Max1025 transducer preparation for F3B/F3J launch analysis

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Abstract:

F3B or F3J launch tension logging may be a demanding application for the Max1025 tension transducer. Even if the transducer itself is rugged and well capable of withstanding the forces experienced during launch, some extra precautions can be taken to ensure that linkages and connections are protected and stay safe even when something goes wrong.

1.1 Introduction

Fig. 1 - 20 mm M4 threaded steel nuts

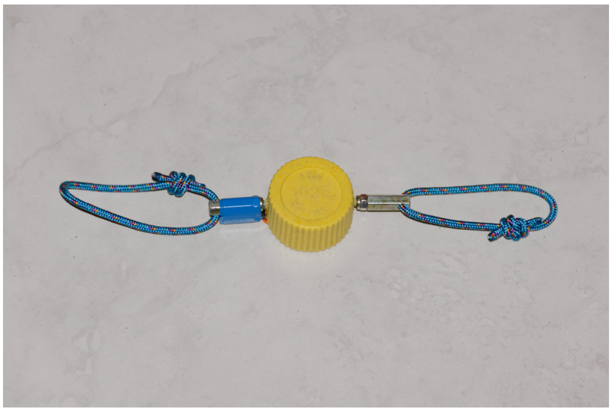

Fig. 2 – Max1025 with nylon lock nuts, coupling nuts and nylon cord loops installed

In a typical F3B/F3J application, the Max1025 transducer is attached at the end of the towline, and the parachute is attached to the transducer. When the parachute is hooked to the model, the signal cable of the Max1025 transducer is connected to the data acquisition system on board the model via a separation connector, so that the analog tension measurement provided by the transducer can be logged or otherwise analysed.

In a "normal" launch, the pilot lets the model climb on the towline until he sees fit, then he dives the model towards the turnaround to convert elastic energy in the towline into kinetic energy, and then makes a sharp pull-up to convert kinetic energy into height. At some point between the dive and the pull-up, the tension of the line reduces enough to let the parachute open and un-hook itself from the model: as the parachute lags behind the model, the separation connector disconnects and the Max1025 falls to the ground, slowed down by the parachute (for more details see ref 1).

There are a number of things that may go wrong during these few seconds. The model may "pop off" unexpectedly, or the line may break, or the parachute itself may fail under tension, or the model may snag the line, the cable or the parachute during the bunt-zoom manoeuvre. Since these things do happen, it is wise to arrange a setup that can prevent or mitigate the damage that may happen to the Max1025 transducer in most, if not all, cases.

1.2 Mechanical coupling

During an F3B or F3J launch, line tension may range from as little as 200 N to 1000 N. The Max1025 transducer can sustain this condition without damage, but it is very important both for safety and durability that the mechanical coupling of the transducer unit to the rest of the towing equipment –line and parachute– is reliable and strong under normal operating conditions, yet able to fail gracefully under abnormal conditions to avoid damage to other equipment.

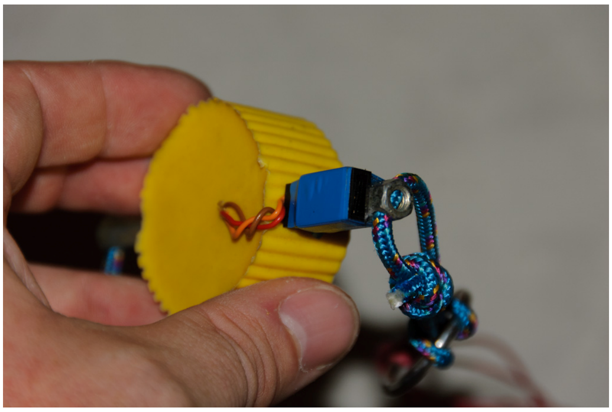

Fig. 3 - male servo receptacle installed on the Max1025 unit

We found that such requirements can be met by using two loops of nylon cord secured to the two force rods of the transducer with the help of two 20 mm long M4 hex nuts, locked in position by two M4 nylon lock nuts and bored at the end farthest from the transducer with a suitable drill bit, so that the nylon cord may be easily inserted through the bore. The edges of the holes must be deburred so to reduce wear on the cord. The cord can then be fastened into a loop with a suitable knot (such as a Fisherman's knot).
It is recommended to periodically check that the lock nuts and the coupling nuts are tight and that the cord loops are in good conditions, and replaced as soon as signs of wear appear.

1.3 Electrical connection

The Max1025 transducer is delivered with a length of 3-wire cable exiting directly from the elastomer shell. The wires are soldered to the PCB inside the shell, and even if some strain relief is provided, strong shocks may induce excessive strain on the PCB, which may lead to internal failure. Such shocks are beyond what is commonly experienced in normal use, but may be within the range of unexpected events such as the cable getting snagged in the tail of the model during the zoom, or in other obstacles while retrieving the line.

