EPAK®

Marine Satellite Systems and Services

DivKit VSAT

Ri-Series | DSi-Series

Table of Contents

1   What is a Diversity Kit?

In RF technologies, you talk about antenna diversity if you have two or more antennas for one transceiver. This is often necessary to provide a seamless functionality while receiving or transmitting, or to increase the receiving quality.
The EPAK Diversity Kit is combining the free line of sight ranges of 2 antennas: once one antenna is blocked in sight, the other antenna seamlessly takes over the satellite connection. This requires a high performance switching device, that can split and reroute RF signals nearly immediately.

The VSAT DivKit is designed for combining all EPAK VSAT antennas.

2   Contents

Your delivery contains the following components:

1x EPAK 19" VSAT DivKit
2x F/TNC RG6 coaxial cable 1,5m
4x TNC/TNC RG6 coaxial cable, 1,5m
3x Ethernet patch CAT5e cable, 1m
1x 24V power supply

3   Installing the EPAK VSAT DivKit

For regular cabling scheme see 4.3 - A.
For advanced cabling scheme with lock modem see 4.3 - B.

Step 1	Check that all required components and cables are there.
Step 2	Place the VSAT DivKit in the rack or at its other final place. Rack mount: For ease of handling follow the installation through and fix it only in the last step.
Step 3	Connect the RX and TX port of the traffic modem with the TX MDM and RX MDM port of the DivKit using the supplied coaxial F/TNC cables.
Step 4	Connect the RX out and TX out ports from the master ACU with the ANT1 RX and the ANT1 TX ports of the DivKit with the supplied coaxial TNC/TNC cables.
Step 5	Repeat step 4 for the slave ACU and the respective ANT2 RX and ANT2 TX ports of the DivKit.
Step 6	Connect the modem, ACUs and the DivKit Switch ports with the supplied Ethernet patch cables. Choose the most left Ethernet port, RJ45(7) in Fig. 2, to be the slave ACU WAN port, RJ45(6) to be the slave lock modem port, RJ45(5) to be the traffic WAN port of the traffic modem, RJ45(4) to be the port for the master lock modem, RJ45(3) to be the WAN port of the master ACU and RJ45(1) the port of the router for ships vessels network. RJ45(2) is a port for miscellaneous use and normally remains unused. **NOTE**: The choice for the LAN ports are only recommendations. It does not matter for functionality but it facilitates orientation for support staff.
Step 7	Plug in the DC power jack of the supplied power adapter into the DC connector at the DivKit's rear side.
Step 8	Power up the modem and ACUs, at the beginning both lock LEDs of the DivKit should turn green. Afterwards it will keep the state of the last run.
Step 9	Turn the rocker switch to AUTO. If the ACUs have connection to the antennas, and those have locked to the proper satellite signal, both Lock LEDs will stay green.
Step 10	Now turn the rocker switch from AUTO to ANT2 and then to ANT1. You will see how first Active LED ANT 2 turns on and then LED ANT 1 turns on while LED ANT 2 is turning off.
Step 11	As the final step the signal power levels of the two antennas have to be equalized in order to ensure seamless hand over. This has to be done for both ways RX and TX. Please see chapter 4.4.2 for further information.

4   Using the VSAT DivKit

The VSAT DivKit comes in a robust 19" rack case, ideal for combining it with the EPAK ACUs in one rack. The holes for fixing it with screws in the rack, are on the far left and the far right side when you look from the front.

