Teseo-VIC3D and Teseo-VIC3DA hardware instructions

Introduction

The Teseo-VIC3D and Teseo-VIC3DA modules are an easy to use dead reckoning global navigation satellite system (GNSS) stand-alone module. It includes TeseoIII single die stand-alone positioning receiver IC working on multiple constellations (GPS/Galileo/Glonass/BeiDou/QZSS) and ST 3D IMU sensors to support Teseo dead reckoning automotive way (Teseo-DRAW) or Teseo dead reckoning unplugged mode (Teseo-DRUM).

The module is designed for top performance in a minimal space and it has been optimized for cost sensitive applications without quality compromise. It allows, at competitive costs, an easy integration and migration from the existing designs of products.

Within its 16 x 12.2 mm compact size, Teseo-VIC3 is offering superior accuracy, a reduced time to first fix (TTFF) and dead reckoning capability. The device is offered with a complete dead reckoning GNSS firmware which performs all GNSS operations including acquisition, tracking, sensors fusion and navigation and data output with no need of external memories.

Table 1. ST GNSS Teseo-VIC3 supported devices

Device type	Firmware version	Device grade
Teseo-VIC3DA	Teseo-DRAW	Automotive grade
Teseo-VIC3D	Teseo-DRAW	Industrial grade

1 Pinout

It is capable of receiving signals from multiple satellite navigation systems, including GPS, Glonass or BeiDou, Galileo and QZSS.

In Figure 1 the pin-out of the module:

Figure 1. Teseo-VIC3 pinout

In Table 2 the pin out description.

Table 2. **Teseo-VIC3 pin out description**

Number	Name	I/O	Description
1	WakeUp	I	External interrupt pin (if not used, must be left floating)
2	Reserved	-	Reserved
3	PPS	O	Time pulse (PPS)
4	WHELLTICK	I	DRAW wheel tick signal
5	Reserved	-	NC
6	IRQ	O	IRQ (if not used, must be left floating)
7	Reserved	-	NC
8	nReset	I	Input signal to force the module under reset
9	VCC_RF	O	Output voltage RF section. It can be used to supply external active antenna
10	GND	Ground	Ground
11	RF_IN	I	RF input signal
12	GND	Ground	Ground
13	GND	Ground	Ground
14	Ant_OFF	O	External antenna control set level pull-up or pull-down to ensure proper standby current;
15	FWD	I	Teseo-DRAW forward signal (if not used, must be left floating)
16	Reserved	-	Reserved
17	Reserved	-	Reserved
18	I2C_SDA	I/O	I2C-Data (internal 10 k pull-up)
19	I2C_SDL	I/O	I2C-Clock (internal 10 k pull-up)
20	UART-TX	O	UART-TX
21	UART-RX	I	UART-RX
22	V_BAT	I	Backup voltage supply
23	VCC	I	Supply voltage
24	GND	Ground	Ground

2 Power

Teseo-VIC3 is supplied by two power pins: VCC (pin 23), and VBAT (pin 22).

2.1 VCC (pin#23)

VCC is the main supply.

VCC has to be 3.3 V ± 10%.

At startup or during low power application current can change suddenly. It is important that supply IC can provide a current consumption of 130 mA.

2.2 VBAT (pin#22)

VBAT is the supply for the low power domain backup: backup RAM and RTC.

