Routing with FL SWITCH GHS

Startup of GHS Layer 3 functions

AUTOMATION

Application note 8146 en 01

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1 Description

Before you can use a gigabit modular switch in the Layer 3 environment, the following conditions must be met:

a) the switch must be equipped with version 2.0 of the firmware (or higher),

b) the Layer 3 license (FL SD Flash/L3/MRM (2700607)) must be installed

or the device concerned must have Layer 3 functionality pre-installed (FL SWITCH GHS 4G/12-L3, Order No. 2700786 or FL SWITCH GHS 12G/8-L3, Order No. 2700787).

The flash card referred to above can be used to

a) save the switch configuration,

b) operate the switch as a master in the MRP ring (according to IEC 62439),

c) and use the Layer 3 functions of static routing and VRRP.

Before you can operate the switch in the Layer 3 environment, you first need to install the valid FW (FW update) and insert the flash card referred to above.



Make sure you always use the latest documentation. It can be downloaded at www.phoenixcontact.net/catalog.







Figure 1 GHS with Layer 3 SD card



2 Startup of the layer 3 functions on the GHS

The sections below demonstrate various routing scenarios. In addition to port- and VLAN-based routing, an example of router redundancy is also provided. The relevant configuration settings are shown in the screenshots.

2.1 Scenario 1: Port-specific routing



Figure 2 Scenario 1: Port-specific routing

Step 1:

The network contains a preconfigured network device (example: MMS including relevant settings, see Figure 3); the device is connected to port 14 of the GHS.

Name of Device	FL SWITCH MM HS
System Description	Modular Managed Switch (MMS)
Physical Location	Unknown
Contact	Unknown
IP Address	172.168.2.10
Subnet Mask	255.255.255.0
Default Gateway	172.168.2.1

Figure 3 MMS IP settings

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Step 2:

The PC is located in the same subnetwork as the GHS; in the example, it is connected to port 18.

Allgemein IP-Einstellungen können automatisch zugewiesen werden, wenn das Netzwerk diese Funktion unterstützt. Wenden Sie sich andernfalls an den Netzwerkadministrator, um die geeigneten IP-Einstellungen zu beziehen. © IP-Adresse automatisch beziehen © Folgende IP-Adresse verwenden: IP-Adresse: 192.168.2.50	Eigenschaften von Internet Protoco	ol (TCP/IP)	?
IP-Einstellungen können automatisch zugewiesen werden, wenn das Netzwerk diese Funktion unterstützt. Wenden Sie sich andernfalls an den Netzwerkadministrator, um die geeigneten IP-Einstellungen zu beziehen. © IP-Adresse automatisch beziehen © Folgende IP-Adresse verwenden: IP-Adresse: 192.168.2.50	Allgemein		
IP-Adresse automatisch beziehen Folgende IP-Adresse verwenden: IP-Adresse: 192.168.2.50	IP-Einstellungen können automatisch a Netzwerk diese Funktion unterstützt. V den Netzwerkadministrator, um die gee beziehen.	zugewiesen werden, wenn das Wenden Sie sich andernfalls an eigneten IP-Einstellungen zu	
Folgende IP-Adresse verwenden: IP-Adresse: 192.168.2.50	C I <u>P</u> -Adresse automatisch bezieher	n	
IP-Adresse: 192.168.2.50	- ← Folgende IP- <u>A</u> dresse verwenden	r	
	IP-Adresse:	192.168.2.50	
Subnetzmaske: 255.255.0	S <u>u</u> bnetzmaske:	255 . 255 . 255 . 0	
Standardgateway:	<u>S</u> tandardgateway:		

Figure 4 PC IP settings

The IP address of the GHS is 192.168.2.110/24 and it can be reached using WBM.

Hardware Version	01	
MAC Address	00:02:BC:00:00:77	
Device Name	FL-SWITCH-GHS	
System Description	Modular Managed Gigabit Switch - Head Station (GHS)	
Location	PHOENIX CONTACT	
Contact	Martin Hecker	
IP Address	192.168.2.110	
Network Mask	255.255.255.0	
Default Gateway	0.0.0.0	
Temperature	43.0°C	

Figure 5 GHS web page

Step 3:

Port 18 must be located in a different subnetwork.

