Installation and operating manual

for POWER SPARK from software version 2.3

Electronic ignition system

POWER SPARK

Versions:

- 1 cylinder
  RC-i 100, RC-i 120, RC-i 125
- 2 cylinders
  RC-i 200, RC-i 220
  (twin 0°, boxer 180°)
- 3 cylinders
  RC-i 400, RC-i 420 (0°, 180° ign. offset)
  RC-i 422 (120° ign. offset)
- 4 cylinders
  RC-i 400, RC-i 420 (0°, 180° ign. offset)
  RC-i 421 (90° ign. offset)

Included in delivery:

- POWER SPARK
- magnet for speed sensor (if no flywheel is ordered with POWER SPARK unit)
- programming magnet
- fuse, fuse holder
- installation and operating instructions

Dear customer,
thank you for your purchase.
Please read the following instructions carefully, so you wouldn`t have any difficulties to install and operate the POWER SPARK.
We wish you a successful installation and much pleasure using the POWER SPARK.

SEVERE WARNING
The ignition system produces electromagnetic interfering fields as well as high voltages at the spark coil and the spark plug. These interfering fields are sufficiently screened if the spark plug is assembled in the engine and the cables are professionally connected.

- ⇨ **Do not touch non insulated cables or the spark plug if the ignition system is activated. HIGH VOLTAGE, MORTAL DANGER**
- ⇨ **Make sure, that you do not use any attachments that are sensitive to electromagnetic interfering fields or devices that are life-supporting (heart pacemaker etc.) if the ignition system is active.**

Warranty
We guarantee the function of the „power spark" two years beginning on the day of purchase. Damages as a result of improper installation make an exception of the guarantee.

We are always interested in improvements and look forward to your feedback. Please contact:

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GERMANY
Tel: +49 7365 9191-41 (sale)
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technology novelties engineering

[1] Only versions with diagnostic functionss RC-i x2x, [2] only multiple cylinders versions RC-i 2xx & RC-i 4xx

Features

General

- micro controlled, high-precision electronic ignition system
- constant spark energy in the complete speed range
- spark energy independent from supply voltage, integrated voltage booster compensates voltage swing
- 2-digit brilliant red LED display
- simple installation and programming
- numerous possibilities to customize
- red anodized, waterproof aluminum housing

- speed up to 30000rpm with one or more cylinders[2)]
- display of the actual engine speed
- ignition starts at a minimum engine speed (safe start-up)
- separate ignition endstages[2)] => low power consumption when using multiple cylinders, (because additional cylinders ignite separately and not parallel to the first one)
- no need of an additional battery pack, ignition system can be powered from the receiver battery pack (min. 4 batt.= 4,8V)

adjustment possibilities

- 10 pre-programmed ignition maps
- application of 5 custom ignition maps
- adjustable speed sensor angle (mechanical sensor offset)
- adjustable ignition energy (3 steps)

diagnosis features

- display of maximum engine speed and battery voltage
- operating time counter
- monitoring of main battery voltage
  - low voltage warning (generation of ignition misses)
  - engine stops if low voltage detected
- monitoring of receiver battery voltage[1)]
- monitoring of receiver servo signal[1)]
  - free definable monitoring window
    => engine stops if FAILSAFE-signal is detected
  - „killswitch“- functionality

[1)] Only versions with diagnostic functionss RC-i x2x, [2)] only multiple cylinders versions RC-i 2xx & RC-i 4xx

Retrofitting an engine with magnetic ignition system

The POWER SPARK ignition was designed in a way that the original magneto ignition can be replaced with few modifications.

This installation and operating instruction describes the modifications using the example of the ZENOAH-260-PUM- engine.
The modifications of other engines can be done in the same way; deviations can result in the geometry of the flywheel, the fitting of the speed sensor etc.

Advantages of the POWER SPARK

Elimination of red primary ignition coil and flywheel with integrated magnets.

- smoother engine running, since the unsymmetrical magnetic brake torque for generating the ignition spark is eliminated
- allows the assembly of compact engines with more cylinders, because the prime-ignition coils are inapplicable.

Replacement of the original flywheel with integrated magnets.

- flywheel with increased inertia can be used (accessories)
  ⇨ increased engine smoothness
  ⇨ reduced idle speeds possible

The original secondary ignition coil(s) are used furthermore.

- Instead of the red primary ignition coil the POWER SPARK is connected to the secondary ignition coil.
  ⇨ high voltage circuit only between secondary ignition coil and spark plug
  ⇨ no high voltage at POWER SPARK
- secondary ignition coil(s) do not have to be mounted to the engine

[1)] Only versions with diagnostic functionss RC-i x2x, [2)] only multiple cylinders versions RC-i 2xx & RC-i 4xx

Quick way to success

The POWER SPARK has a lot of adjustment possibilities and functions. To ensure a fast assembly and initial startup, please act according to the following checklist.

Assembly

Programming

Initial startup

[1)] Only versions with diagnostic functionss RC-i x2x, [2)] only multiple cylinders versions RC-i 2xx & RC-i 4xx

Safety and installation instructions

Please read the following instructions carefully.

Please work carefully. Do not pull on cables or cable connections. Improper cable connections may result in cable fires by reason of short circuits.
Improper cable installations or cable connections may result in malfunction or damages to the components.
Correct positioning and connection of cables is essential for long term, error free function of the POWER SPARK.

The connector plugs of the sensor cable have adjustments, please notice that and plug in the connector very carefully to avoid damage of pins.

- Install the cables in unpowered state, disconnect all battery packs.
- Do not locate the cables near sharp edges or hot or moving parts, so that they cannot be damaged.
- To connect the cables use only suitable connectors. Make sure, that the cables have a good contact and that the conductive parts of the connector cannot be touched when connected.
- **Install the cables, especially the sensor cable and the cable to the RC-receiver as far as possible from the ignition coils to avoid interference.**
- **Place the secondary ignition coil at least 7cm (3”) away from the speed sensor and POWER SPARK unit.**
- **To avoid short circuit or damages of components isolate non-used cables with insulating band or insulating screw joints.**
- If possible, install the plug-in connectors at a suitable place where no splash water or other liquids like petrol or oil can reach them and keep care that they cannot detach from their place (use tape or cable binders).
- Please ask an expert if you have problems with the installation.

We are not responsible for consequential damages by installing and using the POWER SPARK .

[1)] Only versions with diagnostic functionss RC-i x2x, [2)] only multiple cylinders versions RC-i 2xx & RC-i 4xx

Assembly of the POWER SPARK

Please note the following points when installing the POWER SPARK:

- **mechanic installation**
  - the housing of the POWER SPARK can get hot when running the engine with high speeds over a long period
    => do not install heat sensitive components near the POWER SPARK
    => make heat dissipation possible (don`t cover)
    => install in an adequate distance to the engine
  - install at a place with low vibration
  - choose the position so that the display of the POWER SPARK can be read easily
  - choose the position that the magnetic sensitive element for programming the POWER SPARK is accessible. (see programming)
  - ensure a robust mechanical installation of the POWERSPARK (for example with special brackets for laminating)
  - the dimensions of the POWER SPARK and the distances of the fastening bores shows the scale on page 62

- **electric installation**
  - engines with more than one cylinder and engine speeds exceeding 20000rpm need battery packs with minimum 7.2V supply voltage
  - keep the supply cables (red & black) as short as possible
  - keep the cables to the ignition coils as short as possible
  - don`t place the cables to the ignition coils near signal cables (for example the cables to the servos)
  - place the signal cable to the speed sensor and to the RC-receiver[1)] in an adequate distance to the ignition coils
  - **fuse the plus cable of the POWER SPARK** (accessories: SI-3, SI-5)
    - ⇨ **fuse 3A** (for versions RC-i 1xx)
    - ⇨ **fuse 3A / 5A** (for versions RC-i 2xx / RC-i 4xx)
  - establish a **ground connection** from the engine to the battery minus with a cable of at least 1,5mm² cross section

[1)] Only versions with diagnostic functionss RC-i x2x, [2)] only multiple cylinders versions RC-i 2xx & RC-i 4xx

Installation of speed sensor

A precise ignition to the right time assumes the correct assembly of the speed sensor to the engine. The magnet and the speed sensor have to be installed in a way that, during a rotation, the speed sensor is triggered by the magnet 75° before reaching the top dead center. As the sensing magnet is surrounded by a magnetic stray field, the speed sensor will be triggered about 10° before passing the magnet mechanically. For this reason the sensing magnet must pass the speed sensor 65° before the top dead center. The value of the stray magnetic field about 10° applies to the shown geometry (see illustration). When installing the magnet on an increased radius the pre-triggering of the speed sensor decreases, see table on page 9.

Speed sensor

➢ Install speed sensor at an adequate place to the engine

- The cable of the speed sensor must be mechanically fixed as close as possible to the sensor in order to avoid damage caused by vibrations. Assemble the speed sensor with M3 screws. For protecting the strip conductors put the provided bushings under the screws. (see d)
- the magnet in the flywheel and the speed sensor element have to be at the same level (see c,d)
  The exact adjustment can be made with the help of two 0,5mm-holes in the area of the speed sensor`s sensitive element, you can find the sensitive element in the middle of the connecting line between the two holes.
- the speed sensor`s flattened side faces the flywheel (see d)
- set the air gap between the speed sensor and the flywheel between 0,5mm - 1,5mm. (see d)

magnet

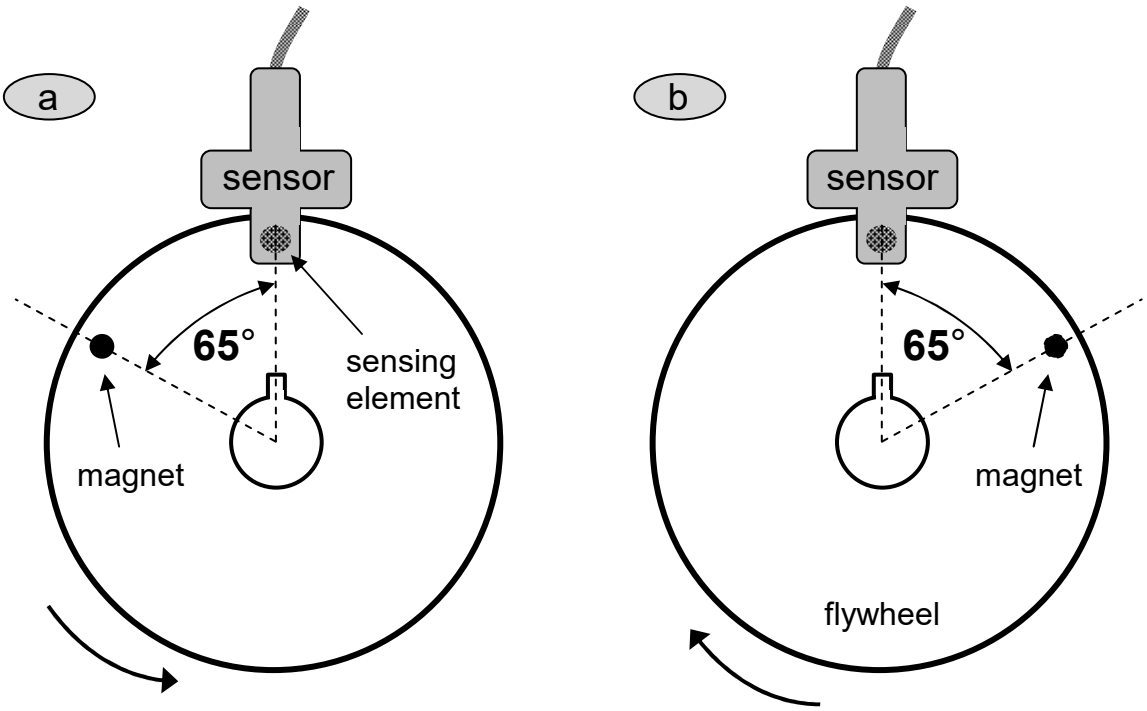
➢ place the magnet (Ø3mm, length 4mm) into the flywheel in a way:

- that it passes the speed sensor in direction of rotation 65° before reaching the top dead center (a,b) For checking the sensor angle use the menu „CS“ (p.38), and correct it with menu „SA“ (p. 37).
- that the surface of the magnet is located max. 1mm under the surface of the flywheel (d)
- that it is permanently fixed (for example use instant adhesive).
- The polarity of the magnet can be ignored.

[1)] Only versions with diagnostic functionss RC-i x2x, [2)] only multiple cylinders versions RC-i 2xx & RC-i 4xx

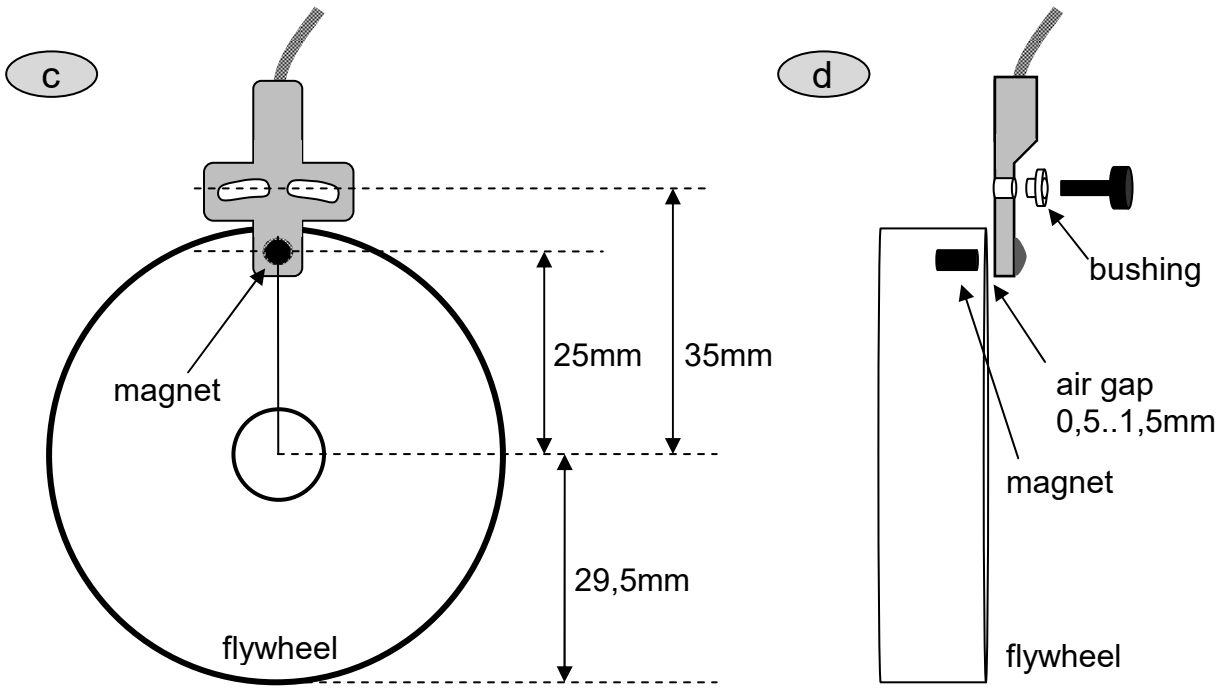
Detail description of magnet and speed sensor

- Presentation a,b: cylinder 1 is on top dead center



rotation „left“ (reverse) direction

rotation „right“ (normal)



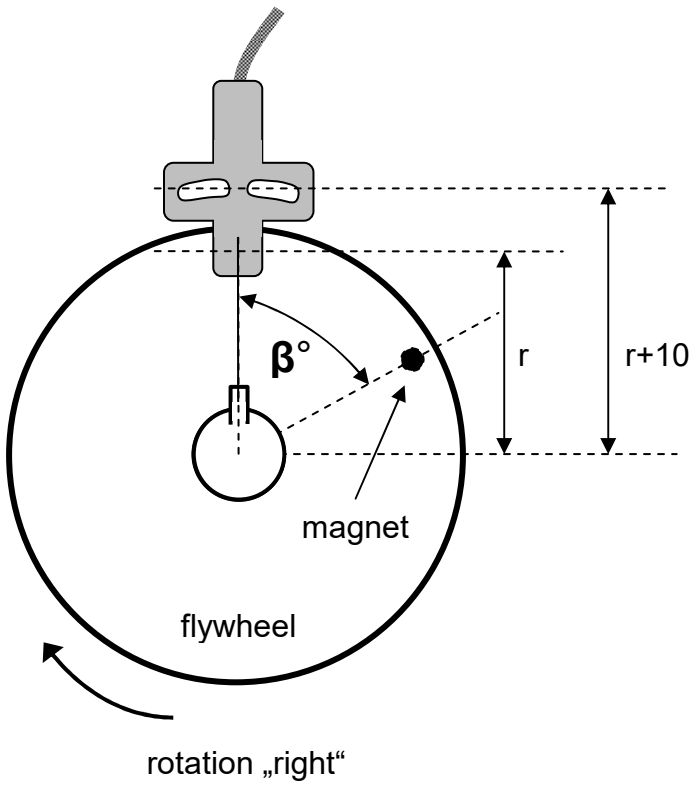
➔ **HINT:** For fine adjustment use menu „control sensor” (p.38 & p.37) in the configuration menu.

