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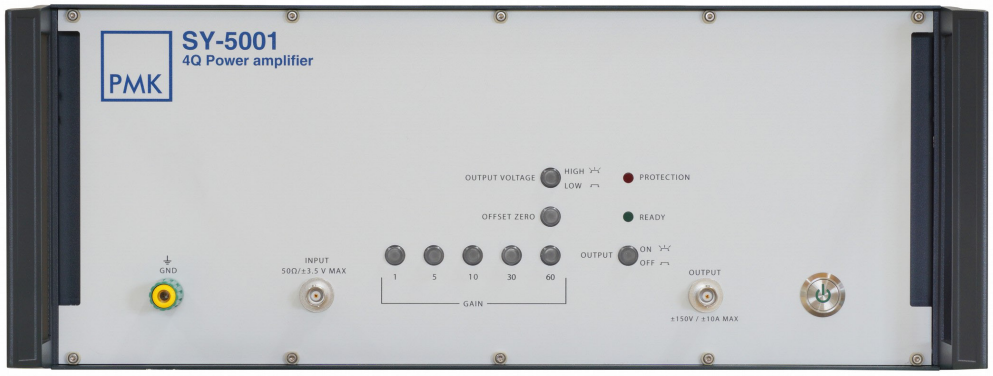

SY-5000 SERIES

4-Quadrant Voltage Amplifier
For Resistive and Inductive Loads

SY-5001 | DC – 5 MHz | 800 V/µs | ±150 V | ±5 A
SY-5002 | DC – 7 MHz | 450 V/µs | ±75 V | ±5 A

Instruction Manual

Contents

Manufacturer

PMK Mess- und Kommunikationstechnik GmbH
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Warranty

PMK warrants this product for normal use and operation within specifications for a period of one year from date of shipment and will repair or replace any defective product which was not damaged by negligence, misuse, improper installation, accident or unauthorized repair or modification by the buyer. This warranty is applicable only to defects due to material or workmanship. PMK disclaim any other implied warranties of merchantability or fitness for a particular purpose. PMK will not be liable for any indirect, special, incidental, or consequential damages (including damages for loss of profits, loss of business, loss of use or data, interruption of business and the like), even if PMK has been advised of the possibility of such damages arising from any defect or error in this manual or product.

IEC Safety Symbols

The following symbols may appear on the product or in this instruction manual:

Caution, risk of danger. Refer to manual.

Caution, risk of electric shock.

Earth (ground) TERMINAL.

Declaration of Conformity

PMK declares the conformity of this product with the actual required safety standards in accordance with the Low Voltage Directive (LVD) 2014/35/EU and EMC Directive 2014/30/EU:

CEI/IEC 61010-1:2010 - Safety requirements for electrical equipment for measurement, control and laboratory use

CEI/IEC 61326-1:2013 - Electrical equipment for measurement and laboratory use - EMC requirements Class A and basic levels

WEEE/ RoHS Directives

This electronic product is classified within the WEEE/ RoHS category list as monitoring and control equipment (category 9) and is compliant to the following EC Directives.

EC Directives:

WEEE Directive 2012/19/EU - Waste Electrical and Electronic Equipment

RoHS Directive 2011/65/EU - Restriction of the use of certain Hazardous Substances in Electrical and Electronic Equipment

Your help and efforts are required to protect and keep clean our environment. Therefore return this electronic product at the end of its life either to our Service Department or take care of separate WEEE collection and professional WEEE treatment yourself. Do not dispose as unsorted municipal waste.

Safety Information

To avoid personal injury and to prevent fire or damage to this product or products connected to it, review and comply with the following safety precautions as well as the caution section for each amplifier and the operating instructions.

Be aware that if you use this instrument in a manner not specified the protection this product provides may be impaired. No liability is assumed for consequences which arise from non-observance of the notes and warnings in this manual.

Caution - danger to life.
Dangerous voltages capable of causing death might be present when using this instrument. Use extreme caution when handling, testing and adjusting.

Only qualified personnel should use this instrument.

Ground the instrument.

The SY-5000 Series is a device of Protection Class I. In order to exclude the hazard of electric shocks, the device housing must be grounded and therefore always operated over the supplied three-conductor mains cable with protective ground conductor. Additionaly a 4 mm ground socket (protective earth) is available at the front panel.

Keep away from hazardous live circuits.
Avoid open circuitry. Do not touch connections or components when power is present.

Do not operate with suspected failures.
Refer to qualified service personnel.

Indoor use only.
Do not operate in wet or damp environment. Keep the product dry and clean.

Do not operate the product in explosive, wet or damp atmospheres.

Do not modify the instrument.

Do not open housing.
Device coverings may not be removed by operating personnel. Maintenance and repair work is exclusively reserved to qualified service personnel.

About 4-Quadrant Voltage Amplifiers

The SY-5000 are linear, extremely wideband precision power amplifiers. They are ideal for all applications that require fast changing signals at any purely resistive and inductive loads.

Two selectable operating voltages modes are available for high voltage/low current and low voltage/ high current applications. SY-5001 offers in addition switchable gain factors and automatic offset control. In case of very low impedance loads, choose the low operating voltage mode to reduce the power loss and increase the output current. The A models also include a slew rate limiter for more precise square wave signal output.

The devices are equipped with a temperature-controlled, low noise fan. Overtemperature protection, power-loss calculation and absolute-current monitoring guarantee perfect short-circuit and overload protection.

The amplifiers can be operated via operating elements on the front panel, and are also fully remote controllable via USB. SY-5001 can also be remote controled via GPIB with SCPI commands. Firmware updates can be installed by customer at any time.

Accessories Supplied

- These operating instructions
- Power cable

Maintenance

- **Cleaning the device**

Wipe over the test device with a soft, moist cloth. Do not use any chemical cleaners.

Specifications

Specifications that are not marked as guaranteed are typical, valid after 30 minutes warm-up time, mains voltage: 230 V / 50 Hz.

