TECHNICAL DATA SHEET

LEONARDO OTS2

	Department and Function	Name	Date
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Version	Release date	Update description
1.0	05/07/2024	First Release
2.0	09/08/2024	Second Release, introduced dedicated paragraph, tables: TX-RX frequencies and powers, Bluetooth and WiFi.
3.0	09/09/2024	RF exposure declaration added and 5G Rlan frequencies removed.
Please, check on MTA website the latest version of this Technical Data Sheet: http://www.mta.it/technical-data-sheet		

Document Change Log

Version	Originator	Paragraph/ Page	Update description

DOCUMENT REFERENCES

ID	Doc.	Rev.	Note
[1]	TS50_16	6	Environmental – Electrical EMC Test Specification
[2]	LEONARDO_OTS2-R4_2200164_SYSREQ	1.2	LEONARDO Display Technical Specification (MTA reserved document)

LEONARDO DISPLAY

PRODUCT VERSION

This technical data sheet targets the version of DISPLAY LEONARDO listed hereafter

ID	P/N	Product DISPLAY LEONARDO 12”	Standard Contents																	Certific.	
			2 CAN BUS	1 LIN	2 USB	1 Ethernet-BR	2 Analog Video Inputs	4 Digital Inputs	2 Analog Inputs	2 High Side Driver Outputs	1 VSS (Vref)	1 Light Sensor	1 Speaker	1 Audio Out	RTC	1 Bicolor led	*1 Microphone Input*	*1 Wi-Fi*	*1 Bluetooth*	Type Approval (R10)	Additional Certifications
1	6100552/1x	OTS2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	-	X	X	X	X

GENERAL DESCRIPTION

LEONARDO OTS2 is a display designed for agricultural or off-highway vehicles, on wheels or tracks.

This state-of-the-art device features a number of high speed interfaces towards typical automotive communication channels such as CAN, Broad-R-Reach & LIN. In addition to a high resolution TFT display with capacitive touch screen and best-in-class brightness and contrast ratio, Leonardo delivers Linux Operating System and QT® cross-platform application development framework. The hardware is designed according to the most robust automotive industry standards.

LEONARDO main hardware features:

- Extended power supply range from 8 to 32Vdc
- 12.1” TFT LCD 1280 x 800 pixel:
- Capacitive touch screen, with light glove operability;
- 4 digital high side or low side inputs, two with wake capabilities
- 2 analog inputs (16 or 32v user definable dynamic range);
- 2 x 350mA high side outputs, with current sense and diagnostics;
- Stereo audio output (needs external amplifier);
- 1 Voltage output for sensor supply (5V, 400mA);
- 1 Real time clock;
- 1 Mono speaker;
- 1 Ambient light sensor;
- 1 Dual color status LED;
- 2 analog video inputs on 2 dedicated Mini-BNC connectors;
- 1 LIN 2.2 Master bus;
- 1 RS232;

