Colour Display

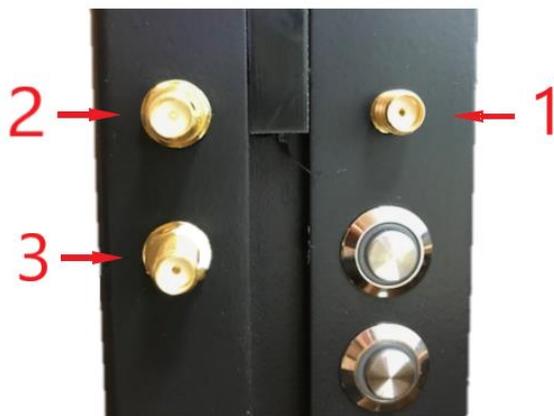# 1. Description

1) Radio antenna
2) Bluetooth antenna
3) GPS antenna
4) Selection switch (blue)
5) Activation switch (green)
6) Input 1 (temperature sensor)
7) Input 2 (Output)
8) Audio out
9) RS232 / RS485
10) Power connector (12V-24V)

1.1   Antennas

There are three antennas connectors on the side panel. All look similar but each of them requires a specific antenna.

1) Radio antenna:
    A 968Mhz antenna with SMA connector.

2) Bluetooth antenna:
    A 2.4Ghz antenna with RP-SMA connector. Compatible with standard WiFi antenna.

3) GPS antenna:
    Standard active GPS antenna with SMA connector.

2. Modes

Seven modes are available on the display.

  Modes 2.1 & 2.2 are included in the display price.

  Modes 2.3 - 2.6 need to be activated and are an optional upgrade "Package 1" available for purchase.

  Mode 2.7 needs to be activated and is an optional upgrade "Package 2" available for purchase.

Free & Inclusive Modes are:

  Mode 2.1 (User Control Mode)

  Mode 2.2 (Time / Date & Temperature)

Also via the User Control Mode you can send data via a PC to the display

2.1   User Control Mode

This is the general display mode. Information can be displayed using either the RS232/RS485 port using TAG Heuer protocol or via Bluetooth with FDS protocol and iOS App.

2.2   Time / Date & Temperature Mode

Alternating time, temperature and date all controlled via GPS and external sensors. Each of which can be a different colours selected by the user for optimum and eye-catching visual impact.

The user can choose between Time, Date and Temperature or a mix of all 3 options.

Temperature can be in °C or °F.

During initial power up the displays internal time is used, but once a valid GPS signal is locked the information displayed is synchronized accurately.

It is also possible to set time manually via the Menu or IOS app.

2.3   Start-Finish Mode

Start-Finish mode is a simple yet accurate mode of displaying time taken between 2 positions or inputs. This mode works either with the external Jack inputs 1 & 2 (via a manual push button), or with WIRC (wireless photocells) signal.

Two input sequence modes are available.

Sequenced mode (Normal):

 - On receiving an impulse manually on Input 1 jack or wirelessly via WIRC 1, the running time starts.

 - On receiving an impulse manually on Input 2 jack or wirelessly via WIRC 2, the time taken is displayed.

No sequenced mode (Any Inputs):

 - Running time starts and Finish actions are triggered by an Inputs or WIRC.

Besides impulse generation, externals Inputs 1 & 2 have two other alternate functions:

  Standard Input: External impulses

  Alternate Function 1:   Short pulse = Block/UnBlock WIRC 1 or 2;   Long pulse = Reset sequence

  Alternate Function 2:   Short pulse = Block/UnBlock WIRC 1 and 2;   Long pulse = Reset sequence

The Result is displayed for a predefined duration (or permanently) as per the user selected parameter.

Inputs 1&2 lock time (delay time frame) can be set in the Menu or via the iOS app.

WIRC wireless photocells 1 & 2 can be paired in the Menu or via the iOS app.

The running time / time taken can be any colour pre-defined by the user.

External Input 1 & 2 can also be configured to be used as WIRC Block/UnBlock control.

