

User manual for LAN interface **LXI** SFL series DC electronic load device

Apply:

This manual applies to LAN cards with firmware 1.0.0.4 or later versions.

Supplement to the Operating manual

Refer to the SFL Series electronic load Operating manual for load installation, safety requirements, specifications, front panel operation, and use of communication interfaces.

M-2579-02 (1.1)

Blank page

Table of contents

1. Overview	1
1.1. Explanation	1
1.2. Features	2
2. Specification	3
2.1. DC electronic load specifications	3
2.2. LAN specifications	3
2.3. LAN command transmission interval	4
3. Control method selection	5
3.1. Abundant control methods	5
3.2. LAN or USB	5
3.2.1. Load mode selection (front panel)	5
3.2.2. USB remote mode selection	5
3.2.3. LAN remote mode selection	5
3.3. LAN option rear panel view	6
3.3.1. Link / Active LED (green):	6
3.3.2. Speed LED (yellow):	6
3.3.3. LAN status LED:	6
4. Connecting to the network	7
4.1. LAN cable	7
4.2. Network type	7
4.3. Turn on the power	8
4.4. IP address	8
4.5. Host name	9
4.6. DNS service name	10
5. LAN setup	11
5.1. View of IP and MAC addresses	11
5.2. IP address change	12
5.3. LAN reset	12
5.4. Default LAN settings	13
6. Web page	14
6.1. Benefits of web pages	14
6.2. Open a web page	14
6.3. Web page	15
6.4. Login	16
6.4.1. Login rules	16
6.5. Load Control page	17
6.5.1. Load Control → Output page	17
6.5.2. DC Electronic Load → Utility page	20
6.6. LAN page	21
6.6.1. LAN → Configure page	21
6.6.2. LAN → Advanced page	23
6.6.3. LAN → Users page	25
6.7. HELP page	25
7. Programming with VISA drivers	26
7.1. VISA description	26
7.2. VXI-11 compatibility	26
7.3. Open VISA connection	26
7.4. Communication using VISA	26
8. Programming with IVI drivers	27
8.1. IVI description	27
8.2. IVI support	27

9. Programming with sockets	28
9.1. Socket description	28
9.2. Communication using socket	28
9.3. Controller access: Single and multiple clients.....	28
9.4. Input buffer request	29
9.5. Message terminator	29
9.6. Using TCP sockets.....	30
9.7. Using UDP sockets	30
10. Connection using WAN	31
10.1. View web page over WAN.....	31
10.2. Use sockets over WAN	31
11. LAN-specific commands	32
11.1. Document syntax	32
11.2. LAN-specific commands	32
11.2.1. Blinking remote display	32
11.2.2. Read host name.....	32
11.2.3. Read IP address	32
11.2.4. Read MAC address.....	32
11.2.5. Hostname and description reset	33
11.2.6. Reset LAN settings	33
12. Troubleshooting	34
12.1. IP address and LAN status cannot be read, LED remains red	34
12.2. All IP addresses are zero and LAN status LED remains red	34
12.3. Cannot communicate with SFL series electronic load	35
12.4. Web pages are not displayed via peer-to-peer network	35
12.5. I can't see the Web on a PC with multiple LAN ports	35
13. Glossary	36

Table of Figures

Figure 1. Front panel LAN function display	1
Figure 2. Rear panel LAN function	1
Figure 3. LAN Options Rear Panel View	6
Figure 4. Server network connection diagram	7
Figure 5. Peer-to-peer connection diagrams	7
Figure 6. Web page	15
Figure 7. Login	16
Figure 8. Load Control page	17
Figure 9. LAN page	21
Figure 10. HELP page	25

1. Overview

1.1. Explanation

The SFL series electronic load can be remotely controlled with using LAN (Local area network) option. For this remote control, the Ethernet connection is used. It can be controlled through a web browser to work through the built-in web server. For applications that include factory or test automation, communication can be done using some standard network protocols and equipment commands. Refer to the SFL Series electronic load Operating manual for optional installation, safety requirements, specifications, sample connection, front panel operation, and use of communication interfaces.

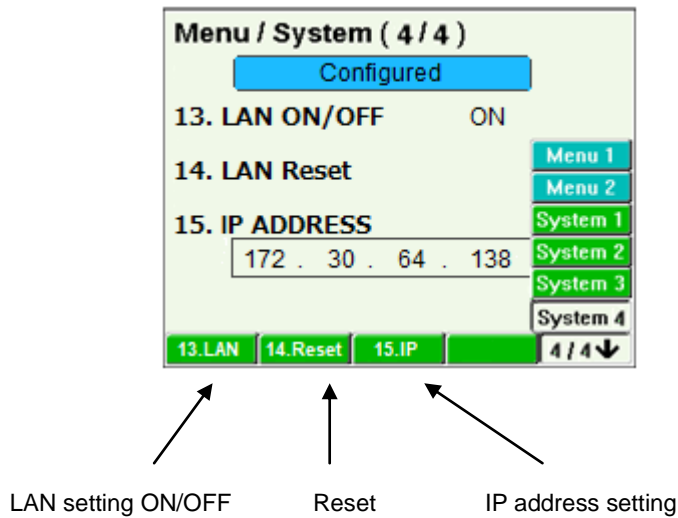


Figure 1. Front panel LAN function display

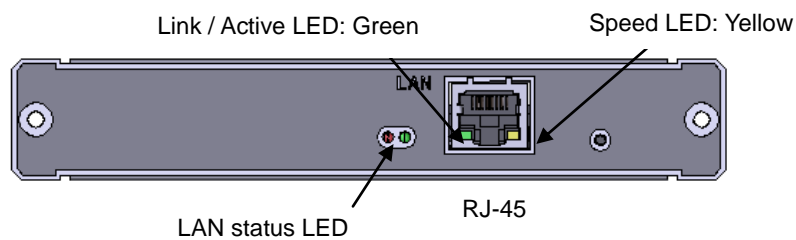


Figure 2. Rear panel LAN function

1.2. Features

A. Communicate over standard TCP / IP networks.

1. LAN (Local Area Network)
2. WAN (Wide Area Network)
3. Communicate using the Internet.

B. Web pages that can be displayed by any web page browser such as Internet Explorer

1. Configure network connection settings.
2. Web page (GUI) for setting and measurement
3. Security settings to block unauthorized connections.
4. Optional password protection prevents unauthorized operation.

C. LAN protocol

1. VISA, TCP and UDP sockets are supported.
2. Supported ARP, DNS, mDNS, and DNS-SD connection protocols
3. VXI-11 discovery and PING server are supported.

D. LXI

1. Comply with the LXI standard (revision 1.5) of the network configuration.
2. The LAN Status LED indicator is ON when a network connection is established.
3. IVI.NET and IVI-C drivers are downloadable.
4. Easily create custom automation programs.



E. Full remote programming capabilities

1. Compatible with VISA driver and all test and measurement utilities.
2. TCP and UDP sockets support PLC, Linux, and other non-VISA controllers.
3. Multiple simultaneous socket connections are allowed.

F. Front panel function

1. Set IP address on the front panel.
2. Reset LAN on the front panel.
3. The user can remotely "blink" the display panel to find the master unit in the rack.

G. Rear panel function

1. Ethernet RJ-45 connector (standard 8-pin jack for LAN)
2. RJ-45 connector link and active LED
3. Speed LED on RJ-45 connector
4. The LAN status LED is used as "LAN failure display" and "blinking identification".

Notice regarding trademarks

LXI is a trademark of LXI Consortium, Inc.
Microsoft and Windows are trademarks of Microsoft Corporation.

2. Specification

2.1. DC electronic load specifications

When using a LAN, the command specifications are the same as for remote programming using IEEE / USB, except for some parts. For these specifications, refer to the SFL series electronic load Operating manual.

Measurement command	USB / IEEE / LAN common commands
Load setting command	
Sweep command	
Sequence command	

For LAN-specific commands, see Section 11.2. LAN-specific commands.

