

SC20-002

OPERATING MANUAL

spidercam systems
setup guide and operating instructions

Author: Bauer Ernst

Authorized by: GP

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 spidercam®

VERSION CONTROL

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0.91	06.09.2017	AN	Max. Pulley forces added
1.0	06.09.2017	SG	Release
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4.0	26.08.2020	GP	Added spidercam MINI
5.0	02.06.2021	GP	Added FPP / Heavy Winches

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SAFETY PRECAUTIONS

WARNING:

- DO NOT OPERATE THE SYSTEM IMMEDIATELY BEFORE, DURING OR IMMEDIATELY AFTER THUNDERSTORMS
- DO NOT EXPOSE THE SYSTEM TO EXTENSIVE RAIN OR MOISTURE
- DO NOT OPERATE THE SYSTEM AT TEMPERATURES BELOW -10°C OR ABOVE 40°C
- DO NOT PLACE LIQUID-HOLDING CONTAINERS ON ANY SYSTEM COMPONENT

CAUTION:

TO REDUCE THE RISK OF FIRE OR SHOCK HAZARD AND ANNOYING INTERFERENCE;
USE THE RECOMMENDED ACCESSORIES ONLY.

NOTE:

The serial number of the system can be found on the Control Station and all Winches.

IMPORTANT SAFETY INSTRUCTIONS

Read these safety instructions carefully before using the **spidercam**[®] cable camera system. Always follow all instructions and guidelines to ensure safe operation.

- Install the system in accordance with the manual and training guidelines and any safety regulations issued by the venue responsible
- Make external personnel aware of any dangers due to low hanging cables or Dolly movements
- Before Operating make sure the system is undamaged and in operational condition
- The system is to be used as intended only. You may only attach a payload, that has been explicitly specified, tested, and cleared by spidercam GmbH.
- Protect the system components from unauthorized access
- The system must be in original, unaltered state. Only adaptations or adjustments specifically authorized by spidercam GmbH may be used.
- All maintenance, service and repair duties must be carried out by spidercam GmbH personnel, under supervision of spidercam GmbH personnel or when specifically authorized by spidercam GmbH.
- Treat the equipment with care
- Safety first: Public safety is always more important than personal performance!

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1. WORKING PRINCIPLE

spidercam® systems are cable robots, enabling positioning and moving of a dolly (camera transport platform) to any defined point above a sizeable area (set). The dolly is held by four (single cable system) or eight (twin / double cable system) catenary cables. Those cables each run through a Pulley in the corner of the Flying area and are attached to a Motor Winch on the ground. By controlling the winches, the cable can be wound and unwound, effectively moving the dolly through the flying area – in all three dimensions.

The control station acts as the input device for all commands; by joysticks the Pilot operates the winch commands and thus the dolly, while the Camera Operator controls the Pan-Tilt-Unit and the camera functions.

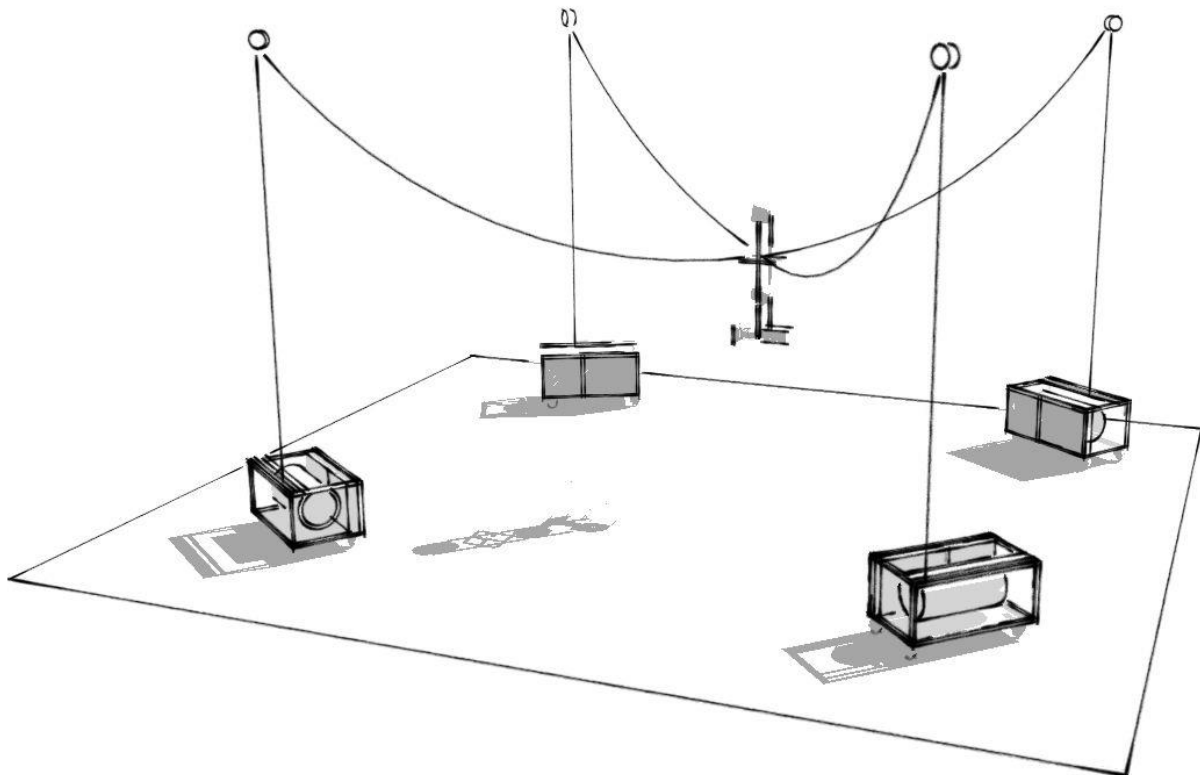


FIG. 1 WORKING PRINCIPLE

2. HARDWARE

The spidercam® systems are composed of the following main components:

- 4 (motor) Winches
- Electronical cabinets (can be part of the Winch or separate)
- Dolly
- Control station
- Control consoles
- Pulleys
- Catenary cables

2.1. WINCHES

2.1.1. INTRODUCTION

The four winches are holding the catenary cables used to carry the dolly. The winches are connected to the electronical cabinets, and in turn to each other and the control station via fiber cables. Logically, a winch is a slave of the control station, but it has its own motion control, error handling and safety monitoring. All information is updated in real-time between winches and the control station. The catenary cables on the drums guarantee a flexible operating area and at least two of them come with fiber optics woven inside. This allows hard-wired transmission of all data signals over fiber cables without any interference.

High performance motion control and precise mechanics enable smooth movements of the winches and provide stable pictures from the dolly.

Please refer to the technical manual for individual Winch details, features and limits.

2.1.2. SAFETY FEATURES

- Redundant brakes
- Cable feed monitoring
- Overload monitoring
- Individual safety protocols
- Network safety protocols
- Emergency-Stop buttons

2.1.3. TECHNICAL SPECIFICATIONS SCL

dimensions (LxWxH)	80cm x 60cm x 80cm
weight	ca. 165kg
cable capacity	120m
power supply	VAC 400V/16A



FIG. 2 SCL WINCHES

2.1.4. TECHNICAL SPECIFICATIONS SSCL

Dimensions combined (LxWxH)	95cm x 75cm x 75cm
Dimensions winch only (LxWxH)	95cm x 55cm x 75cm
Dimensions E-cabinet (LxWxH)	92cm x 20cm x 60cm
weight	ca. 127kg winch; 50kg E-cabinet
cable capacity	120m
power supply	VAC 400V/16A

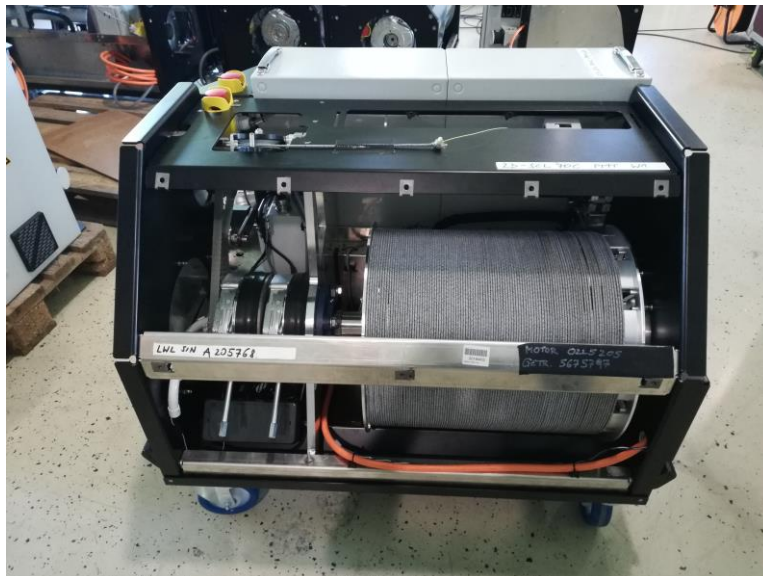


FIG. 3 SSCL WINCH INCLUSIVE E-CABINET

2.1.5. TECHNICAL SPECIFICATIONS Mk3

Dimensions winch only (LxWxH)	106cm x 56cm x 72cm
Dimensions E-cabinet (LxWxH)	72cm x 44cm x 90cm
weight	ca. 165kg winch; 99kg E-cabinet
cable capacity	195m
power supply	- VAC 480V/32A; 7H CEE plug - VAC 400V/32A; adapter 7H to 6H - VAC 208V/32A; camlock series 16 adapter