[1)] Only versions with diagnostic functionss RC-i x2x, [2)] only multiple cylinders versions RC-i 2xx & RC-i 4xx

Mounting the magnet on a different radius

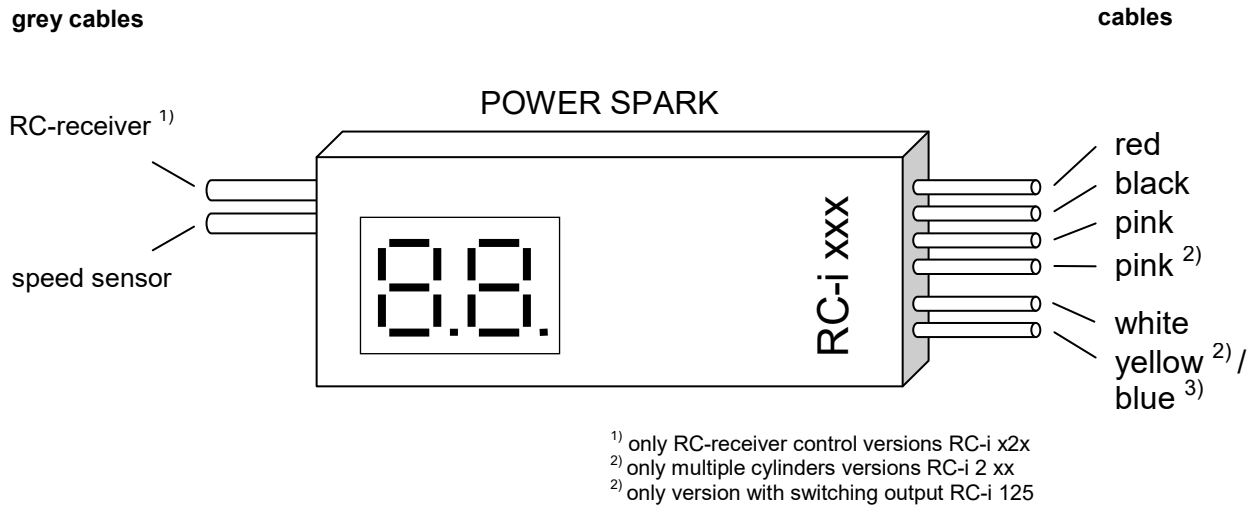
- When mounting the encoder magnet / sensor on a radius other than 25mm, the following angle must be applied between top dead center (TDC) and the mounting position of the magnet in the flywheel:

Mounting radius r [mm]	Angle between magnet and TDC β [°]
15	58
20	62
25	**65**
30	67
35	68
40	69
45	69
50	70
60	70



[1)] Only versions with diagnostic functionss RC-i x2x, [2)] only multiple cylinders versions RC-i 2xx & RC-i 4xx

Connections

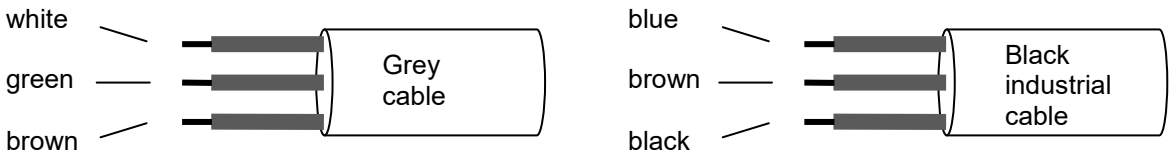


Pin assignment of POWER SPARK

color	Function	cross section	length
red	+ supply (4..12V), **use fuse** (value see p. 62)	1 mm²	25 cm
black	- supply (earth)	1 mm²	25 cm
pink	+ supply ignition coil 1	1 mm²	35 cm
pink[2)]	+ supply ignition coil 2[2)]	1 mm²	35 cm
white	- supply ignition coil 1	1 mm²	35 cm
yellow[2)]	- supply ignition coil 2[2)]	1 mm²	35 cm
blue[3)]	- supply switching output	1 mm²	35 cm

Pin assignment of RC-receiver-cable[1)]

color	Function	length
white (blue)	+ voltage receiver (3..12V)	21 cm
green (brown)	receiver signal (servosignal)	21 cm
brown (black)	- voltage receiver (ground)	21 cm

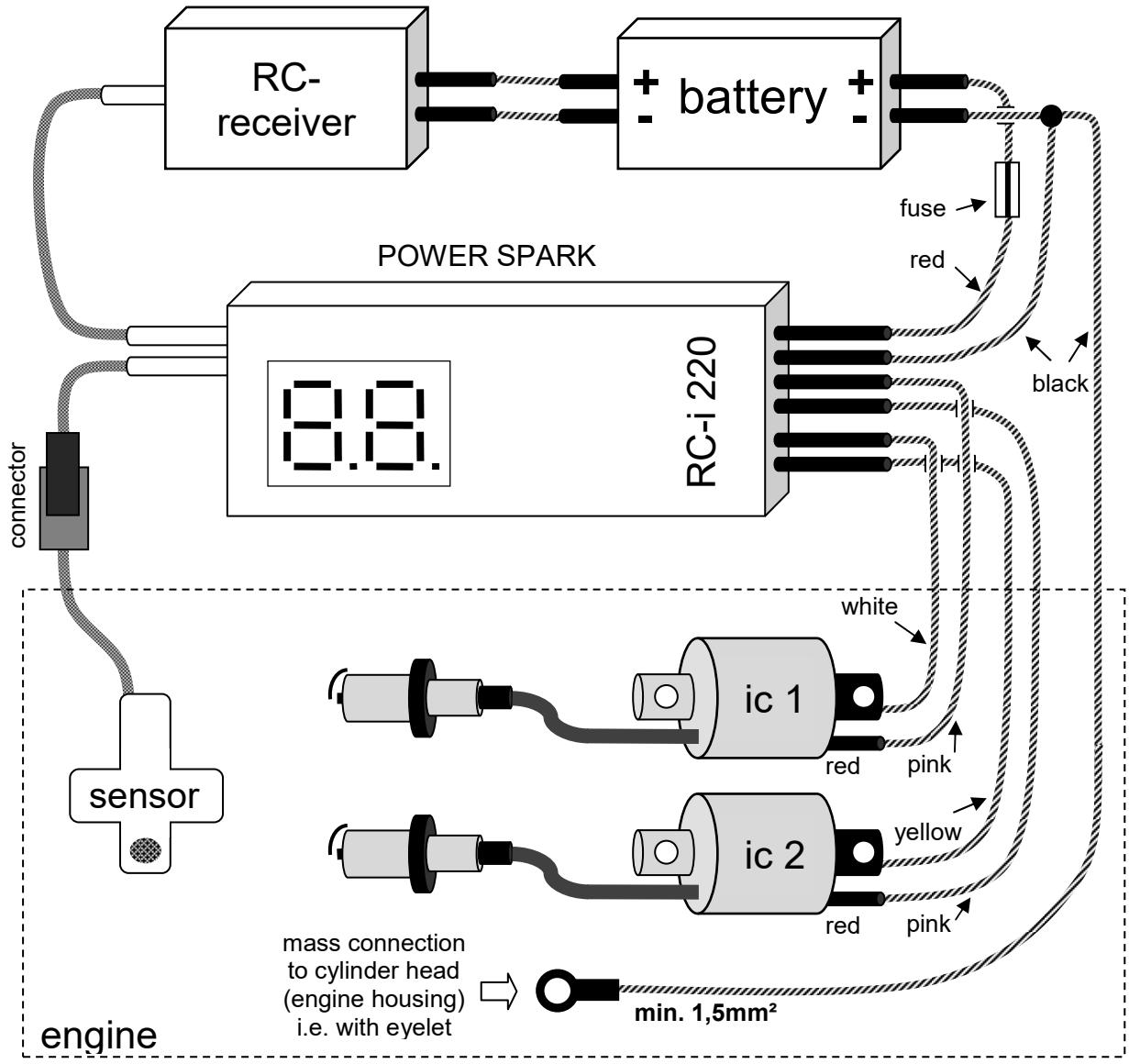


[1)] Only versions with diagnostic functionss RC-i x2x, [2)] only multiple cylinders versions RC-i 2xx & RC-i 4xx

Connecting diagram 1

exemplary for POWER SPARK RC-i 220:

- shared battery pack for receiver and POWER SPARK



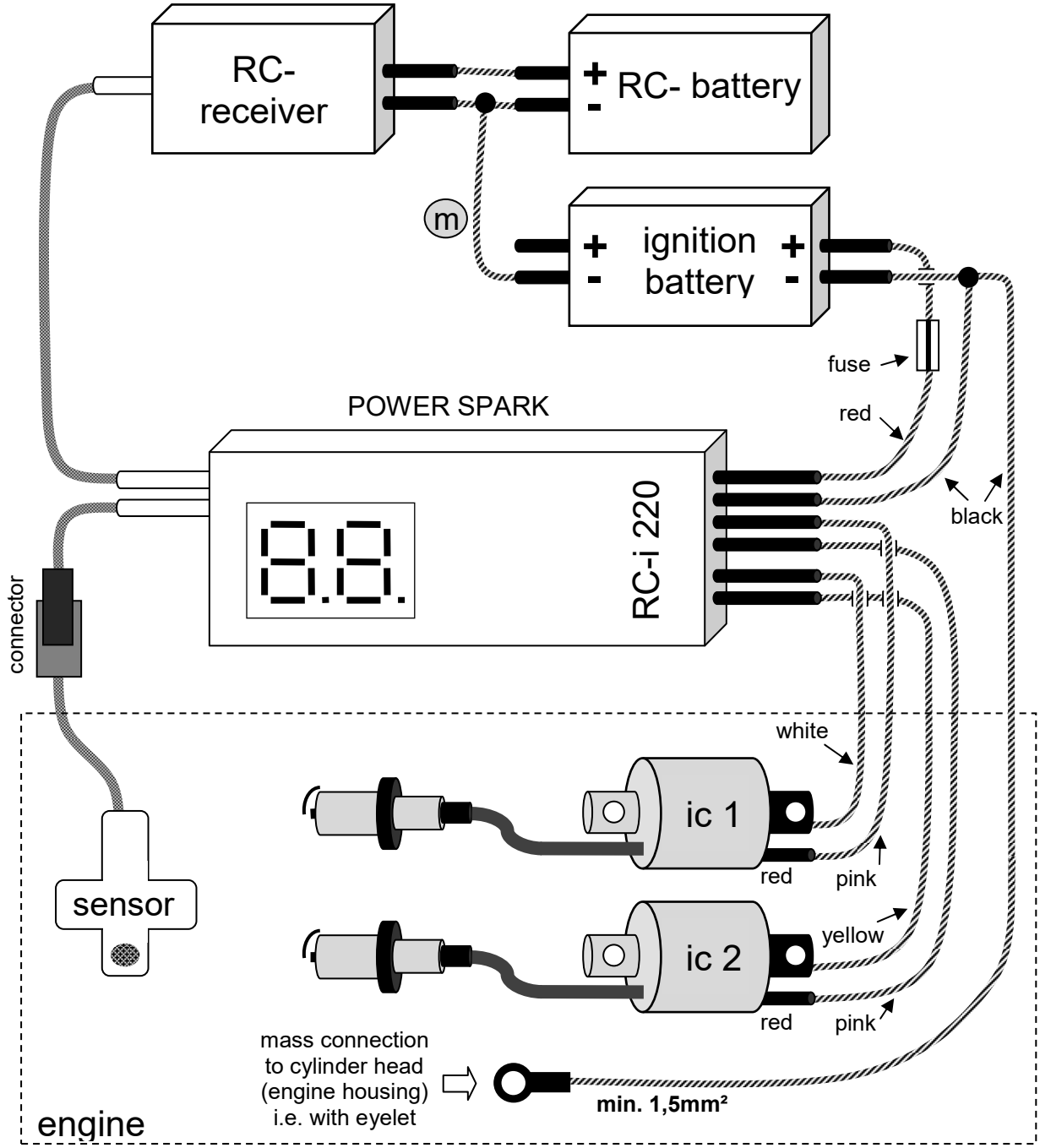
important: ➔ make sure there is a low-resistance connection between battery minus and cylinder head (engine housing)
➔ insulate non-used cables with insulating tape
➔ extend cables only with min 1,5mm² cables

[1)] Only versions with diagnostic functionss RC-i x2x, [2)] only multiple cylinders versions RC-i 2xx & RC-i 4xx

Connecting diagram 2

exemplary for POWER SPARK RC-i 220:

- separate battery packs for receiver and POWER SPARK
  ⇨ mass connection (m) established between batteries



important: ➔ **make sure there is a low-resistance connection between battery minus and cylinder head (engine housing)**
➔ **insulate non-used cables with insulating tape**
➔ **elongate cables only with min 1,5mm² cables**

[1] Only versions with diagnostic functionss RC-i x2x, [2] only multiple cylinders versions RC-i 2xx & RC-i 4xx

Suitable ignition coils and spark plugs

The POWER SPARK can realize very high speeds. To make this possible, there are requirements for the ignition coils and spark plugs.

ignition coils

- Only compact ignition coils with low charging time and low internal resistance may be used.
- Compatible ignition coils
    - RCMK, ZENOAH or compatible coils (see following page)
    - High-energy ignition coils for scooters, see picture (connection: pink cable to green connector on coil)

suitable

not suitable

spark plugs

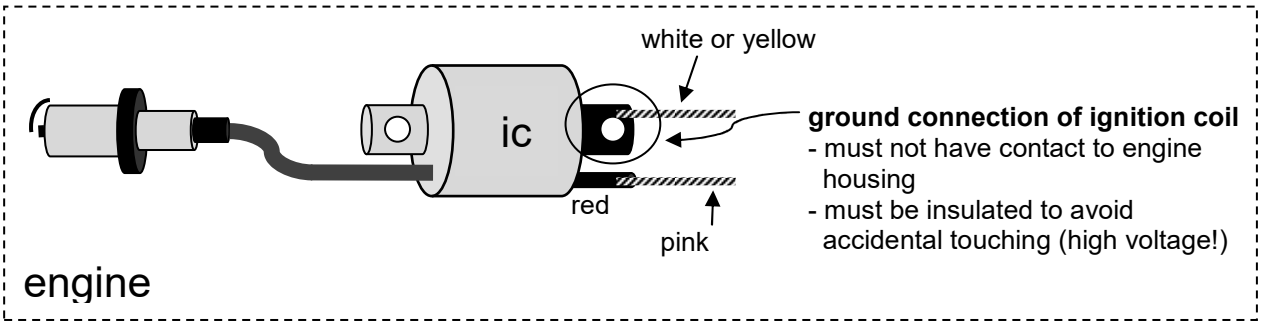
- Only spark plugs with built-in resistor (“R” types) may be used. (The value of the internal resistor is around 5kOhm)
- **The use of spark plugs without resistor is not allowed, as high electromagnetic interference would be generated that could interfere with the POWER SPARK and other electrical devices.** (i.e. radio system)

!

