

TECHNICAL MANUAL FOR
LAN INTERFACE
GENESYS™ POWER SUPPLIES

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TDK-Lambda Americas Inc.

High Power Division

405 Essex Road, Neptune, NJ 07753

Tel: (732) 922-9300

Fax: (732) 922-9334

Web: www.us.TDK-Lambda.com/HP

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1. GENERAL INFORMATION

1.1. INTRODUCTION

The Local Area Network (LAN) option for the Genesys™ series power supply allows the user to remotely program, measure and check status of the power supply. It uses an Ethernet connection like those used to connect computers to each other and to the Internet

A computer's web page browser may be used to operate the power supply through a built-in web page server. For applications including factory and test automation, communication may be done using standard network protocols and instrument commands

Refer to the Genesys™ Technical Manual for information on installing the power supply, safety requirements, specifications, connecting the power-in and out, operating the front panel, using the serial (RS-232/485) programming and the analog (J1) programming

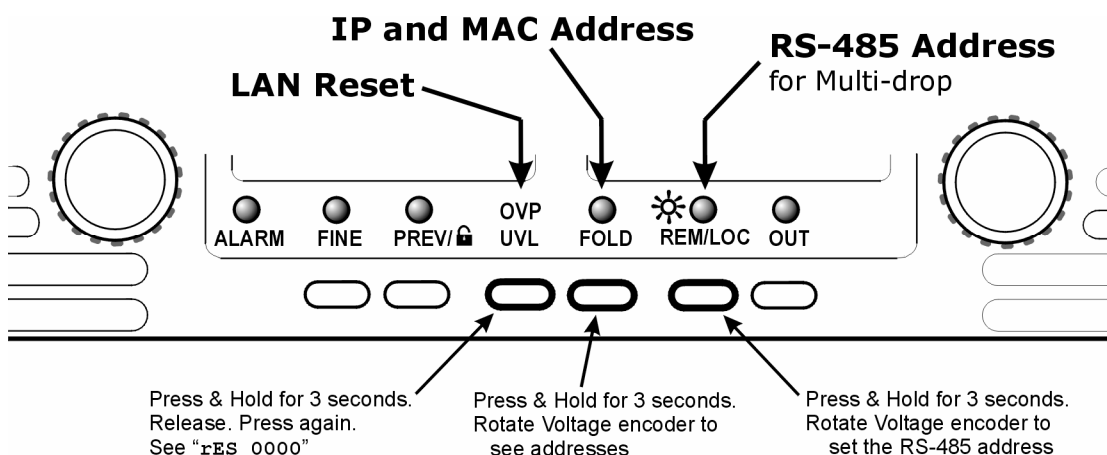


Figure 1. Front Panel LAN Features

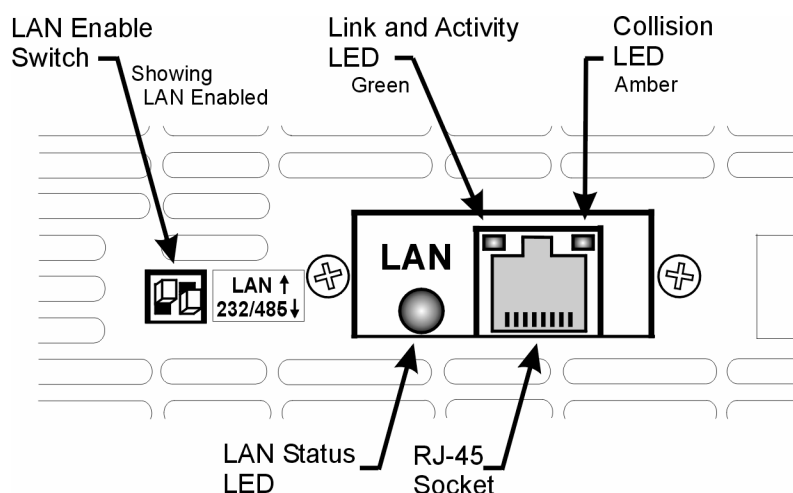


Figure 2. Rear Panel LAN Features

1.2. FEATURE SUMMARY

- **Communicate** over any standard TCP/IP network
LAN (Local Area Network)
WAN (Wide Area Network)
Communicate across the world using the Internet
- **Web page** viewable with any web page browser, such as Internet Explorer
Optional password protection prevents unauthorized operation
Program the output settings and protections
Measure the power supply output, view the power supply status
Configure the network connection settings
- **LXI Class C**
Conforms to LXI standards (revision 1.1) for network configuration
A “LAN Status” indicator shows when the network connection is established
“VXI-11 Discovery” protocol is implemented to search for connected devices
IVI-COM drivers are available for download
Easily write custom automation programs
- **Full remote programming functions**
Control and read-back of all settings
Full status and error reporting
Uses SCPI command language, an instrumentation standard
Compatible with VISA instrument drivers
(VISA drivers are available for almost any programming language)
Supports network “socket” programming
Same functional features as the IEEE option card.
- **Front Panel features**
View IP and MAC address on front panel
LAN Reset on front panel
User may remotely “Blink” the front panel to locate a power supply in a rack
- **Rear Panel features**
RJ-45 connector (standard 8-pin phone jack for LAN)
Link and Activity LED on RJ-45 connector
LAN Status LED shows LAN fault and is a 2nd “Blink Identify” on rear panel
A LAN/Serial (RS-232/485) select switch
- **RS-485 Multi-drop Chain**
Allows connecting up to 30 power supplies
One LAN IP address shared by all RS-485 power supplies
The LAN option is not needed in the RS-485 power supplies, but they must be Multi-drop enabled



Trademark Notices

LXI is a trademark of the LXI Consortium Inc.

Microsoft and Windows are trademarks of Microsoft Corporation

1.3. GLOSSARY

- 1.3.1. Auto-IP:** This is when the power supply configures its own settings because they cannot be obtained using DHCP. When forced into an auto-IP situation, the power supply will select a random address in the range of 169.254.xxx.xxx
- 1.3.2. Auto-MDIX:** An electrical connection that automatically detects either a patch (straight-through) or a cross-over LAN cable. Either type of LAN cable is acceptable
- 1.3.3. Auto-Negotiate:** The power supply will automatically choose the fastest speed that the network can support. The Genesys™ power supply can operate at 10 megabits per second (Mbps) or 100 Mbps
- 1.3.4. Command:** A message sent to the power supply which changes one or more of its settings. It may be sent using a SCPI command or from the web pages. No response message is returned, but an error message may be created
- 1.3.5. DHCP:** The Dynamic Host Configuration Protocol is a method where the IP address and other settings are loaded from the network server to the power supply. This means the IP address and other settings may automatically change each time the network connection is created
- 1.3.6. Hostname:** A unique name for a device on a network. A descriptive name may be created by the operator. For the default hostname, see section 3.6
- 1.3.7. IEEE 802.3, 10BASE-T, 100BASE -T:** These specifications define the physical characteristics of a network including the cables and transmission speeds. Most often have 8-conductor twisted-pair CAT-5 cables with RJ-45 connectors
- 1.3.8. Ethernet:** The most common configuration for a LAN. It includes connection detection and message collision protection
- 1.3.9. IP Address:** The "Internet Protocol" address is a numeric identifier that says where messages are sent to or received from. The IP address may be fixed or it may be assigned a different value every time the power supply is turned on. It has four numbers, each zero to 255. Example: 10.190.34.17
- 1.3.10. LAN:** A "Local Area Network" is usually a small group of computers, printers and other devices connected to share information and services. With a gateway, these devices can also connect to a Wide Area Network (WAN)
- 1.3.11. LXI:** "LAN Extensions for Instrumentation". A standard adopted by many test and measurement companies. To be LXI certified, an instrument must conform to many requirements including network connectivity, web page operation and software drivers. See <http://www.lxistandard.org/home> for details
- 1.3.12. MAC Address:** The "Media Access Control" address is a identifier for the manufacturer and the instrument. It is like a serial number and it may be used to configure the LAN connection. It has six hexadecimal values.
Example: 00:19:f9:00:3e:26
- 1.3.13. Query:** A message sent to the power supply which reads back a setting or a measurement. A query does not change any settings. It may be sent using a SCPI command or from the web pages
- 1.3.14. RS-485:** A communication bus used by the Genesys™ power supply for a multi-drop system. One LAN supply controls a string of supplies that do *not* have the LAN option. This bus uses a 4-wire twisted pair cable through the J3-IN and J3-OUT connectors
- 1.3.15. SCPI:** The "Standard Commands for Programmable Instrument" is a structure of text-based commands. For example, for any SCPI compliant instrument that has a volt meter, it will return a voltage measurement with the "MEAS:VOLT?" query

- 1.3.16. Subnet Mask:** A number that divides an IP address into two sections; one for the network identifier and one for the LAN instrument on the network
- 1.3.17. VISA:** The “Virtual Instrument Software Architecture” is a single interface library for controlling instruments over many types of communication busses. In an automation program, a “resource descriptor” string is given for each instrument. The descriptor defines the instrument including it’s address and bus type

1.4. REQUIRED ACCESSORIES

1.4.1. LAN Cable

The LAN cable must be supplied by the customer. It may be a standard straight “patch” CAT-5 (or better) network cable or it may be a “crossover” cable where the pins are reversed on one end. The cable type is auto-detected by the power supply

The serial link cable (0.5 m long) provided with the Genesys™ power supply *cannot be used* for a LAN connection

1.4.2. Web Browser with Java Runtime Engine

To operate the web pages from a web browser, such as Microsoft Internet Explorer or Netscape Navigator, the Java runtime engine must be installed on your computer. The engine may be downloaded from:

www.java.com Java is a trademark of Sun Microsystems

1.4.3. NetBIOS for Hostnames

If, instead of the IP address, you want to use the power supply’s hostname to open a network connection, your computer must be running the NetBIOS naming protocol

1.4.4. VISA Drivers for Programs

If you are writing custom test or automation programs for the Genesys™ LAN power supply, the programs must operate using the VXI-11 with RPC protocols. This is most easily done by using VISA drivers. These drivers allow you to easily send SCPI commands in many programming languages and in several operating systems

VISA drivers are available from many instrumentation companies. The drivers are usually included with their hardware or software products, or they may be purchased separately

2. SPECIFICATIONS

2.1. POWER SUPPLY SPECIFICATIONS

When using the LAN, the power supply ratings and accuracies are the same as for the digital remote programming using RS-232 or RS-485. See the *Technical Manual for Genesys™ Power Supply* for those specifications

2.2. LAN OPTION PHYSICAL DESCRIPTION

The power supply rear panel, with the LAN option installed, is shown below.

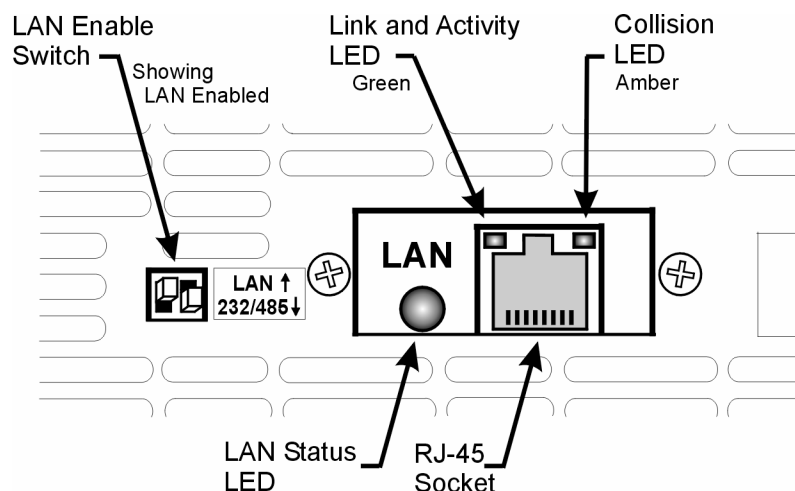


Figure 3. Rear Panel LAN Features

2.2.1. LAN Enable Switch: This two-pole DIP switch allows you to select the LAN or the RS-232/485 mode. The switch on the left is the only one used

The supply's AC power must be *OFF* to switch between the LAN and RS-232/485 modes. The change is only detected during the supply's power-up sequence

- **SWITCH UP:** select the LAN mode. The power supply shows “LAN” at power-up. The rear panel J3-IN port for RS-232/485 does not operate. The J3-OUT port may be used to start a multi-drop chain of supplies (see section 9)
- **SWITCH DOWN:** select the RS-232/485 mode. The power supply does *not* show “LAN” at power-up. The rear panel J3 ports for RS-232 and RS-485 do operate. The power supply may be used in a chain of multi-drop supplies (see section 9). See the *Technical Manual for the Genesys™ Power Supply* for the description of the RS-232/485 mode

2.2.2. Link and Activity LED: this small LED, embedded in the RJ-45 socket, glows green when the connection is made to an active network and it blinks when any message packets are detected

2.2.3. Collision LED: this small LED, embedded in the RJ-45 socket, blinks amber when the LAN packets are corrupted by collisions

2.2.4. LAN Status LED: This is a two-color LED to the left of the RJ-45 connector. It shows:

- **Normal Operation:** Steady green. The power supply has an active LAN connection

- **Device Identify:** Blinking green. The identify function is turned on from a remote computer using the web page or a SCPI command. The front panel blinks along with the rear. It is used to identify one power supply in a rack of instruments. The blinking is turned off by the web page, by sending another SCPI command, or by changing any front panel control. In multi-drop chain, only the master LAN supply blinks.
- **LAN Fault:** Steady red. Turns on to show the LAN connection was never made, or that the LAN connection was made and then broken

2.3. LAN FEATURES

2.3.1. Ethernet

Meets the requirements of the IEEE 802.3u specification

2.3.2. Auto-Negotiate, LAN Speed

May be used with 10Base-T or 100Base-T networks (10 or 100 Megabits per second). The fastest compatible speed is automatically selected (unless disabled by the web page)

