RV-14A
N59ER
Pilot's Operating Handbook

Revision 1.7

Constructed by:
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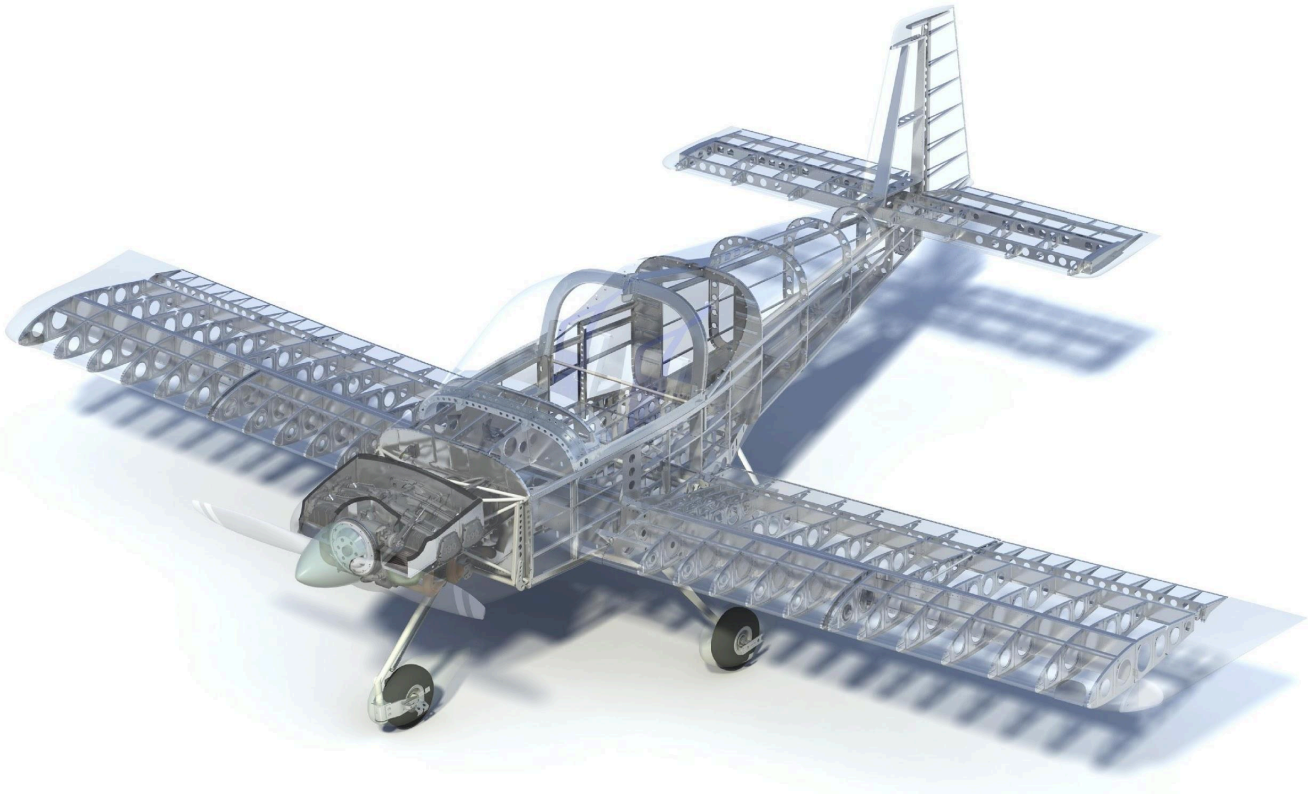
Serial number 140059
Construction: April 2013 through October 2017
http://rv-14a.blogspot.com/

RV-14A Cutaway Drawing



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1 General

1.1 Introduction

Before getting into the construction details of the RV-14, let's take a look at the design philosophy and goals that are the basis for this airplane. The goal was to achieve the maximum overall performance, flying enjoyment, ease of construction, building and flying economy, ease of maintenance and pleasing appearance possible for a two-place airplane. Understanding how this was achieved might help you better appreciate many features of the RV-14.