[1)] Only versions with diagnostic functionss RC-i x2x, [2)] only multiple cylinders versions RC-i 2xx & RC-i 4xx

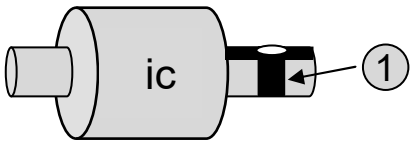
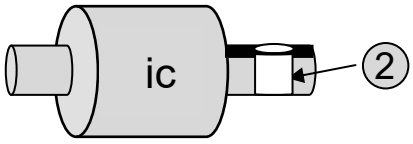
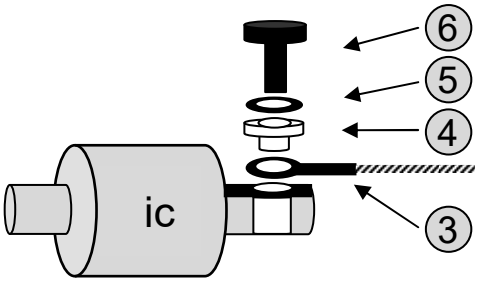
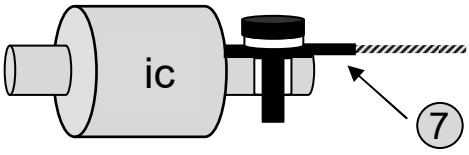
Connection of RCMK/ZENOAH ignition coils or compatible

The POWER SPARK conducts the ignition pulse via the white or yellow cable to the ignition coil`s ground connection. The ground connection of the ignition coil must not have an electric contact to the engine housing, contrary to the original application. Furthermore it has to be insulated to avoid accidental touching.



Modification of ignition coil

(Proposal on application of an insulating bushing that is available as accessories, item-nr.: IB-1)

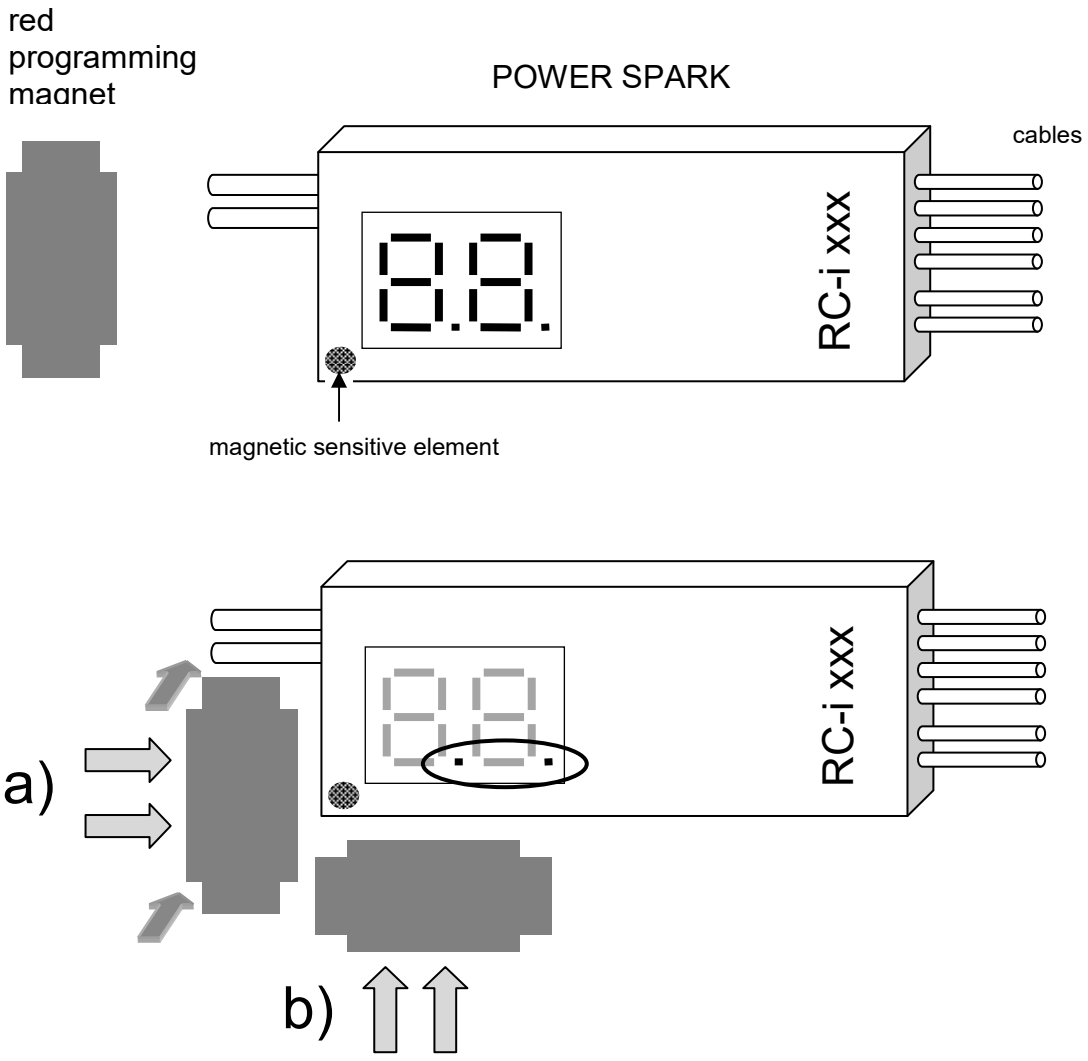
original state - ignition coil with electrically conductive metal bushing (1)	
➢ drill out bushing - use drill with Ø 6,2mm - be careful, risk of tearing the bushing	
➢ (3) connection of white/ yellow cable with eye (4) insulation bushing (access.) (5) washer (6) screw M4	
➢ (7) insulate the electrically conductive components, for example with silicone or adhesive tape	

[1)] Only versions with diagnostic functionss RC-i x2x, [2)] only multiple cylinders versions RC-i 2xx & RC-i 4xx

Programming - essentials

General

To make the programming as simple as possible, the POWER SPARK can be programmed with the provided programming magnet. In the left bottom corner there is a magnetic sensitive element that can be triggered by approaching the red programming magnet.



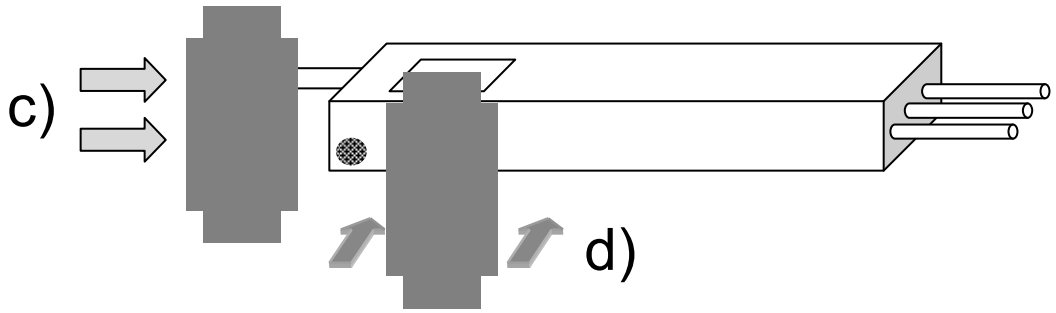
By approaching the programming magnet parallel to the **left side** of the POWER SPARK (sideways or from top, position a)) in a distance of less than 10 mm the magnetic sensitive element is triggered. The POWER SPARK confirms the activation and shows „ **. .** “ additional to the active display.

- After that confirmation remove the magnet.

[1)] Only versions with diagnostic functionss RC-i x2x, [2)] only multiple cylinders versions RC-i 2xx & RC-i 4xx

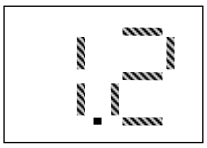
Alternatively the programming magnet can be approached along the bottom side (position b), see figure.
If there is few space the programming magnet can also be approached vertically to the magnetic sensitive element.

c) Approach the magnet vertical from the left side to the bottom left corner.
d) Alternatively approach the magnet vertical from the bottom to the bottom left corner of the POWER SPARK.

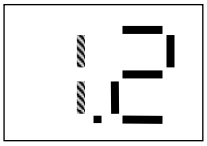


Symbolic

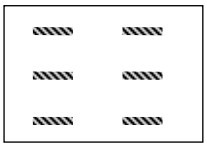
display: „1.2“
=> no input expected



display: „1.2“, flashing
=> user input expected



display: „1.2“
„1“ flashing, „2“ not flashing
=> user input expected



display: „Ξ“
modified values are stored

0..9 acceptable range of values (0 to 9)

➢ action of operator required

[1)] Only versions with diagnostic functionss RC-i x2x, [2)] only multiple cylinders versions RC-i 2xx & RC-i 4xx

Menu structure

The operation of the POWER SPARK results by selection of the desired set or displayed parameters by approaching and removing the programming magnet.

The parameters are arranged in three main menu groups

- configuration menu „Co“
  - engine adjustments, that are changed rarely
- status menu „||||“
  - displays actual values
- diagnostics menu „dd“
  - modifying of diagnostic parameters

A parameter can be modified by the following procedure

- select the according main menu
  - the adjustable menu items flash one after another for 3sec
- confirm the desired menu item by approaching and removing the programming magnet
  - (for confirmation the display shows „ **. .** “ additionally)
- display shows the actual value of the parameter
- selection of values by the user
  - adjustable values flash one after another for 3sec
- confirm the desired menu item by approaching and removing the programming magnet (possibly several times)
- display shows the new modified values
- POWER SPARK returns to the normal operation mode (display of engine speed)

Annotations

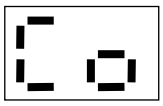
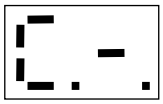
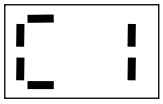
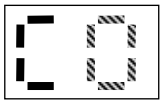
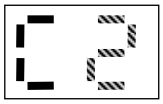
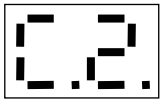
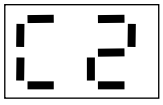
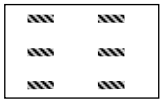
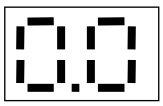
- the configuration menu can only be activated when the POWER SPARK is turned on
- the status- and diagnostic menus can be called only when the engine is not running
- the POWER SPARK returns to the normal operation mode (display of engine speed and ignition standby) if no confirmation happens during the changing displays of the individual menu items
- if no confirmation (with the programming magnet) happens during the change of any value, the prior values will be retained

[1)] Only versions with diagnostic functionss RC-i x2x, [2)] only multiple cylinders versions RC-i 2xx & RC-i 4xx

Example:

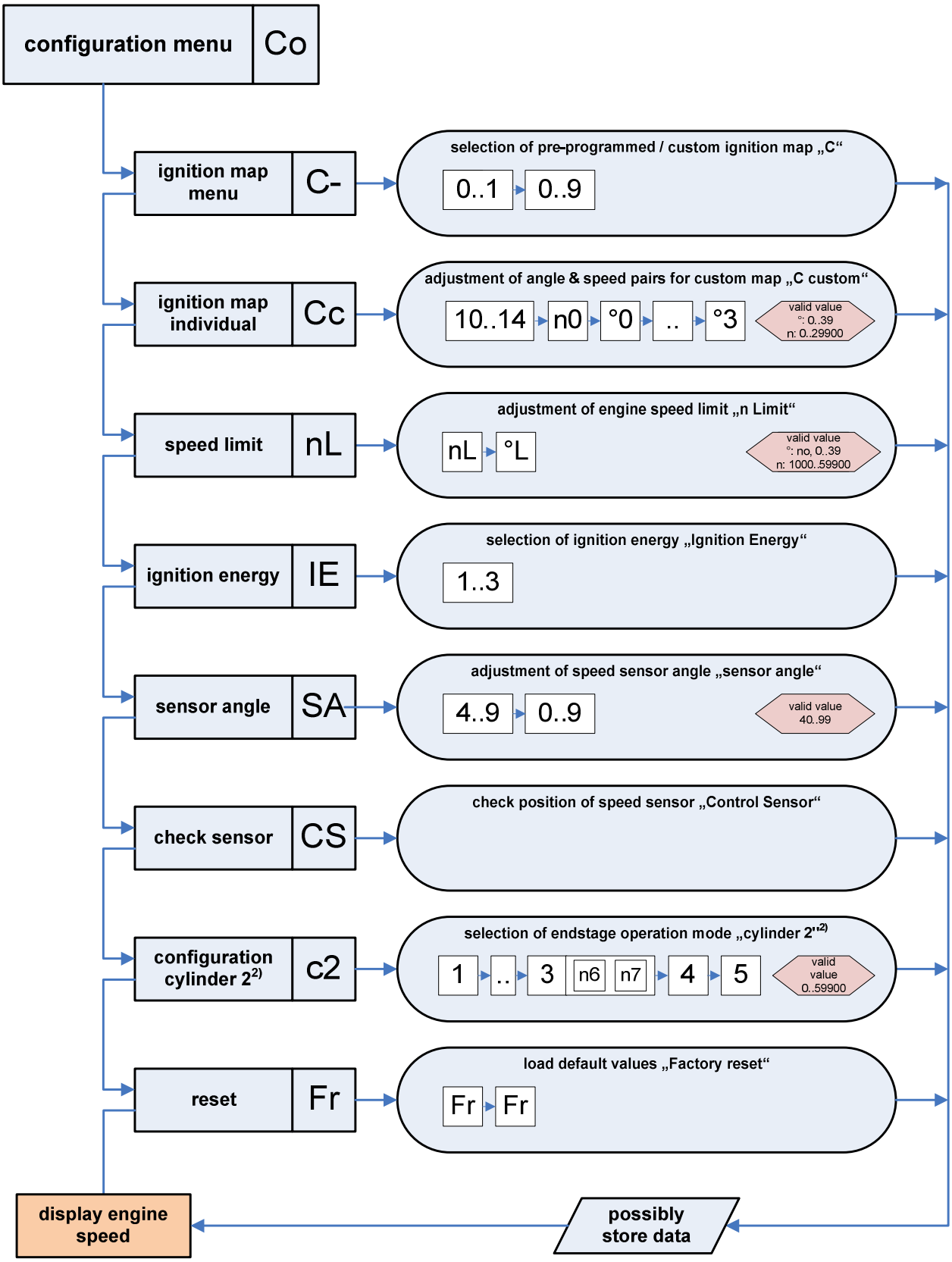
The preset ignition map „2“ shall be selected:

- the ignition map can be adjusted in the menu item „ignition map menu“ contained in „configuration menu“

nr.	action	display
1-4	➢ select configuration menu, see page 21	
5	selectable menu items flash one after the other (see configuration menu) ➢ wait until „C-“ flashes	
6	➢ actuate magnetic element (by approaching the programming magnet to the housing near the magnet sensitive element, remove after display shows “. .”)	
7	display shows current ignition map (here ignition map „1“)	
8	adjustable values flash one after another for 3sec	
9	➢ wait until „2“ flashes	
10	➢ actuate magnetic element (by approaching the programming magnet to the housing near the magnet sensitive element, remove after display shows “. .”)	
11	display shows the new selected ignition map (ignition map „2“)	
12	display indicates that new values are stored	
13	POWER SPARK returns to the normal operation mode (display of engine speed and ignition standby)	

