drotek

DP0601 GNSS RTK (F9P)

## Delivers centimeter level accuracy within seconds based on U-blox ZED-F9P L1/L2 GNSS module

Datasheet - In Production

50.0x50.0x7.0 mm
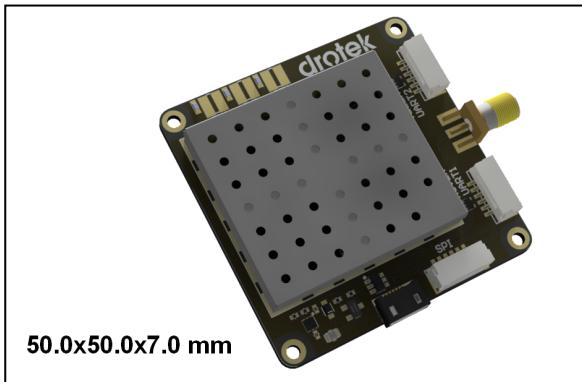
Features

- 5V - 100mA power supply
- LEDs status : Timepulse/Power/RTK
- Timepulse & External Interrupt
- USB/I²C/SPI/UART digital interfaces
- Gold plated SMA connector
- ESD protection diodes

Applications

- Drones
- RTK Base
- Ground vehicles
- Precise navigation
- Automation of moving machinery

Description

The DP0601 is an affordable compact and high precision L1/L2 GNSS RTK (Real Time Kinematic) device.

Based on the last generation of GNSS U-blox ZED-F9P modules, the DP0601 offers reliable and fast convergence time to provide centimeter accuracy within seconds.

The device allows concurrent reception of GPS / GLONASS / BeiDou & Galileo signals to improve signal availability.

The JST-GH connectors make them perfect to be connected to a Pixhawk3Pro or any other autopilot.

The DP0601 GNSS RTK is guaranteed to operate over a temperature range of -20˚C to +70˚C.

Table 1. Device summary

Order ref code	Temperature range [˚C]	Product size [mm]
0891B08A	-20 to +70	50.0 x 50.0 x 8.0

Contents

1. Block diagram and pin description

1.1 Block diagram

Figure 1. DP0601 block diagram & connectivity (top view)
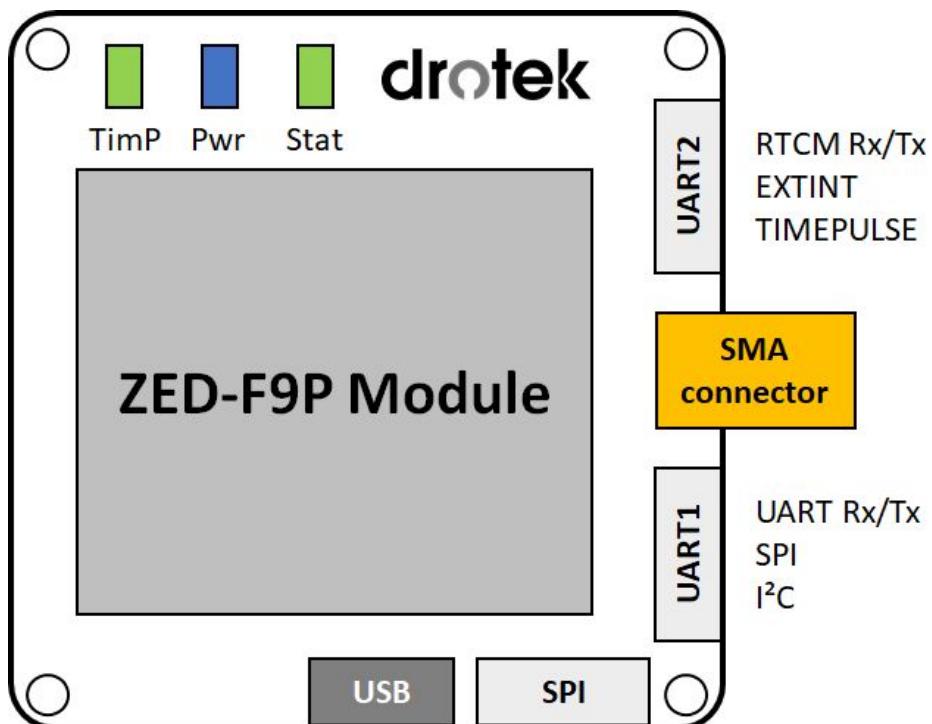
1.2 LED description

