Type /Flywheel Teeth /Rated Speed/Crank Disconnect.

dula la	Paulas Ant	1
-Nodule Settings	Engine Opt	tions
Timers	Engine Options	
Engine	Engine Type 00 Conventional Engine	
Engine Options	Flywheel Teeth 128 (10-300)	
Speed Settings	Rated Speed \$1500 r/min	1500r/min (0-6000)r/min
Generator	Loading Speed 90 %	90%(1350r/min) (0-100)%
Switch		
Sensor		
Digital Inputs	Cranking	
Scheduled Run	Start Attempts 3 🗘 (1-10)times	
Scheduled Not Run	Crank Disconnect	
Maintenance	Frequency \$30 %	30%(15.0Hz) (0-200)%
-Alternative Config	Speed	30%(450r/nin) (0-200)%
Sync		200kPa (0-1000)kPa
Sync Calibration		
Expansion		

Fig. 33 Engine Options Setting

2.2 Generator Setting

2.2.1 AC System /Rated Voltage/Rated Frequency Setting

GMP6-HGM9510 V5.2.0.3 - [Gen Options]			- 0 ×
Eile Connection Option Language pack Language/语言	Help		
🗋 🕶 📴 🔜 🔜 COM: USB 🗸 Refurbish COM			
⊟-Module <<	Gen Options		
-Module Settings			
-Timers	Generator Options		
Generator	AC System 3 Phase, 4 Wire (3P4W)		
Gen Options	Poles	4 (2-64)	
Gen Voltage	Rated Voltage 230 V	230V (30-30000)V	
-Gen Frequency	Loading Voltage \$90 %	90%(207V) (0-200)%	
-Gen Current	Rated Frequency	50.0Hz (10.0-600.0)Hz	
Gen Power	Loading Frequency 290 %	90%(45,0Hz) (0-200)%	
B-Sensor	✓ Loss Of Phase		
B-Digital Inputs			
B-Relay Outputs	PT Fitted		
-Scheduled Run	PT Primary 100 V	100V (30-30000)V	
-Scheduled Not Run	PT Secondary 100 V	100V (30-1000)V	
Alternative Config			



2.2.2 CT/Full Load Rated Current Setting

SmartGen ideas for power		Part 2	Parameters	s setting
🕌 iGMP6-HGM9510 V5.2.0.3 - [Gen Current]				
File Connection Option Language pack Language/i	吾言 Help			
🗋 • 📂 🛃 🔜 COM: USB 🛛 🗸 Refurbish COM				
-Module <<		Gen Current		
 Mains Module Settings Timers Engine Generator Gen Options 	Generator Current CT Primary Full Load Rating \$900		1000/5 900A	(5-6000)/5 (5-6000)A
Gen Voltage Gen Frequency Gen Current Gen Power	Generator Current Alarms Over Current \$120 % Action Trip and Stop	~	120%(1080A)	(0-200)%
Switch - Sensor - Digital Inputs - Relay Outputs	Type Definite Time Delay 🗘 10 s	~ 	10s	(0-3600)s

Fig. 35 Generator Current Setting

2.2.3 Full Load Rated Active Power/Full Load Rated Reactive Power Setting

👪 iGMP6-HGM9510 V5.2.0.3 - [Ger	n Power]						
File Connection Option	Language pack Language	/语言 Help					
🗋 • 📂 🛃 🔜 🔜 сом: USB	~ Refurbish COM						
□Module	<<				Gen Power		
⊞—Mains —Module Settings		Generator Power					
Timers		Full kW Rating	\$ 500	kw 🧧		500kW(628kVA)	(1-20000)kW
Engine Generator		Full kvar Rating	\$ 380	kvar 🧧		380kvar(0.80pf)	(1-20000)kvar
Gen Options		Load Ramp Rate	€ 3.0	%/s		3.0%/s	(0.1-100.0)%/s
Gen Voltage Gen Frequency		Load Ramp Point	‡ 10.0	%		10.0%	(0.1-40.0)%
Gen Current		Load Ramp Delay	\$ 0	s 🥊		0s	(0-30)s
Gen Power		-Insufficient Capacity					

Fig. 36 Generator Power Setting

2.3 Mains Setting

2.3.1 Mains Supply System



Fig. 37 Mains Options Setting

2.3.2 Mains Rated Voltage

Ideas to power		Part 2 Parameters settir
GMP6-HGM9510 V5.2.0.3 - [Mains Voltage]		
le <u>Connection</u> <u>Option</u> <u>Language</u> pack La	nguage/语言 Help	
• 📴 🛃 🔜 COM: USB 🛛 🗸 Refurbish COM	t	
-Module ^ <<	Mains Voltag	e
8-Mains	Robert Wolfstein	
Mains Options	Mains Voltage	
Mains Voltage	Rated Voltage 230 V	230V(230V) (30-30000)
-Mains Frequency	PT Fitted	
Current/Power	DT Drimany a Alton by	1001/ (20.20000
Mains Decoupling	FT Frinary	1004 (30-30000)
Module Settings	PT Secondary 100 V	100V (30-1000)V
Engine Concretor	✓ Over Voltage	
Gen Ontions	Set Value 120 %	4000 0000 0000 00 00000
Gen Voltage	Set value 120 %	120%(276V:276V) (0-200)%
-Gen Frequency	Return 🔁 116 %	116%(267V:267V) (0-200)%
-Gen Current	Delay 호 5 s	5s (0-3600)s
Gen Power	C Under Veltere	
-Switch		
-Sensor	Set Value 🔹 80 %	80%(184V:184V) (0-200)%
-Digital Inputs	Return 🗘 84 %	84%(193V:193V) (0-200)%
-Relay Outputs	Delay 5 s	5s (0-3600)s
Scheduled Run		(0 0000)0
Scheduled Not Run		



2.3.3 Mains Rated Frequency

GMP6-HGM9510 V5.2.0.3 - [Mains Frequency]			
File Connection Option Language pack Languag	e/语言 Help		
🕽 🛛 📴 🔜 🔜 COM: USB 🛛 🗸 Refurbish COM			
-Module <<	Mains Free	luency	
 Mains Mains Options Mains Voltage Mains Frequency Current/Power Mains Decoupling Module Settings Timers Engine 	Iains Frequency Rated Frequency Image: Constraint of the second	50.0 Hz 114%(57.0Hz) 110%(55.0Hz) 5s	(10.0-75.0)Hz (0-200)% (0-200)% (0-3600)s
-Switch	Set Value 👻 90 %	90%(45.0Hz)	(0-200)%
Digital Inputs Relay Outputs Scheduled Run Scheduled Not Run	Return 🔄 94 % 📕 Delay 💽 5 s	94%(47.0Hz) 5s	(0-200)% (0-3600)s

Fig. 39 Mains Frequency Setting



e <u>C</u> onnection <u>O</u> ption <u>L</u> anguage pack La 🎯 层 🔜 🖶 COM: USB 🗸 Refurbish COM	nguage/语言 Help			
Module ^ <<		Cu	rrent/Power	
- Mains - Mains Options - Mains Voltage - Mains Frequency - Current/Power - Mains Decoupling - Module Settings Tisene	Mains Curre CT Primary(L Full Load Rat Load kvar Ra	nt Options 1) € 1000 /5 ing € 500 kW teing € 380 kvar	1000/5 500kW(628kVA) 380kvar(0.80pf)	(5-6000)/5 (1-60000)kW (1-60000)kvar
Generator Gen Voltage Gen Frequency Gen Current	Output Pow Trip Action	er Limit Alarm	85%(425kW)	(0-200)%

Fig. 40 Current/Power Setting



2.3.5 Mains Decoupling



Fig. 41 Mains Decoupling Setting

2.4 Inputs Setting

2.4.1 HGM9510 Gens Parallel Mode Application Digital Inputs Setting

File Connection Option	Language pack	Language/语言	Help	
] - 📂 🔚 🔜 COM: USB	 Refurbish 	COM		
-Module	<<			Digital Inputs
- Module Settings - Timers - Engine - Generator - Switch - Sensor - Digital Inputs - Relay Outputs		[Digit 1	al Inputs 31 Remote Start On Loać - Close to Active -
Scheduled Run Scheduled Not Run Maintenance Alternative Config Sync Sync Calibration			3	27 Low Oil Pressure Sht > Close to Active > 26 High Temperatue Shut > Close to Active >
-PLC -Module Monitoring -Module Calibrate			4	13 Generator Closed Aux \sim Close to Active \sim
			5	Input Delay 2.0s (0-20.0s) Enter remarks(e.g. High Temperatur 00 User Configured V Close to Active Indication V Never V

Fig. 42 HGM9510 Gens Parallel Mode Digital Inputs Setting





2.4.2 HGM9510 Mains Parallel Mode Application Digital Inputs Setting

👪 iGMP6-HGM9510 V5.2.0.3 - [E	igital Inputs]		
File Connection Option	<u>L</u> anguage pack	Language/语言	Help
🗋 • 💕 🔒 🔜 🔜 COM: USB	~ Refurbish	COM	
Module	<<		Digital Inputs
 B-Mains Module Settings Timers B-Engine Generator Switch B-Sensor Digital Inputs B-Relay Outputs Scheduled Run Maintenance B-Alternative Config B-Sync B-Sync B-Sync Calibration B-Expansion PLC B-Module Calibrate 			Digital Inputs 1 31 Remote Start On Load ~ Close to Active ~ 2 27 Low Oil Pressure Sht ~ Close to Active ~ 3 26 High Temperatue Shut ~ Close to Active ~ 4 13 Generator Closed Aux ~ Close to Active ~ 5 43 Mains Parallel Mode ~ Close to Active ~



2.4.3 HGM9510 Power Management Mode Application Digital Inputs Setting

👪 iGMP6-HGM9510 V5.2.0.3 - [D	igital Inputs]		
File Connection Option	<u>L</u> anguage pack	Language/语言	Help
🗅 • 📂 🔒 🔜 Com: USB	~ Refurbish	COM	
Module	<<		Digital Inputs
			Digital Inputs 1 31 Remote Start On Load ~ Close to Active ~ 2 27 Low Oil Pressure Sht ~ Close to Active ~ 3 26 High Temperatue Shut ~ Close to Active ~ 4 13 Generator Closed Aux ~ Close to Active ~
⊞—Module Calibrate			5
			42 Power Management Moć - Close to Active -