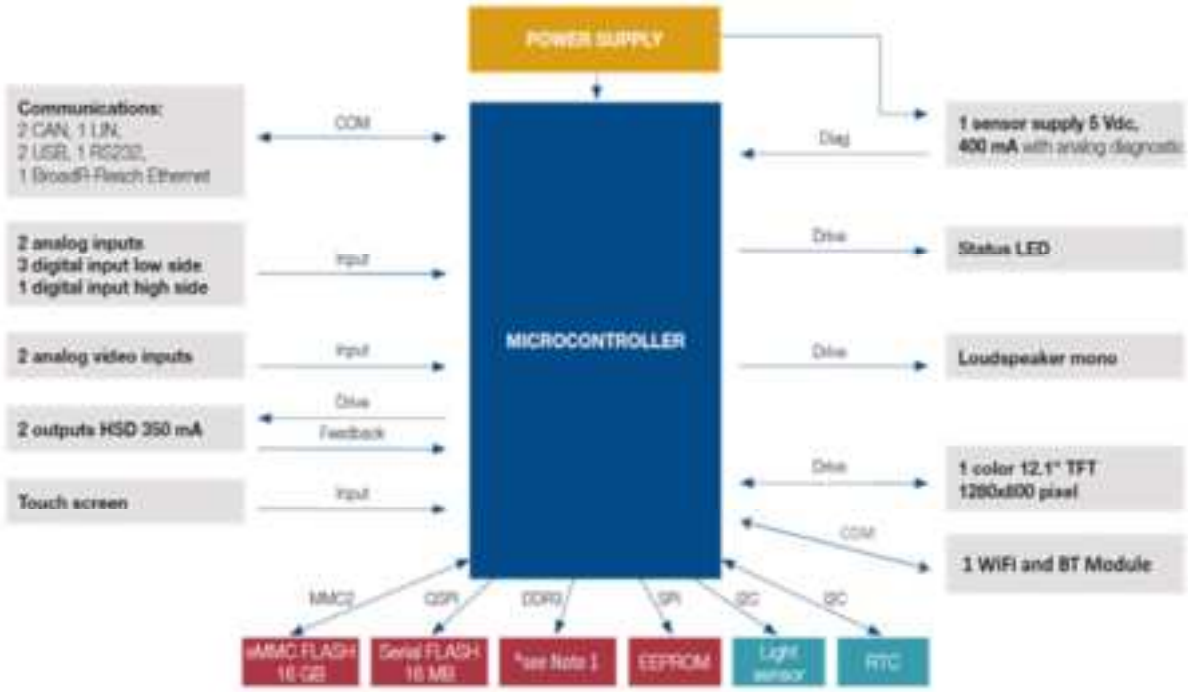
- 2 CAN bus;
- 1 Broad-R-Reach Ethernet;
- 1 WiFi 2.4GHz Module
- 1 Bluetooth and BLE v5.0 Module:
    - Protocols: SDP, L2CAP, RFCOMM , SPP, OBEX
    - Profiles: HFP 1.7.1, PBAP 1.2.1, MAP 1.4, PAN/BNEP, A2DP 1.3.1, AVRCP 1.6.1, AVDTP 1.3, AVCTP 1.4 with SBC CODEC, ATT/GATT

- 2 USB:
    - 1 USB accessible on a type 'A' side connector;
    - 1 USB available on the rear Tyco Super seal connector;

Memory:
- DDR3 RAM 2GB;
- Flash EMMC 16GB;
- SERIAL FLASH 16MB;
- EEPROM 32kB.

Software options:
- Linux Op. Sys. + QT® Framework.

BLOCK DIAGRAM



Note 1: RAM DDR3
6100552/1x - 2GB (4 x 512MB)

DETAILED SPECIFICATIONS

CHARACTERISTIC	DESCRIPTION
Operating voltage	
Nominal	12Vdc
Supply voltage, permissible range	8÷16Vdc
Power requirement	
Average power draw	24W @12V
Peak power draw (all loads)	54W @12V
No load (inputs/outputs floating, Vref floating)	< 2,0A at key on (12Vdc)
With load (inputs/outputs active, Vref active)	< 4,5A at key on (12Vdc) + 2 x 350 mA (high side current) for 12 Vdc + 400mA on sensor output +2 x 1,5A on USB
Standby current	< 2mA at key off (12Vdc)
Power output	
Power source for external sensors	5Vdc ± 5% max 400mA / 2W (max)
Thermal and IP characteristics	
Operating ambient temperature	-30 to +70°C (-22 to 158°F)
Storage temperature	-40 to +85°C (-40 to 185°F)
Ingress Protection rate	IP66
Weight	
Total mass	2250g (4.96lbs)
Mounting location	
Suggested	Cab interior
Status LED	
High efficiency dual color LED	Red or green, software configurable
TFT	
Size	12.1'' Normally white
Form factor	16:10
Brightness	1000 cd/m² typical; 800 cd/m² minimum (@20°C)
Contrast ratio	600:1 minimum (@20°C)
Color depth	24 bits (3 x 8 bits per color)
Resolution	1280 x 800
Viewing area	262 x 164 mm
Viewing angles	88/88/88/88
Backlight	With automatic and user programmable dimming function
Protective glass features	
Optically bonded (OCA)	☑