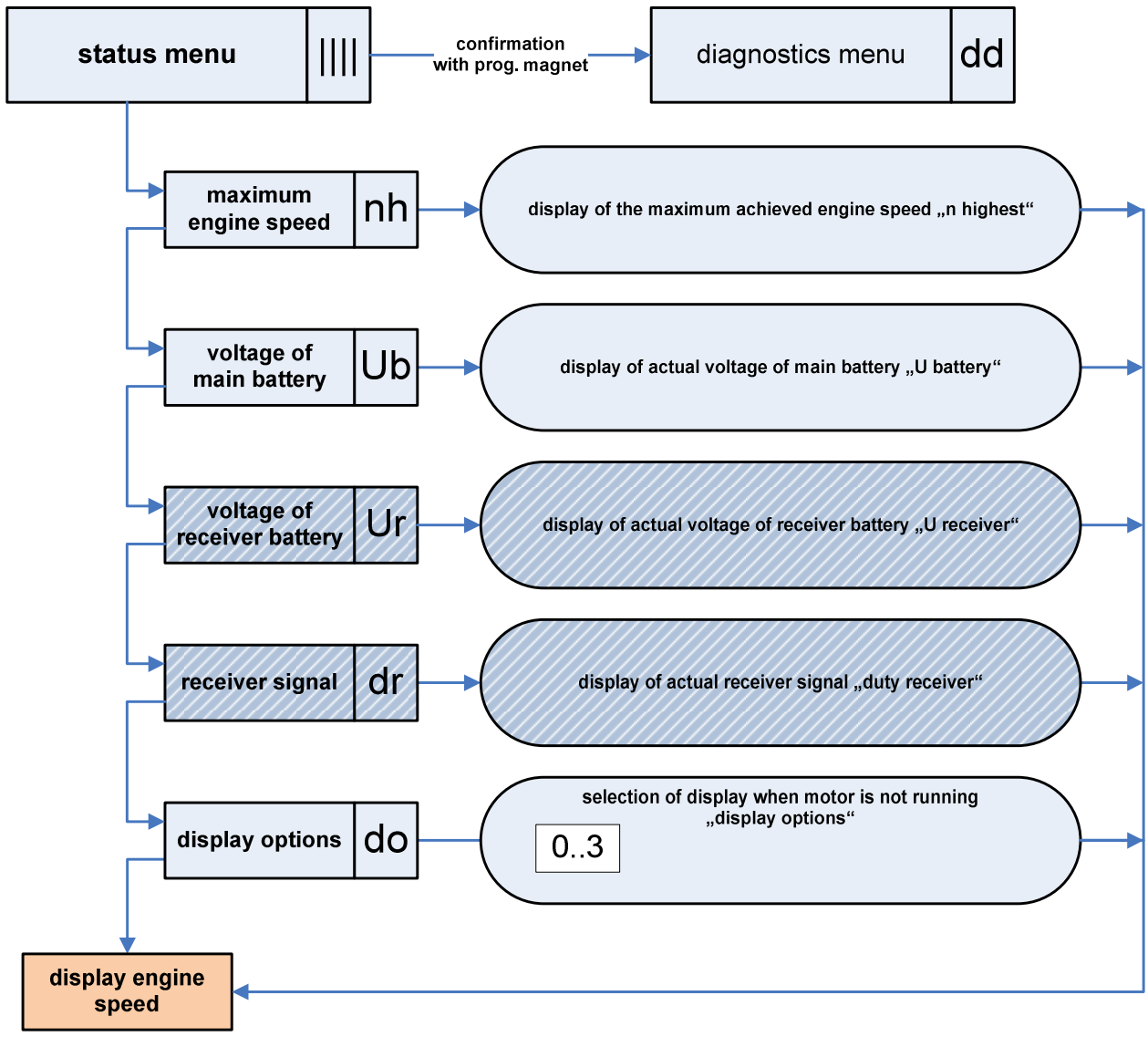
[1] Only versions with diagnostic functionss RC-i x2x, [2] only multiple cylinders versions RC-i 2xx & RC-i 4xx

Overview configuration menu



[1] Only versions with diagnostic functionss RC-i x2x, [2] only multiple cylinders versions RC-i 2xx & RC-i 4xx

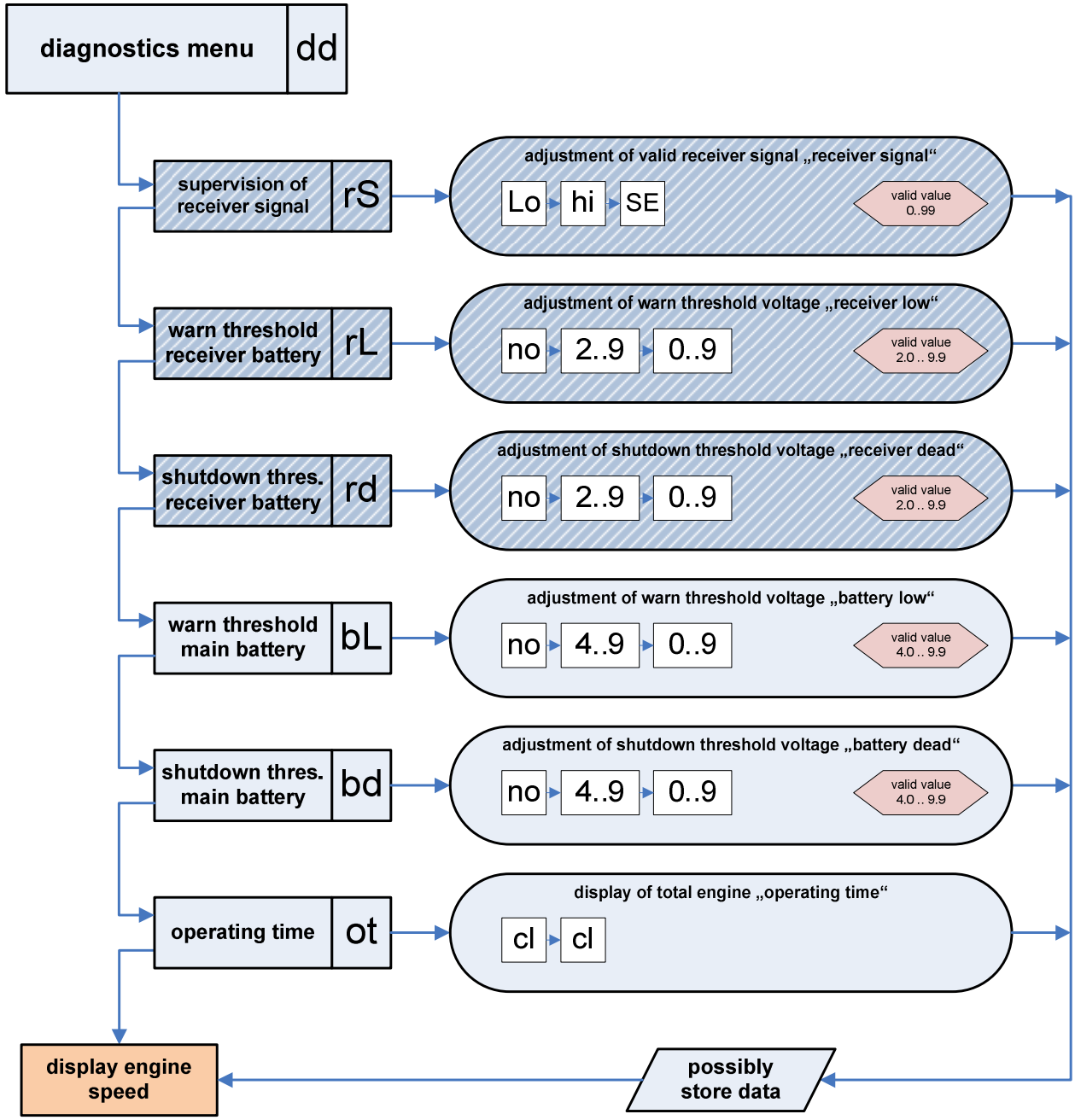
Overview status menu



only versions RC-i x2x

[1] Only versions with diagnostic functionss RC-i x2x, [2] only multiple cylinders versions RC-i 2xx & RC-i 4xx

Overview diagnostics menu



only versions RC-i x2x

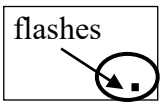
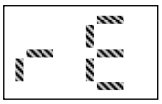
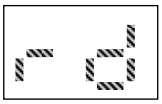
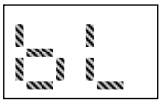
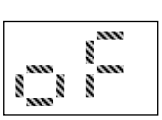
[1] Only versions with diagnostic functionss RC-i x2x, [2] only multiple cylinders versions RC-i 2xx & RC-i 4xx

display

- **engine is running**
  - display shows the current engine speed
  - display shows current warnings and errors
- **engine halts**
  - display of maximum achieved engine speed or battery voltages alternately, depending on the chosen display options. (see menu „do“ in the diagnostics menu)
  - display of occured warnings or errors alternately
  - the right decimal point will blink additionally if a warning or an error is pending

  How to clear warnings or errors:
  - restart engine OR
  - interrupt and reconnect power supply of POWER SPARK (reset)

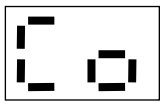
warn- and error messages

display	parameter	condition
	**warning/ error is pending** engine cannot be started	the value of a monitored signal is out of the valid range
	**„rE“ receiver error**[1)]	no receiver signal
	**„rd“ receiver dead**[1)]	receiver battery voltage has fallen below shutdown threshold
	**„bd“ battery dead**	main battery voltage has fallen below shutdown threshold
	**„rL“ receiver low**[1)]	receiver battery voltage has fallen below warning threshold
	**„bL“ battery low**	main battery voltage has fallen below warning threshold
	**„oF“ kill switch off**[1)]	engine shutdown due to „kill switch“ functionality / invalid receiver signal

[1)] Only versions with diagnostic functionss RC-i x2x, [2)] only multiple cylinders versions RC-i 2xx & RC-i 4xx

Programming

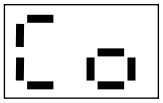
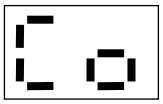
CONFIGURATION MENU



The configuration menu includes the following menu items

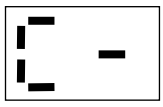
a) ignition map menu
selection of one of nine pre-programmed ignition maps
b) ignition map individual
configuration of one custom ignition map
c) speed limit
adjustment of engine speed limit / cut-off angle
d) ignition energy
selection of ignition energy
e) sensor angle
compensation of mechanical displacement of speed sensor
f) check sensor
check mechanical position of speed sensor
g) configuration cylinder 2
selection of endstage operation mode
h) factory reset
reset POWER SPARK to factory settings

The configuration menu contains engine parameters, which shouldn`t be manipulated thoughtless. To avoid an unintended changing the configuration menu can be called only in the following way:

nr.	action	Display
1	➢ interrupt voltage supply of POWER SPARK	
2	➢ approach programming magnet to the housing near the magnet sensitive element	
3	➢ turn on voltage supply	
4	➢ remove programming magnet	

[1] Only versions with diagnostic functionss RC-i x2x, [2] only multiple cylinders versions RC-i 2xx & RC-i 4xx

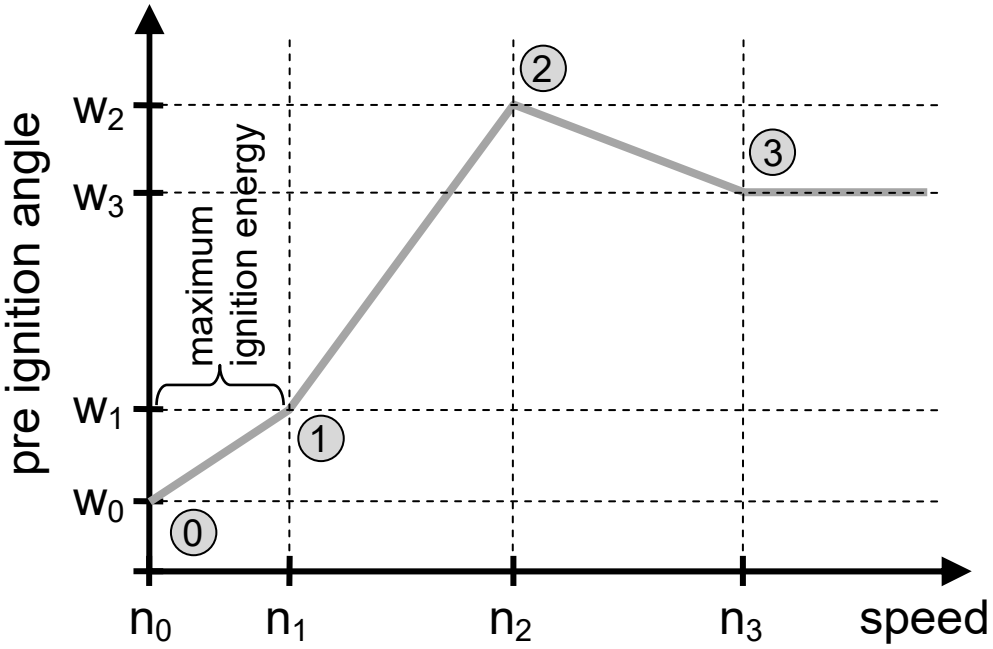
a) ignition map menu



selection of one of nine pre-programmed ignition maps
(factory setting: map <1>)

To enable a quick initial operation of the engine the POWER SPARK contains ten pre-programmed ignition maps. They serve as basic adjustment and starting point for a further optimization. For a specific adjustment to the engine you can use an individual created map.

The five individual ignition maps (10-14) are activated in the same manner as the pre-programmed maps. The adjustment of the individual ignition map is described in the next section.



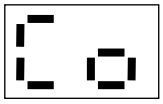
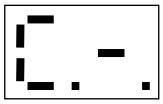
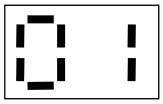
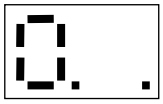
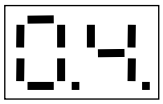
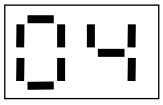
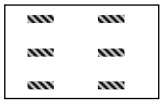
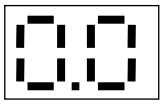
map	⓪		①		②		③		
	n_0	w_0	n_1	w_1	n_2	w_2	n_3	w_3	
0	0	20	3000	20	6000	20	22000	20	basic map
1	0	25	3000	25	6000	30	22000	25	similar Zenoah
2	0	25	3000	20	6000	25	22000	20	
3	0	25	3000	20	6000	25	22000	25	
4	0	25	3000	20	6000	25	22000	30	
5	0	25	3000	20	6000	25	22000	35	
6	0	30	3000	20	6000	30	22000	25	
7	0	30	3000	20	6000	30	22000	30	
8	0	30	3000	20	6000	30	22000	35	
9	0	30	3000	20	6000	30	22000	39	
10..14	see individual map b)								

See page 27

[1)] Only versions with diagnostic functionss RC-i x2x, [2)] only multiple cylinders versions RC-i 2xx & RC-i 4xx

Selection of a pre-programmed ignition map

example: ignition map „4“ shall be selected

nr.	action	display
1-4	➢ select configuration menu	
5	➢ wait until „C-“ flashes	
6	➢ actuate magnetic element	
7	display shows the current ignition map (for example map „1“)	
8	adjustable values of the tens flash one after another for 3sec (0-1)	
9	➢ wait until the desired figure for the tens flashes (for example „0“) ➢ actuate magnetic element	
10	➢ wait until the desired figure for the unit position flashes (for example „4“) ➢ actuate magnetic element	
11	display shows the new selected map (map „4“)	
12	display indicates that new values are stored	
13	POWER SPARK returns to the normal operation mode (display of engine speed and ignition standby)	

Please note:

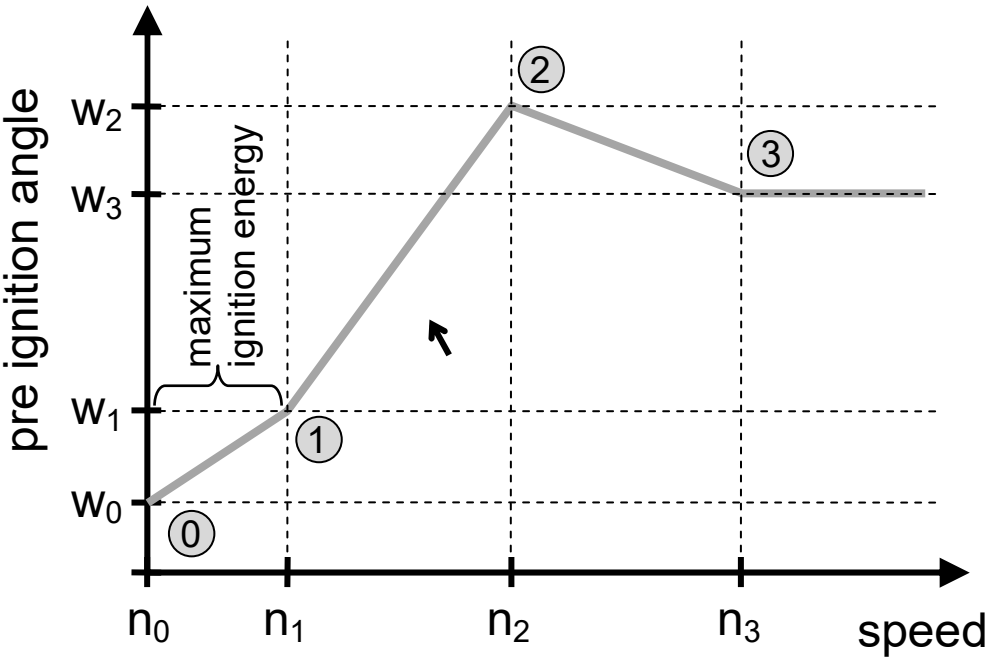
The pre-programmed maps represent only a starting point or are derived from customer´s experiences. Each engine has to be adjusted specifically depending of use (hints see page 27). We apologize for any inconvenience, that we cannot be responsible for consequential damages by installing the pre-programmed ignition maps.

