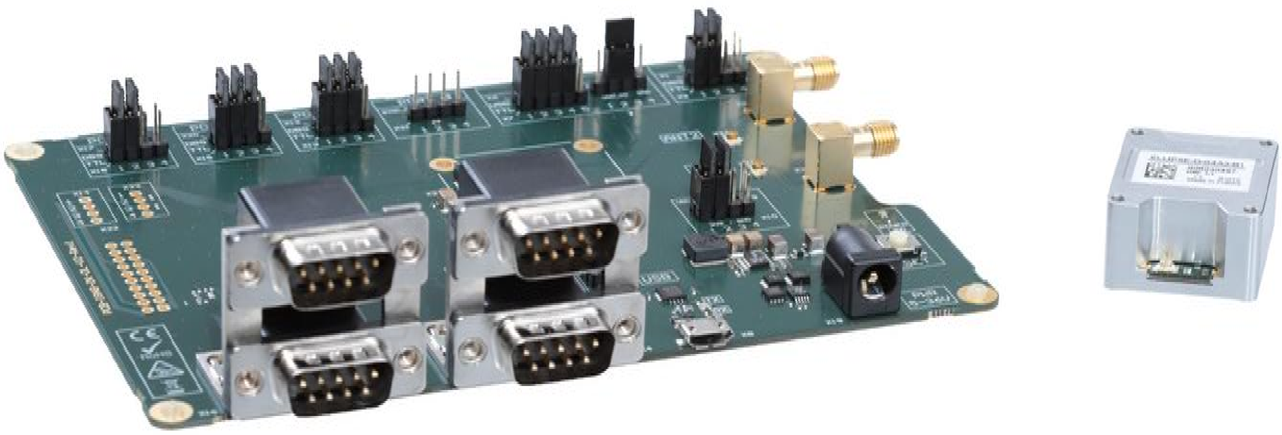
Development kit
Ellipse series – OEM version

High Performance, Miniature Inertial Sensors

Hardware Manual



Document	ELLIPSE3DKHM.1.0	**Support**	support@sbg-systems.com
Revision	1.0 - Nov 16, 2020		

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Asia: +65 98 643 776

SBG SYSTEMS

Revision history

Rev.	Date	Author	Information
1.0	Nov 16, 2020	RB	First Release

Index

Terminology

ADC: Analog to Digital Converter
AHRS: Attitude and Heading Reference System
CAN (Bus): Controller Area Network
DHCP: Dynamic Host Configuration Protocol
DVL: Doppler Velocity Log
EKF: Extended Kalman Filter
EEPROM: Electrically-Erasable Programmable Read-Only Memory
FIR: Finite Impulse Response (filter)
FTP: File Transfer Protocol
FS: Full Scale
FOG: Fiber Optic Gyroscope
GNSS: Global Navigation Satellite System
GPS: Global Positioning System
IMU: Inertial Measurement Unit
INS: Inertial Navigation System
IP: Internet Protocol
LBL: Long Baseline
MAC (address): Media Access Control
MEMS: Micro Electro-Mechanical Systems
NED: North East Down (coordinate frame)
NA: Not applicable
NMEA (NMEA 0183): National Marine Electronics Association (standardized communication protocol)
PPS: Pulse Per Second (signal)
RAM: Random Access Memory
RMA: Return Merchandise Authorization
RMS: Root Mean Square
RTCM: Radio Technical Commission for Maritime Services (Protocol)
RTK: Real Time Kinematics
SI: International System of Units
TBD: To Be Defined
TCP: Transmission Control Protocol
UDP: User Datagram Protocol
UTC: Coordinated Universal Time
USBL: Ultra Short Base Line
VRE: Vibration Rectification Error
WGS84: World Geodetic System 1984
WMM: World Magnetic Model

1. General information

1.1. Development kit components

The OEM Ellipse Series Development Kit allows to simplify the using of the OEM Ellipse modules, thanks to the following components. It gives an access to all communication ports with the possibility to use several protocols (USB, CAN, RS232, UART).

A direct access to TTL signals is also possible to further analyze the ELLIPSE OEM behavior.

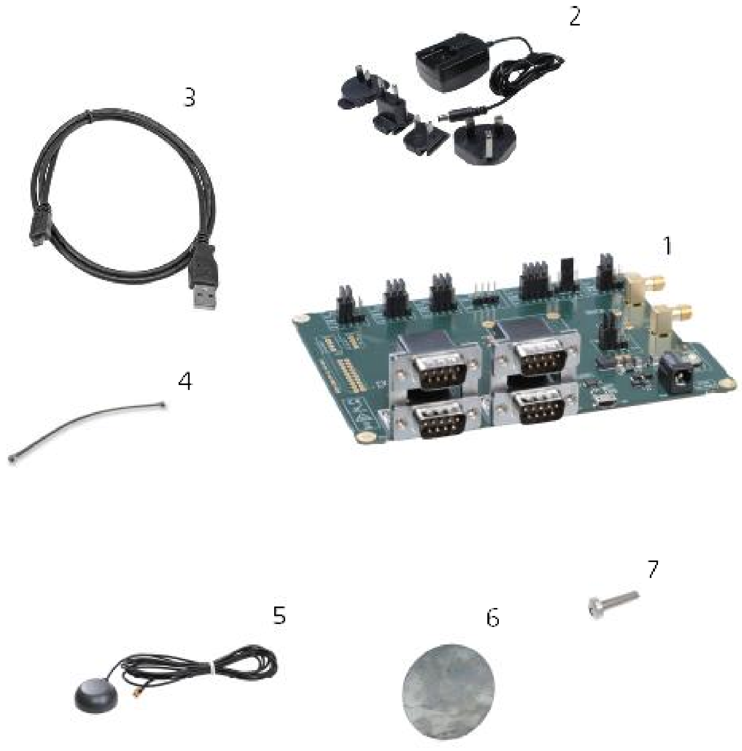

Figure 1.1: Package components

N°	Description	DK Ellipse – OEM	DK Ellipse N – OEM	DK Ellipse D – OEM
1	Development Board for ELLIPSE OEM	1 pcs	1 pcs	1 pcs
2	AC/DC wall mount power supply, 3m cable and DC jack 2.1mm (US, UK & EU adapters included)	1 pcs	1 pcs	1 pcs
3	Cable, USB A Male to USB Micro-B, 1m, black	1 pcs	1 pcs	1 pcs
4	Coax Cable, U.FL to U.FL, Micro COAX 1.13/0.68 mm, 50 mm length	-	2 pcs	2 pcs
5	Dual band GNSS patch antennas	-	1 pcs	2 pcs
6	Ground plane for patch antennas 100 mm	-	1 pcs	2 pcs
7	Screw Philips M2xL10	4 pcs	4 pcs	4 pcs

2. Development board specifications

2.1. Board overview

The evaluation board has been designed to allow the customer to test and configure the OEM Ellipse Series without any electronics development, thanks to standard connectors and cables. It can be directly interfaced with your application (DB-9 for serial ports & CAN, DIL connectors for SYNC In and SYNC Out).

