SCT7033
AIS Class B Protocol Stack Processor - CSTDMA

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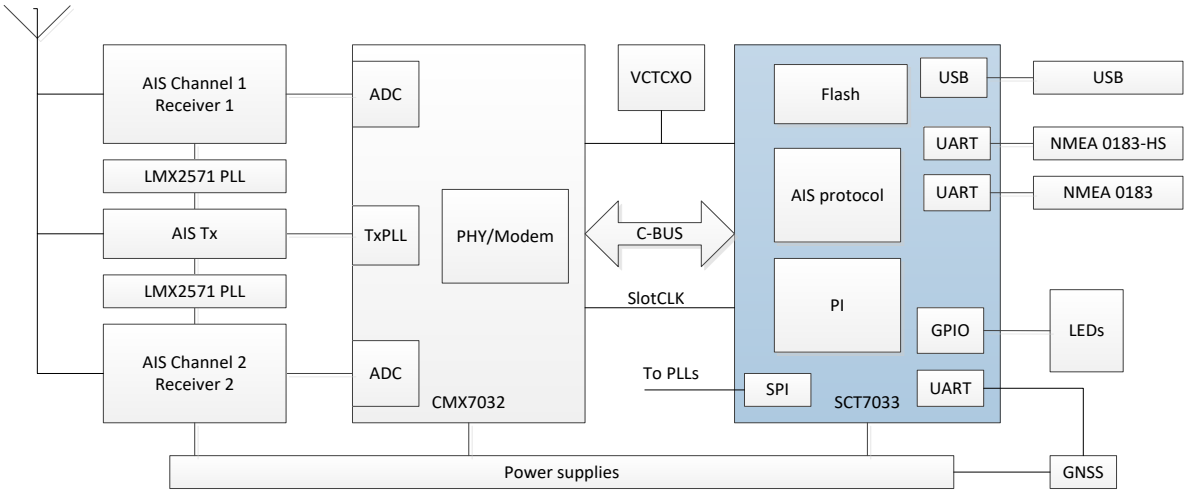
D/7033/3 December 2019 **DATASHEET** Advance Information

Features

- **Class B CSTDMA protocol stack**
- **CMX7032 / DE70322TC compatible**
- **uBlox GNSS interface**
- **USB and UART Presentation Interfaces**
- **DSC decoder included**
- **IEC 62287-1 edition 3 compatible**
- **ITU-R M.1371-5 compliant**
- **Runs directly on DE70322TC**
- **Small 100LQFP Package**

Applications

- **Low-cost Class B CSTDMA AIS transponder**
- **exactTrax asset tracking and monitoring**



1 Brief Description

The SCT7033 implements a full AIS Class-B CSTDMA protocol stack on a low-cost microcontroller. This provides the higher protocol layers to implement a complete Class B AIS transponder when used in the hardware architecture provided by the DE70322TC demonstration / evaluation kit (which includes the CMX7032 AIS Baseband Processor and CMX902 RF PA device) coupled with customer-specific power supplies and interface conditioning. The SCT7033 is provided in a LQFP100 14 x 14 mm package.

The SCT7033 provides:

- C-BUS interface and controller for the CMX7032 AIS Baseband Processor
- SPI interface and controller for dual LMX2571 frequency synthesisers and VCOs.
- UART interface and controller to uBlox M8M GNSS module
- USB and UART interfaces and drivers for the Presentation Interface
- Additional UART for dedicated GNSS interface
- LED indicator drivers for channel and operational status
- Optional GPIO for future customisation
- GNSS aligned Slot Clock output for synchronising CMX7032

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The SCT7033 is available with GUI software to allow:

- Factory set-up and adjustment of DE70322TC parameters
- User-specific programming (MMSI and other vessel-specific parameters)
- Support for exactTrax operation

The SCT7033 is delivered with the MMSI set to zero and so will not be able to transmit until programmed with a valid and appropriate MMSI, which must be obtained from the local regulatory body[1]. The GUI is provided in two modes, one for manufacturer / factory only and the second for dealer use, it should not be made available to the end user / mariner. In particular, re-programming the MMSI is not possible without first executing a manufacturer-only sequence.

The DE70322TC provides the serial interfaces as CMOS-digital compatible UARTs, the customer must provide suitable interface driver/protection to implement either RS232 or NMEA-0183 compatible interfaces. Other interface options can be implemented at the customer's discretion – WiFi, Bluetooth etc. but are outside the scope of this document.

[1] In the UK this is OFCOM. In the USA this is the FCC / BOATUS / SEA-TOW / Shine

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Figure Page

History

Version	Changes	Date
3	Updated GUI screen shots	December 2019
2	All references to DE70322T changed to DE70322TC	October 2019
1	First release, Advance Information	September 2019

This is Advance Information; changes and additions may be made to this specification. Parameters marked TBD or left blank will be included in later issues. Items that are highlighted or greyed out should be ignored. These will be clarified in later issues of this document.

2 Block Diagram

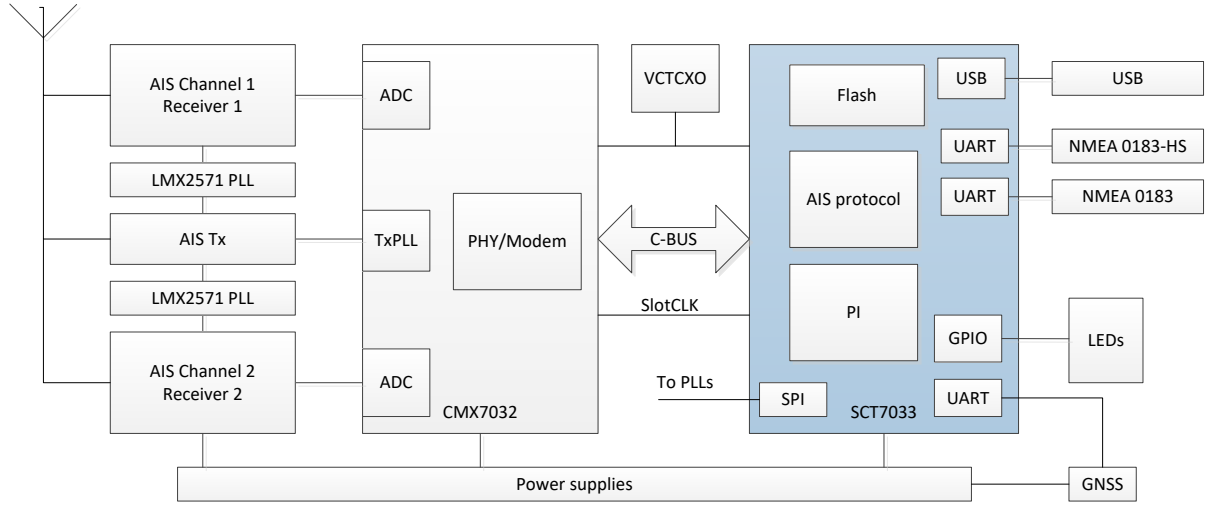

Figure 1 Block Diagram

3 Performance Specification

3.1 Electrical Performance

3.1.1 Absolute Maximum Ratings – typical figures

Exceeding these maximum ratings can result in damage to the device.

	Min.	Max.	Unit
Supply: DV_{DD}- DV_{SS}	–0.3	4.0	V
AV_{DD}- AV_{SS}	–0.3	4.0	V
Voltage on any pin to DV_{SS}	–0.3	4.0	V
Voltage on any pin to AV_{SS}	–0.3	4.0	V
Current into or out of any power supply pin		100	mA
Total current into sum of all DV_{DD} pins		160	mA
Current into or out of any I/O or control pin		25	mA
Total current into sum of all I/O and control pins		120	mA

100LQFP Package	Min.	Max.	Unit
Total Allowable Power Dissipation at T_{AMB} = 25°C	–	1300	mW
... Derating	–	27	mW/°C
Storage Temperature	–55	+125	°C
Operating Temperature	–40	+85	°C

3.1.2 Operating Characteristics

For the following conditions unless otherwise specified:

Current consumption figures quoted in this section apply to the device when loaded with FI-3.x only. The use of other SCT7033 Function Images can modify the current consumption of the device.

DC Parameters	Notes	Min.	Typ.	Max.	Unit
Supply Current					
Operational Mode					
DI_{DD}	11	–	62	–	mA
AI_{DD}		–	1.8	–	mA

Notes: 11 T_{AMB} = 25°C: measured on DE70322TC across L4, assumes GNSS unit takes 23 mA. Includes external pull-up/pull-down resistors.

AC Parameters	Notes	Min.	Typ.	Max.	Unit
CLK Input					
Frequency		-	19.2	–	MHz
Duty cycle		45		55	%
Input Impedance					
Capacitance		–	5	–	pF
Start-up Time (from powersave)		–	20	–	ms
Input pin hi level		0.7 DV_{DD}	-	DV_{DD}	
Input pin lo level		DV_{ss}	-	0.3 DV_{DD}	
High or low time		5	-	-	ns
Rise or fall time		-	-	10	ns

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4 Pin and Signal List

Table 1 Pin and Signal List

SCT7033 LQFP100	Pin Function	Type	Description
1	LED_ERROR	OP	Active high
2	LED_CH2_GREEN	OP	Active high
3	LED_CH1_RED	OP	Active high
4	LED_CH1_GREEN	OP	Active high
5	Not used		
6	VBAT	PWR	Connect to DVDD via 10k
7	Not used		
8	Not used	IP	
9	Not used	OP	
10	GND	PWR	
11	+3.3	PWR	
12	CLOCK	IP	19.2 MHz Clock input
13	Not used	OP	
14	RESET	IP	Hold low during power-on, high for normal operation
15	7032_IRQN	IP	IRQ from CMX7032
16	GPS_1PPS	IP	1PPS signal from GNSS unit
17	Not used		
18	GPS_Ant_ok	IP	Input from GNSS antenna fault detector
19	+3.3	PWR	
20	GND	PWR	
21	VREFP	PWR	Connect to VDDA
22	VDDA	PWR	Connect to VREFP, decouple with 10u and 10n
23	Not used		
24	GPS_Enable	OP	Enable for GNSS unit
25	GPS_UART2_Tx	OP	Tx connection from UART2 to GNSS unit
26	GPS_UART2_Rx	IP	Rx connection to UART2 from GNSS unit
27	GND	PWR	
28	+3.3	PWR	
29	7032_CSN	OP	C-BUS connection from SPI1 to CMX7032
30	7032_SCLK	OP	C-BUS connection from SPI1 to CMX7032
31	7032_RDATA	OP	C-BUS connection from SPI1 to CMX7032
32	7032_CDATA	OP	C-BUS connection from SPI1 to CMX7032
33	Tx_INHIBIT	IP	Low signal will inhibit AIS Transmit functionality
34	Not used		
35	7032_SLOTCLK	OP	37.5 Hz AIS Slot Clock to CMX7032
36	Not connected		
37	Not connected		
38	Not used		
39	RF_PA_ON	OP	Enable for RF PA section for test
40	RF_TXVCOEN	OP	Enable for RF Tx VCO section
41	Not used		
42	Not used		
43	Not used		
44	Not used		
45	Not used		
46	Not used		
47	LOCKDET_RXB	IP	PLL Lock detect from LMX2571 on RXB
48	VCAP1	IP	Connect to AVSS via 2.2uF
49	GND	PWR	
50	+3.3	PWR	
51	LOCKDET_RXA	IP	PLL Lock detect from LMX2571 on RXA

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SCT7033 LQFP100	Pin Function	Type	Description
52	PLL_SCLK	OP	SPI2 SCLK to LMX2571's
53	PLL_MISO	IP	SPI2 Data Input (not used)
54	PLL_MOSI	OP	SPI2 Data output to LMX2571's
55	Not used		
56	Not used		
57	USB_CON	IP	Input from USB detect circuit
58	Not used		
59	Not used		
60	Not used		
61	Not used		
62	ALARM	OP	Output to indicate an alarm condition (active high)
63	USART6_Tx	OP	4800 8N1 GNSS output
64	USART6_Rx	IP	4800 8N1 GNSS input (used for test only)
65	Not used		
66	Not used		
67	USB_RESET		USB Pull up / soft reset
68	UART1_Tx_PI	OP	38400 8N1 Presentation Interface UART
69	UART1_Rx_PI	OP	38400 8N1 Presentation Interface UART
70	USB_DM		USB Interface
71	USB_DP		USB Interface
72	JTAG_JTMS_SWDIO		Reserved for test
73	VCAP2	IP	Connect to AVSS via 2.2uF
74	GND	PWR	
75	+3.3	PWR	
76	JTAG_JTCK_SWCLK		Reserved for test
77	JTAG_JTDI		Reserved for test
78	Not used		
79	Not used		
80	Not used		
81	PLL_SSEL1	OP	SPI2 LMX2571 RxA CSN
82	PLL_SSEL2	OP	SPI2 LMX2571 RxB CSN
83	Not used		
84	Not used		
85	Not connected		
86	Not connected		
87	Not connected		
88	Not connected		
89	JTAG_JTDO_SWO		Reserved for test
90	JTAG_JTRST		Reserved for test
91	RxON	OP	Enable for RF Rx section
92	Not Used		
93	Not used		
94	GND	IP	Reserved for test, connect to VSS
95	Not used		
96	Not used		
97	LED_CH2_RED	OP	Active high
98	LED_TX_TIMEOUT	OP	Active high
99	GND	PWR	
100	+3.3	PWR	

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IP	=	Input (+ PU/PD = internal pullup / pulldown resistor)
OP	=	Output
PWR	=	Power Connection
NC	=	No Connection - should NOT be connected to any signal.
NU	=	Not used in this implementation

5 Component and PCB Recommendations

5.1 Recommended External Components

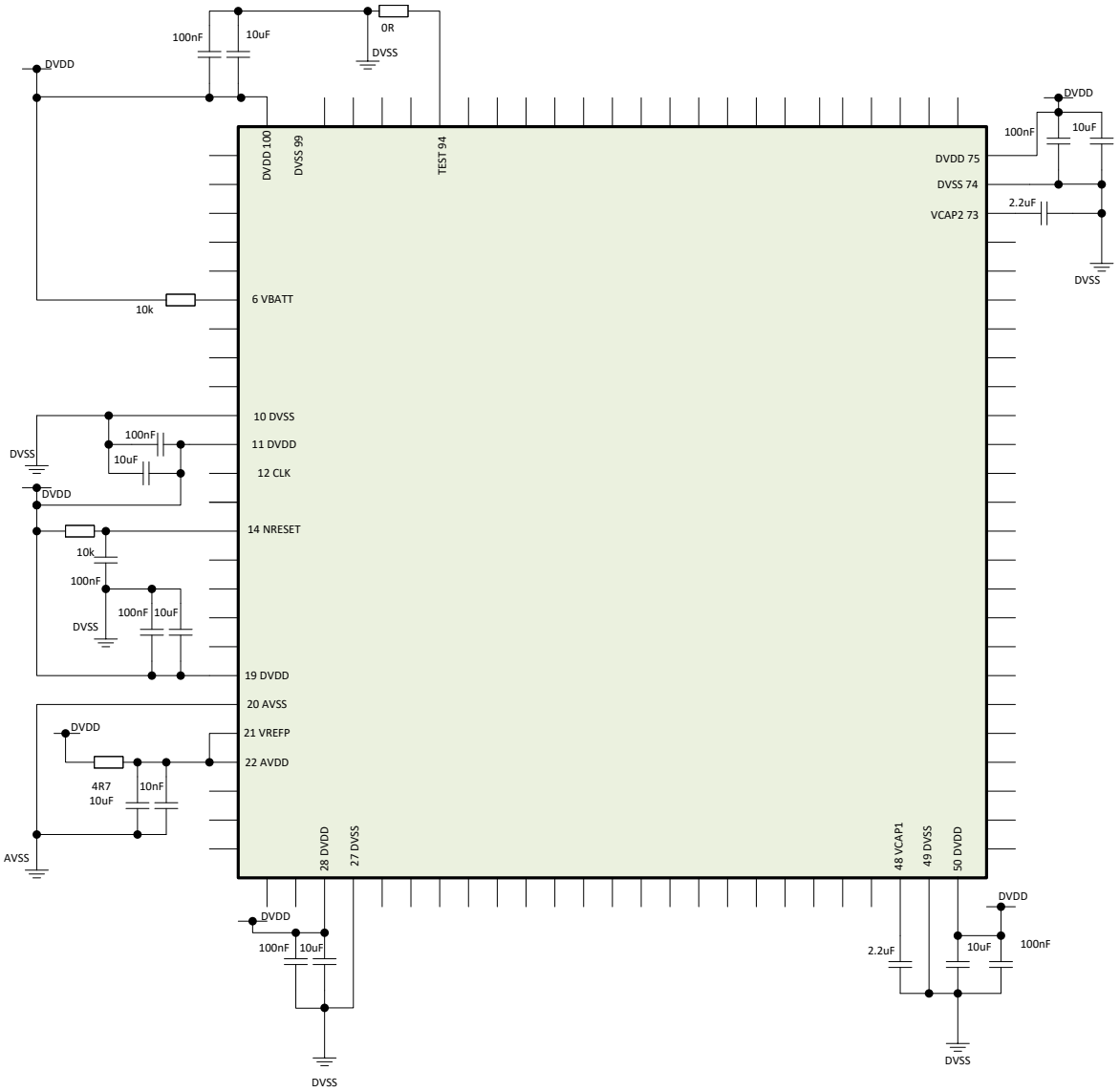

Figure 2 SCT7033 Recommended External Components

Resistors ±5%, capacitors and inductors ±20% unless otherwise stated.

Notes:

The decoupling capacitors should be as close as possible to the device. Use of a multi-layer printed circuit board will facilitate the provision of ground planes on separate layers. The DE70322TC can be used as an example of a suitable pcb layout.

6 Detailed Description

The SCT7033 implements a full Class B CSTDMA protocol stack compliant with IEC 62287-1 and ITU-R M.1371-5 international standards for non-SOLAS vessels. The core protocol is designed specifically to operate with the CMX7032 baseband AIS processor using Function Image 3.0.0.9 or later, uBlox M8M GNSS receiver and LMX2571 PLL/VCO devices as implemented on the DE70322TC evaluation pcb. All references in this document refer to this implementation.

6.1 Hardware Interfaces

The SCT7033 interfaces with:

- AIS Baseband processor CMX7032 C-BUS/SPI1
- RxChannel A Synthesiser LMX2571 SPI2
- RxChannel B Synthesiser LMX2571 SPI2
- GNSS receiver uBlox M8M UART2 (9600 8N1)
- Presentation Interface USB or UART1 (38400 8N1)
- GNSS pass-through UART6 (4800 8N1)
- LED indicators
    - ChanA/B Rx/Tx/DSC (dual colour)
    - Error
    - TxTimeout
- RF controls Enables for Rx, TxVCO and GNSS
- Digital Outputs Alarm output
- Digital Inputs Tx Inhibit

In order to operate, the SCT7033 requires:

- Power Supply: 3.3 V dc
- 19.2 MHz clock input (derived from common 38.4 MHz VCTCXO on DE70322TC)
- Reset - held low at power on (an RC network is sufficient)

The USB port implements device-mode only and is used for factory set-up and initial configuration of the device in conjunction with the ES70322TC GUI software available from the CML Technical Portal. It functions as the Presentation Interface whilst connected. If no USB connection is detected, the Presentation Interface will use UART1 instead.

