

## dicodes E-Cigarette Control Unit “Telegonos”: Technical Specification and Manual

### 1. Common

The electronic control unit from dicodes is equipped with an electronic, which incorporates a small 2-digit 7-segment display and a push-button to adjust several parameters by means of a menu structure and to show different measured values. The top M7x0.5 metric thread is compatible with most available types of vaporisers on the market today.

With its outer diameter of 17mm, the Telegonos is especially designed for a number of slim atomizers, particularly the “Penelope”, an atomizer with 17mm diameter, to gain a harmonic and nice overall picture. [The naming Telegonos refers to Greek mythology. Telegonos was married to Penelope (who was his step-mother before)].

The Telegonos is offered in two different lengths, prepared to use a single “14500” or “14650” type of Li-Ion accumulators. (Do not supply the electronic by more than 4.5V.)

The adjustments and handling is intuitive by pressing the button short term or for a longer interval. With the button actuated for more than 0.25 sec., power is applied to the heating winding, until the button is released or the maximum vapour time is exceeded.

The selected power is – combined with the creation of the heater winding – decisive for the vaping result. The device is designed to work within a resistance range of 0.7 to 3 Ohms, typically 0.16mm Kanthal-wire.

In general, the output power is independent of the heater resistance. The power chosen is always transferred to the load (power controller). Outside the permitted resistance range, vaping is possible but with certain power limitations. The optimal efficiency is achieved with about 1.5 Ohm.

The battery holder is powered up by consecutive fast pressing of the button for 1 to 5 times, see extended functions menu (Oc “On clicks”). With continued pressing of the button the user steps through the programming menu and the error menu. When the button is released, the current value of that specific menu is displayed after a short time. The value can be changed by repeated pressing of the button or keeping the button pressed (auto repeat). The display duration of the menu item and value and thus the speed is selectable in the extended functions menu.

As soon as the display is off and the button is pressed for longer than 0.25 seconds, the heating winding is powered.

## 2. Menu Structure

The main menu is explained first at this point. It serves to change most used values in the daily usage. Beside this, there is a sub-menu, designated as the extended functions menu, which enables the user to choose several individual settings. This menu is explained later in the text. As far as the extended functions menu has an impact on the main menu entries, the text includes related hints.

- Pu => Power up increases the output power in steps of 1W or 0.5W or counts up during auto repeat. When reaching 12W (or the value set by the extended functions menu item "PL") the power adjustment jumps back to 5W (roll over). Also see half wattage steps option in the extended functions menu.
- Pd => Power down decreases the output power in steps of 1W or 0.5W or counts down during auto repeat. When reaching 5W the power adjustment jumps up to 12W (or the value set by extended functions menu item "PL", roll over). Also see half wattage steps option in the extended functions menu.
- Co => Check ohms performs a resistance measurement of the heating winding by means of a constant current pulse. The accuracy is about +/-0.05Ohms. When the button is pressed again during the display of the value, a second measurement result is displayed, referred to as the AC-resistance.
- Cb => Check battery measures the accumulator voltage under load, or displays the last voltage measurement, respectively, see 11. Measuring the battery voltage.
- Sb => Set battery defines the minimum battery discharge voltage and therefore also the thresholds for the power reduction slope. See below item 7 for further explanations.
- So => Switch off. When this menu item is displayed and the button is kept pressed, first the decimal points are lid and then "- -" and the electronic switches off completely. It can be switched on again by consecutive short term pressing of the button, the number of which is defined via the extended functions menu.
- EF => Extended Functions menu, see item 12. of this datasheet.
- F- => Fault indication. With no fault pending the display shows F-. The error codes are defined as:
  - F1 => Resistance of heater winding open
  - F2 => Resistance too high (> 3.0 Ohms)
  - F3 => Resistance too low (< 0.7 Ohms)
  - F4 => Short or loose winding or overload (Heater winding for chosen wattage too high)
  - F5 => Battery (accu) voltage too low
  - F6 => Temperature too high (PCB-temperature > 55°C)
  - F7 => maximum vapor time exceeded
  - F8 => Heater winding too low resistant for power chosen

Note: Depending on the setting of Ec (Error control) in the extended functions menu, certain Errors are either not displayed at all (F2/F3) or are no longer to be acknowledged to reset the fault condition (F1).

