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<b>Name and address of responsible development side:</b>	<b>Aptiv Services Deutschland GmbH</b> 42367 Wuppertal Germany
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<b>Name of product:</b>	<b>Radio and Entertainment Module</b>		
<b>Type designations/ Versions</b>	<b>P2952 REM</b>		
<b>Customer:</b>	VGTT	<b>Customer's Project:</b>	Volvo Trucks P2952 REM

**Document revision history:**

#	Date	Name	Description of the changes
1	2018 06 18		Rev1.0. Initial release
2	2018 10 23		Rev2.0. Draft
3	2018 10 25		Rev 3.0 Release
4.	2019.05.24		Rev 3.0 Review
5.	2019.12.17		Rev 4.0 Review

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## Mission

The document shall describe the product, its functionalities and services in context to the car. The focus is for certification reasons.

It shall give basic data and parameters. In order to handle the unit in certification tests, different scenarios are described and explained how to set up the unit accordingly.

In order to keep handling and actuality, all these information are kept within one single document.

## General Product Specification

This is an automotive radio head unit equipped with AM/FM tuner, DAB tuner, USB as media source and Bluetooth with audio streaming and voice call profiles. REM is remotely control by the web-based reference application. The interaction with the application is achieved via a desktop browser.

HW/SW-Variant

Variant	Market	Hardware	Software under Test
REM no DAB	EU/RoW	C	M0
REM DAB	EU/RoW	C	M0
REM NAR	NAR		

## Feature Content

- AM-FM Tuner with FM back ground tuner, weak signal processing in tuner DSP of Dirana 3
- Dual DAB tuner SAF3602 with background scanning
- DSP Dirana 3 for audio inputs (AUX and Microphone)
- Antenna phantom supply with diagnosis (current measurement)
- Power amplifier class AB with High efficiency mode and low operating voltage
- CAN interface via TJA 1043
- 2 AUX's input with adjustable gain
- Microphone mono input
- USB 2.0 for media playing
- BRR Ethernet interface via TJA1100

## Product photo



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**Planned Label drawing:**

<b>VOLVO</b>		PAAAAAAA TSSSSSSSS VZZZZZ	
P/N YYYYYYYY.PYY (HW)			
Model: Radio and Entertainment Module			
RU: Registration Nr. IBPD-6368 ETA-SD-20190803395 FCC ID LTQVTREM2 CMIIT ID: 2019DJ10078 T/4/11/11/9555 CNC ID: C-23891		   	
 NR: 2019-09-I-0510		10R-05 15130 	
 HHHHH-AA-FFFFF		Type approved No. ESD - 1920377C	
AGREE PAR L'ANRT MAROC Numéro d'agrément: MR 20563 ANRT 2019 Date d'Agrément: 25/07/2019		Complies with IMDA Standards DA105282	
Approved by PTA (YEAR)  Pakistan Telecom Authority		Oman - TRA R/7955/19 D100428	
CR-CRM-ABC-XXXXXXXXXX  X JJ-5NNN AAA ABCD12345678		<b>TRA</b> REGISTERED No: ER73515/19 DEALER No: DA0062437/11	
Product name(產品名稱): 帶藍牙和WLAN的無線電主機 Model(型號): 服務和娛樂模塊 Country of origin(產地): 葡萄牙 Product Spec: 12 V --- 10A		RXXXXXXX RoHS == 10A +12VDC	
XXXXZZXZZZZXZ			
• <b>APTIV</b> • MADE IN PORTUGAL Aptiv Services Deutschland GmbH 42367 Wuppertal		APTIV PART NUMBER XXXXXXXX PART NAME MANUFACTURED YYYMMDD AAAAHHHHHHHHFYDDSSSSK	