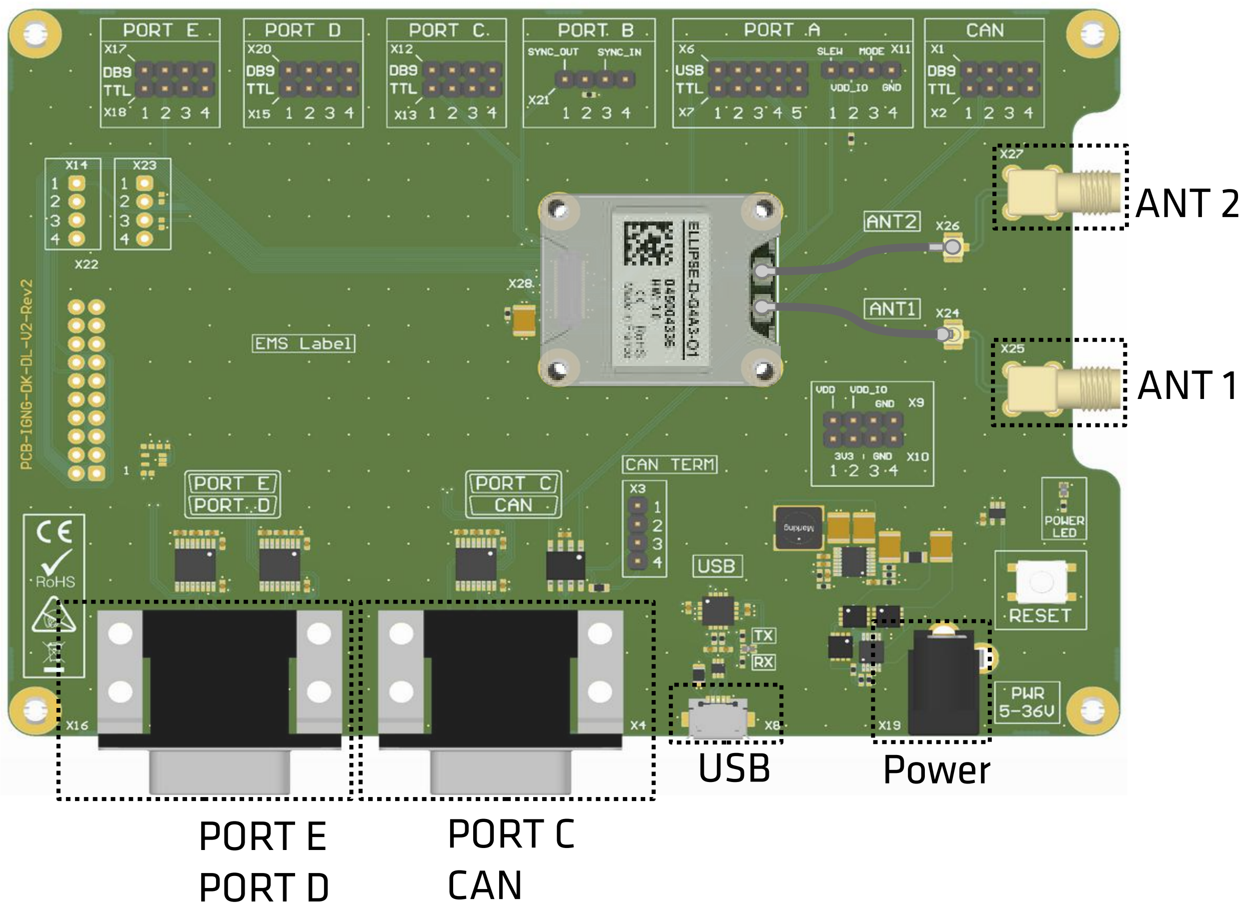

Figure 2.1: External connectors of Development Board with Ellipse-D OEM.

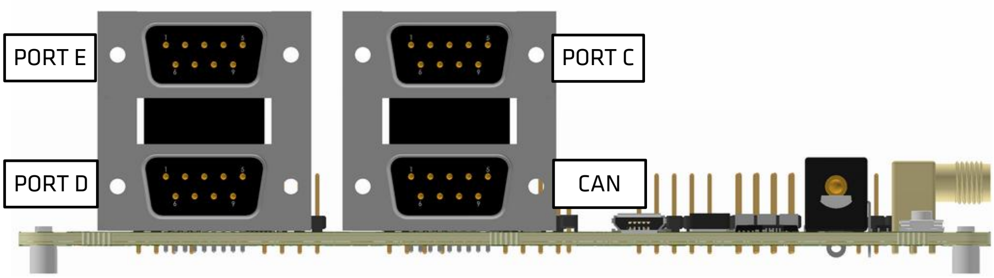

Figure 2.2: External Connectors Front View

Following connectors provide easy access to the board functionalities:

Port	Functionalities	Communication
A	Port A TX/RX SYNC IN A / SYNC OUT A (Mapped no RTS/CTS)	USB, DIL (LVTTL)
B	Port B Rx SYNC OUT B SYNC IN B	DIL (LVTTL)
C	Port C TX/RX SYNC IN C	DB-9 (RS232), DIL (LVTTL)
D	Port D TX/RX SYNC IN C	DB-9 (RS232), DIL (LVTTL)
E	Port E TX/RX	DB-9 (RS232), DIL (LVTTL)
CAN	CAN_L/CAN_H	DB-9 (CAN)

2.2. Dimensions

2.2.1. Top View

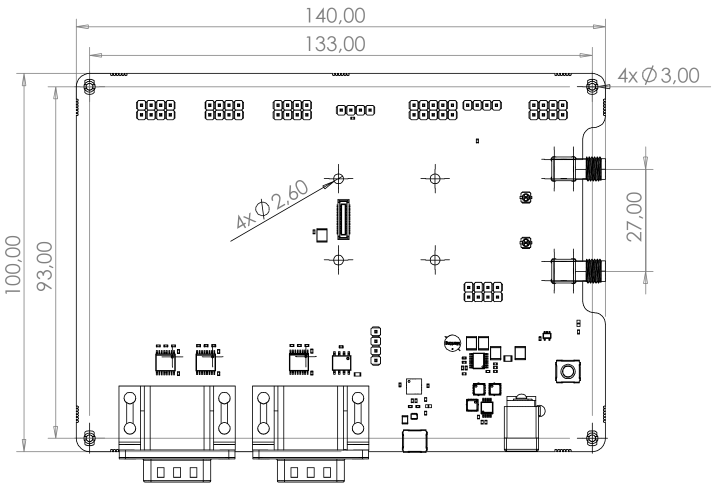

Figure 2.3: Top Dimensions

2.2.2. Side View

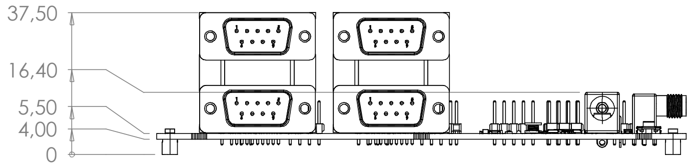

Figure 2.4: Front Dimensions

2.3. GNSS Antenna Connectors

In order to test the Ellipse-N or D, two GNSS antenna connectors are available on the board. These antenna connectors are located on the bottom of the GNSS receiver module.
The connector type is UFL. The main antenna should be connected to ANT1 and the secondary antenna should be connected to ANT2.

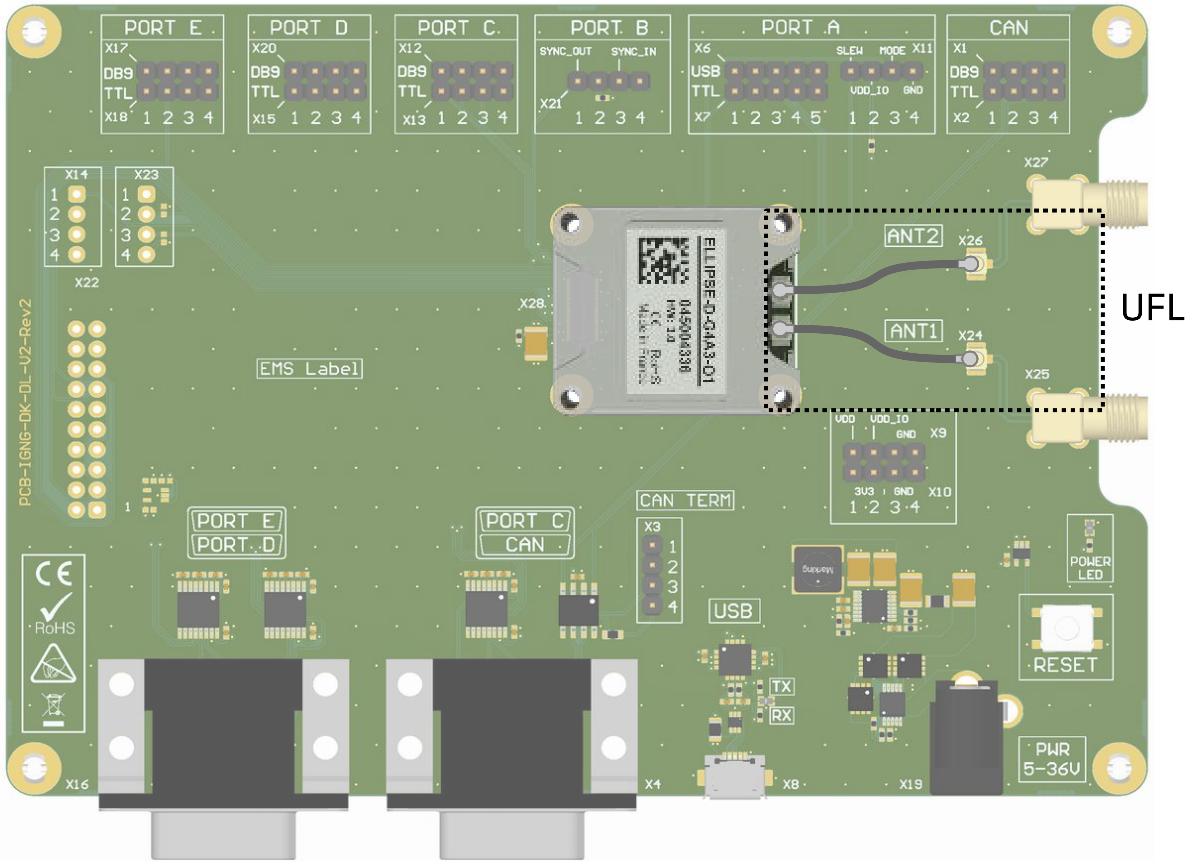

Figure 2.5: UFL Antenna Connectors for Ellipse-N or D

The GNSS antenna connectors are located on the top of the Ellipse N and D OEM. Only the ANT1 connector is available for the Ellipse N OEM.