	SY-5001			SY-5002		
Signal input BNC	Input impedance	50 Ω ±2 %		Input impedance	50 Ω ±2 %	
	Gain	60 / 30 / 10 / 5/ 1 ±2 % (±100 ppm / °C)		Gain	30 ±1 % (±100 ppm / °C)	
	Input voltage range	±3 V		Input voltage range	±3.2 V	
	Input voltage (max.) [1]	±3.5 V		Input voltage (max.) [1]	±5 V	
Power output BNC	OFF position	Galvanic isolation from amplifier output and connection to GND.		OFF position	Low impedance 0 V output, can be switched to 100 kΩ to signal ground via remote command.	
Output voltage (50 Ω load, max. 3% THD)	HIGH mode	±150 V_{peak} (f < 800 kHz)		HIGH mode	-	
		±130 V_{peak} (f < 1 MHz)			±75 V_{peak} (f < 1 MHz)	
		±65 V_{peak} (f < 2 MHz)			±37.5 V_{peak} (f < 2 MHz)	
		±43 V_{peak} (f < 3 MHz)			±25 V_{peak} (f < 3 MHz)	
	LOW mode	±64 V_{peak} (f < 2 MHz)		LOW mode	±37.0 V_{peak} (f < 2 MHz)	
		±42 V_{peak} (f < 3 MHz)			±24.5 V_{peak} (f < 3 MHz)	
Output current	HIGH mode	Maximum	±2.5 A_{DC}	HIGH mode	Maximum	±2.5 A_{DC}
			±5.0 A_{AC} (f >10 Hz)			±5.0 A_{AC} (f >10 Hz)
		Impulse (< 5 ms)	±7.5 A_{peak}		Impulse (< 5 ms)	±6.0 A_{peak}
	LOW mode	Maximum	±5.0 A_{DC}	LOW mode	Maximum	±5.0 A_{DC}
			±10.0 A_{AC} (f >10 Hz)			±6.0 A_{AC} (f >10 Hz)
		Impulse (< 5 ms)	±15.0 A_{peak}		-	-
Over current switch off	±6 A [2] (initial)	Switch back on after 10 s [3]		±6 A	Switch back on after 10 s [3]	
Small signal bandwidth (100 mVrms @ 50 Ω load)	-3 dB	> 5 MHz		-3 dB	> 7 MHz	
	-1 dB	> 3 MHz		-1 dB	> 3 MHz	
Output offset voltage	±1.5 mV	±0.1 mV/°C		±2 mV	±0.1 mV/°C	
	±3 mV max.			±5 mV max.		
DC offset control	automatic, controllable via firmware			automatic		
Slew rate (50 Ω load)	> 800 V/µs			> 450 V/µs		
	640 V/µs with Slew Rate Limiter (only SY-5001A)			340 V/µs with Slew Rate Limiter (only SY-5002A)		
Rise time	< 380 ns	±150 V square wave @ 50 Ω load		< 270 ns	±75 V square wave @ 50 Ω load	
Noise	Gain 60	DC - 20 Hz	100 mV_{pp}	Gain 30	DC - 20 Hz	1.5 mV_{pp}
		20 Hz - 10 MHz	< 25 mV_{rms}		20 Hz - 10 MHz	< 10 mV_{rms}
	Gain 1 / 5 / 10 / 30	DC - 20 Hz	40 mV_{pp}	-		
		20 Hz - 10 MHz	< 6 mV_{rms}			
Distortion (50 Ω load)	< 0.1 %	100 kHz / 75 V_{peak}		< 0.1 %	100 kHz / 65 V_{peak}	
	< 1.0 %	700 kHz / 115 V_{peak}		< 1.0 %	800 kHz / 70 V_{peak}	
	< 1.0 %	1 MHz / 100 V_{peak}		< 1.0 %	1 MHz / 65 V_{peak}	
	< 1.0 %	2 MHz / 43 V_{peak}		< 1.0 %	2 MHz / 30 V_{peak}	
	< 1.0 %	3 MHz / 26 V_{peak}		< 1.0 %	3 MHz / 15 V_{peak}	
Output impedance	30 mΩ +0.33 µH			50 mΩ +0.3 µH		
Over temperature switch off	> 70 °C	Switch back on: < 50 °C [3]		> 70 °C	Switch back on: < 50 °C [3]	
Power loss [5] (permissible)	DC+ / DC-: 400 W up to 25 °C, linear decrease to 220 W at 70 °C			DC+ / DC-: 200 W up to 25 °C, linear decrease to 110 W at 70 °C		
	AC > 10 Hz: 800 W up to 25 °C, linear decrease to 440 W at 70 °C			AC > 10 Hz: 400 W up to 25 °C, linear decrease to 220 W at 70 °C		

[1] Maximum non-destructive input voltage. [2] Change current limit via remote control command. [3] Output stays off after recovery time. [4] "Maximum power dissipation".
[5] The generated power loss of AC signals depends on signal shape and phase angle between current and voltage.
This product comes with 1 year warranty. Specifications that are not marked as guaranteed are typical.

Specifications

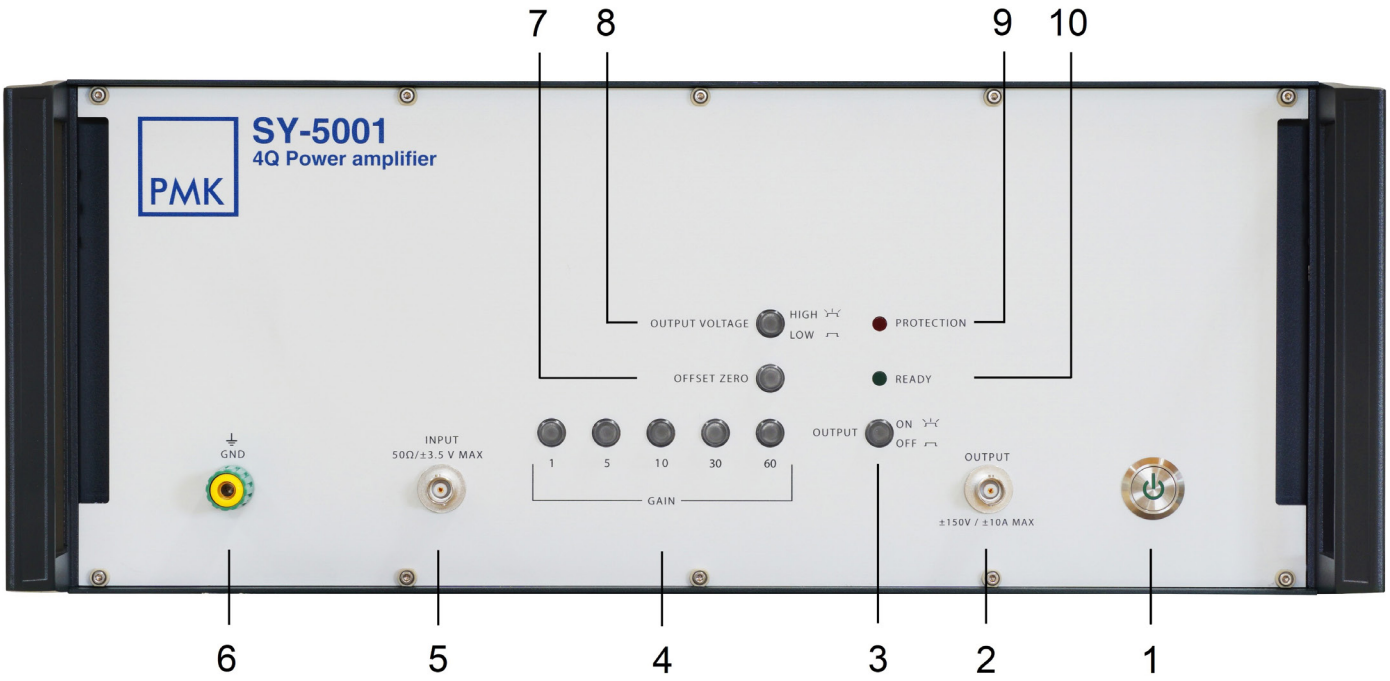
Specifications that are not marked as guaranteed are typical, valid after 30 minutes warm-up time, mains voltage: 230 V / 50 Hz.

	SY-5001		SY-5002	
Power loss switch off	See graph [4]	Switch back on after 10 s [3]	See graph [4]	Switch back on after 10 s [3]
Interfaces	USB, GPIB		USB	
Power input	100V / 115V / 220V / 230V / 240V; 50Hz / 60Hz Switchable by mechanical switch with protective plate		100V / 115V / 220V / 230V / 240V; 50Hz / 60Hz Switchable by mechanical switch with protective plate	
	Power consumption	max. 800 W	Power consumption	max. 450 W
	Overvoltage category	CAT II	Overvoltage category	CAT II
	Pollution degree	2	Pollution degree	2
Safety standard	IEC61010-1:2010		IEC61010-1:2010	
Operating temperature	10 °C to 40 °C		10 °C to 40 °C	
Humidity	80 % or less at 40 °C non-condensing		80 % or less at 40 °C non-condensing	
Cooling	Forced air		Forced air	
Dimensions (W x H x D)	449 x 178 x 435.5 mm		449 x 133 x 495.5 mm	
Weight	Approx. 19 kg		Approx. 14 kg	

[3] Output stays off after recovery time. [4] "Maximum power dissipation".
This product comes with 1 year warranty. Specifications that are not marked as guaranteed are typical.

Operating Elements, SY-5001

Front Panel Elements:



[1]: ON / STANDBY Switch to turn the amplifier from standby to „ON“. Switch to standby with output off [3] only.

[2]: OUTPUT Power connector for output (±150 V / ±10 A max.). In „OFF“ state the output is switched to signal ground.

[3]: OUTPUT Switch to turn the output „ON“ or „OFF“. The switch lights up when the amplifier is switched on.

