



XAP Formula Steering Wheel User Manual



15/02/2018

	This document is the property of XAP Technology, it cannot be used or reproduced without the written authorization of XAP Technology	20/12/2017	XAP-BE
---	--	------------	--------

Changes

Vers.	Date	Description	Auteur
001	01/03/17	Document creation	JR-TP-AL
002	19/12/17	Document revision	TP
002	20/12/17	Document validation	JR-AL-FH
003	15/02/18	Document modification	TP

Summary

1	General Introduction.....	4
2	General Information.....	5
2.1	Pinout	5
2.2	Dimensions (in a full configuration)	6
2.3	Overall Information	6
2.4	Controls disposition.....	7
2.5	Materials and cleaning advices	7
3	Rotary buttons learning	8
3.1	Rotary buttons Learning operating mode	8
4	Paddle learning	14
4.1	Paddle Learning operating mode	14
5	CAN PROTOCOL EMISSION.....	16
5.1	Frame 0x410 : General informations.....	16
5.2	Frame 0x411 : Paddles 1,2,3 &4 ANA Values	17
5.3	Frame 0x412 : Rotary and buttons.....	18
5.4	Frame 0x413 : Paddles 5&6 ANA Values, 1&2 detection threshold.....	20
5.5	Frame 0x414 : Paddles 3, 4, 5 & 6 detection threshold	21
6	CAN PROTOCOL Reception.....	22
6.1	Frame 0x400 – 0x408 : LED Specification, Dimming	22
6.2	Frame 0x409 : Page specification & button	28
7	Computer programming	29
7.1	USB Connection.....	29
7.2	Dash editor display configuration	30

	This document is the property of XAP Technology, it cannot be used or reproduced without the written authorization of XAP Technology	20/12/2017	XAP-BE
---	--	------------	--------

1 GENERAL INTRODUCTION

XAP Formula is the last steering wheel generation engineered by XAP Technology.

It has been developed with the help of our experience acquired during many single-seater championships. It is homologated by FIA technical department according to the 2014 FIA LMP test procedure.

The steering wheel body is made with innovative carbon shell which insures its light weight, a perfect rigidity and a heavy strength. In full configuration it weighs 1500g (without quick release system) and is built to a diameter of 292mm to be suitable to a cramped single seater cockpit while keeping turning torque in case of a strong aerodynamic package car.

The full version is equipped with:

- 10 illuminated pushbuttons (2 different versions available).
- 6 Hall effect paddles shift
- 5 Hall rotary knobs (3 on the front part of the wheel and 2 optional on the handles).
- A transfective 4.3" programmable display.
- 16 RGB Leds.
- A luminosity sensor.
- Handles rotary protection integrated to the polyurethane grip
- Light guide on all the leds to improve their visibility
- 1 opto-isolated RADIO command output
- 2 additional command output: OUT1, OUT2

The rotative knobs and paddles use non-contact Hall effect technology sensors for maximum reliability in vibration environment.

All controls (switches, rotative knobs, paddles) states are sent on CAN.

For illuminated white switches, illumination can also be defined by can or configured into Dash Editor. On this version, switch cap is made of polycarbonate, it can be laser engraved.

RADIO, OUT1 and OUT2 outputs can be controlled by any switches: see CAN Reception protocol

The two grips are manufactured in FR70 Shore polyurethane rubber molded to the carbon frame.

The integrated sunlight viewable display is a 4.3" 480x272 transfective one to ensure perfect readability in all environments. It is full configurable with XAP Dash_editor software.

An integrated sensor adapts screen backlight to ambient luminosity.

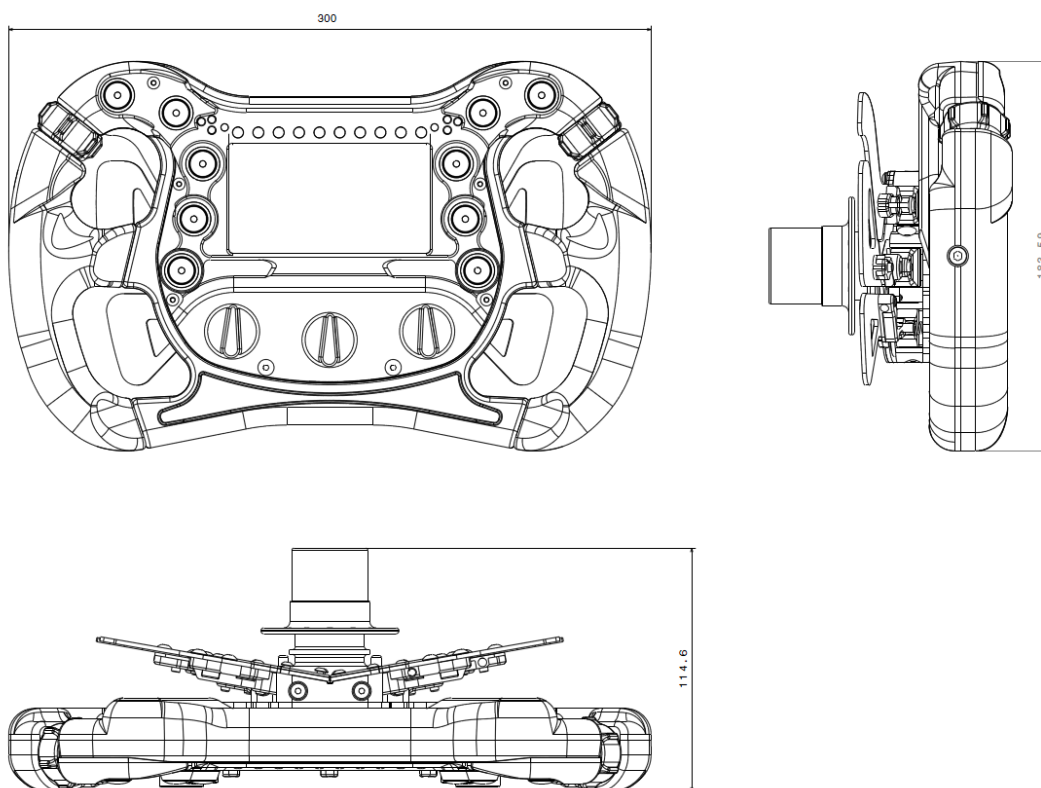
At last, the steering wheel is designed for a Sadev or SPA Design quick release mechanism.