Anti reflection finish	☑
Anti fingerprint finish	☑
Touch screen	
Touch screen	Capacitive with multi-touch capability (up to 10 points). Detection compatible with light glove.
Microcontroller	
Family and Manufacturer	Texas instruments JACINTO 6 (DRA744x)
Clock frequency	1GHz
Cores	2 x A15, 2 x M4
GPU	SGX544 core 3D Graphics accelerator + 2D G320 BitBLT
DSP	C66x Digital signal processing core
Internal ROM	256kB
Internal RAM with ECC	512kB
External Memory capability	
DDR3 RAM	2GB
Flash EMMC	16GB (application and operating system)
SERIAL FLASH (QSPI bus)	16MB (boot process)
EEPROM (SPI bus)	32kB (application configuration)
Real time clock	
Backed up by capacitors	Typical retention time >10 minutes, precision @ extremes (-40, +85C) ±2.17sec/day
Audio	
Internal speaker	Sound intensity of 85 ±3dbA @ 1kHz measured at 10cm from speaker. On the back panel.
Stereo output	Unbalanced, Line level output, -3dB BW: 15Hz to 30kHz R_{LOAD} > 1kΩ, 1.45V_{PP}; external amplifier required.
Analog video inputs	
2 x Automatic PAL/NTSC	on Mini-BNC connectors
Input characteristics	As per analog video standard: 75Ω , 1Vpp
Other	
Ambient light sensor	Ambient light sensor for user-evaluated night and day view managing. No algorithm implemented
Battery Voltage measurement	Accuracy: ±(8%+0.2V) (-30÷70°C)
Interfaces	
2 x CAN bus	2.0B high speed (up to 500 Kbps) ISO 11898 – SAE J1939 capable Wake-up function CAN 1 termination: software selectable only when powered CAN 2 termination: not populated
1 x LIN	LIN 2.2 Master Wake-up function
1 x RS232	Up to 115kbps only for DEBUG

1 x Broad-R-Reach	100Mbps on 1 UTP
2 x USB	USB 2.0 'type A' connector on the side, 1.5A charging current USB 2.0 on the rear TYCO connector, 1.5A charging current
1 x WiFi/ BT Module	Wifi Standard IEEE 802.11b IEEE 802.11g BT/BLE v5.0
Multifunction inputs	
2 x Analog 0-16Vdc (software configurable)	- (pull down 6,8kΩ), ADC with 12bit resolution - Accuracy 0-16Vdc: ±(8%+0.1V) (-30÷70°C) - No built in Fault detection available
3 x Digital low side input	- Internal pull-up 6,8kΩ, no wake function - No built in Fault detection available
1 x Digital high side input	- Internal pull-down 6,8kΩ, wake function on rising edge - No built in Fault detection available
Power outputs	
2 x High Side outputs	- Max 350mA with current sense. PWM up to 50Hz, duty 2÷98%
Additional features	
Reverse polarity protection on Power supply	☑
Reverse polarity protection on Inputs	☑
Reverse polarity protection on Outputs	☑
Rear button	Wakeup function possible, user programmable functionality
Materials and others mechanical characteristics	
Front frame:	Plastic PC+ABS/TPS Black RAL 9005 painted
External cover glass:	Mineral glass
Back side:	Metal aluminum Black RAL 9005 painted
Chassis to environment air exchange	Gore valve (P/N GORE AMF200200)

CHARACTERISTICS

COMMUNICATION INTERFACES

- **2 x CAN**

The device provides 2 CAN ports capable up to 500Kbps. capability. ISO 11898-1 and ISO11898-2 (CAN standard) – SAE J1939

CAN1:
- PIN 1 CAN1-L
- PIN 2 CAN1-R
- 120 ohm termination software selectable. Wakeup functionality available.
- Default speed set to 250kBaud

CAN2:
- PIN 3 CAN2-L
- PIN 4 CAN2-R
- No termination present on board. Wakeup functionality available.
- Default speed set to 250kBaud

- **1 x BR** (BroadR-Reach) Ethernet

The device provides 100Mbit/s transmit and receive capability over a single Unshielded Twisted Pair (UTP) cable through this automotive Ethernet standard IEEE 802.3bw.
- PIN 5 ETH1-BR+
- PIN 6 ETH1-BR-
- 120 ohm UTP cable
- 100 BASE-T1, compliant to IEEE 802.3bw
- Wake-up capability unavailable

- **2 x USB 2.0**

A full speed USB on a Type-A connector is available on the side of the device, featuring a USB Battery Charger Detection (BC 1.2 Specification). A second USB 2.0 interface is available on the TYCO connector, configured as a Standard Downstream Port. This interface has a 1.5A charging current. USB Short circuit to battery is currently unsupported for both interfaces. Charging currents are user programmable in EEPROM.
- USB 1
  - Type 'A' connector on side of device
  - USB2.0 full speed
  - 1.5A charging current (default)
- USB 2
  - On TYCO superseal connector
  - USB 2.0 full speed
  - 1.5A charging current (default)
  - PIN 8 USB2_D+
  - PIN 9 USB2_D-
  - PIN 16 USB2_GND
  - PIN 17 USB2_VCC

- **1 x RS232**

Port used only for debugging purposes. With speeds up to 115200 baud.
- PIN13 RS232_TX
- PIN12 RS232_RX
- PIN11 RS232_GND
- Speeds up to 115200

- Managed by the operating system, unavailable to Android.