Table 2. DP0601 LED sequence status

LED name	Color	Light sequence	Comment
Timepulse	Green	🟢⚪🟢⚪	Blinking LED when RTK fix is available
Power	Blue	🔵🔵🔵🔵	Solid blue LED when powered ON
RTK Status	Green	⚪⚪⚪⚪	3D fix mode / No RTK fix
		🟢⚪🟢⚪	RTK fix but no FIXED RTK fix
		🟢🟢🟢🟢	FIXED RTK fix

1.3   Pin description
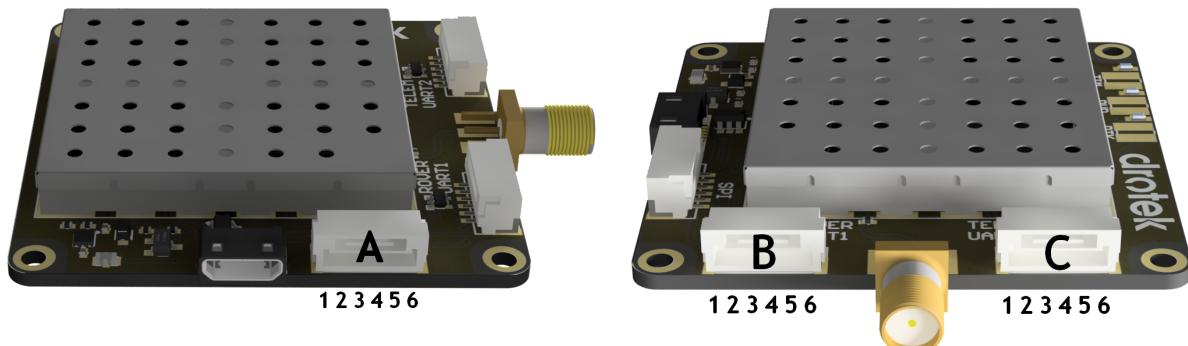
Table 2. Pinout configuration

	Pin	Name	Type	Function
SPI	A1	5V SPI	P	5V input to select SPI instead of UART1
	A2	SPI CLK	I	SPI clock input
	A3	SPI MISO	I/O	SPI Master Input Slave Output
	A4	SPI MOSI	I/O	SPI Master Output Slave Input
	A5	SPI CS	I	SPI chip select input
	A6	GND	P	Ground reference
UART 1	B1	5V IN	P	5V input
	B2	UART1 RX / SPI MOSI	I/O	UART1 receive **OR** SPI MOSI
	B3	UART1 TX / SPI MISO	I/O	UART1 transmit **OR** SPI MISO
	B4	I2C SCL / SPI SCLK	I	I2C clock **OR** SPI clock
	B5	I2C SDA / SPI CS	I/O	I2C data **OR** SPI chip select
	B6	GND	P	Ground reference
UART 2	C1	5V IN	P	5V input
	C2	UART2 TX	I/O	UART2 transmit NMEA/RTCMdata
	C3	UART2 RX	I/O	UART2 receive NMEA/RTCMdata
	C4	EXTINT	O	External interrupt
	C5	TIMEPULSE	O	External interrupt on Timepulse
	C6	GND	P	Ground reference

P : Power / I : Input / O : Output

2. Specifications

@Vdd = 5V, T = 25˚C unless otherwise noted

Table 3. DP0601 mechanical and electrical specifications

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
Vusb	USB supply voltage		4.5	5.0	5.5	V
Vdd	Internal supply voltage			3.3		V
Vdd_IO	Supply voltage for I/O			3.3		V
Idd	Current consumption	w/o active antenna		50		mA
		w/ TW7972 antenna		130		mA
Vil	IO pin low level input voltage		0		0.8	V
Vih	IO pin high level input voltage		2		Vdd+ 0.3	V
Vol	IO pin low level output voltage	Iol = 2mA			0.4	V
Voh	IO pin high level output voltage	Ioh = 2mA	Vdd- 0.4			V
W	Weight	w/o active antenna		18		g
Top	Operating temperature		-20		+70	˚C