2 GENERAL INFORMATION

2.1 Pinout

Connector pin	Function
Pin 1:	CAN Low
Pin 2:	CAN High
Pin 3:	USB Data -
Pin 4:	N/C
Pin 5:	N/C
Pin 6:	PTT+ (RADIO)
Pin 7:	PTT- (RADIO)
Pin 8:	OUT 2 Configurable
Pin 9:	OUT 1 Configurable
Pin 10:	VBatt
Pin 11:	Ground
Pin 12:	USB Power
Pin 13:	USB Data +

2.2 Dimensions (in a full configuration)



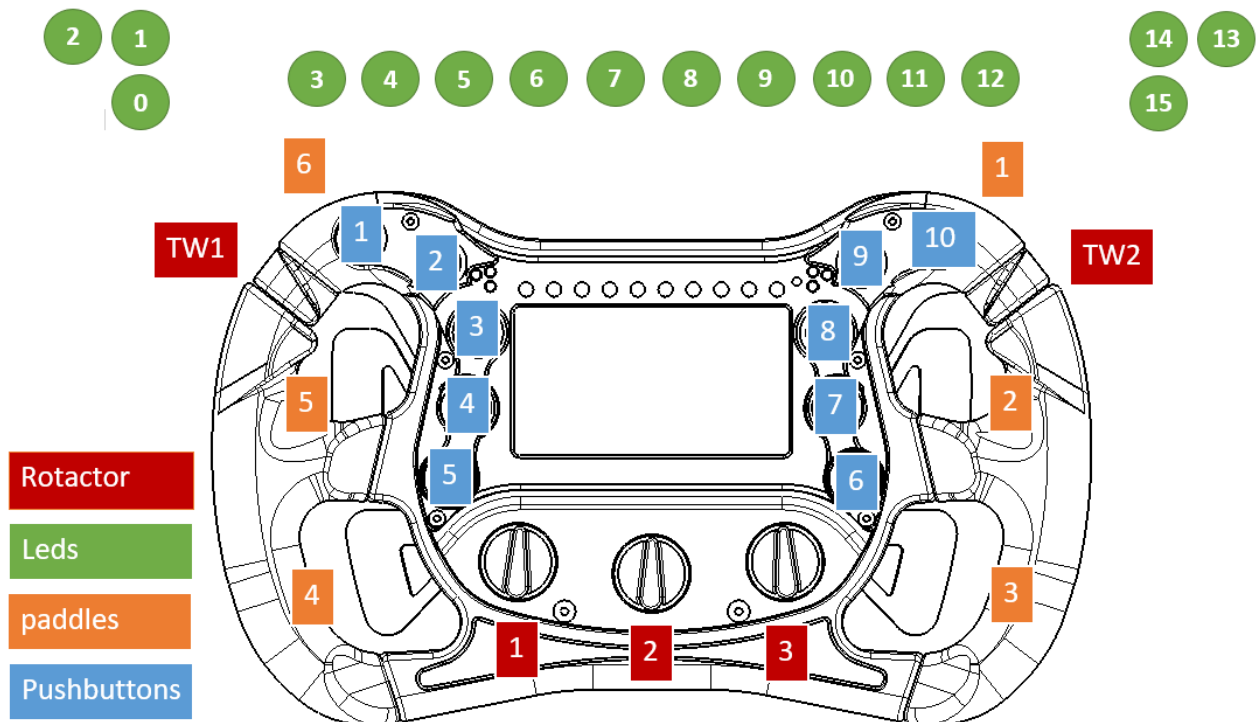
2.3 Overall Information

Data	
Material	Carbon fiber
Diameter	300 mm
Weight (approx.)	1 500g +/- 30g without quick release system
Push switch	10
Rotary switches	5
Paddleshift	6
Screen	4.3 inch TFT LCD sunlight readable
Viewable area	95 mm x 51 mm
Resolution	480 x 272 pixels
Temperature rating	-20°C to 80°C
Supply voltage	8.5 to 18.5V
Current consumption	0.4A at 12V (to be confirmed)

2.4 Controls disposition

We defined a position for each pushbuttons, leds, paddles and rotary knobs of the steering wheel. You will need it for steering wheel parameterization with dash editor and Can communication. The position of each functionalities, illumination, color... are customizable by CAN. It is detailed below.