2.4   Speed Mode

Speed mode is a simple yet accurate mode of displaying speed between 2 positions or inputs.

This mode works either with the external Jack inputs 1 & 2 (via a manual push button), or with WIRC (wireless photocells) signal.

Units displayed can be Km/h, Mph, m/s or knots and can be configured manually on the display or via the iOS App. Equally, distance measured can be configured on the display or via the iOS App.

Two input sequence modes are available.

   a)   Sequenced mode (Normal):

 - On receiving an impulse manually on Input 1 jack or wirelessly via WIRC 1, start time is recorded
 - On receiving an impulse manually on Input 2 jack or wirelessly via WIRC 2, finish time is recorded.
   Speed is then calculated (using the time difference and distance) and displayed.

   b)   No sequenced mode (Any Inputs):

 - Starts and Finish time stamps are triggered by impulses coming from any Input or WIRC.
   Speed is then calculated (using the time difference and distance) and displayed.

Besides impulse generation, externals Inputs 1 & 2 have two other alternate functions:

   Standard Input: External impulses
   Alternate Function 1:   Short pulse = Block/UnBlock WIRC 1 or 2;   Long pulse = Reset sequence
   Alternate Function 2:   Short pulse = Block/UnBlock WIRC 1 and 2;   Long pulse = Reset sequence

The speed is displayed for a predefined duration (or permanently) as per the user selected parameter.

Inputs 1&2 lock time (delay time frame) can be set in the Menu or via the iOS app.

WIRC wireless photocells 1 & 2 can be paired in the Menu or via the iOS app.

The speed can be displayed in any colour pre-defined by the user.

2.5   Counter Mode

This mode works either with the external Jack inputs 1 & 2, or with WIRC signals.

Input 1 or WIRC 1 is used for counting up and Input 2 or WIRC 2 for counting down.

Depressing and holding for 3 seconds the manual input 2 will reset the counter to the initial value.

Inputs 1&2 lock time can be set in the Menu or via the iOS app.

WIRC 1&2 can be paired in the Menu or via the iOS app.

Counter initial value as well as a 4 digits prefix can be set in the Menu or via the iOS app.

Settings also allow the possibility to hide the leading '0'.

Text colour can also be defined by the user.

2.6   Count-Down Mode

This mode works either with the external Jack inputs 1 & 2, or with WIRC signals.

Input 1 or WIRC 1 is used to start/stop the countdown and Input 2 or WIRC 2 to reset it to its initial value.

Inputs 1&2 lock time can be set in the Menu or via the iOS app.

WIRC 1&2 can be paired in the Menu or via the iOS app.

Counter initial time value can be set in the Menu or via the iOS app.

Settings also allow the possibility to hide the leading '0'.

Text colour can be defined for 3 segments. Segment 1 start at the initial counter value. Segments 2 and 3 threshold can be define in the menu or via the iOS app.

A beep is generated at 10 seconds from the end of countdown, then from 5 seconds, 1 beep every second. Reaching zero a long beep with higher tone is generated.

After a reset, the pre-defined counter value can either be displayed right away or hidden until the next start.

2.7   Start-Clock Mode

This mode allows the use of an FDS color Display as a start clock.

Different layouts with traffic lights, count down value and text, can be selected according to the user application. External Jack inputs 1 & 2 control the start/stop and reset functions. Full control is also possible from our IOS application.

Guide line for a proper countdown sequence setting:

1. Chose if you want a manual countdown start or automatic start at a defined TOD value. If TOD is selected, countdown will start before TOD value in order to reach zero at the selected TOD.
2. Set the number of countdown cycles. If more than one cycle, the interval between cycles as also to be define. For proper operation, the interval value must be greater than the sum of the countdown value and the « End of countdown time ».
3. Select the desired countdown layout (see description below).
4. According to the selected layout, all other relevant parameters should be set.

Before countdown:

After power up, the display enter in GPS synchro state. User can decided to use other synchro source via the "Disp control" app. Once synchro is completed, the state changes to wait for countdown. According the selected parameters, the Countdowns will either be started manually by the user or automatically at a defined time of day.