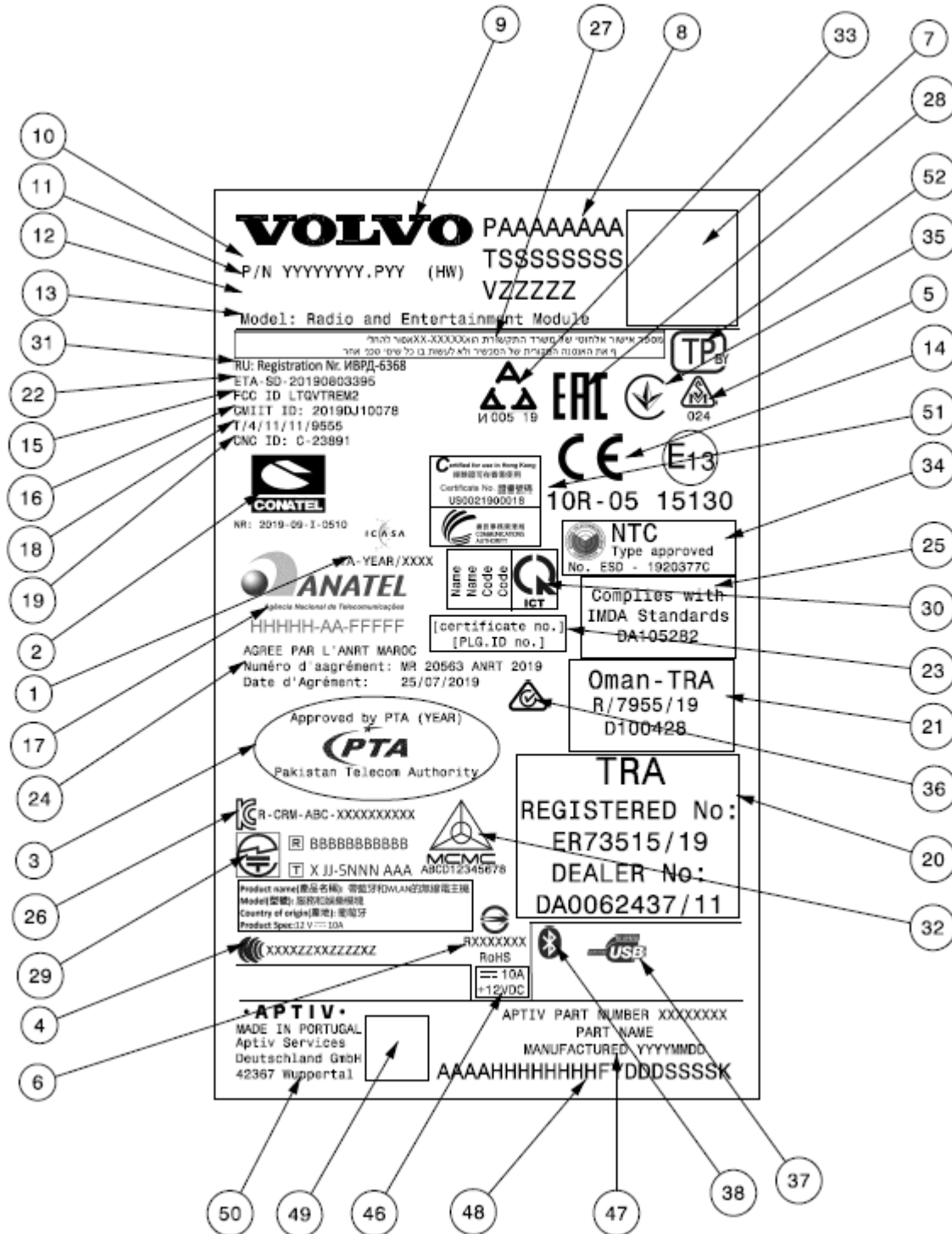
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Number	Information	Country	Number	Information	Country
1	Certification	South Africa	27	Certification	Israel
2		Paraguay	28		EAC
3		Pakistan	29		Japan
4		Taiwan (Radio)	30		Vietnam
5		Moldova	31		Russia
6		Taiwan	32		Malaysia
7	Customer Bar Code	-	33		Serbia
8	Customer Traceability Number	-	34		Philippines
9	Customer Logo	-	35		Ukraine
10	ASM Customer PN	-	36		Australia
11	HW Customer PN	-	37	USB	-



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12	SW Customer PN	-	38	Bluetooth	-
13	Model Name	-	39	Removed	-
14	Certification	EU	40	Removed	-
15		USA	41	Removed	-
16		China	42	Removed	-
17		Brazil	43	Removed	-
18		Jordan	44	Removed	-
19		Argentina	45	Removed	-
20		UAE	46	Operating Current	-
21		Oman	47	Aptiv Identification	-
22		India	48	Traceability Code	-
23		Indonesia	49	Aptiv 2D Code	-