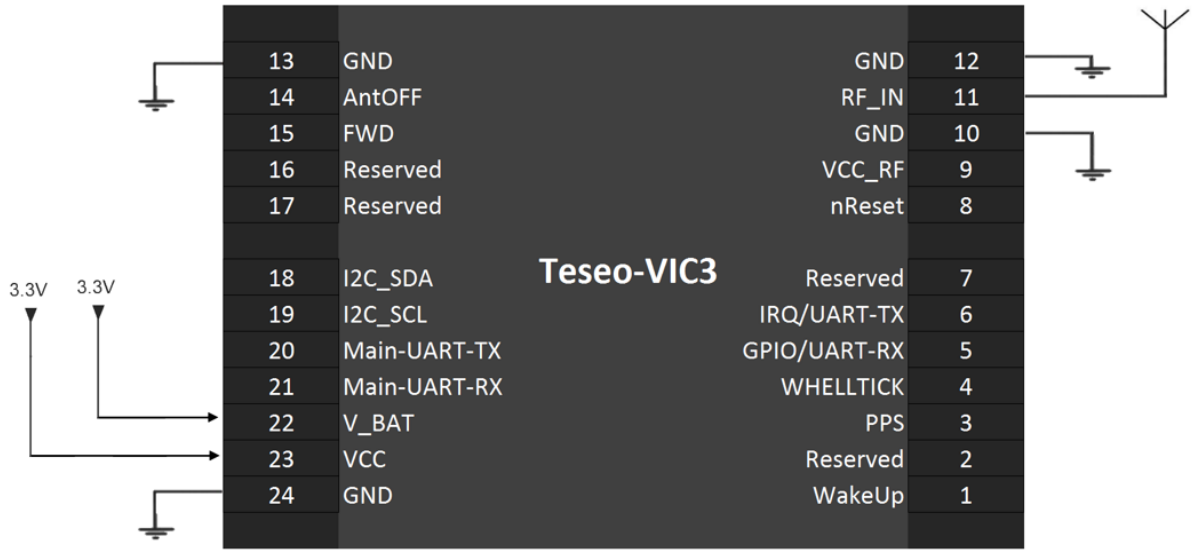
VBAT can be either connected to VCC or it can be supplied by a dedicated supply always ON. When VBAT supply is kept ON VBAT must be 3.3 V ± 10%.

2.3 GND (pin#10, #12, #13, #24)

In Teseo-VIC3 pin#10, pin#12, pin#13 and pin#24 are ground reference.

Figure 2 shows the minimum connection to make Teseo-VIC3 GNSS working.

Figure 2. Teseo-VIC3 minimum connection



3 Reserved (pin#2, #5, #7, #16, #17)

In Teseo-VIC3 pin#2, pin#5, pin#7, pin#16 and pin#17 are reserved.

4 Interfaces

4.1 I2C (pin#18, #19)

I2C port is only compatible for 3.3 V IO voltage.

Teseo-VIC3 acts on the I2C-bus as slave only.

Internal 10 k pull-up resistor on the VCC is present. It is important to avoid having other pull-up for current leakage in low power mode.

4.2 UART (pin#20, #21)

UART is a universal asynchronous receiver/transmitter that supports much of the functionality of the industry-standard 16C650 UART.

This UART differs from the industry-standard 16C650 on some minor points which are:

- Receive FIFO trigger levels
- The internal register map address space, and the bit function of each register differ
- The deltas of the modem status signals are not available
- 1.5 stop bits are not supported
- Independent receive clock feature is not supported

For the first PCB, it is recommended to plan to have some filtering components on Teseo-VIC3 UART lines.

5 I/O pins

5.1 PPS (pin#3)

PPS is the time pulse per second. It can be configured with different condition of pulses.

For the first PCB, it is recommended to plan to have some filtering components on Teseo-VIC3 PPS pin.

5.2 WakeUp (pin#1)

It is an external interrupt that is used to wake-up Teseo-VIC3 for asynchronous wake-up during standby software for instance.

Wake-Up pin is active high.

It can be activated by a GPIO from host for instance.

5.3 nRESET (pin#8)

It forces the Tese-VIC3 under reset.

Reset signal is active low.

Host processor must have full control of this pin to guarantee the Teseo-VIC3's firmware upgrade support.

5.4 RF_IN (pin#11)

It is the RF input.

No DC is present.

ESD diode is present. Avoid any DC on the pin.

5.5 AntOFF (pin#14)

AntOFF is a GPIO used to switch OFF external LNA or switch OFF current for the active antenna.