During the wait for countdown state, a predefined message can be displayed on the upper and lower lines as well as TOD.

During countdown:

Depending on the selected layout, information like countdown value, lights and text will be displayed. Countdown value and traffic light color will changes according to the following rules: When the countdown starts, the main color is defined by the parameter « Countdown Color ».

Up to 3 color sectors can be defined. When the countdown reaches the time defined in a sector, the color will change according to the sector definition. Sector 3 has priority over sector 2 which has priority over sector 1. Countdown will stop at the value define by the parameter « Countdown end time» its value can be set from 0 to 30s after countdown reach 0. When the countdown end time is reached, the TOD is displayed until the next countdown.

3 audio beeps can be programmed independently. A threshold for continuous beeps (every sec) can also be defined. Continuous beeps will sounds until countdown reach zero (0 will have a higher and longer tone).

In some Layouts a text can be displayed during and at the end of the countdown.

2.7.1 Parameters

Countdown layouts:

A) Counter only
Full size Countdown value is displayed.

B) Counter and text
Full size countdown value is displayed until it reach zero. On reaching a Text is displayed instead.

C) 5 Lights Off
Initially full size countdown value is displayed. At value = 5, five full traffic lights replace the value. Traffic lights color is set according to the sectors definition. Every second a light is turned off. At zero, all lights are turned back on with sector's color.

D) 5 Lights On
Initially full size countdown value is displayed. At value = 5, five empty traffic lights replace the value. Traffic lights color is set according to the sectors definition. Every second a light is turned on until zero is reached.

E) Cnt 2 Lights
Full size countdown value is displayed (max 4 digits) as well as 1 traffic light on each side.

F) Cnt Text 2 Lights
Full size countdown value is displayed (max 4 digits) as well as 1 traffic light on each side. When zero is reached A Text replace the countdown.

G) TOD Cnt
Time of day is displayed on upper left side.
A full size Countdown value is displayed (max 3 digits) or the right side.

H) TOD Cnt 5Lt Off
Time of day is displayed on upper left side.
A full size Countdown value is displayed (max 3 digits) or the right side.
when the countdown reach 5, five full small traffic lights appear on the bottom left side under the TOD. Lights color is set according to the sectors definition. Every second a light is turned off. At zero, all lights are turned back on with sector's color.

I) TOD Cnt 5Lt On
Time of day is displayed on upper left side.

A full size Countdown value is displayed (max 3 digits) or the right side.
when the countdown reach 5, five empty small traffic lights appear on the bottom left side under the TOD. Lights color is set according to the sectors definition. Every second a light is turned On until zero is reached.

J) 2 Lines Text Cnt

K) Bib TOD Cnt
Time of day is displayed on upper left side.
A full size Countdown value is displayed (max 3 digits) or the right.
The bib number is displayed on the bottom left side under the TOD.
At the end of each cycle, the next Bib value is selected. The Bib list can be download into the display via the IOS application.

Start CntDown mode:	Manual Start or at defined TOD.
Manual start sync:	Manual start can be defined to start at the next 15s, 30s or 60s. If 0 is set the countdown start immediately.
Cycles number:	Number of countdown cycles performed automatically once the first is started.
Cycles time interval:	Time between each countdown cycles. This value must be equal or greater than the "countdown value" plus the "end of countdown time".
Countdown value:	Countdown time in seconds.
Countdown color:	Initial color for countdown.
Sector 1 time:	Start of sector 1 (compare to countdown value)
Sector 1 color:	Color of sector 1
Sector 2 time:	Start of sector 1 (compare to countdown value)
Sector 2 color:	Color of sector 1
Sector 3 time:	Start of sector 1 (compare to countdown value)
Sector 3 color:	Color of sector 1
End of Countdown:	Time at which a countdown cycle is completed. Value goes from 0 to -30sec. Sector 3 color is used.
Beep 1 time:	Countdown time of the first beep (0 if not used)
Beep 2 time:	Countdown time of the second beep (0 if not used)
Beep 3 time:	Countdown time of the third beep (0 if not used)
Continuous Beep:	Countdown time at which a beep is generated every seconds until zero is reached.

