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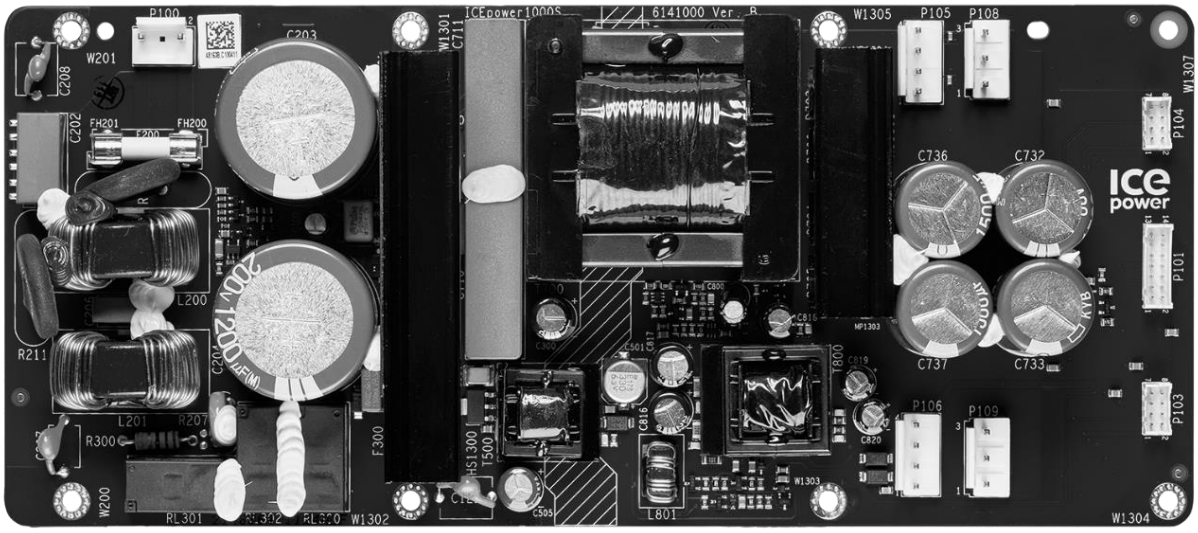


ICEpower 1000S

Universal mains power supply, AUX converter and standby converter for professional audio.

1 Contents

2 General Description

ICEpower 1000S is a universal mains power supply for professional audio/music.

The ICEpower 1000S provides numerous auxiliary supplies for amplifiers hanger modules and for external circuitry, a standby converter supply and an easy-to-use control interface for fast end-product integration.

ICEpower 1000S is safety pre-approved, enabling fast design-in and minimum time to market.

2.1 Features

A powerful power supply designed to supply audio amplifier hanger modules	ICEpower 1000S can supply up to four ICEpower 400A2 modules enabling up to 8 channels of music
Power rails overload protection	Keeps track of module power rails operation and protects the module power rails from overload
Powerful 20W auxiliary power supply, and 5W standby converter	Supply for analog and control circuits in e.g. a signal front-end and audio amplifier hanger modules
Auxiliary power supplies with short circuit protection	Many different auxiliary supplies for easy integration and usage in end-products
Universal mains	No need for region specific variants and designed for optimal usage of available AC power
Safety pre-approved	For easy CE approved end-product designs
Designed for flexible mounting	Either through standoffs or through mechanical heatsink interface mounting
Standby mode	ErP (1275/2008/EC) compliant Energy Star® v3.0 compliant

2.2 Key Specifications

- Universal Mains
- 1000Watt Output power
- ±69V_{DC} power rails
- 20W auxiliary Converter, ±5V_{DC}, Vdrive and ±12V_{DC} auxiliary supply outputs
- 5W standby converter, +5V_{DC} supply output. Up to 60mA in standby mode and 1A in on mode

3 Document History

Version	Date	Revised by	Changes
1.0	2023-03-13	LBH/JKC/FLL/SWG	Release version

4 Getting Started

The ICEpower 1000S is a fully self-contained power supply module and requires no interaction nor control to operate. ICEpower 1000S will start operating a few seconds after mains is applied.

Its strongly recommended to use AVDD_+12V and AVSS_-12V for hanger modules (like ICEpower 400A2), instead of AVDD_+5V and AVSS_-5V. This is both due to the higher current, and power, capabilities of this rail, and because AVDD_+12V and AVSS_-12V are regulated. Since the auxiliary supplies are regulated from AVDD_+12V, AVSS_-12V and Vdrive it is recommended that these are loaded externally, especially if high current is needed from AVDD_+5V and/or AVSS_-5V (See I_{AVDD_+5V} and I_{AVSS_-5V} in section 8.5).

AVDD_+12V and AVSS_-12V can supply up to 4 x ICEpower 400A2. AVDD_+5V and AVSS_-5V can supply up to 2 x ICEpower 400A2, but should only be used if the total current capability of AVDD_+12V/ AVSS_-12V are needed for other external circuitry. The ICEpower 1000S can maximum supply 4 x ICEpower 400A2 modules in total.
If ICEpower 400A2 amplifier hanger modules are connected to ICEpower 1000S, VD, VS and Vdrive needs to be connected to the ICEpower 400A2 in addition to AVDD_+12V and AVSS_-12V.

For more details on how to connect the ICEpower 400A2 hanger modules to ICEpower 1000S, see:
Application Guide for ICEpower400A2 & ICEpower1000S-69V

The maximum current draw of DVDD/DVDDstby output, when mains in applied to the module, while the module is in standby mode or when the module is going from standby mode to ON mode, is 50mA at 230Vac and 60mA at 120Vac. Higher current draw from DVDD/DVDDstby can cause the module not to startup or can cause the standby power consumption to exceed 0.5W.

5 Block Diagram

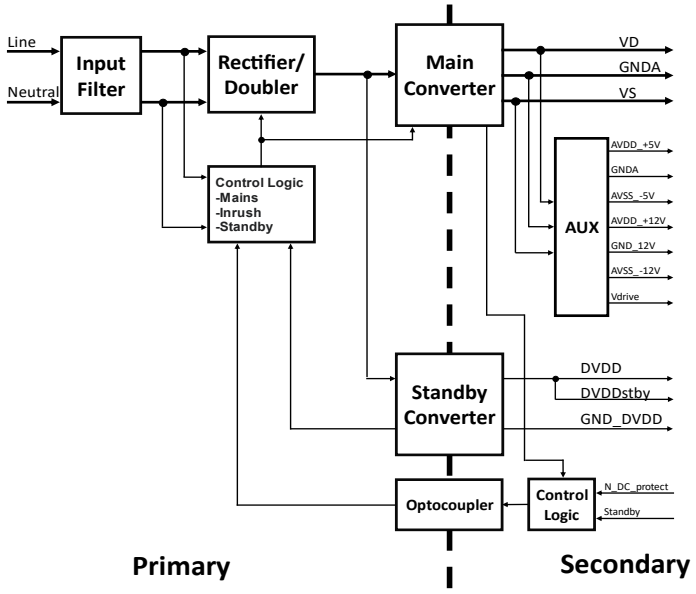


Figure 1: ICEpower 1000S block diagram

6 Connectors

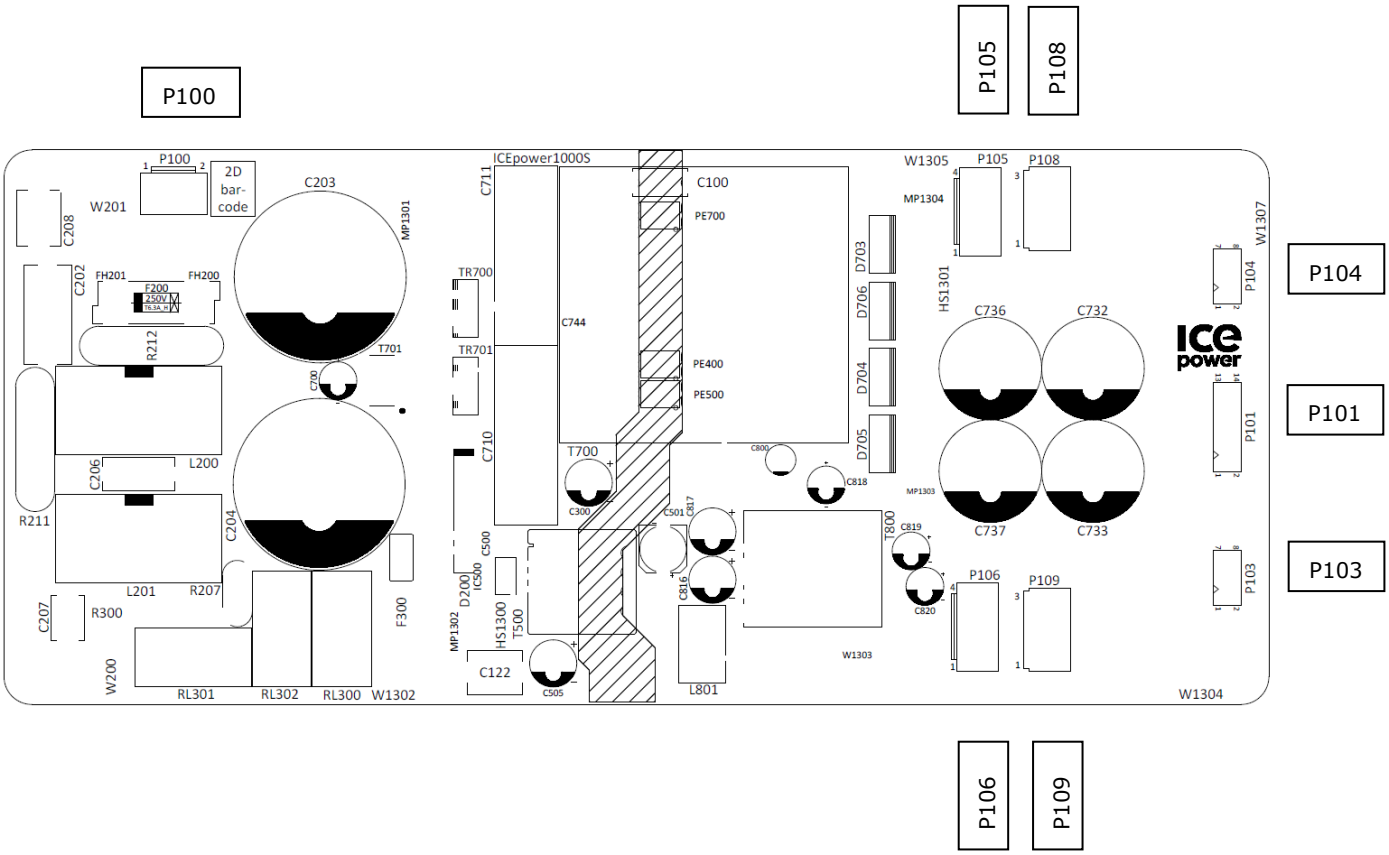


Figure 2: ICEpower 1000S connector overview

6.1 P100: AC Mains Connector

Type: JST, B2P3-VH (LF)(SN)			
Pin	**Function**	**Description**	**Type**
1	Neutral	Neutral AC	Mains input
2	Live	Live AC	Mains input

Table 1: AC Mains Connector

6.2 P101: Basic Control Connector

Type: JST, B14B-PHDSS (LF)(SN)				
Pin	**Function**	**Description**	**Type**	**Reference**
1	DVDD	Control auxiliary supply (Hardwired with Pin 3 DVDDstby)	Power output	GND_DVDD
2	GND_DVDD	Ground for DVDD, DVDDstby, N_DC_Protect and Standby	GND	N/A
3	DVDDstby	Control auxiliary standby supply (Hardwired with Pin 1 DVDD)	Power output	GND_DVDD
4	GND_12V	Auxiliary ground	GND_12V	N/A
5	AVDD_+12V	Positive analog auxiliary supply	Power output	GND_12V
6	Standby	Module standby	Control input, active high	GND_DVDD
7	AVSS_-12V	Negative analog auxiliary supply	Power output	GND_12V
8	Reserved	Not connected		N/A
9	Reserved	Not connected		N/A
10	Reserved	Not connected		N/A
11	Reserved	Not connected		N/A
12	Reserved	Not connected		N/A
13	Reserved	Not connected		N/A
14	GNDA	Ground	GND	N/A