5.6 IRQ (pin#5)

It is a GPIO-Out signal driver by Teseo-VIC3 to notify to the host an internal event happened.

IRQ pin is active high.

This pin must be tightened to high or low (pull-up or pull-down) in case standby state will be used

6 DRAW pins

Teseo-VIC3DA has two special pins to acquire odometer information:

- FWD pin#15
- WHEELTICK pin#4

6.1 FWD (pin#15)

FWD is an input pin compatible to 3.3V IO voltage.

It reports the movement's direction.

In details:

- A logical high value means forwards direction
- A logical low value means backward direction

A 10 k pull-up or pull-down is necessary in case of software standby usage.

6.2 WHEELTICK (pin#4)

WHEELTICK is an input pin compatible to 3.3V IO voltage.

It's a pulsing signal which reports the wheel movement.

The number of pulses per wheel revolution has to be configured in the firmware (CDB-ID 653).

7 Standby modes

Standby mode, is the mode where only low power backup domain is running. It means VBAT must be always maintained. It allows to have very low current consumption and fast GNSS reacquisition at the end of the standby time due to RTC.

Teseo-VIC3 offers two different ways of standby:

- Software standby
- VCC standby

As IO buffers are not supplied during standby mode, it is important to keep all IO without external voltage to avoid any current leakage. UART_RX is an exception it can be left high.

7.1 Software standby

Software standby is activated by the binary for periodic standby. More details on how to set it are in the Software Manual. As HW standby, all supplies are kept ON.

Periodic fixes are from 5 s up to 24 hours between 2 fixes.

It ensures a current below 30 µA (20 µA typ.) on Teseo-VIC3.

Be careful that VCC_RF is ON during this standby, then in case of active antenna, it is important to switch them OFF.

7.2 VCC standby

VCC standby is ensured by switching OFF the VCC supply. It can be activated asynchronously from the GNSS binary with one GPIO switching OFF the supplies from a host.

During this standby only VBAT is kept ON.

It ensures a current below 15 µA (TBC). During this standby mode VCC_RF is OFF.

8 Front ends management

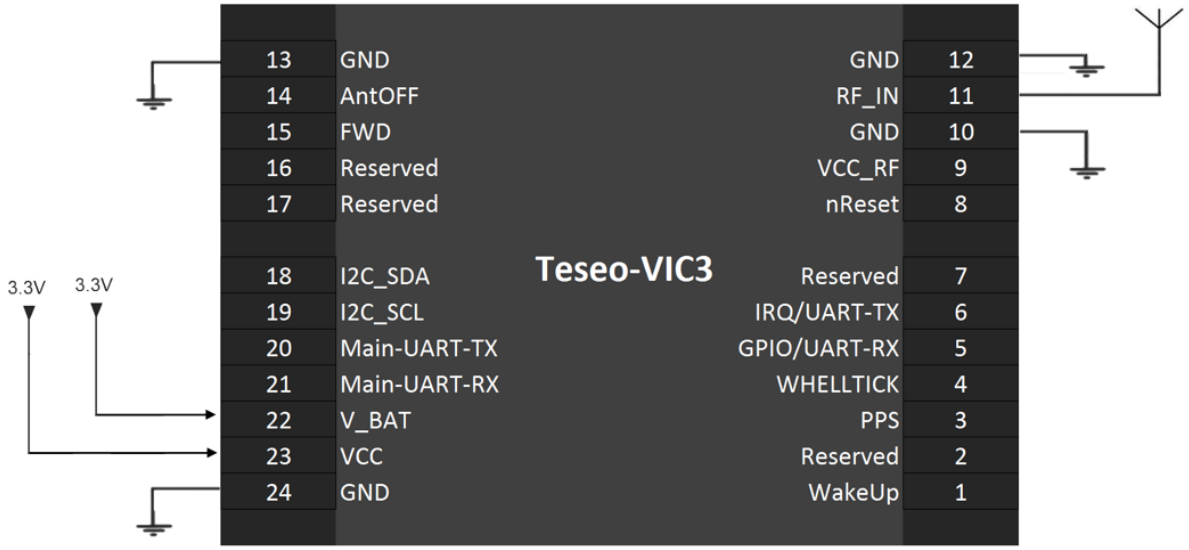
RF input impedance is 50 Ω.