Fig. 44 HGM9510 Power Management Mode Digital Inputs Setting

2.4.4 HGM9520 Single Genset Parallel with Mains /Load Control/AMF Control Mode Application Digital Inputs Setting



Fig. 45 HGM9520 Digital Inputs Setting

2.4.5 HGM9510N Fast Parallel Mode Application Digital Inputs Setting

👪 iGMP6-HGM9510N V5.4.0.4 - [Digital Input 1-10]		- 0	×
File Connection Option Language/语言 Help			
🗋 🕶 🔛 🔜 E. COM: USB 🗸 Refurbish COM			
— Module <<	Digital Input 1-10		
Module Settings	Disitellanut		^
the Mains	Digital input		
Inters			
Generator	31 RemoteStart Demand		
- Sensor			
-Digital Input	2		
-Digital Input 1-10	27 Low OP Shutdown Close to Activate ~		
Digital Input 11-15			
-Digital Output			
Scheduled Not Run	3 26 High Tenn Shutdown V Close to Activate V		
Maintenance			
-Alternative Config			
-Sync	4		
-Sync Calibration	13 Gen Closed Aux \sim Close to Activate \sim		
Expansion			
-PLC			
- Module Calibrate	D 19 Static Parallal Class to Activate V		
Date/Time and Accumulation			
	6		
	44 First Priority \checkmark Close to Activate \checkmark		
	- Delay 2.0s (0-20.0s) Enter remarks(e.g. High Temp. Warn)		
· · · · · · · · · · · · · · · · · · ·			Ŷ

Fig. 46 HGM9510N Fast Parallel Mode Digital Inputs Setting



2.4.6 HGM9510N Black-start Mode Application Digital Inputs Setting



Fig. 47 HGM9510N Black-start Mode Digital Inputs Setting

2.4.7 HGM9560 Busbar Parallel with Mains Application Digital Inputs Setting



Fig. 48 HGM9560 Busbar Parallel with Mains Digital Inputs Setting





2.4.8 HGM9580 Busbar Parallel Application Digital Inputs Setting

iGMP6-HGM9580 V5.2.0.3 - [Digital Inputs]		
File Connection Option Language pack	Language/语言 <u>H</u> el	p
🗋 🕶 📴 🔜 📖 COM: USB 🛛 🗸 Refurbish (COM	
Module <<		Digital Inputs
	Di	gital Inputs
	1	28 Remote Close On Load - Close to Active -
B-Sync D-Module Monitoring D-Module Calibrate	2	Input Delay 2.05 (0-20.05) Enter remarks (e.g. Bus Closed Failu 00 User Configured v Close to Active v Indication v Never v
	3	Input Delay 2.05 (0-20.05) Enter remarks (e.g. Bus Closed Fail) 00 User Configured V Close to Active V Indication V Never V
	4	13 Bus Closed Auxiliary \vee Close to Active \vee
	5	Input Delay 2.0s (0-20.0s) Enter remarks (e.g. Bus Closed Fail) 00 User Configured Close to Active Indication Never
	6	Input Delay 20s (0-20.0s) Enter remarks (e.g. Bus Closed Fail) 00 User Configured v Close to Active V Indication v Never v

Fig. 49 HGM9580 Busbar Parallel Digital Inputs Setting



GMP6-HGM9530N/HMB9700 V5.2.0.3 - [Digital]	input]
File Connection Option Language/语言	Help
🗋 • 📴 🛃 🔜 COM: USB 🛛 🗸 Refurbish	a COM
P-Module ^ ≪	Digital Input
. Mains	Digital Input
Timers	
-Engine	1
- Generator	31 RemoteStart Demand V Close to Activate V
Switch	
🗈 Sensor	
Digital Input	2
🕀 — Digital Output	27 Low OP Shutdown V Close to Activate V
Scheduled Run	
Scheduled Not Run	
Maintenance	3
-Alternative Config	26 High Temp Shutdown V Close to Activate V
. Sync	
- Sync Calibration	
- Expansion	4
PLC	13 Gen Closed Aux
- Module Monitoring	
Generator Status	-
Control	5
Data Display 1	07 Redundancy Active V Close to Activate V
Data Display 2	

Fig. 50 HGM9530N Redundancy Mode Digital Inputs Setting

2.5 Outputs Setting

2.5.1 HGM9510 Gens Parallel Mode Application Digital Outputs Setting



Fig. 51 HGM9510 Gens Parallel Mode Digital Outputs Setting

2.5.2 HGM9520 Single Genset Parallel with Mains Application Digital Outputs Setting



Input output remark, as:Preheat

Input output remark, as:Preheat

Input output remark, as:Preheat



Custom Period 5

Custom Period 6

-Custom Combined 1--Custom Combined 3-

Custom Combined 5-

Scheduled Run

Scheduled Not Run Maintenance

Fig. 52 HGM9520 Single Genset Parallel with Mains Digital Outputs Setting

File Connection Option Language/语言 Help 🗋 🕶 📴 🔜 🔜 COM: USB 🛛 🗸 Refurbish COM -Module Relay Outputs ~ Module Settings -Mains Digital Output Timers -Engine Input output remark, as:Preheat 1 Open V 044 Generator OK Generator Switch 2 048 Common Alarm Input output remark, as:Preheat Open Digital Input Input output remark, as:Preheat -Digital Output 3 V 038 Energise to Stop Open Relay Outputs Custom Period 1 4 ✓ 035 Idle Control Input output remark, as:Preheat Open -Custom Period 2 -Custom Period 3 5 030 Open Gen Output Input output remark, as:Preheat Open -Custom Period 4

6 Open

7 Open

8 Open

Fig. 53 HGM9510N Fast Parallel Mode Digital Outputs Setting

V 029 Close Gen Output

V 024 Generator Excite

✓ 000 Not Used

2.5.3 HGM9510N Fast Parallel Mode Application Digital Outputs Setting



Fig. 54 HGM9560 Gens Busbar Parallel with Mains Digital Outputs Setting



GMP6-HGM9580 V5.2.0.3 - [Relay Outputs] File Connection Option Language pack Language/语言 Help ✓ Refurbish COM 🗋 - 📂 🔒 🔜 COM: USB -Module Relay Outputs -Module Settings -Battery Voltage Input output remark, as: Preheat Bus 2 $\texttt{Output}\,(\texttt{N/O})\, \sim\,$ 048 Common Alarm Switch Digital Inputs Input output remark, as:Preheat Relay Outputs 3 Output (N/O) ~ 046 Mains Ok Relay Outputs -User Defined Combine Input output remark, as:Preheat User Defined Combine 7 Output (N/O) ~ 000 Not Used -Sync -Sync Calibration Input output remark, as:Preheat -Module Monitoring 8 Output(N/O) ~ 000 Not Used ~ -Module Calibrate Relay Output(Volts Free) Input output remark, as:Preheat Output (N/O) ~ 047 Synchronizing output 4 ~ Input output remark, as:Preheat 5 Output(N/O) ~ 030 Open Bus Output ~ Input output remark, as:Preheat 6 Output (N/O) ~ 029 Close Bus Output \sim

2.5.5 HGM9580 Busbar Parallel Application Digital Outputs Setting



2.5.6 HGM9530N Redundancy Control Mode Application Digital Outputs Setting

GMP6-HGM9530N/HMB9700 V5.2.0.3 - [Digital Outp	put]			
File Connection Option Language/语言 He	elp			
🗋 • 📂 🛃 🔜 COM: USB 🛛 🗸 Refurbish COM	M			
-Module			Digital O	utput
Module Settings				
+Mains	Digi	tal Out	put	
Timers				
-Engine	1	Open	✓ 044 Generator OK	 Input output remark, as:Preheat
• Generator				
Switch	2	()man	065 Dury Speed Paint	Turnut output venark as Proheat
🖅 Sensor	2	Open	000 Fwn Speed Kaise	input output remark, as .FIeneat
-Digital Input		-		
- Digital Output	3	Open	✓ 066 PWM Speed Drop	✓ Input output remark, as:Preheat
Scheduled Run				
-Scheduled Not Run	4	Open	224 Redundancy Active	 Input output remark, as:Preheat
Maintenance		5		
-Alternative Config	5	0	000 0 0 0 0 0	Trout output month of Trobert
-Sync	5	Open	♥ 030 Open Gen Output	Input output remark, as :Preheat
-Sync Calibration				
-Expansion	6	Open	\sim 029 Close Gen Output	 Input output remark, as:Preheat
PLC				
-Module Monitoring	7	Onen	✓ 063 PWW Voltage Baise	Input output remark, as:Preheat
Generator Status	'	opon		
Control	0			
—Data Display 1	8	Open	✓ 064 PWM Voltage Drop	 Input output remark, as:Preheat
Data Display 2				
Expansion DIN16/DOUT16				

Fig. 56 HGM9530N Redundancy Control Mode Application Digital Outputs Setting

2.6 Sync Setting



2.6.1 HGM9510/HGM9530N Start Sets as Load Requires Application Multi Sync Setting

👪 iGMP6-HGM9510_V5.2.0.3 - [Multi Sync]					
File Connection Option Language pack La	inguage/语言 Help				
🗋 • 📂 🛃 🔜 COM: USB 🛛 🗸 Refurbish COM	t				
-Module <<		Multi	Sync		
Module Settings — Timers — Engine — Generator — Switch — Digital Inputs — Relay Outputs — Scheduled Run — Scheduled Not Run — Maintenance	MSC Link MSC Number Too Few Modules Action MSC Baud Rate Load Demand	€2 Warn 250 kBit/s	C	2	(1-32)
-Alternative Config	Starting Options	Start Sets as Load Require ~			
Auto Sync	Start All Time	÷120 s		2min	(0-3600)s
Check Sync Multi Sync — Load Shedding Contro — Sync Calibration — Expansion	Balance Engine Hours Hours Generator Number	‡1 h ‡1		— 1h — 1	(1-1000)h (1-32)
	Calling Other Generator Calling for More Sets	\$ 90 %		90%	(0-100)%
	Calling for Less Sets	\$40 %		40%	(0-100)%