The formula for achieving maximum overall performance is straightforward: Maximize thrust, minimize drag, maximize lift and minimize weight. The implementation of this formula is a bit more complex, however. Thrust, for a given horsepower engine, has been maximized through use of a good propeller, streamlining of the engine cowl and directing the engine outlet rearward. Drag was minimized by keeping the aircraft frontal area to a minimum and shaping all airframe components to reduce aerodynamic drag. Lift was maximized through use of a wing with adequate area and good airfoil. Weight is minimized by careful structural design, by using the best airframe materials and by installation of only essential instrumentation and equipment.

1.2 Design Objectives

In basic form the RV-14 is a super-sized RV-7 fuselage mated to a downsized RV-10 wing. Utilizing the RV-10 wing provided an improved aspect ratio for better load carrying, along with a slotted flap to provide more lift for achieving moderate landing speeds. The RV-10 wing also provided a deep spar to achieve the strength needed for aerobatic flight. The horizontal tail was adapted from the RV-9, strengthened as necessary for the RV-14's higher weight and aerobatic strength requirements.

However, it would not be accurate to describe the RV-14 as a cobbled together collection of previously used airframe parts. More accurately, it is the culmination of many years of airframe component evolution, combined and refined to arrive at this next-generation two-seat airplane. This design development process also included the opportunity to simplify assembly, assure accuracy and improve quality. Literally hundreds of component changes and structural upgrades were incorporated in the creation of the RV-14. The result: A truly new design.

1.3 Design Features

The RV's "traditional" configuration - tractor engine, monoplane, stabilizer in the rear - is an exercise in logic and not simply a concession to convention. There are many good reasons why light planes have been built this way for decades, other than the often-heard arguments of "entrenched design mentality" from those seeking "technological breakthroughs". The reality is that this configuration has proven to offer the best compromise resulting in the best all around functional airplane. Why try to re-invent the wheel?

Designers often use the term "Mission Profile" which simply refers to the function an airplane is designed to perform, *e.g.*, “what will it be used for?” and “what kind of flying will it do?”. The RV-14's mission profile is rather broad: It is intended to fill nearly all sport flying needs: Excellent flying qualities, high cruise speeds, sport aerobatics, modest stall speed, outstanding visibility, easy assembly for the home-builder and economical to own and operate. Meeting all these needs required a design "balancing act". Favoring one capability can adversely affect others.

An example would be that of utilizing a larger wing to achieve a lower landing speed and shorter runway requirements. A by-product would be reduced cruise speed and roll rate. Thus, wing size has been optimized to provide more than adequate take-off, landing and climb performance for operation from all reasonably anticipated airports yet still yield high cruise speeds.

The constant chord wing planform chosen for the RV-14 offers the ultimate in construction ease, aerodynamic stability and lifting ability. The possible drag and aesthetic penalties for the rectangular wing, vs. a tapered wing planform are negligible in light of its advantages. The airfoil used is an SSV-2315, the proprietary airfoil section which had been used on RV-10 with great success.

Seating arrangements vary between the RV designs, depending on the primary mission envisioned. Side-by-side seating was chosen for the RV-14 because this arrangement is generally preferred for its primary mission: Cross-country travel and sport flying. Specific advantages of the side-by-side configuration include equal visibility for both occupants, more easily achieved dual control capability, an abundance of instrument panel space, minimized CG travel for various loading conditions and a full width cowling which offers more space for engine accessories and plumbing.

The RV-14 design incorporates a deeper cabin than other side-by-side RV designs. This positions the pilots higher relative to the engine and wings and thus improves the field of view. The RV-14's field of view is further enhanced because the canopy has lower sides, improving the forward/downward view. Compared with Van's previous side-by-side aircraft, the RV-14 incorporates a cabin that is larger in all respects.

1.4 Kit Construction Philosophy

The design of the RV-14 required much thought and planning to make the "journey" as easy and enjoyable as possible. The journey, figuratively, is that undertaken by the builder who is tasked with transforming a pile of kit parts into an airworthy airplane. Because the RV-14 was designed for amateur construction, every component in its structure was designed with amateur construction and assembly in mind. Also, because the RV-14 kit was developed to be licensed in the USA as Experimental Amateur-Built, it needed to comply with FAA rules which require that the amateur builder fabricate and assemble the major portion: More than 50%, of the aircraft.