[4]: GAIN The gain switches are used to adjust the overall gain of the amplifier. The LED of the selected amplification factor lights up permanently. Changing the gain triggers an automatic offset adjustment.

[5]: INPUT Signal input (±3 V input voltage range), input impedance 50 Ω, BNC.

[6]: GROUND SOCKET Protective earth connection.

[7]: OFFSET ZERO Switch to trigger, an DC offset adjustment. Lights up permanently after successful offset adjustment, flashes at approx. 1 Hz in the event of an error during the offset adjustment.

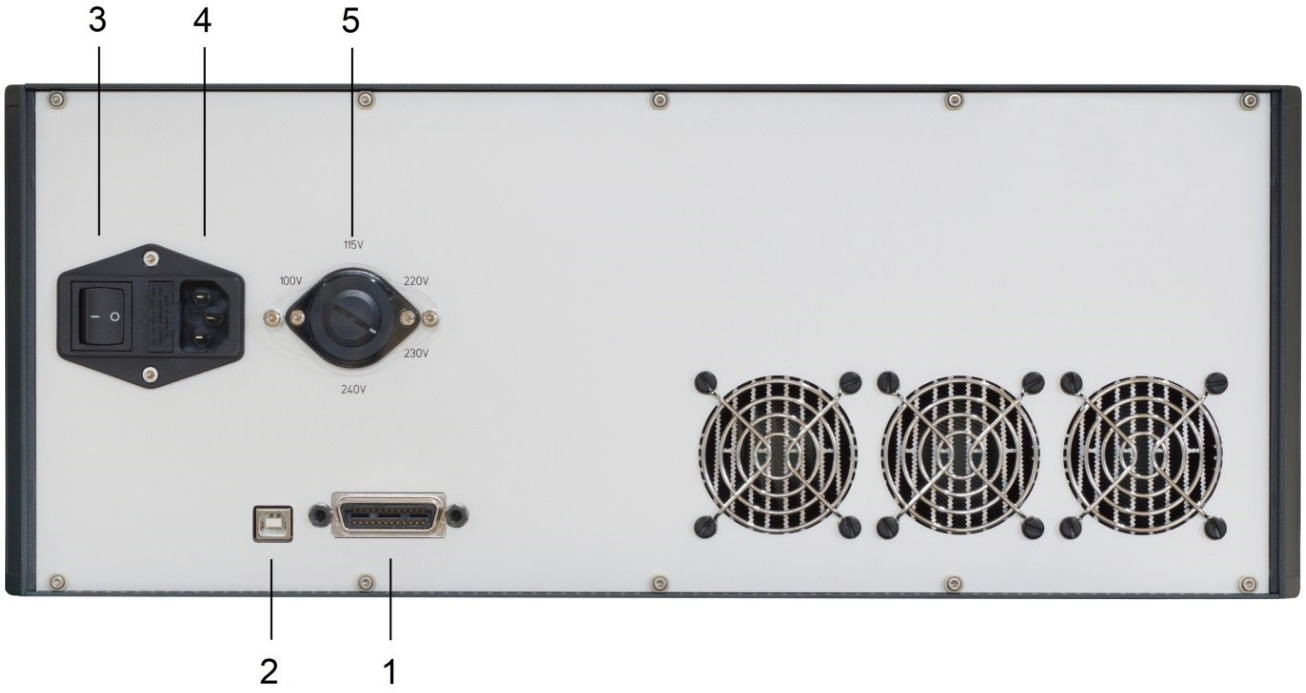
[8]: OUTPUT VOLTAGE HIGH / LOW Switch to change the output voltage mode from HIGH (±150 V) to LOW (±75 V) or vice versa. The LED lights up in HIGH voltage mode. Switch only when output is in idle state, e.g. deactivated, for amplifier board firmware V1-05 or lower.

[9]: PROTECTION Lights up continuously at an overtemperature, flashes slowly (1 Hz) when exceeding maximum current limit or permissible power loss, and flashes quickly (3 Hz) at a hardware defect.

[10] READY Lights up permanently when the amplifier is ready for operation.

Operating Elements, SY-5001

Back Panel Elements:



[1]: GPIB CONNECTOR IEEE488-2 connector for remote interface.

[2]: USB CONNECTOR TYPE B USB service interface for software updates, and for remote control.

[3]: MAINS SWITCH All-pole mains switch for complete mains isolation of the instrument.

[4]: MAINS SOCKET Socket for a C13 connector for mains supply.

[5]: SELECTABLE MAINS VOLTAGES Selectable AC mains voltages 100V / 115V / 220V / 230V / 240V.

CAUTION

Failure to observe this can lead to malfunctions or even destruction of the amplifier!
Please mind the local mains voltage before connecting the device.

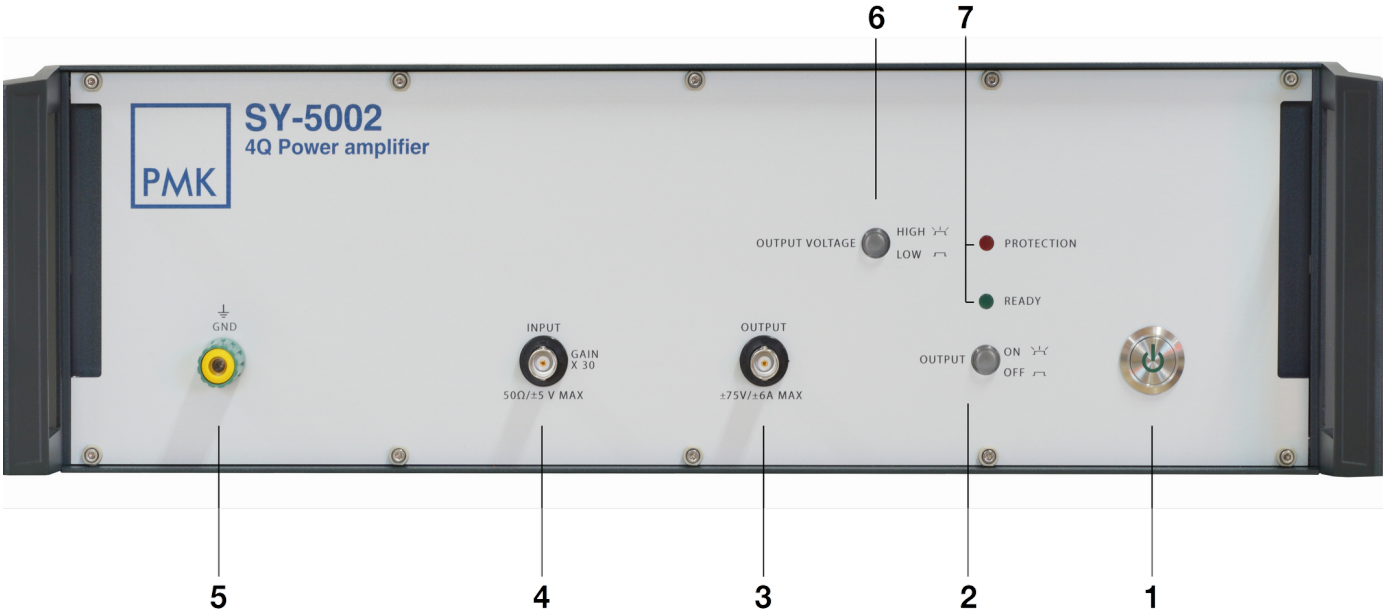
Switch to standby with output off only.

For amplifier firmware V1.05 or lower, switch output voltage HIGH / LOW only with output in idle state.

Overcurrent protection is an exceptional working condition and should be prevented in regular use.

Operating Elements, SY-5002

Front Panel Elements:



[1]: ON / STANDBY Switch to turn the amplifier from standby to „ON“. Switch to standby with output off [3] only.

[2]: OUTPUT Switch to turn the output „ON“ or „OFF“. The switch lights up when the output is switched on.