6.2 Protocol Support

The SCT7033 supports all mandatory functions required by IEC 62287-1 edition 3 and ITU-R M.1371-5:

Table 2 Protocol Support

	Name of message	1371-5 Annex 8	Receive & process	Transmit	Remark
0	Undefined		No	No	Ignored by CMX7032
1	Position report (Scheduled)	§ 3.1	Yes	No	Optional in 1371-5
2	Position report (Assigned)	§ 3.1	Yes	No	Optional in 1371-5
3	Position report (When interrogated)	§ 3.1	Yes	No	Optional in 1371-5
4	Base station report	§ 3.2	Yes	No	Class B “CS” should obey the 120 NM rule.
5	Static and voyage related data	§ 3.3	Yes	No	Optional in 1371-5
6	Addressed binary message	§ 3.4	No	No	
7	Binary acknowledge	§ 3.5	No	No	
8	Binary broadcast message	§ 3.6	Yes	No	Optional in 1371-5
9	Standard SAR aircraft position report	§ 3.7	Yes	No	Optional in 1371-5
10	UTC and date inquiry	§ 3.8	No	No	
11	UTC/Date response	§ 3.2	Yes	No	Optional in 1371-5

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12	Safety related addressed message	§ 3.10	Yes	No	Information can also be transferred via Message 14
13	Safety related acknowledge	§ 3.5	No	Optional	Should be transmitted if the option to process Message 12 is implemented
14	Safety related broadcast message	§ 3.12	Yes	Optional	Transmit with predefined text only, see § 4.3.3.7
15	Interrogation	§ 3.13	Yes	No	respond to interrogations for Msg 18 and 24.
16	Assigned mode command	§ 3.21	No	No	Msg 23 is applicable to the “CS”
17	DGNSS broadcast binary message	§ 3.15	Yes	No	
18	Standard Class B equipment position report	§ 3. 16	Yes	Yes	A Class B “CS” AIS should indicate “1” for “CS” in flag bit 143
19	Extended Class B position report	§ 3.17	Optional	Yes	Transmit ONLY as response on base station interrogation
20	Data link management message	§ 3.18	Yes	No	Message 4 should be received and evaluated for the 120 NM rule before responding.
21	Aids-to-navigation report	§ 3.19	Yes	No	Optional in 1371-5
22	Channel management message	§ 3.20	Yes	No	The 120 NM rule does not apply
23	Group assignment	§ 3.21	Yes	No	Message 4 should be received and evaluated for the 120 NM rule before responding.
24	Class B “CS” static data	§ 3.22	Yes	Yes	Part A and Part B
25	Single slot binary message	§ 3.23	Yes	No	Optional in 1371-5
26	Mult. slot binary message with Communications State	§ 3.24	Yes	No	
27	Position report for long-range applications	§ 3.25	No	No	
	Undefined	None	No	No	Reserved for future use

6.3 Flash Memory

The SCT7033 provides 512 kB of built-in flash memory which is split up into separate pages. It is delivered with Protocol Stack and CMX7032 Function Image for a Class-B CSTDMA AIS unit already programmed in. Space in the flash is reserved for configuration and calibration data.

6.4 Clocks and Synchronisation

On reset, the 16 MHz internal RC oscillator is selected as the default CPU clock. Following the successful boot from the internal Flash memory, the external 19.2 MHz clock is selected and the internal PLL set to produce the maximum CPU clock speed of 96 MHz.

The AIS system requires all transmissions to be aligned to UTC. On the SCT7033 this is achieved by using the 1 pps signal from the uBlox M8 GNSS device, with reference to the data in the accompanying data stream to ensure that the 37.5 Hz SlotCLK signal is correctly aligned to the minute boundary. If the GNSS signal is lost, then the time-of-arrival of AIS messages from other stations is used to estimate the correct timing.

6.5 Power Supply Schemes

DVDD = 3.0 to 3.6 V (3.3 typical)

AVDD = 3.0 to 3.6 V: external analogue power supplies for Reset blocks, RCs and PLL. DVDD and VSSA must be decoupled to VDD and VSS, respectively.

VBAT = 1.65 to 3.6 V: power supply for RTC, external clock 32 kHz oscillator and backup registers (through power switch) when DVDD is not present.

6.6 Boot Modes

At startup, the device will automatically boot from the internal flash. Re-programming can only be performed using the built in bootloader. It is not possible to read the executable code out of the Flash memory. The bootloader can be invoked from the GUI, and new firmware downloaded into flash.

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7 Operation

7.1 Start-up

On startup, the SCT7033 implements an embedded RTOS which will load the CMX7032 with its Function Image and initialise it with the appropriate data (for Tx PLL, RF PA ramp profile, Tx Timing tables etc) for use on the DE70322TC. It will then read the calibration and configuration data from the Flash and load the data into the external devices and internal memory as appropriate. It will then initialise the GNSS module and perform a Built-In-Self-Test to ensure that all devices are performing normally. If this is not the case, then the ERROR LED will be activated and an Alarm message sent over the Presentation Interface (PI).

The SCT7033 will output a 37.5 Hz SLOTCLK to allow the CMX7032 to synchronise to the AIS messages by analysing both the 1PPS signal from the GNSS device in conjunction with the timing data provided over UART2 to compensate for differences between UTC and GPS time. It is essential that the unit be power-cycled after every change in UTC leap second (usually 1st January) to ensure continued synchronisation to other units on the AIS system. If a valid UTC signal cannot be detected, then the SCT7033 will attempt to synchronise with other AIS traffic heard over the AIS channels as defined in IEC 62287-1. Note that the initial cold start GNSS time to first fix requires an unobstructed view of the satellites for long enough to allow the almanac data to be downloaded – this may take up to 15 minutes.

On the DE70322TC, a battery back-up is provided to save this data so that subsequent cold starts should take approximately 28s. See the uBlox datasheet for further information.

The SCT7033 will monitor the RSSI levels on the RF channels for the first minute to establish the current CS-Threshold level and allow the GNSS unit to achieve a fix. After this period it will, by default, transmit msg18 at either 30s or 3 minute intervals (depending on the current value of SOG from the GNSS) and msg24a and ms24b at the appropriate times according to the protocol in ITU-R M.1371-5. These values can be affected by the reception of msg22 and msg23 transmitted by a “competent authority” according to the protocol described in ITU-R M.1371-5.

7.2 Transmitter

The AIS transmit data packet is generated from the data held in the configuration memory and the position/speed/time data provided by the GNSS unit, assembled into the appropriate AIS message 18, 24a or 24b and provided to the CMX7032 baseband processor at the appropriate time over the C-BUS interface. The CMX7032 will then transmit this data in AIS format following the next slot clock edge based on the CS-TDMA protocol. If the transmission attempt fails due to the CS mechanism, then the TxTimeout LED will be activated and an Alarm message sent over the PI. The SCT7033 also programs the CMX7032 TX PLL to the correct frequency for the AIS transmission and provides the correct timing and PA ramping profiles(s) to suit the CMX902 RF Power Amplifier.

The Tx_VCO_ENABLE line is activated 10ms before the slot edge for the intended transmission occurs, to allow time for the Tx PLL and VCO implemented in the CMX7032 to lock to the correct frequency. The remaining Tx control signals are implemented by the CMX7032.

exactTrax operation is available if the appropriate activation code / manufacturer ID is used and enabled. The SCT7033 will automatically defer any CS transmissions if the CMX7032 / CMX7042 is actively transmitting an exactTrax message. excactTrax message generation and timing is executed within the CMX7032 / CMX7042 device (see the CML datasheet for details) by using the information in the msg18s generated by the SCT7033.

7.3 Receiver

The SCT7033 programs the LMX2571 PLL devices to the appropriate frequencies for AIS1 and AIS2 (161.975 MHz and 162.025 MHz by default). AIS data received by the CMX7032 is transferred to the SCT7033 over the C-BUS interface and formatted into the appropriate NMEA 0183-HS data string and presented to either the serial UART or the USB port. The CMX7032 can assert an IRQ line to the SCT7033 to indicate that it has data available. In addition, the channel management messages received from a base station will be acted on appropriately to change the operation characteristics of the device as defined in IEC 62287-1 edition 2 (RF power, reporting rate, RF channel frequency etc). It is also possible to enter channel management data over the UART or USB ports from a validated source.

If enabled, the SCT7033 will command the CMX7032 to change to DSC receive mode at the appropriate times and implement any channel management commands as appropriate. Whilst the SCT7033 is in DSC Rx mode, the LED for the appropriate channel will be activated.

7.4 LED Indicators

The function of the LED indicators is shown in the following table (Dx references correspond with the implementation on the DE70322TC).

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Table 3 LED Indicators

LED	Colour	Function
D2 - CH2_LED	Red	Indicates channel A is in DSC Rx mode
	Green	Indicates successful reception of a packet on channel A
	Amber	Indicates a transmission on channel A.
D3 - CH1_LED	Red	Indicates channel B is in DSC Rx mode
	Green	Indicates successful reception of a packet on channel B
	Amber	Indicates a transmission on channel B
D4 - ERROR	Amber	This is lit if an error occurs
D5 - TX_TOUT	Amber	This is lit if the transmitter times out or a CSTDMA Tx is deferred.

7.5 GNSS Support

The SCT7033 is designed to support the uBlox M8M module. This defaults to GPS + GLONASS with SBAS enabled. The module can also be ordered from the manufacturer to default to GPS + Beidou for use in China. Note that the NMEA output strings will use the appropriate identifier depending on which system is in use - $GN, $GP, $GL, $GB.

Note that DGNSS support using msg 17 is available on the Presentation Interface, but is not automatically applied to the M8M module as this will automatically disable SBAS operation. See the uBlox datasheet and programming manuals for further details.

7.6 NMEA Format

The SCT7033 supports NMEA-0183-HS which uses 38400 baud. Multi-sentence messages are supported.

7.7 Software GUI Set-Up

The SCT7033 is designed to use the built-in USB port to connect with the ES70322TC GUI software which provides configuration and control features. Installation of device drivers is similar to the procedure for the CML PE0003 Universal Interface Card. If running on Windows 10, the drivers will install automatically without the prompt for driver signing.
Open the Windows Device Manager as shown in Figure 3.

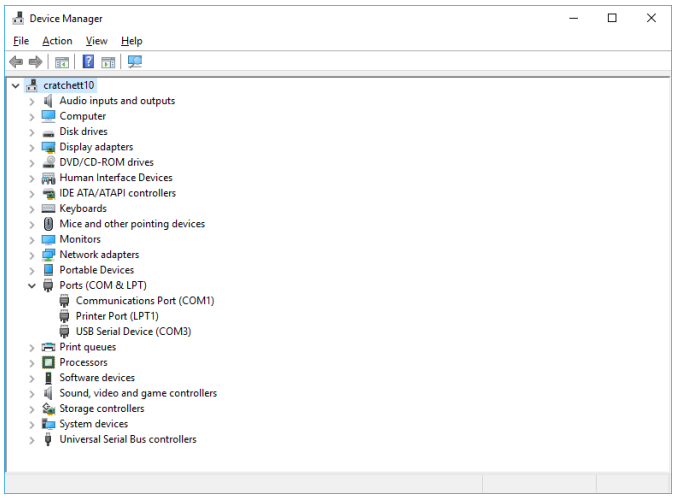


Figure 3 Windows Device Manager COM Port Allocation

Click on the Ports (COM & LPT) entry and note the COM port allocated to the device. Start the GUI by clicking on the icon. The COM Port Number dialogue shown in Figure 4 will be displayed. Select the allocated COM port and click OK.

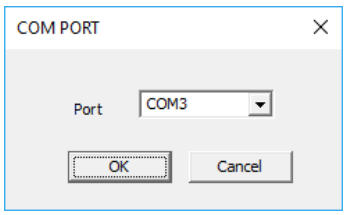
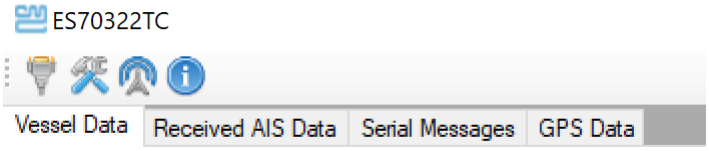


Figure 4 COM Port Number

8 Factory Settings and Alignment

For DE70322TC-style designs, a number of variables need to be set to ensure the correct operation of the system. These are made available on the “Commands” and “CMX setup” screens of the ES70322TC GUI. They are accessed by selecting the “settings” icon in the menu bar. This option should not be made available outside of the factory environment. This tab is enabled by invoking the ES70322TC GUI with the command line argument “ /factory”.



To aid test and alignment, a number of test modes can be implemented through these pages. Additional test modes are provided to facilitate approvals testing to IEC 62287-1 only, which should not be required in normal use.

8.1 Commands Tab

This enables various test and debug modes that can be used during development or testing. They should not be used outside of a lab / factory environment.

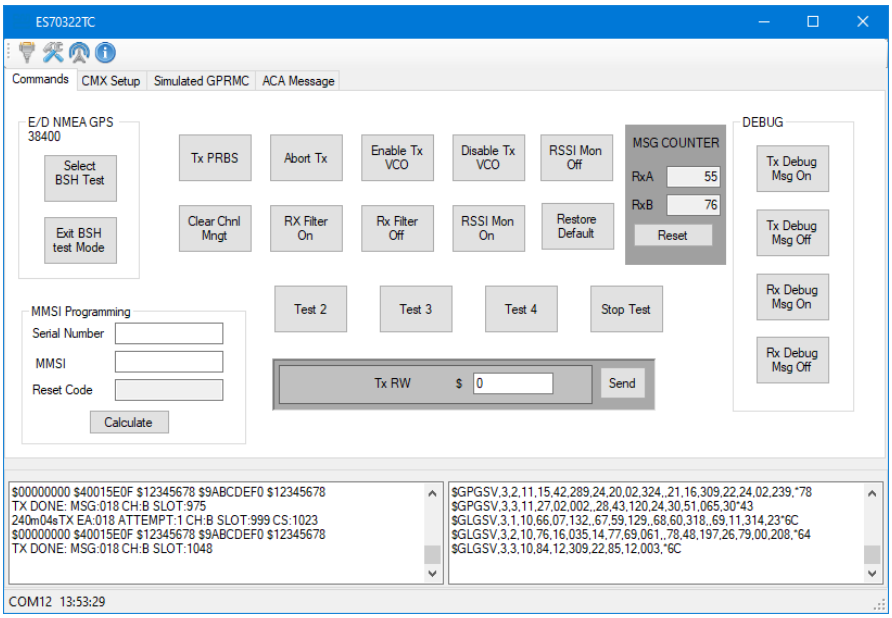


Figure 5 Commands Tab

8.1.1 Select / Exit BSH Test Modes

When enabled, allows GNSS data to be fed externally via the PI instead of the internal GNSS unit. This is required for type approvals process.

8.1.2 Debug Modes

Selection of these features enables the selected messages to appear in the debug window so that they are easier to be seen.

8.1.3 MMSI Programming

Entering the Serial Number and the current MMSI here will generate a reset code that the dealer can use to reset the MMSI of units in the field using the Operational Settings page.

8.2 CMX Setup Tab

The CMX7032 and its associated circuits require alignment to ensure that the AIS messages are transmitted and received correctly. The datasheets for the CMX7032/CMX7042 and DE70322TC provide details on the tests and methods.

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The current settings can be recalled from the flash memory of the SCT7033 using the “Read MFG Data” key and should be saved, when finally adjusted, by the “Update Mfg Data” key.

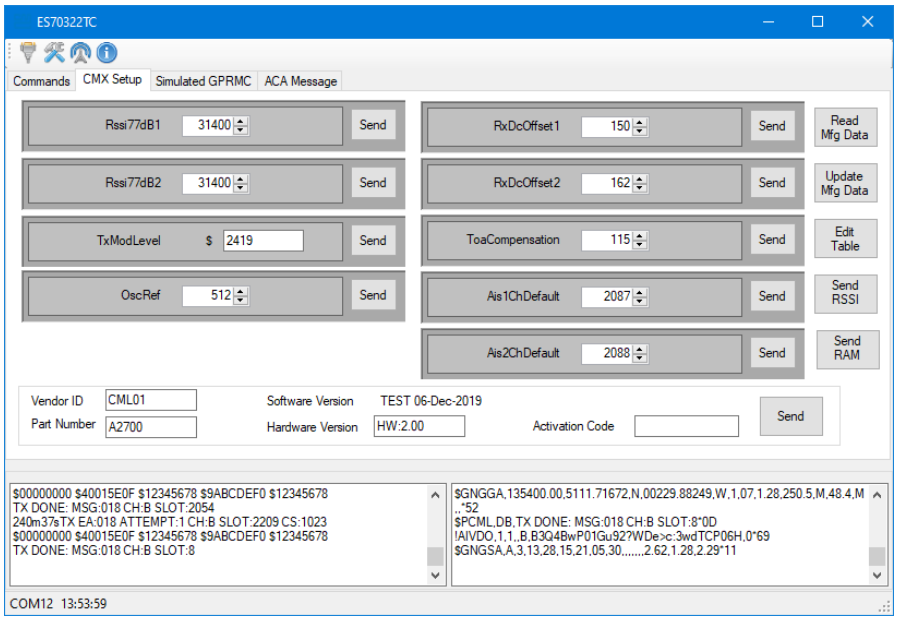

Figure 6 CMX Setup Tab

8.2.1 Tx Modulation Settings

Use “Tx RW” (repeated word) with data 0x00FF and adjust “Tx ModLevel1” and “TxModLevel2” for “flattest” signal on the transmitted waveform.

8.2.2 Tx RF Power and Profile

Generate an Excel .csv file with the required values of the RAMDAC table and load into the SCT7033 using the “Send RAMDAC Table” button. Values should be in hexadecimal with no prefix.

8.2.3 Tx Carrier Frequency

Use “Tx RW” ” (repeated word) with data 0x5555 and adjust “OscRef” to centre the RF frequency on channel. This adjusts the output level on DAC2 of the CMX7032.

8.2.4 Rx RSSI Settings

The Carrier-Sensing operation relies on the RSSI levels being aligned with the characteristics of the chosen IF components and Limiter/Discriminator circuits. These default to the settings used on the DE70322TC but can be adjusted to take account of component or design variations.

The RSSI profile can be loaded using an Excel .csv file using the “Send RSSI Table”. Values should be in hexadecimal with no prefix.

The RSSI level at -77dBm level can be set by the “RSSI77dB” keys. This can be set per-channel, in case the gains are different.