8.1 Passive antenna

A passive antenna can be directly connected to Teseo-VIC3.

In addition, it could be possible that matching component must be necessary to match the antenna.

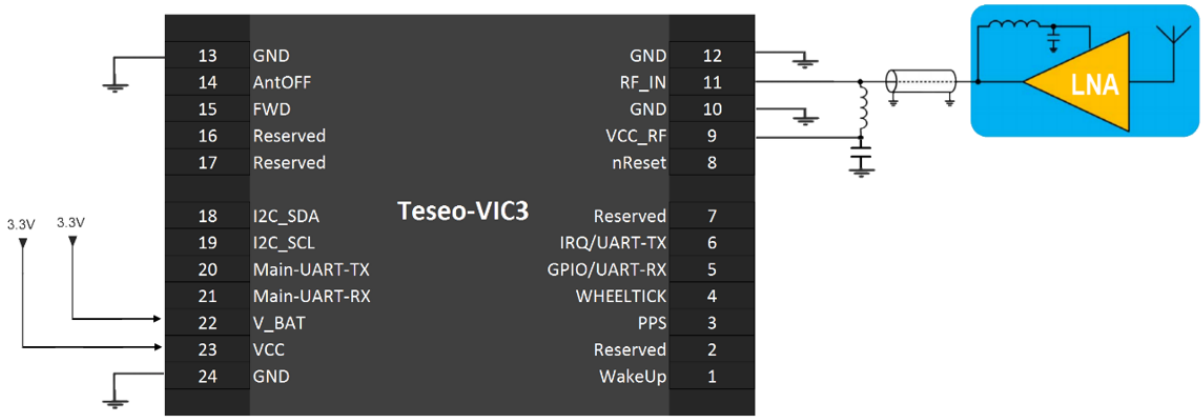
Figure 3. Connection with passive antenna



8.2 Active antenna

In case of Active antenna, antenna power supply can be acquired from VCC_RF (pin#9) which is a filtered mirror of VCC.

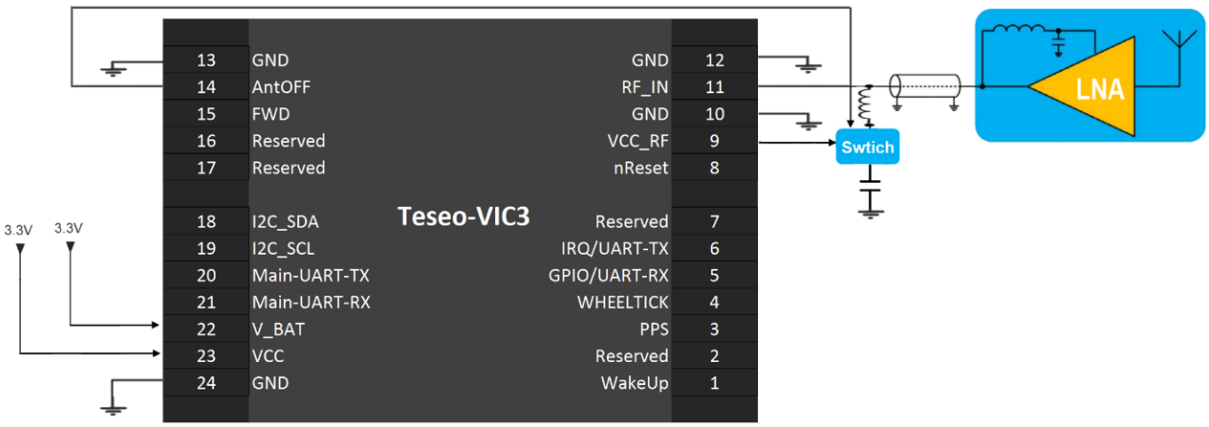
Figure 4. Teseo-VIC3 with Active Antenna



Moreover, to optimize the current during low power operating mode, the active antenna can be used with a switch to cut the current flow during the standby operation.

