V6

Contents

General Considerations

Rubidium frames	Maximum power dissipation	Power consumption
RUB S1/T1 frame	**6.5 W**	**0 W** (USB powered from PC)
RUB D1 frame	**20 W**	**2,0 W** minimum; **5,0 W** typical; **7,0 W** maximum
RUB Q1 frame	**34 W**	**3,5 W** minimum; **6,0 W** typical; **8,5 W** maximum
RUB H1 frame	**34 W**	**1.6 W** (fan ...)
RUB H3 frame	**68 W**	**3.1 W** (fans ...)

Power Limitations

- RUB PS/PT/PQ: These 60 W power supplies are specified with “Full load @ 50 °C” and “75% @ 60 °C”. We calculate an internal heat-up of $\Delta T = 20$ K ($T_{int} = T_{amb} + \Delta T$). Maximum output power depending on the ambient temperature: at $T_{amb} \leq 30$ °C: 60 W and at $T_{amb} \leq 40$ °C: 45 W. So **45 W** would be the maximum output power for the whole specified temperature range.
- Carrying power from one frame to another (via RLC connector): Maximum **60 W**.
- No Power Supply module should be plugged to an **S1** or **T1** frame, because these modules will heat up!
- Power redundancy: Similar power supplies in a parallel configuration, hot-swapping power supplies.
  - Secondary redundancy = N+1 configuration. N power supply modules must be able to provide the whole power and each power supply must be within its rated operating current.
  - Primary redundancy = even number of power supply modules, 2N configuration. Two separate primary circuits. N power supply modules must be able to provide the whole power and each power supply must be within its rated operating current.

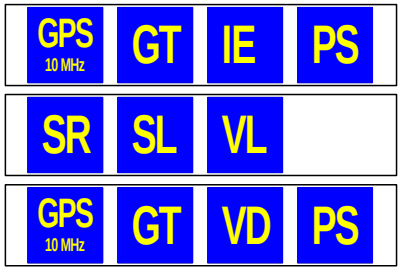
Power Consumption (Maximum) of RUBIDIUM Modules

Modules	Power		Modules	Power
SI, SL, SR, SV	1.5 W		XT	4.7 W
VD(V1), VI, VM	1.6 W		GT, GI, GW	5.0 W
RUB H1 frame (fan, ...)	1.6 W		DT(V2)	5.9 W
IE(V2)	1.8 W		HT	6.2 W
VD(V2)	2.1 W		GPS 10 MHz (LQ)	6.2 W
IE(V1)	2.7 W		GLS 10 MHz (TCXO)	5.9 W
AV(V1, V2), DV(V1)	2.8 W			
VL, XV	3.0 W		RUB D1 frame (fan, display ...)	8.5 W
RUB H3 frame (fans, ...)	3.1 W		PS, PT (electronic part: 1.2 W)	8.7 W
GL	3.4 W		PQ (electronic part: 1.9 W)	9.4 W
DV(V2)	4.2 W			
AT(V1, V2), DT(V1), HV	4.5 W			

Note: if there is any load at a voltage output of a module, this power consumption has to be added!

GPS16/GPS17	0.5 W			

Example of Calculating the Power Consumption of a RUB H1 System



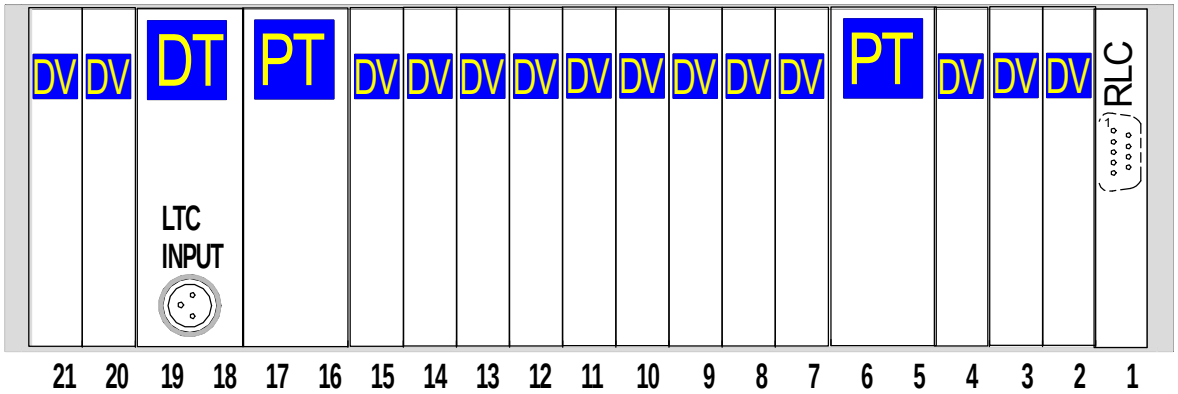
Adding the power consumption of each module + each frame + the electronic parts of the power supplies:

2 x GPS 10 MHz	12.4
1 x SR	1.5
2 x GT	10.0
1 x SL	1.5
1 x IE(V2)	1.8
1 x VL	3.0
1 x VD(V2)	2.1
3 x H1	4.8
2 x PS (electronic)	2.4
==========	
	39.5 W

Maximum output power of a RUB PS module: **45 W**.

This system basically has a primary and secondary power redundancy. The overall power consumption does not exceed the output of one power supply module – as long as there is no additional load at any voltage output.

Example of Calculating the Power Dissipation for a RUB H3 System



Adding the power consumption of each module including the power supplies + H3 frame:

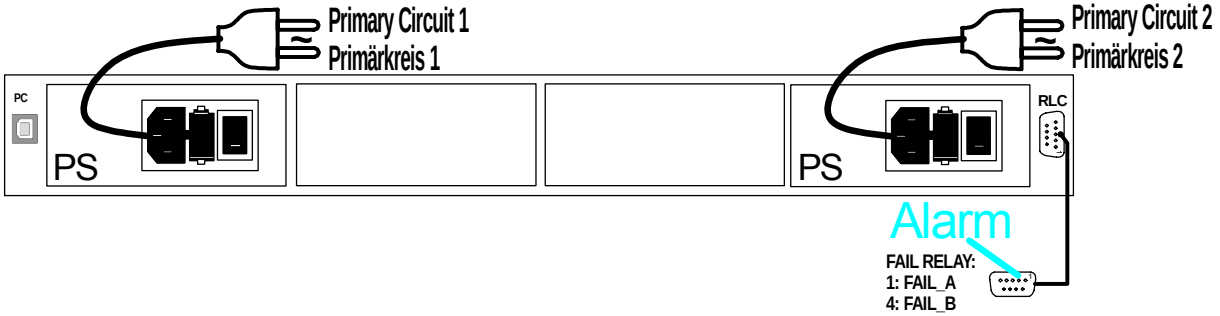
1 x DT(V2)	5.9
14 x DV(V2)	58.8
1 x H3	3.1
2 x PT	17.4
==========	
	85.2 W

Maximum power dissipation allowed for a RUB H3 frame: **68 W**. This system exceeds the rated power, which has been calculated worst case for a H3 mounted with no clearance beneath and above.

If you allow one rack unit clearance beneath and above, this would prevent internal heat build-up and allow a power dissipation of up to **86 W**!

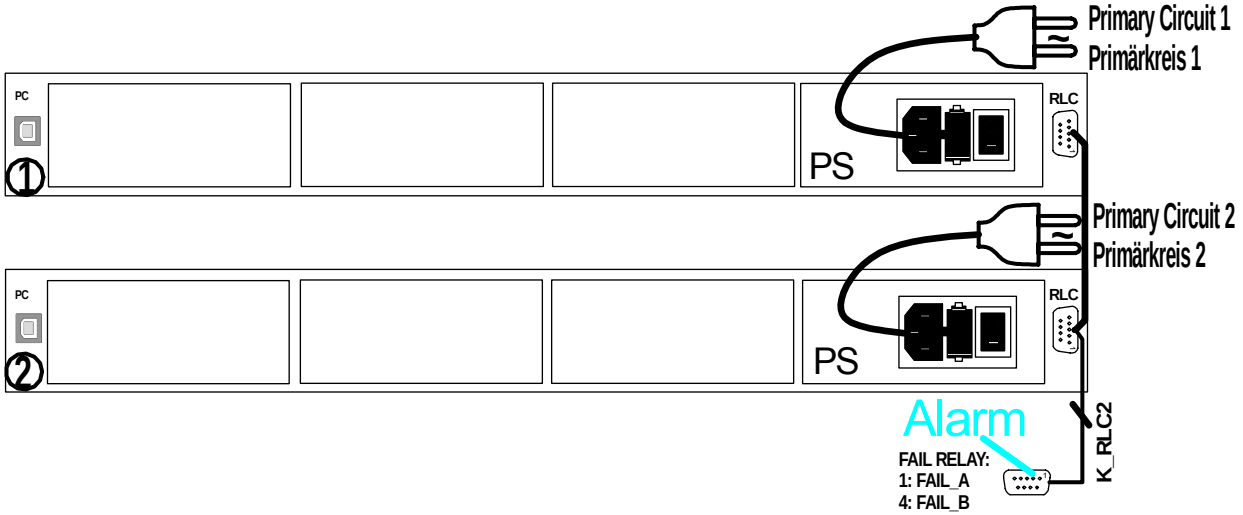
Please note: To prevent heat build-up at the power supply modules, the recommended position of PT modules are at slots 5/6 (or 6/7) and 16/17 (or 15/16).