8.2.5 Default Channel Settings

These should be set to 2087 and 2088 to correspond to the internationally agreed AIS1 and AIS2 channels. In exceptional circumstances, and only with the permission of the local regulatory authority, these can be changed using the “Ais1ChDefault“ and “Ais2ChanDefault” keys. Possible uses for this may include test and installation when it is desired to transmit without disturbing or participating in the operational AIS network.

8.2.6 Manufacturing Information

The fields for “Vendor ID”, “Part Number” and “Hardware Version” may be set by the equipment manufacturer as appropriate. Note the format shown in ITU-R M.1371-5:

Manufacturers ID: Three 6-bit ASCII characters

Unit Model Code: 4-bit binary field

Unit Serial Number: 20-bit hexadecimal field

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8.2.7 Activation Code / exactTrax Options

The activation code allocated by CML / ExactEarth should be entered here to enable exactTrax operation. The exactTrax Manufacturers ID will be displayed as confirmation on the “Operational Settings / Vessel Data” tab. The default activation code supplied ($0x0E28 0x2FBF) will disable all exactTrax modes and report manufactures id $01. Once enabled, exactTrax operation can be started/stopped via the “Operational Settings / Vessel Data” tab.

8.3 Simulated GPRMC Tab

This page can be used to generate specific GNSS data for test and debug, used with “BSH Test” modes in the command tab.

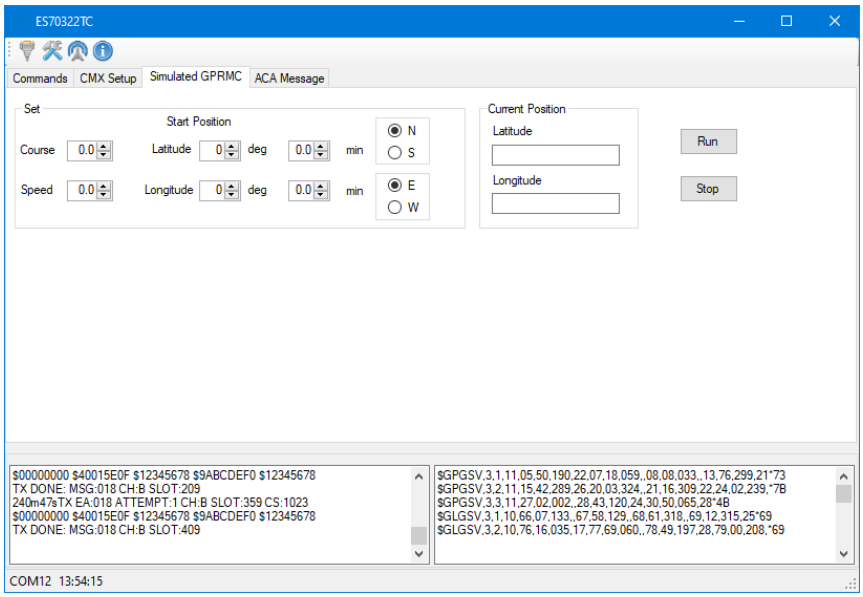

Figure 7 Simulated GPRMC Tab

8.4 ACA Message Tab

This page can be used to generate specific ACA sentences for test and debug.

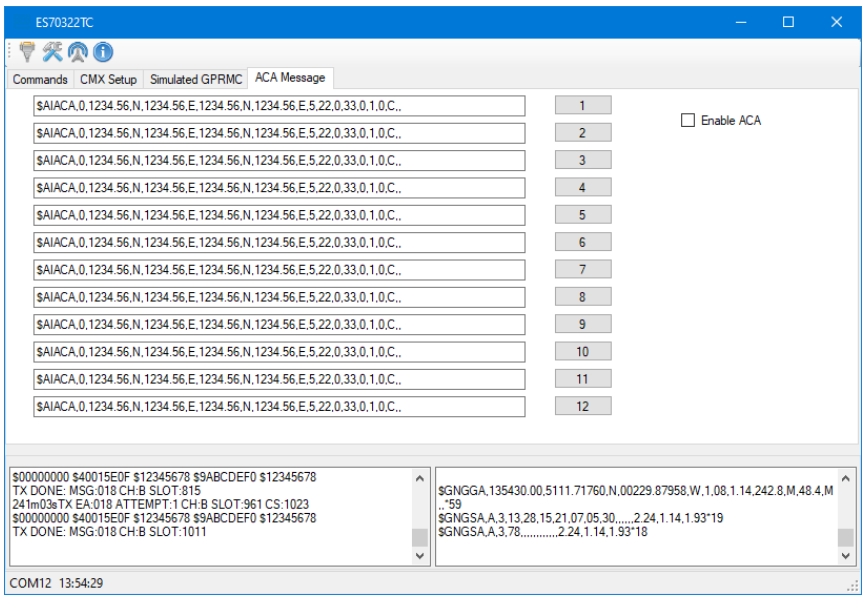

Figure 8 ACA Message Tab

9 Operational Settings

Before the unit can be used on an active AIS network a number of operational settings must be programmed from the "evaluation" icon in the ES70322TC menu bar. The principal one is the MMSI which must be programmed to an appropriate value before the unit will transmit. The unit will not transmit if the MMSI is 000 000 000, in which case the TX Error LED will become active after a short timeout. Note that it is a requirement in ITU-R M.1371-5 that the end user should NOT be able to re-program the MMSI once it has been set without reference to the manufacturer.

9.1 Vessel Data Tab

The current settings can be recalled from the flash memory using the "Read AIS" button and the new values saved into flash using the "Update AIS" button whenever they are changed.

All settings should be set appropriately to the installation / vessel to ensure that the AIS network performs correctly. Any incorrect values in these fields could cause misleading information to be presented to other AIS users in the network. It should be noted that some regulatory bodies monitor AIS transmissions for incorrect data and have been known to impose fines or restrictions on vessels found to be transmitting erroneous data.

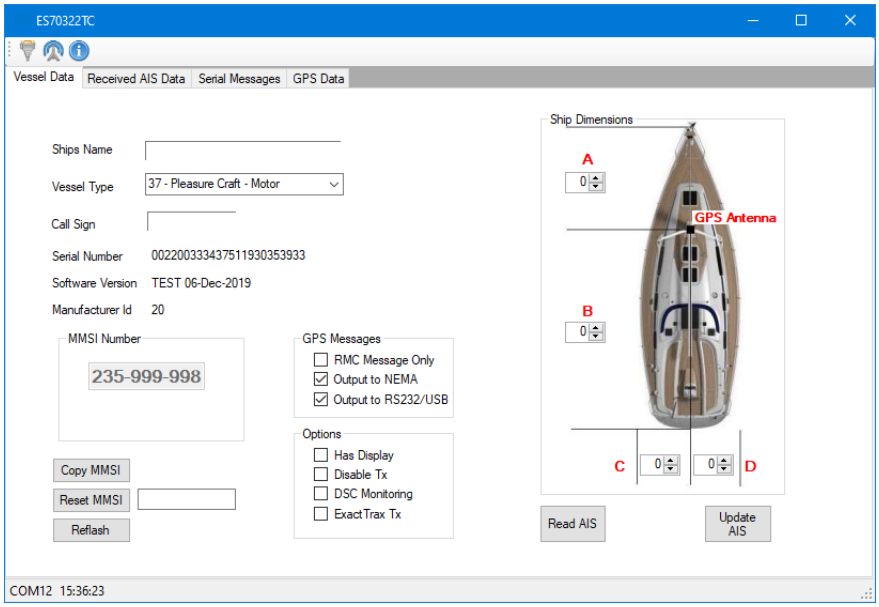

Figure 9 Vessel Data Tab

9.1.1 Ship / Vessel Data

The values for "Ships Name", "Call Sign" and "Ship Dimensions" should be set appropriately.

"Vessel Type" should be set according to the table in ITU-R M.1371-5. For most pleasure / leisure craft this would be 36 or 37.

9.1.2 MMSI Settings

The MMSI should be entered here – it can only be updated if the existing MMSI is zero. The dealer can supply the serial number and current MMSI value to the manufacturer from this page, who can then generate a reset code which can be entered on this page to reset the MMSI back to 000-000-000. The dealer can then re-program the MMSI to the correct value.

9.1.3 Reflash

Allows the firmware in the SCT7033 to be updated from the file provided by the manufacturer. The default SCT7033 firmware is available on the CML Technical Portal.

9.1.4 Options

"Has display" should be set if the SCT7033 is connected to a display. This state is reflected in the msg18 data "Class B display flag" bit.

"Disable TX" inhibits transmit operation for use where the DE70322TC does not have a Transmit Power supply or where Rx-only operation is desired.

"DSC monitoring" enables the DSC monitoring protocol as defined in IEC 62287-1.

"exactTrax Tx" enables exactTrax mode if it is available (specific activation codes are required for this feature).

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9.2 Received AIS Data Tab

Displays received AIS messages and data (note that the Ships Name field will only be populated following receipt of a valid msg24a/b or msg5).

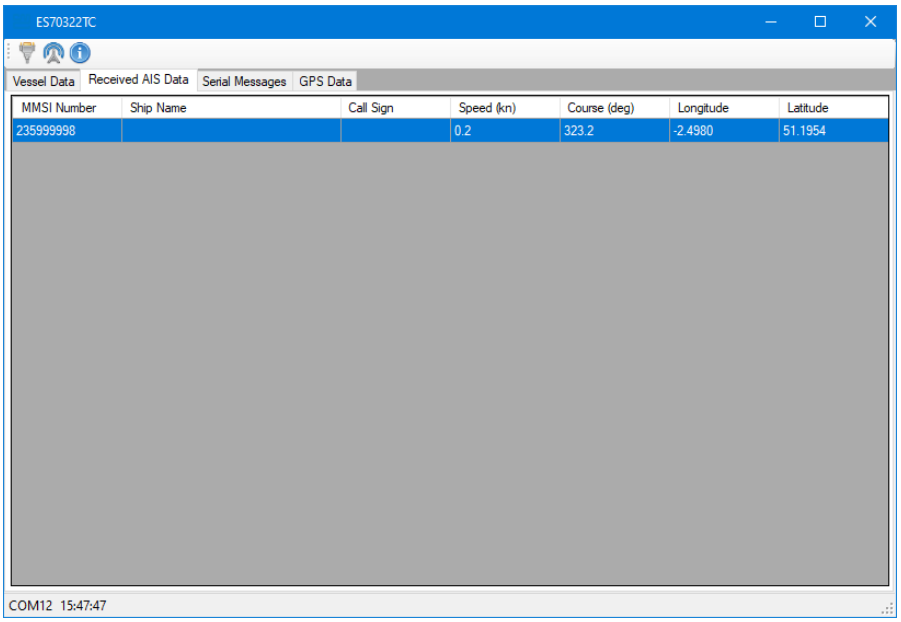

Figure 10 Received AIS Data Tab

9.3 Serial Messages Tab

Displays the NMEA messages sent over the Presentation Interface (USB or UART).

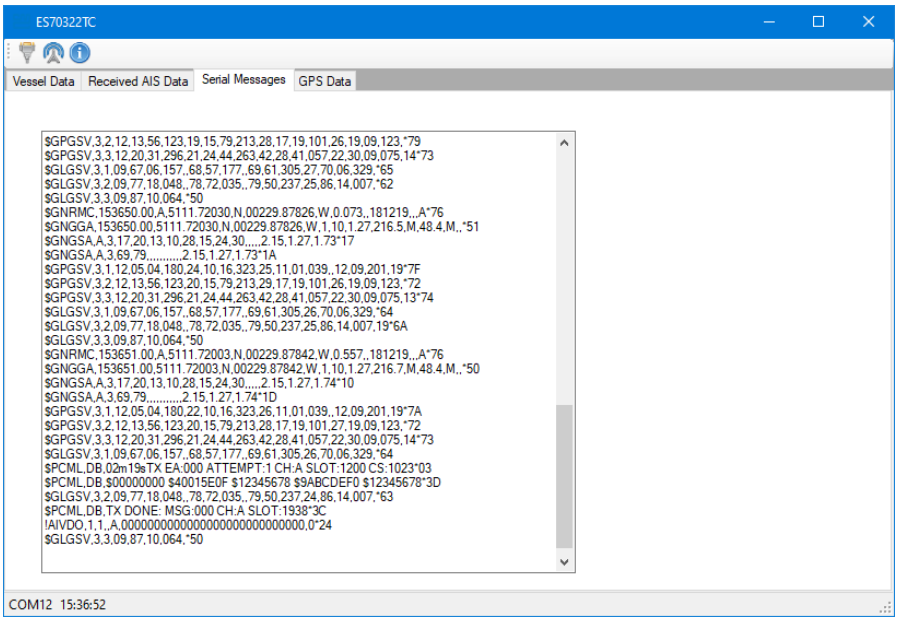

Figure 11 Serial Messages Tab

9.4 GPS Tab

Displays the current status of the GNSS module.

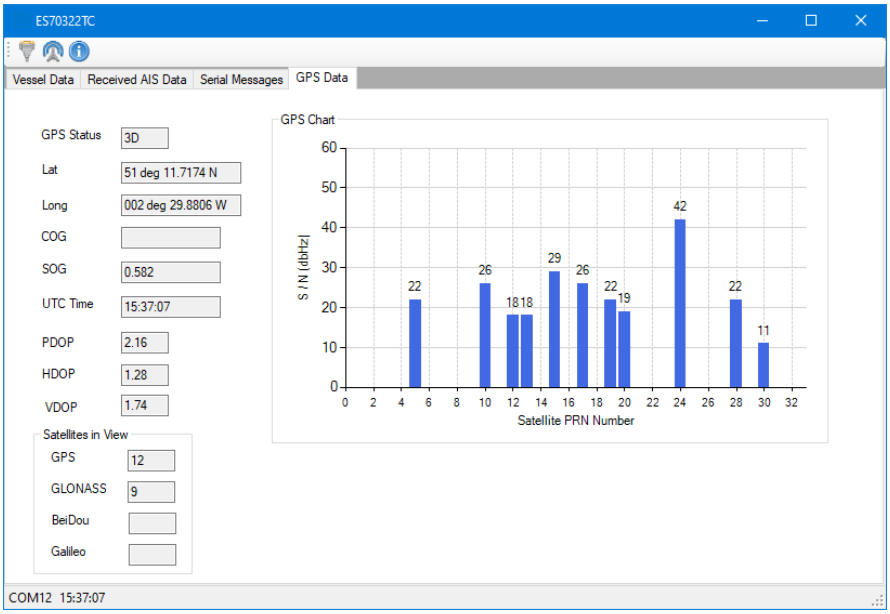

Figure 12 GPS Tab

10 Approvals

The protocol used in the SCT7033 has previously been used on AIS units that have been successfully tested to IEC 62287-1 and was approved for use in the EU, USA and elsewhere. In this product, it has been further developed to incorporate the latest version of the appropriate standards, ported to the SCT7033 processor architecture and supports the DE70322TC hardware design. Manufacturers are responsible for the final approvals of units that incorporate the SCT7033 and approval from the local regulatory authority should be obtained before deploying on an active AIS network. The test report from the independent test house for the original release is included below for information only.

Test of Class-B CS Protocol Stack

This is summary of the Test Results performed by an external accredited test house on the software used as the basis for the SCT7033 Class-B CS Protocol Engine. There should be no significant differences between this report and the current release of the SCT7033.

Summary

Test No.	Reference	Section	Result (passed/ not passed / not applicable / not tested)
2	IEC 62287	10 Operational tests	pass
3	IEC 62287	11 Physical tests	Not included
4	IEC 62287	12 Specific tests of link layer	pass
5	IEC 62287	13 Specific tests of network layer	pass
6	IEC 62287	C.3 DSC functionality tests	pass

Remarks:
Compass Safe Distance cannot be tested until production enclosure is available.

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- General information
- **Composition**

Display

☐ Internal ☐ Remote ☒ not available

DSC

☐ Dedicated DSC Rx ☒ Time sharing with TDMA Rx

RF Band ability

☒ Only upper band ☐ upper and lower band can be used

Channel management by msg 22

☒ Msg 22 implemented ☐ Only AIS 1 and AIS 2 can be used

Serial Interface

☒ Available ☐ Not available

Standard of serial interface:	RS232, RS422

If not available, a serial test interface is required

Sync signal for Carrier sense test

Required for testing

Parameters	
Polarity:	positive
Level	3 V

4. General requirements

4.2 Manuals

The manuals shall include:

- *the type of external connectors if applicable;*
- *the required information for correct siting of the antennas;*
- *the required information for compass safe distance.*

	Test details – Requirements of IEC 62287		
Test item	Check	Remark	Result
Type of external Connectors	Check that type of external connectors is included	Manual not yet available	N/T
Siting of antennas	Check that information about siting the GPS antenna is included		N/T
	Check that information about siting the VHF antenna is included		N/T
Compass safety distance	Check that information about the compass safety distance is included		N/T

4.3 Marking and identification

Each unit of the equipment shall be marked externally with the following information which, where practicable, shall be clearly visible when the equipment is installed in its recommended position:

- *identification of the manufacturer;*
- *equipment type number or model identification;*
- *serial number of the unit;*
- *power supply requirements; and*
- *compass safe distance.*

Alternatively, the marking may be presented on a display at equipment start-up.

The version of software shall be either marked or displayed on command on the equipment.

When the marking and the title and version of the software are presented only on the display, such information shall also be included in the equipment manual.

	Test details – Marking and identification		
Test item	Check	Remark	Result
Type of marking and identification	Check if the equipment is marked		Ok
	Check if the marking and identification is shown on a display	No display	N/A
Marking items	Check that the Identification of the manufacturer is available		Ok
	Check that the equipment type number or model identification is available		Ok
	Check that the serial number of the unit is available		Ok
	Check that power supply requirements information is available		Ok
	Check that the compass safety distance is available	Missing The CSD measurement will be performed after this test phase.	Nok
Software version	Check that the software version is displayed		Ok
	Note if the software version is displayed on the equipment or on the display	On the equipment It is also available	Ok
	If displayed only on the display: check that the software version is also included in the manual		N/A

10 Operational tests

10.2 Modes of operating

(see 4.1.5)

10.2.1 Autonomous mode

(see 4.1.5.1)

10.2.1.1 Transmit Position reports

10.2.1.1.1 Method of measurement

Set up standard test environment. Record the VDL communication and check for messages transmitted by the EUT.

10.2.1.1.2 Required results

Confirm that the EUT transmits Messages 18 and 24 following the nominal schedule and alternates between channel A and channel B.

	Test details – Transmission of Position reports		
Test item	Check	Remark	Result
Set up standard test environment			
Msg 18	Check that message 18 is transmitted continuously		Ok
	Check the transmission schedule of msg 18		Ok
	Check that msg 18 alternates between channel A and B		Ok
Msg 24	Check that message 24 is transmitted continuously		Ok
	Check that msg 24 part A and B are transmitted.		Ok
	Check the transmission schedule of msg 24		Ok
	Check that msg 24 alternates between channel A and B		Ok

10.2.1.2 Receive Class A position reports

10.2.1.2.1 Method of measurement

Set up standard test environment.