Fig. 57 Start Sets as Load Requires Setting

2.6.2 HGM9510 Start All Sets Initially Application Multi Sync Setting

👪 iGMP6-HGM9510 V5.2.0.3 - [Multi Sync]					
File Connection Option Language pack Language	ge/语言 Help				
🗋 📲 🔚 🔜 COM: USB 🛛 🗸 Refurbish COM					
-Module <<		∎ulti Syn	c		
Module Settings					
Timers	MSC Link				
Engine					
· Generator	MSC Number	÷2		2	(1-32)
Switch					
Digital Innuts	Too Few Modules Action	Warn			
E-Relay Outputs	MSC Raud Data	250 HDH/a			
Scheduled Run	MSC Baud Rate	250 KBIUS			
Scheduled Not Run			_		
Maintenance	Load Demand				
-Alternative Config					
E-Sync	Starting Options	Start An Sets mitually			
Auto Sync	Start All Time	≑ 120 s		2min	(0-3600)s
Multi Smc	Balance Engine Hours				
Load Shedding Contro	Hours	‡1 h			(1-1000)h
-Sync Calibration	Constant Number	A 4			(4.20)
-Expansion	Generator Number	× 1		- 1	(1-32)
PLC	Calling Other Generator				
Module Monitoring	Calling for More Sets	± 80 %		80%	(0-100)%
⊞—Module Calibrate	Cuming for More Sets			0.070	(0 100/10
	Calling for Less Sets	\$50 %		50%	(0-100)%
	L				

Fig. 58 Start All Sets Initially Setting

2.6.3 HGM9510 Balanced Engine Running Time Application Multi Sync Setting



Fig. 59 Balanced Engine Running Time Setting

2.6.4 HGM9510N Fast Parallel Mode Application Multi Sync Setting



Fig. 60 Fast Parallel Mode Setting

2.6.5 HGM9510N Economical Fuel Consumption Parallel Application Multi Sync Setting



Fig. 61 Economical Fuel Consumption Parallel Setting

2.6.6 HGM9560 Gens Busbar Parallel with Mains Application Multi Sync Setting

File Connection Option Language pack	.anguage/语言 Help
🕽 🕶 🔀 🔜 🔜 COM: USB 🛛 🗸 Refurbis	MO
Module <<	Multi Sync
Module Settings	
-Mains	MSC Link
-Timers	
-Battery Voltage	MSC Number 4 (1-32)
⊞—Bus	
Switch	Too Few Modules Action Warn
-Digital Inputs	
-Relay Outputs	MSC Baud Rate 250 kBit/s
Scheduled Run	
-Scheduled Not Run	
Maintenance	Minimum Number of Sets Not Reached
-Alternative Config	
-Sync	Minimum Number of Sets 💼 1 1 (1-32)
Check Sync	Start Request Delay 120 s 2min (0-3600)s
-Multi Sync	
	Action
-Sync Calibration	

Fig. 62 Gens Busbar Parallel with Mains Setting

2.6.7 HGM9580 Busbar Parallel Application Multi Sync Setting

Smart Gen ideas for power		Part 2	Parameters setting
👪 iGMP6-HGM9580 V5.2.0.3 - [Multi Sync]			
File Connection Option Language p	ack Language/语言 <u>H</u> elp bish COM		
Module <<		Tulti Sync	
Module Settings Battery Voltage Bus	MSC Link		
	MSC Number	÷2	2 (1-32)
	Too Few Modules Action	Warn	
- Multi Sync	MSC Baud Rate	250 kBit/s V	
Sync Calibration Module Monitoring	Other		
-Module Calibrate	Control Prior	Bus 1 ~	
	MSC1/2 Level	Same Level 🗸	
	MSC1 PT		
	Primary	\$100 V	100V (30-30000)V
	Secondary	\$100 V	100V (30-30000)V

Fig. 63 HGM9580 Busbar Parallel Setting

2.7 Sync Calibration Setting

2.7.1 MSC Setting

👪 iGMP6-HGM9510 V5.2.0.3 -	[MSC]			
File Connection Optio	on <u>L</u> anguage pack Language/语	言 <u>H</u> elp		
🗋 • 💕 🔚 🔜 🔜 com: Us	B v Refurbish COM			
- Module	<<		ISC	
Module Settings				
Finers		Multi Set		
-Generator		Set Value		Current Setting Value
Switch		MSC ID		MSC ID
🗈 Sensor		2 💠 (0-31)	Set	0
🕀 Digital Inputs		Madula Details		
⊞Relay Outputs		Module Priority		Module Priority
Scheduled Run		2 🗘 (0-31)	Set	0
Scheduled Not Rur	1			
Maintenance				

Fig. 64 MSC Setting

2.7.2 Load Mode/Active Power Output /Reactive Power Output Setting





2.7.3 GOV/AVR Setting





2.8 Bus Setting

2.8.1 AC System/Bus Rated Voltage/Bus Rated Frequency





2.8.2 Bus Current Setting





2.8.3 Bus Full Load Rated Active Power / Bus Full Load Rated Reactive Power Setting

iGMP6-HGM9560 V5.2.0.3 - [Bus	Power]						
File Connection Option I	language pack Language,	/语言 Help					
🗅 🕶 📴 🔜 🔜 COM: USB	V Refurbish COM						
ĢModule	<<				Bus Power		
Module Settings BMains		Bus Power					
Timers		Full kW Rating	\$ 2000	kW		2000kW(2516kVA)	(1-20000)kW
Battery Voltage		Full kvar Rating	1526	kvar		1526kvar(0.80pf)	(1-20000)kvar
-Bus Options		Load Ramp Rate	\$ 3.0	%/s		3.0%/s	(0.1-100.0)%/s
Bus Current Bus Power		Load Ramp Point	10.0	%		10.0%	(0.1-40.0)%
Switch		Load Ramp Delay	0	s		0s	(0-30)s
Digital Inputs Relay Outputs		Insufficient Capacity					
		Delay	\$ 20	S	•	20s	(0-1800)s
		Action	Warn		~		



2.9 Module Setting



Fig. 70 HGM9530N Redundancy Mode Setting



3 Commissioning Guide

3.1 Precautions Before Paralleling

- Know the Engine Type: EFI or non-EFI. For EFI engine, please refer to < EFI Engine Parameter Setting > for wiring and setting. If there is no corresponding ECU wiring and configuration table or communication is abnormal, please contact the engine manufacturer to confirm whether the parallel point of the engine itself has been opened and obtain the correct wiring method. For non-EFI engine, please check the brand and model of the governor: For example, the speed control unit of Cummins EFC needs to connect with a 120k Ω resistor for automatic speed regulation. For ordinary engine speed control unit, it is necessary to understand how to connect the terminals on the unit to the controller, and set SW1 and SW2 values on the controller according to the voltage adjustment signal range of different governors. Parameters and wiring can be set according to < HGM9500 Controller GOV/AVR Parameter Setting > or < HGM9500N Controller GOV/AVR Parameter Setting > EFI engine needs to set the values of SW1 and SW2 on the controller according to the voltage regulation range of different ECU automatic speed regulation.
- Know the brand and model of the generator AVR: Please refer to the AVR part wiring and setting of <
 HGM9500 Controller GOV/AVR Parameter Setting > or < HGM9500N Controller GOV/AVR
 Parameter Setting > If there is no corresponding AVR model in the scheme, please contact the
 genset manufacturer to obtain the correct wiring method and set the voltage regulation range. Set the
 values of SW1 and SW2 on the controller or software according to the correct voltage regulation
 range.
- If necessary, the customer can submit the wiring diagram of HGM series parallel controller to the relevant SmartGen technicians, who will assist in reviewing whether the wiring diagram is correct and setting the program in advance to save the customer's time for setting programs on site.
- Two 120Ω resistors and two 120KΩ resistors have been equipped in the controller packaging box. The 120Ω resistor is used to connect between the MSC communication ports H and L of the head controller and between the MSC communication ports H and L of the tail controller. The 120KΩ resistor is used to connect in series between Terminal 8 of the EFC series GOV of Cummins and Terminal 31 of the controller.



- For MSC communication cable, it is recommended to use high-quality 120Ω impedance cable. If ordinary communication cable is used, MSC communication may be abnormal (SmartGen has provided two 120Ω resistors before leaving the factory, and 120Ω resistors have been added in some new models of hardware).
- When wiring, try not to put the MSC communication cable in the same trunking as the wire with strong current to prevent interference.
- The main setting items of the parallel controller are shown in the table below.

ltem	Parameters				Parameters						
nom	1	2	3	4	5	6	7				
Engine Setting	Engine Type	Flywheel Teeth	Rated Speed								
Generator Setting	Power System	Rated Voltage	Rated Frequency	Ct	Rated Curren t	Rated Active Power	Rated Reactiv e Power				
Analog Sensors Setting	Temperature	Oil Pressure	Liquid Level								
Digital Input Ports	Remote Start	Low Oil Pressure Shutdown	High Temperatu re Shutdown	Gen Close Status Input							
Digital Output Ports	Idle Control	Open Gen Output	Close Gen Output								
Multi Sync Setting	Num. On MSC Bus										
Sync Calibration	MSC ID	Module Priority	Load Mode select	GOV/AVR							

Table 31 Main Setting Items of Parallel Controller

All the above Parameters are set according to the site use.

3.2 Preparation before Parallel

 a) Check whether the battery power is sufficient to ensure that the "Starting motor" starts, and then start the engine. If the starting instantaneous voltage is lower than 10V (12V power supply battery system) and 20V (24V power supply battery system), the battery has lost power.



- b) Check whether the diesel, oil and coolant of the engine are normal.
- c) Before starting the engine, remove the air in the fuel injection pump through the manual fuel injection valve to ensure the smooth start of the engine.
- d) Check whether the wiring between the controller and the periphery is correct according to the circuit diagram to avoid wrong wiring; mainly check the MSC communication line (shielded wire) from the controller to the GOV, AVR and the unit, and ensure that the shielded wire is fully grounded, Close Gen Output, Open Gen Output, Gen Close Status Input, and the whole system is connected to ground.
- e) Check whether the controller is well grounded (connected to the generator set grounding pile head).
- f) Configure the controller parameters according to the actual situation of the generator unit.
- g) Manually start the generator by the controller. After the generator runs normally, adjust the rated speed and rated voltage of the generator.
- h) By manually closing or opening, confirm whether the opening and closing of the controller control switch is normal.
- i) The speed regulation and voltage regulation of single unit test are normal. Before the switch is closed, properly change the rated frequency and rated voltage; after the switch is closed, whether the power generation frequency and voltage are adjusted to the set rated value; after the switch is opened, restore the rated frequency and rated voltage.
- j) Before paralleling, make sure that the single unit is running normally, and adjust the gain and stability of the generator.
- k) After manual loading, observe whether the generator operates normally.
- After the manual parallel debugging is normal, adjust the controller to the Auto mode, and realize the automatic parallel after the remote startup input is valid.