Figure 2.6: Ellipse-D OEM GNSS Antenna Connectors

2.4. Electrical specifications

2.4.1. Main Connector

Connector	Manufacturer	Part Number	Description
Ellipse main connector	HIROSE	DF40HC(3.0)-40DS-0.4V(51)	40 Position Connector Receptacle, Center Strip Contacts Surface Mount
Mating Connector	HIROSE	DF40C-40DP-0.4V(51)	40 Position Connector Plug, Outer Shroud Contacts Surface Mount

2.4.2. Electrical specifications

Items	Conditions	Min	Typical	Max	-	Unit
Power Supply						
Input Power Supply Voltage Range		5	12	36		V
Consumption (With Antennas)		240	102	43		mA
Power (With Antennas)		1.2	1.224	1.55		W
Consumption (Without Antennas)		220	94	40		mA
Power (Without Antennas)		1.10	1.13	1.44		W
RS-232 Receivers, Sync In pins						
Input range		-15		15		V
Low level threshold		0,6				V
High level threshold				2		V
Input resistance		3	5	7		kΩ
RS-232 Transmitters						
Output range		+/-5	+/-5,5			V
Sync Out pins						
High Level Output voltage	ILoad < 100µA	3,2				V
	ILoad < 16mA	2,6				V
Low Level Output voltage	ILoad < 100µA			0,1		V
	ILoad < 16mA			0,4		V
CAN Bus						
Recessive Bus Voltage		2	2,5	3		V
CAN H Output Voltage	Dominant	2,75	3,5	4,5		V
CAN L Output Voltage	Dominant	0,5	1,25	2,25		V
Absolute input voltage	CANH, CANL	-58		58		V
Differential input voltage	CANH, CANL	0,5	0,7	0,9		V

2.5. Interfaces specifications

2.5.1. Power input

The DC 2.1 mm Barrel connector input supports a wide DC input voltage range [5 – 36V].

Alternatively, for current monitoring purpose, it's possible to directly power the Ellipse OEM module (without powering on the external components). In order to do so, the two jumpers between X9 and X10 should be defined according to the following configurations:

- Use jumpers between X9 and X10 on position 1 and 2 for internal power supply.
- Remove Jumpers between X9 and X10 on position 1 and 2 for external power supply. Apply Ellipse power supply at X9 pin 1 or 2.
- RESET Button allows to shut down the Ellipse OEM without shut down the entire board

In the case or the power supply is done without the Dev kit please connect theses voltages on the following pins:

Net Name	Voltage
VDD	3,3V
VDD_IO	3,3V

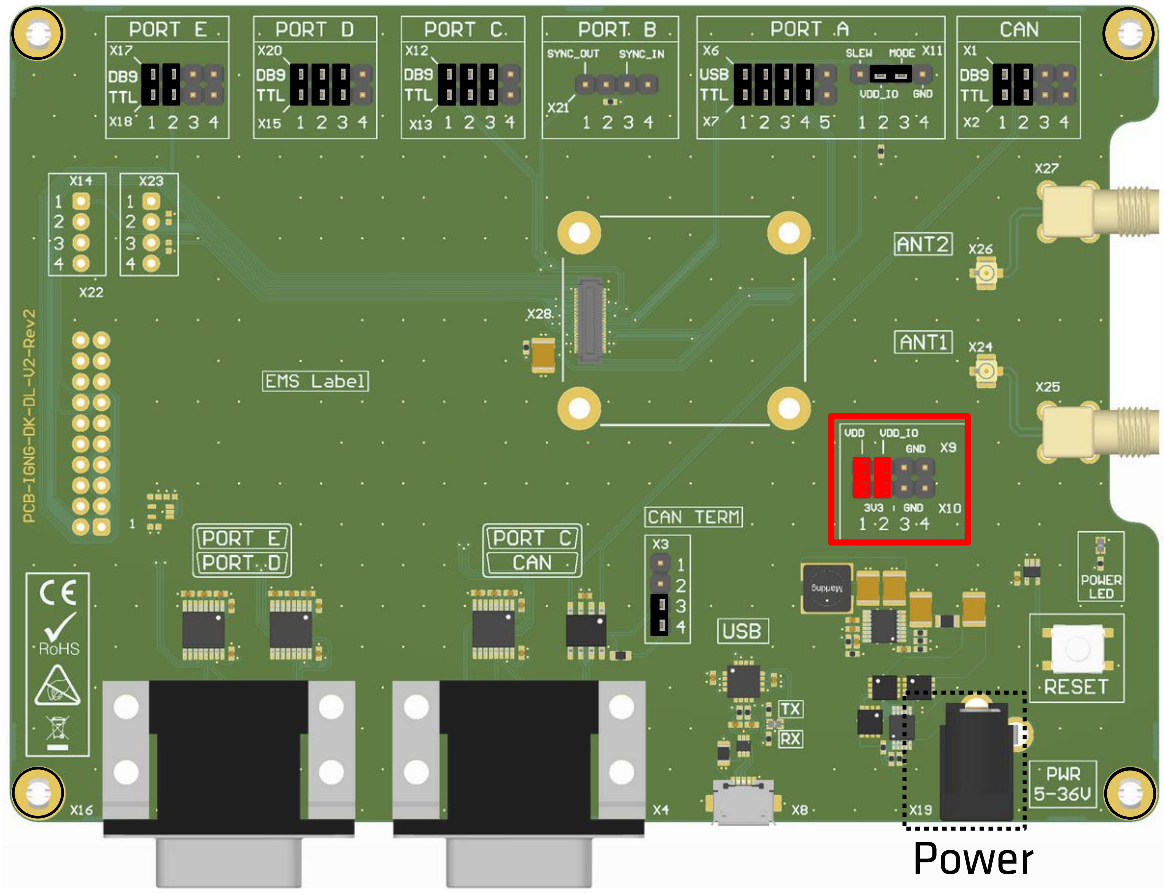

Figure 2.7: Power Supply Settings

2.5.2. LED Configuration

The development Kit has 3 LED which have the following functionalities:

- POWER LED: Indicate when the board is power supplied.
- USB TX: Works when TX USB TX frame detected
- USB RX: Works when RX USB RX frame detected

2.5.3. PORT A

By default, PORT A, SYNC IN A and SYNC OUT A are accessible through the USB micro connector available on the evaluation board (X8).

Alternatively, these signals (LVTTL) can also be directly accessed from the Ellipse board using the dedicated 2,54mm DIL connectors (X7).

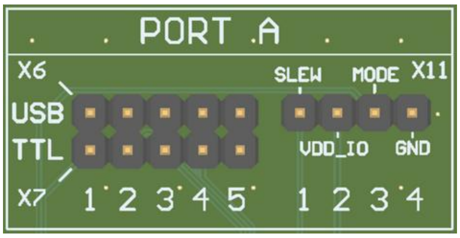

Figure 2.8: PORT A 2,54 mm DIL Connectors Without Jumpers

Figure 2.9: PORT A 2,54 mm DIL Connectors With Jumpers

When the jumpers are removed, user can access to the direct Ellipse LVTTL signals with the following pin definition: Refer to Figure 2.8

When these jumpers are ON, the access is driven to the USB port. Refer Figure 2.9

X6, X7

Pin #	Definition (at TTL side)	Type
1	PORTA_RX	LVTTL Input
2	PORTA_TX	LVTTL Output
3	SYNC_IN_A	LVTTL Input
4	SYNC_OUT_A	LVTTL Output
5	GND	Ground

Note: The current using transceiver is a FT230XQ-R from FTDI

Note: Ellipse electrical specifications apply when accessing directly at the TTL outputs.

2.5.4. PORT B

By default, PORT B, SYNC IN B and SYNC OUT B are accessible through the dedicated DIL connector (X21) available on the evaluation board.

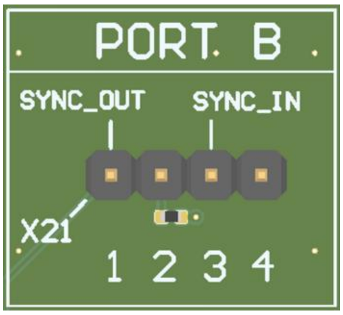

Figure 2.10: Port B 2,54 mm DIL Connector Zoom

X21

Pin #	Definition (at TTL side)	Type
1	SYNC_OUT_B	LVTTL Output
2	VDD_IO	Power In
3	SYNC_IN_B/PORTB_RX/ODO_DIR	LVTTL Input
4	GND	Ground

2.5.5. PORT C, PORT D and PORT E

By default, PORT C & D as well as SYNC IN C and D are accessible through their dedicated RS-232 DB-9 male connector available on the evaluation board (X4-Port C and X16-Port D).

Alternatively, these signals can be directly accessible from the Ellipse OEM development board using the dedicated DIL connector (X13, X15 and X18).