Switch on test targets, then start operation of the EUT.

Start operation of the EUT, then switch on test targets.

Transmit test targets using same time periods on channel A and channel B.

Check the VDL communication, test output, and where provided, display or external interface of the EUT.

10.2.1.2.2 Required results

Confirm that EUT receives continuously under conditions 10.2.1.2.1 a), b) and c) and, where provided, outputs the received messages on the external interface or display.

	Test details a)– Receive Position reports, Target started first		
Test item	Check	Remark	Result
Switch on Test targets, then start operation of the EUT Check the following items on external interface and display			
Check for continues receiving	On test output	Not implemented	N/A
	On external interface		Ok
	On display	If implemented Not implemented	N/A
Channels	Check that the position reports are received on channel A		Ok
	Check that the position reports are received on channel B		Ok

	Test details a)– Receive Position reports, EUT started first		
Test item	Check	Remark	Result
Switch on EUT, then start Test targets Check the following items on external interface and display			
Check for continuous receiving	On test output	Not implemented	N/A
	On external interface		Ok
	On display	If implemented Not implemented	N/A
Channels	Check that the position reports are received on channel A		Ok
	Check that the position reports are received on channel B		Ok

	Test details a)– Receive Position reports in same time periods		
Test item	Check	Remark	Result
Start 2 test targets using the same time slots on channel A and B Check the following items on external interface and display			
Check for continuous receiving	On test output	Not implemented	N/A
	On external interface		Ok
	On display	If implemented Not implemented	N/A
Channels	Check that the position reports of one target are received on channel A		Ok
	Check that the position reports of the other target are received on channel B		Ok
Remark:	This test result has been derived from the Rx performance test (□) because in this test the EUT is receiving in the same time slots on both channels.		

- 10.2.1.3 Receive Class B"CS" position reports

This test is only applicable if a display or display interface for the received messages is provided.

10.2.1.3.1 Method of measurement

Set up standard test environment. Simulate at least one additional Class B"CS" test target (bit stuffing shall not increase 4 bit)

Check the VDL communication, test output, and display or external interface of the EUT.

10.2.1.3.2 Required results

Confirm that EUT receives the Class B"CS" test target continuously and, where provided, outputs the received Messages 18 and 24 on the external interface.

	Test details a)– Receive Class B "CS" position reports		
Test item	Check	Remark	Result
Switch on Test targets, then start operation of the EUT Check the following items on external interface and display			
Check for continuous receiving of msg 18	On test output	Not implemented	N/A
	On external interface		Ok
	On display	If implemented Not implemented	N/A
Check for continuous receiving of msg 24	On test output	Not implemented	N/A
	On external interface		Ok
	On display	If implemented Not implemented	N/A
	Check that msg 24 A and B are received		Ok
Channels	Check that the position reports are received on channel A		Ok
	Check that the position reports are received on channel B		Ok

- 10.2.1.4 Receive in adjacent time periods

10.2.1.4.1 Method of measurement

Set up standard test environment. Simulate additional targets so that the first 4 of each 5 time periods are used. The reporting rate may be increased for the purpose of this test.

Check the VDL communication, test output, and where provided, display or external interface of the EUT.

10.2.1.4.2 Required results

Confirm that EUT continuously receives messages in the time periods adjacent to own transmission period with an acceptable loss of 5 %.

	Test details - Receive in adjacent time periods		
Test item	Check	Remark	Result
Simulate targets in 4 of 5 time periods (80 % channel load, VDL tester set "test 80% 4-1") Check the following items on external interface			
Received targets	Check that the targets transmitting in the time periods before the EUT transmission slot are received		Ok
	Check that the targets transmitting in the time periods after the EUT transmission slot are received		Ok
	Check that the Rx loss is < 5 %	• There are no stops of operation. • All message on channel A in the slot after the own transmission are received. • All messages in the slot before the own transmission are received.	Ok Ok Ok

- 10.2.1.5 Rx performance test

10.2.1.5.1 Method of measurement

Set up standard test environment. Simulate additional targets so that 9 of 10 time periods are used.

Check the VDL communication, test output, and where provided, display or external interface of the EUT.

10.2.1.5.2 Required results

Confirm that EUT continuously receives messages and, where provided, outputs the received messages on the external interface with a loss of not more than 5 %.

	Test details - Receive in adjacent time periods		
Test item	Check	Remark	Result
Simulate targets in 9 of 10 time periods (90 % channel load), record the test or external interface			
Rx probability	Check that at least 95 % of the target position reports are received	The Rx probability is about 99.5 %. There is no stop of transmission.	Ok

- 10.2.2 Assigned mode

(see 4.1.5.2)

- 10.2.2.1 Group assignment

10.2.2.1.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Transmit a group assignment command Message 23 to the EUT addressing stations by

- *region,*
- *station type and*
- *type of ship*

and commanding for

- *Tx/Rx mode,*
- *reporting rate,*
- *quiet time.*

Record transmitted messages.

10.2.2.1.2 Required results

Confirm that the EUT transmits position reports Message 18 according to the defined parameters and reverts to standard reporting rate after 4 min to 8 min.

Confirm that the operation of the EUT is not affected when not addressed.

	Test details - Group assignment, addressed		
Test item	Check	Remark	Result
Test 1: Send a msg 23 with the following parameters: speed = 10 kn			
Region: inside Station type: 0 = all types Type of ship: 0 = all types Tx/ Rx mode = 0: Tx A and B Reporting interval: 8 = 5 s Quiet time: 0 = no quiet time Msg “B Msg 23 Test 10.2.2.1 T1”	check that the reporting rate = 5 s	UTC 11:20	Ok
	Check that EUT reverts to standard reporting rate after 4...8 min	UTC 11:28	Ok
Test 2: Send a msg 23 with the following parameters:			
Region: inside Station type: 2 = all class B Type of ship: 37 = pleasure craft Tx/ Rx mode = 0: Tx A and B Reporting interval: 9 = next shorter Quiet time: 0 = no quiet time Msg “B Msg 23 Test 10.2.2.1 T2”	check that the reporting rate = 15 s	UTC 11:31 No transmission	Ok
	Check that EUT reverts to standard reporting rate after 4...8 min		Ok
Test 3: Send a msg 23 with the following parameters:			
Region: inside Station type: 5 = all class B CS Type of ship: 37 = pleasure craft Tx/ Rx mode = 0: Tx A and B Reporting interval: 7 = 10 s Quiet time: 0 = no quiet time Msg “B Msg 23 Test 10.2.2.1 T3”	check that the reporting rate = 10 s	UTC 12:35	Ok
	Check that EUT reverts to standard reporting rate after 4...8 min	UTC 12:41	Ok
Test 4: Send a msg 23 with the following parameters:			
Region: inside Station type: 5 = all class B CS Type of ship: 37 = pleasure craft Tx/ Rx mode = 1: Tx A Reporting interval: 6 = 15 s Quiet time: 0 = no quiet time Msg “B Msg 23 Test 10.2.2.1 T4”	check that the reporting rate = 30 s (Ed.1) or 15 s (Ed.2)	UTC 2010-08-19 08:38 Reporting interval = 15 s	Ok
	Check that all transmissions are on channel A	All transmissions are on channel A	Ok
After 3 minutes send the same msg 23 but Tx/ Rx mode = 2: Tx B Msg “B Msg 23 Test 10.2.2.1 T4”, manually change Tx/Rx mode to 2	check that the reporting rate = 30 s (Ed.1) or 15 s (Ed.2)	08:41 Reporting interval = 15 s	Ok
	Check that all transmissions are on channel B	All transmissions are on channel B	Ok

Test 5: Send a msg 23 with the following parameters:			
Region: inside Station type: 5 = all class B CS Type of ship: 37 = pleasure craft Tx/ Rx mode = 0: Tx A and B Reporting interval: 0 = auto. Quiet time: 8 = 8 min Msg “B Msg 23 Test 10.2.2.1 T5”	Check that EUT stops transmission for 8 min	UTC 09:05	Ok
	Check that the EUT reverts to 30 s reporting rate after 8 min.	UTC 09:13	Ok

	Test details - Group assignment, not addressed		
Test item	Check	Remark	Result
Send a msg 23 with the following parameters: speed = 10 kn, EUT ship type = 0 Tx/ Rx mode = 0: Tx A and B Reporting interval: 8 = 5 s Quiet time: 0 = no quiet time			
Test 6: Region: outside Station type: 0 = all types Type of ship: 0 = all types Msg “B Msg 23 Test 10.2.2.1 T6”	check that the reporting interval = 30 s	2010-08-18 UTC 13:18	Ok
Test 7: Region: inside Station type: 4 = AtoN Type of ship: 0 = all types Msg “B Msg 23 Test 10.2.2.1 T7”	check that the reporting interval = 30 s	UTC 09:20 Tested with 1, 3,4,6 UTC 09:24 Crosscheck with type 2 that the assignment is accepted	Ok
Test 8: Region: inside Station type: 0 = all types Type of ship: 70 = cargo vessel Msg “B Msg 23 Test 10.2.2.1 T8”	check that the reporting interval = 30 s		Ok

- ## 10.2.2.2 Base station reservations

10.2.2.2.1 Method of measurement

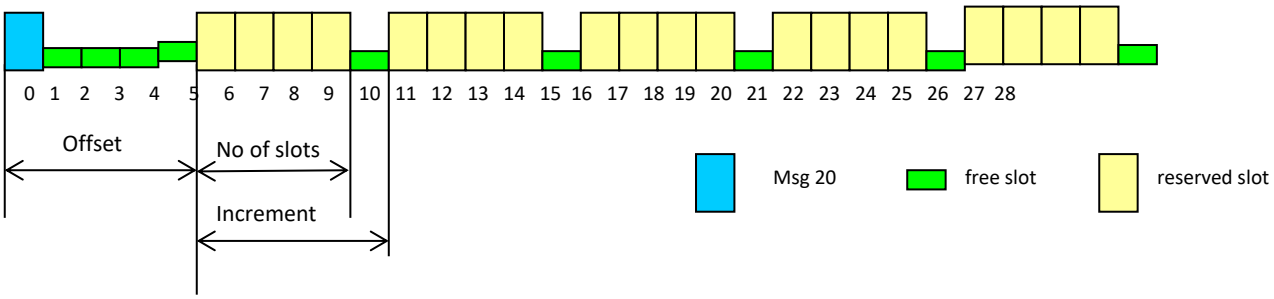
Set up standard test environment and operate EUT in autonomous mode. Transmit a reservation Message 20 to the EUT specifying reserved time periods.

Record transmitted messages.

10.2.2.2.2 Required results

Confirm that the EUT transmits position reports Message 18 without using reserved time periods.

	Test details - Base station reservations		
Test item	Check	Remark	Result
Test 1: Send a msg 20 with the following parameters: Msg: “B Msg 20 Test 10.2.2.2”			
Tx-slot: 0 offset number: 5 number of slots: 4 slot increment: 5 time-out = 7 Repetition of msg 20: 10 times	Check that only the time periods 0,1..4, 9, 14, 19 ... are used for transmissions	The reserved slots are not used for transmission	Ok
	check that after 18 minutes (Tx of msg 20 + time-out) all time periods are used for transmissions	All slots are used for transmission	Ok


0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28
Offset
No of slots
Increment
Msg 20
free slot
reserved slot

- 10.2.3 Polled mode/interrogation response

(see 4.1.5.3)

- 10.2.3.1 Interrogation for Messages 18 and 24

10.2.3.1.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Apply an interrogation message (Message 15; EUT as destination) to the VDL according to message table (ITU-R M.1371 table13) for responses with Message 18, Message 24:

a) with transmission offset = 0,

b) with transmission offset = defined value,

c) with a Message 23 "quiet time" command transmitted before the interrogation.

Record transmitted messages and frame structure.

10.2.3.1.2 Required results

Check that the EUT transmits the appropriate interrogation response message as requested after defined transmission offset. Confirm that the EUT transmits the response to the interrogation on the same channel as that received.

	Test details - Interrogation for msg 18, 20		
Test item	Check	Remark	Result
a) Test 1: Send a msg 15 transmission offset = 0:			
Interrogation for msg 18 and 24 for destination 1, on channel A Msg: "B Msg15 Test 10.2.3.1 T1",	Check that msg 18 is responded		Ok
	Check that the response was within 30 s		Ok
	Check that the response is transmitted on channel A		Ok
	Check that msg 24 A is responded within 60 s		Ok
	Check that msg 24 B is responded within 90 s		Ok
b) Test 2: Send a msg 15 transmission offset = 10:			
Interrogation for 24 for destination 1, offset = 20, 30 and for msg 18, destination 2, offset = 10 Request on channel B Msg: "B Msg15 Test 10.2.3.1 T2",	Check that msg 18 is responded with the defined offset	The response is transmitted in the correct slot (if it is not the first transmission after the request – see below)	Ok
	Check that msg 24 A is responded with the defined offset	The response is transmitted in the correct slot	Ok
	Check that msg 24 B is responded with the defined offset	The response is transmitted in the correct slot	Ok
	Other problems	The first response is also transmitted using the correct slot.	Ok
		The VDM output is correct	Ok
	Check that the responses are transmitted on channel B		Ok
c) Test 3: Send a msg 23 commanding quiet time for 8 min, (setting "B Msg23 Test 10.2.2.1 T5") Send a msg 15 with transmission offset = 10: (setting "B Msg15 Test 10.2.3.1 T2", same as Test 2)			
Interrogation for msg 18 for destination 2	Check that msg 18 is responded with the defined offset	Message 18 and 24 are responded The offset error is the same as in b)	Ok

- 10.2.3.2 Interrogation for Message 19

10.2.3.2.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Apply an interrogation message (Message 15; EUT as destination) to the VDL according to message table (M.1371 Table13) for responses with Message 19:

a) with transmission offset = 0,

b) with transmission offset = defined value.

Record transmitted messages and frame structure.

10.2.3.2.1 Required results

Check that

a) the EUT does not respond,

b) the EUT transmits the appropriate interrogation response message as requested after defined transmission offset.

Confirm that the EUT transmits the response on the same channel as that received and the data content is identical with that in Message 24.

	Test details - Interrogation for msg 19		
Test item	Check	Remark	Result
Test 1: Send a msg 15 transmission with interrogation for msg 19: (setting "B Msg 15 Test 10.2.3.2");			
Offset = 0, destination 1	Check that msg 19 is not responded		Ok
Offset = 15, destination 1 channel = B	Check that msg 19 is responded		Ok
	Check that msg 19 is responded with the defined offset	Message 19 is responded also if it is the first or single requested response.	Ok
	Check that the response is transmitted on channel B		Ok

• 10.3 Messages extending one time period

(see 4.1.5)

10.3.1 Method of measurement

Check the documentation for a possibility to initiate transmission of messages longer than one time period.

10.3.2 Required results

It shall not be possible for the user to initiate the transmission of messages longer than one time period.

	Test details - Tx of msg with more than 1 slot		
Test item	Check	Remark	Result
Check documentation	Check that there is no way to initiate the transmission of message longer than 1 time period	The EUT does not transmit messages applied on the serial port.	Ok

• 10.4 Channel selection

(see 6.2)

• 10.4.1 Valid channels

10.4.1.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Switch the EUT to different channels within the operating band as specified in 6.2 by transmission of channel management message (Message 22) broadcast and addressed to EUT,

Record the VDL messages on the designated channels and check "band flag" and "Message 22 flag" in Message 18. (note that DSC command is covered in Annex C)

10.4.1.2 Required results

Confirm that the EUT switches to the required channel accordingly.

	Test details - Channel selection by msg 22

Test item	Check	Remark	Result
Test 1: Send a msg 22 broadcast, EUT inside the area			
Channels 2020, 2022 (msg "B Msg 22 Test 10.4.1 a")	Check that EUT transmits on the assigned channels	Tx on channel 2018, 2020, 2022 and 2024 ok	Ok
	Check that EUT receives on the assigned channels		Ok
	Check and note the band flag	Band flag = 0 (upper 500 kHz only) This is according to Manufacturers Declaration	Ok
	Check that the Msg 22 flag = 1	Msg 22 flag = 1	Ok
Send an addressed msg 22 to the EUT, channels 2084, 2086 (msg "B Msg 22 Test 10.4.1 b")	Check that EUT transmits on the assigned channels		Ok
	Check that EUT receives on the assigned channels		Ok

- 10.4.2 Invalid channels

10.4.2.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Check units capability on the "band flag" and "Message 22 flag" in Message 18. Switch the EUT to channels outside the operating band as specified in 6.2..

Record the VDL messages on the designated channels.

10.4.2.2 Required results

Confirm that the EUT does not switch to the respective channels and stops transmissions.

	Test details - Channel selection by msg 22		
Test item	Check	Remark	Result
Test 1: Send a msg 22 broadcast, EUT inside the area			
If the EUT is able to operate in the lower band: Channels 1084, 2084 (msg "B Msg 22 Test 10.4.1 a"), modify channels manually	Check that EUT transmits on the assigned channels	The EUT is not able to operate in the lower band (Manufacturers Declaration)	N/A
	Check that EUT receives on the assigned channels		N/A
	Check the band flag = 1		N/A
	Check that the Msg 22 flag = 1		N/A
If the EUT is not able to operate in the lower band: Send a msg 22 broadcast with channels outside the upper band Channels 1001, 2005 (msg "B Msg 22 Test 10.4.1 a"), modify channels manually	Check that EUT stops transmission	UTC 08:45	Ok
	Check that EUT receives on AIS 1 and AIS 2 (default)		Ok
	Check the band flag = 0	Band flag = 0	Ok
	Check that the Msg 22 flag = 1	Message 22 flag = 1	Ok

• 10.5 Internal GNSS receiver

(see 6.3)

Relevant tests according to IEC 61108-1shall be performed with regard to

- *position accuracy, static;*
- *position accuracy, dynamic;*
- *COG/SOG accuracy;*
- *position update;*
- *status indications (including RAIM, where fitted).*

Note: The GNSS receiver test is not part of this test report. The GNSS receiver is tested in a separate test with a separate test report.

10.6 AIS information

(see 6.5)

10.6.1 Information content

(see 6.5.1)

10.6.1.1 Defaults

10.6.1.1.1 Method of measurement

Set up the standard test environment and reset the equipment to enable the manufacturers static data delivery defaults. Attempt to set the equipment to operate in autonomous mode.

10.6.1.1.2 Required results

Confirm that the default MMSI is set at 000000000 and that other static data defaults unambiguously identify that the equipment has been properly initialised. Confirm that the transmissions are inhibited and that an indication is given that transmissions are inhibited.

	Test details - Defaults		
Test item	Check	Remark	Result
Reset the EUT to the default settings			
Default settings	Check that the MMSI is 00000000	The MMSI is 0 (displayed by the configuration tool)	Ok
	Check that the other static data are set to default values	Name:testbase01, Ship type: 37	Ok
	Check that the EUT does not transmit		Ok
	Check that the transmission stop is indicated on the EUT		Ok

10.6.1.2 Required information

10.6.1.2.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Apply all static data to the EUT.