2.3.3. Auto-MDIX, LAN Cable

Automatically detects if LAN cable is a patch ("1-to-1") or cross-over cable. Either cable may be used

2.3.4. MAC Address

Each power supply has a unique identifier which may be used to configure the LAN connection. It is viewable from the supply's front panel by holding the FOLD button. See section 4.1 below

2.3.5. IP Address

This is the Internet Protocol address of a networked instrument. The IP addressing mode may be set using the web page (section 5.5.2) or by the front panel LAN reset (section 4.2). There are three modes for setting the IP address:

DHCP: The IP address is set by the network server when the power supply is first turned on or connected

Auto-IP: If the IP address cannot be obtained from the network server, the power supply uses an address in the range 169.254.xx.xx, where "xx" are numbers from 0 to 255

Static IP: The IP address is set by the web page and it does not change even after the power supply is turned off and on

2.3.6. TCP/IP Protocols

IPv4: conforms to Internet Protocol version 4

TCP: conforms to the Transmission Control Protocol for data packets over the network

HTTP: the Hyper Text Transfer Protocol is a communication protocol that enables web page browsing over the network and the internet

ICMP / Ping Server: Response to another device's ping requests (unless disabled by the web page as described in section 5.5.4)

2.3.7. Remote Programming Protocols

VXI-11: This is a protocol that allows ASCII-based text communications to take place between a controller and a device over a computer network. Supported messages are the VXI-11 Device_write, Device_read and others

RPC: The Remote Procedure Call is a message protocol used to ensure the VXI-11 messages are processed correctly by the LAN interface

Sockets: Raw socket commands are available through port 8001. See section 6.5

VISA: The Genesys™ LAN interface is compatible with programs using VISA drivers. This includes the viRead and viWrite functions for sending and reading SCPI messages

SCPI: The Standard Commands for Programmable Instrumentation is a command structure for text-based commands. The Genesys™ LAN interface is SCPI 1999 compliant

2.3.8. SCPI Programming Functions

General: Almost any setting which may be done from the front panel may also be done over the LAN using the web pages or a SCPI command. All settings made from the front panel may similarly be read back.

Status and Errors: Command acceptance and power supply conditions may be checked using the SCPI "SYSTEM:ERROR?" query or by using the IEEE-488.2 Status and Error registers. See section 7.8

IEEE-488 Compatibility: The LAN SCPI commands are compatible with the IEEE-488 option for the Genesys™ power supply, except serial poll and service requests are not supported in the LAN

2.3.9. Web Pages

Remote Control: Most settings which may be done from the front panel may also be done remotely using the "DC Power" web page. Most settings made from the front panel may similarly be read back

HTTP: The web pages use the Hyper Text Transfer Protocol. Any W3C compliant browser program can view web pages sent using HTTP

Java: The browser program must have the Java runtime engine installed, see section 1.4.2 above

SCPI: A "Utility" web page allows you to send any SCPI command to explore how SCPI works and to operate features not available in the other web pages. See section 0 for a description of the SCPI commands

3. GETTING STARTED

3.1. SELECT THE INTERFACE

The power supply, with the LAN option installed, may be operated through three interfaces. This section describes how to enable each. Only one interface may be enabled at a time

	MODE NAME	MODE DESCRIPTION
1	Local Mode	Control using the front panel encoders and buttons
2	RS-232 & RS-485	Control using the 3 or 4-wire serial digital J3-IN and J3-OUT connectors. Also called serial mode
3	LAN	Control using an Ethernet connection

The first two modes are described in the *Technical Manual for the Genesys™ Power Supply*

3.1.1. Select Local (Front Panel) Mode

The supply may be operated in the local, or front panel, mode even when a computer is communicating over the LAN connection. There are, however, settings which may prevent local operation

If the supply is in remote mode, the front panel “REM/LOC” LED is *ON*. The supply may be returned to local by pressing and releasing the “REM/LOC” button

If the front panel “REM/LOC” button will *not* set the supply into local mode, then:

- If the LAN is being used to change settings, the supply will automatically go into remote mode with every command. Stop the LAN program and then press “REM/LOC” button
- The LAN computer may have sent a Local Lockout command. Use the LAN to send “SYST:SET LOC” (see section 7.4.2) or turn the supply AC off and on and then press the “REM/LOC” button

3.1.2. Select RS-232 & RS-485 (Serial) Remote Mode

The RS-232 & RS-485 (serial) remote control may be selected even if the LAN option is installed. The serial remote is described in the *Technical Manual for the Genesys™ Power Supply*. The LAN has the same capabilities as the serial remote, but the LAN SCPI programming language is not compatible with the serial language (see section 0 for details on the SCPI language)

To select the RS-232 & RS-485 mode:

- A. Switch the supply AC power off
- B. Set the LAN card switch pin1 to DOWN (see Figure 3)
- C. For RS-232, set rear-panel SW1 pin 6 to DOWN. For RS-485, set SW1 pin 6 to UP
- D. Switch the supply AC power on. The front panel will *not* show “LAN” at startup

3.1.3. Select LAN Remote Mode

Selecting the LAN mode will allow programming over the Ethernet cable. Any settings and measurements may be done from a remote computer using the power supply’s built-in web pages or using SCPI programming

The steps to use this feature are described in the next section

3.2. SETUP THE LAN COMPUTER

3.2.1. Using a Network Connection

If the computer you are using is connected to a network server (as shown below), and the Genesys™ power supply is connected using routers, switches or hubs, then no further setup should be required for the computer

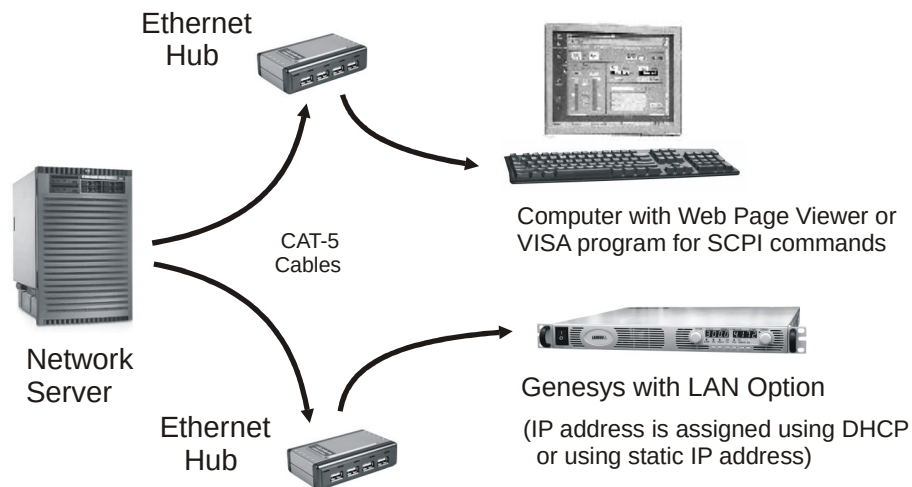


Figure 4. Network Connection Diagram

3.2.2. Using a Peer-to-Peer Connection

It is possible to connect the Genesys™ power supply directly to a non-server computer (as shown below). This is called a Peer-to-Peer connection

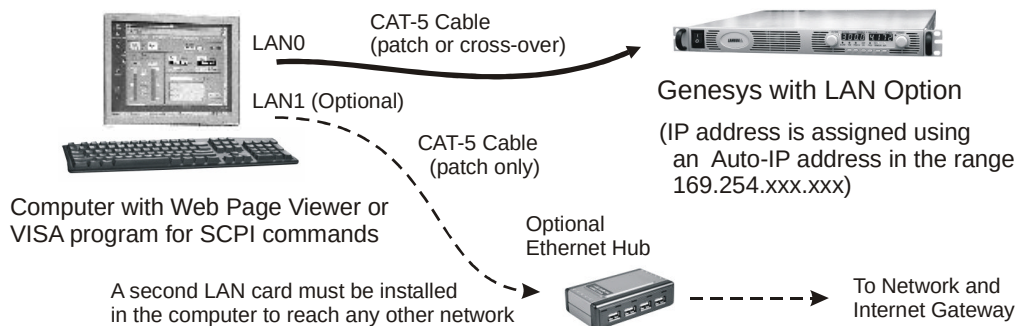


Figure 5. Peer-to-Peer Connection Diagram

By default, the power supply will create it's own valid IP address through the auto-IP feature. The auto-IP address will be in the form 169 . 254 . xxx . xxx. If necessary, do a front panel LAN reset (described in section 4.2) to ensure the auto-IP is selected

By default, the computer's network interface card (NIC) will also be DHCP/auto-IP, so if no network server is detected, the computer will create it's own valid IP address using the auto-IP feature

If the computer and power supply both have auto-IP addresses, then the LAN connection may be made by simply typing the supply's IP address into a web browser as described in section 3.4

3.3. SETUP THE LAN POWER SUPPLY

Start With a "LAN Reset". When you are making the first LAN connection to a Genesys™ power supply, or are recovering from a connection problem, then it is recommended that you do a "LAN Reset" on the power supply's front panel (see section 4.2)

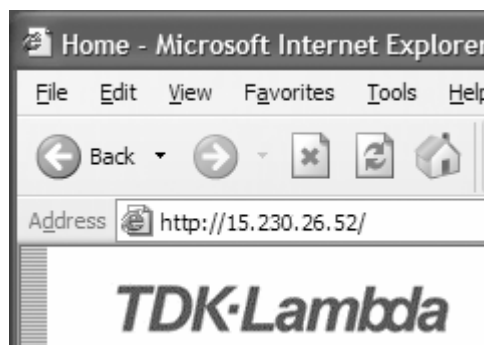
To start up the Genesys™ power supply with the LAN option enabled:

1. Turn OFF the power supply AC power
2. Set LAN card rear panel switch to UP (see Figure 3)
3. Connect an Ethernet cable from the power supply's LAN connector to the network (section 3.2.1) or to a computer (section 3.2.2). The cable to the power supply may be wired as a patch cable (or straight-through) or as a cross-over cable
4. Turn ON the power supply AC power. See the front panel show "LAN" for about 3 seconds. After that, the supply will show "OFF" or the last output settings
5. In about 10 seconds (for DHCP and static IP), or 30 seconds (for auto-IP), see on the rear-panel: (see Figure 3)
 - The Link and Activity LED should be green to show the cable is connected. It may blink to show messages are being sent on the network
 - The Status LED should be steady green to show the supply has a valid IP address

3.4. CONNECTING WITH THE WEB PAGE

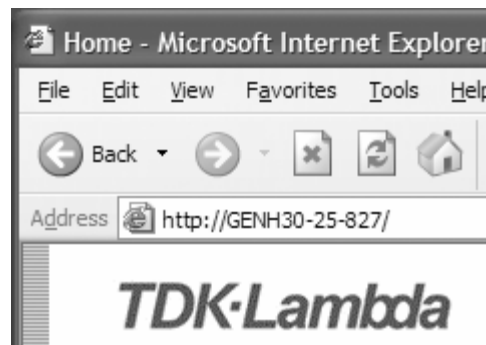
Once the power supply has been connected to a network and it is powered up, the power supply may operated, and it's LAN settings may be changed, by using the built-in web page. The details of the web pages are described in section 5

1. Read the IP address from the supply's front panel by holding the FOLD button (see section 4.1 for details)
2. Open a web page viewer program such as Internet Explorer or Netscape Navigator. Type the power supply's IP address as shown below. Click the GO button



The power supply's Home page will appear. If it does not, see section 3.7

- Alternately, if the power supply is set for “DHCP/Auto-IP”, and if NetBIOS naming service is running on the computer, the hostname may then be used for addressing the web page as shown below. See Section 3.6 for a description of the hostname



3.5. IP ADDRESS OVERVIEW

The simplest and most reliable way to open a network connection is with the power supply's IP address. This is a group of four numbers separated by periods (for example: 10 . 225 . 15 . 123). This IP address may be viewed from it's front panel (see section 4.1)

There are three modes which the power supply can get an IP address. Each mode has a different way to set the IP address. This is shown in the table below

IP Address	DHCP	Auto-IP	Static IP
Mode Select	DHCP is default after "LAN Reset"	Default after "LAN Reset" if <i>no</i> DHCP server is used	May be selected by user in the "LAN Modify" web page (see section 5.5.2)
Assignment	Assigned by the network server	Assigned by the power supply	Assigned by the user in the "LAN Modify" web page (see section 5.5.2)
Range	Any address	169 . 254 . xxx . xxx	Any address
Lifetime	Address may change as the DHCP server assigns addresses dynamically to many instruments	Fixed for the power supply, except if an address collision is detected	Always fixed for the power supply
Duplicate Addresses	The DHCP server should prevent duplicate IP addresses	Find another available auto-IP address	Disconnect from the network and indicate a LAN error

3.6. HOSTNAME OVERVIEW

The hostname is an address in the form of a text description for the power supply (for example: GEN30 - 25 - 729). This address is less reliable than the IP address because the hostname

cannot be viewed from its front panel, and because a special naming service (NetBIOS) must be running in the LAN computer

After a “LAN Reset” is done (see section 4.2), the power supply will create a default hostname based on the model and serial number of the supply

The default hostname is in the format:

< Product > < Voltage rating > – < Current rating > – < last 3 digits of serial number >

If the rating has a decimal point, substitute “p” for the decimal point. For example,

Model	Serial Number	Hostname
GEN8-180-LAN	28J4210	GEN8-180-210
GEN600-2.6-LAN	15M3229	GEN600-2p6-229
GENH12.5-60-LAN	37B12830	GENH12p5-60-830

The power supply may be set to one of three network modes. Each mode has a different way to use the hostname. This is shown in the table below

Hostname	DHCP	Auto-IP	Static IP
Default Hostname	GENvv-aa-nnn (see above)	GENvv-aa-nnn (see above)	None, hostname cannot be used
Hostname Protocol	Hostname by NetBIOS	Hostname by NetBIOS	None, hostname cannot be used
Hostname on Web Pages	Shows IP address on “Home” page Shows hostname on “LAN Configure” page	Shows IP address on “Home” page Shows hostname on “LAN Configure” page	Shows IP address on “Home” page Hostname disabled on “LAN Configure” page

3.7. TROUBLESHOOTING THE WEB CONNECTION

If the web page cannot be opened, here are some common troubleshooting steps

A. Verify the Ethernet Connection

Look at the rear-panel Link and Activity LED (see Figure 2). If it is not green or blinking, then the Ethernet cable is bad or the other end is not connected to a working Ethernet port

B. Verify the Supply's IP Address

View the IP address by holding the “FOLD” button (see section 4.1).