3.3 Four Steps of Parallel

3.3.1 Description

Three elements of parallel: voltage, frequency, and phase.

As the name suggests, three conditions must be met in order to realize the parallel of multiple units: the AC power generation voltage is within the synchronization range of multiple parallel units (for example, the voltage difference is within $\pm 3V$), and the power generation frequency is within the synchronization range of multiple parallel units (for example, the frequency difference is within $\pm 0.1Hz$), the phases of the power generation of multiple units should be consistent with 0°-120°-240°, and the phase difference should be guaranteed to be within a certain range, for example: within 10 degrees. The smaller the deviation of the three elements of the



parallel operation of multiple units, the smaller the circulation generated immediately after the parallel, and vice versa.

3.3.2 Step 1: Speed Regulation and Voltage Regulation Control

3.3.2.1 Speed Regulation Control

Take the ESD5500 GOV as an example, wire and set the values of SW1 and SW2 of GOV.



Fig.71 GOV parameter setting and wiring diagram

Adjust the SW1 value of GOV (speed regulation control) in synchronization setting.



Fig.72 Adjust SW1 of GOV

Adjusting the SW1 of GOV (speed regulation control) has two purposes, one is to judge whether the GOV itself is normal; the other is to judge whether the wiring between the controller and the GOV is correct.



—If the SW1 value is increased, the speed increases accordingly; turn down the SW1 value and the speed decreases accordingly. This indicates that the wiring is correct.

- ——If the SW1 value is increased, the speed decreases; turn down the SW1 value and the speed
- increases. This indicates that the wiring between the controller and GOV is wrong.

Solutions for wiring errors:

-----Change the position of the two GOV wires.

—Select Output Reverse.

igmp6-Hgm9530N/HmB9700	V5.4.0.4 - [Auto Syn	ic]			
File Connection Option	Language/语言	Help			
🗅 • 📂 🔒 🔜 сом: USB	✓ Refurbish	COM			
Ģ —Module	<u>^</u> <<			Auto Sync	
Module Settings					
Hains			GOV		
·····Timers					
Engine			Output	Internal Analogue	~
Generator					
Switch			U Output Revers	e	
- Sensor			Action	Adjust to Rated Exampler	~
Digital Input			Action	Aujust to Kated Frequency	•
Scheduled Run			- Im		
Scheduled Not Fur			AVK		
Maintenance			Output	Internal Analogue	~
-Alternative Config					
Sync			🗌 Output Revers	e	
Auto Sync					
Check Sync			Action	Adjust to Rated Voltage	~
Multi Sync					
Load Shedding C	ont				
Dummy Load					
Heavy Load					
-Sync Calibration					

Fig.73 GOV Output Reverse enable

The rated frequency of the engine speed shall be adjusted for a single unit, and the adjustment range is between ±1Hz. When the frequency changes, the speed of the engine changes accordingly. The purpose is to make the speed adjustment range of the controller relatively wide when finding the synchronization point (applicable to different engines in parallel). For example, the power of the unit is 30kW, the number of teeth is 130, the rated frequency of the engine is 50Hz, the speed is 1500rpm, SW1 of GOV is 9 and SW2 is 2.

First increase the frequency by 1Hz, change it to 51Hz and write it into the controller.



Fig.74 Set the rated frequency to 51HZ

The controller is turned on in manual mode. After the unit is running normally, press the closing button, the generator switch is closed, and the frequency slowly rises to 51HZ. At this time, the GOV output percentage should be 26%, and the corresponding speed is 1530rpm and 51Hz.

dule «	Data	Display 2
Bodule Settings Mains Mains Timers Generator Switch Sensor Svitch Sensor Scheduled Kun Schedu	Generator Ourrent Active Power PCT 0.0% AVR Output PCI -48.0 % Current Reactive Power PCT 0.0% GOV Output PCI -26.0% Target Active Power PCT 0.0% Difference Value Voltage -1V Prequency 0.00Hz Phase Angle 359.8° Total A Rum Time 0:9:24 Starts 5 Total Energy 0.0KWh	Current 0.0A % Negative Sequence Current 0.0A % Earth Fault Current 0.0A % Negative Sequence Current PCT 0% % Earth Fault Current PCT 0% % Total Gensets Power 0.0kW Total Active Power 0.0kWar 0.0kvar % Total B 0:9:24 % Starts 5 % Total Energy 0.0kWh
Data Display 2 Expansion DINIO/DOUTIO Expansion AIN8 Expansion AIN8 Expansion AIN84 Event Log Data Analysis Module Calibrate	Module Count 1	


Part 3 Commissioning Guide



Fig.75 GOV output percentage at rated frequency 51HZ

If the GOV output percentage is not 26.0%, adjust the value of SW2 until the GOV output percentage reaches 26.0% corresponding to the speed of 1530rpm. The specific settings are shown in Figure 76, and then press the opening button to open the generator switch.

GMP6-HGM9530N/HMB9700 V5.4.1.	.0 - [GOV/AVR]		- 0
File Connection Option Lang	uage/语言 Help		
🗅 🕶 📴 🔜 🔜 сож: USB 🗸 🗸	Refurbish COM		
⊡-Module Module Settings	«	GOV/AVR	
 Mains Timers Engine 		Center(SW1) Generator Frequency	
Generator Switch		0.00(0.00V) 0.00 C Set 9.00(4,50V) 51.00Hz	
 B-Digital Input Digital Output 		Range(SW2) Engine Speed	
Scheduled Run Scheduled Not Run		2.00(1.50V) 200 C Set 2.00(1.50V) 1530r/min	
Maintenance Alternative Config Sume		AVR Center(SWI)	
- Sync Calibration - MSC - Sync Control	CI	0.00(0.00V) 0.00 © Set 0.00(0.00V) 230V 230V 230V	
Load Control		Range(SW2) L1-L2 L2-L3 L3-L1	
-Expansion 		2.00 € Set 2.00(1.50V) 400V 400V 400V	
⊟—Module Monitoring ⊟—Module Calibrate			
-Date/Time and Accumulati			

Fig.76 Adjust SW2 of GOV at rated frequency of 51HZ

Reduce the frequency by 1Hz, change it to 49Hz and write it to the controller.



Fig.77 Set the rated frequency to 49HZ

Press the closing button, the generator switch is closed, the frequency slowly drops to 49HZ, and the GOV

output percentage at this time should be -29.8%.







Fig.78 GOV output percentage at rated frequency 49HZ

If the GOV output percentage is not -29.8%, adjust the value of SW2 until the GOV output percentage reaches -29.8% corresponding to the speed of 1470rpm, then press the opening button, the generator switch is open, and press the stop button to stop the unit.



Fig.79 Adjust SW2 of GOV when the rated frequency is 49HZ

After completing the above steps to adjust the engine speed (frequency), it is necessary to rewrite the rated frequency into the controller.

Precautions for adjusting engine speed (frequency):

- ——After the frequency is adjusted to 51Hz, if the engine itself is stable, there is no need to adjust the gain and stability of frequency synchronous voltage control under the synchronization control (as appropriate).
- ——After the frequency is adjusted to 49Hz, if the engine itself is stable, there is no need to adjust the gain and stability of frequency synchronous voltage control under the synchronization control (as appropriate).
- ——After the adjustment is completed, the rated frequency needs to be rewritten into the controller.

3.3.2.2 Voltage Regulation Control

Take the SX440 AVR as an example, wire and set the values of SW1 and SW2.









Fig.81 Adjust SW1 of AVR

Adjusting the SW1 of AVR has two purposes, one is to judge whether the AVR board itself is normal; the other is to judge whether the wiring between the controller and the AVR board is correct.

- ——If the SW1 value is increased, the voltage increases; turn down the SW1 value, the voltage decreases
 - accordingly. This indicates that the wiring is correct.
- ——If the SW1 value is increased, the voltage decreases instead; turn down the SW1 value, the voltage increases. This indicates that the wiring between the controller and AVR board is wrong.
- Solutions to wiring errors:



-Change the position of the two AVR wires.

-----Select Output Reverse.



Fig.82 AVR Output Reverse Enable

The adjustment range of the voltage is between ±10V, the purpose is to make the adjustment range of the voltage relatively wide when the controller finds the synchronization point (applicable to different generators in parallel).

File Connection Option Language/语言 Help 🗋 - 💕 🛃 🔜 🔜 COM: USB ✓ Refurbish COM -Module Gen Options Module Settings Hains Generator Timers AC System 3 Phase, 4 Wire (3P4W) -Engine -Generator 4 -Poles 4 (2-64) Gen Options 240 ÷ v Rated Voltage 240V (30-30000)V Gen Voltage Gen Frequency Loading Voltage 90.0 \$ % 90.0%(216.0V) (0-200.0)% -Gens Current Rated Frequency 49.0 ÷ Hz 49.0Hz (10.0-75.0)Hz -Gens Power Switch 90.0 \$ % Loading Freq 90.0%(44.10Hz) (0-200.0)% -Sensor Harmonic Display -Digital Input -Digital Output PT Fitted Scheduled Run 100 🌲 V -Scheduled Not Run Maintenance 100 ÷ V Alternative Config

First increase the voltage by +10V, adjust it to 240V, and write it into the controller.





The controller is turned on in manual mode. After the unit is running normally, press the closing button, the generator switch is closed, and the generator voltage slowly rises to 240V. At this time, the AVR output percentage is 43.8%

percentage is 43.8%.







Fig.84 AVR output percentage at rated voltage of 240V

If the AVR output percentage is not 43.8%, increase or decrease the value of SW2 until the AVR output percentage is adjusted to 43.8% corresponding to 416V, press the opening button to open the power generation switch.