Table 2: Basic Control Connector

6.3 P103/P104: Auxiliary Supply Connector

Type: JST, B8B-PHDSS (LF)(SN)				
Pin	**Function**	**Description**	**Type**	**Reference**
1	GNDA	GNDA	GND	N/A
2	AVDD_+5V	Positive supply for control circuit	Power output	GNDA
3	AVDD_+12V	Positive supply for analog circuit	Power output	GND_12V
4	AVSS_-5V	Negative supply for control circuit	Power output	GNDA
5	AVSS_-12V	Negative supply for analog circuit	Power output	GND_12V
6	N_DC_Protect	DC error for the supply to shut down	Status input, active low	GND_DVDD
7	Vdrive	Vdrive voltage for the power stage	Power output	Vs
8	GND_12V	Auxiliary ground	GND	N/A

Table 3: Control Connector

6.4 P105/P106: Hanger Rail Supply Connector

Type: JST, B4P-VH(LF)(SN)				
Pin	**Function**	**Description**	**Type**	**Reference**
1	VD	Positive DC rail voltage	Power output	GNDA
2	GNDA	Ground	GND	N/A
3	VS	Negative DC rail voltage	Power output	GNDA
4	Vdrive	Auxiliary Vdrive supply	Power output	VS

Table 4: Hanger Rail Supply Connector with Vdrive

6.5 P108/P109: Hanger Rail Supply Connector

Type: JST, B3P-NV(LF)(SN)				
Pin	**Function**	**Description**	**Type**	**Reference**
1	VD	Positive DC rail voltage	Power output	GNDA
2	GNDA	Ground	GND	N/A
3	VS	Negative DC rail voltage	Power output	GNDA

Table 5: Hanger Rail Supply Connector

7 Absolute Maximum Rating

Symbol	Parameter	Min	Max	Units
V_{ac}	Mains input voltage (for safety test) – **Note 1**	90	264	V_{RMS}
V_{ac}	Datasheet specification range Mains input voltage	100 200	120 240	V_{RMS}
f_{mains}	Nominal mains frequency	50	60	Hz

Table 6: Absolut maximum ratings

Note 1: The usage mains voltage is between 100Vac and 120Vac or between 200 Vac and 240 Vac.

8 Electrical Specifications

Unless otherwise specified:

- Passive cooled, **no fan**
- Module placed vertically without external heatsink.
- Resistive or active load is used to emulate power supply loading
- Ta = 25 °C, 230 Vac / 50 Hz mains
- P_{Aux} = 20W means all aux outputs (DVDD load not included) are loaded with the maximum current as specified in section 8.5. Current draw of AVDD_+12V and AVSS_-12V is adjusted, so the total sum is not exceeding 20W.

8.1 Power

Symbol	Parameter	Condition	Min	Typ	Max	Unit
P_o	Rated combined VD/VS output power	f_{in} = 1 kHz, 20W aux,5W DVDD load 230 V_{ac} / 50 Hz 120 V_{ac} / 60 Hz 100 V_{ac} / 50 Hz		 1000 1000 700		W
$P_{o\ -20Hz}$	Maximum power at 20 Hz, Combined VD/VS output power - load 2 x ICEpower 400A2 in BTL, 20 Hz sine wave output **Note A, do not exceed these ratings**	f_{in} = 20 Hz, - **Note B** 20W aux, 5W DVDD load 230 V_{ac} / 50 Hz 120 V_{ac} / 60 Hz 100 V_{ac} / 50 Hz		 750 750 700		W
$t_{Pmax-heatsink}$	Duration of rated combined VD/VS output power **Note A, do not exceed these ratings**	f_{in} = 1 kHz, no fan, 20W aux,5W DVDD load, not preheated. Module mounted on a R_{th} 0.75 K/W heatsink 230 V_{ac} / 50 Hz, P_o=1000W 120 V_{ac} / 60 Hz, P_o=1000W 100 V_{ac} / 50 Hz, P_o=700W		 90 10 30		S

t_{Pmax}	Duration of rated combined VD/VS output power **Note A, do not exceed these ratings**	f_{in} = 1 kHz, no fan, 20W aux, 5W DVDD load, not preheated. No external heatsink mounted on module 230 V_{ac} / 50 Hz, P_o=1000W 120 V_{ac} / 60 Hz, P_o=1000W 100 V_{ac} / 50 Hz, P_o=700W		 90 10 30		S
P_{o-con}	Continuous combined VD/VS output power without thermal shutdown or module damage **Note A, do not exceed these ratings**	Module placed vertically and without heatsink, 20W aux, 5W DVDD load, no fan Ta = 25 °C 230 V_{ac} / 50 Hz 120 V_{ac} / 60 Hz 100 V_{ac} / 50 Hz		 360 200 160		W
$P_{o-con-fan}$	Continuous combined VD/VS output power without thermal shutdown or module damage **Note A, do not exceed these ratings**	Module placed vertically and without heatsink, 20W aux,5W DVDD load, slow air flow from 6 CFM fan, 10 cm distance from ICEpower 1000S primary input filter. Ta = 25 °C 230 V_{ac} / 50 Hz 120 V_{ac} / 60 Hz 100 V_{ac} / 50 Hz		 500 300 250		W
$P_{o-con-heatsink\_25}$	Continuous combined VD/VS output power without thermal shutdown or module damage **Note A, do not exceed these ratings**	Module placed vertically and mounted on a R_{th} 0.75 K/W heatsink, 20W aux,5W DVDD load, no fan (limited by mains input filter) Ta = 25 °C 230 V_{ac} / 50 Hz 120 V_{ac} / 60 Hz 100 V_{ac} / 50 Hz		 360 200 160		W
$P_{o-con-heatsink\_60}$	Continuous combined VD/VS output power without thermal shutdown or module damage **Note A, do not exceed these ratings**	Module placed vertically and mounted on a R_{th} 0.75 K/W heatsink, 20W aux,5W DVDD load, no Fan Ta = 60 °C 230 V_{ac} / 50 Hz 120 V_{ac} / 60 Hz 100 V_{ac} / 50 Hz		 125 125 87		W

Table 7: Power performance

Note A: Exceeding these durations or power levels can cause damage or degradation to components, or the main fuse F200 to blow. Failure to comply with these requirements is against the ICEpower warranty policy.

Note B: Two ICEpower 400A2 amplifier modules in BTL as load connected to one ICEpower 1000S.

8.2 Control and Status

This table is for the control signal "Standby"

Symbol	Parameter	Conditions	Min	Typ	Max	Units
$V_{Standby}$	Control input voltage range		0		DVDD	V
$V_{Standby, low}$	Control input low signal				0.5	V
$V_{Standby, high}$	Control input high signal		2.5			V
$Z_{Standby}$	Control input impedance	Internal pull down		50		kOhm

This table is for the control signal "n_DC Protect"

Symbol	Parameter	Conditions	Min	Typ	Max	Units
$V_{n\_DC\_Protect}$	Control input voltage range		0		DVDD	V
$V_{n\_DC\_Protect, low}$	Control input low signal				0.3	V
$V_{n\_DC\_Protect, high}$	Control input high signal		2.5			V
$I_{n\_DC\_Protect}$	Required current to pull N_DC_Protect input down to GND_DVDD	Internal pull up		1		mA

Table 8: Control and Status specifications

8.3 Timing

For more detailed description of the below listed timing values, please consult section 11 of this datasheet. Unless otherwise specified timing values have been measured with ICEpower 1000S connected to 2 x ICEpower 400A2 in idle and an additional current draw on AVDD_+12V and AVSS_-12V of 200mA each and control auxiliary DVDD=50mA. No current draw from AVDD_+5V and AVSS_-5V. Auxiliary supplies being AVDD_+12V, AVSS_-12V, AVDD_+5V, AVSS_-5V and Vdrive.

Symbol	Parameter	Conditions	Min	Typ	Max	Units
$t_{Mains ON, Rails stable}$	Mains input on – time until main rails become stable	Mains input applied		500		ms
$t_{Mains OFF, Rails drop}$	Mains input off – time until main rails drop	(high) Knee point Rails dropped by $3V_{DC}$		470 960		ms
$t_{Mains ON, Aux stable}$	Mains input on – time until auxiliary supplies become stable	Mains input applied		480		ms
$t_{Mains OFF, Aux drop}$	Mains input off – time until auxiliary supplies drop	Mains input removed		1.63		s
$t_{Mains ON, DVDD stable}$	Mains input on – time until DVDD/DVDDstby become stable	Mains input applied		35		ms
$t_{Mains OFF, DVDD drop}$	Mains input off – time until DVDD/DVDDstby drop	Mains input removed		2.3		s
$t_{Stby EN, Rails drop}$	Enabled standby mode – time until main rails drop	Standby input Enabled (high) Knee point Rails dropped by $3V_{DC}$		 40 120		ms
$t_{Stby DIS, Rails stable}$	Disabled standby mode – time until main rails become stable	Standby input disabled (low)		290		ms
$t_{Stby EN, Aux drop}$	Enabled standby mode – time until auxiliary supplies drop	Standby input Enabled (high)		1.1		s

Symbol	Parameter	Conditions	Min	Typ	Max	Units
$t_{Stby\ DIS,\ Aux\ stable}$	Disabled standby mode – time until auxiliary supplies become stable	Standby input disabled (low)		280		ms
$t_{DC\ Error\ EN,\ Rails\ drop}$	Enabled DC error mode – time until main rails drop	DC Error Enable (low) Knee point Rails dropped by $3V_{DC}$		 40 120		 ms
$t_{DC\ Error\ DIS,\ Rails\ stable}$	Disabled DC error mode – time until main rails become stable	DC Error not Enabled (high)		290		ms
$t_{DC\ Error\ EN,\ Aux\ drop}$	Enabled DC error mode – time until auxiliary supplies drop	DC Error Enable (low)		1.1		s
$t_{DC\ Error\ DIS,\ Aux\ stable}$	Disabled DC error mode – time until auxiliary supplies become stable	DC Error not Enabled (high)		280		ms
$t_{OCP\ EN,\ Rails\ Aux\ drop}$	Overcurrent of rails occurred– time from Overcurrent occurs until main rails and auxiliary supplies start drop *Outside datasheet usage operating conditions. This timing value depends on temperature, module cooling and on power level.*	230 V_{ac} / 50 Hz, ~10A from each rail, Rail drop/Knee point: 120 V_{ac} / 60 Hz, ~10A from each rail, Rail drop/Knee point: 100 V_{ac} / 50 Hz, ~10A from each rail, Rail drop/Knee point:		 ~0.8 ~0.8 ~0.8		 s
$t_{OCP\ DIS,\ Rails\ Aux\ stable}$	Overcurrent of rails removed– time from main rails and auxiliary starts to drop (due to Overcurrent event) until main rails and auxiliary supplies are stable again (high)			1.2		s
$t_{OVP,\ Rails\ drop}$	Time from overvoltage occurs on V_D until main rails drops *OVP bypassed on both ICEpower 400A2 hanger modules.* *Drop of auxiliary supplies depend on rail loading and OVP condition.*	Rail drop below nominal rail voltage f_{in} 400A2= 40 Hz f_{in} 400A2= 20 Hz		 8 23		 ms
$t_{OVP,\ Rails\ stable}$	Time from overvoltage condition stopped until V_D and V_S are stable *OVP bypassed on both ICEpower 400A2 hanger modules.*	Until main rails are high/ stable again f_{in} 400A2= 40 Hz f_{in} 400A2= 20 Hz		 425 425		 ms

Table 9: Timing specifications

8.4 Power Supply – Main Output

Symbol	Parameter	Condition	Min	Typ	Max	Unit
V_{VD}	Positive hanger supply, output voltage	2 x ICEpower 400A2 modules connected in idle Combined VD/VS output power= 1000W	68 68	69 69	71 71	V
I_{VD}	Positive hanger supply, output current (higher output current can trigger current protection)	Combined VD/VS output power= 1000W 230 V_{ac} / 50 Hz, 120 V_{ac} / 60 Hz, Combined VD/VS output power= 700W 100 V_{ac} / 50 Hz,		 7.3 7.3 5.4		A
C_{VD}	VD external decoupling capacitor				10000	uF
$Ripple_{VD}$	Voltage ripple on VD (**Note 2**)	P_o=1000W on VD/VS P_o=125W on VD/VS		1000 225		mVpp
V_{VS}	Negative hanger supply, output voltage	2 x ICEpower 400A2 modules connected in idle Combined VD/VS output power= 1000W	-71 -71	-69 -69	-68 -68	V
I_{VS}	Negative hanger supply, output current (higher output current can trigger current protection)	Combined VD/VS output power= 1000W 230 V_{ac} / 50 Hz, 120 V_{ac} / 60 Hz, Combined VD/VS output power= 700W 100 V_{ac} / 50 Hz,		 7.3 7.3 5.4		A
C_{VS}	VS external decoupling capacitor				10000	uF
$Ripple_{VS}$	Voltage ripple on VS (**Note 2**)	P_o=1000W on VD/VS P_o=125W on VD/VS		1000 225		mVpp
OVP	Overvoltage rail protection level			80		V

Table 10: Power specifications

Note 2: Measured with 20MHz BW limited oscilloscope with a short GND loop directly on output connector. No external capacitance.