2.2. LAN specifications

Electrical specifications	
Ethernet	IEEE802.3 compliant
Auto-MDIX	Straight or crossover cable connection
Auto-Negotiate	Choose the faster of 10Base-T or 100Base-T networks (10 or 100 MB / sec)
Network settings	
MAC address	00: 19: f9: xx: xx: xx
IP address	Display or set the address
DHCP	IP address obtained from network server
Auto-IP	Automatically generate your own IP address: 169.254.xx.xx
Static IP	Any IP static address
DHCP lease time	Minimum 20 seconds
DHCP auto-reconnect	Restore connection if DHCP server goes down and restarts
Address Resolution	ARP protocol
Host name	DNS and mDNS protocols Operator-configurable host name
Service name	DNS-SD Service Discovery Protocol
Duplicate IP Detection	Detect duplicate address settings
Sub-net mask	DHCP or statically configured mask
Default gateway	DHCP or statically configured address
DNS server	Address set by DHCP
VXI-11 Discovery	Detect connected devices
Ping server	Check LAN connection
LAN reset	Reset network configuration from front panel or SCPI command
LAN protocol	
IPv4	Internet protocol version 4
Device protocol:	
VXI-11	Supports core channels (excluding aborts and interrupts)
VISA	Uses VISA VXI-11 compliant RPC and portmapper
TCP Sockets	Use port 8003
UDP Sockets	Use port 8005
HTTP	Web page server with Javascript

Multiple controller

Single client settings

Only one may be opened at a time:

Web page (logged in as "admin"), VISA, TCP socket

Simultaneous access by multiple clients

Multiple client settings

WEB page

Multiple users

It can open multiple web pages at once

ID

Identify electronic load models, serial numbers, revisions, etc.

LAN configuration

View and set LAN configuration

Active Control GUI

Program and read settings

Send Commands

Send and receive commands

Help

Links to websites / documents

Configuration

Local control

Can be operated from the front panel when using a LAN

LAN remote control

Can be controlled and monitored via LAN

USB control

Can be controlled and monitored via USB

Parallel load

Standard SFL series specifications apply even when using LAN

Indicator

IP address

Shows the address on the front panel

MAC address

Shows the address on the front panel

Links and activity LEDs

See LAN status indicator specifications

Speed LED

See LAN status indicator specifications

LAN status LED

See LAN status indicator specifications

Blink Identify

Front remote display and LED on the rear blink

Security

Web page password

Password lock for LAN or electronic load settings

Single Client Only

Limited to a single client so that multiple clients cannot be controlled

Block UDP Sockets

Block attacks via UDP sockets

Disable mDNS

Reduce network traffic

Disable VXI-11 Discovery

Stop load detection

Disable Ping

Stop load detection

2.3. LAN command transmission interval

Send commands more than 100ms to 400ms (depending on command) apart.

3. Control method selection

3.1. Abundant control methods

The SFL series electronic loads can be controlled using USB in addition to LAN. For details on local (front panel) and USB control, refer to the SFL series electronic load Operating manual.

3.2. LAN or USB

Electronic loads with the LAN option installed can be operated through three interfaces. This Section describes how to enable each of them.

	Mode	Mode description	
1	LAN	Controlled by Ethernet connection	Do not use the USB port when using a LAN.
2	Local	Control with front panel encoder and buttons	
3	USB	Controlled by USB connection	Do not use the LAN port when using USB.

3.2.1. Load mode selection (front panel)

If the load is in remote mode, you will see a "remote" message on the front panel. You can release the remote and return it to local by pressing the "CANCEL" key. If the "CANCEL" key does not switch the load to local mode, do the following:

If the LAN program is running, it will automatically be remote every time you send a command. Stop the LAN program and press the "CANCEL" key.

3.2.2. USB remote mode selection

USB remote control may be selected even if the LAN option is installed. The USB remote control is described in the SFL series electronic load Operating manual. The LAN has the same function as the USB remote control.

To select USB mode:

- A. Open "Menu / System (4/4)" by operating the front panel.
- B. Select "13. LAN ON / OFF" and set to OFF.

3.2.3. LAN remote mode selection

Selecting LAN mode allows programming over an Ethernet cable. Settings and measurements can be performed from a remote computer using the load's built-in web page or by using programming commands.

To select LAN mode:

- A. Open "Menu / System (4/4)" by operating the front panel.
- B. Select "13. LAN ON / OFF" and set to ON.

3.3. LAN option rear panel view

The rear panel of the LAN option is shown below.

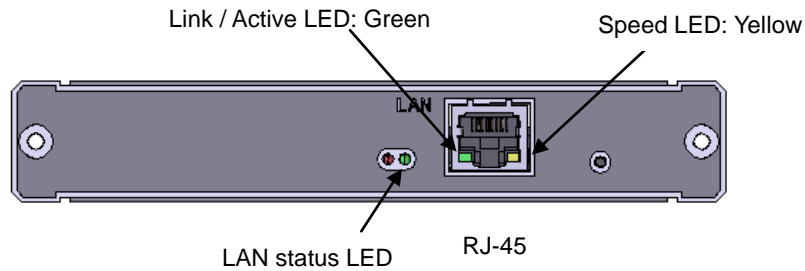


Figure 3. LAN Options Rear Panel View

3.3.1. Link / Active LED (green):

Embedded in an RJ-45 socket, this small LED lights up when connected to an active network and flashes when a message packet is detected.

3.3.2. Speed LED (yellow):

Embedded in an RJ-45 socket, this small LED turns on at 100 Mbps and turns off at 10 Mbps.

3.3.3. LAN status LED:

These are the red LED (left) and the green LED (right) next to the RJ-45 connector.

- Normal operation: The green LED will light up. The load has an active LAN connection.
- Device identification status: Blinks green. The identification feature is turned on from a remote computer using a web page or command. The REMOTE display on the front panel also blinks. Blinking can be turned off by a web page (Load Control/Output/Blink Identify), sending a "blinking OFF" command (see Section 11.2.1), or by controlling the front panel (Press "CANCEL").
- LAN failure: The red LED lights up. Indicates that LAN mode is not enabled, the LAN connection is not established, or the LAN connection was established and then disconnected.

4. Connecting to the network

4.1. LAN cable

The LAN cable must be prepared by the customer. This can be a standard straight "patch" CAT-5 (or higher) network cable, or it can be a "crossover" cable with one end of the pin reversed. The cable type is automatically detected by SFL.

4.2. Network type

There are basically two types of networks. :

- A. Networking with Servers:** This is a typical local area network that server computers and network administrators continue to run. The server automatically assigns the IP address and other settings to the electronic load.

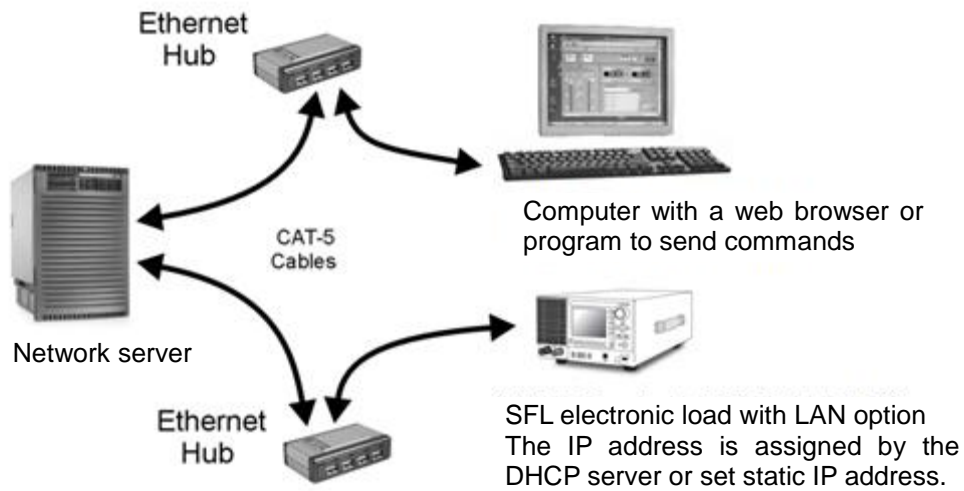


Figure 4. Server network connection diagram

- B. Peer-to-peer network:** This is usually the case when you connect the SFL directly to a computer that is not a network server. SFL configures its own IP address and other settings.