Figure 2.11: Ports C, D, E 2,54 mm DIL Connector Zoom With Jumper

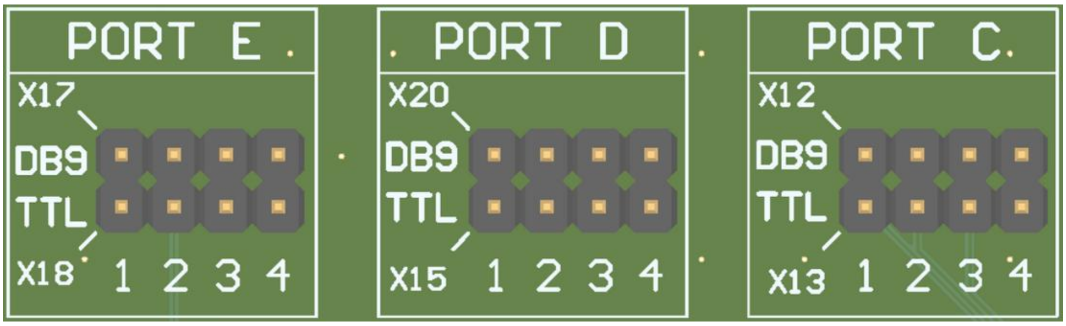

Figure 2.12: Ports C, D, E, 2,54 mm DIL Connectors Zoom

When the jumpers are ON, the access is driven to the RS-232 port.

The pinout on the DB-9 plugs is the following:

Pin #	Definition			Type
	PORT C	PORT D	PORT E	
1	SYNC IN C	SYNC IN D	N/C	RS232 Input
2	PORT C RX	PORT D RX	PORT E RX	RS232 Input
3	PORT C TX	PORT D TX	PORT E TX	RS232 Input
4	N/C	N/C	N/C	N/C
5	GND	GND	GND	Ground
6	N/C	N/C	N/C	N/C
7	N/C	N/C	N/C	N/C
8	N/C	N/C	N/C	N/C
9	N/C	N/C	N/C	N/C

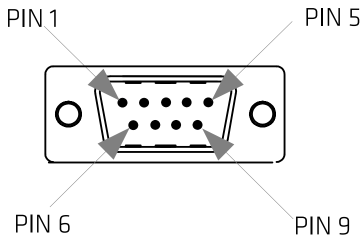

Figure 2.13: DB-9 Male Pinout

Note: At DB-9 side, the SYNC IN signals are inverted by the RS-232 transceiver.

When the jumpers are removed, user can access to the direct Ellipse signals with following pin definition:

X13 Port C

Pin #	Definition (at TTL side)	Type
1	PORT C RX	LVTTL Output
2	PORT C TX	LVTTL Input
3	SYNC IN C	LVTTL Input
4	GND	Ground

X15 Port D

Pin #	Definition (at TTL side)	Type
1	PORT D RX	LVTTL Output
2	PORT D TX	LVTTL Input
3	SYNC IN D	LVTTL Input
4	GND	Ground

X18 Port E

Pin #	Definition (at TTL side)	Type
1	PORT E RX	LVTTL Output
2	PORT E TX	LVTTL Input
3	GND	Ground
4	GND	Ground

Note: Ellipse electrical specifications apply when accessing directly at the TTL outputs.

2.5.6. CAN

CAN bus operation is available by default on the dedicated DB-9 plug (X4B) using a standard CAN pin-out as follows:

Pin #	Definition	Type
1	NC	-
2	CAN_L	I/O
3	GND	Ground
4	NC	-
5	NC	-
6	NC	-
7	CAN_H	I/O
8	NC	-
9	NC	-

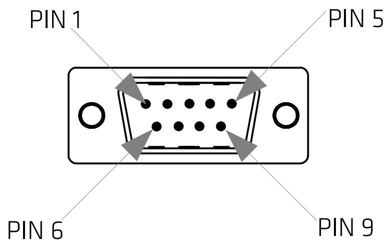

Figure 2.14: DB-9 Male Pinout

A CAN bus termination resistor can be implemented by moving the X3 jumper as follows:

X3 jumper position	Meaning
1-2	120 Ohm Termination Disconnected
3-4	120 Ohm Termination Connected

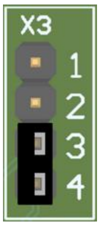

Figure 2.15: CAN 120 Ohms resistors settings

Alternatively, putting off the X1 jumpers will give access to the direct TTL CAN interface signals.

The pinout at X2 level is the following:

<u>X2 CAN</u>

Pin #	Definition	Type
1	CAN RX	LVTTL Output
2	CAN TX	LVTTL Input
3	GND	
4	GND	

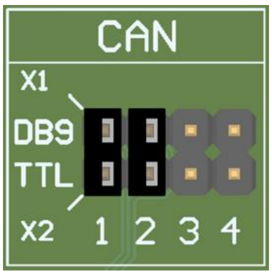

Figure 2.16: CAN 2,54mm DIL

2.6. Default jumpers configuration

The following jumpers configuration will be found when unboxing the development board:

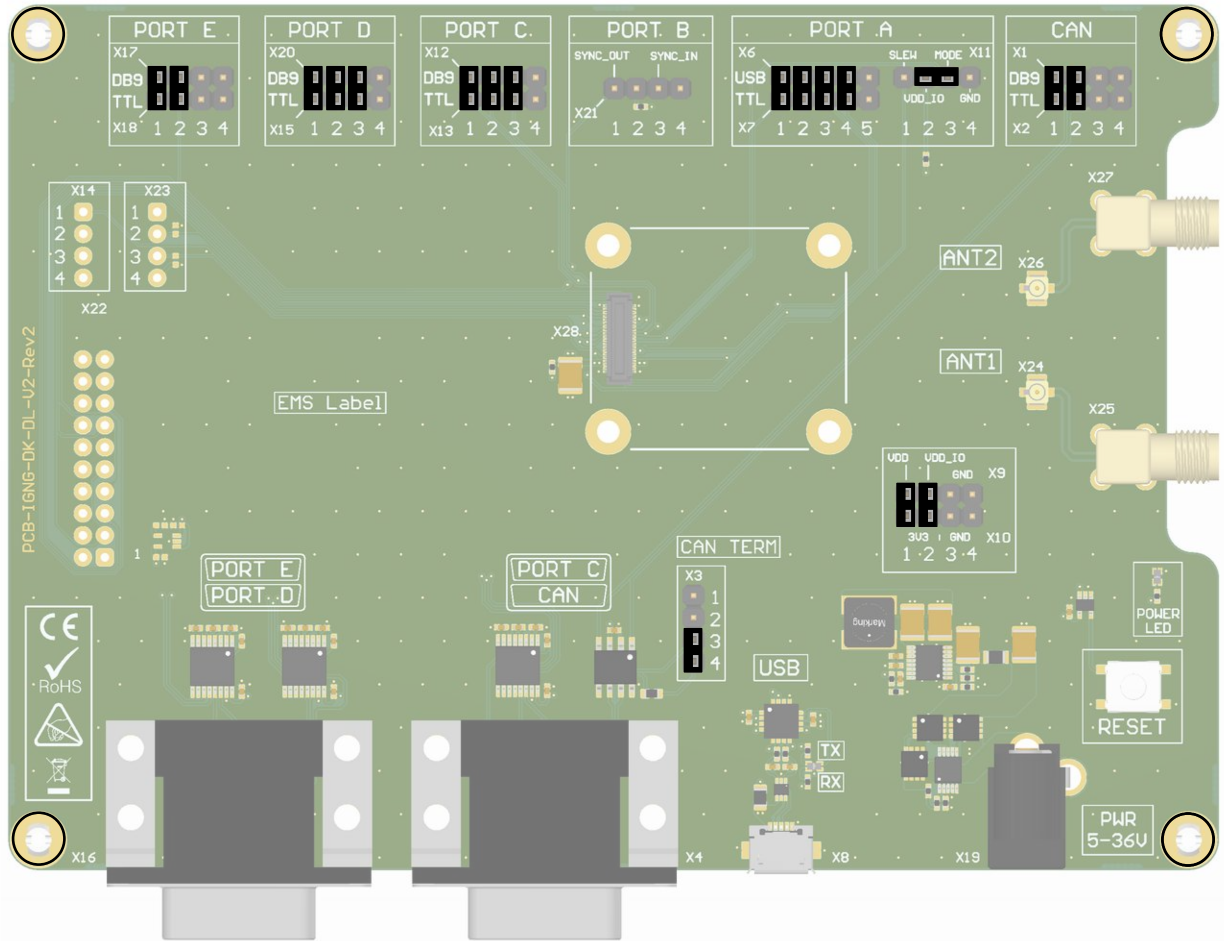

Figure 2.17: Default Jumpers Position

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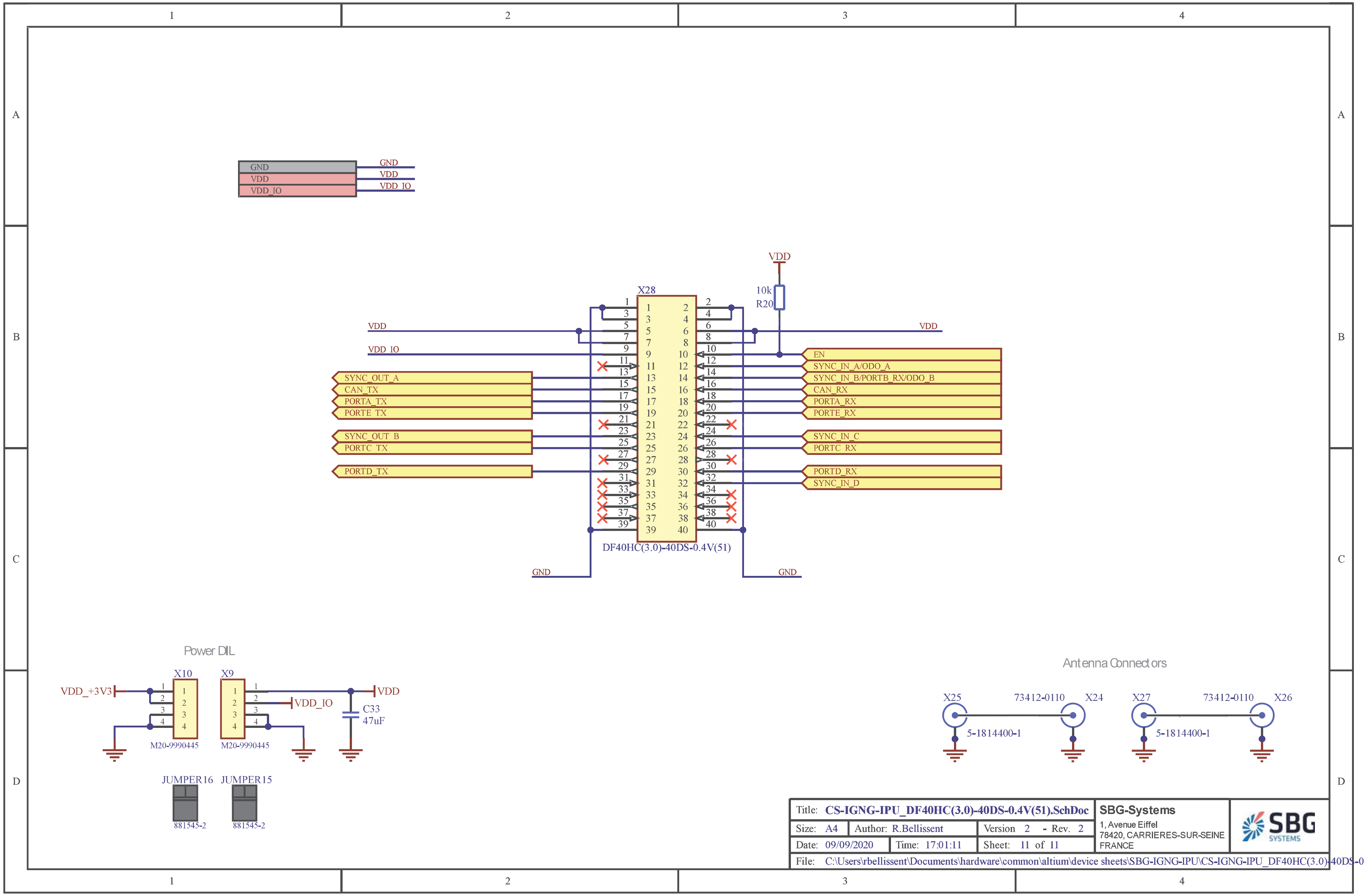
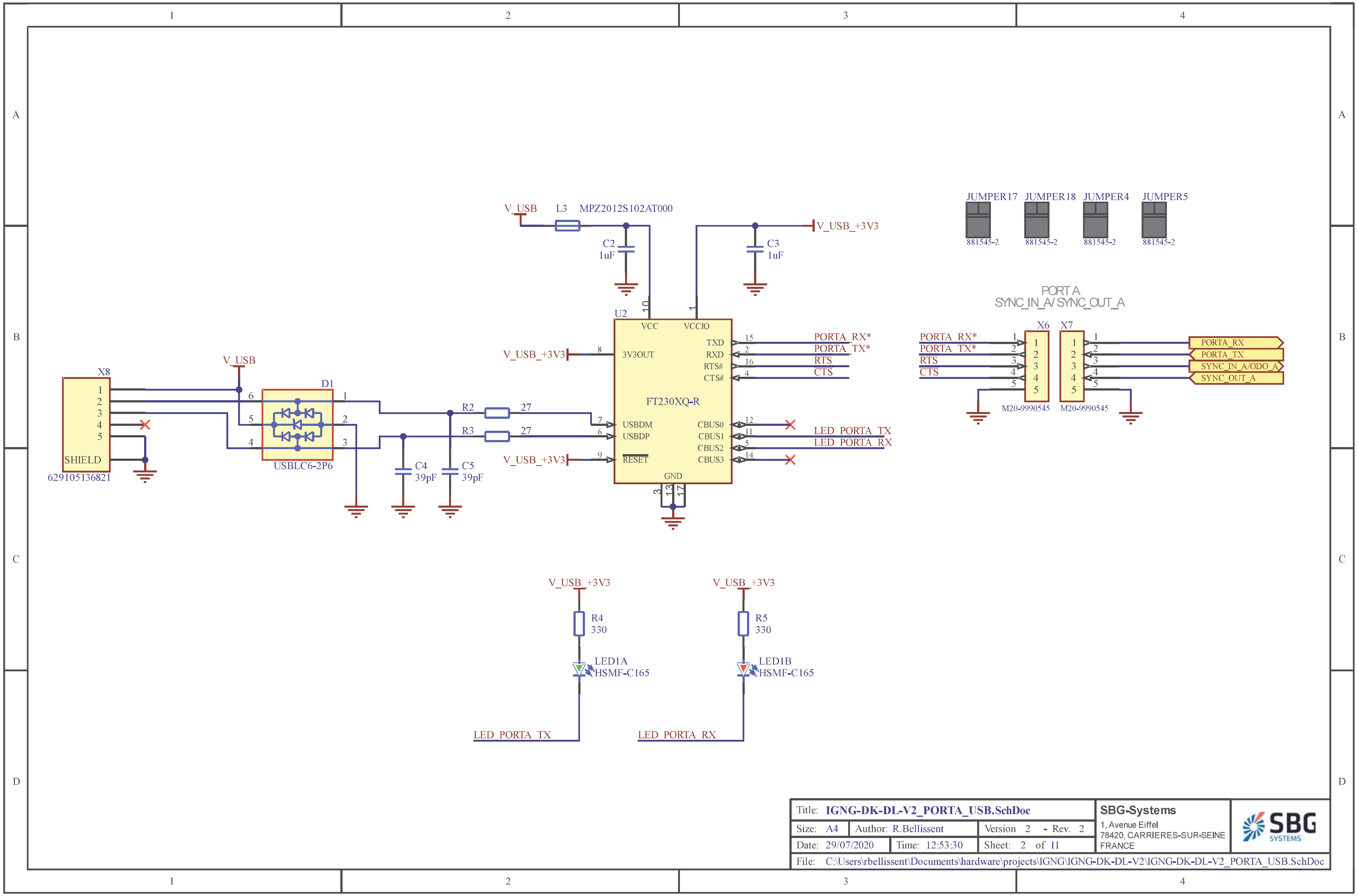
2.7. Schematics

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C2
1uF
C3
1uF
V_USB_+3V3
JUMPER17
JUMPER18
JUMPER4
JUMPER5
881545-2
PORT A
SYNC_IN_A/ SYNC_OUT_A
X6
X7
U2
VCC
VCCIO
3V3OUT
TXD
RXD
RTS#
CTS#
PORTA_RX*
PORTA_TX*
RTS
CTS
FT230XQ-R
USBDM
USBDP
RESET
CBUS0
CBUS1
CBUS2
CBUS3
GND
LED_PORTA_TX
LED_PORTA_RX
PORTA_RX
PORTA_TX
SYNC_IN_A/ODO_A
SYNC_OUT_A
M20-9990545
X8
SHIELD
629105136821
D1
USBLC6-2P6
R2
27
R3
27
C4
39pF
C5
39pF
R4
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R5
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LED1B
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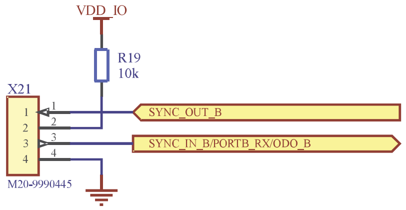
78420, CARRIERES-SUR-SEINE
FRANCE