For Layouts (B, F, J)

Final Text down:	Text displayed in the center when countdown reach zero :

For Layout (J)
Text displayed on upper line during countdown :
Text display on upper line when countdown reach zero :
Upper line text color during countdown :
Upper line text color when countdown reach zero:

3. Settings

Display and Mode parameters can be defined via 2 different methods.

a) Navigating the display integrated menu using the onboard display push buttons

b) Via the iOS App

3.1 Display Menu hierarchy

To enter the display menu, press the illuminated Blue button for 3 seconds.

Once in the menu use the illuminated Green button to navigate through the menu and the illuminated Blue button to make a selection.

Depending on the mode selected or activated options status some menu items might be not visible.

Main menu:

- MODE SETTINGS   (Define the parameters of the selected mode)
- MODE SELECTION   (Select a mode. Some modes need to be activated first with a code from your supplier)
- GENERAL SETTINGS   (Display general settings)
- EXT INPUTS   (Parameters of the 2 external inputs – Jack connectors)
- RADIO   (Radio settings and WIRC wireless photocell pairing)
- EXIT   (Leave the menu)

General Settings:

- DISP INTENSITY   (Change the display intensity)
- BIG FONTS   (Define 3 different fonts, Big Fonts – Full height)
- GPS STATUS   (Display the GPS status)
- LICENSE CODE   (Enter a license code to activate additional modes)
- EXIT   (Leave the menu)

Mode Selection:

- USER CONTROL   (Standard display mode to be used with iOS App or RS232 connection)
- TIME/TEMP/DATE   (Display the time of day and/or the temperature)
- START/FINISH   (Start with Input 1 and Finish With Input 2- With running time)
- SPEED   (Speed between Input 1/WIRC 1 and Input 2/WIRC 2)
- COUNTER   (Input 1 increments Counter, Input 2 decrements Counter, reset with Input2 long press)
- COUNTDOWN   (Count Down Start/Stop with Input 1 impulse, reset with Input2 long press)
- EXIT   (Leave the menu)

Mode Settings (Display Mode)

- LINES ADDRESS   (Set the address lines)
- LINES COLOR   (Set the colour of each line)
- BAUDRATE   (Select the RS232/RS485 baud rate)
- EXIT   (Leave the menu)

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Mode Settings (Time / Temperature & Date Mode)
- DATA TO DISP   (Select what to display : temp, time, date)
- TEMP UNITS   (Change the temperature unit °C or °F)
- TIME COLOR   (Colour of the Time value)
- TEMP COLOR   (Colour of the Temperature value)
- SYNCHRO   (Re Synchronize the clock – Manual or GPS)
- EXIT   (Leave the menu)

Mode Settings (Start/Finish Mode)
- DISP HOLDING TIME   (set the time the information is displayed. 0 = always displayed)
- DISP COLOR   (Colour of Running time and result)
- INPUTS SEQUENCE   (Select the inputs sequence mode : Standard / Any Inputs)
- INPUT 1 FCN   (Function of Input 1 : Std input / Alternate FCN 1 / Alternate FCN 2)
- INPUT 2 FCN   (Function of Input 2 : Std input / Alternate FCN 1 / Alternate FCN 2)
- EXIT   (Leave the menu)

Mode Settings (Speed Mode)
- DISTANCE   (Set the distance between Input 1/WIRC 1 and Input 2/WIRC 2)
- DISTANCE UNITS   (Select the distance unit – metres or feet)
- SPEED UNITS   (Select the speed unit – Km/h, Mph, m/s or Knots)
- DISP HOLDING TIME   (set the time the result is displayed. 0 = always displayed)
- COLOR   (Colour of the speed value)
- INPUTS SEQUENCE   (Select the inputs sequence mode : Standard / Any Inputs)
- INPUT 1 FCN   (Function of Input 1 : Std input / Alternate FCN 1 / Alternate FCN 2)
- INPUT 2 FCN   (Function of Input 2 : Std input / Alternate FCN 1 / Alternate FCN 2)
- EXIT   (Leave the menu)