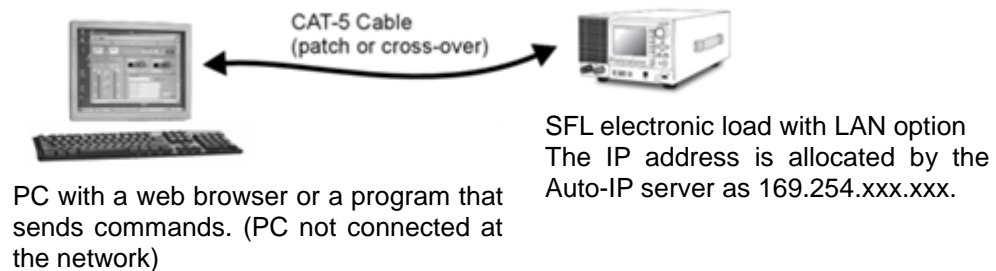


Figure 5. Peer-to-peer connection diagrams

4.3. Turn on the power

SFL with LAN option will automatically detect if you are connected to the network. It also automatically searches for network servers and obtains or creates an IP address. Broadcast the IP address and host name to all other devices on the network.
increase.

- A. Turn on the power of SFL.
- B. For DHCP servers or static IP networks, wait approximately 15 seconds.
- C. Notice that the LAN status LED on the rear panel turns green.
- D. For peer-to-peer networks, wait about 40 seconds.
Notice that the LAN status LED on the back panel turns green.
When the LAN status LED turns green, it changes to a valid address.
The IP address can be seen on the front panel. (See Section 5.1)

Note

If the LAN status LED does not turn green, see Section 12 of troubleshooting procedure.

4.4. IP address

Use an IP address to open a network connection in an easy and reliable way. This is a group of four numbers separated by periods (e.g., 10.1.15.123). This IP address can be seen from the front panel. (See Section 5.1)
As shown in this table, there are three modes in which the load can get an IP address.

IP address	DHCP	Auto-IP	Static IP
Mode selection	DHCP is the default after "LAN reset"	This is the default after "LAN reset" if the DHCP server is not used.	It can be set on the LAN Modify web page (see 6.6) or by setting the IP address on the front panel (see Section 5.2).
Assignment	Assigned by a network server.	Assigned by load.	Assigned by setting the IP address on the LAN Modify web page (see Section 6.6) or on the front panel (see Section 5.2).
Range	Any address	169.254.xxx.xxx	Any address
Lifetime	The address may change as the DHCP server dynamically sets the address.	It is fixed to the electronic load unless duplicate addresses are detected.	Always fixed to the electronic load
Duplicate address	The DHCP server prevents duplicate IP addresses.	Find another available address.	Revert to the original IP (before change). The LAN status LED (green) flashes. If AC ON detects IP duplication (when the device is in static IP mode), the IP will be 0.0.0.0 and the LAN status LED (red) will light up.

4.5. Host name

Hostname is a way to communicate to a load by using a name instead of an IP address. You can find the host name of the load on its web home page. To use a host name, you need a network with a naming service such as DNS.

The factory default host name has the following format:

<SFL><Voltage or Current specification>-<Last 3 digits of MAC address>

For the default host name, use the higher value of the voltage or current rating, then add V or A. If the voltage and current contain a decimal point, the default host name uses the higher value of the voltage or current rating before adding V or A. The decimal point is replaced with p. The last 3 digits of the MAC address skip all characters.

Factory default host name example:

Model	Default host name
SFL 500-12-300	SFL500V-055
SFL 120-180-1K	SFL180A-17E

You can create a custom host name from a web page. (See Section 6.6.1.). For example, you can change the host name to Heater_3.

Hostname Conflict: Electronic load can detect if the hostname is already in use by another device. This is called a host name conflict. In this case, the electronic load makes its name unique by adding dashes and numbers. For example, Heater_3-2.

LAN reset (see Sections 5.3 and 5.4) does not change the host name, even if it is a custom name, but it may remove the dash and number if the host name conflict is resolved.

To use the factory default hostname, open the LAN Modify web page and enter a blank for the new hostname (see Section 6.6.1.) or send the DIAG:COMM:LAN:FAC command. (See Section 11.2.5).

Note

After restoring the factory default host name, you will need to power cycle to enable the settings.

The host name can be confirmed in each network mode as shown in the table below.

Host name	DHCP	Auto-IP	Static IP
Default Host name	SFLnnnx- (See above)	SFLnnnx- (See above)	Host name Usage prohibited
Host name protocol	DNS host name	DNS host name	Host name Usage prohibited
On a web page Host name	Show the host name on the LAN Configure page	Show the host name on the LAN Configure page	Host name Usage prohibited

4.6. DNS service name

The "Description" on the web page is also the DNS-SD service name. The service name may be used on networks running the DNS-SD protocol (also known as the "Bonjour" discovery protocol). The factory default "Description" has been added to "SFL Electronic DC Load SFL":

<SFL><Voltage or Current rating>

The default Description uses the higher number of voltage or current ratings before adding V or A. It's similar to a host name, but it doesn't have a MAC address.

Example: SFL Electronic DC Load SFL500V

You can create a custom service name from a web page. (See Section 6.6.1. "Description"). For example, you can change the service name to AuxMixer.

Service name conflict: SFL series electronic load can detect if a service name is already in use by another device. This is called a service name conflict. In this case, the SFL series electronic load makes its name unique by adding parentheses and numbers. For example, AuxMixer (2).

LAN reset (see Sections 5.3 and 5.4) does not change the service name, even if it is a custom name, but the dash number may be removed if the service name conflict is resolved.

Restore factory settings: Opens the LAN. From the web page, enter a blank in Description (see Section 6.6.1) or send the DIAG:COMM:LAN:FAC command (see Section 11.2.5).

Note

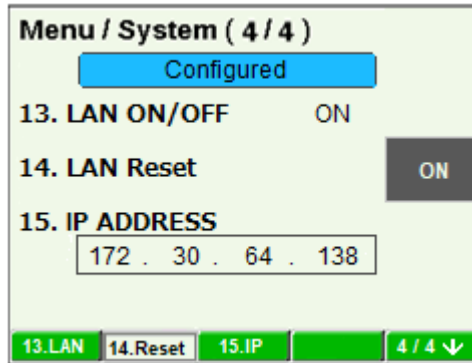
After restoring the factory default "Description" and service name
It is necessary to restart the SFL series electronic load for the
setting to take effect.

5. LAN setup

5.1. View of IP and MAC addresses

If you have LAN enabled, you can display the IP address and MAC address on the front panel by following the steps below.

A) You can check the IP address in "Menu / System (4/4)".



B) You can check the MAC address in the version display of "Menu / System (2/4)". You can also check it with a LAN command (see Section 11.2.4: SYS:COMM:LAN:MAC?).

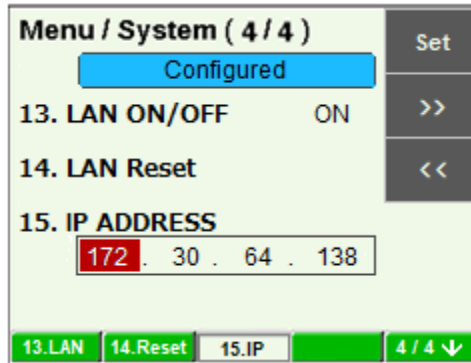


5.2. IP address change

The IP address consists of four numbers.
(Example: "192.168.53.44"). For each number, you can select any number from 0 to 255.

When changing the IP address, the SFL series electronic load must be in local mode.
See Section 3.2.1 for settings to local mode. When changing the IP address, it automatically changes to the static IP address mode.