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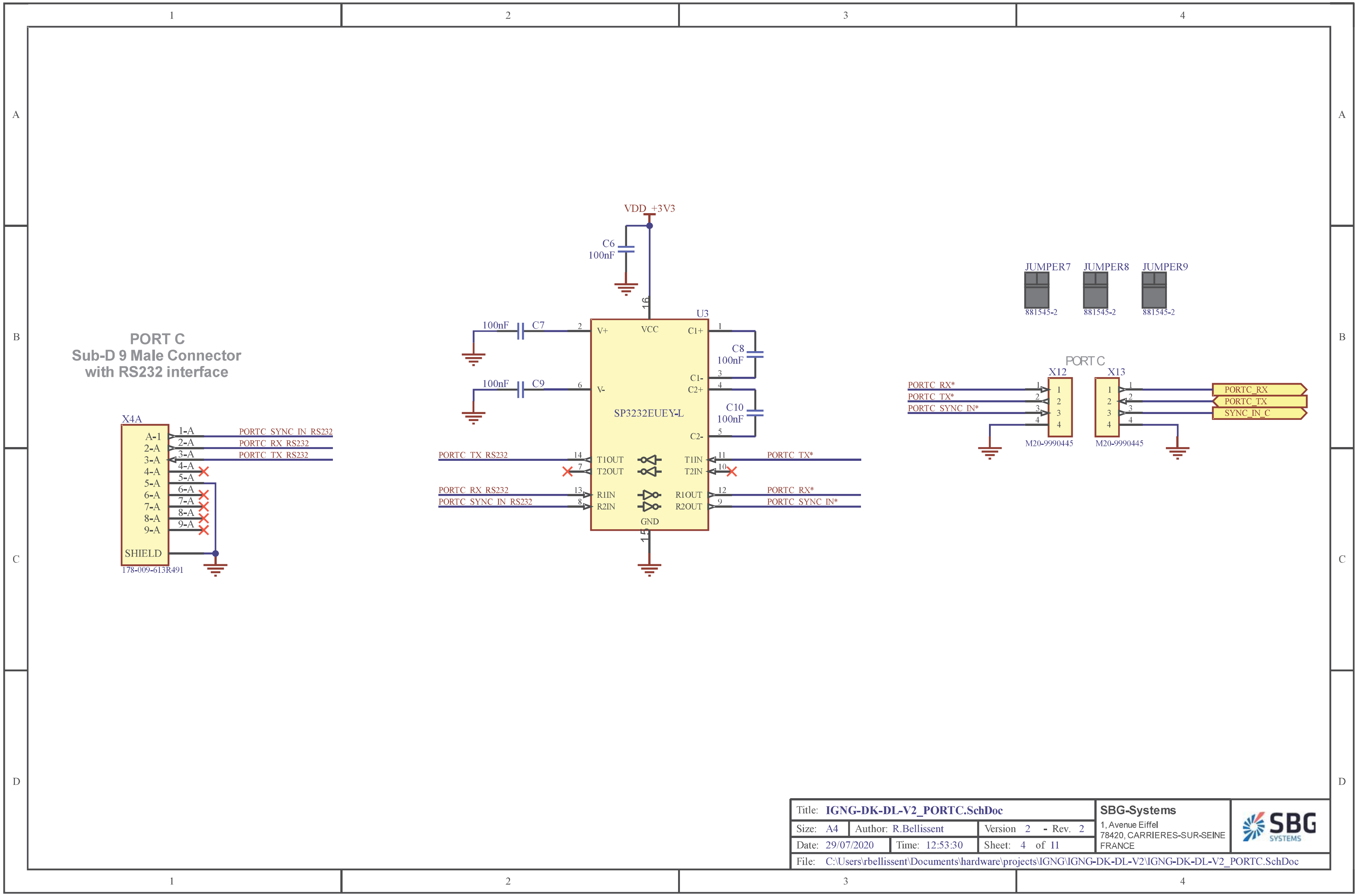
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Sub-D 9 Male Connector
with RS232 interface
X4A
178-009-613R491
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PORTC_RX_RS232
PORTC_TX_RS232
VDD_+3V3
C6
100nF
C7
100nF
C9
100nF
C8
100nF
C10
100nF
U3
SP3232EUEY-L
VCC
GND
V+
V-
C1+
C1-
C2+
C2-
T1OUT
T2OUT
R1IN
R2IN
T1IN
T2IN
R1OUT
R2OUT
PORTC_TX*
PORTC_RX*
PORTC_SYNC_IN*
JUMPER7
JUMPER8
JUMPER9
881545-2
PORT C
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X13
M20-9990445
PORTC_RX
PORTC_TX
SYNC_IN_C
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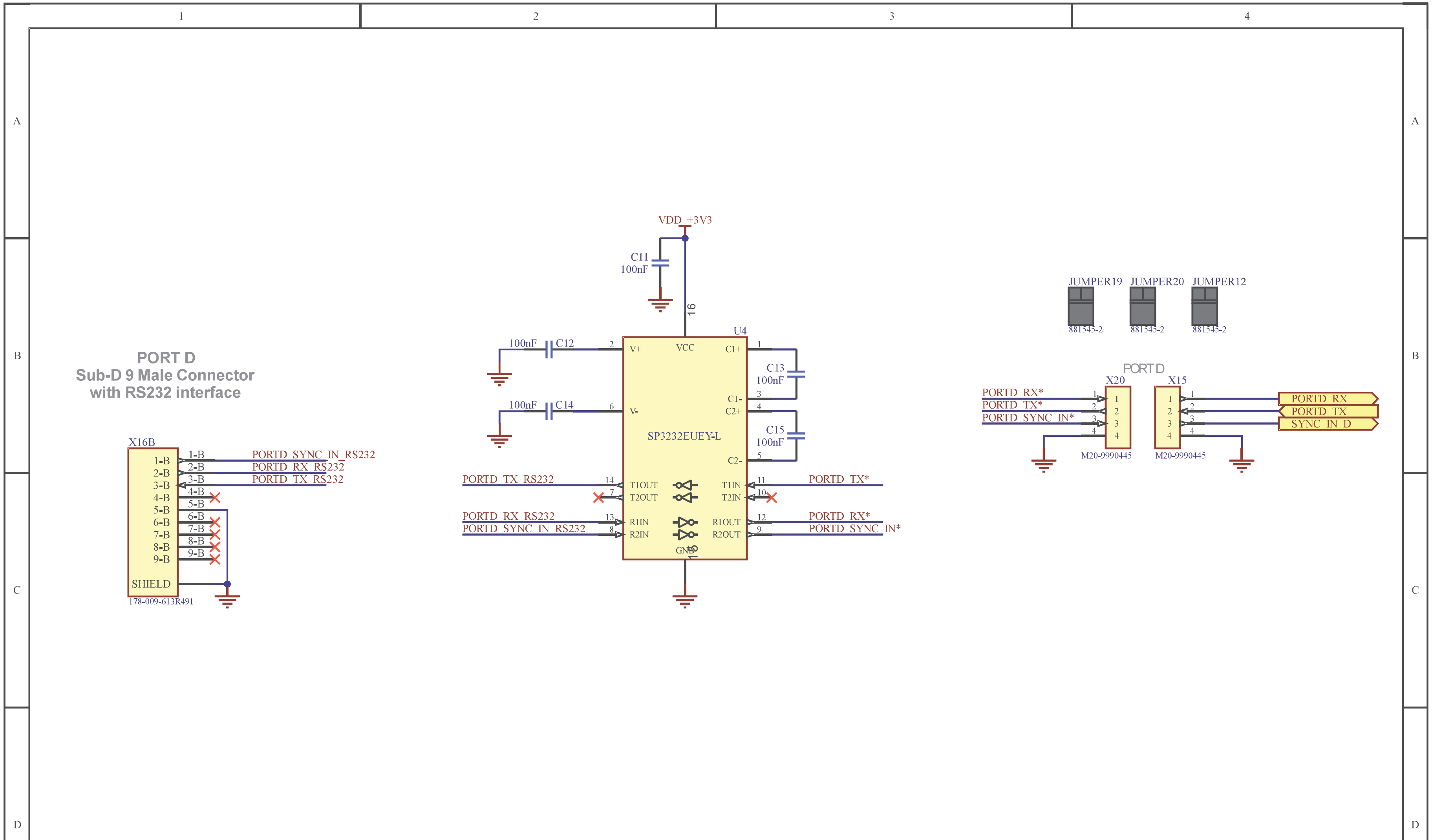
FRANCE