If the power supply's IP address stays at all zeroes, then the power supply never got a valid IP address. This may happen when:

- You did not wait enough time. It takes 30 seconds to get an auto-IP address
- The power supply is set to static IP (see section 3.5) and there is an address conflict with another instrument on the subnet

If the power supply is connected to a network, verify its address is in a range acceptable to the network server

These problems are best solved by doing a power supply “LAN Reset” (see section 4.2) and try to connect again

C. Try to “PING” the Supply

The Ping utility verifies the computer can send a message and get a response from the power supply over the network

On a Windows XP computer, open a command line window by:

1. Click the “Start” button, Select “Run...”
2. A “Run” window opens. Type: cmd <Enter>. See the command window open
3. Type “ping <IP address>” (IP from the supply front panel, see section 4.2). Verify the ping packets had successful responses

If the “ping” does not get responses from the power supply, then there is a mismatch between the power supply and the computer LAN settings. Also, the ping function may be disabled in the power supply (see section 5.5.4). In this case, do a power supply “LAN Reset” (see section 4.2) and try to connect again

D. Check the Computer LAN Settings

The computer LAN settings must be compatible with the power supply LAN settings

Since the default power supply setting is “DHCP/Auto-IP” (after doing a “LAN Reset”), the computer’s network card should have the same setting

Refer to your operating system instructions on configuring the TCP/IP connection for DHCP (also called, “Obtain an IP address automatically”)

3.8. OTHER TROUBLESHOOTING

3.8.1. Cannot Connect using Hostname

If the power supply’s IP address is set to “static IP”, you can not use the hostname address

To use the hostname address, the NetBIOS naming service must be running in your computer or network server (shown below in the Windows XP “Local Area Connection Properties”)



If the power supply has a static address or the computer is *not* running NetBIOS, then hostname addressing may be used if you edit the “hosts” file in the network server.

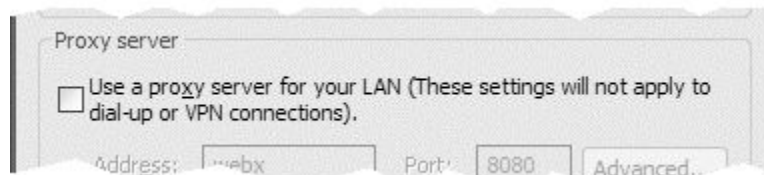
In Windows XP, see the text file “C:\WINDOWS\system32\drivers\etc\hosts”

3.8.2. Cannot View Web Pages Over a Peer-to-Peer Network

If there is no gateway to a network, verify the proxy server is disabled in the web browser. With Microsoft Internet Explorer, open the browser and, on the toolbar, navigate:

“Tools” → “Internet Options...” → “Connections” → “LAN Settings...”

and see the windows open:



Verify the “Proxy server” checkbox is *NOT* checked

3.8.3. Cannot Open Web Page using Laptop or Dual-LAN Card Computer

If you have a computer with two network cards, the computer may not know which card to use when trying to open the Genesys™ web page. Verify the two cards do not have overlapping IP address ranges, otherwise it may be necessary to disable or disconnect the network card that is not being used

If you have a laptop computer with an Ethernet jack and a wireless network, it may be necessary to disable the wireless LAN port

For running VISA programs (see section 6.3), two network cards is not a problem because the VISA resource descriptor includes the network [board] identifier

3.8.4. The IP Address Changes to Zeroes

If a network connection is made, but then the connection is broken, check the IP address on the front panel of the power supply (see section 4.1). If the IP address is all zeroes, then:

- The Ethernet cable connection may not be proper. Verify the Link LED is glowing (as shown in Figure 2)
- If the power supply obtained it's IP address from a DHCP server but that address was *not* renewed

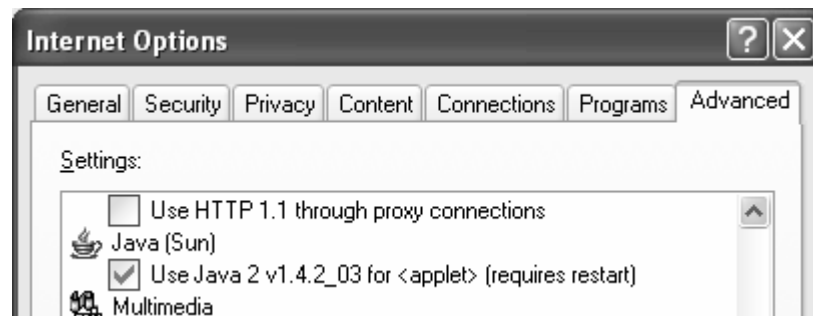
3.8.5. Web Page Fields Show as Little Blocks

For numeric fields, such as the voltage settings, if icons show instead of numbers, then the Java Runtime Engine (JRE) may need to be installed on your computer. If the JRE is already installed, a slow network connection can also create this situation. See section 1.4.2 for details

Also, in the web browser, you may have to enable Java scripts and Java applets. With Microsoft Internet Explorer, do this by opening the browser and, on the toolbar, navigate:

“Tools” → “Internet Options...” → “Advanced” → “LAN Settings...”

and see the windows open:



Verify the “Use Java...” checkbox *IS* checked

3.9. CONNECTING OVER WAN

To connect over the a Wide Area Network (i.e.: the global internet), the following settings must be made in the network server

In the Genesys™ power supply LAN interface, there are two servers. One web server is listening in Port 80. The other, on port 8000, is an auxiliary to serve internal requests. The network server has to ensure that both port 80 and 8000 are exposed to WAN connectivity. The network administrator must obtain and assign a Global IP for the power supply. On the network server, the network administrator also has to ensure that requests to port 80 and 8000 can be used

3.10. CONNECTING WITH VISA PROGRAMMING

In addition to the web pages, the power supply may be controlled using test and automation programs through VISA drivers and SCPI commands. See sections 6 and 0 for details

4. LAN SETUP

4.1. VIEW THE IP AND MAC ADDRESSES

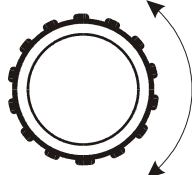
When the power supply is running with the LAN enabled, the IP and MAC addresses may be viewed on the front panel by following these steps:

1. Press and hold the FOLD button for three seconds. The 7-segment displays will show something such as:

IP-1 010

By turning the voltage encoder knob, the complete IP and MAC addresses may be seen. Note, these addresses may *not* be changed from the front panel, but they can be changed by the web page (see section 5.5.2)

Rotate voltage knob



IP-1	10
IP-2	225
IP-3	26
IP-4	38
AC-1	00
AC-2	19
AC-3	F9
AC-4	27
AC-5	d3
AC-6	b0

In this example,

– the IP address is:

10 . 225 . 26 . 38

– the MAC address is:

00 . 19 . F9 . 27 . D3 . B0

(“AC” is short for “MAC”)

2. If the voltage knob is *not* changed for five seconds, the supply will revert to the normal voltage and current displays. If this happens, press and hold the FOLD button again

4.2. LAN RESET BUTTON

If it is necessary to reset the supply to the factory default LAN settings, use the front panel to:

1. Press and hold the OVP/UVL button for 2 seconds
2. The 7-segment displays will show:

LAN rES

3. Release the OVP/UVL button
4. If, the OVP/UVL button is pressed and released again, before 5 seconds pass, the LAN will be reset to the default settings (listed below) and displays will briefly show:

rES 0000

If the OVP/UVL button is *not* pressed again, the LAN settings will *not* be reset

5. It may be required to AC cycle the power supply off and on. This ensures a new network connection is established with the reset values

The default LAN settings are:

- DHCP is enabled
- If DHCP fails to get a lease, the auto-IP settings will be obtained:

IP address:	169.254.xxx.xxx (see section 3.2.2)
Subnet mask:	255.255.0.0
Default gateway	0.0.0.0
DNS Server	0.0.0.0

list continued →

Default LAN settings (continued)

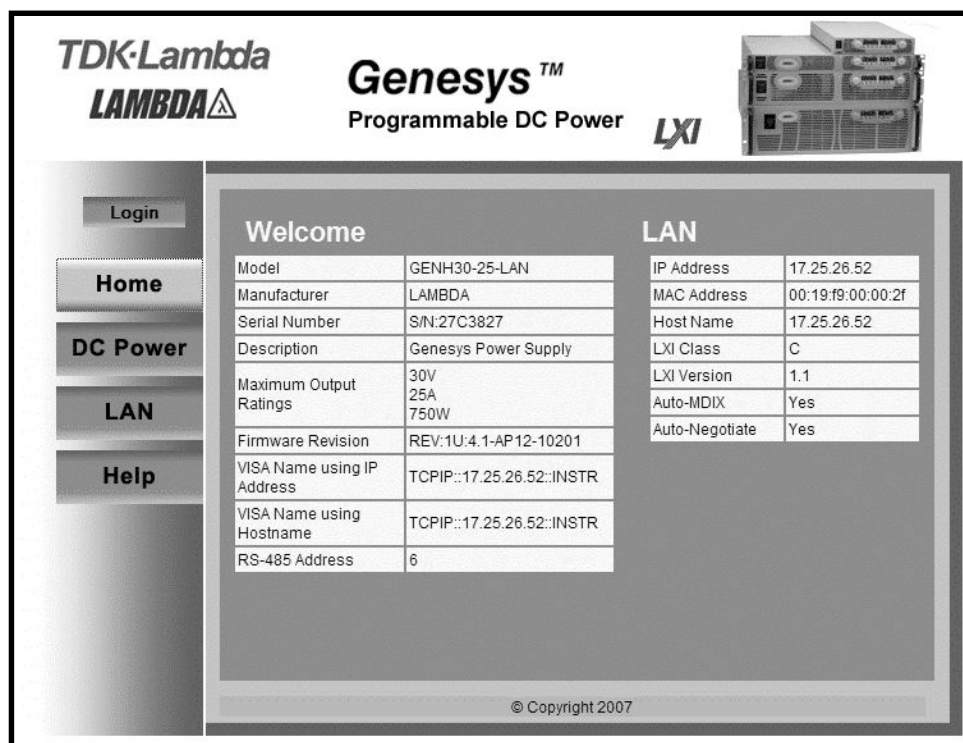
- Hostname: GENvvv-aaa-sn (see hostname in section 5.2)
- Description: "Genesys Power Supply"
- Ping Server: Enable
- Keep-Alive 1800 Seconds (30 minutes) idle time before a logged-in user's web session will expire
- Auto-Negotiate: Automatic select network speed
- VXI-11 Discovery Enable
- Password: None

5. USING THE WEB PAGES

5.1. OVERVIEW

Once the web page is opened in a web browser program, most of the power supply's settings may be viewed or changed from any location on the network

5.2. HOME PAGE



The opening web page displays the model identity and LAN settings. Some of the fields are:

VISA Name Using IP Address: For automation programming, VISA is a type of communication driver. For LAN instruments, the IP address may be used in the VISA resource descriptor. See glossary section 1.3.16

VISA Name Using Hostname: For automation programming, an alternate VISA resource descriptor using the power supply's hostname. See glossary section 1.3.16

RS-485 Address: This address only applies to a multi-drop chain of supplies. This is the RS-485 address of the LAN supply (also called the master supply). To set this address on the front panel, see section 9.2.2

Hostname: A unique name for a device on a network. The default hostname is described in section 3.6, but it may be configured by the user (see section 5.5.2). If the hostname is not properly registered with the network name server, the IP address will be shown

LXI Class: (LAN Extensions for Instrumentation) Class C means the IEEE-1588 timing and the Trigger bus are *not* implemented by the Genesys™ power supply

LXI Version: This is the LXI version that the Genesys™ power supply is certified to

Auto-MDIX: This is a setting which allows the LAN port to automatically detect if a patch or cross-over LAN cable is used

Auto-Negotiate: This is a setting which allows the LAN port to adjust its speed to the fastest available on the network

5.3. LOGGING IN

To change power supply output settings or to change the LAN settings, a user must first log in. By clicking the “Login” button at the top-left side of the web page, a pop-up window appears (the only acceptable user name, “admin”, is shown):



5.3.1. Login Rules

- Any number of users may view the web pages of one power supply at the same time. However, the update rate becomes slower as more web pages are opened.
- Only one user at a time may be logged-in to modify the power supply settings
- If an automation program with VISA drivers is running, then settings may be viewed by the web pages but you cannot login to change any settings
- If a user is logged in, then a VISA connection cannot be opened by a program
- A user may logout by clicking the “Logout” button, by closing the web browser or by leaving the web browser idle for “LAN Keep-alive” seconds (see section 5.5.3)

5.3.2. User Name

Only one user account name is available and it cannot be changed. This field must be entered even if no password is required