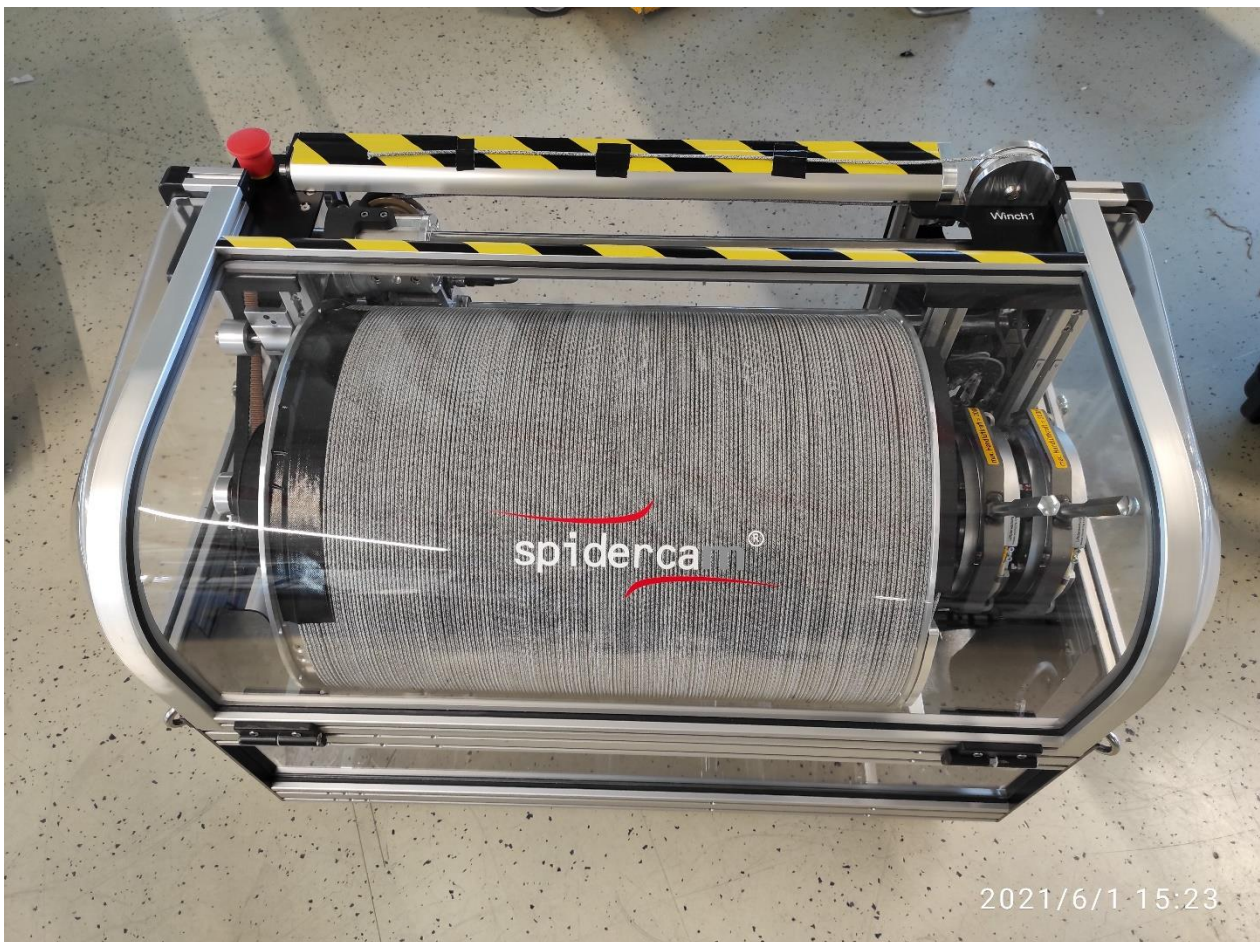


FIG. 4 MK3 WINCH

2.1.6. TECHNICAL SPECIFICATIONS MINI

Dimensions winch only (LxWxH)	60cm x 44cm x 68cm
Dimensions E-cabinet (LxWxH)	120cm x 45cm x 200cm
weight	Winch: ca. 100kg E-cabinet: 190kg
cable capacity	60m
power supply	- VAC 480V/32A; 7H CEE plug - VAC 400V/32A; adapter 7H to 6H

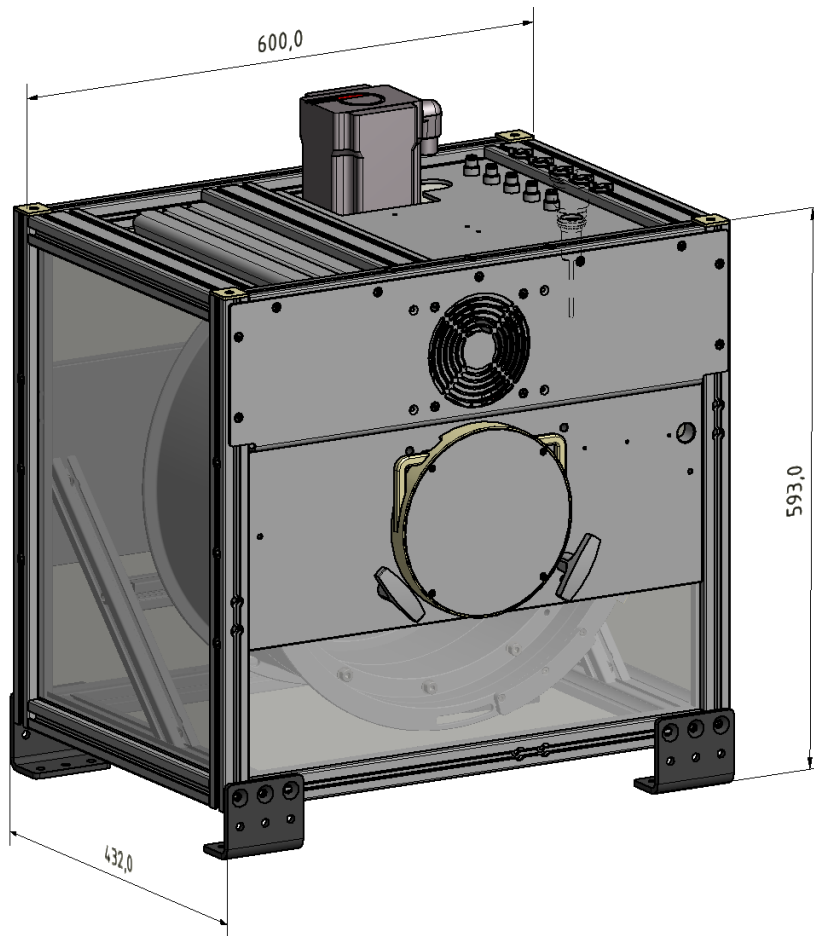


FIG. 5 SCM WINCH

2.1.7. TECHNICAL SPECIFICATIONS UTILITY

Dimensions winch only (LxWxH)	212cm x 103cm x 112cm
Dimensions E-cabinet (LxWxH)	62cm x 45cm x 190cm
weight	Winch: ca. 600kg E-cabinet: 165kg
cable capacity	400m (per drum)
power supply	- VAC 480V/32A - VAC 400V/32A