MP6-HGM9510N V5.4.1.0 - [GOV/AVR]			-	
e Connection Option Language/语言	E Help			
🎽 🔚 🔜 COM: USB 🛛 🗸 Refurbi	sh COM			
Module <<		GOV/AVR		
Module Settings	COV			
H-Mains	GOV			
limers	Center(SW1)		Generator Frequency	
Engine	9.00(4.50V)		50 00Hz	
Generator		9.00 Set 9. 00(4.50V)	50.00112	
Sensor				
-Digital Input	Range(SW2)		Engine Speed	
H-Digital Output	2 00/1 50\/		Engine Speed	
Scheduled Run	2.00(1.001)	2.00 \$ Set 2.00(1.50V)	1500r/min	
Scheduled Not Run			13001/1111	
Maintenance				
-Alternative Config	AVR			
B-Sync	Center(SW1)		1411 1011 1211	
-Sync Calibration	1 00/0 50\0		L1-N L2-N L3-N	
MSC	1.00(0.001)	1.00 + Set 0.00(0.00V)	240V 240V 240V	
Sync Control				
Load Control				
-Load Levels	Range(SW2)		L1-L2 L2-L3 L3-L1	
GOV/AVR	2.00(1.50V)		44 GV 44 GV 44 GV	
- Expansion		2.00 ÷ Set 2.00(1.50V)	4100 4100 4100	
PLC				
Module Monitoring				
noquie calibrate				
Date/lime and Accumulation				

Fig.85 SW1 of AVR at rated voltage of 240V

Reduce the voltage by -10V, adjust it to 220V, and write it into the controller.

iGMP6-HGM9530N/HMB9700 V5.4.0.4 - [Gen Options]					
<u>File Connection Option Language/语言 Help</u>					
🗋 🕶 📴 🔜 🔜 COM: USB 🛛 🗸 Refurbish COM					
□-Module ^ <<			Gen Options		
Module Settings					
-Mains	Generator				
Timers	10.0				
-Engine	AC System	3 Phase, 4 Wire(3P4W)	~		
Generator	Poles	4 🔄		4	(2-64)
- Gen Options	Rated Voltage	220 ÷ V		220V	(30-30000)V
Gen Voltage					
Gen Frequency	Loading Voltage	90.0 🜩 %	•	90.0%(198.0V)	(0-200.0)%
-Gens Current	Rated Frequency	49.0 ÷ Hz		49.0Hz	(10.0-75.0)Hz
Gens Power					
Switch	Loading Freq	90.0 👻 %	•	90.0%(44.10Hz)	(0-200.0)%
B Digital Input	🗌 Harmonic Displa	ау			
-Digital input					
Scheduled Run	PT Fitted				
Scheduled Not Run	PT Primary	100 ÷ V		100V	(30-30000)V
Maintenance					
-Alternative Config	PT Secondary	100 V		100V	(30-1000)V
Sync					

Fig.86 Set the rated voltage of generator to 220V

The controller is turned on in manual mode. After the unit is running normally, press the closing button, the generator switch is closed, and the generator voltage slowly drops to 220V. At this time, the AVR output percentage should be -84.7%.



GMP6-HGM9530N/HM89700 V5.4.1.0 - [Data Display 2]

Date/Time and Accumulati

de «	Data Display 2			
Module Settings Mains Timers Engine Generator Switch Sensor Digital Input Digital Output Scheduled Run Scheduled Not Run	Generator Current Active Power PCT 0.0% AVR Output PCT -84.7% Current Reactive Power PCT 0.0% Target Active Power PCT 0.0% Target Reactive Power PCT 0.0% Difference Value Voltage 0 Voltage 0 Frequency 0.00Hz	Current Negative Sequence Current 0.0A Earth Fault Current 0.0A Negative Sequence Current PCT 0% Earth Fault Current PCT 0% Total Gensets Power Total Active Power 0.0KW		
Maintenance -Alternative Config -Sync -Sync Calibration Expansion	Phase Angle 359.5° Total A Run Time 0:33:37	Total Reactive Power 0.0kvar Total B Run Time 0:33:37		
FLC ule Monitoring -Generator Status -Control	Starts 8 Total Energy 0.0kWh	Starts 8 Total Energy 0.0kWh		
Data Display 1 Data Display 2 Expansion DIN16/DOUT16 Expansion AIN8 Expansion AIN24 Furnt Los	MSC ID 1 Priority 0 Module Count 1			







If the AVR output percentage is not -84.7%, increase or decrease the value of SW2 until the AVR output percentage is adjusted to -84.7% corresponding to a voltage of 380V, press the opening button to open the generator switch, and then press the stop button to stop the unit.



Fig.88 SW2 of AVR at rated voltage of 220V

After completing the above steps to adjust the engine voltage, it is necessary to rewrite the rated voltage into the controller.

Precautions for adjusting generation voltage:

- ——After the generation voltage is adjusted to 240V, if the engine itself is stable, there is no need to adjust
 - the gain and stability of voltage control under synchronous control (as appropriate).
- ——After the generation voltage is adjusted to 220V, if the engine itself is stable, there is no need to adjust the gain and stability of voltage control under synchronous control (as appropriate).

3.3.3 Step 2: Inspect the Installation Position and the Wiring of Current Transformer

Inspection purpose: To avoid incorrect wiring of S1 and S2 on the current transformer, resulting in inaccurate load distribution by the controller, to avoid reverse current direction, negative current and negative power.

Inspection steps: First check whether the installation position and direction of the current transformer is correct (the correct direction is P1 to P2, and the power generation to the load); then check whether the wiring



of the current transformer is correct (in the correct wiring, S1 of the three current transformers are connected to

IA, IB, IC respectively, and S2 is connected to the common terminal Icom for grounding).

Detection method: After the unit is turned on, take a little load, and judge the direction of the current.



Fig. 89 Position and wiring of current transformer



Fig. 90 Current and power display of correct current transformer installation



If the wiring is wrong, the following phenomena may occur.

Fig. 91 Current and power display negative values of incorrect current transformer installation



Part 3 Commissioning Guide

The wrong wiring of L1, L2 and L3 phase current transformers will cause the active power value and the apparent power value to display negative values. Therefore, the correct installation position and wiring of the current transformers are very important for the units to be loaded in parallel, otherwise the reverse power trip warning will appear.

3.3.4 Step 3: Check MSC Communication between Multiple Units

3.3.4.1 Description

3.3.4.1.1 Set the ID number of each unit correctly and cannot be repeated ((avoid alarm)); Set the correct ID number. If there is a module ID error alarm, after modifying the conflicting ID address, long press the stop button to eliminate the alarm.

3.3.4.1.2 Check whether a 120ohm resistor is connected between the MSC communication ports H and L of the first controller; check whether a 120ohm resistor is connected between the MSC communication ports H and L of the last controller.

3.3.4.2 Setting Module Running Priority Can Realize Two Functions

3.3.4.2.1 If the module running priority is set to the same number, all units will start when the unit is in the Auto position.

3.3.4.2.2 If the module running priority is set to the same number as the respective ID, the unit with the smallest number will have the highest priority, and the unit with the highest priority will start up and load first. When the load power is greater than the power setting value when the unit is scheduled to start up, the unit with the second highest priority starts up and loads in parallel with the bus, and so on.







iGMP6-HGM9530N/HMB9700 V5.4.0.4 - [Digital Input		
File Connection Option Language/语言 He		
🗅 • 💕 🔒 🔜 COM: USB 🛛 🗸 Refurbish COM		
Ģ—Module <<	Digital Input	
Module Settings Mains Timers Engine Generator Switch Switch	Digital Input 1 31 RemoteStart Demand	
Borgar Digital Input Digital Output Scheduled Run Scheduled Not Run Maintenance	2 27 Low OP Shutdown Close to Activate ~	
 Alternative Config Sync Sync Calibration Expansion PLC 	26 High Temp Shutdown Close to Activate I3 Gen Closed Aux Close to Activate 	
- Module Monitoring - Module Calibrate - Date/Time and Accumulation	5 Delay 2.0s (0-20.0s) Enter remarks(e. 00 User Configured ~ Close to Activate ~ Safety Stop ~	g. High Temp. Warn) Never ~
	6 44 First Priority V Close to Activate V	



3.3.5 Step 4: Sync Check

3.3.5.1 Check Wiring





Fig.94 Correct wiring of Gens cables



GEB

V



Fig.95 Wrong wiring of Gens cables

3.3.5.2 Check Phase Sequences

Before paralleling, check whether the phase sequence of the single unit and the busbar is consistent; if it is inconsistent, the paralleling may not be successful and may even be dangerous. The correct phase sequence is 0°-120°-240°.





Fig.96 Correct phase sequence display

Genset

0

2

Fn

Load

О



The wrong phase sequence is 0°-240°-120°. If the phase sequence is connected incorrectly, the unit will

send out a phase sequence error alarm and shutdown after starting up to establish the generating voltage.



Fig.97 Gens phase sequence error shutdown alarm



3.3.5.3 Phase Sequence Inspection Method for Parallel Connection between Generators or Parallel

Connection between Generator and Mains

When the generator sets are connected in parallel, start one unit first, check whether the generation phase sequence on the controller is 0° - 120° - 240° after the power generation is normal. In case of power generation phase sequence error alarm and shutdown, check whether the generation cable and generation voltage sampling line are connected reversely. After the generation phase sequence is correct, close the generation switch and observe whether the bus phase sequence is correct. If the voltage bus phase sequence error alarm and shutdown, check whether unit in parallel with the busbar synchronously. If there is a voltage bus error alarm and shutdown after synchronous closing, check whether the power generation cable and to the busbar and the busbar woltage sampling line of the unit or the cable from the switch output end to the busbar and the busbar voltage sampling line are connected reversely.

When the generator and the mains are connected in parallel, check whether the phase sequence of the mains on the controller is 0°-120°-240°. If there is a warning of the reverse phase sequence of the mains, check whether the power cable and the mains voltage sampling line are reversed; Start the generator set, check whether the generation phase sequence is 0° - 120° - 240° after the generator runs normally. In case of power generation phase sequence error alarm and shutdown, check whether the generation cable and generation voltage sampling line are connected reversely. After the generation phase sequence is correct, close the generation switch and observe whether the bus phase sequence is correct. If the voltage bus phase sequence error alarm and shutdown, check whether the power generation switch is connected reversely to the bus cable and the bus voltage sampling line.

Regarding phase sequence detection, it can also be detected by other external auxiliary tools, such as phase sequence meters and multimeters, which can improve the efficiency in the parallel process.