[1)] Only versions with diagnostic functionss RC-i x2x, [2)] only multiple cylinders versions RC-i 2xx & RC-i 4xx

b) ignition map individual

configuration of custom ignition maps

Five individual created ignition maps can be programmed with four pre-ignition angle and speed pairs. **The value of the speed n_0 cannot be modified; it is set constantly to 0rpm**.
The creation of an individual map should result on experience with a pre-programmed map. Wrong adjustments can have negative effects on engine smoothness, responding behavior or also on mechanical components.
We are not responsible for consequential damages as a result of improper engine adjustments.



The speed values n_x can be adjusted in 100rpm- steps,
the pre ignition angles in 1°-steps.

restrictions:

- $n_3 > n_2 > n_1 > n_0$
- $n_3, n_2, n_1 < 30000$
- $w_3, w_2, w_1, w_0 < 39°$

[1] Only versions with diagnostic functionss RC-i x2x, [2] only multiple cylinders versions RC-i 2xx & RC-i 4xx

Procedure for evaluating the appropriate ignition map

The preset maps have been evaluated with our partner MATHO at various RCMK and ZENOAH marine engines. Depending on the engine set-up, the degree of tuning and the exhaust system, the maps work better or worse in the respective application. Basic knowledge of the effect in the adaptation of the pre-ignition angle is advantageous. For adjustment, several optimization steps are usually required.

Ignition maps

- The pre-set ignition characteristic <1> is similar to the original ZENOAH CDI ignition system. The advantage of the POWER SPARK compared to the original system is the strong spark at low and very high speeds.
- The other ignition characteristics <2..9> are variations of this basic characteristic, they vary the pre-ignition angle in the middle and high speed range.
- Ignition map <0> provides a pre-ignition angle of constant 20 ° over the entire speed range and is suitable as a starting point for unknown engines.

Example: Determination of the appropriate ignition map

- test the engine with map <1> or <0>, evaluate performance and engine response at low / medium / high speed
- then set and evaluate map <7>
  (Pre-ignition in the middle speed range higher, in the high speed range equal to <1>)
- Set and evaluate the alternative map <4>
  (Pre-ignition in the middle speed range is equal, higher in the high speed range compared to <1>)
- Find out in this way which pre-ignition angle the engine requires at different speeds (use further maps)
- An individual ignition map can then be entered with the determined pre-ignition angles and the specified speed values
- For further optimization of the individual characteristic curves, the engine speeds can now be adapted to the behavior of the engine

[1)] Only versions with diagnostic functionss RC-i x2x, [2)] only multiple cylinders versions RC-i 2xx & RC-i 4xx

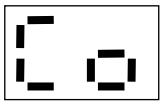
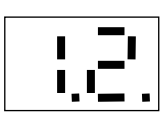
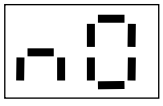
Adjustment of the custom ignition map

The adjustment of the custom ignition map is basically more complex than other menu adjustments. Before starting, please collect experience with the operation concept in other menu adjustments. Change primarily only few parameters and check the adjusted values, possibly note the values down.

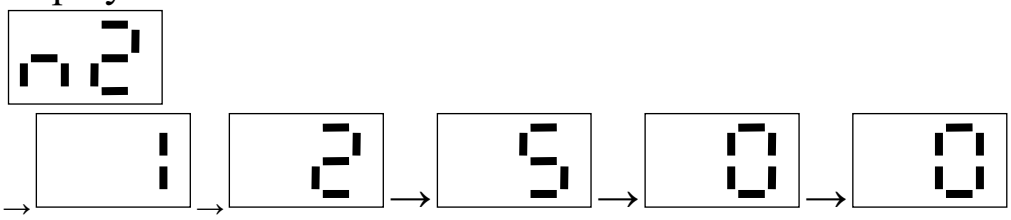
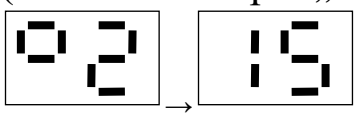
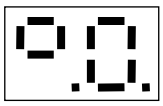
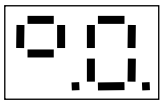
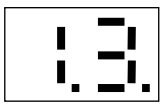
- By default and after a factory reset the individual maps 10 to 14 contain the parameters of the map 1.

- After changing parameters of an active individual map the map has to be activated again with the ignition map menu a), so that the values are stored correctly. (Even if the map was previously activated)

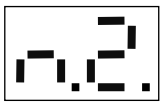
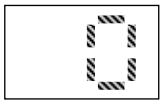
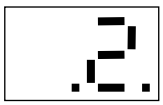
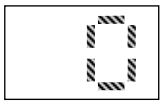
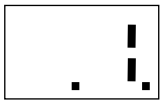
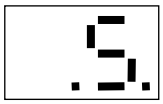
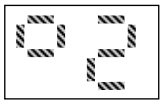
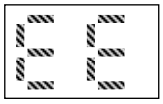
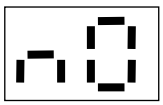
In the following example the custom ignition map “12” is modified. The current ignition angle and speed pairs shall be unchanged, only angle w_0 shall be changed to 13° and speed n_2 to 21500 rpm.

nr.	action	display
1-4	➢ select configuration menu	
5	➢ wait until „Cc“ flashes	
6	➢ actuate magnetic element	
7	adjustable parameters flash one after another for 3sec (10..14)	
8	➢ wait until the desired map for modification flashes (for example „12“) ➢ actuate magnetic element	
9	display shows the current speed values „n“ and the current angle values „°“ one after another $n_0 \rightarrow w_0 \rightarrow n_1 \rightarrow w_1 \rightarrow n_2 \rightarrow w_2 \rightarrow n_3 \rightarrow w_3$	

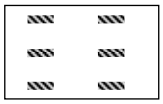
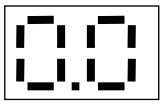
[1)] Only versions with diagnostic functionss RC-i x2x, [2)] only multiple cylinders versions RC-i 2xx & RC-i 4xx

9a	The POWER SPARK has a two digit LED display. This is why the display of speed values occurs by sequentially displaying the figures. The display shows the speed figures one after another (here for example „n_2“=12500rpm). display: 	
9b	display of pre-ignition angle: (here for example „w_2“=15°) 	
TIP	For a faster adjustment of the parameters the display of the values can be interrupted: ➢ wait, until any angle will be displayed (for example „w_0“) ➢ actuate magnetic element	
10	display shows „i i“, an information, that the proper programming can start and inputs from the user are expected	
11	adjustable parameters flash one after another for 3sec: $w_0 \rightarrow n_1 \rightarrow w_1 \rightarrow n_2 \rightarrow w_2 \rightarrow n_3 \rightarrow w_3$	
12	➢ actuate magnetic element to select the parameter for modifying. Example: the angle „w_0“ is selected for modifying	
13	adjustable values of the tens flash one after another for 3 sec (0-3)	
14	➢ wait until the desired figure flashes (for example „1“) ➢ actuate magnetic element	
15	adjustable values of the unit position flash one after another for 3 sec (0-9)	
16	➢ wait until the desired figure flashes (for example „3“)	

[1)] Only versions with diagnostic functionss RC-i x2x, [2)] only multiple cylinders versions RC-i 2xx & RC-i 4xx

	➢ actuate magnetic element	
17	the remaining adjustable parameters flash one after another for 3 sec: $n_1 \rightarrow w_1 \rightarrow n_2 \rightarrow w_2 \rightarrow n_3 \rightarrow w_3$	
18	➢ actuate magnetic element to select the parameter for modifying. Example: the speed „n_2“ is selected for modifying	
19	adjustable values of the ten thousands flash one after another for 3sec (0-2)	
20	➢ wait until the desired figure flashes (for example „2“) ➢ actuate magnetic element	
21	adjustable values of the thousands flash one after another for 3sec (0-9)	
22	➢ wait until the desired figure flashes (for example „1“) ➢ actuate magnetic element	
23	adjustable values of the hundreds flash one after another for 3sec (0-9)	
24	➢ wait until the desired figure flashes (for example „5“) ➢ actuate magnetic element	
25	the remaining adjustable parameters flash one after another for 3sec: $w_2 \rightarrow n_3 \rightarrow w_3$	
26	➢ wait until w_3 had flashed	
27a	The error message „EE“ will be shown if wrong values are entered. The values before modification are retained.	
27b	display shows the new (or retained) speed values „n“ and angle values „°“ one after another $n_0 \rightarrow w_0 \rightarrow n_1 \rightarrow w_1 \rightarrow n_2 \rightarrow w_2 \rightarrow n_3 \rightarrow w_3$ (also described in (9))	

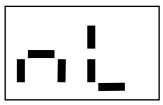
[1] Only versions with diagnostic functionss RC-i x2x, [2] only multiple cylinders versions RC-i 2xx & RC-i 4xx

28	If all values are entered correctly and the described requirements are fulfilled, the values will be stored. Display indicates that the new values are stored.	
29	POWER SPARK returns to the normal operation mode (display of engine speed and ignition standby)	
30	(Re-) activate the individual map by selecting the desired map (again) in map menu "C-"	!

Please note:
After a parameter of the individual map has been changed, the map has to be reinitialized. To do this, call the "C-" map menu again and select the individual characteristic (10..14). (see page 24)

[1)] Only versions with diagnostic functionss RC-i x2x, [2)] only multiple cylinders versions RC-i 2xx & RC-i 4xx

c) Speed limit



adjustment of engine speed limit / cut-off angle
(factory setting: nL=<59900rpm>, °L=<no>)

To protect the engine from excessive speed, a speed limit can be adjusted with a resolution of 100rpm. If this function is not desired, then the value of the speed limit has to be chosen greater than the maximum engine speed.
When exceeding the engine speed limit the POWER SPARK can either interrupt the ignition (=>fast stuttering of engine) or switch to a defined ignition angle (=>prevent further acceleration of engine).

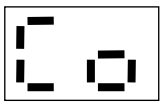
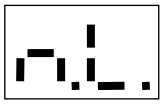
Adjustment oft he speed limit

- 1000 ≤ nL ≤ 59900rpm

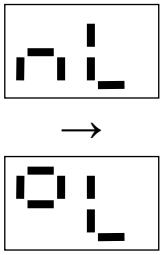
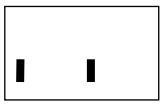
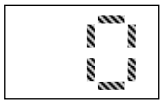
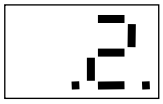
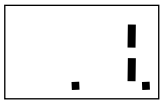
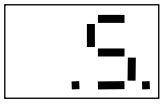
Adjustment of the cut-off angle

- setting „no“ interrupt the ignition when exceeding the speed limit
- 0° ≤ °L ≤ 39° switch to a defined cut-off angle when exceeding the speed limit

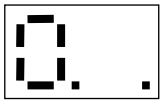
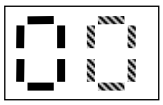
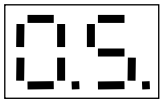
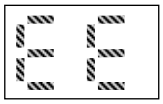
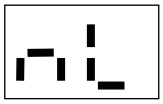
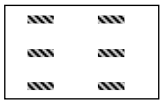
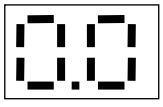
For example: speed limit of „21500 rpm“ and cut-off angle of “5°” shall be adjusted

nr.	action	display
1-4	➢ select configuration menu	
5	➢ wait until „nL“ flashes	
6	➢ actuate magnetic element	

[1] Only versions with diagnostic functionss RC-i x2x, [2] only multiple cylinders versions RC-i 2xx & RC-i 4xx

7	The current values of the speed limit „nL“ and the cut-off angle „°L“ are displayed one after another: nL → °L display shows the current speed limit by displaying the figures of the speed one after another. display scheme see section b) point 9a) (for example 2→0→0→0→0) After that the cut-off angle „°L“ is displayed (for example „no“)	
8	display shows „i i“, an information, that the proper programming can start and inputs from the user are expected	
9	adjustable parameters flash one after another for 3sec: - „nL“ (speed limit) - „°L“ (cut-off angle) nL → °L	
10	➢ actuate magnetic element to select the parameter for modifying. Example: the speed limit „nL“ is selected for modifying	
11	adjustable values of the ten thousands flash one after another for 3sec (0-5)	
12	➢ wait until the desired figure flashes (for example „2“) ➢ actuate magnetic element	
13	adjustable values of the thousands flash one after another for 3sec (0-9)	
14	➢ wait until the desired figure flashes (for example „1“) ➢ actuate magnetic element	
15	adjustable values of the hundreds flash one after another for 3sec (0-9)	
16	➢ wait until the desired figure flashes (for example „5“) ➢ actuate magnetic element	

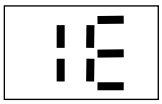
[1] Only versions with diagnostic functionss RC-i x2x, [2] only multiple cylinders versions RC-i 2xx & RC-i 4xx

17	the remaining adjustable parameter flashes for 3 sec	
18	➢ actuate magnetic element to select parameter for modifying here: the speed limit „nL“ is selected	
19	Adjustable values flash one after another for 3sec (no, 0-9)	
19a	To enable the stuttering function: ➢ actuate magnetic element	
19b	To enable the cut-off angle: ➢ wait until the desired figure of the tens flashes (for example „0“) ➢ actuate magnetic element	
20	adjustable values of the unit position flash one after another for 3sec (0-9)	
21	➢ wait until the desired figure flashes (for example „5“) ➢ actuate magnetic element	
21a	The error message „EE“ will be shown if a wrong values of the speed limit is entered. The value before modification is retained.	
21b	display shows the new (or retained) values of the speed limit and cut-off angle one after another nL → °L (also described in (7))	
22	If all values are entered correctly and the described requirements are fulfilled, the values will be stored. Display indicates that the new values are stored.	
23	POWER SPARK returns to the normal operation mode (display of engine speed and ignition standby)	

[1] Only versions with diagnostic functionss RC-i x2x, [2] only multiple cylinders versions RC-i 2xx & RC-i 4xx

d) Ignition energy

selection of ignition energy (<2>)



The ignition energy of the POWER SPARK can be adapted to the engine. The stronger the spark is the safer is the ignition of the air fuel mixture; however the POWER SPARK consumes more electric power. To extend the operating time of the battery the ignition energy should be chosen not higher than needed for a smooth engine running. To improve the startup behavior the highest ignition energy is used between speed n_0 and n_1.

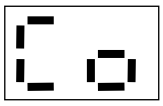
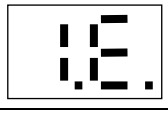
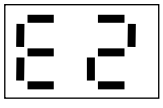
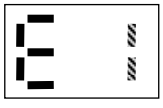
The use of ignition energy setting <3> leads to an increase in the current consumption and to additional heat in the POWER SPARK and in the ignition coils.

