TDK

G+ENESYS™ *Series*

Programmable DC Power Supplies
Half-Rack GH1kW/1.5kW in 1U Height
Full-Rack G1kW/1.7kW/2.7kW/3.4kW/5kW/7.5kW in 1U Height
GSP10kW/15kW in 2U/3U Height
GSPL15kW/22.5kW in 2U/3U Height
GSPS30kW/45kW/60kW/90kW in 20U Height

Built-in LAN (LXI 1.5), USB, RS-232 & RS-485 Interfaces
Built-in Remote Isolated Analog Program/Monitor/Control Interface
Optional Interface: IS420, IEEE488.2 SCPI (GPIB), Modbus TCP or EtherCAT

TDK·Lambda

User Manual

GENESYS™ Series

Programmable DC Power Supplies

GH1kW in 1U Half-Rack 0–600V / 0–100A

GH1.5kW in 1U Half-Rack 0–600V / 0–150A

G1kW in 1U 0–600V / 0–100A

G1.7kW in 1U 0–600V / 0–170A

G2.7kW in 1U 0–600V / 0–265A

G3.4kW in 1U 0–600V / 0–340A

G5kW in 1U 0–1500V / 0–500A

G7.5kW in 1U 0–1500V / 0–375A

GSP10kW in 2U 0–600V / 0–1000A

GSP15kW in 3U 0–600V / 0–1500A

GSPL15kW in 2U 0–1500V / 0–750A

GSPL22.5kW in 3U 0–1500V / 0–1125A

GSPS30kW, 45kW, 60kW in 20U 0–600V / 0–4500A

GSPS90kW in 20U 0–1500V / 0–4500A

Built in LXI compliant LAN, USB, RS-232 & RS-485 Interface

Optional Interface: IS420, IEEE488.2 (GPIB), MODBUS TCP or EtherCAT

USER MANUAL

For units equipped with MODBUS TCP interface option, refer to MODBUS TCP User manual IA761-04-04_.

For units equipped with EtherCAT interface option, refer to EtherCAT User manual IA761-04-05_.

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EtherCAT® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

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This Manual Covers Models:

1kW Half-Rack:

GH10-100	GH80-12.5	GHB10-100	GHB80-12.5
GH20-50	GH100-10	GHB20-50	GHB100-10
GH30-34	GH150-7	GHB30-34	GHB150-7
GH40-25	GH300-3.5	GHB40-25	GHB300-3.5
GH60-17	GH600-1.7	GHB60-17	GHB600-1.7

1.5kW Half-Rack:

GH10-150	GH80-19	GHB10-150	GHB80-19
GH20-75	GH100-15	GHB20-75	GHB100-15
GH30-50	GH150-10	GHB30-50	GHB150-10
GH40-38	GH300-5	GHB40-38	GHB300-5
GH60-25	GH600-2.6	GHB60-25	GHB600-2.6

1kW:

G10-100	G80-12.5	GB10-100	GB80-12.5
G20-50	G100-10	GB20-50	GB100-10
G30-34	G150-7	GB30-34	GB150-7
G40-25	G300-3.5	GB40-25	GB300-3.5
G60-17	G600-1.7	GB60-17	GB600-1.7

1.7kW:

G10-170	G80-21	GB10-170	GB80-21
G20-85	G100-17	GB20-85	GB100-17
G30-56	G150-11.2	GB30-56	GB150-11.2
G40-42	G300-5.6	GB40-42	GB300-5.6
G60-28	G600-2.8	GB60-28	GB600-2.8

2.7kW:

G10-265	G80-34	GB10-265	GB80-34
G20-135	G100-27	GB20-135	GB100-27
G30-90	G150-18	GB30-90	GB150-18
G40-68	G300-9	GB40-68	GB300-9
G60-45	G600-4.5	GB60-45	GB600-4.5

3.4kW:

G10-340	G80-42	GB10-340	GB80-42
G20-170	G100-34	GB20-170	GB100-34
G30-112	G150-22.5	GB30-112	GB150-22.5
G40-85	G300-11.5	GB40-85	GB300-11.5
G60-56	G600-5.6	GB60-56	GB600-5.6

5kW:

G10-500	G150-34	GB10-500	GB150-34
G20-250	G200-25	GB20-250	GB200-25
G30-170	G300-17	GB30-170	GB300-17
G40-125	G400-13	GB40-125	GB400-13
G50-100	G500-10	GB50-100	GB500-10
G60-85	G600-8.5	GB60-85	GB600-8.5
G80-65	G1000-5	GB80-65	GB1000-5
G100-50	G1500-3.4	GB100-50	GB1500-3.4

7.5kW:

G20-375	G150-50	GB20-375	GB150-50
G30-250	G200-37.5	G30-250	GB200-37.5
G40-188	G300-25	G40-188	GB300-25
G60-125	G600-12.5	GB60-125	GB600-12.5
G80-94	G1000-7.5	GB80-94	GB1000-7.5
G100-75	G1500-5	GB100-75	GB1500-5

GSP10kW:

GSP10-1000	GSP100-100	GBSP10-1000	GBSP100-100
GSP20-500	GSP150-68	GBSP20-500	GBSP150-68
GSP30-340	GSP200-50	GBSP30-340	GBSP200-50
GSP40-250	GSP300-34	GBSP40-250	GBSP300-34
GSP50-200	GSP400-26	GBSP50-200	GBSP400-26
GSP60-170	GSP500-20	GBSP60-170	GBSP500-20
GSP80-130	GSP600-17	GBSP80-130	GBSP600-17

GSP15kW:

GSP10-1500	GSP100-150	GBSP10-1500	GBSP100-150
GSP20-750	GSP150-102	GBSP20-750	GBSP150-102
GSP30-510	GSP200-75	GBSP30-510	GBSP200-75
GSP40-375	GSP300-51	GBSP40-375	GBSP300-51
GSP50-300	GSP400-39	GBSP50-300	GBSP400-39
GSP60-255	GSP500-30	GBSP60-255	GBSP500-30
GSP80-195	GSP600-25.5	GBSP80-195	GBSP600-25.5

GSPL15kW:

GSPL20-750	GSPL150-100	GBSPL20-750	GBSPL150-100
GSPL30-500	GSPL200-75	GBSPL30-500	GBSPL200-75
GSPL40-376	GSPL300-50	GBSPL40-376	GBSPL300-50
GSPL60-250	GSPL600-25	GBSPL60-250	GBSPL600-25
GSPL80-188	GSPL1000-15	GBSPL80-188	GBSPL1000-15
GSPL100-150	GSPL1500-10	GBSPL100-150	GBSPL1500-10

GSPL22.5kW:

GSPL20-1125	GSPL150-150	GBSPL20-1125	GBSPL150-150
GSPL30-750	GSPL200-112.5	GBSPL30-750	GBSPL200-112.5
GSPL40-564	GSPL300-75	GBSPL40-564	GBSPL300-75
GSPL60-375	GSPL600-37.5	GBSPL60-375	GBSPL600-37.5
GSPL80-282	GSPL1000-22.5	GBSPL80-282	GBSPL1000-22.5
GSPL100-225	GSPL1500-15	GBSPL100-225	GBSPL1500-15

GSPS30kW:

GSPS10-3000	GSPS100-300	GBSPS10-3000	GBSPS100-300
GSPS20-1500	GSPS150-204	GBSPS20-1500	GBSPS150-204
GSPS30-1020	GSPS200-150	GBSPS30-1020	GBSPS200-150
GSPS40-750	GSPS300-102	GBSPS40-750	GBSPS300-102
GSPS50-600	GSPS400-78	GBSPS50-600	GBSPS400-78
GSPS60-510	GSPS500-60	GBSPS60-510	GBSPS500-60
GSPS80-390	GSPS600-51	GBSPS80-390	GBSPS600-51

GSPS45kW:

-	GSPS100-450	-	GBSPS100-400
GSPS20-2250	GSPS150-306	GBSPS20-2250	GBSPS150-306
GSPS30-1530	GSPS200-225	GBSPS30-1530	GBSPS200-225
GSPS40-1125	GSPS300-153	GBSPS40-1125	GBSPS300-153
GSPS50-900	GSPS400-117	GBSPS50-900	GBSPS400-117
GSPS60-765	GSPS500-90	GBSPS60-765	GBSPS500-90
GSPS80-585	GSPS600-76.5	GBSPS80-585	GBSPS600-76.5

GSPS60kW:

GSPS10-4500	GSPS100-600	GBSPS10-4500	GBSPS100-600
GSPS20-3000	GSPS150-408	GBSPS20-3000	GBSPS150-408
GSPS30-2040	GSPS200-300	GBSPS30-2040	GBSPS200-300
GSPS40-1500	GSPS300-204	GBSPS40-1500	GBSPS300-204
GSPS50-1200	GSPS400-158	GBSPS50-1200	GBSPS400-158
GSPS60-1020	GSPS500-120	GBSPS60-1020	GBSPS500-120
GSPS80-780	GSPS600-102	GBSPS80-780	GBSPS600-102

GSPS90kW:

GSPS20-4500	GSPS150-600	GBSPS20-4500	GBSPS150-600
GSPS30-3000	GSPS200-450	GBSPS30-3000	GBSPS200-450
GSPS40-2256	GSPS300-300	GBSPS40-2256	GBSPS300-300
GSPS60-1500	GSPS600-150	GBSPS60-1500	GBSPS600-150
GSPS80-1128	GSPS1000-90	GBSPS80-1128	GBSPS1000-90
GSPS100-900	GSPS1500-60	GBSPS100-900	GBSPS1500-60

TABLE OF CONTENTS

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GENERAL INFORMATION

Documentation (including this Manual) is subject to change without notice. Refer to TDK-Lambda Technical Data web page for an up-to-date documentation and optional communication interfaces user manuals (including MODBUS-TCP and EtherCAT):

https://www.emea.lambda.tdk.com/manual

Drivers and GUIs are updated periodically to support new features. Refer to TDK-Lambda Technical Centre web page for up-to-date drivers and GUIs:

https://www.emea.lambda.tdk.com/software

Further technical assistance, if needed, may be obtained at TDK-Lambda Technical Centre:

https://www.emea.lambda.tdk.com/about_global

CHAPTER 1: FRONT/REAR PANEL CONTROL & CONNECTORS

1.1 Introduction

The **GENESYS™** power supply series has a full set of controls, indicators, and connectors that allow the user to setup and operate the unit. Before starting to operate the unit, please read the following sections for an explanation of the functions, controls, and connector terminals.

- Section 1.2: Front Panel Controls
- Section 1.3: Front Panel Display and Indicators
- Section 1.4: Blank Front Panel
- Section 1.5: Rear Panel Connections and Controls
- Section 1.6: J1 Connector Terminal and Function

1.2 Front Panel Controls

Refer to Figure 1–1 and Table 1-1 for description of the Front Panel Controls.

1kW–1.5kW Half-Rack
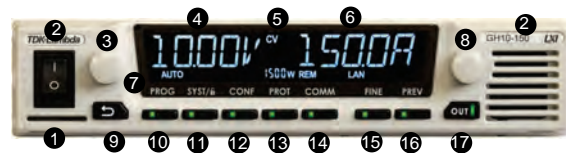
1kW–7.5kW Full-Rack

GSP10kW and GSPL15kW Full-Rack
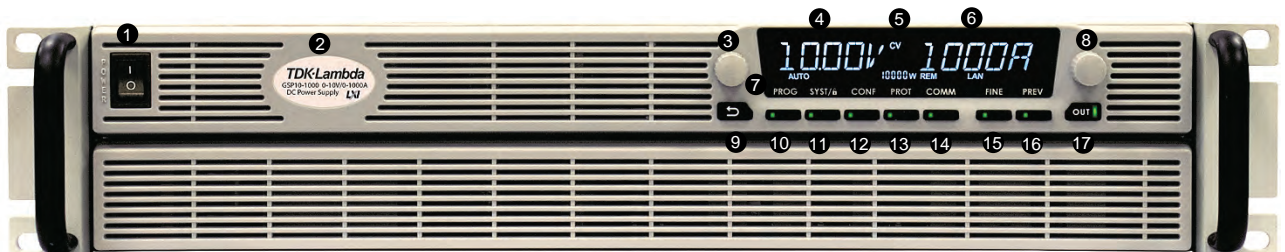
GSP15kW and GSPL22.5kW Full-Rack
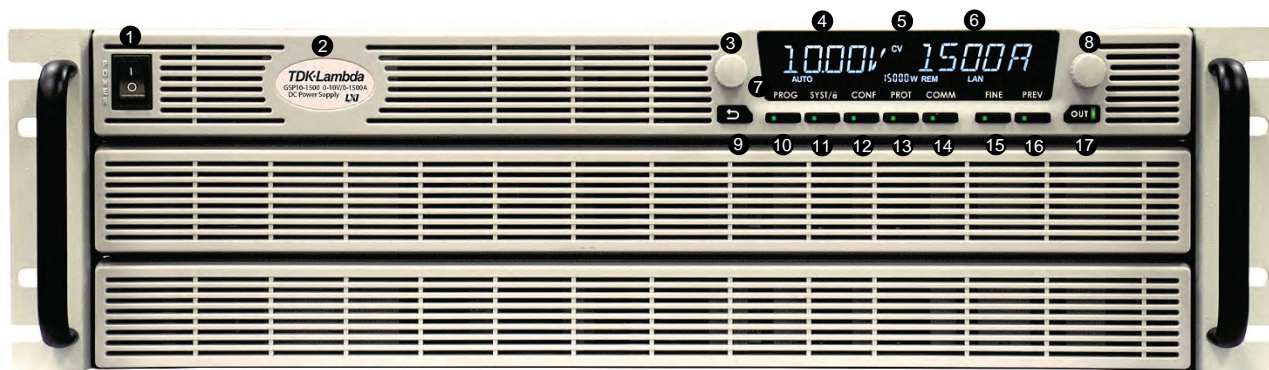
Figure 1–1: Front Panel Controls

No.	Control/Indicator	Description
1	Power Switch	POWER ON/OFF control.
2	Power Supply Model	Model, Voltage, & Current Identifier.
3	Voltage Encoder and Button	Encoder: A high-resolution detent rotary Encoder adjusting the output voltage and navigating menu. Button: An auxiliary function to accept the voltage-setting value in Preview mode.
4	Voltage Display	4-digit 16-segment Voltage display. Normally displays the output voltage. In Preview mode, the display indicates the setting of the output voltage. In Menu navigation, the display indicates the selected function.
5	Operation Mode Indicator	CV/CC/CP Operation mode indicator.
6	Current Display	4-digit 16-segment Current display. Normally displays the output current. In Preview mode, the display indicates the setting of the output current. In menu navigation, the display indicates the selected parameter.
7	Indicators Bar	Refer to Figure 1–2 and Table 1-2: Front Panel Display and Indicators for description of the front panel Indicators bar.
8	Current Encoder and Button	Encoder: A high-resolution detent rotary Encoder adjusting the output current and navigating menu. Button: An auxiliary function to accept the current-setting value, select menu level, and set parameter value.

No.	Control/Indicator	Description
9	BACK Button	Return one step back in menu navigation mode.
10	PROG Button / Indicator	Activates the Program / Sequencer menu. The Program menu provides Sequencer function control, Trigger function control, and loads a sequence stored inside the power supply memory. Green LED lights when Program menu is active. If Program menu is active, press PROG button to exit to the main display. *
11	SYST / Lock Front Panel Button / Indicator	Activates the System menu. The System menu provides output sensing point selection (Local / Remote sense), Interlock function control, Enable function control, Power Supply OK signal control, SAVE/RECALL power supply configuration, Programmable Signals control, Preload function control, Display brightness & dimming function control, and reset power supply settings. Green LED lights when System menu is active. If System menu is active, press the SYST button to exit to the main menu. Lock / Unlock Front Panel buttons by pressing the SYST button, followed by current encoder press. *
12	CONF Button / Indicator	Activates the Configuration menu. The Configuration menu provides power supply start mode control, Voltage & Current source control, Analog Programming / Monitoring range selection, Internal Resistance function, Constant power limit function, and Slew-Rate control function. Green LED lights when the Configuration menu is active. If Configuration menu is active, press the CONF button to exit to the main menu. *
13	PROT Button / Indicator	Activates the Protection menu. The Protection menu provides OVP setting, UVL setting, UVP function control, Foldback function control, and OCL function ON/OFF control. Green LED lights when the Protection menu is active. If Protection menu is active, press the PROT button to exit to the main menu. *

No.	Control/Indicator	Description
14	COMM Button / Indicator	Activates the Communication menu.
		The Communication menu provides communication interface selection, power supply address selection, LAN settings control, communication baud-rate selection, communication language selection, and software revision information.
		Green LED lights when Communication menu is active.
		If Communication menu is active, press the COMM button to exit to the main menu. *
15	FINE Button / Indicator	Voltage/Current Fine/Coarse adjustment control.
		Operates as a toggle switch.
		In the Fine mode, Voltage and Current encoders operate in high-resolution mode.
		In the Coarse mode, Voltage and Current encoders operate in standard-resolution mode (approx. 3 turns for full voltage/current rated scale).
		Green LED lights when the unit is in Fine mode.
16	PREV Button / Indicator	Press the PREV button to display the Output Voltage and Current Limit settings.
		The display shows the settings for 5 seconds.
		If buttons are not pressed for 5 seconds, the display returns back to show actual output voltage and current.
		If Voltage or Current values are changed, and there is no keypress for 15 seconds, the display returns back to show actual output Voltage and Current.
		Green LED lights when PREV mode is active.
17	OUT Button / Indicator	Output ON/OFF control. Press OUTPUT to set the output ON or OFF.
		Green LED lights when DC Output is enabled.
		Red LED blinks in case of an alarm. Refer to Section 2.9 Alarms and Protective Functions.

Table 1-1: Front Panel Controls

NOTE

* If a menu is active, and there is no key press within 15 seconds, power supply returns to the main display (OFF or actual Voltage and Current display).

1.3 Front Panel Display and Indicators

Refer to Figure 1–2 and Table 1-2 for description of the Front Panel Display and Indicators.
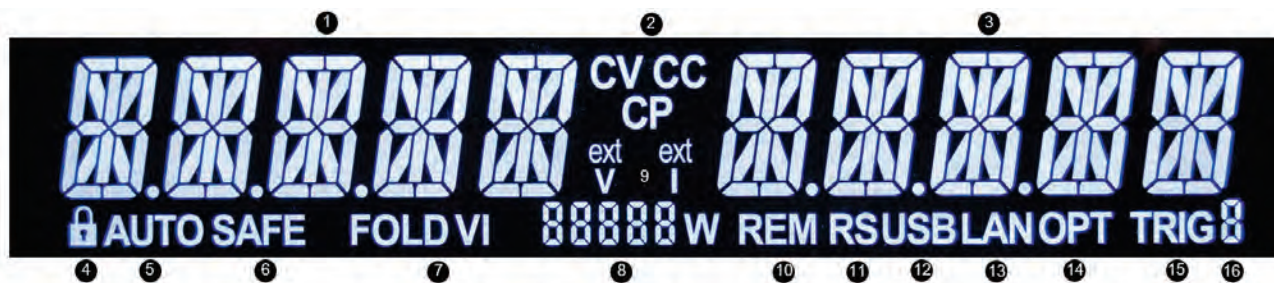
Figure 1–2: Front Panel Display and Indicators

No.	Control/Indicator	Description
1	Voltage Display	4-digit 16-segment Voltage display.
		Normally displays the output voltage.
		In preview mode, the display indicates the program setting of the output voltage.
		In menu navigation, the display indicates the selected function.
2	Operation Mode Indicator	CV/CC/CP operation mode indicator.
3	Current Display	4-digit 16-segment Current display.
		Normally displays the output current.
		In preview mode, the display indicates the program setting of the output current.
		In menu navigation, the display indicates the selected parameter.
4	LFP Indicator	Locked Front Panel indicator.
		LFP is on if the Front Panel is locked.
5	AUTO Indicator	AUTO-Start indicator.
		AUTO is on if the Auto-Start mode is active.
6	SAFE Indicator	SAFE-Start indicator.
		SAFE is on, if the Safe-Start mode is active.
7	FOLD VI Indicator	Foldback indicator.
		FOLD V is on if Foldback CV is active.
		FOLD I is on if Foldback CC is active.

No.	Control/Indicator	Description
8	Power / Address Indicator	If power supply output is ON, actual output power is displayed.
		If power supply output is OFF, power supply address is displayed.
		* The address is displayed while Communication menu is active, regardless of the power supply output state.
9	Ext V / Ext I Indicators	External Voltage / External Current Analog Programming Indicators.
		Ext V is on if Analog Voltage Programming channel is active.
		Ext I is on if Analog Current Programming channel is active.
10	REM Indicator	REMOTE indicator.
		REM is on if power supply is controlled by a remote communication (RS232/485, USB, LAN, OPTional).
11	RS Indicator	Recommended Standard indicator.
		RS232 or RS485 communication type is selected.
12	USB Indicator	Universal Serial Bus indicator.
		USB communication type is selected.
13	LAN Indicator	Local Area Network indicator.
		LAN communication type is selected.
14	OPT Indicator	Optional communication type indicator.
		Optional communication type is selected.
15	TRIG Indicator	Trigger Indicator.
		TRIG is on if the trigger-in is enabled and initialized.
		Power supply is ready to receive trigger-in signal.
16	Active Memory-Cell Indicator	Display active memory cell.
		1,2,3,4 – A sequence is loaded from cells 1,2,3, or 4
		_ - A sequence is loaded from a PC
		The indicator is blinking if a sequence is running.

Table 1-2: Front Panel Display and Indicators

1.4   Blank Front Panel

Refer to Figure 1–3 and Table 1-3 for description of the Blank Front Panel Controls and Indicators.

1kW–1.5kW Half-Rack

1kW–7.5kW Full-Rack

Figure 1–3: Blank Front Panel Controls and Indicators

No.	Connection	Description
1	Power Switch	POWER ON/OFF control.
2	Power Supply Model	Model, Voltage, & Current Identifier.
3	Power LED	Power supply ON/OFF status LED. Green LED lights when power supply is ON (Power Switch ON).
4	REM LED	REMOTE status LED. Green LED lights if power supply is controlled by a remote communication. (RS232/485, USB, LAN, OPTional).
5	OUT LED	Output ON/OFF status LED. Green LED lights when DC Output is enabled. Red LED blinks in case of an alarm. Refer to Section 2.9 Alarms and Protective Functions.

Table 1-3: Blank Front Panel Controls and Indicators

NOTE

Refer to section 1.9 for basic operation of Blank Front Panel power supply.

1.5 Rear Panel Connections and Controls

Refer to Figure 1–4 and Table 1-4 for description of the Rear Panel Connections and Controls.

1kW–1.5kW Half-Rack
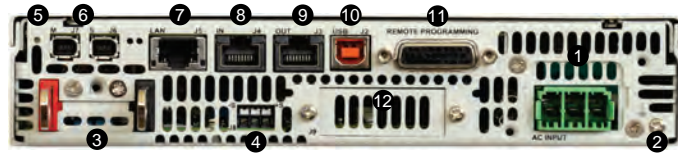
1kW–5kW Full-Rack
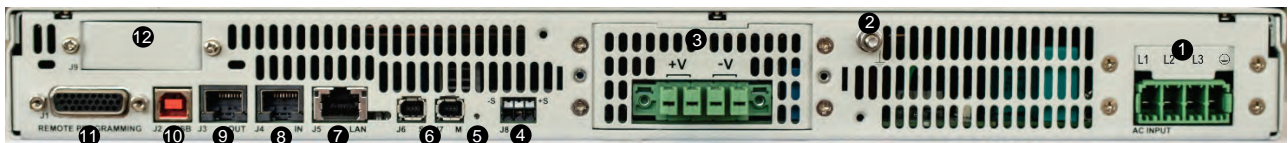
5kW: 1000V–1500V and 7.5kW Full-Rack
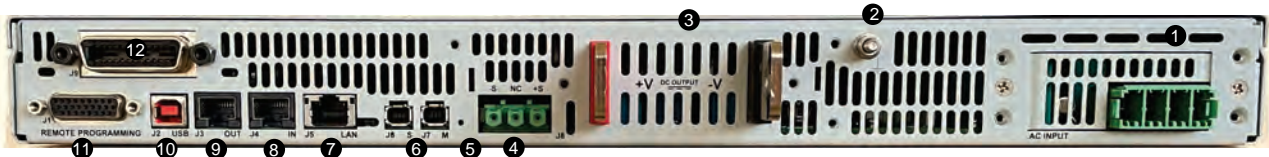
GSP10kW Full-Rack
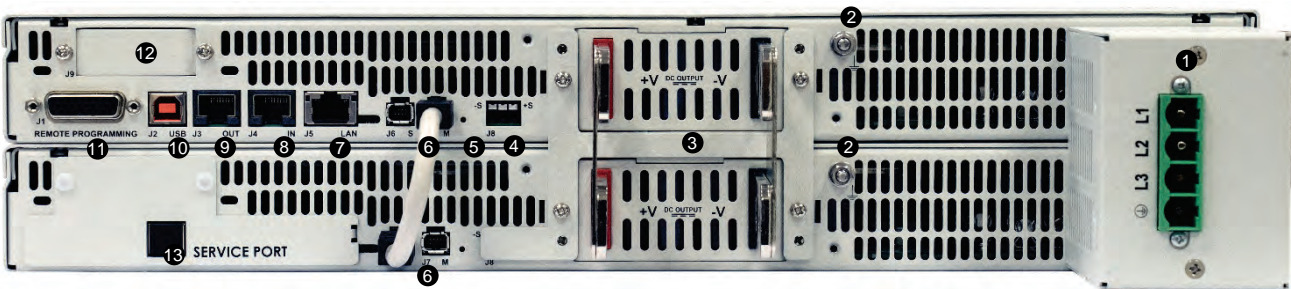
GSP15kW Full-Rack
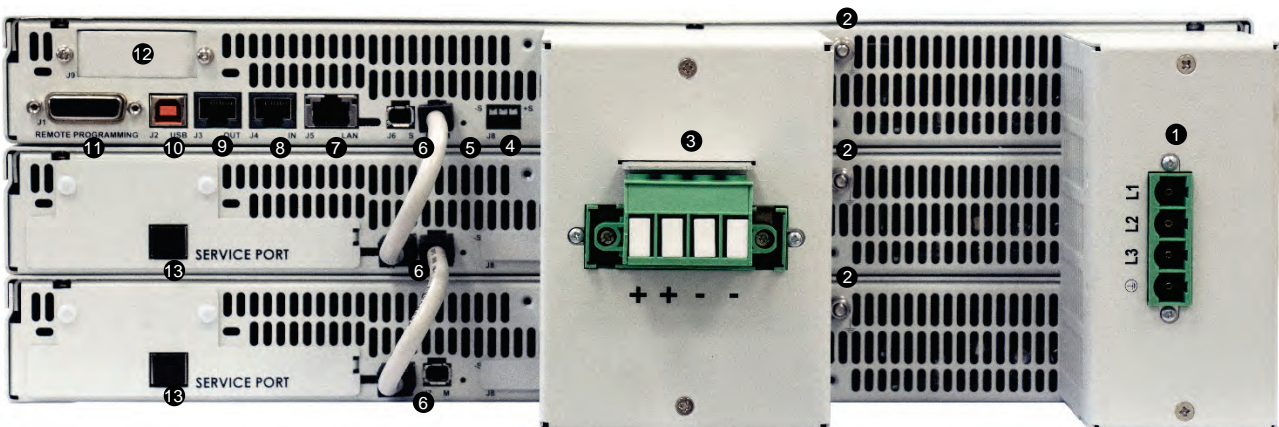
GSPL15kW Full-Rack
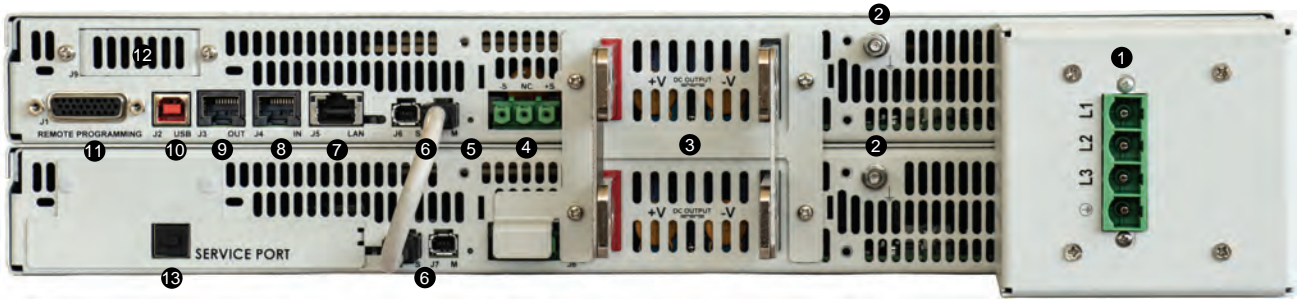
GSPL22.5kW Full-Rack 3-Phase 208
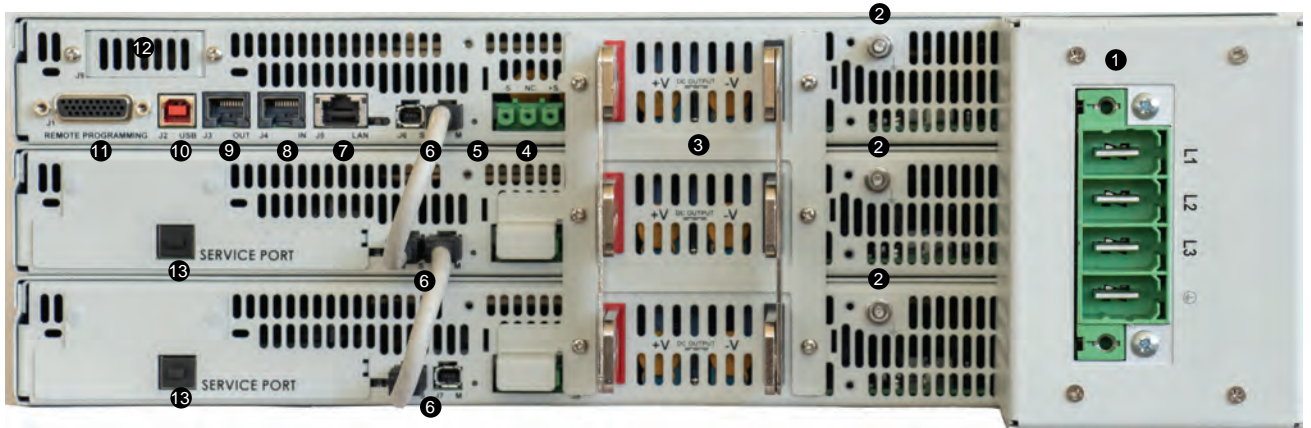
GSPL22.5kW Full-Rack 3-Phase 480
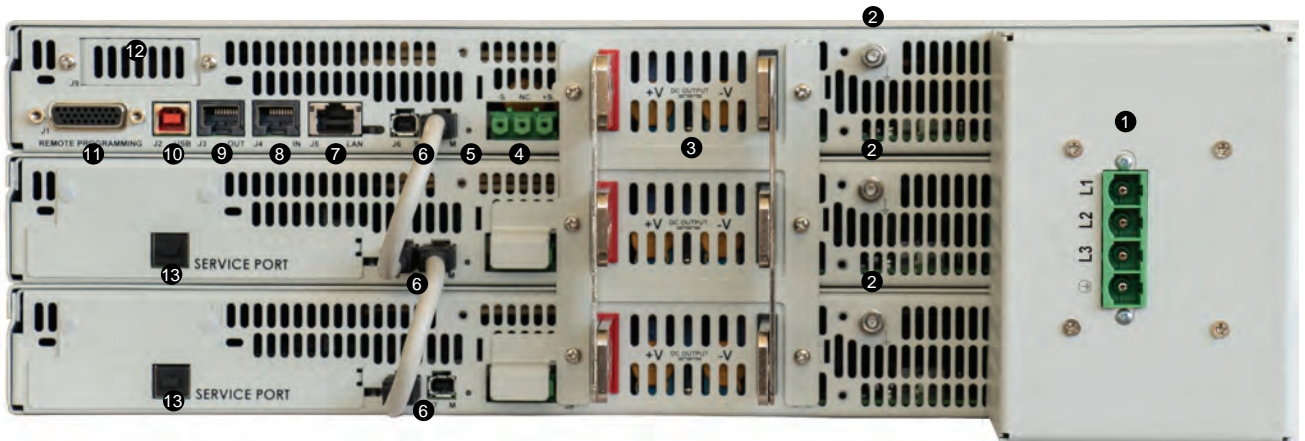
Figure 1–4: Rear Panel Connections and Controls

No.	Connection	Description
1	AC Input Connector	Connector type: 1kW 1-Phase: 6110.4310 SCHURTER (IEC C16). 1.5kW–3.4kW 1-Phase: PC 5/ 3-G-7,62 PHOENIX CONTACT. 2.7kW–5kW: 10V–600V 3-Phase: PC 5/ 4-G-7,62 PHOENIX CONTACT. 5kW: 1000V–1500V 3-Phase 208 and 7.5kW 3-Phase 208:

No.	Connection	Description
		PC 6-16/ 4-GF-10,16 PHOENIX CONTACT.
		5kW: 1000V–1500V 3-Phase 480 and 7.5kW 3-Phase 480:
		PC 5/ 4-G-7,62 PHOENIX CONTACT.
		GSP10kW–15kW: DFK–PC 16/ 4-ST-10,16 PHOENIX CONTACT.
		GSPL15kW 3-Phase and GSPL22.5kW 3-Phase 480:
		DFK-PC 16/ 4-STF-10, 16 PHOENIX CONTACT.
		GSPL22.5kW 3-Phase 208: PC 35 HC/ 4-GF-15,00 PHOENIX CONTACT.
2	Ground Stud	Functional Ground connection: M3x8 SEMS screw for Half-Rack, M4x15 Stud for Full-Rack.
3	DC Output Busbars / Connector	1kW–5kW: 150V–600V Connector type:
		GIC 2,5/ 4-G-7,62 PHOENIX CONTACT for Half-Rack models.
		IPC 5/ 4-GF-7,62 PHOENIX CONTACT for Full-Rack models.
		GSP10kW–15kW:
		DFK-IPC 16/ 4-STF-10,16 PHOENIX CONTACT.
		1kW–5kW: 10V–100V, 5kW: 1000V–1500V, 7.5kW and GSPL15kW–22.5kW: Busbars for all models.
4	Remote Sense Connector	A Connector for remote sensing connections.
		Connect to the load for regulation of the load voltage and compensation of load wire drop.
		1kW–5kW: 10V–600V: SPT-THR 1,5/ 3-H-3,5 P26 PHOENIX CONTACT.
		5kW: 1000V–1500V, 7.5kW, and GSPL15kW–22.5kW:
		GIC 2,5 HCV/ 3-ST-7,62.
		GSP10kW–15kW: SPT-THR 1,5/ 3-H-3,5 P26 PHOENIX CONTACT.
5	Reset Button	Set default power supply settings (Factory Reset).
		Refer to Table 2-6 & Table 2-7.
		Firmware revision 02.105 and below:
		Press and hold Reset button between 5 and 10 seconds, default communication interface following reset is set to USB.
		Firmware revision 02.106 and above:
		Press and hold Reset button up to 5 seconds, default communication interface following reset is set to USB.

No.	Connection	Description
		Press and hold Reset button above 5 seconds, default communication interface following reset is set to optional communication interface (i.e., IEEE, MODBUS-TCP, or EtherCAT). * Power Switch must be set to ON position.
6	Paralleling Connectors	Master/Slave connectors, mini I/O type
7	LAN Connector + Indicators *	LAN interface connector, RJ-45 type + LAN status indicators. Green LED on RJ45 connector – Link / Activity. Amber LED on RJ45 connector – Speed. Lit – 100Mbps, otherwise 10Mbps. Green status indicator (close to RJ45) – Connection active. Red status indicator (close to RJ45) – LAN fault / Not connected.
8	Serial In Connector	RJ-45 type connector, used for connecting power supplies to RS232 or RS485 port of a computer for remote control purposes. When using several power supplies in a power system, the first unit Serial-In is connected to the computer and the remaining units are chained, Remote-Out to Remote-In.
9	Serial Out Connector	RJ-45 type connector, used for chaining power supplies to/from a serial communication bus.
10	USB Connector	USB interface connector, type B.
11	Isolated control and signals	Isolated analog Control and monitoring signals, DB26HD type female, isolated from the output potential.
12	Optional Interface	Position for optional communication interface.
13	Service Port	Service port for factory use. USB interface connector, type B. Connector type: SAMTEC P/N: USBR-B-S-F-O-TH.

Table 1-4: Rear Panel Connections and Controls

NOTE

* LAN Connector LEDs (Green & Amber) and Red Status Indicator might light in Power Switch OFF state.

WARNING

Refer to the Safety & Installation Manual for any connect/disconnect of any connector on the rear panel.

1.6   J1 Connector Terminal and Function

Control and monitoring signals are SELV.

Connector Technical Information:

Connector type: 618026325223, WURTH

DB26HD Receptacle type: 10090769-P264ALF, FCI

Wire: AWG 24–28
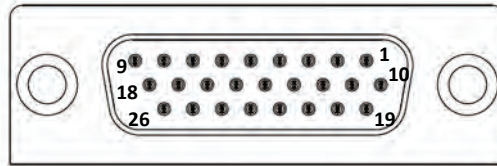
Figure 1–5: J1 Connector Terminals and Functions

No.	Connection	Description
1	Daisy In / SO	Input for Series Operation / Input for Shut Off control of the power supply output.
2	Daisy Out / PS_OK #2	Output for Series Operation / Output #2 for indication of power supply status. High level is OK.
3	PS_OK #1	Output #1 for indication of power supply status. Open Collector type, low level is OK.
4	CV/CC	Output for Constant-Voltage / Constant-Current mode indication.
5	LOC/REM MON	Output for indicating if the unit is in Local (digital) or Remote (analog) programming mode.
6	LOC/REM SELECT	Input for selecting between Local (digital) or Remote (analog) programming of the output Voltage and Current.
7	IPGM	Input for Remote (analog) voltage/resistance programming of the Output Current.
8	VPGM	Input for remote (analog) voltage/resistance programming of the Output Voltage.
9	NOT USED	
10	ENA_IN	Enable / Disable the power supply output by dry-contact (short / open) or voltage source. Selectable signal polarity.
11	COM	COMMON. Return for all signals.
12	COM	COMMON. Return for all signals.
13	COM	COMMON. Return for all signals.
14	COM	COMMON. Return for all signals.

No.	Connection	Description
15	NOT USED	
16	NOT USED	
17	COM	COMMON. Return for all signals.
18	COM	COMMON. Return for all signals.
19	ILC	Enable / Disable the power supply output by dry-contact (short / open) or voltage source.
20	Programmed Signal 2	General Purpose Open Drain Port 2.
21	Programmed Signal 1	General Purpose Open Drain Port 1
22	Trigger In	Power supply trigger input for sequencer operations. Positive edge triggered, pulse width: min. 10usec.
23	Trigger Out	Trigger output, positive edge, pulse width: min. 100usec.
24	NOT USED	
25	I_MON	Output for monitoring the power supply output Current.
26	V_MON	Output for monitoring the power supply output Voltage.

Table 1-5: J1 Connector Terminals and Functions

1.7   Front Panel Display Messages

Table 1-6 shows the various messages shown on the display in different operating modes.

Display Text	Text Description	Display Text	Text Description
OUT	OUTPUT	LOCK	LOCK
OFF	OFF	ULOCK	UNLOCK
INTFC	Interface	SENSE	SENSE
RS232	RS232	LOCAL	LOCAL
RS485	RS485	REM	REMOTE
USB	USB	ILC	INTERLOCK
LAN	LAN	ON	ON
ADR	ADDRESS	ENA	ENABLE
IP	IP	ENA.PL	ENABLE POLARITY
MAC	MAC	NORM	NORMAL
BAUD	BAUD RATE	REV	REVERSE
LANG	LANGUAGE	PSO.DL	POWER SUPPLY OK DELAY
SCPI	SCPI	SAVE	SAVE
GEN	GENESYS	RECAL	RECALL
REV.	REVISION	FRST	FACTORY RESET
OVP	OVP	DEFLT	DEFAULT
UVL	UVL	SURE	SURE
UVP	UVP	YES	YES
UVP.DL	UVP DELAY	NO	NO
FOLD	FOLDBACK	PIN 1	PIN 1
FLD.DL	FOLDBACK DELAY	PIN 2	PIN 2
CC	CC	CURR	CURRENT
CV	CV	VOLT	VOLTAGE
OCL	OVER CURRENT LIMIT	PREL	PRELOAD
START	START	DISP	DISPLAY
SAFE	SAFE	BRT	BRIGHTNESS
AUTO	AUTO	DM.BRT	DIMMING BRIGHTNESS
V.SRC	VOLTAGE SOURCE	DM.DL	DIMMING DELAY

Display Text	Text Description	Display Text	Text Description
PANEL	PANEL	TRIG	TRIGGER
E.VOL	EXTERNAL VOLTAGE	INIT	INIT
E.RES	EXTERNAL RESISTANCE	ABORT	ABORT
C.SRC	CURRENT SOURCE	LOAD	LOAD
RANGE	RANGE	TRG.IN	TRIGGER INPUT
R.INT	INTERNAL RESISTANCE	EXT	EXTERNAL
C.PWR	CONSTANT POWER	BUS	BUS
POWER	POWER	CONT	CONTINUOUS
SLEW	SLEW	TRG.DL	TRIGGER DELAY
CSL.UP	CURRENT SLEW UP	TRG.OU	TRIGGER OUT
CSL.DN	CURRENT SLEW DOWN	FSTR	FUNCTION STROBE
VSL.UP	VOLTAGE SLEW UP	OPT	OPTIONAL COMMUNICATION
VSL.DN	VOLTAGE SLEW DOWN	RES	RESISTANCE
RESET	RESET	WD	WATCHDOG
WD.TIM	WATCHDOG TIMER	PSINK	POWER SINK
WAIT ACK	WAIT ACK		

Table 1-6: Front Panel Display Messages

1.8 Menu Navigation

1.8.1 Introduction

GENESYS™ power supply series contains the following five independent menus:

- COMMUNICATION
- PROTECTION
- CONFIGURATION
- SYSTEM
- PROGRAM

1. To enter a menu, press COMM, PROT, CONF, SYST, or PROG button. An appropriate LED lights indicating that a menu is active.