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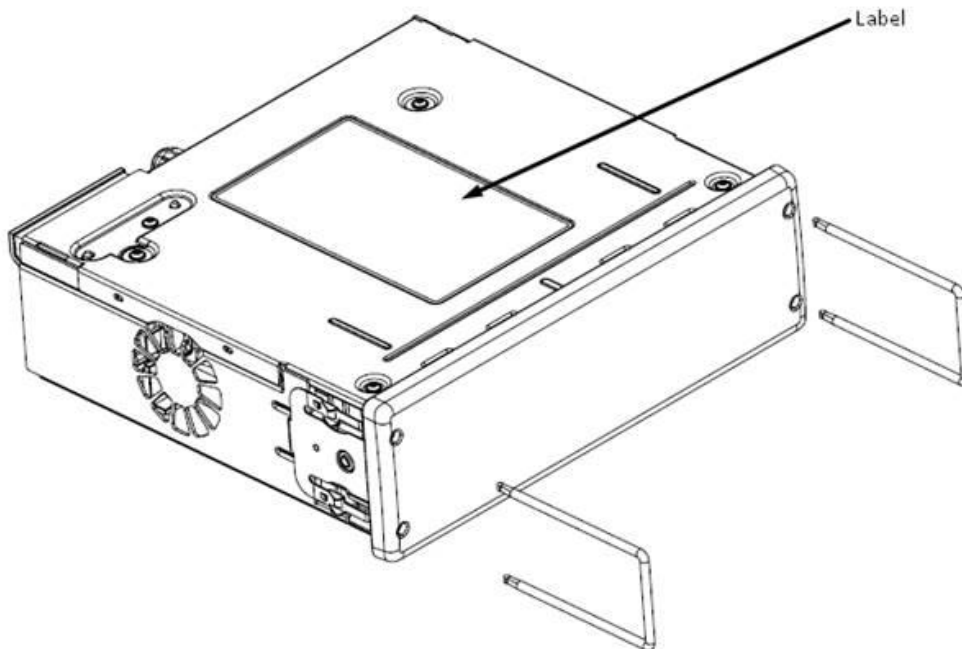
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24	Certification	Morocco	50	Aptiv Address	-
25		Singapore	51	Certification	Hong Kong
26		South Korea	52		Belarus

**Label Location on Device:**



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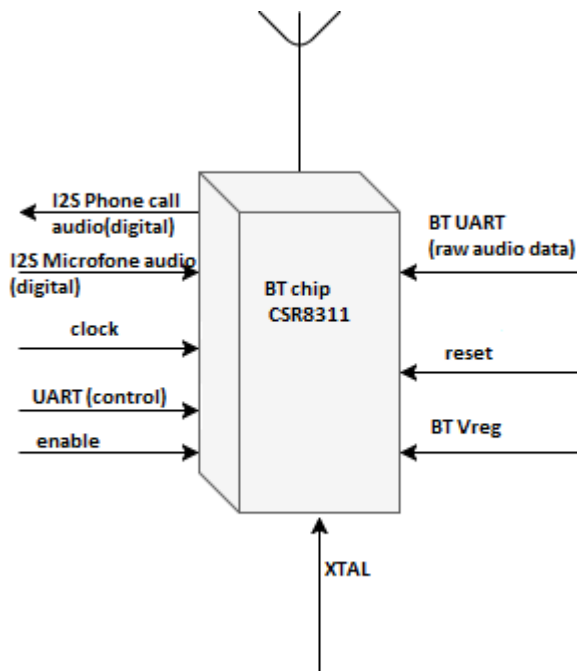
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## BT

- Bluetooth version 4.0 (BETULA7 stack), BR+EDR, BLE disabled
- The BT module used:
  - o CSR8311A08



- Supported profiles:

Profile	Version	Role
PBAP	1.1.1	PCE
A2DP	1.3	Sink
AVRCP	1.5	Controller
HFP	1.6	Unit

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REM Bluetooth version: 4.0 (BETULA7 stack), BR+EDR, BLE disabled in stack  
BT SIG record:

Declaration ID	QDID	Company	Product	Specification	Listing date
<u>D031980</u>	<u>84996 - Host Subsystem</u>	Aptiv Corporation	Delphi Radio, Betula7	4.0	2016-07-27
B017701	<u>30846 - Controller Subsystem</u>	Qualcomm Technologies International, Ltd. (QTI)		4.0	2011-05-22

- Connecting user's mobile phone via Bluetooth Hands-free profile
  - Number dialling
  - Multiparty calls / conference calls
  - Address book (up to 2000 contacts)
  - Call stacks (outgoing calls, received calls, missed calls)
- Connecting user's mobile phone / media player via Bluetooth A2DP/AVRCP profile
  - Stereo audio streaming from mobile device
  - Controlling remote device (play, pause, stop, skip)
  - Display of meta data (title, artist, album, etc.)
- Two different Bluetooth devices can be connected simultaneously (one phone and one media player)
- One microphone supported

Frequency range (please indicate for each used technology separately) 2402-2480 MHz

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## Media/USB

- USB 2.0 (full speed maximum 12 Mbit/s)
- Mini USB connector on backside
- Maximum output
  - o I = 1.5 A
  - o U = 4.75 V – 5.25 V