For 2-paddle shift version, active paddles are Paddle 2 (Right) and Paddle 5 (Left). All other parameters are similar to 6-paddleshift version.



2.5 Materials and cleaning advices

The steering wheel is made of a carbon body closed with an anodized aluminum front face. On each side, handles are made of 70shore polyurethane. On the rear side, paddleshift support is also made of anodized aluminum except paddle who are carbon made. Dashboard is protected by a polycarbonate front screen.

In a way to guaranty correct sealing of the steering wheel, it must remain closed in any case. Only XAP staff is allowed to open it to ensure correct re-sealing of the wheel after servicing.

We recommend using alcohol for each element cleaning. All others cleaning solvents can be too strong and risks to expose carbon body and polyurethane handles. To avoid any screen scratch we also recommend using a soft cotton wipe.

3 ROTARY BUTTONS LEARNING

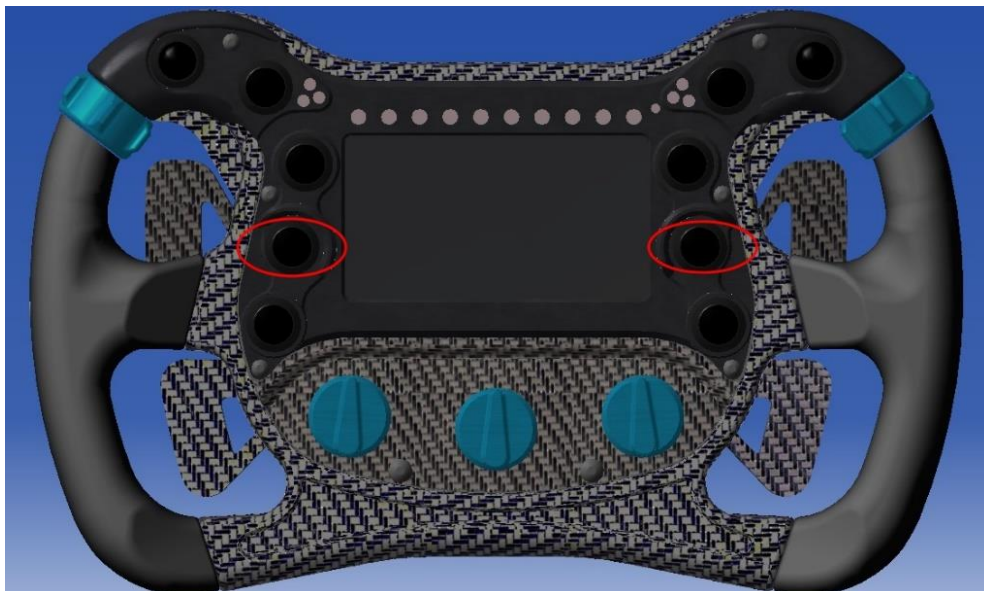
The rotary knobs learning procedure aim is to save rotary selectors positions of the steering wheel:

- 2 rotary knob in handles (6 positions),
- 3 rotary knob on the front face (10 positions).

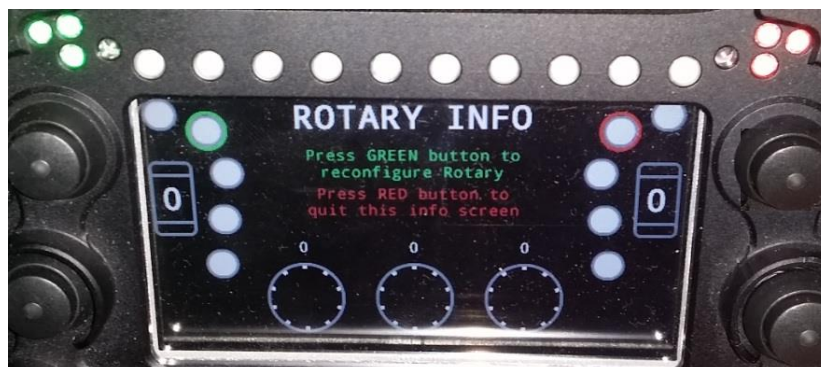
3.1 Rotary buttons Learning operating mode

Rotary buttons learning mode is only available during the five first seconds after steering wheel starting.