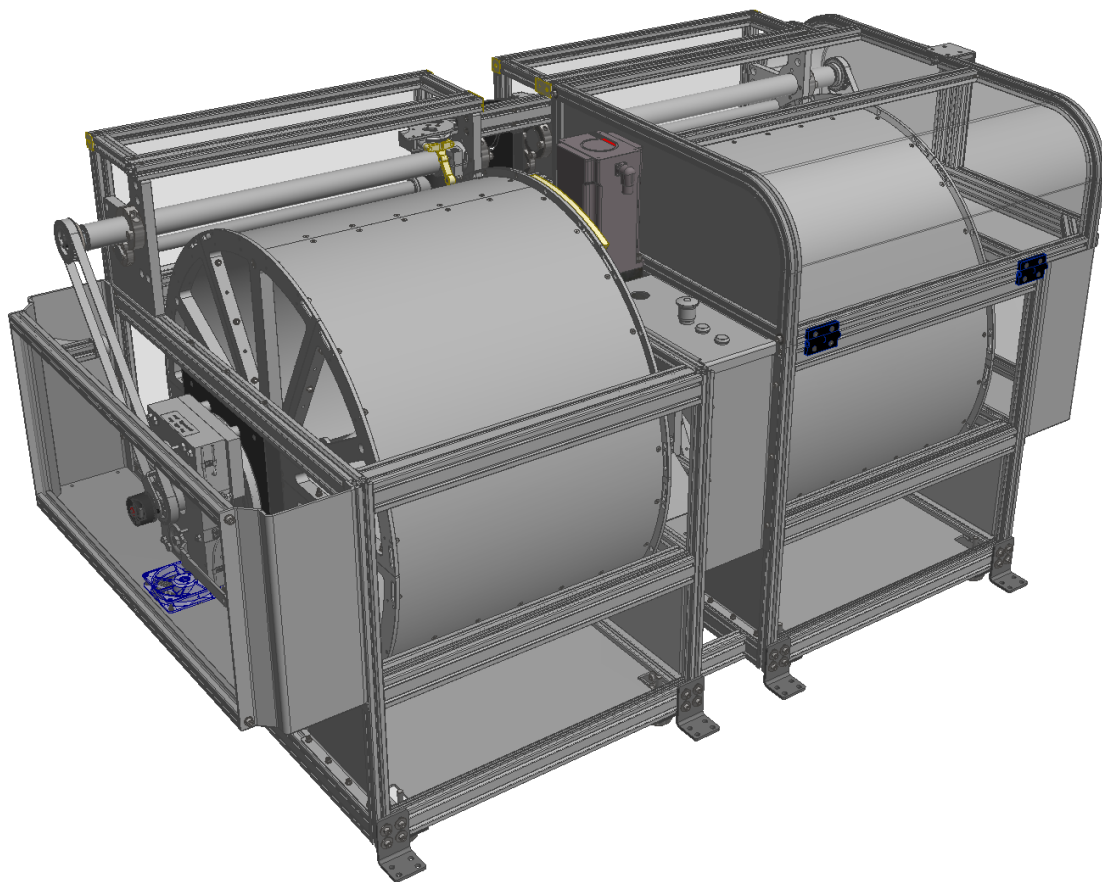


FIG. 6 FPP WINCH

2.2. DOLLY

2.2.1. INTRODUCTION

The dolly is basically a camera transportation unit. It carries the camera and is connected via winding cable termination to the catenary cables. It moves three-dimensionally. Every system can be equipped with different spidercam dollies. Therefore the settings must be changed as the different dollies allow different flight heights and speeds. The spidercam dollies are the Light Dolly (LD), Field Dolly (FD) and Utility Dolly (UD).

Please note: as there are different combinations only the lowest maximum value determines the system maximum. E.g.: A field dolly is cleared for a maximum speed of 9m/s, but a spidercam light is only cleared for 4,5m/s. Thus the maximum speed of this combination is 4,5m/s.

Details on all limits can be found in the respective technical manuals.

Dolly parameter overview		Value/Unit		
Parameter	Description	LD	FD+	UD
Maximum flight height	height loss of flight area diagonal	-5,71°	10°	TBD
Maximum speed	Limiting speed in horizontal and vertical direction	4,5m/s	9,0m/s	TBD
Maximum acceleration	Limiting acceleration in horizontal and vertical direction	4,5m/s ²	4,5m/s ²	TBD
Maximum dolly weight	Maximum allowable total weight including all payload	23,0kg	34,0kg	TBD



FIG. 7 PASSIVELY STABILIZED LIGHT DOLLY WITH NEWTON AND CAMERA/LENS



FIG. 8 ACTIVELY STABILIZED FIELD DOLLY+ WITH NEWTON AND CAMERA/LENS




FIG. 9 UTILITY DOLLY WITHOUT REMOTE HEAD

The dolly typically carries a 3-axes stabilized remote-head. Alternatively, the dolly can be supplied without the remote head in order to mount a different payload.

The dolly is linked to the control station via fiber cables, which are used to receive commands and transmit status information and the camera-feed. The camera is mounted on the remote head, allowing movements in the Pan-, Tilt- and Roll-axis. Zoom, focus and other camera functions are controlled by the remote-control unit (RCP) which is connected via serial connection (RS4xx, RS232) or Ethernet (RJ45).

The remote head comes with two Li-Ion-batteries, which are used at the LD configuration to power the whole dolly. This configuration allows operations on an average of 5 hours. The FD+ is equipped with its own set of Li-Ion batteries. In this configuration the remote head is powered from the dolly (the batteries of the remote-head are removed). Usually this allows operations up to 8 hours.

	<p>The FD+ and the remote camera head must be proper balanced. Inadequate balancing will cause bad performance and cad lead to the damage of equipment.</p>
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Balancing the remote head and dolly is a delicate but important procedure, as the quality of the picture and the battery runtime depend on it. Please take extra care when balancing equipment and contact spidercam GmbH for support if unsure how to balance it properly.

2.2.2. REMOTE HEADS



FIG. 10 NEWTON



FIG. 11 MOVI XL

Detailed information about the respective remote-heads and their configuration can be found in the supplier's manual.

2.3. CONTROL STATION

2.3.1. INTRODUCTION

The Control Station is the master unit of the spidercam® system. It controls the movement of the four spidercam® winches via Ethernet over fiber cables. Motion control, error handling and a safety report is updated in real-time between winches and control unit. Console inputs of the camera console (Dominion) and the pilot console are processed and continuously checked for plausibility. The control station is also the link between the spidercam® dolly and the OB-Van. It tunnels all video formats of the used camera to the OB-Van, supports RCP controls based on RS485, RS232, RS422 and Ethernet and provides a contact-based and 12V Tally input.

2.3.2. TECHNICAL SPECIFICATIONS

dimensions (LxWxH)	120cm x 80cm x 60cm
footprint requirements	200cm x 150cm x 200cm
weight (without operators)	120kg
power supply	230VAC, 16A, 50/60Hz, P+N+G

2.4. PILOT CONSOLE



FIG. 12 PILOT CONSOLE

The pilot console is the main control for the winches, and thus the dolly position or movement. Two joysticks allow the pilot to control the movements: The left joystick moves the dolly up and down (Z-Axis), the right joystick moves the dolly left and right (X-Axis) and back and forth (Y-Axis).

An emergency stop button in the top right corner puts the system into safe state.

The digital console has an inbuilt raspberry pi with a touch screen, currently used to run the motion control feature.

Next to the display if the raspberry pi an either side is a push able LED button. The left one is labelled "System status", and its colour feedback gives a quick information on the system. The one on the right side is labelled "Console Status", and changes colour according to the console status. The "System Status" button doubles as the "Fast Restart" button, and will restart safety circuit, activate motors, correct cable lengths and activate joystick mode (similar to the FastRestart in FlyIt).

On the left and right side of the pilot console there are four buttons, each with an LED feedback. These buttons are currently without functions.

2.4.1. CONSOLE STATUS

The console status lets the user know whether the console is ready.

The colour feedback table:

red - continuous	console is powered, but no communication with control station
green – continuous	console ready

2.4.2. SYSTEM STATUS

The System-status button can be pushed; its main function is to put the system into “ready” state. The function is context-dependent, and it can be “restart the safety circuit”, “confirm cable length adjustment” and “activate joystick mode”.

The colour feedback table:

red - flashing	„Safe State“ brakes engaged, motors deactivated
red - continuous	no communication with at least one component
green-yellow alternating	Cable length adjustment necessary
green - flashing	system ready (joystick mode not active)
green – continuous	system ready (joystick mode active)
green – red alternating	script mode – motion playback feature active
yellow - flashing	ADC parameters missing

2.5. CAMERA CONSOLE (DOMINION)



FIG. 13 DOMINION

Depending on the used remote head a corresponding camera console is used to control the remote head and camera functions. Most commonly used is the “Dominion”, the camera console for the Newton Nordic remote head.

Please refer to the Camera console manual for details.

2.6. DEFLECTION PULLEYS

2.6.1. INTRODUCTION

Spidercam pulleys are designed to deflect the incoming catenary cables to the dolly. Depending on the setup different versions are available.

2.6.2. 3D-PULLEY

Most of the time the 3D version is used. They can swing freely in three dimensions. A 3D pulley can be equipped with one (standard single cable operation) or two (twin / double cable operation) roller units.

The pulley is fitted on a backplate of 30x30cm, compatible with the industry standard truss size, and has slit openings to allow mounting with ratchet straps.

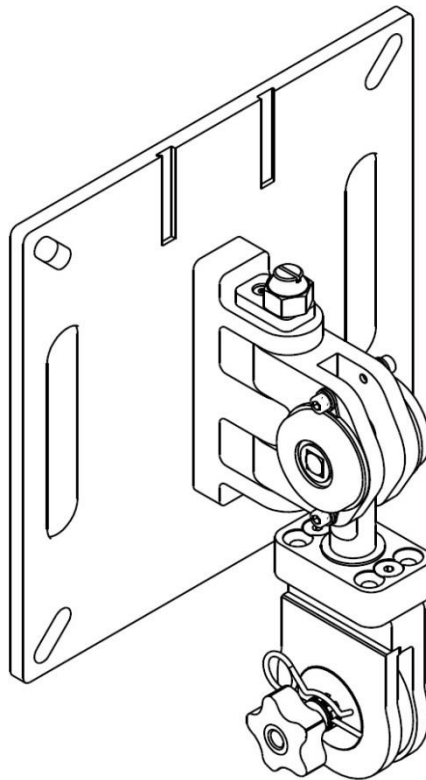


FIG. 14 3D-PULLEY

2.6.2.1. TECHNICAL SPECIFICATION

Mechanical specifications	
dimensions (LxW) - backplate	30cm x 30cm
weight	5,5kg

2.6.3. 1D-PULLEY

Another common Pulley is the 1D-Pulley, which rotates in the vertical axis only.