-----Phase Sequence Meter Measurement





Fig. 98 Phase sequence meter installation



Fig. 99 Correct phase sequence indication



Fig. 100 Wrong phase sequence indication

-----Multimeter Measurement

For Low voltage 400V or below, set the multimeter to AC 500V or 750V, first set the three-phase A, B, and C of the power supply side, then use a test lead to set the A phase of the power supply side, and another test lead to measure the three phases A, B and C on the opposite side, three different voltage values will be obtained at this time, but two of the voltage values are high and almost equal, and the other is low. Choose the phase A with the lowest value in the same phase as the phase A on the power side. According to this method, measure the other two phases B and C respectively, and finally measure the phase sequence of the power supply on both sides of 400V under the same voltage. When measuring the phase sequence of the high voltage 10KV and above power supply on both sides, while using the above method to measure, it should be measured on the secondary outgoing line of the voltage transformer on both sides, and the selected voltage range should be AC 500V or 700V. At the same time, it is also necessary to check whether the wiring of the voltage transformers on both sides is correct to prevent accidents in parallel caused by different phases.

3.4 Application Diagram of Two Units in Parallel





Fig. 101 Unit Parallel Application Diagram



4 GOV/AVR/EFI Engine Setting

4.1 GOV/AVR Control Description

The adjustment of engine speed and generator voltage can be controlled by the DC voltage output of the module. The control voltages of GOV and AVR of different gensets are different, and the GOV and AVR center voltage and range voltage of the parallel controller must be correctly set to match them.



Fig. 102 GOV and AVR setting

4.2 GOV/AVR Parameter Setting

Table 32 GOV and AVR description

Control Interface	ltem	Function Description		
	Center Voltage (SW1)	Set the GOV speed control center voltage.		
GOV	Voltage Range (SW2)	Set the GOV speed control offset voltage range.		
	Output Reverse	When the GOV control voltage increases but the engine speed decreases, the Output Reverse needs to be enabled.		
AVR	Center Voltage (SW1)	Set the AVR speed control center voltage.		
	Voltage Range (SW2)	Set the AVR speed control offset voltage range.		
	Output Reverse	When the AVR control voltage increases but the generator voltage decreases, the Output Reverse needs to be enabled.		

Table 33 SW1/SW2 Setting value and corresponding control voltage



6

7

8

9

10

ideas for power		Part 4 GOV/AVF	R /EFI Engine Settings
SW1(Cent	er Voltage)	SW2(Vol	tage Range)
Setting Value	Voltage	Setting Value	Voltage
0	0V	0	<u>+</u> 0.5V
1	0.5V	1	<u>+</u> 1.0V
2	1.0V	2	<u>+</u> 1.5V
3	1.5V	3	<u>+</u> 2.0V
4	2.0V	4	<u>+</u> 2.5V
5	2.5V	5	<u>+</u> 3.0V

6

7

8

9

10

<u>+</u>3.5V

<u>+</u>4.0V

<u>+</u>4.5V

<u>+</u>5.0V

<u>+</u>5.5V

4.3 HGM9500 Controller GOV/AVR Parameters setting

4.3.1 HGM9500 Controller GOV/AVR Connection Diagram

3.0V

3.5V

4.0V

4.5V

5.0V



Fig. 103 HGM9500 Controller GOV/AVR Connection diagram

4.3.2 GOV Connection

4.3.2.1 GAC GOV 5100-5500 Series





Fig. 104 GAC(5100-5500)

4.3.2.2 CUMMINS

4.3.2.2.1 EFC* Series



Fig. 105 CUMMINS EFC*Series

4.3.2.2.2 EFCILS





Fig. 106 CUMMINS EFCILS

4.3.2.3 VOLVO

4.3.2.3.1 EMS2





4.3.2.3.2 EDC3





Fig. 108 VOLVO EDC3

4.3.2.4 PERKINS

4.3.2.4.1 2000 Series Engine



Fig. 109 PERKINS2000 Series

4.3.2.4.2 1300 Series Engine





Fig. 110 PERKINS1300 Series

4.3.2.5 AMBAC

4.3.2.5.1 EC5000*/EC5100*/EC5110*



Fig. 111 AMBAC(EC5000*)

4.3.2.5.2 CW673C





Fig. 112 AMBAC(CW673C)

4.3.2.6 BARBERCOLMAN

4.3.2.6.1 DYN110502/10503/10504/10506



Fig. 113 BARBERCOLMAN(DYN110502)

4.3.2.6.2 DYN110693/10694/10695/10752/10753/10754/10756





Fig. 114 BARBERCOLMAN(DYN110693)

4.3.2.6.3 DYN110794*



Fig. 115 BARBERCOLMAN(DYN110794*)

4.3.2.6.4 DYN110871





Fig. 116 BARBERCOLMAN(DYN110871)

4.3.2.6.5 DPG2201*



Fig. 117 BARBERCOLMAN(DPG2201*)

4.3.2.6.6 DPG2401





Fig. 118 BARBERCOLMAN(DPG2401)

4.3.2.6.7 DYNA8000*



Fig. 119 BARBERCOLMAN(DYNA8000*)

4.3.2.7 CATERPILLAR ADEM*





Fig. 120 CATERPILLAR ADEM*

4.3.2.8 DETROIT

4.3.2.8.1 DDECIII



Fig. 121 DETROIT DDECIII

4.3.2.8.2 DDECIV*





Fig. 122 DETROIT DDECIV*

4.3.2.9 DEUTZ EMR2



Fig. 123 DEUTZ EMR2

4.3.2.10 DOOSAN DGC





Fig. 124 DOOSAN DGC

4.3.2.11 GHANACONTROLDGC-2007*



Fig. 125 GHANACONTROLDGC-2007*

4.3.2.12 HEINZMANN

4.3.2.12.1 KG Series




Fig. 126 HEINZMANN KG Series

4.3.2.12.2 PANDAROS*



Fig. 127 HEINZMANN PANDAROS*

▲Note: Pandaros need to be configured in "PandarosPackager" software:

----Single unit/parallel without sagging.

——Analog Input 1 (Load Sharing) is not enabled.

——Analog Input 2 (Synchronous Input) is configured as 0-5V input.

4.3.2.13 IVECO CURSOR13TE2(WITHSCIBOX)*





Fig. 128 IVECO SCIBOX

ANote: The dial switch in SCI box is set as follows:1=OFF, 2=ON, 3=OFF, 4=OFF

4.3.2.14 JOHNDEERE JDEC



Fig. 129 JOHNDEERE JDEC

4.3.2.15 MITSUBISHI XB400*





Fig. 130 MITSUBISHIXB400*

4.3.2.16 MTUADEC2000*/4000



Fig. 131 MTU(ADEC2000*/4000)

4.3.2.17 SCANIA S6 Engine







4.3.2.18 TOHO1TOHOXS*





4.3.2.19 WOODWARD

4.3.2.19.1 721 Digital GOV





Fig. 134 WOODWARD 721 Digital GOV

4.3.2.19.2 2301A GOV



Fig. 135 WOODWARD 2301A GOV

4.3.2.19.3 2301A Load Sharing





Fig. 136 WOODWARD 2301A Load Sharing

4.3.2.19.4 DPG



Fig. 137 WOODWARD DPG

4.3.2.19.5 EPG(ELECTRICALLYPOWEREDGOVERNORS)*





Fig. 138 WOODWARD EPG

4.3.2.19.6 PROACTI/II



Fig. 139 WOODWARD PROACTI/II

4.3.3 AVR Connection

4.3.3.1 STAMFORD

SX421/SX440*/SX465-2/AS440/MX321/MX325/MX327/MX341





Fig. 140 STAMFORD SX440

4.3.3.2 MARATHON

4.3.3.2.1 DVR2000/DVR2000C



Fig. 141 MARATHON DVR2000

4.3.3.2.2 DVR2000E





Fig. 142 MARATHON DVR2000E

4.3.3.2.3 PM100*/PM200*



Fig. 143 MARATHON PM100*/PM200*

4.3.3.3 LEROYSOMER

4.3.3.3.1 R230/R438*/R448/R449





Fig. 144 LEROYSOMER R448

4.3.3.3.2 R6103F



Fig. 145 LEROYSOMER R6103F

4.3.3.4 ENGGA

4.3.3.4.1 WT-2/WT-3





4.3.3.4.2 MECCALTE



Fig. 147 MECCALTE DSR

4.3.3.4.3 S.R.7*





Fig. 148 MECCALTE S.R.7

4.3.3.4.4 U.V.R*



Fig. 149 MECCALTE U.V.R

4.3.3.4.5 DER1





Fig. 150 MECCALTE DER1

4.3.3.5 MARELLIMOTOR

4.3.3.5.1 M16FA655A*



Fig. 151 MARELLIMOTOR(M16FA655A)

4.3.3.5.2 M40FA610A





Fig. 152 MARELLIMOTOR(M40FA610A)

4.3.3.5.3 M40FA640A*



Fig. 153 MARELLIMOTOR(M40FA640A)

4.3.3.6 BASLER

4.3.3.6.1 AVC63-12





Fig. 154 BASLER(AVC63-12)

4.3.3.6.2 DECS15/DECS100



Fig. 155 BASLER(DECS15/DECS100)

4.3.3.6.3 DECS200







4.3.3.6.4 SSR



Fig. 157 BASLER(SSR)

4.3.3.7 CATERPILLAR

4.3.3.7.1 CDVR





Fig. 158 CATERPILLAR CDVR

4.3.3.7.2 VR3



Fig. 159 CATERPILLAR VR3

4.3.3.7.3 VR6





Fig. 160 CATERPILLAR VR6

4.3.3.8 COSIMAT(COSIMATN)



Fig. 161 COSIMAT(COSIMATN)

4.3.3.9 GRAMEYER(GRT7-TH*)





Fig. 162 GRAMEYER(GRT7-TH*)

4.3.3.10 KATO(K65-12B/K125-10B)







4.4 HGM9500N Controller GOV/AVR Parameter Setting



4.4.1 HGM9500N Controller GOV/AVR Connection Diagram

Fig. 164 HGM9500N Controller GOV/AVR Connection Diagram

4.4.2 GOV Wiring

4.4.2.1 GAC Governor(5100-5500 Series)



Fig. 165 GAC(5100-5500)