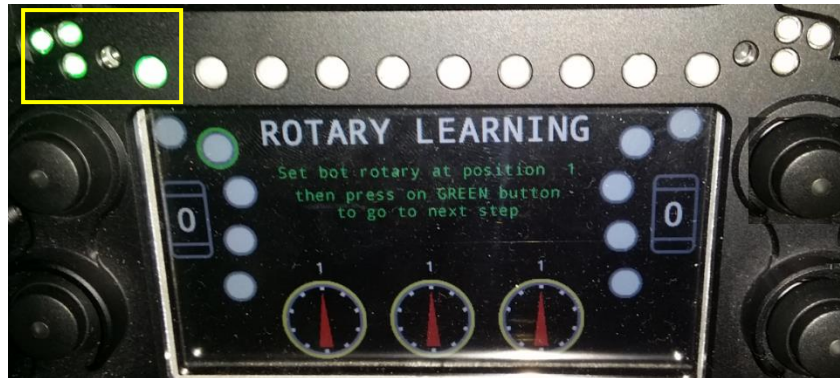
First, press simultaneously the two buttons below:



The page below will appear, press on button marked in green to start rotary learning :



The four first Led on the left are activated, this means the learning mode is initiated (see the image below).

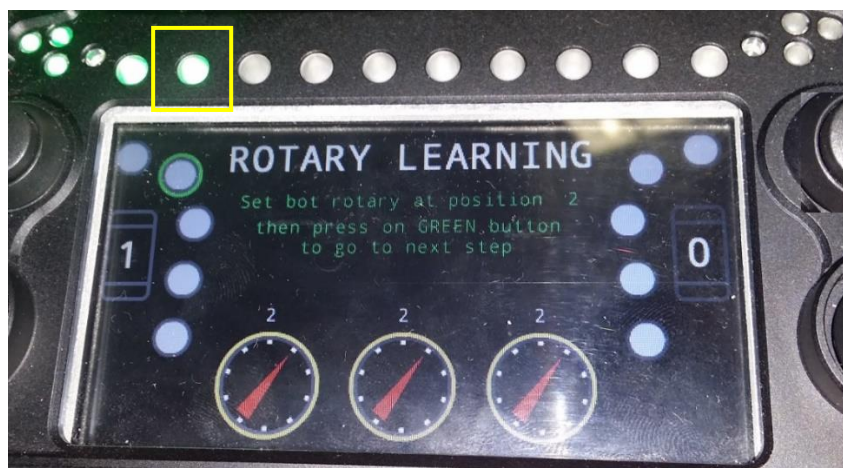


The first step of the learning process concerns the three front side rotary knobs; they must be on vertical position.

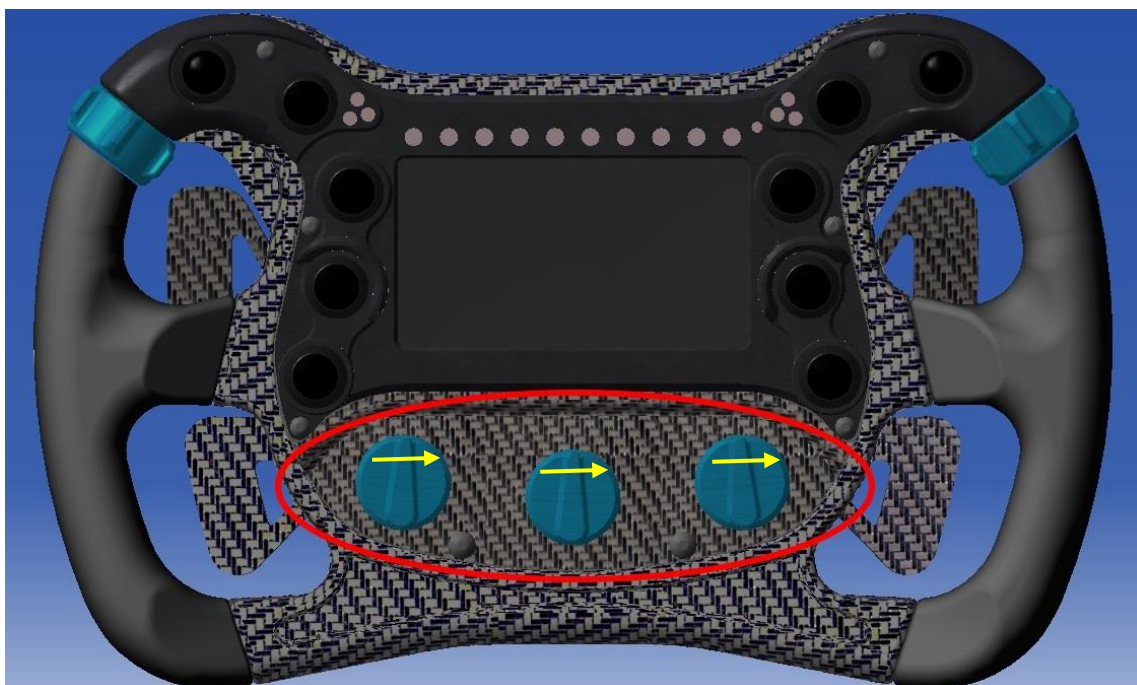
These 3 positions are memorized with the second button on the left (see image the below), press it one time to save the 3 positions at once.