Mode Settings (Counter Mode)
- INITIAL VALUE   (Initial counter value after reset)
- COUNTER PREFIX   (Prefix displayed before the counter – 4 digits max)
- LEADING 0   (Leave or remove the leading '0')
- COLOR   (Colour of the counter)
- INPUTS SEQUENCE   (Select between standard inputs sequence and No inputs sequence)
- EXIT   (Leave the menu)

Mode Settings (CountDown Mode)
- INITIAL VALUE   (Initial value after reset)
- LEADING 0   (Leave or remove the leading '0')
- COLOR SEG 1   (Colour of the first segment)
- COLOR SEG 2   (Colour of the second segment)
- COLOR SEG 3   (Colour of the third segment)
- THRESHOLD SEG 2   (Time value to switch from Seg1 to Seg2)
- THRESHOLD SEG 3   (Time value to switch from Seg2 to Seg3)
- EXIT   (Leave the menu)

Mode Settings (Start-Clock Mode)

- OFF SESSION MODE   (Select what to display when not in a countdown session)
- START MODE   (Select between Manual and Automatic Start)
- CYCLES NUMBER   (Number of countdown cycles: 0 = infinite)
- CNTDOWN PARAM   (Countdown parameters menu)
- CNTDOWN LAYOUT   (Select the way countdown info are displayed)
- SYNCHRO   (Perform a new synchro: GPS or manual)
- EXIT   (Leave the menu)

CntDown Param menu (Start-Clock Mode)

- COUNTDOWN VALUE   (Countdown value)
- COUNTDOWN COLOR   (Default countdown color)
- SECTOR 1 TIME   (Start time of color sector 1)
- SECTOR 1 COLOR   (Color of sector 1)
- SECTOR 2 TIME   (Start time of color sector 2)
- SECTOR 2 COLOR   (Color of sector 2)
- SECTOR 3 TIME   (Start time of color sector 3)
- SECTOR 3 COLOR   (Color of sector 3)
- CNTDWN END TIME   (Time when countdown sequence is completed)
- BEEP 1   (Time of Beep 1: 0 = disabled)
- BEEP 2   (Time of Beep 2: 0 = disabled)
- BEEP 3   (Time of Beep 3: 0 = disabled)
- CONTINUOUS BEEP   (Start time for continuous Beep: 0 = disabled)
- EXIT   (Leave the menu)

4. WIRC / WINP

WIRC or WINP can be uses to send impulses in some modes like "Start-Finish", "Speed", "Counter", "Count-Down". In order to be recognized by the display a pairing must be done using either the Display manual menu or the IOS "Disp-Control" application. Unlike a TBox-Radio, the display only listens to the WIRC/WINP signal and no acknowledge is send back. This allows a display to intercept a WIRC signal send to a TBox without interfering with the communication. However if used without any TBox, a WIRC/WINP will not receive any acknowledge and therefore send again and again its data until the max transmission time of 8 is reached. This has the disadvantage to generate a lot of radio traffic on the selected channel and can create perturbation on other radio transmission. To reduce this drawback, a special WIRC mode has been implemented (blind transmission) reducing to 3 the number of time data are resent. To activate this mode, first make sure the WIRC is ON then press for 5 sec the power switch of the WIRC (the power led blink twice green once completed). Normal operation can be resumed by pressing a second time the power switch for five seconds or by turning OFF the WIRC.

Here are the 3 possible combinations with WIRC, TBox and Display:

1) TBox-Radio + WIRC
 - WIRC set in normal mode
 - Two way communication is establish between TBox and WIRC

2) Tbox-Radio + WIRC + DISPLAY
 - WIRC set in normal mode
 - Two way communication is establish between TBox and WIRC
 - Display listen to communication between TBox and WIRC

3) DISPLAY + WIRC
 - WIRC set in blind transmission mode
 - Display listen to WIRC broadcast

5. Factory settings

Factory setting can be restored by pressing both display switches during power up.