The pulley is fitted on a backplate of 20x30cm, compatible with the industry standard truss size, and has slit openings to allow mounting with ratchet straps.

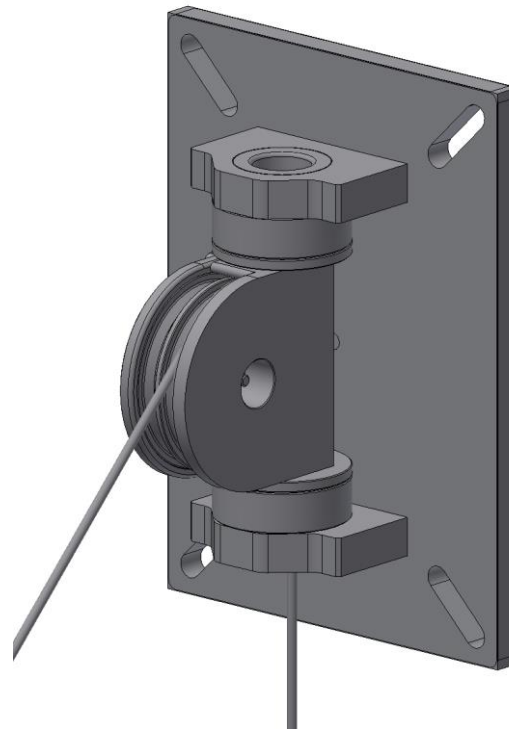


FIG. 15 1D-PULLEY

2.6.3.1. TECHNICAL SPECIFICATION

Mechanical specifications	
dimensions (LxW) - backplate	20cm x 30cm
weight	4,5kg

2.6.4. FIXED-PULLEY

Another common Pulley is the fixed Pulley, which is used if the cable needs to be deflected. It does not swing or pivot in any axis, and is aligned and fastened during the system setup.

The pulley is fitted on a versatile circular backplate of 30x30cm, compatible with the industry standard truss size, and has slit openings to allow mounting with ratchet straps.



FIG. 16 FIXED-PULLEY

2.6.4.1. TECHNICAL SPECIFICATION

Mechanical specifications	
dimensions Ø- backplate	20cm
weight	2kg

2.7. CATENARY CABLES


2.7.1. INTRODUCTION

The catenary cables enable the dolly movement. One end of the cable is wound and fastened on the winch. The cable then runs through the pulley to the dolly, where it is fastened on the winding termination. There are different cables with different features in use:

Polyamid cables: The cables are a combination of aramid and polyester, where the resilient aramid is responsible for holding the load, and the polyester mantle offers protection against UV radiation and abrasion. Optionally these cables can also hold a fiber core used for signal transmission, or a copper core to convey power.

Steel cables: These cables are composed of steel with a protective mantle. Steel cables are heavier than Polyamid cables, but also more resilient to cutting. The steel cable can be used to convey power to the dolly.

The cable must be checked for any damages or irregularities before operation and is replaced annually regardless of its condition.

	<p>Treat the cables carefully and inspect them closely for any damages. A damaged cable poses a high risk, and the system may not be used until all damaged parts have been removed and/or replaced!</p>
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2.7.2. TECHNICAL SPECIFICATION – POLYAMIDE CABLES

mechanical specification	
material	Polyamide and Polyester
diameter	3,6mm
breaking load	12,5kN
glass fiber specifications	
wavelength	Single mode, 1310nm/1550nm

2.7.3. TECHNICAL SPECIFICATION – STEEL CABLES

mechanical specification	
material	Steel and plastic
diameter	tbd
breaking load	tbd

3. SOFTWARE

3.1. FLYIT

Flyit is the main operating software for all spidercam systems. It processes all commands, controls all system functions and its GUI gives feedback to the User.



Although the software offers various tools and features to assist the pilot to fly safely, the pilot is always responsible for the safe operation of the system. Never blindly trust the software and safety features!

Please refer to the Flyit Manual for detailed information.

3.2. MOTION PLAYBACK

The Motion Playback feature allow recording and replaying of moves automatically. Starting with “Flyit 3” it is part of the Flyit-software, on older systems it is either housed on the system’s notebook, or already embedded within the digital console.

Please refer to the Flyit or Motion Playback Feature manual for detailed information.

4. OPERATING THE SPIDERCAM

4.1. SAFETY REQUIREMENTS AND GUIDELINES

Make sure the following conditions and requirements are met:

- The system is in its original, unmodified state
- All components have been serviced according to their maintenance requirements
- Only spidercam GmbH certified crew may operate the system
- Only spidercam GmbH certified pilot may move the dolly
- The crew must be in a proper state of health (physical and mental) and may not be intoxicated or under the influence of any substance that influence their abilities
- Operating temperature between -10°C and +40°C
- Maximum Humidity 90% (no condensation)
- Power the system at least 60 minutes prior to operating
- A safe position must be defined as “landing place” for the dolly in case of a necessary service stop or emergency shut down
- Prior to every start of the system the pilot must reassure himself of the safe and secure condition of the system
- In case the crew leaves the control station unattended the emergency-stop must be activated, and the main safety key switch must be disabled, and the key removed
- In case of service actions at the dolly, a pulley, winch or cable the emergency-stop must be activated
- When outside do not operate the system immediately before, during or immediately after a thunderstorm
- If unauthorized persons gain access to any part of the system (Control Station, Winches, Pulley, Dolly, Cable) the system must be shut down immediately. The spidercam crew must closely inspect the incident site and operation may only be started again if the crew reassured themselves that no damage was done, no safety protocols compromised, and further manipulation will not be possible.

4.2. SAFETY CHECKLIST

To guarantee the safe operation of the **Spidercam**® the crew is responsible to reassure that all safety protocols are in place, and all components have been checked for functionality. This is achieved by controlling the system condition, setup and parameters with the respective checklists. These checks must be done every time before the system may be operated, and all checks must be positive in order to proceed.



You may not operate the system before the checklist is completed, and all checks are positive!

You can complete the checklist at any time during setup, but it must be completed before you start flying (exception: Test flight).

You will find these checklists in the Production Log. The Log holds the Checklists and Paperwork for 26 Jobs, and a new Log can be obtained by contacting spidercam GmbH Austria (+43 4228 200 40 0) or spidercam GmbH Germany (+49 40 308 5166 60).

The completed checklists, including date, time and name of the crewmember that checked the system are considered part of the operating documentation. Failure to complete the checklists and file them may pose a safety risk.

4.3. SETUP

Once the system has arrived at the venue, check for any visible transport damage. Although the **spidercam**® is transported in and protected by flight cases, improper handling during the transport, loading or unloading may cause damage and compromise the system functionality. If any damage is present, check if it is superficial or has an impact on the actual equipment. Equipment damage must be reported immediately to spidercam GmbH, and the system may not be operated until all damage has been repaired.

4.3.1. WINCH POSITIONING

The winches are to be positioned at the designated areas, determined during the site survey. These areas are generally at the corners of the flight area below the pulley positions, but this may vary depending on the venue conditions or other circumstances. If unsure where these positions are, please call your spidercam GmbH contact.

The winches 1 – 4 are positioned counter-clockwise, with the control station being between winch 1 and winch 2.


The winch positions must be:

- Strong enough to support the winch weight without giving in (no soft soil, fragile substructures...)

- Flat / planar
- Protected from unauthorized access – if necessary, security barriers / blockades or security personnel must be deployed
- In accordance with local safety protocols, e.g. not blocking an emergency exit

The winches may support different cable outlets, details for each are in the technical manuals specific for the used winch system.

Once the optimal position has been achieved, engage the Winch wheel brakes or otherwise attach the winch to the ground and make sure the winch cannot move by itself. Use ratchet straps or suitable weights to prevent unintended displacement if needed. Connect the power cord, turn on the winch by using main power switch.

	<p>spidercam Light and Mini Winches must always be fixed with ratchet straps or held down by using additional weights, as the weight of the winches compared to the possible cable forces make them prone to move unintended!</p>
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4.3.2. CONTROL CABINET POSITIONING

If the system has separated control cabinets and winches (e.g. MkIII), choose the position of the control cabinets similar to those of the winches:

- Strong enough to support the control cabinet weight without giving in (no soft soil, fragile substructures...)
- Flat / planar
- Protected from unauthorized access – if necessary, security barriers / blockades or security personnel must be deployed
- In accordance with local safety protocols, e.g. not blocking an emergency exit

Make sure, the distance between the winch and control cabinet is not longer than the connecting cable.