The user name is always `admin`

5.3.3. Password

By default, no password is required and the field must be left blank

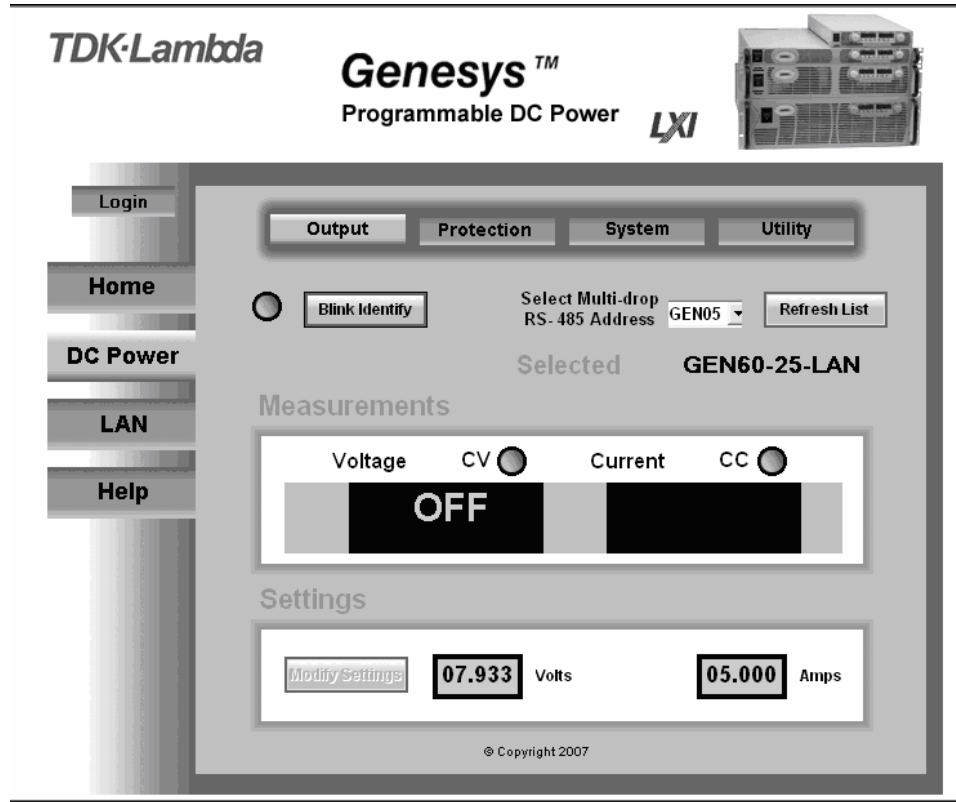
A password may be set in the “LAN → Users” page (see section 5.5.5)

To change or remove the password, or if you forget the password, perform the “LAN Reset” operation from the power supply’s front panel (described in section 4.2)

5.4. DC POWER PAGE

When the “DC Power” tab is clicked, the following web page opens. This page, and its sub-menus, allow you to operate the power supply and adjust its output settings

5.4.1. DC Power → Output Page



When the “DC Power” tab is selected, four buttons are available across the top of the panel. Click the “Output” button to open the above panel. This panel is the soft front panel of the power supply

First, select the desired power supply with:

Refresh List: When this button is clicked, the web page will scan the power supply's RS-485 bus and put the discovered addresses into the Select RS-485 Address listbox. This button only applies to a multi-drop chain as described in section 9.

Select RS-485 Multi-drop Address: This address is described in section 9.2.2. This address only applies to a multi-drop chain of RS-485 supplies. If there is no multi-drop, only the address from the single LAN supply is available

After the desired power supply is selected, the web page shows:

Blink Identify: When this button is clicked ON, the web page LED blinks, the selected power supply front panel blinks and the rear panel LAN LED blinks. This function allows you to quickly identify which power supply is being communicated to in a rack of instruments. In a multi-drop chain, only the LAN power supply will blink

The blink identify is turned OFF by clicking this button again or by operating any knob or button on the power supply front panel

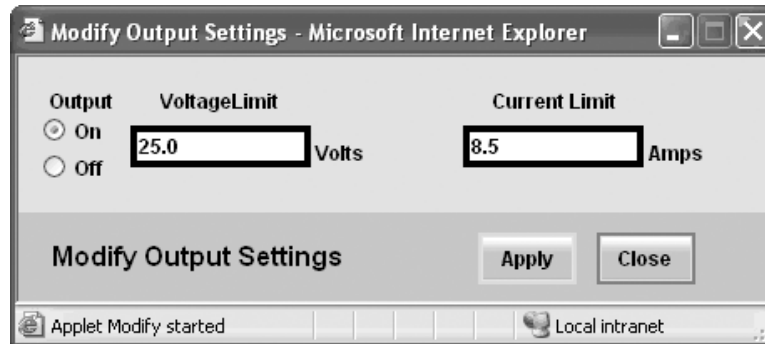
Measurements: This section displays the selected power supply's actual output voltage and current and the operating mode (constant-voltage or constant-current or off). Also, faults are shown in the voltage display

Settings: This section displays the selected power supply's voltage and current limit settings (as if they were set on the front panel encoders)

Modify Settings: This button is disabled (gray text) until you login (see section 5.3). After logging in, click this button to open the window shown below

5.4.2. DC Power → Output → Modify Settings Page

After you have logged in and clicked the “DC Power → Modify Settings” button, a pop-up window shows:



In this window, you may enter new values for the voltage and current limits and turn the output on and off. The new settings will not take place until the “Apply” button is clicked and the pop-up window closes

5.4.3. DC Power → Protection Page

Under the “DC Power” tab, a “Protection” button is available at the top of the panel. When opened, the window that allows you to view and set four protections. The “Apply” buttons are not enabled until you log in

Note, a control slider on the right side of the panel is needed to view all four settings, which are:

- E. Over-Voltage Protection (see section 7.5.1)
- F. Under-Voltage Limit (see section 7.5.2)
- G. Foldback Protection ON or OFF (see section 7.5.4)
- H. Auto-Start or Safe-Start (see section 7.4.3)

In a multi-drop chain, these settings affect only the supply selected in the RS-485 address listbox

5.4.4. DC Power → System Page

Under the “DC Power” tab, a “System” button is available at the top of the panel. When it is clicked, the window that allows you to operate four functions:

- A. Reset One Instrument (see section 7.7.2)
(this resets only the supply selected in the RS-485 address listbox)
- B. Reset All Instruments (see section 7.7.2)
(this resets any supplies connected to the multi-drop bus)
- C. Save (see section 7.7.3)
(this saves the settings for only the supply selected in the RS-485 listbox)
- D. Recall (see section 7.7.4)
(this recalls the settings for only the supply selected in the RS-485 listbox)

5.4.5. DC Power → Utility Page

This page is used to send any SCPI command and see the response. It is a learning tool for SCPI operation and it allows commands which are otherwise not on the web pages. The SCPI commands are described in section 0

After logging in (see section 5.3), type any SCPI message into the top text box. Then click the “Send and Read” button.

For commands, there is no response. For queries, the response is shown in the middle text box

You may read any System Error message (see section 7.8.1) by clicking the “Read Errors” button. The error message (or “No error”) will show in the bottom text box

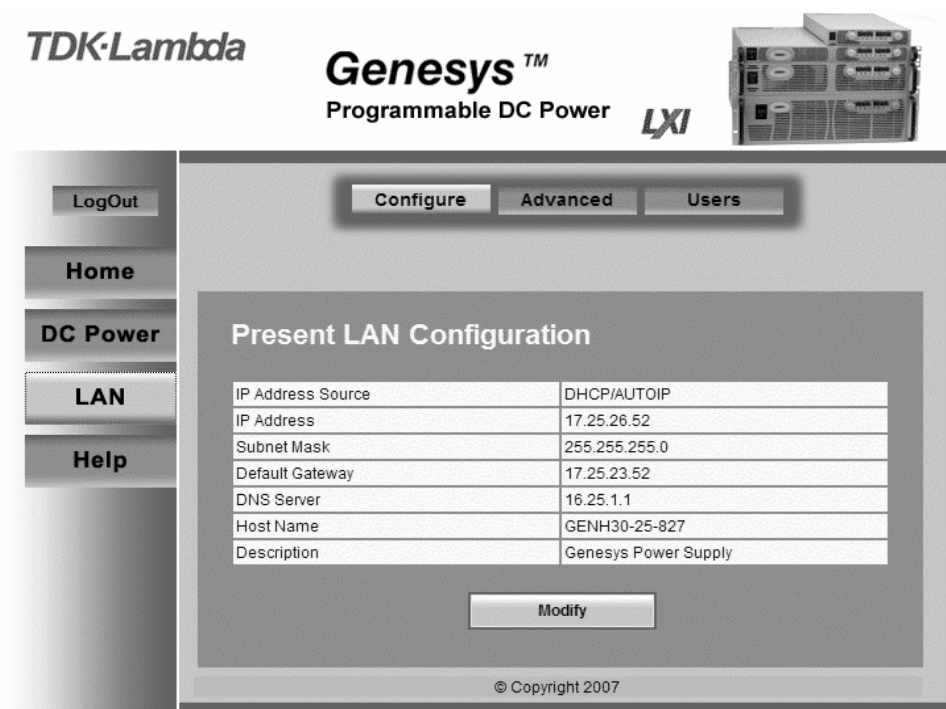
5.5. LAN PAGE

When the “LAN” tab is clicked, the following web page opens. This page, and it’s sub-pages, allow you to view and configure the power supply’s LAN settings

5.5.1. LAN → Configure Page

When the “LAN” tab is selected, three buttons show across the top of the panel. Click the “Configure” button to open the panel below. This panel shows the basic LAN settings

There is *no* “Select RS-485 Multi-drop Address” listbox for the LAN pages because the LAN settings do not apply to any of the multi-drop power supplies



The following settings are shown on the “LAN → Configure” web page:

IP Address Source: Displays the way the IP address was selected. Options are DHCP/Auto-IP and Static IP

IP Address: Displays the IP address assigned to the power supply through either DHCP, Auto-IP or Static IP sources

Subnet Mask: Displays the subnet mask assigned to the power supply through either DHCP, Auto-IP or Static IP (see glossary 1.3.16)

Default Gateway: Address of the network router to allow the power supply to communicate outside of the local subnet

DNS Server: Address of the server running the Domain Naming Service. This is used for hostname addressing

Hostname: the power supply name that may be used by a web browser (see section 3.4) or by a VISA resource name (see section 6.3) to create a communication link. The default hostname is derived from the model and serial number (see the hostname in section 5.2) or it may be changed in the “LAN → Configure → Modify” web page

Description: By default, this is “Genesys Power Supply”, but it may be changed in the “LAN → Configure → Modify” web page

Modify: After logging in (see section 5.3), click this button to open the window shown below

5.5.2. LAN → Configure → Modify Page

If you are logged in and click the “Modify” button on the “LAN → Configure” window, the following pop-up window appears. On this window, you may enter new values for the LAN settings. Changes to these setting will not take place until the “Apply” button is clicked

Note: After changing the LAN settings (other than the description), the web browser will automatically close. Re-open it using the new address (see section 3.4)

The screenshot shows a web browser window titled "Lan Modify - Microsoft Internet Explorer". The main content area is a form titled "Lan Modify". At the top of the form, there is a section for "TCP/IP Mode" with two radio buttons: "DHCP Assigned / AUTO IP" (which is selected) and "Static IP". Below this are several text input fields, each with a label to its left: "IP address" (containing "16.205.23.116"), "Subnet Mask" (containing "255.255.255.0"), "Default Gateway" (containing "16.205.23.253"), "DNS Server" (containing "16.205.23.11"), "Host Name" (containing "GENH30-25-827"), and "Description" (containing "Genesys Power Supply"). At the bottom of the form are two buttons: "Apply" and "Close". The browser's status bar at the very bottom shows "Done" on the left and "Local intranet" on the right.

TCP/IP Mode: This selects how the power supply gets it's network settings. Select either:

- **DHCP Assigned / AUTO IP:** If this mode is selected, the network server uses DHCP to assign the IP address, subnet mask , default gateway and DNS server (see glossary section 1.3). Since the server assigns these, they are disabled (gray) on the web page. If the server cannot make the assignment, the power supply shall revert to the Auto IP method described in section 3.2.2

In this mode, the user may only change the hostname and description

- **Static IP:** If this mode is selected, the IP address, subnet mask and default gateway must be entered in the window fields. The settings must be compatible with the requirements of the network server. They do not change as the power supply is moved to different LAN connections

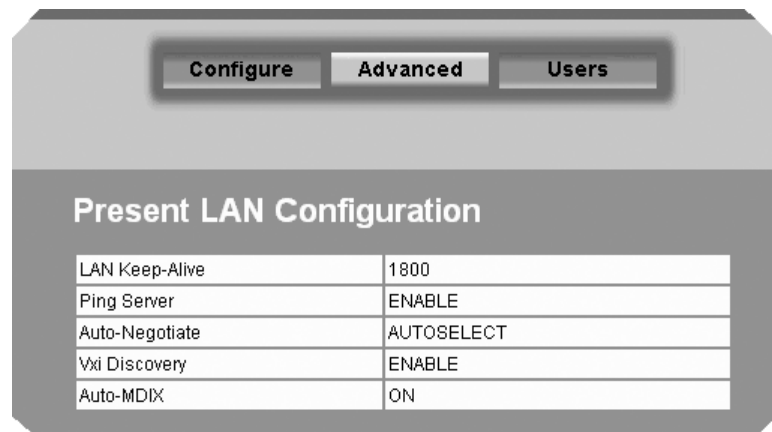
In this mode, there is no hostname connectivity so the hostname and DNS server fields are disabled (gray)

Apply: Click this button to save the new settings

Close: Click this button to close the window

5.5.3. LAN → Advanced Page

Under the “LAN” tab, an “Advanced” button is available at the top of the panel. When it is clicked, the window that allows you to view and set four advanced LAN settings. These settings are:



Present LAN Configuration	
LAN Keep-Alive	1800
Ping Server	ENABLE
Auto-Negotiate	AUTOSELECT
Vxi Discovery	ENABLE
Auto-MDIX	ON

LAN Keep-Alive: If you are logged in as an administrator, this is how many seconds the web pages may be unused (idle) before the power supply automatically logs you out.