### **3. Power Controller**

The electronic within the Telegonos is able to govern the output power in a range from 5 Watts to 12 Watts, or up to 16 Watt, respectively (see "PL"). The power control is independent from the wiring resistance. I.e. it does not matter, whether the heater has 0.7 Ohm or 3 Ohms of resistance, the power will always be adjusted to the pre-set value. In case that the resistance check (Fault-codes F1 to F3) is enabled in the extended functions menu, the permitted range for the resistance is 0.7 to 3 Ohms.

Remark: Even when the wiring resistance is outside the nominal and checked range of 0.7-3 Ohms, vaping is possible in a certain range.

For resistances outside the recommended range (or checked range if enabled), full power of 16W cannot always be achieved. For example, the maximum power of about 15W with 0.7 Ohm is reduced to about 10W with 0.3 Ohm. These values were measured on a typical device, but cannot be guaranteed. In case that the requested power can not be transferred to the load, fault F4 indicates the overload condition. After reduction of power and fault acknowledgement, vaporising is possible.

### **4. Time limited power output**

The maximum uninterrupted activation time for vaping is limited and depends on the power setting. For a power of up to 10W maximum vape-time is 20 seconds. Above 10W the time decreases by 1 second per Watt, i.e. 14 seconds at 16W.

So in case that the button is accidentally activated permanently, further power output is stopped after 20-14 seconds and the display shows F7.

### **5. Short Circuit Protection**

When the heating winding is applied, unintentional shortages between housing and the wire can happen. If the button is pressed then, the electronics will not be damaged, but shows the error condition with "F4 short or wobbling contact or overload" in case of a low-ohmic short or intermitted contact. After acknowledgement of the error message – and removal of the shortage – vaping is possible again.

Error message F4 is displayed in contrast to error F1 (open winding), when a short or opening happens during power output. So F1 is displayed as soon as the winding is removed or opened with no power applied, e.g. when the winding is applied or created.

## 6. Reverse Polarity Protection

Several accumulator manufacturers offer devices whose polarity is hard to identify compared to standard batteries. In the past it could happen that the heater-winding was powered permanently or the power switch was even damaged in case that the accumulator was insert with reversed polarity. The **dicodes** battery holder is equipped with a reverse polarity protection so that no current flows in this condition. Vaping is impossible then, of course.

The battery should always be inserted with the +pin first in the direction of the electronics and the device in an angular position.

## 7. Deep Discharge Protection and Power Limitation

Common Lithium-Ion accumulators have a voltage of about 4.2V when fully charged. During discharge the voltage reduces to 3.7V down the 3.3V and stays within this range while reducing slowly for a longer period of time. At the end of the capacity (about 70-80%) the voltage decreases somewhat faster until its value reaches about 2.5 to 2.7V, below which the accumulator is irreversibly damaged or even destroyed due to chemical reactions inside.

