

# **RR1 WURKS**

**DIGITAL - 3**

**INSTRUCTION MANUAL**



## 1. Introduction

Thank you for trusting R1 WURKS products. Purchasing DIGITAL-3 Brushless ESC means that you selected the best ESC out of currently existing ones. This ESC is integrated with Hi-Technology features, and it is the most outstanding ESC you can get in the market. It is very dangerous when used improperly or remodeled without an approval, and this can cause critical damages to peripheral products & devices. Please carefully read this manual before use of this product.

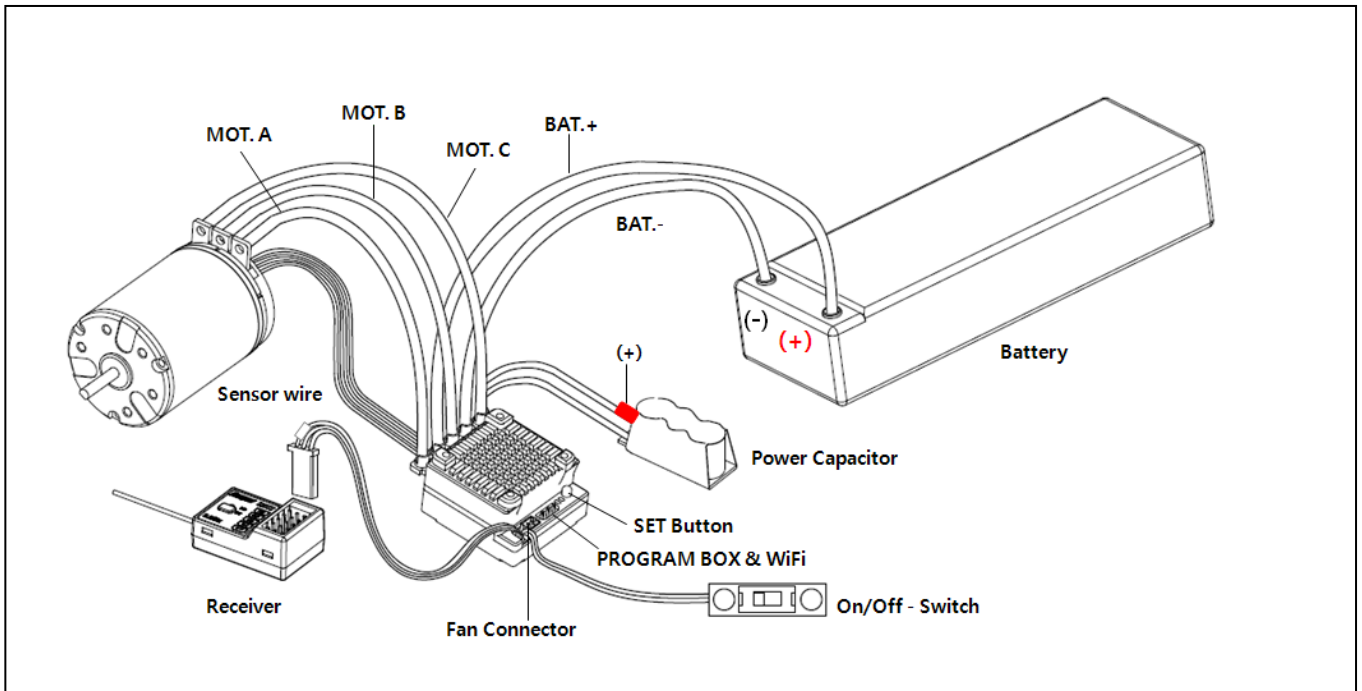
## 2. Caution

- Avoid short circuits: make sure all ESC wires and connections are protected and are not in contact with peripheral devices.
- When soldering input/output wires and connections, set the iron to 60W minimum.
- Protect the ESC from humidity, water, oil and other substances. Keep the operation atmosphere dry.
- Provide the ESC with good ventilation to prevent overheating.
- Always separate the ESC from the battery after each use.