4.1   Description of the operating elements on front plane.
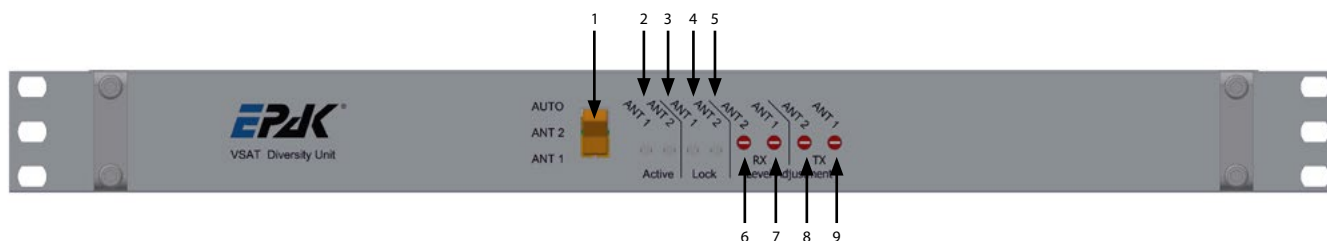

Fig. 1: EPAK VSAT-DivKit - front panel view.

No.	Name	Description
**Explanation**		
1	Rocker switch	Rocker switch for switching between AUTO, ANT2 and ANT1.
2	Active ANT1 LED	Turns green if antenna 1 (master) is active (used for connection).
3	Active ANT2 LED	Turns green if antenna 2 (slave) is active (used for connection).
4	Lock ANT1 LED	Indicates "lock" state on antenna 1 (master).
5	Lock ANT1 LED	Indicates "lock" state on antenna 2 (slave).
6	Attenuator RX2	16 step rotary switch for attenuating the RX2 (slave) signal path.
7	Attenuator RX1	16 step rotary switch for attenuating the RX1 (master) signal path.
8	Attenuator TX2	16 step rotary switch for attenuating the TX2 (slave) signal path.
9	Attenuator TX1	16 step rotary switch for attenuating the TX1 (master) signal path.

Tab. 1: Description of the operating elements on the front plane.

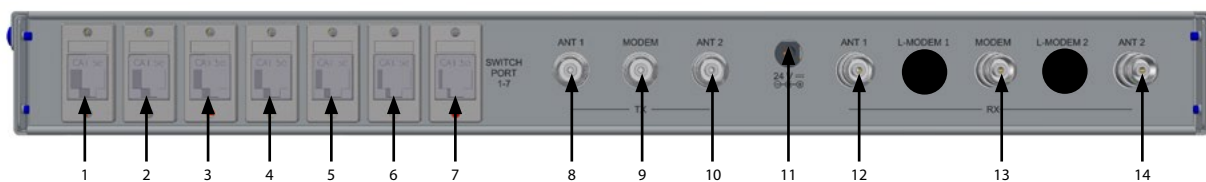## 4.2   Description of the of the connectors on the back plane.

Fig. 2: EPAK VSAT-DivKit - back panel view.

		Explanation
No.	Name	Description
1	RJ45(1)	Ethernet port 1, recommended for ship's LAN
2	RJ45(2)	Ethernet port 2, recommended to be spare
3	RJ45(3)	Ethernet port 3, recommended to connect to WAN port of the master ACU
4	RJ45(4)	Ethernet port 4
5	RJ45(5)	Ethernet port 5, recommended to connect with traffic modem
6	RJ45(6)	Ethernet port 6
7	RJ45(7)	Ethernet port 7, recommended to connect to WAN port of the slave ACU
8	ANT1 TX	TX signal output to antenna 1 (master)
9	TX MDM	TX signal input coming from traffic modem
10	ANT2 TX	TX signal output to antenna 2 (slave)
11	DC power in	Input for 24V power supply
12	ANT1 RX	RX signal input from antenna 1 (master)
13	RX MDM	RX signal output going to traffic modem
14	ANT2 RX	RX signal input from antenna 2 (slave)

Tab. 2: Description of the connectors on the back.

