

# Prime contender

**Making its UK debut at the Farnborough International Airshow in July, a really high-performance Light Sport Aircraft with military trainer aspirations**

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**P**unching through some choppy turbulence along the Adriatic coast it is hard to believe I'm flying a GA machine. I'm sitting under a big bubble canopy, with a switch-studded stick in my right hand and a powerful throttle in my left. A plethora of precise digital

information glows on the big centrally-mounted screen, and the needle of the standby ASI is nudging 300!

'You never get a second chance to make a first impression' is a hackneyed old cliché with more than a grain of truth, and when I saw the Blackshape Prime at AERO in Germany my initial

impressions were all positive – I couldn't wait to fly it. Some aircraft look like they're moving even when they're standing still, and this one definitely falls into that category.

Fast-forward a couple of months to an airfield in Italy and I was about to get my wish.



BLACKSHAPE  
*prime*

Before flying the aircraft I was treated to a tour of Blackshape's very impressive facility at Monopoli. Unlike many light aircraft manufacturers, Blackshape has serious backers. It is part of a huge Italian industrial conglomerate that makes everything from trains to spacecraft and is very well resourced.

The giant autoclave alone must be worth millions. With several aircraft in various stages of construction on the production line, I was able to see under the skin. Most of the metal components are made in either chro-moly 4130 steel or anodized 7075 aluminium, while the wings and fuselage are constructed of





Above: with the cowlings off, the propeller drive extension and unusually long engine mount are visible

Right: another unusual sight – this safety cage allows engines to be run straight off the production line

Below: laying out wing components on one of Blackshape's impressive array of production jigs



pre-preg, hot-melt carbon fibre. This material offers an excellent strength to weight ratio, enabling a designer to create a very light yet stiff structure with a smooth, low drag shape and aerodynamically efficient compound-curve surfaces.

### Surprisingly small flight test field

By now I simply can't wait to get behind the controls, and as soon as we arrive at Antares (a surprisingly small grass field used by Blackshape for flight tests) I'm introduced to Blackshape's Chief Test Pilot, Elio Rullo, who I'll be flying with. There are three Primes in the hangar and one outside, and I study the sleek-looking machine with considerable interest.

Even just sitting on the ramp the aircraft looks good, and from the tip of the sharp-looking spinner to the top of the swept-back fin it's easily the sexiest-looking Light Sport Aircraft I've ever seen. Indeed, it looks rather like a scaled-down version of the Pilatus PC-21 I'd flown

earlier in the year. The military trainer analogy proves remarkably apposite when Elio reveals that the aircraft I'll be testing is the same one that has been at sea on the Italian Navy's aircraft carrier *Cavour*. Finished in a matt grey air defence paint scheme (complete with lo-viz roundel) it really does look like a 'mil spec' machine.

Starting at the spinner, I note with interest the very low frontal area. Like the majority of LSAs, it's powered by a Rotax 912, but this one is very closely cowled. However, access to it is excellent – simply pull on the two recessed handles at the front and the top half of the cowling is released. It's one of the neatest arrangements I've seen, and undoing four bolts allows the bottom half to detach. The engine spins a two-blade, constant-speed MT propeller and is fed from two wing tanks with a combined capacity of ninety litres. The retractable tricycle undercarriage is operated electrically: it has a wide track but a relatively short

wheelbase, as the mainwheels retract inwards and the nosewheel aft. None of the wheel-wells have doors. Berringer wheels and hydraulic disc brakes are standard, although curiously the discs are located on the outside of the wheels.

The wing's leading and trailing edges taper towards the tips, and as there is very little dihedral I speculate what the lateral stability will be like. As it's a very clean design fitted with a sophisticated laminar flow aerofoil, I'm also curious to see how well the designers have addressed the problem of providing adequate drag on the approach – for although the trailing edge of the wing is fitted with electrically actuated four-position double-slotted flaps, they only extend to a maximum of 30°.

The tail consists of a rakishly swept back fin which carries a horn-balanced rudder, a fixed, swept back tailplane with considerable anhedral, and horn-balanced elevators. There's a small ventral fin below the tailplane, which leads me to wonder if



**Above:** as demonstrated on this 'civvie model' prototype, the Prime's side-hinged canopy offers good cockpit access and a superb all-round view

**Above right:** while the prototype flown by Dave flew lacked rear-seat instruments, the standard model will have a basic altimeter/ASI/compass, with headset and power sockets on the right

**Left:** the upholstery is nicely done, but the tapered fuselage contours that help reduce drag and grant impressive performance do cramp space somewhat for the rear seater

**Opposite, left to right:** steerable telescopic nose leg carries an LED landing light and Berringer wheel; the tail end looks to be almost Harrier inspired – Dave felt it was lacking in vertical surface area, despite the strake; and the trailing-link main gear, with its 'wrong side of the wheel' brake mounting (perhaps designed to aid cooling and ease maintenance)

perhaps directional stability had been an issue.