The 5th Led activates, it means the steering wheel is ready to learn another position of the 3 front side rotary buttons.



To do so, you need to turn the three buttons on the image below one side notch on the right.

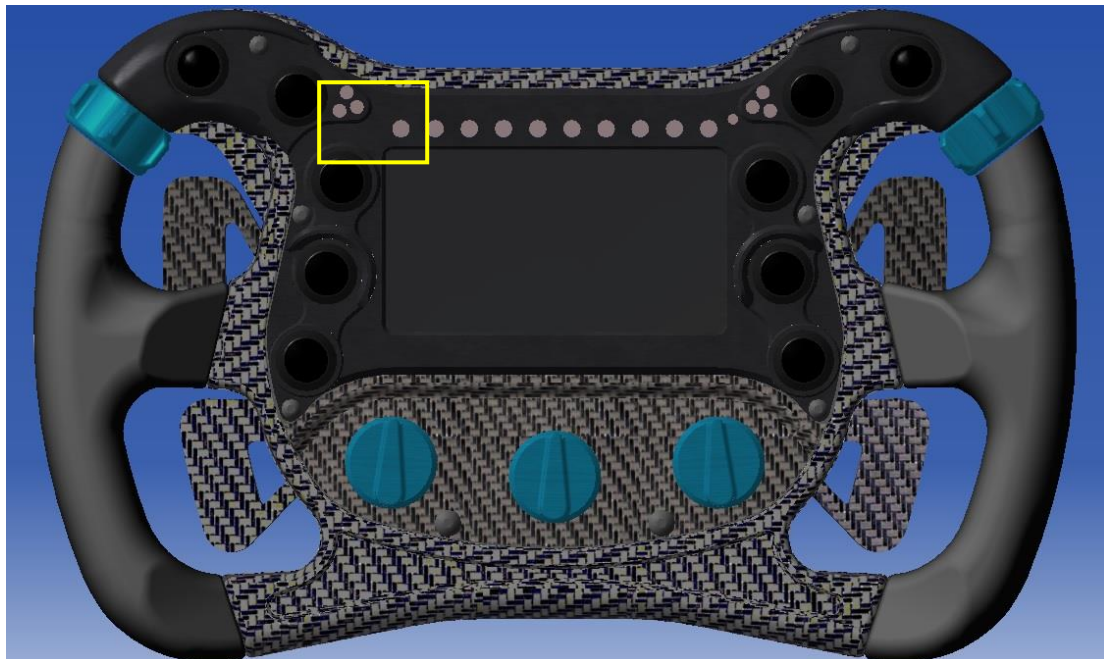


then, press the memorization button:



The Led that follows the fives already activated is switched on, you can repeat these actions (8 times) until the last front side buttons position is reached.

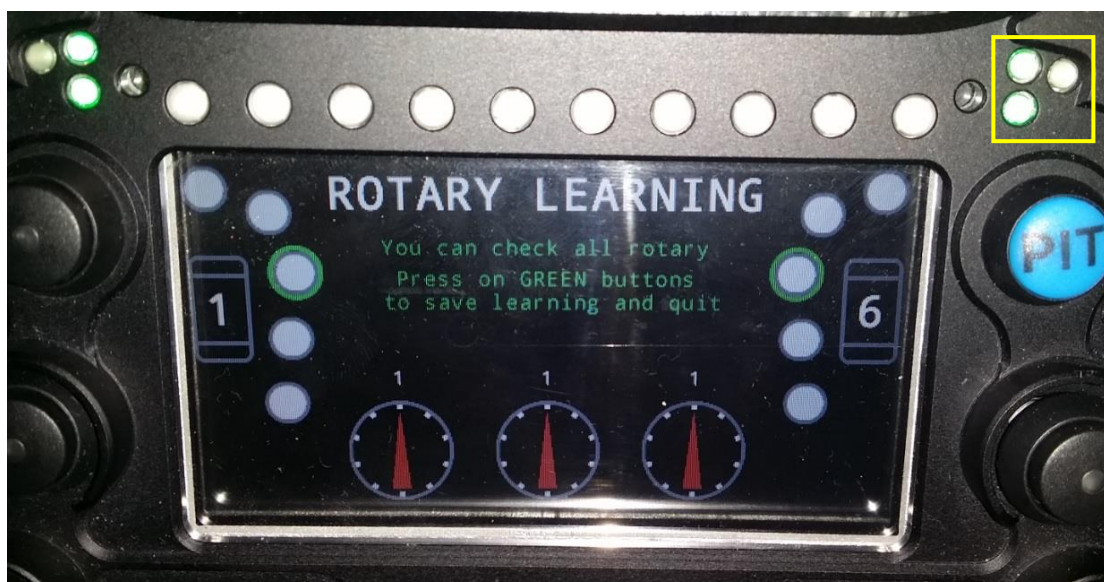
At the end of this first learning procedure step, the activated Leds are switched on, this means the 2 rotary buttons at the sides can be configured (only for a 5 Rotary steering wheel version).



The learning procedure is the same, you have to turn the side buttons one step by one and save it. Repeat procedure 6 times.