2. Navigate the menu by rotating the Voltage encoder to scroll through the selected Menu functions.

3. Rotate the Current encoder to select a parameter or a parameter value.

4. Press the Current encoder to accept a desired parameter value.

5. If the parameter is accepted, the display blinks once indicating the parameter is accepted.
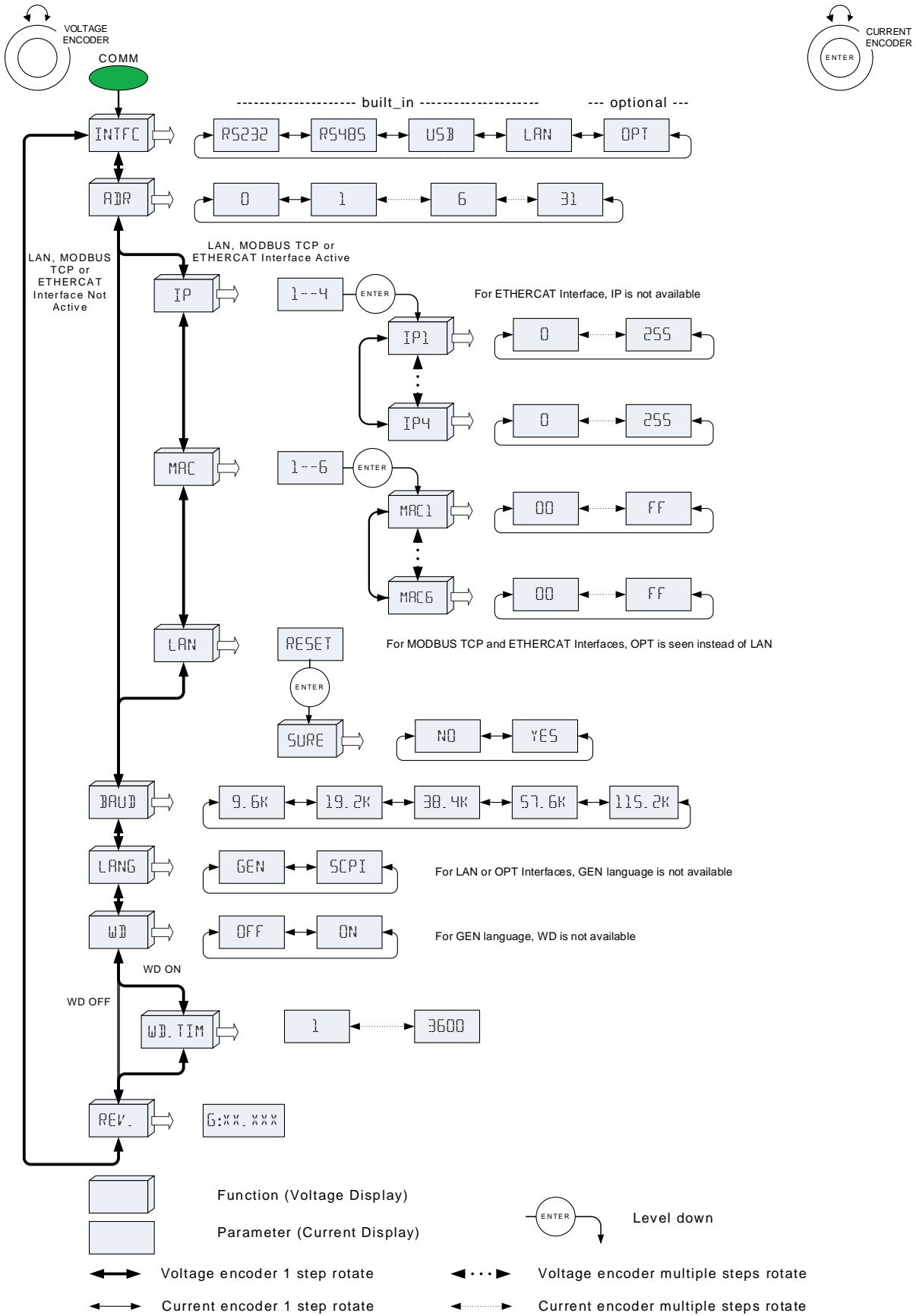
TDK·Lambda

COMMUNICATION MENU

Figure 1–6: COMMUNICATION Menu Diagram

PROTECTION MENU
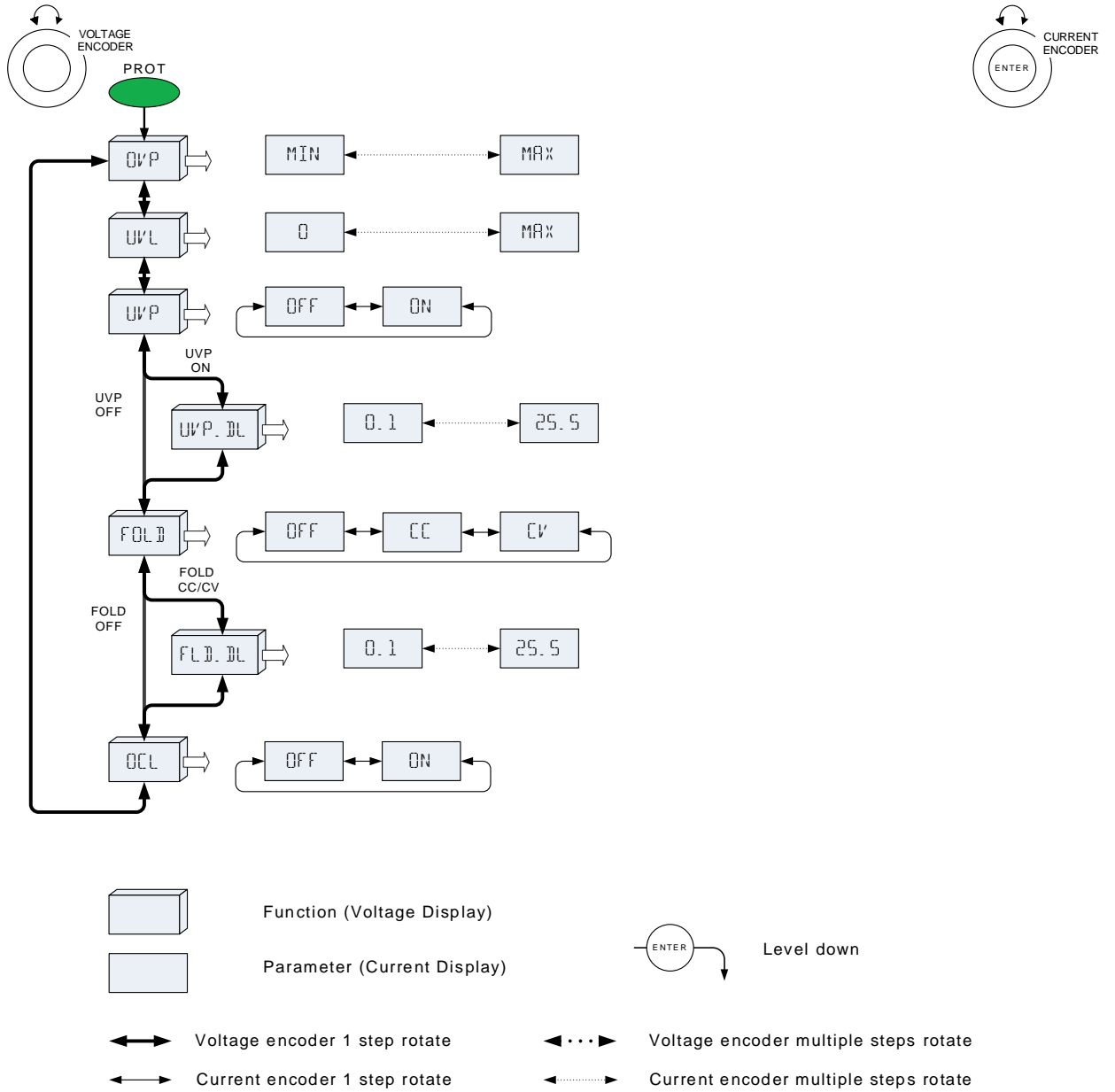
Figure 1–7: PROTECTION Menu Diagram
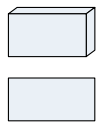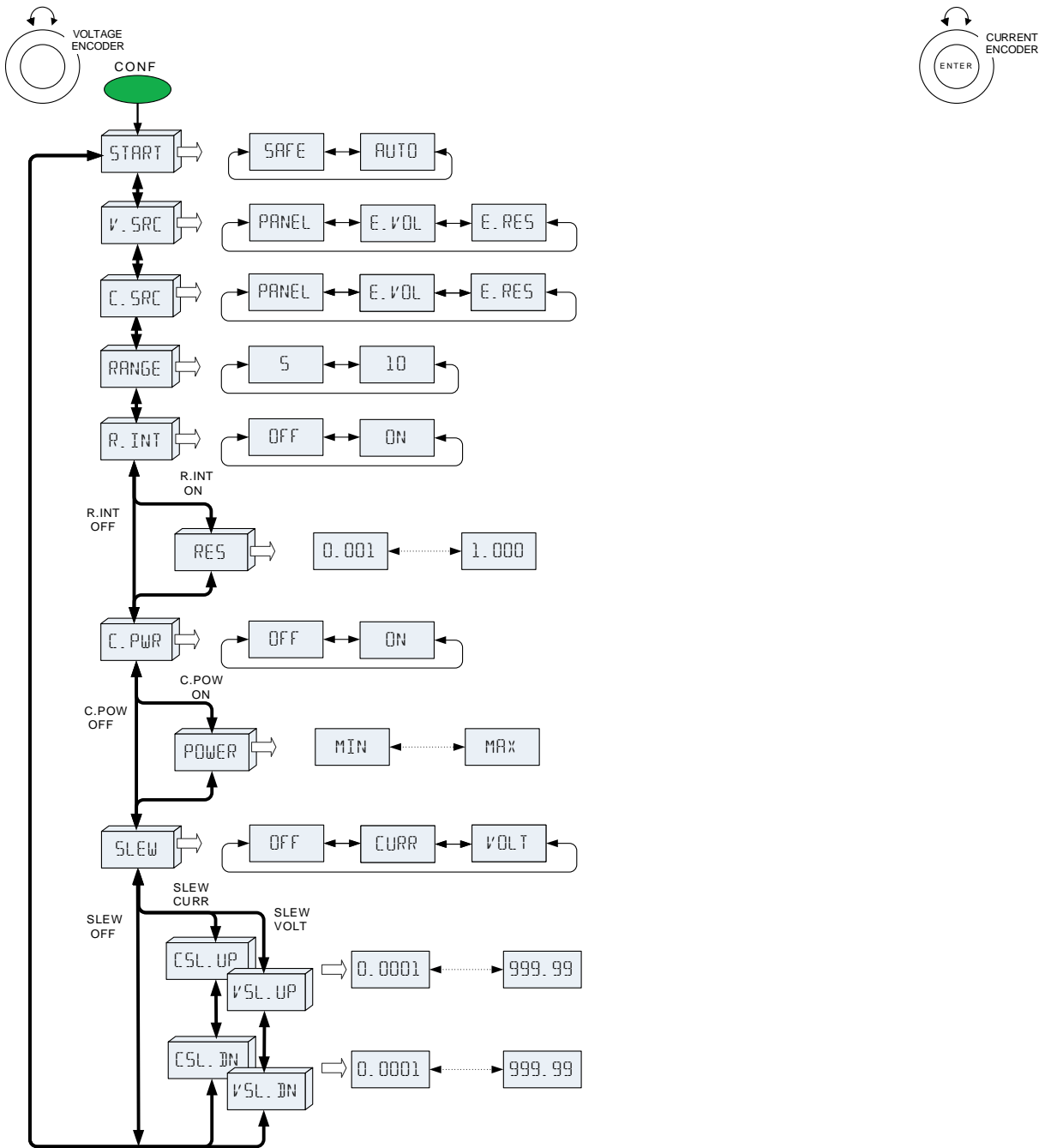
Note: Press Current encoder to select required parameter. Current display blinks - Parameter accepted

CONFIGURATION MENU
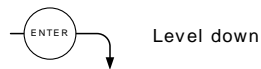
Figure 1–8: CONFIGURATION Menu Diagram
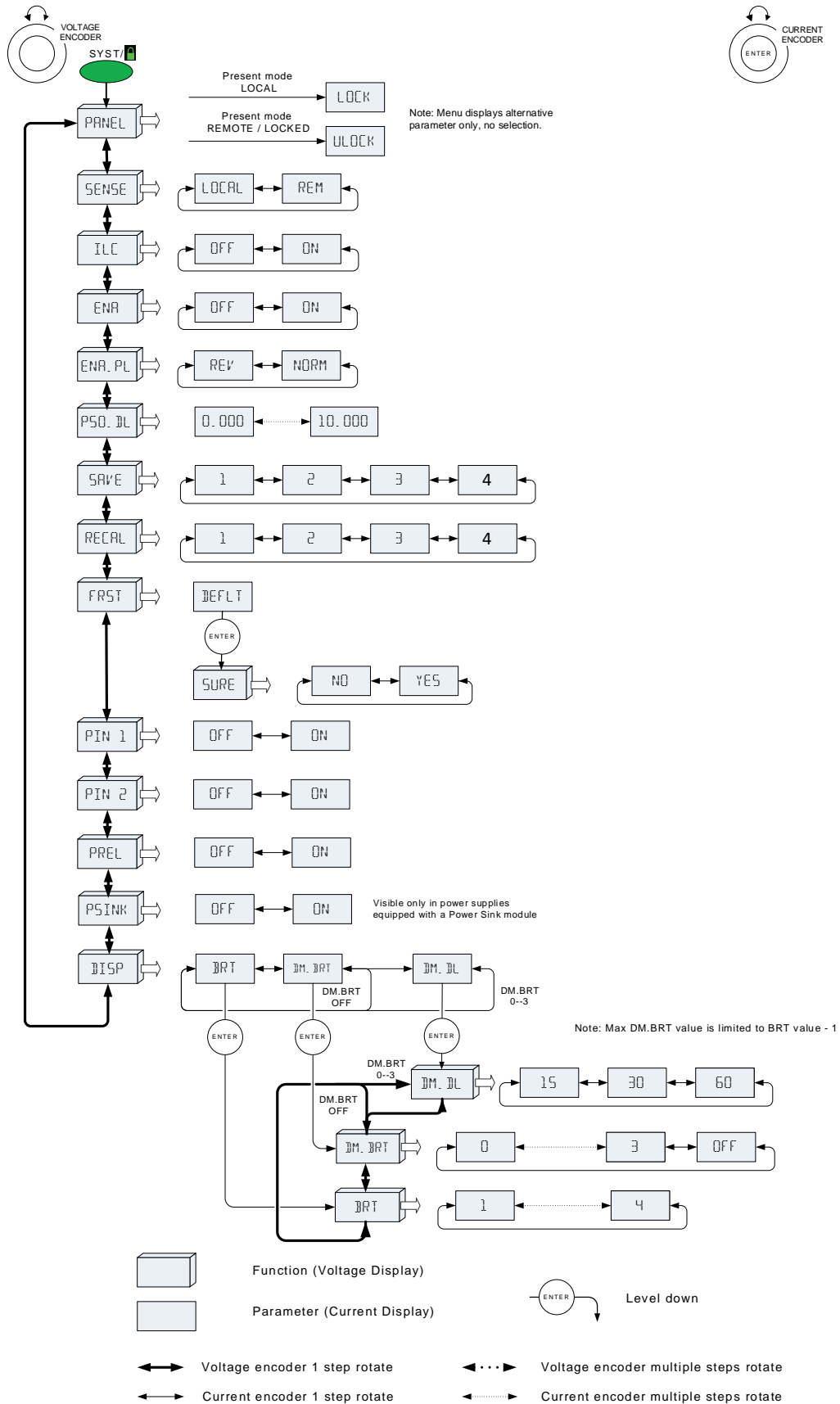
Note: Press Current encoder to select required parameter. Current display blinks - Parameter accepted

SYSTEM MENU

Figure 1–9: SYSTEM Menu Diagram

PROGRAM MENU
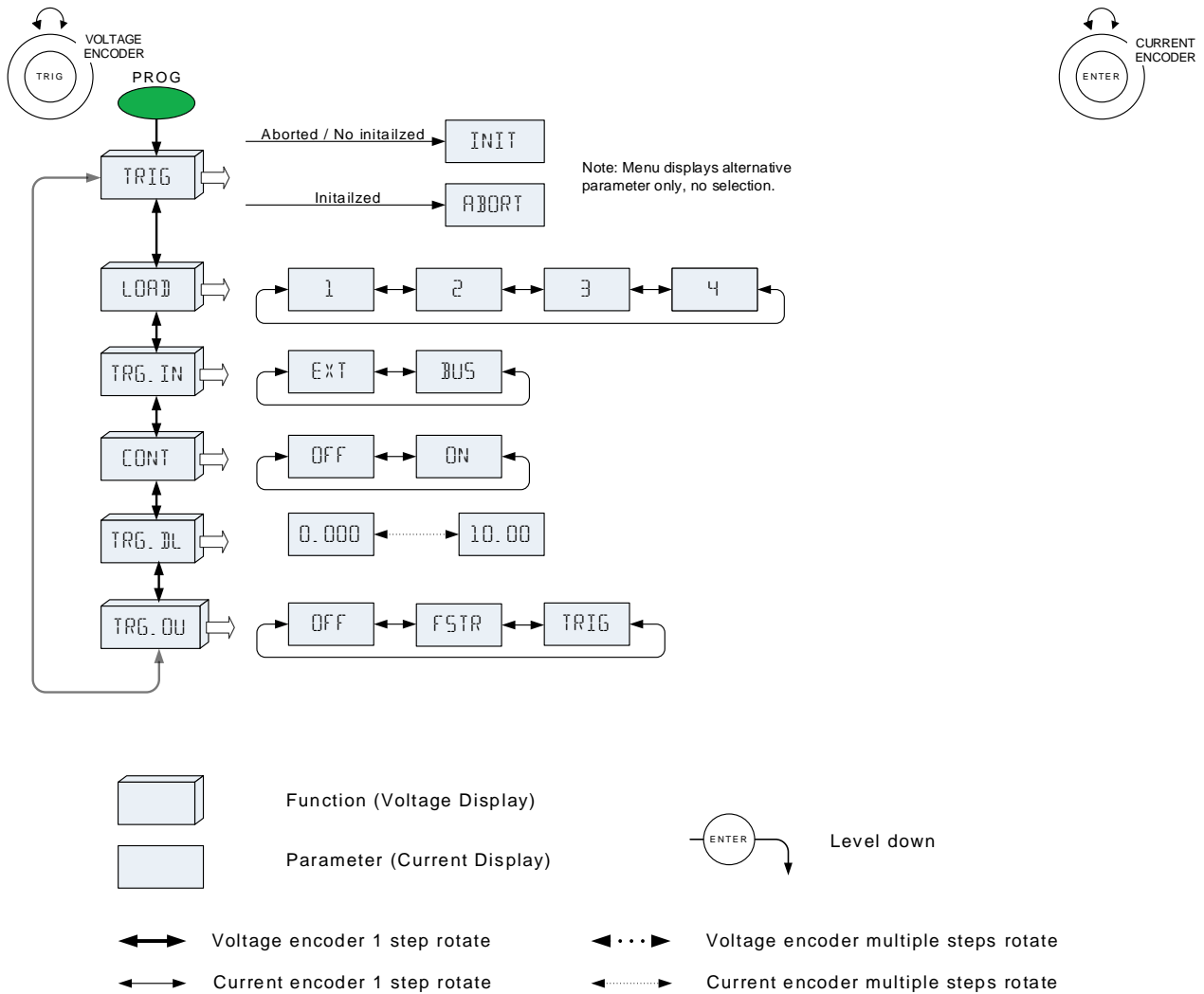
Figure 1–10: PROGRAM Menu Diagram

1.8.2 Exiting a Menu

There are three ways to exit a Menu:

- Press the active Menu button.

  Appropriate MENU LED turns OFF. The display shows the present power supply status.

- Press the Back button multiple times, corresponding to the depth inside the Menu.

  Appropriate MENU LED turns OFF. The display shows the present power supply status.

- No action for 15 sec.

  Appropriate MENU LED turns OFF. The Display shows the present power supply status.

1.9　Blank Front Panel (GB Series) - Basic Operation

This section serves as a basic guide to operate **GENESYS™** Blank Front Panel power supply via its communication interfaces.

NOTE

This chapter, being referred to Blank Front Panel power supply applies to Standard (Full) Panel power supply as well.

1.9.1　USB Driver Installation (PC)

GENESYS™ power supply default communication interface is set to USB. To communicate with the supply, it is recommended to install USB driver before USB cable connection (USB drivers are available on TDK-Lambda Website). To install USB driver, download it from TDK-Lambda Website, decompress zipped file (if compressed), navigate to x86 folder for 32-bit operating system or x64 folder for 64-bit operating system, launch dpinst.exe file. Follow on-screen instructions to accomplish the installation process (refer to Applications Guide, IA761-04-03_ for step-by-step installation procedure). Following driver installation, connect power supply to PC using USB cable. Power supply COM port is detected in Device Manager, under Ports (COM & LPT) category as G serial port (COMX), where X stands for COM address number (refer to Figure 1–11 as an example for G serial port installed over COM5).

> Ports (COM & LPT)
>   Communications Port (COM1)
>   G serial port (COM5)
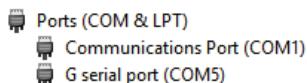
Figure 1–11: G serial port

1.9.2　Establish USB Communication

Communication with a power supply could be established by any terminal software (e.g., Tera Term, an open-source terminal). By default, power supply is configured to USB communication interface, 115200 baud rate, SCPI language, address 6. Configure terminal software as follows:

Port: According to Device Manager (refer to Figure 1–11 for an example of COM5).

Baud rate: 115200.

Data: 8-bit.

Parity: None.

Stop bit: 1.

Flow control: None.

Transmit delay: 0 mSec. (both for character and line).

Newline receive: CR + LF (Carriage Return + Line Feed).

Newline transmit: CR (Carriage return).

Send the following commands to the power supply to test communication:

1. INST:NSEL 6   (power supply with address 6 will receive commands and answer queries).

2. *IDN?   (query power supply for its identification string).

Power supply replies its identification string (TDK-LAMBDA,G…), refer to section 4.14, *IDN? command for an example.

NOTE

Power supply ordered with an optional communication interface (i.e., IEEE, MODBUS TCP, or EtherCAT) is configured, by default, to optional communication interface. Baud rate is set to 115200, SCPI communication language (unless optional interface requires unique language such as registers for MODBUS TCP or SDOs/PDOs for EtherCAT), address 6.

1.9.3 Set RS232 Communication Interface (Example)

GENESYS™ power supply default communication interface is set to USB. Send the following commands to the power supply to set RS232 communication interface.

1. INST:NSEL 6   (power supply with address 6 will receive commands).

2. SYST:INT RS232   (switch communication interface to RS232 interface).

NOTES

1. Following SYST:INT RS232 command, power supply communication interface immediately switches to RS232. Execution time is ~25mS.
2. Power supply must be re-addressed using INST:NSEL 6 command following communication interface change before sending additional commands.

1.9.4 Set 9600 Communication Baud Rate (Example)

GENESYS™ power supply default baud rate is set to 115200. Send the following commands to the power supply to set 9600 baud rate.

1. INST:NSEL 6   (power supply with address 6 will receive commands).

2. SYST:BAUD 9600   (switch baud rate to 9600).

NOTE

If baud rate is switched in USB communication interface, only multi-drop baud rate is affected.
If baud rate is switched in RS232/485 communication, remember to switch baud rate setting in PC terminal software.

1.9.5 Set Power Supply Communication Address (Example)

GENESYS™ power supply default address is set to 6. Send the following commands to the power supply to set address to 10.

1. INST:NSEL 6   (power supply with address 6 will receive commands).

2. SYST:ADDR 10   (switch address to 10).

NOTE

Following SYST:ADDR 10, power supply is addressed as 10. To send commands to this supply, send INST:NSEL 10.

1.9.6 Set GEN Communication Language (Example)

GENESYS™ power supply default communication language is set to SCPI. Send the following commands to the power supply to set GEN language.

1. INST:NSEL 6   (power supply with address 6 will receive commands).

2. SYST:LANG GEN   (switch communication language to GEN language).

3. ADR 6   (confirm power supply replies with "OK").

1.9.7 Configure GENESYS™ to Genesys Power Supply Communication Settings

GENESYS™ power supply default communication parameters are as follows:

Interface: USB.

Language: SCPI.

Baud rate: 115200.

Address: 6.

Genesys power supply default communication parameters are as follows:

Interface: RS232.

Language: GEN.

Baud rate: 9600.

Address: 6.

PC terminal software parameters are as follows:

Port: USB, According to Device Manager (refer to Figure 1–11 for an example of COM5).

Baud rate: 115200.

Data: 8-bit.

Parity: None.

Stop bit: 1.

Flow control: None.

Transmit delay: 0 mSec. (both for character and line).

Newline receive: CR + LF (Carriage Return + Line Feed).

Newline transmit: CR (Carriage return).

Send the following commands to the power supply to set **GƎNESYS™** communication parameters as Genesys.

1. INST:NSEL 6   (power supply with address 6 will receive commands).

2. SYST:BAUD 9600   (switch baud rate to 9600).

3. SYST:INT RS232   (switch communication interface to RS232 interface).

Update PC terminal software parameters as follows:

Port: RS232, According to Device Manager (refer to Figure 1–11 for an example of COM5).

Baud rate: 9600.

Following commands are sent via RS232 communication interface.

4. INST:NSEL 6   (power supply with address 6 will receive commands).

5. SYST:LANG GEN   (switch communication language to GEN language).

NOTE

> There are differences between **GƎNESYS™** power supply series GEN language commands to Genesys power supply series GEN language commands. Verify commands-set used by PC software meets **GƎNESYS™** power supply series (refer to section 4.9).

1.9.8   Reset Blank Front Panel Power Supply to Default Settings

GƎNESYS™ power supply default settings are described in section 2.13.1. In case of communication failure (or unknown communication settings), press and hold Reset button (refer to Table 1-4, item number 5) located on the rear panel for 5 to10 seconds and release. Power supply settings will be set according to Table 2-6 and Table 2-7.

CHAPTER 2:   LOCAL OPERATION

2.1   Introduction

This Chapter describes the operating modes that do not require programming and monitoring the power supply via its communication interfaces: LAN, USB, RS232/RS485, Optional communication, or by remote analog signals. Ensure that the REM indicator on the display is off (indicating Local mode). If the REM indicator is on, press the Front Panel SYST button, PANEL ULOCK is seen on the display. Press Current encoder to unlock.

For information regarding remote analog programming, refer to CHAPTER 3 REMOTE ANALOG PROGRAMMING.

For information regarding usage of the LAN, USB, or serial communication interfaces, refer to section 4.2.2.

The power supply has three operating modes. The two basic operating modes are: Constant Voltage mode and Constant Current mode. The mode in which the power supply operates at any given time depends on the output voltage setting, output current limit setting, and the load resistance. The third operation mode is the Constant Power mode. In this mode a power limit is created by an internal algorithm. Refer to section 5.5 for further explanation.

2.2   Load Connections Options

2.2.1   Connecting Single Loads, Local Sensing (Default)

Figure 2–1 shows recommended load connections for a single load. This connection is for local sensing mode. Local sensing is suitable for applications where load regulation is less critical.
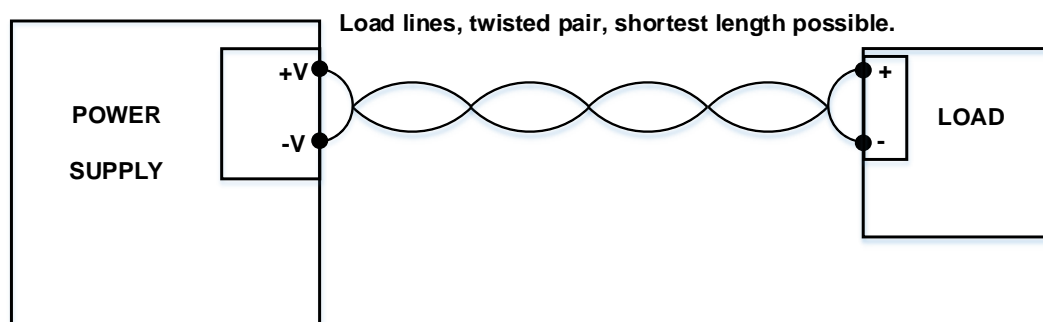
Figure 2–1: Single Load Connection, Local Sensing

2.2.2   Connecting Single Loads, Remote Sensing

WARNING

There is a potential shock hazard at the sense point when using power supply with an output voltage greater than 60VDC. Ensure that the connections at the load end are shielded to prevent accidental contact with hazardous voltages.

WARNUNG

Bei Einsatz einer Stromversorgung mit einer Ausgangsspannung von über 60VDC besteht am lastseitigen Sense-Punkt die potentielle Gefahr eines elektrischen Schlags. Stellen Sie sicher, dass die Anschlüsse an der Last abgedeckt sind, um versehentlichen Kontakt mit gefährlicher Spannung zu vermeiden.

CAUTION

When using shielded sense wires, ground the shield in one place only. The location can be the power supply chassis or one of the output terminals.

Figure 2–2 shows recommended remote sensing connection for single loads. Remote sensing is used when, in Constant Voltage mode, the load regulation is important at the load terminals. Use twisted or shielded wires to minimize noise pick-up. If shielded wires are used, the shield should be connected to the ground at one point, either at the power supply chassis or the load ground. The optimal point for the shield ground should be determined by experimentation.

Load lines, twisted pair, shortest length possible.
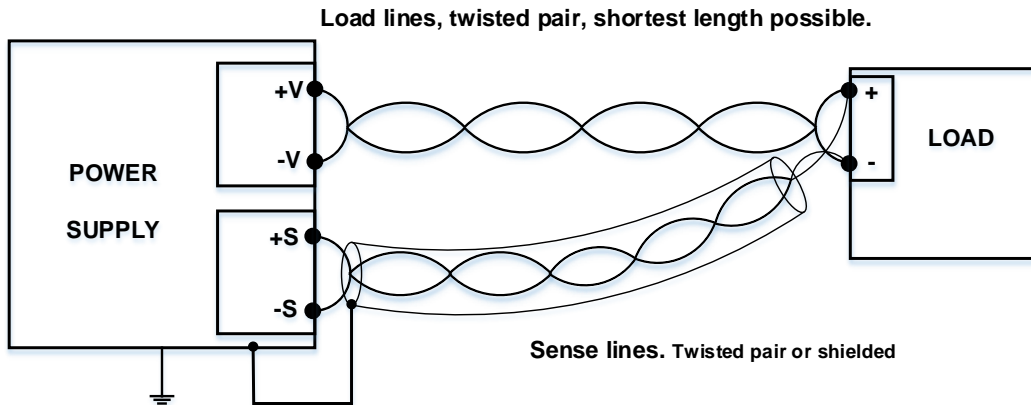
Figure 2–2: Remote Sensing, Single Load

2.2.3   Connecting Multiple Loads, Radial Distribution Method

Figure 2–3 shows multiple loads connected to one supply. Each load should be connected to the power supply's output terminals using separate pairs of wires. It is recommended that each pair of wires will be as short as possible and twisted or shielded to minimize noise pick-up and radiation.
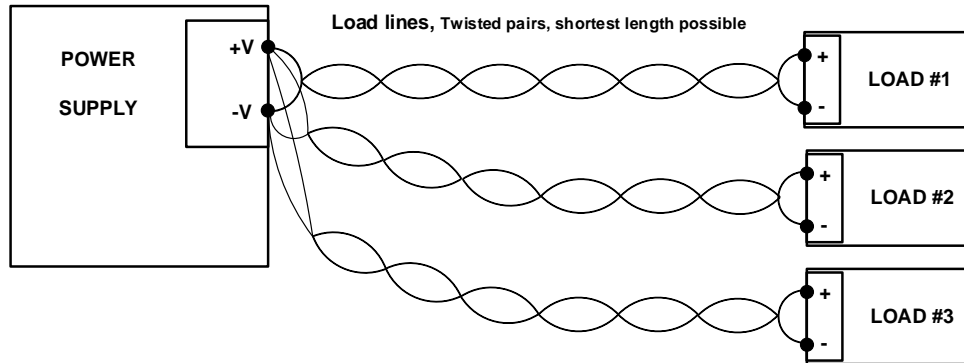
Figure 2–3: Multiple Loads Connection, Radial Distribution, Local Sense

2.2.4   Multiple Load Connection with Distribution Terminals

If remotely located output distribution terminals are used, the power supply output terminals should be connected to the distribution terminals by a pair of twisted and/or shielded wires. Each load should be separately connected to the remote distribution terminals (see Figure 2–4).

If remote sensing is required, the sensing wires should be connected to the distribution terminals or at the most critical load.

In remote sense, the power supply will compensate for voltage drop on the load wires. Refer to the Specifications in the Safety and Installation Manual for the maximum voltage drop on load wires. The voltage drop is subtracted from the total voltage available at the output.
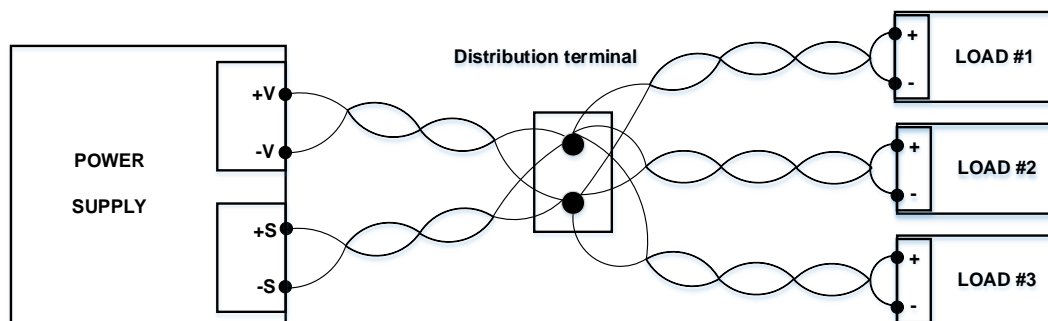
Figure 2–4: Multiple Loads Connection with Distribution Terminal

2.3 Constant Voltage Mode and Voltage Setting

In Constant Voltage mode, the power supply regulates the output voltage at the selected value, while the load current varies as required by the load.

While the power supply operates in Constant Voltage mode, the CV indicator on the display illuminates.

1. Adjust the output voltage, when the power supply output is enabled (Output On) or disabled (Output Off). There are three options to set output voltage:

   (a) When the output is enabled, rotate the Voltage encoder knob to program the output voltage. This method affects output voltage immediately.

   (b) When the output is enabled, press the PREV button, and then rotate the Voltage encoder to a required value. Press the Voltage encoder to select the required value. The display will blink once to acknowledge the setting. This method affects output voltage only after acknowledgement by encoder press. Exit the PREV menu by pressing the Back button or the PREV button.

   (c) When the output is disabled, press the PREV button, and then rotate the Voltage encoder to a required value. Press the Voltage encoder to select the required value. The display will blink once to acknowledge the setting. Exit the PREV menu by pressing the Back button or the PREV button.

2. Set voltage programming resolution to the Coarse or Fine adjustment.

   (a) Press the FINE button to select between the lower (about 1% of rated voltage) and higher (setting least significant digit seen on the voltage display) resolution.

   (b) The FINE LED illuminates when the resolution is set to Fine.

NOTE

If after completing the adjustment, the display shows a different value than the setting, the power supply may be at current limit. Check the load condition and the power supply current limit setting.

NOTE

The maximum and minimum setting values of the output voltage are limited by the Over Voltage protection and Under Voltage limit settings. Refer to section 2.9.2 and section 2.9.3 for more details.

2.4 Constant Current Mode and Current Setting

In the Constant Current mode, the power supply regulates the output current at the selected value, while the voltage varies with the load requirement.

While the power supply is operating in Constant Current mode, the CC indicator in the display illuminates.

1. Adjust the output current, when the power supply output is enabled (Output On) or disabled (Output Off). There are three options to set output current:

   (a) When the output is enabled, rotate the Current encoder knob to program the output current. This method affects output current immediately.

   (b) When the output is enabled, press the PREV button, and then rotate the Current encoder to a required value. Press the Current encoder to select the required value. The display will blink once to acknowledge the setting. This method affects output current only after acknowledgement by encoder press. Exit the PREV menu by pressing the Back button or the PREV button.

   (c) When the output is disabled, press the PREV button, and then rotate the Current encoder to a required value. Press the Current encoder to select the required value. The display will blink once to acknowledge the setting. Exit the PREV menu by pressing the Back button or the PREV button.

2. Set current programming resolution to Coarse or Fine adjustment.

   (a) Press the FINE button to select between the lower (about 1% of rated current) and higher (setting least significant digit seen on the current display) resolution.

   (b) The FINE LED illuminates when the resolution is set to Fine.

2.5 Automatic Crossover

When the power supply operates in the Constant Voltage mode, while the load current is increased to greater than the current limit setting, the power supply will automatically switch to the Constant Current mode. If the load is decreased to less than the current limit setting, the power supply will automatically switch back to the Constant Voltage mode.

2.6 Output On/Off Control

The Output On/Off enables or disables the power supply output.

The Output On/Off can be activated from the front panel using the OUTPUT button or from the communication interface. The OUTPUT button can be pressed at any time (except in the Front Panel Lock mode, Remote control mode by communication, LLO mode, or when a Fault condition exists).

When the output is disabled, the output voltage and current fall to zero, the display shows OUT OFF. Press the OUTPUT button to recover from Faults such as: OVP, UVP, and FOLD faults after the Fault conditions have been removed.

2.7 Safe-Start and Auto-Restart Modes

At AC turn on, the power supply can start at the last setting of the Output Voltage and Current limit with the output enabled (Auto-restart) or it can start with the output disabled (Safe mode).

1. Press the Configuration button. Display shows START SAFE or START AUTO, depending on the currently selected start mode.

2. Rotate the Current encoder to select between SAFE or AUTO start mode.

3. Press the current encoder to select Safe mode or Auto-restart mode.

   The default setting is Safe mode.

Automatic Start Mode (AUTO)

The power supply is restored to last operation setting. Upon start-up, the output is enabled or disabled according to the last setting.

Safe Start Mode (SAFE)

The power supply is restored to last operation setting and sets the Output to Off state.

At start-up, the output is disabled and the output voltage and current are zero (settings are preserved). To enable the output momentarily, press the OUTPUT button.

2.8 Viewing Software Revision

Via the Front Panel Menu, it is possible to view the installed software revision.

1. Press the COMM button. COMM (GREEN) LED illuminates.

2. Rotate the Voltage encoder until the REV. message appears on the Voltage display, and the installed software revision number appears on the Current display.

2.9 Alarms and Protective Functions

2.9.1 Introduction

There are several conditions that cause alarm (RED LED blinks). All alarms affect the output. When an alarm occurs, the respective fault will appear on the display and the alarm LED illuminates. It is possible that more than one fault (alarm) may be triggered, but only the first will be shown on the display. If the second fault is still active when the first fault is removed, then the second fault will be displayed.

The following protective functions are incorporated in the power supply:

- OVP - Over Voltage Protection
- UVP - Under Voltage Protection
- ILC - Interlock
- ENA - Enable
- FOLD - Fold Back Constant Current or Constant Voltage
- AC FAIL - AC Power failure
- OTP - Over Temperature Protection

2.9.2   Over Voltage Protection

The OVP circuit protects the load in the event of a remote or local programming error or a power supply failure. The protection circuit monitors the voltage at the power supply sense points thus providing the protection level at the load. Upon detection of an Over Voltage condition, the power supply output will shut down.

Setting the OVP Level

The OVP can be set when the power supply output is Enabled (On) or Disabled (Off). The minimum setting level is 5% above the output voltage, or the value in Table 2-1, whichever is higher. The maximum setting level is shown in Table 2-1.

1. Press the PROT button.

    PROT (GREEN) LED illuminates. ᴏᴠᴘ message appears on the display.

2. Rotate the Current encoder to adjust the OVP level.

3. Press the Current encoder to select the required OVP level.

    The display blinks once to acknowledge the setting.

4. Exit the PROT menu by pressing the Back button or the PROT button.

Model	Max. OVP (V)	Min. OVP (V)
10V	12	0.5
20V	24	1
30V	36	2
40V	44.1	2
50V	55.125	5
60V	66.15	5
80V	88.2	5
100V	110.25	5
150V	165.37	5
200V	220.5	5
300V	330.75	5
400V	441	5
500V	551.25	5
600V	661.5	5
1000V	1102.5	5
1500V	1653.75	5

Table 2-1: Maximum/Minimum OVP Setting Levels

2.9.2.1   Resetting the OVP Circuit

To reset the OVP circuit after activation:

1. Reduce the power supply Output Voltage setting below the OVP set level.

2. Ensure that the load and the sense wiring is connected properly.

Four methods to reset the OVP circuit:

- Pressing the OUTPUT button
- AC recycle
- On/Off recycle by analog control (Interlock/Enable)
- Sending a communication command to enable output

2.9.2.2   Activated OVP Alarm

When the OVP is activated, the power supply output shuts down. The display shows OVP FAULT.
RED alarm LED blinks 1/2Hz frequency.

2.9.3   Under Voltage Protection and Under Voltage Limit

The UVL function prevents output voltage setting below the UVL set value and prevents an adjustment of the output voltage below a certain limit.

The UVP function prevents power supply operation if the output voltage is below the UVL set value. Upon detection of an Under Voltage condition, the power supply output will shut down. The combination of the UVP/UVL and the OVP functions enable the user to create a protection window for the sensitive load circuitry.

Setting the UVP/UVL Mode and Level

The UVP/UVL can be set when the power supply output is Enabled (On) or Disabled (Off).

UVL setting value is limited at the maximum level to approximately 5% below the Output Voltage setting. Attempting to adjust the value above this limit will result in no response to the adjustment attempt. The minimum value setting is zero. UVP must be turned "ON" to be operational.

1. Press the PROT button. PROT (GREEN) LED illuminates.

2. Rotate the Voltage encoder until UVL appears on the Voltage display.

3. Rotate the Current encoder to set the required UVL level.

4. Press the Current encoder to select the required level. The display blinks once to acknowledge the setting.

5. Rotate the Voltage encoder until UVP appears on the Voltage display.

6. Rotate the Current encoder to set UVP ON/OFF.

7. Press the Current encoder for selection. The display blinks once to acknowledge the setting.

8. Set the UVP delay time by rotating the Voltage encoder until UVP.DL appears.

    The delay can be set by the Current encoder between 0.1 and 25.5sec.

9. Press the Current encoder to select the required delay.

The display blinks once to acknowledge the setting.

10. Exit the PROT menu by pressing the Back button or the PROT button.

Model Rated Output Voltage (V)	Minimum (V)	Maximum (V)
10	0	9.5
20	0	19
30	0	28.5
40	0	38
50	0	47.5
60	0	57
80	0	76
100	0	95
150	0	142.5
200	0	190
300	0	285
400	0	380
500	0	475
600	0	570
1000	0	950
1500	0	1425

Table 2-2: UVL Programming Range

2.9.3.1   Activated UVP Alarm

When the UVP is activated, the power supply output shuts down. The display shows UVP FAULT. RED alarm LED blinks 1/2Hz frequency.

2.9.3.2   Resetting UVP Alarm

To reset the UVP alarm:

1. Reduce the load, power supply might have entered CC mode, which caused output voltage to drop.

2. Increase current limit setting, power supply might have entered CC mode, which caused output voltage to drop, due to current requirement which exceeds current limit setting.

Four methods to reset UVP alarm:

- Pressing the OUTPUT button
- AC recycle
- On/Off recycle by analog control (Interlock/Enable)
- Sending a communication command to enable output

2.9.4   Foldback Protection

Foldback protection will shut down the power supply output if power supply operation mode crosses over from CC to CV or from CV to CC, according to a selected operation mode.

There are three states of Foldback protection.

- OFF (default)
- CV
- CC

For CC (or CP) to CV protection mode, the setting should be CV.

For CV (or CP) to CC protection mode, the setting should be CC.

Setting the Foldback Protection

The Foldback can be set when the power supply output is Enabled (On) or Disabled (Off).

1. Press the PROT button. PROT (GREEN) LED illuminates.

2. Rotate Voltage encoder until FOLD OFF appears.

3. Rotate the Current encoder to set the required Foldback state (CV or CC).

4. Press the Current encoder for selection of Foldback state. The display blinks once to acknowledge the setting.

   If the CC state is selected, the FOLD I indicator appears on the display.

   If the CV state is selected, the FOLD V indicator appears on the display.

5. To turn off the Foldback protection, select FOLD OFF, following the same procedure above. Foldback indicator disappears from the display.

6. Exit the PROT menu by pressing the Back button or the PROT button.

7. Set the Foldback delay time by rotating the Voltage encoder until FLD.DL appears.

   The delay can be set by the Current encoder between 0.1 and 25.5sec.

8. Press the Current encoder to select the required delay.

   The display blinks once to acknowledge the setting.

9. Exit the PROT menu by pressing the Back button or the PROT button.

2.9.4.1   Activated FOLD Alarm

When the Foldback is activated, the power supply output shuts off. The display shows FOLD FAULT, and the alarm LED blinks with 1/2 Hz frequency.

2.9.4.2   Resetting FOLD Alarm

To reset the FOLD alarm:

1. FOLD I - Reduce the load, power supply might have entered CC mode, which caused output voltage to drop.

2. FOLD I - Increase current limit setting, power supply might have entered CC mode, which caused output voltage to drop, due to current requirement which exceeds current limit setting.

3. FOLD V – Increase the load, power supply might have entered CV mode, which caused output voltage to increase.

4. FOLD V – Increase voltage limit setting, power supply might have entered CV mode, which caused output voltage to increase, due to current requirement which has reduced.

Four methods to reset FOLD alarm:

- Pressing the OUTPUT button
- AC recycle
- On/Off recycle by analog control (Interlock/Enable)
- Sending a communication command to enable output.

2.9.5   Protection Delay

Foldback protection delay is the time between feedback transition (CV to CC transition or vice versa) event occurrences to output shutdown.

UVP protection delay is the time between UVL crossover point events to output shutdown.

NOTE

At output OFF -> ON transition, additional 500ms delay is added.

Total protection delay = 500ms + delay setting.

2.9.6   Over Temperature Protection

The OTP circuit shuts down the power supply before the internal components can exceed their safe internal operating temperature. When an OTP shutdown occurs, the display shows OTP FAULT, and the alarm LED blinks RED with 1/2 Hz frequency. Resetting the OTP circuit can be automatic (non-latched) or manual (latched) depending on the power supply mode: Safe start mode or Auto-restart mode.

- **Safe start mode**: The power supply stays off after the OTP condition has been removed. The display shows OUT OFF.
- **Auto-restart mode**: The power supply recovers to its last setting automatically after the OTP condition is removed.

2.9.7   AC Fail Alarm

The AC Fail alarm indicates whether the AC input has been shut down or AC input is incorrect. When any of these faults occur, the display shows AC FAULT, Output power is disabled, and the alarm RED LED blinks 1/2 Hz frequency.

Safe start mode: The power supply stays off after AC power returns. The display shows `OUT OFF`.

Auto-restart mode: The power supply recovers to its last setting automatically when the AC power returns.

2.10   Series Operation (Applicable to 10V–600V Only)

NOTES

1.   Section 2.10 is **not** applicable for power supplies above 600V and GSPS Systems.

2.   It is prohibited to connect power supplies above 600V in series.

Power supplies of the same model (up to two units) can be connected in series to obtain increased output voltage.

WARNING

When power supplies are connected in series, and the load or one of the output terminals is **grounded**, no point may be at a greater potential according to the following definition:

For 10–100VDC rated output: No point may be at a greater potential of +/- 200VDC from ground.

For 150–600VDC rated output: No point may be at a greater potential of +/- 600VDC from ground.

WARNUNG

Wenn Stromversorgungen in Reihe geschaltet werden und die Last oder eine der Ausgangsklemmen **geerdet** ist, darf kein Anschluss ein größeres Spannungspotential gemäß der folgenden Definition aufweisen:

Bei den Ausgangsmodellen von 10–100VDC: An den Anschlüssen darf kein größeres Potential von bis zu +/- 200VDC gegen Erde haben.

Bei den Ausgangsmodellen 150–600VDC: An den Anschlüssen darf kein größeres Potential von bis zu +/- 600VDC gegen Erde haben.

WARNING

When power supplies are connected in series, and the output terminals are **floating** (including load terminals), no point may be at a greater potential according to the following definition:

For 10–100VDC rated output: No point may be at a greater potential of +/- 200VDC from ground.

For 150–600VDC rated output: No point may be at a greater potential of +/- 600VDC from ground.

i.e., 600VDC output power supplies can be connected in series, as long as the maximum voltage on any output terminal (plus or minus) does not exceed +/- 600VDC to ground.

WARNUNG

Wenn Stromversorgungen in Reihe geschaltet sind und die Ausgangsklemmen **potentialfrei** sind (einschließlich den Lastklemmen), darf kein Anschluss ein größeres Spannungspotential gemäß der folgenden Definition aufweisen:

Bei den Ausgangsmodellen von 10–100VDC: An den Anschlüssen darf kein größeres Potential von bis zu +/- 200VDC gegen Erde haben.

Bei den Ausgangsmodellen 150–600VDC: An den Anschlüssen darf kein größeres Potential von bis zu +/- 600VDC gegen Erde haben.

d.h. 600VDC Ausgangsspannungen können in Reihe geschaltet werden, um 1200VDC zu erzeugen, solange die maximale Spannung an jeder Ausgangsklemme (plus oder minus) +/- 600VDC gegen Erde nicht überschreitet.

2.10.1   Series Connection for Increased Output Voltage

Two units are connected so that their outputs are summed. Set the current limit of each power supply to the maximum that the load can handle without damage. It is recommended that diodes be connected in parallel with each unit output to prevent reverse voltage during start up sequence or in case one of the units shuts down. Each diode should be rated to at least the power supply rated output voltage and output current. Refer to Figure 2–5 for series operation with local and remote sensing.
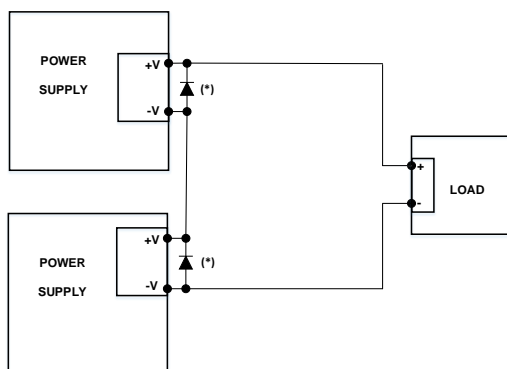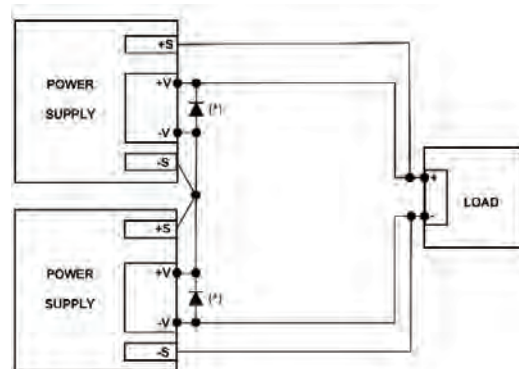
(*) Diodes are user supplied.

Figure 2–5: Series Connection, Local and Remote Sensing

2.10.2   Series Connection for Positive and Negative Output Voltage

In this mode, two units are configured as positive and negative output.

Set the current limit of each power supply to the maximum that the load can handle without damage. It is recommended that diodes be connected in parallel with each unit output to prevent reverse voltage during start-up or in case one of the units shuts down. Each diode should be rated to at least the power supply rated output voltage and output current. Refer to Figure 2–6 for this operating mode.
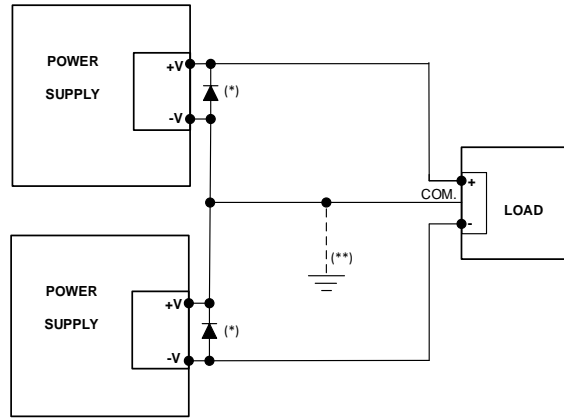
Figure 2–6: Series Connection for Positive/Negative Output Voltages

(*) Diodes are user supplied.
(**) Optional ground connection.