! This can lead to the destruction of the ignition coil and saturation phenomena (speed limitation, misfire) especially at high speeds. !

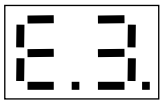
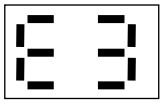
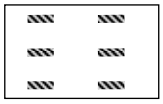
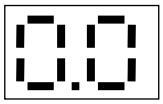
➔ Select the ignition energy only as high as necessary (at best "1")

Adjustment possibilities:

- setting „1“ low ignition energy
- setting „2“ medium ignition energy (factory setting)
- setting „3“ high ignition energy

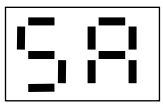
nr.	action	display
1-4	➢ select configuration menu	
5	➢ wait until „IE“ flashes	
6	➢ actuate magnetic element	
7	display shows the current ignition energy (for example „2“)	
8	adjustable values flash one after another for 3 sec (1-3)	

[1] Only versions with diagnostic functionss RC-i x2x, [2] only multiple cylinders versions RC-i 2xx & RC-i 4xx

9	➢ wait until the desired value flashes, (for example „3“) ➢ actuate magnetic element	
10	display shows the new selected ignition energy (here „3“)	
11	display indicates that the new value is stored	
12	POWER SPARK returns to the normal operation mode (display of engine speed and ignition standby)	

[1)] Only versions with diagnostic functionss RC-i x2x, [2)] only multiple cylinders versions RC-i 2xx & RC-i 4xx

e) Sensor angle



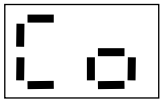
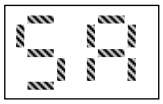
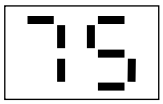
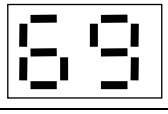
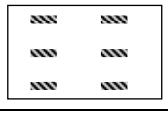
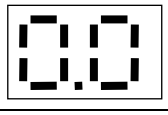
compensation of mechanical displacement of speed sensor (<75>)

A small angular offset between the ideal trigger of the speed sensor (75° before top dead center) and the current value can be adjusted by setting the actual angle value between the speed sensor and the sensor magnet.

- Mark the angle between the trigger point of the speed sensor and the top dead center using menu „CS“ (see next page).

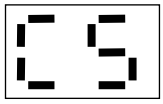
If you adjust angle values less than the nominal 75° the available computing time of the microcontroller will be shorter. For example, an adjustment of the sensor angle to 70° limits the use of high pre-ignition angles (≈35°) to engine speeds (<26500rpm).

!

nr.	action	display
1-4	➢ select configuration menu	
5	➢ wait until „SA“ flashes	
6	➢ actuate magnetic element	
7	display shows the current sensor angle value (for example „75“)	
8	adjustable values of the tens flash one after another for 3 sec (4-7) ➢ wait until the desired figure flashes (for example „6“) ➢ actuate magnetic element	
9	adjustable values of the unit position flash one after another for 3 sec (4-7) ➢ wait until the desired figure flashes (for example „9“) ➢ actuate magnetic element	
10	display shows the new selected angle value (here: 69)	
11	display indicates that the new value is stored	
12	POWER SPARK returns to the normal operation mode (display of engine speed and ignition standby)	

[1] Only versions with diagnostic functionss RC-i x2x, [2] only multiple cylinders versions RC-i 2xx & RC-i 4xx

f) Check sensor



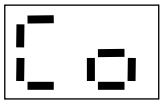
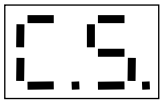
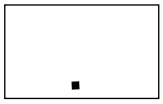
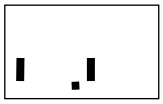
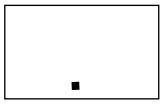
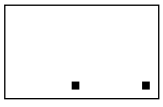
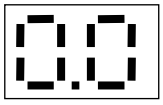
check mechanical position of speed sensor

The speed sensor has to be positioned in a way that it is triggered by the sensor magnet **75° before reaching** the top dead center. With the help of this menu the adjustment can be done easily. => see also page 7 and page 37

If there is no further mechanical correction possible:

- measure the actual triggering angle (for example mark flywheel at the triggering point and at the top dead center with a pen and measure this angle).
- adjust the angle value in menu point „SA“ (page 37)

Important: Please note the constraints when adjusting the value of the sensor angle (p.37)!

nr.	action	display
1-4	➢ select configuration menu	
5	➢ wait until „CS“ flashes ➢ actuate magnetic element	
6	display shows permanently the first decimal point	
7	➢ turn flywheel in direction of rotation until the display shows „ii“ The sensor magnet of the flywheel is detected by speed sensor.	
8	➢ turn back flywheel until only the first decimal point is shown	
9	➢ repeat step 7 to adjust an angle of 75 ° between top dead center and trigger point	
10	after making the adjustment: ➢ actuate magnetic element	
11	POWER SPARK returns to normal operation mode (display of engine speed and ignition standby)	

[1] Only versions with diagnostic functionss RC-i x2x, [2] only multiple cylinders versions RC-i 2xx & RC-i 4xx

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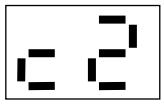
[1)] Only versions with diagnostic functionss RC-i x2x, [2)] only multiple cylinders versions RC-i 2xx & RC-i 4xx

g) configuration cylinder 2[2)]

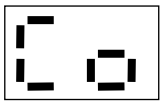
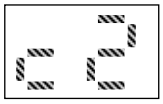
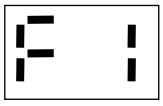
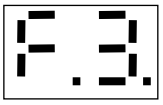
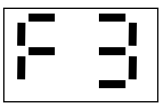
selection of endstage operation mode (<2>)



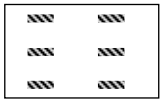
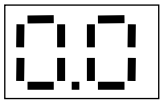
The second ignition endstage can be configured for engines in boxer or twin arrangement. Alternatively the second ignition endstage can be used as a switching output when the POWER SPARK is in one cylinder operation. In this configuration the switching output is either speed-dependent or error-dependent. (when engine is shut-off, see diagnostic menu, „rS“, „bd“, „rd“). This function of the switchable output is also available for version RC-i 125.

Adjustment possibilities:

- setting „F1“[2)] boxer- engine: 0° ignition offset
- setting „F2“[2)] twin-Motor: 180° ignition offset
- setting „F3“ speed-dependent switching output
- setting „F4“ error-dependent switching output “ON”
- setting „F5“ error-dependent switching output “flashing”

nr.	action	display
1-4	➢ select configuration menu	
5	➢ wait until „c2“ flashes	
6	➢ actuate magnetic element	
7	display shows the current function of the second ignition stage (for example „1“)	
8	adjustable values flash one after another for 3 sec (1-5)	
9	➢ wait until the desired value flashes, (for example „3“) ➢ actuate magnetic element	
10	display shows the new selected ignition energy (here „3“)	
10a	• proceed with page 42 point 13, if function „3“ is selected	

[1)] Only versions with diagnostic functionss RC-i x2x, [2)] only multiple cylinders versions RC-i 2xx & RC-i 4xx

11	display indicates that the new value is stored	
12	POWER SPARK returns to the normal operation mode (display of engine speed and ignition standby)	

Speed-dependent switching output „F3“

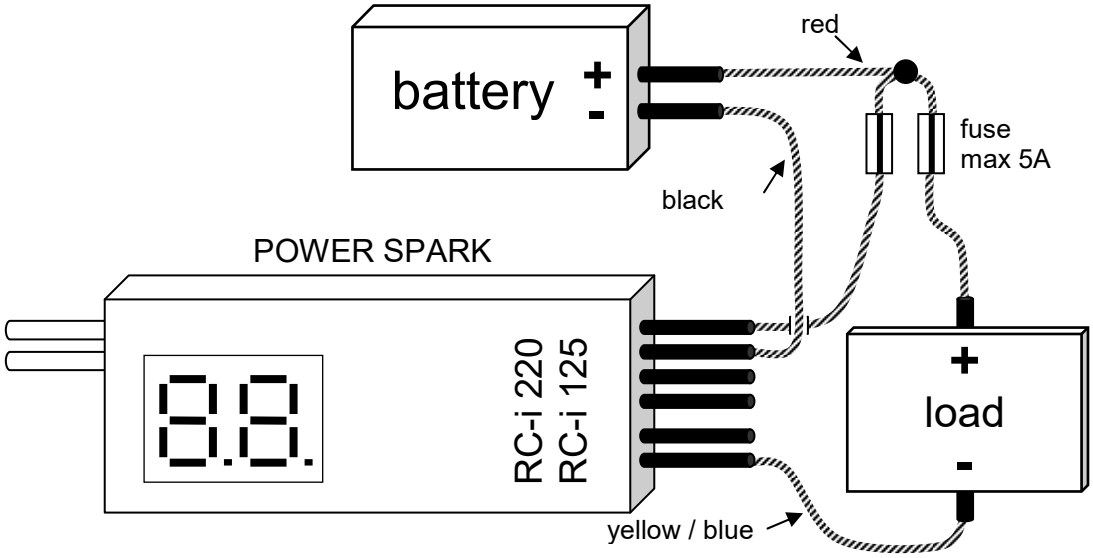
If the function „speed-dependent“ switching output is selected, the POWER SPARK switches the output of the second ignition endstage in dependence of the engine speed on and off. The ignition endstage switches the output to ground, that means the negative connection of a load must be connected to the POWER SPARK and the positive connection must be connected to the battery (=>use fuse). When exceeding the lower speed threshold n_6 the output is switched to ground, when exceeding the upper speed threshold n_7 the output is disabled (high impedance).

- the switching output is updated every 0,2sec
- the speed threshold values n_6 and n_7 can be adjusted in 100rpm- steps

restrictions:

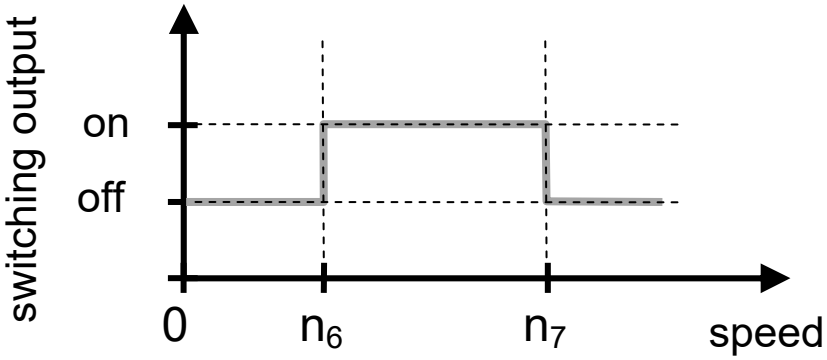
- $n_6 < n_7$
- $0 < n_6, n_7 < 59900$

Connection scheme when using the switching output



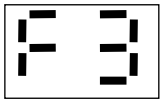
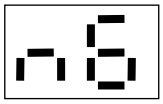
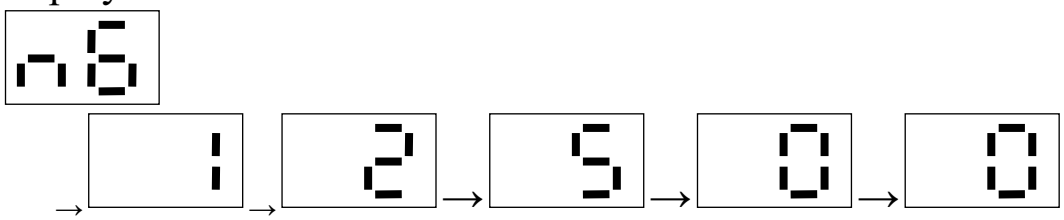
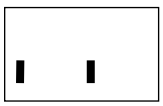
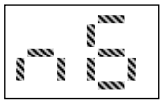
[1] Only versions with diagnostic functionss RC-i x2x, [2] only multiple cylinders versions RC-i 2xx & RC-i 4xx

function of the switching output

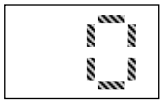
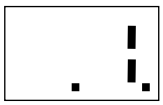
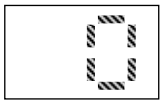
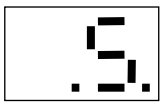
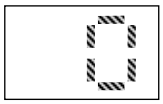
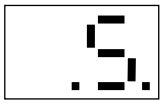
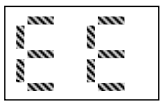
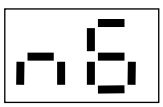
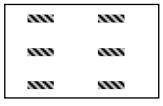
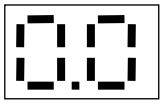


Adjustment of speed threshold values

For example: speed threshold n_6 = „15500 rpm“ shall be adjusted

nr.	action	display
1-10	➢ chose function „3“ to enable the speed-dependent switching output, see points (1-10) on previous page	
13	display shows the current speed values „n“ one after another $n_6 \rightarrow n_7$	
14	The POWER SPARK has a two digit LED display. This is why the display of speed values occurs by sequentially displaying the figures. The display shows the speed figures one after another (here for example „n_6“=12500rpm). display: 	
15	display shows „i i“, an information, that the proper programming can start and inputs from the user are expected	
16	adjustable parameters flash one after another for 3sec: $n_6 \rightarrow n_7$	

[1] Only versions with diagnostic functionss RC-i x2x, [2] only multiple cylinders versions RC-i 2xx & RC-i 4xx

17	➢ actuate magnetic element to select the parameter for modifying. Example: the speed „n_6“ is selected for modifying	
18	adjustable values of the ten thousands flash one after another for 3sec (0-5)	
19	➢ wait until the desired figure flashes (for example „1“) ➢ actuate magnetic element	
20	adjustable values of the thousands flash one after another for 3sec (0-9)	
21	➢ wait until the desired figure flashes (for example „5“) ➢ actuate magnetic element	
22	adjustable values of the hundreds flash one after another for 3sec (0-9)	
23	➢ wait until the desired figure flashes (for example „5“) ➢ actuate magnetic element	
24	the second adjustable parameter flashes for 3sec	
25	if this speed value should be changed: ➢ actuate magnetic element (input as described in point 18)	
26a	The error message „EE“ will be shown if wrong values are entered. The values before modification are retained.	
26b	display shows the new (or retained) speed values „n“ one after another $n_6 \rightarrow n_7$ (also described in (14))	
27	If all values are entered correctly and the described requirements are fulfilled, the values will be stored. Display indicates that the new values are stored.	
28	POWER SPARK returns to the normal operation mode (display of engine speed and ignition standby)	

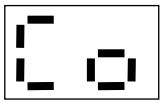
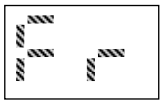
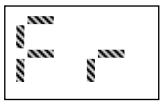
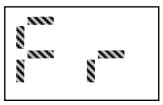
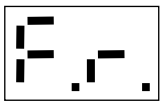
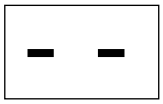
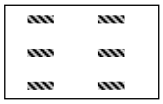
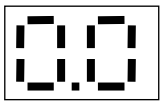
[1] Only versions with diagnostic functionss RC-i x2x, [2] only multiple cylinders versions RC-i 2xx & RC-i 4xx

h) Factory reset

reset POWER SPARK to factory settings

The POWER SPARK can be reset in the initial state with default values at any time.

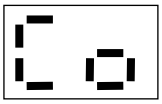
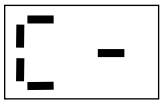
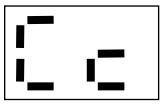
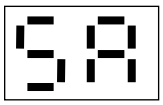
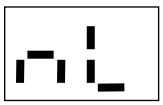
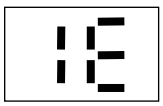
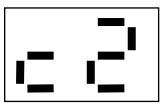
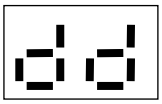
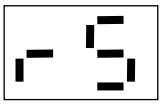
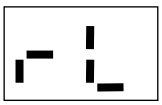
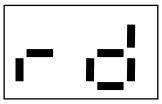
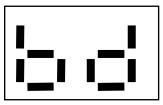
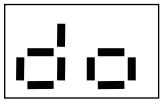
WARNING: all stored settings get lost

nr.	action	display
1-4	➢ select configuration menu	
5	➢ wait until „Fr“ flashes	
6	➢ actuate magnetic element	
7	„Fr“ flashes again for 3sec	
8	➢ within this time actuate magnetic element	
9	„Fr“ flashes again for 3sec	
10	➢ within this time actuate magnetic element	
11	display confirms the initialization with the factory settings	
12	display indicates that the values are stored	
13	POWER SPARK returns to the normal operation mode (display of engine speed and ignition standby)	

- The next page shows the values of the factory setting.