When the last position of the six is memorized, the 3 last Led are switched on, this means the learning procedure is finished:



	This document is the property of XAP Technology, it cannot be used or reproduced without the written authorization of XAP Technology	20/12/2017	XAP-BE
---	--	------------	--------

You can now press the two buttons below simultaneously to quit the learning mode and save rotary buttons position.



Central Led are switched off, the steering wheel is configured.

4 PADDLE LEARNING

The paddle learning process is memorizing into Formula E Steering wheel minimum and maximum values of the 6 paddles (pressed and released).

4.1 Paddle Learning operating mode

Paddles learning mode is available during the 5 first seconds after steering wheel starts.

First, press simultaneously the two buttons below:



The three first Led on the left are switched on, which means learning process is started. Press green button to start the learning.



	This document is the property of XAP Technology, it cannot be used or reproduced without the written authorization of XAP Technology	20/12/2017	XAP-BE
---	--	------------	--------

To learn minimum and maximum paddle positions, press each paddle several times.
Learning process is finished, to leave and save values, press simultaneously the two buttons below:



5 CAN EMISSION PROTOCOL

By default, the CAN Base address is 0x400, this can be changed using Dash Editor

5.1 Frame 0x410 : General informations

Basic Parameters

ID Hex (Dec)	Rate	Format
0x410(1040)	100 Hz	Big Endian

Detailed Payload Description

Byte	STW Name	External Name	Calibration	Notes
0	Software version	XAP_SOFT_V	U8 [1/bit]	
1	Running counter	XAP_CNT	U8 [1/bit]	Increments every frame
2	Light Sensor	XAP_LS	U12[1/bit]	12 bits conversion [0 – 4095]
3				
4	Current Page Number	XAP_STW_CURR_PN	U8[1/bit]	
5				
6	Session Num		U8[1/bit]	
7				

5.2 Frame 0x411 : Paddles 1,2,3 &4 ANA Values

Basic Parameters

ID Hex (Dec)	Rate	Format
0x411(1041)	100 Hz	Big Endian

Detailed Payload Description

Byte	STW Name	External Name	Calibration	Notes
0	Paddle 1 ANA value	XAP_STW_PDL1	U12[1/bit]	12 bits conversion [0 – 4095]
1				
2	Paddle 2 ANA value	XAP_STW_PDL2	U12[1/bit]	12 bits conversion [0 – 4095]
3				
4	Paddle 3 ANA value	XAP_STW_PDL3	U12[1/bit]	12 bits conversion [0 – 4095]
5				
6	Paddle 4 ANA value	XAP_STW_PDL4	U12[1/bit]	12 bits conversion [0 – 4095]
7				

5.3 Frame 0x412 : Rotary and buttons

Basic Parameters

ID Hex (Dec)	Rate	Format
0x412(1042)	100 Hz	Big Endian

Detailed Payload Description

Byte	STW Name	External Name	Calibration	Notes
0	Push Buttons & Paddles	XAP_STW_PB_PDLL	U16[bitmap]	See table below
1				
2	Rotary 1 position	XAP_STW_R1	U8[1/bit + 1]	1 to 10
3	Rotary 2 position	XAP_STW_R2	U8[1/bit + 1]	1 to 10
4	Rotary 3 position	XAP_STW_R3	U8[1/bit + 1]	1 to 10
5	Thumbwheels 1 position	XAP_STW_THB1_P	U8[1/bit + 1]	1 to 6
6	Thumbwheels 2 position	XAP_STW_THB2_P	U8[1/bit + 1]	1 to 6
7	Output State	XAP_OUTPUT_STATE	U8[bitmap]	BIT0: Radio, BIT1: OUT1, BIT2: OUT2

Push buttons & Paddle switches Bitmap table

Bit	Meaning
0	=1 if Push Button 1 is pressed =0 if not
1	=1 if Push Button 2 is pressed =0 if not
2	=1 if Push Button 3 is pressed =0 if not
3	=1 if Push Button 4 is pressed =0 if not
4	=1 if Push Button 5 is pressed =0 if not
5	=1 if Push Button 6 is pressed =0 if not
6	=1 if Push Button 7 is pressed =0 if not
7	=1 if Push Button 8 is pressed =0 if not
8	=1 if Push Button 9 is pressed =0 if not
9	=1 if Push Button 10 is pressed =0 if not
10	=1 if Paddle 1 is pressed =0 if not
11	=1 if Paddle 2 is pressed =0 if not
12	=1 if Paddle 3 is pressed =0 if not
13	=1 if Paddle 4 is pressed =0 if not
14	=1 if Paddle 5 is pressed =0 if not
15	=1 if Paddle 6 is pressed =0 if not