Table 4. DP0601 general performance

Parameter	Specifications	Value
Receiver type	Multi-band GNSS high precision	
Accuracy of Timepulse	RMS 99%	30 ns 60 ns
Frequency of Timepulse		0.25 Hz to 10 MHz
Operational limits	Dynamics Altitude Velocity	< 4g 50,000 m 500 m/s
Velocity accuracy		0.05 m/s

Table 5. DP0601 performance in different GNSS mode

GNSS	Parameter	GPS+GLO+GAL +BDS	GPS+GLO	GPS+BDS	GPS
Acquisition	Cold start Hot start Aided start	24 s 2 s 2 s	26 s 2 s 2 s	28 s 2 s 2 s	29 s 2 s 2 s
Update rate	RTK PVT RAW	8 Hz 10 Hz 20 Hz	15 Hz 25 Hz 25 Hz	15 Hz 25 Hz 25 Hz	20 Hz 25 Hz 25 Hz
Convergence time	RTK	< 10 s	< 10 s	< 10 s	< 30 s
Horizontal pos. accuracy	PVT RTK	1.5 m CEP 0.01 m + 1ppm CEP	1.5 m CEP 0.01 m + 1ppm CEP	1.5 m CEP 0.01 m + 1ppm CEP	1.5 m CEP 0.01 m + 1ppm CEP
Vertical pos. accuracy	RTK	0.01 m + 1ppm CEP	0.01 m + 1ppm CEP	0.01 m + 1ppm CEP	0.01 m + 1ppm CEP
Sensitivity	Tracking & Nav. Reacquisition Cold start Hot start	-167 dBm -160 dBm -148 dBm -157 dBm			

Table 6. DP0601 moving-base performance in different GNSS mode

GNSS	Parameter	GPS+GLO+GAL +BDS	GPS+GLO	GPS+BDS	GPS
Update rate		5 Hz	8 Hz	8 Hz	10 Hz
Heading accuracy		0.4 deg	0.4 deg	0.4 deg	0.4 deg

3. Absolute maximum ratings

Stresses above those listed as "absolute maximum ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device under these conditions is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.

Table 7. DP0601 absolute maximum ratings

Symbol	Parameter	Maximum value	Unit
Vusb	USB supply voltage	-0.3 to +6	V
Vdd	Internal supply voltage	-0.5 to +3.6	V
Vdd_IO	I/O pins supply voltage	-0.5 to Vdd+0.5	V
Icc_RF	RF output current	100	mA
Prfin	Input power at RF_IN	10	dBm
TOP	Operating temperature	-20 to +70	˚C
TSTG	Storage temperature	-40 to +80	˚C

⚠ CAUTION — Electrostatic sensitive device

This device is sensitive to electrostatic discharge (ESD), improper handling can cause permanent damage to the part.

4. Applications

4.1 Standalone Base/Rover configuration

Figure 2. DP0601 connected to a Drotek telemetry kit + a L1/L2 Tallysman antenna
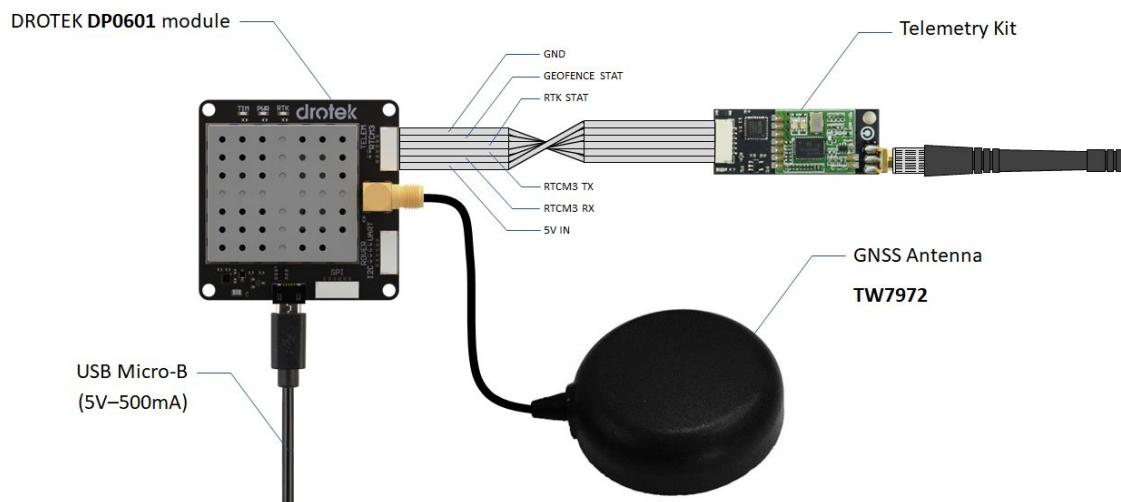
Drotek radio telemetry kit : https://store.drotek.com/radio-telemetry-kit-433-915-mhz
*Tallysman TW7972 antenna :* https://store.drotek.com/tw7972-triple-band-gnss-antenna