2.10.3 Remote Programming in Series Operation

Programming by external voltage:	The analog programming circuits of this power supply are isolated from the output potentials. Therefore, the circuits used to control each series connected unit don't have to be separated and floated from each other.
Using the SO function and (\PS_OK_OUT) signal:	DAISY_IN signal (J1-1) serves as Output Shut OFF (SO) via daisy chain connection. This signal is used only for the Daisy Chain application, connected to DAISY_OUT signal (J1-2) of a master unit. The signal is referenced to the isolated interface (COM_SELV: J1-11, 12, 13, 14). The function is active after initial high to low transition. (\PS_OK_OUT) signal is Power Supply OK– Open Collector type which indicates output status (DC On/Off). The signal is referenced to the isolated interface (COM_SELV: J1-11, 12, 13, 14). The COM_SELV terminals of the units can be connected to obtain a single control circuit for the power supplies connected in series.
Programming by external resistor:	Programming by external resistor is possible. Refer to Section 3.5 for details.
Programming via communication ports (RS232/RS485, USB, LAN, and GPIB (IEEE)):	The Communication ports are referenced to COM_SELV, which is isolated from the power supply output potential. Therefore, power supplies connected in series can be chained using the Remote-In and Remote-Out connectors. Refer to section 1.5 for details.

2.11　Daisy-Chain Connection

It is possible to configure a multiple power supply system to shut down all units when a fault condition occurs in one of the units. When the fault is removed, the system recovers according to a preset state: Safe start mode or Auto-restart mode.

If a fault occurs in one of the units, its "Daisy out" signal will be set to low level and the display will indicate the fault. The other units will shut off and their displays will indicate SO FAULT. When the fault condition is removed, the units will recover to their last setting according to their respective Safe start or Auto-restart setting.

Figure 2–7: Daisy-Chain Connection shows connection of three units, however the same connection method may be applied to systems with more units.
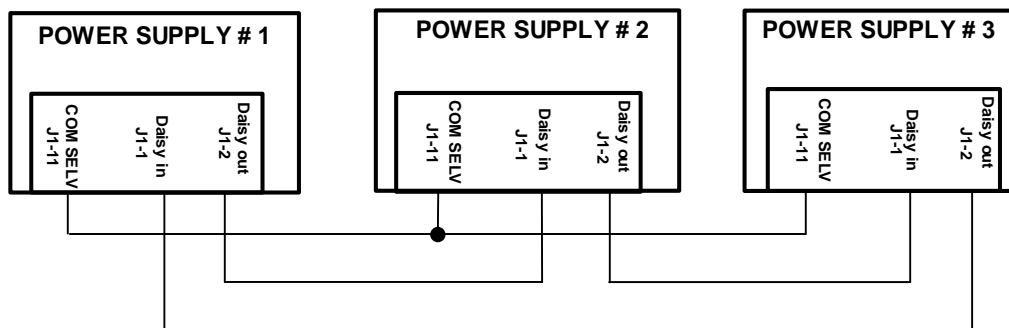
Figure 2–7: Daisy-Chain Connection

2.11.1　Daisy In Function

DAISY_IN signal is used only for Daisy Chain application, connected to DAISY_OUT signal of a master unit. It is an isolated signal from the power supply output.

Connection to the signal is made via pin J1-1 (DAISY_IN) and pin J1-11 (COM_SELV).

The DAISY_IN pin accepts 2–25V as high-level signal, 0–0.6V as low-level signal, or Open-Short contact to enable or disable the power supply output.

The Daisy in function will be activated only after initial High to low transition is detected.

Thus, in the Auto start mode, the output will be enabled after applying AC power, even if DAISY_IN is in low level. DAISY_IN is ignored after power supply output OFF event, Power Switch OFF event & Faults.

After high to low transition is detected, the SO will enable or disable the power supply output according to the signal level or the short/open applied to J1. When the external DAISY_IN is triggered, the power supply will display SO FAULT on the voltage display.

For signal details, refer to Table 2-3.

SO signal level (J1-1 – J1-11)	Power Supply Output	DAISY_Out Level (J1-2 – J1-11)	PS_OK Level (J1-3 – J1-11)
2–30V or Open	On	High	Low
0–0.6V or Short	Off (SO FAULT)	Low	High (Open Collector)

Table 2-3: Daisy_In Signal Definition

2.12 Rear Panel (J1 Connector) Functions

2.12.1 Interlock Function - Analog On/Off (Enable/Disable)

Interlock signal (\ILC_IN) serves as power supply output enable control via a switch or relay.

Use the Interlock function to enable or disable the output as emergency shutoff or door open switch. It is an isolated signal from the power supply output. Connection to the signal is made via pin J1-19 (\ILC_IN) and pin J1-11 (COM_SELV).

The ILC function can be enabled or disabled via communications or the Front panel as follows:

1. Press the SYST button. SYST (GREEN) LED illuminates.

2. Rotate the Voltage encoder until ILC OFF appears.

3. Rotate Current encoder to select ILC ON or ILC OFF. Press Current encoder to accept. The display blinks once to acknowledge the setting.

4. Exit SYST menu by pressing the Back button or the SYST button.

Front Panel ILC Setting	ILC Input	Power Supply Output	Display	Alarm LED
OFF – Default	Open or Short	On	Voltage/Current	Off
ON	Open or 2–30V	Off	ILC FAULT	On
	Short or 0–0.6V	On	Voltage/Current	Off

Table 2-4: Interlock Functions and Settings

CAUTION

To prevent possible damage to the unit, do not connect any of the Enable/Disable inputs to the positive or negative output potential.

NOTE

Safe Start mode - If the Interlock fault condition clears while units are in the Safe Start mode, the power supply returns to Output Off mode.

Auto-Restart mode - The output will automatically return to the previous setting.

The following faults will require \ILC_IN recycle: UVP, OVP, or Foldback.

2.12.1.1 Activated ILC Alarm

When the ILC is activated, the power supply output shuts down. The display shows ILC FAULT. RED alarm LED blinks 1/2Hz frequency.

2.12.2 Enable In Function

ENA_IN signal serves as power supply output enable control. Connection to the signal is made via pin J1-10 (ENA_IN) and pin J1-11 (COM_SELV), which are isolated from the power supply output.

ENA_IN is reported by a display message ENA FAULT, RED alarm LED is blinking 1/2 Hz frequency.

ENA_IN can be enabled/disabled via communications or the Front Panel as follows:

1. Press the SYST button. SYST (GREEN) LED illuminates.
2. Rotate the Voltage encoder until ENA OFF appears.
3. Rotate Current encoder to select ENA ON or ENA OFF. Press Current encoder to accept. The display blinks once to acknowledge the setting.
4. Exit SYST menu by pressing the Back button or the SYST button.

2.12.2.1 Activated ENA Alarm

When the ENA is activated, the power supply output shuts down. The display shows ENA FAULT. RED alarm LED blinks 1/2Hz frequency.

2.12.3 Enable In Polarity

This function provides the ability to select ENA_IN signal polarity.

Polarity selection via the Front Panel is performed as follows:

1. Press the SYST button. SYST (GREEN) LED illuminates.
2. Rotate the Voltage encoder until ENA.PL appears.
3. Rotate Current encoder to select NORM or REV. Press Current encoder to accept. The display blinks once to acknowledge the setting.
4. Exit SYST menu by pressing the Back button or the SYST button.

CAUTION

To prevent possible damage to the unit, do not connect any of the Enable /Disable inputs to the positive or negative output potential.

NOTE

Safe Start mode - If the Enable fault condition clears while units are in the Safe Start mode, the power supply returns to Output Off mode.

Auto-Restart mode - The output will automatically return to the previous setting.

The following faults will require \ENA_IN recycle: UVP, OVP, or Foldback.

Front Panel ENA Setting	ENA Polarity	ENA Input	Power Supply Output	Display	Alarm LED
OFF – Default	-	Open or Short	On	Voltage/Current	Off
ON	NORM	Open or 2–30V	Off	ENA FAULT	On
	NORM	Short or 0–0.6V	On	Voltage/Current	Off
	REV	Open or 2–30V	On	Voltage/Current	Off
	REV	Short or 0–0.6V	Off	ENA FAULT	On

Table 2-5: Enable Functions and Settings

2.12.4 Auxiliary Programmed Signals Prog_out_1 and Prog_out_2

The programmed signals Prog_out_1 (J1-21) and Prog_out_2 (J1-20) are open drain, maximum input voltage 25V, and maximum sink current 100mA. Programmed signals can be controlled via the Front Panel or via communications. Selection of "OFF" via front panel or communication will result in low output signal level ("OFF" - internal FET conducts) and selection of "ON" via front panel or communication will result in high output signal level ("ON" - internal FET does not conduct).

Pin 1 or Pin 2 settings are set as follows:

1. Press the SYST. button. SYST (GREEN) LED illuminates.

2. Rotate the Voltage encoder until PIN 1 OFF or PIN 2 OFF appears.

3. Rotate Current encoder to select PIN 1 ON or PIN 1 OFF, PIN 2 ON or PIN 2 OFF. Press Current encoder to accept. The display blinks once to acknowledge the setting.

4. Exit the SYST menu by pressing the Back button or the SYST button.

CAUTION

Do not connect Prog_out_1 and Prog_out_2 to a voltage source higher than 25V. Always connect Prog_out_1 and Prog_out_2 to the voltage source with a series resistor to limit the sink current to less than 100mA.

2.12.5 Power Supply OK Signal

Power Supply OK signal (\PS_OK_OUT) indicates power supply output state (ON/OFF).

It is an open collector signal at J1-3, referenced to COM_SELV at J1-11 (Isolated Interface Common). When a fault condition occurs or power supply output is Off, \PS_OK_OUT level is high, maximum input voltage is 30V. When no fault condition occurs or power supply output is On, \PS_OK_OUT level is low with maximum sink current of 10mA.

The \PS_OK_OUT signal can be delayed via Front Panel setting or via communication. The delay affects \PS_OK_OUT signal high -> low transition only (power supply output state from OFF to ON), low -> high (power supply output state from ON to OFF) is not affected.

This function is used to prevent signal rise before output reaches set value.

PS_OK delay setting:

1. Press SYST button, SYST (GREEN) LED illuminates. Rotate Voltage encoder until $PSO.\ IL$ appears.

2. Rotate the Current encoder to set the required delay time. Press on the current encoder to select the desired delay value.

3. The display will blink once to acknowledge the setting.

4. Exit SYST menu by pressing the Back button or the SYST button.

2.12.6 CV/CC Signal

CV/CC_MON signal indicates the power supply operation mode (Constant Voltage / Constant Current /Constant Power).

CV/CC_MON signal is an open collector output, maximum voltage of 30V, at J1-4, referenced to COM_SELV at J1-11 (Isolated Interface Common). When the power supply operates in the Constant Voltage mode, the Constant power mode, or OUTPUT OFF, CV/CC_MON signal is high. When the power supply operates in the Constant Current mode, CV/CC_MON signal output is low (0–0.6V), with maximum 10mA sink current.

CAUTION

Do not connect CV/CC signal to a voltage source higher than 30VDC. Always connect CV/CC signal to the voltage source with a series resistor to limit the sink current to less than 10mA.

NOTE

For all rear panel functions and for navigation of all menus, refer to the Rear Panel menus in section 1.5 & section 1.8.

2.13 Parameter Setting Memory

Power supply has the following memory configuration modes:

2.13.1 Default Setting

This function sets all parameters to their default state, as defined in Table 2-6 and Table 2-7. Factory Reset settings can be restored via Front Panel menu, Reset button, or communication command. The following states are cleared: OVP, Foldback, and UVP.

1. Press SYST button, SYST (GREEN) LED illuminates. Rotate Voltage encoder until $FRST\ IEFLT$ appears.

2. Press Current encoder to accept default settings.

3. Display shows $SURE\ NO$. Rotate current encoder to display $SURE\ YES$. Press Current encoder to accept. The display will blink once to acknowledge the setting.

4. Exit SYST menu by pressing the Back button or the SYST button.

TDK·Lambda

> 1. If FRST function is performed by communication command, power supply loses communication due to communication settings change and addressing is lost. Firmware 02.106 and above has the ability to select communication interface following factory reset operation. Refer to section 4.15.10, SYSTem:FRST <DSC> command.
>
> 2. Press and hold Reset button located on the rear panel to perform reset function (refer to Table 1-4, Reset Button).
>
> 3. If FRST function is performed via the Front Panel, communication interface is set to USB.

2.13.2 Reset

This function sets basic parameters to their default state (as defined in Table 2-6).

It is set via communication only. The following states are cleared: OVP, Foldback, and UVP.

2.13.3 Last Setting Memory

Last setting stores power supply state into the non-volatile memory. Stored settings are defined in

Table 2-6. Settings are stored at AC fault condition. Settings are restored at power supply AC ON.

2.13.4 Save <1..4>

This function stores parameters into the non-volatile memory. It is set via the Front Panel or communication.

User can save up to 4 sets of parameters. Refer to Table 2-6 for available Store parameter sets.

To save the Front Panel setting, perform the following steps:

1. Press the SYST button. SYST (GREEN) LED illuminates. Rotate Voltage encoder until SAVE 1 appears.

2. Rotate Current encoder to select the desired memory cell (1–4). Accept by pressing Current encoder. The display blinks once to acknowledge the setting.

3. Exit the SYST menu by pressing the Back button or the SYST button.

2.13.5 Recall <1..4>

This function recalls parameters from the non-volatile memory. It is set via the Front Panel or communication.

User can recall up to 4 sets of parameters. Refer to Table 2-6 for available Recall parameter sets.

To recall the Front Panel setting, perform the following steps:

1. Press the SYST button. SYST (GREEN) LED illuminates. Rotate Voltage encoder until RECAL 1 appears on the display.

2. Rotate Current encoder to select the desired memory cell (1–4). Accept by pressing Current encoder. The display blinks once to acknowledge the setting.

3. Exit the SYST menu by pressing the Back button or the SYST button.

Function	Factory Reset (Default Settings)	Reset	Last Setting	Save & Recall
Power Supply Start Mode	SAFE	SAFE	+	+
Power Supply Output State	OFF	OFF	+	OFF
Voltage Set Point [V]	0	0	+	+
Current Set Point [A]	1.05 * RATED	0	+	+
Over Voltage Protection (OVP) [V]	1.1 * RATED or 1.2 * RATED (Model Dependent)	1.1 * RATED or 1.2 * RATED (Model Dependent)	+	+
Under Voltage Level (UVL) [V]	0	0	+	+
Under Voltage Protection (UVP) Mode	OFF	OFF	+	+
Under Voltage Protection (UVP) Delay [S]	01.0	01.0	+	+
Fold-Back Mode	OFF	OFF	+	+
Fold-Back Delay [S]	01.0	01.0	+	+
Constant Power Function	OFF	OFF	+	+
Constant Power Set Point [W]	RATED VOLTAGE MULTIPLYED BY RATED CURRENT	RATED VOLTAGE MULTIPLYED BY RATED CURRENT	+	+
Slew Mode	OFF	OFF	+	-
Voltage Slew Up / Down [V/mS]	999.99	999.99	+	-
Current Slew Up / Down [A/mS]	999.99	999.99	+	-
Internal Resistance Function	OFF	OFF	+	+
Internal Resistance Set Point [Ω]	0.001	0.001	+	+
Voltage Reference Programming Source	DIG	-	+	-
Current Reference Programming Source	DIG	-	+	-
Analog Mode Current Limit (OCL)	OFF	-	+	-
Analog Programming & Monitoring Range [V]	5	-	+	-
Programmable Pin 1	OFF	OFF	+	+
Programmable Pin 2	OFF	OFF	+	+
Front Panel Remote Mode	LOCAL	REM	+ *1	-
Front Panel LOCK	OFF	-	+	-
Output Sense (LOC / REM)	LOC	-	+	-
Interlock (ILC) Function	OFF	-	+	-
Enable (ENA) Function	OFF	-	+	-
Enable (ENA) Polarity	REV	-	+	-
Power Supply OK (PS_OK) Delay [S]	00.01	-	+	-
Preload	ON	-	+	-
Communication Interface	User-Selectable *2	-	+	-
Communication Power Supply Address	06	-	+	-
Communication Baud Rate [Baud]	115200	-	+	-
Communication Language	SCPI	-	+	-

Function	Factory Reset (Default Settings)	Reset	Last Setting	Save & Recall
LAN parameters	Default (Ref. LAN Spec.)	-	+	-
Special Voltage Upper Limit (SVUL)	RATED	-	+	-
Special Current Upper Limit (SCUL)	RATED	-	+	-
Enable registers	00000	-	Depends on *PSC (SCPI only)	-
Event registers	00000	00000	-	-
Power-On Status Clear	1	-	+	-
Display State	ON	-	-	-
Display Flash	OFF	-	-	-
Display Brightness	3	-	+	-
Display Dim Delay [S]	30	-	+	-
Display Dim Brightness	2	-	+	-
Factory Calibration Parameters	Factory Calibration	-	-	-
Communication Watchdog (WD)	OFF	-	+	-
Communication Watchdog Timeout (WD.TIM) [S]	1	-	+	-
Boolean commands return value	DIGIT	DIGIT	+	-
Power Sink *3	ON	-	+	-

Table 2-6: Non-Volatile Memory Parameters

NOTES

*1 REM mode is set after AC recycle if LLO mode was set before AC recycle.

*2 Refer to Table 1-4, Reset Button, if Reset operation is performed by Reset button located on the rear panel. Refer to section 4.15.10, SYSTem:FRST <DSC> command, if Reset operation is performed by communication interface. Communication is set to USB if reset is performed via Front Panel.

*3 Available for Power Sink models only.

Function	Factory Reset (Default Settings)
IP Address DHCP configuration	DHCP
Ping server	Enabled
Auto-Negotiation	Enabled
Description (Service Name)	TDK-LAMBDA Supply <last 3 serial number digits>
Password	Clear field (None)
Hostname	G[H]<rated voltage>-<rated current>
VXI-11 Discovery	Enabled
Keep-Alive Time [S]	1800
mDNS & DNS-SD	Enabled
Controller Access	One Client Only

Table 2-7: LAN Non-Volatile Memory Parameters

CHAPTER 3:   REMOTE ANALOG PROGRAMMING

3.1   Introduction

The Rear Panel connector J1 allows the user to program the power supply output voltage and current with an analog device. J1 also provides monitoring signals for output voltage and output current. The programming range and monitoring signals range can be selected between 0–5V and 0–10V using the Front Panel menu or communication.

3.2   Local/Remote Analog Control

Signal LOC/REM_INPUT J1-6 accepts electrical signal or dry contact (Referenced to J1-11) to select between Local or Remote Analog programming of the output voltage and current. Refer to Table 3-1 for signal levels.

In Local mode, the output voltage and current can be programmed via the Front Panel Voltage and Current encoders or via the Communication interface. In the Remote Analog mode, the output voltage and current can be programmed by analog voltage or by programming resistors via J1 contacts. Refer to Analog Programming Setting Table 3-1 & Figure 3–1 for remote voltage programming connection or Figure 3–2 for remote resistor programming connection.

3.3   Local/Remote Analog Indication

Contact J1-5 is an open collector output that indicates if the power supply is in the Local mode or in the Remote Analog mode. To use this output, connect a pull-up resistor to a voltage source of maximum 30VDC. Choose the pull-up resistor so that the sink current is less than 10mA when the output is in low state. J1-5 signal is low if J1-6 is low and at least one of the Analog control modes is selected. Refer to Analog Programming Setting Table 3-1.

LOC/REM_INPUT	Voltage source (V.SRC)	Current source (C.SRC)	LOC/REM_MON
2–30V or Open	Not applicable	Not applicable	Off
0–0.6V or Short	PANEL	PANEL	Off
0–0.6V or Short	E.VOL or E.RES	PANEL	0–0.6V or Short
0–0.6V or Short	PANEL	E.VOL or E.RES	0–0.6V or Short
0–0.6V or Short	E.VOL or E.RES	E.VOL or E.RES	0–0.6V or Short

Table 3-1: Local/Remote Analog Control and Indication

3.4   Remote Voltage Programming of Output Voltage and Current

For Voltage Analog Programming wiring, refer to Figure 3–1.

Set the Remote Programming settings as follows:

1. Short the pin J1-6 to J1-11.

2. Press the CONF button. CONF (GREEN) LED illuminates.

3. Rotate the Voltage encoder until V.SRC OR C.SRC appears on the voltage display.

4. Rotate the Current encoder to set E.VOL. Press the Current encoder for selection, display blinks once to acknowledge the setting.

5. Rotate the Voltage encoder until RANGE appears on the voltage display.

6. Rotate the Current encoder to set 5 or 10 (External 5V or 10V). Press the Current encoder for selection, display blinks once to acknowledge the setting.

7. Exit CONF menu by pressing the Back button or the CONF button.

CAUTION

When programming from J1, use a programming source with floated outputs to maintain the isolation of the power supply.
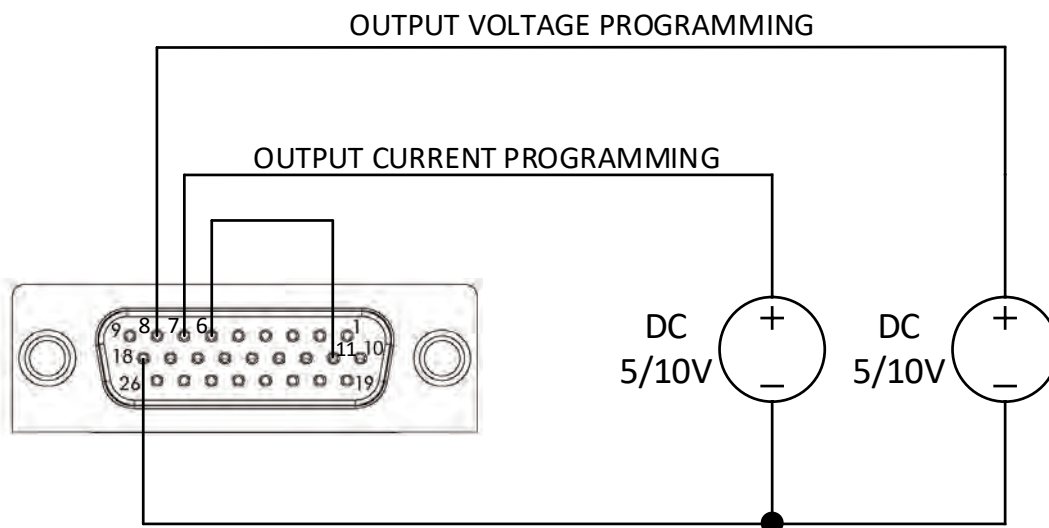
Figure 3–1: J1-Remote Voltage Programming Connection

NOTE

To limit the maximum remote (analog) programming value of the current programming channel, refer to Section 5.7 OCL – Analog Programming Over Current Limit.

3.5 Remote Resistor Programming of Output Voltage and Output Current

For resistive programming, the internal current sources for output voltage and/or output current control supply 1mA current through external programming resistors connected between J1-8 and J1-18, and between J1-7 and J1-18. The outcome voltage, as a result, of current flow across the programming resistors is used as a programming voltage for the power supply. Resistance of 0–5 kΩ or 0–10 kΩ can be selected to program the output voltage and current from zero to full scale. A variable resistor can control the output over the entire range, or a combination of variable resistors and series/parallel resistors can control the output over a restricted portion of the range.

For Resistor Analog Programming wiring, refer to Figure 3–2.

Set the Remote Programming settings as follows:

1. Short the pin J1-6 to J1-11.

2. Press the CONF button, CONF (GREEN) LED illuminates.

3. Rotate Voltage encoder until $V.SRC$ or $C.SRC$ appears on the voltage display.

4. Rotate the Current encoder to set $E.RES$. Press the Current encoder for selection, display blinks once to acknowledge the setting.

5. Rotate the Voltage encoder until $RANGE$ appears on the voltage display.

6. Rotate the Current encoder to set 5 (5Kohm) or 10 (10Kohm). Press the Current encoder for selection, display blinks once to acknowledge the setting.

7. Exit CONF menu by pressing the Back button or the CONF button.
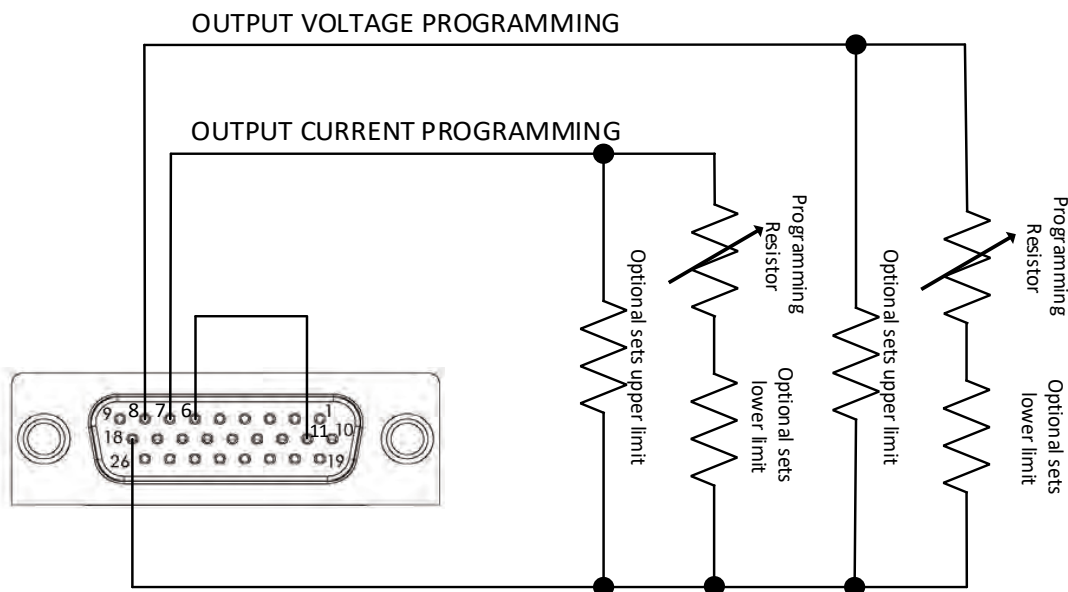
Figure 3–2: J1-Remote Resistor Programming Connection

NOTES

1. The power supply can be programmed to up to 108% of the rated output voltage and current. However, it is forbidden to operate the power supply over its voltage and current ratings. Performance is not guaranteed when operating the power supply above its ratings.

2. Communication: In the Remote Analog mode, power supply parameters can be programmed and read back via the Communication port, except for output voltage and current settings.

3. To maintain the temperature stability specification of the power supply, the resistors used for programming should be stable and low noise resistors, with a temperature coefficient of less than 50ppm.

4. Radiated emissions, FCC requirements: FCC requirements for radiated emissions: use a shielded cable for the Analog control signals. When using a non-shielded cable, attach an EMI ferrite suppressor to the cable, as close as possible to the power supply.

5. Front panel PREV button: Use the PREV button to display the output voltage and current settings defined by the Encoders or Communication.

6. To limit the maximum remote (analog) programming value of the current programming channel, refer to Section 5.7 OCL – Analog Programming Over Current Limit.

3.6   Monitoring of Output Voltage (V_MON) and Current (I_MON)

The J1 connector, located on the rear panel, provides analog signals for monitoring the output voltage and output current. Selection of the voltage range between 0–5V and 0–10V is made via the Front Panel or communication.

The monitoring signals represent 0 to 100% of the power supply output voltage and output current. The monitor outputs have 500Ω series output resistance.

CAUTION

Ensure that the sensing circuit has an input resistance of greater than 500kΩ or accuracy will be reduced.

Perform range selection as follows:

1. Press the CONF button. CONF (GREEN) LED illuminates.

2. Rotate the Voltage encoder until RANGE appears on the voltage display.

3. Rotate the Current encoder to set 5 or 10 (5V or 10V monitoring range). Press the Current encoder for selection, display blinks once to acknowledge the setting.

4. Exit CONF menu by pressing the Back button or the CONF button.

CHAPTER 4: SERIAL RS232/RS485, USB, & LAN INTERFACES

4.1 Introduction

This chapter describes the set-up, operation, commands, and communication protocols of the **GENESYS™** power supplies via serial communication interfaces: RS232, RS485, or USB, and LAN.

4.2 Configuration

Function Level	Display	Parameter Level	Display	Description
Communication Interface	INTFC	RS232	RS232	
		RS485	RS485	
		USB	USB	
		LAN	LAN	
		OPT	OPT	Available only if an optional communication card is installed.
Address	ADR	0...31	0...31	
Baud Rate	BAUD	9600...115200	9.6K...115.2K	
Language	LANG	SCPI	SCPI	
		GEN	GEN	
IP Address	IP	IP1...IP4	IP1...IP4	
MAC Address	MAC	MAC1...MAC6	MAC1...MAC6	
LAN Reset	LAN	RESET	RESET	

Table 4-1: Front Panel Setup

4.2.1 Default Setting

Refer to Table 2-6: Non-Volatile Memory Parameters and Table 2-7: LAN Non-Volatile Memory Parameters for factory default settings.

4.2.2 Communication Interface Selection

The power supply communication interface can be set to RS232, RS485, USB, LAN, or OPT *.

1. Press the COMM button.

   COMM LED illuminates. INTFC message appears on the Voltage display.

2. Rotate the Current encoder to select a required communication interface.

3. Press the Current encoder to accept a parameter.

   When the parameter is accepted, the display blinks once.

4. To exit the menu, press the COMM button or the BACK button.

NOTE

* OPT option is available only if an optional communication card (i.e., IEEE, MODBUS TCP, or EtherCAT) is installed.

4.2.3   Address Setting

The power supply address can be set to any address in the range of 0 to 31.

1. Press the COMM button.

    COMM LED illuminates. `INTFC` message appears on the Voltage display.

2. Rotate the Voltage encoder 1 step clockwise.

    `ADR` message appears on the Voltage display.

3. Rotate the Current encoder to select the required address: `0...31`.

4. Press the Current encoder to accept a parameter.

    When the parameter is accepted, the display blinks once.

5. To exit the menu, press the COMM button or the BACK button.

4.2.4   IP Address Setting

The power supply IP address setting is split into four fields: IP1.IP2.IP3.IP4. These four fields represent an IPv4 address. Each IP field can be set to any value in the range of 0 to 255.

1. Press the COMM button.

    COMM LED illuminates. `INTFC` message appears on the Voltage display.

2. Rotate the Voltage encoder 2 steps clockwise.

    `IP` message appears on the Voltage display.

3. Rotate the Current encoder to select a required IP address field: `IP1`, `IP2`, `IP3`, or `IP4`.

4. Press Current encoder to accept a parameter.

    When the parameter is accepted, the display blinks once.

5. Rotate the Current encoder to select the required IP address: `0...255` *.

6. Press the Current encoder to accept the parameter.

    When the parameter is accepted, the display blinks once.

7. To exit the menu, press the COMM button or the BACK button twice.

NOTES

The IP Address Setting is available only if the LAN communication interface is selected.

* IP Address update step is set by Coarse or Fine mode selection. In Coarse mode, IP address field is updated in steps of 10 addresses. In Fine mode, IP address field is updated in step of one address. Use the FINE button on the Front Panel to toggle between modes (Coarse or Fine).

4.2.5　Baud Rate Setting

Five optional rates are possible: 9600, 19200, 38400, 57600, and 115200.

1. Press the COMM button.

   COMM LED illuminates. `INTFC` message appears on the Voltage display.

2. Rotate the Voltage encoder 2 steps clockwise *.

   `BAUD` message appears on the Voltage display.

3. Rotate the Current encoder to select required baud rate: `9600`, `19200`, `38400`, `57600`, or `115200` **.

4. Press the Current encoder to accept a parameter.

   When the parameter is accepted, the display blinks once.

5. To exit the menu, press the COMM button or the BACK button.

NOTE

* If LAN interface is active, rotate the Voltage encoder 5 steps clockwise.

** If LAN interface is active, baud rate is locked to 115200.

4.2.6　Language Selection (RS232/RS485, USB)

GENESYS™ power supply Series implement the SCPI standard interface to control the unit by remote communication. In addition, GEN legacy commands subset is provided for ease of use and backward compatibility.

1. Press the COMM button.

   COMM LED illuminates. `INTFC` message appears on the Voltage display.

2. Rotate the Voltage encoder 3 steps clockwise *.

   `LANG` message appears on the Voltage display.

3. Rotate the Current encoder to select the required language: GEN or SCPI **.

4. Press the Current encoder to accept a parameter.

   When the parameter is accepted, the display blinks once.

5. To exit the menu, press the COMM button or the BACK button.

NOTE

* If LAN interface is active, rotate the Voltage encoder 6 steps clockwise.

** If LAN or optional (i.e., IEEE, MODBUS TCP, or EtherCAT) interface is active, only SCPI language is available (for MODBUS TCP, registers are used. For EtherCAT, SDOs/PDOs are used).

4.2.7 Setting Unit in Remote, Local Lockout, or Local Mode

If power supply is in Local mode, it can receive communication commands & queries. If a command is received, power supply will execute and change its mode to Remote. If a query is received, power supply will reply and remain in the Local mode.

Remote Mode:

If a communication command is received, power supply will perform the command and change its mode to Remote.

If power supply is in Remote mode, the REM indicator illuminates.

Parameters cannot be changed via the front panel. If an attempt is made to change parameters via the front panel, Current display shows REM message for 2 seconds.

It is possible to return to Local mode by pressing the front panel SYST button, followed by Current encoder press, or via communication command SYSTem:REMote[:STATe] LOC.

Local Lockout Mode:

If power supply is in Local Lockout mode, REM indicator illuminates.

Parameters cannot be changed via the front panel. If an attempt is made to change parameters via the front panel, Current display shows LLO message for 2 seconds.

It is possible to return to the Remote mode by the communication command SYSTem:REMote[:STATe] REM or by AC power recycle.

4.3   Rear Panel RS232/RS485 IN Connector

RS232/485 in the interface is accessible through the rear panel RS232/485 IN connector. The connector is eight contacts, shielded RJ-45 type. The connector is used to connect power supplies in RS232 or RS485 configurations. Refer to Figure 4–1 for the connector description.

Shield
(Connector enclosure)

1 2 3 4 5 6 7 8
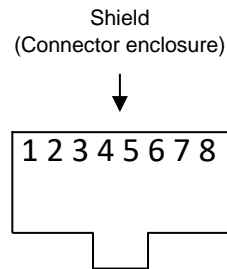
Figure 4–1: J4 Rear Panel RS232/485 IN Connector Pinout

RS232/485 IN Pinout:

1 – RS232 RX

2 – RS232 TX

3 – RS485 RXD-

4 – RS485 TXD-

5 – RS485 TXD+

6 – RS485 RXD+

7 – NC (Not Connected)

8 – SG (Signal Ground)

NOTE

TX and RX are used for RS232 communication. TXD +/- and RXD +/- are used for RS485 communication. Refer to RS232 (Figure 4–3) and RS485 (Figure 4–4) cable descriptions for connection details.

4.4   Rear Panel RS485 OUT Connector

RS485 OUT interface is accessible through the Rear panel RS485 OUT connector. The connector is eight contacts, shielded RJ-45 type. The connector is used to connect power supplies in RS485 Daisy chain configuration. Refer to Figure 4–2 for the connector description.

Shield
(Connector enclosure)

1 2 3 4 5 6 7 8
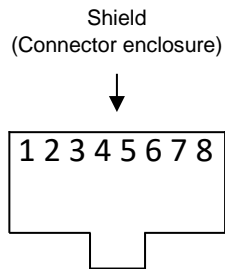
Figure 4–2: J3 Rear Panel RS485 OUT Connector Pinout

RS485 OUT Pinout:

1 – NC (Not Connected)

2 – NC (Not Connected)

3 – RS485 TXD-

4 – RS485 RXD-

5 – RS485 RXD+

6 – RS485 TXD+

7 – NC (Not Connected)

8 – SG (Signal Ground)

NOTE

TXD +/- and RXD +/- are used for RS485 communication. Refer to RS485 (Figure 4–4) cable description for connection details.

4.5 Connecting Power Supply to RS232 or RS485 BUS

Connect rear panel RS232/RS485 IN connector to the controller, or a PC RS232 or RS485 port using a suitable shielded cable. Refer to Figure 4–3 and Figure 4–4 for the available RS232 and RS485 cables.
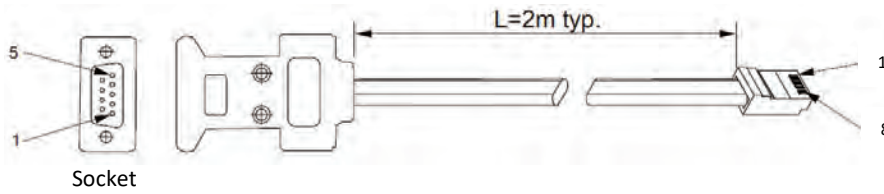
Db-9 Connector		8 Pin Connector		Remarks
Pin No.	Name	Pin No.	Name	
Housing	Shield	Housing	Shield	
2	RX	2	TX	TWISTED
3	TX	1	RX	PAIR
5	SG	8	SG	

Figure 4–3: RS232 Cable with DB9 Connector (P/N: GEN/232-9)
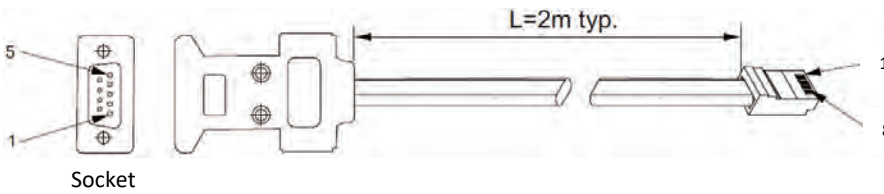
DB-9 CONNECTOR		8 PIN CONNECTOR		REMARKS
Pin No.	Name	Pin No.	Name	
Housing	Shield	Housing	Shield	
9	TXD-	3	RXD-	TWISTED
8	TXD+	6	RXD+	PAIR
1	SG	8	SG	
5	RXD-	4	TXD-	TWISTED
4	RXD+	5	TXD+	PAIR

Figure 4–4: RS485 Cable with DB9 Connector (P/N: GEN/485-9)

4.6   Rear Panel USB Connector

A standard USB Type B connector is located on the rear panel of the USB communication interface. Refer to Figure 4–5.
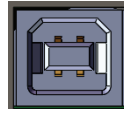
Figure 4–5: USB Connector

4.6.1   USB Getting Started

USB Cable (*)
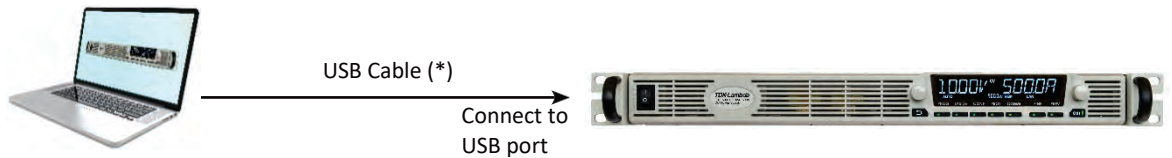
Connect to
USB port

Figure 4–6: USB Connection

To install USB driver, download it from TDK-Lambda Website, decompress zipped file (if compressed), navigate to x86 folder for 32-bit operating system or x64 folder for 64-bit operating system, launch dpinst.exe file. Follow on-screen instructions to accomplish the installation process (refer to Applications Guide, IA761-04-03_ for step-by-step installation procedure).

NOTE

* Do not connect or disconnect the USB cable when USB communication is active, communicating with an external device.

4.7 Rear Panel LAN

4.7.1 Introduction

The Local Area Network (LAN) connection for the **GΞNESYS™** power supply series allows the user to remotely program, measure, and check status of the power supply.

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

4.7.1.1 Feature Summary

Communicate over any standard TCP/IP network

- LAN (Local Area Network)

- WAN (Wide Area Network)

- Communicate worldwide using the Internet.

Web page is viewable with any web page browser (e.g., Microsoft Internet Explorer)

- Configurable network connection settings.

- Active web page (GUI) that programs and reads the power supply output and status.

- Security settings to block multiple controllers and risky protocols.

- Optional password protection to prevent unauthorized operation.

LAN protocols

- VISA, Telnet, TCP and UDP sockets are supported.

- VXI-11 Discovery and PING server are supported.

- ARP, DNS, mDNS, and DNS-SD connectivity protocols are supported.

- 1.5 **LXI** Device Specification 2016

Full remote programming functions

- Uses SCPI command language, an instrumentation standard. Refer to section 4.13.

- Compatible with VISA drivers and all the test & measurement utilities.

- TCP and UDP sockets that support PLCs, Linux, and other non-VISA controllers.

Front Panel features

- View IP and MAC address on front panel or via communication commands.

- Set the complete IP address on front panel or via communication command.

- LAN Reset on front panel or via communication command.

- Option for user to remotely "Blink" the front panel to locate the Master power supply in a rack.

Rear Panel features

- Ethernet RJ-45 connector (standard 8-pin phone jack for LAN).

- Link and Activity LED, and Speed LED on RJ-45 connector.

- LAN Status LEDs show LAN fault and "Blink Identify" on rear panel, close to LAN RJ-45 connector

RS-485 Multi-drop Chain

- Allows connection of up to 31 power supplies using simple Link cable.

- One LAN IP address shared by all RS-485 power supplies.

Trademark Notices

Microsoft, Internet Explorer, and Windows are trademarks of Microsoft Corporation.

NOTE

Windows Telnet application is not supported, as characters are sent as these are typed.
GENESYS™ power supply Telnet supports only strings (characters sent in a complete packet with Carriage Return or Line Feed characters as a terminator).

4.7.2 Specifications

4.7.2.1 LAN Specifications

ELECTRICAL

Ethernet	Meets IEEE 802.3u specifications
Auto-MDIX	Accepts patch or cross-over cable connection
Auto-Negotiate	Selects fastest of 10Base-T or 100Base-T networks (10 or 100 Megabits per second)

NETWORK CONFIGURATION

MAC Address	TDK-Lambda assigned: 00:19:f9:xx:xx:xx xx:xx:xx is the unique address for each unit
IP Address	View or set from the Front Panel or embedded web page
DHCP	Receive an address from network server. Leasing services
Auto-IP	Create its own IP address: 169.254.xxx.xxx
Static IP	Any IP fixed by an operator
Address Resolution	ARP Protocol
Hostname	DNS and mDNS protocols. Operator settable hostname
Service Name	DNS-SD Service Discovery Protocol
Duplicate IP Detection	Reject duplicate setting or disconnect from network
Subnet Mask	Mask set by DHCP or static

Default Gateway	Address set by DHCP or static
DNS Server	Address set by DHCP
LAN Reset	Reset configuration

LAN PROTOCOLS

TCP	LAN packets follow Transmission Control Protocol
IPv4	Internet Protocol version 4

INSTRUMENT PROTOCOLS

VXI-11	Supports Core channel, not Abort or Interrupt channels
VISA	VXI-11 compliant, uses RPC and Portmapper, SCPI commands
TCP Sockets	Send SCPI commands to port 8003
UDP Sockets	Send SCPI commands to port 8005
VXI-11 Discovery	Find connected instruments
SNMP Ping Server	Verify LAN connection to instrument
HTTP	Web page server with Java scripts

COMMANDS

SCPI	SCPI 1999 compliant command set, measure and status
IEEE-488.2	Condition and event register tree

MULTIPLE CONTROLLERS

Single Client Setting	Only one may be open at a time: Web Page (login as 'admin'), VISA, or TCP sockets
Multiple Client Setting	Up to two TCP or UDP sockets may be open at a time

WEB PAGES

Multiple users	Multiple web pages can be open at the same time
Identity	Identify power supply model, serial number, revision, etc.
LAN Configuration	View and set LAN configuration
Active Control GUI	Program and read output settings
Send Commands	Send SCPI commands, read errors
Help	Link to TDK-Lambda web sites

SUPPLY CONFIGURATIONS

Local Control	Supply may be controlled from the Front Panel even if LAN is monitoring
LAN Remote Control	Supply may be controlled and monitored through LAN
RS232, RS485, USB, or Option Control	LAN interface is disabled if the standard RS-232, RS-485, USB, or Optional communications are active
Analog Control	LAN may monitor supply while analog control is used

INDICATORS

IP and MAC Address	View addresses on Front Panel or communication
Multi-drop Address	View RS-485 address on Front Panel
Link/Activity LED	Indicates that connection is active, network packets are being received/transmitted
Speed LED	Indicates the speed
LAN Status LED	Red/Green, indicates power supply has valid IP connection
Blink Identify	Find the Master Supply by remotely blinking Front Panel and Rear Panel LEDs

SECURITY

Web Page Password	Can set password to prevent unauthorized or accidental changes to LAN settings or power supply output settings
Single Client Only	Set to prevent multiple programs from taking control
Block UDP Sockets	Single client will block attacks through UDP sockets
Disable VXI-11 Discovery	Stop power supply detection
Disable Ping Server	Stop power supply detection
Disable mDNS	Stop power supply detection

4.7.2.2 LAN Command Speed

The following communication speeds are typical values only. In addition to the variability in the GENESYS™ LAN interface, there are timing variations within the controller and the network routing.

The following speed specifications are subject to change without notice.

- VISA Drivers, Sockets, Web.
- Typical Command or query speeds.

All commands and queries have a response time in the range of 5–30ms, depending on the command and the number of parameters sent/received. Refer to the notes for specific commands which require longer process/transmission time.

4.7.3   Select the Control Method

4.7.3.1   Control Method Options

The power supply may be operated through four interfaces. This section describes how to enable each option.

	MODE	MODE DESCRIPTION	
1	LAN	Control using an Ethernet connection	LAN disables serial and optional communication ports
2	Local	Control using the front panel encoders and buttons	LAN can be used to measure and read (monitor)
3	Serial	Control using RS-232, RS-485, or USB	Serial disables the LAN port
4	Analog	Control using analog signals	LAN, local, or serial may still be used to measure and set protections
5	Optional Communication	Control using Optional communication card (IEEE, MODBUS TCP, or EtherCAT)	Optional Communication disables the LAN port

4.7.3.2   Select LAN Remote Mode

Selecting the LAN mode enables 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 commands.

To select the LAN mode:

1. Press the COMM button on the front panel.

2. Rotate the Current encoder to select LAN, LAN message appears on current display. Press Current encoder to accept, display blinks to acknowledge selection.

NOTE

Refer to SYSTem[:COMMunicate]:INTerface <DSC> command to select LAN communication interface via communication.

4.7.3.3   LAN Status LEDs

There are two LEDs at the bottom of the RJ-45 connector that indicate the following:

- 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 Panel green status LED. This feature is used to identify the Master (LAN) power supply in a rack full of instruments. The blinking is turned off by the web page, by sending another SCPI command, or by pressing Front Panel encoders/buttons. In a multi-drop chain, only the master LAN supply blinks.

- Duplicate IP: Blinking green

  If there are two (or more) instruments with the same IP address, green led is blinking.

