

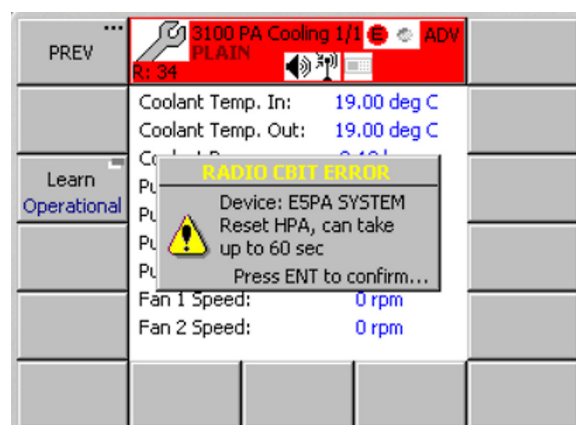


Figure 4-32: Info "Learn Start learn" → "Operational"

Note: Because of the reboot, the connection between the Base Unit and the OPLC briefly breaks and the following message appears.

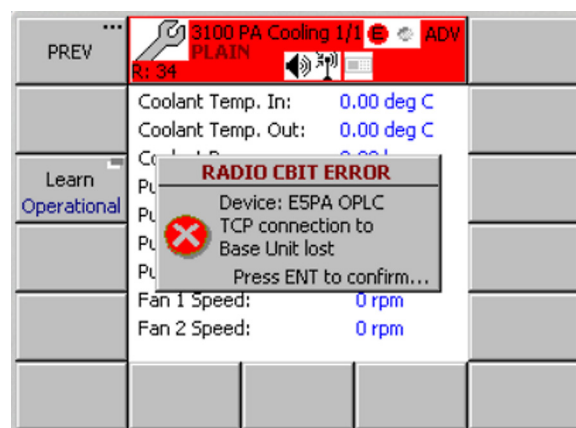


Figure 4-33: Error message on reboot

Note: After the full reboot process is completed (duration approx. 4 minutes), the configuration is considered successful if no error messages are displayed after the last self-test and the cooling parameters are visible

PREV	3100 PA Cooling 1/1 R: 34 PLAIN	MON
	Coolant Temp. In: 20.00 deg C	
	Coolant Temp. Out: 21.00 deg C	
Learn	Coolant Pressure: 2.40 bar	
Operational	Pump 1 Speed: 1280 rpm	
	Pump 1 Flow: 45.000 LPM	
	Pump 2 Speed: 1260 rpm	
	Pump 2 Flow: 45.000 LPM	
	Fan 1 Speed: 580 rpm	
	Fan 2 Speed: 580 rpm	

Figure 4-34: Cooling parameters



Note: A false indication of "0" as pump rpm can occur, especially at high speeds during the learning phase or during daily maintenance run. This display occurs when the radio uses a software version below 14.40.

4.2.6 Connecting coolant hoses and rigid lines

A connecting piece from the 1½" fitting set (2079.0392.00) in line with the TH9-C4 cooling accessories is used to form a hose connection, as shown in the following illustration. One end of the connecting piece is screwed in. The thread must be sealed with hemp packing (packing hemp 0071.4150.00 is contained in cooling circuit accessory TH9-C4). At the other end of the connecting piece, the hose is connected using two clamping pieces (half-shells).

4.2.6.1 Optional bleeder valves for in-hose assembly

Optional bleeders should be installed if an excessive length of the coolant hoses is routed above the standard bleeder on the heat exchanger, see [Section 4.2.6.5, "Cooling system configurations"](#), on page 115.



For hose lengths < 2 meters above the standard bleeder, no additional hose bleeder is required.

Hose bleeders must be installed at the highest elevation point of the hoses to efficiently collect and expel air.

The version 03 bleeder is an in-flow directional bleeder with an air-separation chamber, which functions effectively within the operational liquid flow as well.

The version 06 bleeder is simpler and only efficiently bleeds air when there is no liquid flow.



Bleeder with air separator (2103.0905.03)



Bleeder only works statically (2103.0905.06)

4.2.6.2 General instructions

Precisely adhere to the following instructions

The cooling system may be damaged or leak due to errors during installation.



The ends of the rigid lines are sealed with plastic plugs. Remove the plugs before installation.

- Only use O-rings provided by Rohde & Schwarz
- Only use coolant and thinners approved by Rohde & Schwarz
- Only use low-diffusion hose material DN 38 with a diameter of 1½" that has been provided by Rohde & Schwarz
If you use a hose that was not provided by Rohde & Schwarz despite this, an elastic compensating element must be installed on the transmitter connection to the rigid piping in order to avoid thermal stresses
- When cutting the hose to the correct length, proceed very carefully so that the inner polyethylene coating does not detach from the rubber, otherwise a blockage could occur when the system is operating under pressure
- After cutting the hose to the correct length, remove any rubber and polyethylene particles inside the hose
- Make sure that only components made of aluminum, plastic or stainless steel are used for installing the cooling system; never use components made of brass, copper, chrome, nickel or bronze
- When sealing the hose connection, only use packing hemp 0071.4150.00 from the optional accessories 2500.5000.50/.60
- Install the hoses in such a way that they do not form loops or kinks in which air pockets or fluid pockets could form; Rohde & Schwarz recommends routing the hoses with a 5 % gradient
- To ensure that the connection does not leak, the thread of the connecting piece must be roughened so that the hemp packing does not slip when the connecting piece is screwed in
- If pipes are used, a piece of hose must always be inserted between the pipe and the fixed connection in order to prevent the transmission of vibrations. To prevent air pockets or fluid pockets from forming, Rohde & Schwarz recommends routing the pipes with a 5 % gradient

- The height difference in the entire cooling circuit must not exceed 20 m
- Measures in the case of long installation distances (> 50 m) and great height differences must be agreed upon at the quotation stage
- Install a bleeder valve at the highest point along both the feed line and return line
- If the heat exchanger is the highest point in the system (more than 2 m above the transmitter roof), one bleeder valve on the heat exchanger is sufficient
- It is particularly important to ensure that the lines used are as short as possible in order to prevent a reduction in flow due to unnecessary pressure loss
- The cooling circuits must be bled. Be absolutely sure that all cooling circuits are completely bled after installation. This can be ensured only if the number and installation location of the bleeders have been selected optimally based on the following information. Any accumulation of air in a cooling circuit leads to insufficient transmitter cooling. For transmitters with a built-in flow monitor, this can cause the transmitter to shut off

4.2.6.3 Connecting the hose end of the connecting piece



The following parts are needed from the half-shell assembly set DN40, 3559.6073.00, in the accessories for the TH9-C1 pump unit and from the 1½" fitting set, 2079.0392.00, in the TH9-C4 cooling circuit accessories.

Quantity	Designation
2	DN40 aluminum half-shell
4	Spacer ring
4	Hexagon socket screw DIN 912 M6x35
4	Self-locking nut M6
1	Hexagon socket wrench (WAF 5)
1	Connecting piece (nipple) HADR DN40 1½" KVA

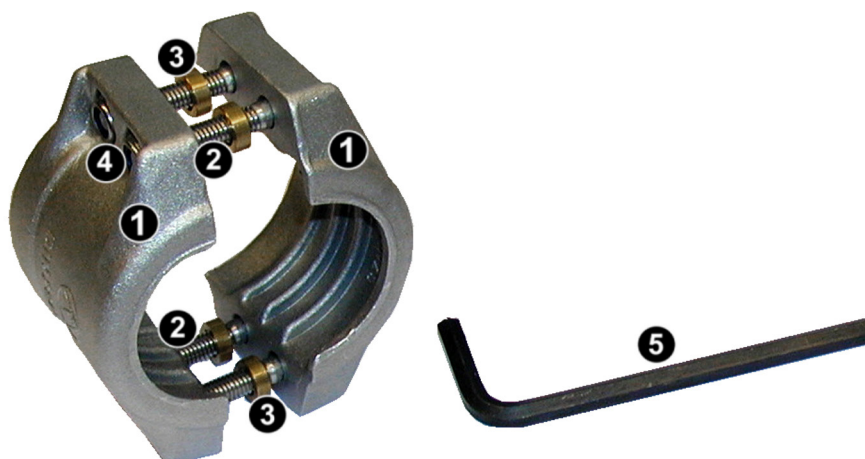


Figure 4-35: Half-shell assembly set.

- 1 = Half-shell
- 2 = Hexagon socket screw M6x35
- 3 = Spacer ring
- 4 = Self-locking nut M6
- 5 = Hexagon socket wrench 5 mm)

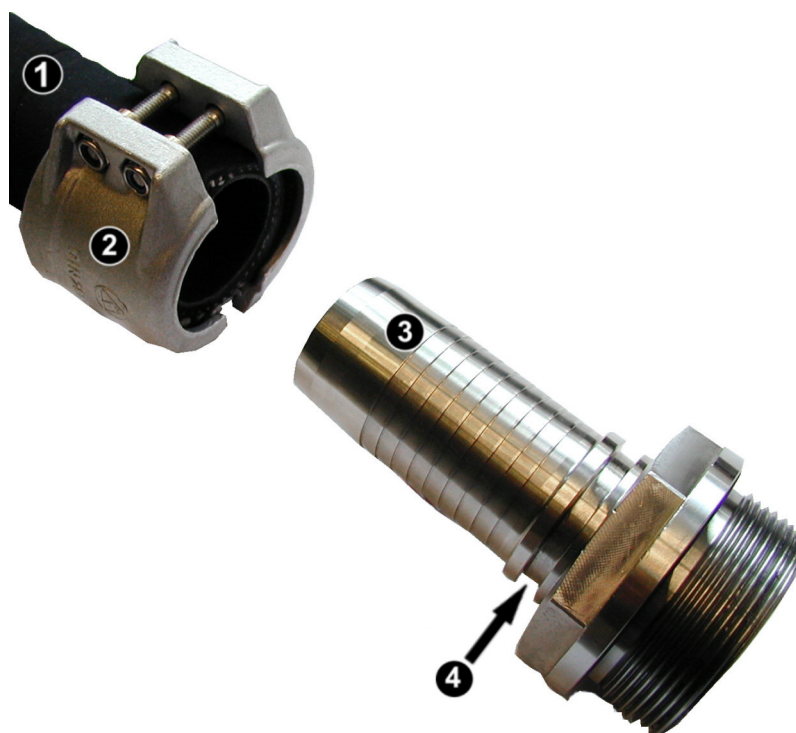


Figure 4-36: Hose connection.

- 1 = Hose
- 2 = Half-shell
- 3 = Connecting piece
- 4 = Groove

Connect the end of the hose to the connecting piece as follows:

1. Loosely preassemble both half-shells with the hexagon socket screws, spacer rings and self-securing nuts.
 2. Push the preassembled half-shell onto the end of the hose.
 3. Push the end of the hose all the way onto the end of the pipe of the connecting piece.
 4. Push the half-shells all the way onto the connecting piece until they engage in the groove.
 5. Tighten the four M6x35 screws in a crosswise sequence.
-
1. Push the end of the hose all the way onto the pipe of the fitting.
 2. Push the clamp all the way onto the connecting piece until it engages in the groove.
 3. Tighten the four M6x36 screws in a crosswise sequence.

4.2.6.4 Connecting the threaded end of the connecting piece



The following parts are needed from the half-shell assembly set DN40, 3559.6073.00, in the accessories for the TH9-C1 pump unit and from the 1½" fitting set, 2079.0392.00, in the TH9-C4 cooling circuit accessories.

The following tools and consumables are required:

- Pipe wrench
- Hacksaw
- Connecting piece (from the 1½" fitting set, 2079.0392.00)
- Neo-Fermit sealant 0041.5420.00
- Wire brush (not shown)



Figure 4-37: Tools, equipment and materials required.

- 1 = Pipe wrench
- 2 = Hacksaw
- 3 = Connecting piece (nipple) HAGR DN40 1½" KVA
- 4 = Packing hemp 0071.4150.00
- 5 = Sealant

Preparing and screwing in connecting piece

1. Roughen the thread.
Hold the saw blade at an angle (approx. 40°) and apply slight pressure to the blade as you run it over the entire surface of the thread starting from the inside and working toward the outside until the thread is roughened.