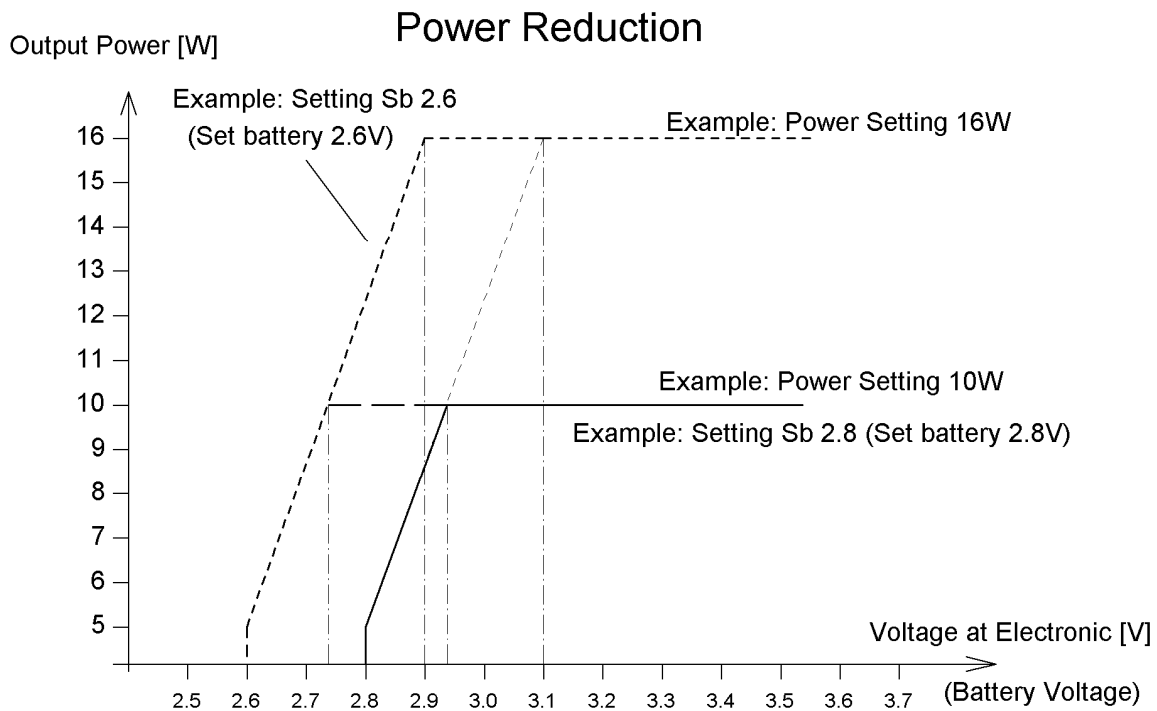
Most electronic cigarettes in the market using a lithium-ion-accu abruptly disable further power output when the voltage under load drops to about 3.3V. This is somewhat unpleasant for the user especially when no replacement accumulator is at hand.

In contrast to this, the electronic within **dicodes** device does not switch off all of a sudden. Beginning at an user adjustable voltage, a power reduction is activated, which enables further vaping at a reduced power, without changing any other adjustments. The output power is reduced proportional as the voltage under load of the accumulator decreases.

The power reduction is adjusted with the menu item "Sb" (Set battery).

The value set under "Sb" adjusts the voltage where the power output is limited to 5W. If the voltage drops below this value, vaping is disabled. In this case the error message F5 "battery voltage too low" is displayed. Effectively this setting defines the low discharge level of the battery.

The power reduction always starts about 0.3V above the set value referred to 16W (!). The following diagram illustrates how the power reduction works. In general it is: The lower the power setting is chosen, the deeper the battery can be discharged, before the power reduction starts.



In the diagram, two example settings of the parameter Sb are shown. With a setting of Sb to 2.6V, for example, and a chosen power of 16W, the power reduction starts at a battery voltage (under load) of about 2.9V; this is the dashed line in the diagram. For the second example, Sb is set to 2.8V and the power is 10W. In this case the reduction starts at about 2.93V (bold line in the diagram). With Sb=2.6V and 10W, the power limitation would start at a voltage of about 2.73V (long dashed line).

The reduction in power is displayed by flashing decimal points.

## 8. Temperature Check

The electronic checks for its own temperature (temperature of printed circuit board). Any electronic has so called power losses, which increase the temperature in the end. To protect the electronics from over-heating, power output is stopped at temperatures above 55°C (approx.). Normally the value is never reached, even under persistent maximum power output.