4.2 NTRIP (Network Transport of RTCM via Internet Protocol) local configuration

Figure 3. Two DP0601 connected to each other using NTRIP + local router
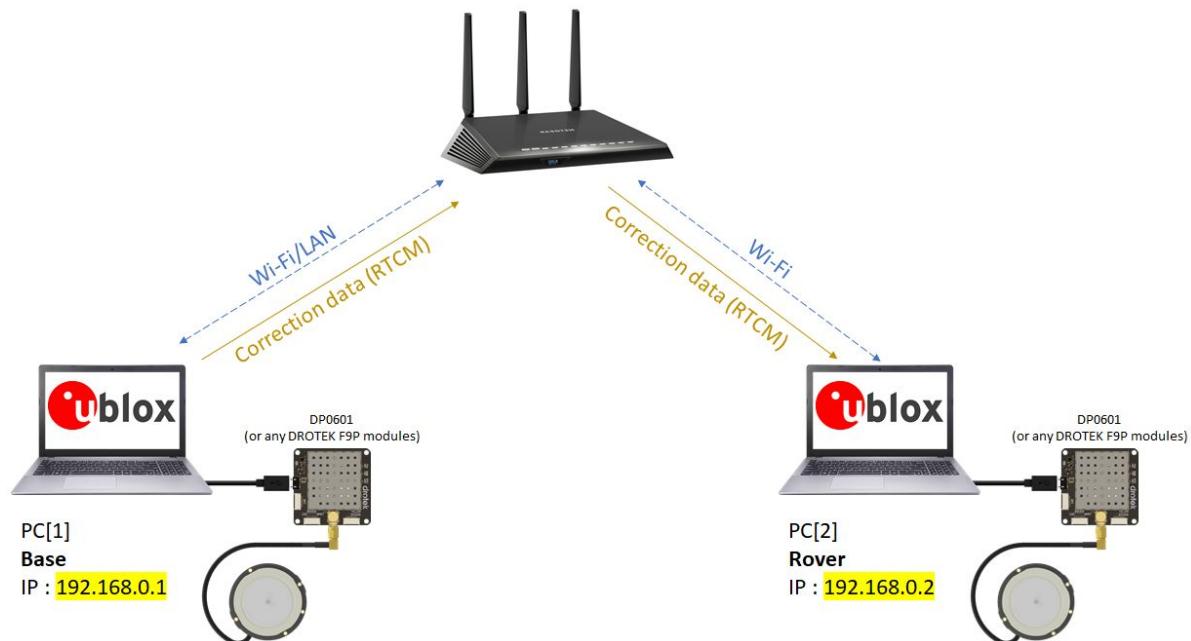
4.3 NTRIP cellular configuration