[3]: OUTPUT Power connector for output (±75 V / ±10 A max.) with isolated BNC socket. In „OFF“ state the output is pulled down with 100 kΩ to signal ground.

Reference potential is connected to protective earth via 1MΩ.

[4]: INPUT 50 Ω Signal input (±3.2 V input voltage range) with isolated BNC socket. Reference potential is connected to protective earth via 1MΩ.

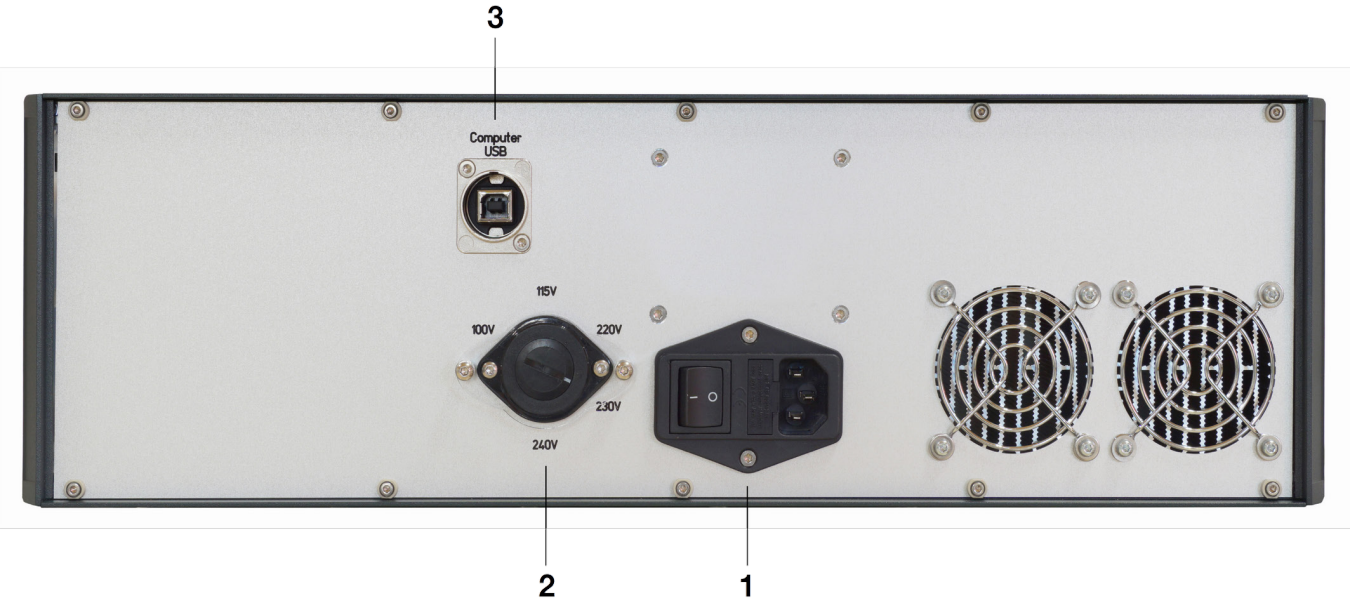
[5]: GROUND SOCKET Protective earth connection.

[6]: OUTPUT VOLTAGE HIGH / LOW Change the operating voltage mode with output in idle state, e.g. off, only:
HIGH (LED on): HIGH operating mode, output voltage up to ±75 V.
LOW (LED off): LOW operating mode, output voltage up to ±37.5 V; recommended with low impedance loads.

[7]: READY / PROTECTION
Green: Lights up when the amplifier is ready for operation („READY“).
Red: Protection mechanism is active (OUTPUT „OFF“).
Red LED lights up constantly: Over-temperature protection; the device switches on automatically after the drop of the temperature.
Red LED flashes slowly (1 Hz): Disconnection because of exceeded permissible power loss.
Red LED flashes rapidly (3 Hz): Hardware fault! Stop usage immidiately! The device needs repair and should be sent to the manufacturer.

Operating Elements, SY-5002

Back Panel Elements:



[1]: Plug for non-heating apparatus with mains switch and fuseholder Fuse 4 AT (5x20 mm).
All-pole mains switch for complete mains isolation of the amplifier.
Socket for a C13 connector for mains supply.

[2]: Selectable mains voltages Selectable AC mains voltages 100 V / 115 V / 220 V / 230 V / 240 V.

[3]: USB-B socket USB service port for connection to a computer (emulated COM-Port) for remote control and firmware updates.

CAUTION

Failure to observe this can lead to malfunctions or even destruction of the amplifier!

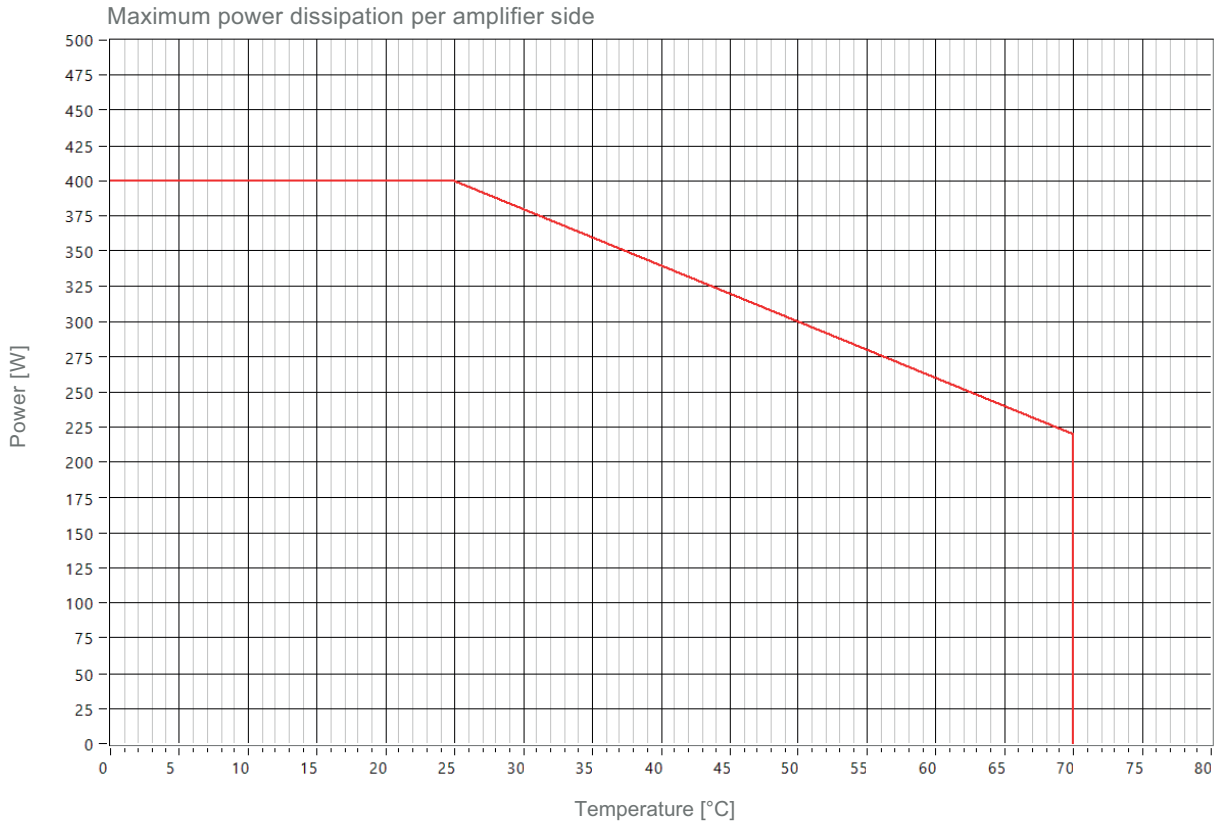
Please mind the local mains voltage before connecting the device.