The factors considered included appraising skills possessed by or easily gained by the median anticipated builder and the tools owned by or readily available to that builder. To the greatest degree possible, the factory manufactured components that required large expensive machinery. Conversely, components that could be fabricated or finished with simple hand tools were assigned to the builder.

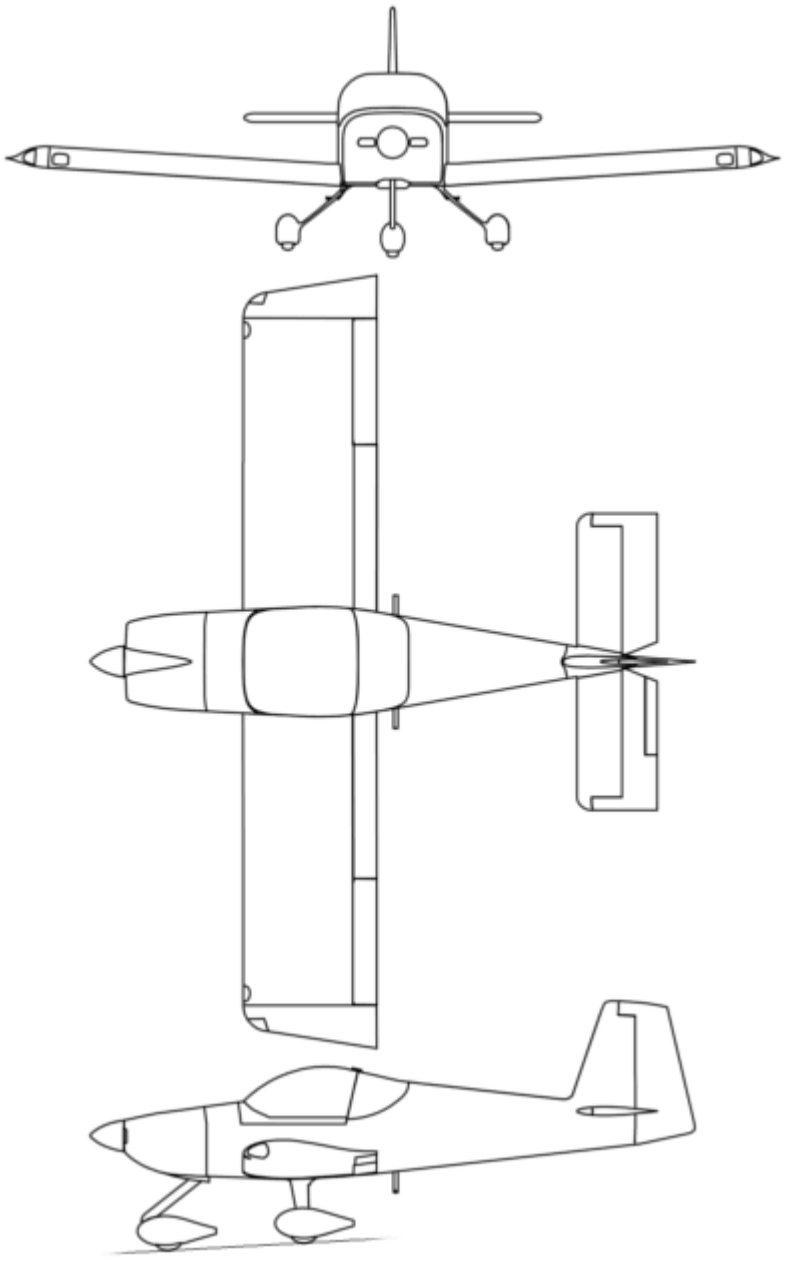
The design of every component required careful thought to determine how much of the work should be done by the factory or by the builder. Obviously, the factory could probably manufacture all components more efficiently than could the builder. This approach would not meet the FAA Major Portion requirement and would not result in an affordable kit.

With respect to the overall finished aircraft cost versus kit cost, if a low kit cost were the goal we would be providing only a basic materials kit or even plans-only, but in crafting the kit we have considered the expense to the builder to have "rubber on the ramp". That is, a ready to fly and enjoy finished aircraft.