4.3 Cabling the EPAK VSAT DivKit - regular scheme
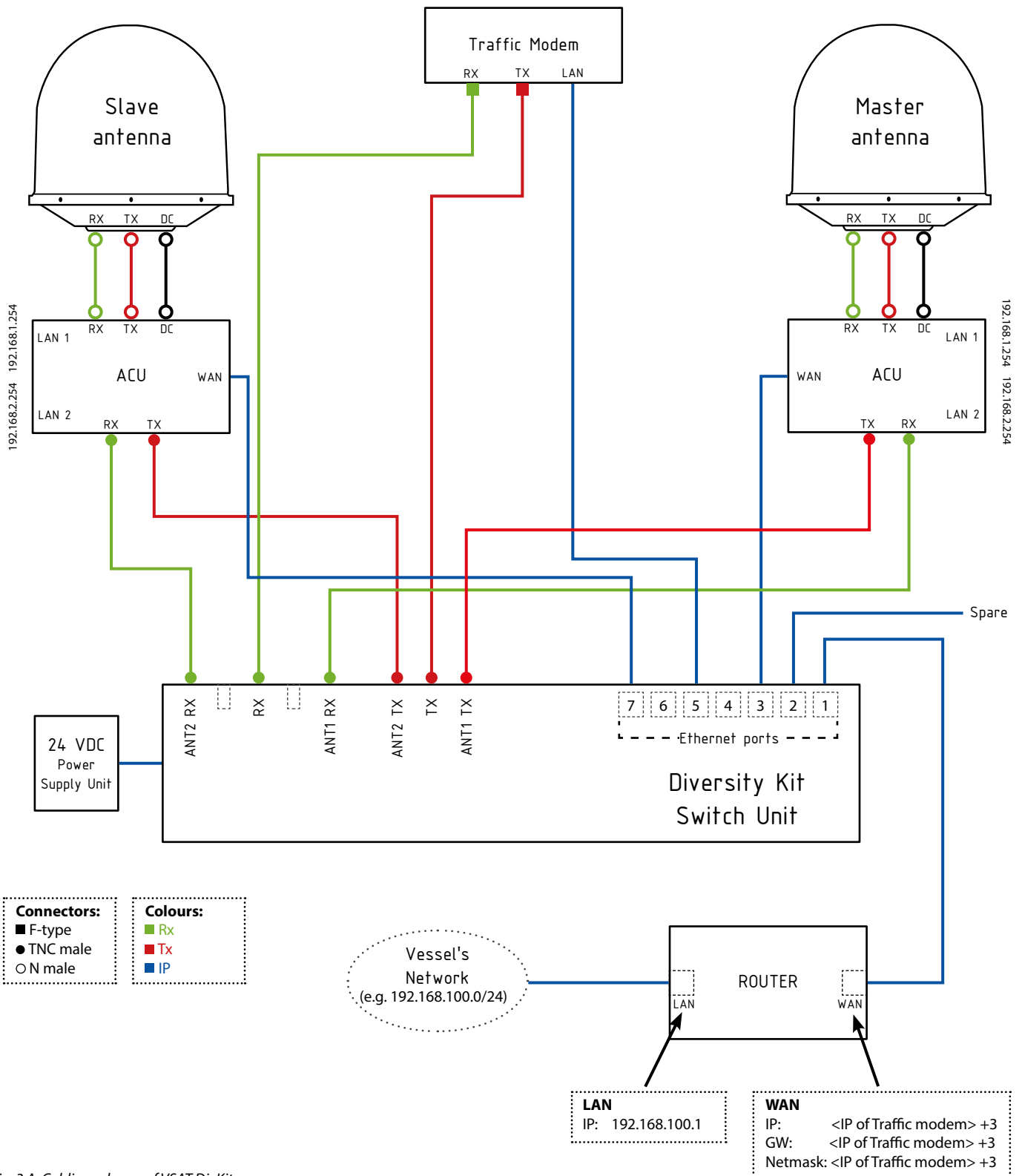

Fig. 3 A: Cabling scheme of VSAT DivKit

Notes:
- Traffic modem needs minimum /29 netmask, a /30 contains only 2 hosts.
- Internet access is also possible from LAN1 or LAN2 on both Master and Slave ACU (DHCP available by default)
- All IP addresses shown here are examples

4.4 The integrated matching system - attenuating and amplifying

4.4.1 The importance of matching

Sometimes in systems with two antennas one of them has a much longer connection cable for receiving and transmitting. So the signal from the antenna with the longer cable has a higher attenuation than the other one, which leads to different power levels at the inputs of the traffic modem and the TX input of the antenna.

