KDE Direct

UAS ESC (UVC) SERIES
INSTRUCTION MANUAL

For the latest instruction manual revisions, software updates, liability policy, and warranty information, visit the KDE Direct website at: http://www.KDEDirect.com.

All technical inquiries, contact support@kdedirect.com.

IMPORTANT: To reduce the risk of fire, bodily injury, and damage to the equipment, read through Instruction Manual before operating ESC and always follow all instructions.

- ⚠ KEEP OUT OF THE REACH OF CHILDREN.
- ⚠ Pay attention to the maximum voltage allowed:

KDE-UAS Series	7.4V (2S LiPo) – 34.8V (8S LiHV)	35V Max.
KDE-UASUVC Series	18.5V (5S LiPo) - 60.9V (14S LiHV)	63V Max.

  If model is not listed, maximum voltage is stated in specifications.
- ⚠ The KDE-UAS and KDE-UASUVC Series are opto-isolated and do not provide BEC power output for the peripheral equipment.
- ⚠ Never operate the ESC beyond the specifications stated on hardware. Serious injury or property damage can result from misuse.
- ⚠ Ensure the polarity is correct with the power supply to the ESC power source leads. Reverse polarity may cause fire and serious injury and will immediately damage the ESC beyond warranty coverage.
- ⚠ Ensure the ESC is installed in a safe location and protected to prevent any exposed connections and solder-locations to touch conductive areas.
- ⚠ Always use electronics-grade solder and make sure to use proper soldering techniques and equipment. Poor soldering technique is a common cause of in-flight failure and ESC damage. Ensure all connectors are protected with insulation and heat-shrink to prevent unwanted conduction and shorts.
- ⚠ Check all connectors for secure connection before flight. Disconnection due to vibration and flight-conditions can result in a dangerous loss of control and potential damage and serious injury.
- ⚠ Do not disassemble or open the ESC. Opening of the case or removal of shrink-wrap may cause damage to the internal components, void all warranty claims, and yield unsafe operation.
- ⚠ Install the ESC in a location with adequate airflow to maintain cool temperatures and increase continuous amperage capability.
- ⚠ An electric motor that is connected to the ESC can start unexpectedly and can cause serious injuries. Always remove the propeller and disengage all gearing when working on the system with power applied.

- ⚠ Do not allow full submersion of the ESC in water. Water can damage the ESC and cause malfunction and failure of the electrical components
- ⚠ KDE Direct is not responsible for the use of this Product(s) or for any damages or injuries caused or sustained by its usage. Always observe all laws and instructions regarding the use of this Product(s), and operation of devices using this Product(s).
- ⚠ This is a high-power, electromechanical device with the potential to be very dangerous – always handle with caution and be aware of proper operation.
- ⚠ This product may contain chemicals known to the State of California to cause cancer and/or birth defects or other reproductive harm. Do not ingest or attempt to ingest this product.

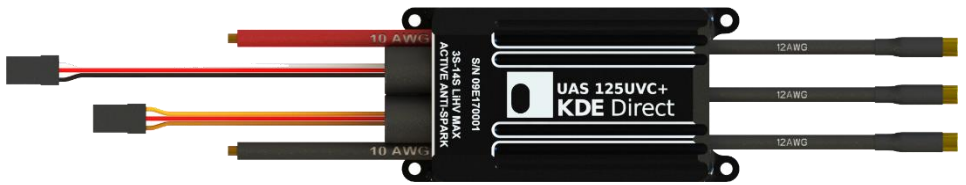
The KDE Direct UAS ESC (Electronic Speed Controller) Series is optimized for multi-rotor and single-rotor applications, and utilizes a proprietary algorithm for up to 2000Hz adaptive-refresh communication and near-instantaneous response for optimal flight performance (both digital and analog control protocols).

The ESC Series is specifically designed and optimized for the KDE Direct UAS Brushless Motor Series; taking advantage of new technologies and specific algorithms for maximum efficiency and thrust generation.

Firmware updates and advanced programming capabilities are available via the onboard mini-USB port, and accessed through the included PC-USB cable and KDE Device Manager Software (provided online).