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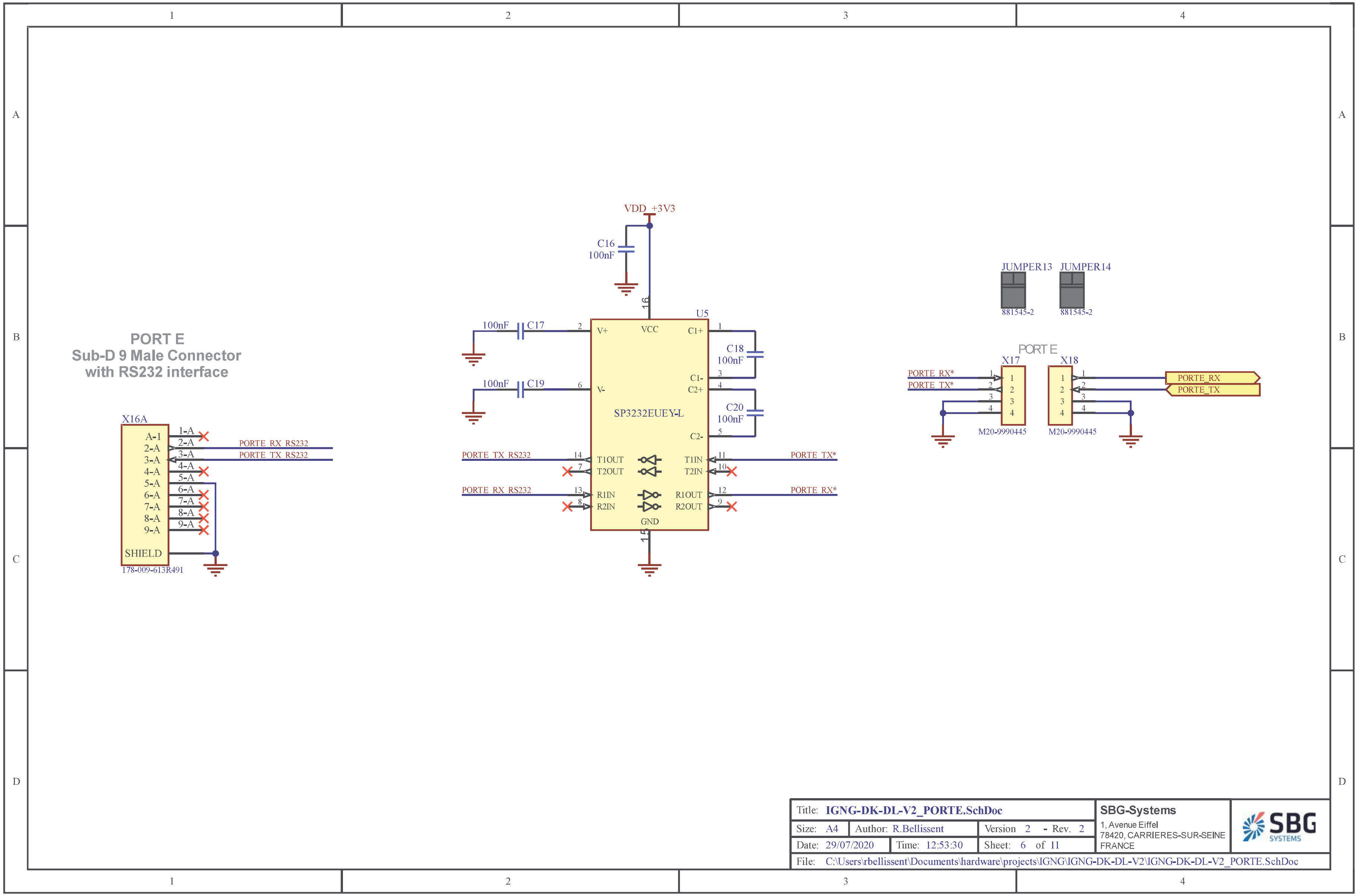
PORT E
Sub-D 9 Male Connector
with RS232 interface
X16A
178-009-613R491
SHIELD
PORTE_RX_RS232
PORTE_TX_RS232
VDD_+3V3
C16
100nF
C17
C18
C19
C20
U5
SP3232EUEY-L
VCC
GND
V+
V-
C1+
C1-
C2+
C2-
T1OUT
T2OUT
R1IN
R2IN
T1IN
T2IN
R1OUT
R2OUT
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PORTE_RX*
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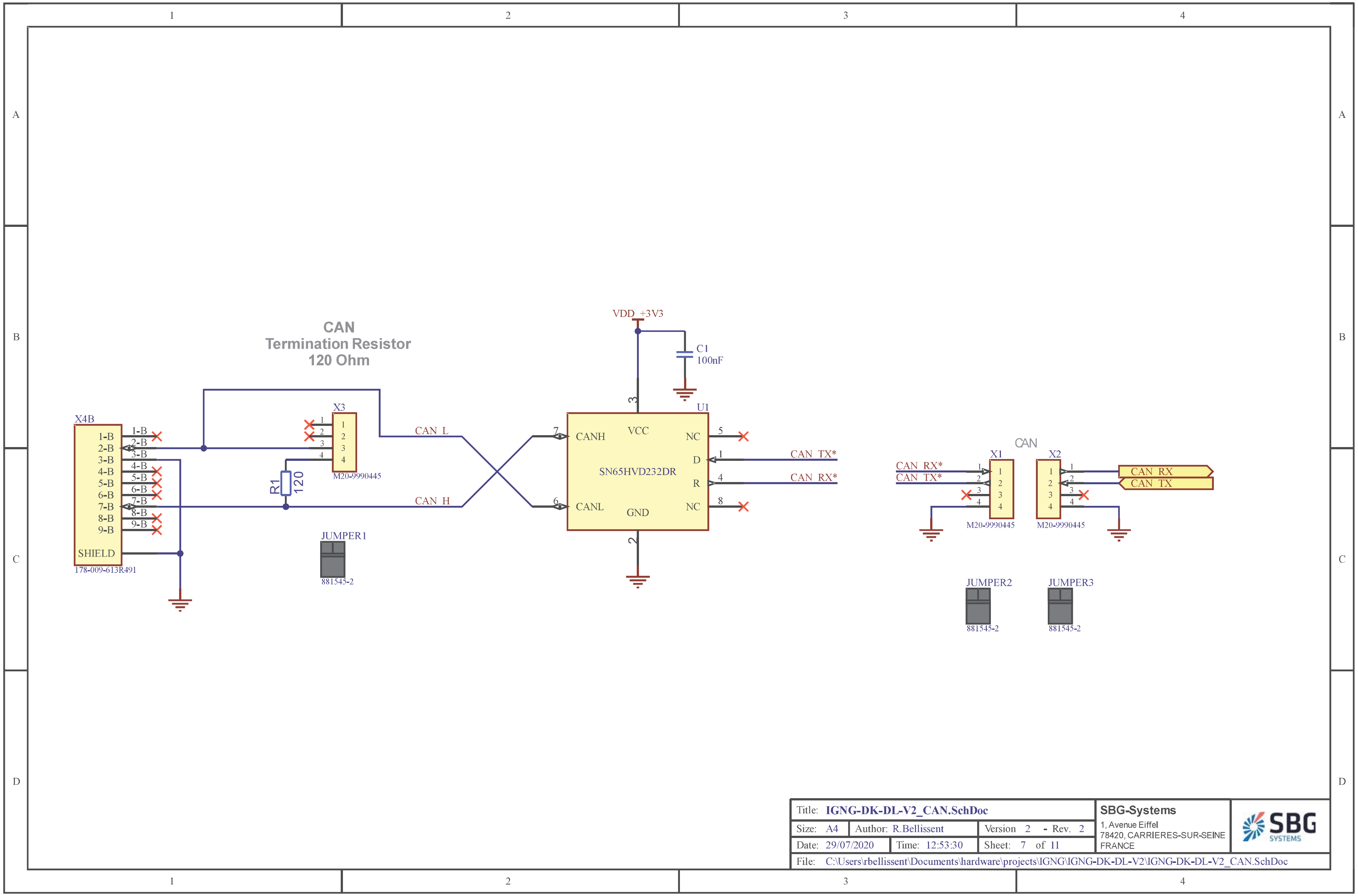