In the context of routing, each port needs to be located in a different subnetwork, including the PC's connection port (port 18 in the example). This means that ports 18 and 14 need to be in different networks. Despite the fact that port 14 is located in network 172.168.2.x-network and the switch with the address 192.168.2.110 is located in a separate network, port 18 needs to be explicitly created in yet another network.

Given that we want to access the switch from the same PC network card, an additional IP address needs to be defined and activated on the card:

Network card -> Properties -> Advanced -> Add

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The address of port 18 (172.168.3.1) must be entered for the GW so that the requests for the external subnetwork can be forwarded (see Figure 6).

igenschaften von Internet Protocol (TCP/IP)	? ×	Erweiterte TCP/IP	-Einstellungen			<u>? ×</u>
Allgemein		IP-Einstellungen	ons (wins) о	ptionen		
IP-Einstellungen können automatisch zugewiesen werden, wenn das		_IP-Adressen				
verzwerk diese Funktion unterstutzt, wenden sie sich andernrails an den Netzwerkadministrator, um die geeigneten IP-Einstellungen zu beziehen.		IP-Adresse 192.168.2.50	ç.	Subnetzmaske 255.255.255.0		
O IP-Adresse automatisch beziehen						
Folgende IP- <u>A</u> dresse verwenden:	- 11		Hinzufügen	Bearbeiten	Entfernen	
IP-Adresse: 192.168.2.50						-
Subnetzmaske: 255 . 255 . 255 . 0		Standardgatew	ays:			
Standardgateway:		Gateway		Metrik		
O DNS-Serveradresse automatisch beziehen						
Folgende DNS-Serveradressen <u>v</u> erwenden:	- 11		Hinzufügen	Bearbeiten	Entfernen	
Bevorzugter DNS-Server:					0	
Alternativer DNS-Server:		Automatisch	ne Metrik			
		Schnittstellenm	etrik:			
OK Abbreck	hen			OK	Abbre	echen

Figure 6 TCP/IP settings on the PC

An additional IP address must be set on the PC.

TCP/IP-Adresse		? ×
<u>I</u> P-Adresse:	172.168.3.10	
<u>S</u> ubnetzmaske:	255 . 255 . 255 . 🚺	
	Hinzufügen A	bbrechen

Figure 7 Additional IP address

The gateway address is likewise entered on the PC.

2 100 2 1	
2.160.3.1	way:
	Automatise
	- trik:
	Automatist strik:

Figure 8 Additional IP for the default gateway

Once everything has been configured correctly, the configuration should look like this:

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The first IP address on the network is 172.168.3.10/24 with 172.168.3.1 as the gateway and the second IP on the network card is 192.168.2.50/24

weiterte TCP/IP-Einstellungen		? >
IP-Einstellungen DNS WINS 0	ptionen	
⊢ IP-Adressen		
IP-Adresse	Subnetzmaske	
192.168.2.50 172.168.3.10	255.255.255.0 255.255.255.0	
<u>H</u> inzufügen	Bearbeiten Entfernen	
Standardgateways:	1	_
Gateway 172.168.3.1	Metrik Automatisch	
(Hinzufügen)	Bearbeiten <u>E</u> ntfernen	
Automatische Metrik		
Schnittstellenmetrik:		
	OK Abbr	echen

Figure 9 IP settings following correct configuration

Step 4

Assign the desired IP address and external subnetwork to port 18:

Routing -> IP -> IP Port Cfg

PortRouting mode: Enable

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Enter the IP address: 172.168.3.1/24 in the example.

