FAST-PS

Current- and Voltage-Controlled Bipolar Digital Power Supply Series

CAENels
Gear For Science

Fast Interface

MAGNET POWER SUPPLY SYSTEMS

Rev. 2 – August 2024

CAEN ELS s.r.l.
Via Karl Ludwig Von Bruck 32– 34144 Trieste (TS)
Italy
Mail: info@caenels.com
Web: www.caenels.com

Table Of Contents

Document Revisions

Revision	Date	Comment
0.4	February 2016	Draft Release
1.0.0	June 2016	Updated the manual with the description of the last version of the protocol
1.0.1	July 2016	Updated some commands
1.0.2	November 2016	Added Multicast compatibility
1.0.3	May 2018	Updated description of the fields
1.0.4	October 2020	Updated description
2	August 8th 2024	Updated address and revision numbering

1. Introduction

This chapter describes the general characteristics of the Fast Interface of the FAST-PS power supply series.

1.1 Fast Interface Overview

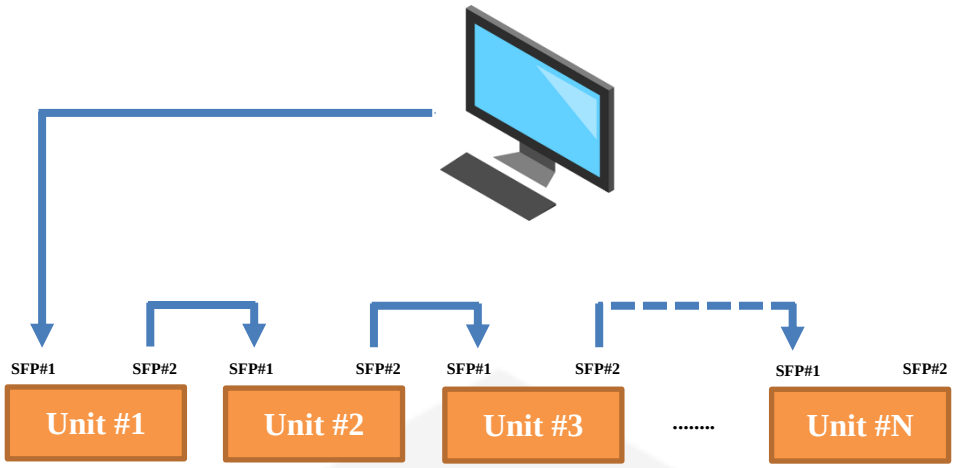
The Fast Interface allows to control the power unit with a deterministic and high-speed protocol. The Fast Interface uses one or both hot-pluggable Small Form-Factor Pluggable (SFP) transceivers, which slots are present on the front panel of the power unit. The SFP slot is compatible with:

- 1000BASE-X (Optical fiber) and 1000BASE-T (Electrical) standards,
- 1000 Mbps speed (10Mbps and 100Mbps are not supported),
- Auto-negotiation is disabled.

The Fast Interface is based on a standard Unicast or Broadcast or Multicast UDP IPv4 packet. This choice allows to control generate the packet directly from a standard PC and to interconnect the power supplies using a standard Ethernet network. The structure of the custom Fast Interface packets is described in the following sections. The power modules can be connected in three different ways:

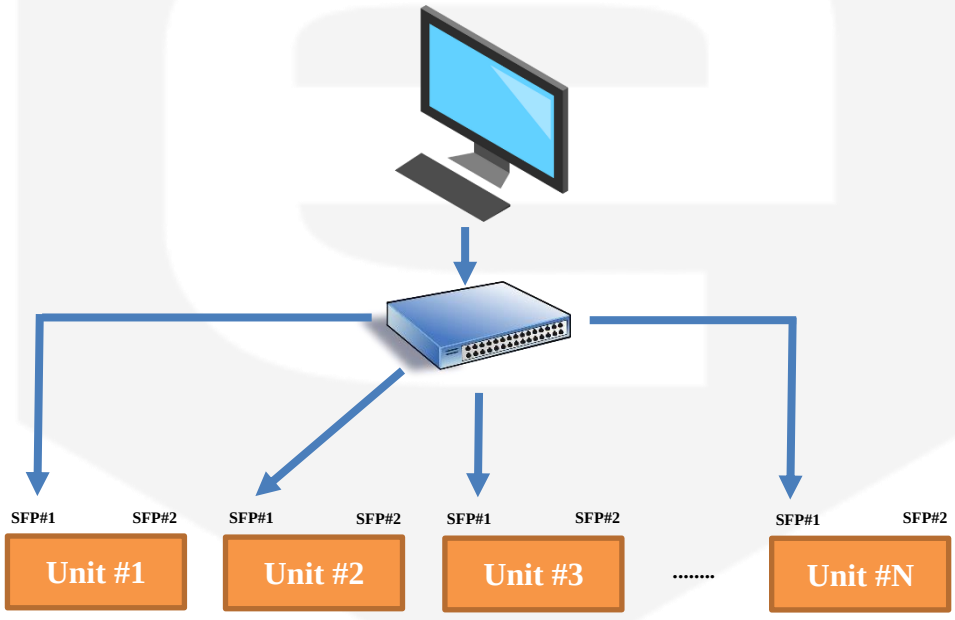
i. DAISY-CHAIN Connection

In this mode of operation the Host PC is connected with the first unit using the SFP#1 port. The SFP#2 port of the first module is connected with the SFP#1 port of the next module and so on. Every unit replicates the incoming packet to the SFP#2 port, for this reason every module receive the generated packet form the Host PC.



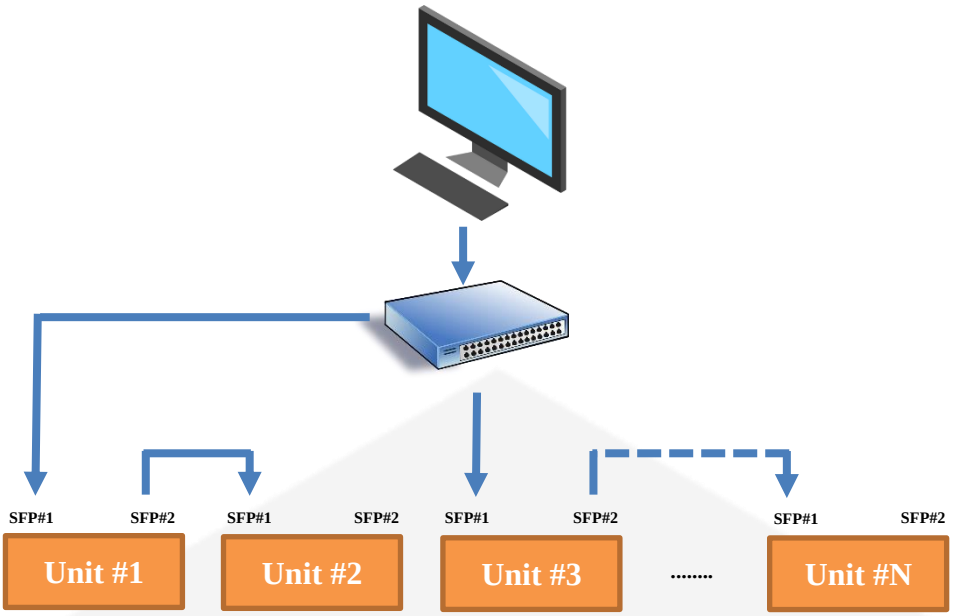
ii. STAR Connection

In this mode of operation the Host PC is connected through a network switch. In this case only the port SFP#1 is used. The packets generated from the Host PC are received and elaborated from all units.