Change the operating voltage mode with output in idle state only e.g. off.

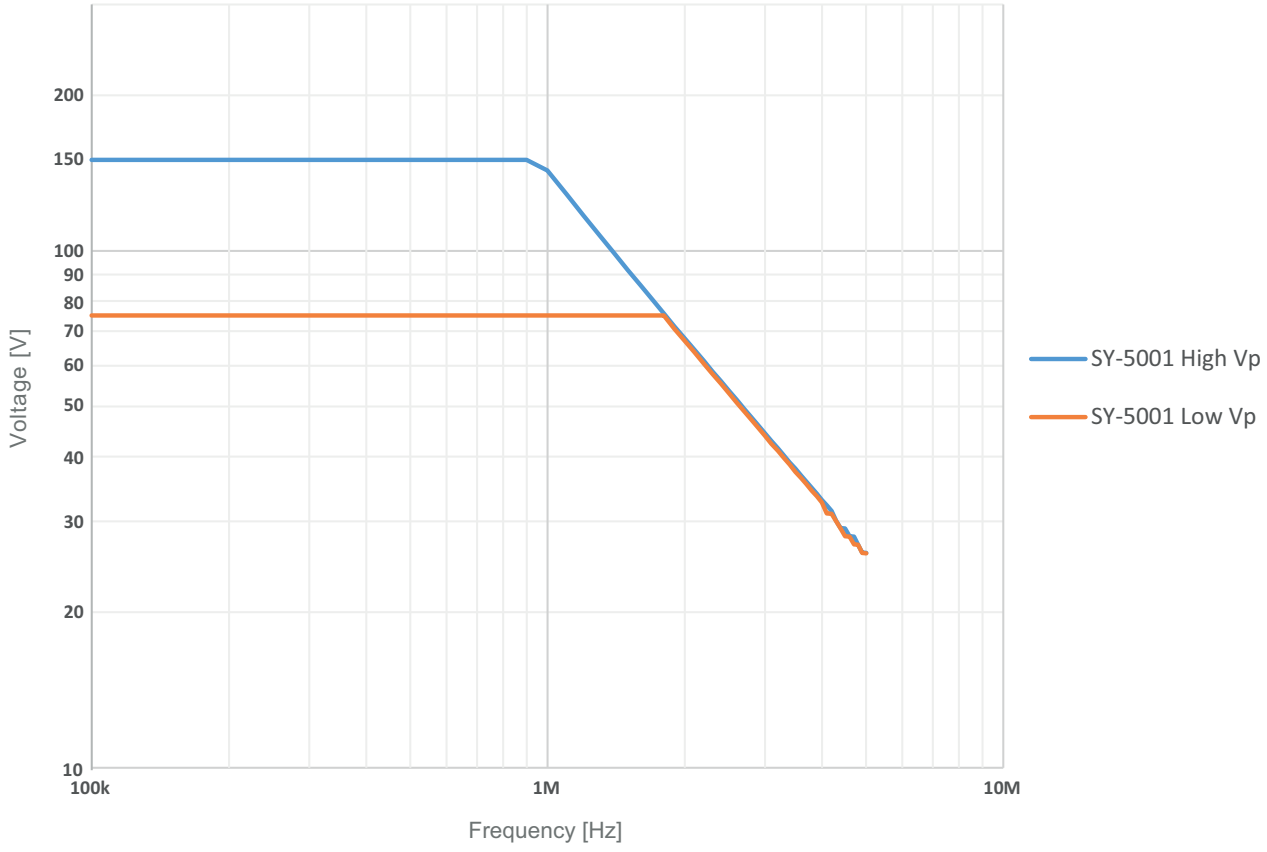
Overcurrent protection is an exceptional working condition and should be prevented in regular use.