PHENIX	FL SWITCH GHS	last update: 14:05:31
		Logout
	IP Port Configur	ration Help
FL SWITCH GHS 12G/8	Port Number Port Name	port-18 💌 Port 18
Home General Instructions	Routing Mode	C Disable C Enable
Energy Saving General Configuration	MAC address	00:02:BC:00:00:8A
Switch Station Routing During	Subnet Mask Link Speed Data Rate	255.255.255.0
□ <u>routing General</u> □ <u>IP</u> □ <u>IP</u> □ <u>IP</u> <u>Configuration</u>	Bandwidth	100000 (1 to 1000000) 1500
BP Port Cfg BP Port Table	Forward Net Directed Broadcasts	Disable Disable
ARP Routes	Proxy ARP Local Proxy ARP	C Disable C Enable C Disable C Enable
VLAN Routing VRP	Destination Unreachables	C Disable C Enable
* <u>Router Discovery</u>	Submit Delete IF	PAddress Helper-IPAddress econdary IPAddress

Figure 10 IP configuration of port 18

Once the parameters have been applied

- 1. the WBM of the GHS can only be reached via 172.168.3.1 and
- 2. the WBM of the GHS can still be reached via 192.168.2.110 if another port (e.g., 5) is selected on the switch.

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Step 5

Configure port 14 with the device and assign the external subnetwork: Routing -> IP -> IP Port Cfg -> PortRouting mode: Enable

Enter the IP address: 172.168.2.1 in the example

PHENIX	FL SWITCH GHS		🖬 last update: 14:08:07
			Logout
and a surger	IP Port Configur	ation	<u>Hela</u>
FL SWITCH GHS 12G/8	Port Number	port-14 💌	
	Port Name	Port 14	
Home			
General Instructions	Routing Mode	O Disable	Enable
Device Information	MAC address	00:02:BC:00:00:86	
Energy Saving Caparal Configuration	IP Address	172.168.2.1	
Switch Station	Subnet Mask	255 255 255 0	
a Routing	Link Sneed Date Date	100 Eull	
EROUTING General		1001101	
	Bandwidth	100000 (1 to	10000000)
- EIP Port Cfg	IP MTU	1500	
EIP Port Table	Forward Net Directed Broadcasts	 Disable 	C Enable
	Proxy ARP	O Disable	Enable
AKP Routes	Local Proxy ARP	Oisable	C Enable
B VLAN Routing	Destination Unreachables	C Disable	 Enable
• VRRP • Nouter Discovery	ICMP Redirects	O Disable	Enable
	Submit Delete IF	Address Hel	per-IP Address

Figure 11 IP configuration of port 14

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The device WBM can be reached via the IP address (FL SWITCH MM HS in the example).



Figure 12 WBM for the connected device

The route that is currently set can be identified by selecting Routing -> Routes -> Current Routes.

otal Number of	Routes 3			
Network Address	Subnet Mask	Protocol	Next Hop Port	Next Hop IP Address
172.168.2.0	255.255.255.0	Local	port-14	172.168.2.1
172.168.3.0	255.255.255.0	Local	port-18	172.168.3.1
172.168.4.0	255.255.255.0	Local	port-17	172.168.4.1

Figure 13 Current routes for the GHS

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2.2 Scenario 2: VLAN-specific routing

If you want several ports of the GHS to belong to the same subnetwork, VLAN-specific routing is used.

Assumption: GHS can be reached via port 18, IP: 172.168.3.1/24

This involves repeating steps 1 to 4 (see page 2 ff).



Figure 14 Scenario 2: VLAN-specific routing

Ports 19 and 20 are to form the VLAN; the devices with IPs 172.168.5.10/24 and 172.168.5.20/24 are connected to the specified ports.

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Step 1:

Switch on the VLAN -> Enable Tagging.

PHENIX	FL SWITCH GHS	last update: 8:46:57
		Logout
The second second		
	General VLAN Co	onfig Help
FL SWITCH GHS 12G/8	Current Tagging Status	The switch is in VLAN Transporent Mode
	VLAN Tagging	O Transparent O Tagging
	Maximum Number of VLANs	223
P Home	Configured VLANs	1
General Instructions	Current GVRP Status	GVRP is not active
Device Information	GVRP	O Disable C Enable
🗄 🧰 <u>Energy Saving</u>		
🗉 🗀 General Configuration		Submit
Switch Station		Gubrint

Figure 15 Enabling "Tagging" for the GHS

Step 2:

Assign the VLAN name ("Erweiterung" in the example) AND define the ports (whether "Tagged" or "Untagged", etc.