## 3. Features

- Full aluminum case and heat sink design
- Full compatibility with modified and stock racing
- Superlative FET and low-resistance power PCB design
- 30mm fan for maximum cooling
- Software/hardware upgrades increase speed by reducing motor temperature by modifying the communication algorithm
- The Built-in booster BEC has a Maximum voltage of 6V and 7.4V, making it easy to operate a variety of servo without the need for a separate receiver power supply
- New turbo / boost timing setting and delay time setting
- New brake response mode and PWM / brake frequency allows various race and control types
- Data port for connecting a program box or WiFi module
- WiFi module allows program parameter settings and firmware upgrades
- ESC and motor telemetry (temperature, current, voltage, RPM and battery consumption) can be stored in real time with the data log

## 4. Connection



### ■ Caution

For maximum performance, the black silicon wire without any connector is 12AWG. For soldering the battery and motor wires onto the solder bar, set the iron to a minimum of 60W. Avoid soldering more than 5 seconds or the ESC may overheat and become damaged. Use the provided tube casing to prevent the short circuit and to check the polarity after connection.

### ■ Motor Wire Connection

When connecting ESC and motor, the wire A/B/C should be inserted in their respective places. However, some cars are wired backwards. In this case, switch the Motor-Wiring setting from A-B-C to C-B-A. The C and A wires will be reversed from how they are shown on the figure above: incorrect setting and connection can cause critical problems. Keep in mind that if the ESC is reset, then the C-B-A wiring setting will default back to A-B-C; change it to C-B-A again before use.

After connecting the A/B/C wires, connect the sensor wire to the 6-pin sensor port.

### ■ Power Capacitor

Never drive without the power capacitor! This is necessary to protect the ESC and improve performance. Pay attention to polarity: incorrect connection and poor soldering will damage the ESC. (The power capacitor is not covered by the warranty.)

As shown in the figure above, connect the indicated red wire to positive (+) ESC post. Connect the short wire to negative (-) ESC post.

### ■ **Battery Wire Connection**

When connecting the battery, pay attention to polarity: incorrect connection will damage the ESC. (The battery is not covered by the warranty.)

As shown in the figure above, connect the positive (+) wire is connected to (+) battery port, and the negative (-) wire is connected to the (-) battery port.

### ■ **Receiver Wire Connection**

Before connecting the ESC to the receiver, the transmitter should be in default settings. See **Transmitter Settings**.

Connect the ESC throttle wire to the receiver CH2. The signal wire has a white indicator. The signal wire supplies 6-7.4V to the receiver, servo, etc., so there is no need to connect an additional battery. External power connected to the receiver may damage the ESC.

### ■ **Fan Connector**

A cooling fan, screws and fan protector are provided per the ESC specification. It is recommended using the fan under the extreme situations, such as modified or 4WD off-road. The fan will not operate if the ESC temperature is at or below 95°F (35°C) or if the motor RPM is low.

Connect the fan using 2-pin connector at the front of the ESC. Mount the fan to the top of the heat sink.

## 5. Connection Install Guide

- Place the ESC in a safe place where is easily accessible to connector and buttons.
- Leave enough distance between the ESC, power wire and antenna/receiver to avoid the parts directly touching. Receivers and antennas placed too close together may result in signal confusion. Parts must be re-install at a further distance apart.
- Tightly affix the ESC with double-sided tape (included).