8.5 Power Supply – Auxiliary Outputs

Symbol	Parameter	Condition	Min	Typ	Max	Unit
V_{AVDD_+5V}	Positive control aux supply, output voltage			5		V
I_{AVDD_+5V}	Control aux supply, output current (**Note 3**) (**Note 5**) 60mA≤I_{AVDD_+12V}, 60mA≤I_{AVSS_-12V}, 60mA≤I_{Vdrive}	(Not overcurrent protected) ICEpower 400A2 modules connect to I_{AVDD_+5V} : 0 x 400A2 connected 1 x 400A2 connected 2 x 400A2 connected	 40 30 20	 	 200 110 20	 mA

Symbol	Parameter	Condition	Min	Typ	Max	Unit
I_{AVDD_+5V}	Control aux supply, output current (**Note 3**) (**Note 5**) (**Note 6**)	(Not overcurrent protected) 60mA≤I_{AVDD_+12V}, 60mA≤I_{AVSS_-12V}, 60mA≤I_{Vdrive}	40		200	mA
		30mA≤I_{AVDD_+12V}<60mA, 30mA≤I_{AVSS_-12V}<60mA, 30mA≤I_{Vdrive}<60mA	2		125	
		7mA≤I_{AVDD_+12V}<30mA, 7mA≤I_{AVSS_-12V}<30mA, 7mA≤I_{Vdrive}<30mA	1		65	
		I_{AVDD_+12V}<7mA, I_{AVSS_-12V}<7mA, I_{Vdrive}<7mA	0		40	
C_{AVDD_+5V}	AVDD external decoupling capacitor				1000	uF
$Ripple_{AVDD\_+5V}$	Voltage ripple on AVDD (**Note 2**)	P_{Aux} = 20W I_{AVDD} = 200mA		175		mVpp
V_{AVSS_-5V}	Negative control aux supply, output voltage			-5		V
I_{AVSS_-5V}	Control aux supply, output current (**Note 3**) (**Note 5**)	(Not overcurrent protected) ICEpower 400A2 modules connect to I_{AVSS_-5V} :				
60mA≤I_{AVDD_+12V}, 60mA≤I_{AVSS_-12V}, 60mA≤I_{Vdrive}		0 x 400A2 connected 1 x 400A2 connected 2 x 400A2 connected	40 30 20		200 125 50	mA
I_{AVSS_-5V}	Control aux supply, output current (**Note 3**) (**Note 5**) (**Note 6**)	(Not overcurrent protected) 60mA≤I_{AVDD_+12V}, 60mA≤I_{AVSS_-12V}, 60mA≤I_{Vdrive}	40		200	mA
		30mA≤I_{AVDD_+12V}<60mA, 30mA≤I_{AVSS_-12V}<60mA, 30mA≤I_{Vdrive}<60mA	2		125	
		7mA≤I_{AVDD_+12V}<30mA, 7mA≤I_{AVSS_-12V}<30mA, 7mA≤I_{Vdrive}<30mA	1		65	
		I_{AVDD_+12V}<7mA, I_{AVSS_-12V}<7mA, I_{Vdrive}<7mA	0		40	
C_{AVSS_-5V}	AVSS external decoupling capacitor				1000	uF
$Ripple_{AVSS\_-5V}$	Voltage ripple on AVSS (**Note 2**)	P_{Aux} = 20W I_{AVSS} = 200mA		175		mVpp

Symbol	Parameter	Condition	Min	Typ	Max	Unit
V_{AVDD_+12V}	Positive analog auxiliary supply, output voltage	I_{AVDD_+12V} ≤ 500mA		12		V
I_{AVDD_+12V}	Positive analog auxiliary supply, output current (**Note 3**) (**Note 5**)	(Not overcurrent protected) ICEpower 400A2 modules connect to I_{AVDD_+12V} : 0 x 400A2 connected 1 x 400A2 connected 2 x 400A2 connected 3 x 400A2 connected 4 x 400A2 connected			500 410 320 230 140	mA
C_{AVDD_+12V}	AVDD external decoupling capacitor				1000	uF
$Ripple_{AVDD\_+12V}$	Voltage ripple on AVDD (**Note 2**)	P_{Aux} = 20W I_{AVDD_+12V} = 500mA		100		mVpp
V_{AVSS_-12V}	Negative analog auxiliary supply, output voltage	I_{AVSS_-12V} ≤500mA		-12		V
I_{AVSS_-12V}	Negative analog auxiliary supply, output current (**Note 3**) (**Note 5**)	(Not overcurrent protected) ICEpower 400A2 modules connect to I_{AVSS_-12V} : 0 x 400A2 connected 1 x 400A2 connected 2 x 400A2 connected 3 x 400A2 connected 4 x 400A2 connected			500 425 350 275 200	mA
C_{AVSS_-12V}	AVSS external decoupling capacitor				1000	uF
$Ripple_{AVSS\_-12V}$	Voltage ripple on AVSS (**Note 2**)	P_{Aux} = 20W I_{AVSS_-12V} = 0.5A		100		mVpp
$V_{DVDD, 5V1}$	Control auxiliary supply		4.9	5.1	5.3	V
$I_{DVDD, 5V1}$	Maximum DVDD supply output current	in on mode			1	A
$I_{DVDD, 5V1\ Protection}$	DVDD supply output current protection limit	in on mode	1.05		3	A
$I_{DVDD, 5V1\ in\ standby\ mode}$	Max DVDDstby output current draw in standby, at startup or from standby to on mode	in standby mode or at startup/ mains applied 240V, 50 Hz 230V, 50 Hz 120V, 60 Hz 100V, 50 Hz			50 50 60 60	mA
$C_{DVDD, 5V1}$	DVDD external decoupling capacitor				1000	uF
$Ripple_{DVDD, 5V1}$	DVDD voltage ripple (**Note 2**)	$I_{DVDD, 5V1}$ = 1A $I_{DVDD, 5V1}$ = 50mA		150 160		mVpp

Symbol	Parameter	Condition	Min	Typ	Max	Unit
$Ripple_{DVDDstby, 5V1}$	DVDDstby voltage ripple (**Note 2**)	$I_{DVDD, 5V1}$ = 50mA		160		mVpp
V_{Vdrive}	Hanger drive supply, output voltage	(Referenced to negative rail supply VS)		V_{VS} + 16		V
C_{Vdrive}	Hanger drive external decoupling capacitor				220	uF
I_{Vdrive}	Hanger drive supply, output current (**Note 3**)	(Not overcurrent protected) ICEpower 400A2 modules connected to Vdrive : 0 x 400A2 connected 1 x 400A2 connected 2 x 400A2 connected 3 x 400A2 connected 4 x 400A2 connected			 400 300 200 100 0	 mA
$Ripple_{Vdrive}$	Voltage ripple on Vdrive (**Note 2**)	P_{Aux} = 20W I_{Vdrive} = 400 mA		325		mVpp

Table 11: Power specifications – Auxiliary

Note 3: The sum of the power consumption on the AVDD_+12V, AVDD+5V, AVSS_-12V, AVSS_-5V and Vdrive supply outputs must not exceed **20W including all current draws from hanger modules,** like for example ICEpower 400A2. Additionally the DVDD can be loaded with 5W.
Note 2: Measured with 20MHz BW limited oscilloscope with a short GND loop directly on output connector. No external capacitance.
Note 5: Its strongly recommended to use AVDD_+12V and AVSS_-12V for hanger modules (like ICEpower 400A2), instead of AVDD_+5V and AVSS_-5V. This is both due to the higher current, and power, capabilities of this rail, and because AVDD_+12V and AVSS_-12V are regulated. Since the auxiliary supplies are regulated from AVDD_+12V, AVSS_-12V and Vdrive it is recommended that these are loaded externally, especially if high current is needed from AVDD_+5V and/or AVSS_-5V (See I_{AVDD_+5V} and I_{AVSS_-5V} in section 8.5).
Note 6 For example if both IAVDD_+12V, IAVSS_-12V and IVdrive have a current draw of minimum 60mA each then it's possible to draw maximum 200mA from both IAVDD_+5V and AVSS_-5V and the minimum current draw of IAVDD_+5V and AVSS_-5V (if used) should be 40mA each. If for example IAVDD_+12V have a current draw of 40mA, IAVSS_-12V have a current draw of 40mA and IVdrive have a current draw of 100mA then it's possible to draw maximum 125mA from both IAVDD_+5V and AVSS_-5V (because both IAVDD_+12V and IAVSS_-12V have a current draw of 40mA, which is the "between 30mA and 60mA" condition) and the minimum current draw of IAVDD_+5V and AVSS_-5V (if used) should be 40mA each (because worst case current draw is 100mA, so it follows the current draw of minimum 60mA condition, requiring minimum 40mA load each).

8.6 Power Supply – Common

Symbol	Parameter	Condition	Min	Typ	Max	Unit
P_{idle}	Module idle consumption,	No load on all outputs Preheated		8		W
P_{main_stby}	Module consumption in standby, Main converter Disabled	P_o = 0W, P_{Aux} = 0W DVDDstby= 0W but available 240V, 50 Hz 230V, 50 Hz 120V, 60 Hz 100V, 50 Hz		 215 210 160 150		 mW
$P_{main,1/8\ Power}$	Module consumption at P_o = 1/8 Power	P_o = 125W, P_{Aux} = 20W, 5W DVDD load 240V, 50 Hz 230V, 50 Hz 120V, 60 Hz 100V, 50 Hz		 175 175 190 200		 W
$P_{main,full\ load}$	Module consumption at full load	P_o = 1000W, P_{Aux} = 20W, 5W DVDD load 230V, 50 Hz 120V, 60 Hz		 1130 1190		 W
η_{Total}	Module power efficiency	P_o = 125W, P_{Aux} = 20W, 5W DVDD load		88		%
η_{Total_max}	Module power efficiency	P_o = 1000W, P_{Aux} = 20W, 5W DVDD load		91		%
η_{AUX}	Aux converter power efficiency	P_{Aux} = 20W,		80		%
PF	Power factor	P_o = 125W, P_{Aux} = 20W, 5W DVDD load 230 V_{ac} / 50 Hz 120 V_{ac} / 60 Hz		 0,62 0,72		
		P_o = 1000W, P_{Aux} = 20W, 5W DVDD load 230 V_{ac} / 50 Hz 120 V_{ac} / 60 Hz		 0,62 0,72		
I_{Inrush}	Inrush current	V_{AC} = 264 V, start phase 90°		14		A_{peak}
I_{VAC}	Mains current (**Note 4**)	P_{Aux} = 20W, 5W DVDD load 230 V_{ac} / 50 Hz, P_o = 1000W 120 V_{ac} / 60 Hz, P_o = 1000W 100 V_{ac} / 50 Hz, P_o = 700W		 8 14,5 12,6		 A_{RMS}

Table 12: Power specifications – Common

Note 4: F200 fuse rating of module is 250VAC T6.3A_H. Fuse is not user replaceable (For safety fault only).

9 Mechanical Specification

9.1 Dimensions and mounting

Symbol	Parameter	Condition	Min	Typ	Max	Unit
L	Module length			228		mm
W	Module width			100		mm
H	Module height				46	mm
Mass	Weight			670		g

Table 13: Mechanical dimensions

The ICEpower 1000S is designed for mounting on the bottom side via spacers and/or on the top side via heat sinks and spacers.