## 9. Auto-Power-Off

When the device is not used for a certain time, it switches off itself. This time-out can be selected in the extended functions menu to be 1, 5, 10, 20, 30, 60, 90 minutes. So if you forgot to actively switch off the device, using menu item So (Switch off), the battery is not discharged further. Note that in conjunction with the options under "Oc" (On clicks) selected to be 0, power output is immediately possible when pressing the button as if the device is still on. Thus the battery discharge can be limited to a minimum, when 1 minute is chosen for the time-out.

## 10. Resistance Measurement

The Telegonos is equipped with a resistance measurement. The result is displayed, once the menu item Co (Check ohms) is selected.

Typical heater windings have a resistance of 0.7 to 3 Ohms, assuming a Kanthal-wire of 0.16mm diameter is used. The device is optimised for this resistance range. Nevertheless, the user is free to choose almost any other winding resistance and different materials like NiCr.

The appliance of a winding typically is as follows: Once you have created a winding, switch on the device by pressing the button single or multiple times (Oc setting). Pu for adjusting the power is displayed. Directly press the button again for two times to get to menu item Co (Check ohms) and wait shortly for the resistance being displayed.

The following refers to the error control for F1 to F3 being enabled by setting "Ec" in the extended functions menu to 1, only.

In case your winding is outside the recommended range of 0.7-3 Ohms, F2 is displayed, if your winding is greater than 3.0 Ohms and F3, if your winding has less than 0.7 Ohms. See also item 12 in this menu.

In order to display the resistance measured, despite the error message, simply press the button several times until you reach Co again, with the lately measured resistance displayed after about 0.5 seconds.

If you have reset the error by pressing the button for a short time during the appearance of F2/F3 in the display (it changes to F-) and then are going to item Co again, you will instantly get the error message again, because the resistance is still outside the specified range.

Normally you will now open the winding to change it. As soon as you open it, the error code F1 will be displayed indicating an open winding. You don't have to care for that at the moment. Modify the winding and press the button. Error code F1 is still displayed. Now reset the error by immediately pressing the knob for a longer time: the display changes from F1 or F-. Now you can step through the menu to "Co" again to measure the changed resistance of your winding.

## 11. Voltage measurement

The accumulator voltage is measured using menu item Cb. The device measures the voltage in two ways. Either during the winding resistance measurement, which represents a light load, or when power is supplied to the winding. The most lately measured value is stored and displayed once you choose Cb.

When you have powered up the device, it instantly performs a resistance measurement. If you then choose Cb (Check battery) the voltage at light load is displayed, as this was measured at latest. If you now apply power to the winding by keeping the button pressed for longer than 0.25 seconds and then shortly press the button again, that battery voltage during applied power is displayed. Thus you can also check the batteries inner voltage drop, which increases when the battery has reached end of life.

If you like to measure the battery voltage at no-load condition, simply switch off the device, remove the atomizer and switch it on again. As the device tries to check the resistance (no with no heating-wire) you can read the no-load voltage at menu Cb (check battery).

Please note that the no-load voltage of an accumulator gives you no reliable information about its quality nor its charging level. A wear-out battery can show 4.1V, although the voltage will drop dramatically when loaded, and then goes back to 4.1V after some time. If you get aware that an accumulator voltage, although fully charged, drops dramatically under load (depending on accumulator size and quality), it has reached its end of life.

## 12. Extended Functions Menu

The Telegonos mod includes several additional parameter settings, to consider individual user preferences. Therefore the main menu includes an item "Extended Functions".

When choosing EF in the main menu, "00" is displayed after a short delay. When the button is pressed now, a blinking pattern is displayed to indicate that the user is now entering the extended functions menu. Consecutive pressing the button, the user steps between the sub-menu items.

Note that the pattern will not disappear until the button is pressed again (without time limit).