## 6. Transmitter Settings

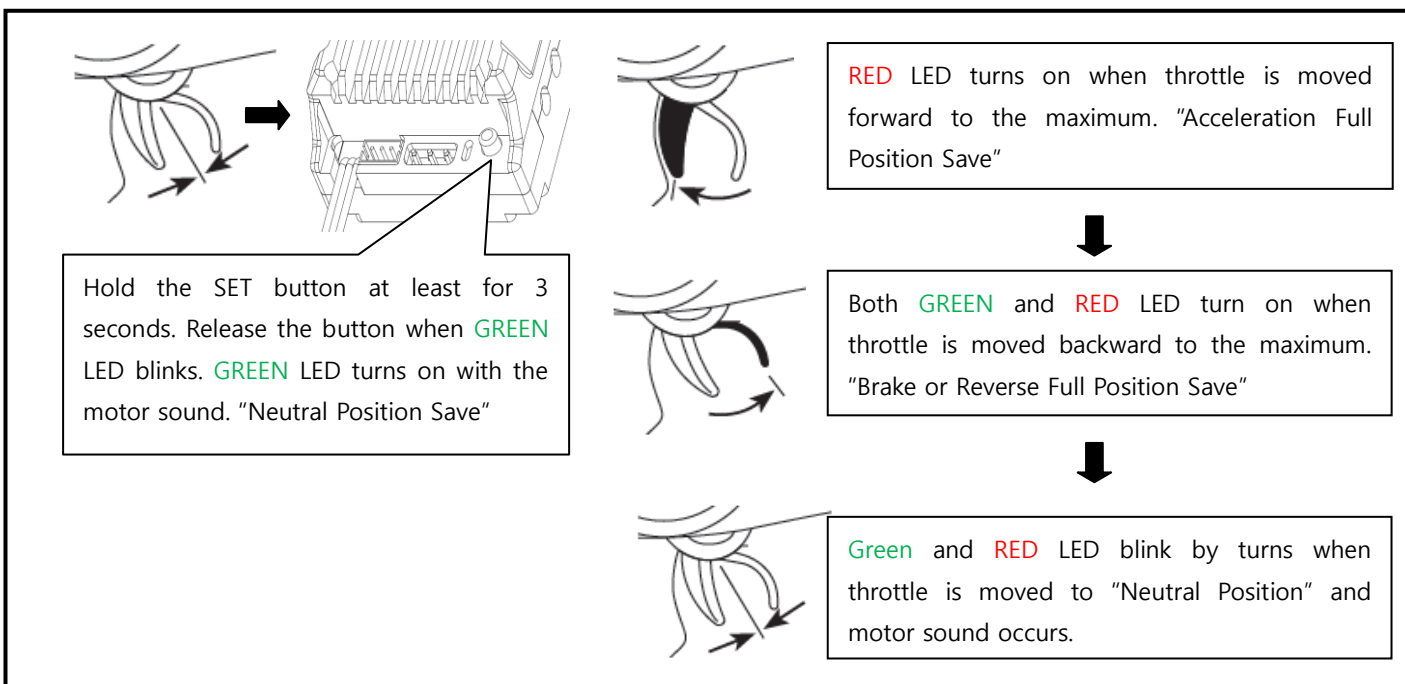
- Before connecting the ESC to the receiver, the transmitter should be in default settings, as shown in below:

<b>Throttle Travel</b>	High ATV,EPA	100%
<b>Brake Travel</b>	Low ATV,EPA,ATL	100%
<b>Throttle Exponential</b>	EXP,EXPO	Start with 0
<b>Neutral Trim</b>	SUB Trim	Center
<b>Trigger</b>	RATE Forward-Brake	F50 : B50

- Disconnect the ESC from the battery. Turn the ESC power switch **OFF**.
- Remove the motor pinion, or lift the car off the ground and verify the wheels rotate freely.
- Turn the transmitter **ON** and place the throttle in **NEUTRAL**.

## 7. CALIBRATION TO TRANSMITTER

- Turn the transmitter on and place the throttle on the neutral.
- Connect the ESC to the battery. Turn the ESC power switch **ON**



- If the motor moves at Neutral Position, there is an inconsistency in the saved neutral value. Re-calibrate the throttle range.
- The LED will broadcast the status of the ESC settings and throttle movements using the indicators listed below.

	<b>GREEN LED</b>	<b>RED LED</b>
<b>Neutral ("BOOST ON MODE")</b>	ON	OFF
<b>Neutral ("BOOST OFF MODE")</b>	Blinking	OFF
<b>Max Acceleration</b>	OFF	ON
<b>Max Reverse or Brake</b>	ON	ON



39	Units	Metric / English	Metric
40	Download	All parameters inside the setup card are downloaded to the ESC.	
41	Factory Setting	Change the setting of ESC to default factory status.	
42	Current Voltage	XX.X	
43	Current Temp	0° ~ 135°C	
44	Max Temperature	0° ~ 135°C	
45	Motor Temp	0° ~ 135°C	
46	Motor Max Temp	0° ~ 135°C	
47	Max Current	0A ~ 999 A	
48	Maximum Speed	XXX.X km/h	
49	Maximum RPM	XXX rpm	
50	Error History	M, T1, T2, S, V, R	

### ■ Motor Type

**Sensor:** The Sensor Mode is the recommended and default mode because it provides the power system with the highest efficiency and racing performance. If a sensor error occurs during operation, the transmission operates in the sensorless mode immediately; check the motor and sensor cable connections.