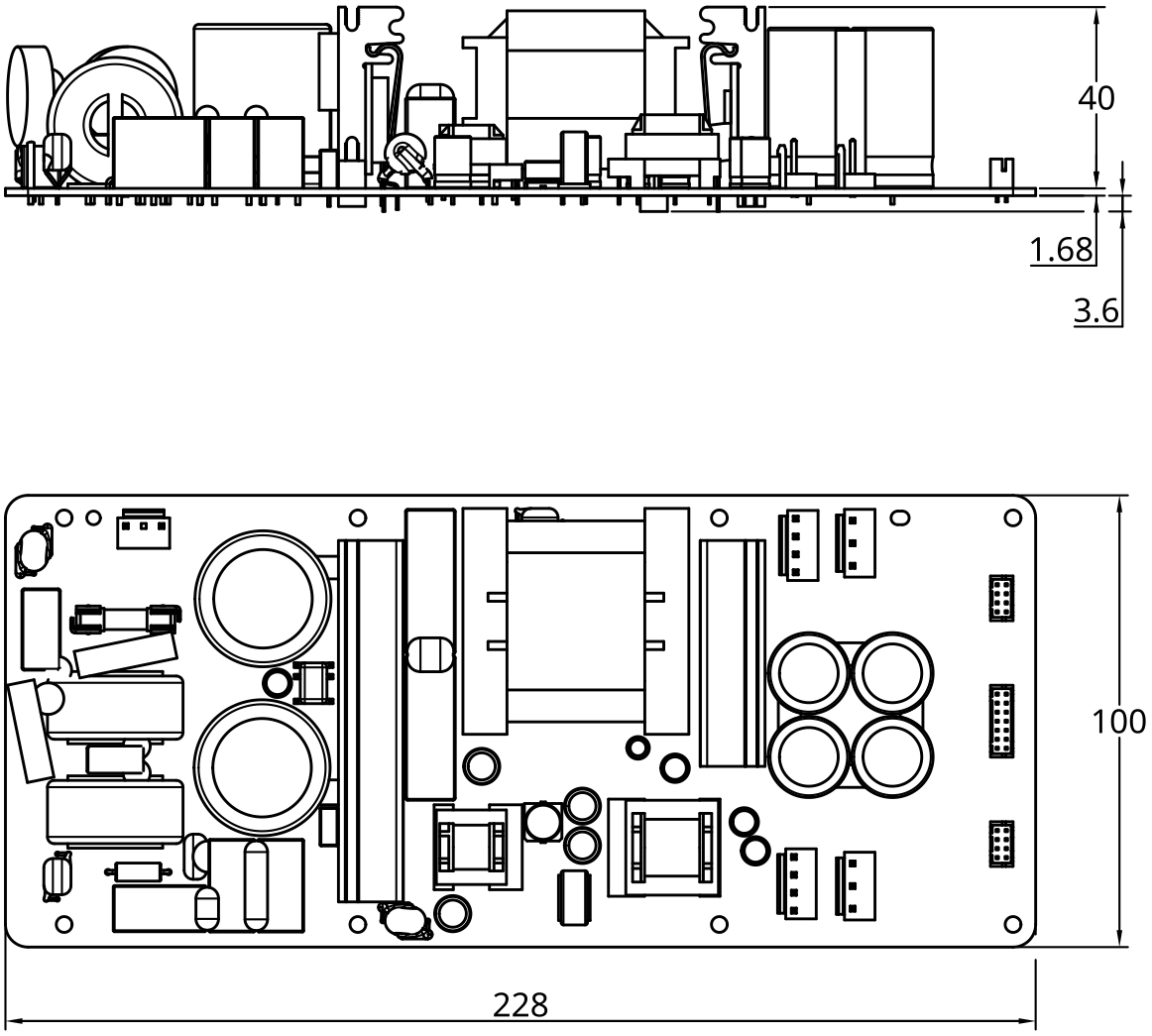


Figure 3: ICEpower 1000S Nominal mechanical dimensions

If ICEpower 1000S is to be mounted on the bottom side, minimum 8 mm spacers/standoffs are recommended for mounting in order to ensure a proper safety clearance between module and chassis (minimum 5 mm spacers/standoffs can be used if safety isolation foil (for example 0.43 mm Lexan FR 700 Film) is applied between bottom of PCB and mounting plate/chassis). For improved airflow 12mm spacers/standoffs are recommended. All 8 holes marked cyan in Figure 4 should be mounted with spacers.

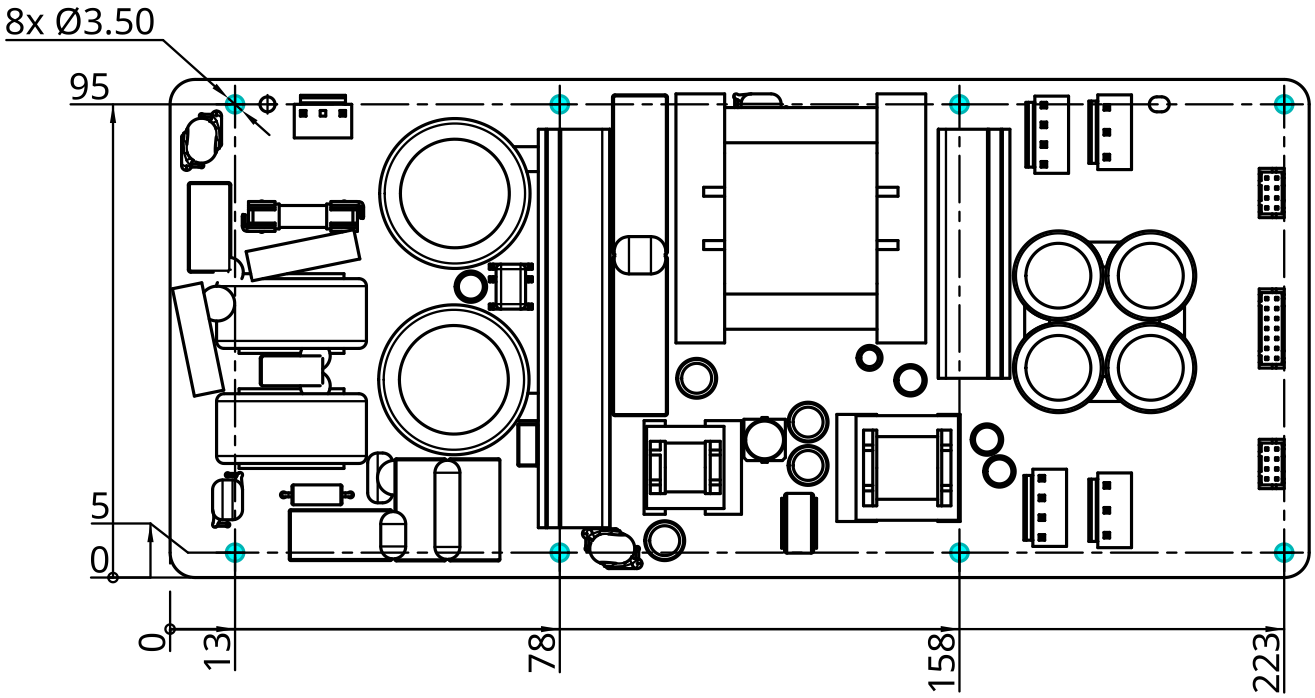
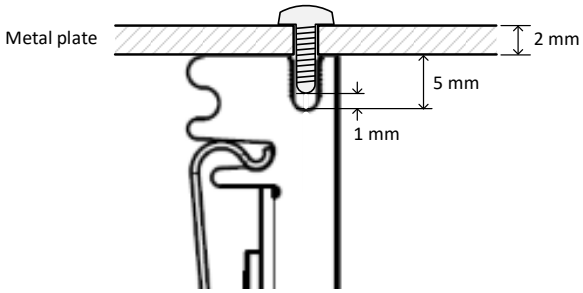


Figure 4: ICEpower 1000S mounting holes (marked for bottom side mounting).

If ICEpower 1000S is to be mounted on the top side via heat sinks and spacers, the module should not be mounted solely by the heat sinks, as this will reduce mounting robustness to the module and impact EMC. Use 40 mm spacers for support in the holes marked cyan and screw directly to the heatsinks marked cyan in Figure 5. Electrically conductive spacers must be used to ensure grounding and EMC filtering.

The mounting slots in the top of the onboard heat sinks are designed for use with M3 DIN 7500 C thread forming screws. Thread forming screws (e.g. Bossard BN5653 M3) must be used in order to avoid burrs, which could cause unintentional short circuits.
The heat sink slot is approximately 5 mm deep. It is recommended to leave 1 mm slack for mechanical tolerances. I.e. to mount the module on a 2 mm plate, a (5-1+2) mm = 6 mm screw is recommended. A minimum of two screws in the 50 mm heat sink and three screws in the 80 mm heat sink are recommended.



Additional spacers are recommended in the holes marked magenta in Figure 5.

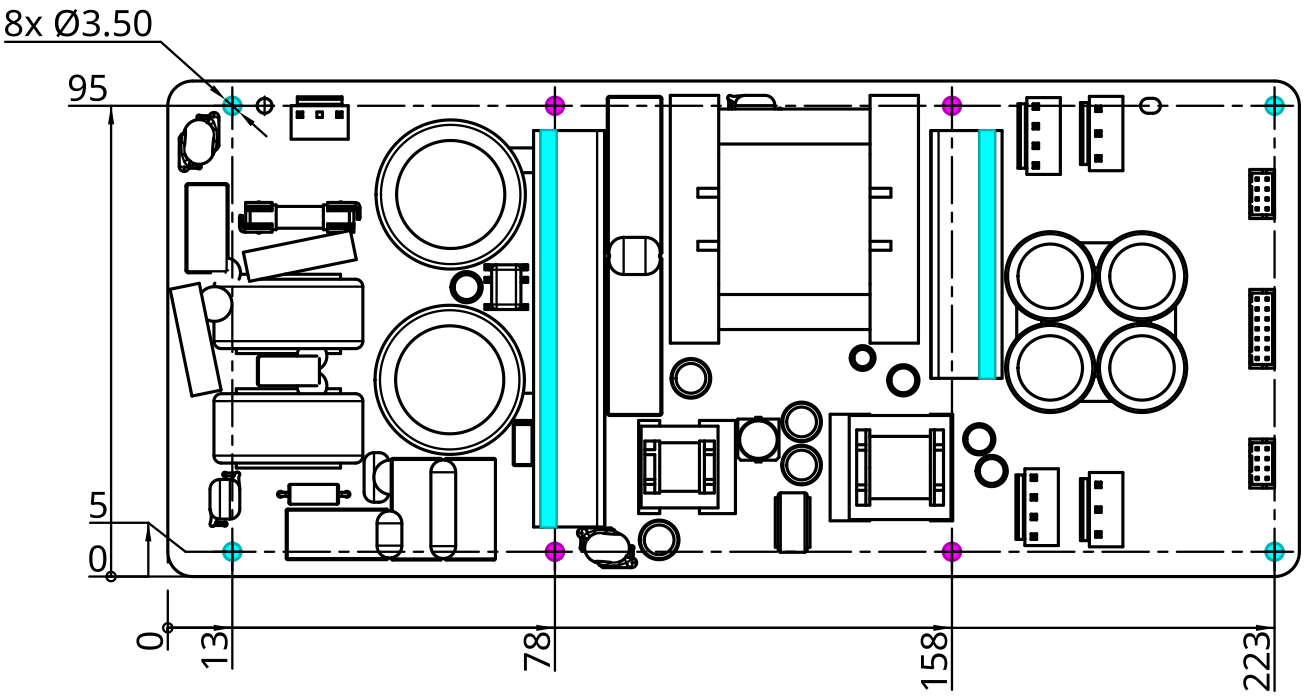


Figure 5: ICEpower 1000S mounting holes (marked for top side/heatsink mounting).