Record all messages on VDL and check the contents of position report Message 18 and static data report Messages 24 A and B.

10.6.1.2.2 Required results

Confirm that data transmitted by the EUT complies with static data and position sensor data.

	Test details - Required information		
Test item	Check	Remark	Result
Apply all necessary data to the EUT			
Required information of msg 18	Check the MMSI		Ok
	Check the SOG		Ok
	Check the PA-flag		Ok
	Check the Longitude		Ok
	Check the Latitude		Ok
	Check the COG		Ok
	Check the Heading	= default. HDT input is not supported Not required because external sensor input is optional,	Ok
	Check the Time stamp	The time stamp is correct (tested with internal and external positon)	Ok
	Check the class B unit flag	= 1 (= CS)	Ok
	Check the Display flag	= 0 (no display)	Ok
	Check the DSC flag	= 0 (currently DSC disabled)	Ok
	Check the band flag	= 0 (only upper band)	Ok
	Check the msg 22 flag	= 1 (Msg 22 is supported	Ok
	Check the Mode flag		Ok
	Check the RAIM flag	= 0	Ok
Required information of msg 24A	Check the MMSI		Ok
	Check the Part number = 0		Ok
	Check the Name		Ok
Required information of msg 24B	Check the MMSI		Ok
	Check the Part number = 1		Ok
	Check the Type of ship and cargo		Ok
	Check the Vendor ID		Ok
	Check the Call Sign		Ok
	Check the Dimension of ship/ reference for position (A, B, C, D)		Ok

- 10.6.1.3 External sensor information

(see 6.3, 6.6.3)

*This test is applicable if an **optiona**l interface for external sensors is provided.*

10.6.1.3.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode.

a) Apply external position data with expected error <10m (from GBS sentence) and within 26 m of internal position.

b) Simulate unavailable/invalid external sensor data and missing/incorrect checksum.

c) Apply a non-WGS-84 or unspecified (no DTM) position input.

d) Apply a low accuracy position input with expected error >10m or without RAIM information (no GBS).

e) Apply position data with more than 26 m apart from internal position

Record all messages on VDL and check the contents of position report Message 18 for position and COG/SOG.

10.6.1.3.2 Required results

a) Confirm that data transmitted by the EUT complies with external sensor inputs.

b), c), d), e) Confirm that external data is not used.

Confirm that accuracy and RAIM flags are set accordingly; confirm that position and COG/SOG are of the same source.

	Test details - Check for implementation		
Test item	Check	Remark	Result
Check the manufacturers documentation			
Implementation of optional function	Check if the input of external sensor data is implemented	Input of external sensor data is not implemented. (Manufacturers Declaration)	Ok

	Test details - External sensor input not implemented		
Test item	Check	Remark	Result
This test is applicable only if external sensor input is not implemented Apply Position sentences, GBS and DTM sentence to the EUT: • Valid position data, • Position within 26 m from internal GPS • GBS < 10 m • GBS = WGS 84			
Apply GLL sentence	Check that external position is not used		Ok
	Check that external speed is not used		Ok
	Check that external heading is not used		Ok
Apply GGA sentence	Check that external position is not used		Ok
	Check that external speed is not used		Ok
Apply GNS sentence	Check that external position is not used		Ok
	Check that external speed is not used		Ok
Apply RMC sentence	Check that external position is not used		Ok
	Check that external speed is not used		Ok

- 10.6.2 Information update rates

(see 6.5.2)

- 10.6.2.1 Nominal reporting interval

10.6.2.1.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode.

	Test details - Autonomous reporting rate

Test item	Check	Remark	Result
Apply SOG according to the test items and check the reporting rate			
a) SOG = 1 kn for 10 min	Check that the reporting rate = 3 min +/- 10s		Ok
b) Change SOG to 10 kn for 15 min	Check that the reporting rate = 30 s +/- 5s		Ok
	Check that the reporting rate is established after the next transmission of the old schedule		Ok
	Change of reporting rate		Ok
	Check that the average reporting rate of 25 Tx = 30 s +/- 2s	30.0 s	Ok
c) SOG = 1 kn for 10 min	Check that the reporting rate = 3 min +/- 10s		Ok
	Check that the reporting rate is reduced after 3 min		Ok

a) Start with own SOG of 1 kn; record all messages on VDL for 10 min and evaluate reporting rate for position report of EUT by calculating average transmission offset over test period.

b) Increase speed to 10 kn.

c) Reduce speed to 1 kn.

Record all messages on VDL and check transmission offset between two consecutive transmissions.

10.6.2.1.2 Required results

a) Reporting interval shall be 3 min (±10 s).

b) Confirm that the reporting interval of 30 s (±5 s) has been established after the next transmission in the old schedule at the latest. The average reporting interval calculated over at least 25 transmissions shall be 30 s (±2 s).

c) Confirm that the reporting rate is reduced after 3 min (speed reduction).

- 10.6.2.2 Assigned reporting interval

10.6.2.2.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode.

a) Transmit an assigned mode command Message 23 to the EUT with designated reporting intervals of 5 s to 3 min according to Table 17.

b) Transmit an assigned mode command Message 23 to the EUT with designated reporting interval of 10 min.

c) Transmit Messages 23 with a refresh rate of 1 min with designated reporting intervals of 6 min and 10 min.

d) Transmit Messages 23 designated reporting interval field settings of 11-15

e) Change course, speed. Record transmitted messages.

10.6.2.2.2 Required results

a) Confirm that the EUT transmits position reports Message 18 according to the parameters defined by Message 23. The EUT shall revert to autonomous mode with nominal reporting interval after 4 min to 8 min.

b) Confirm that the EUT reverts to autonomous mode with nominal reporting interval after 4 min to 8 min.

c) Confirm that the EUT transmits position reports Message 18 according to the parameters defined by Message 23.

d) Confirm that the EUT does not change its nominal behaviour.

e) The reporting interval shall not be affected by course or speed.

Remark: Reporting rates 5, 10, 15 s are tested in 10.2.2.1

	Test details - Assigned reporting interval		
Test item	Check	Remark	Result
Test a: Send a msg 23 with the following parameters: speed = 1 kn			
Region: inside	Check that the reporting interval = 30 s	UTC 10:29	Ok

Reporting interval: 5 = 30 s Msg “B Msg 23 Test 10.6.2.2. Ta1”	Check that EUT reverts to standard reporting rate after 4...8 min	UTC 10:33 (4 min)	Ok
Test a: Send a msg 23 with the following parameters: speed = 10 kn			
Region: inside Reporting interval: 3 = 3 min Msg “B Msg 23 Test 10.6.2.2. Ta2”	check that the reporting interval = 3 min	UTC 10:58 – 11:02	Ok
	Check that EUT reverts to standard reporting rate after 4...8 min	UTC 11:08 (6 min)	Ok
Test b: Send a msg 23 with the following parameters:			
Reporting interval: 1 = 10 min Msg “B Msg 23 Test 10.6.2.2. Tb”	Check that EUT reverts to standard reporting rate after 4...8 min	UTC 10:15 UTC 10.22	Ok
Test c1: Send a msg 23 with the following parameters and repeat it every minute for at least 15minutes			
Reporting interval: 2 = 6 min Msg “B Msg 23 Test 10.6.2.2. Tc1”	check that the reporting rate = 6 min	Msg 23 UTC 13:04 – 13:19 Tx: 13:04, 13:10, 13:16, 13:22	Ok
	Check that EUT reverts to standard reporting rate 4...8 min after last msg 23	UTC 13:16 (7 min)	Ok
Test c2: Send a msg 23 with the following parameters and repeat it every minute for at least 22 minutes			
Reporting interval: 1 = 10 min Msg “B Msg 23 Test 10.6.2.2. Tc2”	check that the reporting rate = 10 min	Msg 23 UTC 12:33 – 12:55 Tx: 12:32, 12:42, 12:52	Ok
	Check that EUT reverts to standard reporting rate 4...8 min after last msg 23	UTC 13:00 (5 min)	Ok
Test d: Send a msg 23 with the following parameters:			
Reporting interval:11 Msg “B Msg 23 Test 10.6.2.2. Td1”	check that the reporting rate is not affected	Reporting interval = 30 s, the reporting interval is not affected	Ok
Reporting interval:15 Msg “B Msg 23 Test 10.6.2.2. Td2”	check that the reporting rate is not affected	Reporting interval = 30 s, the reporting interval is not affected	Ok
Test e: Send a msg 23 with the following parameters: Reporting rate: 4 = 1 min, Msg “B Msg 23 Test 10.6.2.2. Te”			
Speed = 1 kn	Check that the reporting rate is 1 min	UTC 14:47	Ok
Change speed to 15 kn	check that the reporting rate is not affected	UTC 14:49 UTC 14:53 reverting to 30 s interval	Ok
Change heading with 20 deg/min	check that the reporting rate is not affected	Not applicable, EUT does not use external heading	N/A

- ### 10.6.2.3 Static data reporting interval

10.6.2.3.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Record the transmitted messages and check for static data (Message 24).

Repeat the test at an assigned reporting interval of 5 s.

10.6.2.3.2 Required results

Confirm that the EUT transmits submessages 24A and 24B every 6 min (24B following 24A within 1 min). Transmission shall alternate between channel A and channel B and be independent of the Message 18 reporting interval.

- ## 10.7 Initialisation period

(see 6.5.3)

10.7.1 Method of measurement

Set up standard test environment with SOG>2 kn.

a) Switch on the EUT from cold (off-time minimum 1 h) with EUT operating in autonomous mode.

b) Switch off the EUT for a period of time between 15 min to 60 min and switch on again.

c) Make the GNSS sensor unavailable for a period of time between 1 min to 5 min

Record transmitted messages.

10.7.2 Required results

Confirm that the EUT starts regular transmission of Message 18 including valid position:

a) within 30 min after switch on;

b) within 5 min;

c) stops transmitting after the next transmission and resumes within 1 min after enabling the position source.

	Test details - Initialisation period		
Test item	Check	Remark	Result
Switch the On and Off according to the test items			
a) Switch the EUT on in the morning (> 1 h off)	Check that the EUT starts msg 18 within 30 min	Transmission starts about 2 min after switching on	Ok
b) Switch the unit of for 15 ... 60 min and on again	Check that the EUT starts msg 18 within 5 min	Transmission starts about 1:20 min after switching on	Ok
c) Disable GNSS for 1 ... 5 min	Check that the EUT stops transmission		Ok
Enable GNSS again	Check that the EUT starts msg 18 within 60 s	The EUT starts transmission within 1 min if there is a transmission scheduled for the next minute.	Ok

• 10.8 Alarms and indications, fall-back arrangements

(see 6.6)

• 10.8.1 Built in integrity test

(see 6.6.1)

10.8.1.1 Method of measurement

Check manufacturer's documentation on built-in integrity test.

10.8.1.2 Required result

Verify that an indication is provided if a malfunction is detected.

	Test details - Built in integrity test		
Test item	Check	Remark	Result
Check manufacturer's documentation			
Malfunction detection	Check that the EUT indicates the detection of a malfunction	Documentation requred	N/T
	Note the kind of indication		N/T

• 10.8.2 Transceiver protection

10.8.2.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Open-circuit and short-circuit VHF antenna terminals of the EUT for at least 5 min each.

10.8.2.2 Required results

The EUT shall be operative again within 2 min after refitting the antenna without damage to the transceiver.

	Test details - Transceiver protection		
Test item	Check	Remark	Result

Open circuit of VHF antenna terminal for > 5 min	Check if the EUT generates an antenna VSWR exceeded alarm	No alarm, not required	Ok
	Check that EUT starts transmission within 2 min after refitting the antenna	The next scheduled transmission (10 s after reconnection) has been received by VDL analyser	Ok
Short circuit of VHF antenna terminal for > 5 min	Check that the EUT generates an antenna VSWR exceeded alarm	No alarm, not required	Ok
	Check that EUT starts transmission within 2 min after refitting the antenna		Ok

- ## 10.8.3 Transmitter shutdown procedure

(see 6.6.2)

10.8.3.1 Method of measurement

Check manufacturer's documentation on transmitter shutdown procedure.

10.8.3.2 Required result

Verify that a transmitter shutdown procedure independent of the operating software is provided.

	Test details - Transmitter shutdown procedure		
Test item	Check	Remark	Result
Check manufacturer's documentation			
Malfunction detection	Check that the transmitter shutdown procedure is described	Documentation required:	N/T
	Check that the transmitter shutdown procedure is independent of the software		N/T

- ## 10.8.3.4 Position sensor fallback conditions

(see 6.6.3)

10.8.3.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Where an option for an external GNSS sensor is not provided, then the respective tests shall be omitted.

Apply position sensor data in a way that the EUT operates in the states defined below:

a) external DGNSS in use if implemented;

b) internal DGNSS in use (corrected by Message 17) if implemented;

c) internal DGNSS in use (corrected by a beacon) if implemented;

d) external GNSS in use if implemented;

e) internal GNSS in use ;

f) no sensor position in use.

Check the position accuracy and RAIM flag in the VDL Message 18 and, where provided, the ALR sentence.

10.8.4.2 Required result

Verify that the use of position source, position accuracy flag, RAIM flag and position information complies with Table 1

Verify that the position sensor status is maintained for the next scheduled report and changed after that.

	Test details - Position priority – Position sensor fallback without external sensor input		
Test item	Check	Remark	Result
Connect sensor inputs and correction data according to the test items. Sensor input file name: AIS01_gll_vtg_hdt_near.sst Internal GPS: RAIM expected, external: RAIM.			
Changing downwards			
b) Internal DGNSS available msg 17	Check that the internal position is used	Not applicable because correction by message 17 is not implemented (Manufacturers Declaration)	N/A
	Check that position accuracy flag = 1		N/A
	Check the RAIM flag		N/A
c) Internal DGNSS available beacon input	Check that the internal position is used	Not applicable because beacon input is not supported	N/A
	Check that position accuracy flag = 1		N/A
	Check the RAIM flag		N/A
d) Change from b: • Internal GNSS	Check that the internal position is used		Ok
	Check that position accuracy flag = 0 (Depending on the RAIM result it can also be 1)		Ok
	Check if there is an source change indication – optional		N/A
	Check the RAIM flag	RAIM flag = 0	Ok
f) Change from e: • Inhibit internal GNSS	Check that there is an ALR output ID 026 (no sensor position in use)	If implemented There is an error output: $PPJB,ER,GPS ANTENNA FAULT	Ok
	Check that EUT stops transmission of position report after the next scheduled position report	The transmission stops The EUT transmits one further message with the last valid position. Then it stops transmission. The antenna disconnection is indicated by an alarm and error LED.	Ok Ok

Changing upwardswards			
d) Change from f: • Internal GNSS	Check that the EUT starts transmission	At the time according to the previous schedule	Ok
	Check that the ALR output is updated	If implemented The GPS antenna fault error message is stopped	Ok
	Check if there is a source change indication - optional		N/A
	Check that position accuracy flag = 0 (Depending on the RAIM result it can also be 1)		Ok
	Check the RAIM flag	RAIM flag = 0	Ok
b) Change from d) Internal DGNSS available msg 17	Check that the internal position is used	If implemented	N/A
	Check if there is a source change indication - optional		N/A
	Check that position accuracy flag = 1		N/A
	Check the RAIM flag		N/A
c) Change from d) Internal DGNSS available beacon input	Check that the internal position is used	If implemented	N/A
	Check if there is a source change indication - optional		N/A
	Check that position accuracy flag = 1		N/A
	Check the RAIM flag		N/A

- ## 10.8.5 Speed sensors

(see 6.6.4)

10.8.5.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Where an option for an external GNSS sensor is not provided, this test shall be omitted.

Apply valid external DGNSS position and speed data.

Make external DGNSS position invalid (for example. by wrong checksum, "valid/invalid" flag) .

10.8.5.1 Required result

Check that the external data for SOG/COG is transmitted in Message 18.

Check that the internal data for SOG/COG is transmitted in Message 18.

	Test details - Speed sensors		
Test item	Check	Remark	Result
Connect sensor inputs and correction data according to the test items. Sensor input file name: AIS01_gll_vtg_hdt_near.sst Internal GPS: RAIM expected, external: RAIM active.			
Set: • Internal GNSS available • External DGNSS	Check that external SOG is used	Not applicable, external sensor data are not used (Manufacturers Declaration)	N/A
	Check that external COG is used		N/A
Change to: • Internal GNSS available • External DGNSS invalid	Check that internal SOG is used		Ok
	Check that internal COG is used		Ok

10.9 User interface

(see 6.7)

- ## 10.9.1 Display

(see 6.7.1)

10.9.1.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode.

a) Check status indications for power, Tx timeout, Error.

b) Apply Message 23 "quiet time" of >7 min.

c) Simulate VDL load in order to make it impossible for the EUT to find free candidate periods.

10.9.1.2 Required results

a) Indicators shall be available and working correctly according to manufacturer's documentation.

b) Check that the Tx timeout indication is activated.

c) Check that the Tx timeout indication is activated.

	Test details - Display		
Test item	Check	Remark	Result
Operate EUT in autonomous mode			
a) Check for indicators	Check that a power indicator is available		Ok
	Check that the power indicator is on		Ok
	Check that a TX timeout indicator is available		Ok
	Check that an error indicator is available.		Ok
b) Apply msg 23 for quiet time > 7 min Msg "B Msg 23 Test 10.2.2.1 T5"	Check that the Tx indicator is on	8 min quiet time The Tx indicator is on	Ok
c) Simulate high channel load to disable transmission	Check that the Tx indicator is on	The Tx indicator is switched on.	Ok
Disable position	Check that the Tx indicator is on	The Tx indicator LED is on	Ok
Simulate an error according to documentation, if possible	Check that the error indicator is on	The error LED is blinking when the GPS antenna has been removed	Ok

- ## 10.9.2 Message display

This test is only applicable if a message display is provided.

10.9.2.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode.

Transmit a Message 14.

10.9.2.2 Required results

Verify that the EUT displays the message.

	Test details - Message display		
Test item	Check	Remark	Result
Only applicable if a message display is provided			
Send a msg 14 from another station	Check that the msg 14 is correctly displayed	Not applicable, there is no message display	N/A

- ## 10.9.3 Static data input

(see 6.7.2)

10.9.3.1 Method of measurement

Verify that static data can be input to the unit according to the manufacturer's documentation. Set up standard test environment and operate EUT in autonomous mode.

10.9.3.2 Required results

Check that static data are transmitted correctly by the EUT and that the MMSI cannot be altered by the user.