Redundant Power: System of 1 or 2 x RUB H1 Frames



1 Frame – 2 x PS:

Primary and Secondary Redundancy - valid for all available modules plugged into the free slots.



2 Frames – 2 x PS:

Primary and Secondary Redundancy with the following limitations:

At $T_{amb} \leq 40$ °C: P_{total} = **40.6 W** available for 6 modules. In average: P_{av} = 6.7 W for each module.

Redundant Power: System of 3 x RUB H1 Frames

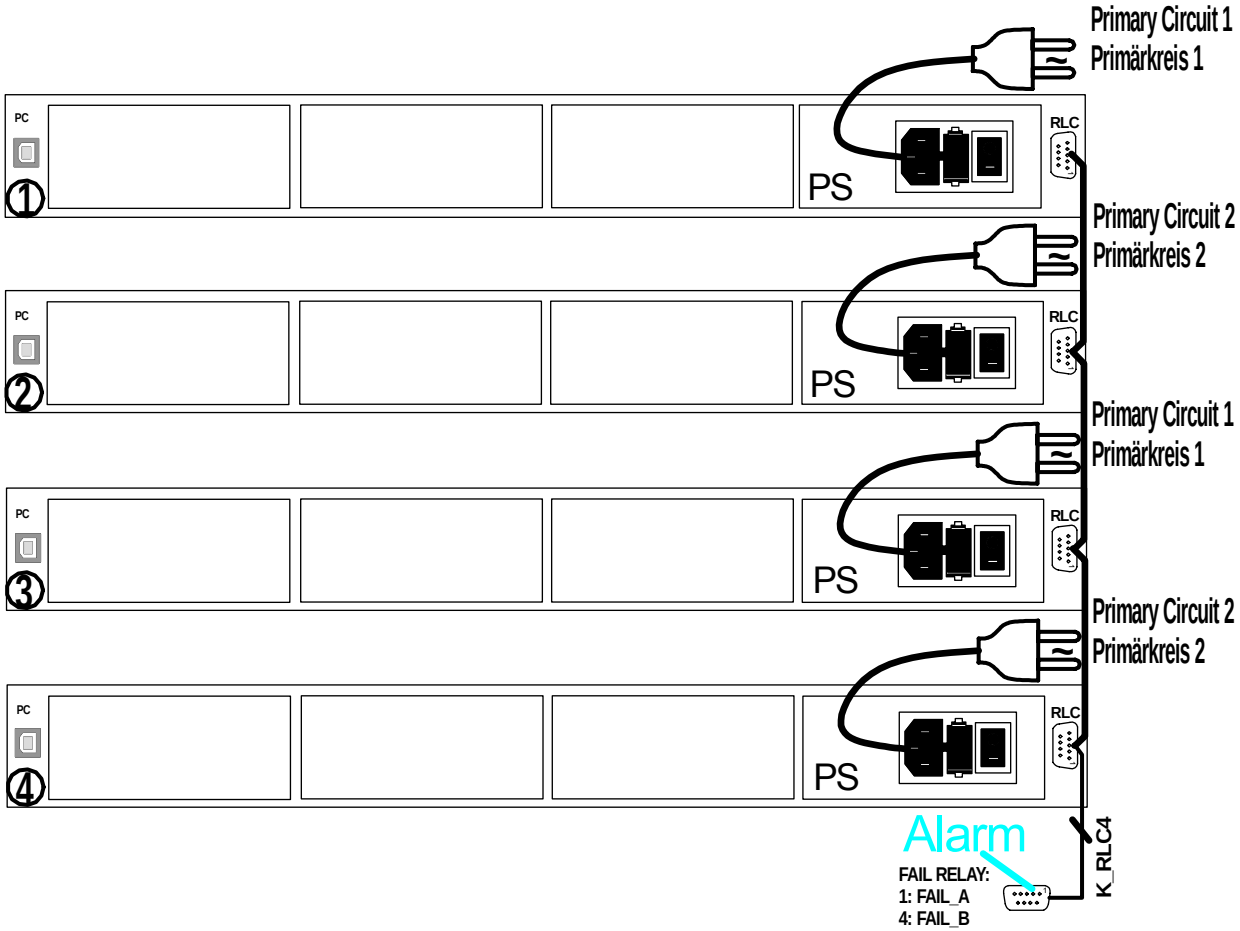
3 Frames – 2 x PS:

Primary and Secondary Redundancy with the following limitations:

At 30 °C ≤ T_{amb} ≤ 40 °C: P_{total} = **39 W** available for 10 modules. In average: P_{av} = 3.9 W for each module.

At T_{amb} < 30 °C: P_{total} = **54 W** available for 10 modules. In average: P_{av} = 5.4 W for each module.

Redundant Power: System of 4 x RUB H1 Frames: Primary and Secondary Redundancy

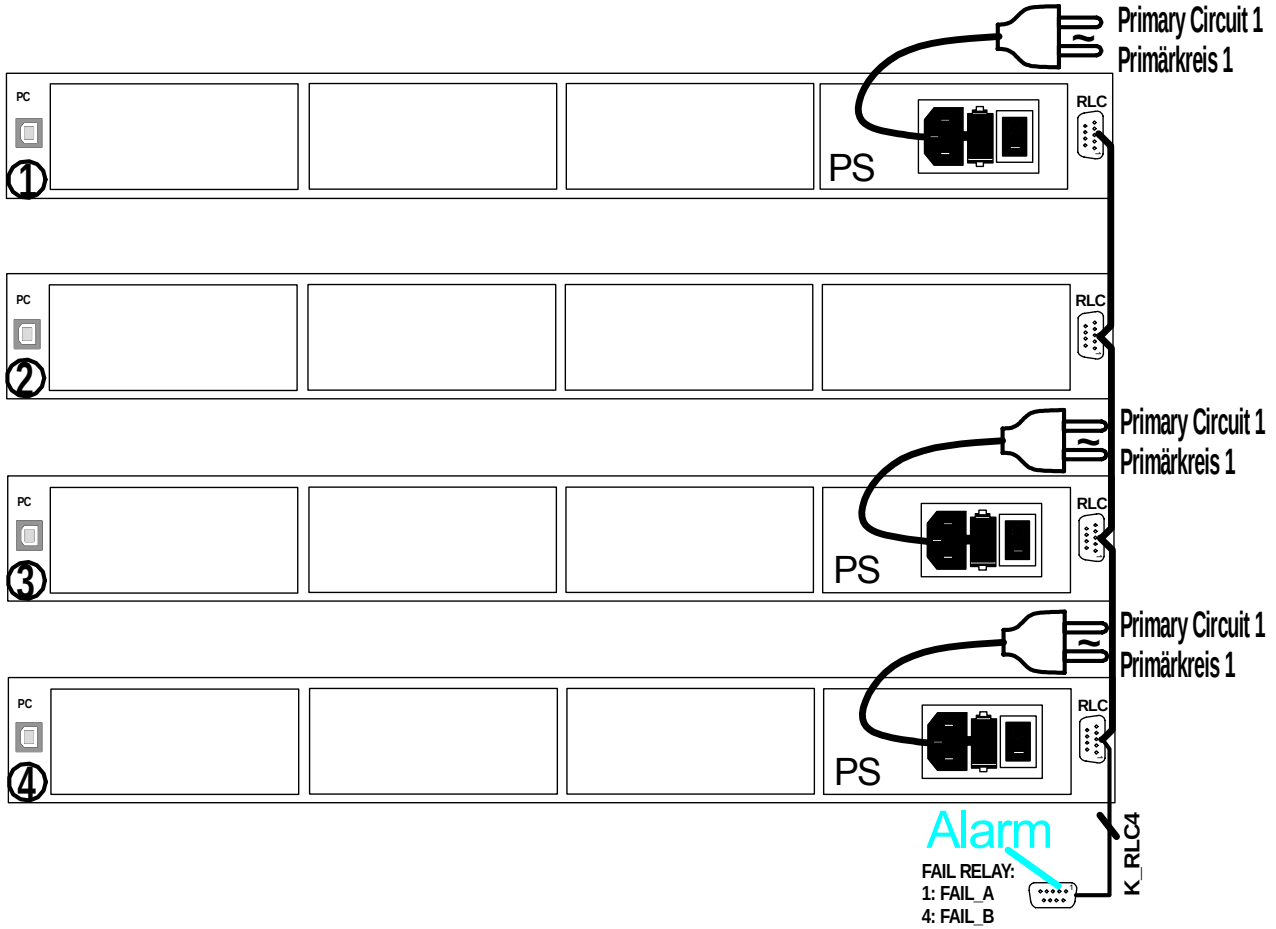


4 Frames – 4 x PS:

Primary and Secondary Redundancy with the following limitations:

At $T_{amb} \leq 40$ °C: P_{total} = **81.2 W** available for 12 modules. In average: P_{av} = 6.7 W for each module.

Redundant Power: System of 4 x RUB H1 Frames: Secondary Redundancy only

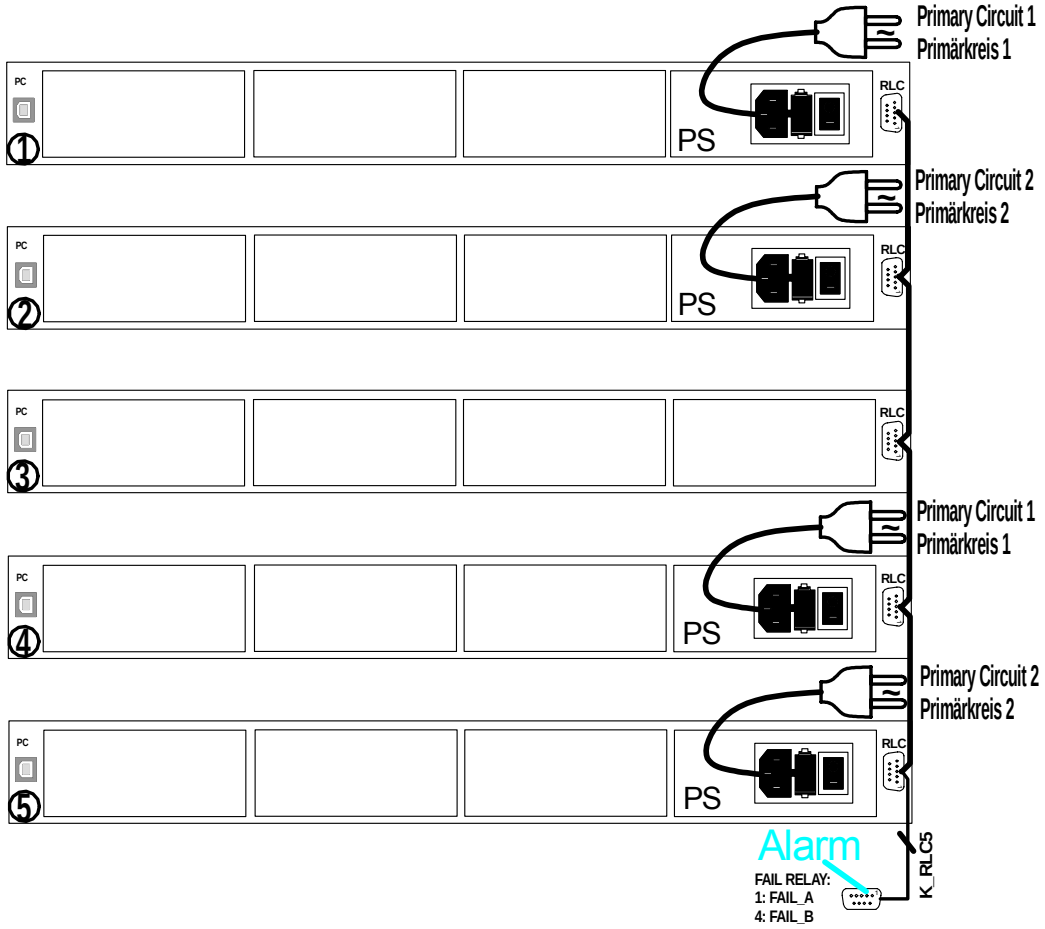


4 Frames – 3 x PS:

Secondary Redundancy only, with the following limitations:

At $T_{amb} \leq 40$ °C: P_{total} = **81.2 W** available for 13 modules. In average: P_{av} = 6.2 W for each module.