Figure 4-38: Roughen the threads with the saw blade



Figure 4-39: Roughened thread

2. Wrap hemp evenly around the thread of the connecting piece in clockwise direction.

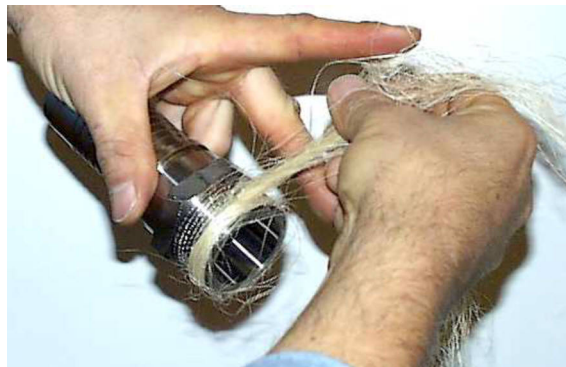


Figure 4-40: Wrap the thread with hemp



Figure 4-41: Thread wrapped with hemp

3. Smooth the hemp by stroking it with the wire brush in clockwise direction.



Figure 4-42: Coating thread with sealant.

4. Coat the hemp evenly with sealant in a clockwise direction.
The hemp packing on the thread of the connecting piece should now look like that shown in the illustration below.



Figure 4-43: Finished hemp packing.

5. **NOTICE!** Be sure to watch for leaks. When the following step is performed, the hemp packing must also turn as the connecting piece is being screwed in. If it sticks, there is a risk that the connection will not be leaktight.

Now slowly screw the connecting piece all the way into the thread of the mating fitting on the cooling system.

Note: Hemp packing that does not behave as specified must be stripped and reapplied immediately.

6. Tighten the connecting piece using the pipe wrench.
7. Remove the protruding hemp frays using the wire brush.



Figure 4-44: Removing protruding hemp frays.

4.2.6.5 Cooling system configurations

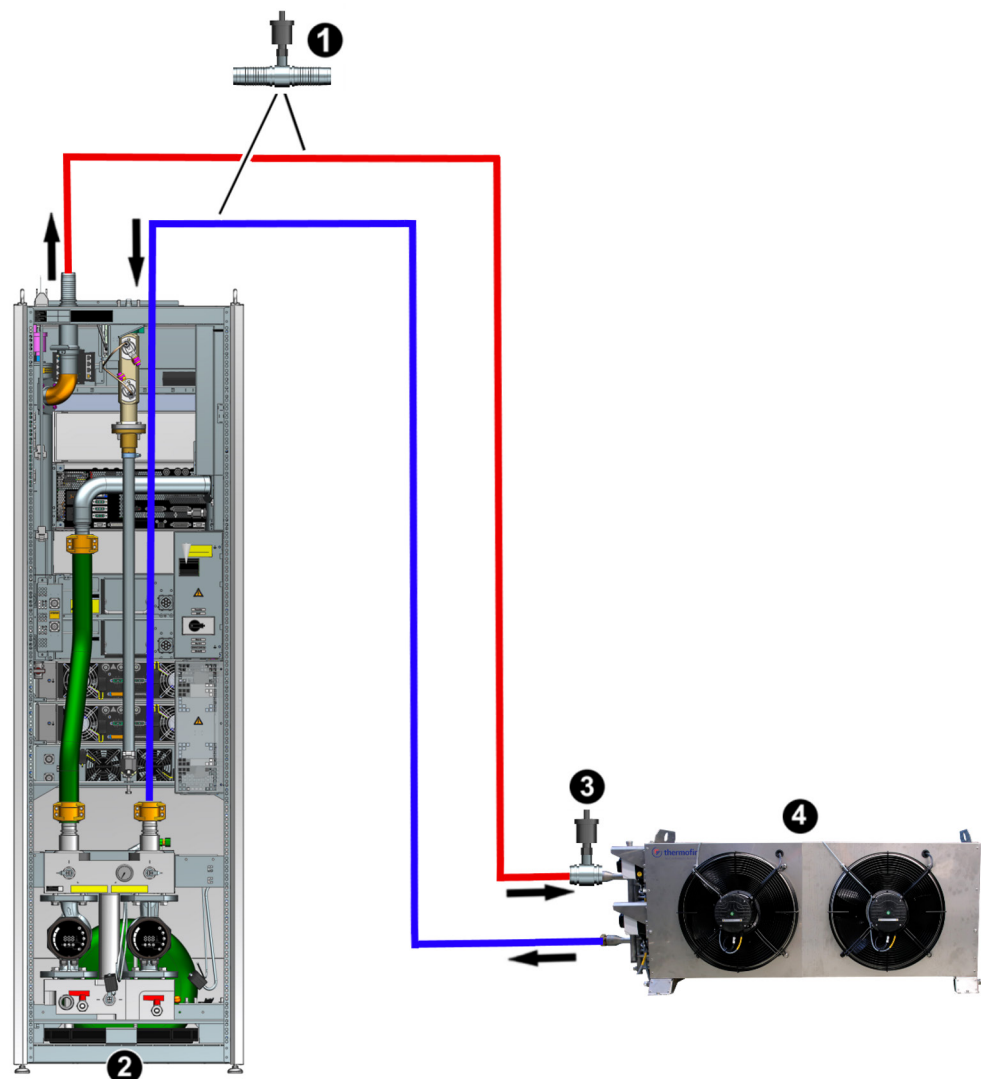


Figure 4-45: Transmitter rack with internal pump and heat exchanger

- 1 = Bleeder 1 and 2 (optional)
- 2 = Transmitter rack with internal pump unit
- 3 = Bleeder valve 3
- 4 = Heat exchanger

4.3 Setting up coolant circuit

This section describes the activities relating to the transmitter. It is assumed that a heat exchanger circuit is present and has been connected correctly in the flow direction. The flow direction of the coolant is indicated by arrows in the rack.

Only Antifrogen N should be used as the coolant. Different mixture ratios with demineralized water are permitted according to the lowest expected outside temperature. Rohde & Schwarz supplies, for example, a ready mix with 39 % vol. which can be used down to -25 °C.

4.3.1 Power classes

Table 4-5: Components for cooling circuit

Transmitter	Pump unit	Heat exchanger ¹⁾
R&S SK4105	Internal pump unit 80 l/min, ID 2500.5000.17	9.0 kW, ID 5304.8881.05
¹⁾ to integrate the amplifier in existing building cooling circuits, the heat exchanger can be replaced with a unit of the same power class.		

4.3.2 Planning pressures in cooling system

Special coolant

The coolant is a mixture of Antifrogen N and deionized water (39 % by vol./61 % by vol.). Observe the manufacturer's safety instructions regarding use of Antifrogen N (see [Section 1.3, "Safety data sheets for hazardous substances"](#), on page 12).

The pre-mixed coolant is included in "TH9-C4 cooling circuit accessories" 2500.6606.12/.14/.17/.24/.27/.34/.37. The coolant ANTIFROGEN N has been used at Rohde & Schwarz for more than 10 years. The use of other coolants is not recommended.

Definition of terms

The **counter pressure** is the static pressure in the expansion tank acting against the air pressure at the location (with empty, open, depressurized cooling system).

The **filling pressure** is the static pressure in the filled system with the pumps switched off.

The **operating pressure** is the dynamic pressure in the cooling system when in operation (with the pumps switched on). It is approx. 0.5 bar above the filling pressure.

The counter pressure values for the desired pressure unit are given in one of the following tables, [Table 4-6](#) or [Table 4-7](#).

Depending on the delivery head in the system and the altitude of the location above sea level, set a counter pressure between 0.6 bar and 2.4 bar at 20 °C. The pressure is measured using the test pressure gauge from the accessories.

All temperature values apply for the point at which startup is performed.

All pressure values given in the pressure table below are in bar. Tolerance for all pressure values: ± 0.2 bar. The pressure values are valid for altitudes from **0 m to 2300 m above sea level**. Additional pressure for higher altitudes: 0.1 bar/1000 m

Note regarding the SI unit for pressure: Pascal, Pa

- 1 bar = 10^5 Pa (i.e. 100 kPa)
- 1 psi = approx. 6895 Pa
- 1 bar = approx. 14.504 psi



The subsequent tables, [Table 4-6](#) and [Table 4-7](#) are valid only under the following conditions:

- The filling process is performed at the pump unit.
- Pump unit and transmitter rack are located at identical height level above NN (maximal difference: 4 meters).
- Delivery head is defined as the height difference between pump unit and heat exchanger. It has to be positive. If the height difference is negative, the values in the first table row are valid.

Table 4-6: Pressure table: pressure in bar, delivery head in m, temperature in °C.

Delivery head in m	Counter pressure in expansion tank in bar	Filling pressure at coolant temperature (static pressure) in bar						P _{warning} in bar	P _{fault} in bar
		10 °C	20 °C	30 °C	40 °C	50 °C	60 °C		
	20 °C								
up to 4	0.6	1.6	1.7	1.7	1.8	1.9	2.0	0.9	0.5
up to 6	0.8	1.7	1.7	1.8	1.8	1.9	2.0	1.1	0.7
up to 8	1.1	1.7	1.7	1.8	1.9	1.9	2.0	1.2	0.8
up to 10	1.3	1.9	2.0	2.1	2.1	2.2	2.3	1.6	1.0
up to 12	1.5	2.1	2.2	2.3	2.3	2.4	2.5	1.8	1.2
up to 14	1.7	2.4	2.5	2.6	2.6	2.7	2.8	2.1	1.4
up to 16	2.0	2.6	2.7	2.7	2.8	2.9	3.0	2.2	1.7
up to 18	2.2	2.9	2.9	3.0	3.1	3.2	3.3	2.4	1.9
up to 20	2.4	3.1	3.1	3.2	3.1	3.4	3.5	2.6	2.1



In the table below, the decimal units of measurement have been converted into the customary non-decimal units: pressure values into psi, length into feet, temperature into °F. Tolerance for all pressure values: +2.9 psi. The pressure values are valid for altitudes from 0 f to 7550 f a.m.s.l.; additional pressure for higher altitudes: 0.44 psi/1000 f.

Table 4-7: Pressure table: pressure in psi, delivery head in feet, temperature in °F.

Delivery head in f	Counter pressure in expansion tank in psi	Filling pressure at coolant temperature (oper- ating pressure, static) in psi						P _{warning} in psi	P _{fault} in psi
	68 °F	50 °F	68 °F	86 °F	104 °F	122 °F	140 °F		
up to 13	8.7	23.2	24.7	24.7	26.1	27.6	29.0	13.1	7.3
up to 20	11.6	24.7	24.7	26.1	26.1	27.6	29.0	16.0	10.2
up to 26	16.1	24.7	24.7	26.1	27.6	27.6	29.0	17.4	11.6
up to 33	18.9	27.6	29.0	30.5	30.5	31.9	33.4	23.2	14.5
up to 39	21.8	30.5	31.9	33.4	33.4	34.8	36.3	26.1	17.4
up to 46	24.7	34.8	36.3	37.7	37.7	39.2	40.6	30.5	20.3
up to 52	29.0	37.7	39.2	39.2	40.6	42.1	43.5	31.9	24.7
up to 59	31.9	42.1	42.1	43.5	43.5	46.4	47.9	34.8	27.6
up to 66	34.8	45.0	45.0	46.4	47.5	49.3	50.8	37.7	30.5

4.3.3 Pouring coolant into closed circuit



Avoid air in the coolant circuit – bleeding is a lengthy process

Before connecting the filling hose, fill it in the coolant container, e.g. let the pump run briefly and pump coolant out of the container through the pump and back into the coolant container until the fluid is bubble-free and clear.

The empty coolant containers are used to collect the coolant when emptying the cooling circuit. It is recommended to keep the containers.



Limited capacity of expansion tank

Expansion tank ET1 is dimensioned for limited coolant quantities:

- ET1 in pump unit 40 l/min up to approx. 80 l
- ET1 in pump unit 80 l/min up to approx. 120 l

The pressure fluctuations are greater for larger coolant quantities. Rohde & Schwarz can provide external expansion tanks for such cases.

4.3.3.1 Adjusting counter pressure in expansion tank with empty cooling circuit

Adjusting counter pressure in expansion tank

Cooling system with expansion tank ET1.

1. The filling pressure depends on the delivery head of the cooling circuit, i.e. the height difference between the amplifier and heat exchanger. Depending on the

delivery head, the associated nominal value for the counter pressure in the expansion vessel is determined from the counter pressure tables: [Table 4-7](#) or [Table 4-7](#).

2. Check that the shutoff valve of the expansion tank is open so that measurements are based on the pressure of the open cooling circuit relative to the atmospheric pressure at the location: [Figure 4-48](#)
3. Remove the protective cap from the valve on the expansion tank.

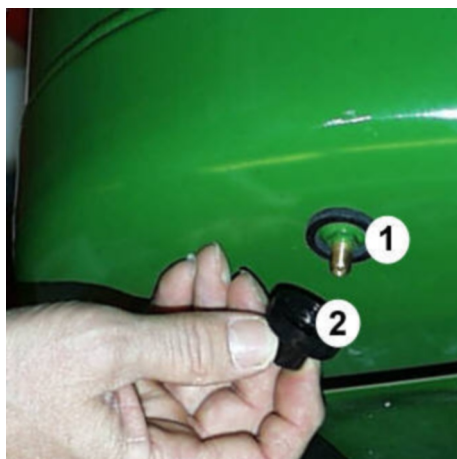


Figure 4-46: Valve on expansion tank

- 1 = Valve
- 2 = Protective cap

4. Using the test pressure gauge, check the counter pressure in the expansion tank. If necessary, reduce the pressure by allowing air to escape or increase it by introducing compressed air or compressed nitrogen.