4.3.3. DEFLECTION PULLEY POSITIONING

The deflection pulleys must be mounted at designated positions, determined during the site survey. The pulley positions mark the corners of the flying area and are usually chosen as far apart as possible to grant the maximum flying area. If unsure where these positions are, please call your spidercam GmbH contact. Ensure that there are no obstructions of all possible cableways (pulley to

winch and pulley to dolly). Also ensure that there are no lights, spots or moveable objects in the immediate area of the pulley.

The pulleys are mounted on a pulley mounting plate, allowing easy attachment to different rigging substructures. The pulley plate can be attached to a Euro truss (40cm x 40cm) with clamps on the long side, or with half cones to the front end of the truss. It is also possible to attach the pulley mounting plate with ratchet straps to any existing rigging substructure, e.g. catwalk.

The requirements for the pulley position are described **SC19-002 Interface and loads pulleys**.

Mount the pulley (and truss construction if applicable) to designated position. Attach the pulley safety (\varnothing 4mm); it attaches the pulley Mounting Plate to the substructure or truss construction. When using a truss construction, use the additional safety (\varnothing 10mm) to attach the trusses to the substructure.

A more complex or risky Pulley Positioning may require assistance from a professional Rigger.

When mounting the pulleys, it makes sense to either mount the Kevlar cable right away or mount a blind rope for the moment. To mount a cable or rope simply open the Pulley by removing the safety splint and turning the Pulley knob counter clockwise. Put the Cable or Rope on the inner pulley gently and close the Pulley again. Turn the Pulley knob clockwise and remember to attach the safety splint again. After closing the Pulley make sure that the cable or rope can move smoothly through the Pulley and does not grind or drag.

Please be aware that different systems allow different flexibility regarding Pulley positioning. Refer to the respective technical manual for detailed information.

Depending on the venue a cable can be redirected several times, using several pulleys. This will be determined during the site survey. Mount each Pulley following the guidelines above.

4.3.4. ADJUST WINCH OUTLET

Some system are equipped with different Winch outlets, commonly referred to as "Standard outlet" and "Single point outlet". The latter uses additional pulleys within the winch to enable a constant, single point outlet, while the standard outlet moves with the cable winding and unwinding. Details what outlets are supported or available for your winches are shown in the respective technical manuals.

The outlet types can be individually combined within a system setup (e.g. 3xSTD and 1xSP), but the proper outlet setting must be adjusted in the e-cabinet.

	<p>Adjust chosen outlet type in the e-cabinet and restart the system! Standard outlet should be preferred, as the single point causes much higher cable degradation!</p>
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Standard Outlet:

The winch position can be in any position within 180° in front of the pulley, but the winch has to be aligned with the pulley in the following manner: The cable outlet pulley of the winch has to face the pulley, with a tolerance of no more than +/- 4°. See the following illustration for a better understanding.

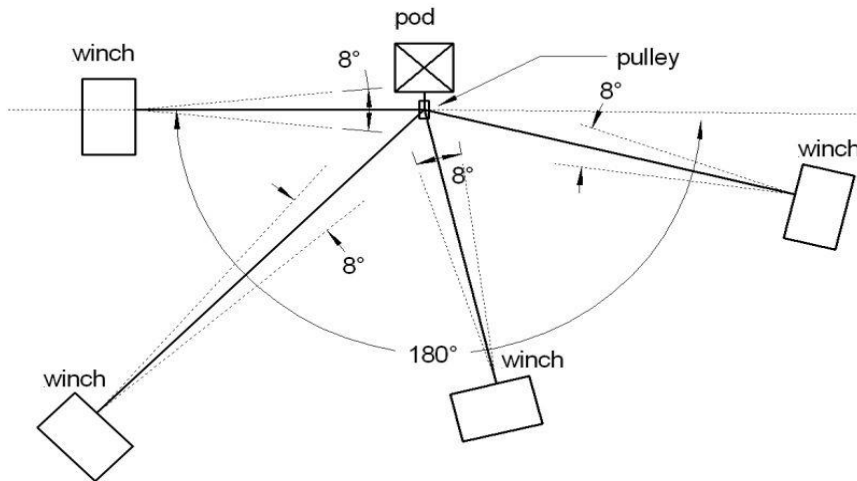


FIG. 17 WINCH POSITIONING (STANDARD OUTLET)

Single Point Outlet:

Using the single point outlets, the winches can be positioned more flexible. The second adjustable deflection unit in the winch (the single point outlet) must have a clear way to the next pulley roller unit. Adjust the deflection roller unit and fix the with the marked screws in the following pictures.