4.4.2.2 CUMMINS

4.4.2.2.1 EFC* Series





Fig. 166 CUMMINS EFC* Series

4.4.2.2.2 EFCILS



Fig. 167 CUMMINS EFCILS

4.4.2.3 VOLVO

4.4.2.3.1 EMS2





Fig. 168 VOLVO EMS2

4.4.2.3.2 EDC3



Fig. 169 VOLVO EDC3

4.4.2.4 PERKINS

4.4.2.4.1 2000 Series Engine















4.4.2.5 AMBAC

4.4.2.5.1 EC5000*/EC5100*/EC5110*



Fig. 172 AMBAC(EC5000)

4.4.2.5.2 CW673C



Fig. 173 AMBAC(CW673C)

4.4.2.6 BARBERCOLMAN

4.4.2.6.1 DYN110502/10503/10504/10506





Fig. 174 BARBERCOLMAN(DYN110502)

4.4.2.6.2 DYN110693/10694/10695/10752/10753/10754/10756



Fig. 175 BARBERCOLMAN(DYN110693)

4.4.2.6.3 DYN110794*





Fig. 176 BARBERCOLMAN(DYN110794)

4.4.2.6.4 DYN110871



Fig. 177 BARBERCOLMAN(DYN110871)

4.4.2.6.5 DPG2201*





Fig. 178 BARBERCOLMAN(DPG2201*)

4.4.2.6.6 DPG2401



Fig. 179 BARBERCOLMAN(DPG2401)

4.4.2.6.7 DYNA8000*





Fig. 180 BARBERCOLMAN(DYNA8000*)

4.4.2.7 CATERPILLAR ADEM*



Fig. 181 CATERPILLAR ADEM

4.4.2.8 DETROIT

4.4.2.8.1 DDECIII





Fig. 182 DDECIII

4.4.2.8.2 DDECIV*



Fig. 183 CATERPILLAR DDECIV

4.4.2.9 DEUTZ





Fig. 184 DEUTZ EMR2

4.4.2.10 DOOSAN



Fig. 185 DOOSAN DGC

4.4.2.11 GHANACONTROL(DGC-2007*)





Fig. 186 GHANACONTROL(DGC-2007*)

4.4.2.12 HEINZMANN

4.4.2.12.1 KG Series



Fig. 187 HEINZMANN KG Series

4.4.2.12.2 PANDAROS*





Fig. 188 HEINZMANN (PANDAROS*)

A Note: Pandaros needs to use "PandarosPackager" software for the following configuration:

——Single unit/Parallel without sagging.

——Analog input 1 (Load sharing) is disenabled.

——Analog input 2 (Synchronous input) is configured as 0-5V input.

4.4.2.13 IVECO CURSOR13TE2(WITHSCIBOX)*



Fig. 189 IVECO (SCIBOX)

ANote: The dial switches in SCI box are set as follows: 1=OFF, 2=ON, 3=OFF, 4=OFF

4.4.2.14 JOHNDEERE





Fig. 190 JOHNDEERE JDEC

4.4.2.15 MITSUBISHI



Fig. 191 (MITSUBISHI XB400*)

4.4.2.16 MTU





Fig. 192 MTU(ADEC2000*/4000)

4.4.2.17 SCANIA





4.4.2.18 TOHO







4.4.2.19 WOODWARD

4.4.2.19.1 721 Digital GOV



Fig. 195 WOODWARD 721 Digital GOV

4.4.2.19.2 2301A GOV





Fig. 196 WOODWARD 2301A Digital GOV

4.4.2.19.3 2301A Load Sharing



Fig. 197 WOODWARD 2301A Load Sharing

4.4.2.19.4 DPG




Fig. 198 WOODWARD DPG

4.4.2.19.5 EPG(ELECTRICALLYPOWEREDGOVERNORS)*



Fig. 199 WOODWARD EPG

4.4.2.19.6 PROACTI/II





Fig. 200 WOODWARD PROACTI/II

4.4.3 AVR Wiring

4.4.3.1 STAMFORD

SX421/SX440*/SX465-2/AS440/MX321/MX325/MX327/MX341



Fig. 201 STAMFORD SX440

4.4.3.2 MARATHON

4.4.3.2.1 DVR2000/DVR2000C





Fig. 202MARATHON DVR2000

4.4.3.2.2 DVR2000E



Fig. 203 MARATHON DVR2000E

4.4.3.2.3 PM100*/PM200*





Fig. 204 MARATHON PM100*/PM200*

4.4.3.3 LEROYSOMER

4.4.3.3.1 R230/R438*/R448/R449





4.4.3.3.2 R6103F





Fig. 206 LEROYSOMER R6103F

4.4.3.4 ENGGA WT-2/WT-3



Fig. 207 ENGGA WT2, WT3

4.4.3.5 MECCALTE

4.4.3.5.1 DSR





Fig. 208 MECCALTE DSR

4.4.3.5.2 S.R.7*



Fig. 209 MECCALTE S.R.7*

4.4.3.5.3 U.V.R.*





Fig. 210 MECCALTE U.V.R*

4.4.3.5.4 DER1



Fig. 211 MECCALTE DER1

4.4.3.6 MARELLIMOTOR

4.4.3.6.1 M16FA655A*





Fig. 212 MARELLIMOTOR(M16FA655A*)

4.4.3.6.2 M40FA610A



Fig. 213 MARELLIMOTOR(M40FA610A)

4.4.3.6.3 M40FA640A*





Fig. 214 MARELLIMOTOR(M40FA640A)

4.4.3.7 BASLER

4.4.3.7.1 AVC63-12



Fig. 215 BASLER(AVC63-12)

4.4.3.7.2 DECS15/DECS100





Fig. 216 BASLER(DECS15/DECS100)

4.4.3.7.3 DECS200



Fig. 217 BASLER(DECS200)

4.4.3.7.4 SSR





Fig. 218 BASLER(SSR)

4.4.3.8 CATERPILLAR

4.4.3.8.1 CDVR





4.4.3.8.2 VR3





Fig. 220 CATERPILLAR VR3

4.4.3.8.3 VR6



Fig. 221 CATERPILLAR VR6

4.4.3.8.4 COSIMAT(COSIMATN)





Fig. 222 COSIMAT(COSIMATN)

4.4.3.8.5 GRAMEYER(GRT7-TH*)



Fig. 223 GRAMEYER(GRT7-TH*)

4.4.3.9 KATO(K65-12B/K125-10B)





Fig. 224 KATO(K65-12B)



4.5 Parameter Setting of EFI Unit

4.5.1 CUMMINS ISB/ISBE(CUMMINS)

Table 34 Connector B

Terminals of controller	Connector B	Remark
Fuel relay output	39	
Starting relay output	-	Connected with starter coil directly;
Auxiliary output port 1	Expansion 30A relay; providing battery voltage for terminal 01, 07, 12, 13.	ECU power Set output 1 as "ECU power"

Table 35 9-Pin Connector

Terminals of controller	9 pins connector	Remark
CAN GND	SAEJ1939 shield	CAN communication shielding line (Connected with ECU terminal only);
CAN(H)	SAEJ1939 signal	Impedance 120Ω connecting line is recommended.
CAN(L)	SAEJ1939 return	Impedance 120Ω connecting line is recommended.

Engine type: Cummins ISB.

4.5.2 CUMMINS QSM11(CUMMINS)

It is suitable for CM570 engine control module. Engine type is QSM11 G1, QSM11 G2.

Table 36 C1 Connector

Terminals of controller	C1 Connector	Remark
		External expansion relay; on fuel output,
Fuel relay output	5&8	make port 5 and port 8 of C1 connector
		be connected;
Starting relay output	-	Connected to starter coil directly;

Table 37 3-Pin Data Link Connector

Terminals of controller	3 pins data link connector	Remark
CANGND	C	CAN communication shielding line
CANOND		(Connected with ECU terminal only);
CAN(H)	A	Impedance 120Ω connecting line is



Terminals of controller	3 pins data link connector	Remark
		recommended.
CAN(L)	В	Impedance 120Ω connecting line is
		recommended.

Engine type: Cummins ISB.

4.5.3 CUMMINS QSL9(CUMMINS)

Suitable for CM850 engine control module.

Table 38 50-Pin Connector

Terminals of controller	50 pins connector	Remark
Fuel relay output	39	
Starting relay output	-	Connected to starter coil directly;

Table 39 9-Pin Connector

Terminals of controller	9 pins connector	Remark
	SAE 11030 shield E	CAN communication shielding line
	SAE J 1959 SHIEIU-E	(Connected with ECU terminal only);
CAN(H)	SAE 11030 signal-C	Impedance 120Ω connecting line is
	SAL 91999 Signal-C	recommended.
	SAE 11020 roturn D	Impedance 120Ω connecting line is
	SAE J 1959 Telum-D	recommended.

Engine type: Cummins-CM850.

4.5.4 CUMMINS QSX15-CM570(CUMMINS)

It is suitable for CM570 engine control module. Engine type is QSX15 etc.

Table 40 50-Pin Connector

Terminals of controller	50 pins connector	Remark
Fuel relay output	38	Injection switch;
Starting relay output	-	Connected to starter coil directly;

Table 41 9-Pin Connector

Terminals of controller	9 pins connector	Remark
CANGND	SAE J1939 shield-E	CAN communication shielding line (Connected with ECU terminal only):
CAN(H)	SAE J1939 signal-C	Impedance 120Ω connecting line is



	recommended.
SAE 11030 roturn D	Impedance 120Ω connecting line is
	recommended.

Engine type: Cummins QSX15-CM570.

4.5.5 CUMMINSGCS-MODBUS(CUMMINS)

It is suitable for GCS engine control module. Use RS485-MODBUS to read information of engine.

Engine types are QSX15, QST30, QSK23/45/60/78 and so on.

Terminals of controller	D-SUB Connector 06	Remark
		Outside expansion relay; on fuel output,
Fuel relay output	5&8	make port 05 and 08 of connector 06 be
		connected.
Starting relay output	-	Connected to starter coil directly;
	20	CAN communication shielding line
N3403GND	20	(Connected with ECU terminal only);
R\$485+	21	Impedance 120Ω connecting line is
	21	recommended.
DC/85	18	Impedance 120Ω connecting line is
10405-		recommended.

Table 42 D-SUB Connector 06

Engine type: Cummins QSK-MODBUS, Cummins QST-MODBUS, Cummins QSX-MODBUS.