- A. Open "Menu / System (4/4)" and select 15.IP ADDRESS
- B. Select the part wanting to change with ">> / <<" on the right and turn the dial to set it.
- C. Press "Set" button.



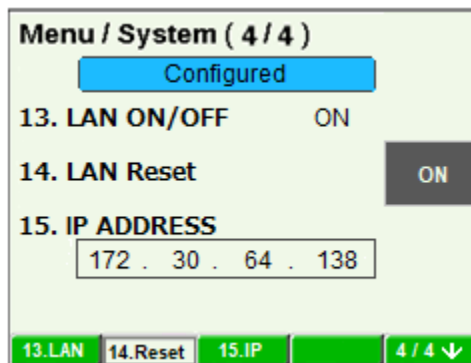
If there is already an address (duplicate address) that you are trying to set on another device, the address will revert back to the state before the change was made.

Note
If you change the IP address from the front panel,
The SFL series LAN switches to STATIC addressing.
(DHCP and AUTO IP addressing will be disabled)

5.3. LAN reset

To return the LAN settings of the SFL series electronic load to the default settings, set as follows on the front panel. The LAN settings must be the default for DHCP to take effect.

- A. Open "Menu / System (4/4)" and press 14.Reset.



5.4. Default LAN settings

DHCP enabled

If DHCP fails to get a lease, the auto-IP setting will take effect:

IP address	169.254.xxx.xxx (See Section 4.4)
Sub-net mask	255.255.0.0
Default gateway	0.0.0.0
DNS server	0.0.0.0

Hostname	SFL<nnn><V or A> -<nnn> (See Section 4.5)
Description	SFL Electronic DC Load<nnn><V or A> (See Section 4.6)
Controller Access	1 client only
Keep-Alive	1800 seconds (30 minutes)
Auto-Negotiate	Automatically select network speed
Ping Server	valid
VXI-11 Discovery	valid
Multicast DNS	valid
Password	None

6. Web page

6.1. Benefits of web pages

SFL series web pages are useful when:

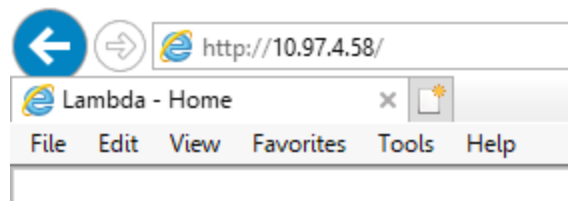
- Reading SFL Series electronic load Model, ID, Revision, and LAN Setup Information
- LAN connection configuration
- Setting and reading of SFL Series electronic load

All this is done graphically.

6.2. Open a web page

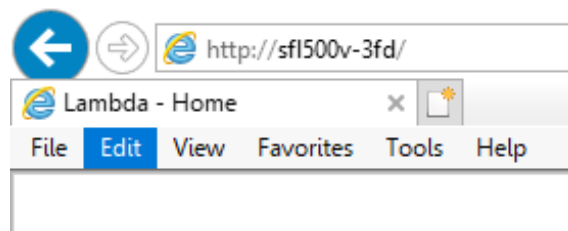
When the LAN Status LED on the rear panel turns green (see Section 3.3.3), open the SFL Series web page.

- A. Open "Menu / System (4/4)" and read the IP address from the front panel of the SFL series electronic load (see Section 5.1 for details).
- B. Open a web page browser program such as Internet Explorer. Enter the IP address of the SFL series electronic load as shown below. Click the GO button.



The SFL Series electronic load web page opens. If it doesn't open, see Troubleshooting Section 12.


- C. Alternatively, you can use the host name to address the web page as shown below (if the SFL series electronic load is set to "DHCP / Auto-IP", and the DNS naming service is running on your computer). See Section 4.5 for a description of the host name.



The SFL Series electronic load web page opens. If it doesn't open, see Section 12.

6.3. Web page

The following page is displayed when the web page is first opened or refreshed.



TDK-Lambda
SFL Series
Programmable DC Electronic Loads
Half-Rack 3U 300W / Full-Rack 3U 1000W

Home	Welcome		LAN	
Load Control	TDK-LAMBDA Model:	SFL 120-60-300	IP Address	10.97.4.26
LAN	Manufacturer:	TDK-LAMBDA	MAC Address	00:19:F9:00:00:98
Help	Serial Number:	010009	Hostname	SFL120V-098.local SFL120V-098
	Maximum Output Ratings:	120V - 60A - 300W	LXI Version	1.5 LXI Device Specification 2016
	Main Firmware Revision:	4.3.4R1	Auto-MDIX	Enabled
	LAN Firmware Revision:	0.0.0.3	Auto-Negotiate	Auto select
			Multicast DNS	Enabled
	VISA			
	Description:	Electronic DC Load SFL120V		
	VISA Name using IP Address:	TCPIP::10.97.4.26::INSTR		
	VISA Name using Hostname:	TCPIP::SFL120V-098::INSTR		

© Copyright TDK-Lambda 2021

Figure 6. Web page

VISA Name Using IP Address: Can be used for VISA resource descriptors when running VISA automation programs. See Section 7.

VISA Name Using Hostname: Can be used as an alternate VISA resource descriptor for automated programming that uses the host name of the SFL series electronic load. See Section 4.5.

Hostname: A unique name for the device on the network. See Section 4.5 and Section 4.6.

Auto-MDIX: LAN will automatically detect if a patch or crossover LAN cable is used.

Auto-Negotiate: Adjusts the communication speed automatically.

Multicast DNS: The LAN broadcasts its host name even if the network server does not exist. This is useful when connecting over a simple peer-to-peer network.

6.4. Login

To change the SFL series electronic load or LAN settings, the user must first log in. Click the Load Control tab or the LAN tab (on the left side of the web page) to display the login box.

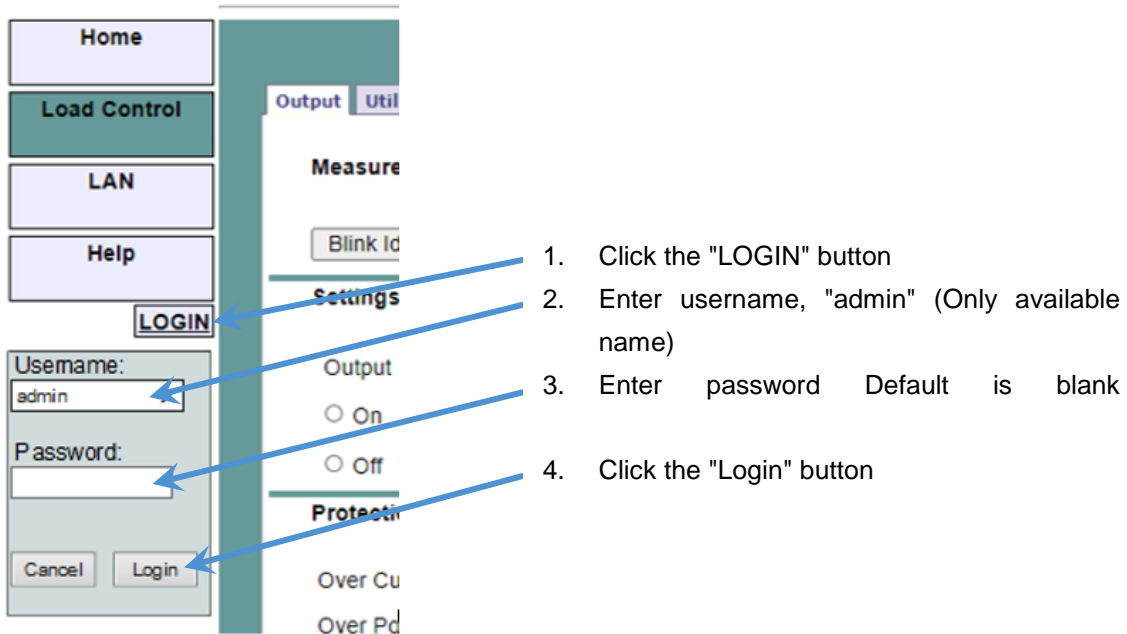


Figure 7. Login

Password can be set / deleted on LAN → Users web page

You can clear the password with the front panel LAN reset or LAN reset command. (Refer to Section 5.3. and 11.2.6 for command.)