9.2 Environmental Specifications

Symbol	Parameter	Conditions	Min	Typ	Max	Units
$T_{operating}$	Ambient temperature, operating, (**Note 7**)	End-customer use cases	0		60	°C
$T_{storage}$	Ambient temperature, storage	End-customer use cases	-40		70	°C
T_{shelf}	Ambient temperature, shelf	Storage before goods sold to end-customer	0		50	°C
RH	Relative humidity	Non-condensing Operating and storage			85	%
	Altitude, operating				3000	m

Table 14: Environment specifications

Note 7: Safety tested at 1/8 power (According to 8.1 $P_{o\text{-}con\text{-}heatsink\_60}$) Module placed vertically and mounted on a heatsink with R_{th} 0.75 K/W (e.g. Fisher Elektronik SK 198 100 – 300mm X 15mm X 100mm)

10 Typical Performance Characteristics

10.1 Power versus mains voltage

The rails are loaded with two ICEpower 400A2 modules in BTL and PAux loaded with 20W and 5W DVDD load.

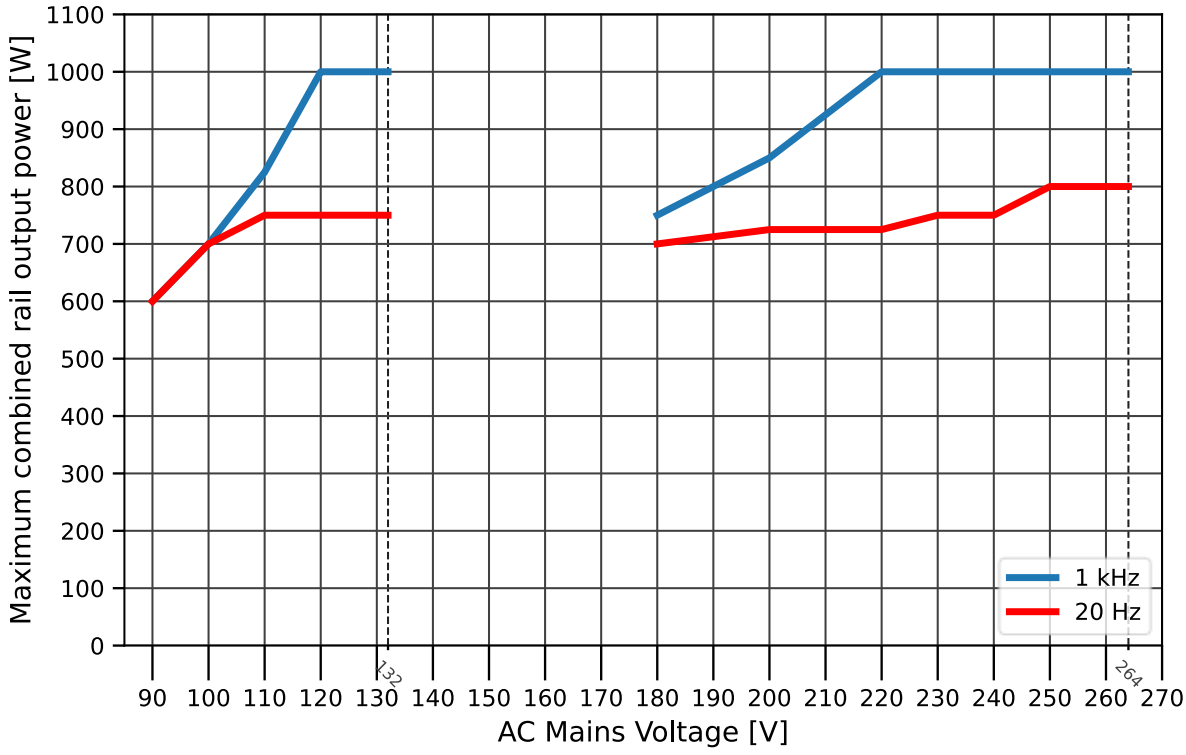


Figure 6: Maximum combined output power from VD/VS, vs mains voltage - freq. 20 Hz (red), 1 kHz (blue)

10.2 Power Efficiency

PAux loaded with 20W and 5W DVDD load.

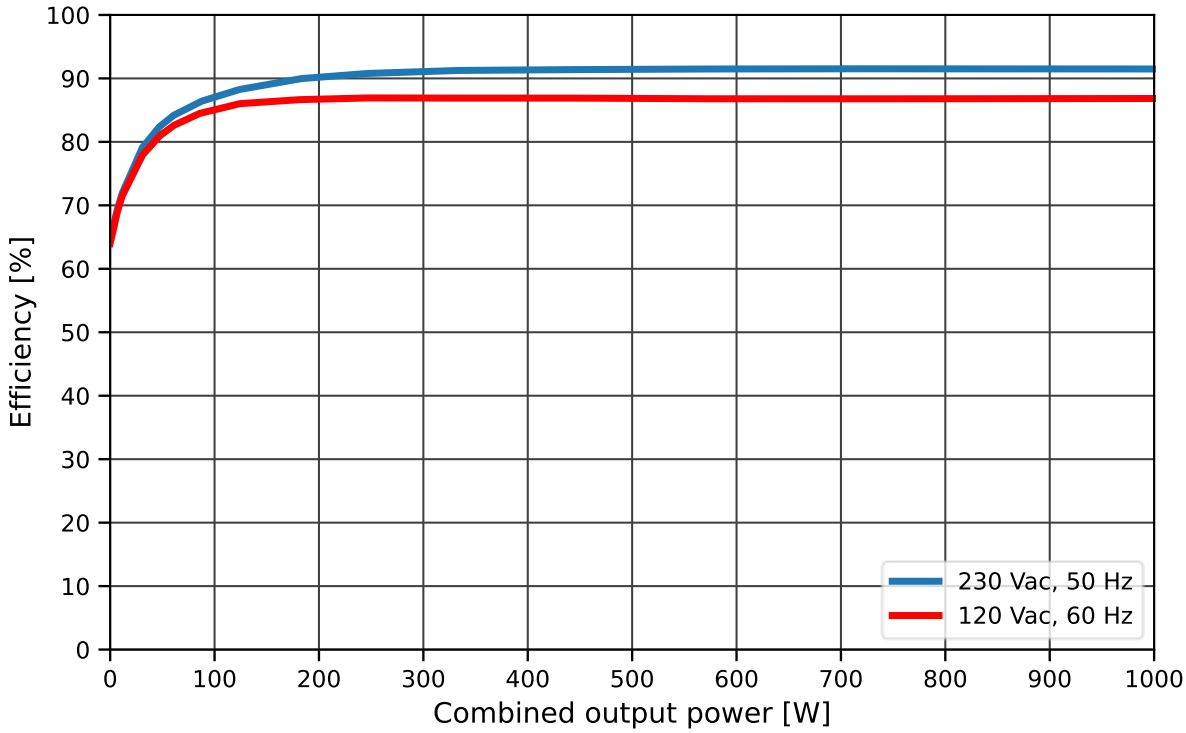


Figure 7: Efficiency vs. combined output power from VD/VS

10.3 Dissipated Power

PAux loaded with 20W and 5W DVDD load.

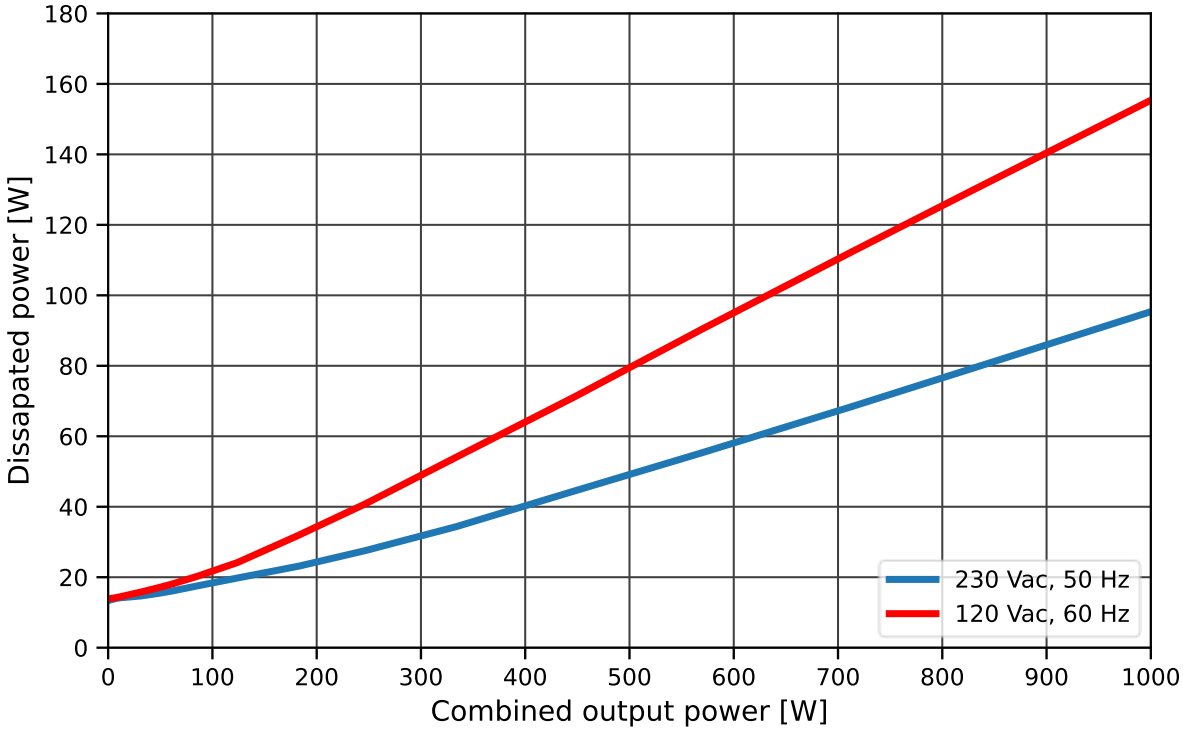


Figure 8 Dissipated power vs. combined output power from VD/VS

11 Functional Description

The ICEpower 1000S is a fully self-contained power supply module and requires no interaction nor control to operate. ICEpower 1000S will start operating less than a second, after mains is applied. To get ICEpower 1000S in standby mode an external high standby signal is required.

Following ICEpower's "Music at All Times" philosophy, the module will operate under all conditions except for potentially destructive or overload situations. At power-up, the ICEpower 1000S module performs comprehensive checks to verify operation conditions and to check for errors. If an error is detected, the module will try to reboot after a short delay. As part of the effort to keep music playing, the module monitors numerous internal parameters during operation and reacts proactively if required.

11.1 AC Mains Input

ICEpower 1000S has universal mains input operating on all common mains supplies. No switching between low and high mains is required.
When power is applied to the ICEpower 1000S the module will, after a short initialization, read the control inputs and start operating accordingly.

The power up and power down timing is shown in Figure 9. Specific timing values are available in Section 8.3.