- **1 x LIN 2.2 Master**

  A Local Interconnect Network port is available. A serial communication bus developed for cost sensitive automotive applications. This port acts as a MASTER.
  PIN 10 LIN communication pin
  - Use power ground for return signal. 1kohm pullup (to V_{BATT})
  - LIN2.2A/SAE J2602. Up to 20kb/s, set to 19.2kb/s

- **1 x WiFi/BT Module**
  - **Wifi 2.4GHz:**
    - Wifi Standard IEEE 802.11b IEEE 802.11g
    - Role to Station Mode
    - No Access Point Mode supported.
  - **BT v5.0:**
    - Protocols: SDP, L2CAP, RFCOMM , SPP, OBEX
    - Profiles: HFP 1.7.1, PBAP 1.2.1, MAP 1.4, PAN/BNEP, A2DP 1.3.1, AVRCP 1.6.1, AVDTP 1.3, AVCTP 1.4 with SBC CODEC, ATT/GATT
  - **BLE (GATT Client):**
    - service discovery
    - device connection
    - read characteristics from device
    - write characteristics from device
    - enable/disable notifications
    - receive notifications

DIGITAL AND ANALOG INPUTS

- **1 x Digital high side input**
  - PIN 14 corresponding to IN 1 on the Tyco connector, wakeup function can be configured on this pin
  - logic level 0 when voltage input under 1Vdc±0.3V over the entire temperature range (*);
  - logic level 1 when voltage input over 5Vdc±0.6V over the entire temperature range (*);
  - pull-down of 6.8kΩ to GND.
  - range from 0 to 32V

- **3 x Digital low side inputs**
  - PIN 21 corresponding to IN 2 on the Tyco connector, no wakeup function associated to this pin
  - PIN 30 corresponding to IN 4 on the Tyco connector, no wakeup function associated to this pin
  - PIN 15 corresponding to IN 6 on the Tyco connector, no wakeup function associated to this pin
  - logic level 1 when voltage input under 1Vdc ±0.3V on both inputs over the entire temperature range (*);
  - logic level 0 when voltage input over 5Vdc ±0.6V on both inputs over the entire temperature range (*)
  - pull-up of 6.8kΩ to V_{BATT}:
  - range from 0 to 16V

- **2 x Analog inputs**
  - PIN22 corresponding to IN 3 on the TYCO connector
  - PIN31 corresponding to IN 5 on the TYCO connector
  - 0-16 Vdc dynamic range, software configurable
- **1 x Key input**
  - PIN27 on the TYCO connector
  - Pulled down with a 15kohm resistor;

- Minimum voltage → 4.5V ±0.5V on the entire temperature range. (*)

(*) T_{amb} -30C° … +70°C

DIGITAL OUTPUTS

- **2 x Digital high side outputs**
  - PIN 28 corresponds to OUT 1;
  - PIN 29 corresponds to OUT 2;
  - Max 350mA with current sense. PWM up to 50Hz, duty 2÷98%
  - PWM frequency and resolution in accordance with rise and fall time of the driver;
  - Protected against short circuit and overload.
  - Current sense with ±10% accuracy with load >50mA;
  - I_{MAX} 350mA;
  - R_{MIN} 35Ω@ 12Vdc
  - L_{MAX}: 50mH; in case of PWM output management it's recommended an external protection of the output;
  - An evaluation must be conducted prior to driving inductive loads outside of the stated specifications.

(*) T_{amb} -30C° … +70°C

AUXILIARY SUPPLIES

- **1 x AUX POWER output**
  An auxiliary power supply to power external sensors is provided at 5Vdc (accuracy: ±5%), with 400mA of maximum current, over the entire range of 8÷32Vdc. The microcontroller monitors this power supply. The output is protected against short circuit to ground and to VBatt.
  - PIN 20 corresponds to Vss;
  - PIN 19 corresponds to GND_Vss;
  - $5V_{DC}$ ±5%, 400mA over the entire range of 8 to 16V

VIDEO

- **2 x ANALOG VIDEO inputs**
  These inputs accept analog video inputs. An automatic sensing mechanism is in place to detect NTSC or PAL video signals.
  - MINI BNC 1 Video in 1
  - MINI BNC 2 Video in 2
  - Automatic NTSC/PAL switching
  - Single ended 75 ohm connections 1_{Vpp}, on board fixed termination.