The default is 1800 seconds = 30 minutes. Any mouse click on any page will reset the timer

Ping Server: ‘Ping’ is a simple network utility that allows the LAN connected computer to verify communication with the LAN power supply. This service may be disabled in the “LAN → Advanced → Modify” web page

Auto-Negotiate: This shows what network speed the LAN card is allowed to operate at. See glossary section 1.3.3

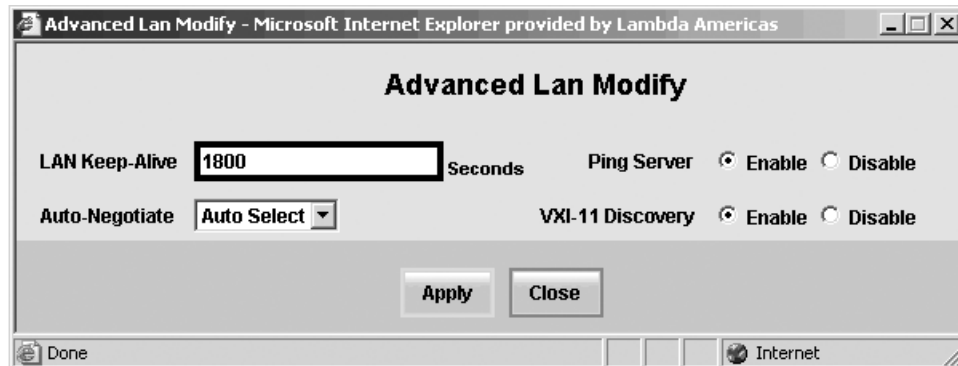
VXI Discovery: This is a protocol which allows the network server to detect what instruments are connected to the LAN

Auto-MDIX: This service is always enabled in the power supply. The power supply LAN connection will always detect a patch or cross-over cable. See glossary section 1.3.2

Modify: After logging in, click this button to open the window shown below

5.5.4. LAN → Advanced → Modify Page

In the window below, you may enter new values for the LAN settings. Changes to these setting will take place when the “Apply” button is clicked. The web page does *not* have to be re-started after changing these settings



The window's fields are described in section 5.5.3 above

5.5.5. LAN → Users Page

This page allows you to create password protection for the web pages. There is *no* password protection for automation programming with VISA (see sections 6 and 0)

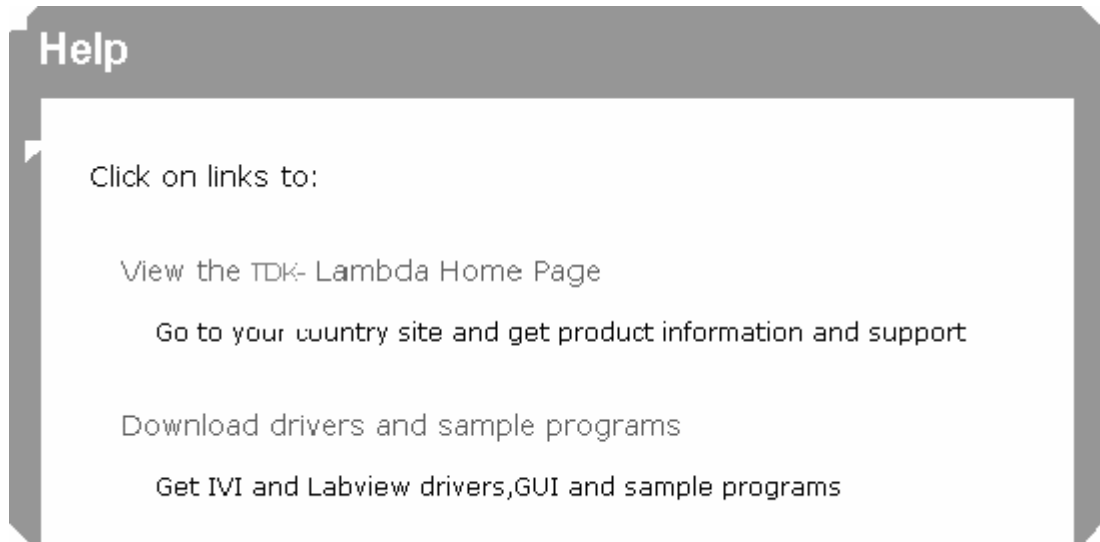
By default, the “old password” is blank. The new password must be four or more characters long

Reset the password: once a password is applied, it may be changed by using this screen, but it can only be removed by performing the “LAN Reset” function from the power supply front panel (see section 4.2)



5.6. HELP PAGE

The left side of the power supply's web page has a Help tab. When clicked, the following page appears:



This page is a set of Internet links to TDK-Lambda Americas Inc. website pages. Your network administrator must assign the power supply's default gateway (see section 5.5.2) and give privileges to view and download from the internet

6.5. SOCKET PROGRAMMING

In addition to web page and VISA communication, programs may be written which communicate through raw sockets.

Open raw socket **port 8001** to send SCPI commands. Responses to queries are sent back automatically.

Special Note for Socket Users:

Ethernet supports three types of sockets: raw, UDP and TCP. The standard Genesys™ power supply optional LAN interface supports only raw sockets. These are not fully compatible with several applications and programming libraries.

For example, instrumentation utilities for VISA and IVI allow 'raw socket' or 'data socket' instruments with a resource name such as:

"TCPIP::169.254.33.192::5025::SOCKET".

These VISA sockets are TCP sockets and they may not be fully compatible with the standard Genesys™ power supply optional LAN interface.

In addition, some PLC libraries support only TCP sockets. They may not be fully compatible with the standard Genesys™ power supply optional LAN interface.

If you expect to use the socket connection, please contact TDK-Lambda Americas sales. A special version of the optional LAN interface that has improved compatibility with TCP sockets is available, along with code samples and other support.

7. SCPI COMMAND REFERENCE

7.1. COMMAND SYNTAX

7.1.1. General SCPI Rules

Terminator: no terminator is required, but carriage-returns or line feeds at the end of the SCPI message is allowed

Characters: commands are made of printable letters, numbers, spaces and some punctuations. Letters may be capital or small; commands are not case-sensitive

Spaces: there must be *no* spaces within the command. There *must* be a space between a command and it's parameter (or setting). For queries, there *cannot* be a space before the question mark

Abbreviations: most SCPI words have an abbreviated form. The full word or the full abbreviation must be used, no partial abbreviations are allowed

Numbers: numbers may have leading and trailing decimal zeroes, up to 12 characters total. The "+" is optional for positive values. The decimal point is optional for whole numbers. Commas for European style decimals are *not* allowed. Exponential numbers (example: "1.35E+2") are *not* allowed

Errors: If a command syntax is not correct, or if a setting is not acceptable, then the command is ignored. To check if the command is accepted, it is necessary to read from the SYSTEM:ERROR queue (see section 7.8.1). The Standard Event Status Register also has a bit to indicate command errors (*ESR, see section 7.8.7)

Command Queries: almost every command has a query form to read back the command's last setting. The query form replaces the command's parameter with a question mark. No space is allowed between the command and the "?". For example, if the command ":VOLT 23" is sent, the query form ":VOLT?" will respond with "23"

Multiple Commands in One Line: Several commands may be sent as one line if they are separated by a semi-colon. These are also called concatenated commands. If one of the commands returns an error, the subsequent commands are skipped. Do not put two queries in one concatenated command because the response from first query cannot be read back

7.1.2. Document Syntax

Courier Font		Represent SCPI commands or responses
ABBReviations		Capital letters are required, small letters are optional
Square Brackets	[]	Items in square brackets are optional.
Angle Brackets	< >	Items in angle brackets are command parameters.
Bar		Vertical bar means "OR", select one of either item. 1 0 ON OFF means 1 or 0 or ON or OFF acceptable
Asterisk	*	Required identifier for IEEE-488.2 common commands
Whole Numbers	nn	Whole numbers with no decimal point allowed
Decimals	nn.nn	Decimal numbers with optional decimal point

7.1.3. Examples of Alternative Forms of SCPI Command

For a command is described as:

[SOURce]:VOLTage:PROTection:LEVEl <nn.nn|MAX>

The following are **correct** forms of the same command:

SOURCE:VOLTAGE:PROTECTION:LEVEL MAX	(longest form of command)
:VOLTAGE:PROTECTION:LEVEL MAX	(SOURCE is optional)
:VOLT:PROTECTION:LEVEL MAX	(Abbreviate VOLTAGE)
:VOLT:PROT:LEV MAX	(Shortest form of command)
:volt:prot:lev max	(Small letters acceptable)

The following are **invalid** forms of the command and will cause an error:

:CURRENT:PROTECTION:STATE	(missing parameter, MAX or number)
:CURRENT: PROTECTION:STATE MAX	(no spaces in command)
:CURR:PROTEC:STATE ON	(PROTEC is not complete abbreviation)
CURR:PROT:STAT ON	(Colon required if SOURCE skipped)

7.2. CONFIGURING THE OUTPUT

7.2.1. Set the Voltage Limit

This command sets the voltage limit. When the power supply is running in constant-voltage mode, this will be it's output voltage

The voltage limit, rounded to four digits, may be viewed on the supply front panel by pressing and releasing the PREView button

Syntax: [SOURce]:VOLTage[:LEVEl][:IMMediate][:AMPLitude] <nn.nn>

Parameter: <nn.nn> is volts, the acceptable range is:
from 5% more than the under-voltage (UVL) setting
to 5% less than the over-voltage protection (OVP) setting

Example: :VOLT 18.5

Query: :VOLT? will return 18.5 in the example
(this may be different than the actual output voltage)

Errors: SYSTEM:ERROR? may return errors including:
-222, "Data out of range"
+301, "PV above OVP"
+302, "PV below UVL"

7.2.2. Set the Current Limit

This command sets the current limit. When the power supply is running in constant-current mode, this will be it's output current

The current limit, rounded to four digits, may be viewed on the supply front panel by pressing and releasing the PREView button

Syntax: [SOURce]:CURRent[:LEVEl][:IMMediate][:AMPLitude] <nn.nn>

Parameter: <nn.nn> is amps, from zero to 5% more than the current rating

Example: :CURR 172.75

Query: :CURR? will return 172.75 in example
(this may be different than the actual output current)

Errors: SYSTEM:ERROR? may return errors including:
-222, "Data out of range"

7.2.3. Set the Output ON or OFF

This command turns the power supply output on or off.

The output on command may not work as expected. The latching power supply faults, including AC fault, over-temperature, J1-Enable and J1-Shut Off, will prevent turning the output on until the fault clears. For non-latching faults, including over-voltage and current fold-back, turning the output on will clear the fault

Syntax: OUTPut : STATe <0|1|OFF|ON>
Parameter: 0 or OFF will set the power supply output to OFF
 1 or ON will set the power supply output to ON, if it is able to
Example: OUTP:STAT 1 (or OUTP:STAT ON)
Query: OUTP:STAT? will return ON in the example, otherwise OFF
Errors: SYSTEM:ERROR? may return errors including:
 +307, "On during fault"

7.3. MEASURING THE OUTPUT

7.3.1. Measure the Output Voltage

This query returns the measured voltage at the output terminals (or remote sense point)

Syntax: MEASure : VOLTage?
Example: MEAS:VOLT? may return 02.006
Response: Volts as a 5-digit number, which is one decimal place more than
 the power supply's front panel voltmeter

7.3.2. Measure the Output Current

This query returns the measured current at the output terminals

Syntax: MEASure : CURRent?
Example: MEAS:CURR? may return 009.48
Response: Amps as a 5-digit number, which is one decimal place more than
 the power supply's front panel ammeter

7.4. OPERATING MODES

7.4.1. Read CV or CC Modes

The power supply may operate in the constant-voltage or constant-current mode. The mode is selected automatically depending on the voltage limit, current limit and load settings. The mode is not defined when the supply's output is off

The CV or CC mode is shown on the supply front panel LEDs above the encoders

Syntax: SOURce : MODe?
Example: SOUR:MOD?
Responses: CV when in constant-voltage mode
 CC when in constant-current mode
 OFF when the output is off

7.4.2. Setting Local or Remote Modes

This command changes the power supply operation to local, remote or local-lockout. The parameter may be a number or text as described below

While the power supply is in local mode, the LAN communication may be used to measure the power supply outputs and statuses. However, as soon as one LAN command is used to change the supply output, the supply will automatically go into remote mode

See section 3.1.1 for further discussion of the local and remote modes

Syntax: SYSTem:SET <0|1|2|LOC|REM|LLO>

Parameter:

Mode	Numeric Setting	Text Setting	Mode Description
Local	0	LOC	Operate supply from front panel. Measurements may be made remotely
Remote	1	REM	Operate supply from LAN port. Measurements may be made on front panel
Local Lockout	2	LLO	Same as Remote, but front-panel "Go to Local" button is disabled

Example: SYST:SET 2 (or SYST:SET LLO)

Query: SYST:SET? will return LLO in example

7.4.3. Set Auto-Restart or Safe-Start Modes

This command sets the way the power supply will power-up when the AC is switched on. It also affects how the supply recovers when latching faults are cleared

Latching faults include: AC fault, over-temperature, J1-Enable and J1-Shut Off. The auto-restart mode changes the response of the power supply when, for example, the AC power recovers from a momentary drop-out or the J1-Enable signal is restored to normal

The start mode may be viewed on the supply front panel by pressing and holding the OUT button (while in local mode). When the AC is first switched on, the power supply output may be forced off, even with the auto-start enabled, by pressing and holding the OUT button during the power-up sequence

This command is in addition to SCPI requirements

Syntax: OUTPut:PON <0|1|OFF|ON>

Parameter:

Mode	Numeric Setting	Text Setting	Mode Description
Safe-Start	0	OFF	Supply will power-up with the output <i>off</i> but it keeps all other last power-down settings. If a latching fault clears, output will stay off but it keeps all other settings made before the fault occurred
Auto-Restart	1	ON	Supply will power-up with the output <i>on</i> at the last power-down settings. If a latching fault clears, output will automatically turn back on to the last settings before the fault occurred

Example: OUTP:PON 1 (or OUTP:PON ON)

Query: OUTP:PON? will return ON in the example

7.5. OUTPUT PROTECTION

7.5.1. Set Over-Voltage Protection

This command sets the over-voltage protection level. If the power supply output exceeds this voltage at its output (or remote sense point), then the output will immediately turn off, the supply front panel will show "OUP" and the Questionable Condition register bit 4 will be set high.