In the following the EF menu-items are explained in detail:

### 1. Lu => Luminosity of display



Changing the value of Lu will set the brightness of the display in 5 steps. A value of 1 selects the least brightness, 5 selects the highest. The default setting is 4.

### 2. Pc => Power Control



With the number set in the menu item Pc, different modes of a build in power-boost function (short high power output) are selected. See further explanations below.

### 3. St => Switch off Time



The switch off time selects the time in minutes for the switch off, when the button is not activated. The minutes to be selected are 1, 5, 10, 15, 20, 30, 60 or 90. Note that selecting 1minute together with a setting of Oc=0 the batteries capacity can be fully exploited without any further latency. The default setting is 60 minutes.

#### 4. Oc => On Clicks



On clicks defines the number the button has to be pressed before the device is switched on (after it was switched off). When 0 is selected immediate power output is possible when pressing the button longer than 0.25sec. The Oc range is 0-5 and the default value is 5.

#### 5. Ac => Activation clicks



In contrast to Oc, this menu item selects the number of clicks to enter the menu structure. The number can be selected between 1 and 5 and 1 is the default value.

#### 6. Ct => Click Time



When you step through the menu, this value defines the duration of the item display and value display. The range is from 1 (fast), 2 (medium fast) and 3 (slow). Note that the timing within the EF-menu is always set to "very slow", as this menu is used less often (2 sec. menu item, 2 sec. value) and the user is not so familiar with the different entries.

#### 7. Ec => Error Control



The user can choose whether to use the wiring resistance range-check feature or not. When disabled (0) the faults F2/F3 (resistance too high/low) are no longer displayed nor are to be acknowledged. When the vaporiser is removed, F1 is only displayed when attempting to fire. The fault condition resets after the vaporiser is attached again. The default setting is "range check disabled" (0).

When enabled the display instantly shows F2/F3 when the fault condition occurs. The fault has to be acknowledged by pressing the button longer before vaping is possible again.

#### 8. Ho => Half Watt Steps on/off



With this parameter set to 1, half wattage steps are selected for the Pu/Pd menu. For half watt steps the right decimal point in the display is lid, for example „09.“ designates 9.5Watt.



## 9. PL => Power Limit sets the maximum power



The Telegonos is delivered with a default setting of 12W as the maximum output power. If the user wants to increase the maximum setting, the menu PL allows to increase the limit up to 16W. See also additional explanations below.

## 10. Sd => Set defaults



Set defaults helps when the user got lost with any settings.

The default settings are as follows:

Lu	4	Display brightness
St	60	Time-out switch off after 60 minutes
Oc	5	Press button 5 times to switch on device
Ac	1	Menu is entered after 1 short click
Ct	3	slowest menu entry
Ec	0	Wiring resistance check disabled
Ho	0	On watt steps selected for Pu/Pd menu
SA	0	AC resistance check with 200kHz not linearised

## 13. Further remarks

### 1. Extended Functions Menu: Power control (Pc)

The mod Telegonos from **dicodes** is the first to be equipped with a new adjustable function designated as Power-Control, which combines 3 functions, depending on the setting.

The 3 functions are:

1. Accelerated heat-up of the heater-wire, i.e. an initial time limited power boost. The power-boost shortly applies 16W to heater. [A quick heat-up is also known from the Dani (PID-control), but without overshoot, and on the Telegonos it is implemented differently and is adjustable).
2. A periodic power-boost function: In certain selectable time-periods the maximum power of 16W (on the Telegonos) is applied to the heater winding. As a consequence, the temperature of the atomizer is not constant, but varies in a certain range. The temperature range depends on the (average) power setting, the boost setting selected and the type of atomizer and heater-winding applied.

Now what is the purpose of this function? => In the liquid – beside the basic substances, whose concentration slightly varies between liquids – there are several flavouring substances. Every single flavour has its own flash point (boiling point) within this composition. This effectively means, that each flavour can only be tasted at a different atomizer temperature. So if the temperature varies only little, the flavour whose flash point

is outside the small temperature range does not come to its own. Now by varying the temperature the tasty-flash is much better and more sophisticated.