Figure 4-47: Adjustment of counter pressure

- 1 = Valve
- 2 = Test pressure gauge

5. Screw the protective cap back onto the valve at the front of the expansion vessel.

4.3.3.2 Adjusting counter pressure in expansion tank with full cooling circuit

Adjusting counter pressure in expansion tank with full cooling circuit

If it is necessary to measure or adjust the counter pressure in the expansion tank when the cooling system is full, the cooling circuit does not need to be emptied in order to do this. The expansion tank can be shut off from the cooling circuit using valve VH3 and then drained separately via valve VS3. If the drain valve is open, the counter pressure can be measured and adjusted relative to atmospheric pressure.

1. Close valve VH3 / VH5.



Figure 4-48: Valves VH3 and VS3 on pump unit 40 l/min); valves VH5 and VS5 on pump unit 80 l/min

- 1 = Valve VH3 / VH5
- 2 = Steel lever
- 3 = Drain valve VS3 / VS5

Note: The direction of the steel lever indicates the position of the valve.

- Parallel to flow direction = OPEN
- Transverse to flow direction = CLOSED

2. **CAUTION!** Risk of scalding and risk of poisoning through ingestion, inhalation and skin contact, see ["Liquid cooling of the product"](#) on page 10 and [Section 1, "Safety and regulatory information"](#), on page 7.

Hold a container under drain valve VS3 / VS5 and open the valve. The tank is emptied.

3. Check or adjust the counter pressure as described: [Section 4.3.3.1, "Adjusting counter pressure in expansion tank with empty cooling circuit"](#), on page 118
4. Close drain valve VS3 / VS5.
5. Open valve VH3 / VH5.

4.3.3.3 Bleeder valve in cooling circuit

The bleeder valve installed (Automatic air vent) in the transmitter functions automatically. It can be made to operate sooner during initial filling of the cooling system. This is done by opening the small valve on the bleeder valve slightly wider by turning the knurled cap; approx. 2 turns are recommended (position of the slot on the valve cap).

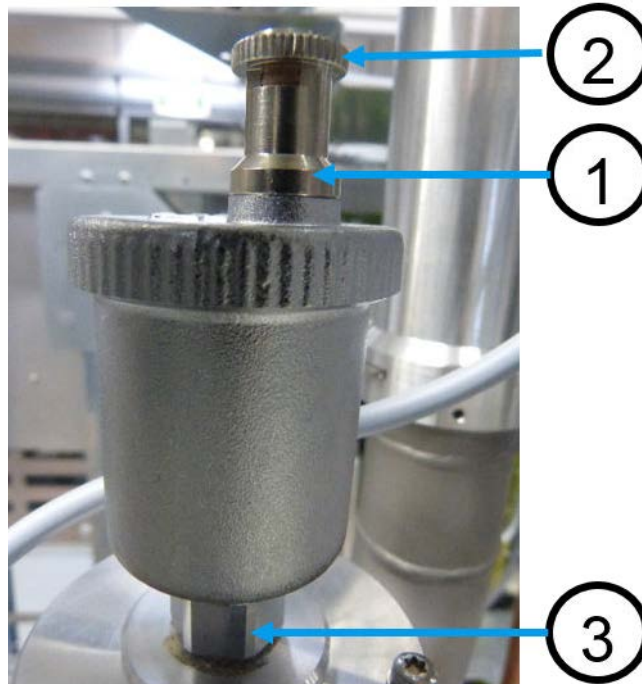


Figure 4-49: Automatic bleeder valve

- 1 = Valve of the bleeder valve
- 2 = Valve cap with slot
- 3 = Shut-off valve (seals cooling circuit when body of bleeder valve is removed)



Bleeder valve in cooling circuit

Make sure that all the bleeder valves of your cooling circuit are functioning properly, especially the bleeder valve at the highest point of the system (usually at the heat exchanger).

Do not remove the knurled cap on the valve of the bleeder valve. It prevents dirt particles from entering from outside and its swellable sealing disks form a tight seal to stop fluid from escaping in the event of a fault, e.g. if the float in the air vent becomes jammed as a result of dirt particles or evaporation residue.

The knurled cap of the valve can be screwed closed when the cooling circuit is in continuous operation.

4.3.3.4 Filling procedure

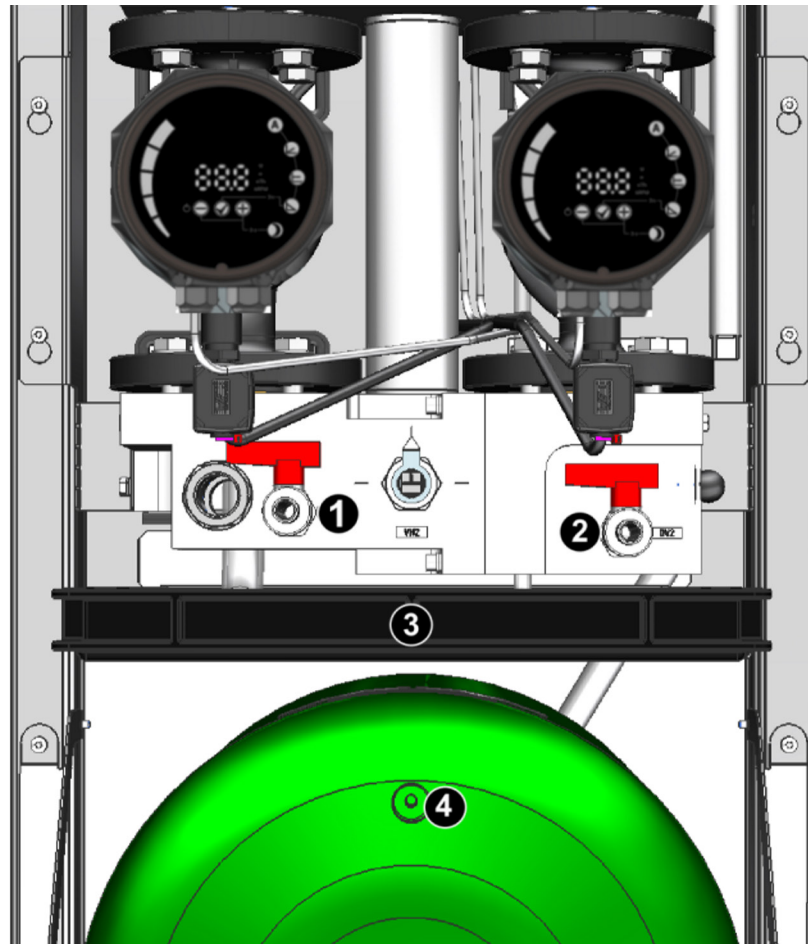


Figure 4-50: Filler valves on the hydraulic block

- 1 = Filler/drain valve DV3
- 2 = Filler/drain valve DV2
- 3 = Collecting tray
- 4 = Valve on expansion tank ET1 (with protective cap)

1. Place the collecting container under filler/drain valve DV2.
2. **CAUTION!** Risk of scalding and risk of poisoning through ingestion, inhalation and skin contact, see ["Liquid cooling of the product"](#) on page 10 and [Section 1, "Safety and regulatory information"](#), on page 7.

Open filler/drain valve DV2. The more the valve is opened, the greater the filling speed will be.

3. In the rack, set all manually operated valves to the flow through position
 - Manually operated valves at the pump unit

The valves at the pump unit are ball valves without limit stop. They are stiff and can only be operated using the lever provided in the accessories. They are 2-way valves which, depending on their position, can open a path that

bypasses the pumps. When filling, both pumps are initially set to "Normal Mode"; one of the two service paths is then later opened to bypass one of the pumps "Maintenance Mode P1, Maintenance Mode P2" so that the central pipe can also be filled. The required position of the valves is shown on the pump unit:

- Valve VH1
- Valve VH2
- Valve VH3

Normal Mode

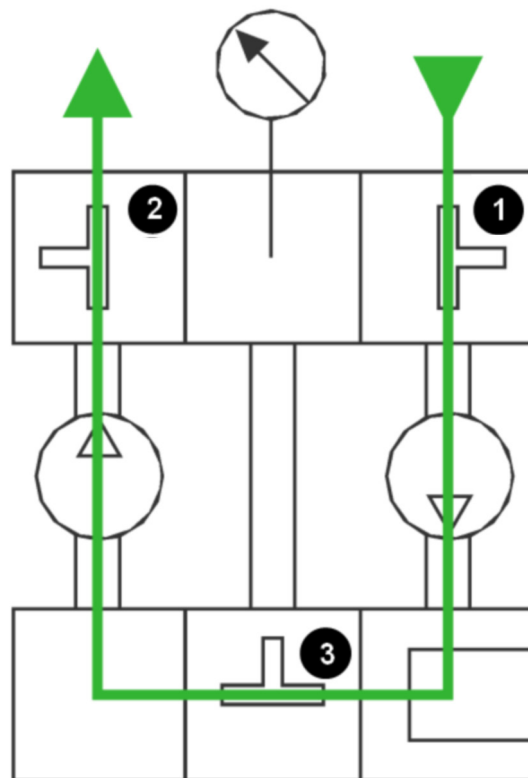


Figure 4-51: Hydraulic diagram showing normal mode

- 1 = Position of valve head of valve VH1
- 2 = Position of valve head of valve VH3
- 3 = Position of valve head of valve VH2

- VH5 (shutoff valve to expansion tank ET1 should always be open so that the expansion tank is functional).
- Valves at the amplifier rackmounts.
Position [OPEN]
 - Inlet
 - Procedure

4. Open the valve cap of the bleeder valve by 2 turns to speed up the bleeding process during initial filling: [Section 4.3.3.5, "Safety valve in cooling circuit"](#), on page 126
5. The filler pump is not self-siphoning. It must be filled with coolant before connection to the cooling system.
The procedure for filling the hoses as described below is only necessary when topping up coolant in a closed cooling system. It is not relevant for the initial filling of an empty cooling system.
 - a) Fill the housing of the filler pump with coolant (approx. 2 l).
 - b) Before connecting the two pump hoses, fill them in the coolant container.
 - c) Then let the pump run briefly and pump coolant out of the container through the pump and back into the coolant container until the fluid is bubble-free and clear.

The filler pump is now full of coolant.
6. Connect the hose at the coolant outlet of the filler pump to filler/drain valve DV2.
7. Insert the suction pipe of the hose connected to the pump inlet into the coolant reservoir.
8. Connect a hose to filler/drain valve DV3 and route it back into the coolant container.
The cooling system is now ready to be filled. The coolant can be pumped through the entire cooling system.
9. To bleed the cooling system, flush it out with coolant
 - a) Switch on the filler pump
 - b) Monitor the coolant flowing from DV3 back into the coolant container
 - c) At first, the returning coolant is cloudy and full of air bubbles. Continue the flushing procedure until the returning coolant has become clear and transparent.
 - d) Several containers of coolant will be required depending on the size of the cooling system

Tip: Change the coolant container during filling.

Changing an empty container during the filling procedure

- Place several full containers within reach of the pump hoses
- With the pump running, close the two filler/drain valves DV2 and DV3. The filler pump is allowed to pump at the two closed filler/drain valves DV2 and DV3 for a short time.
- Lift the hoses out of the empty container and immerse them in the next full container
- Open the two filler/drain valves DV2 and DV3 immediately afterwards

Tip: Swap the filler and drain valves. The role of filler/drain valves DV2 and DV3 is interchangeable. This can be useful if the installed cooling circuit is known to have a preferred side that could take up a larger coolant volume.

10. While flushing the system with coolant, close drain valve DV3. Flushing stops and pressure immediately builds up in the cooling system.
Watch the indicator on the pressure gauge PI1.

11. Fill with coolant and perform the leak test at approx. half nominal pressure.
 - a) Watch the indicator on the pressure gauge PI1.
 - b) Switch on the filler pump and fill the cooling system up to approx. half nominal pressure.
 - c) Close filler/drain valve DV2.
 - d) Switch off the filler pump immediately afterwards.
 - e) Now check the cooling system for leaks.

12. Topping up coolant

- a) Switch on the filler pump.
- b) Open filler/drain valve DV2.
- c) Watch the indicator on the pressure gauge PI1.
- d) Fill the cooling system until the pressure is approx. 0.3 bar above the operating pressure as specified in the pressure table.
- e) When the nominal pressure is reached, close filler/drain valve DV2 and switch off the filler pump.