The voltage limit setting, made by the front panel encoder or the :VOLT command (in section 7.2.1), is restricted to 95% of the OVP setting. Likewise, the OVP setting cannot be made lower than 105% of the voltage limit setting. The over-voltage protection may *not* be disabled

The OVP setting may be viewed on the supply front panel by pressing and releasing the OVP/UVL button. This fault is cleared by turning the power supply output on again

Syntax: [SOURce]:VOLTage:PROTection:LEVel <nn.nn|MAX>

Parameter: nn.nn will set the OVP to a value in volts
MAX will set the OVP to the maximum value,
typically 10% above the power supply's voltage rating

Example: :VOLT:PROT:LEV 70

Query: :VOLT:PROT:LEV? will return 70 in the example

Errors: SYSTEM:ERROR? may return errors including:
+304,"OVP below PV"
-222,"Data out of range"

7.5.2. Read Over-Voltage Tripped

This query reports if an over-voltage protection fault has occurred. If a fault has occurred, it may be cleared by turning the power supply output on again (see the OUTP:STAT ON command, section 7.2.3)

Syntax: [SOURce]:VOLTage:PROTection:TRIPped?

Example: :VOLT:PROT:TRIP?

Responses: 0 when no OVP fault is active
1 when supply is shut-down because of an OVP fault

7.5.3. Set Under-Voltage Limit

The under-voltage limit keeps the voltage setting from being less than a certain value. If the actual power supply output (or remote sense point) drops below the UVL, no fault is reported and the supply continues to operate in the constant-current mode (you may use the foldback protection to report a fault when this occurs, see section 7.5.5)

The voltage limit setting, made by the front panel encoder or the :VOLT command (in section 7.2.1), must always be higher than 105% of the UVL setting. Likewise, the UVL setting cannot be made higher than 95% of the voltage setting

The UVL setting may be viewed on the supply front panel by pressing and releasing the OVP/UVL button twice

Syntax: [SOURce]:VOLTage:LIMit:LOW <nn.nn>

Parameter: nn.nn will set the UVL to a value in volts
Range is zero to 95% of the present voltage setting

Example: :VOLT:LIM:LOW 5.100

Query: :VOLT:LIM:LOW? will return 5.100 in the example

Errors: SYSTEM:ERROR? may return errors including:
 +302,"PV below UVL"
 +306,"UVL above PV"
 -222,"Data out of range"

7.5.4. Set Foldback Protection

This command enables or disables the foldback protection. When the FB protection is enabled, if the power supply goes into constant-current (CC) mode for about a ½ second, then the output will turn off, the front panel will show "Fb" and the Questionable Condition register bit 3 will be set high.

This protection is normally used to prevent a hazard condition if the output load goes into a short-circuit. For applications where the power supply is normally operating in CC mode, such as driving electro-magnets, the FB protection cannot be used

The FB setting is seen on the supply's front panel FOLD LED. A foldback fault is cleared by turning the power supply output on again

Syntax: [SOURCE]:CURRENT:PROTECTION:STATE <0|1|OFF|ON>

Parameter: 0 or OFF will turn the foldback protection OFF
 1 or ON will turn the foldback protection ON

Example: :CURR:PROT:STAT 1 (or :CURR:PROT:STAT ON)

Query: :CURR:PROT:STAT? will return ON in the example, otherwise OFF

7.5.5. Read Foldback Tripped

This query reports if a foldback protection fault has occurred. If a fault has occurred, it may be cleared by turning the power supply output on again (see the OUTP:STAT ON command, section 7.2.3)

Syntax: [SOURCE]:CURRENT:PROTECTION:TRIPPED?

Example: :CURR:PROT:TRIP?

Responses: 0 when no FB fault is active
 1 when supply is shut-down because of a FB fault

7.6. LAN SPECIFIC COMMANDS

7.6.1. Blinking the Identify LED

When communicating to a stack of Genesys™ power supplies, it may be difficult to know which supply is selected for communicating. The LAN computer may send a command to cause the selected supply's front panel displays to blink on and off. Also, the LAN LED on the rear panel will blink. In a multi-drop chain of supplies (see section 9), only the LAN supply will blink

If blinking is turned on, then it may be turned off by sending the OFF command or by changing any front panel control

Syntax: SYSTem:COMMunicate:LAN:IDLED <0|1|OFF|ON>

Example: SYST:COMM:LAN:IDLED ON

Query: There is no query to read if flashing is turned on

7.6.2. Read the Hostname

The hostname (see section 1.3.6) may be read with this query

Syntax: SYSTem:COMMunicate:LAN:HOST?

Example: SYST:COMM:LAN:HOST?

Response: The hostname string, up to 15 characters long
Example: GEN7p5-1000-123 is a typical default hostname

7.6.3. Read the IP Address

The IP address (see section 1.3.9) may be read with this query

Syntax: SYSTem:COMMunicate:LAN:IP?

Example: SYST:COMM:LAN:IP?

Response: The IP address string, up to 15 characters long
Example: 169.254.9.35 is a typical default IP address

7.6.4. Read the MAC Address

The MAC address (see section 1.3.11) may be read with this query

Syntax: SYSTem:COMMunicate:LAN:MAC?

Example: SYST:COMM:LAN:MAC?

Response: The MAC address string, 17 characters long
Example: 00:19:f9:00:24:3b is a typical default IP address

7.6.5. Reset the LAN Settings

WARNING: Sending this command could disable the LAN connection to the power supply

This command will reset the LAN settings to the factory default state. The effect of this include changing the IP address and hostname, so LAN communication could be lost. Therefore, only use this command as a diagnostic tool. See section 4.2 for a description of the LAN reset condition and section 3.4 to restore the connection

Syntax: SYSTem:COMMunicate:LAN:RESet

Example: SYST:COMM:LAN:RES

7.6.6. Serial Command Pass-Through

The Genesys™ power supply RS-232/485 (serial) command set has several functions that cannot be implemented by the LAN SCPI command set. For example, power supply calibration is done using the RS-232 port, so the LAN port has no calibration commands. The serial command pass-through allows any serial command to be sent through the LAN SCPI port

The response message from a pass-through command is the same response as seen over the serial port. Unlike the SCPI commands, all pass-through commands have a response message that may be read back

Refer to the Genesys™ Technical Manual for a description of the RS-232 & RS-485 Remote Control command set

Syntax: DIAGnostic:COMMunicate:PASSthrough <string>

Parameter: <string> is any RS-232/485 command or query
(no quotes are used to enclose the string)

Example #1: DIAG:COMM:PASS PV 25 will program the voltage limit to 25 volts

Response #1: OK will be returned by the above command,
(or an error such as E01 may be returned)

Example #2: DIAG:COMM:PASS MV? will measure the output voltage

Response #2: 24.983 is a sample response to the above query

7.7. COMMON COMMANDS

Common commands were first defined in the IEEE-488.2 standard, which is the predecessor of the SCPI standard. They are not specific to power supplies. They are common commands which are useful for any remote communication

Many common commands refer to bit-mapped registers in which setting bits to "1" or "0" indicates an operating mode or fault condition. These are described in the Error and Status section 7.8 below

7.7.1. Identity Query

This is a request for the power supply to identify itself. It is used by the remote computer to verify the correct instrument is being communicated to and to determine the model ratings of the power supply.

Syntax: *IDN?

Response: Four fields separated by commas:
 Field 1: Manufacturer name
 Example: LAMBDA
 Field 2: Model name, GEN<Volt rating>–<Curr rating>–Option
 Example: GEN150-22-LAN
 Field 3: Serial number, typically 7 alpha-numeric characters
 Example: 25B1234
 Field 4: Revisions, <Main firmware>–<LAN firmware>
 Example: REV:2U:4.5–AP17

Example Response:
 LAMBDA, GEN60-25-LAN, S/N:26M5470, REV:1U:4.0-AP17

7.7.2. Reset the Power Supply

This command will reset all settings in the power supply to a known, safe state. This includes setting the programming limits to zero, output off, and auto-restart off. Other protections are disabled

Sending *RST is the same as sending *all* nine of the following commands:

:VOLT 0	:CURR 0
OUTP:STAT 0	SYST:SET REM
OUTP:PON OFF	:CURR:PROT:STAT OFF
:VOLT:LIM:LOW 0	:VOLT:PROT:LEV MAX
	*CLS

Syntax: *RST

7.7.3. Save All Settings

This saves the present power supply settings. This is used along with the *RCL 0 command (in section 7.7.4) which allows you to bring the power supply back to some setup configuration with only one command

When the supply is powered-down, the *SAV 0 settings are over-written by the power-down settings

Syntax: *SAV 0

7.7.4. Recall All Settings

This recalls the last saved power supply settings. These may be from the last *SAV 0 command (in section 7.7.3) or, if no *SAV 0 has been sent, the last settings restored at power-up

The recall command will change the following settings with only one command, where <last> are the last settings from *SAV 0 or from power-up

:VOLT <last>	:CURR <last>
OUTP:STAT <last>	SYST:SET <last>
OUTP:PON <last>	:CURR:PROT:STAT <last>
:VOLT:LIM:LOW <last>	:VOLT:PROT:LEV <last>

The status and event registers are not affected by the recall command

Syntax: *RCL 0

7.7.5. Self-Test

This is query to launch a simple self-test. It verifies the basic connections between the LAN microcontroller and the control board microcontroller. The self-test result (pass or fail) is read from the message queue

If the self-test failed and it returns 1, contact TDK-Lambda Americas Inc. Customer Service for further instructions

Syntax: *TST?

Responses: 0 when the self-test passed
 1 when the self-test failed

7.8. ERROR AND STATUS COMMANDS

Any program that operates a remote power supply should routinely verify that the supply is accepting commands as expected. There is always a chance that the program sent a command incorrectly, the supply is set so a command cannot be carried out, or a fault condition has shut down the supply. A reliable program will check for these errors

There are three methods for checking the Genesys™ power supply status:

- **IEEE-488.2 Registers:** these are a few simple registers in which a bit is set because of a command error or instrument fault condition. Little information about the type of fault is returned to the operator. The registers are read, set and cleared using the Common Commands (these start with an asterisk)
- **SCPI Registers:** these are an extension of the IEEE-488.2 register set. SCPI adds registers which describe exactly what fault conditions occur in the power supply. It also adds status registers that report operating modes during normal operation
- **SYSTEM:ERROR Queue:** This is a message-based error and status reporting system. When registers are used, the operator must use a look-up table to find the meaning of each register bit position. The SYSTEM:ERROR is a message where the status and error conditions are expressed in readable text. This is the preferred method to verify commands are accepted

7.8.1. Read System Error

This is query to read error messages from the power supply. It is recommended that after any command is sent over the LAN, the SYSTEM:ERROR should be read to verify the command is accepted. The SYSTEM:ERROR queue can also be set to report faults which have shut-down the supply's output

The SYSTEM:ERROR is a queue, or stack, that holds the last ten messages. The last error message entered is the last one read. It is a good idea to read the SYSTEM:ERROR

queue regularly. When a faulty command is sent and the SYSTEM:ERROR is read, the error message could relate to an earlier command.

The SYSTEM:ERROR queue may be cleared by:

- Sending the *CLS command (this also clears other registers)
- Sending the SYSTEM:ERROR:ENABLE command
- Reading the errors until the response is 0, "No error"

Power supply shut-down faults will be reported by the SYSTEM:ERROR queue if the STAT:QUES:ENAB 255 command is first sent (or a value other than 255, see section 7.8.15 for bit descriptions). If a fault is reported, no further faults are reported by SYSTEM:ERROR unless the event registers are cleared by sending STAT:QUES? or *CLS.

See Section 10 for a complete list of SYSTEM:ERROR messages

Syntax: SYSTem:ERRor?

Example: SYST:ERR?

Response: <error number>,"<error description>;<serial address>"

 <error number> is a value from –350 to +399

 Negative values are errors. The command was *not* understood or it could *never* be executed by the power supply

 Positive values are warnings. The command was understood but it could not be executed at this time, or a fault has shut-down the output

 <error description> is brief description of the error

 <serial address> is the address of the reporting power supply. It is the supply's RS-485 address set using the front panel. (see section 9.2.2). The address will be "99" if multiple RS-485 supplies report the same fault condition

Examples: 0, "No error" (this response has no serial address)

 -222, "Data out of range;address 06"

 +321, "AC fault shutdown;address 02"

7.8.2. Enable System Error

This command clears any error messages from the SYSTEM:ERROR queue. No other status registers are affected

For the LAN option, the SYSTEM:ERROR messages are automatically enabled at power-up. (With the Genesys™ IEEE option, SYST:ERR:ENAB is required to enable the SYSTEM:ERROR messages)

Syntax: SYSTem:ERRor:ENABle

Example: SYST:ERR:ENAB

Query: This command has no query form

7.8.3. Read SCPI Version

This query returns the SCPI version that the Genesys™ power supply is compatible with

Syntax: SYSTem:VERSion?

Example: SYST:VERS?