- LAN Fault/Disconnected: Steady red

  Shows that the LAN interface is not selected, LAN connection is disconnected or broken.

4.7.4 Connect to a Network

4.7.4.1 LAN Cable

The LAN cable must be supplied by the customer. One of the following cables can be used:

- A standard straight "patch" CAT-5 (or better) network cable.
- A "crossover" cable. The cable type is auto detected by the power supply.

NOTE

The serial link (RS-485) cable (0.5m long) provided with the **GENESYS™** power supply cannot be used for LAN connection.

4.7.4.2 Types of Networks

There are two types of networks discussed in this document:

- NETWORK WITH A DHCP SERVER

  A typical local area network with a server computer and network administrator to keep it operating. The server downloads the IP address and other settings to the power supply.
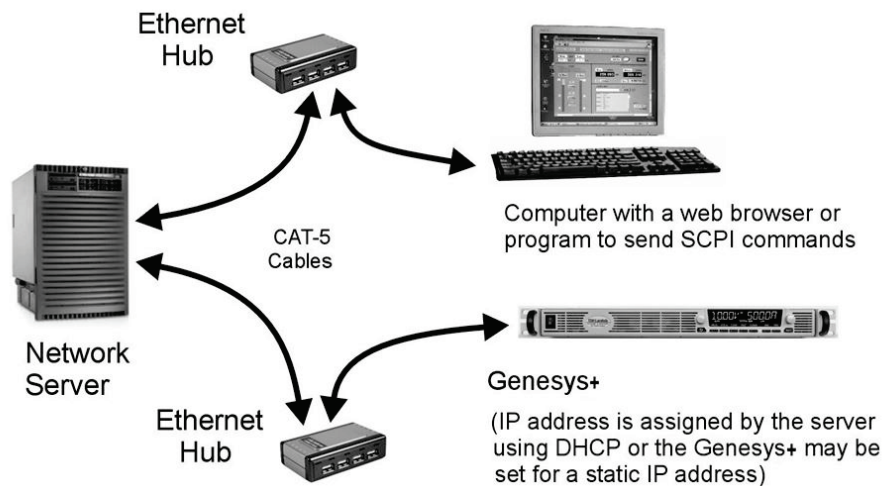
Figure 4–7: Network with a DHCP Server

• PEER-TO-PEER NETWORK

In this type of configuration, the power supply is connected directly to a computer that is not a network server. The power supply configures its own IP address and other settings.
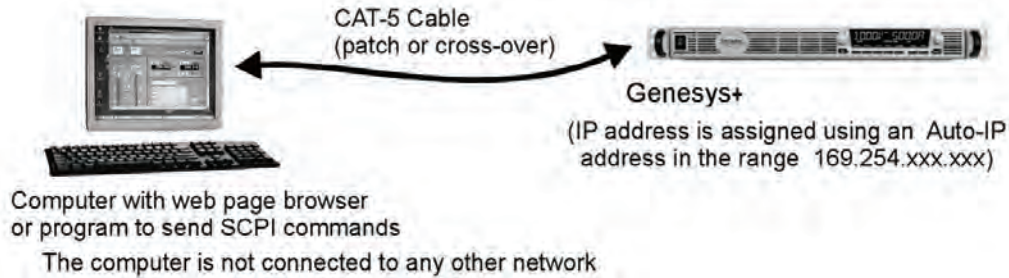
Figure 4–8: Peer-to-Peer Network

4.7.4.3   Power-up the LAN Power Supply

The power supply LAN option automatically detects if it is connected or disconnected from a network. It automatically searches for a network server and receives or creates an IP address. It will also broadcast its IP address and hostname to all other devices on the network.

1.   Apply the AC power and switch ON the power supply.

2.   Connect the LAN cable before or after the power supply is switched ON.

3.   For a network with a DHCP server, wait about 10 seconds.

The rear panel green LAN Status LED turns ON.

4.   For a peer-to-peer Auto IP configuration, wait about 60 seconds.

The rear panel green LAN Status LED turns ON.
The computer screen may show LAN notification, "This connection has limited or no connectivity".

5.   For a peer-to-peer static IP configuration, wait about 10 seconds.

The rear panel green LAN Status LED turns ON.
The computer screen may show LAN notification, "This connection has limited or no connectivity".

NOTE

Power Supply IP address can be viewed via the Front Panel or communication.

NOTE

If the green LAN Status LED does not turn ON, refer to Section 4.7.5.3 - LAN Reset to perform LAN Reset.

4.7.4.4   IP Addresses

The simplest and most reliable way to open a network connection is via the power supply's IP address, which is represented by a group of four numbers separated by periods (e.g., `10.1.15.123`).

The power supply can receive an IP address in three modes:

	DHCP	Auto-IP	Static IP
IP Mode Select	DHCP is default after "LAN Reset"	Default after "LAN Reset" if no DHCP server is used	Assigned on the "LAN Modify" web page (refer to section 4.7.6.6) or by setting the IP1-4 address via the front panel (refer to section 4.7.5.2) or by communication SYSTem[:COMMunicate]:LAN:IP <SRD> command (refer to section 4.15.10).
Assignment	Assigned by the network server	Assigned by the power supply	Assigned on the "LAN Modify" web page (refer to section 4.7.6.6) or by setting the IP1-4 address via the front panel (refer to section 4.7.5.2) or by communication SYSTem[:COMMunicate]:LAN:IP <SRD> command (refer to section 4.15.10).
Range	Any address	169.254.xxx.xxx	Any address
Lifetime	Address may change as the DHCP server assigns addresses dynamically to many instruments.	Fixed prefix for the power supply, except if an address collision is detected.	Always fixed for the power supply.
Duplicate Addresses	The DHCP server should prevent duplication of IP addresses	Finds another available auto-IP address	Returns to original IP (before change). LAN status LED (Green) and front panel blink. If duplication of IP is detected at AC ON (if the device was in Static IP mode), the IP goes to 0.0.0.0, LAN status LED (Red) turns on and the Front Panel blinks.

4.7.4.5   Hostname

The hostname is an address in the form of name instead of IP address (e.g., `G10-40`). This address mode is less common than the IP address because the hostname cannot be viewed from the front panel, and because a naming service (such as NetBIOS or DNS) must be running in the LAN computer.

The default hostname has the following format:

< Product Series Name> < Voltage rating > – < Current rating >.

If the rating has decimal point, substitute "P" for the decimal point.

For example:

Model	Default Hostname
G10-500	G10-500
G600-2.8	G600-2P8

A custom host name can be created through the web pages (refer to section 4.7.6.6).

For example, host name can be set to TDK. In this case, the control program can send commands to TDK.

The power supply can detect if its host name is already in use by another device. This state is called a host name conflict. In this case, the supply will make its host name unique by appending a dash and a number (e.g., TDK-2).

NOTE

Hostname is case-sensitive (e.g., TDK and tdk is not treated as a duplicate Hostname). It is recommended to avoid naming such as TDK and tdk on the same network, as it might be interpreted incorrectly by the network server.

LAN Reset does not change the host name, even if it is a custom name, but it may remove the dash and the number if a host name conflict has been removed.

To restore the factory default host name, open the LAN → Modify web page and enter a blank for the new host name (refer to section 4.7.6.6).

The power supply may be set to one of the three network modes, each with a different way to use the host name. This is shown in the table below.

	DHCP	Auto-IP	Static IP
Hostname Default Hostname	xxxxvvvv-aaaa (Refer to the above example)	xxxxvvvv-aaaa (Refer to the above example)	None, hostname cannot be used
Hostname Protocol	Hostname by NetBIOS or DNS	Hostname by NetBIOS or DNS	None, hostname cannot be used
Hostname on Web Pages	Shows Host name on the Home page and on the LAN Configure page	Shows Host name on the Home page and on the LAN Configure page	Shows Host name on the Home page and on the LAN Configure page

4.7.4.6   Description and DNS Service Names

On the power supply web page, the Description field is also the DNS-SD service name.
The factory default description is:

< Manufacturer> <Product > < last 3 digits of serial number >

Example: TDK-LAMBDA Supply 123

The power supply can detect if its service name (description) is already in use by another device. This is called a service name conflict. In this case, the supply will change its service name to a unique name by appending a number in brackets to it.

For example, its service name will become `TDK-LAMBDA Supply 123 (2)`.

NOTE

DNS Service Name is case-sensitive (e.g., TDK-LAMBDA Supply 123 and tdk-lambda supply 123 is not treated as a duplicate Service Name). It is recommended to avoid naming such as TDK-LAMBDA Supply 123 and tdk-lambda supply 123 on the same network, as it might be interpreted incorrectly by the network server.

A LAN Reset does not change the service name, even if it is a custom name, but it may remove the dash and the number if a service name conflict has been removed.

To restore the factory default service name, open the LAN → Modify web page and enter a blank for the new service name (refer to section 4.7.6.6).

4.7.5   LAN Setup

4.7.5.1   View the IP and MAC Addresses

When the power supply is operating with the LAN enabled, the IP and MAC addresses may be viewed on the front panel. To view the IP and MAC addresses, perform the following steps:

To view the IP address:

1. Press COMM button.

2. Rotate Voltage encoder until `IP` appears on the Voltage display, `1` appears on the Current display.

3. Press Current encoder to enter IP configuration. Rotate Voltage encoder to view the IP address.

    The voltage display shows `IP1-IP4` by rotating Voltage encoder. The current display shows the corresponding IP field.

To view the MAC address:

1. Press COMM button.

2. Rotate Voltage encoder until `MAC` appears on the Voltage display, `1` appears on the Current display.

3. Press Current encoder to enter MAC configuration. Rotate Voltage encoder to view the MAC address.

    The voltage display shows `MAC1-MAC6` by rotating Voltage encoder. The current display shows the corresponding MAC field.

4.7.5.2   Change the IP Address

The power supply allows changing all four numbers (octets) of the IP address via the front panel. The IP address has four numbers (e.g., 10.97.4.4). Each number may be set to any value from 0 to 255.

NOTE

Some restrictions may apply due to subnet settings restrictions.

To change the IP address:

1. Press COMM button. Rotate Voltage encoder until IP appears on the Voltage display, 1 appears on the Current display.

2. Press Current encoder to enter IP configuration. Rotate Voltage encoder to view the IP address. Voltage display shows IP1-IP4 by rotating Voltage encoder. The Current display shows the corresponding IP address.

3. Rotate Current encoder to change the IP address. Press Current encoder to acknowledge new IP address.

4. If another device is using the same address, the Front Panel display, and the rear LAN status LED (Green) blinks. The address reverts to the previously set address.

5. Press any button or encoder to stop blinking.

NOTES

1. Modifying the IP address via the Front Panel, a command, or (LAN>Configure>Modify Page), **switches to STATIC IP addressing.** (DHCP and Auto-IP addressing is disabled).

2. Refer to SYSTem[:COMMunicate]:LAN:IP <SRD> command to modify the IP address by communication.

4.7.5.3   LAN Reset

To reset the power supply LAN settings to its factory settings, perform the following steps:

1. Press the COMM button.

2. Rotate Voltage encoder until LAN appears on the Voltage display, RESET appears on the Current display. Press Current encoder.

3. SURE appears on the Voltage display, NO appears on the Current display. Rotate current encoder 1 click clockwise. YES appears on the Current display.

4. Press Current encoder to reset LAN configuration to factory default settings.

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
Subnet mask:	255.255.0.0
Default gateway	0.0.0.0
DNS Server	0.0.0.0
Hostname:	Refer to section 4.7.4.5
Description	Refer to section 4.7.4.6
Controller Access:	One Client Only
Ping Server:	Enabled
Keep-Alive:	1800 Seconds (30 minutes)
Auto-Negotiate:	Automatically select network speed VXI-11
Discovery:	Enabled
Password:	None
Multicast DNS:	Enabled

4.7.6   Web Pages

4.7.6.1   Benefits of Web Pages

The **GENESYS** web pages are useful for:

- Reading the power supply model, identity, revision, and LAN setup information

- Configuring the LAN connection

- Programming and reading the power supply DC output

4.7.6.2   Opening the HOME Page

Once the rear panel green LAN Status LED turns ON, the web page is accessible.

1. Read the IP address from the front panel (Refer to section 4.7.5.1).

2. Open a web page browser program such as Internet Explorer. Enter the power supply IP address as shown below.

3. Press the Enter key.
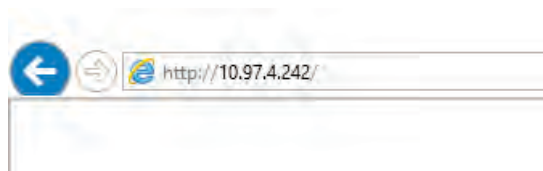
The power supply Home page appears. If it does not, refer to Section 4.7.5.3 - LAN Reset to perform LAN Reset.

4. Alternately, the hostname may be used for addressing the web page as shown below (if the power supply is set for DHCP/Auto-IP, and if a DNS naming service is running on the computer). Refer to section 4.7.4.5 for a description of the hostname. Refer to the example below.
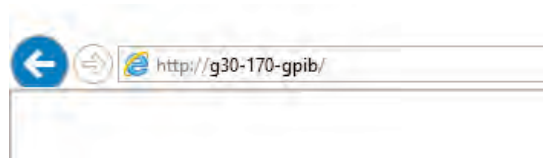
5. The power supply Home page appears. If it does not, refer to Section 4.7.5.3 - LAN Reset to perform LAN Reset.

4.7.6.3   The Home Page

The following page appears when the web page is opened for the first time or when it is refreshed:

Figure 4–9: GENESYS™ Home Page

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. Refer to section 4.7.4.4.

VISA Name Using Hostname

An alternate VISA resource descriptor may be the hostname. Refer to section 4.7.4.5.

RS-485 Address

This address applies to a multi-drop chain of power supplies only.

The RS-485 address of the LAN supply is also called the Master Supply.

Hostname

A unique name for a device on a network. The default hostname is described in section 4.7.4.5.

It is configured as described in section 4.7.6.6.

Auto-MDIX

Power supply LAN automatically detects if a patch or crossover LAN cable is used.

Auto-Negotiate

Power supply LAN automatically adjusts its speed to the fastest speed available.

Multicast DNS

The LAN broadcasts its hostname even if no network server is present. This is useful for connecting over simple peer-to-peer networks.

Logging In

To change power supply output or LAN settings, a user must first log in.

When the DC Power tab or LAN tab is clicked, a login box appears:

1. Click the Login button at the bottom-left side of the web page. A window appears (refer to the screenshot below).

   The only acceptable user name is "admin". By default, the password field is empty.

Figure 4–10: LOGIN Button

2. Click Login.

3. The password may be set or removed on the LAN -> Users web page.

4. LAN Reset clears the password.

4.7.6.4   Login Rules

- Up to 2 users may view the web pages of a power supply at the same time. However, the update rate becomes slower as more web pages are open.
- Only one user at a time may be logged-in to modify the power supply settings.
- If an automation program with VISA or socket is running, user may view the web pages but cannot login to change settings.
- If a user is logged in, a VISA or socket connection cannot be opened by an automation 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.

4.7.6.5   DC Power Page

When the DC Power tab is selected, the following web page opens. This page and its sub-menus allow a user to operate the power supply and adjust its output settings.

A. DC Power ➜ Output Page

When the DC Power tab is selected, the Output page opens by default (GUI).
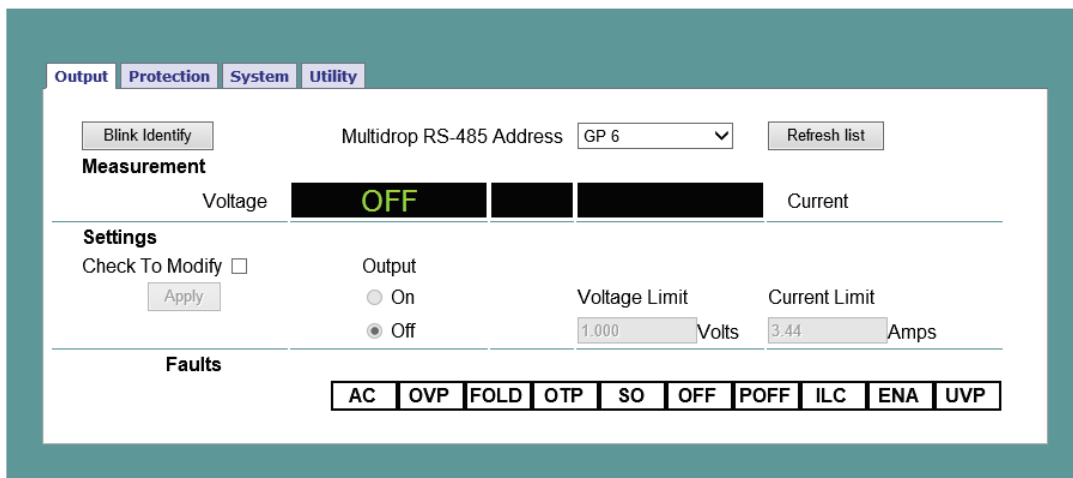
Figure 4–11: Output Page

Refresh List

When this button is clicked, the web page scans to find connected Multi-drop power supplies and adds the discovered addresses into the list box. This button applies to a multi-drop chain only as described in section 4.7.1.1.

Click the Refresh List button after clicking the DC power button, after connecting or disconnecting a power supply, or after changing the RS-485 address.

Select RS-485 Multi-drop Address

This address is described in section 4.7.1.1. This address applies to a multi-drop chain of RS-485 supplies only. If there is no multi-drop chain, only the address of the single LAN supply is available.

Blink Identify

When this button is clicked, the Master (LAN) power supply Front Panel display and the rear panel green LAN status LED blinks.

In a multi-drop chain, only the master (LAN) power supply blinks. The blink identification is turned OFF by clicking this button again or by clicking any button or encoder on the power supply Front Panel or by SCPI command. Login is not required to use this function.

Measurements

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

Settings

This section displays the selected power supply's output voltage, current limit, and output ON/OFF settings.

The settings cannot be changed until you have logged-in as 'admin'.

To change a setting, perform the following:

1. Tick Check to Modify.

2. Set desired settings. After settings are made, click Apply.

3. To view the actual settings, deselect Check to Modify.

Faults

For the selected supply, these boxes show any fault which may be active in the supply.

B. DC Power ➔ Protection Page

On the DC Power tab, the Protection button is available at the top of the panel. When opened, the window allows viewing and setting four protections.

- Over-Voltage Protection Limit
- Under-Voltage Limit
- Fold back Protection
- Auto-Start or Safe-Start

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

The settings can be changed only by logging-in as 'admin'.
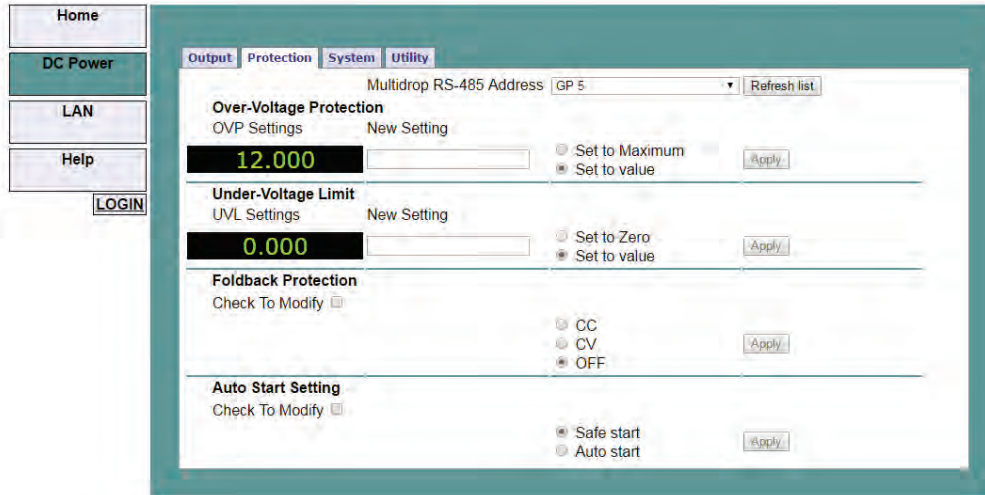
Figure 4–12: DC Power - Protection Tab

C. DC Power ➔ System Page

On the DC Power tab, the System button is available at the top of the panel. When opened, the window allows the user to operate four functions:

- Reset One Instrument (this resets only the supply selected in the RS-485 list box).
- Reset All Instruments (this resets all the supplies connected to the multi-drop bus).
- Save (saves the settings only for the supply selected in the RS- 485 list box).
- Recall (recalls the settings only for the supply selected in the RS-485 list box).

The settings can be changed only by logging-in as 'admin'.
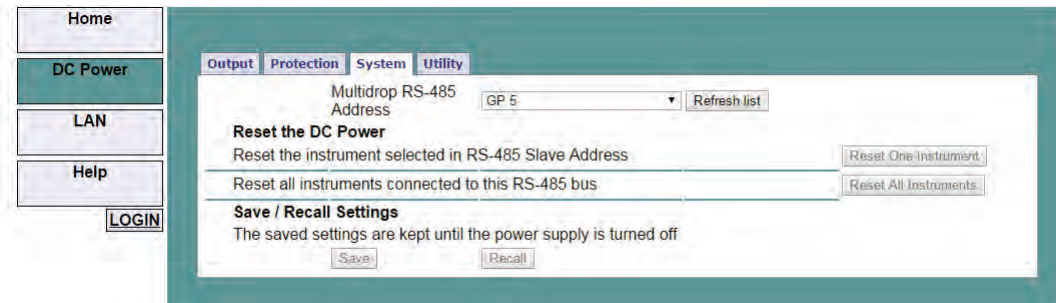
Figure 4–13: DC Power - System Tab

D. DC Power ➔ Utility Page

On the DC Power tab, the Utility button is available at the top of the panel. This page is used for sending any SCPI command and viewing the response. It is a learning tool for SCPI language operations. It allows operations, which are not available in the web pages.

Type any SCPI message in the top text box.

1. Click the Send and Read button.

2. For commands, there is no response.

3. For queries, the response appears in the middle text box.

4. You may read any System Error message by clicking the Read Errors button. The error message (or 0,"No error") appears in the bottom text box.

5. To read system errors, send `SYST:ERR:ENAB` command to enable the error system (has to be sent once before reading errors).

The settings can be changed only by logging-in as 'admin'.
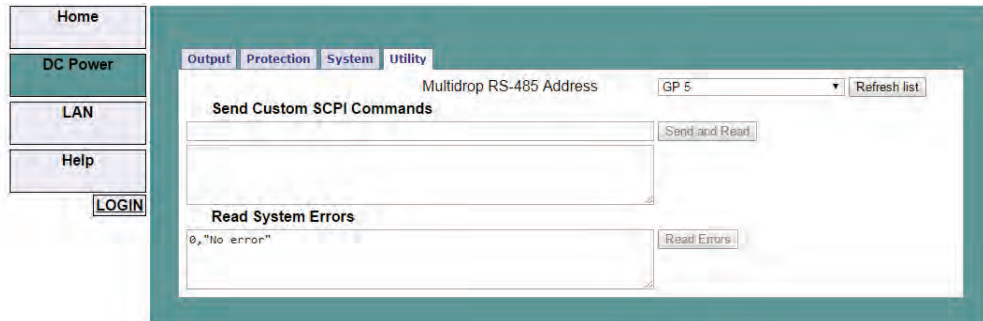
Figure 4–14: DC Power - Utility Tab

4.7.6.6   LAN Page

When the LAN tab is selected, the following web page opens. This page and its sub-pages allow you to view and configure the power supply's LAN settings.

A.   LAN ➔ Configure Page

When the LAN tab is selected, the Configure page opens:
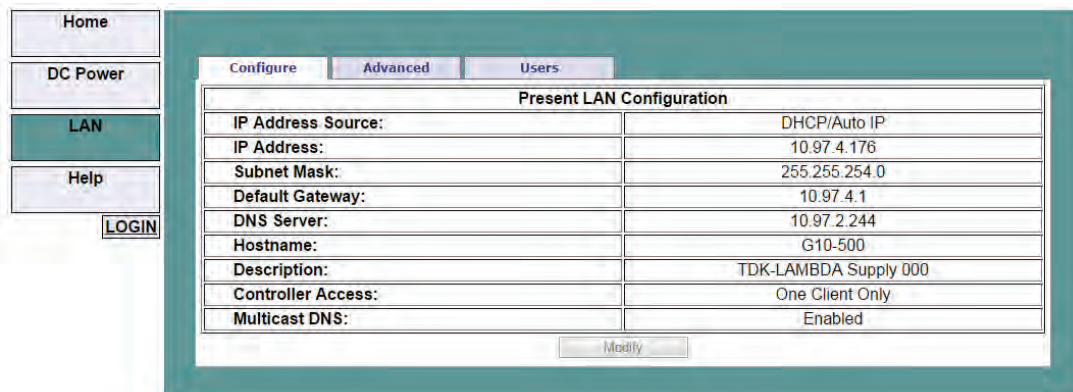
Figure 4–15: LAN - Configure Tab

The following settings are available on the LAN ➔ Configure web page:

- **IP Address Source**

Displays the way the IP address was selected. Options are DHCP/Auto-IP or 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.

- **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 hostname may be used instead of the IP address to create a communication link.

- **Description**

By default, this is "TDK-LAMBDA Supply <Last 3 digits of the Serial Number>", but it may be changed.

- **Controller Access**

The "One Client Only" setting is the default setting for the highest networking security. This setting allows only one TCP socket to be open at a time, it disables the connectionless UDP sockets. The multiple client setting is needed to allow more than one controller connection at a time and to enable UDP sockets connections.

- **Multicast DNS**

mDNS is a protocol which allows devices on a network to advertise and use hostname addressing even if no DNS server is connected. This service may be disabled for security reasons or just to reduce network traffic.

- **Modify**

Click this button to open the window shown in the next section.

B. LAN ➜ Configure ➜ Modify Page

The Modify button on the LAN ➔ Configure page allows changing the LAN settings. The available fields depend on the selection of DHCP Enabled / AUTO IP or Static IP. Changes to these setting will take place only after clicking the Apply button.

The settings can be changed only by logging-in as 'admin'.
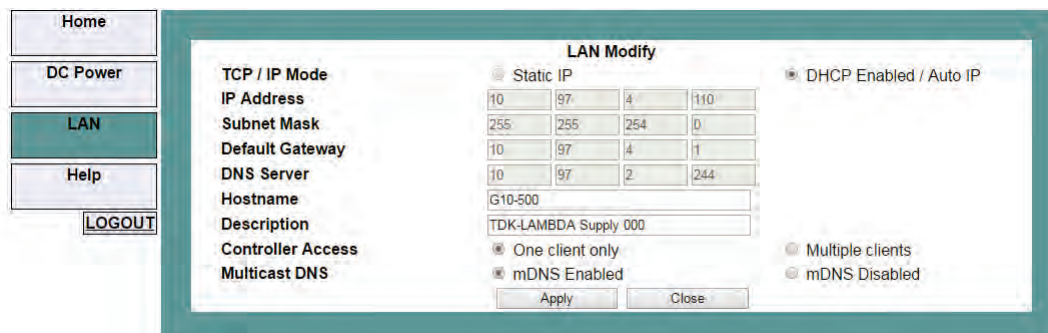
Figure 4–16: LAN – Changing Settings

NOTE

After changing the LAN settings, you are requested to close the web browser. Re-open the web page. If the change duplicates IP, the LAN Status green LED and the Front Panel display will blink, IP address will revert to the previous state. Press any Front Panel button or encoder to stop the blinking.

NOTE

You may be required to perform AC reset of the power supply after changing the LAN settings.

TCP/IP Mode

This selects how the power supply receives network settings. Select one of the following:

- **DHCP Enabled / AUTO IP:** This is the default mode. If this mode is selected, the network server uses DHCP to assign the IP address, subnet mask, default gateway, and DNS server. Therefore, these fields are disabled (gray) on the web page. If the server cannot make the assignment, the power supply reverts to the Auto IP method, described in section 4.7.4.4 on page 67. In this mode, the user can change the hostname and description only.

NOTE

The Hostname must not exceed 15 characters.

- **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. These settings do not change if the power supply is transferred to a different LAN connection.

DNS server field is disabled (gray).

NOTE

In this mode, there is no hostname connectivity.

- **Apply:** Click this button to save the new settings. A pop-up dialog requests to close or refresh the page. 'admin' log-in will be logged-out after refresh.
- **Close:** Click this button to return to the LAN Configure Page shown in section A.

C. LAN ➔ Advanced & LAN ➔ Advanced ➔ Modify Page

Click the LAN ➔ Advanced button to view advanced LAN settings:
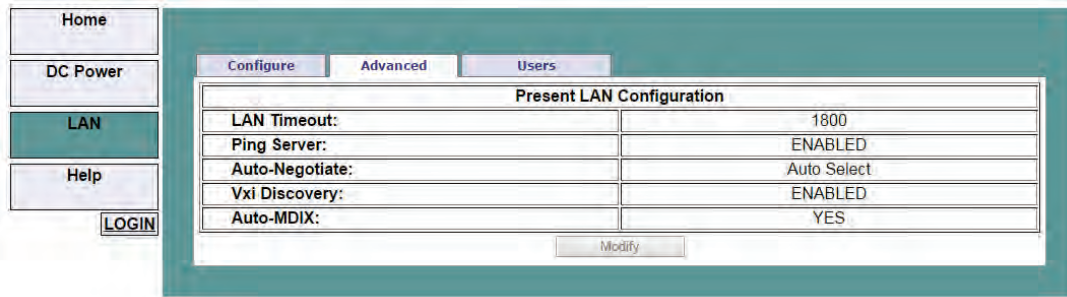
Figure 4–17: LAN – Advanced Tab

These settings can be changed only by logging-in as 'admin'.
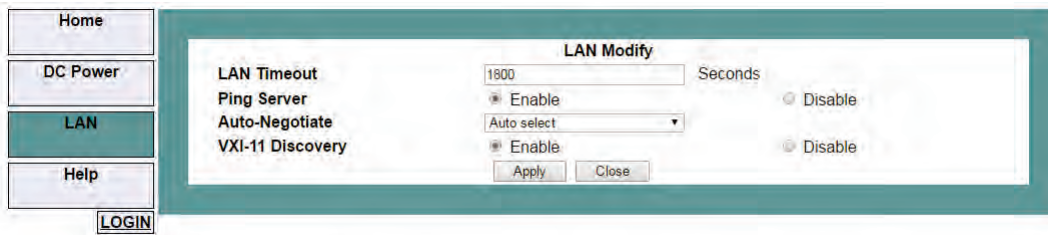
Figure 4–18: LAN – Changing Settings

- **LAN Timeout**

If the user is logged in via the web page or by using VISA or TCP sockets, this is the time duration (in seconds) in which the web pages may be inactive (idle) before the power supply automatically logs out.

The default is 1800 seconds = 30 minutes.

NOTE

Maximum Timeout setting is limited to 60000 seconds = 1000 minutes.

- **Ping Server**

Ping is a network utility that allows the computer to verify communication with the power
supply. This service can be disabled on the Modify panel for security reasons.

- **Auto-Negotiate**

Shows the network speed at which the LAN card is allowed to operate. The choices are 100
Mbps, 10 Mbps (for slower networks), or Auto select.

- **VXI-11 Discovery**

This is a protocol, which allows the network server to detect which instruments are connected
to the LAN. It may be disabled for security reasons.

- **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 automatically.

- **Apply**

Click this button to save the new settings. A pop-up box will ask you to close or refresh the
page. 'admin' log-in will be logged-out.

- **Close**

Click this button to return to the LAN Configure Page shown in section A.

D. LAN ➜ Users Page

This page allows creating password protection for the web pages. There is no password protection
for automation programming with VISA or sockets.

By default, the old password is blank. The new password must contain between 6 and 16
characters. Password is case sensitive.

NOTE

Only a–z, A–Z and 0–9 characters are allowed.

Reset Password

Once a password is applied, it may be changed by using the same screen, but it can only be
removed by performing the LAN Reset function.
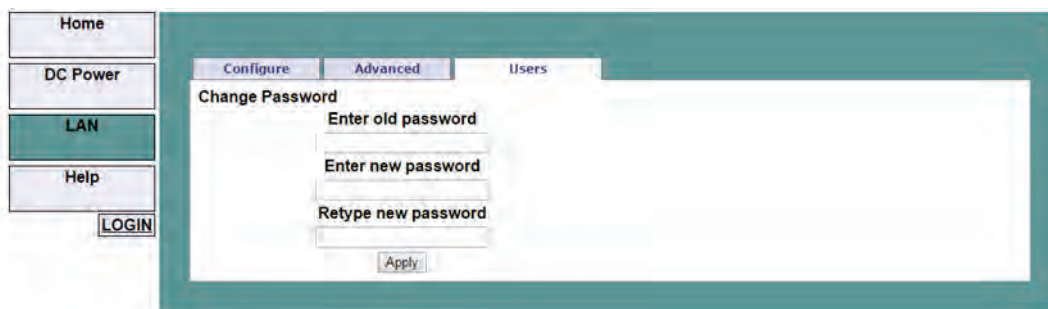
Figure 4–19: LAN – Users Tab

4.7.6.7   HELP Page

A Help tab is available. This page is an Internet link to TDK-Lambda's website pages.

Figure 4–20: Help Tab

4.7.7   Programming Using VISA Drivers

4.7.7.1   VISA Description

In the test and measurement industry, Virtual Instrument Software Architecture (VISA) is a popular framework that includes hardware drivers, configuration utilities, and connection managers.

Varieties of communication busses are supported. VISA drivers are available from several instrument vendors.

Any programming language that supports Windows COM or DLL libraries can call the VISA functions.

4.7.7.2   VXI-11 Compatibility

VXI-11 is a protocol that allows communications between a computer port and an instrument. VISA is built upon the VXI-11 specification. The **GƎNESYS™** power supply is compatible with the VXI-11 protocols:

- VXI–11 Device_link   Open link to an instrument
- VXI–11 Device_write Write text to an instrument
- VXI–11 Device_read Read text from an instrument
- VXI–11 Destroy_link Close link to an instrument

4.7.7.3   Opening a VISA Connection

Test and automation programs may easily be written if they use the VISA libraries. The supported VISA functions include Open, Read, Write, and Close.

A VISA resource descriptor is used to describe a particular supply. For the **GƎNESYS™** power supply, the descriptors are found on the supply's Home web page. The VISA resource may use the supply's IP address or hostname.

Example of VISA resource descriptors are:

Format: TCPIP[board]::IP address/Host Name[::LAN device name][::INSTR]

`[board]` is the LAN card number, zero is optional

`[::LAN device name]` is by default "inst0"

`[::INSTR]` is optional

Examples:

TCPIP::10.255.26.60

TCPIP::10.225.26.60::inst0::INSTR

TCPIP0::10.225.26.60::inst0::INSTR

4.7.7.4 Communicating Using VISA

The VISA Write function sends SCPI commands to the power supply. The VISA read function reads the response returned from the SCPI query.

4.7.8 Programming Using Sockets

4.7.8.1 Socket Description

The VISA drivers for the **GENESYS™** power supply are commonly used in the Test and Measurement industry. For customers who cannot use VISA because of installation, licensing issues, or because the controller (e.g., industrial PLC) does not support VISA, the **GENESYS™** offers socket connections. Socket is a low-level LAN protocol that is universally available in all operating systems and programming environments.

4.7.8.2 Communicating Using Sockets

Communicating through sockets involves opening a socket connection, sending SCPI text commands, and reading the responses. The function by which a programming language manages the socket is the TCP stack.

There are two types of socket protocols which may be used: TCP and UDP. Each has its own port number, as described in sections 4.7.8.6 and 4.7.8.7.

4.7.8.3 Controller Access: Single and Multiple Clients

The web page has a security setting to limit or enable the types of connections and the number of control computers (called "clients") that may be connected at a time.

The single or multiple clients setting may be viewed on the LAN → Configure → Modify web page.

NOTE

The performance of the **GENESYS™** LAN interface is impacted as more web pages, ports, and sockets are open at the same time. No more than two pages are open at the same time.

The rules for the One Client/Multiple Clients are:

	One Client Only	**Multiple Clients**
Web Page Not logged-in	Maximum of 2 copies of the web page may be open at any time. You may view but cannot change the power supply operation.	
Web Page Logged-in as "admin"	You cannot log in as 'admin' if a VISA or TCP socket port is already open. If you are logged in, any VISA, TCP, or UDP connections are blocked.	
TCP Socket UDP Socket	One TCP socket may be open if no VISA or 'admin' web page is open. UDP sockets are blocked.	Multiple connections of TCP and UDP are allowed to be open at a time, if no 'admin' web page is open. Up to 3 TCP and 3 UDP connections may be open at a time.
VISA Connection	Only one VISA port may be open at a time.	Up to two VISA ports may be open at a time.
Mixed VISA and Sockets	N/A	Up to two VISA ports and 3 TCP/UDP sockets may be open at a time.

4.7.8.4 Input Buffer Requirements

With a controller using TCP or UDP sockets, the power supply can receive commands much faster than it can process. To make sure the **GΞNESYS™** LAN is not overloaded, it is required that the controller sometimes sends a query and then waits for the response. The response is the acknowledgement from the power supply that it has finished processing all commands.

It is recommended that your controller routinely sends "SYST:ERR?". This query takes 10 mSec. and verifies that all commands have been accepted correctly.

NOTE

When using sockets, it is recommended that no more than 20 SCPI commands may be sent before a query is sent

4.7.8.5 Message Terminators

When using a program that sends separate SCPI commands through a TCP socket, the socket drivers may combine all the messages into one long packet. Therefore, it is necessary to add a terminator character to the end of each SCPI command.

NOTE

All SCPI commands must have a terminator character.

	Terminator Character (and ASCII hex)
Commands from the Controller	One or more terminators required: Line-feed, Carriage-return 0x0A 0x0D
Responses from the GENESYS™	All responses have Line-feed and Carriage-return 0x0D and 0x0A

4.7.8.6   Using TCP Sockets

This is the most commonly used socket type. It features a managed connection, message acknowledgements, transmission error detection and correction.

Open **TCP socket port 8003** to send SCPI commands.

Responses to queries are sent back automatically with a line-feed terminator and carriage return appended.

If the web page LAN controller access is set to "Multiple Clients", up to three controllers may open TCP sockets to one power supply at the same time.

4.7.8.7   Using UDP Sockets

This is a simpler socket type with reduced network traffic. It is a 'connectionless' protocol because messages are sent and there is no acknowledgement that they have been received.

Open **UDP socket port 8005** to send SCPI commands.

Responses to queries are sent back automatically with a line-feed terminator and carriage return appended.

Before opening a UDP socket, it is required to open the web page and set the controller access to Multiple Clients.

4.7.9   Connecting Over WAN

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

4.7.9.1   View Web Pages Over WAN

The GENESYS power supply LAN interface has a server for running the web pages. The web server is listening in Port 80.

The network administrator must obtain and assign a Global IP for the power supply. On the network server, the network administrator also must ensure port 80 is exposed to WAN connectivity.

4.7.9.2   Use Sockets Over WAN

The network administrator must obtain and assign a Global IP for the power supply. On the network server, the network administrator also must ensure port 8003 (for TCP sockets) or port 8005 (for UDP sockets) is exposed to WAN connectivity.

4.8 Multi Power Supply Connection (Daisy-Chain) to RS232, RS485, USB, or LAN

A Daisy-chain configuration of up to 32 units can be connected to RS232, RS485, USB, LAN, or optional communication (i.e., IEEE or MODBUS TCP). The first unit connects to the controller or PC via RS232, RS485, USB, LAN, or optional communication, while the RS485 bus connects the other units. The user must set **all** Power Supplies in the chain to a unique address.

NOTE

Multi-Power Supply Connection (Daisy-Chain) is not supported for EtherCAT communication interface (EtherCAT power supply can't be the Master/First unit in Daisy-Chain connection).

1. **First unit connection**: Select a communication Interface. Refer to section 4.2.2.

2. **Other units' connection**: The other units on the bus are connected via RS485 interface. Refer to Figure 4–21 for typical connections.

3. Using the Linking cable supplied with each unit (Refer to Figure 4–21), connect each unit's OUT connector to the next unit's IN connector.
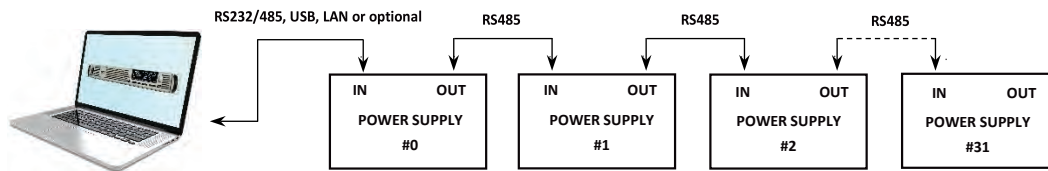
Figure 4–21: Multi Power Supplies RS232/485, USB, or LAN Connection

NOTE

If ten or more Power Supplies are connected in a Daisy-chain configuration, it is recommended to connect 120Ω resistive termination at the last unit's RS-485 OUT connector:

120Ω, 0.5W between TXD+ to TXD-.

120Ω, 0.5W between RXD+ to RXD-.
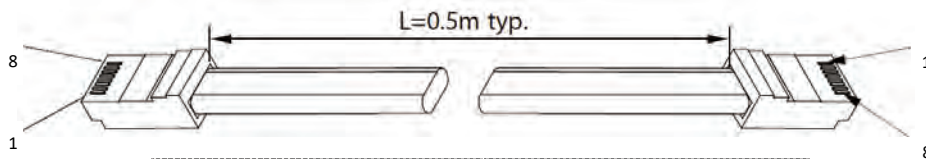
8 PIN CONNECTOR (IN)		8 PIN CONNECTOR (OUT)	
Pin No.	**Name**	**Pin No.**	**Name**
Housing	**Shield**	**Housing**	**Shield**
8	SG	8	SG
3	TXD-	3	RXD-
6	TXD+	6	RXD+
4	RXD-	4	TXD-
5	RXD+	5	TXD+

Table 4-2: Serial Link Cable with RJ-45 Shielded Connectors (P/N: GEN/RJ45)

NOTE

If a custom cable is used, connect only the pins listed in the table above. Keep pins 1, 2, and 7 not connected.

CAUTION

When using multiple LAN controllers with Multi-drop, only one power supply may be "selected" at a time because one controller may change the selected address and the others may not be aware that a new address is active.

Set the Master Power Supply (First unit)

1. Set the Master power supply communication interface (RS232, RS485, USB, LAN, or Optional communication (i.e., IEEE or MODBUS TCP). Refer to section 4.2.2.

2. Set the supply's RS-485 address as described below. Refer to section 4.2.3.

Set the Slave Power Supply (RS-485 units)

1. Set the Slave power supply communication interface to RS485. Refer to section 4.2.2.

2. Set the supply's RS-485 address as described below. Refer to section 4.2.3.

Selecting One Power Supply in a Multi-drop Chain

All the SCPI commands may be sent to any one of the supplies in an RS-485 chain by first sending the INSTrument:[N]SELect <NR1> address command.

All commands and queries will then apply only to the selected supply, until a new INSTrument:[N]SELect <NR1> is sent.

After sending INSTrument:[N]SELect <NR1>, it is recommended to verify the command by sending INSTrument:[N]SELect?, otherwise further commands may go to the wrong power supply.

Global Commands in a Multi-drop Chain

*   The GLOBAL commands affect all the supplies at the same time (Master and Slaves).
*   There is no SYSTEM:ERROR? response message if one or more supplies cannot execute a global command.
*   There is no query version of these commands. Global settings must be queried by selecting one power supply at a time and reading its setting.
*   The global commands do not affect which power supply has been selected using the INSTrument:[N]SELect <NR1> command. For example, if the following commands are sent:

    INST:NSEL 4
    VOLT 50
    GLOB:VOLT 70
    VOLT 90

    All the supplies on the multi-drop chain will be set to 70 volts, except for the supply at RS-485 address 4 that will be set to 90 volts.

NOTE

RS-485 retransmit baud-rate is automatically set to 115,200 bps if USB, LAN, or optional communication (i.e., IEEE or MODBUS TCP) is selected.

4.9 Multi Power Supply Connection (Daisy-Chain) - Multiple DC Programmable Power Supply Series

A Daisy-chain configuration of up to 32 units, consisting of GENESYS+, Z+, and/or GENESYS DC Programmable Power Supply Series can be connected to RS232, RS485, or USB. The first unit connects to the controller or PC via RS232, RS485, or USB, while the RS485 bus connects the other units.

Some restrictions apply when multiple DC programmable Power Supply Series from a Daisy-Chain.

- The Master power supply, connected to the controller (PC or PLC) must be GENESYS+.

- The Master power supply (GENESYS+) communication interface could be set to RS-232, RS-485, or USB (Daisy-Chain of multiple programmable DC power supply series via optional communication interfaces is not supported).

- Slave power supplies (daisy-chained via RS-485, which are not the first supply in the chain) must be set to RS-485 communication interface.

- Each power supply must have a unique address (addressing multiple power supplies with the same address will result in a communication failure).

- All power supplies (including the Master and the Slave units) must be set to the same communication language (SCPI or GEN).

NOTE

If daisy-chained power supplies (Slave power supplies) include Z+ only, SCPI language can be set.

If daisy-chained power supplies (Slave power supplies) include Z+ and GENESYS or GENESYS only, GEN language must be set.

- All power supplies (including the Master and the Slave units) must be set to the same baud-rate (9600, 19200, 38400, or 57600).

NOTE

If daisy-chained power supplies (Slave power supplies) include Z+ only, it is recommended to set 57600 to achieve maximum communication speed (limited to Z+ maximum communication speed).

If daisy-chained power supplies (Slave power supplies) include Z+ and GENESYS or GENESYS only, it is recommended to set 19200 to achieve maximum communication speed (limited to GENESYS maximum communication speed).

4.10　GEN Protocol (GEN series communication language)

GEN communication language is supported to provide compatibility to the legacy GENESYS Programmable Power Supplies Series. To use the advanced functions of the power supply, refer to SCPI language, section 4.13.

Recommended time delay between commands: 5mSec minimum.

NOTES

- The address (ADR n) command must return an "OK" response before any other command is accepted.

- GEN language is supported only in Serial communication interfaces (RS232, RS485, and USB).

4.10.1　Data Format

Serial data format is 8-bit, one start bit, and one stop bit.

No parity bit.

4.10.2　End of Message

The End of Message is the Carriage Return character (ASCII 13, 0x0D).

Power supply ignores the Line Feed (ASCII 10, 0x0A) character.

4.10.3　Command Repeat

The backslash character "\" causes the last command to be repeated.

4.10.4　Checksum

The user may optionally add a checksum to the end of the command. The checksum is "$" followed by two hex characters. If a command or a query has the checksum, the response will also have one. There is no CR between the command string and the "$" sign. Example: STT?$3A, STAT?$7B.

STT?$3A checksum is calculated as follows: S = 0x53, T = 0x54, T = 0x54, ? = 0x3F.

0x53 + 0x54 + 0x54 + 0x3F = 0x013A, checksum is the least significant byte – 0x3A.

STAT?$7B checksum is calculated as follows: S = 0x53, T = 0x54, A = 0x41, T = 0x54, ? = 0x3F.

0x53 + 0x54 + 0x41 + 0x54 + 0x3F = 0X017B, checksum is the least significant byte – 0x7B.

4.10.5　Acknowledge

The power supply acknowledges the commands received by returning an "OK" message. If an error is detected, the power supply returns an error message. The rules for the checksum apply to the Acknowledge feature as well.