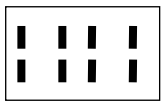
[1)] Only versions with diagnostic functionss RC-i x2x, [2)] only multiple cylinders versions RC-i 2xx & RC-i 4xx

default setting

main menu	menu	parameter	value	
 configuration menu		ignition map	**1** (0-9)	
		individual ignition map	values of map 1	
		sensor angle	**75** (40..99)	
		engine speed limit	**59900** (0-59900)	
		ignition energy	**2** (1-3)	
		operation mode of ignition endstage	**RC-i 220: 2** (1-5)	**RC-i 125: 5** (3-5)
 diagnostic menu	 1)	receiver signal monitoring[1)]	**no** (no, 0..99)	
	 1)	warn threshold low voltage receiver battery[1)]	**no** (no, 2..9,9)	
	 1)	shutdown threshold low voltage receiver battery[1)]	**no** (no, 2..9,9)	
		warn threshold low voltage main battery	**no** (no, 4..9,9)	
		shutdown threshold low voltage main battery	**no** (no, 4..9,9)	
		display options	**0** (0..3)	

[1)] Only versions with diagnostic functionss RC-i x2x, [2)] only multiple cylinders versions RC-i 2xx & RC-i 4xx

STATUS MENU



The status menu can only be selected when the engine halts.
It includes the menu items:

a) maximum engine speed „nh“
display of maximum achieved engine speed

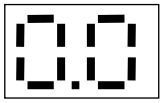
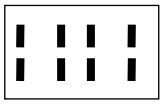
b) voltage of main battery „Ub“
display of actual main battery voltage

c) voltage of receiver battery[1)] „Ur“
display of actual receiver battery voltage

d) display receiver signal[1)] „dr“
display of the currently measured signal of the RC receiver

e) display options „do“
selection of display content when engine halts

selection of status menu

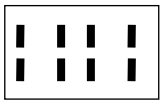
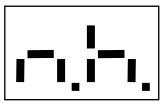
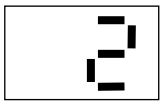
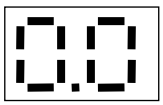
nr.	action	display
1	POWER SPARK in normal operation mode	
2	➢ actuate magnetic element (by approaching the programming magnet to the housing near the magnet sensitive element)	
3	after 3sec the right figure „d“ flashes ➢ wait 3 sec to get to the status menu	
4	the selectable menu items flash one after the other for 3sec in the order: „nh“ → „Ub“ → „Ur“[1)] → “dr”[1)] → „do“	

[1)] Only versions with diagnostic functionss RC-i x2x, [2)] only multiple cylinders versions RC-i 2xx & RC-i 4xx

a) Display of maximum achieved engine speed „nh“ (n highest)

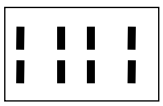
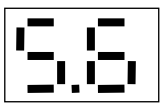
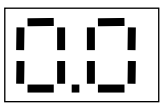
- value will be erased when removing the power supply
- value will be erased when starting the engine
- value is averaged over a period of 0.8sec

For example: the maximum achieved engine speed was n_h = „25654 rpm“

nr.	action	display
1-4	➢ select status menu	
5	➢ wait until „nh“ flashes ➢ actuate magnetic element	
6	display shows the figures of speed one after another (for example 2→5→6→5→4)	
7	POWER SPARK returns to the normal operation mode (display of engine speed and ignition standby)	

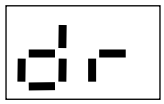
b) & c) Display of actual battery voltages

- **„Ub“ (U battery)**
- **„Ur“ (U receiver)**

nr.	action	display
1-4	➢ select status menu	
5	➢ wait until „Ub“ or „Ur“ flashes ➢ actuate magnetic element	
6	display shows the actual battery voltage (for example 5,6 Volt)	
7	POWER SPARK returns to the normal operation mode (display of engine speed and ignition standby)	

[1] Only versions with diagnostic functionss RC-i x2x, [2] only multiple cylinders versions RC-i 2xx & RC-i 4xx

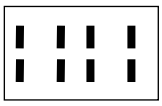
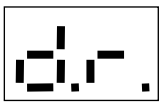
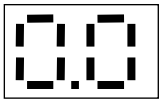
d) display receiver signal„dr“



display of the currently measured signal of the RC receiver

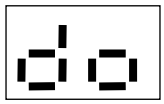
The POWER SPARK can display the currently measured value of the received signal for diagnostic purposes and to determine the valid value range when using the receiver signal monitoring (p.53).

To do this, proceed as follows:

Nr.	Aktion	Display
1-4	➢ select status menu	
5	➢ wait until „dr“ flashes	
6	➢ actuate magnetic element	
7	The currently measured value of the receiver signal is displayed in the following 30 seconds ➢ During this time, the lower and upper signal value of the receiver signal can be easily find out by moving the gas potentiometer / switch between the end positions (at remote control).	value
8	POWER SPARK returns to the normal operation mode (display of engine speed and ignition standby)	

[1] Only versions with diagnostic functionss RC-i x2x, [2] only multiple cylinders versions RC-i 2xx & RC-i 4xx

e) display options „do“



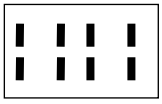
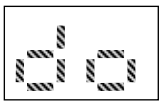
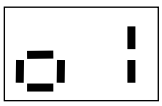
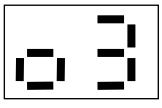
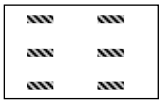
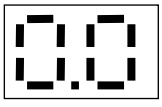
selection of display content when engine halts (<0>)

After an engine stop the POWER SPARK can automatically display the maximum achieved engine speed „nh“ and the voltage of the ignition battery „Ub“ and receiver battery „Ur“ alternately.

Adjustment possibilities:

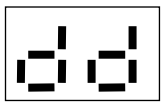
- setting „o0“ no automatic display after engine stops
- setting „o1“ display: „nh“
- setting „o2“ display: „nh“ → „Ub“
- setting „o3“[1)] display: „nh“ → „Ub“ → „Ur“

The automatic display of the maximum engine speed is activated after an engine run for at least 4 seconds.

nr.	action	display
1-4	➢ select status menu	
5	➢ wait until „do“ flashes	
6	➢ actuate magnetic element	
7	display shows the current display function (here „1“)	
8	adjustable values flash one after another for 3 sec (0-3)	
9	➢ wait until the desired function flashes (for example „3“) ➢ actuate magnetic element	
10	display shows the new selected display function (here „3“)	
11	display indicates that the values are stored	
12	POWER SPARK returns to the normal operation mode (display of engine speed and ignition standby)	

[1)] Only versions with diagnostic functionss RC-i x2x, [2)] only multiple cylinders versions RC-i 2xx & RC-i 4xx

DIAGNOSTICS MENU



General

The POWER SPARK provides several diagnostic functions to increase the reliability of the system.

- If the monitored voltage falls below the adjusted warning threshold ignition failures will be systematically generated **starting from the half maximum allowed engine speed.**
  (=> engine splutters) to inform the user of a weak battery.
  (adjustment of speed in menu item „nl“, p.32)
- If the monitored voltage falls below the switch-off threshold the engine will be shut down for safety.
  (for example cable break of power supply on the RC-receiver)
- When receiving an illegal signal from the RC-receiver the engine will be shut down [1)]. (i.e. in case of failure of radio transmission)

A warning or shutdown is only triggered after a defined time (see table on page 52) when the monitored parameters have exceeded or under-run the permissible range of values. The warning or shutdown criteria are explained in the respective menus descriptions.

The diagnostic menu can only be selected when the engine halts.
It includes the menu items:

a) monitoring of receiver signal[1)] / “kill switch”[1)]
activation and adjustment of the valid receiver signal range
➔ engine shutdown

b) Warning threshold receiver battery[1)]
activation and adjustment of warning threshold of receiver battery voltage
➔ engine splutters from speed nL/2 (p.32)

c) Shutdown threshold receiver battery[1] ➔ engine shutdown
activation and adjustment of shutdown threshold of receiver battery voltage
➔ engine shutdown

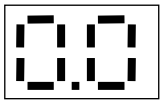
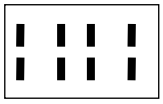
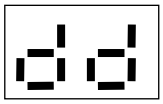
d) Warning threshold main battery ➔ engine splutters at nL/2
activation and adjustment of warning threshold of main battery voltage
➔ engine splutters from speed nL/2 (p.32)

[1)] Only versions with diagnostic functionss RC-i x2x, [2)] only multiple cylinders versions RC-i 2xx & RC-i 4xx

e) Shutdown threshold main battery ➔ engine shutdown
activation and adjustment of shutdown threshold of main battery voltage
➔ engine shutdown

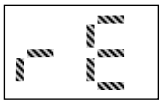
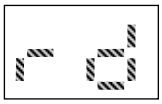
f) Operating time
display and reset of total operating time

selection of diagnostic menu

nr.	action	display
1	POWER SPARK in normal operation mode	
2	➢ actuate magnetic element (by approaching the programming magnet to the housing near the magnet sensitive element, remove after display shows ". .")	
3	after 3sec the right figure „d" flashes	
3b	during this time: ➢ actuate magnetic element (by approaching the programming magnet to the housing near the magnet sensitive element, remove after display shows ". .")	
4	Diagnostic menu will be selected	

[1] Only versions with diagnostic functionss RC-i x2x, [2] only multiple cylinders versions RC-i 2xx & RC-i 4xx

Shutdown criteria and display of diagnostic response

display	parameter	condition	result
	**„rE“ receiver error**[1)] monitoring of receiver signal	no receiver signal	engine shutdown
	**„rd“ receiver dead**[1)] shutdown threshold receiver battery	battery voltage falls below shutdown threshold for minimum 2sec	engine shutdown
	**„bd“ battery dead** shutdown threshold main battery	battery voltage falls below shutdown threshold for minimum 5sec	engine shutdown
	**„rL“ receiver low**[1)] warn threshold receiver battery	battery voltage falls below warn threshold for minimum 5sec	engine splutters when reaching half allowed maximum engine speed
	**„bL“ battery low** warn threshold main battery	battery voltage falls below warn threshold for minimum 5sec	engine splutters when reaching half allowed maximum engine speed
	**„oF“ killswitch off**[1)]	receiver signal out of the adjusted range	engine shutdown

- The valid input values of the shutdown or warning thresholds and the receiver signal shows the table „ technical data“ (last page)

PLEASE NOTE:

- After triggering a diagnostic function the occurred warning or error is displayed
- After switching off a restart of the engine is blocked for 5sec

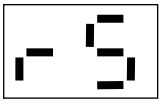
How to clear warnings or errors:

- restart engine OR
- interrupt and reconnect power supply of POWER SPARK (reset)

[1)] Only versions with diagnostic functionss RC-i x2x, [2)] only multiple cylinders versions RC-i 2xx & RC-i 4xx

a) monitoring of receiver signal[1] / "kill switch"[1]

activation and adjustment of the valid receiver signal range



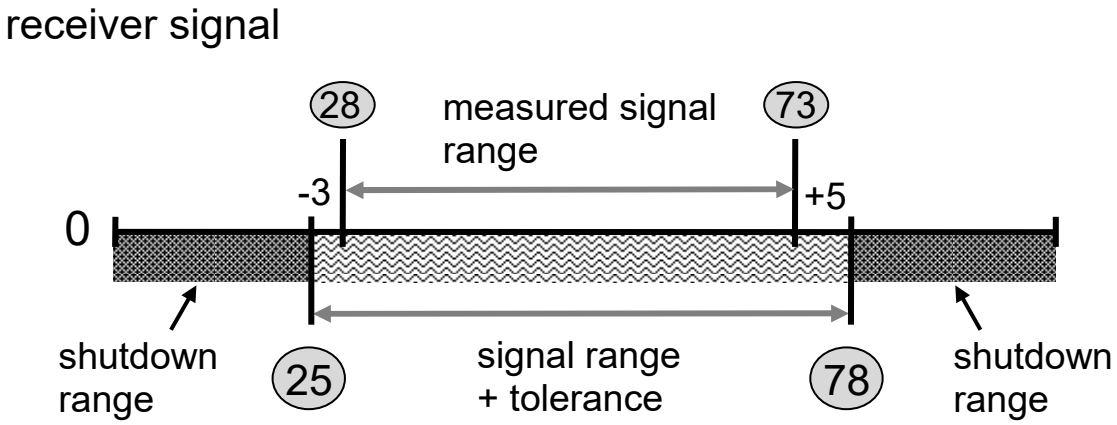
The POWER SPARK can monitor the signal of a radio-control receiver. The engine is shut down if the received signal is above or below the adjusted threshold values, the sensitivity can be adjusted.

An appropriate signal for the monitoring can be the „gas"-signal (to accelerate / slow down (reverse)). Alternatively any signal can be used (for example steering signal) or a signal that is exclusively reserved for monitoring / shutdown.

sequence of programming: The POWER SPARK displays the adjusted values, afterwards it displays the actual measured value of the receiver signal for 10 seconds. Following the thresholds can be modified; in the last step the new values are confirmed.

The nominal receiver signal range can be displayed within the 10-second time window by moving the gas-poti / switch at the remote control. To avoid an unintended shutdown of the engine caused by this diagnostic function a tolerance up to about 5-10% should be added (respectively subtracted) to the nominal values.

In the following example a signal range from „28" – „73" was determined. To avoid an unintended shutdown of the POWER SPARK, a tolerance value was added to the upper signal value respectively subtracted from the lower signal value.
=> The thresholds „25" and „78" are chosen.



[1] Only versions with diagnostic functionss RC-i x2x, [2] only multiple cylinders versions RC-i 2xx & RC-i 4xx

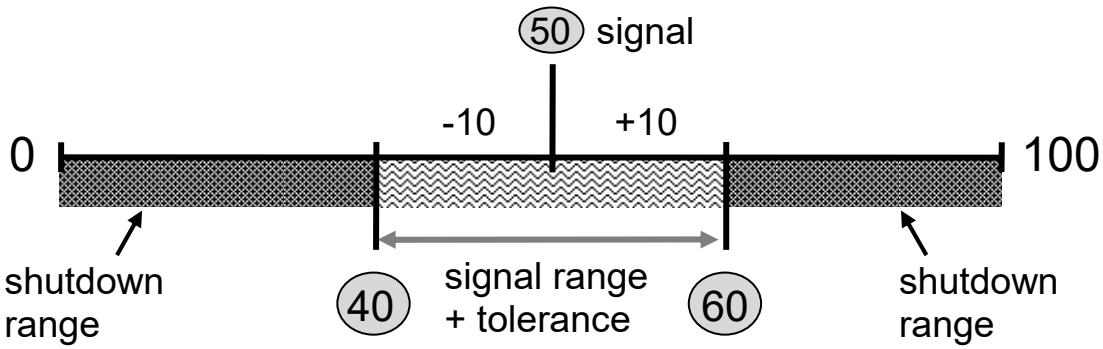
KILL SWITCH and FAILSAFE- functions

- **KILL SWITCH with separate channel**
  The POWER SPARK can act as a „KILL SWITCH“ and shut down the engine when a button on the remote control system is pushed:
  - select a free channel on the remote control system and connect the signal to the POWER SPARK.
  - identify signal values for „button on“ and „button off“
  - enter the threshold values for the receiver signal monitoring

Example: engine should shut down by pushing „button on“

The receiver provides for - „button off” the value 50
- „button on“ the value 20

➔ chose the valid signal range from 40 to 60



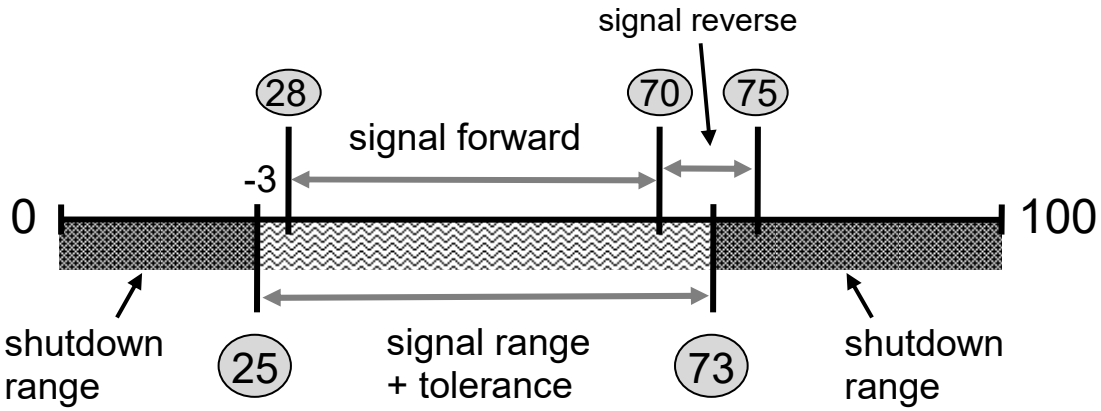
- **KILL SWITCH with gas signal**
  The POWER SPARK can act as a „KILL SWITCH“ and shut down the engine when a specific gas position (f.e. „reverse“) is reached:
  - Adjust the according threshold of the receiver signal monitoring to a value within the signal range of the desired shutdown criteria.