Note: Do not block the filler pump. Open filler/drain valve DV2 immediately after the filler pump is started. The pump must never be allowed to work against a closed valve for longer than approx. 3 seconds.

Close filler/drain valve DV2 immediately before switching off the filler pump. The coolant would otherwise flow through the depressurized pump and back into the container.

13. If the pressure drops as a result of the bleeding procedure, switch the filler pump on again briefly. If necessary, repeat this procedure several times until a constant operating pressure is obtained.

Note: Bleeding. The bleeding procedure will be performed correctly provided that measures were taken during installation to ensure that no air enters the coolant circuit and that a bleeder valve has been installed at the highest point in the system. Depending on the size of the cooling system, bleeding can take a long time. It is recommended to carry out a pressure check after 24 hours.

14. Test the safety valve.

- Pressure relief valve DV1 must not have responded during the filling procedure. It is designed for a pressure of ≤ 5 bar.
- Test preparations and implementation as described in [Section 4.3.3.5, "Safety valve in cooling circuit"](#), on page 126
- After the safety valve has been tested, the cooling system can be put into operation.

The coolant circuit is now ready for operation.

4.3.3.5 Safety valve in cooling circuit

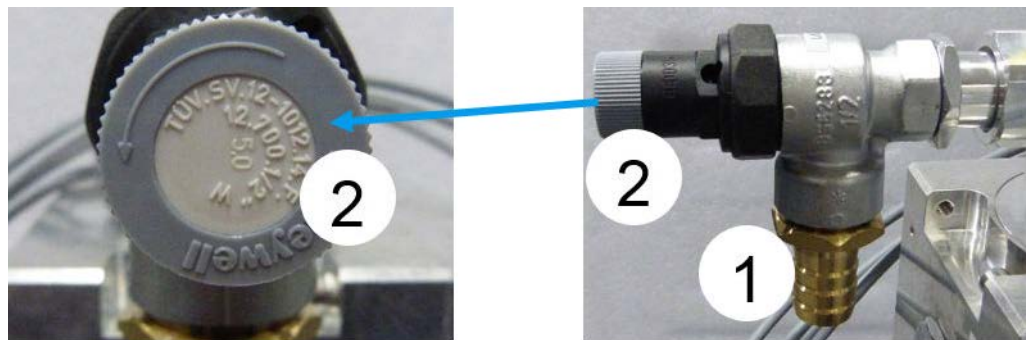


Figure 4-52: Pressure relief valve DV1

- 1 = Discharge opening (routed to collecting tray using hose)
 2 = Plastic cap (for valve test, turn in direction of arrow)

Test the safety valve.

- Pressure relief valve DV1 must not have responded during the filling procedure. It is designed for a pressure of ≤ 5 bar.
- For safety reasons, the pump unit should be shut off and should not run during the test; the cooling system must, however, remain steady at nominal pressure. (The test is pointless if performed when the cooling system is in the depressurized state.)
- As a precautionary measure, route the outlet hose of the safety valve into the coolant containers provided.
- To perform the test, turn the outer plastic cap rapidly against the internal resistance in the direction of the arrow (counterclockwise in the figure). This briefly overcomes the internal pressure mechanism. The valve releases a small amount of coolant and immediately closes again.
- After the safety valve has been tested, the cooling system can be put into operation.

Test faults

- No coolant is discharged
 The cause is a sticking diaphragm
 - Repeat the test several times
 - If the test remains unsuccessful, the cooling circuit must be taken out of operation and the pressure relief valve must be changed.
- Coolant drips continuously
 The cause can be dirt particles or evaporation residue
 - Repeat the test several times
 - If the test remains unsuccessful, the cooling circuit must be taken out of operation and the pressure relief valve must be changed.
- Coolant is discharged at high pressure

The cause may be a broken compression spring (corrosion) or a worn cap (aging)

- Quickly repeat the test once
- Take the cooling circuit out of operation immediately and shut it off
- Replace the pressure relief valve



Preparing for failure of safety valve during test

A possible form of failure is that pressure relief valve DV1 does not close fully again after the test. The cause can be dirt particles or evaporation deposits. It is possible to remove the unwanted particles by repeatedly performing the test, e.g. by repeatedly turning the plastic cap in the direction of the arrow. If this has no effect, the cooling circuit must be shut off and the pressure relief valve replaced.

If the pressure relief valve becomes defective during the test itself (as a result of aging and corrosion), all the coolant is discharged from the circuit into the coolant containers. In such a case, you must be prepared to quickly shut off the cooling system. If you have not installed any stopcocks in your cooling system, it might be helpful to shut off the pump unit. This impedes the coolant flow discharged but does not fully stop it.

- Pump unit 80 l/min

The shutoff valves are ball valves without hand lever and without limit stop. They are stiff and can only be operated using the lever provided in the accessories. They are 2-way valves which, depending on their position, can open a path that bypasses the pumps. The corresponding diagrams are printed on the valves.

- To shut off the cooling circuit, valves VH1 and VH3 must be closed as shown in the "Normal Mode" diagram by turning 90°. The valves can be turned in either direction (turning clockwise or counterclockwise will have the same effect).

4.3.3.6 Test operation of freshly filled cooling circuit

If the system is switched on after an installation check, the pressure conditions in the cooling system must be monitored again. It is necessary to repeat some filling and bleeding steps:

- With the pumps running, watch the indicator on pressure gauge PI1.
- Monitor the coolant through the inspection glass. If visibility is poor, the inspection glass can be lit from behind (e.g. using a flashlight). The coolant must become clear.
- If the coolant is still opaque and cloudy, bleeding was not sufficient. The cooling circuit has to run for up to 24 h before it is fully bled.
- The filling procedure must be repeated until the pressure in the active coolant circuit remains constant at the nominal value. This can be the case in the first weeks after refilling.

5 Troubleshooting

General

The transmitter R&S SK4105 is equipped with an intuitive failure display. Failures in the system are indicated as warning or as error. A warning normally allows further operation with limited parameters. An error indicates a serious problem that needs to be fixed before the system can continue to operate with full performance.

All errors are displayed at the user interface of Exciter R&S GX4100 and saved in a separate log under “Radio Maintenance” – “Errors”. Each failure is recorded with an initial time, an end time and with a counter, indicating the total number of appearances. If a failure reappears that is already recorded in the log, then the related end time is erased and updated to the latest time, when the failure disappeared again.

If a warning occurs, a yellow bar is displayed at the top of the user interface of the Exciter R&S GX4100. If an error occurs, a red bar is displayed instead.

The following tables list all errors of the transmitter system and its subunits and give useful information to isolate the fault.

• System warnings / errors	129
• Amplifier (R&S HPA4100) warnings / errors	132
• Harmonic filter (R&S HPF4100) warnings / errors	133
• OPLC warnings / errors	134
• Exciter warnings / errors	136
• Contacting customer support	139

5.1 System warnings / errors

Error Message	Possible root cause
System component error	Communication problem with ACB or directional coupler: • Check LAN connection W107 / W207 • Check control cable W19 to power detector
Coupler fan 1 / 2 warning	Fan1 or Fan2 in RF Combiner is defective or not detected: • Check control cable W15 / W16
Rack fan E1 / E2 failure	Rack fan is defective or not detected: • Check cable W14
Rack fan E1 & E2 failure	Both rack Fans are defective or not connected: • Check cable W14
Base Unit fan failure	Fan in Base Unit is defective or not detected: • Check internal fan cable
Interlock open	Indicates an open external or internal loop: • Check interlock terminal X100 rack Interface • Check interlock cables W461 to W464 to PA • Check control cables W15, W16 to Combiner • Combiner thermal sensor has triggered

Error Message	Possible root cause
Selftest running	Indicates a currently active self-test.
Selftest ended with warning	Indicates that the self-test has detected a problem.
Selftest ended with error	Indicates that the self-test has detected a major problem.
Power detector error	Indicates a communication loss between Base Unit and Power Detector. Check cable W19
High VSWR: Tx power reduced	The output power of the transmitter was reduced due to high VSWR: Check RF output connection / antenna
Operation not possible too many defects	More than one failure occurred preventing further operation: Check error log for individual errors
Recurring error active	Indicates an error that is still persisting after 3 attempts to reset it: This fault indication can only be cleared by fixing the problem and starting the internal IBIT
RCBSER SYNC LOSS	Indicates a communication loss between Base Unit and Exciter: Check optical cable W8
Failure in pump unit P1	Pump 1 is not responding, powered off or defective: - Check Fuse F7 - Check AC Cable W.P1 - Check Control Cable W11 - Check for missing Pump 1 ID, refer to Exciter GUI – Maintenance – Liquid Cooling and set the ID if necessary
Failure in pump unit P2	Pump 2 is not responding, powered off or defective: - Check Fuse F8 - Check AC Cable W.P2 - Check Control Cable W12 - Check for missing Pump 2 ID, refer to Exciter GUI – Maintenance – Liquid Cooling and set the ID if necessary
Pump unit P1/P2 error	Both pumps are not responding, powered off or defective (see above).
Failure in heat exchanger unit M1	Fan1 in heat exchanger is not responding, powered off or defective: - Check Fuse F9 - Check AC Cable W.R1.1 - Check Control Cable W11R - Check for missing Fan1 ID of the Heat Exchanger, refer to Exciter GUI – Maintenance – Liquid Cooling and set the ID if necessary
Failure in heat exchanger unit M2	Fan2 in heat exchanger is not responding, powered off or defective: - Check Fuse F11 - Check AC Cable W.R1.2 - Check Control Cable W12R - Check for missing Fan2 ID of the Heat Exchanger, refer to Exciter GUI – Maintenance – Liquid Cooling and set the ID if necessary

Error Message	Possible root cause
Heat exchanger unit M1/M2 error	Both fans in heat exchanger are not responding, powered off or defective (see above).
Temperature of liquid cooling too high	The temperature of the coolant outlet exceeds 60° C: Check the pumps and fans of the heat exchanger for correct operation
Pressure of liquid cooling too low	The measured pressure of the cooling system is below 1.0 bar: Check for leakages, refill the system
Pressure Sensor B1 – Pressure Warning	The built-in pressure sensor B1 is not detected or defective: Check cable W114F
Temp.Sensor B2-Temp Inlet Warning	The built-in temperature sensor B2 at the liquid inlet of the rack is not detected or defective: Check cable W114F
Temp.Sensor B3-Temp Outlet Warning	The built-in temperature sensor B3 at the liquid outlet of the rack is not detected or defective: Check cable W114F
Ready to configure cooling devices	The exciter is ready to start the configuration process of the pumps and fans.
Pump P1/P2 successfully configured	The configuration process for the related pump was successful.
Fan M1/M2 successfully configured	The configuration process for the related fan was successful.
Pump P1/P2 configuration failed	The configuration process for the related pump failed: Try again or check cables W11P/W12P
Fan M1/M2 configuration failed	The configuration process for the related fan failed: Try again or check cables W11R/W12R
System component warning	The connection to the environmental sensor has been lost, transmission is possible: Check the sensor or the connection cable
System dew point undercut	The temperature at the built-in temperature sensor B2 at the liquid inlet of the rack is near or below the dew point: - Operate the transmitter in a cool and dry environment - If there are repeated messages, check the transmitter for condensation. - If condensation is visible, inform R&S customer service.

5.2 Amplifier (R&S HPA4100) warnings / errors

Error Message	Possible root cause
Unknown HPA error	Indicates a general problem in an amplifier.
Temperature warning in module A0 to A3	Temperature in the designated amplifier is > 75° C: • Cooling problem or Amplifier overload
Temperature error in module A0 to A3	Temperature in the designated amplifier is > 80° C: • Cooling problem or Amplifier overload
Current error in module A0 to A3	Indicates a too high input level of the related PA module or indicates a defective PA module (module needs to be replaced).
Voltage error in module A0 to A3	Indicates a defective PA module (module needs to be replaced).
General error in module A0 to A3	Indicates a defective PA module (module needs to be replaced).
HW defect in module A0 to A3	Indicates a defective PA module (module needs to be replaced).
RF input level for module A0 to A3 too high	OPLC generates too high output power.
1 Power supply error in module A0 to A3	1 power supply in the designated amplifier is faulty.
2 Power supply error in module A0 to A3	2 power supplies in the designated amplifier are faulty.
3 Power supply error in module A0 to A3	3 power supplies in the designated amplifier are faulty.
Phase Failure of 1 phase	All amplifiers in the rack indicate an AC fail of the power supplies, connected to the same AC phase.
Phase Failure of 2 phases	All amplifiers in the rack indicate an AC fail of the power supplies, connected to the same 2 AC phases.
Phase Failure of 3 phases	All amplifiers in the rack indicate an AC fail of all 3 power supplies.
General error in module A0/A1	Indicates a defective PA module (module needs to be replaced).
General error in module A2/A3	Indicates a defective PA module (module needs to be replaced).
Cannot operate (Interlock open)	The operation of amplifier is prevented due to an open interlock loop.