6.4.1. Login rules


- Up to 3 users can view SFL series electronic load web pages at the same time. However, the more web pages you open, the slower the update speed.
- Only one user can log in to change the load settings at a time.
- If you are running an automation program with VISA or a socket connection, you can view web pages, but you cannot log in to change the settings.
- If the user is logged in, the automation program will not be able to open VISA or socket connections.
- Users can log out by clicking the Logout button, closing the web browser, or leaving the web browser idle for the LAN login timeout period (see Section 6.6.2).


6.5. Load Control page

Click the Load Control tab to open the following web page. This page and its submenus allow you to control SFL series electronic loads to adjustment output settings.

6.5.1. Load Control → Output page

Select the [Load Control] tab to load the [Output] panel (GUI) first.





TDK-Lambda

SFL Series

Programmable DC Electronic Loads

Half-Rack 3U 300W / Full-Rack 3U 1000W

Home

Load Control

LAN

Help

LOGIN

Output
Utility

Measurements

	Voltage	Current	Power
<input type="button" value="Blink Identify"/>	0.01 V	0.0018 A	0.00 W

Settings

Output	Mode	CC <input type="button" value="v"/>	Current Range	Auto <input type="button" value="v"/>
<input type="radio"/> On	Value	<input type="text"/>	Voltage Range	High <input type="button" value="v"/>
<input type="radio"/> Off	Slew Rate	<input type="text"/>		

Protection / Current Limit Check To Modify

	Load State		Current Limit	
Over Current	<input type="radio"/> On <input type="radio"/> Off		<input type="text"/>	<input type="button" value="Apply"/>
Over Power	<input type="radio"/> On <input type="radio"/> Off		<input type="text"/>	[A]

Register

Questionable	AOV	ALC	ALP	AOT	AE	ARV	ABC	ABM
Reset Alarm	<input type="button" value="Reset"/>							

Clear Device

© Copyright TDK-Lambda 2021

Figure 8. Load Control page

Blink Identify: Click this button to blink the front panel of the SFL series electronic load and the LAN LED (green) on the rear panel. This feature allows you to quickly identify which SFL Series electronic load is being transmitted in the equipment rack.

You do not need to log in as "admin" to use this control.

Blinking can be stopped by clicking the button again, touching the front panel button or rotary knob, or sending the "SYST:COMM:LAN:IDLED OFF" command (Section 11.2.1).

Measurements: Displays the voltage, current, and power measured by SFL series electronic loads.

Settings: These fields allow you to change the operating mode, current and voltage operating range, slew rate, settings, and whether the output is set to ON or OFF for the selected SFL series electronic load.

You cannot change the settings until you log in as "admin" (see Section 6.4).

1. Log in as "admin"

3. Enter the desired settings

Settings

Output	Mode	<input type="text" value="CC"/>	Current Range	<input type="text" value="Auto"/>
<input type="radio"/> On	Value	<input type="text"/>	Voltage Range	<input type="text" value="High"/>
<input type="radio"/> Off	Slew Rate	<input type="text"/>		

Protection / Current Limit

Over Current	Load State	<input type="radio"/> On <input type="radio"/> Off	Current Limit	<input type="text"/>	Check To Modify <input type="checkbox"/>
Over Power		<input type="radio"/> On <input type="radio"/> Off		[A]	<input type="button" value="Apply"/>

4. Set to Output ON or OFF

2. Check

5. Click "Apply".
Confirm the load setting change.

Protection / Current Limit: These fields allow you to set the current limit value for SFL series electronic loads.

1. Log in as "admin"

Settings

Output Mode Current Range
 On Value Voltage Range
 Off Slew Rate

Protection / Current Limit

Over Current On Off Load State Check To Modify
 Over Power On Off Current Limit [A]

3. Set the limit value

4. Click "Apply".
Confirm the load setting change

2. "Check"

Note

Check on "**Check to Modify**" and the "**Apply**" button are common to the Settings and Protection / Current Limit Sections.

Register: These boxes display the status of SFL series electronic loads (alarms and errors). These are the registers read by ST and QUES queries. Refer to the SFL Series Electronic Load Operating Manual for status and register descriptions.

Register

Questionable

Reset Alarm

Clear Device: This button returns to the power-on condition. Refer to the status and register description in the SFL series Electronic Load device Operating Manual.

Clear Device

6.5.2. DC Electronic Load → Utility page

This page is used to send commands and check responses. This is an operation learning tool that allows you to send commands that are not otherwise available on your web page. The commands are described in Section 11.



TDK-Lambda
SFL Series
Programmable DC Electronic Loads
Half-Rack 3U 300W / Full-Rack 3U 1000W




You must be logged in as "admin" to send commands (see Section 6.4 to log in). Enter your message in the text box at the top. Then click the Send and Read button. For commands, there is no response. For queries, the response is displayed in the central text box.

6.6. LAN page

Click the "LAN" tab to open the following web page. This page and its subpages allow you to view and configure LAN settings for SFL series electronic load. You must be logged in as "admin" to change the settings. See Section 6.4 for login.

6.6.1. LAN → Configure page

Select the LAN tab to open the Configure panel:



TDK-Lambda

SFL Series

Programmable DC Electronic Loads

Half-Rack 3U 300W / Full-Rack 3U 1000W

Home

Load Control

LAN

Help

LOGIN

Configure
Advanced
Users

Present LAN Configuration	
IP Address Source:	DHCP/Auto IP
IP Address:	10.97.4.7
Subnet Mask:	255.255.254.0
Default Gateway:	10.97.4.1
DNS Server:	10.97.2.244
Hostname:	SFL500V-3FD
Description:	Electronic DC Load SFL500V
Controller Access:	One Client Only

© Copyright TDK-Lambda 2021

Figure 9. LAN page

The following settings are displayed on the LAN → Configure web page.

IP Address Source: Displays the IP address allocation method. Choices are DHCP / Auto IP and Static IP

IP Address: Displays the IP address assigned to the SFL Series electronic load via DHCP, Auto IP or static IP source.

Subnet Mask: Shows the subnet mask assigned to the SFL series electronic load via either DHCP, Auto IP, or static IP.

Default Gateway: The address of the network router that allows the SFL series electronic load to communicate outside the local subnet.

DNS Server: The address of the server running the domain name service. This is used to address the host name.

Host Name: You can use the host name of the SFL series electronic load instead of the IP address to create a communication link. The default hostname is taken from the model and MAC address (see Hostname in Section 4.5). Or you can change it on the LAN → Configure → Modify web page. See Section 6.6.1.

Description: By default, this is "Electronic DC Load SFL...>" (see Section 4.6), but it is subject to change on the LAN → Configure → Modify web page. See Section 6.6.1.

Controller Access: The "One Client Only" setting is the highest level of network security and is the default setting. This setting allows you to open only one VISA or TCP socket at a time, and disables connectionless UDP sockets. See Section 9.3.

Modify: After logging in (see Section 6.4), click this button to change the settings as shown in the next Section.

LAN → Configure → Modify page

You can change the LAN settings using the "LAN" → "Configure" → "Modify" button. You must be logged in as "admin" for the button to take effect.

DHCP Enabled / Auto IP

This is the default setting for SFL series LANs.



TDK-Lambda

SFL Series

Programmable DC Electronic Loads

Half-Rack 3U 300W / Full-Rack 3U 1000W

LAN Modify

Static IP DHCP Enabled / Auto IP

10	97	4	7
255	255	254	0
10	97	4	1
10	97	2	244

SFL500V-3FD
Electronic DC Load SFL500V

One client only Multiple clients

Apply Close

© Copyright TDK-Lambda 2021

If you select the DHCP Enabled / Auto IP radio button, you can change only the following settings. Invalid settings (gray) are set by the DHCP server on your network.