iii. MIXED Connection

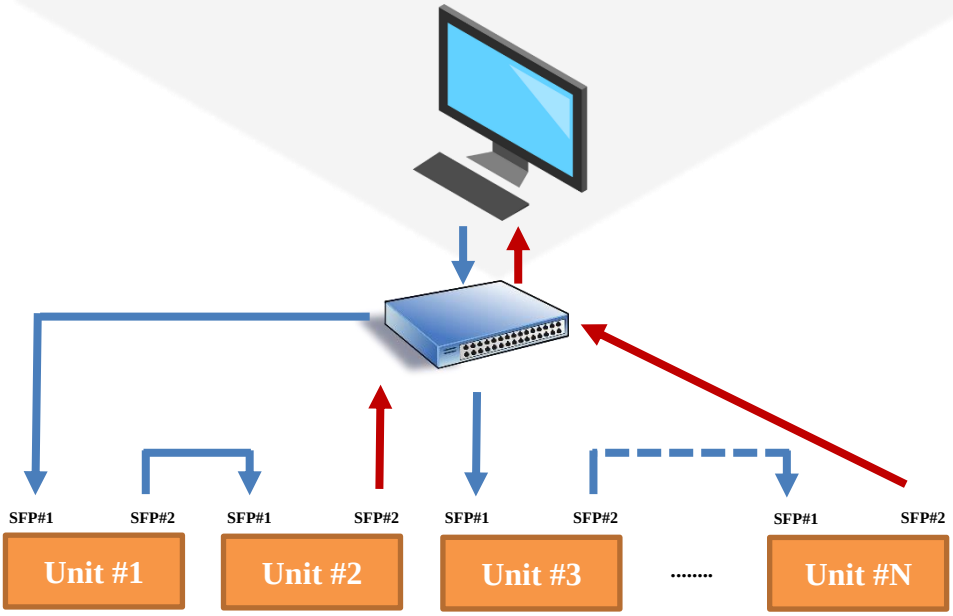
In this mode of operation the Host PC is connected to the power units using both previous described connections. The packet generated from the Host PC are received by the power units directly or through the daisy-chain connection.



The unit can receive the packets from the network in three different ways:

- **UNICAST**: packet sent to its MAC address and its IP address
- **MULTICAST**: packet sent to its Multicast MAC address (01:00:5E:00:02:16)
- **BROADCAST**: packet sent to broadcast MAC (FF:FF:FF:FF:FF) and broadcast IP (255.255.255.255)

In any case the packet is forwarded to SFP #2 and so if a feedback is needed the SFP #2 port should be connected to the network to receive back the data. More detailed information are given in the following chapter.



1.2 Fast Interface UDP protocol

The Fast Interface is based on a standard UDP IPv4 packet. This transmission model has a minimum protocol mechanism and it has no handshaking dialogues. The UDP header consists of 4 fields, each of 16 bits (source port, destination port, length and checksum). The header is concatenated with UDP data.

The standard structure of an UDP packet is the following:

Word #	bits[31:16]	bits[15:0]
1	Source port	Destination port
2	Length	Checksum
…	UDP data	

The meaning of each field is hereafter represented:

- **Source port (2 bytes):** This field identifies the sender's port and is assumed to be the port to which the reply will be sent.
- **Destination port (2 bytes):** This field identifies the receiver's port and will be a predefined port number. The standard Fast Feedback interface will work on port **30721**.
- **Length (2 bytes):** This field identifies the length in bytes of the UDP packet. For the Fast feedback packet, the length is **20 + (6·*n*) bytes**, where *n* is the number of the couples address-setpoint contained in the packet.
- **Checksum (2 bytes):** This field is used for error-checking of the UDP header and data. The checksum control is not performed.
- **UDP data:** This field contains the custom Fast Interface Set or Reply packet, which are described in the following sections.