Harmonic filter (R&S HPF4100) warnings / errors

Error Message	Possible root cause
Reduced Power due to HPA error	Indicates an error that has caused a power limitation by the OPLC to prevent components getting overloaded.
Amplifier dew point undercut	The temperature at the built-in temperature sensors of the PA modules is near or below the dew point: • Operate the transmitter in a cool and dry environment. • If there are repeated messages, check the transmitter for condensation. • If condensation is visible, inform R&S customer service.

5.3 Harmonic filter (R&S HPF4100) warnings / errors

Error Message	Possible root cause
Module A61 to A64 missing	The related Harmonic Filter is not detected by the system: • Check cables W1561 to W1564 or • Problem in the related filter • Check the related fuse F661 / F662 in the Base Unit
Warning in module A61 to A64	Indicates a temperature problem in the related filter.
Error in module A61 to A64	Indicates that one of the following failures is active: • Fan failure • Temperature failure • Power failure (too high / too low) • VSWR failure
Fan failure	Fan in Harmonic Filter is defective or not detected.
Temperature too high	The filter is overheated, the temperature exceeds the threshold of 90° C.
Tx power too high	The measured input power of the PA, connected to this input, is above the threshold: • Check the related PA
VSWR too high	The measured reflected power of the filter input is above the threshold: • Transmitter frequency does not match the selected filter section • Mismatch between filter output and combiner input
Tx power too low (module A61; bank 1 / 2)	The measured input power of the related Filter is below the threshold: • Check the related PA • Check the RF cabling W1161 / W1162
Tx power too low (module A62; bank 1 / 2)	The measured input power of the related Filter is below the threshold: • Check the related PA • Check the RF cabling W1261 / W1262

Error Message	Possible root cause
Tx power too low (module A63; bank 1 / 2)	The measured input power of the related Filter is below the threshold: • Check the related PA • Check the RF cabling W1361 / W1362
Tx power too low (module A64; bank 1 / 2)	The measured input power of the related Filter is below the threshold: • Check the related PA • Check the RF cabling W1461 / W1462
Freq. band 1/2/3/4/5/6/7/8 limited to medium Tx power	The filter indicated a problem when being switched to the related frequency band. Therefore the output power of transmitter was reduced to medium power in this specific frequency band.
Freq. band 1/2/3/4/5/6/7/8 limited to low Tx power	The filter indicated a problem when being switched to the related frequency band. Therefore the output power of transmitter was reduced to low power in this specific frequency band.
Tx not possible in Freq. band 1/2/3/4/5/6/7/8	The filter indicated a major problem when being switched to the related frequency band. RF operation is not possible: • Check / replace the related filter

5.4 OPLC warnings / errors

Error Message	Possible root cause
Onboard voltage out of range	HW error, OPLC has to be replaced.
Supply voltage out of range	HW error, OPLC has to be replaced.
High temperature	OPLC temperature >80 °C, Warning threshold reached: • Check air filter and fan of the Base Unit
Temperature out of range	OPLC temperature >90 °C, Fault Limit reached.
Reduced power due to HPA error	The OPLC was set to reduced power mode, as an amplifier has indicated a problem: • Check Error log for failures in module A0 to A3
Reduced power due to HPF error	The OPLC was set into reduced power mode, as a filter indicated a problem: • Check Error log for failures in module A61 to A64 and check / replace the related filter
No internal LAN connection	A problem with the internal LAN communication occurred: • Check built-in LAN switch • Check Fuse F3
TCP connection to Base Unit lost	The OPLC has lost the connection to the Base Unit: • System reconfiguration occurred • OPLC was rebooted

Error Message	Possible root cause
RF input power too low	The measured RF input level, generated by the Exciter is below a threshold: • Check Exciter Output • Check Exciter RF cable W7
RF input power too high	The measured RF input level, generated by the Exciter is above a threshold: • Check Exciter Output
RF output power too low	The measured RF level of the OPLC is too low to achieve the nominal transmitter power: • Check RF cabling • Check directional coupler
RF output power too high	The measured RF level of the OPLC preamplifier is too high to achieve the nominal transmitter power.
RF reflected power too low	The measured reflected power at transmitter output (directional coupler) is lower than expected when operating into a dummy load or antenna: • Check cable W351 between directional coupler and Base Unit (RF REFL) • Check RF cabling W1x61 / W1x62 • Check for other messages in the logbook for more details • -Check Rigid Line RF connection between Combiner output and directional coupler input
RF output power limit reached	OPLC has reached its upper power limit to achieve the designated transmitter output power: • Check cable W301 between directional coupler and Base Unit (RF FWD)
RF forward power too low	The measured forward power at transmitter output (directional coupler) is lower than the set transmitter power level: • Power loss in the RF path (amplifier, filter, combiner)
OPLC booted from fallback system	During the update of the OPLC the connection was interrupted. The OPLC started again but used the fallback configuration: • Start the update again and avoid interruptions during the update process • After successful installation of the update, the device must be restarted by a power cycle
OPLC System time invalid	This warning could indicate a discharged buffer battery: • Check the buffer battery and replace if necessary, see R&S SK41xx Service manual

5.5 Exciter warnings / errors

5.5.1 Radio controller

Error Message	Module(s) / Device(s) to be replaced and/or action
RC RCB PA Motherboard	Radio Controller, if further RCB failures are detected.
RC RCB FE Frontend	Radio Controller, if further RCB failures are detected.
RC RCB SYN Synthesizer	RC Radio Controller, if further RCB failures are detected.
RC RCB DLI	Replace that optional board (accessible from the back side of the radio).
Radio Controller	If further RCB failures are detected.
RC REFCLK 10 KHZ	Frontend, Radio Controller
RC CLK 9600 KHZ	Frontend, Radio Controller
RC FE FSYN	Frontend, Radio Controller
RC RF AGC DATA	Frontend, Radio Controller
RC UNLOCK FPGA	Radio Controller
RC DSP1/2 COM	Radio Controller
RC ESSI LOOPBACK	Radio Controller
RC +5 V ANALOG	Radio Controller
RC +3 V ANALOG	Radio Controller
RC +1.8 V	Radio Controller
RC +6 V	Radio Controller
RC +3.3 V	Radio Controller
RC +5 V	Radio Controller
RC LOW BACKUP BATT	Backup Battery on Radio Controller
RC DSP1 DWNLOAD	Radio Controller
RC DSP2 DWNLOAD	Radio Controller
RC COPROC	Radio Controller

5.5.2 Synthesizer

Error Message	Module(s) / Device(s) to be replaced and/or action
SYN UNLOCK LO1	Synthesizer
SYN UNLOCK LO2	Synthesizer
SYN PLL CLEAN UNLOCK	Synthesizer
SYN UNLOCK 10MHZ	Synthesizer
SYN LO1 LOW LEVEL	Synthesizer
SYN LO2 LOW LEVEL	Synthesizer
SYN VCC	Synthesizer
SYN LO1 DAC	Synthesizer
SYN FLASH	Synthesizer
SYN VCO	Synthesizer

5.5.3 Frontend

Error Message	Module(s) / Device(s) to be replaced and/or action
FE PWR 1STLO	Synthesizer, Frontend
FE IF LOOPBACK	Frontend
FE PLL LOCK	Frontend
FE CHECKSUM	Frontend
FE PREAMP	Frontend
FE VCC	Frontend

5.5.4 Motherboard

Error Message	Module(s) / Device(s) to be replaced and/or action
MB 3.3V INT	Motherboard
MB 1.8V	Motherboard
MB 5V INT	Motherboard
MB 5 V ANALOG	Motherboard
MB 2.5V	Motherboard
MB 1.8 V TO RC	Motherboard

Error Message	Module(s) / Device(s) to be replaced and/or action
MB 1.2 V TO FPGA	Motherboard
MB BATU	Motherboard

5.5.5 Power supply

Error Message	Module(s) / Device(s) to be replaced and/or action
PS 5V	Power Supply
PS 3.3V	Power Supply
PS 8V TO PA DRIVER	Power Supply
PS -6.5V	Power Supply
PS 22 V	Power Supply
PS 28V TO PA RIGHT	Power Supply
PS 28V TO PA LEFT	Power Supply
PS 28V TO X33	Check external cabling at connector X33, replace Power Supply.
PS -12V	Power Supply
PS 12V	Power Supply
PS 33V	Power Supply
PS MAIN INPUT	Check external 28 V power supply or cabling between that supply and connector.
X31	Check sensor lines on connector X31 as well.

5.5.6 NMEA interface

Error Message	Module(s) / Device(s) to be replaced and/or action
DSC PLL UNLOCK	NMEA Interface

For detailed information, refer to Service Manual M3SR 4100 HF Receivers / Exciters (6124.9107.82).

5.6 Contacting customer support

Technical support – where and when you need it

For quick, expert help with any Rohde & Schwarz product, contact our customer support center. A team of highly qualified engineers provides support and works with you to find a solution to your query on any aspect of the operation, programming or applications of Rohde & Schwarz products.

Contact information

Contact our customer support center at www.rohde-schwarz.com/support, or follow this QR code:



Figure 5-1: QR code to the Rohde & Schwarz support page

6 Cleaning, disinfection, storage and disposal

• Cleaning	141
• Disinfection	141
• Storage	141
• Disposal	141

6.1 Cleaning

How to clean the product is described in "[Cleaning the product](#)" on page 10.

Do not use any liquids for cleaning. Cleaning agents, solvents, acids and bases can damage the front panel labeling, plastic parts and display.

6.2 Disinfection

The surfaces of the R&S SK4105 should be disinfected at regular intervals depending on its area of application. For this purpose, use a soft, lint-free dust cloth that has been moistened with commercially available disinfectant. As the instrument is not water-proof, do not spray disinfectant directly onto it.

6.3 Storage

Protect the product against dust. Ensure that the environmental conditions, e.g. temperature range and climatic load, meet the values specified in the specifications document.

6.4 Disposal

Rohde & Schwarz is committed to making careful, ecologically sound use of natural resources and minimizing the environmental footprint of our products. Help us by disposing of waste in a way that causes minimum environmental impact.

Disposing of electrical and electronic equipment

A product that is labeled as follows cannot be disposed of in normal household waste after it has come to the end of its life. Even disposal via the municipal collection points for waste electrical and electronic equipment is not permitted.



Figure 6-1: Labeling in line with EU directive WEEE

Rohde & Schwarz has developed a disposal concept for the eco-friendly disposal or recycling of waste material. As a manufacturer, Rohde & Schwarz completely fulfills its obligation to take back and dispose of electrical and electronic waste. Contact your local service representative to dispose of the product.

Disposing of batteries

A product that contains a battery cannot be disposed of in the normal household waste after it has come to the end of its service life. It is labeled as follows:



Figure 6-2: Disposal information in line with EU battery directive

Dispose of batteries as specified by the local waste disposal agency. Alternatively, you can contact the Rohde & Schwarz local service representative.

For information on returning batteries to Rohde & Schwarz subsidiaries, see "[Handling batteries safely](#)" on page 10.

Annex

A R&S SK4105 interface description

Table A-1: Description of table columns D, T and TI

Column D (direction):	Column T (type):	Column TI (trimming instruction):
• O = output • I = input • B = bidirectional	• A = analog • D = digital • P = power	• P = test value • T = trimming value • D = Type test value • E = setting value

• Mains input.....	143
• RF out.....	144
• Interlock.....	144
• Fill Gun.....	146
• Headphone.....	148
• Headset.....	149
• Ethernet.....	151
• Audio / PTT / Multi-Purpose-IO.....	152

A.1 Mains input

Signal	D	T	Value range	TI	Fig. No.	Contact	Remarks
L1	I	P	230/400 V +- 10%	P		Q1MP T1	
L2	I	P	230/400 V +- 10%	P		Q1MP T2	
L3	I	P	230/400 V +- 10%	P		Q1MP T3	
N	I	P		P		Q1MP N	
PE	I	P		P		X.PE1	

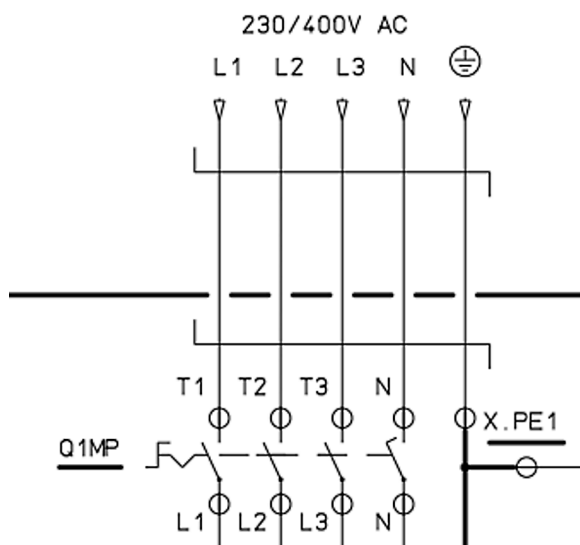


Figure A-1: Mains input

System power	Cable diameter	Preliminary fuse	Fuse type
5 kW	5x16 mm ²	63 A	3VA1063-2ED32

A.2 RF out

Signal	D	T	Value range	TI	Fig. No.	Contact	Remarks
X2	O	A	1,5 MHz to 30 MHz 5 kW	P		1 5/8" EIA	

A.3 Interlock

This connector is used to connect an interlock loop in order to deactivate the transmitter if the loop is opened (e.g. by a door of the transmitter cabinet).