Figure 4. DP0601 linked to a on-field PC running u-center and connected to a 4G/LTE cellphone to receive RTCM data from distant servers
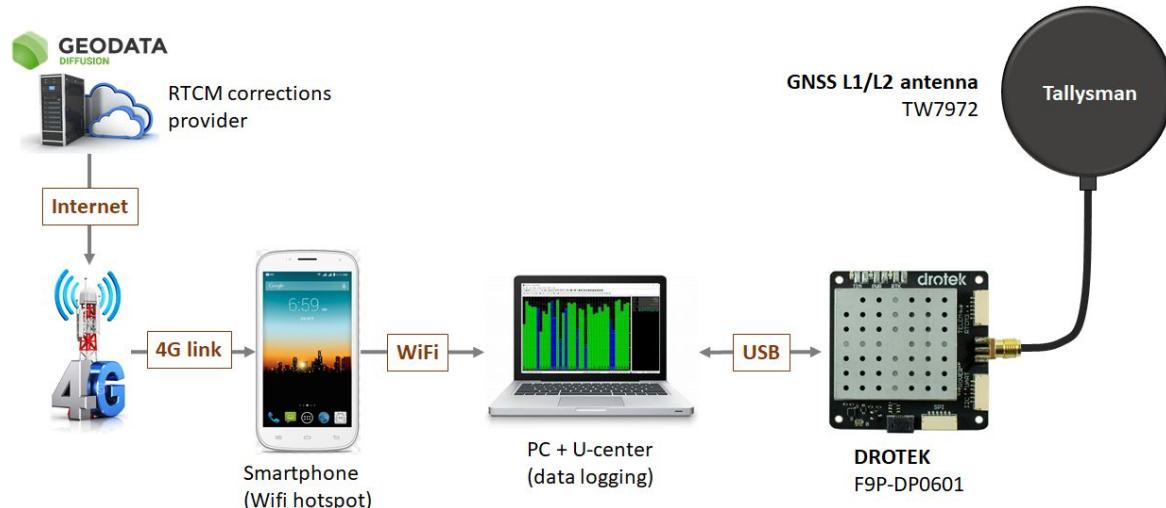
Tallysman TW7972 antenna : https://store.drotek.com/tw7972-triple-band-gnss-antenna

4.4 Moving Base/Rover for distance & heading evaluation

Figure 5. Two DP0601 used in a moving base configuration
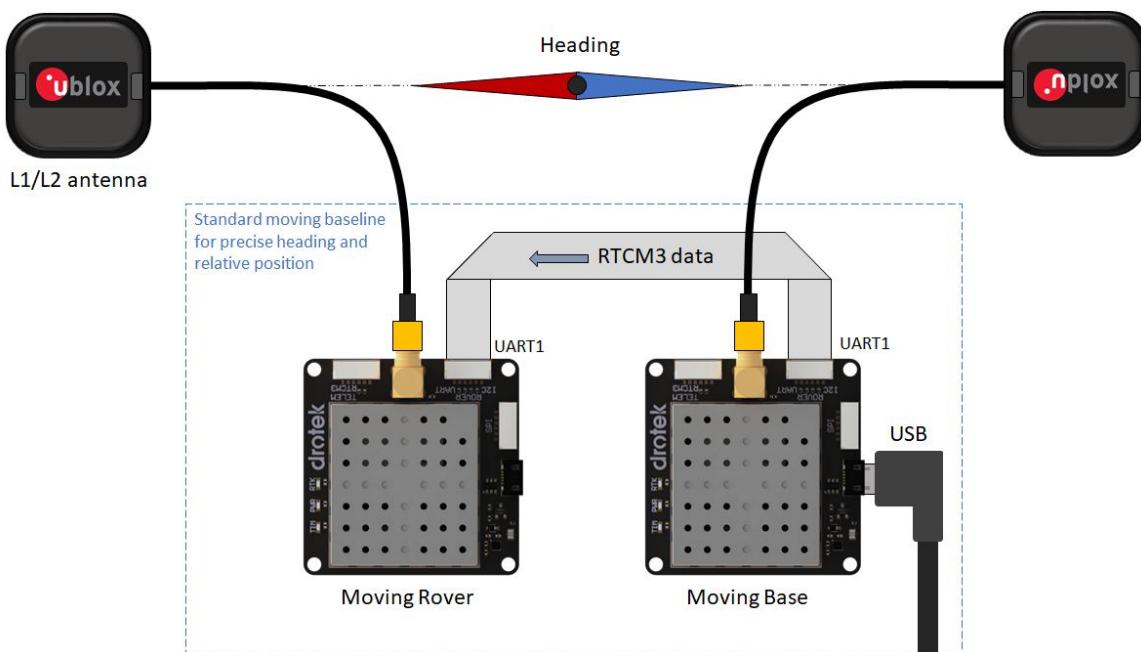
U-blox ANN-MB antenna : https://store.drotek.com/u-blox-ann-mb-multi-band-antenna

5. Communication interfaces

There are several communications interfaces including UART, SPI, I2C and USB. All the inputs have internal pull-up resistors in normal operation and can be left open if not used. All the PIOs are supplied by VCC, therefore all the voltage levels of the PIO pins are related to Vdd supply voltage.