ESC INSTALLATION AND WIRING

(+) TO POWER SOURCE
(RED POWER LEAD)



TO FLIGHT CONTROLLER
(W-R-BLK CONTROL LEAD)

(-) TO POWER SOURCE
(BLACK POWER LEAD)

TO BRUSHLESS MOTOR
(BLACK MOTOR LEADS)

TO FLIGHT CONTROLLER (OPTIONAL)
(O-R-BRN E-RPM SIGNAL LEAD)

Pay close attention to proper wiring as shown in the diagram above. Ensure the polarity is correct and proper soldering techniques are used when connecting the power source and brushless motor to prevent damaging the ESC.

REVISION PR02

ESC PROGRAMMING AND OPERATION

The UAS ESC Series is optimized for the KDE Direct UAS Brushless Motor Series and will not require additional programming for most flight applications. **Throttle calibration is not required** – the ESCs are factory-calibrated and the proprietary control algorithm will dynamically adjust to the receiver (RX) and/or flight controller for simple plug-and-play operation. If manual throttle calibration is desired, this option can be selected via the KDE Device Manager Software in addition to alternate Advanced Settings available.

1. Ensure the ESC control lead is connected to the throttle channel on your receiver (RX) or flight controller, confirming correct orientation of plugs.
2. Turn on the transmitter (TX) and set the throttle-stick position to zero or low (0% throttle signal) to arm the ESC circuitry.
3. Connect the battery or power system to the ESC power source leads. The ESC will remain disarmed until a 0% throttle signal is received. An arming-tone will be heard and the number of LiPo battery cells will be heard as individual tones, followed by additional and final arming tones.
4. If arming tones are not heard, adjust the transmitter throttle end-points (ATV/AFR) values until the arming sequence is heard. Check the operation of the ESC with the receiver (RX) throttle channel for correct direction and reverse if necessary (reverse direction for Futaba systems).
   - ⚠ If the arming throttle signal (0%) is not applied when the power source is first connected to the ESC, short tones will continuously sound after approximately five (5) seconds. This is a warning tone and move the throttle to 0% throttle signal or disconnect power.
5. Check for proper rotation direction of each ESC/motor combination. To change rotation direction, swap ANY two brushless motor lead connections.

COMPATIBILTY AND OPTIMIZATIONS

New technologies incorporated into the latest production designs include:

- **Regenerative Braking** – active braking during motor deceleration phase, providing instantaneous response to the flight controller commands and matched-response to acceleration profiles (less "float" during flight).
- **Temperature-Controlled Synchronous Rectification** – new proprietary algorithm for smooth-running motors at low-throttle and improved, faster response under high-peak loads; all while significantly increasing flight-time efficiency and reducing operating temperatures.

A wide-range of KDE Direct UAS Brushless Motors are available to suit your UAS and multi-rotor applications; ranging from smaller 180-class (2S+) tuned motors, up to industrial 1800-class (14S+) and larger motors.

DEVICE MANAGER SOFTWARE INSTALLATION

1. Download and install the KDE Device Manager Software from the KDE Direct Device Manager Software webpage at:
   www.kdedirect.com/products/kde-dms
2. Complete installation of the software (and all prerequisites), and run the KDEDevice application from the Windows start menu or desktop shortcut.
3. Connect the Mini-USB cable to an available PC-USB port.
4. Connect the Mini-USB cable to the ESC, pulling back the weather-proofing grommet and accessing the available Mini-USB port.
   - Detection of the ESC via the Device Manager software may take up to five (5) seconds to properly boot the internal microprocessor and download current settings.

MINI-USB PORT

ESC PROGRAMMING AND FIRMWARE UPDATE

1. Download the latest production firmware file (make sure to choose the appropriate version for your ESC model) from the KDE Direct website at:
   www.kdedirect.com/products/kde-dms
2. Update the ESC to the latest production firmware release by pressing the "UPDATE FIRMWARE" button in the Device Manager software and selecting the downloaded firmware file (.kde).
   - ⚠ Do not disrupt power or connection to the ESC or PC during the update process, or corruption of the firmware and permanent-failure of the ESC can occur ([6]*ESC can be restored in most cases via the "REPAIR MODE" feature*).
3. When update is completed, the default settings will be automatically applied to the ESC and confirmed (allow up to five (5) seconds for this to complete).
   - Optimized settings will be applied to the ESC, and no additional changes are required for correct operation with the KDE Direct UAS Multi-Rotor Brushless Motor Series for UAS and multi-rotor applications.
   - Default Settings can be reloaded by pressing the "DEFAULT SETTINGS" button, followed by pressing the "SEND SETTINGS" button in the Device Manager software (allow five (5) seconds to pass before unplugging).
4. Disconnect the Mini-USB cable from the ESC to complete the update.