The interlock connector is connected to the Rack Interface Board RIF3 (A21).

Signal	D	T	Value range	TI	Fig. No.	Contact	Remarks
INTER-LOCK_MAIN_INP	I	D	24 V	P		X100.1	Input Device Interlock (in) Source: X101.2
24V_INT	I	D	24 V	P		X100.2	Interlock Loop, positive voltage source of 24V_INT Source: X101.6 Device-Interlock (out)

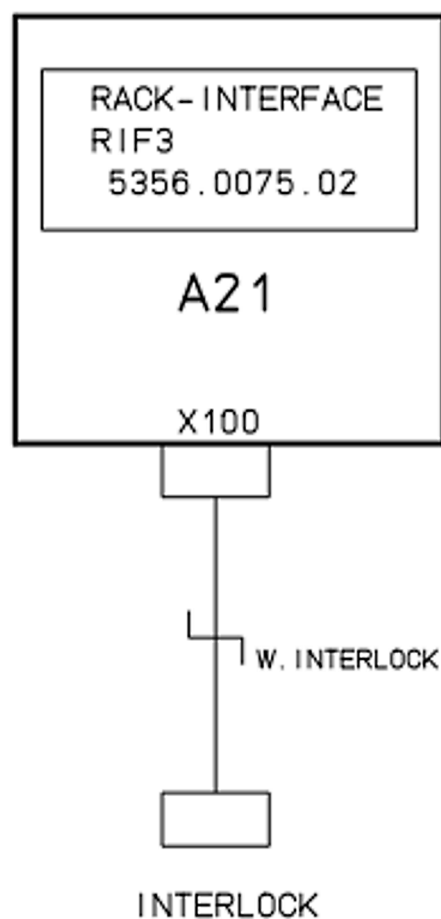


Figure A-2: Interlock



There is always a bridge set between the pins X100.1 to X100.2, X100.3 to X100.4 and X100.5 to X100.6. X100.7 is always left free.

The interlock loop used by the customer shall be between X100.1 and X100.2.

If the interlock loop is opened and closed afterwards the RF operation is enabled again.

A.4 Fill Gun

This connector is only used to connect a fill gun to the radio and is a 22 way socket (mating connector: 22 way connector material number: 0750.6896.00 with preformed shrink pitch material number: 0080.2205.00 and adaptor material number: 0618.3459.00).

Signal	D	T	Value range	TI	Fig. No.	Contact	Remarks
Not connected						X5.1	
Not connected						X5.2	
Not connected						X5.3	
Not connected						X5.4	
TXD_232	O	D	-5 V < U < 5 V limited to ±15 V by transient voltage sup- pressor	P	Figure A-3	X5.5	Data to Fill Gun Data Rate < 120 kBit/sec unbalanced signal according to V.28 reference ground is DGND X5.16
Not connected						X5.6	
Not connected						X5.7	
Not connected						X5.8	
Not connected						X5.9	
Not connected						X5.10	
Not connected						X5.11	
Not connected						X5.12	
Not connected						X5.13	
Not connected						X5.14	

Signal	D	T	Value range	TI	Fig. No.	Contact	Remarks
Not connected						X5.15	
DGND	B	P	0 V	D		X5.16	Reference Ground for all signals on X5
RXD_232	I	D	-12 V < U < 12 V limited to ± 15 V by transient voltage suppressor	P	Figure A-3	X5.17	Data from Fill Gun Data Rate < 120 kBit/sec unbalanced signal according to V.28 reference ground is DGND X5.16
Not connected						X5.18	
Not connected						X5.19	
VBATT	O	P	10 V < U < 33 V I < 100 mA Absolute maximum static reverse input voltage 0 V < U < 33 V	P	Figure A-4	X5.20	Reference ground is DGND X5.16 current-limited
Not connected						X5.21	
Not connected						X5.21	

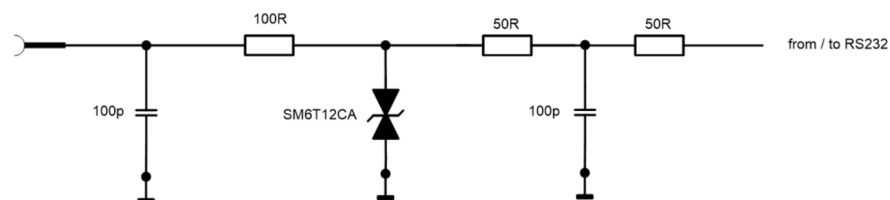


Figure A-3: X5 Pin 5; 17

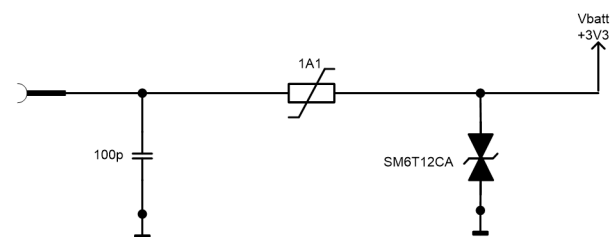


Figure A-4: X5 Pin 20

A.5 Headphone

Stereo 6.3 mm Jack (PL-68) mating connector (material number: 0361.8333.00).

Signal	D	T	Value range	TI	Fig. No.	Contact	Remarks
GND	B	A	GND		Figure A-5	X6.1	GND for AF_HEADPHONE (X6.3/.2) return line to ground
AF_HEADPHONE	O	A	$U \geq 3,4 \text{ Vrms}$ at $R_L = 600 \Omega$ frequency response $\pm 2.5 \text{ dB}$ (300 Hz to 3050 Hz, J3E) Distortion (1 kHz AF tone): $\leq 5 \%$ at 25 mVrms (F3E Mode) $\leq 1 \%$ at 25 mVrms (all other Modes)		Figure A-5	X6.2	AF Output source Decoupling resistance ($2 \times 100 \Omega = 200 \Omega$) between X6.3 and X6.2
AF_HEADPHONE	O	A	$U \geq 3,4 \text{ Vrms}$ at $R_L = 600 \Omega$ frequency response $\pm 2.5 \text{ dB}$ (300 Hz to 3050 Hz, J3E) Distortion (1 kHz AF tone): $\leq 5 \%$ at 25 mVrms (F3E Mode) $\leq 1 \%$ at 25 mVrms (all other Modes)		Figure A-5	X6.3	AF Output source Decoupling resistance ($2 \times 100 \Omega = 200 \Omega$) between X6.3 and X6.2

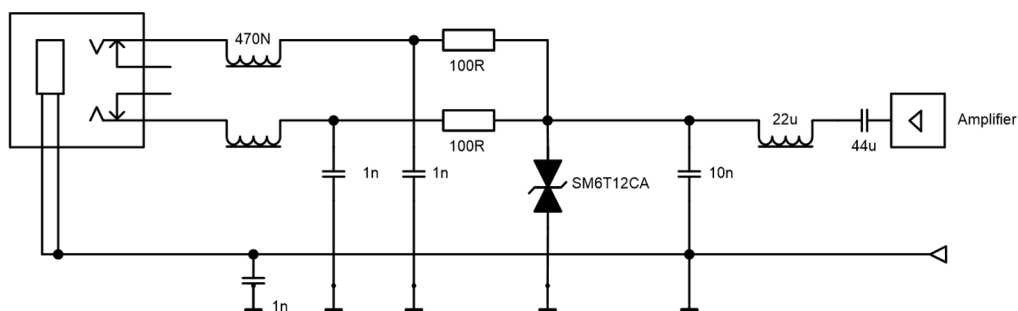


Figure A-5: X6 Pin 1; 2; 3

A.6 Headset

Used to connect audio accessories:

Microphone with PTT: e.g., R&S GA2100 / material number: 6064.5001.02

Headset with PTT, dynamic: e.g. R&S GA015 / material number: 0583.6012.02

7 way recessed socket (material number: 586.7855.00). Mating connector: 7-way connector (material number: 586.8239.00) with preformed shrinking sleeve (material number: 586.8245.00).

Signal	D	T	Value range	TI	Fig. No.	Contact	Remarks
AF_HEAD-SET	O	A	$U \geq 4 \text{ Vrms}$ at $R_L = 300 \Omega$ frequency response $\pm 2.5 \text{ dB}$ (300 Hz to 3050 Hz, J3E) Distortion (1 kHz AF tone): $\leq 5 \%$ at 25 mVrms (F3E Mode) $\leq 1 \%$ at 25 mVrms (all other Modes)	P	Figure A-6	X7.A	AF Output source
GND	B	P	0 V		Figure A-6	X7.B	AFEAR (X7.A) return line to ground
MICRO_DYN	I	A	$U = 0,3 \text{ mVrms}$ to 10 mVrms at $R = 600 \Omega$ for full RF power frequency response $\pm 2.5 \text{ dB}$ (300 Hz to 3050 Hz, J3E) harmonic distortion (RF modulation distortion, A3E, F3E) $\leq 5 \%$ at 25 mVrms F3E Mode $\leq 1 \%$ at 25 mVrms (all other Modes)	P	Figure A-7	X7.C	Unbalanced input for dynamic microphones AF Input source (LSB, USB) selectable via GB4000C or remote control SW short circuit proof
MICRO_GND	B	P	Ground		Figure A-7	X7.D	For microphone inputs and PTT switch

Signal	D	T	Value range	TI	Fig. No.	Contact	Remarks
MICRO_E LEC	I	A	U = 3 mVrms to 100 mVrms at R = 430 Ω for full RF power +8 V voltage output (≤ 4 mA) for microphone supply frequency response ± 2.5 dB (300 Hz to 3050 Hz, J3E) harmonic distortion (RF modulation distortion, A3E, F3E) ≤ 5 % at 25 mVrms F3E Mode ≤ 1 % at 25 mVrms all other Modes		Figure A-8	X7.E	Unbalanced input for electret microphones AF Input source (LSB, USB) selectable via GB4000C or remote control SW short circuit proof
~PTT_HEA DSET	I	D	Internal pull up 1 kW to +3.3 V		Figure A-9	X7.F	Contact to GND = transmit; open = receive Audio source is X7.E or X7.C.
MICRO_G ND	B	P	Ground		Figure A-8	X7.G	For microphone inputs and PTT switch

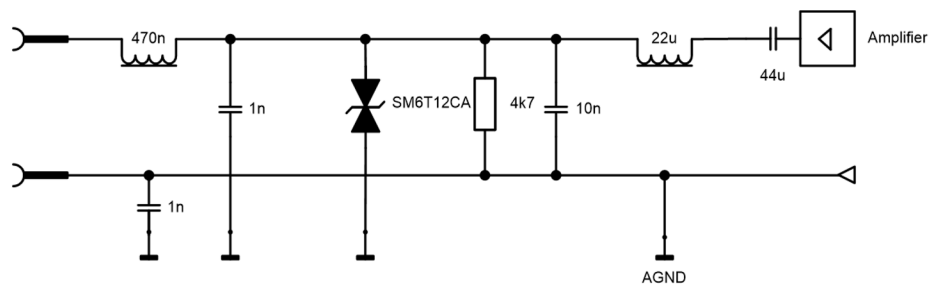


Figure A-6: X7 Pin A; B

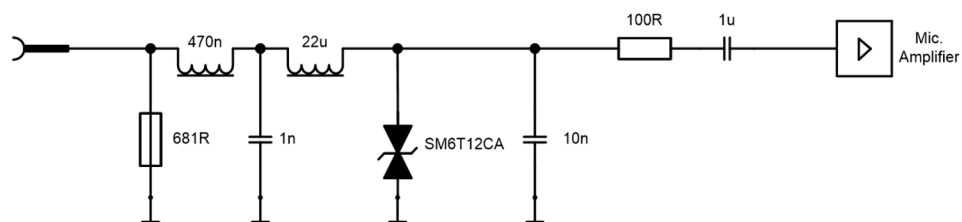


Figure A-7: X7 Pin C; D

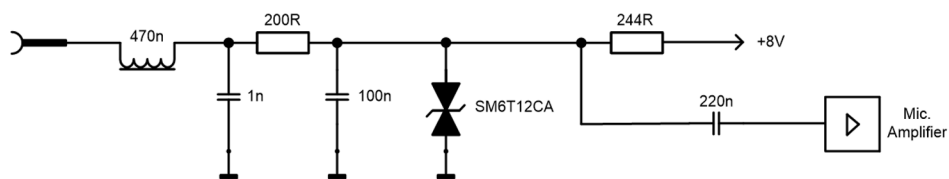


Figure A-8: X7 Pin E; G

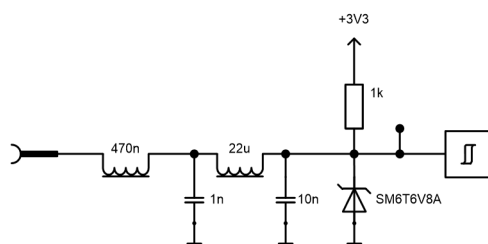


Figure A-9: X7 Pin F

A.7 Ethernet

Type: RJ45; Note: X20 is an MDI connector. Mating connector, 8-way cable plug (material number: 6083.5984).