All the primary controls (including, unusually, the rudder) are actuated by pushrods. Pitch trim is provided by an electrically actuated tab in the port elevator. Preflight complete, it was time to go flying. Access to the cockpit is good. A very large side-hinged bubble canopy covers the tandem cockpit and there is a big wing root walkway on the port side. Again, this is reminiscent of a scaled-down PC-21. For the first sortie I'll fly from the back: Antares is not overly long and the brakes can only be operated from the front seat. Test pilot Elio needs to be happy that I can make good landings in the right place before we swap seats.

To be honest, the rear seat is distinctly unsatisfactory. The complete absence of instruments I can live with, but the rudder pedals are so badly located that it's very

uncomfortable. This is a prototype, the company is well aware of the issue and Elio assures me that it has already been addressed, although I'm still surprised that they were mounted so badly in the first place – very poor practice. On the plus side the field of view is superb and the stick and throttle fall nicely to hand.

### Spirited takeoff

After a spirited takeoff we chase the cameraship up and down the coast while trying to find some good light, then as soon as the shoot is finished and we're well clear of camera ship I begin to examine the general handling characteristics. By looking over Elio's left shoulder I can see the standby analogue metric ASI and Dynon Skyview, and quickly conclude that at times there is significant disparity between the two indicated air speeds. After a few

experiments and discussion we agree that the analogue appears the more accurate, and Elio explains apologetically that the time the aircraft spent at sea aboard the *Cavour* has clearly been to the detriment of the pitot-static system! The salt-laden marine environment is just brutal on practically every aspect of an aircraft and its systems. At high angles of attack I also get an occasional and unpleasant waft of fumes (an unfortunate by-product of the aircraft being a prototype is that it has had a few holes cut into it for instrumentation purposes – production aircraft will not have this issue).

Moving on to an examination of the control and stability reveals that the general handling is very taut and responsive. It's not perfect, as the elevator is slightly lighter than the ailerons – so the control harmony is not the ideal 1:2:4 ratio, but it's still very good. Indeed,



slow the sink rate rapidly increases. The first one (as is so often the case) is the best – a real greaser. The second one is firm but acceptable and the third is good, so it's back to Antares where another good landing convinces Elio I'm okay.

### Best seat in the house

After a quick glass of water we switch seats. It's much better sitting in the front and Elio agrees, saying "It's a different aircraft" – and he's right. It's not just having access to all the controls, the adjustable rudder pedals or the exceptional field of view – it's a really superb environment. The spacious cockpit is very nicely laid out, with the throttle, prop and brake levers on the left, the undercarriage selector and position lights in front of the prop lever and the flap switch at the base of the instrument panel. It's almost perfect, but strictly speaking the undercarriage selector should be wheel-shaped.

Cockpit instrumentation is almost entirely electronic, and consists of a large centrally-mounted Dynon SkyView MFD (multi-function display) plus standby analogue altimeter and ASI. Most of the electrical services are controlled via tumbler switches in a sub-panel by the right knee, with the circuit-breakers underneath and a red T-handle for the BRS (emergency parachute) above. The fuel valve is ideally located directly in front of the stick, while the parking brake (a simple non-return valve) is by your left elbow.

Closing the canopy confirms that this one has no DV panels at all (although most of the other Primes I examined did) and generates my usual complaint that you should really be able to open some kind of small window in flight. The Rotax starts instantly and I taxi the Prime carefully out to the active runway. The nosewheel steers through the rudder pedals, the undercarriage confers a very comfortable ride, and the field of view is excellent. The Berringer hydraulic disc brakes are smooth and powerful, although I don't like the hand-lever operation (Elio says production aircraft will have toe brakes).

At the run-up point, I complete the pre-takeoff checks and note the ambient conditions and our all-up weight. With an OAT of 22°C, barometric pressure of 1018.4 and a field elevation of 120ft, the density altitude is around 800ft. The 420m grass runway has a slight downslope and there's a light crosswind from the left, while with two on board, half fuel and no baggage, we're about 44kg below the 600kg maximum all-up weight. Lining up with the centre of Runway 15, I open the

overall the handling is superb, but the stability side of the control and stability equation proves to be less satisfactory. Directional stability could be better (the fin isn't that big, and although it does have a ventral strake there is still quite a lot of

we fly some circuits at a nearby airport. This place looks fantastic – and deserted, and Elio explains that there is some sort of political wrangling going on. With its big, well-maintained runway and art deco hangars, Aeroporto di Lecce looks like a

### **The spacious cockpit is very nicely laid out... it's almost perfect**

side area forward of the centre of pressure) while longitudinal stability is slightly 'soft' but acceptable. However this aeroplane's lateral stability is clearly unsatisfactory: not only does it diverge in roll but in the stall it drops a wing every time. On the plus side there's plenty of buffet, flaps up; enough buffet flaps down. I'm increasingly keen to fly from the front, so Elio suggests

wonderful facility that is just screaming to be converted into a fly-in community.