5.1 UART Interface

There are two UART interfaces: UART1 and UART2. UART1 and UART2 operate up to and including a speed of 921600 baud. No hardware flow control on UART1 and UART2 is supported. UART1 is enabled by default if there is no 5V input voltage on pin A1 (5V SPI).

Figure 6. UART chronogram specifications
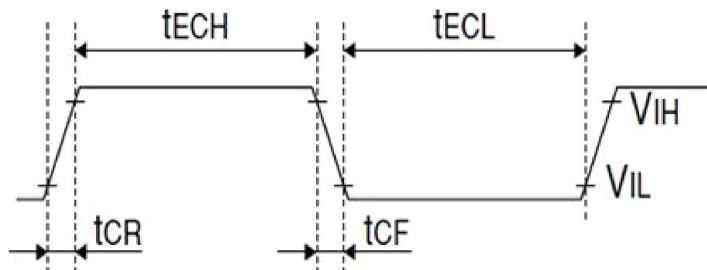
Table 8. DP0601 serial UART timing specifications

Symbol	Parameter	Min.	Max.	Unit
Vil	LOW-LEVEL input voltage	0	0.2xVdd	V
Vih	HIGH-LEVEL input voltage	0.7xVdd	Vdd+0.3	V
tECH	HIGH period of external data input	0	0.4	µs
tECL	LOW period of external data input	TBA	TBA	µs
Ru	Baudrate	9600	921600	bps
tCR	Rise time of data		5	ns
tCF	Fall time of data		5	ns

5.2 SPI interface

The DP0601 has an SPI slave interface that can be selected by supplying a 5V voltage on pin A1 (5V SPI). The SPI slave interface is shared with UART1. The SPI pins available are: SPI_MISO (TXD), SPI_MOSI (RXD), SPI_CS_N, SPI_CLK. The SPI interface is designed to allow communication to a host CPU. The interface can be operated in slave mode only. Note that SPI is not available in the default configuration because its pins are shared with the UART and I2C interfaces. The maximum transfer rate using SPI is 125 kB/s and the maximum SPI clock frequency is 5.5 MHz.

This section provides SPI timing values for the ZED-F9P slave operation. The following tables present timing values under different capacitive loading conditions. Default SPI configuration is CPOL = 0 and CPHA = 0.
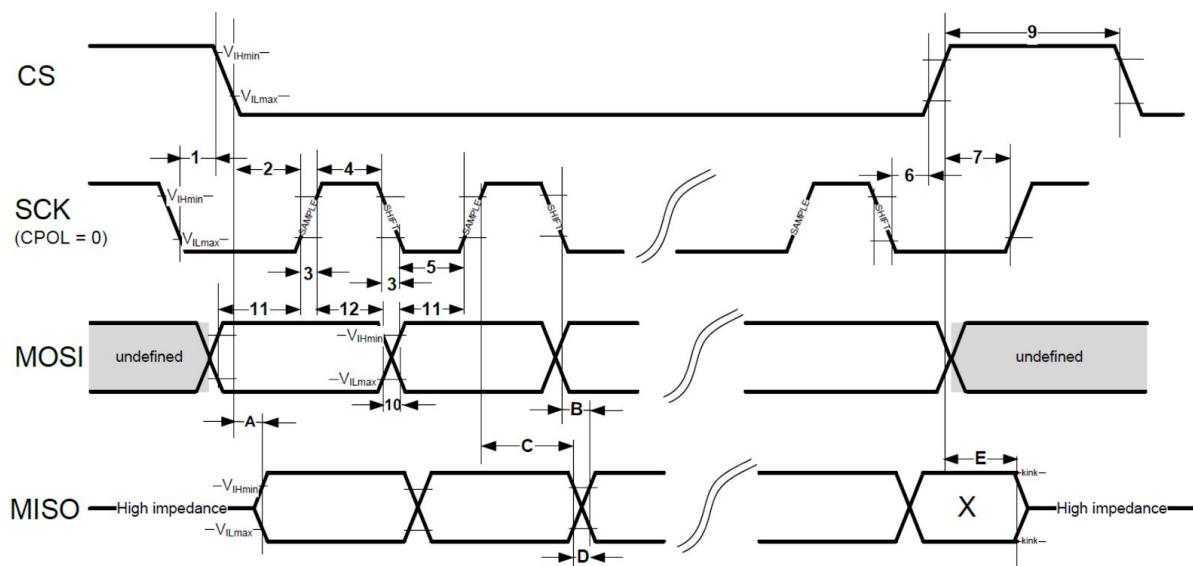
Table 9. DP0601 SPI timing specifications