5.4 Frame 0x413 : Paddles 5&6 ANA Values, 1&2 detection threshold

Basic Parameters

ID Hex (Dec)	Rate	Format
0x413(1043)	100 Hz	Big Endian

Detailed Payload Description

Byte	STW Name	External Name	Calibration	Notes
0	Paddle 5 ANA value	XAP_STW_PDL5	U12[1/bit]	12 bits conversion [0 – 4095]
1				
2	Paddle 6 ANA value	XAP_STW_PDL6	U12[1/bit]	12 bits conversion [0 – 4095]
3				
4	Paddle 1 threshold	XAP_STW_PDL1	U12[1/bit]	12 bits conversion [0 – 4095]
5				
6	Paddle 2 threshold	XAP_STW_PDL2	U12[1/bit]	12 bits conversion [0 – 4095]
7				

5.5 Frame 0x414 : Paddles 3, 4, 5 & 6 detection threshold

Basic Parameters

ID Hex (Dec)	Rate	Format
0x414(1044)	100 Hz	Big Endian

Detailed Payload Description

Byte	STW Name	External Name	Calibration	Notes
0	Paddle 3 threshold	XAP_STW_PDL3	U12[1/bit]	12 bits conversion [0 – 4095]
1				
2	Paddle 4 threshold	XAP_STW_PDL4	U12[1/bit]	12 bits conversion [0 – 4095]
3				
4	Paddle 5 threshold	XAP_STW_PDL5	U12[1/bit]	12 bits conversion [0 – 4095]
5				
6	Paddle 6 threshold	XAP_STW_PDL6	U12[1/bit]	12 bits conversion [0 – 4095]
7				

6 CAN RECEPTION PROTOCOL

Behavior of the LED frames:

- If there is a LED order (another value than 0 on RGB LED values)
 - The specified LED will be forced by RGB values in the frame
- If there is no LED order (0 on the RGB LED values)
 - The specified LED will have the “**DASH EDITOR**” behavior

6.1 Frame 0x400 – 0x408 : LED Specification, Dimming

1. LED 0&1

Basic Parameters

ID Hex (Dec)	Rate	Format
0x400 (1024)	100 Hz	Big Endian

Detailed Payload Description

Byte	STW Name	External Name	Calibration	Notes
0	LED 0 RED Value	LED_0_R	U8	
1	LED 0 GREEN Value	LED_0_G	U8	
2	LED 0 BLUE Value	LED_0_B	U8	
3	LED 1 RED Value	LED_1_R	U8	
4	LED 1 GREEN Value	LED_1_G	U8	
5	LED 1 BLUE Value	LED_1_B	U8	
6	NA	NA	NA	
7	NA	NA	NA	

	This document is the property of XAP Technology, it cannot be used or reproduced without the written authorization of XAP Technology	20/12/2017	XAP-BE
---	--	------------	--------

2. LED 2&3

Basic Parameters

ID Hex (Dec)	Rate	Format
0x401(1025)	100 Hz	Big Endian

Detailed Payload Description

Byte	STW Name	External Name	Calibration	Notes
0	LED 2 RED Value	LED_2_R	U8	
1	LED 2 GREEN Value	LED_2_G	U8	
2	LED 2 BLUE Value	LED_2_B	U8	
3	LED 3 RED Value	LED_3_R	U8	
4	LED 3 GREEN Value	LED_3_G	U8	
5	LED 3 BLUE Value	LED_3_B	U8	
6	NA	NA	NA	
7	NA	NA	NA	

3. LED 4&5

Basic Parameters

ID Hex (Dec)	Rate	Format
0x402(1026)	100 Hz	Big Endian

Detailed Payload Description

Byte	STW Name	External Name	Calibration	Notes
0	LED 4 RED Value	LED_4_R	U8	
1	LED 4 GREEN Value	LED_4_G	U8	
2	LED 4 BLUE Value	LED_4_B	U8	
3	LED 5 RED Value	LED_5_R	U8	
4	LED 5 GREEN Value	LED_5_G	U8	
5	LED 5 BLUE Value	LED_5_B	U8	
6	NA	NA	NA	
7	NA	NA	NA	

4. LED 6&7

Basic Parameters

ID Hex (Dec)	Rate	Format
0x403(1027)	100 Hz	Big Endian

Detailed Payload Description

Byte	STW Name	External Name	Calibration	Notes
0	LED 6 RED Value	LED_6_R	U8	
1	LED 6 GREEN Value	LED_6_G	U8	
2	LED 6 BLUE Value	LED_6_B	U8	
3	LED 7 RED Value	LED_7_R	U8	
4	LED 7 GREEN Value	LED_7_G	U8	
5	LED 7 BLUE Value	LED_7_B	U8	
6	NA	NA	NA	
7	NA	NA	NA	

5. LED 8&9

Basic Parameters

ID Hex (Dec)	Rate	Format
0x404(1028)	100 Hz	Big Endian

Detailed Payload Description

Byte	STW Name	External Name	Calibration	Notes
0	LED 8 RED Value	LED_8_R	U8	
1	LED 8 GREEN Value	LED_8_G	U8	
2	LED 8 BLUE Value	LED_8_B	U8	
3	LED 9 RED Value	LED_9_R	U8	
4	LED 9 GREEN Value	LED_9_G	U8	
5	LED 9 BLUE Value	LED_9_B	U8	
6	NA	NA	NA	