Redundant Power: System of 5 x RUB H1 Frames



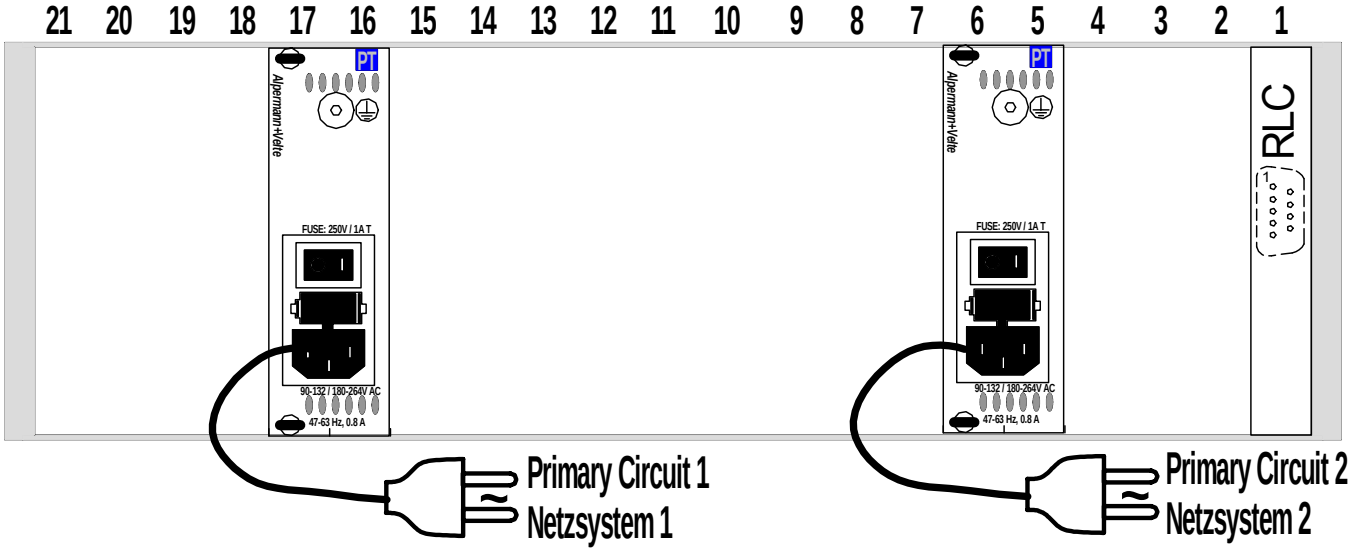
5 Frames – 4 x PS:

Primary and Secondary Redundancy with the following limitations:

At 30 °C ≤ T_{amb} ≤ 40 °C: P_{total} = **79.6 W** available for 16 modules. In average: P_{av} = 4.97 W for each module.

At T_{amb} < 30 °C: P_{total} = **109.6 W** available for 16 modules. In average: P_{av} = 6.85 W for each module.

Redundant Power: System of a single RUB H3 Frame



1 Frame – 2 x PT:

Primary and Secondary Redundancy with the following limitations:

At 30 °C ≤ T_{amb} ≤ 40 °C: P_{total} = **40.7 W** available for further modules.

At T_{amb} < 30 °C: P_{total} = **55.7 W** available for further modules.

The RUB H3 frame offers 21 slots in total; the width of one slot = 4 HP. Each PT needs two slots, the RLC connector one slot. There are 16 slots remaining to plug in modules, e.g. 8 modules of 8 HP, or 16 modules of 4 HP, or combinations of 8/4 HP modules.

Examples: OK for: 6 x HT (37.2 W)
9 x DV (37.8 W)
7 x HV + 1 x HT (37.7 W)
etc.

Carrying Power between Frames (RLC Cable)

Carrying power from one frame to another (via RLC connector): Maximum **60 W**.