To achieve that the ANT_OFF (pin#14) signal can be used as enable on an external switch as shown in Figure 5.

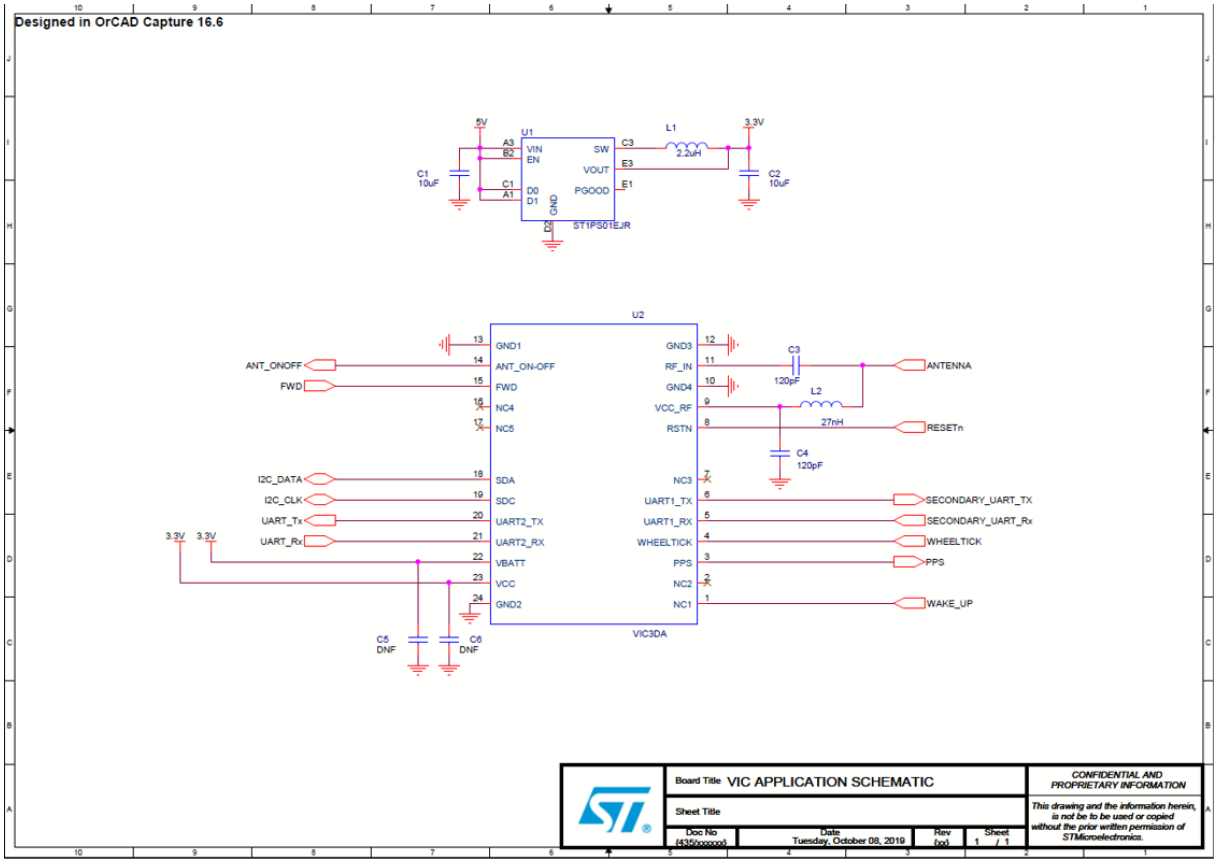
Figure 5. Teseo-VIC3 with active antenna and switch control