4.10.6　Backspace

The backspace character (ASCII 8) clears the last character sent to the power supply.

4.11 GEN Command Set Description

4.11.1 General Guides

- Any command or argument may be in capital letters or small letters.
- In commands with an argument, a space must appear between command and argument.
- For any command that sets a numeric value, the value may be up to 12 characters long.
- Carriage Return: If the CR character (ASCII 13) is received by itself, the power supply will respond with an "OK" and CR.

4.11.2 Numeric / Data Type Parameters

Data Formats	Description
<NR1>	Digits with an implied decimal point assumed at the right of the least significant digit. Example: 255
<NR2>	Digits with an explicit decimal point. Example: .0253
<NRh>	Digits in the hexadecimal format
<Bool>	Boolean data. Examples: 0|1 or OFF|ON. Boolean parameters represent a single binary condition that is either true or false, i.e., for a false condition, the power supply will accept "OFF" or "0". For a true condition, the power supply will accept "ON" or "1" (OUT {OFF|ON}). Any number x which holds -0.5<x<0.5 is regarded as FALSE, otherwise TRUE.
<DSC>	DiSCrete. Discrete parameters are used to program settings that have a limited number of values (i.e., RMT {LOC|REM|LLO})
<SRD>	String Response Data. Predefined format of symbolic string parameters. Example: 29920Bits/V,00000Bits,3.3459E-05Volt/Bit,-0.0016Volts

Table 4-3: Numeric / Data Type Parameters

4.11.3 Command Set Categories

The command set is divided into six categories as follows:

- Identification Commands
- Initialization Commands
- Output Commands
- Global Output Commands
- Auxiliary Commands
- Status Commands

4.11.4 Identification Commands

IDN?

Query	Returns the power supply model identification as an ASCII string (one comma, no spaces)
Returns	<SRD>
Example	TDK-LAMBDA,G100-50

REV?

Query	Returns the software version as an ASCII string
Returns	<SRD>
Example	G:XX.XXX

SN?

Query	Returns the supply's serial number. Up to 12 characters in any format
Returns	<SRD>
Example	111111-22222

DATE?

Query	Returns the date of last calibration. Format: yyyy/mm/dd
Returns	<SRD>
Example	2017/12/17

4.11.5 Initialization Commands

CLS

Function	Clear Status. Sets FEVE and SEVE registers to zeroes
Returns	<DSC> OK

ADR <NR1>

Function	Send 'ADR' and address (0 to 31) to open a communication channel.
Returns	<DSC> OK

RMT <DSC>

Function	Set the power supply control source (front panel or communication) to local, remote, or LLO mode.
	Local – Enable front panel control.
	Remote – Disable front panel settings change (settings preview only).
	LLO – same as Remote + Disable front panel unlock function by front panel.
	Change mode by communication or AC recycle.
Parameters	0|1|2 or LOC|REM|LLO
Query	RMT?
Returns	<DSC> LOC|REM|LLO

RST

Function	Reset setting. Refer to Table 2-6.
Returns	<DSC> OK

****

Function	Repeat last command. If \<CR> is received, the power supply will repeat the last command
Returns	<DSC> OK

FRST

Function	Restore factory reset parameters. Refer to Table 2-6 & Table 2-7
Returns	None

NOTES

1. Factory Reset does not affect advanced parallel configuration acknowledgment (does not affect power supply configuration (Single, Master or Slave roles does not change).

2. Execution time for this command is ~250mS.

3. FRST command sets USB communication interface.

4.11.6   Output Commands

PV <NR2>

Function	Set digital programming output voltage value in Volts
Parameters	Range is limited by the power supply model, OVP, and UVP settings. Refer to Table 4-4
Query	PV?
Returns	<NR2> 5-digits format

MV?

Query	Returns a measured output voltage
Returns	<NR2> 5 digits format

PC <NR2>

Function	Set digital programming output current value in Amperes
Parameters	Range is limited by the power supply model. Refer to Table 4-5 up to Table 4-8.
Query	PC?
Returns	<NR2> 5-digits format

MC?

Query	Returns a measured output current
Returns	<NR2> 5 digits format

MP?

Query	Returns the measured output power
Returns	<NR2> 5 digits format

DVC?

Query	Displays Voltage and Current data. Data returns as a string of ASCII characters. A comma separates different fields. Fields order: Measured Voltage, Programmed Voltage, Measured Current, Programmed Current, Over Voltage Set Point, and Under Voltage Set Point
Example	10.000, 10.000, 020.02, 010.00, 040.5, 000.0

OUT <Bool>

Function	Enable / Disable power supply output. OUT ON will respond with 'E07' if the output cannot be turned on because of a latching fault (OTP, AC, ENA, ILC, POFF, SO) shutdown
Parameters	0|1, OFF|ON
Query	OUT?
Returns	<Bool> 0|1

FLD <DSC>

Function	Sets the Foldback protection to OFF, CC, or CV mode. "FLD 0/OFF" deactivates Foldback protection. "FLD 1/CC" arms CC Foldback protection. "FLD 2/CV" arms CV Foldback protection
Parameters	0|1|2 or OFF|CC|CV
Query	FLD?
Returns	<DSC> OFF|CC|CV

FBD <NR1>

Function	Sets the delay time from Foldback fault event to output disable
Parameters	1–255 (1=0.1sec). Value rounded to 0.1 resolution
Query	FBD?
Returns	<NR1>

FBDRST

Function	Reset the added Fold Back Delay to default

OVP <NR2>

Function	Sets the Over-Voltage Protection level. An attempt to adjust the OVP level below voltage setting level will result in the execution error response ('E04') and the OVP setting will stay unchanged.
Parameters	OVP programming range is limited by: 1. 5% above voltage setting. 2. OVP programming range. OVP programming range is given in Table 2-1.
Query	OVP?
Returns	<NR2> 4 digit format

OVM

Function	Sets the Over-Voltage Protection to maximum. The OVP programming range is given in Table 2-1.

UVL <NR2>

Function	Sets the Under Voltage Limit. Value 'n' may be equal or less than 95% of PV setting. Returns 'E06' if higher
Parameters	Range is limited by the UVL programming range and voltage programmed value. Refer to Table 2-2 for UVL programming range
Query	UVL?
Returns	<NR2> 4 digit format

UVP <Bool>

Function	Enable/Disable Under Voltage Protection
Parameters	0|1, OFF|ON
Query	UVP?
Returns	<Bool> 0|1

AST<Bool>

Function	Sets the auto-restart mode to ON or OFF
Parameters	0|1, OFF|ON
Query	AST?
Returns	<Bool> 0|1

SAV <NR1>

Function	Saves the power supply settings to a specific memory location
Parameters	1,2,3,4. SAV without a parameter stores the power supply settings in the memory location 1

RCL <NR1>

Function	Restores the power supply settings from a stored memory location (locations 1, 2, 3, or 4), previously stored by the SAV command
Parameters	1,2,3,4. RCL without a parameter restores the power supply settings stored in the memory location 1

MODE?

Query	Returns the power supply operation mode. If power supply is off, returns OFF. If power supply is on, returns CV for Constant Voltage, CC for Constant Current, or CP for Constant Power
Return	<DSC> OFF|CV|CC|CP

MS?

Query	Returns the Master/Slave setting Single, Master + # (# - number of slaves units connected) or Slave
Return	<SRD> SINGLE|MASTER+#|SLAVE

NOTE

Power supply does not execute commands in the Slave mode.

4.11.7   Global Output Commands

General

Global commands are received by all Power Supplies connected to the BUS, without any need of individual addressing commands.

All Power Supplies execute commands immediately. There is no acknowledgment back to the PC. A delay of at-least 10mSec must be set after each global command. Error messages are not reported back to the issuing PC.

GRCL <NR1>

Function	Refer to RCL command description.
Parameters	1,2,3,4
Returns	No reply

GRST

Function:	Refer to RST command description.
Returns	No reply

GSAV <NR1>

Function	Refer to SAV command description.
Parameters	1,2,3,4
Returns	No reply

GPC <NR2>

Function	Refer to PC command description.
Returns	No reply

GOUT <Bool>

Function	Refer to OUT command description.
Parameter	0|1, OFF|ON
Returns	No reply

GPV <NR2>

Function	Refer to PV command description.
Returns	No reply

Model Rated Output Voltage (V)	Minimum (V)	Maximum (V)
10	0	10
20	0	20
30	0	30
40	0	40
50	0	50
60	0	60
80	0	80
100	0	100
150	0	150
200	0	200
300	0	300
400	0	400
500	0	500
600	0	600
1000	0	1000
1500	0	1500

Table 4-4: Voltage Programming Range

NOTE

The power supply can accept values higher by 5% than the table values. However, it is not recommended to program the power supply above the rated values.

Model 1kW	Maximum (A)	Model 1.5kW	Maximum (A)	Model 1.7kW	Maximum (A)	Model 2.7kW	Maximum (A)	Model 3.4kW	Maximum (A)
10-100	100	10-150	150	10-170	170	10-265	265	10-340	340
20-50	50	20-75	75	20-85	85	20-135	135	20-170	170
30-34	34	30-50	50	30-56	56	30-90	90	30-112	112
40-25	25	40-38	38	40-42	42	40-68	68	40-85	85
60-17	17	60-25	25	60-28	28	60-45	45	60-56	56
80-12.5	12.5	80-19	19	80-21	21	80-34	34	80-42	42
100-10	10	100-15	15	100-17	17	100-27	27	100-34	34
150-7	7	150-10	15	150-11.2	11.2	150-18	18	150-22.5	22.5
300-3.5	3.5	300-5	5	300-5.6	5.6	300-9	9	300-11.5	11.5
600-1.7	1.7	600-2.6	2.6	600-2.8	2.8	600-4.5	4.5	600-5.6	5.6

Table 4-5: Current Programming Range 1kW–3.4kW

Model 5kW	Maximum (A)	Model 7.5kW	Maximum (A)
10-500	500	---	---
20-250	250	20-375	375
30-170	170	30-250	250
40-125	125	40-188	188
50-100	100	---	---
60-85	85	60-125	125
80-65	65	80-94	94
100-50	50	100-75	75
150-34	34	150-50	50
200-25	25	200-37.5	37.5
300-17	17	300-25	25
400-13	13	---	---
500-10	10	---	---
600-8.5	8.5	600-12.5	12.5
1000-5	5	1000-7.5	7.5
1500-3.4	3.4	1500-5	5

Table 4-6: Current Programming Range 5kW–7.5kW

Model GSP10kW	Maximum (A)	Model GSP15kW	Maximum (A)	Model GSPL15kW	Maximum (A)	Model GSPL22.5kW	Maximum (A)
10-1000	1000	10-1500	1500	20-750	750	20-1125	1125
20-500	500	20-750	750	30-500	500	30-750	750
30-340	340	30-510	510	40-376	376	40-564	564
40-250	250	40-375	375	60-250	250	60-375	375
50-200	200	50-300	300	80-188	188	80-282	282
60-170	170	60-255	255	100-150	150	100-225	225
80-130	130	80-195	195	150-100	100	150-150	150
100-100	100	100-150	150	200-75	75	200-112.5	112.5
150-68	68	150-102	102	300-50	50	300-75	75
200-50	50	200-75	75	600-25	25	600-37.5	37.5
300-34	34	300-51	51	1000-15	15	1000-22.5	22.5
400-26	26	400-39	39	1500-10	10	1500-15	15
500-20	20	500-30	30	---	---	---	---
600-17	17	600-25.5	25.5	---	---	---	---

Table 4-7:Current Programming GSP / GSPL Range 10kW–22.5kW

Model GSPS30kW	Maximum (A)	Model GSPS45kW	Maximum (A)	Model GSPS60kW	Maximum (A)	Model GSPS90kW	Maximum (A)
10-3000	3000	20-2250	2250	10-4500	4500	20-4500	4500
20-1500	1500	30-1530	1530	20-3000	3000	30-3000	3000
30-1020	1020	40-1125	1125	30-2040	2040	40-2256	2256
40-750	750	50-900	900	40-1500	1500	60-1500	1500
50-600	600	60-765	765	50-1200	1200	80-1128	1128
60-510	510	80-585	585	60-1020	1020	100-900	900
80-390	390	100-450	450	80-780	780	150-600	600
100-300	300	150-306	306	100-600	600	200-450	450
150-204	204	200-225	225	150-408	408	300-300	300
200-150	150	300-153	153	200-300	300	600-150	150
300-102	102	400-117	117	300-204	204	1000-90	90
400-78	78	500-90	90	400-158	158	1500-60	60
500-60	60	600-76.5	76.5	500-120	120	---	---
600-51	51	---	---	600-102	102	---	---

Table 4-8: Current Programming GSPS 30kW–90kW

NOTES

1. The power supply can accept values higher by 5% than the table values. However, it is not recommended to program the power supply over the rated values.

2. Minimum current programming range is 0 Amperes.

4.11.8 Auxiliary Commands

BOOL <DSC>

Function	Select query Return format of Boolean (<Bool>) commands. DIGIT – Boolean queries are replied with 0|1. TEXT – Boolean queries are replied with OFF|ON.
Parameters	DIGIT|TEXT, 0|1
Query	BOOL?
Returns	<DSC> DIGIT|TEXT

NOTE

BOOL <DSC> command is available from firmware revision 02.110.

LANG <DSC>

Function	Sets the communication protocol to SCPI language.
Parameter	SCPI

RIE <Bool>

Function	Enable / Disable ILC function. If disabled, power supply ignores the ILC pin state.
Parameters	0|1, OFF|ON
Query	RIE?
Returns	<Bool> 0|1

PVS <DSC>

Function	Set the Voltage programming source: Front Panel, External Resistor, or External Voltage.
Parameters	0|1|2 or DIG|VOL|RES
Query	PVS?
Returns	<DSC> DIG|VOL|RES

PCS <DSC>

Function	Set the Current programming source: Front Panel, External Resistor, or External Voltage.
Parameters	0|1|2 or DIG|VOL|RES
Query	PCS?
Returns	<DSC> DIG|VOL|RES

APR <DSC>

Function	Set the power supply analog programming & monitoring range. Programming – 5/10 volt or 5/10kΩ. Monitoring – 5/10 volt
Parameters	5|10
Query	APR?
Returns	<DSC> 5|10

REL1 <Bool>

Function	Set the Programmable Pin 1 state (J1.21). 0 – MOSFET ON. 1 – MOSFET OFF.
Parameter	0|1, OFF|ON
Query	REL1?
Return	<Bool> 0|1

REL2 <Bool>

Function	Set the Programmable Pin 2 state (J1.20). 0 – MOSFET ON. 1 – MOSFET OFF.
Parameter	0|1, OFF|ON
Query	REL2?
Return	<Bool> 0|1

4.11.9   Status Commands

Refer to section 6.3.1 for GEN Registers tree.

STT?

Query	Reads the complete power supply status. Returns ASCII characters representing the following data, separated by commas. MV<actual (measured) voltage>,PV<programmed (set) voltage>, MC<actual (measured) current>,PC<programmed (set) current>, SR<status condition register>,FR<fault condition register>
Example	MV(10.000),PV(10.000),MC(04.000),PC(05.000),SR(04ff),FR(00C0)

FLT?

Query	Returns the value of the Questionable Group Condition register, a read-only register holding the real-time power supply faults.
Returns	<NRh>
Example	09FA

FENA <NRh>

Function	Sets the value of the Questionable Group Enable register. This register is a mask to enable specific bits from the Condition register to the Event register.
Parameters	0...FFFF
Query	FENA?
Returns	<NRh> 0...FFFF

FEVE?

Query	Returns the value of the Questionable Group Event register, which is a read-only register. Fault Events are updated as a transition from 0 to 1. Reading the register clears it (All Zeros).
Returns	<NRh>

STAT?

Query	Returns the value of the Operation Group Condition register, which is a read-only register that holds the real-time status of the power supply.
Returns	<NRh>
Example	09FA

SENA <NRh>

Function	Sets the value of the Operation Group Enable register. This register is a mask to enable specific bits from the Condition register to the Event register.
Parameters	0...FFFF
Query	SENA?
Returns	<NRh> 0...FFFF

SEVE?

Query	Returns the value of the Operation Group Event register, which is a read-only register. Fault Events are updated as a transition from 0 to 1. Reading the register clears it (All Zeros).
Returns	<NRh>

4.12   Serial Communication Test Set-Up

Basic set-up to test serial communication operation.

1   Equipment

PC with a serial communication terminal software installed, power supply, and RS232 or USB cable.

2   PC Set-up

Bits per second: 115200
Data bits: 8
Parity: None
Stop bits: 1
Flow control: None

3   Power Supply Set-up

Connect power supply to the PC using RS232 or USB cable.
Set power supply settings:
Baud Rate – 115200
Address – 06
Interface – RS232 or USB
Communication Language – GEN

4   Communication

PC write: ADR 06
Power supply response: OK
PC write: OUT 1
Power supply should turn output ON.
Power supply response: OK
PV write: PV n (for n values, refer to Table 4-4)
Power supply response: OK
PC write: PC m (for m values, refer to Table 4-5 up to Table 4-8)
Power supply response: OK

Display indicates the output voltage and actual output current.
If Blank Panel Power Supply is tested, add the following commands to measure the output voltage and output current settings:
PV write: PV?
Power supply response: n (actual voltage setting)
PC write: PC?
Power supply response: m (actual current setting)

NOTE

If USB communication is used, the USB driver installation is required before communication.

4.13   SCPI Protocol

Recommended time delay between commands: 5mSec minimum. Some commands might require longer time. In such cases, refer to NOTE following command description.

NOTE

Selecting the power supply (INSTrument:NSELect <address>) is necessary before using any other command.

4.13.1   Data Format

Serial data format is 8-bit, one start bit, and one stop bit. No parity bit.

4.13.2   End of Command

The end of command is the Carriage Return character (ASCII 13, 0x0D) and/or the Line Feed (ASCII 10, 0x0A) character.

4.13.3   Checksum

The user may optionally add a checksum to the end of the command. The checksum is "$" followed by two hex characters. If a command or a query has checksum, the response will also have one. There is no CR between the command string and the "$" sign. Example: STT?$3A, STAT?$7B.

STT?$3A checksum is calculated as follows: S = 0x53, T = 0x54, T = 0x54, ? = 0x3F.

0x53 + 0x54 + 0x54 + 0x3F = 0x013A, checksum is the least significant byte – 0x3A.

STAT?$7B checksum is calculated as follows: S = 0x53, T = 0x54, A = 0x41, T = 0x54, ? = 0x3F.

0x53 + 0x54 + 0x41 + 0x54 + 0x3F = 0X017B, checksum is the least significant byte – 0x7B.

4.13.4   SCPI Requirements

The power supply conforms to the following SCPI requirements:

- SCPI common commands.
- SCPI Command Tree.
- Subsystem commands.
- The ROOT level.
- The power supply is powered On.
- A device clear (DCL) is sent to the power supply.
- The SCPI interface encounters a root specifier (:).
- Questionable Status Register (QSR), Condition, Event, Enable.
- Operation Status Register (OSR), Condition, Event, Enable.
- Status Byte Register (SBR).
- Standard Event Status Register (SESR).
- MIN and MAX Parameters.
- Suffix and Multipliers.
- Boolean data. 0|1 or OFF|ON.

4.13.5 SCPI Command Hierarchy

SCPI is an ASCII-based command language designed for use in test and measurement equipment. The command structure is organized around common roots, or nodes, which are the building blocks of the SCPI subsystems. An example of a common root is OUTPut. Some of the commands that reside in the OUTPut subsystem are:

```
OUTPut
        [:STATe] <bool>
        :PON
                [:STATe] <DSC>
        :PROTection
                :CLEar
                :FOLDback
                        [:MODE] <DSC>
```

A colon (:) is used to separate a command keyword from a lower-level keyword.

4.13.6 Header

Headers are instructions recognized by the power supply. Headers (which are sometimes known as "keywords") may be either in a long or short form.

Long form: The header is completely spelled out, such as VOLTAGE, STATUS, and DELAY.

Short form: The header has only the first three or four letters, such as VOLT, STAT, and DEL.

The SCPI interface is not case sensitive. It will recognize any case mixture, such as TRIGGER, Trigger, and TRIGger. Short form headers result in a faster program execution.

4.13.7 Data Formats

Data Formats	Description
<NR1>	Digits with an implied decimal point assumed at the right of the least significant digit. Example: 255
<NR2>	Digits with an explicit decimal point. Example: .0253
<NR3>	Digits with an explicit decimal point and exponent. Example: 2.33E+2
<NRf>	Extended format that includes <NR1>, <NR2>, and <NR3> Examples: 263, 263.1, 263E+2
<NRf+>	Expanded decimal format that includes <NRf> and MIN, MAX. Examples: 263, 263.1, 263E+2, MIN, MAX. MIN and MAX are the minimum and maximum limit values that are implicit in the range specification of the parameter. *
<Bool>	Boolean data. Examples: 0|1 or OFF|ON. Boolean parameters represent a single binary condition that is either true or false. i.e., for a false condition, the power supply will accept "OFF" or "0". For a true condition, the power supply will accept "ON" or "1" (OUTPut:STATe {OFF|ON}). Any number x which holds -0.5<x<0.5 is regarded as FALSE, otherwise TRUE.

Data Formats	Description
<DSC>	DiSCrete. Discrete parameters are used to program settings that have a limited number of values (e.g., TRIGger:SOURce {BUS|EXTernal}). Discrete parameters have a short form and a long form, just like command keywords. One can mix upper-case and lower-case letters. Query responses will always return the short form in all upper-case letters.
<SRD>	String Response Data. A predefined format of symbolic string parameters. Example: 29920Bits/V,00000Bits,3.3459E-05Volt/Bit,-0.0016Volts
<STR>	STRing. String parameters are ASCII strings to be sent with double quotes as delimiters. Example: "Example".

NOTE

* MIN & MAX parameters for voltage setting are adopted according to OVP and UVL settings.

4.13.8 Commands Notes

Expressions enclosed in square brackets [ ] are optional, entered without the [ ]. For example MEASURE:CURRENT? or MEASURE:CURRENT:DC? can be used.

Expressions enclosed in angle brackets < > are programming values, entered without the < >. For example *ESE 255.

Vertical bars | separate alternative parameters. For example, BUS|EXT, BUS or EXT can be used.

Braces { } enclose parameters within a command string. For example LIST:CURR 2.0,2.5,3.0.

Upper-case characters are interchangeable with lower-case characters in any command. For example *EsE 255.

4.14   SCPI Common Commands

Common commands begin with an * and consist of three letters (command), or three letters and a ? (query). Common commands are defined by the IEEE 488.2 standard to perform common interface functions.

*CLS

Function	This command performs the following actions over the registers tree: • Clears the Standard Event Status, Operation Status Event, and Questionable Status Event registers • Clears the Status Byte • Clears the Error Queue • If *CLS immediately follows a program message terminator (<LF>), then the output queue and the MAV bit are also cleared.

NOTE

Execution time for this command is ~20mS

TDK·Lambda

*ESE <NR1>

Function	This command programs the Standard Event Status Enable register bits. The programming determines which events of the Standard Event Status Event register (see *ESR? below) are allowed to set the ESB (Event Summary Bit) of the Status Byte register. "1" in the bit position enables the corresponding event. All the enabled events of the Standard Event Status Event Register are logically OR-ed to cause the Event Summary Bit (ESB) of the Status Byte Register to be set. • Use *PSC to control whether the Standard Event Status Enable register is cleared at AC power on. For example, *PSC 0 preserves the Standard Event Status Enable register contents through power cycles. • The *CLS (clear status) command does not clear the Standard Event Status Enable register. • Any or all conditions can be reported to the Standard Event summary bit through the enable register. To set the enable register mask, write a decimal value to the register using *ESE.
Parameters	0...255
Query	*ESE? Reads Standard Event Status Enable register and returns a decimal value, which corresponds to the binary-weighted sum of all bits set in the Standard Event Status Enable register.
Returns	<NR1> 0...255

ESE Register Bit Configuration:

Bit Position	7	6	5	4	3	2	1	0
Bit Name	PON	-	CME	EXE	DDE	QYE	-	OPC
Bit Weight	128	-	32	16	8	4	-	1

PON = Power On, CME = Command Error, EXE = Execution Error, DDE = Device Dependent Error, QYE = Query Error, OPC = Operation Complete.

*ESR?

Query	Returns the value of the Standard Event Status Event register. The Event register is a read-only register, which stores (latches) all standard events. Reading the Standard Event Status Event register clears it. Bit configuration of the Standard Event Status Event register is as follows:

Position	7	6	5	4	3	2	1	0
Value	128	-	32	16	8	4	-	1
Name	PON	-	CME	EXE	DDE	QYE	-	OPC

PON – Power ON
Set to "1" when power is ON (set once at power up).

CME - Command Error
Set to "1" when command syntax is incorrect.

EXE - Execution Error
Set to "1" when command syntax is correct, but the command cannot be executed in the current state (i.e., parameters are outside of the setting range).

DDE – Device Dependent Error
Set to "1" when command execution is not possible due to an internal problem in the instrument that is not a command error or an execution error.

QYE - Query Error
Set to "1" if the output queue is empty or if the data is missing even after a query has been sent.

OPC - Operation Complete

- ***CLS** (Clear Status) command clears all the bits in the Standard Event Status Event register.
- Once a bit is set in the Standard Event Status Event Register, it remains set until it is cleared by a query or *CLS.

Returns	<NR1> 0...255

*IDN?

Query	Returns a unique power supply identification code. The unique identification code is a string that is separated by three ",". The string includes manufacturer, model number, type of installed option, serial number, and Interface firmware revision.
Returns	<SRD>
Example	TDK-LAMBDA,GH100-50-GPIB,12345-123456,G:01.000

*OPC

Function	Sets Operation Complete (bit 0) in the Standard Event Status Event Register at the completion of the current operation.
Query	*OPC? Commands cannot be executed until this command completes. This query returns 1 to the output buffer after all pending commands complete.
Returns	<SRD>

*OPT?

Query	Returns the type of an optional card installed.
Returns	<SRD>
	0,No Option Installed
	1,GPIB
	2,MODBUS
	3,ETHERCAT

*PSC <Bool>

Function	The Power ON Status Clear (PSC) command controls automatic Power ON clear of the Service Request Enable Register, the Standard Event Status Enable Register, and Device Specific Event Enable registers.
	• ON (1) - Enables the Power ON clear of the listed registers (default).
	• OFF (0) - Disables clear of the listed registers. Registers retain their status when a Power ON condition occurs.
Parameters	0|1, OFF|ON
Query	*PSC?
Returns	<Bool> 0|1

*RCL <NR1>

Function	This command restores power supply to a state stored in the memory (locations 1 through 4), previously stored by the *SAV <NR1> command. Refer to Section 2.13.5
Parameters	1,2,3,4.
	RCL without a parameter restores the power supply state stored in the memory cell 1.

NOTE

Execution time for this command is ~100mS

*RST

Function	Executes reset. Refer to Table 2-6

*SAV <NR1>

Function	Saves the power supply state to a specific memory location. Refer to section 2.13.4.
Parameters	1,2,3,4.
	SAV without a parameter stores the power supply state in the memory cell 1.

NOTE

Execution time for this command is ~100mS

*SRE <NR1>

Function	Sets the condition of the Service Request Enable Register. This register determines which bits from the Status Byte Register are allowed to set the Request for Service (RQS) summary bit. A "1" in any Service Request Enable Register bit position enables the corresponding Status Byte Register bit. All such enabled bits are logically OR-ed to determine the Status Byte Register, RQS bit state.
Parameters	0...255
Query	*SRE? Reads the Service Request Enable Register. Used to determine which Status Byte Register events are allowed to generate a service request.
Returns	<NR1> 0...255

SRE register bit configuration:

Bit Position	7	6	5	4	3	2	1	0
Bit Name	OPR	-	ESB	MAV	QUE	SYS	-	-
Bit Weight	128	-	32	16	8	4	-	-

OPR = Operation Condition Status Register Summary, ESB = Standard Event Status Register Summary, MAV = Output Queue Message Available, QUE = Questionable Condition Fault Register Summary, SYS = System Error Queue Message available.

*STB?

Query	This query reads Status Byte Register. Reading Status Byte Register clears QUE, ESB, OPR bits.
	<table><tr><td>Position</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr><tr><td>Value</td><td>128</td><td>64</td><td>32</td><td>16</td><td>8</td><td>4</td><td>-</td><td>1</td></tr><tr><td>Name</td><td>OPR</td><td>RQS</td><td>ESB</td><td>MAV</td><td>QUE</td><td>SYS</td><td>-</td><td>BSY</td></tr></table> **OPR** – Operation Status Summary **MAV** – Message Available **RQS** – Request Service **QUE** – Questionable Status summary **ESB** – Event Status Byte summary **SYS** – System Error query not empty **BSY** – Operation is not complete
Parameter	<NR1> 0...255

*TRG

Function	Generates a trigger to the sequencer subsystem. Active only if BUS is selected as a trigger source.

NOTE

*TRG command activates sequencer following TRIGger:DELay <NRf+> setting. Refer to TRIGger[:IMMediate] command to override TRIGger:DELay <NRf+> setting.

*TST?

Query	Self-test query. If one or more tests fail, "1" is returned. Error is stored in the error queue.
Returns	<Bool> 0|1

*WAI

Function	Configures the instrument to wait for all pending operations to complete before executing any additional commands over the interface.

ABORt

Function	This command cancels any sequencer actions in progress. It returns the trigger system to the Idle state. TWI bit is cleared in the Status Register Group Condition Register.

4.15   SCPI Subsystem Commands

Subsystem commands are specific to power supply functions. Those can be a single command or a group of commands. Groups are comprised of commands that extend one or more levels below the root.

Commands followed by a question mark (?) take only the query form.

4.15.1   Display Subsystem

DISPlay[:WINDow]:STATe <Bool>

Function	Sets front panel (Display, Buttons) OFF/ON. Power switch is active, disregarding command OFF/ON state.
Parameter	0|1, OFF|ON
Query	DISPlay[:WINDow]:STATe?
Return	<Bool> 0|1

NOTE

Display & Buttons are active after AC recycle or after Power Switch OFF (above four seconds at Power Switch OFF state).

DISPlay[:WINDow]:FLASh <Bool>

Function	Blink Display
Parameter	0|1, OFF|ON
Query	DISPlay[:WINDow]:FLASh?
Return	<Bool> 0|1

DISPlay[:WINDow]:TEST <Bool>

Function	Turns all display segments & LEDs on.
Parameter	0|1, OFF|ON

4.15.2 Initiate Subsystem

INITiate[:IMMediate]

Function	Initialize trigger system.
	If initialized, trigger in system is active (system is ready to receive trigger signal).
	If not initialized, all trigger signals are ignored.

INITiate:CONTinuous <Bool>

Function	Continuously re-initiates a trigger.
	If inactive, the trigger system must be re-initiated for each trigger by the INITiate command.
Parameters	0|1, OFF|ON
Query	INITiate:CONTinuous?
Return	<Bool> 0|1

NOTE

When power supply is in the INIT state, it is impossible to change any sequence programming parameter. Send ABORt commands to allow parameters change.

4.15.3 Instrument Subsystem

INSTrument:COUPle <DSC>

Function	Defines coupling between all Power Supplies connected in a multi drop connection (RS485).
	All – All power supplies connected in daisy chain (coupled power supplies) receive communication commands.
Parameters	NONE|ALL

NOTE

INSTrument:COUPle <DSC> command preserves power supply selection command. The unit selected by INSTrument:[N]SELect command is the only unit which will reply to query commands. If none of the units is selected, there will not be a response to query commands.

INSTrument:[N]SELect <NR1>

Function	Enables communication with the addressed power supply.
Parameters	0–31
Query	INSTrument:[N]SELect?
Return	From 0 up to 31

4.15.4 Global Subsystem

Global Commands General

- Power Supplies acting upon Global Commands don't have to be addressed.
- All Power Supplies attached to the Interface must be capable of accepting Global Commands.
- Global commands have no reply, execution only.

GLOBal:*RCL <NR1>

Function	Refers to *RCL <NR1> command description.
Parameters	1,2,3,4

GLOBal:*RST

Function:	Refers to *RST command description.

GLOBal:*SAVe <NR1>

Function	Refers to *SAV <NR1> command description.
Parameters	1,2,3,4

GLOBal:CURRent[:AMPLitude] <NRf+>

Function	Refers to [SOURce]:CURRent[:LEVel][:IMMediate][:AMPLitude] <NRf+> command description.
Units	A

GLOBal:OUTPut[:STATe] <Bool>

Function	Refers to OUTPut[:STATe] <Bool> command description.
Parameter	0|1, OFF|ON

GLOBal:VOLTage[:AMPLitude] <NRf+>

Function	Refers to [SOURce]:VOLTage[:LEVel][:IMMediate][:AMPLitude] <NRf+> command description.
Units	V

4.15.5 Measure Subsystem

MEASure:CURRent[:DC]?

Query	Returns a measured output current.
Return	<NR2> - Current in Amperes, 5 digits format.

MEASure:VOLTage[:DC]?

Query	Returns a measured output voltage.
Return	<NR2> - Voltage in Volts, 5 digits format.

MEASure:POWer[:DC]?

Query	Returns a measured output power.
Return	<NR2> - Power in Watts, 5 digits format.

4.15.6 Output Subsystem

OUTPut[:STATe] <Bool>

Function	Enables / Disables the power supply output Setting.
	Query returns an actual output status.
Parameter	0|1, OFF|ON
Query	OUTPut[:STATe]?
Return	<Bool> 0|1

OUTPut:ENA[:STATe] <Bool>

Function	Enables / Disables the ENA function.
	If disabled, power supply ignores the ENA pin signal (J1-10).
Parameter	0|1, OFF|ON
Query	OUTPut:ENA[:STATe]?
Return	<Bool> 0|1

OUTPut:ENA:POLarity <DSC>

Function	Sets the ENA signal polarity.
	NORM - (same as interlock) - Output ON if ENA pin signal (J1-10) is low ('0').
	REV - Output ON if ENA pin signal (J1-10) is high ('1').
Parameter	0|1, REV|NORM
Query	OUTPut:ENA:POLarity?
Return	<DSC> REV|NORM

OUTPut:ILC[:STATe] <Bool>

Function	Enables / Disables the ILC function.
	If disabled, power supply ignores the ILC pin signal (J1-19).
Parameter	0|1, OFF|ON
Query	OUTPut:ILC[:STATe]?
Return	<Bool> 0|1

OUTPut:MODE?

Query	Returns the power supply operation mode.
	If power supply output is OFF, returns OFF.
	If power supply output is ON, returns CV for Constant Voltage, CC for
	Constant Current, or CP for Constant Power Limit.
Return	<DSC> OFF|CV|CC|CP

OUTPut:PON[:STATe] <DSC>

Function	Determines the power supply output state after the AC recovery or non-
	latching (OTP, ILC, ENA, DAISY_IN) faults.
	SAFE – Power supply output recovers to off state.
	AUTO – Power supply output recovers to prior failure state.
Parameter	0|1, OFF|ON, SAFE|AUTO
Query	OUTPut:PON[:STATe]?
Return	<Bool> 0|1

OUTPut:PROTection:CLEar

Function	Clears latching faults (OVP, UVP, and Foldback).
	An actual fault condition must be removed before the latch is cleared.
	The power supply output recovery according to OUTPut:PON state.

OUTPut:PROTection:FOLDback[:MODE] <DSC>

Function	Foldback mode is used to disable the power supply output if a transition
	between operation modes occurs.
	Power supply turns output off after a specified delay if there is a transition
	into CV mode or into CC mode. This feature is particularly useful for
	protecting current or voltage sensitive loads.
Parameter	0|1|2, OFF|CC|CV
Query	OUTPut:PROTection:FOLDback[:MODE]?
Return	OFF|CC|CV

OUTPut:PROTection:FOLDback:DELay <NRf+>

Function	Sets the delay time from Foldback fault event to output disable.
Parameter	0.1–25.5 |MIN|MAX. Step: 0.1
	Note: Round input parameter to the closest 100mSec step.
Unit	S
Query	OUTPut:PROTection:FOLDback:DELay?;
	OUTPut:PROTection:FOLDback:DELay? MAX

OUTPut:RELay1[:STATe] <Bool>

Function	Sets PROG_OUT_1 pin (J1-21) in a rear panel connector. 0 – MOSFET is ON. 1 – MOSFET is OFF.
Parameter	0|1, OFF|ON
Query	OUTPut:RELay1[:STATe]?
Return	<Bool> 0|1

OUTPut:RELay2[:STATe] <Bool>

Function	Sets PROG_OUT_2 pin (J1-20) in a rear panel connector. 0 – MOSFET is ON. 1 – MOSFET is OFF.
Parameter	0|1, OFF|ON
Query	OUTPut:RELay2[:STATe]?
Return	<Bool> 0|1

OUTPut:TTLTrg:MODE <DSC>

Function	Sets the operation mode of the Trigger Out signal to OFF, FSTR, or TRIG mode. Programming Mode - NONE: • In TRIG mode, a trigger is generated if output state changes. • In FSTR mode, an output pulse is generated automatically any time an output parameter, such as output state, voltage, or current is programmed. Programming Modes - LIST or WAVE: • In TRIG mode, a trigger is generated if LIST or WAVE has completed. • In FSTR mode, an output pulse is generated automatically any time a step has completed.
Parameter	0|1|2, OFF|FSTR|TRIG
Query	OUTPut:TTLTrg:MODE?
Return	<DSC> OFF|FSTR|TRIG

4.15.7   Program Subsystem

[PROGram]:COUNter <NR1> | INFinity

Function	Sets the sequencers' iterations counter
Parameters	1–9999. Any number greater than 9999 is interpreted as INFinity.
	Use INFinity if you wish to execute a sequence indefinitely.
Query	[PROGram]:COUNter? (if COUNter > 9999, the response is INF)
Return	<NR1>| INF

[PROGram]:LIST:CURRent <NRf+>,{<NRf+>}

Function	Specifies the output current points in a list.
	Current points are separated by commas.
	The function accepts up to 100 parameters.
Parameters	The range is limited by the power supply current programming range.
Unit	A
Query	[PROGram]:LIST:CURRent?
Return	<NR2>,{<NR2>} 5-digits format.
Example	LIST:CURR 2.5,3.0,3.5; LIST:CURR MAX,2.5,MIN

NOTE

A delay of ~100mSec is required after the [PROGram]:LIST:CURRent command if long sequences are used, before sending any additional command.

[PROGram]:LIST:DWELl <NRf+>,{<NRf+>}

Function:	Specifies the time interval of each value (point) in a list to remain in effect.
	The function accepts up to 100 parameters.
Parameters	0.001–129,600
Unit	S
Query	[PROGram]:LIST:DWELl?
Return	<NR2>,{<NR2>}
Example	LIST:DWEL .6,1.5,1.5,.4

NOTE

A delay of ~100mSec is required after the [PROGram]:LIST:DWELl command if long sequences are used, before sending any additional command.

[PROGram]:LIST:VOLTage <NRf+>,{<NRf+>}

Function	Specifies output voltage points in a list.
	Voltage points are separated by commas.
	The function accepts up to 100 parameters.
Parameters	The range is limited by the power supply voltage programming range (including UVP & OVP settings).
Unit	V
Query	[PROGram]:LIST:VOLTage?
Return	<NR2>,{<NR2>} 5-digits format
Example	LIST:VOLT 2.0,2.5,3.0; LIST:VOLT MAX,2.5,MIN;

NOTE

A delay of ~100mSec is required after the [PROGram]:LIST:VOLTage command if long sequences are used, before sending any additional command.

[PROGram]:LOAD <NR1>

Function	Loads a sequence from a memory previously stored by the STOR command.
Parameters	1|2|3|4
Query	[PROGram]:LOAD?
Return	<NR1> 1|2|3|4.
	If any loaded sequence data has changed, but has not been stored yet, or if no sequence is loaded, the reply is 0.

NOTES

Delay of ~20mSec is required after a LOAD command, before sending any additional command.
UVL and OVP level settings clamp sequence-programmed values.
Loading an empty sequence results in error -286,"Data Load Empty".
Loading a sequence while any sequence is running, results in error -284,"Program Currently Running".

[PROGram]:STEP <DSC>

Function	Determines if a trigger executes the whole sequence or a single step.
	AUTO - When triggered, it creates waveforms consecutively, until the whole sequence is over.
	ONCE - When triggered, it executes a single step.
Parameters	ONCE|AUTO
Query	[PROGram]:STEP?
Return	<DSC> AUTO|ONCE

[PROGram]:STORe <NR1>

Function	Stores a sequence in a specified memory cell 1, 2, 3, or 4.
	Stored parameters: mode, voltage/current, dwell/time, step, and counter.
Parameters	1|2|3|4

NOTE

A delay of ~100mSec is required after the STORE command, before sending any additional command.

[PROGram]:WAVE:CURRent <NRf+>,{<NRf+>}

Function	Specifies output current points in a wave.
	Current points are separated by commas.
	The function accepts up to 100 parameters.
Parameters	The range is limited by the power supply current programming range.
Unit	A
Query	[PROGram]:WAVE:CURRent?
Return	<NR2>,{<NR2>} 5-digits format
Example	WAVE:CURR 2.5,3.0,3.5; WAVE:CURR MAX,2.5,MIN;

NOTE

A delay of ~100mSec is required after the [PROGram]:WAVE:CURRent command if long sequences are used, before sending any additional command.

[PROGram]:WAVE:TIME <NRf+>,{<NRf+>}

Function:	Specifies the time interval of each slope between 2 points of a WAVE.
	The function defines up to 100 parameters.
Parameters	0.001–129,600 seconds. Default: 0.001s
Unit	S
Query	[PROGram]:WAVE:TIME?
Return	<NR2>,{<NR2>}
Example	WAVE:TIME .6,1.5,1.5,.4

NOTE

A delay of ~100mSec is required after the [PROGram]:WAVE:TIME command if long sequences are used, before sending any additional command.

[PROGram]:WAVE:VOLTage <NRf+>,{<NRf+>}

Function	Specifies output voltage points in a wave.
	Voltage points are separated by commas.
	The function accepts up to 100 parameters.
Parameters	The range is limited by the power supply voltage programming range
	(including UVP & OVP settings).
Unit	V
Query	[PROGram]:WAVE:VOLTage?
Return	<NR2>,{<NR2>} 5-digits format
Example	WAVE:VOLT 2.0,2.5,3.0; WAVE:VOLT MAX,2.5,MIN

NOTE

A delay of ~100mSec is required after the [PROGram]:WAVE:VOLTage command if long sequences are used, before sending any additional command.

NOTE

[PROGram]:LIST:CURRent, [PROGram]:LIST:VOLTage, [PROGram]:WAVE:CURRent, and [PROGram]:WAVE:VOLTage commands share the same memory space.

For example, if [PROGram]:LIST:CURRent command is sent, [PROGram]:LIST:VOLTage, [PROGram]:WAVE:CURRent, and [PROGram]:WAVE:VOLTage are set to zero.

NOTE

[PROGram]:LIST:DWELl and [PROGram]:WAVE:TIME commands share the same memory space.

For example, if [PROGram]:LIST:DWELl command is sent, [PROGram]:WAVE:TIME is set to zero.

4.15.8 Source Subsystem

[SOURce]:CURRent:EXTernal:LIMit[:STATe] <Bool>

Function	Enables/disables the current limit in the analog source control mode.
	If enabled, the analog current programming range by the rear panel is
	limited to a digital current programming value.
	Refer to section 5.7 for additional information explaining OCL – Analog
	Programming Over Current Limit.
Parameter	0|1, OFF|ON
Query	[SOURce]:CURRent:EXTernal:LIMit[:STATe]?
Return	<Bool> 0|1

[SOURce]:CURRent:EXTernal:MODE <DSC>

Function	Sets the current programming source: Front panel/Communication (Digital), external voltage, or external resistor.
Parameter	0|1|2 or DIG|VOL|RES
Query	[SOURce]:CURRent:EXTernal:MODE?
Return	<DSC> DIG|VOL|RES

[SOURce]:CURRent[:LEVel][:IMMediate][:AMPLitude] <NRf+>

Function	Sets a digital programming output current value.
Parameter	The range is limited by the power supply model
Unit	A
Query	[SOURce]:CURRent[:LEVel][:IMMediate][:AMPLitude]?
Return	<NR2> 5-digits format
Example	:CURR? returns the present programmed current level. :CURR? MAX and :CURR? MIN return the maximum and minimum programmable current level.

[SOURce]:CURRent:SLEW:DOWN <NRf+>

Function	Sets a digital current reference down programming slew rate.
Parameters	0.0001–999.99
Unit	A/mS
Query	[SOURce]:CURRent:SLEW:DOWN?
Return	<NR2>
Example	:CURR:SLEW:DOWN 1 sets digital current reference down programming slew to 1A/mSec. :CURR:SLEW:DOWN? returns a digital current down programming slope value. :CURR:SLEW:DOWN? MAX and :CURR:SLEW:DOWN? MIN return the maximum and minimum digital current reference down programming slope value.

[SOURce]:CURRent:SLEW:UP <NRf+>

Function	Sets a digital current reference up programming slew rate.
Parameters	0.0001–999.99
Unit	A/mS
Query	[SOURce]:CURRent:SLEW:UP?
Return	<NR2>
Example	:CURR:SLEW:UP 1 sets a digital current reference up programming slew to 1A/mSec. :CURR:SLEW:UP? returns a digital current up programming slope value. :CURR:SLEW:UP? MAX and :CURR:SLEW:UP? MIN return the maximum and minimum digital current reference up programming slope value.

[SOURce]:CURRent:MODE <DSC>

Function	Sets the current sequence mode.
Parameters	0|1|2, NONE|LIST|WAVE
Query	[SOURce]:CURRent:MODE?
Return	<DSC> NONE|LIST|WAVE

[SOURce]:VOLTage:EXTernal:MODE <DSC>

Function	Sets the voltage programming source: Front panel/Communication (Digital), external voltage, or external resistor.
Parameter	0|1|2 or DIG|VOL|RES
Query	[SOURce]:VOLTage:EXTernal:MODE?
Return	<DSC> DIG|VOL|RES

[SOURce]:VOLTage[:LEVel][:IMMediate][:AMPLitude] <NRf+>

Function	Sets a digital programming output voltage value.
Parameters	The range is limited by the power supply model, OVP, and UVP settings.
Unit	V
Query	[SOURce]:VOLTage[:LEVel][:IMMediate][:AMPLitude]?;
Return	<NR2> 5-digits format
Example	:VOLT? returns the present programmed voltage level. :VOLT? MAX and :VOLT? MIN return the maximum and minimum programmable voltage level.

[SOURce]:VOLTage:SLEW:DOWN <NRf+>

Function	Sets a digital voltage reference down programming slew rate.
Parameters	0.0001–999.99
Unit	V/mS
Query	[SOURce]:VOLTage:SLEW:DOWN?
Return	<NR2>
Example	:VOLT:SLEW:DOWN 1 sets a digital voltage reference down programming slew to 1V/mSec. :VOLT:SLEW:DOWN? returns a digital voltage down programming slope value. :VOLT:SLEW:DOWN? MAX, and :VOLT:SLEW:DOWN? MIN return the maximum and minimum digital voltage reference down programming slope value.