Furthermore it is normal that antennas have different output power levels as well as input sensitivities, even if they are structurally identical. This can cause errors like short lockouts of the traffic modem or over powering the transceiver. To match these different power levels, the VSAT DivKit has four power regulators attenuating from -15dB to amplifying to +15dB: one for each RX line and one for each TX line. You can adjust the power levels in a resolution of 16 steps of 2dB each, where "0" corresponds to 15dB amplification and 16 corresponds to 15dB attenuation. The following examples describe situations where it is necessary to use the power regulators.
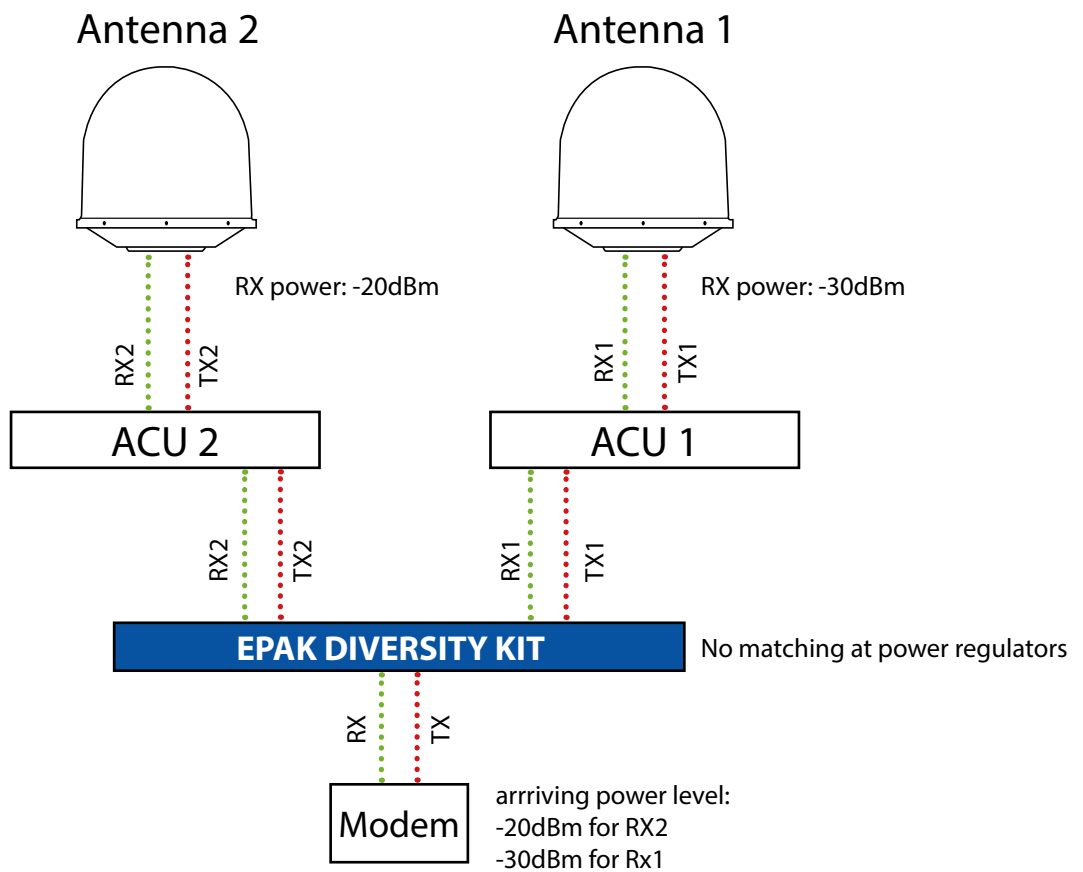

Fig. 4: Example for the mismatching power levels of RX at the inputs of the modem.