In summation, the builder accomplishes plenty of the work without needing to spend excessively on specialized tools and Van's is able to offer an affordable kit, yet include high-tech and high quality pre-fabricated parts where they are most appropriate.

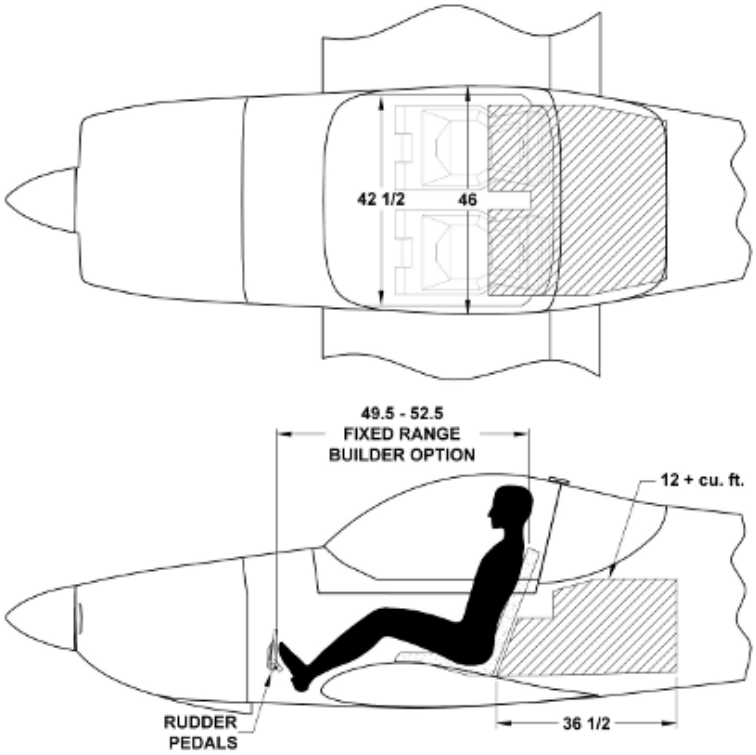
The RV-14 in its basic form with constant speed prop, modest instrumentation & avionics and 215 HP Lycoming IO-390 engine represents the best compromise.

1.5 Exterior Dimensions



Exterior Dimensions	
Wing Span	27'
Horiz Stab Span	10' 4”
Length	21' 1”
Height	8' 5.25”
Wheel Base	87.9”
Wing Area	126.1 sq. ft.

1.6 Interior Dimensions



1.7 General Specifications

Wing Span	27'
Horizontal Stab Span	10' 4”
Length	21' 1”
Height	8' 5.25”
Wheel Base	87.9”
Wing Area	126.1 sq. ft.
Empty Weight	1,319 lbs.
Gross Weight	2,050 lbs.
Wing Loading – Gross	16.25 lbs/sq. ft.
Power Loading – Gross	9.53 lbs/HP
Engine	215 HP

Propeller	Hartzell C/S
Fuel Capacity	50.8 U.S. Gallons
Baggage Capacity	100 lbs.

1.8 Performance Specifications

Light weight at 1,715 lbs. Gross weight at 2,050 lbs.

Speed – Light Weight	
Top	189 KIAS
Cruise (75% @ 8,000 ft)	178 KIAS
Cruise (55% @ 8,000 ft)	158 KIAS
Stall	47 KIAS
Speed – Gross Weight	
Top	187 KIAS
Cruise (75% @ 8,000 ft)	176 KIAS
Cruise (55% @ 8,000 ft)	155 KIAS
Stall	51 KIAS
Ground Performance – Light Weight	225 ft
Takeoff Distance	330 ft
Landing Distance	
Ground Performance – Gross Weight	375 ft
Takeoff Distance	340 ft
Landing Distance	
Climb/Ceiling – Light Weight	
Rate of Climb	2,050 ft/min
Ceiling	26,000 ft
Climb/Ceiling – Gross Weight	
Rate of Climb	1,680 ft/min
Ceiling	18,000+ ft
Range – Light Weight	
Range (75% @ 8,000 ft)	920 SM
Range (55% @ 8,000 ft)	1,050 SM
Range – Gross Weight	
Range (75% @ 8,000 ft)	911 SM
Range (55% @ 8,000 ft)	1,033 SM