Host Name: If your network supports DNS services, you can use the host name instead of the IP address to establish the connection. You can enter a custom name for the SFL Series electronic load such as[SFL500V-3FD].

To restore the host name to the factory default, clear the host name text box and click [Apply].

Description: The Description can be viewed on a web page. If your network supports the DNSSD protocol, it will also be advertised as a load service name. You can enter a custom Description that describes the load.

To return the Description to factory defaults, clear the Description text box and click [Apply].

Controller Access: Select the "One Client Only" or "Multiple Clients" security feature. Multiple client configurations are required to allow multiple controller connections at once and enable UDP socket connections. See Section 9.3 for more information.

Apply: Click this button to save the new settings. A pop-up box may ask you to close or refresh the page. The "admin" login will be logged out.

Close: Click this button to return to the LAN Configure page shown in Section 6.6.1.

Static IP

In many automation systems, the device's IP address is statically configured. This prevents possible IP address changes if you use a DHCP server to generate the address.

If the Static IP button is selected, you can change the following settings on the web page:



TDK-Lambda

SFL Series

**Programmable DC Electronic Loads
Half-Rack 3U 300W / Full-Rack 3U 1000W**

Home

Load Control

LAN

Help

LOGIN

LAN Modify

Static IP DHCP Enabled / Auto IP

IP Address	10	97	4	7
Subnet Mask	255	255	254	0
Default Gateway	10	97	4	1
DNS Server	10	97	2	244

Hostname: SFL500V-3FD
 Description: Electronic DC Load SFL500V

One client only Multiple clients

© Copyright TDK-Lambda 2021

Note

If the new IP address is already used by another device on the subnet, (in case creating duplicate IPs), the new address will be rejected. SFL series electronic loads will continue to use the old address. The rear panel flashes until the front panel button is pressed.

Note

When using Static IP, the host name address designation is Not supported.

6.6.2. LAN → Advanced page

Click the LAN → Advanced tab to see the LAN settings.



TDK-Lambda

SFL Series

**Programmable DC Electronic Loads
Half-Rack 3U 300W / Full-Rack 3U 1000W**

Home

Load Control

LAN

Help

LOGIN

Configure
Advanced
Users

Present LAN Configuration	
LAN Timeout (sec):	1800
Ping Server:	Enabled
Auto-Negotiate:	Auto Select
Vxi Discovery:	Enabled
Auto-MDIX:	Enabled
Multicast DNS:	Enabled

© Copyright TDK-Lambda 2021

You can change the settings by logging in as "admin" and clicking the "Modify" button.



SFL Series
 Programmable DC Electronic Loads
 Half-Rack 3U 300W / Full-Rack 3U 1000W

Home	<p>LAN Modify</p> <p>Login Timeout <input type="text" value="1800"/> Seconds</p> <p>Ping Server <input checked="" type="radio"/> Enable <input type="radio"/> Disable</p> <p>Auto-Negotiate <input type="text" value="Auto select"/> ▾</p> <p>VXI-11 Discovery <input checked="" type="radio"/> Enable <input type="radio"/> Disable</p> <p>Multicast DNS <input checked="" type="radio"/> Enable <input type="radio"/> Disable</p> <p><input type="button" value="Apply"/> <input type="button" value="Close"/></p>
Load Control	
LAN	
Help	
<u>LOGOUT</u>	

© Copyright TDK-Lambda 2021

Login Timeout: When logged in as "admin", this is the timeout period until you are automatically logged out. Or when you are using a VISA or TCP socket, the timeout period to close the port if there is no connection.

The default time is 1800 seconds = 30 minutes. Maximum = 60000 (~ 16 hours).

Ping Server: "Ping" is a network utility that allows a computer to check the communication status with SFL series electronic load. This service may be disabled for security reasons.

Auto-Negotiate: Sets the network speed at which SFL series electronic loads can operate. The choices are 100 Mbps, 10 Mbps (slow), or automatic selection.

VXI Discovery: A protocol that allows a network server to detect devices connected to a LAN. It may be disabled for security reasons.

Multicast DNS: mDNS allows devices on your network to advertise and use hostname addressing even when a DNS server is not connected. This service may be disabled for security reasons or simply to reduce network traffic.

Apply: Click this button to save the new settings. A pop-up box asks if you want to close or refresh the page. The "admin" login will be logged out.

Close: Click this button to return to the LAN details page above.

6.6.3. LAN → Users page

This page allows you to create password protection for web pages. There is no password protection for automated programming using VISA or sockets (see Sections 7 and 9). By default, "old password" is blank. The new password should be 6 to 16 characters long. The characters you can use are a to z, A to Z, and 0 to 9. Passwords are case sensitive.

Reset Password: Once the password has been created, you can either perform the LAN Reset function from the front panel of the SFL Series electronic load (see Section 5.3) or use the LAN reset command (Section 11.2.6.) to remove the password.

TDK-Lambda

SFL Series

*Programmable DC Electronic Loads
Half-Rack 3U 300W / Full-Rack 3U 1000W*



Home
Load Control
LAN
Help
LOGOUT

Configure Advanced **Users**

Change Password

Enter old password

Enter new password

Retype new password

© Copyright TDK-Lambda 2021

6.7. HELP page

A Help tab is available. This page is a set of internet links to the TDK-Lambda website page. The network administrator or DHCP server must assign a load default gateway (see Section 2.2.) and grant access to view and download from the Internet.

TDK-Lambda

SFL Series

*Programmable DC Electronic Loads
Half-Rack 3U 300W / Full-Rack 3U 1000W*



Home
Load Control
LAN
Help

Help

[View the Lambda Home Page](#)

© Copyright TDK-Lambda 2021

Figure 10. HELP page

7. Programming with VISA drivers

7.1. VISA description

Virtual Instrument Software Architecture (VISA) is a popular framework that includes hardware drivers, configuration utilities, and connection managers. Various communication buses are supported. VISA drivers are available from several equipment vendors.

Programming languages that support Windows COM or DLL libraries can call VISA functions. VISA drivers are available for download for Windows, Linux, and Mac OS. Some licenses may apply.

Remote programming uses a LAN connection to send text commands to the SFL series electronic load and read back the text response. See Section 11 for the format.

7.2. VXI-11 compatibility

VXI-11 is a protocol that enables communication between computer ports and devices. VISA is built on the VXI-11 specification. The SFL series is compatible with the VXI-11 protocol.

- VXI-11 Device_link Open link to device
- VXI-11Device_write Write text to the device
- VXI-11Device_read Read text from device
- VXI-11Destroy_link Close link to device

7.3. Open VISA connection

The VISA library makes it easy to write test and automation programs. Supported VISA features include open, read, write, and close.

The VISA resource descriptor is used to describe a particular load. For SFL series, the descriptor is on the SFL series electronic load web page. VISA resources may use the IP address or host name of the SFL series electronic load.

Here is an example of a VISA resource descriptor for an SFL series electronic load over a LAN:

Format: TCPIP [board] :: host address [:: LAN device name] [:: INSTR]
 [board] LAN card number, 0 is optional.
 [:: LAN device name] The default is "inst0"
 [:: INSTR] Option

Example: TCPIP :: 10.225.26.60 :: inst0 :: INSTR
 TCPIP :: 169.254.57.10 :: INSTR
 TCPIP :: SFL60-25-470 :: INSTR

7.4. Communication using VISA

The VISA-write function sends the command to the load, and the VISA-read reads the response returned by the query. See the Visa vendor's website for programming examples and support.

8. Programming with IVI drivers

8.1. IVI description

In the testing and instrument industry, "Interchangeable Virtual Instrument (IVI)" is a set of specifications that standardize instrument driver technology. IVI is built based on the VISA hardware driver. The exposed interface of the IVI allows you to use standard calls to .NET, COM, and DLL libraries in almost any programming language.

IVI devices can be configured using management utilities such as the National Instruments Measurement & Automation Explorer (MAX) program and the Agilent I / O Library. IVI settings can also be set programmatically using optional parameters. These have several advantages.