Use of video inputs must not be intend for continuous video capture

AUDIO

- **1 x STEREO LINE OUTPUT**
  'Audio Out' Line level audio out. Conveys audio from internal audio sources to an external amplifier.
  - PIN 23 AUDIO_OUT_R
  - PIN 32 AUDIO_OUT_L
  - PIN 24 AUDIO_GND
  - $V_{out} \leq 1.45_{Vpp}$
  - $R_{LOAD} > 1k\Omega$ (external load)
  - Frequency response $_{-3dB}$ → 15Hz to 30kHz
  - Single ended, AC coupled.

LOAD DUMP PROTECTION

Complete Load dump protection is available for 12Vdc systems:

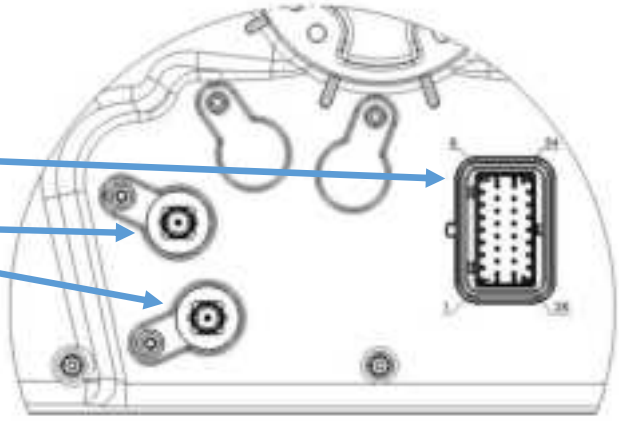
- Load dump test for 12 Vdc system (without centralized suppression):
  Us= 101 Vdc; Ri = 1 Ω; Td = 400 ms; Tr = 10 mS.
  Resistance to two pulses with a 60 second interval.

An evaluation must be conducted in case different test requirements are necessary.

CONNECTORS

Main connector
Tyco 34 pins, 3 keys, PN# Tyco 4-1437290-0.

Video inputs 1 and 2
Molex MINI BNC connector PN# 73180-5041.



FUSES

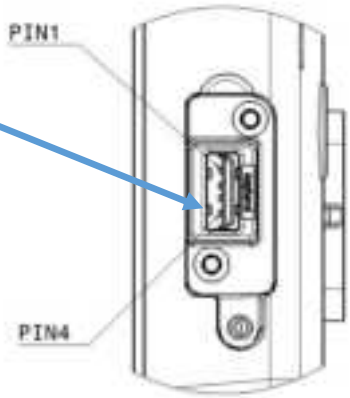
The fuse value suggested on the battery power supply is 7,5A MiniVal.

VIDEO INPUT CABLES

The Video Input cable must be properly designed and produced to guarantee the video signal integrity and quality. MTA suggests to use a "LEONI Dacar® 360" type cable (Nominal cross-section 0.089 mm²; impedance 75 Ω) or similar for Automotive applications.

Depending on to the Video Camera, a specific connector must be selected (e.g. BNC 75 Ohm - Diam. 14.5 mm), which must be properly soldered and insulated with heat shrink material. Please contact MTA for proper connection suggestions.

USB (on the right side of the display)
Amphenol USB TYPE A connector PN# MUSBR-A111-R0.