1.9 Engine

Manufacturer	Lycoming
Model	YIO-390-A3B6 (converted to -C)
Serial Number	EK-460-80E
Rated Horsepower	215 HP
Rated Speed	2,700 RPM
Bore	5.319 inches
Stroke	4.375 inches
Displacement	390 cubic inches
Compression Radio	8.9:1
Type	Four cylinder, direct drive, horizontally opposed, air cooled, down exhaust

1.10 Propeller

Manufacturer	Hartzell
Model	C2YR-1BFP/F7497
Serial Number	NS2567B
Blades	2
Blade Serial Numbers	L64296 and L64293
Hub Serial Number	151661
Low Pitch	13.6 inches
High Pitch	35 inches
Diameter (max)	74 inches
Diameter (min)	72 inches
Blade Life Limit	10,000 hours
Type	Constant speed, hydraulically actuated

1.11 Fuel

Fuel Capacity	50.8 gallons	U.S.
Usable Fuel	50.7 gallons	U.S.
Minimum Grade	100LL octane	

1.12 Oil

Oil Capacity (U.S. Quarts)	7 maximum, 2 minimum
Oil Specifications	MIL-L-22851 or SAEJ1899 ashless dispersant
Oil Viscosity:	
All Temperatures	SAE15W-50 or
Above 80°F	SAE20W-50
Above 60°F	SAE60
30°F to 90°F	SAE 40 or SAE50
0°F to 70°F	SAE40
Below 10°F	SAE40, SAE30, SAE20W-40 SAE30 or SAE20W-30

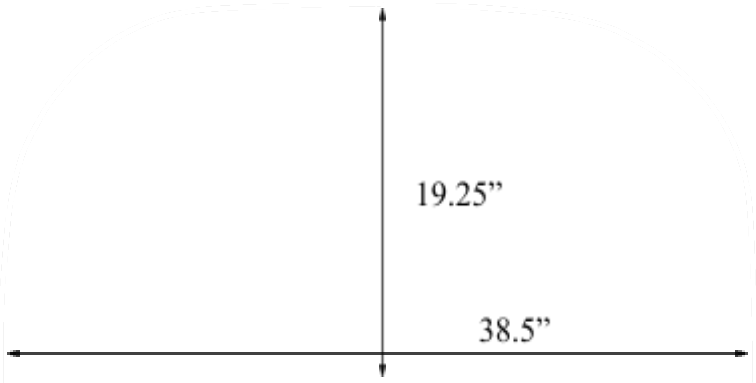
1.13 Maximum Weights

Maximum Takeoff Weight	2,050 lbs
Maximum Ramp Weight	2,050 lbs
Maximum Landing Weight	2,050 lbs
Maximum Baggage Compartment Weight	100 lbs
Empty Weight	1,280 lbs
Gross Weight	2,050 lbs

1.14 Baggage Space

Entry Width	38.5”
Entry Height	19.25”
Volume	12+ cubic feet

Baggage entry outline.



1.15 Specific Loadings

Wing Loading	16.26 lbs/sq. ft.
Power Loading	9.53 lbs/HP

2 Operating Limitations

2.1 General

This section provides the operating limitations, instrument markings, color coding and basic placards necessary for the safe operation of the airplane and its systems. This airplane must be operated as a utility or aerobatic category airplane in compliance with the operating limitations stated in the form of placards and markings and those given in this section and handbook.