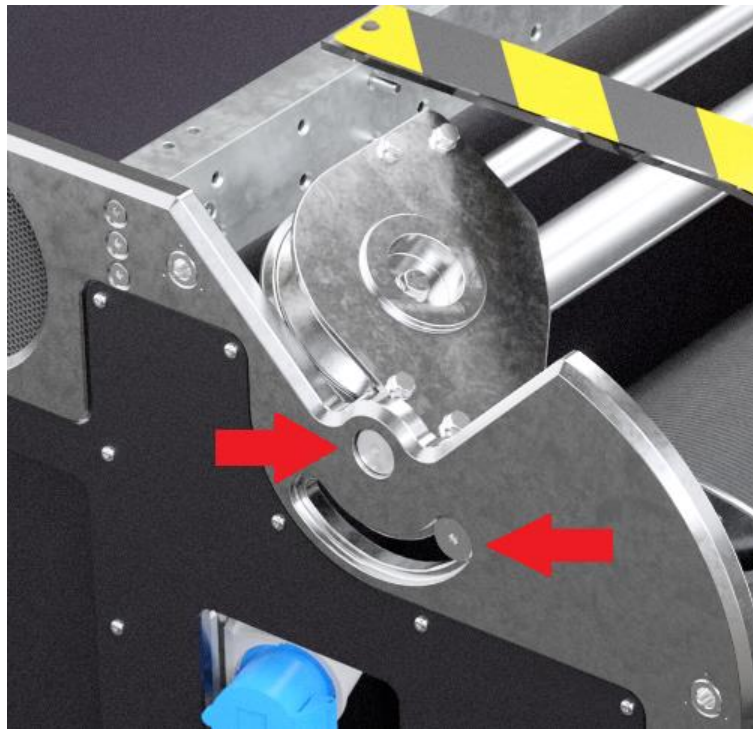


FIG. 18 SCL CABLE OUTLET PULLEY SCREWS

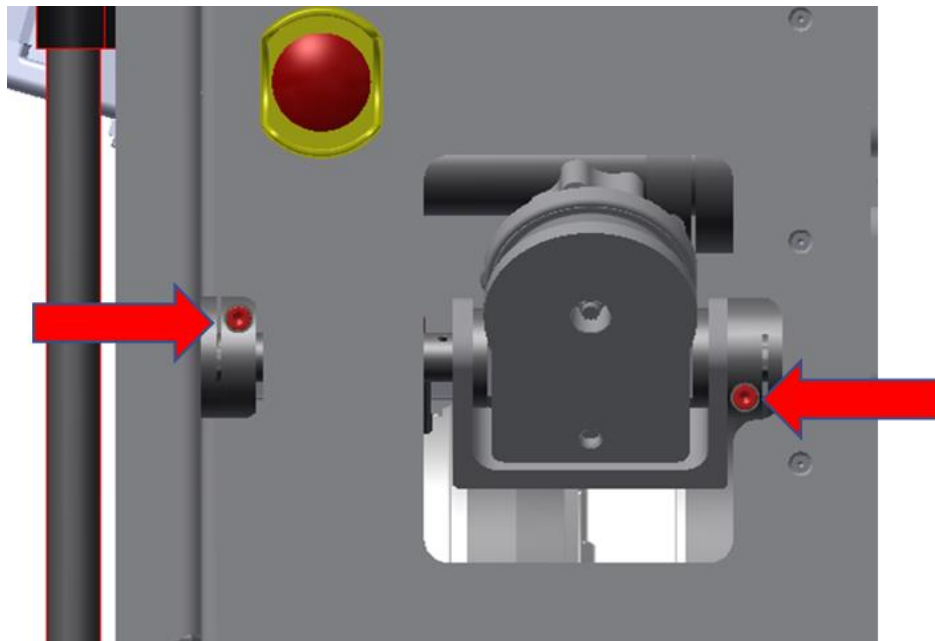


FIG. 19 SSCL CABLE OUTLET PULLEY SCREWS

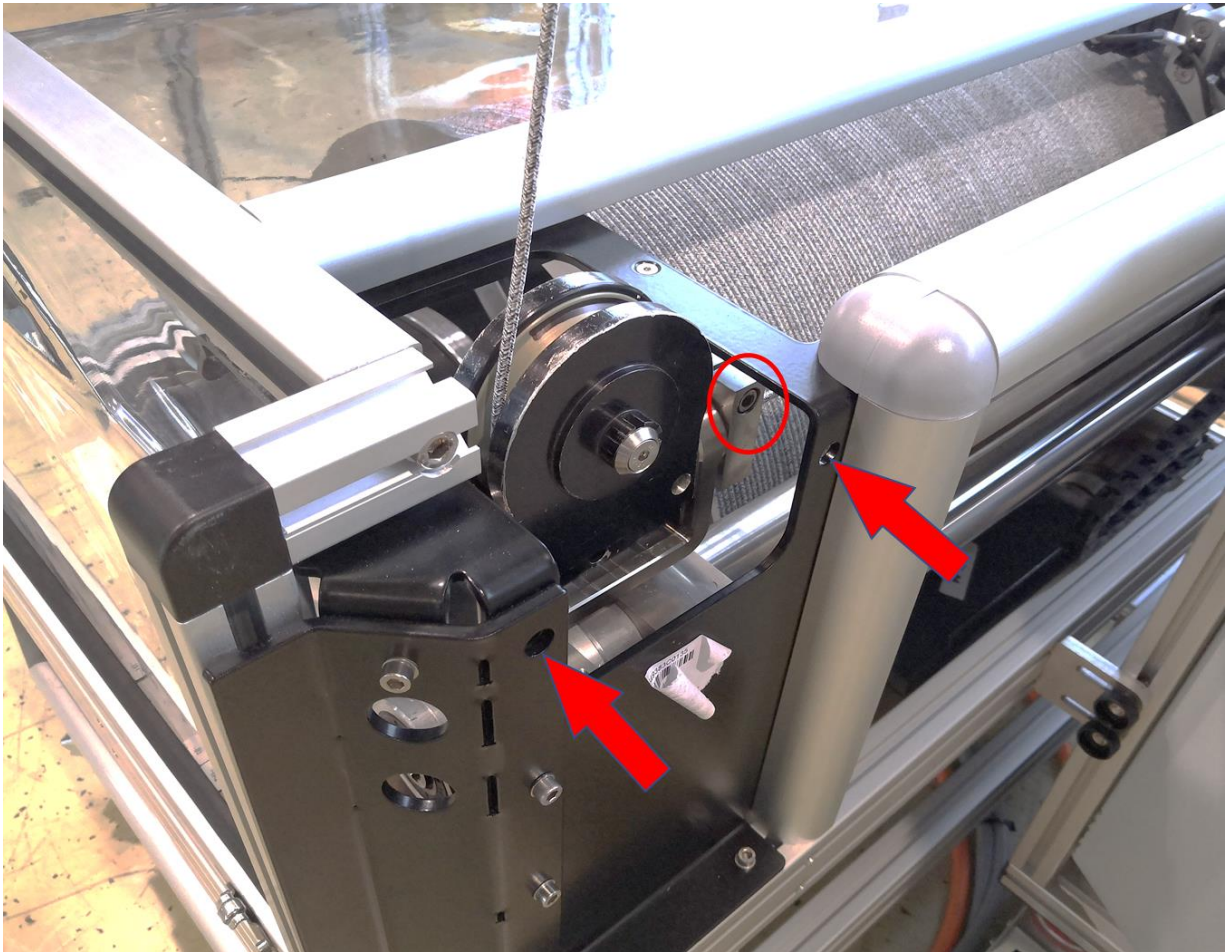


FIG. 20 MK3 CABLE OUTLET PULLEY SCREWS

MINI outlet

As spidercam Mini uses no spindle/pulley supported cable laying at all, the outlet needs to be aligned with the first deflection pulley in a precise way. Please refer to the technical specifications manual for details.

4.3.5. CONTROL STATION POSITIONING

The Control Station position is used for the system operation by the Crew during operation. The Control Station position houses the actual Control Station, the Dolly- and Camera- Control Consoles, the Periphery (Intercom and monitors for the operator), pilot monitors and usually (although not imperative) the drawer cases and additional equipment cases. Move all needed cases to the designated area, which has been determined during the site survey. If unsure where the position is, call your spidercam GmbH contact.

The Control Station position is always located between Winch 1 and Winch 2.

The Control Station position must meet the following requirements:

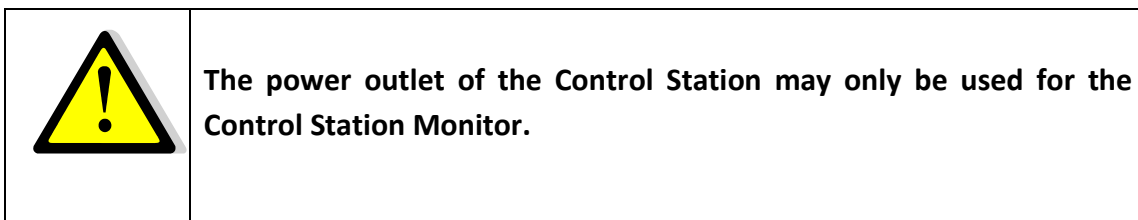
- Flat / Planar area of at least 2m x 3m
- Unobstructed view at any possible Dolly position for the pilot

Arrange all the Cases used for the Control Station according to the Pilot's and Camera Operator's preferences. Plug in all required cables, connect all required equipment.

Connect Power (C13) to:

- Control Station
- Pilot Monitors (2x)
- Periphery Case (Monitors and Intercom)
- SWIT Charger
- Radio case

Use one C13 Plug to connect the Control Station Outlet with the Control Station Monitor. As the control Station is equipped with an UPS (Uninterruptible Power Supply) the System remains active for several minutes even during a Power Loss at the Control Station.



Connect the Monitors with BNC cables:

Spidercam Picture

- Connect "HD / SDI" of the Control Station with the "In(put)" of the HD-Splitter in the Periphery Case.
- Connect "Out 3" of the HD Splitter with the bigger Pilot's Monitor
- Connect "Out 4" of the HD-Splitter with the BNC cable for the OB-Van / Director's Room

Program Picture

- Connect the program Picture from the OB-Van / Director's Room with the "HD-In" of one of the Camera Operator's Monitors (inside the Periphery Case)
- Connect the "HD-Out" of the same Camera Operator's Monitor with the smaller Pilot's Monitor

Connect the RCU (also called CCU) with the “RS 485” outlet (XLR)

RS 485 is the standard spidercam RCU communication protocol, if you must use RS 232 or RS 422 use the respective outlets and flip the switch accordingly.

Connect the Control Consoles:

- Connect the Camera Console with its respective outlet (Sub-D)
- Connect the Dolly Console with its respective outlet (Sub-D)

Connect the Control Station Input / Output Devices:

- Connect the Mouse with the respective USB outlet
- Connect the Keyboard with the respective USB outlet
- Connect the Monitor with the respective DVI (or VGA) outlet

Connect the Tally:

- Connect the Tally cable (XLR) from the OB-Van / Director’s Room with the Tally outlet
- Connect the Pilot’s Tally with “T1” (Stereo Jack)
- Connect the Camera Operator’s Tally with “T2” (Stereo Jack)

Flip the switch to “Straight” or “Crossed” to match the actual Signal configuration from the OB-Van / Director’s Room

Connect the Emergency Stop Button with the respective outlet

Arrange the Control Consoles and Monitors according to the Pilot’s and Camera Operator’s preferences, and put the Emergency Stop Button on an easily accessible place at the Control Station.

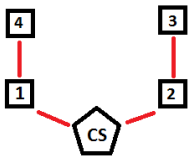
4.3.6. CONNECTING FIBER CABLES

The Fiber Cables, sometime referred to as “Huber & Suhner” cables, connect the Winches and Control Station. On each end they are equipped with a 4 Fiber OCD plug. Place the Fiber cable in a safe location; the safest path is usually not the shortest. Keep in mind that the Fiber Cables are fragile, and every mistreatment increases the damping of the cable and thus the achievable quality.

When putting the cables in place use proper precaution, especially in risky areas.

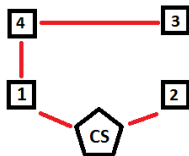
- Use cable bridges where people or vehicles will cross the cable run
- Use tape to protect the cables from accidental displacement
- Use pre-existing cable runs where possible
- If necessary, the cables can be suspended over gaps, rather going down and up again

The following connection model applies for the “U-Setup”, the most common setup:



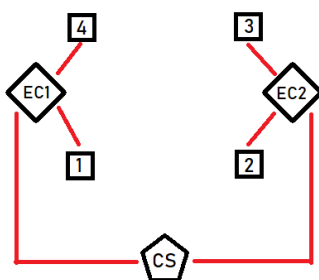
- Control Station “A” <> Winch 1 “IN”
- Winch 1 “OUT” <> Winch 4 “IN”
- Control Station “B” <> Winch 2 “IN”
- Winch 2 “OUT” <> Winch 3 “IN”

Other setups, as well as extensions (by using a Fiber Extension Box) are possible. Here the Connection configuration of a “C-Setup”:



- Control Station “A” <> Winch 1 “IN”
- Winch 1 “OUT” <> Winch 4 “IN”
- Winch 4 “OUT” <> Winch 3 “IN”
- Control Station “B” <> Winch 2 “IN”

Setups with separated electrical cabinets (e.g. spidercam Mini) may look like this:



- Control Station “A” <> Electrical Cabinet 1 “IN”
- EC1 “left” <> Winch 4 “IN”
- EC1 “right” <> Winch 1 “IN”
- Control Station “B” <> Electrical Cabinet 2 “IN”

- EC2 “left” <> Winch 2 “IN”
- EC2 “right” <> Winch 3 “IN”

4.3.7. MOUNTING THE DOLLY

The Dolly must be mounted preferably at the centre of the pitch, although it is also possible to use a predetermined Service position. Move the Dolly Case and Dolly Stand to this position. Before mounting the **Spidercam**® dolly make sure there is nobody but the trained crew in the pitch. The low hanging cables may pose a threat to untrained or unaware personnel.