- IVI standardizes common features and reduces the time required to learn new IVI equipment. No need to learn SFL series commands.
- Instrument simulation allows developers to execute code without equipment.
- Perform a status check automatically to ensure that each load setting is acceptable.
- The IVI driver has various wrappers that allow an easy interface to different Windows programming environments.
- The IVI driver provides compatibility that makes it easy to replace equipment without changing the control program.

8.2. IVI support

- There are various websites that provide additional information about IVI.
- The IVI Foundation home page has excellent "Getting Started" tutorials for various programming languages.
<https://www.ivifoundation.org/>
- Pacific Mindworks is a leading developer of IVI technology. They provide several white papers on IVI.
<https://www.pacificmindworks.com/>
- SFL series IVI drivers are available to download from TDK-Lambda Corporation website:
<https://product.tdk.com/en/products/power/switching-power/load/designtool.html>

9. Programming with sockets

9.1. Socket description

VISA (and IVI) drivers are commonly used in the testing and measurement industry. However, some customers may not be able to use VISA due to installation or licensing issues, or because the controller (such as an industrial PLC) does not support VISA.

If you cannot use the VISA driver, you can use a socket connection. These are low-level LAN protocols that are widely available in all operating systems and programming environments.

9.2. Communication using socket

Communication over a socket involves opening a socket connection, sending a text command, and reading a text response (see Section 11.).

The functions that programming languages use to manage sockets are called the TCP stack. The basic socket call for any language is "create, connect, send, read, close".

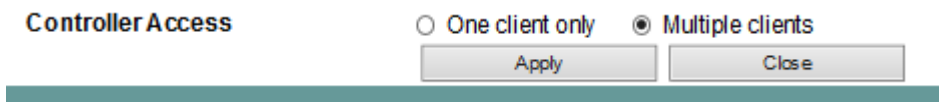
There are two types of socket protocols available: TCP and UDP. Each has its own port number, as described below.

9.3. Controller access: Single and multiple clients

Web pages have security settings that limit or enable the types of connections that can be connected at one time and the number of control computers (called "clients").

Single or multiple client configurations can view LAN → Configure → Modify changes on the web.

See Sections 6.4 and 6.4.1 for information on how to log in as "admin" to change this setting. The default after a LAN reset (see Section 5.4) is only one client.



Note

When a web page, port, and socket are opened at the same time, performance of SFL series LAN interface is affected.

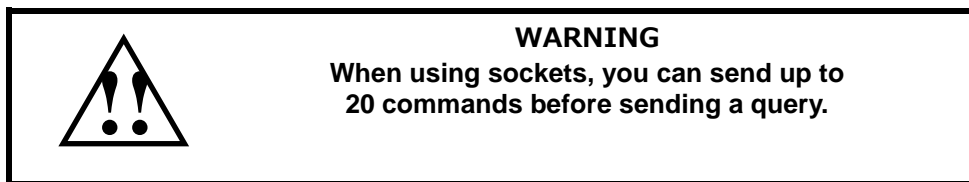
We recommend that you open no more than three at a time.

The rules for one client or multiple clients are as follows:

LAN setting→	For a single client	For multiple clients
Web page Without logging in	You can open up to three web pages at any time. You can view the behavior of SFL series electronic loads, but you cannot change them.	
Web page Login as "admin"	If the VISA or TCP socket port is already open, you will not be able to log in as "admin". If you are logged in, all VISA, TCP, or UDP connections will be blocked.	
VISA connection or TCP socket	If the web "admin" is not logged in, one VISA or TCP socket may be opened.	If you do not have a web page logged in as "admin", you can open multiple VISA, TCP, and UDP sockets at the same time. You can open up to 3 TCP, 3 VISA, or 3 UDP connections at a time. These can be mixed up to a total of three. Additional sessions may affect the communication speed, etc.
UDP socket	UDP messages are blocked.	

9.4. Input buffer request

Controllers that use TCP or UDP sockets allow SFL series electronic loads to send commands much faster than they can process them. To prevent the SFL Series LAN from overloading, the controller must send a query and then wait for a response.



This warning is to prevent the controller (such as a PLC) from sending commands faster than it can process SFL series electronic load commands.

9.5. Message terminator

If you are using a program that sends individual commands over a TCP socket, the socket driver may combine all the messages into one long packet. Therefore, you need to add a message terminator at the end of each command.



Message terminator rules:

	Terminator character (and ASCII hex)
Command from controller	One or more terminators required: Line-Feed, carriage return, or semicolon 0x0A 0x0D 0x3B
Response from SFL series LAN	All responses end with a Line-Feed. 0x0A

9.6. Using TCP sockets

This is the most common socket type. It features managed connections, message acknowledgments, and detection and correction of outbound errors.

Open TCP socket port 8003 and send the command.

Responses to queries are automatically returned with the addition of a terminator.

If the web page's LAN controller access is set to Multiple Clients (see Section 6.6.1), up to three controllers can open TCP sockets for one load at the same time.6.6.1

Instrumentation utilities in the testing and measurement industry support TCP sockets. For example, VISA and IVI can use "data socket" devices with resource names such as:
TCPIP :: 169.254.33.192 :: 8003 :: SOCKET.

9.7. Using UDP sockets

This is a simpler socket type with reduced network traffic. This is a "connectionless" protocol because the message was sent and there was no acknowledgment that the message was received.

Open UDP socket port 8005 and send the command.

Responses to queries are automatically returned with the addition of a terminator.

Before opening the UDP socket, you must open the web page and set the controller access to "Multiple Clients" (see Section 9.3). You can then access one SFL series electronic load at the same time from up to three controllers via UDP sockets.

10. Connection using WAN

To connect over a wide area network (such as the Global Internet), you need to configure the following settings on your network server:

10.1. View web page over WAN

The SFL series load LAN interface has a server listening on port 80. The network administrator must obtain and assign the global IP of the load. On the network server, the network administrator also needs to make sure that port 80 is exposed to the WAN connection.

10.2. Use sockets over WAN

The network administrator must obtain and assign the global IP of the load. On the network server, the network administrator must also ensure that port 8003 (for TCP sockets) or port 8005 (for UDP sockets) is exposed to the WAN connection.

11. LAN-specific commands

LAN-specific commands are for the SFL series with LAN options and can only be used via the LAN interface. For device control commands, refer to the SFL series electronic load Operating Manual.

11.1. Document syntax

Courier Font		Represents a command or response
ABBReviations		Uppercase letters are required. Lowercase letters are optional.
Angle Brackets	<>	command parameters.
Bar		Bar () means "OR" and either one is chosen. What is 1 0 ON OFF? 1 or 0, or ON or OFF is acceptable.

11.2. LAN-specific commands

11.2.1. Blinking remote display

When communicating with multiple SFL series electronic loads in the same location, it can be difficult to know which SFL series electronic load is selected. The LAN can send commands to blink the front panel display of the selected SFL series electronic load. The LAN LED on the back panel will also blink.

If blinking is on, you can turn it off by sending an OFF command or changing front panel controls.

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

Example: SYST:COMM:LAN:IDLED ON

Query: If it is blinking, there is no query.

11.2.2. Read host name

The host name is read in this query (see Section 4.5)

Syntax: SYSTem:COMMunicate:LAN:HOST?

Example: SYST:COMM:LAN:HOST?

Response: The host name can be up to 15 characters long.

Example: SFL500V-055

11.2.3. Read IP address

The IP address (see Section 4.4) is read in this query.

Syntax: SYSTem:COMMunicate:LAN:IP?

Example: SYST:COMM:LAN:IP?

Response: The IP address can be up to 15 characters in length.

Example: 192.168.37.219

11.2.4. Read MAC address

Read the MAC address in this query

Syntax: SYSTem:COMMunicate:LAN:MAC?

Example: SYST:COMM:LAN:MAC?

Response: The MAC address can be up to 17 characters in length.

Example: 00:19:F9:00:00:55

11.2.5. Hostname and description reset

The host name and description (which is also the DNS service name) is reset to factory setting by entering a blank in the LAN (see Section 6.6.1.) or by sending the following command: This command closes all open ports and LAN communication is lost.