Timing value @ 20pF load	Min [ns]	Max [ns]
"A" - MISO data valid time (CS)	19	52
"B" - MISO data valid time (SCK) weak driver mode	25	51
"C" - MISO data hold time	117	137
"D" - MISO rise/fall time, weak driver mode	6	16
"E" - MISO data disable lag time	20	32

5.3 Slave I2C interface

An I2C compliant interface is available for communication with an external host CPU. The interface can be operated in slave mode only. It is fully compatible with Fast-Mode of the I2C industry standard. Since the maximum SCL clock frequency is 400 kHz, the maximum bit rate is 400 kbit/s. The interface stretches the clock when slowed down while serving interrupts, therefore the real bit rates may be slightly lower.

Note : The I2C interface is only available with the UART default mode. If the SPI interface is selected by supplying a 5V onto the A1 pin (5V SPI), the I2C is not available.
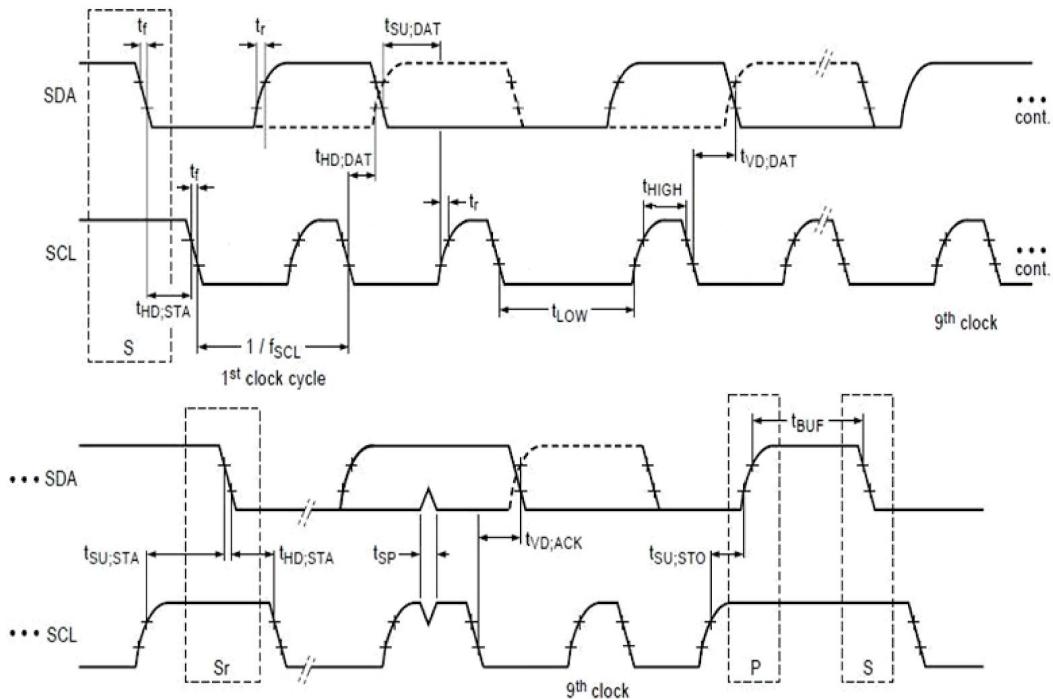

Table 10. DP0601 I2C timing specifications

Symbol	Parameter	Min	Max	Unit
Vil	LOW-LEVEL input voltage	Vss-0.3	0.3xVdd	V
Vih	HIGH-LEVEL input voltage	0.7xVdd	Vdd+0.3	V
Vol	LOW-LEVEL output voltage		0.4	V
Voh	HIGH-LEVEL output voltage	Vdd-0.4		V
Fscl	SCL clock frequency	0	400	KHz

5.4 USB interface

A USB interface, which is compatible to USB version 2.0 FS (Full Speed, 12 Mbit/s), can be used for communication as an alternative to the UART.