To mount the Dolly, all the Winches must be unwound individually. This can be achieved by two different methods, depending on the current system condition. In every case it is imperative to treat the Cable carefully and keep constant tension on it while pulling.

4.3.8. MANUALLY PULL THE CABLES

As the winch systems have different system architectures and therefor different features the setups must fulfil certain points to allow this function:

- **SCL/SSCL:** All winch data lines must be connected to the control station. All involved equipment must be powered. Turn the Safety Brake Open key switch to MAN.
- **Mk3:** The winch must be powered, and the data line of the CX to the control station need to be disconnected. Turn the Safety Brake Open key switch to MAN.
- **Powerless winch – SCL/SSCL:** Open the brakes by hand. The feeder unit, as synchronised by a timing belt, will move automatically when the winch drum is rotated.
- **Powerless winch – Mk3:** Open the brakes by hand. The feeder unit, as synchronised by a motor, must be moved by hand when the winch drum is rotated. Use the handwheel which is connected to the linear unit gear box.

When the brakes are open gently pull the cable. If not done yet, move the cable through the Pulley before continuing to the Centre of the Pitch (or the Service Position).


	<p>Afterwards ensure that the safety brakes are closed correctly and the key switch is in AUTO mode!</p>
---	---

4.3.9. USE THE JOG MODE VIA THE CONTROL STATION

As the winch systems have different system architectures and therefor different features the setups must fulfil certain points to allow this function:

- **SCL/SSCL:** All winch data lines must be connected to the control station. All involved equipment must be powered. Turn the Jog Mode key switch to ON. The winch can be operated remote form the control station. At the control station, activate the respective Winch, adjust the speed of the unwinding operation, and click and hold “unwind” or “wind” to operate the winch.
- **Mk3:** The winch must be powered, and the data lines need to be disconnected. Turn the Jog Mode key switch to ON. Use the relevant push button direct at the winches to wind or unwind. The speed is set to a predefined value of 1000mm/s.

A second crewmember must hold and pull the cable. If not done yet, move the cable through the Pulley before continuing to the centre of the Pitch (or the Service Position).

	<p>Crew members must be in constant contact. Use radios to coordinate your efforts.</p> <p>Afterwards ensure that the jog mode key switch is turned to off.</p>
---	---

4.3.10. WINDING TERMINATIONS


Once the cables are at the canter of the Pitch attach the Winding Termination to the Cables. The Cables from Winch 1 and Winch 2 have a Fiber woven into the Kevlar cable; this Fiber needs to be “exposed” from the Lifting cable. Follow this exposing procedure:

- Use a lighter and carefully melt the mantle, approximately 50cm from the cable end
- Remove the mantle
- Gently push the woven Kevlar Cables back, so the meshwork intervals get bigger
- Carefully pull the green or yellow Fiber Cable through the meshwork
- Make a knot into the meshwork 10cm from the Fiber-Extraction
- Cut off the Kevlar meshwork behind the knot



FIG. 21 WINDING TERMINATION WITH FIBER

If done correctly, the Winding Termination from Winch 1 and Winch 2 should look like this.

	<p>Use utmost care when handling the green or yellow Fiber cable. It is extremely fragile.</p>
---	---

The Cables from Winch 3 and Winch 4 usually do not have a Fiber cable inside; simply make a knot in the Cable after the clamping.



FIG. 22 WINDING TERMINATION WITHOUT FIBER

Make sure there are four Windings on the Termination, and the clamping screws are fastened properly. Take the Dolly out of its Transport case and place it in the Dolly Stand. Attach the first Winding Terminations on the Dolly. Make sure to properly fasten the Bolt and Nut. Repeat with all four Winding Terminations.



Thoroughly check the Winding Terminations: Make sure all screws and nuts are tightened properly, and the clamping holds the Cable in place firmly.

If necessary, crimp new SC Plugs onto the Fiber Cables. Check the Appendix “Fiber Crimping” (if applicable) for detailed information how to crimp properly.

Attach the SC-Plug from the cable coming from Winch 1 to “Data” plug on the dolly. Attach the SC Plug from the cable coming from Winch 2 to “HD/SDI” or “Video”. Mount one set of fully loaded batteries and put the other sets on the battery charger.

4.4. STARTING UP

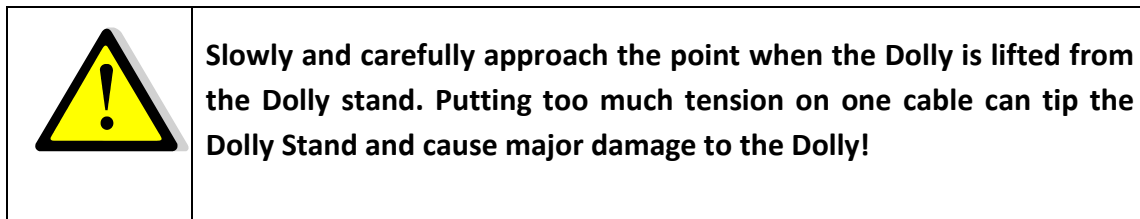
With all components in place and connected, you can proceed to power up the system.

- Power up the four Winches by turning their red power switch clockwise (if not done before). Systems with a separate electric cabinet have the Main power switch on the respective cabinet.
- Power up the Control Station by pressing the power button on the front of the Control Station

Please check the relevant FlyIt Manual for detailed Information on the software and the start-up procedure. The following steps will assume a proficient FlyIt user and will not go through the FlyIt basics.

The following procedure requires one crewmember at the Control Station, and at least one, preferably two crew members at the Dolly. Remember to use radios to coordinate your efforts.

Once FlyIt is loaded correctly, activate the Jog mode for the Cable with the most sag. Slowly jog in the winch, until the cable has slightly more tension than the other cables. Repeat the procedure with the next cable again, use the one with the most sag. Repeat this procedure until the Dolly is held in the air by the cable tension instead of the dolly stand.



Remove the Dolly Stand from the Dolly and switch on the Dolly. Then continue to slowly jog in the cables. Once the Dolly has reached a height of three meters.

4.4.1. MEASURING THE PLACE

To get the Flying Area and Dolly position it is necessary to measure the Pitch / Venue and Dolly. This is done with the Tachymeter. The FlyIt Software uses the angles and distances from the Tachymeter to calculate the Flying Area and Dolly position.

Make sure the Tachymeter is set to the following:

- Angle measurement unit: Decimal degrees
- Distance unit: millimetre
- Measurement direction: Counterclockwise
- Horizontal Angle value: 0°

Follow these steps to obtain the required results:

- Place the Tachymeter on a position from which you can easily aim at all Pulleys and the Dolly
- Level the Tachymeter using the analogue bubble level and digital level
- Aim for the reflector of Pulley 1
- Set Horizontal to 0, activate Measuring and note vertical angle and Distance to Pulley (NOT horizontal distance)
- Aim for Pulley 2
- Activate Measuring and note the Horizontal angle, vertical angle and Distance to Pulley (NOT horizontal distance)
- Repeat the last two steps for Pulley 3, Pulley 4 and Dolly
- Note the height offset (=height of the Tachymeter, usually between 150cm and 180cm)

At the control Station, enter the values in the respective fields and have the system calculate the Place and Dolly Position. Check if the Place and Dolly position are plausible, do not blindly trust the software. Remeasure if you have any doubts about the Place or Dolly coordinates.

4.4.2. FINAL PREPARATIONS

To make sure the cables have the same tension, move the Dolly to the centre of the Flying area. Then check the torque setting, and jog cables in and out, until all motors the same cable tension. Once an acceptable result has been achieved, use the Tachymeter to remeasure the Dolly position. Enter the values and check for plausibility.

Perform a slow test flight and watch for unusual behaviour; if the Dolly flies stable and the cables show the same sag, you can continue to control the borders of the Flying Area. Have one crewmember accompany the Dolly to examine the maximum flyable area and possible obstacles or hazards. Adjust the Software borders respectively, and note "No-Fly-Zones", obstacles etc. at the Control Station; there should be transparent sheets and markers you can use as an overlay over the Plan view (attach the transparent sheet with tape).

Using the latest software FlyIt 3.0 allows to integrate obstacles in the flying area. The system will then automatically avoid the marked areas, similar then with the existing borders. For details use the relevant software documentation.