Example: engine should shut down by actuating „backwards“

The receiver provides for - „forward” the values 28-70
- „reverse“ the values 70-75

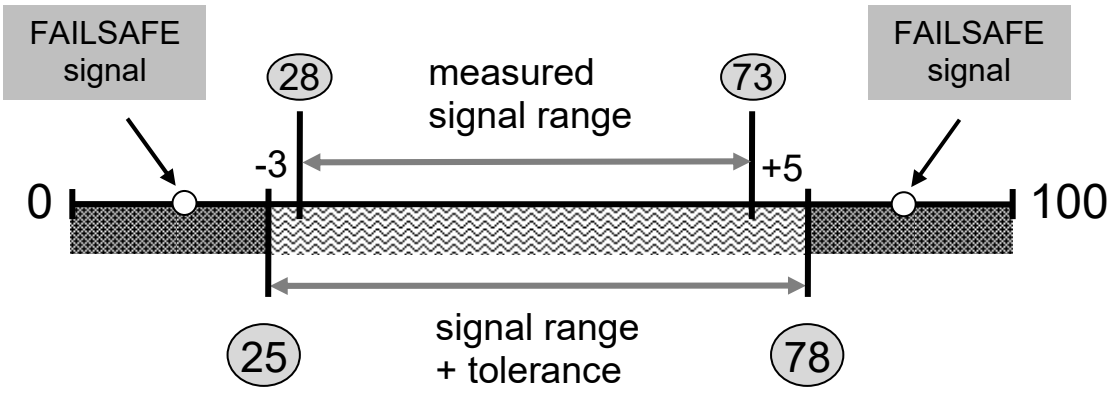
➔ Chose the threshold of the receiver signal monitoring in a way that it is not reached unintended or by too small tolerances. Here chosen: „73“

[1] Only versions with diagnostic functionss RC-i x2x, [2] only multiple cylinders versions RC-i 2xx & RC-i 4xx



- **FAILSAFE:**
  The POWER SPARK can react with an engine shutdown to a FAILSAFE signal of the remote control system:
  - To enable this functionality a FAILSAFE-signal value outside the programmed threshold values for the receiver signal monitoring has to be programmed to the remote control system.

  Example: The receiver provides values between 28 and 73
  - the signal range including tolerances is chosen to 25-78
  - the FAILSAFE- values on the remote controller system are set to f.e. 20 or 85



[1] Only versions with diagnostic functionss RC-i x2x, [2] only multiple cylinders versions RC-i 2xx & RC-i 4xx

sensitivity „SE“ <1>

The sensitivity for engine shutdown in case of loss of a valid receiver signal can be selected in three steps. The more sensititive the receiver signal monitoring is set, the faster the engine is shut off. However the possibility of a misdiagnosis increases and accordingly the tolerance against short glitches decreases.

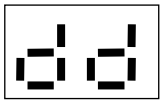
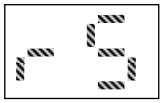
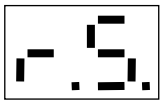
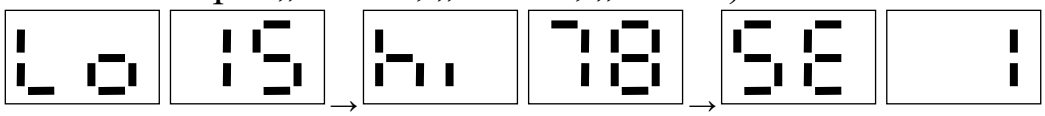
Adjustment possibilities:

- setting „1“ low sensititvity (factory setting)
- setting „2“ medium sensititvity
- setting „3“ high sensititvity

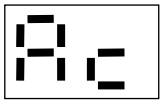
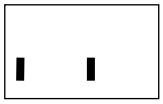
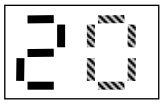
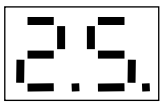
Programming

In the following example the limits „15“ and „78“ are selected.

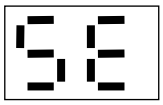
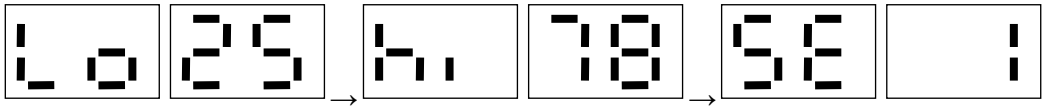
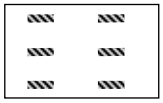
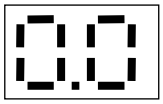
- the lower limit should be changed to the value „25“.
- the upper limit should not be changed
- the sensitivity of the signal monitoring should not be changed

nr.	action	display
1-4	➢ select diagnostic menu	
5	➢ wait until „rS“ flashes	
6	➢ actuate magnetic element	
7	display shows the actual values of the lower and upper limit: (here for example „lo“=15, „hi“=78, „SE“=1) 	

[1] Only versions with diagnostic functionss RC-i x2x, [2] only multiple cylinders versions RC-i 2xx & RC-i 4xx

8	in the following 10 seconds the actual value of the receiver signal is displayed ➢ during this time determine the lower and upper signal value of the receiver signal by moving the gaspoti in the end positions (on the remote-controller)	
9	➢ choose the values for the receiver signal monitoring thoroughly (see introductory text)	
10	display shows „i i“, an information, that the proper programming can start and inputs from the user are expected	
11	The selectable parameters flash one after another for 3 sec - „lo“ (lower limit) - „hi“ (higher limit) - „SE” (sensitivity) lo → hi → SE	
12	➢ actuate magnetic element to select parameter for modifying here: the lower limit „lo“ is selected	
13	Adjustable values flash one after another for 3sec (no, 0-9)	
13a	To disable this diagnostic function: ➢ actuate magnetic element	
13b	To enable this diagnostic function: ➢ wait until the desired figure of the tens flashes (for example „2“) ➢ actuate magnetic element	
	adjustable values of the unit position flash one after another for 3sec (0-9)	
	➢ wait until the desired figure flashes (for example „5“) ➢ actuate magnetic element	
14	the remaining adjustable parameters flash one after another for 3 sec: hi → SE	

[1] Only versions with diagnostic functionss RC-i x2x, [2] only multiple cylinders versions RC-i 2xx & RC-i 4xx

14a	if the upper limit „hi“ should be changed: ➢ actuate magnetic element • (input as described in point 13)	
14b	if the sensitivity „SE“ should be changed: ➢ wait until “SE” flashes ➢ actuate magnetic element • (input analog to point 13)	
15	display shows the new values of the lower and upper limit: (here for example „lo“=25, „hi“=78, „SE“=1) 	
16	Display indicates that the new values are stored.	
17	POWER SPARK returns to the normal operation mode (display of engine speed and ignition standby)	

PLEASE NOTE:

- To deactivate the receiver signal monitoring
  - set the upper or lower threshold to „no“
- To activate the receiver signal monitoring
  - set the upper and lower threshold to valid values
- The receiver signal monitoring is activated 7sec after power up

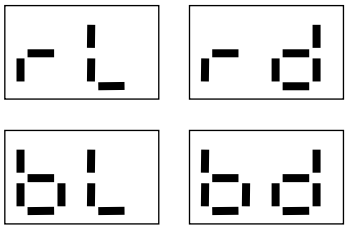
TIPP:

- With menu item "dr" in the status menu (p. 48), the currently measured value of the RC signal is displayed for 30 seconds. During this time, the signal range of the connected RC receiver signal can be easily determined.

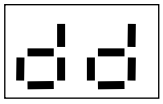
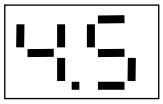
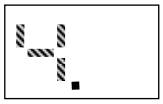
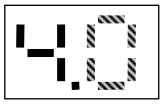
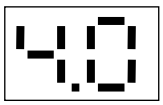
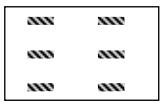
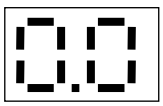
[1)] Only versions with diagnostic functionss RC-i x2x, [2)] only multiple cylinders versions RC-i 2xx & RC-i 4xx

b) - e) Voltage monitoring

activation and adjustment of warning or shutdown thresholds of main or receiver battery voltage



The following example shows exemplarily the deactivation / activation of the warning threshold for monitoring the voltage of the main battery. The adjustments of the other thresholds are identical.

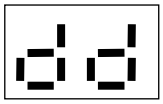
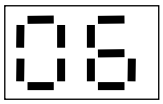
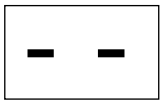
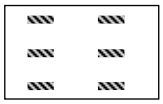
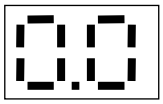
nr.	action	display
1-4	➢ select diagnostic menu	
5	➢ wait until „bl“ flashes	
6	➢ actuate magnetic element	
7	display shows actual voltage value (for example „4.5“)	
8	adjustable values flash one after another for 3sec (no, 0-9)	
8a	To disable this diagnostic function: ➢ actuate magnetic element	
8b	To enable this diagnostic function: ➢ wait until the desired figure of the unit value flashes (for example „4“) ➢ actuate magnetic element	
9	➢ wait until the desired figure of the decimal place flashes (for example „0“) ➢ actuate magnetic element	
10	display shows the new voltage values (here „4.0“)	
11	Display indicates that the new value is stored	
12	POWER SPARK returns to normal operation mode (display of engine speed and ignition standby)	

[1)] Only versions with diagnostic functionss RC-i x2x, [2)] only multiple cylinders versions RC-i 2xx & RC-i 4xx

f) operating time

display and reset of total operating time

The POWER SPARK sums the total operating time of the engine with an internal resolution of 1min, the display shows it with a resolution of 1h. After displaying the operating time the user can reset the operating time counter.

nr.	action	display
1-4	➢ select diagnostic menu	
5	➢ wait until „ot“ flashes	
6	➢ actuate magnetic element	
7	the total engine operating time in hours is displayed (for example „06“)	
8	„cl“ (clear) flashes for 3sec	
8a	operating time counter should <u>not</u> be reset: ➢ wait	
8b	to reset the operating time counter: ➢ within this time actuate magnetic element	
9	„cl“ flashes again for 3sec	
10	➢ within this time actuate magnetic element again	
11	the reset of the operating time counter is confirmed	
12	Display indicates that the new value is stored	
13	POWER SPARK returns to normal operation mode (display of engine speed and ignition standby)	

[1] Only versions with diagnostic functionss RC-i x2x, [2] only multiple cylinders versions RC-i 2xx & RC-i 4xx

troubleshooting

1) The receiver signal is not displayed (display "00")

Possible causes: broken wire, missing ground connection

- check the wiring, if separate batteries for POWER SPARK and receiver are used, the negative poles of both batteries must be clamped together.
  => see p.12

2) Engine does not start, no display of speed at startup

Possible causes: broken wire / defect speed sensor

- check the correct function of the speed sensor system using the menu item "CS" => see p.38

3) Sparking at the speed sensor

Possible cause: insufficient ground connection at the engine => see 4a)

4) Engine does not run smoothly / stutters
display shows insteady engine speeds
display shows “8.8.” and engine stops suddenly

Possible causes:

a) **insufficient ground connection at the engine** => see p.11,p.12
   - check the continuity of the ground connection from the battery minus to the spark plug. The current induced into the spark plug must be able to flow unhindered through the cylinder head / engine housing to the battery minus pole. A connection of the battery minus pole as close as possible to the thread of the spark plug is to be preferred. Anodized parts or insulating paper seals etc. can make the current flow more difficult or completely prevent it. By means of a suitable screw connection, ensure that a low-resistance electrically conductive connection exists (=> measure with a multimeter, the resistance should be less than 1 Ohm)

b) **wrong ignition coil =>** see p.13

c) **spark plugs without resistor =>** see p.13

d) **ignition coil too close to sensor =>** see p.5

e) **unfavorable cable routing** => see p.5

5) Engine does not reach high speeds

Possible causes:

a) **speed limiter active** => increase speed limiter value p.32

b) **insufficient ground connection of** engine => see 4a) above

c) **wrong ignition energy selected** => see p. 35

d) **excessive pre-ignition angle at high speeds** => decrease pre-ignition see p 27

Further support can be found on our homepage www.power-spark.de

[1)] Only versions with diagnostic functionss RC-i x2x, [2)] only multiple cylinders versions RC-i 2xx & RC-i 4xx

Technical data

feature		version		
		RC-i 1xx	RC-i 2x0	RC-i 4xx
number of cylinders		1	2	3 & 4
max. speed [rpm]		30000		
accuracy of speed measurement		+/- 1% (25°C)		
power supply		4 - max12V[3)]		
detectable pulse width of receiver signal[1)]		0,8 .. 2,2ms		
min. signal level of receiver signal[1)]		1,6V		
warn- and shutdown- threshold for low voltage main battery		4..9,9V		
warn- and shutdown- threshold for for low voltage receiver battery[1)]		2..9,9V		
reverse polarity protection with fuse		3A	3A	5A
current consumption	standby	0,03A	0,03A	0,04A
current consumption: [4)] energy 2: 6V	7500rpm	≈0,5A	≈1,0A	≈2,0A
	15000rpm	≈1,0A	≈2,0A	≈4,1A
current consumption: [4)] energy 2: 9V	7500rpm	≈0,4A	≈0,7A	≈1,4A
	15000rpm	≈0,7A	≈1,3 A	≈2,7A
current consumption: [4)] energy 2: 12V	15000rpm	≈0,5A	≈1,1A	≈2,2A
	30000rpm	≈1,1A	≈2,2A	≈4,4A
dimensions [mm] (without flange)		82 x 42	82 x 42	82 x 82
dimensions [mm] (with flange)		110 x 42	110 x 42	110 x 82
height [mm]		18	18	18
hole pattern [mm]		100 x 32	100 x 32	100 x 72 100 x 36
weight [g]		~100	~110	~195

DISPOSAL
The device must not be disposed of with the household waste. It must be disposed of at suitable collection points at which (e.g. also television sets, computers, etc. are delivered). Please ask your local authority or municipal authorities for these collection points for electronic waste.

WEEE-Reg.-Nr.:30823516

[3)] for multiple cylinders versions and high speed (>20000rpm) the supply should be min. 9V
[4)] current consumption has a strong dependency on ignition coil, spark plug an wiring cross section

[1)] Only versions with diagnostic functionss RC-i x2x, [2)] only multiple cylinders versions RC-i 2xx & RC-i 4xx