**Hybrid:** In Hybrid Mode, after the ESC is switched ON it works with a sensed motor at low RPM. Conversely, upon being switched ON the ESC automatically works with a sensorless motor. This mode could be used for 4WD SCT of 4 pole motors.

### ■ Select Battery

Select the correct battery type. Incorrectly selecting the battery type can irreparably damage the battery.

### ■ Cut Off Voltage

Set the minimum voltage at which the battery will run. This function automatically cuts-off the battery to protect it from excessive discharging, which causes irreparable damage.

### ■ Power Curve

ESC output is effected by the throttle curve parameters in relation to the throttle position. Default setting is "5"; the power curve should be changed into other shapes using a PC program or WiFi module. For example, if +EXP value is added at the beginning of the curve, the value of the initial output is increased, conversely, if -EXP value is added, smaller throttle value is output.

### ■ Boost Max+TB

**OFF:** All timing is disabled. The LED should **blink GREEN at neutral** in this mode. This is the preferred mode for Stock Racing.

**ON:** The speed and efficiency of the motor is depending on boost timing setting. When boost timing is bigger, speed should be fast, and it also impacts the output depending on the motor RPM. Higher values would increase the power and RPM but also cause high heating. So, excessive setting could cause fatal problems to the ESC and motor.

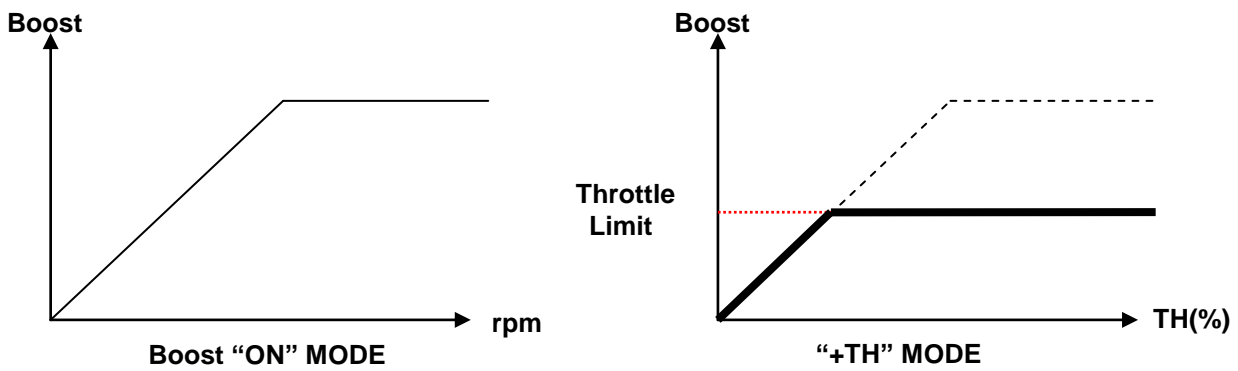
- **TB (TURBO):** should be activated when the throttle is located at 100%. (Boost setting + TB setting) are applied into timing. Although the combined value of the two can be set up to 116, its upper limit is 88. If the motor timing is set to more than 60 from the center, it can cause heating in the motor and ESC. It is recommended to set to 60 or lower. This item is an ideal for long straight course. In Hybrid Mode, the maximum value of both settings is limited to 25.

- **ATH(Auto Throttle)**

If the Auto Throttle function is set, the Boost does not get affected by RPM, but operates only according to the throttle ratio. For example, if the set value for the Boost is 30 and the throttle position is 40%, the operating boost outputs "12" which is 40% of 30.

- **Boost-TH. Limit**

At Boost Mode, +TH mode allows the setting of timing limit with 10 steps of the throttle location. Please refer to the graphs below.



- **Boost Min-rpm**

Set the minimum RPM that will activate the Boost timing. For example, with a minimum set to 1000 RPM, the boost timing will be activated as soon as the RPM reaches 1000. This option can be set between 0~64500 but cannot be higher than the Boost Max RPM.

- **Boost Max-rpm**

Set the maximum RPM limit for the boost timing. For example, with a boost value set to 20-degrees and maximum RPM set at 20000, the boost will cap out and hold at 20-degrees once the ESC crests 20000. This option can be set between 0~65000 but cannot be lower than the Boost Min RPM.

