01. PERFORMANCES

<table>
<thead>
<tr>
<th>MODEL: SHADOW MK-1</th>
<th>MAX. TAKE OFF WEIGHT: 90 kg (198 lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>WINGSPAN: 5.2 m</td>
<td>PAYLOAD: &gt;15 kg. Until 25 kg (55 lb)</td>
</tr>
<tr>
<td>LENGTH: 1.95 m</td>
<td>FUEL CAPACITY: 30 litres</td>
</tr>
<tr>
<td>HEIGHT: 0.89 m</td>
<td>SHAFT POWER: 22 BHP (Twin-cylinder</td>
</tr>
<tr>
<td>WING AREA: 3.09 sq.m (30 sq.ft.)</td>
<td>piston engine)</td>
</tr>
<tr>
<td>DRY WEIGHT: 55 kg (121 lb)</td>
<td></td>
</tr>
</tbody>
</table>

SPEED RANGE: 75-208 kmPH (47-130 mph)
RANGE: 200 km (125 miles)
ENDURANCE: 6 hours (Prop:28×8; Fuel:13 litres; ISA:3000 ft; Endurance 4 hours)
LANDING DISTANCE: 49.213 m (150 ft)
LH AILERON Down=0º; Neutre=14º; Up=41º;
RH AILERON: Down=0º; Neutre=11º; Up=40º;
+/-36 mm (20% MORE MAX. ALLOWED)

ELEVATOR: Down=0º; Neutre=8º; Up=25º;
Up=36 mm; Down=15 mm; (20% MORE MAX. ALLOWED)

RUDDER: Left=0º; Neutre=0º; Right=0º;
+/-36 mm (20% MORE MAX. ALLOWED)

STEERING: Left=-20º; Neutre=0º; Right=+22º;

SERVOS: 150 in/ounce of torque. 1400 mAh four-cell batery pack

CENTER OF GRAVITY
27-35% BEHIND THE LEADING EDGE OF THE WING (NEXT TO THE FUSELAGE SIDE)
40% BEHIND MAX. ALLOWED

RUNUP (Break in)
Mixture 32-1 during 2-3 hours of run time with High Octane Unlead Fuel (98 Octane)
12-20 hours engine running time @ 2000-2500 RPM

ENGINE 3W_240iB2
239ccm/22hp 6900g 34×12-36×12
Info: http://www.3w-modellmotoren.com/mounting_tips/uebersicht.htm
Cylinder capacity: 239 ccm / 14.57 cu.in
Normal Cylinder Temperature: 80-100 ºC (Celsius) / 176-212 ºF (Fahrenheit)
Critical Temperature: 300 ºC
Seize temperature: 400 ºC
COLD TEMPERATURE: Will build up carbon on top of the piston below 200 ºC
Overheat: 110 Celsius / 230 Fahrenheit

Power: 22 PS / HP / CV; 16.5 kW
Bore dia.: 57.5 mm / 2.26 in
Stroke: 46 mm / 1.8 in
Speed range: 1000 - 7000 min-1 / rpm
Weight: 6575g / 14.46 Ibs - incl. ignition\Gasoline-Version 1 : 50 - 1 : 80 Mix
Automatic ignition timing: 0-30 (Depending on speed)
RPM MAX: 12000 RPM
Battery: 1800 mAH Per ignition unit (500 mA max @ 8000 RPM)
For UAVs to share airspace with manned aircraft, civil and military authorities in Europe, the United States, Japan and Australia have launched UAV certification initiatives. One of the first was the complex certification of the Royal Netherlands Army’s Sperwer UAV system. But some European officials believe individual initiatives are of dubious value in the absence of an internationally accepted roadmap governing airworthiness and certification issues. Because airspace has become a global concern, we have to move ahead together on a consensual basis.

International agreement is needed on such basics as the terminology surrounding UAVs before even starting to think about common codes and practices. In defining thousands of technical terms, Euro UVS working parties have wrestled with such questions as:

- What constitutes a control station, since this can be on the ground or in the air?
- Whether the person who guides the UAV is a pilot or an operator?
- Whether data link should be considered as two entities, one for control and the other for information? And, reaching right to the heart of the matter,
- What precisely a UAV is? (Various other acronyms have been used, as well as different definitions for UAV, such as “uninhabited” air vehicle.)