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Test item	Check	Remark	Result
Input static data according to manufacturers documentation, as far as not yet set by the manufacturer			
Check the static data	Check the User ID (MMSI)	Can input only once	Ok

transmitted in msg 18 and 24	Check the Name		Ok
	Check the Type of ship and cargo	Only the types 36 (pleasure craft sailing) and 37 (pleasure craft) are available	Ok
	Check the Vendor ID	The vendor ID	Ok
	Check the call sign		Ok
	Check the dimension of ship/reference for position		Ok
Input protection	Check that the MMSI cannot be altered by the user	Can input only once	Ok
	Check that the Vendor ID cannot be changed by the user		Ok
Manufacturing setup	Check that the manufacturing setup cannot be accessed by the normal installer		N/A

- 10.9.4 External interfaces

(see 6.7.3)

- 10.9.4.1 Display interface

This test only applies if a display interface is provided.

10.9.4.1.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Apply a safety related broadcast Message 14 through the VDL to the EUT.

Check the output on the display interface.

10.9.4.1.2 Required results

The interface shall be compliant with IEC 61162 series protocol and the manufacturer's documentation of interface hardware.

	Test details - Display interface		
Test item	Check	Remark	Result
Only applicable if a display interface is provided			
Send a msg 14 from another station	Check that the msg 14 is correctly output on the display interface		Ok
	Check that the format is according to IEC 61162		Ok

11 Physical tests

Physical test are not part of this test document.

The physical tests are covered by the notification according to R&TTE

12 Specific tests of Link Layer

(see 7.3)

12.1 TDMA synchronisation

12.1.1 Synchronisation test sync mode 1

12.1.1.1 Definition

Synchronisation jitter (transmission timing error) is the time between nominal start of the transmission time period as determined by a UTC synchronisation source ($T_{\circ\ ref}$) and $T_{\circ}$ of the EUT ($T_{\circ\ EUT}$).

12.1.1.2 Method of measurement

Set up standard test environment and set the EUT to assigned mode for a reporting rate of 5 s. Enable test conditions for the following:

a) station transmitting Message 1 or 2, 3, 4, 18, 19 not subject to a CS-delay, with repeat indicator = 0, with no propagation delay and with position available is received by the EUT;

b) no sync source (switched off);

c) with the internal clock of the EUT out of sync (sync jitter > 1000 μs), transmit messages not to be used as sync source (see 7.3.1.1) to the EUT;

d) repeat test a) using a sync source transmitting Message 4; simulate the position of the station providing the sync source (for example a base station 60 NM = 416 μs away from EUT position) in order to simulate a propagation delay;

e) Repeat test d) with an additional source transmitting Message 1 or 2, 3, 4, 18 not subject to a CS-delay, with repeat indicator = 0, with no propagation delay and with position available is received by the EUT.

Record VDL messages and measure the time between $T_{\circ\ ref}$ of the synchronisation source and the initiation of the "transmitter on" function T_A and calculate back to $T_{\circ\ EUT}$ (a sync output may be used for the purpose of this test). Alternative methods, for example by evaluating the start flag are allowed.

12.1.1.3 Required results

a) The EUT shall synchronise on the received source and the synchronisation jitter shall not exceed ±312 μs (sync mode 1).

b) The synchronisation jitter shall not exceed ±312 μs during a 30 s period from the time a proper sync source was last received.

c) The EUT shall not synchronise on these received messages.

d) The synchronisation jitter of the EUT shall be within –416 μs ±312 μs .

e) The synchronisation jitter of the EUT shall be –208 μs ±312 μs within 60 s.

	Test details - Synchronisation test sync mode 1		
Test item	Check	Remark	Result
Setup an assigned reporting rate of 5 s The correct timing is T_{classA}+ 1568 µs			
a) Transmit an appropriate position report as sync source Msg "B Msg 23 Test 10.2.2.1 T1"	Check that the EUT does synchronise to the sync source		Ok
	Check that the sync jitter does not exceed ±312 µs from the sync source	The basic syncronisation is very good and inside the limits. The sync timing was ok, with and without GPS available. Confirmed by a test over night.	Ok Ok
	Check that the sync mode value in the comm state is 3		Ok
b) Remove sync source	Check that the sync jitter does not exceed ±312 µs for the next 30 s after last received sync msg		Ok
	Check that the sync mode value in the comm state is 3		Ok
c) Restart the EUT to get it out of sync (>1000µs) Transmit a position report with repeat indicator not 0. Msg "B Msg 1 Test 12.1.1 c"	Check that EUT does not synchronise to the msg	The EUT does not synchronize to the position report	Ok
d) Transmit msg 4, range to EUT = 60 NM Msg "B Msg 4 Test 12.1.1 d"	Check that the sync jitter of the EUT is within –416 µs ±312 µs from the msg 4	The timing is correct	Ok
e) Transmit msg 4, range to EUT = 60 NM, and msg 1/3, range = 0 Msg "B Msg 1 Test 12.1.1 d"	Check that the sync jitter of the EUT is within –208 µs ±312 µs from the msg 1, after 60 s	The timing is correct	Ok

- ## 12.1.2 Synchronisation test sync mode 2

12.1.2.1 Method of measurement

Set up standard test environment and enable test conditions for the following:

a) operate EUT in sync mode 2 for more than 5 min.

b) Switch on sync source immediately after scheduled transmission of EUT. Sync source shall be a station transmitting Message 1 or 2,3,4,18,19 not subject to a CS-delay, with repeat indicator = 0 and with position available with a reporting rate of 10 s.

Record VDL messages and measure the time between $T_{\circ\ ref}$ of the synchronisation source and the initiation of the "transmitter on" function T_A and calculate back to $T_{\circ\ EUT}$ (a sync output may be used for the purpose of this test). Alternative methods, for example by evaluating the start flag are allowed.

12.1.2.2 Required results

Verify that the EUT synchronises its next scheduled transmission on the sync source. The synchronisation jitter shall not exceed ±312 µs.

	Test details - Synchronisation test sync mode 2		
Test item	Check	Remark	Result
Operate in autonomous mode The correct timing is T_{classA}+ 1568 µs			
a) Operate in sync mode 2 for more than 5 min	Check that the EUT is not synchronised		Ok
b) After scheduled transmission start appropriate sync source	Check that the sync jitter of the next transmission does not exceed ±312 µs from the sync source	There is no break in the transmission schedule. The second transmission after the start of sync source does not exceed the limits	Ok

- ## 12.1.3 Synchronisation test with UTC

This test is only relevant if optional synchronisation sources providing UTC are implemented.

12.1.3.1 Method of measurement

Set up standard test environment and enable test conditions in a way that EUT operates in UTC synchronised mode.

12.1.3.2 Required results

The synchronisation jitter shall not exceed ±312 μs.

	Test details - Synchronisation test sync mode 1		
Test item	Check	Remark	Result
Connect the optional synchronisation source The correct timing is T_{classA}+ 20 bit (2083μs)			
Optional synchronisation	Check that the sync does not exceed ±312 μs from the correct UTC timing	If implemented Not implemented	N/A

12.2 Carrier-Sense tests

12.2.1 Threshold level

12.2.1.1 Definition

Carrier-Sense threshold is the signal level below that which a time period shall be regarded as unused and a transmission may take place.

12.2.1.2 Method of measurement

The test configuration is described here in its most basic form, using three signal sources with RF (PIN) switches selecting when each signal is applied to the EUT. Other equipment configurations may be used if they fulfil the same requirements (for example a single RF source fed via a switched attenuator, which is controlled by a timing circuit).

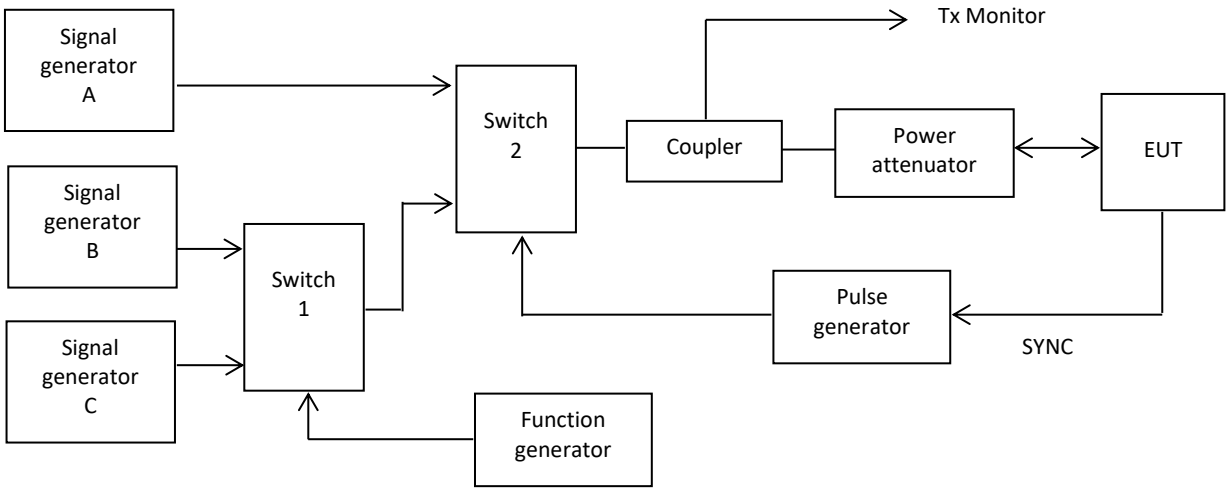


Figure 13 – Configuration for Carrier-Sense threshold test

a) Signal C is a carrier modulated with a 400 Hz FM signal with a deviation of 3 kHz equivalent to –60 dBm at the EUT. The switches connect this signal to the EUT most of the time to mimic 100 % channel loading with strong traffic.

b) Signal B is a carrier modulated with a 400 Hz FM signal with a deviation of 3 kHz equivalent to –87 dBm at the EUT. Switch 1 replaces signal C with signal B for 26,67 ms. The function generator makes this happen once every 2 s. This imitates one vacant time period in a 99 % loaded channel. The level of Signal B can be manually switched between –87 dBm and OFF to mimic high and low background levels (resulting in a threshold level of –77 dBm and –107 dBm).

c) Signal A is a carrier modulated with a 400 Hz FM signal with a deviation of 3 kHz equivalent to –104 dBm at the EUT. When the EUT attempts a transmission, switch 2 replaces the 'background traffic' with signal A to imitate an incoming message intended to inhibit the transmission attempt. The level of signal A can be manually set to –74 dBm, –104 dBm and OFF (defined as less than –117 dBm).

d) All three signal generators are tuned to the same frequency. The test shall be carried out on the lowest frequency declared by the manufacturer and AIS 2 (162,025 MHz).

e) For the purposes of this test, the EUT will be equipped with a test signal (SYNC) indicating the start of each time period that it intends to transmit into. This is used to trigger the pulse generator which after a delay of 0,8 ms (8 bits) generates a 23,3 ms (224 bits) pulse for switch 2.

f) With the signal levels set to the levels shown in the first row of the following table, the EUT shall be observed making routine scheduled position reports. Levels shall then be adjusted as per subsequent steps and the EUT monitored for 10 min (or at least 20 reporting attempts) to confirm if transmission has ceased.

12.2.1.3 Required results

- **Table 24 – Required threshold test results**

Step	Description	Signal A (dBm)	Signal B (dBm)	EUT transmission
1	Time period free	OFF	OFF	Yes
2	Time period used	–104	OFF	Ceased
3	Recovery	OFF	OFF	Yes
4	Raised background	OFF	–87	Yes
5	Time period used	–74	–87	Ceased
6	Recovery	OFF	–87	Yes

	Test details - Threshold level		
Test item	Check	Remark	Result
Run the test automatically with all steps, using the automatic test adapter. Record the transmissions of the EUT and the step information output of the test adapter			
Step 1	Check that the EUT has transmitted	The EUT has transmitted	Ok
Step 2	Check that the EUT has not transmitted	The EUT has not transmitted	Ok
Step 3	Check that the EUT has transmitted	The EUT has transmitted	Ok
Step 4	Check that the EUT has transmitted		Ok
Step 5	Check that the EUT has not transmitted	The EUT has not transmitted	Ok
Step 6	Check that the EUT has transmitted	The EUT has transmitted	Ok

- 12.2.2 Carrier sense timing

12.2.2.1 Definition

This test is to verify that signals that are received before the CS detection window starts are not used for the detection of used time periods.

12.2.2.2 Method of measurement

Use the test configuration and signals of test 12.2.1.

Signal B is switched off, signal A can be manually set to -74 dBm, -104 dBm and OFF.

The SYNC signal of the EUT indicating the start of each time period that it intends to transmit into is used to trigger the pulse generator to generate a 0,7 ms (7 bits) pulse for switch 2 starting at the SYNC signal (this pulse ends 1 bit before start of the CS detection window of the EUT)

f) Levels shall be adjusted as per the steps given in Table 25 and the EUT monitored for 10 min (or at least 20 reporting attempts) to confirm if EUT transmits.

12.2.2.3 Required results

1 Table 25 Required carrier sense timing results

Step	Description	Signal A (dBm)	Signal B (dBm)	EUT transmission
1	Time period free	OFF	OFF	Yes
2	Time period free	-104	OFF	Yes
3	Time period free	-74	OFF	Yes

	Test details - Carrier sense timing		
Test item	Check	Remark	Result
Run the test automatically with all steps, using the automatic test adapter. Record the transmissions of the EUT and the step information output of the test adapter			
Step 1	Check that the EUT has transmitted		Ok
Step 2	Check that the EUT has transmitted		Ok
Step 3	Check that the EUT has transmitted		Ok

- **12.3 VDL state/reservations**

12.3.1 Method of measurement

Set up standard test environment and operate EUT with assigned reporting interval of 10 s. Record transmitted scheduled position reports Message 18 and check time periods used for transmission.

a) Transmit a Message 20 to the EUT reserving a block of time periods including timeout.

b) Transmit a Message 20 to the EUT reserving a block of time periods without timeout.

12.3.2 Required results

a) Verify that the reserved block is not used and used again after the timeout specified in Message 20.

b) Verify that the reserved block is not used and used again after a timeout of 3 min.

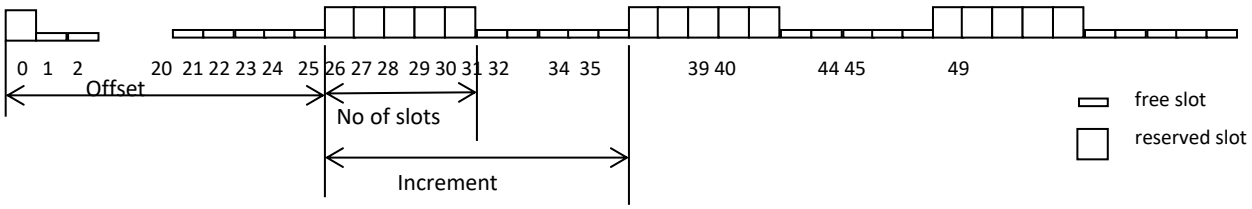
	Test details – VDL state/ reservations		
Test item	Check	Remark	Result

Send a message 20 from VDL Generator with slot offset and increment for slot reservation according to the description below. Set time-out according to the test item. Set assigned reporting interval of 10 s.			
a) Timeout = 6 Msg “B Msg 20 Test 12.3 a” Msg “B Msg 23 Test 12.3”	Check that the reserved slots are not used by the EUT within the time-out	The reserved slots are not used if there is a message 4 from the same basestation with a distance < 120 NM	Ok
	Check that after end of reservation all slots are used again.		Ok
b) Timeout = 0 (not available) Msg “B Msg 20 Test 12.3 b” Msg “B Msg 23 Test 12.3”	Check that the reserved slots are not used by the EUT within 3 min		Ok
	Check that after end of reservation all slots are used again.		Ok

Test scenario: Msg 20 transmission by test system.
Msg 20 reserves slots which should not be used by mobile stations.
Msg 20 parameters:

- Msg 20 is transmitted in slot 0 in each frame
- Offset number 1: 25
- Number of slots: 5
- Time out 1: 6 / 0 depending on test item
- Increment: 10

FATDMA reservation



• 12.4 Data encoding (bit stuffing)

12.4.1 Method of measurement

Set up standard test environment.

Set ships name to a value that requires bit-stuffing for example "wwwww" and check the VDL (note that this might require that the manufacturer provides means to input this data).

12.4.2 Required results

Confirm that transmitted VDL Message 24 conforms to data input.

	Test details - Data encoding (bit stuffing)		
Test item	Check	Remark	Result
Set ships name to a value requiring bit stuffing			
Msg 24 content	Check that the ships name in msg 24 on VDL is correct		Ok

• 12.5 Frame check sequence

12.5.1 Method of measurement

Apply simulated position report messages with wrong CRC bit sequence to the VDL.

a) Check test output; if a display interface is provided, check this.

b) Repeat test 12.1.1 and check that a station transmitting messages with wrong CRC are not used for synchronisation.

12.5.2 Required results

Confirm that messages with invalid CRC are not accepted by the EUT in cases a) and b).

	Test details - Frame check sequence		
Test item	Check	Remark	Result
Transmit position report message from VDL generator			
Set CRC bit sequence to ok Msg "B Msg 1"	Check that position report is received from EUT (VDM output)		Ok
a) Set CRC bit sequence to false	Check that position report is not received from EUT (VDM output)		Ok
	Check that the target is not displayed on the display	If implemented Not implemented	N/A
b) Disable GPS, apply external position. Transmit position report with wrong CRC	Check that the EUT does not synchronise to the incorrect message	The EUT does not synchonize to reports with wrong CRC	Ok

• 12.6 Slot allocation (channel access protocol)

• 12.6.1 Autonomous mode allocation

12.6.1.1 Method of measurement

Set up standard test environment and operate EUT with assigned reporting interval of 10 s. Record transmitted scheduled position reports Message 18 and check time periods used for transmission. Check the Communication State of transmitted messages.

Repeat the test with additional simulated channel load of 80 % (4 time periods used, 1 time period unused).

12.6.1.2 Required results

The time periods used for transmission shall in both tests

- *not exceed the transmission interval TI;*
- *not always use the same time period;*
- *not always use the first unused time period.*

Check that the Communication state of Message 18 is the default value as defined in 7.3.3.5.

	Test details - Autonomous mode allocation		
Test item	Check	Remark	Result
Set assigned reporting rate of 10 s (Msg "B Msg 23 Test 12.3") Record the transmission slots for at least 30 min and evaluate the used slots			
Test 1: No channel load	Check that the slots do not exceed the TI		Ok
	Check that the EUT does not always use the same time period		Ok
	Check that the EUT not always uses the first unused time period		Ok
Test 1: 80% channel load	Check that the slots do not exceed the TI		Ok
	Check that the EUT does not always use the same time period		Ok
	Check that the EUT does not always use the first unused time period		Ok
	Check that the EUT does not use slot used by the received targets	The EUT does not use slot used by the received targets	Ok
Communication state	Check that the com state of msg 18 is always as defined in 7.3.3.5		Ok

- 12.6.2 DSC listening periods

12.6.2.1 Method of measurement

This test is applicable only if DSC functionality is implemented.

Set up standard test environment and operate EUT with assigned reporting interval of 10 s. Enable DSC functionality. Record transmitted scheduled position reports Message 18 and check time periods used for transmission.