- **Turbo Delay**

Delay the turbo activation. Turbo is immediately activated when the delay value is set as "0.00" and the throttle is moved to "full". When a value is entered, the turbo is only activated after the throttle is moved to full and the set delay time has elapsed.

- **Turbo + Slope**

Set the amount of time it takes to reach turbo speeds after activation. The lower the value, the more the acceleration and heating is increased.



■ **Turbo – Slope**

Set the amount of time it takes to recover from turbo speeds when the throttle is back to the original location. The lower the value, the more the brake effect and vehicle movement is decreased.

■ **Acceleration**

Set the amount of time it takes to reach maximum output from idle.

■ **Start Power**

Set the minimum amount of power to be used to start the motor or when the motor is rotated

■ **Smooth Start Rate**

The modified motor has a large output when starting, which hinders a car from moving gently due to the strong power of its start. This function allows a gentle start with the effect of applying the boost value in “-” direction according to the set value.

■ **Smooth Start Range**

This is to set throttle stick range for smooth start. For example, if it is set to 50%, the smooth start function works up to 50% of the throttle stick. If one of the Smooth Start Rate and the Smooth Start Range is set to “0”, this function does not work.

■ **Reverse Function**

**One Way:** forward / brake

**Two Way:** Forward / brake / reverse. Reverse is activated after reverse delay. Brake is activated during the delay period.

**Two Way2:** Forward / brake / reverse. Reverse is activated after 1second of motor pause, regardless of the reverse delay. Direction can be changed after max 6~7 seconds.

**Two Way3:** Forward / brake / reverse. When the motor is rotated forward, if the throttle stick is moved to the reverse, the brake is activated. Even if the stick stays there, reverse function is not activated. To activate reverse, move the throttle stick to the neutral position and back to the reverse direction again.

■ **Reverse Delay**

Set the delay time between when the function is triggered and the reverse is activated.

■ **M- Reverse Amount**

Set the max reverse speed during driving between 20~100%.

■ **Neutral Width**

Set the neutral width. The neutral width is the area around transmitter’s neutral position.

■ **Motor Direction**

Set the forward / reverse rotation of the motor.

■ **Brake Response**

Adjust the break strength. The higher the percent, the stronger the brake.

■ **FAN Control**

In the Auto mode, it works depending on the ESC temperature and throttle position. In the On mode, it works all the time.

■ **Drag Brake**

Set the auto brake function to deliver a small brake effect at neutral position.

■ **Min Brake Amount**

Set the minimum percent of the brake range.

■ **Mid Brake Amount**

Set the middle percentage of the brake range.

■ **Mid Brake Location**

Set the position of the middle brake range.

This function is deactivated when mid brake amount and mid brake location are set at 0%.

■ **Max Brake Amount**

Set maximum percent of the brake range. Always leave the brake at the "FULL BRAKE" position.

■ **Soft Brake**

This is to set the brake power like "Hard" or "Soft". It is recommended to use "Hard" brake when using Stock Motor.

■ **Brake Freq**

This is to set the brake frequency. When the frequency is lower, control becomes also bigger, and if the frequency is higher, soft control is achieved.

■ **Motor Freq**

Set the motor frequency. The lower the frequency, the faster the initial acceleration; the higher the frequency, the softer the acceleration and more heat is generated by the ESC.

Note: Hybrid Mode only supports 8khz and 16khz.

■ **Drag Freq**

Set the drag frequency. The lower the frequency the better the effect of the brake control; the higher the frequency the softer the brake control becomes.

■ **Cut Off Temp**

Set the ESC cutoff temperature. The ESC will cutoff when reaching the set temperature. Disabling this function is not recommended, as the ESC will not be temperature-protected and may become irreparably damaged.

■ **Cut Off M-Temp**

Set the motor cutoff temperature. The motor will cutoff when reaching the set temperature. Disabling this function is not recommended, as the motor will not be temperature-protected and may become irreparably damaged.

■ **B.E.C Voltage**

Set the voltage supplied to the receiver. Refer to the servo specifications for accurate voltage values, as the ESC may become irreparably damaged.

7.4V does not work when using a 1S battery.

■ **Motor Pole Num**

Set the motor poles. Incorrect pole setting could result in inaccurate maximum speed readings.