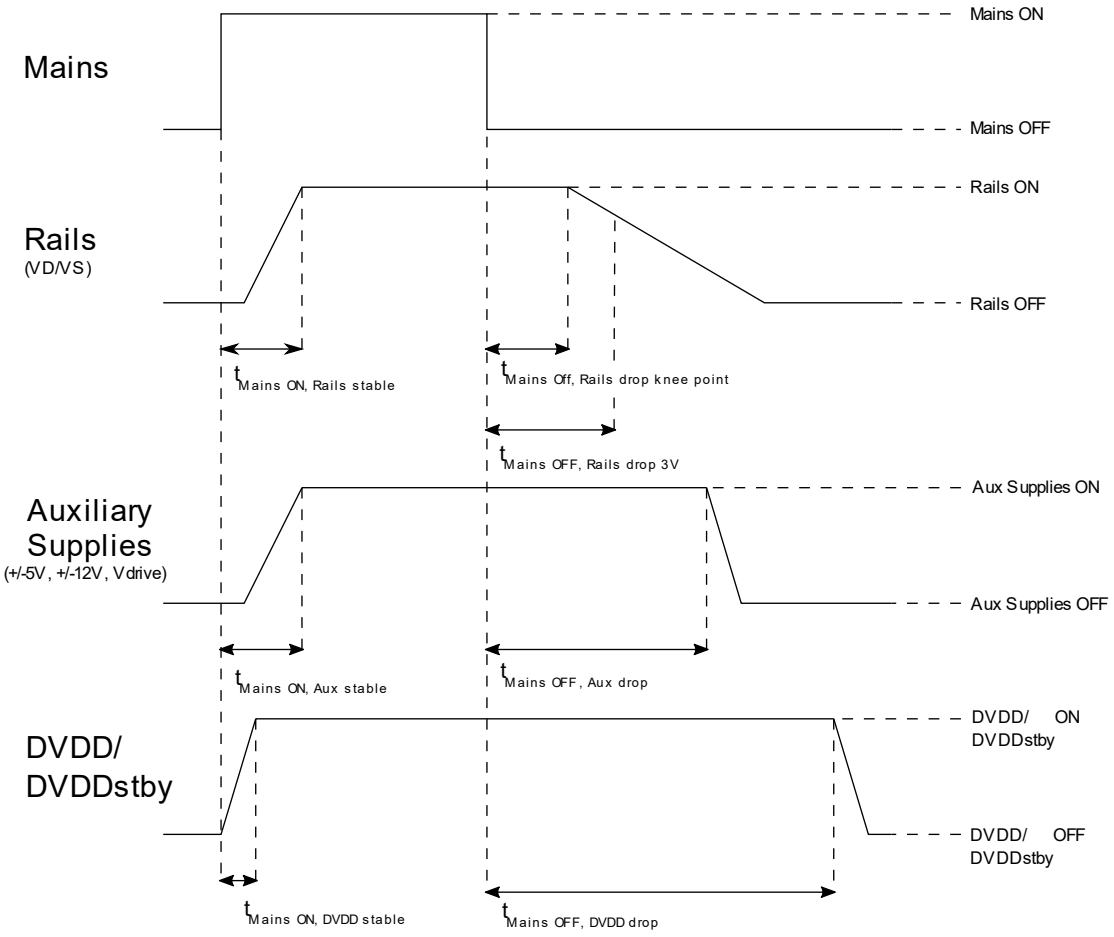


Figure 9: Mains timing diagram

11.2 Control and Status

The Basic Control Connector (P101) and Auxiliary Supply Connectors (P103/104) contain the following inputs and supplies:

- Standby – Active High input
- N_DC_Protect – Active Low input
- Auxiliary supplies being AVDD_+12V, AVSS_-12V, AVDD_+5V, AVSS_-5V and Vdrive
- DVDDstby/DVDD Control auxiliary standby/On mode supply

The Hanger Rail Supply Connectors (P105/106, P108/109) includes power supply outputs for amplifier hanger modules:

- VD, VS and Vdrive

The recommended connection to the control input is shown in 12.1

11.2.1 Standby Input

The Standby input brings the ICEpower 1000S in standby mode when pulled high. An internal pull down ensures on mode operation if the standby input is left unconnected. Interface schematics can be found in Section 12.1

Entering standby mode causes rails and all auxiliary outputs to turn off; except the DVDD/DVDDstby.

Entering standby mode happens shortly after the standby pin is activated (logic high). Standby timing is shown in Figure 10. Specific timing values are available in section 8.3

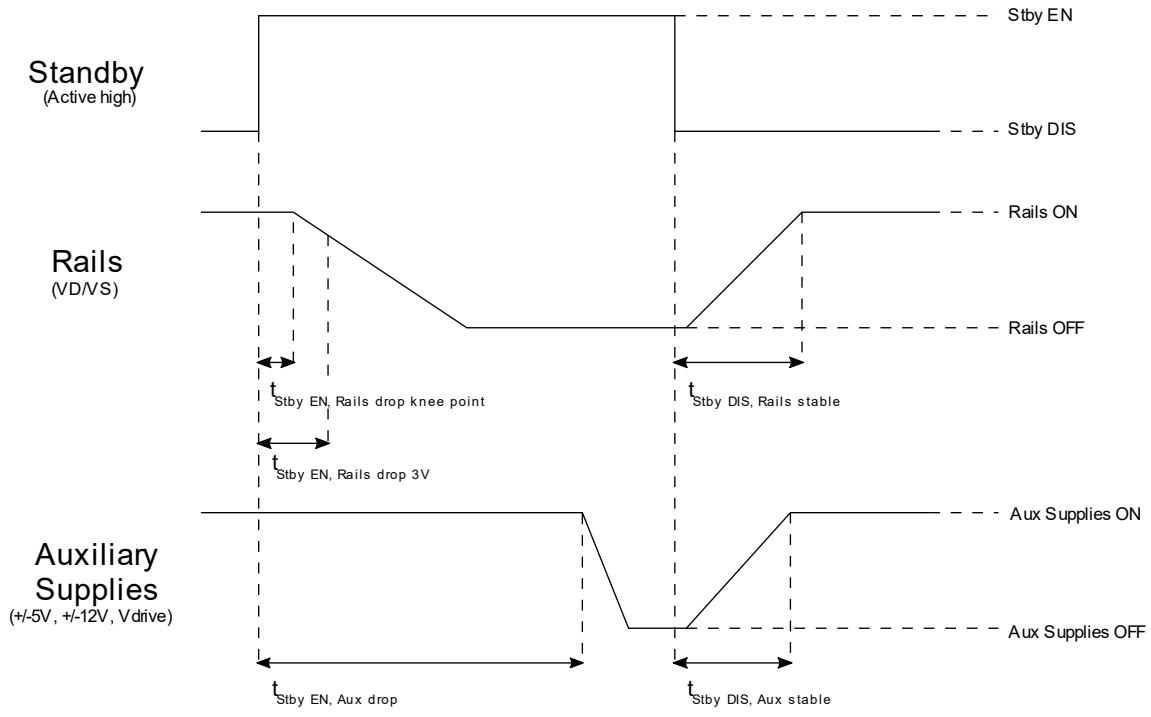


Figure 10: Standby input timing

11.2.2 N_DC_Protect input

In case of amplifier DC error, the N_DC_Protect input can be used to put the ICEpower 1000S in standby mode thereby leaving only the standby power supply DVDD/DVDDstby operating. Interface schematics can be found in Section 12.1.

The N_DC_Protect input brings the ICEpower 1000S in standby mode when pulled low. An internal pull up ensures on mode operation if the N_DC_Protect input is left unconnected. N_DC_Protect timing is shown in Figure 11. Specific timing values are available in Section 8.3.

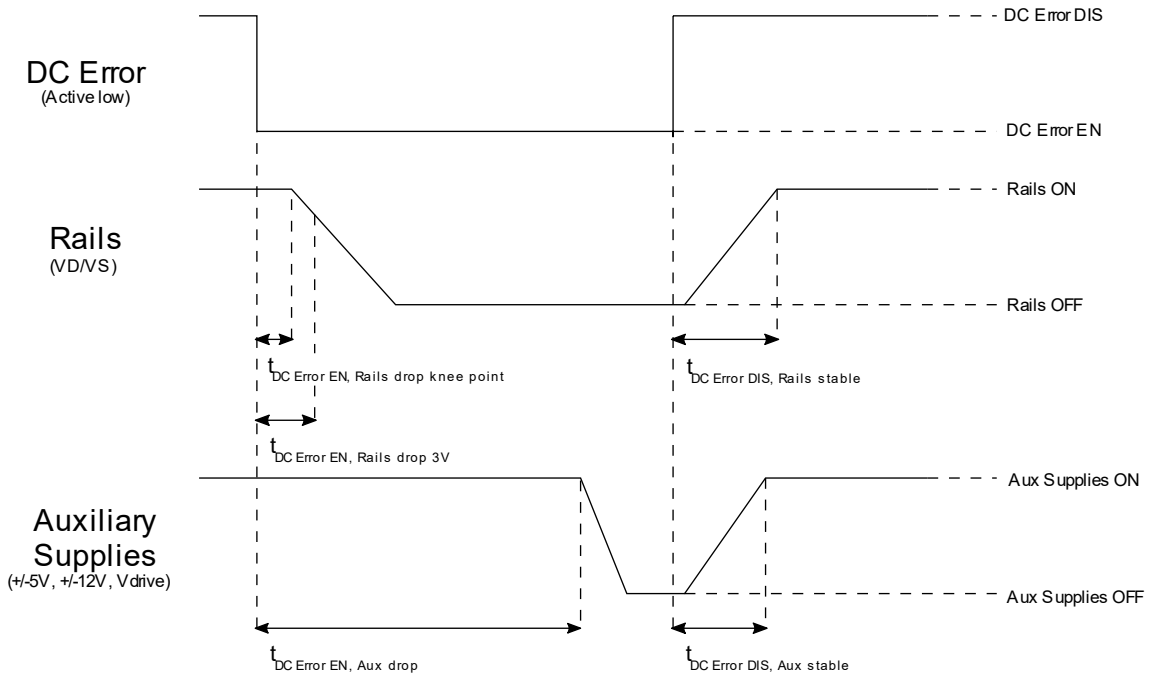


Figure 11: N_DC_Protect input timing

11.2.3 Rail overcurrent event

In case of a rail overcurrent event occurring, the ICEpower 1000S shuts down both rails (VD/VS) and all auxiliary supplies (AVDD_+12V, AVSS_-12V, AVDD_+5V, AVSS_-5V and Vdrive), leaving only DVDD/DVDDstby on. When the rail overcurrent is no more present, both rails (VD/VS) and all auxiliary supplies (AVDD_+12V, AVSS_-12V, AVDD_+5V, AVSS_-5V and Vdrive) will automatically re-enable. Rail overcurrent timing is shown in Figure 12. Specific timing values are available in Section 8.3.

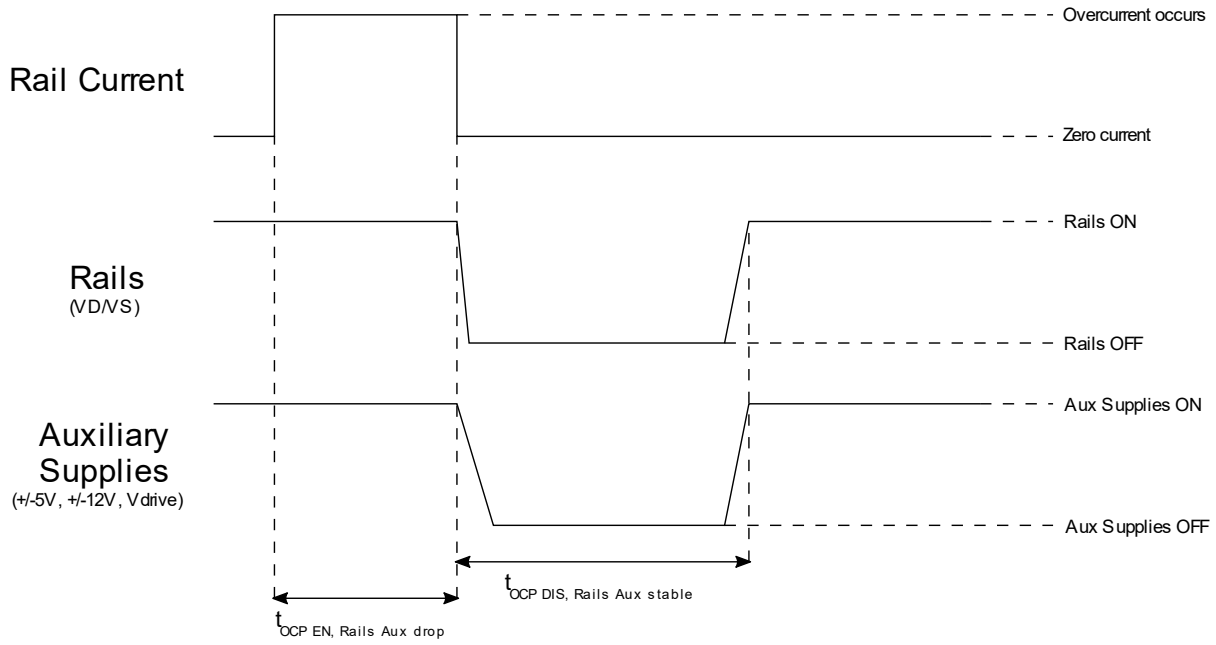


Figure 12: Rail overcurrent timing

11.2.4 Rail overvoltage event

In case of a rail overvoltage event occurring, the ICEpower 1000S shuts down both rails (VD/VS). Depending on auxiliary loading and overvoltage condition, shut down can occur on the auxiliary supplies (AVDD_+12V, AVSS_-12V, AVDD_+5V, AVSS_ -5V and Vdrive), leaving only DVDD/DVDDstby on/active. When the rail overvoltage is no more present, both rails (VD/VS) and all auxiliary supplies (AVDD_+12V, AVSS_-12V, AVDD_+5V, AVSS_-5V and Vdrive) will automatically re-enable. Rail overvoltage timing is shown in Figure 13. Specific timing values are available in Section 8.3.