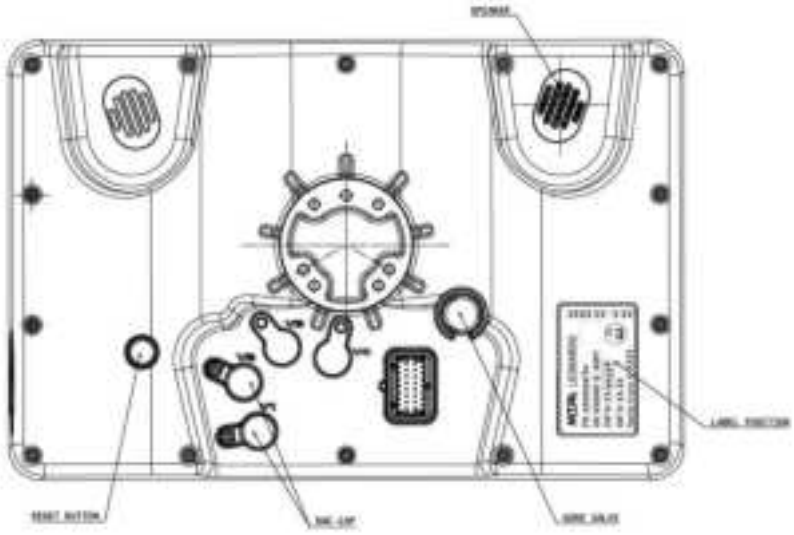
PINOUT

PIN	NAME	TYPE
1	CAN1_L	CAN1 bus low
2	CAN1_H	CAN1 bus high
3	CAN2_L	CAN2 bus low
4	CAN2_H	CAN2 bus high
5	ETH1-BR+	BROADR-REACH ETHERNET1 Plus
6	ETH1-BR-	BROADR-REACH ETHERNET1 Minus
7	- reserved -	- reserved -
8	USB2_D+	USB2 Plus
9	USB2_D-	USB2 Minus
10	LIN	LIN bus
11	RS232_GND	RS232 Ground
12	RS232_RX	RS232 In
13	RS232_TX	RS232 Out
14	IN_1	Digital Input high side with wake-up function on rising edge
15	IN_6	Digital input low side
16	USB2_GND	USB2 Ground
17	USB2_VCC	USB2 Power
18	GND (Terminal 31)	Battery Ground
19	GND Vss	Sensor Supply Ground
20	Vss	+5V Aux Power Supply
21	IN_2	Digital input low side
22	IN_3	Analog Input 0-16V
23	AUDIO_OUT_R	Audio Output right
24	AUDIO_OUT_GND	Audio Output ground
25	- reserved -	- reserved -
26	VB (Terminal 30)	Battery Power Supply
27	VCTRL (Terminal 15)	Ignition Input
28	OUT_1	High Side Output 350mA
29	OUT_2	High Side Output 350mA
30	IN_4	Digital Input low side
31	IN_5	Analog Input 0-16V
32	AUDIO_OUT_L	Audio Output left
33	- reserved -	- reserved -
34	- reserved -	- reserved -

LAYOUT


SYSTEM CHECK
TYRE PRESSURE
LIGHT
COOLINGS
ENGINE
52
MAIN MENU

DIMENSIONS



FIXING

Fixing to the vehicle is obtained using a RAM mount system. Part Number suggested : EC1414

The datasheet for the mount is available, contact your MTA sales representative.

LCD

FEATURES

- Diagonal 12.1”
- Form factor 16:10
- Active area 261 x 163 mm
- Resolution 1280 x 800 pixels, 262k colors
- Portrait and landscape modes supported (see viewing angles below)
- Contrast ratio: typ 1000:1
- Normally white
- Brightness: 1000 cd/m^2 (@20°C) typ; (800 cd/m^2 min.)
- Viewing angles (Mitsubishi): -80~80°(H), -60~80°(V)
- Viewing angles (TIANMA): 88/88/88/88
- Transmissive color TFT

LCD APPEARANCE SPECIFICAION

The following specification defines the amount of unexpected defects on the LCD panel. Bright dots are pixels that are always on (never turn dark), Dark dots are defined as pixels that are always black (never turn bright). The total amount of dark + bright is specified on the last line. If upon reception the TFT panel shows the following defects, it is rejected.

		MAX NUMBER
Dot-Defect	Bright dot-defect	N≤3 dot
	Dark dot-defect	N≤3 dot
	Total (Bright + Dark) dot	N≤5 dot