4.5.6 CUMMINS QSM11(XiM11(CUMMINS)

Table 43 Engine OEM Connector

Terminals of controller	OEM connector of engine	Remark
Fuel relay output	38	
Starting relay output	-	Connected with starter coil directly;
CANGND	-	CAN communication shielding line (Connected with ECU terminal only);
CAN(H)	46	Impedance 120Ω connecting line is recommended.
CAN(L)	37	Impedance 120Ω connecting line is recommended.

Engine type: Common J1939.

4.5.7 CUMMINSQSZ13(Dongfeng CUMMINS)



Table 44 Engine OEM Connector

Terminals of controller	OEM connector of engine	Remark
Fuel relay output	45	
Starting relay output	-	Connected to starter coil directly;
		Set as idling speed control; (N/C) output;
Programmable output 1	16&41	by expansion relay, make 16&41 close as
		the controller is running.
		Set as pulse speed raising control; (N/O)
Programmable output 12	19&41	output; by expansion relay, make 19&41
		for 0.1s as the controller is entering
		warming-up time.
	_	CAN communication shielding line
	-	(Connected with ECU terminal only);
CAN(H)	1	Impedance 120Ω connecting line is
		recommended.
	21	Impedance 120Ω connecting line is
	21	recommended.

Engine type: Common J1939.

4.5.8 DETROIT DIESEL DDEC III/IV(DETROIT)

Table 45 Engine CAN Port

Terminals of controller	CAN port of engine	Remark
Fuel relevieutput	Expansion 30A relay, proving	
	battery voltage for ECU;	
Starting relay output	-	Connected to starter coil directly;
CAN GND		CAN communication shielding line
	-	(Connected with ECU terminal only);
	CAN(H)	Impedance 120Ω connecting line is
		recommended.
CAN(L)		Impedance 120Ω connecting line is
	CAN(L)	recommended.

Engine type: Common J1939.

4.5.9 DEUTZ EMR2(DEUTZ)

Table 46 F Connector

Terminals of controller	F connector	Remark
Fuel relay output	Expansion 30A relay, proving	



	battery voltage for 14; Fuse is	
	16A.	
Starting relay output	-	Connected to starter coil directly;
-	1	Connected to battery negative;
CANGND	-	CAN communication shielding line (Connected with ECU terminal only);
CAN(H)	12	Impedance 120Ω connecting line is recommended.
CAN(L)	13	Impedance 120Ω connecting line is recommended.

Engine type: Volvo EDC4.

4.5.10 JOHN DEERE

Table 47 21-Pin Connector

Terminals of controller	21 pins connector	Remark
Fuel relay output	G, J	
Starting relay output	D	
CANGND	-	CAN communication shielding line
OANGIND		(Connected with ECU terminal only);
CAN(H)	V	Impedance 120Ω connecting line is
0, ((())	v	recommended.
CAN(L)	U	Impedance 120Ω connecting line is
		recommended.

Engine type: John Deere.

4.5.11 MTUADEC (SMART MODULE)

Suitable for MTU engines with ADEC (ECU8) and SMART module.

Table 48 ADEC

Terminals of controller	ADEC (X1 port)	Remark
Fuel relay output	X110	X1 9 shall connect battery negative.
Starting relay output	X134	X1 33 shall connect battery negative.

Table 49 SMART

Terminals of controller	SMART (X4 port)	Remark
	X43	CAN communication shielding line
	740	(Connected with ECU terminal only);



CAN(H)	X41	Impedance 120Ω connecting line is recommended.
CAN(L)	X42	Impedance 120Ω connecting line is recommended.

Engine type:MTU-ADEC

4.5.12 MTUADEC (SAM MODULE)

It is suitable for MTU engine with ADEC (ECU7) and SAM module.

Table 50 ADEC

Terminals of controller	ADEC (X1 port)	Remark
Fuel relay output	X143	X1 28 shall connect negative of battery.
Starting relay output	X137	X1 22 shall connect negative of battery.

Table 51 SAM

Terminals of controller	SAM (X23 port)	Remark
CANCND	Vooo	CAN communication shielding line
CANGID	A233	(Connected with ECU terminal only);
CAN(H)	¥030	Impedance 120Ω connecting line is
	7232	recommended.
	¥221	Impedance 120Ω connecting line is
CAN(L)	AZ31	recommended.

Engine type: Common J1939.

4.5.13 PERKINS

It is suitable for ADEM3/ADEM4 engine control module. Engine type is 2306, 2506, 1106, and 2806.

Table 52 Connector

Terminals of controller	Connector	Remark
Fuel relay output	1, 10, 15, 33, 34	
Starting relay output	-	Connected to starter coil directly;
CAN GND	-	CAN communication shielding line (Connected with ECU terminal only);
CAN(H)	31	Impedance 120Ω connecting line is recommended.
CAN(L)	32	Impedance 120Ω connecting line is recommended.

Engine type: Perkins.

4.5.14 SCANIA



It is suitable for S6 engine control module. Engine type is DC9, DC12, and DC16.

Table 53 B1 Connector

Terminals of controller	B1 Connector	Remark
Fuel relay output	3	
Starting relay output	-	Connected to starter coil directly;
CANGND	-	CAN communication shielding line
0/ WOND		(Connected with ECU terminal only);
CAN(H)	9	Impedance 120Ω connecting line is
	·	recommended.
CAN(L) 10	Impedance 120Ω connecting line is	
(-)		recommended.

Engine type: Scania

4.5.15 VOLVO EDC3(VOLVO)

Suitable engine control mode is TAD1240, TAD1241, and TAD1242.

Table 54 "Stand Alone" Connector

Terminals of controller	Standalone Connector	Remark
Fuel relay output	Н	
Starting relay output	E	
Programmable output 1	P	ECU power;
	F	Set output 1 as "ECU power";

Table 55 "Data Bus" Connector

Terminals of controller	Databus Connector	Remark
CANGND	-	CAN communication shielding line
		(Connected with ECU terminal only);
CAN(H)	1	Impedance 120Ω connecting line is
	I	recommended.
CAN(L)	Impedance 120Ω connecting	Impedance 120Ω connecting line is
	2	recommended.

Engine type: Volvo.

NOTE: When this engine type is selected, preheating time should be set to at least 3 seconds.

4.5.16 VOLVO EDC4



Suitable engine types are TD520, TAD520 (optional), TD720, TAD720 (optional), TAD721, TAD722, and TAD732.

Table 56 VOLVOEDC4

Terminals of controller	Connector	Remark
	Expansion 30A relay, providing	
Fuel relay output	battery voltage for terminal 14.	
	Fuse is 16A.	
Starting relay output	-	Connected to starter coil directly;
	1	Connected to negative of battery;
CANGND	-	CAN communication shielding line
		(Connected with ECU terminal only);
CAN(H)	12	Impedance 120Ω connecting line is
		recommended.
CAN(L)	13	Impedance 120Ω connecting line is
		recommended.

Engine type: Volvo EDC4.

4.5.17 VOLVO EMS2

Volvo Engine types are TAD734, TAD940, TAD941, TAD1640, TAD1641, and TAD1642.

Table 57 Engine CAN Port

Terminals of controller	Engine's CAN port	Remark
Programmable output 1	6	ECU stop;
		Set output 1 "ECU stop";
Programmable output 2	5	ECU power;
	5	Set output 2 "ECU power";
	3	Power negative
	4	Power Positive
CANGND		CAN communication shielding line
	-	(Connected with ECU terminal only);
CAN(H)	1/Hi) Imped	Impedance 120Ω connecting line is
		recommended.
CAN(L)	2(1 0)	Impedance 120Ω connecting line is
	2(LU)	recommended.

Engine type: Volvo-EMS2.



NOTE: When this engine type is selected, preheating time should be set to at least 3 seconds.

4.5.18 YUCHAI

It is suitable for Yuchai BOSCH common rail electronic-controlled engine.

Table 58 Engine 42-Pin Port

Terminals of controller	Engine 42 pins port	Remark
Fuel relay output	1.40	Connected to engine ignition lock;
Starting relay output	-	Connected to starter coil directly;
CANGND	-	CAN communication shielding line (Connected with ECU terminal only);
CAN(H)	1.35	Impedance 120Ω connecting line is recommended.
CAN(L)	1.34	Impedance 120Ω connecting line is recommended.

Table 59 Engine 2-Pin

Battery	Engine 2 pins	Remark
Battery negative	1	Wire diameter 2.5mm ²
Battery positive	2	Wire diameter 2.5mm ²

Engine type: BOSCH

4.5.19 WEICHAI

It is suitable for Weichai BOSCH common rail electronic-controlled engine.

Table 60 Engine Port

Terminals of controller	Engine port	Remark
Fuel relay output	1.40	Connected to engine ignition lock;
Starting relay output	1.61	
CANGND	-	CAN communication shielding line
		(Connected with ECU terminal only);
CAN(H)	1.35	Impedance 120Ω connecting line is
		recommended.
CAN(L)	1 34	Impedance 120Ω connecting line is
	1.04	recommended.

Engine type: Weichai.



If there is any question of connection between controller and ECU communication, please feel free to contact SmartGen's service



5 Summary

Smartgen products involved in this article include:

- ——HGM9510, HGM9510N Genset Parallel Controller.
- -----HGM9520 Genset and Mains Parallel Controller.
- -----HGM9530N Genset Parallel Redundant Controller.
- -----HGM9560 Unit Bus and Mains Parallel Controller.
- ——HGM9580 Unit Bus and Unit Bus Parallel Controller.
- -----HGM6110N Genset Controller.
- ——BAC06A, BAC2410, BAC2420 Battery chargers.
- ——HVD100, and HVD300 Voltage Detection Multi-Function Protection Device (Provides Remote Start Signal).
- ——DIN16A Digital Input Module (When there are many external digital signals, the communication is extended through the ECU J1939 interface).
- ——DOUT16 Digital Output Module (When multiple digital outputs are required, communication is extended through the ECU J1939 interface).
- ——HEP300 Electronic Potentiometer (In electronic speed regulation, voltage regulation and parallel system, it is necessary to convert digital signal or analog voltage signal into voltage, current, PWM signal and other functions).
- ——CMM366A-4G, CMM366B-4G, CAMM366CAN-4G, CMM366A-ET, CMM366A-WIFI Cloud Monitoring Module (Units need cloud service).

Visit SmartGen official website <u>http://www.smartgen.com.cn/</u> And <u>http://www.smartgen.cn/</u> for detailed product information

In addition, more product application solutions and application cases can be obtained through the official website.