[SOURce]:VOLTage:SLEW:UP <NRf+>

Function	Sets a digital voltage reference up programming slew rate.
Parameters	0.0001–999.99
Unit	V/mS
Query	[SOURce]:VOLTage:SLEW:UP?
Return	<NR2>
Example	:VOLT:SLEW:UP 1 sets a digital voltage reference up programming slew to 1V/mSec. :VOLT:SLEW:UP? returns digital voltage up programming slope value. :VOLT:SLEW:UP? MAX and :VOLT:SLEW:UP? MIN return the maximum and minimum digital voltage reference up programming slope value.

[SOURce]:VOLTage:MODE <DSC>

Function	Sets the voltage sequence mode.
Parameters	0|1|2, NONE|LIST|WAVE
Query	[SOURce]:VOLTage:MODE?
Return	<DSC> NONE|LIST|WAVE

[SOURce]:VOLTage:PROTection:LEVel <NRf+>

Function	Sets a voltage protection level (OVP).
Parameters	The range is limited by the OVP programming range and voltage programmed value. Minimum setting level is about 105% of the programmed voltage value.
Unit	V
Query	[SOURce]:VOLTage:PROTection:LEVel? [SOURce]:VOLTage:PROTection:LEVel? MAX [SOURce]:VOLTage:PROTection:LEVel? MIN
Return	<NR2> 5-digits format

NOTE

Minimum value is limited to 5% above the actual voltage setting value

[SOURce]:VOLTage:PROTection:LOW:DELay <NRf+>

Function	Sets the time delay between UVP fault event and output disable.
Parameters	0.1–25.5|MIN|MAX. Resolution: 0.1 Note: Round input parameter to closest 100mSec step.
Unit	S
Query	[SOURce]:VOLTage:PROTection:LOW:DELay? VOLTage:PROTection:LOW:DELay? MAX VOLTage:PROTection:LOW:DELay? MIN
Return	<NR2>

[SOURce]:VOLTage:PROTection:LOW:STATe <Bool>

Function	Enables/Disables the under voltage protection (UVP) mode. If enabled, the output is disabled when measured output voltage reaches the UVL level. UVP bit is set in the Questionable Condition register.
Parameters	0|1, OFF|ON
Query	[SOURce]:VOLTage:PROTection:LOW:STATe?
Return	<Bool> 0|1

NOTE

UVP function is disabled if under voltage limit setting is below 5% of the rated power supply voltage.

[SOURce]:VOLTage:PROTection:LOW[:LEVel] <NRf+>

Function	Sets the under voltage limit level.
Parameters	The range is limited by the UVL programming range and voltage programmed value.
Unit	V
Query	[SOURce]:VOLTage:PROTection:LOW:LEVel?; VOLTage:PROTection:LOW:LEVel? MIN; :VOLTage:PROTection:LOW:LEVel? MAX
Return	<NR2> 5-digits format

NOTE

UVL setting is 5% below the actual voltage setting.

[SOURce]:POWer:STATe <Bool>

Function	Enables/Disables the constant power limit mode.
Parameters	0|1, OFF|ON
Query	[SOURce]:POWer:STATe?
Return	<Bool> 0|1

NOTE

Analog programming, internal resistance, sequencer, and Slew-Rate functions should be disabled to enable Constant Power.

[SOURce]:POWer[:LEVel] <NRf+>

Function	Sets the constant power limit level.
Parameters	The range is limited to a multiplication of maximum voltage by maximum current rating values.
Unit	W
Query	[SOURce]:POWer[:LEVel]?
Return	<NR1> 5-digits format

NOTE

[SOURce]:POWer[:LEVel] <NRF+> command accepts NRf+. The returned value is rounded to the closest integer value.

4.15.9 STATus Subsystem

STATus:OPERation[:EVENt]?

Query	Returns the value of the Operational Condition Group Event register.
	The value is according to the Operational Condition Group Condition register and Operational Condition Group Enable register.
	The Event register is a read-only register.
	Events are updated as transition from 0 to 1. Reading the register clears it.
	Bit configuration of the Operational Condition Group Event register is as follows:

Position	15	14	13	12	11	10	9	8
Value	32768	16384	8192	4096	2048	1024	512	256
Name	CP	CPE	ECR	EVR	CFB	ENA	ILC	UVP

Position	7	6	5	4	3	2	1	0
Value	128	64	32	16	8	4	2	1
Name	LOC	SSA	FBE	AST	TWI	NFLT	CC	CV

CP – Constant Power.
Set to "1" when power supply is in the Constant Power mode.

CPE – Constant Power Enabled.
Set to "1" when Constant Power mode is enabled.

ECR – External Current Reference.
Set to "1" when analog current programming channel is set.

EVR – External Voltage Reference.
Set to "1" when analog voltage programming channel is set.

CFB – Current Foldback Enabled.
Set to "1" when Constant Current operation mode Foldback is enabled.

ENA – Enable Enabled.
Set to "1" when Enable function is enabled.

ILC – Interlock Enabled.
Set to "1" when Interlock function is enabled.

UVP – Under Voltage Protection.
Set to "1" when under voltage protection function is enabled.

LOC – Local/Remote.
Set to "1" when power supply is in the Local mode.

SSA – Sequencer Step Active.
Set to "1" when sequencer is running.

FBE – Foldback Enabled.
Set to "1" when Foldback function is enabled.

AST – Auto-Start Enabled.
Set to "1" when Auto-Start mode is enabled.

TWI – Trigger Wait.
Set to "1" when power supply is waiting for a trigger.

NFLT – No Fault.
Set to "1" when there are no faults, according to Questionable Condition Group Enable register.

CC – Constant Current.
Set to "1" when power supply is in the Constant Current mode.

CV – Constant Voltage.
Set to "1" when power supply is in the Constant Voltage mode.

Returns	<NR1> 0...65535
Example	00136

STATus:OPERation:CONDition?

Query	Returns the value of the Operational Condition Group Condition register, which is a read-only register that holds the real-time operational status of the power supply. Refer to STATus:OPERation[:EVENt]? command for the complete registers list.
Returns	<NR1> 0...65535
Example	00136

STATus:OPERation:ENABle <NR1>

Function	Sets the value of the Operational Condition Group Enable register. This register is a mask for enabling specific bits from the Condition register to the Event register. Refer to STATus:OPERation[:EVENt]? command for the complete list of the registers that can be masked.
Parameters	0...65535
Query	STATus:OPERation:ENABle?
Returns	<NR1> 0...65535

STATus:QUEStionable[:EVENt]?

Query	Returns the value of the Questionable Condition Group Event register. This is a read-only register.
	The value is according to the Questionable Condition Group Condition register and Questionable Condition Group Enable register.
	Events are updated as transition from 0 to 1. Reading the register clears it.
	Bit configuration of the Questionable Condition Group Event register is as follows:

Position	15	14	13	12	11	10	9	8
Value	32768	16384	8192	4096	2048	1024	512	256
Name	CWT	POFF	PWS	PERR	GERR	PACK	UVP	ENA

Position	7	6	5	4	3	2	1	0
Value	128	64	32	16	8	4	2	-
Name	ILC	OFF	SO	OVP	FLD	OTP	AC	-

CWT (*) – Comm. Watchdog Timeout
Set to "1" when Watchdog Timeout period expires.

POFF – Power OFF.
Set to "1" when the power supply Power Switch is OFF.

PWS – Parallel Wait Slave.
Set to "1" when master power supply is waiting for slaves to become ready.

PERR – Parallel Error.
Set to "1" when an error occurs in Advanced Parallel system.

GERR – General Error.
Unrecoverable system fault. Recycle AC input.

PACK – Parallel Acknowledge.
Acknowledge new parallel system. Refer to section 5.9.

UVP – Under Voltage Protection.
Set to "1" when Under Voltage Protection fault occurs.

ENA – Enable.
Set to "1" when Enable fault occurs.

ILC – Interlock.
Set to "1" when Interlock signal fault occurs.

OFF – DC Output OFF.
Set to "1" when the power supply DC output is OFF.

SO – Shut OFF (Daisy In).
Set to "1" when Shut OFF signal is high.

OVP – Over Voltage Protection.
Set to "1" when Over Voltage Protection fault occurs.

FLD – Foldback.
Set to "1" when Foldback fault occurs.

OTP – Over Temperature Protection.
Set to "1" when Over Temperature Protection fault occurs.

AC – AC.
Set to "1" when AC fault occurs.

Returns	<NR1> 0...65535
Example	00106

NOTE

* Communication Watchdog function is available from firmware revision 02.105.

* CWT bit is always 0 in firmware revisions before 02.105.

STATus:QUEStionable:CONDition?

Query	Returns the value of the Questionable Condition Group Condition register, which is a read-only register that holds the real-time conditional status of the power supply. Refer to STATus:QUEStionable[:EVENt]? command for the complete registers list.
Returns	<NR1> 0...65535
Example	00136

STATus:QUEStionable:ENABle <NR1>

Function	Sets the value of the Questionable Condition Group Enable register. This register is a mask for enabling specific bits from the Condition register to the Event register. Refer to STATus:QUEStionable[:EVENt]? command for the complete list of the registers that can be masked.
Parameters	0...65535
Query	STATus:QUEStionable:ENABle?
Returns	<NR1> 0...65535

4.15.10 SYSTem Subsystem

SYSTem[:COMMunicate]:ADDRess <NR1>

Function	Sets the power supply communication address.
Parameters	0...31
Query	SYSTem[:COMMunicate]:ADDRess?
Return	<NR1> 0...31

NOTE

Power supply addressing is lost after an address change.

SYSTem[:COMMunicate]:BAUDrate <DSC>

Function	Sets a serial communication Baud Rate (including multi-drop).
Parameters	9600|19200|38400|57600|115200 or 0|1|2|3|4
Query	SYSTem[:COMMunicate]:BAUDrate?
Return	<DSC> 9600, 19200, 38400, 57600, 115200

SYSTem[:COMMunicate]:BOOL[:STATe] <DSC>

Function	Select query Return format of Boolean (<Bool>) commands.
	DIGIT – Boolean queries are replied with 0|1.
	TEXT – Boolean queries are replied with OFF|ON.
Parameters	DIGIT|TEXT or 0|1
Query	SYSTem[:COMMunicate]:BOOL[:STATe]?
Return	<DSC> DIGIT, TEXT

NOTE

SYSTem[:COMMunicate]:BOOL[:STATe] <DSC> command is available from firmware revision 02.110.

SYSTem[:COMMunicate]:INTerface <DSC>

Function	Sets a communication interface.
	Power supply addressing is lost after communication interface change.
Parameters	0|1|2|3|4, RS232|RS485|LAN|USB|OPTion
Query	SYSTem[:COMMunicate]:INTerface?
Return	<DSC> RS232, RS485, LAN, USB, OPT

NOTE

Execution time for this command is ~25mS

SYSTem[:COMMunicate]:LAN:HOST?

Query	Reads hostname. LAN specific command.
Return	<SRD> up to 15 characters long
Example	G10-500-<X>

NOTES

<X> represents a running number (1, 2, 3, etc.) according to the number of Power Supplies from the same type.

A number is added only if at least 2 Power Supplies of the same type are connected to the same network.

SYSTem[:COMMunicate]:LAN:IDLED <Bool>

Function	Blink Display & green LXI LED. LAN specific command.
Parameters	0|1, OFF|ON

SYSTem[:COMMunicate]:LAN:IP <SRD>

Function	Sets a LAN IP address. LAN specific command.
Parameters	xxx.xxx.xxx.xxx
Query	SYSTem[:COMMunicate]:LAN:IP?
Return	<SRD> xxx.xxx.xxx.xxx
Example	192.200.0.10, 192.9.33.110 (No zeros padding)

SYSTem[:COMMunicate]:LAN:MAC?

Query	SYSTem[:COMMunicate]:LAN:MAC? LAN specific command.
Return	<SRD> xx:xx:xx:xx:xx:xx (hexa-decimal)
Example	A0:12:34:FF:01:6D

SYSTem[:COMMunicate]:LAN:RESet

Function	Sets LAN parameters to default.
	Refer to LAN reset settings, Section 4.7.5.3.

SYSTem[:COMMunicate]:LANGuage <DSC>

Function	Sets the communication protocol to GEN language.
	GEN language is available in RS232/485 and USB.
Parameter	GEN
Query	SYSTem[:COMMunicate]:LANGuage?
Return	<DSC> SCPI

NOTE

SYSTem[:COMMunicate]:LANGuage GEN command returns -220 "Parameter Error" to SYSTem:ERRor? query if sent via LAN or optional communication interface. LAN or optional communication interfaces do not support GEN language.

SYSTem[:COMMunicate]:WATCHdog[:STATe] <Bool>

Function	Enable or disable communication watchdog
Parameter	0|1, OFF|ON
Query	SYSTem[:COMMunicate]:WATCHdog[:STATe]?
Return	<Bool> 0|1

SYSTem[:COMMunicate]:WATCHdog:TIMe <NR1>

Function	Set communication watchdog timeout (in seconds)
Parameter	1...3600|MIN|MAX Step:1
Unit	S
Query	SYSTem[:COMMunicate]:WATCHdog:TIMe?
Return	<NR1> 1...3600

SYSTem:DATE?

Query	Returns the date of last calibration. Format yyyy/mm/dd
Return	\<SRD\>
Example	2017/12/17

SYSTem:ERRor:ENABle

Function	Enables log of last 10 Error messages.

SYSTem:ERRor?

Query	Returns an error number and a corresponding error message stored in an error queue. Works as FIFO. When no error exists, 0,"No error" is returned. If Buffer reaches above 10 messages, the command returns -350,"Queue Overflow".
Return	\<SRD\>
Example	0,"No error"

SYSTem:FRST \<DSC\>

Function	Restores factory default parameters and sets communication interface according to \<DSC\> parameter. Refer to Table 2-6 & Table 2-7.
Parameters	1|2|3|4|5, USB|RS232|RS485|LAN|OPTion SYSTem:FRST without a parameter sets USB communication interface.

NOTES

1. Factory Reset does not affect advanced parallel configuration acknowledgment (does not affect power supply configuration (Single, Master, or Slave roles do not change).

2. Execution time for this command is ~250mS.

3. \<DSC\> Parameter is available for firmware revision 02.106 and above.

SYSTem:FIRMware[:VERSion]?

Query	Returns firmware versions string: Interface, Master Control, Display, and Option (if available).
Return	\<SRD\> xx.xxx,xx.xx,x.x,xx.xxx

NOTE

Option firmware revision (last xx.xxx field) is seen if the query is sent through optional communication interface.

SYSTem:PANel:LOCK?

Query	Returns the front panel unlocked (0)/locked (1) state.
Return	\<Bool\> 0|1

SYSTem:PARallel?

Query	Returns the Master/Slave setting Single, Master + # or Slave
Return	<SRD> SINGLE|MASTER+#|SLAVE

NOTE

represents the number of slave units connected.

SYSTem:PARallel:ACKNowledge

Function	Accept present parallel configuration.

SYSTem:PON:TIME?

Query	Returns the total time power supply is connected to AC & Power Switch is ON. Max value: 2^{32}-1
Unit	Minutes
Return	<NR1> 0–4294967295

SYSTem:PON:TIME:AC?

Query	Returns the total time power supply is connected to AC. Max value: 2^{32}-1.
Unit	minutes
Return	<NR1> 0–4294967295

SYSTem:PRELoad[:STATe] <Bool>

Function	Enables / Disables Preload. If disabled, preload is deactivated 5 seconds after DC output off.
Parameters	0|1, OFF|ON
Query	SYSTem:PRELoad[:STATe]?
Return	<Bool> 0|1

SYSTem:PSINk[:STATe] <Bool>

Function	Enables / Disables Power Sink.
Parameters	0|1, OFF|ON
Query	SYSTem:PSINk[:STATe]?
Return	<Bool> 0|1

NOTES

1. SYSTem:PSINk[:STATe] <Bool> command is applicable for power supplies equipped with a Power Sink module.

2. SYSTem:PSINk[:STATe]? query will always return 0 for power supplies which do not have a Power Sink module installed.

3. Command is available for firmware revision 02.112 and above.

SYSTem:PSOK:DELay <NRf+>

Function	Set PS_OK signal delay following output ON.
Parameters	0.000–10|MIN|MAX. Resolution: 0.001
Unit	S
Query	SYSTem:PSOK:DELay?
	SYSTem:PSOK:DELay? MAX
	SYSTem:PSOK:DELay? MIN
Return	<NRf>

SYSTem:RANGe <DSC>

Function	Sets the power supply analog programming & monitor range.
	Programming – 5/10 Volts or 5/10kΩ.
	Monitoring – 5/10 Volts.
Parameters	5|10
Query	SYSTem:RANGe?
Return	<DSC> 5|10

SYSTem:RIN[:LEVel] <NRf+>

Function	Sets the internal resistance value.
Parameters	0.001...1|MIN|MAX. Resolution: 0.001
Unit	Ω
Query	SYSTem:RIN[:LEVel]?
	SYSTem:RIN[:LEVel]? MAX
	SYSTem:RIN[:LEVel]? MIN
Return	<NRf> "x.xxx"

SYSTem:RIN:STATe <Bool>

Function	Enables / Disables the internal resistance function.
Parameters	0|1, OFF|ON
Query	SYSTem:RIN:STATe?
Return	<Bool> 0|1

NOTE

The Internal Resistance function can be set to ON only if the Sequencer, Constant Power Limit, Analog Programming, and Slew-Rate modes are disabled.

SYSTem:REMote[:STATe] <DSC>

Function	Sets the power supply control source (front panel or communication) to local, remote, or LLO mode. Local – Enables the front panel control. Remote – Disables the front panel settings change. LLO – same as remote + disable front panel unlock by the front panel. Deactivates LLO only by communication or AC recycle.
Parameters	0|1|2 or LOC|REM|LLO
Query	SYSTem:REMote[:STATe]?
Return	<DSC> LOC|REM|LLO

NOTES

System state changes from LOC to REM only if a communication command, which changes a setting, is sent (Queries does not change system state to Remote mode). System state changes from LLO to REM after AC power recycle.

SYSTem:SENSe[:STATe] <DSC>

Function	Selects the output sensing point - local or remote
Parameters	0|1, LOC|REM, OFF|ON
Query	SYSTem:SENSe[:STATe]?
Return	<DSC> LOC|REM

SYSTem:SLEW[:STATe] <DSC>

Function	Sets OFF / Voltage / Current reference slew control. OFF – Slew control is disabled. VOLT – Voltage reference slew control enabled. CURR – Current reference slew control enabled.
Parameters	0|1|2 or OFF|VOLT|CURR
Query	SYSTem:SLEW[:STATe]?
Return	<DSC> OFF|VOLT|CURR

SYSTem:TEMPerature[:AMBient]?

Query	Returns ambient temperature
Unit	ºC
Return	<NR1>
Example	25

SYSTem:VERSion?

Query	Returns SCPI language version
Return	<SRD> 1999.0

4.15.11 TRIGger Subsystem

NOTE

The Trigger subsystem must be enabled from the Initiate subsystem. If disabled, commands from the trigger subsystem will not affect power supply output.

TRIGger[:IMMediate]

Function	If Trigger is enabled (by INITiate command), TRIG generates an immediate trigger signal.

NOTE

TRIGger[:IMMediate] command overrides TRIGger:DELay <NRf+> setting. It activates trigger immediately. Refer to *TRG command to activate trigger with a delay function.

TRIGger:DELay <NRf+>

Function	Sets a time delay between trigger events of a specified trigger source to the start of any corresponding trigger action over the power supply output.
Parameters	0.000...10.000s Step:0.001 Sec.
Unit	S
Query	TRIGger:DELay?; TRIGger:DELay? MIN; TRIGger:DELay? MAX
Return	<NR2>

NOTE

The TRIGger command overrides TRIGger:DELay. It activates trigger immediately. Refer to *TRG command to activate trigger with a delay function.

TRIGger:SOURce <DSC>

Function	Selects a trigger source: • BUS - *TRG or TRIG commands and Front Panel. • EXT – Rear Panel Trigger IN pin (J1-22).
Parameters	BUS|EXT
Query	TRIGger:SOURce?
Return	<DSC> BUS|EXT

4.16   SCPI Commands Summary

Common Commands (SCPI)	Description	GEN
*CLS	Clear standard event status register	CLS
*ESE <NR1> (?)	Set standard event status enable register	<NC>
*ESR?	Return standard event status event register	<NC>
*IDN?	Return instrument identification string	IDN?
*OPC (?)	Set "operation complete" bit in ESR	<NC>
*OPT?	Return the type of option installed	<NC>
*PSC <Bool> (?)	Power - ON status clear	<NC>
*RCL <NR1>	Recalls a saved instrument state	RCL
*RST	Reset settings	RST
*SAV <NR1>	Saves an instrument state	SAV
*SRE <NR1> (?)	Set service request enable register	<NC>
*STB?	Return status byte	<NC>
*TRG	Trigger	<NC>
*TST?	Performs self-test, returns a result	<NC>
*WAI	Wait for all operations to complete	<NC>
ABORt	Aborts the triggered action	<NC>

Subsystem Commands (SCPI)	Description	GEN
[:]DISPlay		
[:WINDow]:STATe <Bool> (?)	Display ON/OFF	<NC>
[:WINDow]:FLASh <Bool> (?)	Display Flash	<NC>
[:WINDow]:TEST <Bool>	Display Test	<NC>
[:]INITiate		
[:IMMediate]	Trigger initiate	<NC>
:CONTinuous <Bool> (?)	Enable/disable continuous trigger	<NC>
[:]INSTrument		
:COUPle <DSC>	Couple for all power supplies	<NC>
:[N]SELect <NR1> (?)	Select the power supply address for communication	ADR
[:]GLOBal		
:*RCL <NR1>	Recalls saved instruments state	GRCL
:*RST	Reset all PSUs	GRST
:*SAVe <NR1>	Saves all instruments state	GSAV
:CURRent		
[:AMPLitude] <NRf+>	Set the output current of all instruments	GPC
:OUTPut		
[:STATe] <Bool>	Enables/disables the supplies output	GOUT
:VOLTage		
[AMPLitude] <NRf+>	Set the output voltage of all instruments	GPV
[:]MEASure		
:CURRent [:DC]?	Returns the measured output current	MC?
:VOLTage[:DC]?	Returns the measured output voltage	MV?
:POWer[:DC]?	Returns the measured output power	MP?
[:]OUTPut		
[:STATe] <Bool> (?)	Enables/disable the supply output	OUT(?)
:ENA		
[:STATe] <Bool> (?)	Enables/disables ENA_IN pin for ON/OFF control	<NC>
:POLarity <DSC> (?)	Polarity of ENA_IN pin	<NC>
:ILC		
[:STATe] <Bool> (?)	Enables/disables ILC_IN output ON/OFF control	RIE(?)
:MODE?	Returns operation mode	MODE?
:PON		
[:STATe] <DSC> (?)	Programs the Power-ON state	AST(?)
:PROTection		
:CLEar	Protection clear	<NC>

:FOLDback		
[:MODE] <DSC> (?)	Set operation protection mode	FLD(?)
:DELay <NRf+> (?)	Set foldback delay	FBD(?)
:RELay {1/2}		
[:STATe] <Bool> (?)	Set control pins status	REL {1/2}(?)
:TTLTrg		
:MODE <DSC> (?)	Set output trigger mode	<NC>
[:][PROGram]		
:COUNter <NR1>,INFinity (?)	Set number of iterations	<NC>
:LIST		
:CURRent <NRf+> (?)	Set LIST output current points	<NC>
:DWELl <NRf+> (?)	Set time intervals	<NC>
:VOLT <NRf+> (?)	Set LIST output voltage points	<NC>
:LOAD <NR1> (?)	Load stored program from memory	<NC>
:STEP <DSC> (?)	Set trigger depends on execution step	<NC>
:STORe <NR1>	Store program in memory	<NC>
:WAVE		
:CURRent <NRf+> (?)	Set WAVE output current points	<NC>
:TIME <NRf+> (?)	Set slopes time	<NC>
:VOLTage <NRf+> (?)	Set WAVE output voltage points	<NC>
[:][SOURce]		
:CURRent		
:EXTernal		
LIMit		
[:STATe]<Bool> (?)	Enable/disable analog mode current limit	<NC>
:MODE <DSC> (?)	External source of current limit control	PCS(?)
[:LEVel]		
[:IMMediate]		
[:AMPLitude] <NRf+> (?)	Set the output current	PC (?)
:SLEW:DOWN <NRf+> (?)	Sets falling reference current slew rate	<NC>
:SLEW:UP <NRf+> (?)	Sets rising reference current slew rate	<NC>
:MODE <DSC> (?)	Sets arbitrary trigger control mode	<NC>
:VOLTage		
:EXTernal		
:MODE <DSC> (?)	External source of voltage limit control	PVS(?)
[:LEVel]		
[:IMMediate]		
[:AMPLitude] <NRf+> (?)	Set the output voltage	PV(?)
:SLEW:DOWN <NRf+> (?)	Sets falling reference voltage slew rate	<NC>
:SLEW:UP <NRf+> (?)	Sets rising reference voltage slew rate	<NC>
:MODE <DSC> (?)	Select arbitrary control mode	<NC>
:PROTection		
:LEVel <NRf+> (?)	Set over-voltage protection level	OVP(?)
:LOW		
:DELay <NRf+> (?)	Set under-voltage protection delay	<NC>
:STATe <Bool> (?)	Set under-voltage limit or protection mode	UVP(?)
[:LEVel] <NRf+> (?)	Set under-voltage level	UVL(?)
:POWer		
[:LEVel] <NRf+> (?)	Set power level in selected above mode	<NC>
:STATe <Bool> (?)	Set power limit mode	<NC>
[:]STATus		
:OPERation		
[:EVENt]?	Returns the value of the Event register	SEVE?
:CONDition?	Returns the value of the Condition register	STAT?
:ENABle <NR1> (?)	Enables specific bits in the Event register	SENA(?)
:QUEStionable		
[:EVENt]?	Returns the value of the Event register	FEVE?
:CONDition?	Returns the value of the Condition register	FLT?

:ENABle <NR1> (?)	Enables specific bits in the Event register	FENA(?)
[:]SYSTem		
[:COMMunicate]		
:ADDRess <NR1> (?)	Set communication address	<NC>
:BAUDrate <DSC> (?)	Set Baud rate	<NC>
:BOOL <NR1> (?)	Set Boolean commands return type	BOOL
:INTerface <DSC> (?)	Set communication interface	
:LAN		
:HOST?	Read hostname	<NC>
:IDLED <Bool>	Blink ID LED & Display	<NC>
:IP <SRD>(?)	Set IP address	<NC>
:MAC?	Read MAC address (once)	<NC>
:RESet	Set LAN parameters to default	<NC>
:LANGuage <DSC> (?)	Set communication language	LANG SCPI
:WATCHdog		
[:STATe] <Bool> (?)	Enable/disable communication watchdog	<NC>
:TIMe <NRf+> (?)	Set communication watchdog timeout	<NC>
:DATE?	Returns system calibration date	DATE?
:ERRor:ENABle	Enable error message	<NC>
:ERRor?	Read system error messages	<NC>
:FRST <DSC>	Factory reset/default	FRST
:FIRMware		
[:VERSion]?	Read Firmware versions	<NC>
:PANel		
:LOCK?	Return F.P. lock state	<NC>
:PARallel:ACKNowledge	Accept present parallel configuration	
:PARallel?	Parallel mode	MS?
:PON		
:TIME?	Response total time power ON & power switch is ON	<NC>
:TIME		
:AC?	Response total time from first power ON	<NC>
:PRELoad		
[:STATe] <Bool> (?)	Preload ON/OFF	<NC>
:PSINk		
[:STATe] <Bool> (?)	Power Sink ON/OFF	<NC>
:PSOK		
:DELay <NRf+> (?)	PS_OK delay	<NC>
:RANGe <DSC> (?)	Analog programming / monitoring range	APR(?)
:RIN		
[:LEVel] <NRf+> (?)	Internal resistance value	<NC>
:STATe <Bool>(?)	Internal resistance state	<NC>
:REMote		
[:STATe] <DSC> (?)	Set the remote/local state	RMT(?)
:SENSe		
[:STATe] <DSC>(?)	Sense configuration	<NC>
:SLEW		
[:STATe] <DSC>(?)	Set slew state	<NC>
:TEMPerature		
[:AMBient]?	Measure ambient temperature	<NC>
:VERSion?	Returns SCPI version	<NC>
[:]TRIGger		
[:IMMediate]	Run trigger	<NC>
:DELay <NRf+> (?)	Set input trigger delay	<NC>
:SOURce <DSC> (?)	Set input trigger source	<NC>
	Reset Fold Back Delay to zero.	FBDRST
	Return general status of the power supply and registers	STT?
	Return general status of the power supply	DVC?

CHAPTER 5:   ADVANCED FUNCTIONS

5.1   Sequencer

The sequencer allows advanced waveforms programming of power supply output in steps of one milli-second. Up to four sequences, 100 points each, can be stored inside power supply memory. There are two programmable modes: LIST and WAVE. These programmable modes are synchronized by input trigger (refer to section 5.2.2). According to the selected mode, power supply activates an output trigger (refer to section 5.2.3).

5.1.1   LIST Mode

The Output values change in steps determined by parameters in the LIST. Output change is activated by input trigger (refer to section 5.2.2). Program LIST parameters are activated by Program Subsystem. For LIST related commands, refer to section 4.15.7.

Set the operation mode by [SOURce]:CURRent:MODE <DSC> and/or [SOURce]:VOLTage:MODE <DSC> command/s (refer to section 4.15.8).
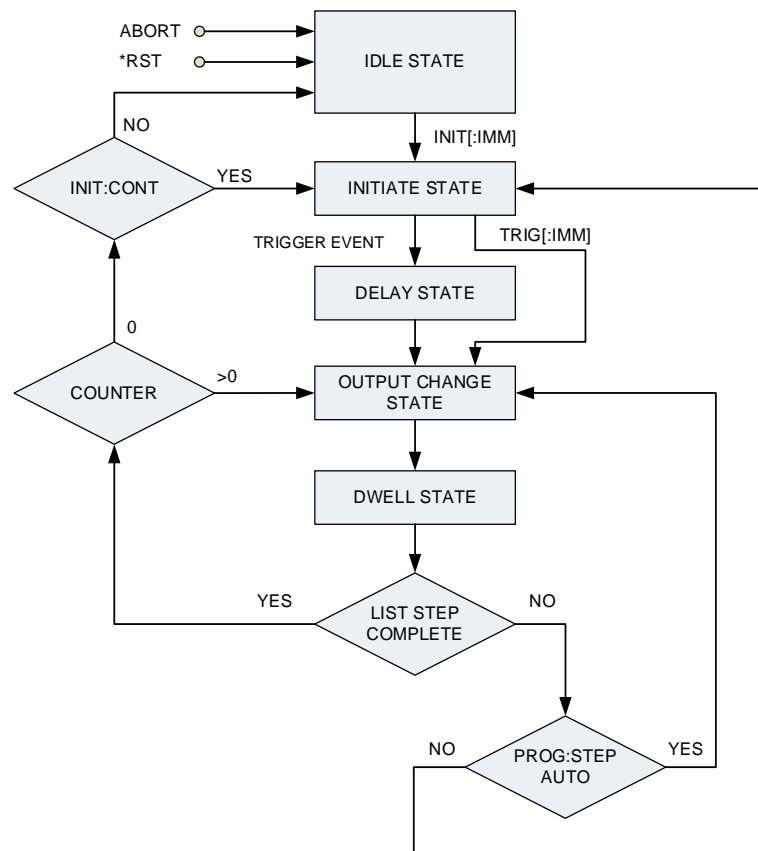
Figure 5–1: Simplified LIST Mode Model
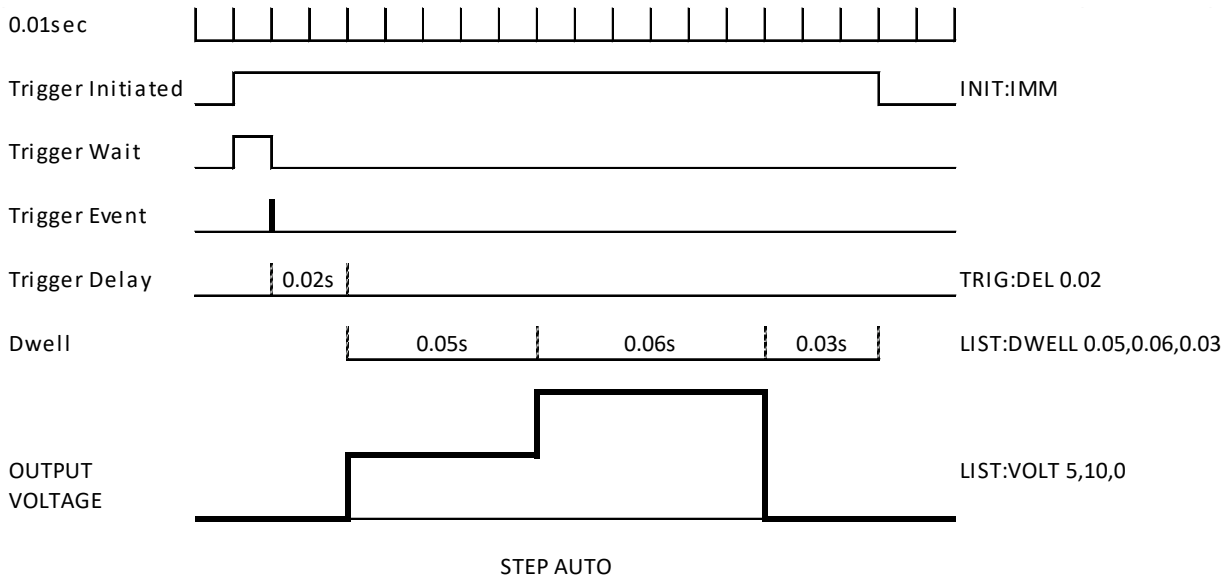
Figure 5–2: LIST Mode Sequence Example

5.1.2   WAVE Mode

Output value change in slopes is determined by parameters in the WAVE. Output change is activated by the input trigger (refer to section 5.2.2). Program WAVE parameters are activated by the Program subsystem. For WAVE related commands, refer to section 4.15.7.

Set the operation mode by [SOURce]:CURRent:MODE <DSC> and/or [SOURce]:VOLTage:MODE <DSC> command/s (refer to section 4.15.8).
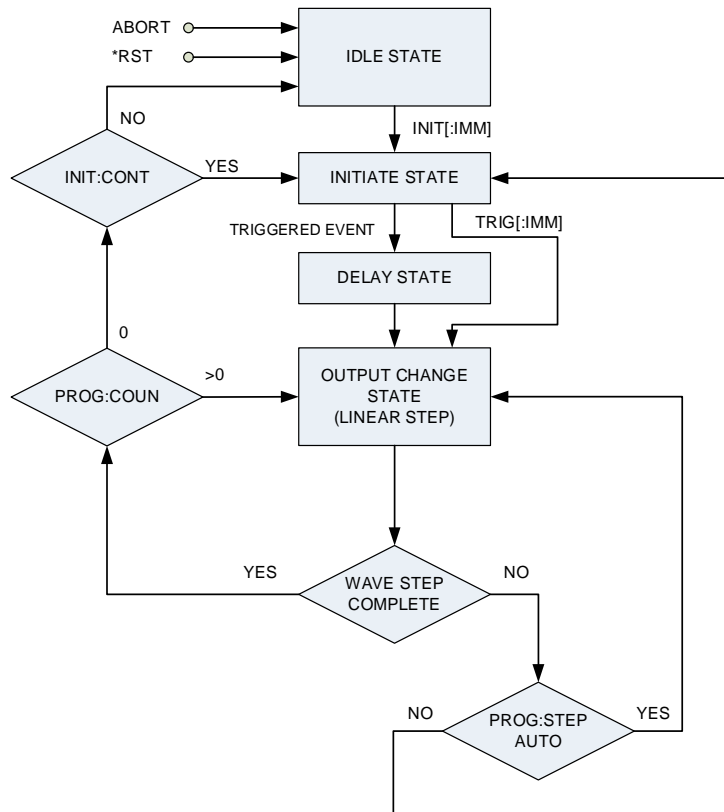
Figure 5–3: Simplified WAVE Mode Model
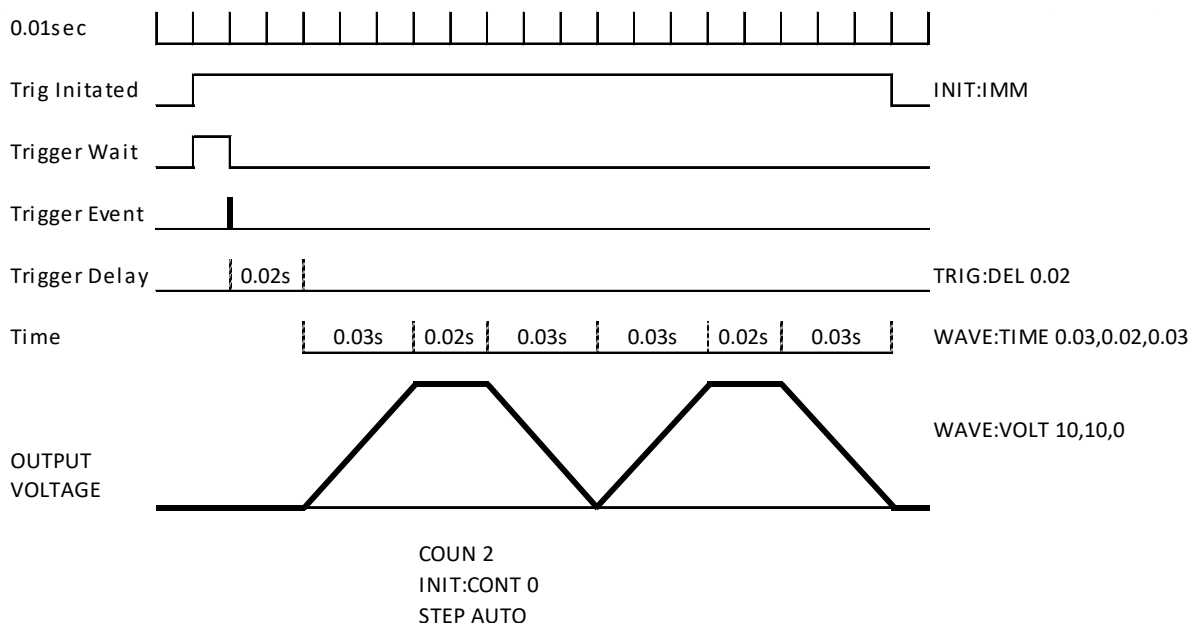
Figure 5–4: WAVE Mode Sequence Example

5.1.3 Sequencer Functions

5.1.3.1 Counter

Defines the number of performed iterations. The Counter can be set to 1–9999. Any number above 9999 sets the number of iterations to infinity. Counter setting is available via the communication command [PROGram]:COUNter <NR1>|INFinity.

5.1.3.2 Dwell

Defines the time of a specific value in the LIST mode to remain in effect. Dwell range is 1mSec–36 hours, in steps of one milli-second. Dwell setting is available via the communication command [PROGram]:LIST:DWELl <NRf+>,{<NRf+>}.

5.1.3.3 Time

Defines the time of each slope between 2 points in the WAVE mode. Time range is 1mSec–36 hours, in steps of one milli-second. Time setting is available via the communication command [PROGram]:WAVE:TIME <NRf+>,{<NRf+>}.

5.1.3.4 Load

Load a sequence from a memory cell, previously stored by the STOR command. Load function is available via the Front Panel menu (refer to section 1.8) or via the communication command [PROGram]:LOAD <NR1>.

5.1.3.5 Store

Store a sequence into a memory cell. Up to four sequences of 100 points each can be stored. Store function is available via the communication command [PROGram]:STORe <NR1>.

5.1.3.6   Step

Execute a single step from a sequence in the LIST or WAVE mode. Step function is available via the communication command [PROGram]:STEP <DSC>.

5.1.3.7   Continuous

Continuous flag provides the ability to skip the IDLE STATE (refer to Figure 5–1 and/or Figure 5–2) after a sequence has completed. If Continuous flag is set ("1"), IDLE STATE is bypassed directly to INITIATE STATE. If the ABORt command is given while Continuous flag is "1", the subsystem transfers to the idle state. Abort function is available via the Front Panel menu (refer to Section 1.8) or via the communication command INITiate:CONTinuous <Bool>.

NOTE

If Abort (refer to Section 5.1.3.8) function is used while Continuous flag is set ("1"), system will return to IDLE STATE (refer to Figure 5–1 and/or Figure 5–2).

5.1.3.8   Abort

Stop sequencer WAVE or LIST mode execution. Return sequencer system to idle state. Abort function is available via the Front Panel menu (refer to section 1.8) or via the communication command ABORt.

NOTES

1. Consecutive ON -> OFF -> ON function via Front Panel or a command has 200 milli-seconds delay. Therefore, it is recommended to program power supply output to 0 volts instead of OFF if fast sequence is required.

2. Refer to section 1.8 to operate the sequencer functions via the Front Panel. Refer to section 4.15.7 to operate the sequencer functions via communication commands.

3. If sequencer system is in the INITIATED STATE (following the INIT command or INIT function via the Front Panel), power supply does not accept additional WAVE or LIST voltage/current/time/dwell parameters. Use the Abort command before applying new parameters.

4. If sequencer system is in the INITIATE STATE (following the INIT command or INIT function via the front panel), power supply does not load previously stored sequences. Use the Abort command before applying new parameters.

5. If the Sequencer function is enabled (INITIATE STATE), the Internal Resistance, Constant Power Limit, Slew-Rate, and Analog Programming functions are disabled.

6. If the Internal Resistance, Constant Power Limit, Slew-Rate, or Analog Programming functions are enabled, the Sequencer function is disabled.

5.1.4 Sequencer Setting Memory

Refer to Table 5-1 for memory parameters stored/loaded using Sequencer Store/Load functions.

Function	Factory Reset (Default Settings)	Reset	Last Setting	Store & Load
Sequence Mode (LIST/WAVE)	None	-	-	+
LIST/WAVE Sequence Voltage/Current values	0	-	-	+
LIST/WAVE Sequence Dwell/Time values	0	-	-	+
Step	ONCE	-	-	+
Counter	1	-	-	+
Continuous	1	-	-	+
Initialize	Not Initialized	+	-	-
Trigger In Source	BUS	-	-	-
Trigger In Delay	0	-	-	+
Trigger Out Mode	OFF	-	-	-

Table 5-1: Sequencer Memory Parameters

5.2 Trigger System

The Trigger system, consisting of Trigger In and Trigger Out functions, provides the ability to synchronize sequencer arbitrary waveforms. In addition, the Trigger Out function provides the ability to generate trigger signal, if power supply output state or voltage / current programming value has changed.

5.2.1 Trigger Initialize

Trigger In initialization is required to activate Trigger In function. The activation is available via the Front Panel (refer to section 1.8) or the communication command INITiate[:IMMediate].

If continuous re-initialization is required, activate the system to be able to receive Trigger In signal continuously via the Front Panel (refer to section 1.8) or the communication command INITiate:CONTinuous <Bool>. Continuous re-initialization allows immediate triggering, thus preventing the need for re-initialization.

5.2.2 Trigger In

Trigger In function triggers an execution of a sequence (LIST or WAVE) loaded into an active memory cell.

There are three available triggers in the sources:

- External trigger (rear panel DB26 J1.22) – Positive edge triggered pulse.
- Front Panel trigger - Current or Voltage encoder press. Active only when power supply output is ON and the display shows the measured voltage and current.
- Communications trigger - *TRG or TRIG command (refer to sections 4.14 & 4.15.11).

Trigger In signal source selection is available via the Front Panel menu (refer to section 1.8) or via the communication command TRIGger:SOURce <DSC>. BUS represents front panel or communication command; EXT represents external trigger (Rear Panel DB26 J1.22).

5.2.3 Trigger Out

Trigger Out function is an active high output signal located on the Rear Panel DB26 J1.23. There are three available trigger out modes: OFF, FSTR, TRIG. Each mode depends on the setting of current and/or voltage programming mode (refer to [SOURce]:CURRent:MODE <DSC> and [SOURce]:VOLTage:MODE <DSC> commands).

Programming mode NONE (for Current and Voltage mode, both set to NONE)

- OFF Mode – No trigger output signal.
- TRIG Mode – Trigger is generated if output state changes.
- FSTR Mode – Trigger is generated in case of output state change (ON/OFF), voltage programming value update, or current programming value update.

Programming mode WAVE or LIST (for Current or Voltage mode)

- OFF Mode – No trigger output signal.
- TRIG Mode – Trigger is generated if the LIST or WAVE sequence is completed.
- FSTR Mode – Trigger is generated every step (after completion).

To enable Trigger Out signal functionality, refer to the Front Panel menu operation (refer to section 1.8) or to the communication command OUTPut:TTLTrg:MODE <DSC>.

5.2.4 Trigger Delay

Trigger Delay function provides the ability to delay the LIST or WAVE sequence execution following a Trigger In. Trigger delay can be set via the Front Panel menu (refer to section 1.8) or the communication command TRIGger:DELay <NRf+>.

To override trigger delay, use the TRIGger[:IMMediate] command. TRIGger[:IMMediate] disregards trigger delay setting. Trigger Delay function range is 0–10 seconds, in steps of 1 mSec.

5.3 Sequencer + Trigger System Examples

A combination of the Sequencer and the Trigger System provides the ability to generate any sequence and synchronize it.

5.3.1 WAVE Mode Voltage Programming via Communication Example

1. Select the Sequencer operation mode: VOLT:MODE:WAVE.

2. Program sequence voltage values: WAVE:VOLT 1,2,3,4.

3. Program time values corresponding to each voltage value: WAVE:TIME 1,2,3,4.

4. Store the sequence into the power supply memory cell 1: STOR 1.

5.3.2 WAVE Mode Execution via Communication Example

1. Load a sequence from the power supply memory cell 1: LOAD 1.

2. Set step parameter: WAVE:STEP AUTO.

3. Set counter parameter: COUN 1.

4. Select communication or front panel as a trigger source: TRIG:SOUR BUS.

5. Set continuous trigger initialization mode: INIT:CONT ON.

6. Initialize trigger system: INIT.

   Power supply is waiting for trigger.

7. Turn on the power supply output and send a trigger command: *TRG.

NOTE

To stop execution of a running sequence, use ABORt command (refer to section 4.14).

5.3.3 WAVE Mode Execution via Front Panel Example

1. Load a sequence from the power supply memory cell 1:

    1.1.   Press the PROG button. PROG (GREEN) LED illuminates.

    1.2.   Rotate the Voltage encoder until LOAD 1 appears.

    1.3.   Rotate Current encoder to select 1, 2, 3, or 4. Press Current encoder to accept. The display blinks once to acknowledge the setting.

2. Select communication or front panel as a trigger source:

    2.1.   Rotate the Voltage encoder until TRG.IN BUS appears.

    2.2.   Rotate Current encoder to select BUS. Press Current encoder to accept. The display blinks once to acknowledge the setting.

3. Set continuous trigger initialization mode:

    3.1.   Rotate the Voltage encoder until CONT OFF appears.

    3.2.   Rotate Current encoder to select ON. Press Current encoder to accept. The display blinks once to acknowledge the setting.

4. Initialize trigger system:

    4.1.   Rotate the Voltage encoder until TRIG INIT appears.

    4.2.   Press Current encoder to initialize trigger system. TRIG ABORT appears on the display, TRIG indicator is on.

    4.3.   Press BACK button, Main screen appears.

   Power supply is waiting for trigger.