7	NA	NA	NA	
---	----	----	----	--

6. LED 10&11

Basic Parameters

ID Hex (Dec)	Rate	Format
0x405(1029)	100 Hz	Big Endian

Detailed Payload Description

Byte	STW Name	External Name	Calibration	Notes
0	LED 10 RED Value	LED_10_R	U8	
1	LED 10 GREEN Value	LED_10_G	U8	
2	LED 10 BLUE Value	LED_10_B	U8	
3	LED 11 RED Value	LED_11_R	U8	
4	LED 11 GREEN Value	LED_11_G	U8	
5	LED 11 BLUE Value	LED_11_B	U8	
6	NA	NA	NA	
7	NA	NA	NA	

7. LED 12&13

Basic Parameters

ID Hex (Dec)	Rate	Format
0x406(1030)	100 Hz	Big Endian

Detailed Payload Description

Byte	STW Name	External Name	Calibration	Notes
0	LED 12 RED Value	LED_12_R	U8	
1	LED 12 GREEN Value	LED_12_G	U8	
2	LED 12 BLUE Value	LED_12_B	U8	
3	LED 13 RED Value	LED_13_R	U8	
4	LED 13 GREEN Value	LED_13_G	U8	
5	LED 13 BLUE Value	LED_13_B	U8	

	This document is the property of XAP Technology, it cannot be used or reproduced without the written authorization of XAP Technology	20/12/2017	XAP-BE
---	--	------------	--------

6	NA	NA	NA	
7	NA	NA	NA	

8. LED 14&15

Basic Parameters

ID Hex (Dec)	Rate	Format
0x407 (1031)	100 Hz	Big Endian

Detailed Payload Description

Byte	STW Name	External Name	Calibration	Notes
0	LED 14 RED Value	LED_14_R	U8	
1	LED 14 GREEN Value	LED_14_G	U8	
2	LED 14 BLUE Value	LED_14_B	U8	
3	LED 15 RED Value	LED_15_R	U8	
4	LED 15 GREEN Value	LED_15_G	U8	
5	LED 15 BLUE Value	LED_15_B	U8	
6	NA	NA	NA	
7	NA	NA	NA	

9. Backlight & LED Dimming

Basic Parameters

ID Hex (Dec)	Rate	Format
0x408(1032)	100 Hz	Big Endian

Detailed Payload Description

Byte	STW Name	External Name	Calibration	Notes
0	Screen backlight Dimming	SCR_BL_DIM	U8	8 light levels (0 : max, 8 mini)
1	Led Dimming	LED_DIM	U8	8 light levels (0 : max, 8 mini)
2	NA	NA	NA	
3	NA	NA	NA	
4	NA	NA	NA	

	This document is the property of XAP Technology, it cannot be used or reproduced without the written authorization of XAP Technology	20/12/2017	XAP-BE
---	--	------------	--------

5	NA	NA	NA	
6	NA	NA	NA	
7	NA	NA	NA	

6.2 Frame 0x409 : Page specification & button

Basic Parameters

ID Hex (Dec)	Rate	Format
0x409(1033)	100 Hz	Big Endian

Detailed Payload Description

Byte	STW Name	External Name	Calibration	Notes
0	Page control	PG_CTRL	U8	0: Pilot manual control 1 – 255: Requested automatic page 1 : Page n°1 255 : page n°255
1	button N° OUT1 OUT2	NUM_BTN_CMD_1_2	U8	See “button choice” below
2	button N° Page+ radio	NUM_BTN_PG+_RAD	U8	See “button choice” below
3	button N° Page-	NUM_BTN_PG-	U8	See “button choice” below
4				
5				
6				
7				

Button choice in frame 0x409

Byte	BIT	FUNCTION	Notes
1	0-3	OUT1 button choice	Number between 1 & 10 Warning: The button will not be affected if that button is already taken. 0 = INACTIVE
	4-7	OUT2 button choice	
2	0-3	Page+ button choice	
	4-7	Radio button choice	
3	0-3	Page- button choice	

	This document is the property of XAP Technology, it cannot be used or reproduced without the written authorization of XAP Technology	20/12/2017	XAP-BE
---	--	------------	--------

	4-7	Set to 0	
--	-----	----------	--

7 COMPUTER PROGRAMMING

7.1 USB Connection

To send new configurations to the steering wheel you will need XAP recommended programming loom.



First, plug the power supply and wait until the steering wheel switches on. Then plug the USB connector on the computer. It is recommended to use USB hub to protect computer's USB ports from electric surge.

Be careful to switch on the steering wheel with unplugged USB, if not it will start in boot mode and will not be programmable.

When correctly plugged, usb connected message will appears on screen:



You can now access to steering wheel folders or load/send your configuration.

7.2 Dash editor display configuration

Dash configuration and steering wheel's data can be easy-programmed using dash editor software. This XAP developed software is available on demand and on XAP website. It is used to define all the parameters and screens of the steering wheel:

- Screens and graphic components,
- CAN data table,
- track map edition,
- Alerts messages,
- Diagnostics messages,
- Leds configuration.

Please refers to embedded Dash Editor's user manual and contextual help for further information.