12.6.2.2 Required results

During the DSC monitoring times, scheduled transmissions of Message 18 shall continue.

	Test details - DSC listening periods		
Test item	Check	Remark	Result
Set assigned reporting rate of 10 s Enable DSC functionality			
Tx of msg 18	Check that the scheduled Tx of msg 18 continues		Ok

12.7 Assigned operation

12.7.1 Assignment priority

12.7.1.2 Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Transmit an Assigned mode command (Message 23) to the EUT with TX/RX mode 1.

a) Transmit a Message 22 defining a region with the EUT inside that region. Transmit a Message 22 to the EUT individually addressed and specifying Tx/Rx mode 2.

b) Repeat the test, clear the region defined by Message 22 under a)[2]. Transmit Message 22 to the EUT with regional settings specifying Tx/Rx mode 2.

Record transmitted messages.

12.7.1.2 Required results

a) The Tx/Rx mode field setting of Message 22 shall take precedence over the Tx/Rx mode field setting of Message 23.

b) The Tx/Rx mode field setting of Message 23 shall take precedence over the Tx/Rx mode field setting of Message 22. The receiving station shall revert to its previous Tx/Rx mode after a timeout value randomly chosen between 240 s and 480 s.

	Test details - Autonomous mode allocation

[2] This can be carried out using the method used in 13.3.1 b) step 2 or by assigning a new simulated position to the EUT.

Test item	Check	Remark	Result
Send a msg 23 with Tx/Rx mode = 1 Msg “B Msg 23 Test 10.2.2.1 T4”			
a) Send a msg 22 defining a region with EUT inside (Tx/Rx mode = 2) Msg “B Msg 22 Test 12.7.1 a1”	Check that the EUT uses Tx/Rx mode 1 as defined by msg 23 (Tx on channel A)	The EUT uses Tx/Rx mode as defined by msg 23, reporting interval = 15s.	Ok
Send an addressed msg 22 to EUT with Tx/Rx mode = 2 Msg “B Msg 22 Test 12.7.1 a2”	Check that the EUT uses Tx/Rx mode 2 as defined by msg 22 (Tx on channel B)	msg 23 Tx/Rx mode = 1 msg 22 Tx/ Rx mode = 2 TX/Rx mode = 0 msg 23 Tx/Rx mode 2 is stored and used for transmission	 Ok Ok Ok
Clear the region defined in test a)			
b) Send a msg 22 defining a region with EUT inside, Tx/Rx mode = 2 Msg “B Msg 22 Test 12.7.1 b1”	Check that the EUT uses Tx/Rx mode 2 (Tx on channel B)	Tx/Rx mode 2 is correctly stored (ACA output). Tx/Rx mode 2 is not used, EUT transmits with Rx/Rx mode 0 (alternating) Tx/Rx mode is 2 (Tx on channel B only) Tx/Rx mode 2 is used also if there was already a region stored with other corner points. A new Tx/Rx mode is not stored and not used if the corner points are identical to an existing area. Tx/Rx mode 2 is used also if there was already a region stored with the same corner points.	 Ok Ok Ok
Send one msg 23 to the EUT with Tx/Rx mode = 1 Msg “B Msg 23 Test 10.2.2.1 T4”	Check that the EUT uses Tx/Rx mode 1 as defined by msg 23 (Tx on channel A)	UTC 12:56 Tx/Rx mode = 1	Ok
	Check that the EUT reverts to Tx/Rx mode 2 after 4...8 min (time-out of msg 23)		Ok

- ## 12.7.2 Entering rate assignment

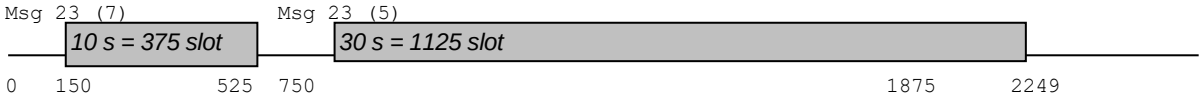
12.7.2.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Transmit a Group Assignment command (Message 23) to the EUT with a reporting interval of 10 s assigned, monitor the VDL, reset by assigning 30 s rate; repeat 10 times.

12.7.2.2 Required result

Verify that the first transmission after receiving the Message 23 is within a time randomly selected between the time the Message 23 has been received and the assigned interval.

	Test details - Entering rate assignment		
Test item	Check	Remark	Result
Send 10 times: Msg 23 with 10 s reporting interval (Msg “B Msg 23 Test 12.7.2 10s”) After 20 s: Msg 23 with 30 s reporting interval. (Msg “B Msg 23 Test 12.7.2 30s”) Repeat after 45 s			
10 s reporting interval	Check that the first Tx is randomly selected in 0 ...10 s after msg 23	The the first Tx is randomly selected in 0 ...10 s after msg 23	Ok
30 s reporting interval	Check that the first Tx is randomly selected in 0 ...30 s after msg 23	The the first Tx is randomly selected in 0 ...30 s after msg 23	Ok


Msg 23 (7)
Msg 23 (5)
10 s = 375 slot
30 s = 1125 slot
0
150
525
750
1875
2249

- ## 12.7.3 Reverting from rate assignment

12.7.3.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Transmit a Group Assignment command (Message 23) to the EUT with a reporting interval of 10 s assigned, monitor the VDL until at least 1 min after timeout occurred; repeat 10 times (transmissions of Message 23 shall not be synchronised to the initial transmission schedule of the EUT).

Measure the time T_{rev} between the reception of Message 23 and first transmission after timeout.

12.7.3.2 Required result

T_{rev} shall be randomly distributed between 240 s and 480 s.

	Test details - Reverting from rate assignment		
Test item	Check	Remark	Result
Send 10 times: Msg 23 with 10 s reporting interval, Msg "B Msg 23 Test 10.2.2.1 T3" Wait until time-out + 1 min.			
Measure time T_{rev}	Check that T_{rev} is randomly distributed between 4 and 8 min		Ok

- ## 12.7.4 Reverting from quiet mode

12.7.4.1 Method of measurement

Set up standard test environment and operate EUT with a reporting interval of 10 s assigned. Transmit a Group Assignment command (Message 23) to the EUT with quiet time = 1 min.

12.7.4.2 Required results

Verify that the first transmission after the quiet period is within the schedule that was in place before the quiet period.

	Test details - Reverting from mode		
Test item	Check	Remark	Result
Send Msg 23 with 10 s reporting interval Msg "B Msg 23 Test 10.2.2.1 T3"			
Reporting rate	Check reporting interval = 10 s		Ok
Send msg 23 with quiet time = 1 min	Check that EUT does not transmit during quiet time		Ok
	Check that the transmissions after end of quiet time matches the previous schedule.		Ok

- ## 12.7.5 Retry of interrogation response

12.7.5.1 Method of measurement

Set up standard test environment. Interrogate the EUT by Message 15 for a response with Message 18.

a) Simulate full VDL load for the following 30 s.

b) Simulate full VDL load for the following 60 s

12.7.5.2 Required result

a) Verify that a response is transmitted between 30 s and 60 s after the transmission of Message 15.

b) Verify that no response is transmitted.

	Test details - Retry of interrogation response		
Test item	Check	Remark	Result
Send an interrogation for msg 18			
Apply full channel load for 30s Target simulation: "50_slotsVer2"	Check that a response is transmitted within 30 ... 60 s after msg 15	Response after 31 s	Ok
Send an interrogation for msg 18			
Apply full channel load for 60s Target simulation: "50_slotsVer2"	Check that no response is transmitted (because retry is inhibited)	No responses	Ok

- ## 12.8 Message formats
  - ### 12.8.1 Received messages

12.8.1.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Apply messages according to Table 11 to the VDL. Record messages output by the PI of EUT where provided.

12.8.1.2 Required results

Confirm that EUT responds as appropriate. Check that EUT outputs the corresponding sentences with correct field contents and format via the PI where provided.

Verify that the EUT does not process addressed messages.

	Test details - Received messages		
Test item	Check	Remark	Result
Send all message to the EUT and check PI output			
General	The messages with number of fill bits = 0 are output correctly with the value 0 in the VDM		Ok
Msg 1,2,3 Position report	Check that message is output	Optional Message 1 is output, message 3 is not output.	Ok
	Check format and content		Ok
Msg 4 base station report	Check that message is output	Optional	Ok
	Check format and content		Ok
Msg 5 Static and voyage related data	Check that message is output	Optional	Ok
	Check format and content Fill bits: ,2	Message 5 is output correctly	Ok
Msg 6 Addressed binary message	Check that message is not output	Message 6 is not output	Ok
Msg 7 Binary acknowledgement	Check that message is not output	Message 7 is not output	Ok
Msg 8 Binary broadcast message	Check that message is output	Optional	Ok
	Check format and content Fill bits: ,4	Fill bits = 4 (correct)	Ok
Msg 9 SAR Aircraft position report	Check that message is output	Optional	Ok
	Check format and content		Ok
Msg 10 UTC and date inquiry	Check that message is not output	Message 10 is not output	Ok
Msg 11 UTC/Date response	Check that message is output	Optional	Ok
	Check format and content		Ok
Msg 12 Safety related addressed message, addressed to EUT	Check that message is output	Message 12 is not output	Ok
	Check format and content		Ok
Msg 12 Safety related addressed message, not addressed to EUT	Check that message is not output	Message 12 to another station is not output	Ok
Msg 13 Safety related acknowledge	Check that message is not output	Message 13 is not output	Ok
Msg 14 Safety related broadcast message	Check that message is output	Optional	Ok
	Check format and content		Ok
Msg 15 Interrogation	Check that message is output	required	Ok
	Check format and content Fill bits: 2	• The fill bits are correct. • The last character is incorrect.	Ok Ok
Msg 16 Assigned mode command	Check that message is not output	Message 16 is not output	Ok
Msg 17 DGNSS broadcast binary message	Check that message is output	Optional	Ok
	Check format and content		Ok
Msg 18 Class B equipment position report	Check that message is output	Optional	Ok
	Check format and content		Ok
Msg 19 Extended Class B equipment position report	Check that message is output	Optional	Ok
	Check format and content		Ok
Msg 20 Data link management message	Check that message is output	Required	Ok
	Check format and content		Ok
Msg 21 Aids to navigation report	Check that message is output	Optional	Ok

	Check format and content		Ok
Msg 22 Channel management message	Check that message is output	Required	Ok
	Check format and content		Ok
Msg 23 Group assignment	Check that message is output	Required	Ok
	Check format and content	The fill bits value is correct.	Ok
Msg 24 Class B “CS” static data, Part A	Check that message is output	Optional	Ok
	Check format and content	The fill bits value is correct.	Ok
Msg 24 Class B “CS” static data, Part B	Check that message is output	Optional	Ok
	Check format and content		Ok
Msg 25	Check that message is output	Message 25 is output if broadcast or addressed to own station	Ok
Msg 26	Check that message is not output	Message 26 is not output	Ok
Msg 27	Check that message is not output	Message 27 is not output	Ok
Undefined message	Check that message is not output	The undefined message is not output	Ok

- ## 12.8.2 Transmitted messages

12.8.2.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Initiate the transmission of messages relevant for a Class B mobile station according to Table 11 by the EUT. Record transmitted messages.

12.8.2.2 Required results

Confirm that only messages as allowed by Table 11 are transmitted by the EUT.

	Test details - Transmitted messages		
Test item	Check	Remark	Result
Initiate transmission of the messages according to table 11 by interrogation with msg 15			
Msg 1,2,3 Position report	Check that message is not transmitted		Ok
Msg 4 base station report	Check that message is not transmitted		Ok
Msg 5 Static and voyage related data	Check that message is not transmitted		Ok
Msg 6 Addressed binary message	Check that message is not transmitted		Ok
Msg 7 Binary acknowledgement	Check that message is not transmitted		Ok
Msg 8 Binary broadcast message	Check that message is not transmitted		Ok
Msg 9 SAR Aircraft position report	Check that message is not transmitted		Ok
Msg 10 UTC and date inquiry	Check that message is not transmitted		Ok
Msg 11 UTC/Date response	Check that message is not transmitted		Ok
Msg 12 Safety related addressed message,	Check that message is not transmitted		Ok
Msg 13 Safety related acknowledge	Check that message is transmitted when msg 12 is processed (Response on msg 12)	Optional No response	Ok
Msg 14 Safety related broadcast message	Check that message is not transmitted (Manually initiated)	Optional	Ok
Msg 15 Interrogation	Check that message is not transmitted		Ok
Msg 16 Assigned mode command	Check that message is not transmitted		Ok
Msg 17 DGNSS broadcast binary message	Check that message is not transmitted		Ok
Msg 18 Class B equipment position report	Check that message is transmitted (Interrogation and automatically)		Ok
Msg 19 Extended Class B equipment position report	Check that message is transmitted (Interrogation with offset)		Ok
Msg 20 Data link management message	Check that message is not transmitted		Ok
Msg 21 Aids to navigation report	Check that message is not transmitted		Ok
Msg 22 Channel management message	Check that message is not transmitted		Ok
Msg 23 Group assignment	Check that message is not transmitted		Ok

Msg 24 Class B "CS" static data, Part A	Check that message is transmitted (Interrogation and automatically)		Ok
Msg 24 Class B "CS" static data, Part B	Check that message is transmitted (Interrogation and automatically)		Ok

- ## 12.8.3 Use of safety related Message 14

This test is only applicable if Message 14 is implemented.

12.8.3.1 Method of measurement

Check manufacturer's documentation.

a) Initiate transmission of Message 14 as specified by the manufacturer.

b) Repeat initiation twice a minute

12.8.3.2 Required results

a) Verify that the data content of Message 14 is predefined and the transmission cannot exceed one time period (see Table 12).

b) Verify that the EUT only accepts the initiation of a Message 14 once a minute without automatic repetition.

	Test details - Use of safety related message 14			
Test item	Check		Remark	Result
Check manufacturers documentation				
a) Send msg 14	Check that the content of msg 14 is predefined	Transmission of message 14 is not supported. (Manufacturers Declaration)		Ok
	Check that msg 14 cannot exceed one time period			N/A
	Check content of msg 14 on VDL			N/A
b) Repeat initiation of msg 14 twice a minute	Check that msg 14 is transmitted only once			N/A

13 Specific tests of network layer

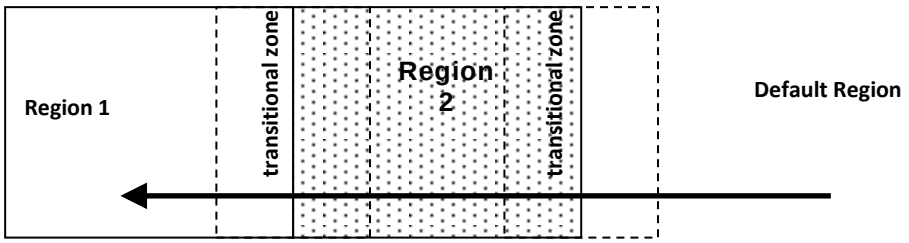
(see 7.4)

13.1 Regional area designation by VDL message

13.1.1 Method of measurement

Set up standard test environment. Apply channel management messages (Message 22) to the VDL defining two adjacent regional areas 1 and 2 with different channel assignments for both regions and a transitional zone extending 4 NM either side of the regional boundary

Let the EUT approach region 1 from outside region 2 more than 5 NM away from region boundary transmitting on default channels. Record transmitted messages on all 6 channels. This can be accomplished by either using a dedicated test input for simulated position information or a GNSS simulator.



	Primary channel	Secondary channel
Region 1	CH A 1	CH B 1
Region 2	CH A 2	CH B 2
Default region	AIS 1	AIS 2

Figure 14 – Regional area scenario

13.1.2 Required results

Check that the EUT transmits and receives on the primary channels assigned for each region alternating channels and doubling reporting rate when passing through the transitional zones (see Table 26). EUT shall revert to default autonomous operation on the regional channels after leaving the transitional zones.

- **Table 26 – Required channels in use**

	Area	Channels in use
1	Default region	AIS 1, AIS 2
2	First transitional zone	AIS 1, CH A 2
3	Region 2	CH A 2, CH B 2
4	Second transitional zone	CH A 2, CH A 1
5	Region 1	CH A 1, CH B 1

	Test details part 1 – Channel management by VDL msg 22		
Test item	Check	Remark	Result
Set-up EUT in autonomous mode transmitting on channel AIS 1/AIS 2, send 2 Msg 22 by VDL generator, defining 2 adjacent areas with channels A1, B1 and A2, B2. Use external sensor input to simulate a voyage through both areas. Set transitional zone to 4nm. Set the position outside the areas. "TZ" is used for "transitional zone" Set the positions near the limits of the transitional zones to check the dimensions Msg: "B Msg 22 Test 13.1 Area1" and " B Msg 22 Test 13.1 Area2"			
Message 22 setting	Check ACA output	• The ACA content is correct. • The TZ size is correct (4). The length of the ACA sentence is correct.	Ok Ok Ok
Area 1: In high sea area	Check that channels AIS 1 and AIS 2 are in use		Ok
Area 2: Move position into outer TZ of region 2	Check the limit of the TZ (5 NM = 8.8 minutes)	The limit is ok. At 12°09 the high sea channels are used, at 12°08 the TZ channels are used	Ok
	Check that channel AIS 1 and A2 are used	Tx and Rx on AIS1 and A2 is ok	Ok
	Check that reporting rate is doubled		Ok
Crossing the area border	Check the border of area	The in-use flag is set to 1	Ok
In Region, inside the TZ	Check that channel AIS 1 and A2 are used	Tx and Rx on AIS1 and A2 is ok	Ok
Area 3: Move position into region 2 (out of TZ)	Check the limit of the TZ (4 NM = 7 minutes)	The border of the TZ is ok	Ok
	Check that channel A2 and B2 are used	A2 and B2 are used for Rx and Tx	Ok
	Check that reporting rate is changed back to normal reporting rate		Ok
Area 4: Move position into TZ between region 1 and 2, inside area 2	Check that channels A2 and A1 are used		Ok
	Check that reporting rate is doubled		Ok
crossing the area border	Check the border of area	UTC 14:30	Ok
Area 5: Move position into region 1 (out of TZ)	Check that channels A1 and B1 are used	UTC 14:31	Ok
	Check the limit of the TZ (4 NM = 7 minutes)		Ok
	Check that reporting rate is changed back to normal reporting rate		Ok
Item 6: Move position into TZ of region 1 to high sea	Check that channels A1 and AIS 1 are used		Ok
	Check that reporting rate is doubled		Ok
Area 7: Move position out of the TZ of region 1, into high sea	Check that channels AIS 1 and AIS 2 are used	UTC 14:35	Ok
	Check that reporting rate is changed back to normal reporting rate		Ok

• 13.2 Regional area designation by serial message or manually

13.2.1 Method of measurement

Check documentation.

13.1.2 Required result

Verify that the user cannot allocate channels (directly or by ACA sentence).