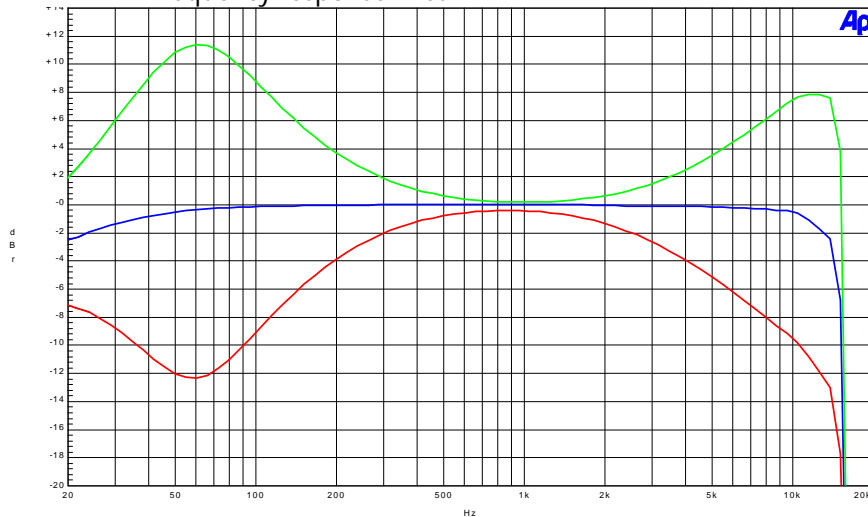
Audio containers	File extension
MP3	*.mp3
ASF	*.wma, *.wmv
M4A	*.m4a
OGG	*.ogg
WAV	*.wav
MP4	*.mp4
M4B	*.m4b
Audio formats	File extension
AAC	*.aac
FLAC	*.flac
Audio Decoder	Container/Form at
PCM (RAW)	WAV
MPEG1 layer3	MP3
MPEG2 layer3	MP3
MPEG2.5 layer3	MP3
WMA 2 Standard	ASF
WMA 7 Standard	ASF
WMA 8 Standard	ASF
WMA 9 Standard	ASF
WMA10 Professional	ASF
AAC LC	AAC, MP4, M4A, M4B
AAC HE	AAC, MP4, M4A, M4B
AAC HE v2	AAC, MP4, M4A, M4B
OGG - Vorbis	OGG
FLAC	FLAC

- Audio playback from multiple sources
  - External mobile devices
    - USB interface
    - Analogue AUX input
  - Bluetooth audio player  
(connected via BT A2DP/AVRCP profile)
  
- Basic control functionality
  - Play / pause
  - Forward / rewind
  - Next / previous track
  - Mix (shuffle)
  - Info (track info)
  - Repeat
  
- Support for many different audio codecs
- Playlists
- Display of included meta data
  - Album, track, artist, year, genre and comment
  - Embedded album covers (GIF, JPEG, PNG, BMP)
- Music Interface → possibility to connect external media player through adapter cables
  - In the car's glove box there is a generic USB which allows the connection of device specific adapter cables

## FM Tuner

- Reception range: 87.5 - 108.0 MHz, RDS
- Tuning steps:
  - 100 kHz automatic
  - 50 kHz manual
- Sensitivity: 26 dB S/N ->  $E' < 6 \text{ dB}\mu\text{V}$
- $S+N/N > 55 \text{ dB} @ E' = 60 \text{ dB}\mu\text{V}$
- Noise threshold  $> 24 \text{ dB}$
- THD  $< 0.6 \% @ E' = 60 \text{ dB}\mu\text{V}$ ,  $h = 22.5 \text{ kHz}$  and  $P = 0.5 \text{ W}$
- Frequency response: CAR specific EQ

- Antenna impedance:  $Z = 50 \text{ Ohm @ } 98 \text{ MHz}$
- FM Frequency response linear:



## AM Tuner

- Reception range: 531 – 1602 kHz
- Tuning steps:

  - 9 kHz automatic
  - 9 kHz manual

- Sensitivity: 26 dB S/N  $\rightarrow E' < 28 \text{ dB}\mu\text{V}$
- S+N/N > 50 dB @  $E' = 60 \text{ dB}\mu\text{V}$
- Noise threshold > 22 dB
- THD < 1 % @  $E' = 60 \text{ dB}\mu\text{V}$ ,  $m = 30 \%$  and  $P = 0.5 \text{ W}$
- Frequency response: CAR specific EQ
- Antenna impedance:  $Z > 1 \text{ kOhm}$

## DAB Tuner

- Digital tuner for DAB/DAB+/DMB
- Dual reception processing with on-chip dual DAB
- Band III support
- Frequency ranges: 174,928 MHz to 239,200MHz

Coding change affects some parameters described in the following table:

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FM Band Coding:	Used for:	Band limits:
EUROPE	Europe, China, Guam, Korea, Pacific Rim, Africa, Russia, Taiwan, Central America, East Europe, East Asia	FM: 87,5 to 108,0 MHz, Band step width 100 kHz, AM/MW: 522-1611kHz, Band step width 9kHz AM/LW: 153-279kHz, Band step width 3kHz
USA	USA, Canada, México, Puerto Rico, Brazil	FM: 87,75+87,9 to 107,9 MHz, Band step width 200 kHz, AM: 530-1710kHz, Band step width 10kHz
JAPAN	Japan	FM: 76,0 to 95,0 MHz, Band step width 100 kHz, AM: 522-1629kHz, Band step width 9kHz
AUSTRALIA	Australia, New Zeland	FM: 87,5 to 108,0 MHz, Band step width 100 kHz, AM: 522-1629kHz, Band step width 9kHz
SAUDI ARABIA	Saudi Arabia, Israel, Gulf States, Middle East	Band Limits: FM: 87,5 to 108,0 MHz, Band step width 100 kHz, AM: 531-1602kHz, Band step width 9kHz
ARGENTINA	South America except Brazil, Caribbean	FM: 87,5 to 108,0 MHz, Band step width 100 kHz, AM: 530-1710kHz, Band step width 10kHz
BRAZIL	Brazil	FM: 76,0 to 107,9 MHz, Band step width 100 kHz, AM: 530-1710kHz, Band step width 10kHz

## Amplifier

- Output power:  $P > 4 \times 16 \text{ W}$  @  $U = 13.5 \text{ V}$  and THD = 10 %
- Supply voltage range:  $10 \text{ V} \leq U \leq 16 \text{ V}$
- Start voltage:  $U > 6 \text{ V}$  for 2 s



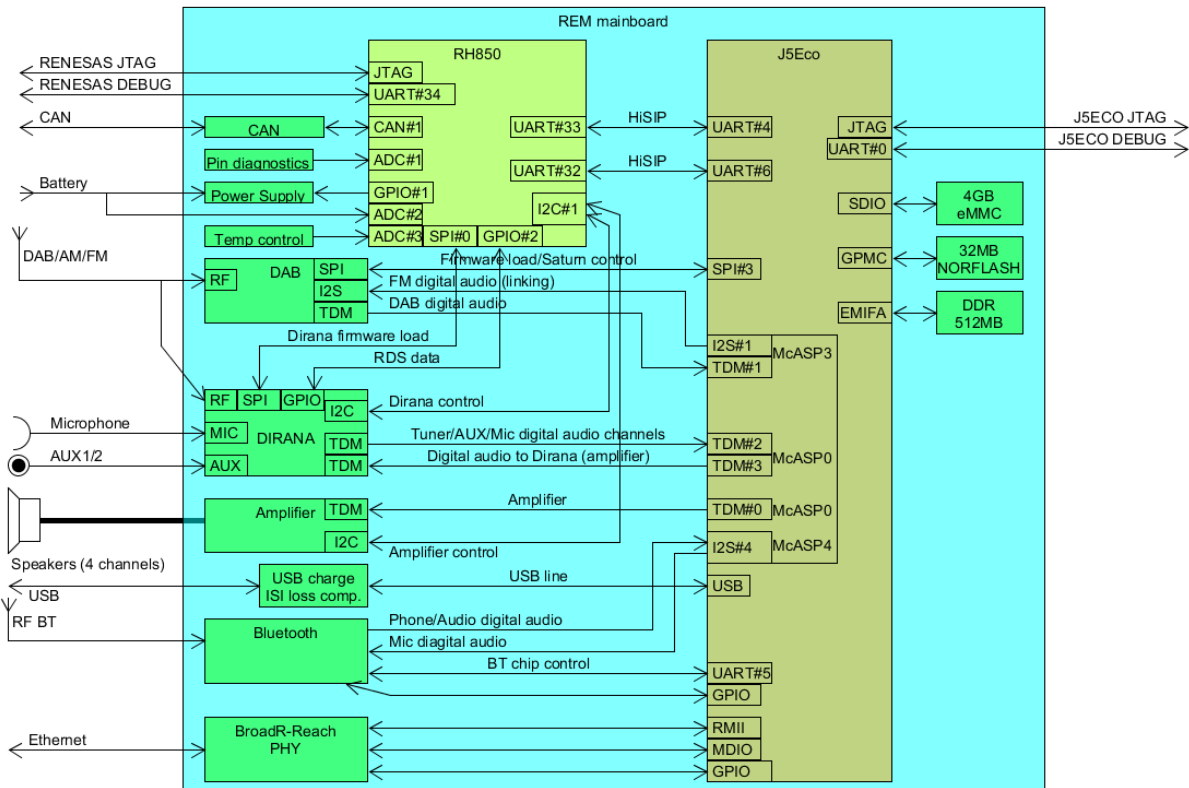
## Ethernet BRR

- TJA 1100 Ethernet PHY
- RMI interface to Ethernet controller
- 100MB/s speed

Ethernet interface is used to control REM with web application. In the application there are component modules like : Am/Fm, Audio, DAB, Media, Radio Settings, Phone, Bluetooth.