1.2.1 UDP Data

The structure of the Fast Interface packet is the following:

Word #	bits[31:16]	bits[15:0]

1	Fast Protocol ID	Command
2	Nonce	
3		
4	Fast Address #1	Setpoint #1 MSB
5	Setpoint #1 LSB	Fast Address #2
6	Setpoint #2 MSB	Setpoint #2 LSB
…	……	
N-1	……	Fast Address #N
N	Setpoint #2 MSB	Setpoint #2 LSB

The meaning of each field is hereafter represented:

- **Fast protocol ID (2 bytes):** This field identifies is a unique ID that identifies the Fast protocol version. This field has to be equal to **0x7631**.

- **Command (2 bytes):** This field identifies the command to configure the Fast-PS actions.

Bit #	Name	Description
[0]	**Enable readback**	0: disable readback, 1: enable readback. When enabled, the setpoint is replaced with the readback value of current or voltage (see bit [1])
[1]	**I/V readback**	0: current readback, 1: voltage readback.
[31:2]	**Not used**	Not used

- **Nonce (8 bytes):** This fields holds a unique value for each packet. It could be for example a counter or a time stamp or something else. From the standard interface it is possible to read the last accepted value.

- **Fast Address (2 bytes):** This field identifies the unique fast protocol address that is associated to the power unit. It is editable using

- **Setpoint (4 bytes):** This field contains the setpoint for the power unit that has to be applied by the unit with the associated fast address. The representation of the setpoint is IEEE754 floating point representation.

Each packet can contain one or more pairs address-setpoint.

1.3 Configuration Commands

The SFP interface on FAST-PS has two parameters which can be configured:

- **Device Fast Address:** 16-bit unique ID, that identify the device. The setpoint reception is related to this address.
- **SFP IP address:** the communication is based on UDP packets and the setpoint elaboration is related to the Devise Fast Address and so the IP can be not needed. Anyhow to avoid any problem with the local network configuration it is possible also to set the IP address to the unit. In addition the unit replies the ICMP (Internet Control Message Protocol) and ARP (Address Resolution Protocol) protocol, for which the IP is needed. This option can be useful for testing purposes.

Please note that each FAST-PS has 2 separated IP addresses, one for TCP server available on standard Ethernet port and one for "Fast Protocol" communication protocol on **SFP1 port.**

1.3.1 Device Fast Address

The device Fast Address (ID) can be set from the standard interface using the MWG command. The field is located at **address 129** and it is parsed as 16-bit unsigned number in decimal format.

Example:

MWG:129:65535\r\n
#AK\r\n

This command requires elevated privileges (see PASSWORD command). The command takes effect immediately, but MSAVE command must be issued to store the new field in EEPROM permanently.

The SFP IP address can be read with MRG command.

Example:

MRG:129:?\r\n
#MRG:129:65535\r\n

1.3.2 SFP IP Address

SFP IP address can be set from the standard interface using the MWG command. To set the IP address, a specific field in EEPROM needs to be updated. The EEPROM field of SFP IP address is located at **address 123**.

Example:

MWG:123:192.168.0.100\r\n
#AK\r\n

This command requires elevated privileges (see PASSWORD command). The command takes effect immediately, but MSAVE command must be issued to store the new field in EEPROM permanently.

The SFP IP address can be read with MRG command.

Example:

MRG:123:?\r\n
#MRG:123:192.168.0.100\r\n

1.3.3 Update Mode

The fast-setpoint interface is always active, but the received setpoint is applied only if the Update mode of the power unit is set is set to SFP. To enable the SFP update mode, it is necessary to use the command UPMODE:SFP using the standard Ethernet interface:

Example:

UPMODE:SFP\r\n
#AK\r\n

1.3.4 Debug Last Command

There is a dedicated command that allows to read the last received SFP packet from the unit, this is the SFP:LAST_CMD command, that could be useful for debug purposes. The command returns the last received command, setpoint and nonce.

Example:

SPF:LAST_CMD\r\n
#SFP:LAST_CMD:\nLast cmd:0x1\n Last setpoint:1.11\nLast nonce:0x5c956d0f\r\n