	Test details - Regional area designation		
Test item	Check	Remark	Result
Check documentation			
Serial message or manual input	Check that the user cannot enter area settings		N/T
	Check that the user cannot change the channels on another way		N/T

• 13.3 Management of received regional operating settings

• 13.3.1 Replacement or erasure of dated or remote regional operating settings

13.3.1.1 Method of measurement

Set up standard test environment. Send a valid regional operating setting to the EUT by Message 22 with the regional operating area including the own position of the EUT. Consecutively send a total of seven valid regional operating settings to EUT, using Message 22, with regional operating areas not overlapping to the first and to each other. Perform the following in the order shown:

a) send a ninth Message 22 to the EUT with valid regional operating areas not overlapping with the previous eight regional operating areas;

b) Step 1: set own position of EUT into any of the regional operating areas defined by the second to the ninth Message 22 sent to the EUT previously;

Step 2: send a tenth Message 22 to the EUT, with a regional operating area which partly overlaps the regional operating area to which the EUT was set by step 1 but which does not include the own position of the EUT;

Step 1: move own position of EUT to a distance of more than 500 miles from all regions defined by previous commands;

Step 2: consecutively set own position of EUT to within all regions defined by the previous Message 22.

This test can be accomplished by either using the test input for simulated position information or a GNSS simulator (see also Annex D).

13.3.2 Required results

After the initialisation, the EUT shall operate according to the regional operating settings defined by the first Message 22 sent.

a) The EUT shall return to the default operating settings.

b) Step 1: check that the EUT changes its operating settings to those of that region which includes own position of the EUT.

Step 2: check that the EUT reverts to the default operating settings.

NOTE Since the regional operating settings to which the EUT was set in Step 1 are erased due to Step 2, and since there is no other regional operating setting due to their non-overlapping definition, the EUT returns to default.

Step 1: check that the EUT operates with the default settings.

Step 2: check that the EUT operates with the default settings.

	Test details – Test of replacement or erasure of dated or remote regional operating settings		
Test item	Check	Remark	Result
Send by msg 22 • 1 area including own position • 7 areas not overlapping, not including own position Msg: “B Msg 22 Test 13.3.1 Area1... Area8”			
Check active area	Check that EUT uses the channels of area 1	UTC 11:30	Ok

a) Send a 9. msg 22 to the EUT not overlapping the previous areas Msg: "B Msg 22 Test 13.3.1 Area9"	Check that the EUT returns to the default operating settings (the area is deleted)	The default settings are used, the oldest area is deleted.	Ok
b) step 1: Set own position to any of the 7 areas	Check channels of area 2	Checked by ACA output and sample tests with setting the position inside the area.	Ok
	Check channels of area 3		Ok
	Check channels of area 4		Ok
	Check channels of area 5		Ok
	Check channels of area 6		Ok
	Check channels of area 7		Ok
	Check channels of area 8		Ok
	Check channels of area 9		Ok
b) step 2: Send an area 10, overlapping the area of step 1 not including own position Msg: "B Msg 22 Test 13.3.1 Area10"	Check that the EUT returns to the default operating settings (the area is deleted)	UTC 11:55	Ok
c) Step 1: Erasure by distance: Move own position of EUT to a distance of more than 500 miles from all regions defined by previous commands	Check that the EUT operates with the default settings	UTC 11:58	Ok
Step 2: Check of erasure: Set own position of EUT to within all regions defined by the previous telecommands. b) step 1: Set own position to any of the 7 areas	Check area 2 = default	Checked by ACA output and sample tests with setting the position inside the area.	Ok
	Check area 3 = default		Ok
	Check area 4 = default		Ok
	Check area 5 = default		Ok
	Check area 6 = default		Ok
	Check area 7 = default		Ok
	Check area 8 = default		Ok
	Check area 10 = default		Ok

- ## 13.3.2 Channel management by addressed Message 22

13.3.2.1 Method of measurement

Set up a standard test environment and operate EUT in autonomous mode. Perform the following tests in the following order:

a) send Message 22 with valid regional operating settings that are different from the default operating settings to the EUT with a regional operating area, which contains the current position of own station;

b) send an addressed Message 22 to the EUT with different regional operating settings than the previous command;

c) move the EUT out of the regional operating area defined by the previous addressed command into an area without regional operating settings.

13.3.2.2 Required results

a) Check, that the EUT uses the regional operating settings commanded to it in a).

b) Check, that the EUT uses the regional operating settings commanded to it in b).

c) Check, that the EUT reverts to default.

	Test details – Test of addressed message 22		
Test item	Check	Remark	Result
All areas are erased by the previous test			
a) Send msg 22 with a new area, position inside Msg: "B Msg 22 Test 10.4.1"	Check, that the EUT uses the regional operating settings	UTC 12:00	Ok
b) Send an addressed msg 22 to the EUT with different regional operating settings Msg: "B Msg 22 Test 13.3.2 b"	Check, that the EUT uses the settings of the new message	UTC 12:02	Ok
c) Move the position out of the area	Check, that the EUT uses the default channels	UTC 12:08	Ok

- ## 13.3.3 Invalid regional operating areas

This test is to check the rejection of invalid regional operating areas (three regional operating areas with same corner).

13.3.3.1 Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Perform the following tests in the following order after completion of all other tests related to change of regional operating settings:

a) send three different valid regional operating settings with adjacent regional operating areas, their corners within eight miles of each other, to the EUT by Message 22. The current own position of the EUT shall be within the regional operating area of the third regional operating setting;

b) move current own position of the EUT consecutively to the regional operating areas of the first two valid regional operating settings.

13.3.3.2 Required test results

c) Check, that the EUT uses the operating settings that were in use prior to receiving the third regional operating setting.

d) Check, that the EUT consecutively uses the regional operating settings of the first two received regional operating areas.

	Test details – Test for invalid regional operating areas		
Test item	Check	Remark	Result
a) Send three different valid regional with adjacent corners by msg 22, Position inside 3rd area. Msg: "B Msg 22 Test 13.3.1 Area6" Msg: "B Msg 22 Test 13.3.1 Area7" Msg: "B Msg 22 Test 13.3.3"	Check, that the default channels are used	UTC 10:10	Ok
b) Move own position to the first area	Check, that the EUT uses the operational settings of the first area	UTC 12:13	Ok
Move own position to the second area	Check, that the EUT uses the operational settings of the second area	UTC 12:15	N/T

- ## 13.3.4 Continuation of autonomous mode reporting rate

13.3.4.1 Method of test

When in the presence of an assigned mode command and in a transition zone, check that the EUT continues to report at the autonomous mode reporting interval.

13.3.4.2 Required result

Ensure that the autonomous reporting interval is maintained.

	Test details – Continuation of autonomous mode reporting rate		
Test item	Check	Remark	Result
Set the EUT into a transitional zone Send an assignment command using msg 23 to the EUT with a different reporting interval Area setting msg Msg: "B Msg 22 Test 10.4.1" Reporting interval: Msg: "B Msg 23 Test 10.2.2.1 T1"			
Assignment command in a transitional zone	Check that an rate assignment command is ignored in a transitional zone	UTC 12:22/12:30 If the EUT has recognized that it is in the transitional zone the group assignment is ignored.	Ok

- ## 13.3.5 Other conditions

The fulfilment of all other conditions of 7.4.2 shall be self-certified by the manufacturer.

Date	**Result**	**Status**
	No selfcertification required	Ok

C.3 DSC functionality tests

C.3.1 General

For the tests in this clause (see also IEC 61993-1), set the EUT into assigned mode using channels AIS 1 and AIS 2 with a reporting interval of 10 s.

Check with a sequence of valid calls consisting of a DSC channel management test signal number 1, a geographic call from ITU-R M.493, a test signal number 1, an individual call from ITU-R M.493 and a test signal number 1 that the EUT's AIS operation is not affected by the interleaved calls.

	Test details– Sequence of 5 calls		
Test item	Check	Remark	Result
Activate DSC function Set reporting interval to 10 s and record VDL			
Start DSC transmission of test sentence File: sequence_C3_1.sst" Delay between the calls is 5 s	Check that the schedule of the AIS position reports is not affected by the transmission of the DSC calls	Has to be tested when the AIS transmission is not affected during DSC time sharing phases (see C.3.3)	N/T

C.3.2 Regional area designation

Perform the following tests using the DSC channel management test signal number 1.

Send to the EUT a standard test signal number 1 but with symbol numbers appropriate to the geographical regions and channels specified in the test. Note the transition boundary is 5 NM in this test.

	Test details - Regional area designation		
Test item	Check	Remark	Result
Activate DSC function			
Start DSC transmission of test sentence File: area_set_region_2084_2086.sst"	Check that the area setting of the DSC command is correctly stored		Ok
	Check that the transitional zone size is 5 NM		Ok
Remarks:	More than one area settings could be applied to the EUT within one 30s time sharing phase.		Ok

C.3.3 Scheduling

Check that the EUT's AIS reporting is not affected during the DSC monitoring times.

Send a valid geographical call to the EUT. Check that a response is not transmitted.

	Test details (b) – Scheduling during DSC monitoring times		
Test item	Check	Remark	Result
Set reporting interval to 10 s and record VDL Msg: B Msg 23 Test 10.2.2.1 T3			
DSC monitoring times	Check that the AIS reporting is not affected during the DSC monitoring times	The transmissions (5 s interval) continue during the DSC monitoring times	Ok
File: area_set_region_2084_2086.sst"	Check that not response is transmitted		Ok

C.3.4 DSC flag in Message 18

Check that the DSC flag is set properly when DSC functionality is available.

	Test details – DSC flag		
Test item	Check	Remark	Result
Record VDL			
DSC activated	Check that the DSC flag is set		Ok
DSC inactivated	Check that the DSC flag is not set		Ok

• C.3.5 DSC monitoring time plan

Check that DSC commands are received during DSC monitoring times and, if time-sharing is used, are not received outside those times.

	Test details (b) – DSC monitoring time plan		
Test item	Check	Remark	Result
Delete all area settings			
Send a DSC area setting outside the monitoring time	If time-sharing is used: Check that the channels are not changed	The correct time of the DSC receiving periods has been verified by evaluation of TDMA reception over several hours. There was a stop of TDMA RX at the defined DSC reception times, alternating between channel A and B	Ok
	If time-sharing is **not** used: Check that the channels are changed according to the area setting	Time sharing is used	N/A
Send a DSC area setting inside the monitoring time	Check that the channels are changed according to the area setting		Ok

• C.3.6 Replacement or erasure of dated or remote regional operating settings

Method of measurement

Set up standard test environment. Send a valid regional operating setting to the EUT by Message 22 with the regional operating area including the own position of the EUT. Consecutively send a further seven (7) valid regional operating settings to EUT, using both Message 22 and DSC telecommands, with regional operating areas not overlapping to the first and to each other. Perform the following in the order shown:

a) send a ninth Message 22 to the EUT with valid regional operating areas not overlapping with the previous eight regional operating areas;

Step 1: set own position of EUT into any of the regional operating areas defined by the second to the ninth telecommands sent to the EUT previously;

Step 2: send a tenth telecommand to the EUT, with a regional operating area which partly overlaps the regional operating area to which the EUT was set by Step 1 but which does not include the own position of the EUT;

Step 1: move own position of EUT to a distance of more than 500 NM from all regions defined by previous commands;

Step 2: consecutively set own position of EUT to within all regions defined by the previous telecommands.

Required results

After the initialisation, the EUT shall operate according to the regional operating settings defined by the first Message 22 sent.

a) The EUT shall return to the default operating settings.

b) Step 1: check that the EUT changes its operating settings to those of that region which includes own position of the EUT.

Step 2: check that the EUT reverts to the default operating settings.

NOTE Since the regional operating settings to which the EUT was set in Step 1 are erased due to Step 2, and since there is no other regional operating setting due to their non-overlapping definition, the EUT returns to default.

Step 1: check that the EUT operates with the default settings.

Step 2: check that the EUT operates with the default settings.

	Test details – Test of replacement or erasure of dated or remote regional operating settings		
Test item	Check	Remark	Result
Send by DSC and msg 22 • 1 area including own position by MSG 22 (Msg: B Msg 22 Test 13.3.1 Area 1...4) • 7 areas not overlapping, not including own position, first 3 by msg 22, last 4 by DSC			
Check active area	Check that EUT uses the channels of area 1		Ok
a) Send a 9. msg 22 to the EUT not overlapping the previous areas	Check that the EUT returns to the default operating settings (the area is deleted)	The first area has been deleted	Ok

b) step 1: Set own position to any of the 7 areas	Check channels of area 2	Remark: in each time-sharing phase only one area could be applied.	Ok
	Check channels of area 3		Ok
	Check channels of area 4		Ok
	Check channels of area 5		Ok
	Check channels of area 6		Ok
	Check channels of area 7		Ok
	Check channels of area 8		Ok
	Check channels of area 9		Ok
b) step 2: Send an area 10 by DSC, overlapping the area 2 of step 1 not including own position	Check that the EUT returns to the default operating settings (the area is deleted)	UTC 11:20	Ok
c) Step 1: Erasure by distance: Move own position of EUT to a distance of more than 500 miles from all regions defined by previous commands	Check that the EUT operates with the default settings		Ok
Step 2: Check of erasure: Set own position of EUT to within all regions defined by the previous telecommands. b) step 1: Set own position to any of the 7 areas	Check area 2 = default		Ok
	Check area 3 = default		Ok
	Check area 4 = default		Ok
	Check area 5 = default		Ok
	Check area 6 = default		Ok
	Check area 7 = default		Ok
	Check area 8 = default		Ok
	Check area 10 = default		Ok
ACA output	Information source	The Information source is corretly set	Ok
	In-use flag	The in-use flag is correctly set. If a new area is received there is an ACA output with the in-use field empty (null field), independent if the position is inside or not. In the output on request it is set correctly	Ok

• C.3.7 Test of addressed telecommand

Method of measurement

Set up a standard test environment and operate EUT in autonomous mode. Perform the following tests in the following order:

a) send a DSC telecommand with valid regional operating settings that are different from the default operating settings, to the EUT with a regional operating area, which contains the current position of own station;

b) send an addressed DSC telecommand to the EUT with different regional operating settings than the previous command;

c) Move the EUT out of the regional operating area defined by the previous addressed telecommand into an area without regional operating settings.

Required results

a) Check, that the EUT uses the regional operating settings commanded to it in a).

b) Check, that the EUT uses the regional operating settings commanded to it in b).

c) Check, that the EUT reverts to default.

	Test details – Test of addressed telecommand		
Test item	Check	Remark	Result
All areas are erased by the previous test			
a) Send a DSC call with a new area, position inside	Check, that the EUT uses the regional operating settings		Ok
b) Send an addressed DSC call to the EUT with different regional operating settings	Check, that the EUT uses the settings of the new message		Ok
c) Move the position out of the area	Check, that the EUT uses the default channels		Ok

• C.3.8 Invalid regional operating areas

Test for invalid regional operating areas (three regional operating areas with same corner).

Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Perform the following tests in the following order after completion of all other tests related to change of regional operating settings:

a) send three different valid regional operating settings with adjacent regional operating areas, their corners within eight miles of each other, to the EUT by DSC telecommand, Presentation interface input and manual input via MKD. The current own position of the EUT shall be within the regional operating area of the third regional operating setting;

b) move current own position of the EUT consecutively to the regional operating areas of the first two valid regional operating settings.

This test can be accomplished by either using a dedicated test input for simulated position information or a GNSS simulator.

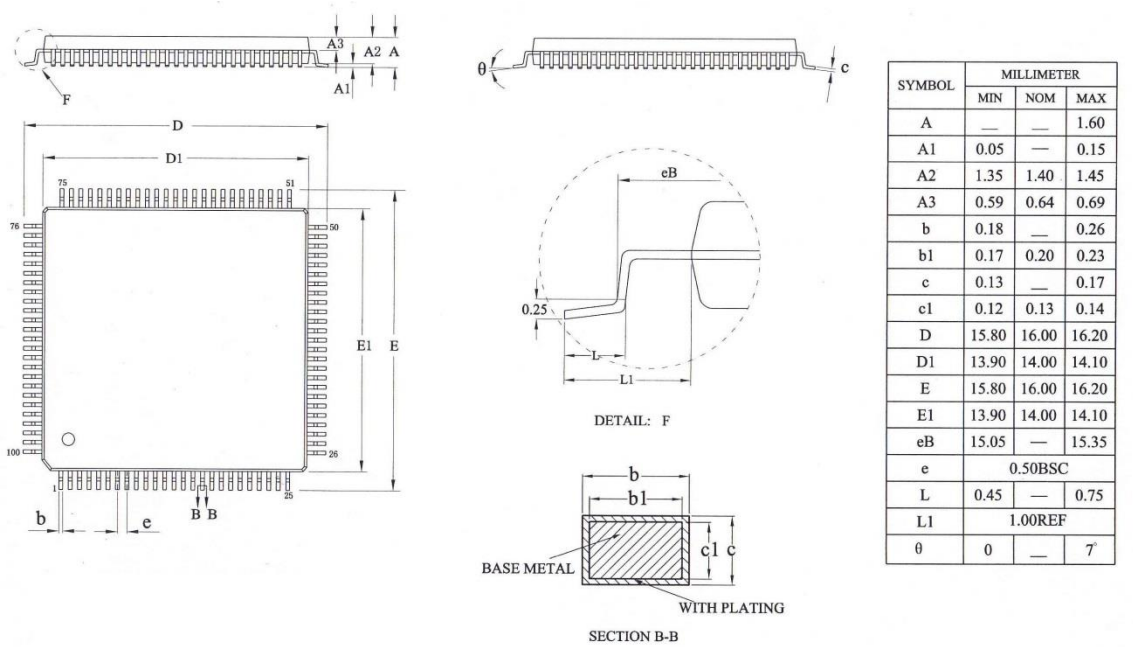
Required test results

a) Check, that the EUT uses the operating settings that were in use prior to receiving the third regional operating setting.

b) Check, that the EUT consecutively uses the regional operating settings of the first two received regional operating areas.

	Test details – Test for invalid regional operating areas		
Test item	Check	Remark	Result
a) Send three different valid regional with adjacent corners by DSC area call, Position inside 3rd area.	Check, that the default channels are used		Ok
b) Move own position to the first area	Check, that the EUT uses the operational settings of the first area		Ok
Move own position to the second area	Check, that the EUT uses the operational settings of the second area		Ok

11 Packaging



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	—	—	1.60
A1	0.05	—	0.15
A2	1.35	1.40	1.45
A3	0.59	0.64	0.69
b	0.18	—	0.26
b1	0.17	0.20	0.23
c	0.13	—	0.17
c1	0.12	0.13	0.14
D	15.80	16.00	16.20
D1	13.90	14.00	14.10
E	15.80	16.00	16.20
E1	13.90	14.00	14.10
eB	15.05	—	15.35
e	0.50BSC		
L	0.45	—	0.75
L1	1.00REF		
θ	0	—	7°

Figure 15 Mechanical Outline of 100LQFP

Order as part no. SCT7033

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