PHENIX	FL SWITCH GHS	🖬 last update: 8:54:49
LECONIACI		Logout
	·	
	Static VLAN Con	figuration Hela
FL SWITCH GHS 12G/8	Select VLAN	1 - Default 2 - Erweiterung
<u> ⊠Home</u>		
<u>General Instructions</u>	VLAN ID	2 (1 to 4061)
Device Information	VLAN Name	Erweiterung
Energy Saving	Porte 1 8	
General Configuration		
Switch Station	Ports 9 - 16	L toggle all
	Ports 17 - 20	– U U 🗌 🗆 toggle all
EDHCP Relay Agent	Trunks	
		(T=Tagged, U=Untagged, F=Forbidden, -=None)
Diagnostics Redundancy	NOTE: The port VID of the corresponding VLAN ID.	configured member ports is automatically set to the
• • • • • • • • • • • • • • • • • • •		Submit Delete
	Adva	nced Configuration : <u>Advanced</u>
E Conoral Config		

Figure 16 Defining the VLAN properties of the ports



Step 3:

Assign the selected ports to a VLAN ID; in this example, ports 19 + 20 are assigned to VLAN ID 2.



Figure 17 Configuration of the VLAN ports





Step 4:

Assign an IP address to VLAN ID 2.

PHŒNIX	FL SWITCH GHS	last update: 9:36:28
LICONTACT		Logout
and and		Hela
	VLAN Routing Con	figuration
FL SWITCH GHS 12G/8	Select Routing VLAN	2 - Erweiterung
₫ <u>Home</u>		
• 🗀 General Instructions	VLAN ID	2 (1 to 4061)
Device Information		
Energy Saving General Configuration	VLAN Routing Port	vrport-1
Switch Station	MAC Address	00:02:bc:00:00:96
[□] <u>Services</u>	IP Address	172.168.5.1
EDHCP Relay Agent ■ Dents	Subnet Mask	255.255.255.0
Diagnostics		
🗉 🗀 <u>Redundancy</u>	Sub	umit Create Delete
🖲 📃 Quality Of Service		

Figure 18 IP configuration of the VLAN

The switch assigns the VLAN routing port name to the VLAN ports, in this example: vrport-1. This also appears in the VLAN Routing Table.

VI	AN ROL	iting Table		
VLAN ID	Port	NAC address	IP Address	Subnat Mask
2	viport-1	00:02:80:00:00:96	172.168.5.1	255.255.255.0
		Refresh		

Figure 19 The VLAN Routing Table for the GHS

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2.3 Scenario 3: Static routing

Access one terminal from a PC via 2 routers.



Figure 20 Scenario 3: Static routing

Assumption: PC connected to router 1 via port 18, port IP address: 172.168.3.1/24. The terminal is connected to router 2 via port 12, port IP address: 172.168.2.1/24. This involves repeating steps 1 to 4 (see page 2 ff).

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Step 1:

Configuration of router 1:

Define port 11 of router 1 as the gateway: Assign the IP address and enable routing mode.

PHENIX	FL SWITCH GHS	S 🖬 last update: 9:39:09
LECONIACI		Logout
	IP Port Confi	iguration Hela
FL SWITCH GHS 12G/8	Port Number	port-11 💌
	Port Name	Port 11
Port Table		
Dort Configuration Table	Routing Mode	O Disable 📀 🖲 Enable
Dort Configuration	MAC Address	00-02-02-02-02-83
Dort Statistics	IP Address	172.168.6.1
Port POF Table	Subnet Mask	255 255 255 0
<u>■Port Mirroring</u>	Link Sneed Date Date	1-00-200-0
E <u>Port PoE Table</u>	Link Speed Data Rate	
ElPort Poe Config	Bandwidth	100000 (1 to 10000000)
Energy Saving Port Configuration	IP MTU	1500
<u>Diagnostics</u>	Forward Net Directed Broadcasts	O Disable C Enable
E Contraction Contraction	Proxy ARP	C Disable 💿 Enable
Quality Of Service	Local Proxy ARP	O Disable
	Destination Unreachables	Disable • Enable
E General Config	ICMP Redirects	C Disable 📀 Enable
ECurrent VLANs		
Static VLAN Configuration	Sub	mit Helper-IP Address
EAdvanced static VLAN Configuration		

Figure 21 Enabling routing mode

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Step 2:

Select the STATIC route type from the menu Routing -> Routes -> Static Routes.