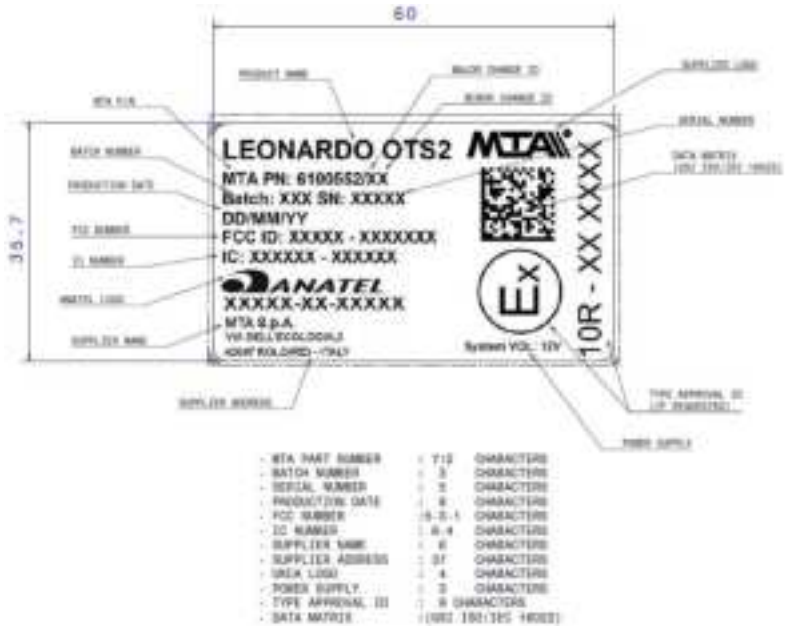
MATING CONNECTORS

The Mating connector used for the main wire harness is a Tyco 34 pin superseal.
The following parts are required for assembling a wiring harness connector:

- 34 pins, 3 key, connector PN#: C-2-1437285-3-05.
- Terminal P/N: TE 3-1447221-3 (ø0.75 to 1.25mm² conductor, ø1.8 to ø2.4mm insulation)
- Terminal P/N: TE 3-1447221-4 (ø0.5mm² conductor, ø1.6 to ø2.2mm insulation)

LABEL DETAIL

Label layout:



PRODUCT QUALIFICATION

MTA's reference test specification is TS50_16 (Rev. 6) [1] which includes:

- Environmental testing
- Mechanical testing
- Chemical testing
- Electrical testing
- EMC testing
- CE Type Approval

Please contact MTA for details on any or all specific tests.

COUNTRY CERTIFICATION AND LOGOS FOR RADIOFREQUENCY

The Leonardo OTS2 is an Off-The-Shelf product, it is not possible to predict in which countries the product will be sold, therefore only the main country certificates are shown on the label.
It is the responsibility of those who assemble the display in their vehicle, or in own final product:

1) To include a paragraph dedicated to the country type approvals required by the reference markets, in the use and maintenance manual of the vehicle itself or other vehicle's manuals released with final veichle.
2) To set into Leonardo OTS2's software stack the right country-code by own final application software, according to be compliant with the Leonardo OTS2 type approvals and prevent unauthorized use of the radio-module mounted on Leonardo OTS2.
3) To implement strategies (hardware and software) to prevent tampering by end-user or third-parties, to prevent unauthorized use of the radio-module mounted of Leonardo OTS2.

MTA REQUIREMENTS FOR RADIOFREQUENCY MODULE USE BY END USER

MTA is not responsible for the final customer application software.
The customer application software must be compliance with the following requirements:

1. It must be within the authorization of the modular transmitter at all times and cannot be changed to include unauthorized modes of operation through accessible interfaces of the host product. The Wi-Fi Tx output power limits must be followed according to country regulatory. In particular, the modular transmitter installed will not have the capability to operate on the operating channels/frequencies referred to in the section(s) below, namely one or several of the following channels: 12 (2467 MHz), 13 (2472 MHz). The channels 12 (2467 MHz), 13 (2472 MHz), are allowed to be used only for modules that are certified for the usage ("modular transmitter").

2. It must verify that the module in use is certified as supporting DFS client/master functionality.

3. It must always follow the requirements specified in Output Power Limits for WiFi Transmission chapter and cannot be changed to include unauthorized modes of operation through accessible interfaces of the product.

4. It must have a regional settings that is compliant with authorized modes for the country where the end product is sold and the end product is protected from being modified by third parties to configure unauthorized modes of operation for the modular transmitter, including the country code and maximum admitted output power.

5. It must always follow the requirements specified in Output Power Limits for Bluetooth as indicated in the Sensitivity and Power Features chapter for each specific operation mode and cannot be changed to include unauthorized modes of operation through accessible interfaces of the host product.

6. It does not provide any interface for the installer and for the end-user to enter configuration parameters into the end product that exceeds those authorized.