Certifying an UAV for civil airspace is comparable to certifying a small manned air vehicle. You have to take four things into account:

- Aircraft certification, which is a little like certifying a Cessna 172’s airworthiness; it had to show specs and their relation to the UAV’s operation.
- An operator’s (pilot’s) license, which requires that the person on the ground manning the UAV is trained and qualified. A user’s manual must accompany the aircraft.
- Qualified maintenance, to assure the UAV remains airworthy. A maintenance manual also must accompany the aircraft.
- And operational rules that allow UAVs to safely mix with manned aircraft.

http://www.avtoday.com/av/categories/military/1022.html Europe’s Answer: UAVs in Controlled Airspace
Unmanned air vehicles require sophisticated control systems with appropriate levels of autonomy, effective sense-and-avoid mechanisms, and high-integrity data links. UAVs may be fitted with GPS for positioning, a Mode C transponder for surveillance on the ground, and an onboard VHF transceiver through which air traffic control can communicate with the UAV operator.

The accuracy of onboard altimetric and other sensors will be defined according to the UAV category and stipulated flight-path accuracy.

To locate and track UAVs on the ground, optical sensors, multilateration or tarmac-embedded induction sensors may be required. And UAV controllers may need improved human/machine interfaces featuring large-screen situational awareness displays and moving maps. They probably will have to file UAV flight plans and listen for ATC calls on emergency frequencies.

UAV controllers (pilots) communicated with air traffic controllers as if they were on the aircraft, and even made ILS approaches at military or private airfields. Controllers want to process UAVs through their sectors by relaying guidance commands in real time via data link—much like processing manned aircraft operating in IFR airspace. EADS is focusing particularly on the safe return of UAVs following a data link failure. Because hostile jamming, tactical maneuvering or other issues can compromise data link continuity, UAVs will have to be able to manage by themselves. This means flying to the UAV’s home base or diverting to a nearby airfield while avoiding controlled airspace in the process.
## 06. DIMENSIONS AND AREAS

<table>
<thead>
<tr>
<th>FM</th>
<th>SHADOW MK-1 I CARUS team</th>
<th>Dimensions and Areas</th>
</tr>
</thead>
</table>

### FRONT VIEW (LOOKING BACKWARDS)

![Front View](image)

### PLAN VIEW (LOOKING FROM TOP TO BOTTOM)

![Plan View](image)

### LATERAL VIEW (LOOKING FROM LEFT TO RIGHT)

![Lateral View](image)

14.11.2008  
06-10  
FM_en  
Rev 1.0
FM
SHADOW MK-1
ICARUS team
Dimensions and Areas

FRONT VIEW (LOOKING BACKWARDS)

PLANT VIEW (LOOKING FROM TOP TO BOTTOM)

LATERAL VIEW (LOOKING FROM LEFT TO RIGHT)
23. COMMUNICATIONS

FM

<table>
<thead>
<tr>
<th>SHADOW MK-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICARUS team</td>
</tr>
<tr>
<td>AP04 Transceiver</td>
</tr>
</tbody>
</table>

Communications

<table>
<thead>
<tr>
<th>Baud rate</th>
<th>115.2 Kb/s (full duplex)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>100 Km</td>
</tr>
<tr>
<td>Frequency</td>
<td>902-928 MHz (1.3 GHz option)</td>
</tr>
<tr>
<td>Method</td>
<td>Freq. hoping spread spectr.</td>
</tr>
<tr>
<td>Simult. multiple UAVs</td>
<td>Yes</td>
</tr>
</tbody>
</table>

19.05.2009

23-10

FM_en

Rev 1
27. FLIGHT CONTROLS

<table>
<thead>
<tr>
<th>Flight Controls</th>
<th>FM</th>
<th>SHADOW MK-1</th>
<th>Icarus team</th>
</tr>
</thead>
</table>

Throttle (BLUE)  
Elevator (YELLOW)  
Rudder (GREEN)  
Ailerons (CYAN)