Step 3:

First, you need to define a network address, as everything for subnetwork 172.168.2.x must be sent via router 2. In our example, router 2 can only be reached via port 5 on this router, which has the IP address 172.168.6.250. It is crucial for port 5 of router 2 and port 11 (172.168.6.1) of router 1 to be located in the same subnetwork.

Packets destined for 172.168.2.x must, therefore, be sent to router 2 via port 11 of this router. For this to happen, the port IP address of router 2 (172.168.6.250) must be entered in "Next Hop IP Address".

FL-SWITCH-GHS	last update: 13:44:38
	Logout

Route Type	Static 💌		
Network Address	172.168.2.0		
Subnet Mask	255.255.255.0		
Next Hop IP Address	172.168.6.250		
Preference	1	(1 to 255)	

Figure 22 Router configuration

Network Address	Subnet Mask	Next Hop IP	Next Hop Port	Preference (1997)	Remove
172.168.2.0	255.255.255.0	172.168.6.250	port-11	1	

Figure 23 The configured routes in the GHS

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Step 4:

Configuration of router 2:

Define port 5 as the gateway: Assign the IP address and enable routing mode.

⊃ort Number	port-5 💌	
Routing Mode	O Disable	Enable
MAC address	00:02:BC:00:00:7D	
P Address	172.168.6.250	
Subnet Mask	255.255.255.0	
∟ink Speed Data Rate		
Bandwidth	100000 (1 to 10)000000)
P MTU	1500	
Forward Net Directed Broadcasts	O Disable	O Enable
Proxy ARP	C Disable	Enable
Local Proxy ARP	O Disable	O Enable
Destination Unreachables	O Disable	Enable
CMP Redirects	O Disable	Enable

Figure 24 Configuration of router 2

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Step 5:

Define port 12 as the gateway:

Assign the IP address for the downstream subnetwork and enable routing mode.

IP Port Configuration		<u>He</u>	
Port Number	port-12 💌		
Routing Mode	O Disable	Enable	
MAC address	00:A0:45:29:ED:F2		
IP Address	172.168.2.1		
Subnet Mask	255.255.255.0		
Link Speed Data Rate	100 Full		

Figure 25 Configuration of port 12



Port 5 of router 2 (172.168.6.250) and port 11 of router 1 (172.168.6.1) are located in the same subnetwork.

Step 6:

Define the network address for the data packet return path.

You need to define a network address for the return path, as everything for subnetwork 172.168.3.x must be sent via router 1. In our example, router 1 can only be reached via port 11 on this router, which has the IP address 172.168.6.1. Enter the port IP address of router 1 (172.168.6.1) in the "Next Hop IP Address" field.

Route Type	Static 💌	
Network Address	172.168.3.0	
Subnet Mask	255.255.255.0	
Next Hop IP Address	172.168.6.1	
Preference	1	(1 to 255)

Figure 26 Entering a static route

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	Static Routes	;			<u>Help</u>
Network Address	Subnet Mask	Next Hop IP	Next Hop Port	Preference	Remove
172.168.3.0	255.255.255.0	172.168.6.1	port-5	1	

Figure 27 The route table

2.4 Scenario 4: VRRP

The terminals are connected redundantly via 2 routers and the router ports are configured.



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Step 1:

Before you can enable VRRP, you first need to enable the routing mode.