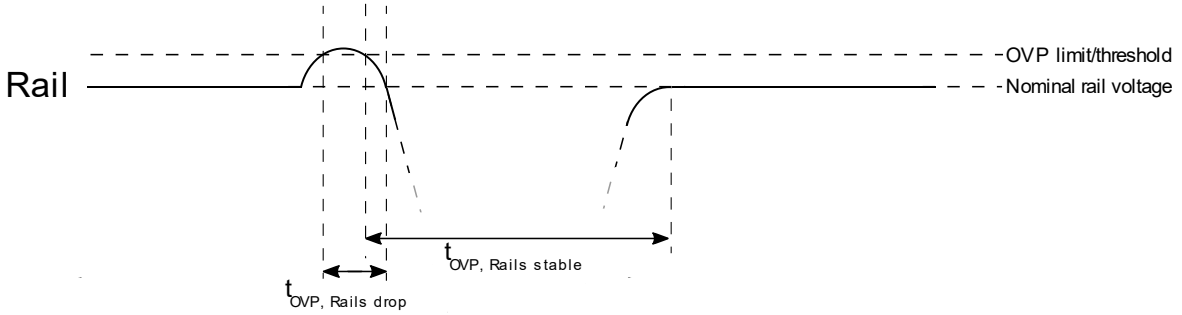


Figure 13: Rail overvoltage timing

11.2.5 DVDD/ DVDDstby Power Supply Output

The DVDD/ DVDDstby output is a power supply output intended for control circuits on a front-end board e.g. microcontrollers and DSPs. DVDD is hardwired together with DVDDstby internally. DVDD/ DVDDstby has reduced output current capabilities (see $I_{DVDD,\ 5V1\ in\ standby\ mode}$ in section 8.5) in standby mode and at startup/ mains applied. When module is fully powered on (all output supplies are on) the DVDD/ DVDDstby output can deliver 1A.

It is recommended though to add extra supply line series feed impedances and decoupling capacitors on the connected PCB to attenuate the power supply voltage ripple. The series impedance can be either a low value resistor or a small inductor. The extra decoupling capacitance must not exceed the value specified in Table 11: Power specifications – Auxiliary. The DVDD/ DVDDstby output is protected against overload conditions. In the event of an overload or short circuit, the converter will shut down and restart (hiccup).

11.2.6 AVDD_+12V, AVSS_-12V, AVDD_+5V, AVSS_-5V Power Supply Outputs

The AVDD_+12V, AVSS_-12V, AVDD_+5V, AVSS_-5V outputs are positive and negative power supply outputs intended for amplifier hanger modules (like ICEpower 400A2) and analog circuits on a front-end board e.g., analog buffers and speaker crossover filters.

To ensure proper suppression of supply related noise and hum, it is important to have all supply related current draw through the ground connections in the power supply interface.
For proposed grounding scheme details, please see Section 13.1

The AVDD_+12V, AVSS_-12V, AVDD_+5V, AVSS_-5V supply outputs are loosely regulated (especially the AVDD_+5V and AVSS_-5V). They may require additional voltage regulators on a front-end board depending on the type of circuit supplied by these pins. It is therefore recommended to add extra supply line series feed impedances and decoupling capacitors on the connected PCB to attenuate the power supply voltage ripple. The series impedance can be either a low value resistor or a small inductor. The extra decoupling capacitance must not exceed the value specified in Table 11: Power specifications – Auxiliary.

The AVDD_+12V, AVSS_-12V, AVDD_+5V, AVSS_-5V outputs are short circuit protected, but not overcurrent protected. Please see Table 11: Power specifications – Auxiliary for current draw limits. A short of these outputs will cause a power down of the Auxiliary converter. When the short circuit condition is removed the auxiliary outputs will automatically re-enable after a short delay.

11.3 Hanger Rail Supply

To supply an amplifier with the ICEpower 1000S, the amplifier power stage positive and negative supply rail lines VD and VS together with Vdrive and power ground GNDA are available in the Hanger Rail Supply connectors. The VD/VS of ICEpower 1000S is internally overcurrent protected, See 11.2.3. The VD of ICEpower 1000S is internally overvoltage protected, See 11.2.4.

For guidance on avoiding rail pumping and connections to ICEpower 400A2, see: Application Guide for ICEpower400A2 & ICEpower1000S-69V.

The Vdrive output should not be connected to anything other than amplifier modules (e.g. ICEpower 400A2). The Vdrive output is short circuit protected to VS only, but not overcurrent protected. Connecting the Vdrive output to any other supply sources, including GNDA or VD will cause damage to the ICEpower 1000S module. Failure to comply with these requirements is against the ICEpower warranty policy.

For power specifications see section 8.4.

12 Interface Schematics

In the following sub-section, proposed interface schematics are shown. These schematics should be considered an assistance to the design process, and they represent the recommended interface to the ICEpower 1000S module.

12.1 Control Inputs

Interface for Standby input

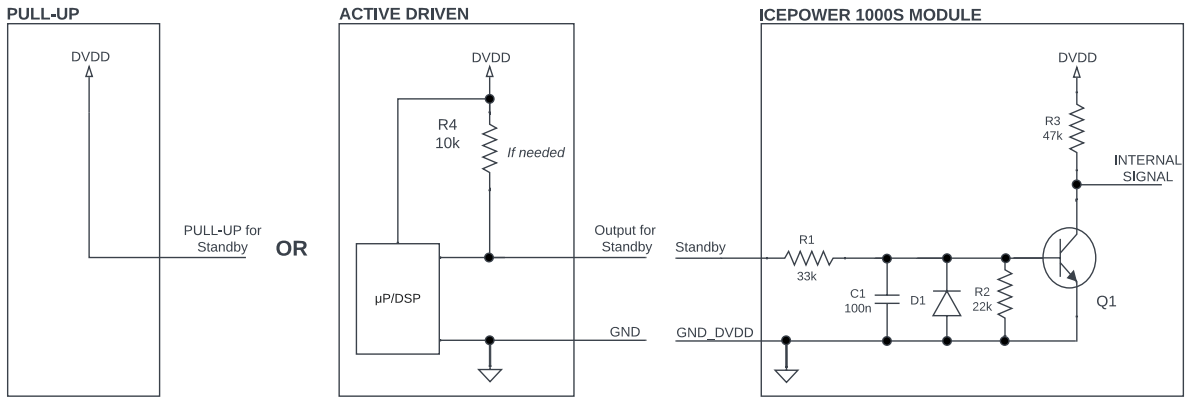


Figure 14: Standby Input Schematic

The Standby input brings the ICEpower 1000S in standby mode, when pulled high. The Standby input is low when not active.

Interface for N_DC_Protect input

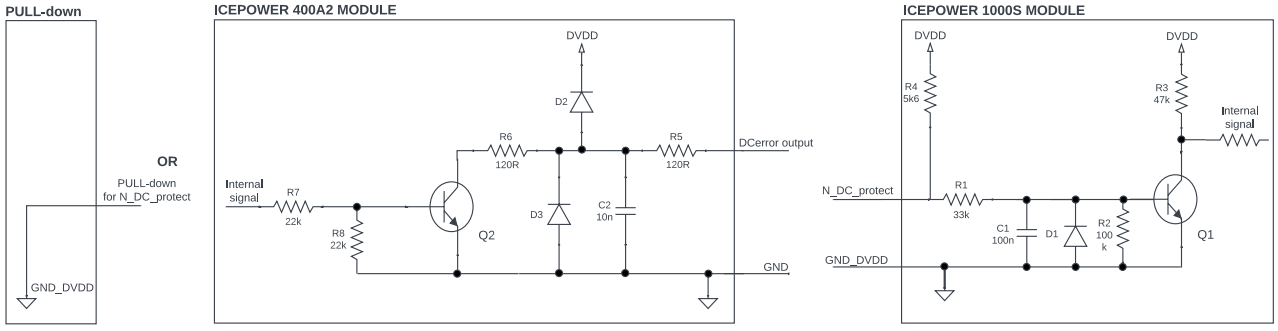


Figure 15: N_DC_Protect input Schematic

The N_DC_Protect input is high (~4.5Vdc) when not active. This input brings the ICEpower 1000S in standby mode, when pulled to GND_DVDD. The N_DC_Protect input is intended to be directly connected to ICEpower 400A2 DCerror output (connector P6, pin 6 on ICEpower 400A2) or to be pulled low to GND_DVDD by external circuitry.

13 Integration Guidelines

The ICEpower 1000S is designed with ease of integration in mind. This includes both electrical, EMC, thermal and mechanical integration. In the following sub-sections, recommendations will be given to assist the end-product design process.

13.1 Grounding Scheme

To ensure Safety compliance, improved EMC filtering and mechanical stability all the mounting holes W200, W201, W1301, W1302, W1303, W1304 and W1305 must electrically be connected to chassis, except if the module is mounted on the top side via heatsink and spacers (see section 9.1). The mounting hole W1307 is non-plated, but must be used for mechanical stability.

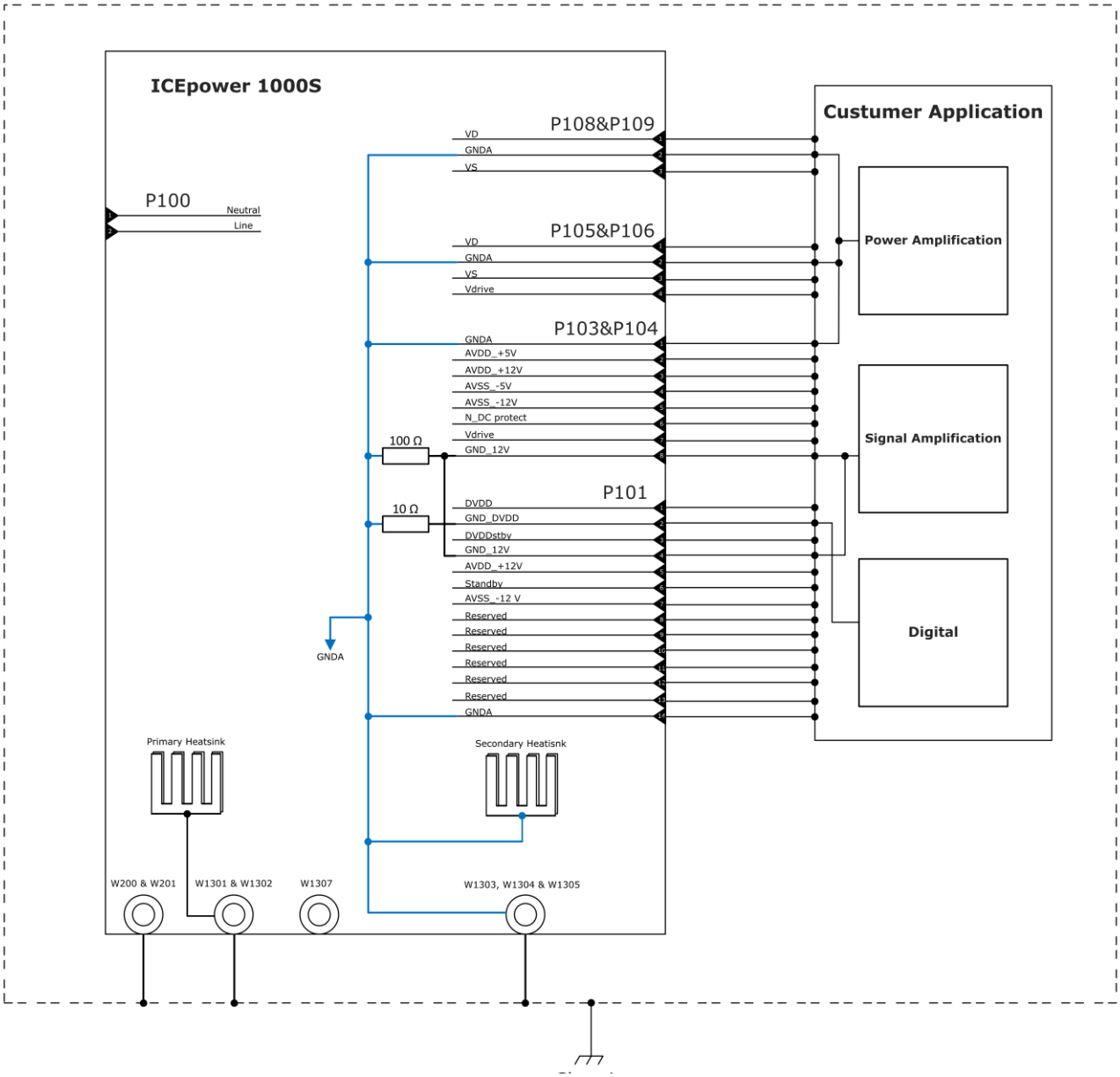


Figure 16: Grounding scheme

13.2 EMC Management

Depending on the end-product application and construction, additional mains power Line EMC Filtering and shielding might be required to have the entire product approved. Some EMC precautions are strongly recommended to make EMC approval easier in end-product design.