Signal	D	T	Value range	TI	Fig. No.	Contact	Remarks
PL_ETH_T X+	O	D	$0\text{ V} < U < 3.3\text{ V}$			X20.1	10BaseT Ethernet transmit line
PL_ETH_T X-	O	D	$0\text{ V} < U < 3.3\text{ V}$			X20.2	10BaseT Ethernet transmit line
PL_ETH_ RX+	I	D	$0\text{ V} < U < 3.3\text{ V}$			X20.3	10BaseT Ethernet receive line
Not connected						X20.4	
Not connected						X20.5	
PL_ETH_ RX-	I	D	$0\text{ V} < U < 3.3\text{ V}$			X20.6	10BaseT Ethernet receive line
Not connected						X20.7	
Not connected						X20.8	

A.8 Audio / PTT / Multi-Purpose-IO

DB44 HD (high density), female. Mating connector, 44-way male multipoint connector (material number: 6104.9547.00), pin contacts (material number: 1006.4504.00), shielded case (material number: 0627.1826.00).

Signal	D	T	Value range	TI	Fig. No.	Contact	Remarks
+12V_AUXILIARY_OUTPUT	O	P	+11.8 to +12.5 V via protection resistor 300Ω / 1W absolute static maximum reverse input voltage U = + 14 V		Figure A-11	X26.1	Can be used to connect pullup resistors. Do not load currents > 10 mA
-12V_AUXILIARY_OUTPUT	O	P	-13.2 to -12 V via protection resistor 300Ω / 1W absolute static maximum reverse input voltage U = - 14 V		Figure A-12	X26.2	Can be used to connect pullup resistors. Do not load currents > 10 mA
RS485_TOD	B	D	balanced signal according to V.11 absolute static maximum input voltage U = +/- 14 V		Figure A-13	X26.3	SPARE RS485 with internal 120 Ω termination resistor
~RS485_TOD	B	D	balanced signal according to V.11 absolute static maximum input voltage U = +/- 14 V		Figure A-13	X26.4	SPARE RS485 with internal 120 Ω termination resistor
NOGO	O	D	0 to 32 V open drain output Maximum sink current 60 mA, internal resistance max 25 Ω, maximum output voltage (externally applied) 32 V, internal 100 kΩ pullup to +3.3 V decoupled by Si-diode allows external pullup to higher voltage.		Figure A-14	X26.5	GO: connection to GND (R < 20 Ω) NOGO: high, open drain (> 100kΩ) in case of PBIT, IBIT, CBIT error results or when unit is not powered
ERASE_A	O	P	Erase-GND			X26.6	Normal operation: X26.6 connected to X26.44 – or X303 fitted on Motherboard Activate ERASE function: open the connection between X26.6 and X26.44 (available only after removing the jumper X303 on Motherboard)

Signal	D	T	Value range	TI	Fig. No.	Contact	Remarks
~PTT1_TTL	I	D	0V < U < 3.3 V, +5 V tolerant, 10 kΩ pullup to +5 V, Schmitt trigger Low: U < 0.8 V High: U > 2 V absolute static maximum input voltage -0.5 V < U < + 5.5 V		Figure A-15	X26.7	Low = transmit Audio source is LINE_TX_USB for standard operation LINE_TX_USB and LINE_TX_LSB for B7D and link operation.
~PTT_USB	I	D	0V < U < 3.3 V, +5 V tolerant, 10 kΩ pullup to +5 V, Schmitt trigger Low: U < 0.8 V High: U > 2 V absolute static maximum input voltage -0.5 V < U < + 5.5 V		Figure A-15	X26.8	Low = Transmit Please Note: This PTT doesn't determine the side band position (upper/lower) in SSB mode. That will be defined by the modulation mode. This PTT just selects the corresponding audio source (LINE_TX_USB on X26.40).
~SQUELCH	O	D	0 to 32 V open drain output Maximum sink current 60 mA, internal resistance max 25 Ω, maximum output voltage (externally applied) 32 V, internal 100 kΩ pullup to +3.3 V decoupled by Si-diode allows external pullup to higher voltage		Figure A-14	X26.9	Rel. 3.0 and higher: Low = active reception, RX signal is audible. Signal is in high-impedance state during transmission and during audio signal gating squelch
LINE_TX_USB-	I	A	Balanced 600 W, -10 dBm to +10 dBm Absolute maximum Ratings: UDC = 0 V to X26.11 UDC = 500 V to GND		Figure A-16	X26.10	mating pin X26.40 LINE_TX_USB+ Input level is adjusted by user
LINE_RX_USB-	O	A	Balanced 600 W, -10 dBm to +10 dBm Absolute maximum Ratings: UDC = 0 V to X26.10 UDC = 500 V to GND		Figure A-17	X26.11	mating pin X26.41 LINE_RX_USB+ Input level is adjusted by user
LINE_TX_LSB-	I	A	Balanced 600 W, -10 dBm to +10 dBm Absolute maximum Ratings: UDC = 0 V to X26.13 UDC = 500 V to GND		Figure A-16	X26.12	mating pin X26.42 LINE_TX_LSB+ Input level is adjusted by user

Signal	D	T	Value range	TI	Fig. No.	Contact	Remarks
LINE_RX_LSB-	O	A	Balanced 600 W, -10 dBm to +10 dBm Absolute maximum Ratings: UDC = 0 V to X26.12 UDC = 500 V to GND		Figure A-17	X26.13	mating pin X26.43 LINE_RX_LSB+ Input level is adjusted by user
~TRSMT	O	D	0 V - 32 V open drain Maximum sink current 60 mA, internal resist- ance max 25 Ω , maxi- mum output voltage (externally applied) 32 V, internal 100 k Ω pullup to +5V decou- pled by Si-diode allows external pullup to higher voltage		Figure A-18	X26.14	Low = transmit > 100 k Ω when unit is not powered
1PPS	B	D	0 V < U < 3.3 V, +5 V tolerant, 10 k Ω pullup to +5 V, Schmitt trigger Low: U < 0.8 V High: U > 2 V absolute static maxi- mum input voltage -0.5 V < U < + 5.5 V			X26.15	From Release 13.00: 1PPS input Releases < 13.00: Reserved for EXT_ECCM_TIMING_ CTRL
GND	B	D	0 V			X26.16	
Not con- nected						X26.17	
GND	B	D	0 V			X26.18	
RXD2	O	D	-5 V < U < + 5 V unbalanced signal according to V.28 absolute static maxi- mum reverse input volt- age U = +/- 13 V		Figure A-10	X26.19	"Data Terminal 2" Radio is used as a DCE (modem) RS232 transmit data Only for waveform F1D
~TX_INHI BIT	I	D	0 V < U < 3.3 V, +5 V tolerant, 10 k Ω pullup to +5 V, Schmitt trigger Low: U < 0.8 V High: U > 2 V absolute static maxi- mum input voltage -0.5 V < U < + 5.5 V		Figure A-15	X26.20	Pull signal to low to block transmission if needed.

Signal	D	T	Value range	TI	Fig. No.	Contact	Remarks
~REM_POWER_ON	I	D	U = 0 to 15 V Internal 10 kΩ pullup to 3.3 V	P	Figure A-19	X26.21	ON: X26.21 connected to GND (loop resistance ≤ 100 Ω) OFF: open circuit See: Error! Reference source not found.
+6V_KEY-LINE	I	D	5.75 V to 6.5 V TX 0 V to 0.75 V RX absolute static maximum input voltage -0.5 V < U < + 10 V		Figure A-20	X26.22	Active high PTT Audio source is LINE_TX_USB for standard operation LINE_TX_USB and LINE_TX_LSB for B8D and link operation.
~PTT_LSB	I	D	0 V < U < 3.3 V, +5 V tolerant, 10 kΩ pullup to +5 V, Schmitt trigger absolute static maximum input voltage -0.5 V < U < + 5.5 V		Figure A-15	X26.23	Low = Transmit Please Note: This PTT doesn't determine the side band position (upper/lower) in SSB mode. That will be defined by the modulation mode. This PTT just selects the corresponding audio source (LINE_TX_LSB on X26.42).
GND	B	D	0 V			X26.24	
GND	B	D	0 V			X26.25	
GND	B	D	0 V			X26.26	
GND	B	D	0 V			X26.27	
GND	B	D	0 V			X26.28	
GND	B	D	0 V			X26.29	
GND	B	D	0 V			X26.30	
5V_AUXILIARY_OUT	O	P	4.5 V < U < 5 V via protection resistor 50Ω / 1W absolute static maximum reverse input voltage 0 V < U < + 5.5 V		Figure A-21	X26.31	Can be used to connect pullup resistors. Do not load currents > 10 mA

Signal	D	T	Value range	TI	Fig. No.	Contact	Remarks
Speaker (rear)	O	A	Output power > 1.5 W at R = 4 W Distortion (1 kHz AF tone): ≤ 5 % at 25 mVrms F3E Mode; ≤ 1 % at 25 mVrms all other Modes absolute static maximum reverse input voltage U = +/- 12 V		Figure A-22	X26.32	AF Output source (LSB, USB) selectable via GB4000C or remote control SW The internal speaker can be switched off with a switch on the front panel reference GND is X26.36
TXD2	I	D	-12 V < U < + 12 V unbalanced signal according to V.28 absolute static maximum input voltage U = +/- 16 V		Figure A-10	X26.33	“Data Terminal 2” Radio is used as a DCE (modem) RS232 receive data Only for waveform F1D
RESERVE D2	B	D	0V < U < 3.3 V, +5 V tolerant, 10 kΩ pullup 4.7 kΩ to +5 V, Schmitt trigger Low: U < 0.8 V High: U > 2 V absolute static maximum input voltage -0.5 V < U < + 5.5 V			X26.34	Reserved for EXT_ECCM_TIMING_CTRL
~RX_INHI BIT	I	D	0 V < U < 3.3 V, +5 V tolerant, 10 kΩ pullup to +5 V, Schmitt trigger Low: U < 0.8 V High: U > 2 V absolute static maximum input voltage -0.5 V < U < + 5.5 V		Figure A-15	X26.35	Pull signal to low to block reception if needed.
Speaker GND	B	A	0 V			X26.36	Reference GND to X26.32
PTT1_V28	I	D	+5 V to +12 V →Transm. -5 V to -12 V →Receive Interface circuit according to V.28 absolute static maximum input voltage U = +/- 16 V		Figure A-10	X26.37	Def. value is Receive. Audio source is LINE_TX_USB for standard operation LINE_TX_USB and LINE_TX_LSB for B8D and link operation.