- All parameters will be set to defaults.
- Bluetooth password will be reset to "**0000**"
- Bluetooth will be activated if previously disabled
- Bluetooth will enter DFU mode (for firmware update)

Once reset completed, power will have to be recycle (OFF/ON) in order to start in a normal mode.

6. Connections

6.1 Power

The display can be powered from 12V to 24V.
Current drawn will depend of the input voltage. Power supply should be design to provide at least 8A at 12V or 5A at 24V.
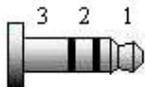
6.2 Audio output

In some display modes, audio tones are generated and output on the 3.5mm stereo jack connector.

6.3 Input_1 / Temperature sensor Input

The top most 3.5mm jack connector combines 2 functionalities.
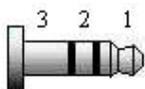1) External inputs 1
2) Temperature sensor input

1: External input 1
2: Temperature Sensor Data
3: GND

If temperature sensor in not used, an FDS jack to Banana cable can be used to connect an input switch.

6.4 Input_2 / Output

The 3.5mm jack connector on the bottom combines 2 functionalities.
1) External inputs 2
2) General purpose output (optocoupler)

1: External input 2
2: Output
3: GND

If output in not used, an FDS jack to Banana cable can be used to connect an input switch.
If output is used, a special adaptor cable is requested.

6.5 RS232/RS485

Any standard RS232 DSUB-9 cable can be used to drive the display from a computer or other compatible device. On the connector, 2 pins are reserved for RS485 connection.

DSUB-9 female pinout:

1	RS485 A
2	RS232 TXD (Out)
3	RS232 RXD (In)
4	NC
5	GND
6	NC
7	NC
8	NC
9	RS485 B

7. Protocol

7.1 RS232/RS485

For basic text strings (no color control), FDS displays are compatible with the standard TAG Heuer display protocol.

7.1.1 Basic Format

<STX>NLXXXXXXXX<LF>

STX = 0x02
N = line number <1..9, A..Z>
L = brightness <1..3>
X = characters (up to 32)
LF = 0x0A

Format: 8bits / no parity / 1 stop bit
Baud Rate: 9600bds

7.1.2 Characters Set

All standard ASCII characters <32 .. 126> excepted for the char ^ which is used as delimiter

!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ
[\]_`abcdefghijklmnopqrstuvwxyz{|}~

Extended Latin ASCII characters (ISO-8859-1) <224 .. 255>
àáâãäåæçèéêëìíîïðñòóôõö÷øùúûüýþÿ

7.1.3 FDS Protocol extension

A dedicated extension to this protocol has been implemented in order to take full advantage of the color and other text attributes.
Inline commands can be add between the ^^ delimiters.

Command	Description
^cs c^ ^ce^	**Color overlay** **cs** = start color overlay cmd **c** = color code **ce** = end of the color overlay cmd *Examples A:* <STX>13Welcome ^cs 2^FDS^ce^Timing<LF> "Welcome" and "Timing" are in the default line color "FDS" is in Green *Examples B:* <STX>23^cs 3^Color^cs 4^ Display<LF> "Color" is in Blue "Display" is in Yellow
^cp s e c^	**Set color between two characters position** **cp** = cmd **s** = first character position <1 .. 32> **e** = last character position <1 .. 32> **c** = color code *Examples:* <STX>13^cp 1 10 2^^cp 11 16 3^ <LF> Characters position 1 to 10 are defined in Green Characters position 11 to 16 are defined in Blue This setting is saved in non-volatile memory.

Colour code:

code	Colour
0	Black
1	Red
2	Green
3	Blue
4	Yellow
5	Magenta
6	Cyan
7	White
8	User define
9	User define
10	User define

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