- Connect the module to the chassis. Mounting of the module isolated from the chassis may cause extended HF radiation.
- Do not use cable/wires between module and other PCBs that are longer than necessary. Especially mains cable inside product is recommended to be as short as possible.
- Avoid wire loops on the speaker output wires. Use wires closely paired side by side or if required use twisted or shielded cables as shown below.

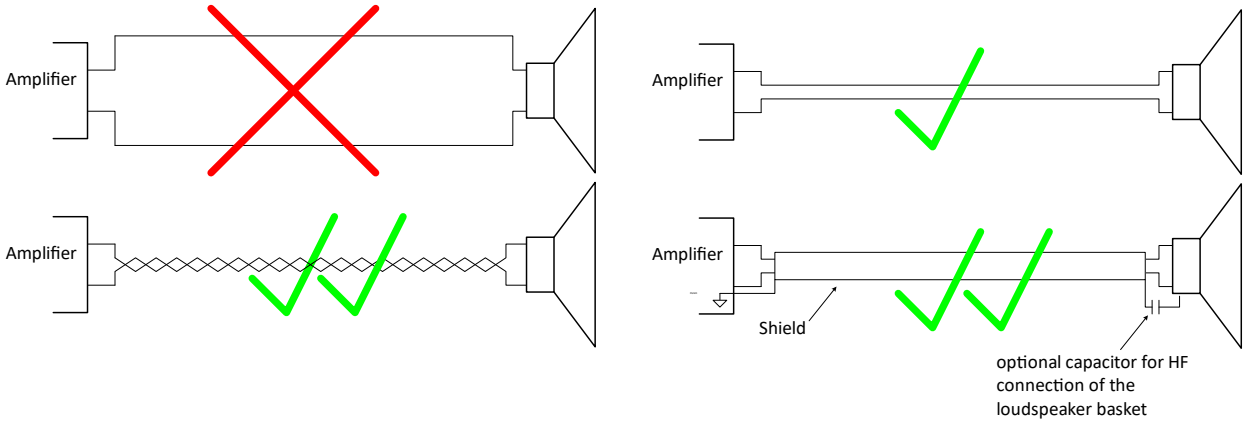


Figure 17: Avoid wire loops on the speaker wires

- Avoid wire loops on the mains wires from the mains inlet to the module mains connector.
- Do not route cables near by the magnetic components on the module i.e. inductors and transformers as shown below.

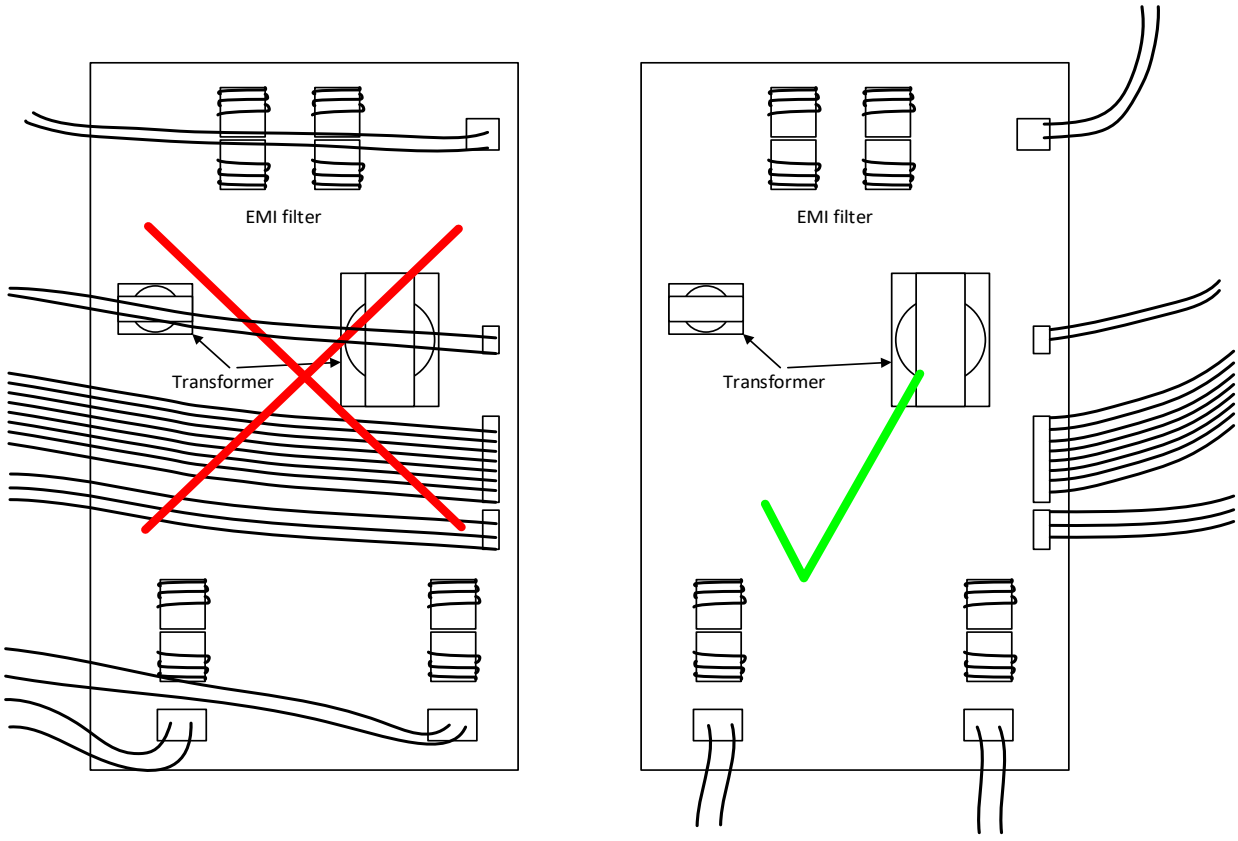


Figure 18: Do not route cables near the module magnetics.

- Do not bundle mains wires together with other cable as shown below and do not draw mains wires close to secondary side of the module.

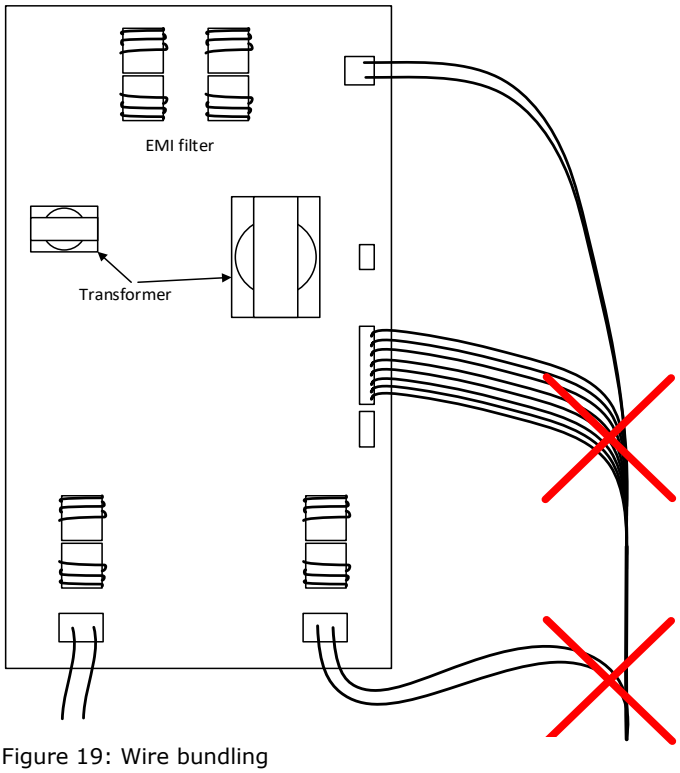


Figure 19: Wire bundling

Depending on the end-product application, additional EMC initiatives and filtering may be required to have the entire product approved. The reason for this could be, among others, inappropriate cable routing, PCB/module placements inside product or length within the application or DSP/microprocessor based front-end systems.
To improve on EMC performance, it is often advisable to revisit the used grounding scheme and cable routing and add EMC filters on some or all the connectors on the end-product.

13.3 Thermal Design

The ICEpower 1000S module is designed with integrated heat sinks. The module can therefore operate without any further cooling. Even though use of the module without further cooling is possible, it is recommended to add slow airflow fan cooling (for example ~6 CFM fan placed 5-10 cm distance from ICEpower 1000S input filter, which is the main hot spot), to ensure even lower component temperatures. At higher ambient temperature an external heatsink could also be added to extend the continued power capabilities. The ICEpower 1000S module is designed for audio amplifier playing music (due to the crest factor in music the total average power would typically be between ~1/8 power and ~1/4 power of Rated combined VD/VD output power P_o. It is important to ensure proper airflow around the module.

If heatsinks are used for mounting instead of the screw holes, isolation foil (e.g. polycarbonate - Lexan®) is not needed for safety isolation between the external heatsink/chassis and the components of ICEpower 1000S (for example between the primary bulk capacitors (C203, C204) and external heatsink/chassis).

13.4 Safety Certification Notes

To ensure safety compliance, it is important to adhere to the following:

- F200 fuse rating of module is 250VAC T6.3H. Fuse is not user replaceable.
- This equipment is not suitable for use in locations where children are likely to be present.
  It is important to mechanically fasten the product as described in section 9.1.

14 Safety Standards

The ICEpower 1000S have been verified to conform to the following standards.

14.1 Safety

IEC 62368-1: 2018

The product fulfils the requirements of:
AS/NZS 62368.1:2022,
CSA/UL 62368-1:2019, 3rd Ed
EN 62368-1:2020+A11:2020,
BS EN 62368-1:2020+A11:2020

Summary of compliance with National Differences
(List of countries addressed):
Australia / New Zealand, EU Group and National Differences, Singapore, USA / Canada, United Kingdom

15 ESD Warning

ICEpower products are manufactured according to the following ESD precautions:

ANSI/ESD-S20.20-2014: Protection of Electrical and Electronic Parts, Assemblies and Equipment.

Further handling of the products should comply with the same standard.

The general warranty policy of ICEpower a/s does not cover ESD damaged products due to improper handling.

16 Ordering, Packaging and Storage

All ICEpower modules are packaged in ESD safe bags and cardboard boxes.

16.1 Ordering Information

Order Codes	Description	Part Number
ICEpower 1000S-69V	ICEpower 1000S with +/- 69V rail hanger voltage	8001000

16.2 Shipping Dimensions and Weight

Package	Quantity	Dimensions (w × d × h) [mm]	Gross Weight [kg]
Carton	14	59X39X20	TBD

16.3 Storage Conditions

Storage Humidity and Temperature:

Please find storage humidity and temperature information in Section 9.2, Environmental Specifications.

Stacking

A maximum of 4 cartons must be stacked on top of each other.

Pallets must not be stacked on top of each other.

17 Contact

For additional information about the ICEpower® technology from ICEpower a/s, visit our web site or contact us.

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18 Legal Notes

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- A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.