<table>
<thead>
<tr>
<th>PERFORMANCES</th>
<th>CL</th>
<th>L(72 km/h)*</th>
<th>CD</th>
<th>D(72 km/h)*</th>
<th>CM</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alpha 0°</td>
<td>0.376</td>
<td>29 kg</td>
<td>0.025</td>
<td>0.300 kg</td>
<td>.0</td>
<td>.0</td>
</tr>
<tr>
<td>Alpha 4°</td>
<td>0.759</td>
<td>59 kg</td>
<td>0.042</td>
<td>0.429 kg</td>
<td>.0</td>
<td>.0</td>
</tr>
<tr>
<td>Alpha 8°</td>
<td>1.163</td>
<td>91 kg</td>
<td>0.074</td>
<td>0.800 kg</td>
<td>.0</td>
<td>.0</td>
</tr>
<tr>
<td>Alpha 12°</td>
<td>1.497</td>
<td>117 kg</td>
<td>0.112</td>
<td>1.100 kg</td>
<td>.0</td>
<td>.0</td>
</tr>
<tr>
<td>Alpha 16°</td>
<td>1.694</td>
<td>132 kg</td>
<td>0.142</td>
<td>1.500 kg</td>
<td>.0</td>
<td>.0</td>
</tr>
<tr>
<td>Alpha 18°</td>
<td>1.690</td>
<td>132 kg</td>
<td>0.146</td>
<td>1.500 kg</td>
<td>.0</td>
<td>.0</td>
</tr>
</tbody>
</table>

*Normal Conditions. ISA atmosphere at SL. 101314.63 Pa, 1.23 kg/m3, 288.16 K
Specifications:
Torque: 43 oz/in
Speed: 0.25 sec/60 Deg
Dimensions: 33.5 x 19 x 38.5 mm
Weight: 38 grams
Single Ball Bearing
3-Pole Ferite
16 I/O lines with PWM rate 50 or 200 Hz
PWM signal 1 to 2 ms in 1 us (microsecond) steps

The first parameter that can be configured for each servo output is its signal source. Each servo output can source one of sixteen autopilot signals, these are:

<table>
<thead>
<tr>
<th>SERVO SOURCE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>aileron</td>
<td>Aileron deflection</td>
</tr>
<tr>
<td>elevator</td>
<td>Elevator deflection</td>
</tr>
<tr>
<td>throttle</td>
<td>Throttle deflection</td>
</tr>
<tr>
<td>rudder</td>
<td>Rudder deflection</td>
</tr>
<tr>
<td>flap</td>
<td>Flap deflection</td>
</tr>
<tr>
<td>nose gear</td>
<td>Nose gear, same as rudder except locked once airborne</td>
</tr>
<tr>
<td>aileron + elevator</td>
<td>Elevon deflection</td>
</tr>
<tr>
<td>aileron - elevator</td>
<td>Opposite elevon deflection</td>
</tr>
<tr>
<td>Aileron + rudder</td>
<td>V-tail deflection</td>
</tr>
<tr>
<td>Aileron - rudder</td>
<td>Opposite v-tail deflection</td>
</tr>
<tr>
<td>pan</td>
<td>Payload pan control signal</td>
</tr>
<tr>
<td>tilt</td>
<td>Payload tilt control signal</td>
</tr>
<tr>
<td>user 1</td>
<td>User servo output 1</td>
</tr>
<tr>
<td>user 2</td>
<td>User servo output 2</td>
</tr>
<tr>
<td>user 3</td>
<td>User servo output 3</td>
</tr>
<tr>
<td>reserved</td>
<td>Reserved</td>
</tr>
</tbody>
</table>
The following parameters that can be adjusted for each servo output are the minimum, center and maximum pulse stretches, and the range of the servo. Each servo output generates a standard (Futaba?) pulse width modulated (PWM) control signal: this signal is high for a period of one millisecond and stretches for up to one additional millisecond (1000us), with a resolution control of one microsecond. The stretching of this signal is used by the servo control electronics to command a proportional servo deflection. The following diagram shows how these parameters are used:

![Diagram showing servo parameters](image)

The last parameters that can be adjusted for each servo output are the direction of the servo (normal or inverted), as indicated by the INV checkbox, and if the servo signal should be digital (200Hz) or analog (50Hz), as indicated by the DIG checkbox.