Explanation: Fig. 4 shows an example of mismatching RX power levels. Antenna 1 has an RX power output level of about -30dBm and antenna 2 has an RX power output level of about -20dBm.

Antenna 1 is currently online. When the VSAT DivKit switches to antenna 2, the power at the modem suddenly jumps from -30 to -20 dBm. Because the modem has to re-adjust its tuner for the new input level, the connection to the network will be intermittent for a short time. In this example, the power regulator switches for RX1 of the VSAT DivKit needs to be adjusted to 10dB attenuation to match the power level of the antenna 2.

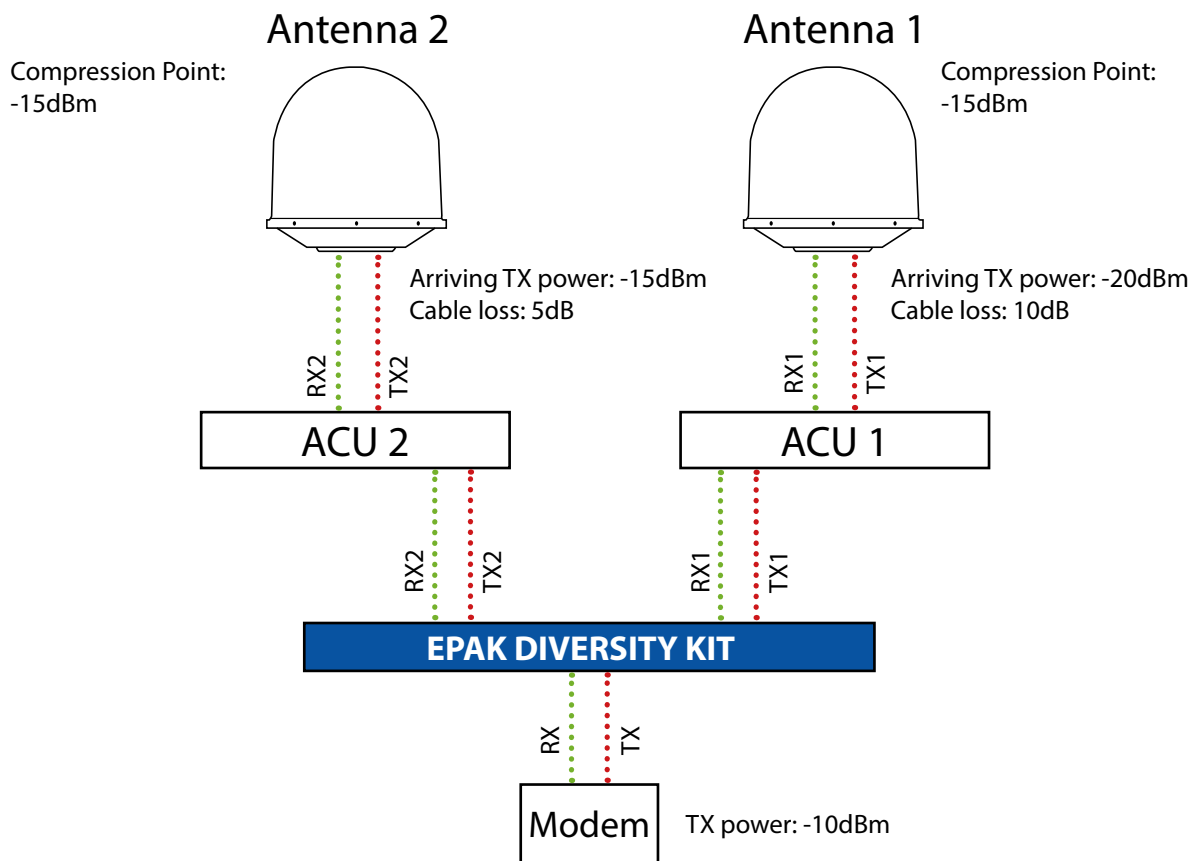Now both RX levels have -30dBm at the modem input.