Despite the fact that I have no instruments at all and have to ask Elio to operate the flaps, fuel pump, propeller and undercarriage, all three landings are satisfactory. Elio recommends 120km/h (65kt) on final and this works well, although I note that if you do start to get

It not only looks fast but goes even quicker than you might imagine



## CLOSER TO PERFECTION

Many private pilots would, given the chance, like to fly either fighters or airliners. I'm definitely a wannabe fighter pilot as, having been lucky enough to log time in both piston and jet-powered fighters, I'm well aware of just how much fun they are!

If it were up to me I'd make the Prime's cockpit slightly more 'military' in appearance. Not only would this appeal to the frustrated fighter pilot that lurks within many of us, but it would also appeal to military procurement specialists. I'd dispense with the key-operated rotary starter/mags switch (how many fighters have keys?) and replace it with guarded tumblers for the mags, a *start* button and an electronic combination lock for the master switch and canopy. I'd also put pistol grips on the stick and throttle and incorporate switches for transponder ident and transceiver flip-flop alongside a 'coolie hat' trim switch and PTT button to make it more like a HOTAS (hands on throttle and stick) arrangement. It also needs large 'Master Caution' and 'Master Warn' annunciators high up on the panel, while the BRS handle should be a yellow-and-black hoop (essentially like an ejection seat's) and located at the base of the seat.

throttle slowly. The acceleration is good and although the surface is quite bumpy the undercarriage copes well, and we're airborne after about three-quarters of the runway. Climbing away I select wheels up, closely followed by the flaps. There's no noticeable pitch trim change with either gear or flap retraction, but it does settle slightly as the flaps retract. The flight is being filmed by Jack Newman from online news resource *Get into flying*, who's asked for a couple of low passes and I'm happy

the pedals, stick and throttle are 'just right' and even the fumes have gone. A further examination of stability and control confirms that this machine is a real thoroughbred. The ailerons are light and powerful, the elevator authoritative and the rudder nicely balanced. Furthermore, all the primary controls are well weighted, with low breakout forces and very little 'stiction'. The electric pitch trim is nicely geared; I never missed being able to adjust either the rudder or aileron trim.

## ***This machine is a real thoroughbred... all the primary controls are well weighted***

to oblige. (Go to [pilotweb.aero](http://pilotweb.aero) and follow the links to see this footage, and also some video of the aircraft operating from the *Cavour*.)

Rudder pedals and fumes aside, I'd felt quite comfortable flying the Prime from the back, but I'm totally in control – and very comfortable – in the front. I could sit in this seat for hours; the view is excellent,

Growing in confidence, I commence a more vigorous exploration of the flight envelope with some steep turns and sharp reversals. The Prime has a commendably rapid roll rate, and only small amounts of rudder are necessary to keep things co-ordinated. Interestingly, for what is a relatively light aircraft it flies and feels like a much heavier machine. In fact, when I



try some 60° banked turns it's as if it's on rails. All you have to do is put the nose just above the horizon, roll on loads of

bank and then reef it around. I also try some steep wing-overs, which are great fun, but as the aircraft is still in the development stage, it is not cleared for aerobatics or spinning – so I don't. One feature that I never tire of is the simply superb field of view conferred by that giant canopy. It really is outstanding – only modern sailplanes and fighters come close.

A quick look at the low-speed side of the envelope confirms that slow flight is very benign; and although as mentioned earlier the aircraft does tend to drop a wing at the stall, recovery was very easy and with minimal loss of altitude. The lowest speed I see is just below 35kt, and although this seems reasonable, the pitot-static system is a bit suspect... As the aerofoil is a laminar flow section, I'd expected that the stall might be somewhat abrupt, but this is not the case. (I would welcome the opportunity to fly the aircraft in rain, as some aircraft I've flown with laminar flow aerofoils behave very differently with wet wings.)

I am less happy with the limiting speeds for the undercarriage and full flap – 81 and 76kt respectively – particularly as the typical approach speed and flap limiting speed,  $V_{fe}$  are barely ten knots apart. I am also somewhat surprised by the low gear limiting speed, as none of the undercarriage legs or wheel-wells is fitted with doors. If you've been zipping along at say 160kt and 5,000ft and ATC suddenly asks you to both descend and slow down, a high undercarriage extension speed is quite useful as you can use the gear as an

airbrake. Of course, this machine is a prototype, and I would imagine that these limits will be revised for production.