Graphs: Frequency and Temperature Dependent Behavior

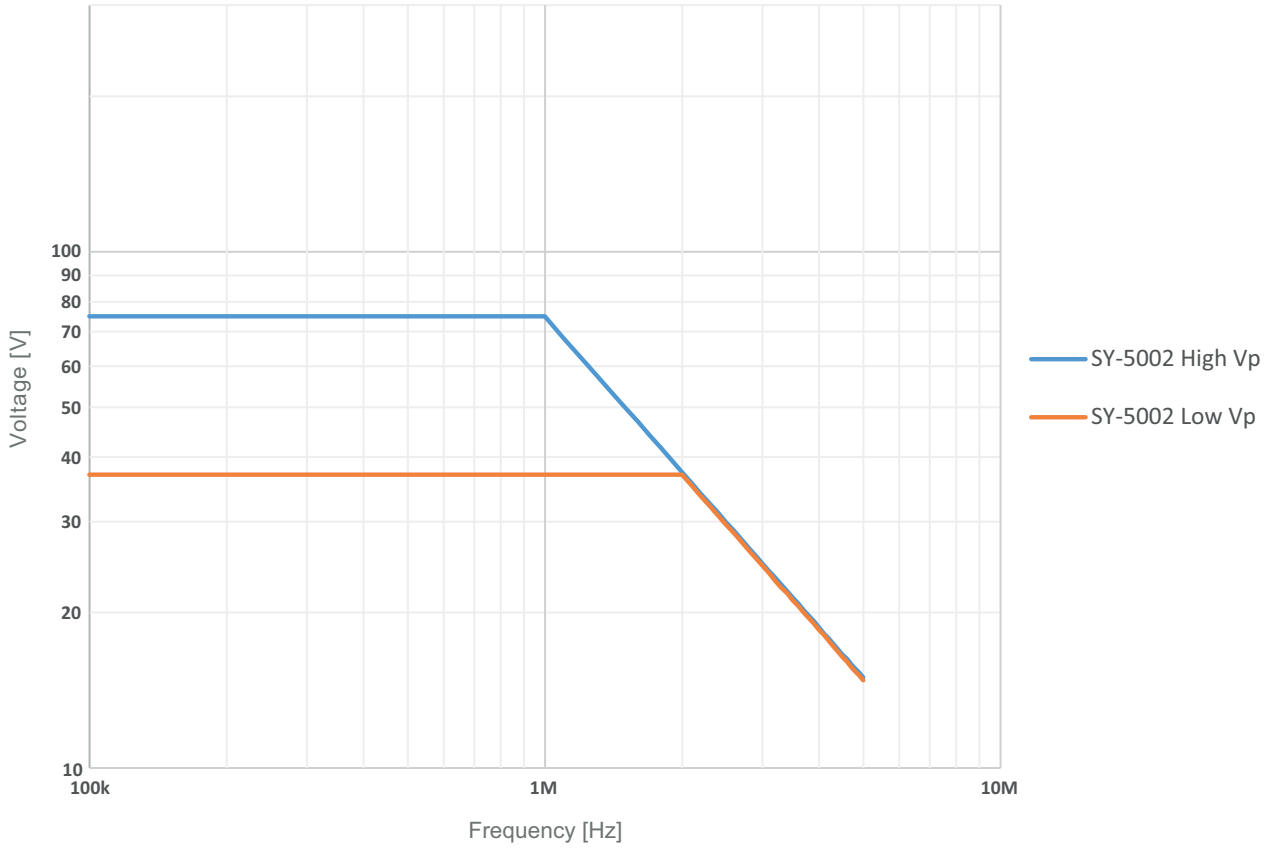
Maximum Power Dissipation, SY-5001



Maximum Output Voltage, SY-5001

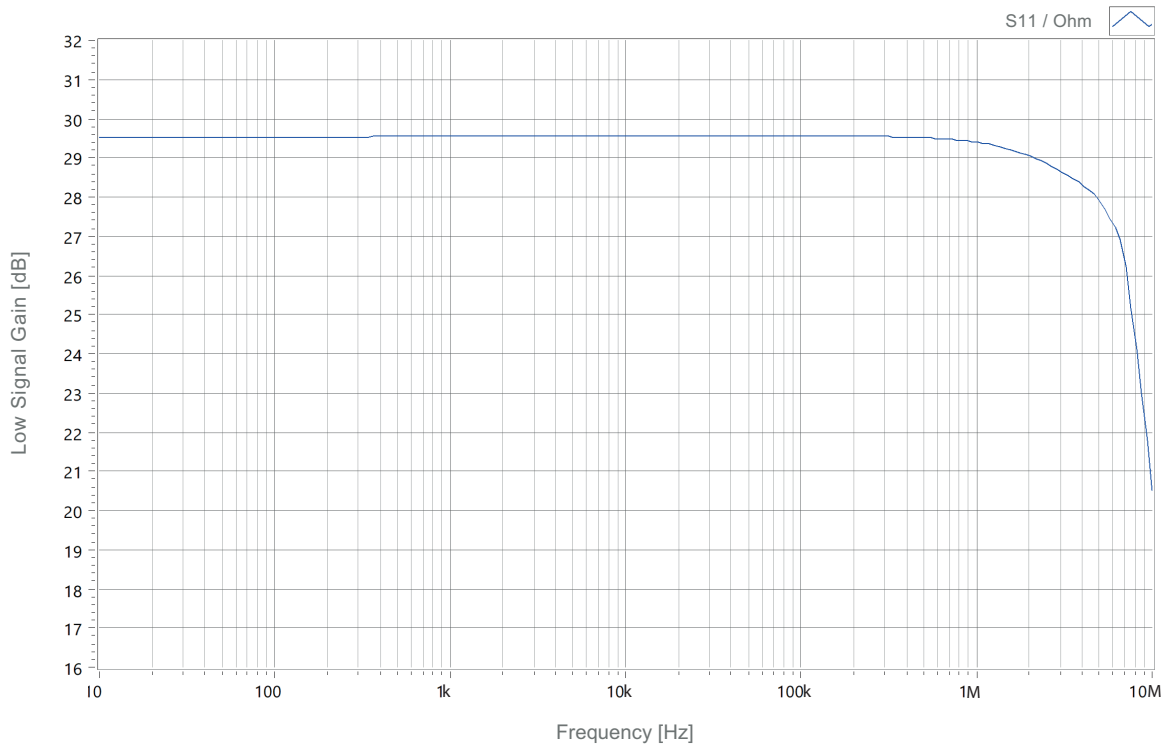


Maximum Output Voltage, SY-5002

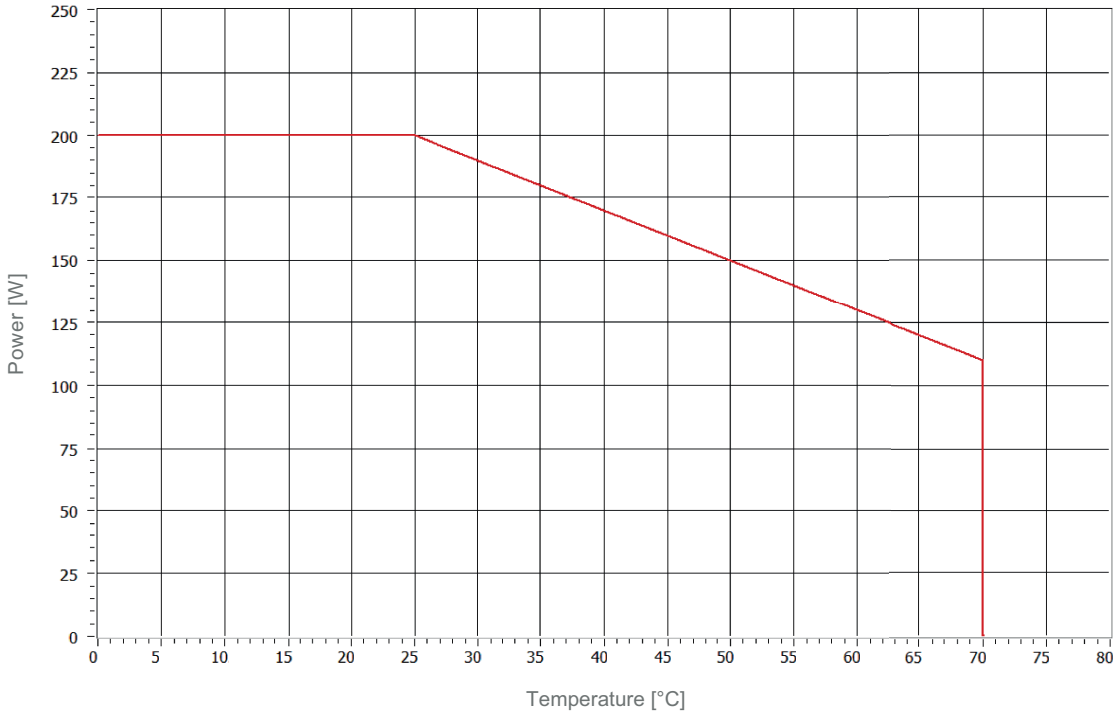


Graphs: Frequency and Temperature Dependent Behavior

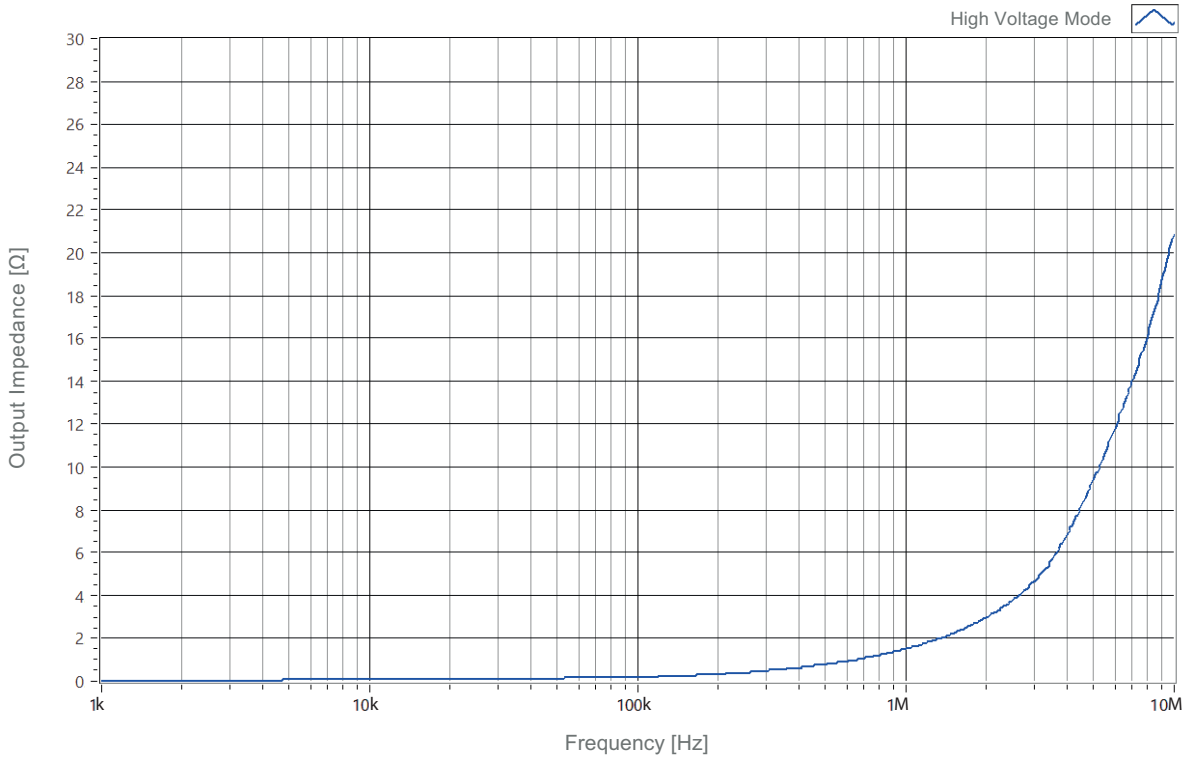
Low Signal Gain, SY-5002



Maximum Power Dissipation, SY-5002



Output Impedance, SY-5000 Series



Operation and Safety Concept

SY-5000 series power amplifiers are equipped with various safety mechanisms in order to protect themselves. If the amplifier self-protection is activated check your application setup, all connections and wiring. Read the caution section and this section before first usage.