Response: <SCPI version>

Example: 1999.0

USING THE ERROR AND STATUS REGISTERS

The SCPI error and status registers report many conditions, statuses and events into short numeric codes. Momentary events may be latched so the remote computer can read about them at a later time. A “fan out” architecture is used to summarize all the data into one Status Byte register

The Genesys™ power supply, with the LAN option, does not support the service request feature defined in the Status Byte register

There are three types of registers. Data, as in a bit is set high or low, flows top to bottom in the following list. See Figure 6 for the diagram

Condition Registers: contain bits that are set when a condition or error occurs. The bits are only cleared when the condition or error is cleared. The contents may be read but not changed

Enable Registers: individual bits may be set to allow the status and errors to be latched for reading even after the status or error condition has cleared. The power-up default is all zeroes, that is, no latching occurs

Event Registers: bits that are set when an event or error occurs. The bits are cleared when the contents of the register are read or when a clear status command is sent

7.8.4. Clear Status

This command resets the error, status and message registers in the LAN board. No power supply settings are changed

The *CLS command will:

- Erase any response message in the output queue
- Erase any errors in the SYSTEM:ERROR queue
- Reset all event registers to zeroes
- Will *not* change any Enable or Condition register bits

Syntax: *CLS

Query: This command has no query form

THE IEEE-488.2 ERROR AND STATUS REGISTERS

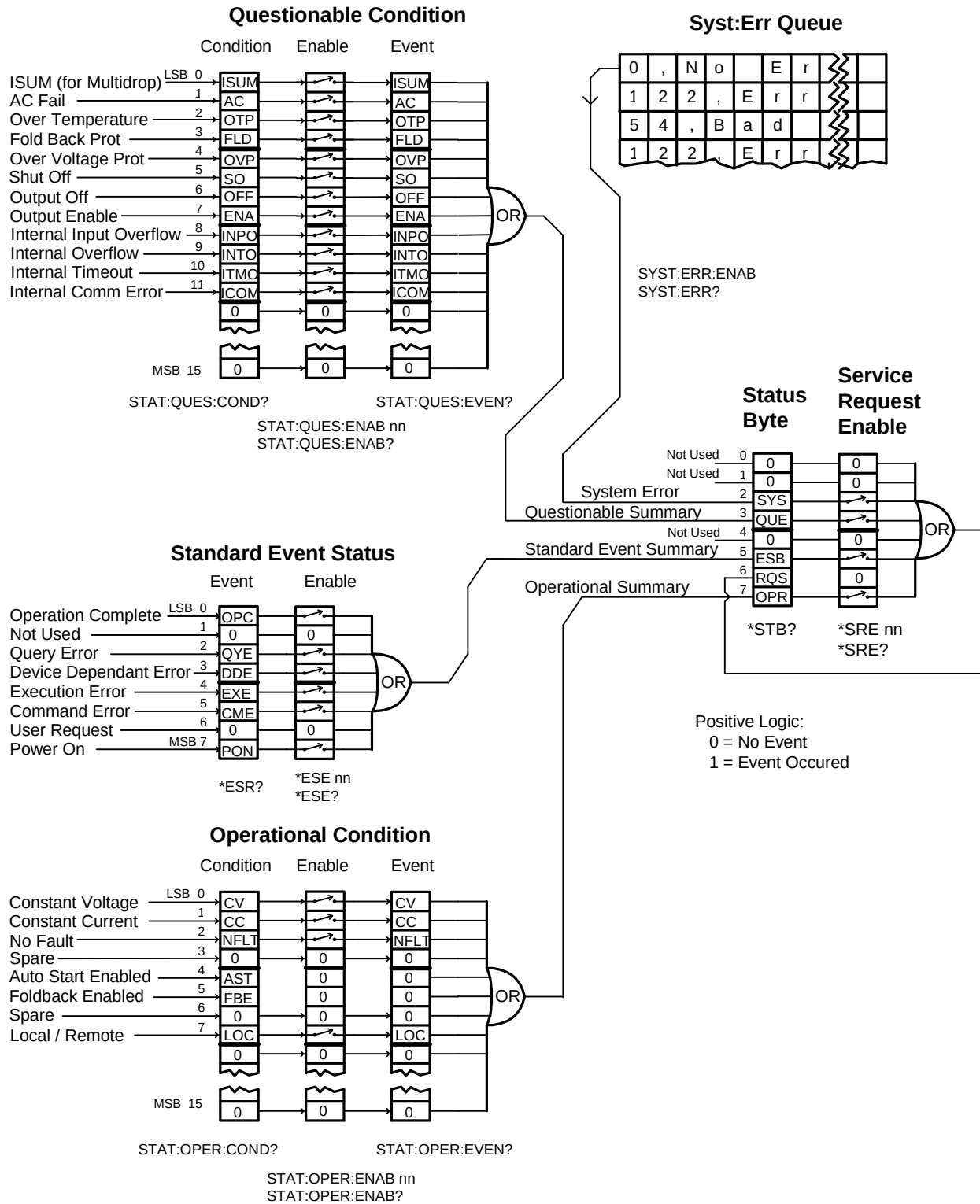


Figure 6. Error and Status Registers

7.8.5. Read the Status Byte Register

The Status Byte register is a summary of all events that have been enabled. Figure 6 shows the commands that are used to enable events. The Status Byte is a condition register, that is, reading it will *not* clear the contents. To clear the Status Byte register, the connected event registers must be read or cleared

These are the bit assignments of the Status Byte:

<i>BIT</i>	<i>VALUE</i>	<i>SYMBOL</i>	<i>DESCRIPTION</i>
0	1	0	Not Used
1	2	0	Not Used
2	4	SYS	System Error, at least one error in error queue
3	8	QUE	Questionable Summary
4	16	0	Not Used
5	32	ESB	Standard Event Summary
6	64	MSS	Master Summary Status, is set if any other bit is set in this register
7	128	OPR	Operational Summary

Syntax: *STB?

Response: <nnn>, a number from 0 to 255

Example: 12 (a supply fault had occurred and there is some error which may be read using the SYSTEM:ERROR? query)

7.8.6. Set the Service Request Enable Register

The IEEE-488.2 and SCPI specifications defined this register so instruments may generate a service request when selected events occur

The Genesys™ power supply LAN option does *not* support the service request feature, although the *SRE command will set bit 6 in the Status Byte

Syntax: *SRE <nnn>

Parameter: <nnn> is a number from 0 to 255. The bit assignments are the same as the Status Byte, in the table above

Example: *SRE 255 will cause Status Byte bit 6 to be set if any other bit is set

Query: *SRE? will return 172 in the example
(bits 0,1,4 and 6 are not settable in the *SRE register)

7.8.7. Read the Standard Event Status Event Register

This is a basic status and fault register that was first defined in IEEE-488.2. It is an event register, which means bits are set to "1" when a condition occurs and they are not cleared until the register value is read using the *ESR? query or the *CLS command

These are the bit assignments of the ESR register:

<i>BIT</i>	<i>VALUE</i>	<i>SYMBOL</i>	<i>DESCRIPTION</i>
0	1	OPC	Operation complete. See section 7.8.9
1	2	0	Not used
2	4	QYE	Query error (response not read)
3	8	DDE	Device dependant error (fault shut-down)
4	16	EXE	Execution error (could not execute command)
5	32	CME	Command error (invalid command received)
6	64	0	Not used
7	128	PON	Power On. Set once when power is switched on.

Syntax: *ESR?

Response: <nnn>, a number from 0 to 255

Example: 32 (an illegal command was received)

7.8.8. Set the Standard Event Status Enable Register

When one or more bits in the Standard Event Status Event Register (*ESR, see above) are set, a bit can be set in the Status Byte (*STB, see section 7.8.5). This is done by setting bits in the enable register. Changing the value of the *ESE register has no affect on the value in the *ESR register

Syntax: *ESE <nnn>

Parameter: <nnn> is a number from 0 to 255. The bit assignments are the same as the *ESR, in the table above

Example: *ESE 60 will cause bit 5 in the Status Byte to be set if there is a query error, fault shut-down, execution error or a command error

Query: *ESE? will return 60 in the example

7.8.9. Enable the Operation Complete

This command will cause bit 0 of the Standard Event Status Register to go to 1 when all pending commands are completed. Because of the Genesys™ power supply architecture, this bit will go to 1 when the *OPC is received, even if the output is in transition because of a prior command

Syntax: *OPC

7.8.10. Read the Operation Complete

This query will read back if all pending operations are completed. This query will always return 1, even if the DC output is in transition because of a prior command

Syntax: *OPC?

THE SCPI ERROR AND STATUS REGISTERS

7.8.11. Read the Operational Condition Condition Register

This register reports several operating modes and settings of the power supply. Although separate SCPI commands may also report this information, the register is beneficial because it may allow any brief mode change to be latched into an event register for later reading

This is a conditional register. The bits are set to "1" when the mode occurs and cleared when the mode turns off. The values are read-only.

These are the bit assignments of the Operational Condition Condition Register:

<i>BIT</i>	<i>VALUE</i>	<i>SYMBOL</i>	<i>DESCRIPTION</i>
0	1	CV	"1" = constant voltage operation
1	2	CC	"1" = constant current operation
2	4	NFLT	"1" = No fault, is set when all faults cleared
3	8	0	Not used
4	16	AST	"1" = Auto start is enabled
5	32	FBE	"1" = Foldback protection is enabled
6	64	0	Not used
7	128	LOC	"1" = Local mode, "0" = Remote mode
8 to 15	0	0	Not used

Syntax: STATus:OPERation:CONDition?

Example: STAT:OPER:COND?

Response: <nnn>, a number from 0 to 255

Example: 128 (local mode with the output off (because CV and CC both zero))

7.8.12. Set the Operational Condition Enable Register

When one or more bits in the Operational Condition Register (see 7.8.11 above) are set, a bit can be set in the Status Byte (*STB, see section 7.8.5). This is done by setting bits in the enable register. Changing the value of the enable register has no affect on the value in the condition register

Syntax: STATus:OPERation:ENABle <nn>

Parameter: <nnn> is a number from 0 to 255. The bit assignments are the same as the table above

Example: STAT:OPER:ENAB 1 will cause bit 7 in the Status Byte to be set if the supply goes into constant-voltage mode

Query: STAT:OPER:ENAB? will return 1 in the example

7.8.13. Read the Operational Condition Event Register

This is a settings and modes event register, which means bits are set to "1" when a condition occurs and they are not cleared until the register value is read or the *CLS command is sent. For the condition to be latched as an event, the event bit must be enabled as described in section 7.8.12 above.

The bit assignments are the same as the Operational Condition Register, described in section 7.8.11 above

Syntax: STATus:OPERation[:EVENT]?

Example: STAT:OPER?

Response: <nnn>, a number from 0 to 255

Example: 2 (the supply went into constant current mode)

7.8.14. Read the Questionable Condition Register

This register reports fault conditions which will cause the power supply output to turn off. The faults include:

- User settable faults (enable, shut-down, over-voltage, fold-back, output off)
- Environmental faults (over-temperature, AC fail)
- Instrument summary fault bit (for RS-485 multi-drop chain, see section 9)
- Internal firmware faults (four faults)

This is a conditional register. The bits are set to "1" when the fault occurs and cleared when the fault is cleared. The values are read-only. See the Technical Manual for more details on faults.

These are the bit assignments of the Questionable Condition Register:

<i>BIT</i>	<i>VALUE</i>	<i>SYMBOL</i>	<i>DESCRIPTION</i>
0	1	0 or ISUM	In single LAN supply, bit is always 0. In Multi-drop system, is Instrument Summary bit.
1	2	AC	AC Fail fault
2	4	OTP	Over-temperature fault
3	8	FLD	Fold-back protection fault
4	16	OVP	Over-voltage protection fault
5	32	SO	Shut-off fault, using the "J1" analog input
6	64	OFF	Output Off, using the front panel button
7	128	ENA	Output Enable fault, using the "J1" analog input
8	256	INPO	Internal Input Overflow
9	512	INTO	Internal Overflow
10	1024	ITMO	Internal Time Out
11	2048	ICOM	Internal Comm Error
12 to 15	N/A	0	Not used

Syntax: STATus:QUESTionable:CONDition?

Example: STAT:QUES:COND?

Response: <nnn>, a number from 0 to 4095

Example: 64 (operator turned the output off using the front panel OUT button)

7.8.15. Set the Questionable Condition Enable Register

When one or more bits in the Questionable Condition Register (see section 7.8.14 above) are set, a bit can be set in the Status Byte (*STB, see section 7.8.5). This is done by setting bits in the enable register. Changing the value of the enable register has no affect on the value in the condition register

Syntax: STATus:QUESTionable:ENABle <nn>

Parameter: <nnn> is a number from 0 to 4095. The bit assignments are the same as the table above

Example: STAT:QUES:ENAB 4095 will cause bit 3 in the Status Byte to be set if the supply shuts down for any fault

Query: STAT:QUES:ENAB? will return 4094 in the example
(bit 0 always 0 for single LAN supply)

7.8.16. Read the Questionable Condition Event Register

This is a fault event register, which means bits are set to "1" as faults occur and they are not cleared until the register value is read or the *CLS command is sent. For the fault to be latched as an event, the event bit must be enabled as described in section 7.8.15.

The bit assignments are the same as the Questionable Condition Register, described in section 7.8.14 above

Syntax: STATus:QUESTionable[:EVENT]?

Example: STAT:QUES?

Response: <nnn>, a number from 0 to 4095

Example: 12 (the supply went into fold-back fault then the AC voltage dropped)

7.8.17. Enable All the Event Registers

This command that will enable some of the events for the operational (section 7.8.12) and all of the events for the questionable (section 7.8.15) registers.

Sending this command is the same as sending:

- STAT:OPER:ENAB 132 and
- STAT:QUES:ENAB 4095

Syntax: STATus:PRESet

Example: STAT:PRES

Query: This command has no query form

7.9. RS-485 MULTI-DROP COMMANDS

For a description of using the RS-485 Multi-drop option, and the global programming commands, see section 9 below.