CAN
Termination Resistor
120 Ohm
X4B
1-B
2-B
3-B
4-B
5-B
6-B
7-B
8-B
9-B
SHIELD
178-009-613R491
X3
M20-9990445
R1
120
JUMPER1
881545-2
CAN_L
CAN_H
VDD_+3V3
C1
100nF
U1
CANH
CANL
VCC
GND
NC
D
R
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CAN_RX*
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X2
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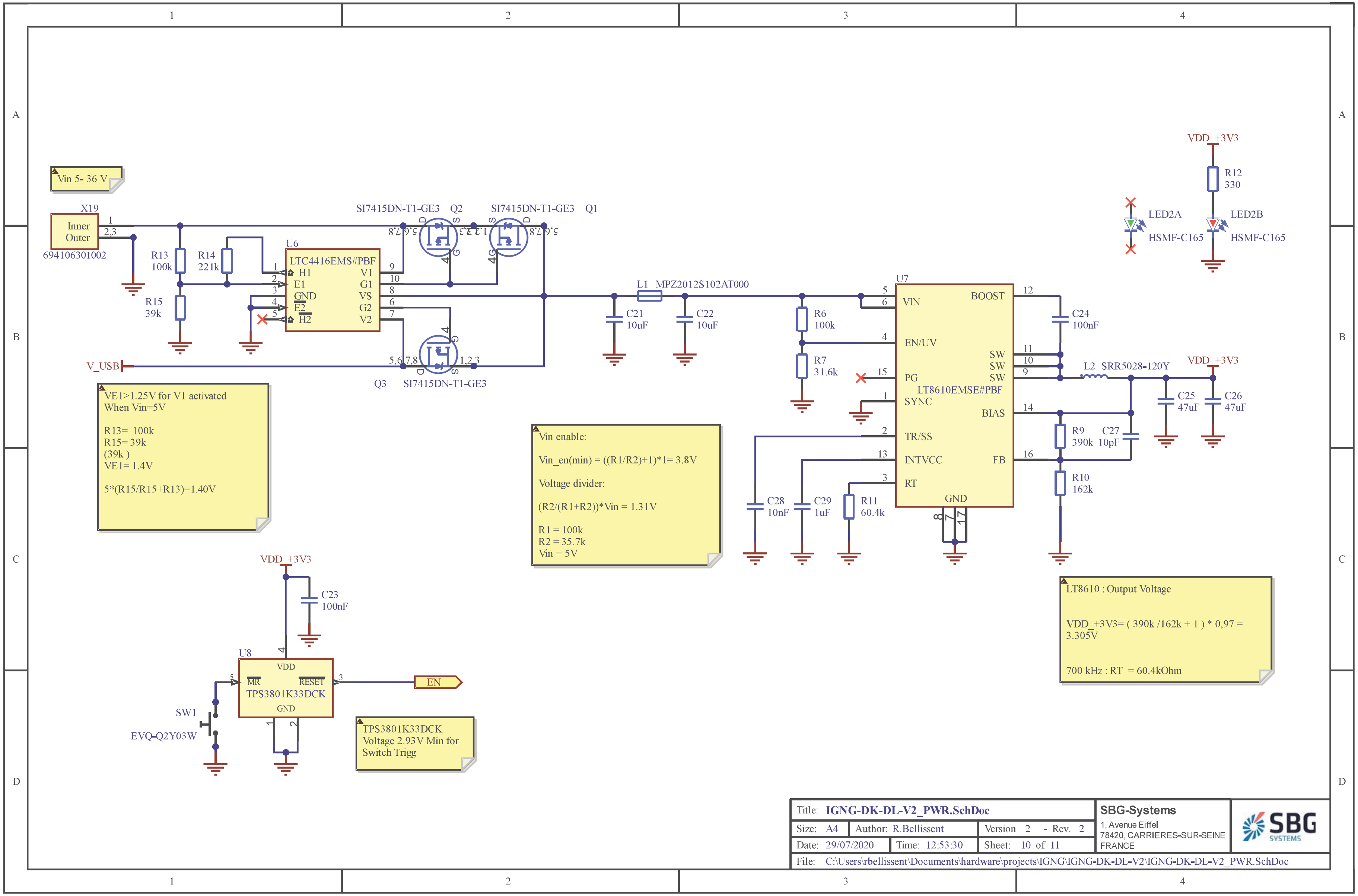

Vin 5- 36 V
X19
Inner
Outer
694106301002
R13
100k
R14
221k
R15
39k
U6
LTC4416EMS#PBF
SI7415DN-T1-GE3 Q2
SI7415DN-T1-GE3 Q1
Q3 SI7415DN-T1-GE3
V_USB
L1 MPZ2012S102AT000
C21
10uF
C22
10uF
R6
100k
R7
31.6k
U7
LT8610EMSE#PBF
VIN
BOOST
EN/UV
SW
PG
SYNC
BIAS
TR/SS
INTVCC
FB
RT
GND
C24
100nF
L2 SRR5028-120Y
VDD_+3V3
C25
47uF
C26
47uF
R9
390k
C27
10pF
R10
162k
C28
10nF
C29
1uF
R11
60.4k
R12
330
LED2A
LED2B
HSMF-C165
VE1>1.25V for V1 activated
When Vin=5V
R13= 100k
R15= 39k
(39k)
VE1= 1.4V
5*(R15/R15+R13)=1.40V
Vin enable:
Vin_en(min) = ((R1/R2)+1)*1= 3.8V
Voltage divider:
(R2/(R1+R2))*Vin = 1.31V
R1 = 100k
R2 = 35.7k
Vin = 5V
LT8610 : Output Voltage
VDD_+3V3= (390k /162k + 1) * 0,97 = 3.305V
700 kHz : RT = 60.4kOhm
C23
100nF
U8
TPS3801K33DCK
VDD
MR
RESET
GND
EN
SW1
EVQ-Q2Y03W
TPS3801K33DCK
Voltage 2.93V Min for
Switch Trigg
Title: IGNG-DK-DL-V2_PWR.SchDoc
Size: A4
Author: R.Bellissent
Version 2 - Rev. 2
Date: 29/07/2020
Time: 12:53:30
Sheet: 10 of 11
File: C:\Users\rbellissent\Documents\hardware\projects\IGNG\IGNG-DK-DL-V2\IGNG-DK-DL-V2_PWR.SchDoc
SBG-Systems
1, Avenue Eiffel
78420, CARRIERES-SUR-SEINE
FRANCE

3. Important notices

3.1. Support

Our goal is to provide the best experience to our customers. If you have any question, comment or problem with the use of your product, we would be glad to help you, so feel free to contact us:

EMEA:

SBG Systems S.A.S.
1 avenue Eiffel
78420 Carrières-sur-Seine
FRANCE

Phone: +33 1 80 88 43 70
support@sbg-systems.com

Americas:

SBG Systems North America, Inc
Phone: +1 (657) 549-5807
support@sbg-systems.com

Asia:

SBG Systems Pte. Ltd.
Phone: +65 98 643 776
support@sbg-systems.com

3.2. Warranty, liability and return procedure

SBG Systems provides a warranty covering this product against any defect in materials or manufacture for a Period of two (2) years from the date of shipment. In the event that such a defect becomes obvious during the stipulated warranty period, SBG Systems will undertake, at its sole discretion, either to repair the defective product, bearing the cost of all parts and labor, or to replace it with an identical product.

In order to avail itself of this warranty, Customer must notify SBG Systems of the defect before expiry of the warranty period and take all steps necessary to enable SBG Systems to proceed. Upon reception of required information (Sensor serial number, defect description), SBG Systems will issue an RMA and will provide return instructions. Customer shall be responsible for the packaging and the shipment of the defective product to the repair center notified by SBG Systems, the cost of such shipment being borne by Customer.

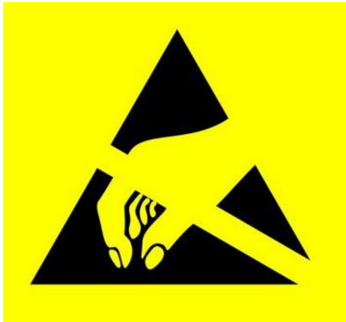
This warranty shall not be construed as covering defects, malfunctions or damages caused by improper use or inadequate maintenance of the product. Under no circumstances shall SBG Systems be due to provide repair or replacement under this warranty in order a) to repair damage caused by work done by any person not representing SBG Systems for the installation, repair or maintenance of the product; b) to repair damage caused by improper use or connection to incompatible equipment, and specifically, the opening of the housing of the equipment under warranty shall cause the warranty to be automatically canceled.

This warranty covers the product here under and is provided by SBG Systems in place of all and any other warranty whether expressed or implied. SBG Systems does not guarantee the suitability of the product under warranty for sale or any specific use. SBG Systems' liability is limited to the repair or replacement of defective products, this being the sole remedy open to Customer in the event the warranty becomes applicable. SBG Systems cannot be held liable for indirect, special, subsequent or consequential damage, irrespective of whether SBG Systems has or has not received prior notification of the risk of occurrence of such damage.

4. APPENDIX A: Safety Information

4.1. Warning: ESD Sensitive Devices

Electronic equipment such as discrete components, hybrid devices, integrated circuits, printed circuit assemblies can be permanently damaged or destroyed when near or in contact with electro-statically charged objects.



Normative references:

Standards	Title
EN 61340-5-1 (2016)	Electrostatics. Protection of electronic devices from electrostatic phenomena – General Requirements
EN 61340-5-2(2007)	Electrostatics. Protection of electronic devices from electrostatic phenomena – User guide
IEC 61340-5-3(2015)	Electrostatics, Protection of electronic devices from electrostatic phenomena – Properties and requirements classification for packaging intended for electrostatic discharge sensitive devices

4.2. Handling

ESD sensitive devices must be handled only in static-protected environment.

According to reference standards above, each ESD protection equipment such as grounding strap, bench matting,
floor matting and ground cord must be tested before handling ESD sensitive devices. In addition, it is strongly
recommended to wear ESD smocks during all service procedures.

4.3. Transport and storage

ESD sensitive devices are supplied in ESD protective packaging such as ESD shielding bags.

ESD sensitive devices and ESD protective packaging are identified with specific labels.

ESD sensitives devices must be stored in ESD protective packaging before final assembly.

5. APPENDIX B: Environmental Statements

5.1. RoHS Statement

Ellipse product line comply with European Union (EU) Directive 2002/95/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS Directive).

Conformity reports are available upon request.

5.2. WEEE Statement

Ellipse product line comply with the European Union (EU) Directive 2002/96/EC on waste electrical and electronic equipment (WEEE). The purpose of this Directive is the prevention of waste electrical and electronic equipment, and in addition, the reuse, recycling and other forms of recovery of such wastes so as to reduce the disposal of waste. If purchased in the European Union, please return the products at the end of its life to the supplier from which it was purchased.