Cooling Concept and Warm-up

Provide sufficient space behind and in front of the amplifier, that air can circulate through the device unobstructed. Cool air is sucked through the slots at the left and right side of the front panel. Allow the amplifier a warm-up phase of 30 minutes after switching on for stabilization of its operating points.

Operating Voltages

Before the amplification begins, some considerations related to the selection of the operating voltage mode are recommended for effective and safe operation. Switch only when output is in idle state, e.g. output off.

The amplifier modes have the following operating voltages:

- HIGH mode for high output voltages and low load currents
- LOW mode for low output voltages and high load currents

In order to keep the power loss of the amplifier low, the operating voltage should always be selected according to the load.

Amplifying Square Wave and Pulsed Signals (only SY-5001A)

The slew rate limiter is recommended for square wave and pulsed signals, and provides clean edges for square wave control at the expense of the maximum slew rate, which declines approx. 20 %. For maximum amplitudes with sinusoidal signals switch the slew rate limiter off. The slew rate limiter is off per default, and can be enabled via remote control command.

Connecting the Signal Source

Connect the BNC input to a suitable 50 Ω source, e.g. the signal output of your IWATSU B-H analyzer. To fully drive the amplifier use an input voltage of ±2.5 V at 50 Ω. Use high quality coaxial cables and connectors to avoid signal problems such as loose contacts.

The input is connected with its reference potential to the protective conductor. Make sure short signal lines and close sockets do not create any disturbing hum loops when using an earthed source.

Connecting the Load

The power output of the amplifier has a BNC connector. The reference potential of the BNC output is connected to protective earth. Ensure sufficient contact protection of the cabling to your load. Life-threatening voltages can occur. The output line is part of the load of the amplifier. The inductance of this supply line is added to the output impedance of the amplifier, i.e. the source impedance becomes higher at higher

frequencies. Keep the output lines as short as possible in order to feed as much current as possible into your load.

The SY-5001 is optimized for resistive and inductive loads. Long coaxial lines at the output can therefore be problematic, as they represent considerable output capacities and make the amplifier unstable. All capacities greater than 300 pF can become critical.

The SY-5002 is stable at all complex loads. Since the output impedance of the amplifier gets inductive at higher frequencies, this may lead to a significant overshoot with predominant capacitive loads. This behavior does not indicate a possible instability of the amplifier, but is established due to an excited series resonant circuit of output and line inductance and connected capacity. In this case, damping the resonant circuit by series resistors is recommended.

Operational Startup

Read the CAUTION section before first usage. Operation with wrong mains voltage leads to malfunctions or even destruction of the amplifier. Make sure the mains voltage switch is set to the correct mains voltage before connecting the mains cable to the amplifier. Switch on mains voltage with the switch on the mains socket. The green mains switch on the front panel illuminates and signals the standby state. Press this button to switch the amplifier on completely, fans start running and the amplifier becomes READY after a short period of time. At startup, the amplifier is set to its initial state, which also can be defined by remote control command. Select best operating voltage mode for your load and connect it to the signal input of your source. 30 minutes warm-up time is recommended. After warm-up phase press OFFSET to start offset compensation. Activate the amplifier with the illuminated OUTPUT button to start signal processing.

Factory default setting is a gain of 60 at HIGH operating voltage for SY-5001. The SY-5001 already carries out an initial offset during the switch-on phase. The OFFSET ZERO LED will light up permanently and indicate a successful offset adjustment. Press the OUTPUT button to release the output. The amplifier supplies the input signal amplified by the gain factor as output voltage.

Overload and Overcurrent Protection

The SY-5000 series has several partly interleaved safety mechanisms which protect the amplifier against overtemperature and overload. Note that overcurrent protection is an exceptional working condition and should be prevented in regular use.

At a heat sink temperature of 70 °C the amplifier switches off, the READY LED turns off and the PROTECTION LED lights up permanently. If this occurs, check air supply and proper operation of the fans. If the temperature falls below 50 °C again, the amplifier automatically becomes ready.

The amplifier switches off, if the remotely controllable short-circuit current or constant DC or AC (>10 Hz) current is exceeded, or if permissible temperature-dependent power dissipation is exceeded. The READY LED is off and the PROTECTION LED flashes with 1 Hz. The amplifier automatically becomes ready after 10 s, but the output is not switched on automatically. In case of a presumed power dissipation, operation with a low operating voltage should be considered. Further information on whichwhich protection is active can be requested by remote control.

If the PROTECTION LED flashes with about 3 Hz, there is a hardware error. In this case switch off the device and wait at least 1 minute. If errors still occur after the hardware has been switched on again or occur again during operation, the amplifier should be analyzed at the manufacturer. Do not continue to use the amplifier.

Gain, Offset Zero and Output Voltage Ranges, SY-5001

Use the GAIN buttons to select the gain of SY-5001. For maximum output voltage, gain 60 must be set, as the input voltage range is limited to ±3 V. The maximum output voltage is set by the gain buttons. Other gain settings may be useful for matching to the signal source. The output noise reduces slightly when the gain is less than 60. Change the gain to activate automatic offset adjustment. For firmware V 1.5 or lower automatic offset adjustment starts when gain is changed from or to 60. During changeover the output is switched off, and automatically on after the offset adjustment is completed. Offset adjustment can be triggered at any time by pressing the OFFSET ZERO switch or by remote control command.

In automatic mode, the output voltage mode is adjusted to the gain setting. If gain < 60 is selected, the output voltage mode is set to LOW. The output voltage mode is set to HIGH when a gain of 60 is selected. Automatic switchover remains active until the output voltage mode is manually set, changed by remote control, or automatic mode is switched off. Automatic mode can also be reactivated by remote control.

Remote Control

Integration into Automated Test Systems, SY-5001

The entire functionality of the SY-5001 can be remote controlled via USB, or GPIB interface with SCPI commands, which makes it ideal in automated test environments. The USB interface is installed as a virtual COM port at 9600 baud, 8 data bits, 1 stop bit and no parity. For more information see chapter „USB Service Port“.

Remote adjustment of the amplifier settings to the load can greatly facilitate operation with switchable output, selectable operating voltage and adjustable gain with offset control. Complete amplifier monitoring with heat sink temperature, power dissipation and detailed error query enable safe automated test sequences.

- The commands for the GPIB interface are ASCII commands and follow the IEEE488.2 standard for SCPI commands.
- Entries in []-brackets are optional and can be omitted.
- Commands with ? are queries.
- Each command is valid in its short form (capital letters) as well as in its long form. The commands are not case sensitive.

Basic Commands

***IDN?**	Query of device ID, e.g. „PMK, SY-5001, 18901980-0101, V1.6“.
***OPC?**	Operation Complete query returns „1“ after all previous commands are completely executed.
***RST**	Reset into defined basic state (Gain = 60, Input = off, Output Voltage Range Auto = on), Slew Rate Limiter = off). A possible error list is deleted.

***RCL <0...3>**	Recall previously saved device states.
***SAV <0...3>**	Save the state of the device under a defined memory number. Memory number “0” defines the start configuration when the device is switched on.