9 Reference schematic and BOM

9.1 Schematics

Figure 6. **VIC application schematic**



9.2 Bill of Material

Table 3. **Teseo-VIC3 carrier BOM**

Ref.	Value	Description	Manufacturer code	
			Name	Part number
C1,C2	10 µF	Chip multilayer ceramic capacitors for general purpose 10 uF+/-20% 0603 X5R 16Vdc	Murata	GRM188R61C106MA73
C3,C4	120 µF	Automotive grade surface mount 0402 capacitor ceramic 120PF, 5% 50 V C0G	Murata	GCM1555C1H121JA16
C5,C6	NA	0603 capacitor footprint in case of filtering needed		
L1	2.2 µH	Surface mount multilayer type inductor for power line 2.2 µH	Murata	LQM21PN2R2MGH
L2	27 nH	Surface mount inductor inductance: 27 nH ±5%	Murata	LQG15HS27NJ02
U1		400 mA nano-quiescent synchronous step-down converter with digital voltage selection and power good	STMicroelectronics	ST1PS01EJR
U2		Dead reckoning global navigation satellite system (GNSS) Teseo-VIC3 module	STMicroelectronics	Teseo-VIC3x

10 Layout recommendations

The RF input pin RF_IN (pin#11) is DC-cut.

For RF passive components, ST recommends using the 0402 (1×0.5mm) components. Please choose the RF ground layer to be able to get 50 ohms RF line width as close as possible to components pads to avoid impedance offsets.

11 Antenna recommendations

11.1 Patch antennas

They have the advantage to be cheap, with good efficiency and highly directive. They can be used when mounted on horizontal support.

For efficiency, the bigger are the antennas and the better are the performances.

The following table gives some antenna compatible part number.

Table 4. List of antenna p/n

Manufacturer	Part number	Constellation	Size
Taoglas	CGGBP.25.4.A.02	GPS+Glonass+Beidou	25 × 25 mm
Taoglas	CGGBP.25.2.A.02	GPS+Glonass+Beidou	25 × 25 mm
Taoglas	CGGP.18.4.C.02	GPS+Glonass	18 × 18 mm
Yageo	ANT2525B00DT1516S	GPS+Glonass	18 × 18 mm
Yageo	ANT1818B00CT1575S	GPS+Glonass	25 × 25 mm

The following table gives some SMD patch antenna part numbers compatible with GPS+Glonass:

Table 5. List of SMD antenna

Manufacturer	Part number	Constellation	Size
Taoglas	SGGP.25.4.A.02	GPS+Glonass	25 × 25 mm
Taoglas	SGGP.18.4.A.02	GPS+Glonass	18 × 18 mm
Yageo	ANT1818B00BT1516S	GPS+Glonass	18 × 18 mm
Yageo	ANT2525B00BT1516S	GPS+Glonass	25 × 25 mm

On the antenna side, there is only a ground plane as large as the antenna with one big via for the antenna pin. If the ground plane can be larger than the antenna side, it will improve the antenna performance. The antenna is usually glued and soldered with the pin.

11.2 Chip antenna

Chip antennas have the advantage to be small. They are less directive than the patch antennas with spherical radiation. Most of the time PCB must be empty of copper. Below the antenna position with a certain aperture.

Table 6. List of chip antenna

Manufacturer	Part number	Constellation	Size
Taoglas	GGBLA.01.A	GPS+Glonass+Beidou	3.2×1.6 mm
Ethertronics	M830120	GPS+Glonass+Beidou	8×3 mm

11.3 Remote antenna

Remote antenna means an antenna connected to PCB where Teseo-VIC3 is soldered with an RF connector.

Revision history

Table 7. **Document revision history**

Date	Version	Changes
17-Feb-2021	1	Initial release.

Contents

List of tables

List of figures