Most of component windows have a similar layout. Standard component view consists of two sections. First one contains buttons with default commands and setting options which force reaction on RBT (setters). Second group of controls is used to send getter commands.

## Block diagram



✓ Core AP(J5Eco) clock is 720MHz

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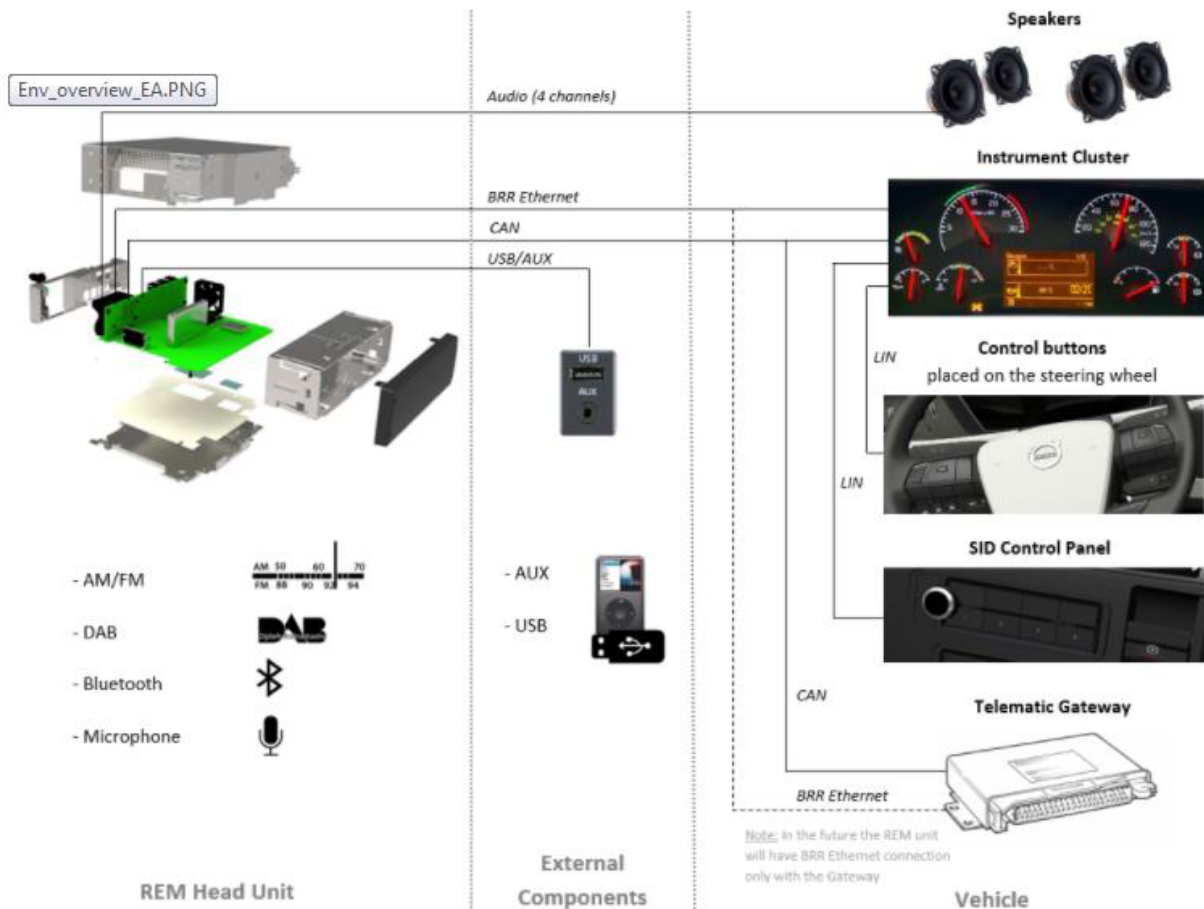
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- ✓ DSP clock is 600MHz
- ✓ RH850 clock is 120MHz

Cristal Reference	Frequency	Cristal Reference	Frequency
Y1	25.0MHZ	Y6	32.768KHZ
Y2	55.46667MHZ	Y7	20MHZ
Y4	20MHZ	Y8	26MHZ
Y5	24.576MHZ		