6. Mechanical drawings

Figure 6. DP0601 v1.2.1 mechanical drawings
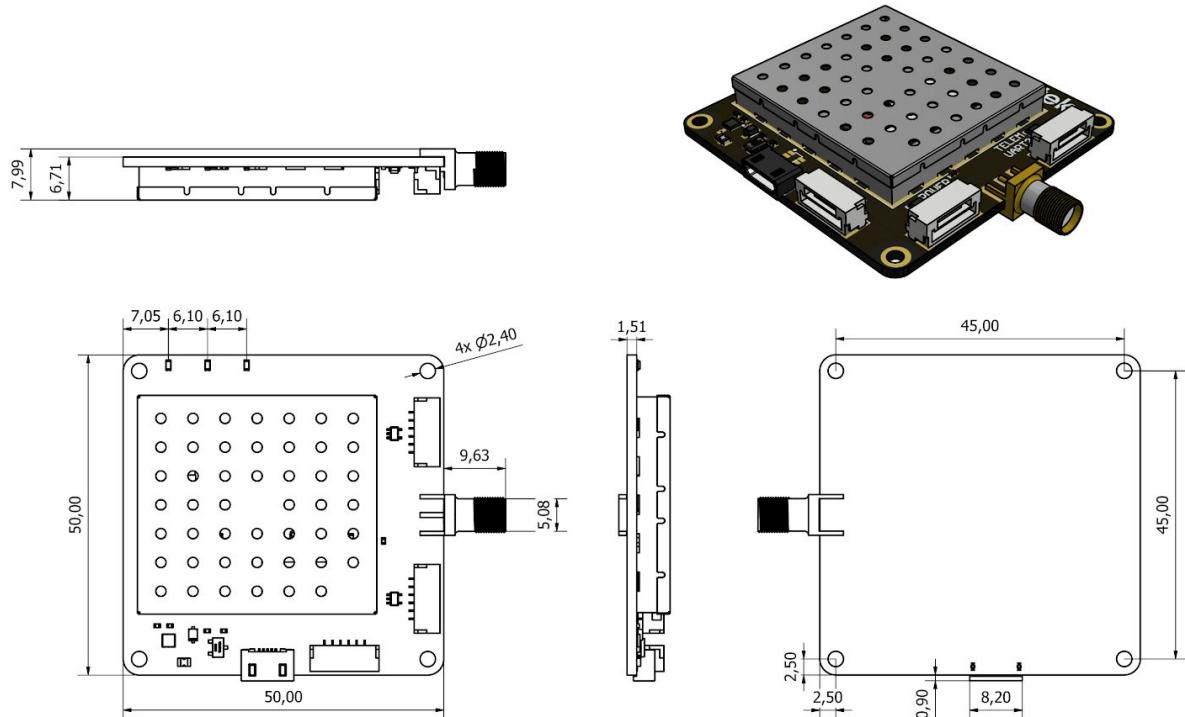
7. Revision history

Table 11. Document revision history

Date	Revision	Changes
22-Oct-2019	1.0	DrotekDoc_0891B08A / Initial release
14-09-2020	1.1	MISO / MOSI pins swapped (page 4)

8. Appendix

U-blox ZED-F9P datasheet :
https://www.u-blox.com/sites/default/files/ZED-F9P_DataSheet_%28UBX-17051259%29.pdf

U-blox ZED-F9P integration manual :
https://www.u-blox.com/sites/default/files/ZED-F9P_IntegrationManual_%28UBX-18010802%29.pdf

U-blox ZED-F9P interface description :
https://www.u-blox.com/sites/default/files/u-blox_ZED-F9P_InterfaceDescription_%28UBX-18010854%29.pdf

Drotek user's guide : https://drotek.gitbook.io/rtk-f9p-positioning-solutions/how-to-get-started

Drotek tutorials : https://drotek.gitbook.io/rtk-f9p-positioning-solutions/tutorials

IMPORTANT NOTICE – PLEASE READ CAREFULLY

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