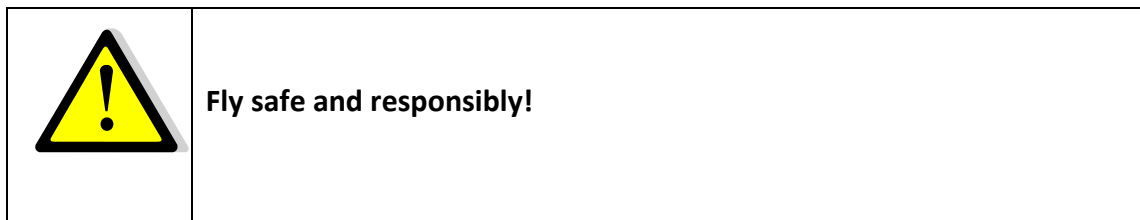
4.4.3. LANDING POSITION / SERVICE POSITION

Find a suitable Landing or Service Position, where you can perform a service Stop. A service stop is a stop during operation, when the dolly must be moved to ground level. Usually this is only

necessary when changing batteries, although it might also be necessary in Emergency situations, or when something on the dolly needs adjusting or checking. A service stop poses the additional danger that it will most likely be unavoidable that additional people are in the pitch. To minimize the risk of an accident, make sure:

- People in the pitch are aware that the dolly is being lowered
- A safety zone around the landing site is established that only the trained crew may enter
- Check that the cables don't hit anything or get too close to uninvolved people
- The service stop is kept as short as possible

If you have set all borders correctly, marked all obstacles and found a suitable Service Position, you are ready to fly. Make sure to properly store away all unneeded equipment, cases etc.

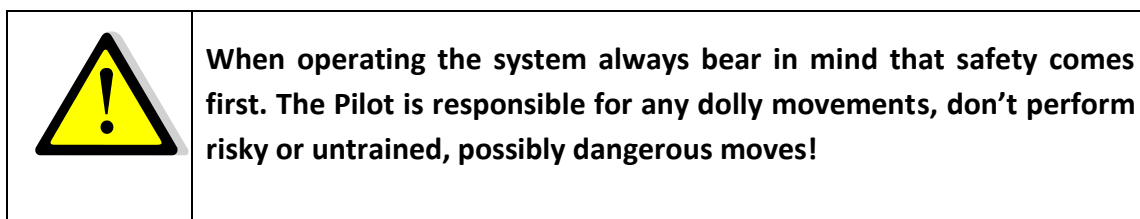


4.5. FLYING

Moving the dolly and camera is basically quite simple: The pilot moves, or “pilots” the dolly via the dolly console. The Camera Operator is responsible for the remote head control and Camera functions like Zoom and Focus, and steer those via the camera console. (Dominion)

The Dolly Control Console features two joysticks, the left one to move the dolly up and down (Z-Axis), the right one to move the dolly the left, right, forward and back (X- and Y-Axis). The Pilot operates each joystick with one hand, allowing him to steer all three axes at the same time.

For more detailed information on the consoles please check the Hardware manual.



Practice new moves when the Stadium is empty to minimize risks; and only if you are familiar and confident with the moves you may implement them in the live show.

Mastering the **Spidercam**® takes practice; constant training and experience from many jobs will improve the Crew's familiarity with the **Spidercam**® and allow them to produce better pictures. But not only the individual ability of the crew determines the outcome, it is also important that the Pilot and Operator work together as a team; the right shot from the right position requires coordination. It is helpful if the operator knows the piloting basics and vice versa; knowing the possibilities and limits of the other crewmember results in better quality.

4.6. AFTER OPERATION

Once the Job is done, you have two main options what to do with the **Spidercam**®: Minor Dismantling if the system can remain at the Venue, or full Dismantling if the system must be removed from the Venue.

4.6.1. MINOR DISMANTLING

If the system can remain at the Venue for following productions or production days, the minor Dismantling is the right option. Minor Dismantling includes replacing the actual Dolly with the Dummy Dolly and covering up / protecting the Control Station from unauthorized access. Make sure there is nobody but the trained crew in the pitch. The low hanging cables may pose a threat to untrained or unaware personnel.

- Bring the Dolly Stand, Dummy Dolly and Dolly case to the Service Position
- Fly the Dolly to the Service position, and carefully lower it into the Dolly Stand
- Turn off the Dolly, Remove Upper Hood and batteries.
- Unplug the Fiber connectors and apply covers where applicable
- Remove the Winding Terminations from the Dolly
- Put the Dolly (with Upper Hood) in the Dolly Case
- Attach the Winding Terminations to the Dummy Dolly
- Plug the Fiber Cables into the Dummy Dolly
- Fly the Dummy Dolly to the centre of the Flying Area
- Note the coordinates of the Dummy Dolly Position
- Remove the Dolly Case and Dolly Stand, and store them away properly

Power down the Winches and Control Station and protect the Control Station against Weather and unauthorized access. If necessary, cover the Winches. Depending on the venue it might be necessary to completely pack up and lock the Control Station, cover it with tarpaulins or simply turn it off.

4.6.2. FULL DISMANTLING

If the job or Production is finished, the system must be fully dismantled. The dismantling mainly consists of: Removing the Dolly, retracting the Kevlar Cables, collecting the Fiber Cables, removing the Pulleys and packing up all cases.

4.6.3. REMOVING THE DOLLY

- Move the Dolly Stand and Dolly Case to the Service Position
- Fly the Dolly to the Service position, and carefully lower it into the Dolly Stand
- Turn off the Dolly, Remove Upper Hood and batteries.
- Unplug the Fiber connectors and apply covers where applicable
- Remove the Winding Terminations
- Put the Dolly (with Upper Hood) in the Dolly Case

4.6.4. RETRACTING THE KEVLAR CABLES

Like the procedure “Mounting the Dolly”, you have two possibilities to retract the cables. You can retract them manually by releasing the brakes on the Winch and turning the drum or use the jog mode at the Control Station. As the Control Station should still be operational during dismantling, the last option is usually the most practical one, and should be preferred:

- One crewmember holds the Kevlar Cable and keeps constant tension on the cable during the Jogging
- One Crewmember slowly jogs in the Cable at the control station or winch
- Interrupt jog mode, remove the Winding Termination and attach a blind rope before going through the Pulley
- Once the Kevlar cable is retracted to the Winch, attach it firmly to the drum with Duct Tape



Coordinate your action via Radios! During jog mode the Crewmember at the control station should be ready to activate the Emergency Stop at any time!

It can be easier to retract the cables while the Dolly is still in the Dolly Stand.

4.6.5. COLLECTING THE FIBER CABLES

Unplug the Fiber Cables and mount all Plug covers. Remove tape that was used to hold the Cables in Place and drum up all the Fiber cables.



Handle the Fiber cables carefully, especially the Plugs.

4.6.6. REMOVING THE PULLEYS

Remove the Pulleys and any Truss constructions. Depending on the Venue requirements work as a team on every Pulley, or have a professional Rigger assist you.



In some venues the pulleys will stay mounted, and blind ropes can be used as placeholders to speed up future setups. Make sure to secure the blind ropes properly (e.g. attach with knots on a safe substructure)!

4.6.7. PACKING UP

Pack all cases according to the Packing list, double check if all equipment is with the system. Fragile components should be protected for transport.

4.7. OPERATIONAL PROCEDURES


4.7.1. EMERGENCY STOP RECOVERY

Should the system encounter an emergency stop, whether manually activated by pushing any emergency-stop-button or if activated by one of the safety systems, the following has to be checked:

- Investigate and resolve reason for the emergency stop
- If necessary or possible take actions to counteract the reason for the emergency stop, e.g. if the system stopped due to heat problems, create shade or add fans to increase system cooling.
- Investigate if any part of the dolly suffered any damage from the emergency stop. Especially at higher speeds there is the danger of parts becoming damaged or loose.
- Check every winch to make sure cables are still tightly wound on the drum, and don't have any loops or irregularities. The sudden stop and loss in tension can cause the cables to become loose on the drum, this has to be resolved before normal operation can proceed. Try to rearrange the cable manually while the system is still deactivated, and then slowly fly

the dolly to the most distant point from the winch (unwinding all the cable) and then towards the winch (winding the cable). This should recreate operational cable tension and tightness.

- Once everything has been checked and any issues resolved the pilot may continue regular operation.


	<p>Safety first: Do not operate the system if you are not convinced the problems have been resolved, and the system is safe to operate. The pilot assumes responsibility when operating the system!</p>
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4.7.2. CHANGING BATTERIES

It might be necessary to change the batteries on the dolly if the production exceeds runtime of the batteries. Schedule battery changes ahead of time, so you don't run out of power during a production.

Follow these steps to safely change batteries

- Make sure the Parking / Landing area is free of people and accessible. Have a crewmember / security guard at the Parking position to keep it clear of people during the entire time the dolly is close to the ground
- Carefully lower the dolly at the Parking / Landing position, continuously visually check the dolly and cables to avoid collision with people or objects
- Once the dolly is parked, remove the old batteries
- Once the new batteries are mounted, attach the safety (if there is a battery safety), fasten the hat and return the dolly into operational state
- Leave the parking position to safe flying height

	<p>A dolly flying low means low hanging cables – watch the cables as well as the dolly. Try to minimize the time the dolly is near ground-level.</p>
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