## Vehicle environment:



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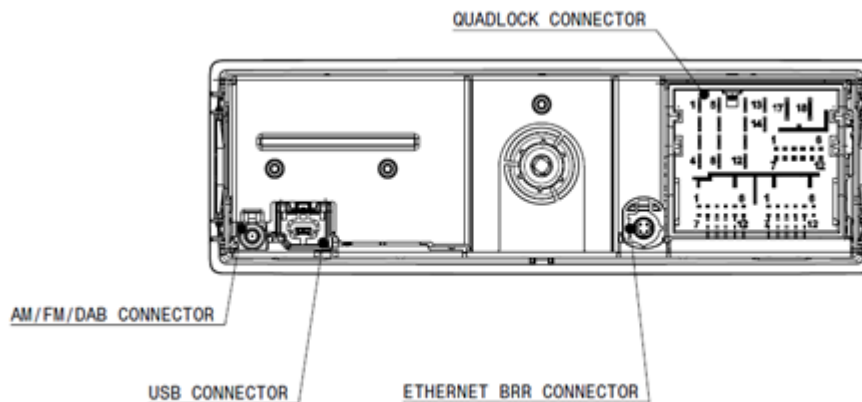
## Electrical Components on Main Board

- Tuner frontend and DSP: DIRANA3-IC SAF7750EL/N207
- Phantom Power supply and diagnosis: TPS7B7702QPWPRQ1
- Power Amplifier: TDA7803
- BT: CSR8311A08
- USB PORT IC: TPS2543RTE
- eMMC: MTFC4GMWDM-3M AIT
- DRAM: IS46TR16256AL-15HBLA
- Flash: S29GL256S90DHIO2
- Application processor: DRA622ZKK
- Power supply: TLV62065TDSG, TPS62090,
- CAN transceiver: TJA1043T
- Ethernet PHY: TJA1100

## Interfaces and connectors

- 1 DIN standard silver-box for all applications
- Quadlock connector
- Antenna connector
- USB connector
- Ethernet BRR connector

### Rear view:



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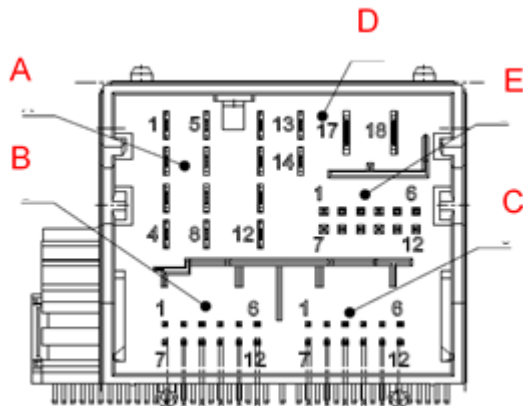
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**Quadlock connector:**



Identifier	Name	
A_01	Rear right +, (A1)	Analogue out
A_02	Front right + (A2)	Analogue out
A_03	Front left + (A3)	Analogue out
A_04	Rear left + (A4)	Analogue out
A_05	Rear right - (A5)	Analogue out
A_06	Front right - (A6)	Analogue out
A_07	Front left - (A7)	Analogue out
A_08	Rear left - (A8)	Analogue out

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Identifier	Name	
D_09	Spare	
D_10	Spare	
D_11	AP debug TX	
D_12	AP debug RX	
D_13	Spare, (layout according to DIBPU)	Digital input
D_14	Not connected	
D_15	Not connected	
D_16	Not connected	
D_17	Ground -	Main ground
D_18	Battery +	Main power

Identifier	Name	
B_01	Not connected	
B_02	Not connected	
B_03	Microphone -	Analogue input
B_04	GPIO3, Amp turn on/ Power antenna	Digital out
B_05	Not connected	
B_06	Not connected	
B_07	Not connected	
B_08	Not connected	
B_09	Microphone +	Analogue input
B_10	Not connected	
B_11	GPIO5, Ignition	Digital in
B_12	GPIO8, Mute	Digital in

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Identifier	Name	
C_01	Not connected	
C_02	Not connected	
C_03	AUX2 – Media: Right channel	Analogue in
C_04	Not connected	
C_05	Not connected	
C_06	Not connected	
C_07	Not connected	
C_08	AUX2 – Media: Common	Analogue in
C_09	AUX2 – Media: Left channel	Analogue in
C_10	GPIO6, Software download activation	Digital in
C_11	Not connected	
C_12	Not connected	

Identifier	Name	
E_01	AUX4 – VAS (Volvo Action Service): Right channel	
E_02	Spare	
E_03	VIP debug RX	Debug
E_04	Not connected	
E_05	UARTs GND	Debug
E_06	CAN High	CAN Communication
E_07	AUX4 – VAS (Volvo Action Service): Left channel	

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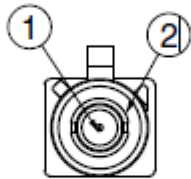
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E_08	AUX4 – VAS (Volvo Action Service): Common	
E_09	VIP debug TX	
E_10	Not connected	
E_11	Not connected	
E_12	CAN Low	CAN Communication