3. With the activation of the periodic power boost function the total energy needed for a good taste is reduced, compared to a constant power setting. With the periodic boost enabled, it is recommended to lower the average power – this without sacrificing the flash. This effectively enlarges the total vape-time, which is advantageous especially when using smaller batteries, like in the Telegonos.

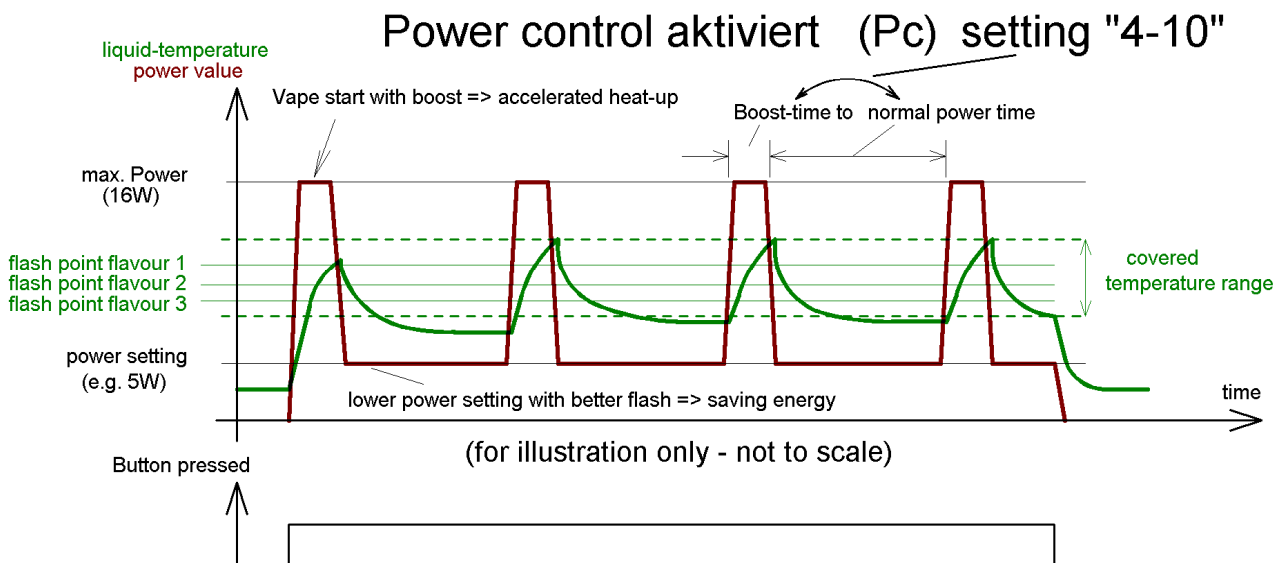
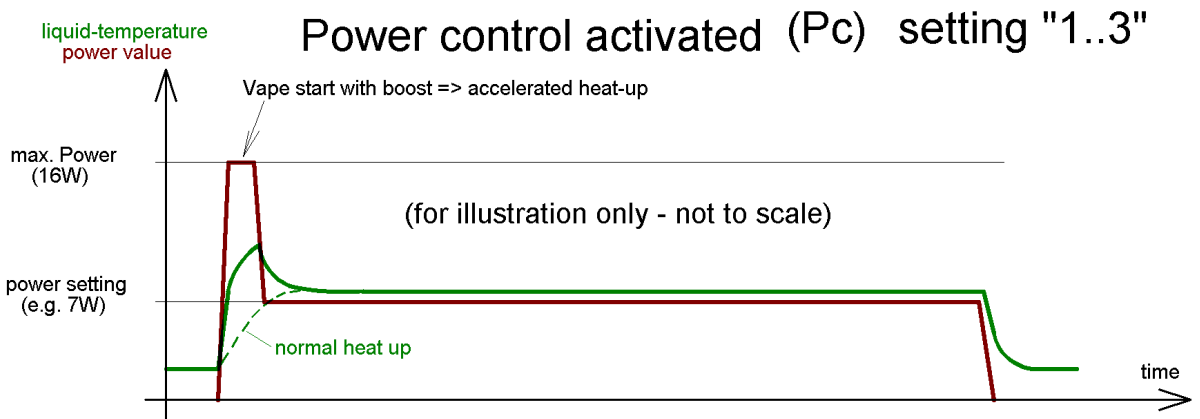
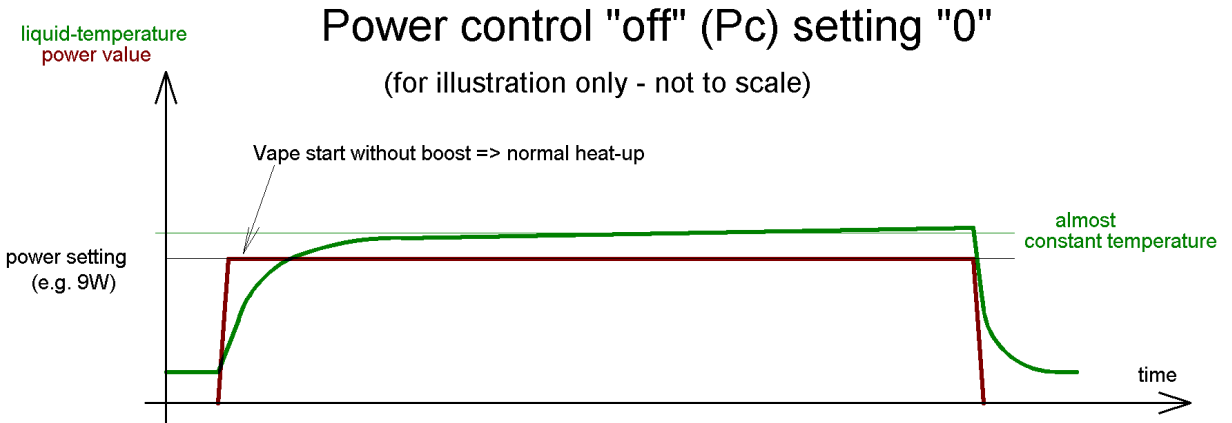
The Power-Control can be set in the extended Functions Menu under PC according to the following table:

Setting of Pc	Boost-time (16W) in milliseconds (seconds)	Time of Set Power (according to Pu/Pd) in milliseconds (seconds)	Total average power in Watts referred to 5W
0	--	--	Normal Power, no Boost
1	300 (0,3)	---	Start-Boost
2	450 (0,45)	--	Start-Boost
3	600 (0,6)	--	Start-Boost
4	50 (0,05)	500 (0,5)	6.18
5	80 (0,08)	600 (0,6)	6.53
6	120 (0,12)	700 (0,7)	6.9
7	160 (0,16)	800 (0,8)	7.17
8	200 (0,2)	900 (0,9)	7.36
9	250 (0,25)	1000 (1,0)	7.6
10	300 (0,3)	1000 (1,0)	8.0

So with Pc=0 there is no power boost, but the normal settings are used. With Pc=1..3 there is an initial 16W power boost, with different length, and with Pc=4...10 different time settings of boost and normal power are selectable.

Note: If the max. power under "PL" is set to 16W and the normal power setting set to 16, the boost has no effect. Also note that if the battery voltage drops to the value set by Sb plus 0.3V, the power limitation starts, indicated by flashing points in the display; this blinking is suppressed during the boost-time, although the power is reduced. I.e. the blinking is only visible for the time of the selected normal power.

The following diagram illustrates the operation of Pc



## **2. Power Limit PL**

With the outer diameter of 17mm, the Telegonos gives a nice overall picture when combined with several atomizer of 17mm diameter.