7. This device complies with FCC radiation exposure limits. The antennas should be installed and operated with mini-mum distance of 20cm between the radiator and your body. This transmitter must not be co-located in conjunction with any other antenna or transmitter.

MEASUREMENT TABLES:

TX AND RX RADIO FREQUENCIES AND POWERS, Bluetooth AND WiFi

Equipment Specifications						
The equipment will be operated under FCC Rule Part(s)					15.247	
Frequency range in MHz		Rated RF power output (Watts)	Frequency tolerance (%, Hz, ppm)		Emission Designator (NOT for Part 15 devices)	FCC Equipment Code (ex:: DTS, DSS, PCE)
2402	2480	0.003 W				DTS
2402	2480	0.009 W				DSS
2400	2483,5	0.427 W				DTS

Test Lab Information (ISED Test Site number(s))				
Open Area Test Site	/	**SAR / NS / RF Exposure Test Laboratory Number**	/	
Type of service requested		**Wireless Test Site Registration Number**	10864A	
Radio Certification	Yes	**Terminal Test Facility**	/	
Terminal Attachment Registration	/			

Product Specifications						
	Band 1	***Band 2***	***Band 3***	***Band 4***	***Band 5***	***Band 6***
RSS # / Issue #	247/3	247/3	247/3	247/3	247/3	247/3
Technology (GSM, CDMA, LTE, HSPA, WiMAX, etc)	WiFi	WiFi	BT	BT	BT	BLE
Band Class	802.11b	802.11g	(1M) GFSK	(2M) π/4 DQPSK	(3M) 8DPSK	1M
Frequency Min (MHz)	2400	2400	2402	2402	2402	2402
Frequency Max (MHz)	2483,5	2483,5	2480	2480	2480	2480
RF Power Min (Watts) Conducted / EIRP/ ERP	/	/	/	/	/	/
RF Power Max (Watts) Conducted / EIRP/ ERP	0.112 W Conducted	0.427 W Conducted	0.009 W Conducted	0.007 W Conducted	0.007 W Conducted	0.003 W Conducted
Field Strength Units @ distance	/	/	/	/	/	/
Measured BW (kHz) 99%	13600	16500	975	1169	1196	1063
Necessary BW (kHz) (As per TRC-43)	13600	16500	975	1169	1196	1063
Emissions Classification F1D, G1D, D1D etc (Refer to TRC 43)	13M6G1D	16M5D1D	975KF1D	1M16G1D	1M19G1D	1M06F1D
Transmitter Spurious (Units / Distance)	38 dBuV/m @3m	38 dBuV/m @3m	34.6 dBuV/m @3m	34.6 dBuV/m @3m	34.6 dBuV/m @3m	37.8 dBuV/m @3m

PRODUCT COUNTRY TYPE APPROVAL FOR RADIOFREQUENCY

ANATEL (Brasil): **07277-24-14287**

"Este equipamento não tem direito à proteção contra interferência prejudicial e não pode causar interferência em sistemas devidamente autorizados. Para maiores informações, consulte o site da ANATEL – www.gov.br/anatel".

"This equipment is not entitled to protection against harmful interference and may not cause interference to duly authorized systems. For more information, see the ANATEL website – www.gov.br/anatel".

FCC (United States of America): 2AACW-LOTS2

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1.- This device may not cause harmful interference; and

2.- This device must accept any interference received, including interference that may cause undesired operation. This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.

- Increase the separation between the equipment and receiver.

- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

- Consult the dealer or an experienced radio/TV technician for help.

TECHNICAL NOTES AND DEVIATIONS

Targets

	Classification Type	Reference: [1]	VALUE
1	System DUT voltage	4	9-16V
2	Mounting Location	6.1	Location C1 (CAB interior)
3	Minimum Temperature (Tmin)	6.2	-40 °C (Code C)
4	Maximum Temperature (Tmax)	6.2	+85 °C
5	Minimum Operating Temperature (Topmin)	6.2	-30 °C (Code B)
6	Maximum Operating Temperature (Topmax)	6.2	+70 °C
7	IP Classification	6.4	IP66
8	Vibration	6.3	Random per Location C1 (CAB interior)
9	Quiescent current		< 2mA at Key off
10	Load dump		Us=-101V | Ri=1Ω
11	Radiated and Conducted Emission limits		Class 4 of CISPR 25 Ed. 4.0
12	Type approval		ECE ONU reg. 10

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