To avoid damaging the sensor even under such abnormal operating conditions, additional strain relief may be provided by splitting the cable a few centimetres from the point where it exits the shell, and installing a male servo-type receptacle. The receptacle is then taped firmly to one of the coupling nuts, and a mating female connector is fitted to the remaining part of the cable. The force required to disconnect the servo plug from the receptacle is typically greater than the one required to disconnect the 4-pin separation connectors at the model end: if this should not be the case, a small piece of electrical tape covering both the plug and the receptacle fixes the problem.
With this setup, the 4-pin connectors should reliably disconnect during normal operation, and the servo connector only separates when experiencing greater stress, which in this way does not propagate to the transducer itself.

The cable may also be protected from damage by sliding it through a length of nylon sleeve (of the kind commonly used to protect loops and knots in F3B and F3J lines): the sleeve may be made somewhat loose at both ends, so that it may be glued with cyanoacrylate to the connector, or covered in hot-melt glue or epoxy resin to make a connector shell. The use of a sleeve will increase the aerodynamic drag experienced by the cable (though the increase will still be marginal in comparison to the overall line drag), and this may lead to premature disconnection: to avoid this situation, the cable may be routed along the parachute lines and through the parachute apex opening.

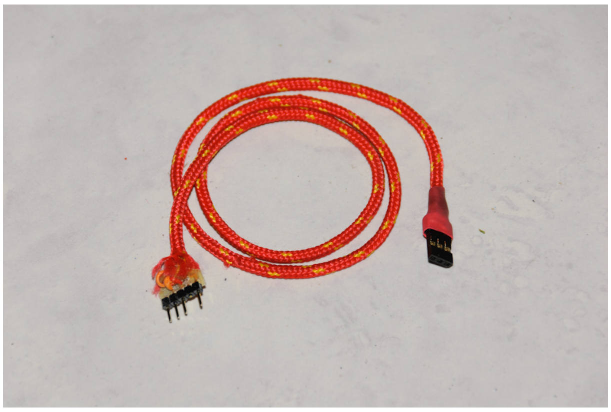

Fig. 4 - the signal cable, protected with a sleeve, with the separation connector (still "naked") at one end, and a servo plug CA-bonded to the sleeve and covered in heat shrink tubing at the other end

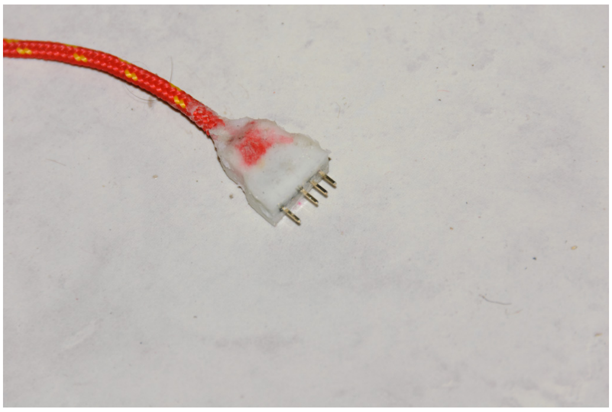

Fig. 5 - epoxy shell moulded around the separation connector

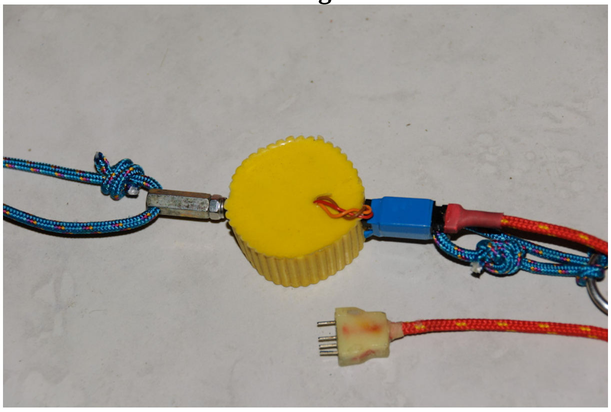

Fig. 6 - detail of the transducer - cable connection

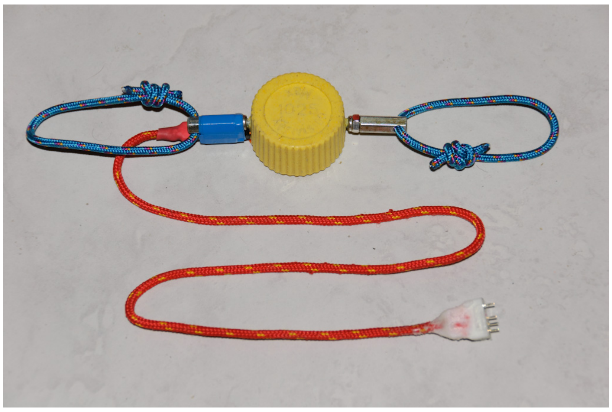

Fig. 7 - the completed Max1025 setup

Reference articles:

(1) "Dalla spanna al data logger " by F. Meschia 2011