ESC PROGRAMMING AND ADVANCED SETTINGS

NOTE: The Device Manager Software allows for modification of control algorithms and tuned ESC operation – in rare instances will the Advanced Settings need to be changed for proper UAS and multi-rotor flight application.

STARTUP POWER	
DYNAMIC	Dynamically adjusts to the startup-requirements of the motor, optimal for most setups and KDE Direct brushless motors.
HIGH (HARD)	Increases the startup-power for high-cogging torque motors or high-stall loading setups.

DRIVE FREQUENCY	
PRECISION (30 kHz – 32 kHz)	Fastest PWM drive frequency to the motor, providing the smoothest/quietest operation (increases ESC temperature).
DYNAMIC (16 kHz – 18 kHz)	Dynamically adjusts the PWM drive frequency to the motor, providing the best overall balance of performance.
BALANCED (8 kHz – 10 kHz)	Lowers the PWM drive frequency to the motor, reducing ESC temperatures (increases motor commutation noise).

SYNCHRONOUS RECTIFICATION (ACTIVE-FREEWHEELING)	
ENABLED	Enables synchronous rectification (also termed active-freewheeling) for improved efficiency and regenerative braking algorithms ideal for UAS and multi-rotor operation.
DISABLED	Disables synchronous rectification for improved light-loading operation (such as motor bench-testing) and minimal-brake activation ideal for specific single-rotor applications.

S.R. BRAKING ACTIVATION (REGENERATIVE-BRAKING)	
PRECISION	Enables synchronous rectification immediately, ideal for FPV racing and light multi-rotor applications. Provides immediate response at spool-up and flight take-off.
DYNAMIC	Enables synchronous rectification upon reaching optimal ESC temperatures, allowing for smooth operation during initial motor spool-up and flight take-off.
BALANCED	Enables synchronous rectification upon reaching higher ESC temperatures, allowing for smooth operation during initial motor spool-up and further into initial flight.

THROTTLE CALIBRATION MODE	
DYNAMIC	Factory-calibrated, automatic throttle calibration to the flight controller for simple, drop-in installation (ideal for most UAS and multi-rotor applications, such as the DJI™ A2/A3 series).
MANUAL	[1]Enables manual (fixed) throttle calibration. After selection, throttle calibration will proceed upon next power-up: - Turn on the transmitter and move throttle stick to maximum upper position (100% throttle). Apply power to ESC. - Motor will emit dual tones, memorizing upper position. - Quickly move throttle stick to low position (0% throttle). - Motor will emit tones, memorizing lower position and arming. - Calibration is now complete and ready for operation.
RANGE	[1]Allows direct input of the throttle calibration, via the MIN(LOW) and MAX(HIGH) range. When selected, values can be typed into the THROTTLE CALIBRATION RANGE textboxes: - Allowable value for MIN(LOW): 800 to 1250 [µs]. - Allowable value for MAX(HIGH): 1750 to 2200 [µs].

VOLTAGE CUTOFF	
ON	[2]Enables voltage-cutoff for specific applications, resulting in a 50% RPM limit reduction when reaching the target cell voltage (selectable with pull-down menu, i.e. 3.2V/CELL).
OFF	Disables voltage-cutoff, **highly-recommended** and default setting for UAS and multi-rotor flight applications to prevent power stall and potential loss of flight control.

ADVANCE TIMING	
DYNAMIC	Dynamically adjusts advance timing (15° to 22°) to the brushless motor, providing higher efficiency and balance of power.
PRECISION	Dynamically adjusts advance timing (22° to 30°) for maximum thrust output and acceleration response (at a slight loss of efficiency), best for high-pole count motors and heavy-lift.