Compression Point:
-15dBm

Compression Point:
-15dBm

Arriving TX power: -15dBm
Cable loss: 5dB

Arriving TX power: -20dBm
Cable loss: 10dB

RX2   TX2   RX1   TX1

ACU 2   **ACU 1**

RX2   TX2   RX1   TX1

EPAK DIVERSITY KIT

RX   TX

Modem   TX power: -10dBm

Fig. 5: Example for mismatching power levels of TX at the output of the modem.

Explanation: Fig. 5 shows different TX power levels arriving the transceiver.

Because of different cable lengths, the cable loss for antenna 1 is higher than for antenna 2. The modem is driving currently -10dBm on the TX line and antenna 1 is online. The arriving TX power at the BUC is now -20dBm, which is below the 1dB compression point of -15dBm. Now the VSAT DivKit switches to antenna 2. The cable to antenna 2 has only a loss of 5dB which means that with a TX power of -10dBm the arriving TX power at the BUC input is about -15dBm.
This is exactly the 1dB suppression point of the antenna. If the Uplink Power Control (ULPC) sends a command to the modem to increase the TX power (because of bad weather for example), the antenna works beyond the compression point and the signal is distorted. That reduces the C/N value and ULPC sends a command to increase the TX power once more which reduces the C/N value again.
To avoid this loop, you can turn the power regulator for TX2 to 6dB attenuation.

Now the arriving power at both antennas is equally at -20dBm.

Measuring the arriving TX power

Normally, the output power of the modem is regulated by the UPLC (Up Link Power Control) of your satellite service. It monitors the arriving power level at the HUB and sends the modem the command to increase or decrease the output power.
Two antennas usually means different cable lengths and hence different arriving TX power levels at the input of the transceiver of the antenna. The transceiver itself is not able to output the arriving TX power to the system, and so you have to request the UPLC for the incoming power level at the HUB. When you know the corresponding values for both antennas, it is highly recommended to match these power levels to avoid missing TX power margins, or even worse, saturation of one transmitter.

4.4.2 The attenuator-regulators

For matching the different power levels of both antennas, four pieces of 16 step rotary switches are located at the front panel of the VSAT DivKit. This is often necessary for matching the signal power of both antennas to avoid lockouts or signal loss like described above. There are two switches for the two receive lines and two for the two transmit lines. You can find them on the front plane of the VSAT DivKit right next to the lock LEDs. (Fig. 6).

To adjust the rotary switches, take a long slotted screwdriver and carefully turn it around like shown in Fig. 6.

Fig. 6: Using the attenuators with a slotted screwdriver.

You can now switch from -15dB to +15dB (from 15dB attenuation to 15dB amplification). Each regulator is divided into 16 positions (0 – F). By turning clockwise, you lower the selected power level to the modem at a rate of 2dB per click/position. To find out which position the regulators currently have, look directly into the hole and you see the numbers around the screw.
The table on the next page shows the values you can select.

Rotary Switch in HEX num	No.	Suppression/ Amplifying in dB	
0	0	15	amplifying
1	1	14	amplifying
2	2	12	amplifying
3	3	10	amplifying
4	4	8	amplifying
5	5	6	amplifying
6	6	4	amplifying
7	7	2	amplifying
8	8	0	
9	9	-2	attenuation
A	10	-4	attenuation
B	11	-6	attenuation
C	12	-8	attenuation
D	13	-10	attenuation
E	14	-12	attenuation
F	15	-15	attenuation

Tab. 3: Adjustable power levels

4.5 The integrated Ethernet Switch

For providing necessary network connections, the DivKit has an integrated network switch. The DivKit itself is connected to it too, inside. There are seven RJ45 ports on the backplane: two for the ACUs, one for the traffic modem, one for the ships LAN and three for miscellaneous use. It does not matter which RJ45 jack you use for the different components, you can use either one, but it is recommended to use the suggested cabling scheme, because it makes it more remote-manageable.