Accelerating out of the final stall, I adjust the throttle and prop levers for 75 per cent power, trim forward and let the aircraft accelerate. The airspeed soon stabilises at 148kt, which is pretty speedy for a two-seater with only 100hp. A more conservative power setting of 60 per cent still gives an impressive TAS of 130kt at 5,000ft, for a fuel flow of around 15lit/hr.

As it has sensibly sized fuel tanks, the Prime's maximum range is around 600 nautical miles (plus VFR reserves). While in the cruise we punch through some light, choppy turbulence, and as the wings are quite stiff and have a reasonably high loading, the ride quality is pretty smooth – unlike some LSAs that I've flown.

I could've happily spent the rest of the afternoon testing the Prime for – in case you haven't guessed – I really enjoyed flying it. And if any of you are wondering about my earlier comments about the unsatisfactory lateral stability, please let me explain: whenever I evaluate an aircraft, two very important areas to examine are, of course, stability and control or, as I prefer, control and stability. Note that although I found the stability to be somewhat sub-standard, the control around all three axes is excellent.

Anyway, although I'd like to remain airborne both Keith and Jack are keen to have a go so I turn back towards Antares and leave the power pushed right up. It doesn't take long to get back. With the

At Farnborough the Prime was displayed alongside Aeromacchi 345 (right) and 346 (left) trainers





Seaborne ops? Not just a fanciful idea: the prototype has been flown from a carrier

throttle right back, wheels and flaps down, fuel pump *on* and prop set, I turn final and nail the speed to 65kt. I can't help but feel that perhaps another ten degrees of flap would be useful, but despite the density altitude, downslope and lack of headwind I make a nice, easy landing and get the Prime down and stopped with minimal braking, even though the runway is only 420 metres long.

Over a welcome glass of water we debrief, Elio agreeing that the lateral stability could be better. He explains that they're experimenting with large winglets that will increase effective dihedral and should improve lateral stability. I also

## ***I don't know what the Italian MoD will make of the Prime – but I absolutely loved it***

wouldn't be surprised if the tailplane area isn't increased slightly (possibly by the addition of horizontal strakes faired into the tailplane's leading edge) while a dorsal fin faired into the vertical stabilizer would improve directional stability. Nevertheless, even for a prototype it's a very impressive machine (and remember, I'm looking for things to complain about). Elio confirms that all of the aspects with which I have issues will be addressed in production aircraft.

### **Farnborough debut**

The following month I'm down at Farnborough for Press Day, and spot a Prime taxiing out to display with two

jets – an Aermacchi 345 and 346. Blackshape and Alenia have teamed up to pitch a new primary trainer to the Italian MoD, and the Prime will be part of an integrated training package whereby students will progress from primary training via the 345 and 346 onto the Typhoon or Harrier. I don't know what the Italian MoD will make of the Prime (I know that the Tecnam P2002 is also in the frame, and during the basic stages of flight training the side-by-side configuration does have its advantages) but I absolutely loved it, and would very much like to own one. Now I know that some of you are thinking "he always says that" and it

is irrefutable that when Spielberg turns my book into a film I'll have a very large hangar stuffed full of toys and next to a lake for my flying boat collection! Indeed, I'd very much like a PC-21, but as they're about €12 million (which really is Monopoly money) I'd happily settle for a Prime, which, while not cheap – is Monopoli money! The aircraft I tested is available now as a Permit aircraft for around £140,000, while the BS115 (available in 2015, certified in the VLA category with a 115hp turbocharged engine and a 750kg MAUW) will be around £200,000. I think I'd look good in one of those. ■

### **SPECIFICATION**

**BLACKSHAPE PRIME BS100 LS  
BASIC PRICE £140K**

#### **■ DIMENSIONS**

Length	7.18m
Height	2.41m
Wingspan	7.9m
Wing area	9.3sq m

#### **■ WEIGHTS AND LOADINGS**

Empty weight	360kg
Max AUW	600kg
Useful load	240kg
Wing loading	64.5kg/sq m
Power loading	8.04kg/kW
Fuel capacity	90 lit
Baggage capacity	20kg

#### **■ PERFORMANCE**

Vne	165kt
Cruise	149kt
Stall	40kt
Climb rate	1,200fpm
Take off (over 50ft)	300m
Landing (over 50ft)	300m

#### **■ ENGINE AND PROPELLER**

Rotax 912iS liquid-cooled flat-four, producing 100hp (74.57kW) at 5,800rpm and driving a MT two-blade constant speed propeller

#### **■ MANUFACTURER**

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