5. Turn on the power supply output and press Current encoder to trigger the sequencer.

NOTE

To stop execution of a running sequence, press the PROG button. PROG (Green) LED illuminates, TRIG ABORT appears. Press Current encoder to abort the running sequence.

5.3.4   LIST Mode Example

VOLT:MODE LIST	Select LIST Mode Sequence
LIST:VOLT 2,4,2,8,5,4	Set voltage values "2,4,2,8,5,4" Volts
LIST:DWEL 0.5,0.5,1,1,1,1	Set dwell values "0.5,0.5,1,1,1,1" Seconds
STEP AUTO	Set AUTO step execution mode "AUTO"
COUN 1	Set list execution iterations "1"
TRIG:SOUR BUS	Select BUS trigger source via communication interface or front panel
INIT:CONT OFF	Trigger system is enabled for a single trigger action
INIT	Trigger initialize
*TRG	Trigger command
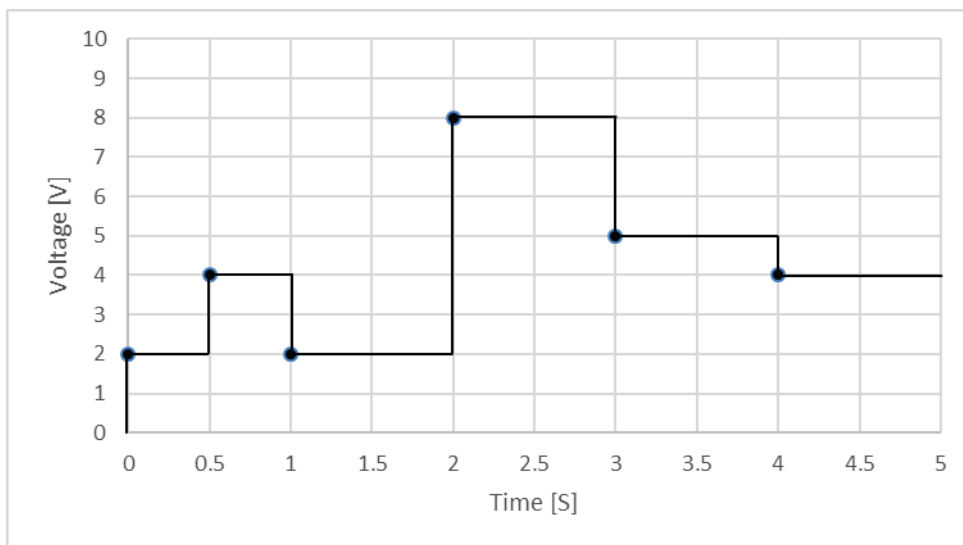
Figure 5–5: LIST Mode Example

NOTE

Start condition: Assume power supply output is on; Initial voltage point is 0 Volts.

NOTE

Arbitrary waveforms can be easily created by using the Waveform Creator application available on TDK-Lambda Website. Refer to Quick Start Guide documentation on TDK-Lambda Website.

5.3.5   WAVE Mode Example

|	
VOLT:MODE WAVE	Select Sequence Mode
WAVE:VOLT 2,4,4,9,9,3,3	Set voltage values "2,4,4,9,9,3,3" Volts
WAVE:TIME 1,0.5,0.5,0.5,0.5,1.5,1.5	Set time values "1,0.5,0.5,0.5,0.5,1.5,1.5" Seconds
STEP AUTO	Set AUTO step execution mode "AUTO"
COUN 1	Set wave execution iterations "1"
TRIG:SOUR BUS	Select BUS trigger source via communication interface or front panel
INIT:CONT OFF	Trigger system is enabled for a single trigger action
INIT	Trigger initialize
*TRG	Trigger command
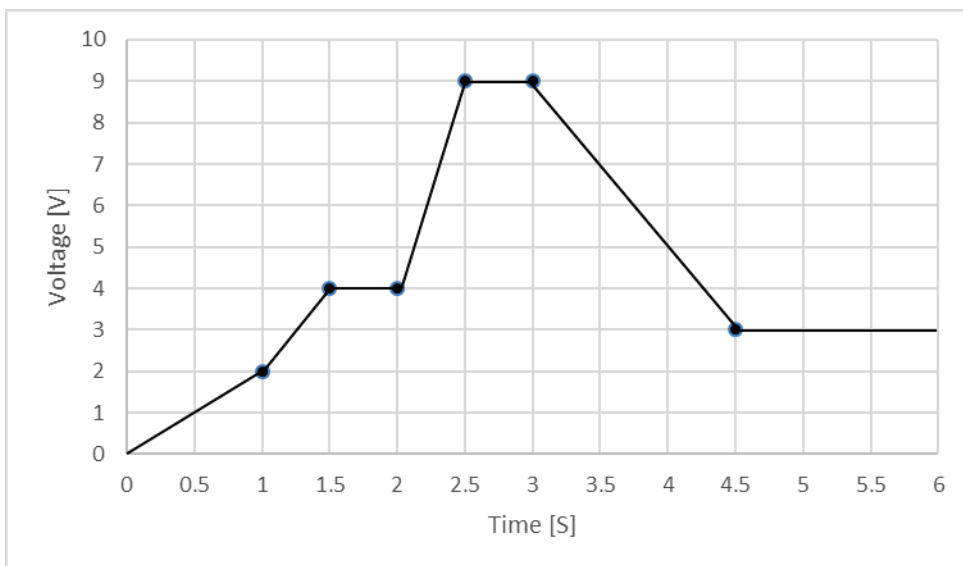
Figure 5–6: WAVE Mode Example

NOTE

Start condition: Assume power supply output is on; Initial voltage point is 0 Volts.

NOTE

Arbitrary waveforms can be easily created by using the Waveform Creator application available on TDK-Lambda Website. Refer to Quick Start Guide documentation on TDK-Lambda Website.

5.4   Internal Resistance

Internal resistance function is primarily used to simulate battery voltage drop, as a response to load current. In addition, it can be used in cases of voltage drop over long load wires.

Power supply output voltage V_{OUT} is set according to voltage setting minus actual load current multiplied by internal resistance value setting ($V_{OUT}=V-I \times R_S$).

Internal resistance function is enabled via the Front Panel menu (refer to section 1.8) or the communication command SYSTem:RIN:STATe <Bool>.

Internal resistance setting range is from 0.001 to 1 ohm, in steps of 0.001 ohms. Internal resistance setting is available via the Front Panel menu (refer to section 1.8) or the communication command SYSTem:RIN[:LEVel] <NRf+>.
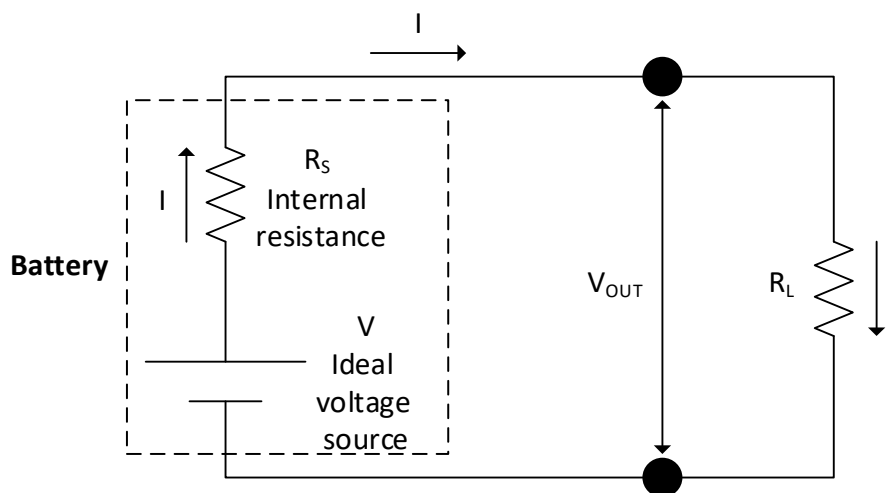
Figure 5–7: Internal Resistance Circuit

NOTE

If the Internal Resistance function is enabled, the Sequencer, Constant Power Limit, Slew-Rate, and Analog Programming functions are disabled.

NOTE

If the Sequencer, Constant Power Limit, Slew-Rate, or Analog Programming functions are enabled, the Internal Resistance function is disabled.

5.5   Constant Power Limit

The Constant Power Limit function limits the output power provided by the power supply.

The Constant Power Limit function is enabled via the Front Panel menu (refer to section 1.8) or the communication command [SOURce]:POWer:STATe <Bool>.

Constant power setting range is limited by multiplication of rated voltage by rated current, in steps of 1 watt. Constant power limit setting is available via the Front Panel menu (refer to section 1.8) or the communication command [SOURce]:POWer[:LEVel] <NRf+>.

....   1kW power limit
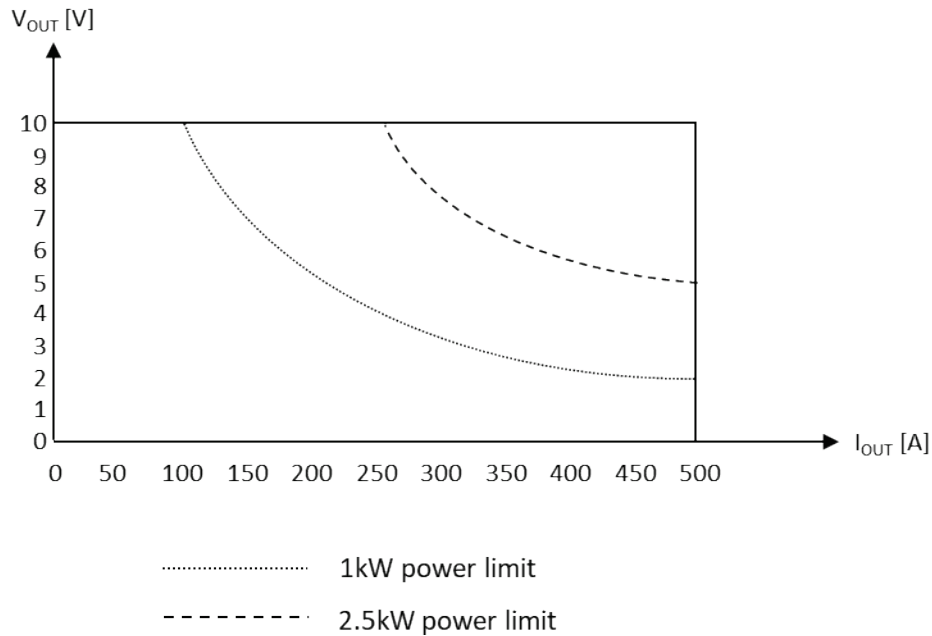
- - - - - - - -   2.5kW power limit

Figure 5–8: Constant Power – Example 1

NOTE

To achieve full constant power limit range, set the voltage and current settings to rated settings. Refer to Figure 5–8 as an example of 5kWatt, 10 Volts, 500 Amperes power supply. Voltage setting is set to 10 Volts, current setting is set to 500 Amperes.

To limit voltage and current values (in addition to constant power limit), set voltage limit and current limit, as shown in Figure 5–9.
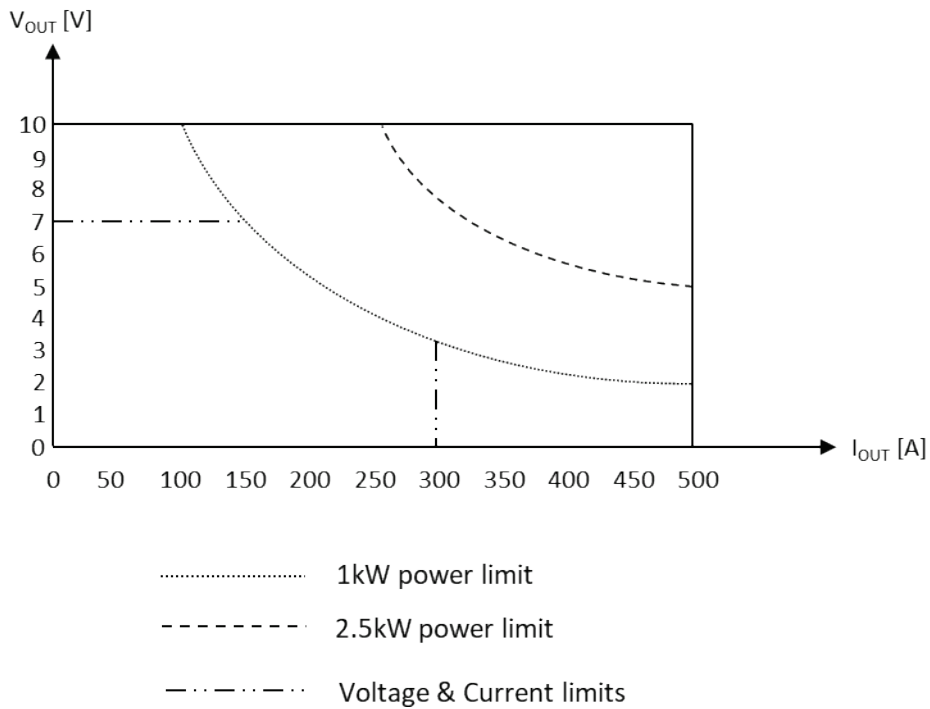
Figure 5–9: Constant Power - Example 2

5.6 Preload Control

Preload Control function provides the ability to enable/disable internal preload circuitry. This function is mainly used to prevent discharge of batteries connected to the power supply output terminals.

Setting preload to ON state (default configuration) keeps the preload active, as long as power supply power switch is ON. Setting preload to OFF state deactivates internal preload 5 seconds after a transition to the output OFF state.

Preload control function is available via the Front Panel menu (refer to section 1.8) or the communication command SYSTem:PRELoad:STATe <Bool>.

5.7　OCL – Analog Programming Over Current Limit

Analog Programming Over Current Limit (OCL) function provides the ability to limit analog programming of maximum current programming value. Setting OCL to ON state clamps maximum current programming value to digital programming value (set by Front Panel or communication). Setting OCL to OFF state (default configuration) provides the ability to program current setting according to power supply rated current value (up to about 108% of rated current).

5.7.1　OCL Example (10 Volts, 500 Amperes supply)

VOLT 10	Set voltage value "10" Volts
CURR 300	Set current value "300" Amperes
SYST:RANG 10	Set analog programming range "10"
CURR:EXT:MODE VOL	Set analog current programming source
Set external voltage to 4V	Current programming set 200 Amperes
CURR:EXT:LIM ON	Enable OCL function
Set external voltage to 8V	Current programming set 400 Amperes
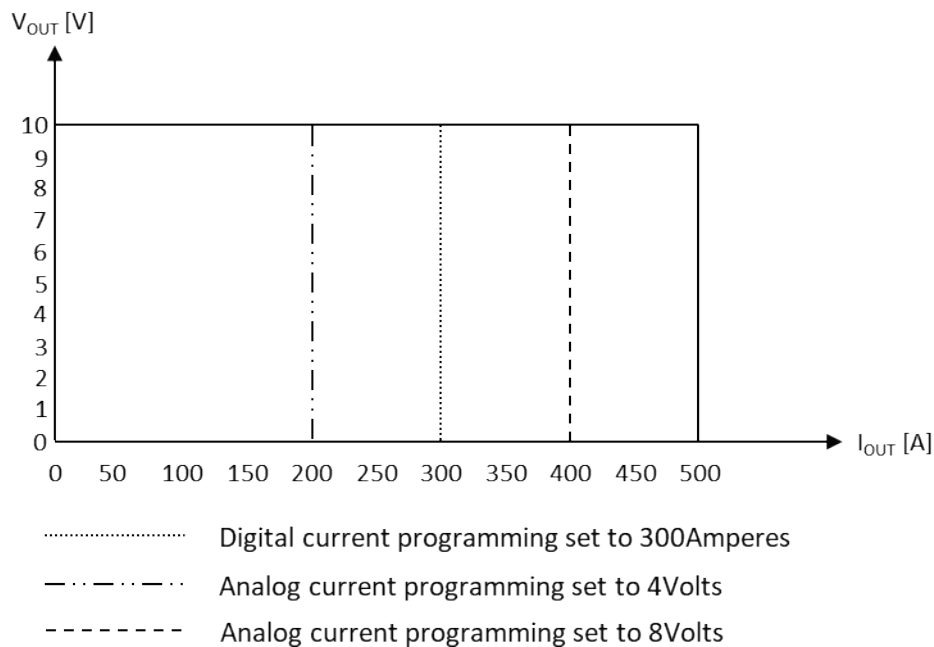
Figure 5–10: OCL example

Operation 2 sets digital current setting to 300 Amperes. Following operation 5, current setting is 200 Amperes. Following operation 6, OCL function is enabled, limiting current programming value to 300 Amperes (output current setting is not affected). Following operation 7, current setting is 300 Amperes (OCL function limits current setting to digital setting).

NOTE

Enable analog programming by rear panel J1 pin 6, short to J1 pin 11.

5.8   Slew-Rate Control

Slew-Rate control function provides the ability to control voltage or current reference slew rate. Slew rate function is enabled via the Front Panel menu (refer to section 1.8) or the communication commands SYSTem:SLEW[:STATe] <DSC>.

- Select VOLT for voltage reference slew control
- Select CURR for current reference slew control
- Select OFF to disable slew-rate control function

Slew rate setting range is from 0.0001 to 999.99 Volts or Amperes per milli-second in steps of 0.0001 Volts or Amperes per milli-second. Slew rate settings are available via the Front Panel menu (refer to1.8) or the following communication commands:

- [SOURce]:CURRent:SLEW:DOWN <NRf+> - Set current reference down programming slew.
- [SOURce]:CURRent:SLEW:UP <NRf+> - Set current reference up programming slew.
- [SOURce]:VOLTage:SLEW:DOWN <NRf+> - Set voltage reference down programming slew.
- [SOURce]:VOLTage:SLEW:UP <NRf+> - Set voltage reference up programming slew.

NOTE

Slew-Rate Control is active in Voltage/Current programming mode only. Slew-Rate Control does not affect OFF to ON or ON to OFF transitions.

NOTE

Maximum slew rate is limited by hardware.

NOTE

If the Slew-Rate function is enabled, the Internal Resistance, Sequencer, Constant Power Limit, and Analog Programming functions are disabled.

NOTE

If the Internal Resistance, Sequencer, Constant Power Limit, or Analog Programming functions are enabled, the Slew-Rate function is disabled.

5.9 Advanced Parallel

Up to four units of the same voltage and current ratings can be connected in parallel to provide up to four times of the output current capability. One of the units operates as a master while the remaining units operate as slaves. The configuration of the system (Master-Slave) is automatic. Each unit configures itself according to advanced parallel cable connection.

NOTES

1. Do not connect in Advanced Parallel, power supplies equipped with a Power Sink module along with power supplies without Power Sink module if firmware revision is **below** 02.112. An error will be shown (A.PRLL ERR4), refer to section 5.9.8.

2. Advanced Parallel connection of power supplies equipped with Power Sink module is supported.

5.9.1 Advanced Parallel Connection (System Assembly)

Advanced parallel connection is established by connecting the master unit to a slave unit using advanced parallel connection cable (G/P).

1. Connect J7 (M) output connector from the master unit to the J6 (S) input connector of the slave unit.

2. To connect additional units, connect J7 (M) connector to the next unit J6 (S) connector.

3. Repeat the procedure until all the units are connected.

NOTE

Advanced Parallel System assembly must be performed while the Power Supplies are disconnected from the grid (disconnected from the AC source).

5.9.2 Advanced Parallel Dis-Connection (System Dis-Assembly)

Advanced parallel disconnection is performed by disconnecting advanced parallel connection cable (G/P), which is connected between a master unit and a slave unit (or between a slave unit and a slave unit in case of multiple slave units).

1. Disconnect J7 (M) output connector from the master unit and J6 (S) input connector from the slave unit.

2. If additional slave units are connected, disconnect J7 (M) connector from the unit and J6 (S) connector from the next unit.

3. Repeat the procedure until all the units are disconnected.

NOTE

Advanced Parallel System disassembly must be performed while the Power Supplies are disconnected from the grid (disconnected from the AC source).

5.9.3   Load Connection

In parallel operation, power supplies can be connected in local or remote sensing. Refer to Figure 5–11 and Figure 5–12 for typical connections of parallel power supplies. Up to four identical units can be connected in parallel.
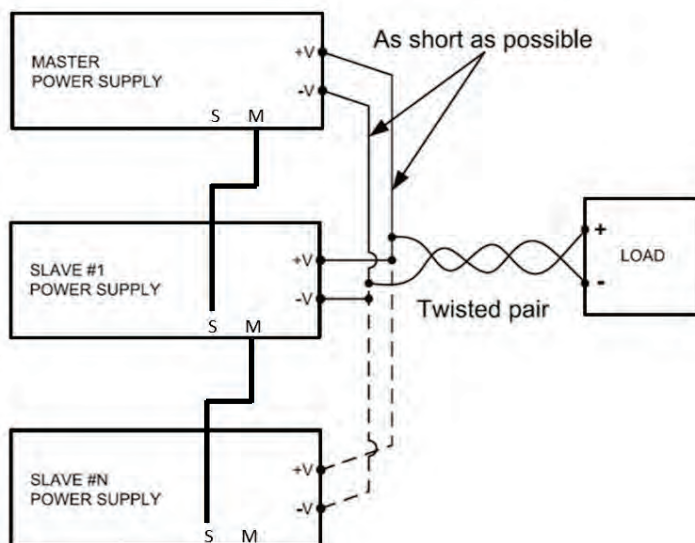

Figure 5–11: Parallel Connection with Local Sensing
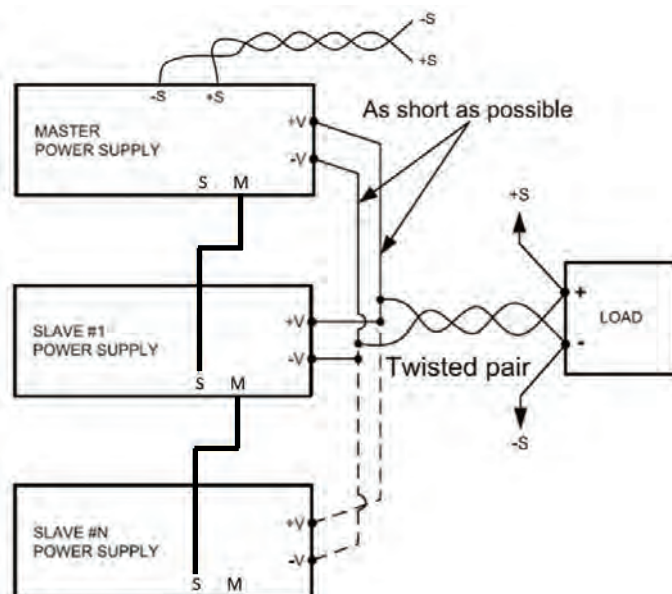

Figure 5–12: Parallel Connection with Remote Sensing

CAUTION

Make sure the connection between –V terminals is reliable to prevent disconnection during operation. Disconnection may cause damage to the power supply.

5.9.4.3 Acknowledge via communication (Blank Panel master power supply)

1. To acknowledge a parallel system assembled with Blank Panel master power supply, turn on the master unit, wait 5 seconds.

   Read questionable condition register by sending STATus:QUEStionable:CONDition? command. If paralleling system is ready for acknowledge, questionable condition register Parallel Acknowledge bit is set (refer to section 6.2.2).

2. To acknowledge, send the SYSTem:PARallel:ACKNowledge command.

NOTE

Factory Reset (FRST) does not affect parallel system assembly acknowledgment. Acknowledged system units does not change its role.

5.9.5 Advanced Parallel operation

Advanced parallel operation is identical to the single power supply operation. Power supplies connected in advanced parallel connection form a system. The system is controlled and monitored by the master unit. Slave units do not receive commands, communications. Front panel buttons and encoders are disabled. Voltage/Current/Power programming and read-back through communications and front panel are the parameters of the system (the current and the power parameters programmed and monitored from the master unit are the total current and power of the system).

NOTE

Constant Power Limit minimum limit setting is dependent on the number of units connected in parallel. Single unit minimum value is 1W. Connecting additional units in parallel results in 1W multiplied by n, while n is the number of units connected in parallel (including the master unit).

5.9.6 Slave units operation in Advanced Parallel connection

Slave units are automatically configured as slaves, according to advanced parallel bus paralleling cable connection (G/P). Slave units show on the display the output state of the system "SLAVE ON" or "SLAVE OFF", or faults in case a fault has occurred. Each slave unit displays only its own faults. Slave units allow only query communication commands.

5.9.7 Advanced Parallel fault system

Advanced parallel fault system combines the faults of the master and slave units. The master unit shows on the display and communications both its own faults and the slave units' faults. Each slave unit shows on the display its own faults only. Slave units show OUT OFF in case of a fault in any of the other units. In case of a fault in any of the slave units, the system acts as if the fault has occurred in the master unit.

5.9.8 Advanced Parallel Errors

Advanced Parallel system automatically turns output off (output of all the units) in case of an error related to parallel connection. Refer to Table 5-2: Advanced Parallel Errors and Display Notifications for the detected errors and display notifications.

Advanced Parallel System Error Description	Display Notification
Slave unit communication error during operation	A.PRLL ERR1
Last Slave unit is missing or not connected	WAIT SLAVE
Advanced Parallel system is waiting for slave unit to become ready (@start-up)	WAIT SLAVE
Unrecoverable Advanced Parallel system error	GNRL ERROR
Paralleled units are not identical (non-matching Voltage and/or Current rating)	A.PRLL ERR3
Paralleled power supplies equipped with a Power Sink module, along with standard power supplies (without a Power Sink module), which have firmware revision below 02.112.	A.PRLL ERR4

Table 5-2: Advanced Parallel Errors and Display Notifications

Advanced Parallel system error status can be detected by the questionable group registers. Refer to Section 6.3.2 Questionable Group (Fault Register) Structure.

5.9.9 Advanced Parallel system identification (*idn?)

To identify a system connected in parallel, master unit updates its identification name. Standard unit identification string format is: TDK-LAMBDA,Gx-y,S/N,G:r.

- x – rated voltage, y – rated current, S/N – serial number, r – firmware revision.

  Parallel system identification string format: TDK-LAMBDA,GSx-z,S/N,G:r.

- z – total advanced parallel system current.

  The "S" letter, following the "G" letter, identifies advanced parallel system.

The total current of the system is updated, identifying the total current. The serial number of the master unit is preserved.

NOTE

In case of a Blank Panel Option power supply, the additional paralleling system 'S' letter is added following the 'B' letter, i.e., TDK-LAMBDA,GBSx-z,S/N,G:r.

5.9.10 Advanced Parallel memory settings

Power supplies change role when assembled (or disassembled) into (from) an Advanced Parallel System. Three roles are available:

Single – No Slave or Master units are connected.

Master – At least one Slave unit is connected.

Slave – A unit (or multiple units) connected to a Master unit.

Before assembling an Advanced Parallel System, each units' role is Single.

NOTE

Memory settings tables are the settings of the power supply immediately following role change. These settings can be modified by the user in Single or Master roles only. Slave role settings can't be modified.

5.9.10.1 Single or Master roles non-volatile memory parameters

Refer to Table 5-3: Single or Master Roles Non-Volatile Memory Parameters for the default non-volatile memory parameters set when power supply changes its role to Single or Master.

Function	Single or Master Role
Power Supply Start Mode	SAFE
Power Supply Output State	OFF
Voltage Set Point [V]	0
Current Set Point [A]	1.05 * RATED
Over Voltage Protection (OVP) [V]	1.1 * RATED or 1.2 * RATED (Model Dependent)
Under Voltage Level (UVL) [V]	0
Under Voltage Protection (UVP) Mode	OFF
Under Voltage Protection (UVP) Delay [S]	01.0
Fold-Back Mode	OFF
Fold-Back Delay [S]	01.0
Constant Power Function	OFF
Constant Power Set Point [W]	RATED VOLTAGE MULTIPLYED BY RATED CURRENT
Slew Mode	OFF
Voltage Slew Up / Down [V/mS]	999.99
Current Slew Up / Down [A/mS]	999.99
Internal Resistance Function	OFF
Internal Resistance Set Point [Ω]	0.001
Voltage Reference Programming Source	DIG
Current Reference Programming Source	DIG
Analog Mode Current Limit (OCL)	OFF
Analog Programming & Monitoring Range [V]	5
Programmable Pin 1	OFF
Programmable Pin 2	OFF
Front Panel Remote Mode	LOCAL
Front Panel LOCK	OFF
Output Sense (LOC / REM)	LOC
Interlock (ILC) Function	OFF
Enable (ENA) Function	OFF
Enable (ENA) Polarity	REV
Power Supply OK (PS_OK) Delay [S]	00.01
Preload	ON
Communication Interface	Not Affected (Preserves Setting)
Communication Power Supply Address	Not Affected (Preserves Setting)
Communication Baud Rate [Baud]	Not Affected (Preserves Setting)
Communication Language	Not Affected (Preserves Setting)
LAN parameters	Not Affected (Preserves Setting), except Host Name
Special Voltage Upper Limit (SVUL)	RATED
Special Current Upper Limit (SCUL)	RATED

Function	Single or Master Role
Enable registers	Not Affected (Preserves Setting)
Event registers	Not Affected (Preserves Setting)
Power-On Status Clear	Not Affected (Preserves Setting)
Display Brightness	Not Affected (Preserves Setting)
Display Dim Delay [S]	Not Affected (Preserves Setting)
Display Dim Brightness	Not Affected (Preserves Setting)
Factory Calibration Parameters	Not Affected (Preserves Setting)
Power Sink *1	ON

Table 5-3: Single or Master Roles Non-Volatile Memory Parameters

NOTES

1. LAN non-volatile memory parameters are not affected (for default parameters, refer to Table 2-7: LAN Non-Volatile Memory Parameters). The only affected parameter is the Host Name which is updated to default due to system identification update.

2. *1 Available for power supplies equipped with a Power Sink module.

5.9.10.2 Slave role non-volatile memory parameters

Refer to Table 5-4: Slave Role Non-Volatile Memory Parameters for the default non-volatile memory parameters set when power supply changes its role to Slave.

Function	Slave Role
Power Supply Start Mode	SAFE
Power Supply Output State	OFF
Voltage Set Point [V]	0
Current Set Point [A]	1.05 * RATED
Over Voltage Protection (OVP) [V]	1.1 * RATED or 1.2 * RATED (Model Dependent)
Under Voltage Level (UVL) [V]	0
Under Voltage Protection (UVP) Mode	OFF
Under Voltage Protection (UVP) Delay [S]	01.0
Fold-Back Mode	OFF
Fold-Back Delay [S]	01.0
Constant Power Function	OFF
Constant Power Set Point [W]	RATED VOLTAGE MULTIPLYED BY RATED CURRENT
Slew Mode	OFF
Voltage Slew Up / Down [V/mS]	999.99
Current Slew Up / Down [A/mS]	SAME AS MASTER POWER SUPPLY
Internal Resistance Function	OFF
Internal Resistance Set Point [Ω]	0.001
Voltage Reference Programming Source	DIG
Current Reference Programming Source	DIG

Function	Slave Role
Analog Mode Current Limit (OCL)	OFF
Analog Programming & Monitoring Range [V]	5
Programmable Pin 1	OFF
Programmable Pin 2	OFF
Front Panel Remote Mode	LOCAL
Front Panel LOCK	OFF
Output Sense (LOC / REM)	LOC
Interlock (ILC) Function	OFF
Enable (ENA) Function	OFF
Enable (ENA) Polarity	REV
Power Supply OK (PS_OK) Delay [S]	00.01
Preload	SAME AS MASTER POWER SUPPLY
Communication Interface	Not Affected (Preserves Setting)
Communication Power Supply Address	Not Affected (Preserves Setting)
Communication Baud Rate [Baud]	Not Affected (Preserves Setting)
Communication Language	Not Affected (Preserves Setting)
LAN parameters	Not Affected (Preserves Setting), except Host Name
Special Voltage Upper Limit (SVUL)	RATED
Special Current Upper Limit (SCUL)	RATED
Enable registers	Not Affected (Preserves Setting)
Event registers	Not Affected (Preserves Setting)
Power-On Status Clear	Not Affected (Preserves Setting)
Display Brightness	Not Affected (Preserves Setting)
Display Dim Delay [S]	Not Affected (Preserves Setting)
Display Dim Brightness	Not Affected (Preserves Setting)
Factory Calibration Parameters	Not Affected (Preserves Setting)
Power Sink *1	ON

Table 5-4: Slave Role Non-Volatile Memory Parameters

NOTES

1. Slave unit parameters read by communication might not reflect actual system status. i.e., slave power supply does not reflect OCL mode, Constant Power mode, Slew-rate mode, etc.

2. LAN non-volatile memory parameters are not affected (for default parameters, refer to Table 2-7: LAN Non-Volatile Memory Parameters). The only affected parameter is the Host Name which is updated due to system identification update.

3. *1 Available for power supplies equipped with a Power Sink module.

5.10   Communication Watchdog

Communication Watchdog function provides the ability to turn off power supply output, if there is no activity on any of the available communication interfaces (communication with a power supply is lost). Watchdog function is enabled or disabled via Front Panel menu (refer to section 1.8) or communication command SYSTem[:COMMunicate]:WATCHdog[:STATe] <bool> (refer to section 4.15.10). Timeout period for no activity over communication interfaces is user defined, in the range of 1 to 3600 seconds, in steps of 1 second. It is set via Front Panel menu (refer to section 1.8) or communication command SYSTem[:COMMunicate]:WATCHdog:TIMe <NRf+> (refer to section 4.15.10).

Timeout period for no activity starts from the first received command or query (including invalid commands) over communication interfaces, following watchdog function enable. Switching communication interface (e.g., USB to RS232) stops communication interface timeout period. It is automatically re-initiated following first command or query (including invalid commands) received in the selected interface. Same applies to timeout period value change.

5.10.1   Activated Communication Watchdog Timeout

When communication watchdog timeout period expires, power supply output shuts down. The display shows WD FAULT. Red alarm LED blinks 1/2Hz frequency, error message is written into error queue "342,Communication Watchdog Timeout;power supply address" and Questionable Group (Fault Register) Condition bit 15 is set.

Communication watchdog timeout fault is cleared (reset) by OUTPut:PROTection:CLEar command (refer to section 4.15.6), Power Switch recycle or AC recycle (Front Panel OUT button does not turn power supply output on under fault condition).

Watchdog function disable via Front Panel or communication clears watchdog fault.

NOTES

1. Communication Watchdog function is available in all communication interfaces except LAN built-in webserver (browsing webpages does not affect communication watchdog).

2. Communication Watchdog function is available in SCPI communication language only (not available in GEN language).

3. Timeout period (WD.TIM) step is set by Coarse or Fine mode selection. In Coarse mode, timeout field is updated in steps of 10 seconds. In Fine mode, timeout field is updated in step of one second. Use the FINE button on the Front Panel to toggle between modes (Coarse or Fine).

4. Front Panel buttons press does not affect watchdog timeout period.

5. Communication Watchdog function is available from firmware revision 02.105.

5.11 Boolean Commands Return Value

Boolean Commands Return Value function provides the ability to select Boolean value reply type for <Bool> parameter commands, between 0|1 to OFF|ON. For example, OUTPut[:STATe] <Bool> default return value is 0|1, it could be switched to OFF|ON.

Refer to SYSTem[:COMMunicate]:BOOL[:STATe] <DSC> command in SCPI language, SYSTem Subsystem, Section 4.15.10.

Refer to BOOL <DSC> command in GEN language, Auxiliary Commands, Section 4.11.8.

NOTES

1. Only Return value is affected.

2. Boolean Commands Return Value function is available from firmware revision 02.110.

CHAPTER 6: STATUS, FAULT, AND SRQ REGISTERS

6.1 General

This section describes various status errors (faults) and SRQ register structures. The registers can be read or set via communication commands. Two individual sets of registers are managed, one set for the SCPI language, another set for the GEN language.

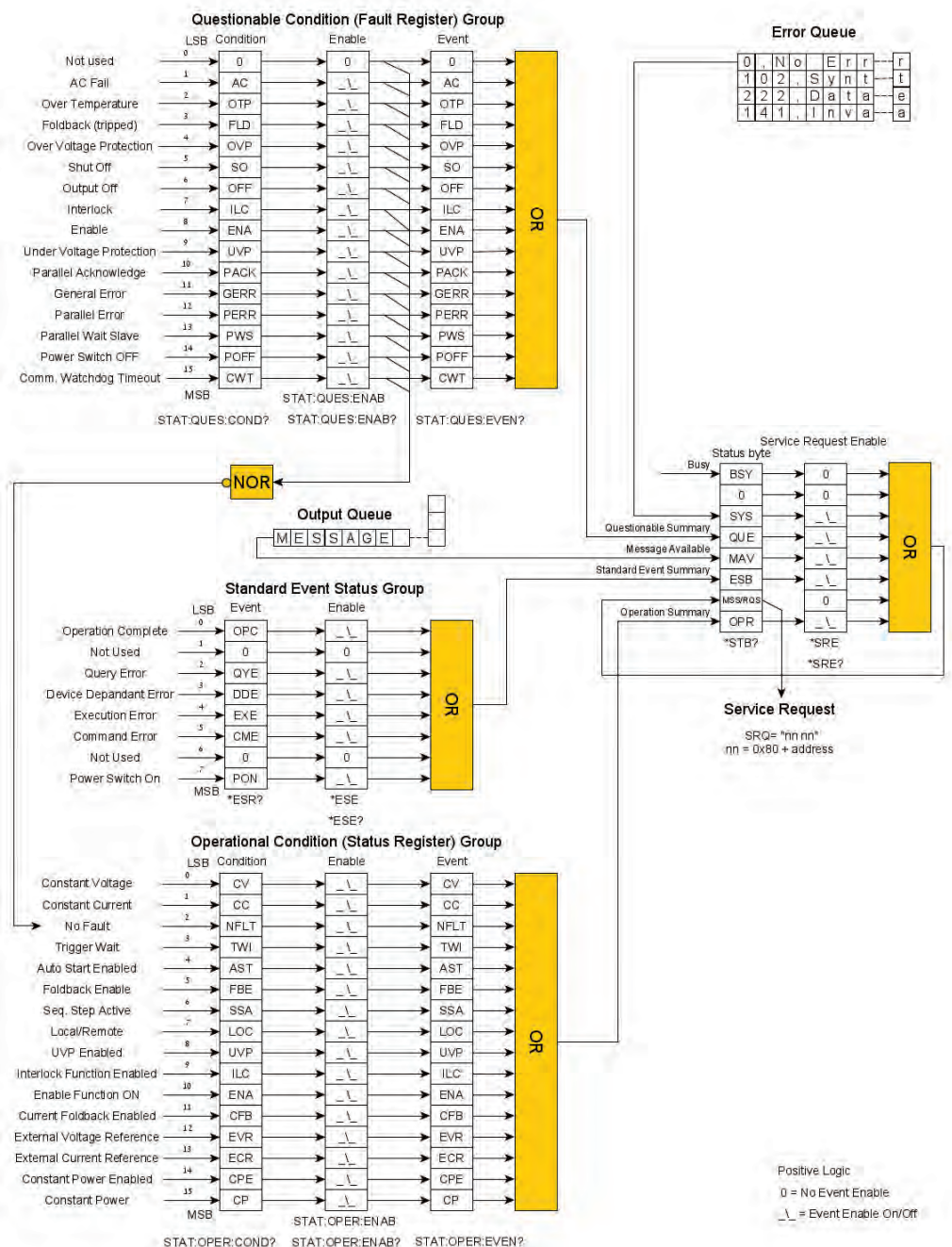### 6.2 SCPI Language

6.2.1 SCPI Register Tree

Figure 6–1: SCPI Register Tree Diagram

SCPI register tree shown in Figure 6–1 describes the structure of status, events, faults, messaging, and service request registers. Condition registers hold a snapshot of the actual state.

The Enable registers can be set by the user to enable SRQ (Service request) in case of a condition change. Event registers latch condition registers state if the corresponding Enable registers are set to logical one. The Event registers remain set (latched) until the user reads the register. Reading the register clears its values until the next event.

NOTE

Event register does not specify that a single condition event has occurred. In the period where an event has occurred and user has read the value, the Condition register might change its value multiple times.

6.2.2 Questionable Condition (Fault Register) Group Structure

Questionable condition fault register group holds a snapshot of the actual faults state of the power supply at a present time. If a fault occurs, the corresponding bit is set. If a fault is removed, the corresponding bit is cleared.

Some of the faults might quickly change state (clear faults) before the controlling PC detects it. Events can be stored in the Event register if the Enable register allows it. Refer to STATUS subsystem (section 4.15.9) Questionable Condition commands set. Table 6-1 describes bit configuration of the questionable condition fault register group.

Bit Number	Decimal Value	Bit Symbol	Description
0	1	0	Not used
1	2	AC	AC Fail
2	4	OTP	Over Temperature Protection
3	8	FLD	Fold Back Protection
4	16	OVP	Over Voltage Protection
5	32	SO	Shut Off (Daisy)
6	64	OFF	Output Off
7	128	ILC	Interlock
8	256	ENA	Enable
9	512	UVP	Under Voltage Protection
10	1024	PACK	Parallel Acknowledge
11	2048	GERR	General Error
12	4096	PERR	Parallel Error
13	8192	PWS	Parallel Wait Slave
14	16384	POFF	Power Switch OFF
15	32768	CWT	Comm. Watchdog Timeout

Table 6-1: Bit Configuration of Questionable Condition Register

NOTE

OFF Bit (Bit Number 6) represents output ON/OFF button only, it is not affected by ON/OFF command.

6.2.3 Operational Condition (Status Register) Group Structure

Operational condition status register group holds a snapshot of the actual status state of the power supply at a present time. Power supply status might quickly change condition before the controlling PC detects it. Events can be stored in the Event register if the Enable register allows it. Refer to STATUS subsystem (section 4.15.9) Operation Condition commands set. Table 6-2 describes bit configuration of the operational condition status register group.

Bit Number	Decimal Value	Bit Symbol	Description
0	1	CV	Constant Voltage operation mode
1	2	CC	Constant Current operation mode
2	4	NFLT	No Fault
3	8	TWI	Trigger Wait
4	16	AST	Auto Start Enabled
5	32	FBE	Foldback Enabled
6	64	SSA	Sequencer Step Active
7	128	LOC	Local / Remote communication mode
8	256	UVP	Under Voltage Protection enabled
9	512	ILC Ena	Interlock control Enabled
10	1024	ENA Ena	Enable control Enabled
11	2048	CFB	CC operation mode Foldback enabled
12	4096	EVR	External Voltage Reference Programming
13	8192	ECR	External Current Reference Programming
14	16384	CPE	Constant Power Enabled
15	32768	CP	Constant Power operation mode

Table 6-2: Bit Configuration of Operational Condition Register

6.2.4 Standard Event Status Group Structure

Standard event status group latches error groups. Power switch on and operation complete events status might quickly change its condition before the controlling PC detects it. Events can be stored in the ESB register if the Enable register allows it. Refer to Common Commands Group (section 4.14) for standard event status group commands. Table 6-3 describes bit configuration of the standard event status register group. Standard event status group registers are cleared when read, refer to *ESR? Command (section 4.14). To program specific bits in the standard event status group enable register, refer to *ESE command (section 4.14). If *PSC is set, Enable register is cleared at power supply power on.

Bit Number	Decimal Value	Bit Symbol	Description
0	1	OPC	Operation Complete
1	2	0	Not Used
2	4	QYE	Query Error
3	8	DDE	Device Dependent Error
4	16	EXE	Execution Error
5	32	CME	Command Error
6	64	0	Not Used
7	128	PON	Power ON

Table 6-3: Bit Configuration of Standard Event Status Register

Operation Complete – Set whenever the last communication command completed its operation, the unit is ready to accept another command.

QYE - Query commands related errors.

DDE – Device Dependent error codes.

EXE – Execution commands related errors.

CME – Commands errors.

Bit Set	Error code	Error Type	Bit Set	Error code	Error type
5	-100 – -199	Command	3	-300 – -399 or 1 – 32762	Device Dependent
4	-200 – -299	Execution	2	-400 – -499	Query

Table 6-4: Standard Event Status Register Error Bits

NOTE

Bits 2, 3, 4, & 5 point to a specific group of errors. For a detailed errors list, refer to Table 6-5.

Power ON – Set once at power up.

6.2.5 Output Queue

The output queue is a queue that stores the message sent from the power supply to the controlling PC until the message is read. The output queue is cleared at power on and by the *CLS command. Whenever the queue holds a message, it sets the MAV bit in the status byte register (refer to Figure 6–1).

6.2.6 Error Queue

The error queue holds up to 10 system error messages. To enable the log of error messages, send SYSTem:ERRor:ENABle command. The error queue acts as a FIFO (First In First Out) queue. The first message entering the queue is the first message read by the controlling PC. To read a message, send SYSTem:ERRor? query. The query returns the error number and a message if an error message is available. If there is no error, the query returns 0,"No error". Error message format is as follows:

<Error Number><Comma><Quote><Error Description;Power Supply Address><Quote>

If more than 10 messages are stored, the last (tenth) message is replaced by -350,"Queue Overflow;Power Supply Address" error message.

The error queue is cleared at power on, by the *CLS command or by reading all available messages until 0,"No error" message is received.

Whenever the queue holds a message, it sets the SYS bit in the status byte register (refer to Figure 6–1).