2.2 Airspeed Limitations

Type	Description	KIAS	KTAS
V_A	Design Maneuvering @2,050 lbs (Utility) @1,900 lbs (Aerobatic)	 130 147	
V_{NE}	Never Exceed		200
V_{NO}	Structural Cruising	156	
V_{FE}	Maximum Flap Extended	100	
V_{S0}	Flaps Down (40°)	51	
V_{S1}	Flaps Up (-3°)	62	
V_X	Best Angle of Climb	70	
V_Y	Best Rate of Climb	95	
V_{GL}	Best Glide	84	

V_A changes with the stall speed according to the formula below. The load factor for the aerobatic category is +6.0 and +4.4 for the utility category.

$$V_A = (StallSpeed) * \sqrt{(LoadFactor)}$$

2.3 Airspeed Indicator Markings

Marking	Type	KIAS	KTAS
Red Line	V_{NE}		200
Yellow Arc	V_A – V_{NE}	130 – 200	

Green Arc	V_{S1} – V_A	62 –130
White Arc	V_{S0} – V_{FE}	51 – 100
Yellow Triangle Δ	V_X	70

2.4 Power Plant Limitations

Engine	YIO-390-A3B 6 Converted to -C
Maximum Horsepower	215 HP
Maximum Speed	2,700 RPM
Maximum Manifold Pressure	Full Throttle
Maximum CHT	475°F
Maximum Oil Temperature	235°F
Oil Pressure	
Start and Warm-Up	115 PSI

Normal	
Idle	25 PSI
Minimum	55 PSI
Maximum	95 PSI
Fuel Pressure	
Inlet to Fuel Pump	
Minimum	-2 PSI
Maximum	35 PSI
Inlet to Fuel Injector	
Minimum	14 PSI
Maximum	45 PSI

2.5 Power Plant EFIS Markings

Tachometer	
Green Arc	0 – 2,700 RPM
Red Line (Max)	2,700 RPM
Oil Temperature	
Green Arc	165°F – 180°F
Yellow Arc	180°F – 235°F
Red Line (Max)	235°F
Oil Pressure	
Green Arc	55 – 95 PSI
Yellow Arc	95 – 115 PSI
Red Line (Min)	55 PSI
Red Line (Max)	115 PSI
Fuel Pressure	
Green Arc	0 – 35 PSI
Red Line (Min)	0 PSI
Red Line (Max)	35 PSI
Cylinder Head Temperature	
Green Arc	150°F – 435°F
Yellow Arc	435°F – 450°F
Red Line (Max)	450°F

2.6 Weight Limits

Maximum Takeoff Weight	2,050 lbs
Maximum Ramp Weight	2,050 lbs
Maximum Landing Weight	2,050 lbs
Maximum Baggage Area Weight	100 lbs
Empty Weight	1,280 lbs
Gross Weight	2,050 lbs

2.7 Center of Gravity Limits

Category of Operation	Range
Utility	18% – 29% of wing chord 82.08" – 88.24" aft of datum
Aerobatic	18% – 25% of wing chord 82.08" – 86.00" aft of datum

Note: Datum is located 72" forward of the wing leading edge.

2.8 Maneuver Limits

This aircraft is approved in both the utility and aerobatic categories. When operating in the utility category, the following maneuvers are permitted:

Maneuver	Recommended Entry
Chandelles	KIAS
Lazy Eights	KIAS
Steep Turns	KIAS
Spins	KIAS
Stalls (except whip)	KIAS

When operating in the aerobatic category the baggage area must by empty. The fuel system does not provide accommodation for inverted flight. The following maneuvers are permitted:

Maneuver	Recommended Entry
Loops	122 – 165 KIAS
Horizontal Eights	130 – 165 KIAS
Aileron and Barrel Rolls	105 – 165 KIAS
Snap Rolls	70 – 95 KIAS
Split-S	87 – 96 KIAS

2.9 Flight Maneuvering Load Factors

Aerobatic Category			
	Positive Limit	Load	+6.0 G
	Negative Limit	Load	-3.0 G
Utility Category			
	Positive Limit	Load	+4.4 G
	Negative Limit	Load	-1.76 G

2.10 Types of Operations

The airplane is approved for the following operations when equipped in accordance with FAR 91: Day VFR, Night VFR, Day IFR, Night IFR, Non-Icing.