■ **Gear Ratio**

Set the vehicle gear rate. Incorrect gear ration setting could result in inaccurate maximum speed readings.

■ **Tire Diameter**

Set the tire diameter. Incorrect tire diameter setting could result in inaccurate maximum speed readings.

■ **Motor-Wiring**

Set the motor cable connection: A-B-C or C-B-A. Make sure the wire configuration and Motor-Wiring setting match, as the ESC could become irreparably damaged.

■ **Units**

You can change the unit to display temperature and speed.

■ **Download**

Download and store to the ESC any setting values changed on the setup card.

■ **Factory Setting**

Restore the ESC setting parameters to the original factory defaults.

■ **Current Voltage**

View the battery voltage when the program is connected.

■ **Current Temp**

View the ESC's temperature when the program is connected.

■ **Max Temperature**

View the ESC's highest temperature achieved during drive time when the program is connected.

■ **Motor Temp**

View the motor's temperature when the program is connected.

■ **Motor Max Temp**

View the motor's highest temperature achieved during drive time when the program is connected.

■ **Max Current**

View the highest current that achieved during drive time when the program is connected.

- **Maximum Speed**

Set a maximum speed limit. This speed will not be exceeded during drive time.

- **Maximum RPM**

Set the maximum motor RPM limit. This level will not be exceeded during drive time.

- **Error History**

**M** = Motor connection problem / motor malfunction / motor damage

**T1** = Temperature issue in ESC

**T2** = Temperature issue in motor

**S** = Sensor problem

**V** = Voltage too low

**R** = Receiver signal problem

## 10. LED Error Status

When the ESC is turned on the LED lights will flash to indicate the following statuses:

- **GREEN and RED LED blink simultaneously:** ESC is not connected to motor or ESC lines are short-circuited. If problem persists, the ESC's FET is damaged. Send the product to the R1WURKS Service Center for repair.
- **RED LED blinks one time repeatedly:** no receiver signal. Check the transmitter/receiver connection.
- **RED LED blinks two times repeatedly:** low voltage, cutoff activated.
- **RED LED blinks three times repeatedly:** motor sensor problem. Check the sensor cable connection and motor status.
- **RED LED blinks four times repeatedly:** ESC temperature protection activated.
- **RED LED blinks five times repeatedly:** PWM output is occurring but the motor is idle for more than 2 seconds. Check the motor status or check the car.
- **RED LED blinks six times repeatedly:** motor temperature protection activated.
- **RED LED blinks seven times repeatedly:** BEC output problem. Check the servo.

	GREEN LED	RED LED
<b>ESC/Motor not connected</b>	Blinking	Blinking
<b>No receiver signal</b>	OFF	Flashes 1x repeatedly
<b>Low voltage</b>	OFF	Flashes 2x repeatedly
<b>Motor problem</b>	OFF	Flashes 3x repeatedly
<b>ESC temperature protection</b>	OFF	Flashes 4x repeatedly
<b>PWM output + motor idle 2sec</b>	OFF	Flashes 5x repeatedly
<b>Motor temperature protection</b>	OFF	Flashes 6x repeatedly
<b>BEC output problem</b>	OFF	Flashes 7x repeatedly

## 11. Data Check

You can check the maximum temperature/current/speed/rpm of ESC and MOTOR through a program box or WiFi module. When using the program box, the ESC should not be powered off after racing and the program box should be connected to the connection port to check the data. Data are deleted if the ESC is powered off.

## 12. Specification

<b>DIGITAL-3</b>	
Motor Type	Sensored / 4Pole Sensored
Motor Limit "Specification when using the fan"	>3.5T
Operating voltage	3.7-7.4V
Forward / Brake / Reverse	yes
Full aluminum case / heatsink	yes
Typ. Voltage Drop @20A per phase	0.0048V
Rated Current per phase	2549A
Plugged 30x30x10mm Fan	yes
BEC Output	6V/7.4V Bult-in DC Booster, Continuous Current of 3A
Multi-Protection-System	yes
"Boost 0" Mode	yes
Multi-frequency system	yes
Power Wires	12Awg
USB Software Updateability	yes
Case Size(with out fan)	32.9 x 34.6 x 21mm
Weight(with out cable)	50g