The cable has to fulfil the following specifications in order to avoid fire hazard:

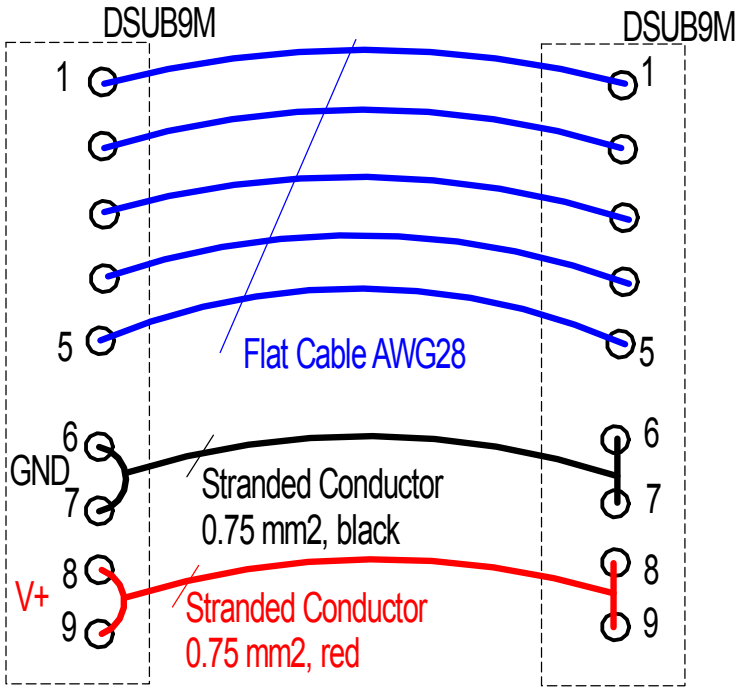
- Each wire carrying power has to be specified for an ampacity of 3 A at least.
- For safety reasons it is recommended to have one wire connected to pins 6 and 7 (GND) and one wire connected to pins 8 and 9 (V+) - instead of using two wires for GND and two wires for V+ connection.

The following wires are recommended:

	Cross Section Area
Solid conductor:	≥ 0,5 mm^2
Stranded conductor	0,75 mm^2
1/20AWG:	0,518 mm^2
7/28AWG:	0,562 mm^2
10/30AWG:	0,507 mm^2

Suitable cable can be ordered from *Alpermann+Velte*: **K_RLC2**, **K_RLC3**, etc.

Example of an RLC Cable:



The Need of Failure Detection in a Redundant Power System

The problem: In a system of redundant power, there will be no failure of outgoing signals if one fan or one power supply fails! Without an alarm system, nobody will detect this failure. Power supplies can be considered as modules with very high power dissipation. If a fan fails, the power supply will heat up, and this will reduce the life time of this module. As a consequence, power supplies should be regarded as a potential point of failure. If another power supply fails, the system may be close to a total failure! In this case, even any signal redundancy – realized by changeover modules – will not help.

Consequence:

A failure of a fan must be detected! A failure of a power supply must be detected!

The RUBIDIUM system offers different methods for monitoring and alarm detection:

1. **FAIL Relay**: The RLC connector at each frame provides FAIL signals. These are contacts of relays. Each module has one relay. The contacts will close if a module has a total failure. This especially indicates a failure of a fan or power supply. If several frames are interconnected, there will be a single alarm available for the whole system. If you use this alarm in an GPI management system, system monitoring and alarm detection will be complete.

   Please also have a look at the document “RUBIDIUM Application: Alarm GPO“, available at: http://www.alpermann-velte.com/faq_e/faq_e.html.

2. **Status Monitor**: Each configurable module offers a status monitor which indicates the status of fan and power supply at the “Fan Monitor“ tab. You will see red flags in an event of a failure. The status monitor is restricted to modules of one frame, so this way of monitoring requires to periodically watch the status monitor of each frame.
3. **SNMP**: If you add a RUB IE module with SNMP option to the system, an automatic monitoring can be realized. Don’t hesitate to contact us if any support will be necessary regarding the integration in your SNMP management system.
4. Customized solutions can be realized as well.

Revision History

V1	July 14, 2010	First release.
V2	July 15, 2010	Revised.
V3	August 02, 2010	Power consumption of Power Supply modules corrected. Power consumption of GPS16/GPS17 added. Chapter “Carrying Power between Frames (RLC Cable)” added.
V4	August 26, 2010	Added: No Power Supply module should be plugged to an **S1** or **T1** frame ...
V5	May 06, 2011	Power consumption IE(V1), IE(V2); XV, XT.
V6	April 26, 2012	Revised. New: Chapter “The Need of Failure Detection in a Redundant Power System”.