MOTOR DIRECTION	
FORWARD	Default motor direction, determined by the motor windings and motor lead connection order.
REVERSE	Alternate motor direction (opposite of Forward setting), reversing the rotational direction for ease of installation.

ARMING TONES	
STANDARD	Initialization of the ESC will emit voltage count tones (number of LiPo battery cells), followed by final arming tones. - Safety warning tones will emit until arming signal is received.
ARM ONLY	Initialization of the ESC will emit final arming tones only. - Safety warning tones will emit until arming signal is received.
INITIALIZE	[3]Initialization of the ESC will emit final arming tones only. - Safety warning tones will not emit before arming signal.

PROPELLER HOLD	
ENABLED	[4]Enables an active-brake to the propeller when minimum throttle position (0%) is received, providing a rapid propeller-stop and hold to position (ideal for emergency parachute recovery).
DISABLED	Disables an active-brake to the propeller, allowing free-spool of the propeller when minimum throttle position (0%) is received.

MOTOR EDITION	
DEFAULT	Enables motor-drive control-algorithm optimizations for simple compatibility to the widest range of motors – ideal for the KDE5215XF and smaller series brushless motors.
KDE6213XF-185 ↓ ↑ KDE10218XF-105	Enables motor-drive control algorithm optimizations for specific KDE Direct motor editions, ideal for the industrial heavy-lift brushless motor series (KDE6213XF and larger).

ACCELERATION RATE	
MEDIUM	Optimizes the maximum acceleration/deceleration control profiles for smooth reaction-rates and safety in industrial-heavy lift applications (dynamic reduction up to 20%).
MEDIUM-HIGH	Optimizes the maximum acceleration/deceleration control profiles for balanced operation in commercial aerial-cinematography applications (dynamic reduction up to 15%).
HIGH	Optimizes the maximum acceleration/deceleration control profiles for increased stability in adverse weather conditions and long-endurance flights (dynamic reduction up to 10%).
ULTRA-HIGH	Maximizes the acceleration/deceleration control profiles for high-speed applications, where fast-reaction rates and tight-control to the flight-controller commands is required.

OVERLOAD PROTECTION	
ULTRA-HIGH	ESC will enable overload protection when witnessing a three (3) second continuous-current duration above 175% of the continuous amperage rating (i.e., 220A for the 125A ESC).
STANDARD	ESC will enable overload protection when witnessing a three (3) second continuous-current duration above 150% of the continuous amperage rating (i.e., 190A for the 125A ESC).
DISABLED	Overload protection is disabled. **Use with caution** - overload protection is designed to protect the internal electronics from high continuous-current situations and circuit damage.

[1]Default calibration for Manual and Range mode is 1100µs to 1940µs and changes will be stored to the EEPROM memory. When changing the Throttle Calibration Mode, EEPROM memory will automatically reset to this default range for safety before calibration.

[2]Voltage-cutoff should always be "OFF" for UAS and multi-rotor flight applications, or a potential loss of flight stability and control can occur during low-voltage events. Voltage-cutoff is advantageous for single-rotor and fixed-wing applications as desired.

[3]Arming tones are provided as three notifications: (1) power application to the ESC via the power-input leads and failsafe-operation state, (2) voltage supplied to the ESC via LiPo cell count, and (3) receipt of flight-controller and/or receiver arming signal for armed and ready-operation state. The arming tones selection of "INITIALIZE" will not provide the failsafe-operation state tones, so special care is needed to ensure safe operation before the appropriate arming signal is received to the ESC for ready-operation state.

[4]Propeller Hold rapidly decelerates and stops the propeller when the throttle reaches minimum value (0% position). Make sure this throttle value does not occur during flight in multi-rotor applications, or an immediate loss of flight control can occur. Propeller Hold is designed for emergency parachute recovery systems and/or operation in high-wind conditions (for quick deceleration of the propeller after landing) and activated via minimum throttle-hold position, to prevent propeller blade rotation and parachute cord strike. Also applicable for fixed-wing applications – allowing for propeller blade fold-back and aerodynamic-drag reduction.
KDE Direct is not responsible for damages or injuries when using this specialized function – make sure to understand the requirements for proper operation before enabling.