Error Number	Error Description	Error Event
0	"No error"	No error reported
-100	"Command Error"	Unit receives command with unspecified error
-101	"Checksum Error"	Command ($) Checksum error
-109	"Missing Parameter"	Valid command received but not enough characters
-115	"Unexpected number of parameters"	The number of parameters received does not correspond to the number of parameters expected
-131	"Invalid Suffix"	Unrecognized units, or units not appropriate
-200	"Execution Error"	Generic syntax error / Can't execute command
-201	"LAN Specific Command"	LAN specific commands are available only through LAN communication interface
-220	"Parameter Error"	Indicates that a program data element related error occurred
-222	"Data Out Of Range"	Attempt to program beyond defined supply limits
-284	"Program Currently Running"	Certain operations dealing with programs may be illegal while the program is running. For example, change a parameter in a running program is not possible
-286	"Data Load Empty"	LIST/WAVE Memory cell is empty
-300	"Device-Specific Error"	Generic device dependent error
-301	"Message Timeout"	Timeout of 15 sec. before receiving a terminator (CR or LF) has occurred

Error Number	Error Description	Error Event
-302	"General Error"	Unrecoverable system error, recycle AC. If problem persists, contact service
-304	"Advanced Slave Fault"	Advance Parallel Fault - Slave unit communication error during operation
-305	"Advance Parallel Last Slave Missing"	Advanced Parallel Last Slave unit is missing or not connected
-306	"Waiting for Slave Unit"	Advanced Parallel waiting for slave unit to turn ON
-307	"Advanced Parallel Slave Unit General Error"	Unrecoverable system error, recycle AC. If problem persists, contact service
-308	"Advanced Parallel Mismatching Units"	Advanced Parallel connected units with different voltage or current rating
-309	"Memory Data Read/Write Failure"	Memory fault, can't load/store data
-310	"Booster Mode"	Booster power supply reply if communication is made through Booster USB port
-350	"Queue Overflow"	Too many SYST:ERR messages are stored in error queue. Newest messages are discarded
301	"PV Above OVP"	Attempt to program voltage above OVP setting
302	"PV Below UVL"	Attempt to program voltage below UVL setting
304	"OVP Below PV"	Attempt to set OVP below voltage setting
306	"UVL Above PV"	Attempt to set UVL above voltage setting
307	"On During Fault"	Attempt to turn power supply output on when a fault exists
320	"UVP Shutdown"	Under-Voltage protection shutdown occurred
321	"AC Fault Shutdown"	AC Fail shutdown occurred
322	"OTP Shutdown"	Over-Temperature shutdown occurred
323	"Fold-Back Shutdown"	Fold-Back shutdown occurred
324	"OverVoltage Shutdown"	Over-Voltage protection shutdown occurred
325	"Daisy-Chain In (SO) Shutdown"	Daisy-Chain In (Shut-Off) shutdown occurred
326	"Output-Off Shutdown"	Output-Off occurred by front panel
327	"Interlock Shutdown"	Interlock shutdown occurred
328	"Enable Shutdown"	Enable shutdown occurred
329	"Slave mode"	Cannot execute command in Slave mode
330	"System is powered off"	Front panel power switch turned to OFF state
334	"Sequencer is ON"	An attempt to set Constant Power Mode, Analog Programming, Slew Rate, or Internal Resistance while Sequencer is running or initialized
335	"Internal Resistance is ON"	An attempt to set Constant Power Mode, Analog Programming, Slew Rate, or Sequencer while Internal Resistance is ON
336	"Constant Power Mode is ON"	An attempt to set Internal Resistance, Analog Programming, Slew Rate, or Sequencer while Constant Power Mode is ON

Error Number	Error Description	Error Event
337	"Analog Mode is ON"	An attempt to set Constant Power Mode, Internal Resistance, Slew Rate, or Sequencer while Analog Programming is ON
338	"Slew Mode is ON"	An attempt to set Constant Power Mode, Internal Resistance, Analog Programming, or Sequencer while Slew rate is ON
340	"Advanced Parallel Wait Acknowledge"	Advanced Parallel Waiting for Acknowledge, system has changed
341	"Input Overflow"	Received over 1500 characters
342	"Communication Watchdog Timeout"	Communication watchdog timeout occurred (no communication for defined timeout period)
343	"Power Sink Not Installed"	An attempt to enable/disable Power Sink while there is no Power Sink module installed
-400	"Query Error"	Generic query error

Table 6-5: SCPI Error Messages

NOTE

If there is no error, SYSTem:ERRor? query returns 0,"No error". Power supply address is excluded.

6.2.7   Service Request Enable Group Structure

Service request enable group register summarizes questionable condition group, standard event status group, and operational condition group events, if these are enabled. The group also contains busy bit, message available bit, and service request bit. The register can be read by *STB? Command. *CLS command clears service request enable register. Table 6-6 describes bit configuration of the service request enable register group.

Bit Number	Decimal Value	Bit Symbol	Description
0	1	BSY	System is busy (Busy bit)
1	2	0	Not used
2	4	SYS	System error message available
3	8	QUE	Questionable condition group summary event
4	16	MAV	Message available in output queue
5	32	ESB	Standard event status group summary event
6	64	RQS	Service request
7	128	OPR	Operation condition group summary event

Table 6-6: Service Request Enable Register

SYS – System error message available bit. Refer to Section 6.2.6 to read the available error messages.

QUE – Questionable condition group summary bit. Questionable condition group event has occurred. Refer to section 6.2.2 to determine which fault has occurred.

MAV – Message available. Refer to section 6.2.5 to read the available message.

ESB – Standard event status group summary bit. Standard event status group event has occurred. Refer to section 6.2.4 to determine which event has occurred.

OPR – Operational condition group summary bit. Operational condition group event has occurred. Refer to section 6.2.3 to determine which status has changed.

RQS – Service request. Whenever the power supply requests service, it latches the service request into service request bit. When the controlling PC services the interrupt, service request bit is cleared.

NOTE

Do not enable Service Request when using IVI driver, as IVI does not support a reply from the unit without initiating a query.

6.2.8   Determining the Cause of a Service Interrupt

A service request (SRQ) is set if the contents of at least one of the event registers has changed (from logical zero to logical one). To determine the reason for an SRQ, perform the following actions:

1. Poll by *STB? query to determine which bits are active in the service request enable status byte.

2. Read the corresponding Event register for each summary group to determine which events caused the summary bit to be set. When an Event register is read, it is cleared. This action also clears the corresponding summary bit.

The interrupt will recur until the specific condition that has caused the event is removed. If this is not possible, the event may be disabled by programming the corresponding bit of any of the status group Enable registers.

A faster way to prevent the interrupt is to disable the service request by programming the appropriate bit of the Service Request Enable register.
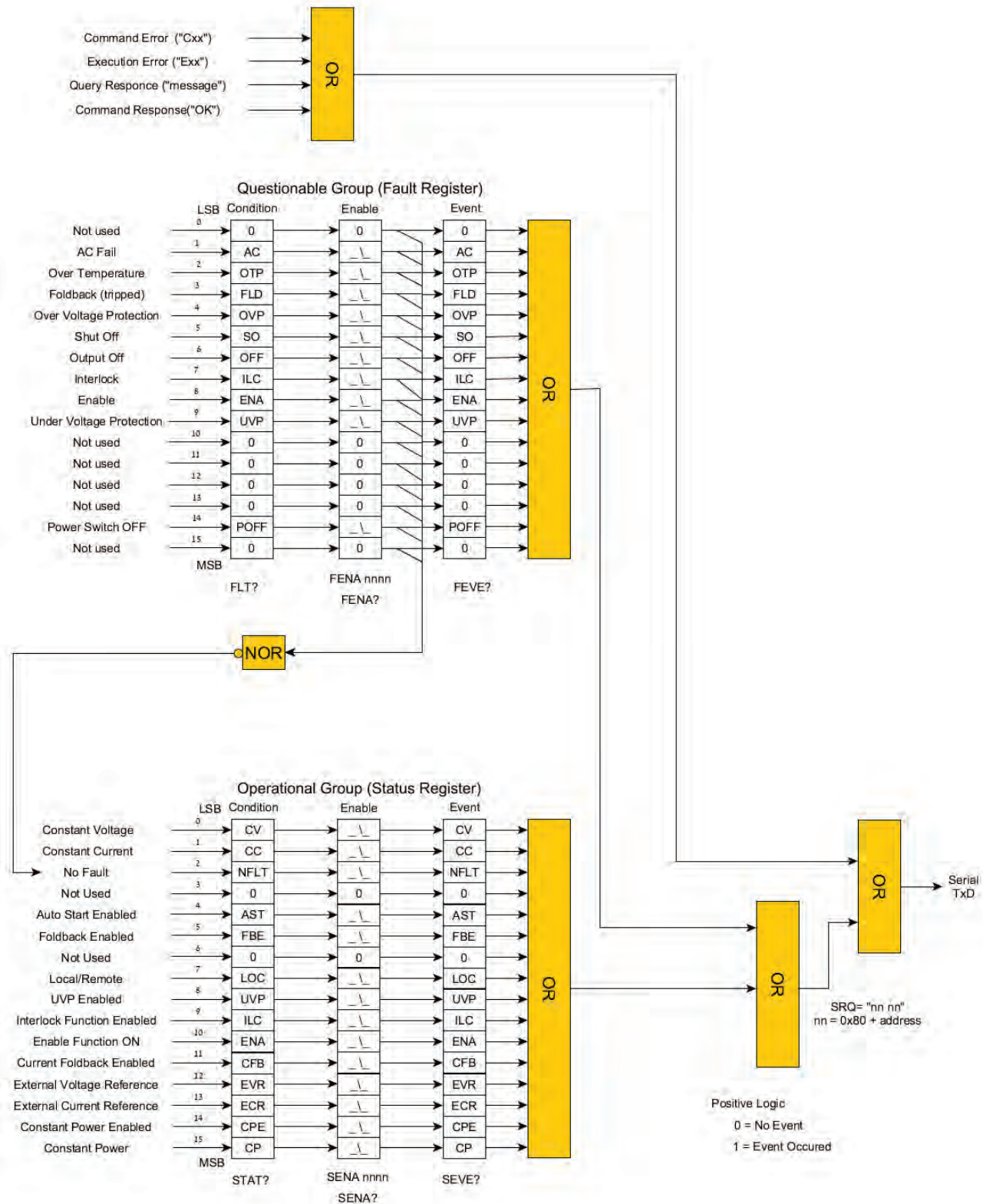
6.3 GEN Language

6.3.1 GEN Register Tree

Figure 6–2: GEN Register Tree Diagram

GEN register tree shown in Figure 6–2 describes the structure of the status, faults, messaging, and service request registers. Condition registers hold a snapshot of the actual state. Enable registers can be set by the user to enable SRQ (Service request) in case a condition change occurs. Event registers latch condition registers state if the corresponding Enable registers are set to logical one. Event registers remain set (latched) until the user reads the register, reading the register clears its values until the next event.

NOTE

Event register does not specify that a single condition event has occurred. In the period where an event has occurred and user has read the value, the Condition register might change its value multiple times.

6.3.2 Questionable Group (Fault Register) Structure

Questionable group fault register holds a snapshot of the actual faults state of the power supply at a present time. If a fault occurs, the corresponding bit is set. If a fault is removed, the corresponding bit is cleared. Some of the faults might quickly change their state (clear faults) before the controlling PC detects it. Events can be stored in the Event register if the Enable register allows it. Refer to General Status Register Commands (section 4.11.9) set. Table 6-7 describes bit configuration of the questionable group fault register.

Bit Number	Decimal Value	Bit Symbol	Description
0	1	0	Not Used
1	2	AC	AC Fail
2	4	OTP	Over Temperature Protection
3	8	FLD	Fold Back Protection
4	16	OVP	Over Voltage Protection
5	32	SO	Shut Off (Daisy)
6	64	OFF	Output Off
7	128	ILC	Interlock
8	256	ENA	Enable
9	512	UVP	Under Voltage Protection
10	1024	0	Not used
11	2048	0	Not Used
12	4096	0	Not used
13	8192	0	Not used
14	16384	POFF	Power Switch OFF
15	32768	0	Not Used

Table 6-7: Bit Configuration of Questionable Group Register

NOTE

OFF Bit (Bit Number 6) represents output ON/OFF button only, it is not affected by ON/OFF command.

6.3.3   Operational Group (Status Register) Structure

Operational status register group holds a snapshot of the actual status state of the power supply at a present time. Power supply status might quickly change its condition before the controlling PC detects it. Events can be stored in the Event register if the Enable register allows it. Refer to General Status Register Commands (section 4.11.9) set. Table 6-8 describes bit configuration of the operational group register.

Bit Number	Decimal Value	Bit Symbol	Description
0	1	CV	Constant Voltage operation mode
1	2	CC	Constant Current operation mode
2	4	NFLT	No Fault
3	8	0	Not Used
4	16	AST	Auto Start Enabled
5	32	FBE	Foldback Enabled
6	64	0	Not Used
7	128	LOC	Local / Remote communication mode
8	256	UVP	Under Voltage Protection enabled
9	512	ILC enable	Interlock control Enabled
10	1024	ENA enable	Enable control Enabled
11	2048	CFB	CC operation mode Foldback enabled
12	4096	EVR	External Voltage Reference Programming
13	8192	ECR	External Current Reference Programming
14	16384	CPE	Constant Power Enabled
15	32768	CP	Constant Power operation mode

Table 6-8: Bit Configuration of Operational Condition Register

6.3.4   Command Error ("Cxx")

Power supply responds with a command error if it receives an unrecognized command or a command, which is recognized, but cannot be executed. Command error response format is 'Cnn<CR>' where 'nn' is '01' to '05'. The following execution error commands are available:

C01 Illegal command or query

C02 Missing parameter

C03 Illegal parameter

C04 Checksum error

C05 Setting out of range

6.3.5   Execution Error ("Exx")

Power supply responds with an execution error if it receives a valid command, but it cannot execute the command at that time, because another setting prevents it. The execution error response format is 'Enn<CR>' where 'nn' is '01' to '08'. The following error commands are available:

E01   Cannot program voltage above the OVP setting (*1)

E02   Cannot program voltage below the UVL setting (*2)

E04   Cannot set OVP below the programmed voltage (*3)

E06   Cannot set UVL above the programmed voltage (*4)

E07   Cannot set OUTPUT ON during fault shut down

E08   General Error (*5)

*1: E01 - Returned if 105% of the 'PV' value is greater than the 'OVP' setting.

*2: E02 - Returned if the 'PV' value is less than 105% of the 'UVL' setting.

*3: E04 - Returned if 'OVP' value is less than 105% of the 'PV' setting.

*4: E06 - Returned if 105% of the 'UVL' value is greater than the 'PV' setting.

*5: E08 - Returned if an attempt to set an operation mode (Internal Resistance, Constant Power, Sequencer, Slew-Rate, or Analog Programming) if another operation mode is enabled or loading an empty memory cell. Only one of the following operation modes can be active at a time: Constant Power, Internal Resistance, Sequencer, Analog Programming, or Slew-Rate.

6.3.6   Service Request (SRQ)

SRQ is defined as the only specific case in which the power supply can initiate a message out over the serial bus. Any other message from the power supply to the controller (HOST PC) is sent as a response to a query.

SRQ is used to alert the HOST PC that a certain change to the power supply has occurred. SRQ is sent if the contents of the Status (SEVE) or Fault (FEVE) registers changes from all zeroes to any bit(s) set. Additional events set additional bits in the fault or status event registers, but no additional SRQs are sent until SEVE and/or FEVE is cleared by reading its contents.

SRQ message format is: 'nn nn<CR>'. This is 0x80 + power supply address repeated twice and a carriage return.

CHAPTER 7:   IEEE OPTION

7.1   General

General Purpose Interface Bus (GPIB, also referred as IEEE), factory installed as an option, allows operation of the **G∃NESYS™** power supply from a controller/computer via IEEE-488.

The interface allows the user a remote control of the power supply, including output voltage, current setting and monitoring, protection setting, trigger, waveform list operation, power supply status, SRQ reporting, and more.

Communication over the GPIB interface meets the IEEE 488.2 standard for Programmable Instrumentation (SCPI) compliant.

7.2   IEEE-488.2 Interface

The IEEE-488 digital programming interface (also called the GPIB interface) is a popular way to connect instruments to a computer. It uses a specialized 24-pin cable with connectors that allow cables to be 'stacked' together. There are eight data wires, eight control wires, and eight ground wires. If the system runs from a personal computer, there are numerous vendors of IEEE controller cards and software.

Because many instruments may be connected and independently controlled by a single IEEE controller, each instrument must have a unique address. The IEEE controller automatically sets its address, identical to the power supply address.

For complete and specific information, refer to the following documents: ANSI/IEEE Std 488.1-1987 IEEE Standard Digital Interface for Programmable Instrumentation and ANSI/IEEE Std 488.2-1987 IEEE Standard Codes, Formats, Protocols and Common Commands.

7.3   Point to Point Connection

One IEEE Interface can control only one **G∃NESYS™** power supply. Refer to Figure 7–1.

- Each power supply must be configured to IEEE communication interface.
- Each unit must have a unique address, ranging from 0 to 31.
- Baud rate and language are automatically fixed to "115200" and "SCPI".

NOTE

Address 31 must be avoided because it is used for special command messages.

7.4 Multi Drop Connection

One IEEE Interface can control more than one **GΞNESYS™** power supply. A maximum of 31 units can be connected via RS485 interface to a power supply with the installed IEEE option. Refer to Figure 7–2.The power supply connected to a PC via the GPIB cable must be configured to an IEEE communication interface, the other must be configured to RS485 interface. Each unit must have a unique address, ranging from 0 to 31. IEEE module automatically receives the address of the unit into which it is installed. For RS485 interface, set Baud rate to "115200" bps and Communication Language to "SCPI".

7.4.1 Selecting a Single Power Supply in a Multi Drop Chain

All of the SCPI commands may be sent to any one of the Power Supplies in RS485 chain by sending the INSTrument:NSELect <NR1> command. All commands and queries will then apply only to the selected power supply, until a new INSTrument:NSELect <NR1> command is sent.

At Power-up, the IEEE master power supply is automatically selected.

After sending INSTrument:NSELect <NR1> command, it is recommended to verify the command by sending INSTrument:NSELect?, to make sure the following commands are not sent to the wrong power supply.

NOTE

Address 31 should be avoided on the GPIB connected power supply. Address 31 is used for special command messages. RS485 power supplies can be set to any address, excluding the address set on the GPIB connected power supply.
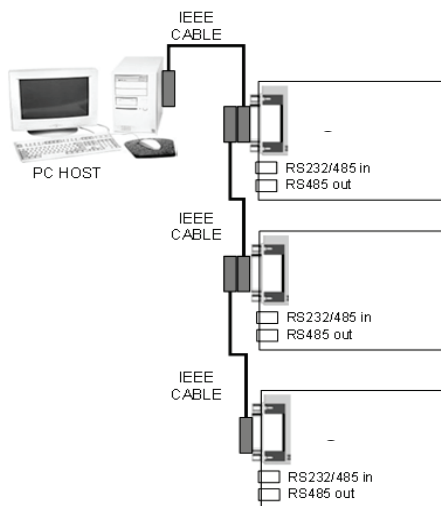
Figure 7–1: Point to Point Connection   **Figure 7–2: Multi Drop Connection**
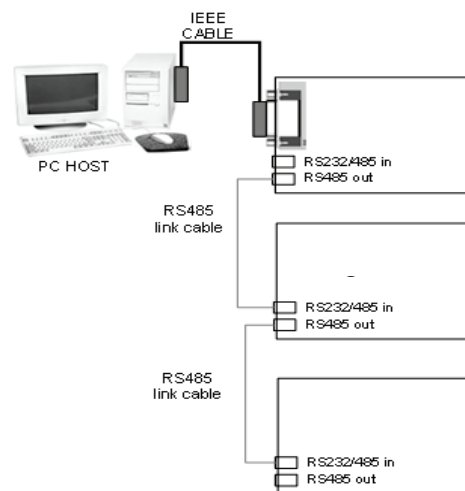
7.5 Communication Cables

- GPIB cable - Use standard IEEE-488, 26 AWG GPIB cable up to 3 meters in length.
- RS485 link cable - Use serial link cable with RJ-45 shielded connectors (P/N: GEN/RJ45).

7.6 IEEE Controller Configuration

A typical IEEE controller is a personal computer with an IEEE interface card. Each card vendor supplies its own configuration instructions and interface software.

Each time the software is executed, the controller is configured as follows:

- GPIB instrument address = Power supply address.
- Serial bus Baud Rate = 115200.
- SCPI protocol.
- EOI Flag = TRUE. The "End or Identify" is a control line in the IEEE cable that is initiated when the last character of a message string is sent. It is not supported by this interface.
- EOS Flag = FALSE: The "End of String", used in some instruments to indicate the last character of a message. It is required for this interface.

7.7 Power Supply Configuration

To communicate over the IEEE interface, power supply must be configured to IEEE. If IEEE option is installed, by default, power supply is pre-configured to the IEEE communication.

If, for any reason, IEEE communication is not selected, navigate to communication menu, and select OPT.

Refer to section 4.2.2 to set the IEEE communication interface via the Front Panel.

Refer to section 4.15.10, SYSTem:[COMMunicate]:INTerface <DSC> command to select communication interface by communication.

7.8 Execution Time

Command execution time through IEEE interface is longer than Serial communication. Refer to some examples below:

INST:NSEL 06	20 millisecond
OUTP:STAT?	25 millisecond
:VOLT 15	20 millisecond
WAVE:TIME 1,1,1,1,1,1,1,1,1,1,1,1	40 millisecond
WAVE:VOLT?	150 millisecond
SYST:ERR?	70 millisecond
*IDN?	90 millisecond
INST:NSEL?	35 millisecond

Add a delay between commands if the communication rate is high (many commands in series).

Refer to execution time above and estimate the required delay according to the application / applied command set.

7.9   Communication Example

This section provides an example of how to communicate with the IEEE option GENESYS™ power supply using the National Instruments™ MAX application.

1. Run the National Instruments™ MAX (Measurement & Automation Explorer).

Figure 7–3: National Instruments™ MAX – Desktop Icon

2. On the side tree, expand My System and select Devices and Interfaces -> "GPIB0".

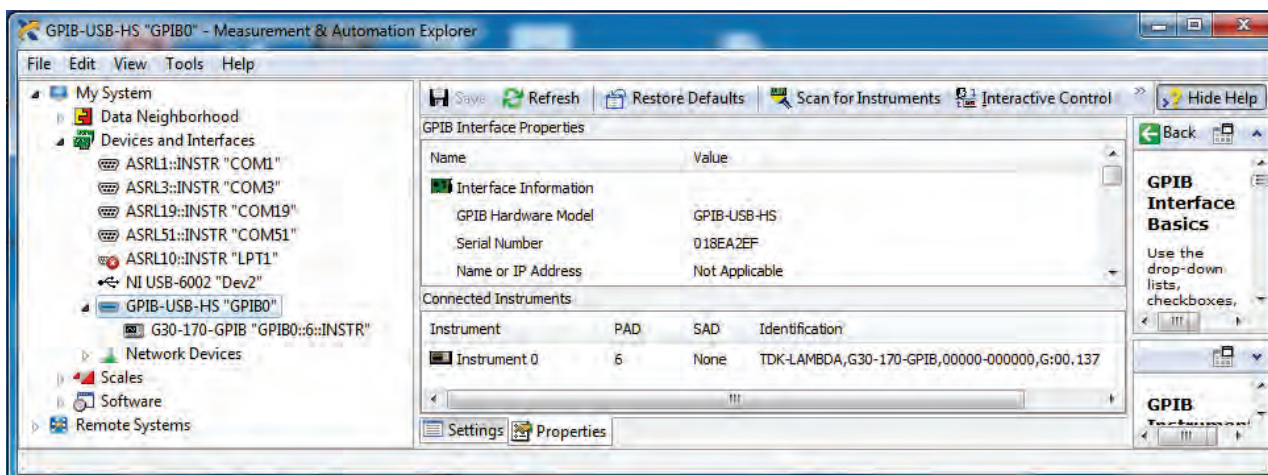3. In the GPIB Explorer toolbar, click Scan for Instruments. Refer to Figure 7–4.

Figure 7–4: Scan for Instruments

4. On the side tree, select GENESYS™ instrument (i.e., G30-170-GPIB) and review the device settings. Refer to Figure 7–5.
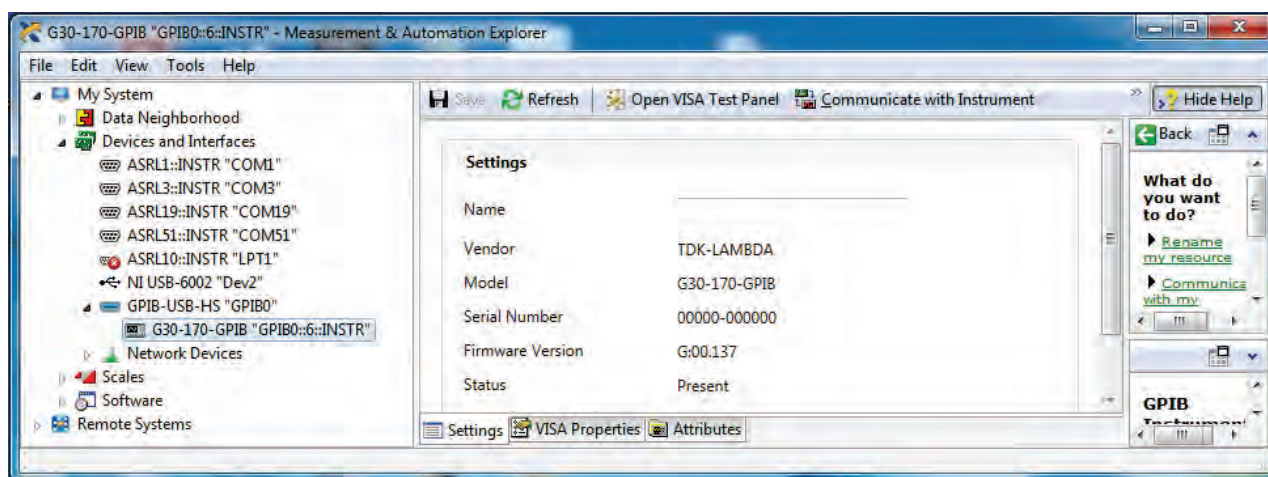
Figure 7–5: Instrument Properties

5. In the GPIB Explorer toolbar, click Communicate with Instrument.

NI-488.2 Communicator appears. Refer to Figure 7–6.
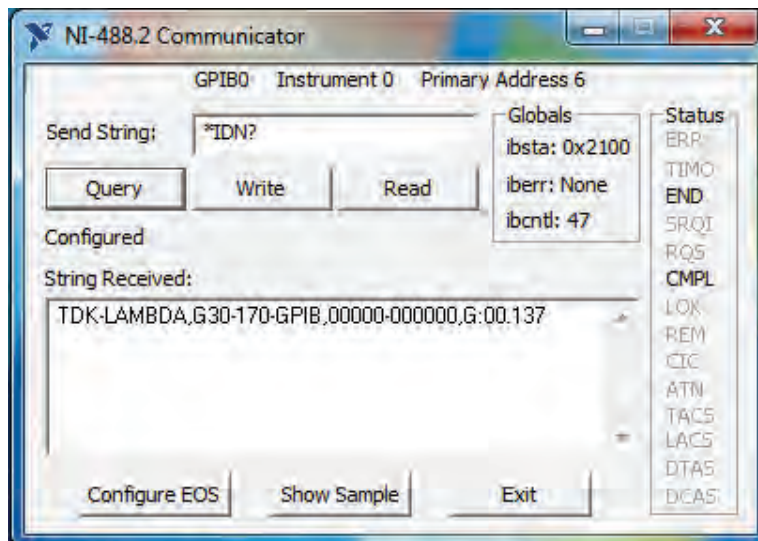
Figure 7–6: ID String Query

In the Send String: text box, *IDN? appears.

6. Click Query. Refer to Figure 7–6.

The ID string indicates the following:

- Company name

- Power supply model

- Serial number & main firmware revision.

CHAPTER 8: G+IS420 ANALOG PROGRAMMING OPTION

8.1 General

Isolated Analog Programming (4-20mA option, PN: G+IS420), factory installed as an option, allows operation of the GENESYS™ power supply from a 4-20mA current source.

Output Voltage and Current limit can be programmed and readback through optically isolated signals, which are isolated from all other ground references in the power supply.

8.2 Specifications

Programming Inputs	Output voltage programming accuracy	%	+/-0.8
	Output current programming accuracy	%	+/-0.8
	Output voltage programming temperature coefficient	PPM/°C	+/-200
	Output current programming temperature coefficient	PPM/°C	+/-200
	Input impedance	Ohm	50
	Absolute maximum input current	mA	0-30
	Max. voltage between program inputs and supply outputs	Vdc	600
Monitoring Outputs	Output voltage monitoring accuracy	%	+/-1
	Output current monitoring accuracy	%	+/-1
	Maximum load impedance	Ohm	500
	Max. voltage between monitoring outputs and supply outputs	Vdc	600

Table 8-1: G+IS420 Specifications

NOTE

Overall Warm-up drift / Temperature stability is equal to the unit's standard specification plus an additional +/-0.1% of rated Voltage / Current (deviation is due to G+IS420 card).

8.3 Isolated Programming & Monitoring Connector

Control and monitoring signals are optically isolated from all other ground references in the power supply.

Connector Technical Information:

Connector type: 618009211821, WURTH
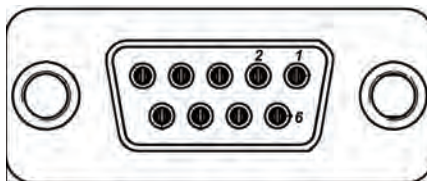
Figure 8–1: J9 Connector Terminals and Functions

No.	Connection	Description
1	+VPROG_ISO	Output voltage programming input, 4-20mA
2	+IPROG_ISO	Output current programming input, 4-20mA
3	+VMON_ISO	Output voltage Monitoring, 4-20mA
4	+IMON_ISO	Output current Monitoring, 4-20mA
5	COM	COMMON. Return for programming signals.
6	N/A	
7	N/A	
8	N/A	
9	COM	COMMON. Return for monitoring signals.

Table 8-2: J9 Connector Terminals and Functions

NOTE

To achieve the lowest noise performance, it is recommended to use shielded-twisted pair wiring.

CAUTION

Keep VPGM and IPGM (J1-8 and J1-7) pins floating for power supplies equipped with G+IS420 interface. All other J1 functions may be used without restrictions. Refer to section 1.6 for a detailed description of J1 functions.

8.4 Isolated Analog Power Supply Setup

Set Remote Programming settings as follows:

1. Short J1-6 pin to J1-11 pin to enable Analog Programming.

2. Press the CONF button. CONF (GREEN) LED illuminates.

3. To set the Voltage channel to isolated analog programming source, rotate the Voltage encoder until $V.SRC$ appears on the voltage display (perform this step only if you would like to set voltage channel to isolated analog programming, otherwise, skip to step 5).

4. Rotate the Current encoder to set $E.VOL$. Press the Current encoder for selection, display blinks once to acknowledge the setting (perform this step only if you would like to set voltage channel to isolated analog programming, otherwise, skip to step 5).

5. To set the Current channel to isolated analog programming source, rotate the Voltage encoder until $C.SRC$ appears on the voltage display (perform this step only if you would like to set voltage channel to isolated analog programming, otherwise, skip to step 7).

6. Rotate the Current encoder to set $E.VOL$. Press the Current encoder for selection, display blinks once to acknowledge the setting (perform this step only if you would like to set voltage channel to isolated analog programming, otherwise, skip to step 7).

7. Rotate the Voltage encoder until RANGE appears on the voltage display.

8. Rotate the Current encoder to set 10 (External 10V). Press the Current encoder for selection, display blinks once to acknowledge the setting.

9. Exit CONF menu by pressing the Back button or the CONF button.

CAUTION

1. Use a floating outputs programming source to maintain the isolation of the power supply.

2. To prevent damage to the unit, do not program output voltage and/or current above power supply ratings.

8.5 Connection Diagram

8.5.1 Analog Programming

Follow Figure 8–2 to program power supply output voltage and/or current by Isolated Analog programming interface.
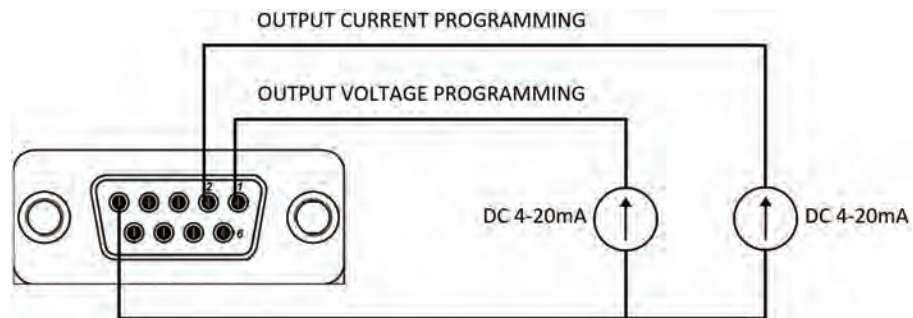
Figure 8–2: Isolated Analog Programming Wiring

8.5.2 Analog Monitoring

Follow Figure 8–3 to monitor power supply output voltage and/or current by Isolated Analog monitoring interface.
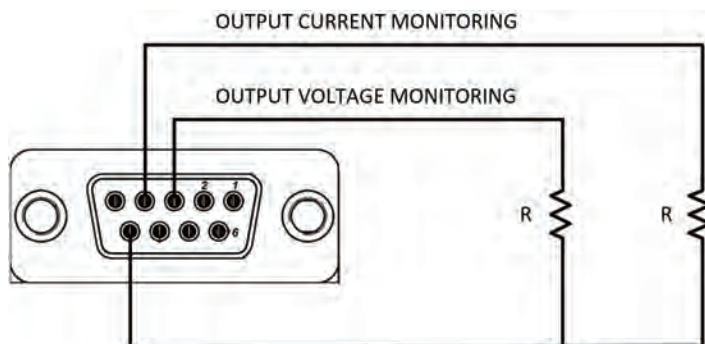
Figure 8–3: Isolated Analog Monitoring Wiring

NOTE

To limit the maximum analog programming current value (of the current programming channel), refer to section 5.7 (OCL).

CHAPTER 9:   G+PSINK POWER SINK OPTION

9.1   General

The power sink module allows the power supply to absorb energy fed back from the load. Internal logic module senses the output voltage on the busbars of the power supply. If the sensed voltage is **higher** than the desired voltage, the logic signals the power sink module to sink current across the output terminals, thus maintain a constant voltage at the load.

The Power Sink module also allows a faster response when the power supply is programmed to a lower output voltage.

- Absorbs 300W peak power.
- Ideal for electric motors (motors often return energy to the power supply during a brake action).
- Ideal for ATE systems, which require a fast response when the power supply is programmed to a lower output voltage.

CAUTION

To prevent damage to the power sink module and/or to the power supply:

1. Do not exceed the On and Off times (refer to Safety & Installation Manual, Specifications section).

2. Do not exceed peak power of 300W returned energy.

9.2   Power Sink Enable / Disable

To enable / disable power sink via power supply's front panel, act as follows:

1. Press the SYST button. SYST (GREEN) LED illuminates.

2. Rotate the Voltage encoder until PSINK appears on the voltage display.

3. Rotate the Current encoder to set ON or OFF. Press the Current encoder for selection, display blinks once to acknowledge the setting.

4. Exit SYST menu by pressing the Back button or the SYST button.

To enable / disable power sink via communication, refer to SYSTem:PSINk[:STATe] <Bool> command.

NOTES

1. When connecting multiple power supplies in parallel, these **CAN** have power sink module installed (a mix of power supplies with/without power sink module is possible).

2. When connecting multiple power supplies in series, **ALL** of these **MUST** have power sink module installed, otherwise, no power could be absorbed.

3. If power sink module is overloaded, OTP fault is triggered. OTP is seen on the front panel; power supply output shuts down.

4. When power supply output is turned off, power sink module will remain **ACTIVE** for 5 seconds.

5. For power sink detailed specification, refer to Safety & Installation Manual, Specifications section.

CHAPTER 10:   MAINTENANCE

10.1   Introduction

This chapter provides information about maintenance, calibration, and troubleshooting.

10.2   Units under Warranty

Units requiring repair during the warranty period should be returned to a TDK Lambda authorized service facility.

Further technical assistance, if needed, may be obtained at TDK-Lambda Technical Centre:

https://www.emea.lambda.tdk.com/about_global

Repairs performed by other than the authorized service facilities may void the warranty.

10.3   Periodic Maintenance

For standard models (without air filter), NO routine maintenance of the power supply is required except for periodic cleaning.

To clean the device:

1.   Disconnect the unit from the AC supply and allow 30sec. for discharging internal voltage.

2.   To clean the front panel and the metal surfaces, use a mild solution of detergent and water.

   The solution should be applied onto a soft cloth, and not directly to the surface of the unit.

CAUTION

Do not use aromatic hydrocarbons or chlorinated solvents for cleaning. Use low pressure compressed air to blow dust from the unit.

3.   For units with optional air filter assembled, refer to Air Filter Kit Manual for maintenance instructions.

10.4   Adjustments and Calibration

No internal adjustment or calibration is required. There is NO REASON to open the power supply cover.

Cover removal is allowed only by TDK-Lambda qualified service personnel.

10.5   Parts Replacement and Repairs

As repairs are made only by the manufacturer or by authorized service facilities, no parts replacement information is provided in the manual. In case of failure, unusual or erratic operation of the unit, contact the TDK Lambda sales or service facility nearest you.

Further technical assistance, if needed, may be obtained at TDK-Lambda Technical Centre:

https://www.emea.lambda.tdk.com/about_global

10.6   Troubleshooting

If the power supply appears to be operating improperly, use the Table 10-1 to determine whether the power supply, load or external control circuits are the cause.

Configure the power supply for basic front panel operation and perform the tests listed in Safety & Installation manual, Turn-On Checkout Procedure section to determine whether the problem can be found with the power supply.

Table 10-1 provides the basic checks that can be performed to diagnose problems, and references to relevant sections of this manual for further information.

SYMPTOM	CHECK	ACTION	REF.
No output. All displays and indicators are blank.	Is the AC power cord defective?	Check continuity and replace if necessary.	Safety & Installation Manual (*)
	Is the AC input voltage within range?	Check input AC voltage. Connect to appropriate voltage source.	Safety & Installation Manual (*)
Output is present momentarily but shuts off quickly. The display indicates: AC FAULT.	Does the AC source voltage sag when load is applied?	Check input AC voltage. Connect to appropriate voltage source.	Safety & Installation Manual (*)
Output voltage does not adjust. Front panel CC indicator is on.	Is the unit in constant current mode?	Check current settings and load current.	2.4
Output voltage does not adjust. Front panel CV indicator is on.	Output voltage cannot be adjusted above OVP setting or below UVL setting via the Front Panel or communication.	Set OVP or UVL not to limit the output.	2.9.2 2.9.3
Output current does not adjust. Front panel CV indicator is on.	Is the unit in constant voltage mode?	Check the current and voltage settings.	2.3 2.4
Large ripple present in output.	Is the power supply in the Remote sense? Is the voltage drop on the load wire high?	Check load and sense wire connections for noise and impedance effects. Minimize the drop on the load wires.	Safety & Installation Manual (*) 2.2
No output. Display indicates OVP	Over Voltage Protection circuit has tripped.	Turn off the AC power to the unit. Check load connections. If analog programming is used, check if the OVP is set lower than the output.	2.9.2
No output.	Display indicates SO	Check if the rear panel J1 Output Daisy is in function.	2.11.1

SYMPTOM	CHECK	ACTION	REF.
No output. Front panel Alarm LED blinks at 0.5Hz frequency.	Display indicates ILC_FAULT	Check the Rear Panel J1 Interlock connection & Functionality.	2.12.1
	Display indicates ENA_FAULT	Check the Rear Panel J1 Enable connection & Functionality.	2.12.2
No output. Front panel Alarm LED blinks at 0.5Hz frequency.	Display indicates FOLD FAULT	Check the Foldback setting and load current.	2.9.4
	Display indicates OTP	Check if air intake or exhaust are blocked. Check if the unit is installed adjacent to heat generating equipment.	2.9.6
Poor Load regulation Front panel CV indicator is on.	Are sensing wires connected properly?	Connect the sense wires according to User Manual instructions.	Safety & Installation Manual (*)
Front Panel controls are non-functional.	Is the power supply in Local-Lockout mode?	Press SYST button. SYST (GREEN) LED illuminates. Press Current encoder to switch between panel Lock state to panel Unlock state. Display shows the state to be selected.	4.2.7
No output.	Display indicates "GNRL ERROR"	Perform AC recycle. If problem persists, contact TDK-Lambda service.	

(*) Refer to the relevant item in the Safety & Installation manual

Table 10-1: Troubleshooting

10.7 Fuse Rating

There are no user replaceable fuses in the power supply. Internal fuses are sized for fault protection. If a fuse has been opened, power supply requires service.

Fuse replacement should be made by qualified technical personnel.

Refer to Safety & Installation manual for a listing of the fuses.

10.1   Einleitung

Dieses Kapitel enthält Informationen über Instandhaltung, Kalibrierung und Fehlersuche.

10.2   Gewährleistungseinheiten

Geräte, die während der Garantiezeit repariert werden müssen, sollten an eine von TDK Lambda autorisierte Serviceeinrichtung geschickt werden.

Weitere technische Unterstützung erhalten Sie bei Bedarf im TDK-Lambda Technikzentrum:

https://www.emea.lambda.tdk.com/about_global

Reparaturen, die nicht von einer autorisierten Werkstatt durchgeführt werden, können zum Erlöschen der Garantie führen.

10.3   Regelmäßige Wartung

Die Standardgeräte (ohne Luftfilter-Option) erfordern über die regelmäßige Reinigung hinaus keine routinemäßige Wartung.

Reinigung:

1. Zur Reinigung das Gerät vom Netzanschluss trennen und 30 Sekunden warten, bis intern vorhandene geladene Spannungen bzw. Energieinhalte abgebaut sind.

2. Die Frontplatte und die Metalloberflächen dürfen nur mit einer sanften Lösung aus Reinigungsmitteln und Wasser gereinigt werden.

Die Lösung auf ein weiches Tuch geben, nicht direkt auf die Oberfläche des Gerätes aufbringen.

VORSICHT

Zur Reinigung keine aromatischen Kohlenwasserstoffe oder chlorhaltige Lösungsmittel verwenden. Im Gerät angesammelter Staub kann mit Niedrigdruck-Pressluft herausgeblasen werden.

3. Bei Geräten mit optionalem Luftfilter-Aufsatz finden Sie im Handbuch Luftfilter-Kit weitere Informationen zur Wartung.

10.4   Einstellungen und Kalibrierung

Es ist intern keine Einstellung oder Kalibrierung erforderlich. Es gibt KEINEN GRUND, die Abdeckung des Netzgerätes zu öffnen.

Das Entfernen des Gerätedeckels ist nur durch TDK-Lambda qualifiziertes Service-Personal erlaubt.

10.5   Bauteilewechsel und Reparaturen

Da Reparaturen ausschließlich vom Hersteller oder von zugelassenen Servicestellen ausgeführt werden, enthält dieses Handbuch keine Informationen zum Austausch von Teilen. Bei Ausfall,

ungewöhnlichem oder fehlerhaftem Betrieb des Gerätes ist die nächstgelegene TDK-Lambda Verkaufsniederlassung oder Servicestelle zu kontaktieren.

Weitere technische Unterstützung erhalten Sie bei Bedarf im TDK-Lambda Technikzentrum: https://www.emea.lambda.tdk.com/about_global

10.6 Fehlersuche

Sollte die Stromversorgung nicht wie erwartet funktionieren, kann die nachfolgende Tabelle zur Problemanalyse helfen, herauszufinden, ob die Stromversorgung, die Last oder eine externe Steuerung die Ursache dafür sind. Dafür konfigurieren Sie bitte das Netzgerät für den lokalen frontgesteuerten Betrieb und führen Sie die angeführten Tests im Kapitel 3.7 durch, um festzustellen, ob das Problem am Netzgerät liegt.

Die Table 10-2 enthält die grundlegenden Tests zur Ausführung einer Problemdiagnose und liefert Hinweise auf Abschnitte dieses Handbuches, welche weiterführende Informationen enthalten.

Feststellung	PRÜFEN	Nächster Schritt	BEZUG
Kein Ausgang. Alle Anzeigen und LED's sind aus.	Ist das Netzkabel defekt?	Durchgängigkeit prüfen und Kabel bei Bedarf austauschen.	Safety & Installation Manual (*)
	Liegt die Netzspannung innerhalb des Nenn-eingangsbereiches?	Eingangsnetzspannung prüfen. An entsprechende Versorgungsspannung anschließen.	Safety & Installation Manual (*)
Ausgangsspannung liegt kurzfristig an, schaltet aber sofort wieder ab. Das Display zeigt: "AC FAULT".	Fällt die AC-Spannung der Quelle ab, wenn ein Verbraucher ange-schlossen ist?	Eingangsnetzspannung prüfen. An entsprechende Versorgungsspannung anschließen.	Safety & Installation Manual (*)
Ausgangsspannung lässt sich nicht einstellen. CC LED an der Frontplatte leuchtet.	Arbeitet das Gerät im Konstantstrom-Modus?	Eingestellter Strombegrenzungswert und Laststrom prüfen.	2.4
Ausgangsspannung lässt sich nicht einstellen. CV LED an der Frontplatte leuchtet.	Prüfen, ob die Einstellung der Ausgangsspannung über der OVP- oder unter der UVL-Begrenzung liegt.	OVP bzw. UVL so einstellen, dass keine Einschränkung des jeweiligen Einstellbereichs der Ausgangsspannung ergibt.	2.9.2 2.9.3
Ausgangsstromlässt sich nicht einstellen. CV LED an der Frontplatte leuchtet	Arbeitet das Gerät im Konstantspannungs-Modus?	Strombegrenzung und Spannungseinstellungen prüfen.	2.3 2.4
Die Ausgangsspannung hat eine hohe Restwelligkeit.	Ist das Netzgerät auf Remote Sense eingestellt? Ist der Spannungsabfall sehr hoch?	Last- und Sense-Leitungen auf Störungs- und Impedanzwirkung überprüfen. Spannungsabfall an den Lastleitungen verringern.	Safety & Installation Manual (*) 2.2
Kein Ausgang. Am Display wird "OVP" angezeigt.	Die Überspannungsschutz-Abschaltung hat ausgelöst.	Gerät mit dem Netzschalter abschalten. Lastverbindungen prüfen. Falls analoge Programmierung verwendet wird, ist zu	2.9.2

Feststellung	PRÜFEN	Nächster Schritt	BEZUG
		prüfen, ob die Einstellung für den OVP niedriger als die Ausgangsspannung eingestellt ist.	
Kein Ausgang.	Display zeigt "SO" an.	An der Rückseite die Shut Off Funktion an J1 Anschluss prüfen.	2.11.1
Kein Ausgang. Frontseitige Alarm LED blinkt an der Frontplatte mit 0.5Hz.	Display zeigt "ILC_FAULT" an.	An der Rückseite den Interlock-Anschluss und deren Funktion am J1-Stecker prüfen.	2.12.1
	Display zeigt "ENA_FAULT" an.	An der Rückseite den ENA-Anschluss und deren Funktion am J1-Stecker prüfen.	2.12.2
Kein Ausgang. Frontseitige Alarm LED blinkt an der Frontplatte mit 0.5Hz.	Display zeigt "Fold Fault" an.	Foldback-Einstellung und Laststrom prüfen.	2.9.4
	Display zeigt "OTP" an.	Prüfe, ob Lufteinlass- oder Ausstoßöffnungen verschlossen bzw. Blockiert sind oder ob sich Heizquellen in der Nähe befinden.	2.9.6
Schlechte Lastregelung. CV LED ist an.	Sind die Senseleitungen korrekt angeschlossen?	Senseleitungen gemäß Anweisungen im Handbuch anschließen.	Safety & Installation Manual (*)
Die Bedienelemente an der Frontplatte sind außer Funktion.	Wird das Netzgerät im Local-Lockout Modus betrieben?	SYST. Taste drücken, SYST.(GREEN) LED leuchtet. Stromeinstellregler drücken um zwischen den Modi „Frontplatte verriegelt" (Lock) und „Frontplatte nicht verriegelt" (Unlock) zu wechseln. Das Display zeigt dann den gewählten Modus an.	4.2.7
Kein Ausgang	Display zeigt "GNRL ERROR" an.	Versuchen Sie durch Netzwiederkehr den Modus zu resetten. Wenn nicht möglich kontaktieren Sie die nächstgelegene TDK-Lambda Servicestätte.	

(*) Weitere Informationen entnehmen Sie den jeweiligen Abschnitten des beiliegenden Handbuches.

Table 10-2: Problemanalyse

10.7 Netzsicherungswert

Im Gerät befindliche Sicherungen können nicht durch den Anwender ersetzt werden.

Die internen Sicherungen trennen das Gerät im Fehlerfall von der Netzspannung und dienen als Fehlerschutzelement.

Hat die Sicherung ausgelöst, ist das Gerät defekt und muss zum Service eingeschickt werden.

Die Sicherung darf nur durch qualifizierte technische Fachkräfte ausgetauscht werden.

Weitere Informationen zu den internen Sicherungen, entnehmen Sie dem Safety & Installation Manual.

CHAPTER 11:   INDEX