8. SAMPLE PROGRAMS

Refer to Lambda website for the latest support software at:

http://www.us.TDK-Lambda.com/HP/product_html/drivers.htm

Downloads may include:

- **GUI program**
This is a “Graphical User Interface” program that gives you remote control of the power supply using the LAN network
- **IVI-COM Drivers**
These are “Interchangeable Virtual Instrument” drivers that allow you quickly write automation programs in National Instruments LabView, Microsoft Visual Studio and other environments. Wrappers for the NET interface are also available
- **Raw Socket Example**
This is a small program written in Visual ‘C’ that opens a LAN Socket connection. It is used to send SCPI commands and read responses using Winsock drivers instead of VISA.

9. RS-485 MULTI-DROP CHAIN

9.1. Introduction

The Genesys™ power supply LAN option allows you to control up to 29 other supplies which do *not* have the LAN option installed. All are controlled through one IP address from the supply with the LAN option

This is called the Multi-drop configuration. The Ethernet cable goes to the LAN supply. All the other supplies are connected using a RS-485 Serial Link Cable between the J3-OUT to J3-IN sockets. The multi-drop feature adds the ability to operate all the linked power supplies with one global command

NOTE: *The RS-485 power supplies must be Multi-drop enabled*
See section 9.3.1 below

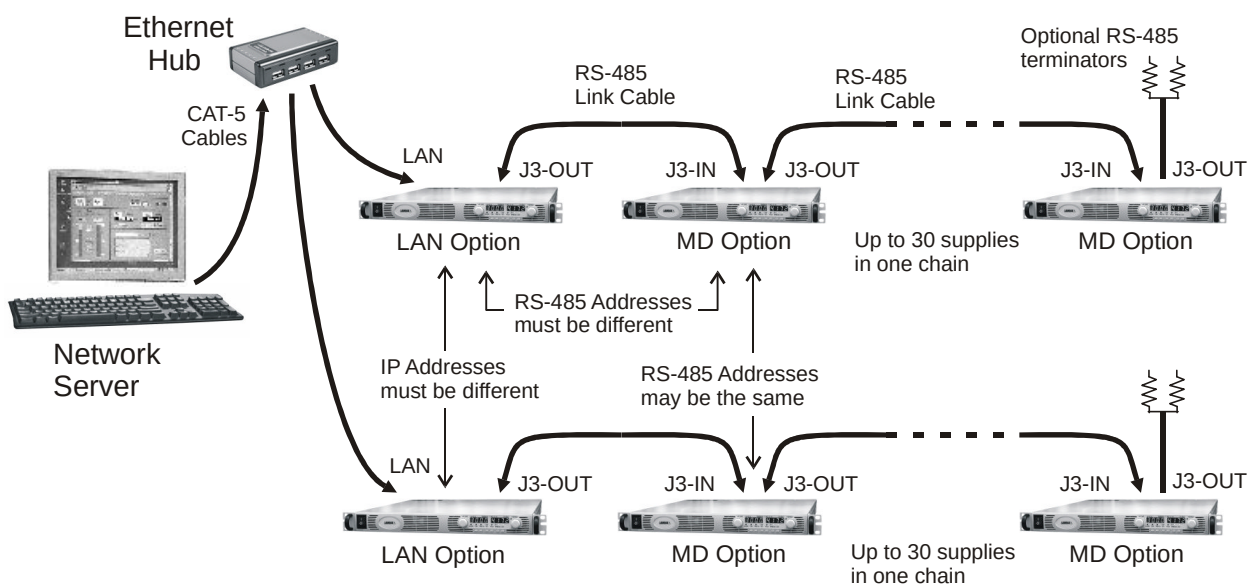


Figure 7. Configuring a Multi-drop System of Supplies

9.2. Configure the LAN Supply

The LAN power supply, at the head of the multi-drop chain, is sometimes called the Master supply.

9.2.1. To Set Up the Master Power Supply:

- Connect the LAN to a computer as described in section 0
- Enable the LAN option with it's rear panel switch. See Figure 3
- Set the supply into RS-232 mode by setting rear-panel SW1 bit 6 to DOWN
- Connect a RS-485 Link cable from the rear J3-OUT jack to the next supply's J3-IN
- Power-up the supply
- Set the supply's RS-485 address as described below

9.2.2. To Set the RS-485 Address:

In addition to the supply's IP address, the multi-drop requires setting an RS-485 address. It is viewed on the front panel of the power supply by setting it to local mode (see

section 3.1.1) and pressing and holding the REM/LOC button. The address may then be changed by turning the voltage encoder

The default RS-485 address is 6. It may be set to any value from 0 to 30. The RS-485 address is not related to the IP address. However, it is required that no other power supply on the multi-drop chain have the same RS-485 address

9.3. Connect and Configure the RS-485 Supplies

The RS-485 linked power supplies, at the tail of the multi-drop chain, are sometimes called the Slave supplies. They may be individually commanded and queried using the LAN port on the Master supply

The RS-485 power supplies must be Multi-drop enabled

9.3.1. To Verify the Multi-drop is Enabled:

- A. Look at the product label for “-MD” in the model description
- B. Or try running the multi-drop chain. Open the LAN web page. On the DC Power page, click the “Refresh List” control (see section 5.4.1). The addresses of all the multi-drop enabled RS-485 supplies will be shown in the list
- C. Or use the RS-232/485 port with a communication program such as HyperTerminal to send the “MDAV?” query. If the response is “1”, the multi-drop is enabled in the supply. Refer to the Technical Manual for details on using the RS-232/485 port

9.3.2. To Set Up an RS-485 Chain:

- A. If the supply has the LAN or IEEE option, disable the option by sliding the LAN enable switch to DOWN. See section 2.2.1 and Figure 3
- B. Set the supply into RS-485 mode by setting rear-panel SW1 bit 6 to UP
- C. Connect the RS-485 Link Cables from the master’s J3-OUT to the slave’s J3-IN
- D. Power-up the supplies
- E. Set the supply’s RS-485 address as described in section 9.2.2
- F. While you are setting the address, also set the BAUD rate to 19.2K by turning the current encoder

9.3.3. Optional RS-485 Terminator

For very long RS-485 cable distances, or if many supplies are chained together, a signal terminator may be added to improve signal integrity. The terminator is plugged into the J3-OUT of the last supply in the chain (see diagram above).

To make a terminator:

- A. Crimp a short cable to a RJ-45 connector (or just use the end of a LAN cable)
- B. Use two ¼ watt resistors, recommended value is 120 ohms, and solder them:
 - from pin-3 to pin-6 (TXD+ to TXD–)
 - from pin-4 to pin-5 (RXD+ to RXD–)
- C. Although the RS-485 bus should not be at hazardous voltages, insulate the terminator properly for your application

9.4. Multi-drop Programming Using SCPI Commands

9.4.1. Selecting One Power Supply in a Multi-drop Chain

All the SCPI commands in section 0 may be sent to any one of the supplies in an RS-485 chain by first sending the `INST:SEL` address command. All commands and queries will then apply only to the selected supply, until a new `INST:SEL` is sent

When a multi-drop chain is first powered-up, the LAN supply is automatically the one selected until the first `INST:SEL` is sent

9.4.2. Global Commands in a Multi-drop Chain

The GLOBAL commands affect all of the chained supplies at the same time, including the LAN supply

There are differences between a normal SCPI command (in section 0) and a global command. The differences are:

- *There is no SYSTEM:ERROR? response message* (see section 7.8.1) if one or more supplies cannot execute a global command
- *It is required that the user's application add a 200 millisecond delay* after a global command before sending any other messages. This is because there is no feedback from the multi-drop chain to indicate the command is still being processed
- *There is no query version of these commands.* Global settings must be queried by selecting one power supply and reading it's setting
- *The error and status registers operate differently.* See section 9.4.10 for details
- The global commands are *not* SCPI compliant

The global commands do not affect which power supply has been selected using the INST:SEL command. For example, if the following commands are sent:

```
INST:SEL 4
:VOLT 50
GLOB:VOLT 70
(wait 200 mSec)
:VOLT 90
```

then all the supplies on the multi-drop chain will be set to 70 volts except the supply at RS-485 address 4 will be set to 90 volts (after the global command, another INST:SEL was *not* required)

9.4.3. Selecting a Supply

This command will select one power supply in a multi-drop chain. Subsequent commands and queries will operate only on that supply, until a new one is selected. At power-up, the LAN supply is automatically selected

Syntax: INSTRUMENT:SElect <nn>

Parameter: <nn> is the supply's RS-485 address. It is a number from 0 to 30
see sections 9.2.1.F and 9.3.2.E for set-up instructions

Example: INST:SEL 6

Query: INST:SEL? will return 06 in the example

Errors: SYSTEM:ERROR? may return errors including:
-241,"Hardware missing;address nn", if nn is an invalid address

GLOBAL COMMANDS

The following global commands affect all power supplies on a multi-drop chain. See section 9.4.2 for requirements. There is no query version of these commands

9.4.4. Global Set the Voltage Limit

This is the global version of the :VOLT command in section 7.2.1

Syntax: GLOBal:VOLTage[:LEVel][:IMMediate][:AMPLitude] <nn.nn>

Parameter: <nn.nn> is volts, the setting applied to all power supplies

Example: GLOB:VOLT 9.45

9.4.5. Global Set the Current Limit

This is the global version of the `:CURR` command in section 7.2.2

Syntax: `GLOBal:CURRent[:LEVel][:IMMediate][:AMPLitude] <nn.nn>`

Parameter: `<nn.nn>` is amps, the setting applied to all power supplies

Example: `GLOB:CURR 350`

9.4.6. Global Set the Output ON or OFF

This is the global version of the `OUTP:STAT` command in section 7.2.3

Syntax: `GLOBal:OUTPut:STATe <0|1|OFF|ON>`

Example: `GLOB:OUTP:STAT 1` (or `GLOB:OUTP:STAT ON`)

9.4.7. Global Reset Power Supplies

This is the global version of the `*RST` command in section 7.7.2

Syntax: `GLOBal:*RST`

Example: `GLOB:*RST`

9.4.8. Global Save All Settings

This is the global version of the `*SAV 0` command in section 7.7.3

Syntax: `GLOBal:*SAV 0`

Example: `GLOB:*SAV 0`

9.4.9. Global Recall All Settings

This is the global version of the `*RCL 0` command in section 7.7.4

Syntax: `GLOBal:*RCL 0`

Example: `GLOB:*RCL 0`

9.4.10. Error and Status Registers

The error and status registers described in sections 7.8.5 through 7.8.17 operate somewhat differently in a multi-drop system.

A structural register difference is, in all the RS-485 chained supplies, the Operational Condition Event Register and the Questionable Condition Event Register are ORed together to generate an event in the LAN supply's Questionable Condition Event Register bit 0. This is called the `ISUM` bit and it may be used to set a bit in the Status Byte if an event occurs in the LAN or any RS-485 supply

Other differences are:

- The Status Byte and Standard Event registers are global. These do not change as different power supplies are selected with `INST:SEL`
- The Questionable Condition and Operational Condition registers are embedded in the selected supply. These will change as different power supplies are selected with `INST:SEL`

Refer to the *User Manual for the IEMD Interface* for further details

10. SYSTEM:ERROR? MESSAGES

These are the system error messages which may be returned from the "SYST:ERR?" query.
See section 7.8.1 for a description of this system error queue

ERROR	ERROR MESSAGE	ERROR DESCRIPTION
0	"No error"	No error reported
-100	"Command error"	LAN card receives command with unspecified error
-101	"Invalid Character"	A character was received that is <i>not</i> : a-z, A-Z, 0-9, ?, *, :, ;, period, space, CR, LF
-102	"Syntax error"	LAN card receives unrecognized command word
-104	"Data type error"	LAN card receives command parameter with wrong type of data. Example: a letter where a number is expected.
-109	"Missing parameter"	Valid command received but not enough parameters.
-112	"Program word too long"	Command word had more than 14 characters before separator (space or colon) was found
-222	"Data out of range"	Attempt to program voltage, current or OVP beyond supply limits
-241	"Hardware Missing"	When operating in RS-485 Multi-drop mode, an attempt was made to address a non-existent supply.
-350	"Queue Overflow"	Too many SYST:ERR messages are stored in this queue and the newest messages are discarded. The max. number of stored messages is 10.
+300	"Execution error"	General execution error.
+301	"PV above OVP"	Attempt to program voltage above OVP setting. (or more exactly, PV not "5% of voltage rating" below OVP)
+302	"PV below UVL"	Attempt to program voltage below UVL setting. (or more exactly, PV not "5% of voltage rating" above UVL)
+304	"OVP below PV"	Attempt to set OVP below voltage setting. (or more exactly, OVP not "5% of voltage rating" above PV)
+306	"UVL above PV"	Attempt to set UVL above voltage setting. (or more exactly, UVL not "5% of voltage rating" below PV)
+307	"On during fault"	Attempt to set supply output "ON" when a fault exists
+320	"Fault shutdown"	General message for non-specified shutdown
+321	"AC fault shutdown"	Brown-out or phase-loss shutdown occurred
+322	"Over-Temperature"	Over-temperature shutdown occurred
+323	"Fold-Back shutdown"	Fold-Back shutdown occurred
+324	"Over-Voltage shutdown"	Over-Voltage shutdown occurred
+325	"Analog shut-off shutdown"	Shut-Off occurred from rear panel J1
+326	"Output-Off shutdown"	Output-Off occurred from front panel button

+327	"Enable Open shutdown"	Enable Open occurred from rear panel J1
+340	"Internal message fault"	General non-specified Internal message fault
+341	"Input overflow"	LAN card input data buffer is too full.
+342	"Internal overflow"	Serial receive buffer in LAN card is full because the Main micro sent too many characters
+343	"Internal timeout"	LAN card did not receive response from supply before timeout period
+344	Internal checksum	LAN card received checksum error, from supply
+345	"Internal checksum error"	LAN card detected checksum error in message from supply
+399	"Unknown Error"	Error not known

11. CUSTOMER SUPPORT

For further assistance regarding the LAN interface, please contact the factory or a local service center in your area.

To get a list of service centers in your country, go to:

www.US.TDK-Lambda.com/HP/service.htm