<table>
<thead>
<tr>
<th>19.05.2009</th>
<th>27-10</th>
<th>FM_en</th>
<th>Rev 1.3</th>
</tr>
</thead>
</table>
The Garmin GTX 330 transponder is a full-featured, TSO certified transponder that brings a unique level of functionality and utility to an aircraft. These Mode S IFR certified digital transponders provide the U.S. market with FAA Traffic Information Service (TIS) Airborne Traffic targets in many Mode S terminal radar coverage areas. The solid state transmitter provides 250 watts nominal power output and eliminates the need for a cavity tube which, sooner or later, will fail and require expensive replacement. And since the transponder’s design is 100 percent solid state, there’s no warm up time, lower power consumption and much lower heat emission. All of which translates to a longer service life.

Temp. range: –20°C to +55°C  
Weight: 4.2 lbs. (1.9 kg)  
Power requirements: 11.0 to 33.0 VDC;  
Typical power input: 27 watts  
Transmitter frequency: 1090 MHz  
Transmitter power: 250 watts nominal at unit  
Receiver frequency: 1030 MHz  
Receiver sensitivity: –74dBm nominal for 90% replies  
WxHxD (159x42x286mm)  
Cost 1450€  
http://www.garmin.es Garmin Iberia Emailto:trep@trep@trep.com  
http://www.aerlyper.es Aerlyper, S.A. (Sabadell) Emailto:snavarro@aerlyper.es  
T2000UAV-S  
71. POWER PLANT

SHADOW MK-1
ICARUS team
ENGINE 3W_240iB2

Engine mounts sizes

11.04.2008 71-20 FM_en Rev 1
ENGINE 3W_240iB2
239ccm/22hp 6900g 34×12-36×12
Info: http://www.3w-modellmotoren.com/mounting_tips/uebersicht.htm
Cylinder capacity: 239 ccm / 14.57 cu.in
Normal Cylinder Temperature: 80-100 ºC (Celsius) / 176-212 ºF (Fahrenheit)
Critical Temperature: 300 ºC
Seize temperature: 400 ºC
COLD TEMPERATURE: Will build up carbon on top of the piston below 200 ºC
Overheat: 110 Celsius / 230 Fahrenheit
Power: 22 PS / HP / CV; 16,5 kW
Bore dia.: 57,5 mm / 2.26 in
Stroke: 46 mm / 1.8 in
Speed range: 1000 - 7000 min-1 / rpm
Weight: 6575g / 14.46 lbs - incl. ignition
Crankshaft: 3 Ball bearings
Connection rod: Needle bearings on both ends
Propeller: 2-bladed 28 x 10; 34 x 10; 36 x 10; 36 x 12; 3-Bladed 32 x 10; 32 x 12; Gasoline-Version 1 : 50 - 1 : 80 Mix
IIS - Ignition / V,cc: 4.8 V
Voltage: 18 kV.ac
Automatic ignition timing: 0-30 (Depending on speed)
RPM MAX: 12000 RPM
MAGNET RED (North Pole): Upper dead point
MAGNET GREEN (South Pole): 55º before upper dead point
Battery: 1800 mAH Per ignition unit (500 mA max @ 8000 RPM)
Alternator: 120 W

ENGINE 3W_275XiB2-TS
Info: http://www.3w-modellmotoren.com/mounting_tips/uebersicht.htm
Power: 24 PS / HP / CV; 17.65 kW
Bore dia.: 59 mm / 2.32 in
Stroke: 50 mm / 1.97 in
Speed range: 1000 - 7000 min-1 / rpm
Weight: 7030g / 15.5 lbs - incl. ignition
Crankshaft: 3 Ball bearings
Connection rod: Needle bearings on both ends
Propeller: 2-bladed 36 x 12; 36 x 14; 3-Bladed 32 x 12; 34 x 12;
Gasoline-Version 1 : 50 - 1 : 80 Mix
IIS - Ignition / V.cc: 6.0 V
Voltage: 18 kV.ac