**Fakra connector:**

AM/FM/DAB FAKRA CONNECTOR  
COLOUR TBD CODE TBD



PIN	FUNCTION
1	SIGNAL
2	SHIELD

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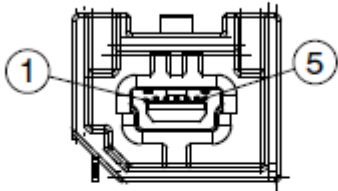
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**USB connector: pin4 NO GND -> NC**

USB CONNECTOR  
BLACK COLOUR



CONTACT NUMBER	SIGNAL NAME
1	V_BUS
2	USBO_DP
3	USBO_DM
4	GND
5	GND



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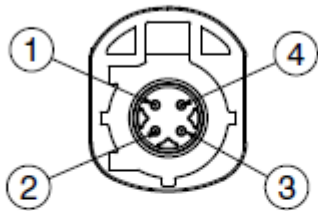
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**Ethernet BRR connector:**

ETHERNET BRR CONNECTOR  
GREEN COLOUR CODING E



PIN	FUNCTION	CHARACTERISTIC
1	TBD	
2	DATA+, TBD	
3	DATA-, TBD	
4	TBD	

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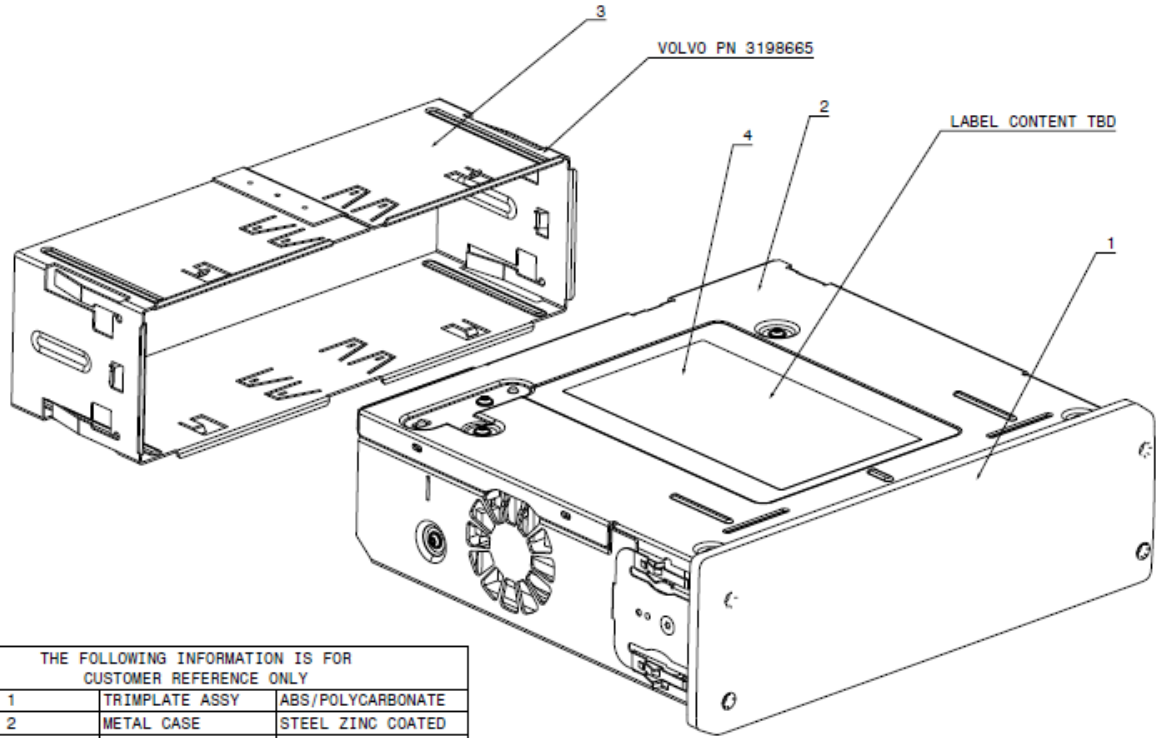
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## Drawings



THE FOLLOWING INFORMATION IS FOR CUSTOMER REFERENCE ONLY		
1	TRIMPLATE ASSY	ABS/POLYCARBONATE
2	METAL CASE	STEEL ZINC COATED
3	SLEEVE	STEEL ZINC COATED
4	LABEL	SELF-ADHESIVE TAPE

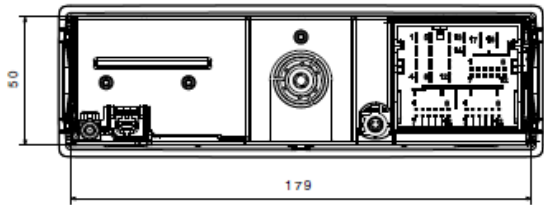
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REAR VIEW