Signal	D	T	Value range	TI	Fig. No.	Contact	Remarks
~PTT2_TTL	I	D	0 V < U < 3.3 V, +5 V tolerant, 10 kΩ pullup to +5 V, Schmitt trigger Low: U < 0.8 V High: U > 2 V absolute static maximum input voltage -0.5 V < U < + 5.5 V		Figure A-15	X26.38	Low = transmit used with X26.19 and X26.33 Audio source is LINE_TX_USB for standard operation LINE_TX_USB and LINE_TX_LSB for B8D and link operation.
~PTT_OUT	O	D	0 to 32 V open drain output Maximum sink current 60 mA, internal resistance max. 25 Ω, maximum output voltage (externally applied) 32 V, internal 100 kΩ pullup to +3.3 V decoupled by Si-diode allows external pullup to higher voltage.		Figure A-14	X26.39	Open drain with pull up 100 kΩ
LINE_TX_USB+	I	A	Balanced 600 W, -10 dBm to +10 dBm Absolute maximum Ratings: UDC = 0 V to X26.41 UDC = 500 V to GND		Figure A-16	X26.40	mating pin X26.10 LINE_USB_TX- Input level is adjusted by user
LINE_RX_USB+	O	A	Balanced 600 W, -10 dBm to +10 dBm Absolute maximum Ratings: UDC = 0 V to X26.40 UDC = 500 V to GND		Figure A-17	X26.41	mating pin X26.11 LINE_USB_RX- Input level is adjusted by user
LINE_TX_LSB+	I	A	Balanced 600 W, -10 dBm to +10 dBm Absolute maximum Ratings: UDC = 0 V to X26.43 UDC = 500 V to GND		Figure A-16	X26.42	mating pin X26.12 LINE_LSB_TX- Input level is adjusted by user

Signal	D	T	Value range	TI	Fig. No.	Contact	Remarks
LINE_RX_LSB+	O	A	Balanced 600 W, -10 dBm to +10 dBm Absolute maximum Ratings: UDC = 0 V to X26.42 UDC = 500 V to GND		Figure A-17	X26.43	mating pin X26.13 LINE_LSB_RX- Input level is adjusted by user
ERASE_B	I	D	U = 0 to 3,6 V pull up 1 MΩ to 3.6 V required loop-resistance $\leq 100 \Omega$ between X26.44 and X26.6 Attention, Erase input has to be enabled by removing jumper X303 on Motherboard.		Figure A-23	X26.44	Normal operation: X26.6 connected to X26.44 – or X303 fitted on Motherboard Activate ERASE function: open the connection between X26.6 and X26.44 (available only after removing the jumper X303 on Motherboard)

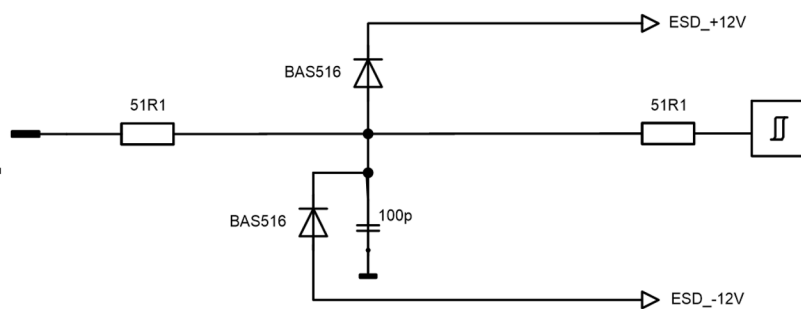


Figure A-10: X26 Pin 19; 33; 37

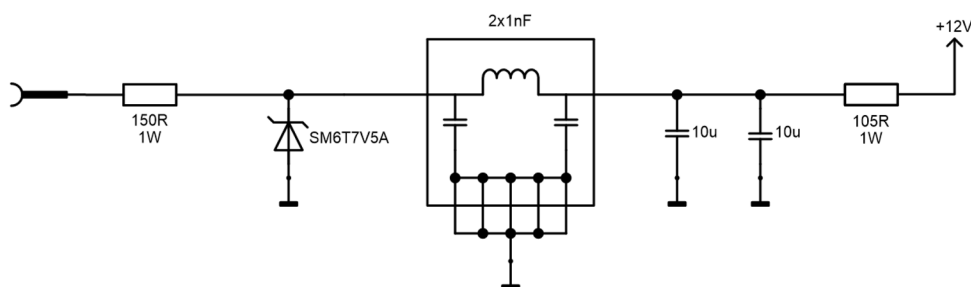


Figure A-11: X26 Pin 1

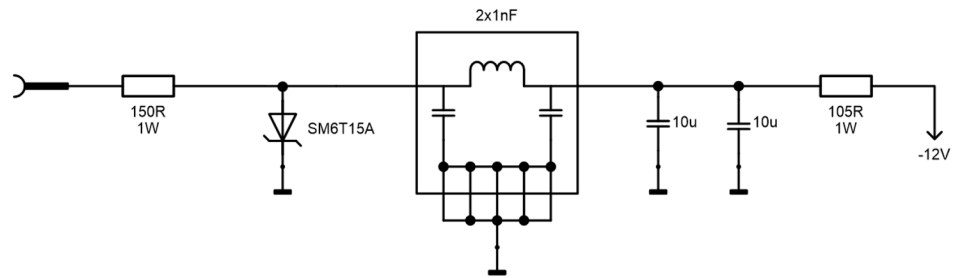


Figure A-12: X26 Pin 2

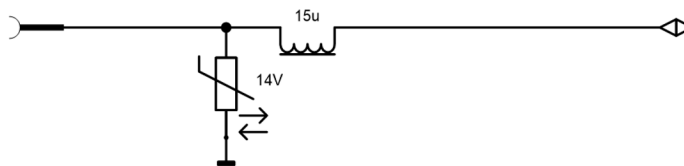


Figure A-13: X26 Pin 3; 4

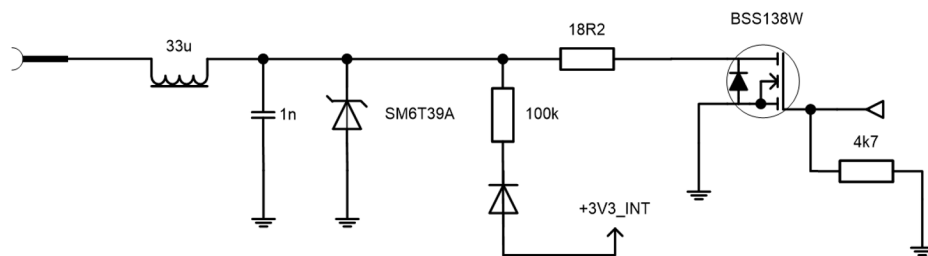


Figure A-14: X26 Pin 5; 9; 39

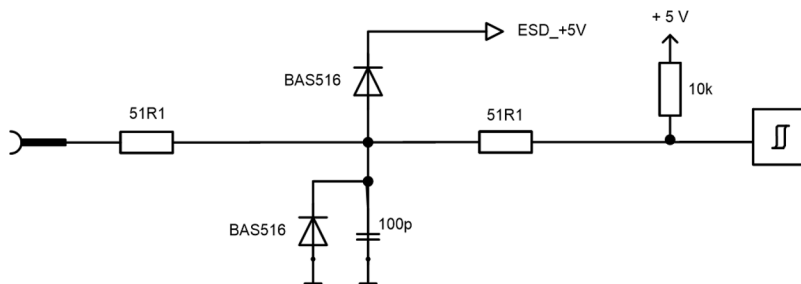


Figure A-15: X26 Pin 7; 8; 20; 23; 35; 38

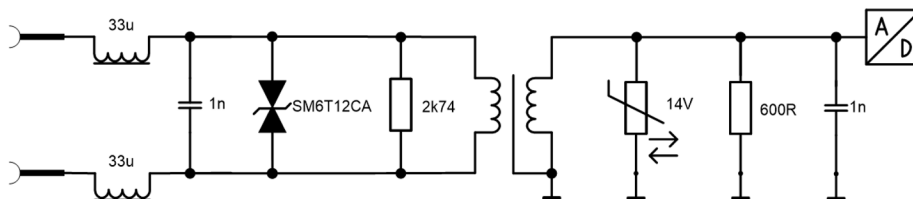


Figure A-16: X26, Pin 10 - 40; 12 - 42

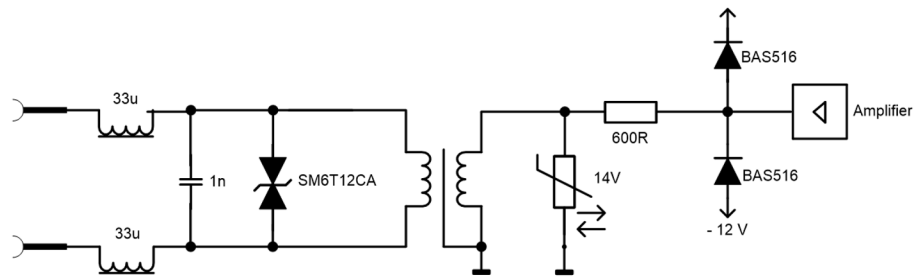


Figure A-17: X26 Pin 11 – 41; 13 - 43

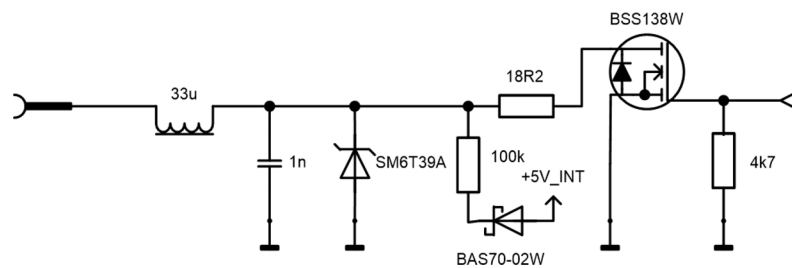


Figure A-18: X26 Pin 14

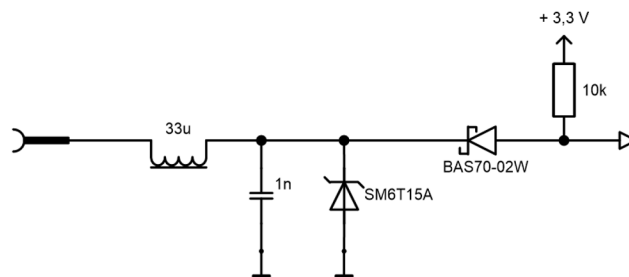


Figure A-19: X26 Pin 21

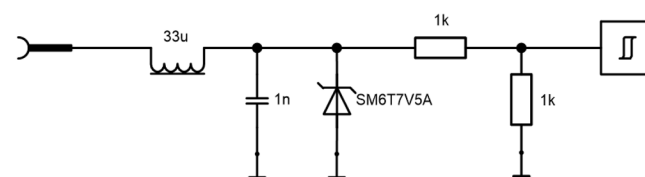


Figure A-20: X26 Pin 22

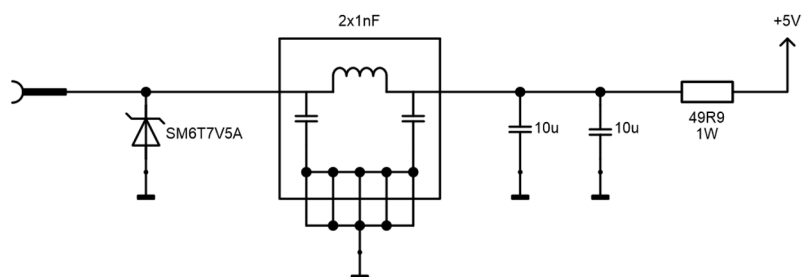


Figure A-21: X26 Pin 31

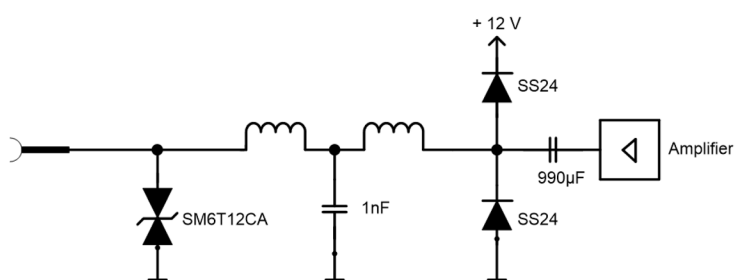


Figure A-22: X26 Pin 32

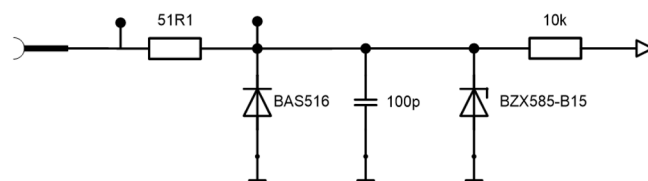


Figure A-23: X26 Pin 44

B Safety data sheets for hazardous substances

The safety data sheets are stored on the documentation CD supplied with the transmitter.

- EC safety data sheet for coolant (Antifrogen N/water mixture)
ANTIFROGEN N WATER-MIXTURE 39%, material number: 2103.0605.00
ANTIFROGEN N WATER-MIXTURE 44%, material number: 2079.0440.00

C Wiring diagrams

The drawings and circuit diagrams are stored on the documentation CD provided with the transmitter.

Circuit diagrams:

5304.9007.01 S