Input Subsystem

INPut:GAIN 60|30|10|5|1	Switch between gain factors. When switching from/to Gain = 60, offset correction is carried out automatically.
INPut:GAIN?	Gain setting query, response: 60|30|10|5|1
INPut:OFFSet	Offset correction is carried out.
INPut:LIMit:SLEW:STATe OFF|0|ON|1	Setting of the Slew Rate Limiter. (only SY-5001A)
INPut:LIMit:SLEW:STATe?	Query the setting of the slew rate limiter (only SY-5001A)

Output Subsystem

OUTPut:CURRent:LIMit <5.5...15>	Set shutdown threshold for short-circuit current detection (default 6.5 A). With HIGH output mode, the value is limited to 7.5 A by hardware.
OUTPut:CURRent:LIMit?	Query shutdown threshold for short-circuit current detection.
OUTPut:[STATe] OFF|0|ON|1	Switch amplifier output signal off or on. (0: off, 1: on)
OUTPut:[STATe]?	Query amplifier output signal, (0: off, 1: on)
OUTPut:VOLTage:RANGe LOW|0| HIGH|1	Set output voltage range. For all gain ≠ 60, range „low“ is sufficient. For Gain = 60 range „high“ may be necessary for an undistorted output signal. If the range is set manually, automatic range selection is switched off.
OUTPut:VOLTage:RANGe?	Query output voltage range, (0: low, 1: high)
OUTPut:VOLTage:RANGe:AUTO OFF|0|ON|1	Automatic selection of the output voltage range depends on the gain setting. The output voltage range is automatically set low for gain ≠ 60 and high for gain = 60. If range is set manually, automatic range selection is switched off.
OUTPut:VOLTage:RANGe:AUTO?	Query of automatic range selection. (0: off, 1: on)

System Subsystem

SYSTem:ERRor[NEXT]?	Output and delete last error in error list (see SCPI error codes).
SYSTem:COMMunicate:GPIB [:SELF]:ADDRess <NR1/1...30>	Set GPIB address (will be saved, default = 6).

Diagnostic Subsystem

DIAGnostic:ERRor?	Query of error state. The output value breaks down the error into individual bits: Bit 0: Short-circuit current Bit 1: Positive overcurrent Bit 2: Negative overcurrent Bit 3: Positive Power dissipation Bit 4: Negative Power dissipation Bit 5: Overtemperature heat sink Bit 6: Overtemperature transformer Bit 7: Hardware error
DIAGnostic:POWer?	Query power dissipation in % of the permitted power dissipation.
DIAGnostic:STATus?	Query the status of the amplifier. The output value breaks down the status into individual bits: Bit 0: Ready Bit 1: Overload cut-off current/power loss Bit 2: Overtemperature heat sink/trans former Bit 3: Output relay (0: off, 1: on) Bit 4: Input relay (0: off, 1: on) Bit 5: Not used (fixed Output: 1) Bit 6: Operating voltage (0: low, 1: high) Bit 7: Not used (fixed Output: 1)
DIAGnostic:TEMPerature?	Query heat sink temperature in °C.
DIAGnostic:REV:AMP?	Query firmware version of the amplifier.

SCPI Error Codes

0	No error
-100	Command error
-101	Invalid character
-102	Syntax error
-103	Invalid separator
-104	Data type error
-108	Parameter not allowed
-109	Missing parameter
-120	Numeric data error
-200	Executing error
-221	Settings conflict
-222	Data out of range
-224	Illegal parameter value
-240	Hardware error
-241	Hardware missing
-350	Queue overflow
-360	Communication error
-400	Query error
500	Offset control loop error
510	Amplifier short circuit error
511	Amplifier over current error
512	Amplifier power dissipation error
520	Amplifier over temperature heatsink
521	Amplifier over temperature transformer
530	Amplifier hardware error

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The USB interface is installed as a virtual COM port at 9600 baud, 8 data bits, 1 stop bit and no parity. The command frame consist of a length byte (entire frame) followed by an address byte. Then there is a command byte and optional parameters. Only command frames corresponding to its own address are considered. There is a timeout, if the required number of bytes are not sent after 500 ms. The previous bytes are ignored. The feedback frame corresponds to the command frame, e.g. length, address, command and optional parameters. The feedback is always carried out after execution of the command. When an unknown command occurs, the feedback is 0xFE with timeout 0xFD.

Several amplifiers can be driven via COM interface. In this case, each amplifier requires its own address (1 ... 99, default = 1), which is determined by a command. The address 100 is answered by all amplifiers regardless of the stored address. The commands 0x80 and 0xD0 are in-house test commands to start the boot loader and should not be used.

0x01	Status query, parameters: no; answer: 1 byte status: Bit 0: Ready Bit 1: Overload shutdown power/power loss Bit 2: Heatsink overtemperature/transformer Bit 3: Output relay (0: off, 1: on) Bit 4: 50Ω-Input relay (0: off, 1: on) Bit 5: not used Bit 6: operating voltage + (0: low, 1: high) Bit 7: operating voltage – (0: low, 1: high)
0x02	Set 50Ω-Input, parameter: 1 byte (0: off, 1: on)
0x04	Set output relay, parameter: 1 byte (0: off, 1: on)
0x05	Set operating voltage, parameter: 1 byte (0: low, 1: high, 2: only UB+ high, 3: only UB– high), see block diagram
0x06	Query temperature, parameter: no, answer: 1 byte, temperature in ºC
0x07	Query max. power loss, parameter: no, answer: 1 byte Power loss in % of the current threshold (maximum since last query)
0x08	Query average power loss, parameter: no, answer: 1 byte Power loss in % of the current threshold
0x09	Query Error, parameter: no answer 1 byte error: Bit 0: short circuit-current Bit 1: Overcurrent + Bit 2: Overcurrent – Bit 3: power loss + Bit 4: power loss – Bit 5: Heatsink overtemperature Bit 6: Overtemperature transformer Bit 7: Hardware failure
0x10	Set start configuration, parameter: 1 byte configuration (default 0x0C): Bit 0: 50Ω-input relay (0: off, 1: on) Bit 1: 100 k input relay (0: off, 1: on) Bit 2: operating voltage + (0: low, 1: high) Bit 3: operating voltage – (0: low, 1: high) Bit 4: Slew Rate Limiter (0: off, 1: on)
0x11	Query start configuration, parameter: no, answer: 1 byte configuration
0x12	Set address, parameters: 1 byte address (1...99)
0x13	Query address, parameters: no, answer: 1 byte address
0x14	Query amplifier type, parameters: no, answer: 1 byte type (0x10)
0x15	Query firmware revision, parameters: no, answer: 1 byte revision
0x16	Set hardware revision, parameters: 1 byte revision (e.g. 0x21 = 2.1)
0x17	Query hardware revision, parameters: no, answer: 1 byte revision
0x18	Set short circuit current, parameters: 1 byte current in 1/10 ampere (55...150)
0x19	Query short circuit current, parameters: no, answer: 1 byte current in 1/10 ampere

Remote Command Examples

- Frame: <length> <address> <command> <parameter>
- Setting 50 Ω Input on (Amplifier address: 1)
  Command frame: 0x04 0x01 0x02 0x01 (all values are in hexadecimal notation)
  Response frame: 0x03 0x01 0x02
- Query Heatsink Temperature
  Command frame: 0x03 0x01 0x06
  Response frame: 0x04 0x01 0x06 0x28 (e.g. 40 °C)

Firmware Update / USB Service Port

The USB interface is to update the firmware of the IO system and of the amplifier block with an update tool, which starts the bootloader and writes the selected firmware into its flash memory. The IO system should have V1-06 or higher. The amplifier block should have at least V1-04.

The USB service port is a full-fledged remote control interface which supports all remote control commands used by the GPIB interface, if available.

- The USB interface uses a FTDI ASIC, which acts as emulated COM port.
- If necessary, visit FTDI website (https://www.ftdichip.com) and download the latest VCP (Virtual COM Port) drivers. FTDI provides suitable drivers for various operating systems.
- When using USB interface, commands must be terminated with „newline“ (0x0A).
  Each answer is always terminated with „newline“.
- The parameters of the emulated COM port are 9600 baud, 1 stop bit, no parity.

Notes