These very compact atomizers are normally not designed for powers higher than about 10W. The Telegonos is designed for the use of 14500 or 14650 Li-Ion batteries. These small size batteries are not as powerful compared to batteries with bigger diameters, which is acceptable when considering the characteristics of the appropriate atomizers.

Together with the Pc function, the Telegonos is able to deliver a remarkably good flash while saving energy when the power setting is reduced accordingly.

Because of this, the Telegonos is delivered with a maximum power output of 12W. This power limitation can be changed in case that the user wants to, e.g. if more powerful batteries will be available in the future or if the liquid requires a higher power.

To change the default power limit, the menu item PL was added to the extended functions menu. With the setting of PL the maximum power output can be increased up to 16W in 1 Watt steps. The value of PL changes the range of the Pu/Pd settings in the main menu accordingly. Please consider that the currently available Li-Ion batteries with 14mm diameter should not be permanently discharge with current greater than 2C, i.e. about 2 Amps. With a fully charged battery this gives about 8W of continuous power output. The continuous discharge limit is based on the self-heating of the battery and not because of the electrical characteristics.

Note: The short-term boost function of menu "Pc" does not damage the battery.

## **3. Behaviour during certain values of Oc (On clicks) and Power off**

The device can be switched off either explicitly by entering menu So (Switch off) or it switches itself off after the time-out minutes.

With the extended function menu OC (On clicks) the number of button actuations can be chosen to switch on the device.

Now, for an Oc-value of 0, i.e. instant power on and possible vapouring, there is a safety issue (risk), in case that the device is unintentionally clamped in a bag or whatever or lays inauspiciously on an edge.

It might happen then, that the device switches on unintentionally, powers the heater winding, then goes into fault condition F7 (maximum vaping time exceeded), reaches the (short) time-out for power off and instantly powers on again and so forth in an endless loop.

Therefore a protection feature is implemented as follows:

1. If, for a value of Oc less or equal to 2 AND (at the same time) a fault condition AND after time-out power off, then the device can only be switched on by consecutive pressing the button 5 times. This is only required one time for the just mentioned conditions. After this the device works again with the pre-set value of Oc.
2. If, for a value of Oc less or equal to 2 and the device is actively switched off by the user with selecting So (Switch off), the device can only be switched on by consecutive pressing the button 5 times.

#### 14. Further technical data and specifications

Maximum ratings specify those values beyond which the operation of the device is not guaranteed and damage or even destruction can not be excluded.

Maximum input supply voltage            4.5 Volts  
Maximum input current                    7 Amps

As a protection against malfunctioning which could lead to high input currents and self heating, the battery holder is equipped with non-replaceable 7Amps melting fuse.

Parameter	Minimum	Typical	Maximum	Unit
Output Power (+/-10 %) @ resistance 0.7-3.1 Ohms	5		16	Watts (rms) at load (1)
Input voltage battery	2.5	3.4	4.2	Volt
Self-current consumption stand-by		22		mA (Vin=3.5V)
Self-current consumption display active		60		mA (Vin=3.5V)
Self-current consumption during power output		30		mA (Vin=3.5V)
Efficiency		95		% (@10 Watt)
Switching frequency		200		kHz
Resistance range, measurable	0.3		9.9	Ohm (2)
Switch off temperature limit (PCB temperature)	52	55	60	°C
Leakage current switched off		1	5	µA
Leakage current reverse polarity			10	µA
Temperature range	-20		40	°C

- (1) Maximum output power within specified voltage range (Sb + 0.3V up to 4.2V) and specified resistance range (0.7 to 3.0 Ohms)
- (2) Measurements in the range of 0.3 to 9.9 Ohms are possible, but outside the range of 0.7 to 3.0 Ohms the results might be less accurate.

**- Specifications and Functions are Subject to changes without further notice -**