Airspeed Sensors & Pitot Tube Mathematics

Airspeed: Motorola MPX 2010G, 0-1.3 psi, 0-705 mph
10 bit ADC -> 705/1024 = .68 mph
12 bit ADC -> 705/4096 = .17 mph

I needed to determine what the maximum pressure the pressure transducer would experience in flight, so I could buy the right sensor for airspeed sensing. The pressure in the ram section of a pitot tube is comprised of two components, the dynamic and the static. Because most pressure transducers sense the difference between some input and static (gauge pressure), we only need to look at the dynamic pressure exerted by the moving air.

Dynamic fluid pressure is defined as: $P(dynamic) = 0.5\ (r)\ (v^2)$, where v = velocity of fluid (air), r = density of fluid (air)

r(air) @ sea level, incompressible (low Mach number) = $1.229\ kg/(m^3)$

We will assume a max velocity of 50 m/s (111 mph). So we get: $Pmax=.5\ (1.229\ kg/(m^3))\ (50\ m/s)^2 = 1536.25\ kg/(m\ s^2)$

We need to convert this to PSI. To do that, we need to convert kg to pounds(force), which is different from pounds(mass). Remember the Mars Observer satellite? It went splat because NASA forgot to convert pounds(force) to pounds(mass).

1 pound(mass) = .4535 kg 1 pound(force) = 32.174 pound(mass) ft/sec^2 (multiplied by gravity at sea level)
1 ft = .3048 meter 1 ft^2 = 144 in^2

After all these numbers are put in the equation, we get:

P(dynamic, air) = 32 pound(force) / ft^2 @ 111 mph = .22 pound(force) / in^2 @ 111 mph = .22 psi @ 111 mph

So, to measure airspeed up to 111 mph, we need a pressure transducer that can read at least .22 psi. I have three Motorola MPX2010G pressure transducers that are rated at 1.4 psi. They should work up to 318 m/s or 705 mph (in an incompressible flow, which at 705 mph is not true, but anyway...) No problem.