Syntax: DIAGnostic:COMMunicate:LAN:FACTory

Example: DIAG:COMM:LAN:FAC

Note

After restoring the factory default hostname,
It is necessary to restart the SFL series electronic load for activation.

11.2.6. Reset LAN settings



WARNING

**Sending this command disables LAN connection to the
SFL series electronic load.**

This command sets the LAN settings to the factory defaults. This command involves closing all open ports and getting the address via DHCP. Therefore, LAN communication is lost, and you need to reopen the port.

Resetting does not restore the factory default hostname and description (see Section 11.2.5 above). See Section 5.4 for a description of LAN reset conditions.

Syntax: SYSTem:COMMunicate:LAN:RESet

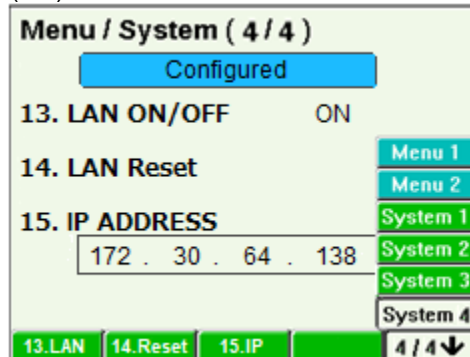
Example: SYST:COMM:LAN:RES

12. Troubleshooting

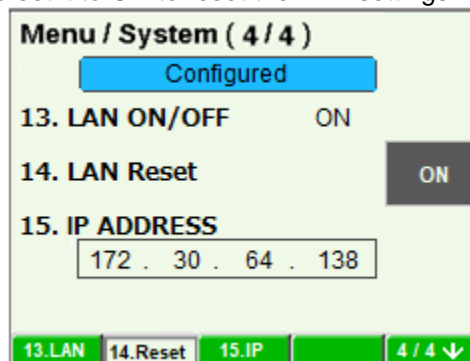
12.1. IP address and LAN status cannot be read, LED remains red

LAN reset

A. Open "Menu / System (4/4)".



B. Select "14. Reset" and set it to ON to reset the LAN settings.



12.2. All IP addresses are zero and LAN status LED remains red

If you view the IP address on the front panel and find that the IP address is all zero, the SFL Series electronic load will not connect to the network.

- A. Make sure the LAN cable is connected to the active network. Look at the link LED on the back panel (part of the RJ-45 connector, see Section 3.3.) and make sure it is green (and possibly a little flashing). If the LED does not light up, the LAN cable is not connected properly.
- B. Please wait for a while and try reading the IP address again. In Auto IP mode, the SFL series electronic load waits about 40 seconds to assign an IP address after powering up.
- C. If two devices on the network have the same IP address, address conflicts can occur on the network. When the SFL series electronic load detects this, it rejects the IP address assignment and remains all zero. This only happens when the SFL series electronic load is in static IP mode. To remedy this situation, do one of the following:
 - i. Perform a LAN reset on the front panel (see Section 5.3). SFL series electronic loads either try to get an address from a network DHCP server or create their own address in the 169.254.xxx.xxx subnet. If this subnet is not your subnet, use the front panel to set up a network-compatible IP address (see Section 5.2).
 - ii. Disconnect LAN devices that may have conflicting addresses from the network. Turn OFF and ON for the SFL series electronic load. After 15 or 40 seconds, the SFL series electronic load gets a static address.

12.3. Cannot communicate with SFL series electronic load

If the LAN status LED is green and the front panel shows a valid IP address, but you still cannot open a web page, VISA, or socket connection, ping the SFL Series electronic load. please look. The ping utility verifies that the computer can send messages and get responses from SFL series electronic loads over the network.

On your Windows computer, open a command prompt as follows:

- A. Right-click on the Start button and select "command prompt".
- B. A command prompt opens.
- C. Enter "ping"<IP address> (IP from the SFL front panel, see Section 5.1.). Verify that the ping packet responded successfully.

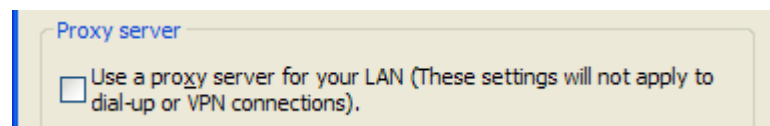
If the "ping" does not receive a response from the SFL series electronic load, there is a mismatch between the load and the computer's LAN settings. In addition, the ping feature may be disabled with SFL series electronic loads (see Section 6.6.2). In this case, apply LAN Reset (see Section 5.3.) and try the connection again.

12.4. Web pages are not displayed via peer-to-peer network

If you do not have a gateway to your network, make sure your proxy server is disabled in your web browser. Use "Internet Option" to set.

"Control Panel" → "Internet Options" → "Connections" → "LAN Settings"

Then make sure the window is open.



Make sure the Proxy server checkbox is unchecked.

12.5. I can't see the Web pages on a PC with multiple LAN ports

If you are using a computer with two network cards, you may not know which card your computer will use when you try to open an SFL series web page.

Make sure that the two cards do not have duplicate IP address ranges. If there are no duplicates, you will need to disable or disconnect the unused network card.

If you are using a computer with an Ethernet jack and a wireless network, you may need to disable the wireless LAN port.

If you are running a VISA program (see Section 7), the two network cards are not an issue because the VISA resource descriptor contains a network [board] identifier.

13. Glossary

Auto-IP: This is when the SFL series electronic load configures its own settings because it cannot be obtained using a network server (DHCP). With Auto-IP, the SFL series electronic load chooses a random address in the range 169.254.xxx.xxx. Also known as link-local addressing.

Auto-MDIX: A connection that automatically detects either a patch (straight through) or a crossover LAN cable. Both types of LAN cables can be used.

Auto-Negotiate: SFL Series electronic load automatically selects the fastest speed the network can support. SFL series electronic load can operate at 10 Mbps or 100 Mbps.

DHCP: Dynamic host configuration protocol is a method in which IP addresses and other settings are assigned from network servers to SFL series electronic loads. IP addresses and other settings may change each time a network connection is created.

Hostname: A unique name for the device on your network. The descriptive name can be created by the operator. See Section 4.5 for the default host name.

Ethernet: The most common configuration of LAN. Includes connection detection and message collision protection.

IP address: The Internet protocol address is a numeric identifier that indicates where to send and receive messages. There are four numbers, each from 0 to 255. Example: 192.168.34.17.

IVI: "Interchangeable Virtual Instrument". Specifications that standardize measuring instrument driver technology. It is built on the basis of the VISA driver. Because IVI has an interface, you can use standard calls to COM and DLL libraries in any programming language.

LAN: A "Local Area Network" is usually a small group of computers, printers, and other devices connected to share information and services. Gateways also allow these devices to connect to wide area networks (WANs).

LXI: "LAN Extensions for Instrumentation". A standard adopted by many testing and measurement companies. To be LXI certified, the device must comply with many requirements such as network connectivity, web page operations, and software drivers. For more information, please visit www.lxistandard.org.

MAC address: The media access control address is the manufacturer and device identifier. It's like a serial number and can be used to configure a LAN connection. It consists of 6 hexadecimal values. Example: 00: 19: F9: 01: 3E: 26

mDNS: Multicast domain name service is a service that can be used by all devices connected to the LAN. This is a protocol that does not require a network server to connect by device name instead of IP address.

Query: A message sent to the SFL series electronic load to read back the settings or measurements. The query does not change the settings. You can send it using a command or from a web page.

Socket: Universal protocol for messages over LAN. The library for creating socket programs is available in almost all programming environments and operating systems, including industrial PLCs. Two types of sockets, TCP and UDP, are common. These are the low-level protocols on which VISA is built.

VISA: Virtual Instrument Software Architecture is a single interface library for controlling equipment over different types of communication buses. In the automation program, a "resource descriptor" string is given to each device. The descriptor defines the device, including the address and bus type.