[5]Overload Protection will decrease the maximum current output to the continuous rating of the ESC (i.e., 125A for the 125A ESC) over a five (5) second interval when triggered. The ESC will not allow amperage higher than the rating until the next initialization or power-cycle (reboot).

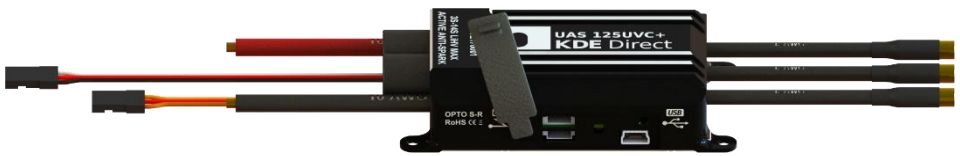
[6]Repair Mode provides the ability to force upload firmware to the ESC, in the case of data corruption from a power-outage or other unusual event. Upon connecting the ESC to the Device Manager Software, turn on Repair Mode by selecting the available checkbox and await for the software to reconnect to the ESC. Once the DEVICE STATUS has turned green solid-fill, press the UPDATE FIRMWARE button to upload the correct firmware file. Upon completion, unselect the Repair Mode checkbox and the software will again reconnect and read the parameters for the Advanced Settings from the internal MCU.

⚠ *Repair Mode allows the install of any firmware file edition – make sure the appropriate version is selected before installation, or incorrect operation of the ESC can occur and potential damage beyond warranty coverage.*

FUTUREPROOF TECHNOLOGIES

New futureproof technologies incorporated into the UAS series controllers and available via future firmware releases:

- **Controller Area Network (CAN)** – digital CAN multiplex serial-bus control, allowing for direct motor control and live-telemetry feedback to the flight-controller for superior safety and operation.
- **IP66 Rating** – ingress protection 66 rating for all weather and dust-proof operation, providing complete protection against contact with external debris and projected water (heavy-rain) and snow conditions.
- **Real-Time Monitoring** – internal hardware and specialized algorithms continually monitor voltage, current, temperature, throttle signal integrity, and a host of other critical parameters for safe and reliable operation.
    - **Overcurrent Protection** – ESC incorporates a real-time, fast-logic monitoring of incoming current to automatically control and prevent catastrophic, overload conditions.
    - **Overvoltage Protection** – during arming sequence, direct measurement of the incoming voltage prevents damage to the internal components and ICs from power above the rated voltage.
    - **Overtemperature Protection** – temperatures along the MOSFET channels and MCU are continually monitored, to prevent unsafe or damaging operation. Output power is actively controlled to maintain optimal operating temperatures and in-flight motor control stability.
    - **Stall Detection** – advanced algorithms detect a blocked or stalled motor incident during startup and in-flight operation, allowing for the immediate shutdown of electronics in the case of a propeller impact or alternate unsafe event.
    - **Anti-Spark Circuitry and Short-Circuit Protection** – ESC incorporates a dedicated and live-MCU controlled anti-spark circuit, preventing connector sparks during initial plug-in of batteries and protection against external short-circuits.
    - **Data-Logging** – high-memory storage, onboard EEPROM allows for continuous logging of critical parameters (voltage, amperage, temperature, throttle signal, throttle output, eRPM, etc.) and download review via standard PC-USB connection or CAN network.
    - **Dedicated E-RPM Output** – for simple compatibility with advanced flight-controller and flybarless-system e-governors.



DUAL CAN BUS PORTS

LIMITED WARRANTY

KDE Direct, LLC (KDE Direct) warrants to the original purchaser that the Product(s) will be free from defects in materials and workmanship for a period of one (1) year from the date of purchase. This warranty does not cover abuse, neglect, or damage to the Product(s) from preventable failure methods, such as incorrect wiring, reverse polarity, voltage exceeding the maximum specification, or amperages exceeding the maximum specification (overloading).

The full definition and terms of this limited warranty are available at: https://www.kdedirect.com/pages/warranty-and-returns-policy.

LIMITS OF LIABILITY

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Always observe all laws and instructions regarding the use of this product, and the operation of devices using this product.

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