PHENIX	FL SWITCH GHS		🖬 last update: -9:42:37
			Logout
ana ana			Hela
	Routing Ge	neral	
FL SWITCH GHS 12G/8	Global Routing Mode	O Disable	Enable
	Routing can only be ena the Device.	bled globally if a valid Rout	i g Licence is attach d to
	VRRP Mode	O Disable	⊙ Enable
-EPort Statistics			
Port POF Table	Default Route Preference	s	
- Port Mirroring	Local	0	
Port PoE Table	Static	1 (1 to 255)	
Dort PoE Config			
Energy Saving Port Configuration		Submit	
🗄 📃 Ext. Port Configuration			



Step 2:

Router 1:

On router 1, both terminals should be connected to ports 12 and 13 as per the drawing (see Figure 28 on page 18). Both ports are located in different subnetworks, in this example: 172.168.2.x and 172.168.4.x.

Router 2:

On router 2, both terminals should likewise be connected to ports 12 and 13. Once again, the ports are located in different subnetworks: 172.168.2.x and 172.168.4.x

Each of the two terminals is connected to both routers. Therefore, both of the connected ports are always located in a dedicated subnetwork. Port 12 = subnetwork 172.168.2.x and port 13 = subnetwork 172.168.4.x.

Router 1, port 12, IP: 172.168.2.11

Router 2, port 12, IP: 172.168.2.10

Router 1, port 13, IP: 172.168.4.11 Router 2, port 13, IP: 172.168.4.10

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Step 3:

Routing must now be enabled on for all ports (i.e., ports 12 and 13 of routers 1 and 2) (procedure demonstrated below for one port).

PHENIX	FL-SWITCH-GHS	last update: 11	:22:26
		La	gout
A REAL PROPERTY AND A REAL			
and the second	IP Port Configura	ation	<u>Help</u>
FL SWITCH GHS 12G/8	Port Number	port-12 💌	
	Routing Mode	O Disable O Enable	
Energy Saving Port Configuration	MAC address	00:02:BC:00:00:84	
Ext. Port comgaration	IP Address	172.168.2.11	
• <u>Redundancy</u>	Subnet Mask	255.255.255.0	
Quality Of Service	Link Speed Data Rate		
• <u>Multicast</u>	Bandwidth	100000 (1 to 10000000)	
	IP MTU	1500	
ERouting General	Forward Net Directed Broadcasts	• Disable • Enable	
	Proxy ARP	O Disable O Enable	
EIP Configuration	Local Proxy ARP	• Disable	
IP Port Table	Destination Unreachables	O Disable O Enable	
EIP Statistics	ICMP Redirects	O Disable 💿 Enable	
P 🔄 ARP			
ARP Create	Submit Delete	PAddress Helper-IPAddress	
EARP Configuration	Se	condary IP Address	
ARP Table	<u>.</u>		

Figure 30 Enabling routing

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Step 4:

Enabling VRRP:

Make the following settings on both routers:

- 1. Select CREATE to create a VRRP.
- 2. Define an ID for the connected terminal (in the example: VRID 3 for the terminal on the left and VRID 5 for the one on the right).
- 3. Assign both ports to the relevant VRRP (in the example ports 12 are associated with VRID 3 and ports 13 with VRID 5).
- 4. Select enable in each case to activate VRRP mode.
- 5. Assign an IP address to the VRRP that has been created (in the example: VRID 3: 172.168.2.1 and VRID 5: 172.168.4.1).
- 6. The IP addresses must be entered as the gateway addresses for the respective terminals.



Figure 31 Enabling VRRP

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Once everything has been configured, you can access an overview of the parameters by selecting VRRP -> Virtual Router Table.

PXC GBit Modular Switch						
PHENIX	FL-SWITCH-GHS last update: 11:27:54					
						Logout
And the second sec						
and sound	Virtual Router Table					<u>Help</u>
FL SWITCH GHS 12G/8	VRID	Port	Priority	Virtual IP Address	State	Status
Energy Saving Port Configuratic	3	port-12	100	172.168.2.1	Initialize	Enabled
 Ext. Port Configuration Diagnostics 	5	port-13	100	172.168.4.1	Initialize	Enabled
<u>Redundancy</u> <u>Quality Of Service</u>		1	11			
E Multicast				Refresh		

Figure 32 The VRRP parameters

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