2.11 Fuel Limitations

Fuel Capacity	50.8 gallons	U.S.
Usable Fuel	50.7 gallons	U.S.
Minimum Grade	100LL octane	

2.12 Placards

On seat brace leading to baggage area:	Maximum Baggage Capacity 100 lbs.
In view from entrance (FAR 45.23(b)):	EXPERIMENTAL
In view of occupants:	PASSENGER WARNING: THIS AIRCRAFT IS AMATEUR BUILT AND DOES NOT COMPLY WITH FEDERAL SAFETY REGULATIONS FOR STANDARD AIRCRAFT.
At each fuel flange:	100 LL, 25.4 Gal.
On each static port:	Static Port. Keep Clear.

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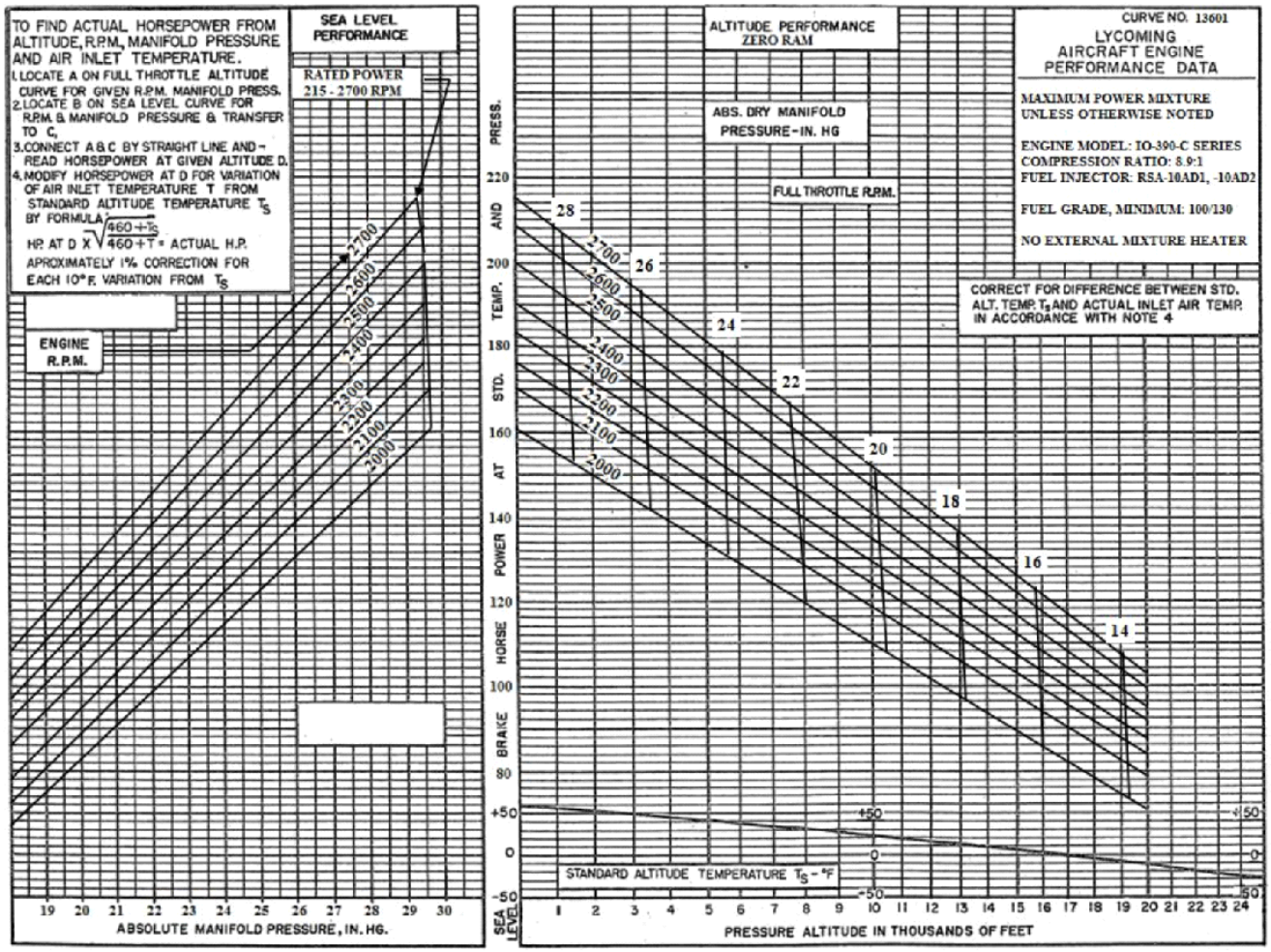
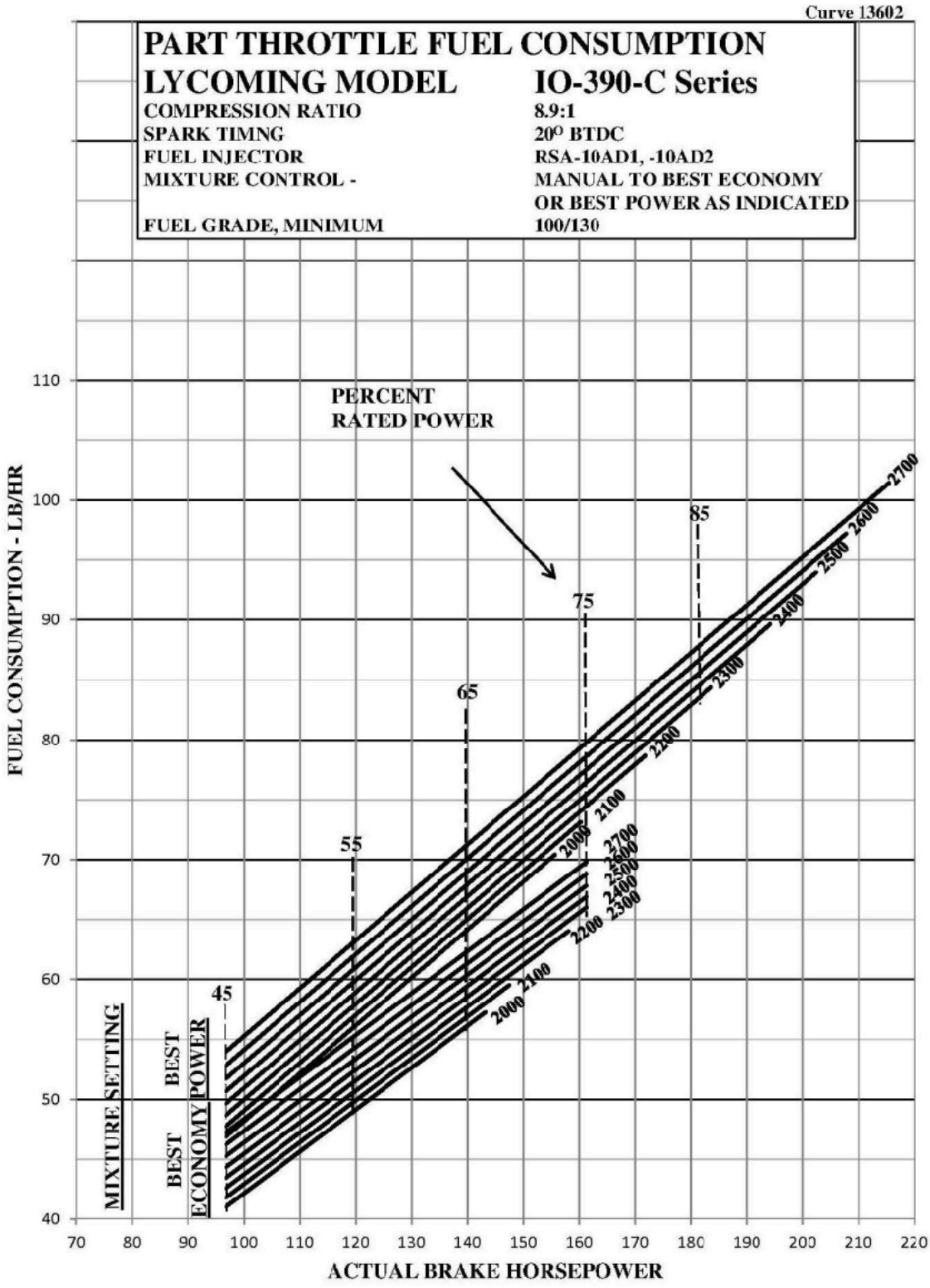
3 Additional Engine Information

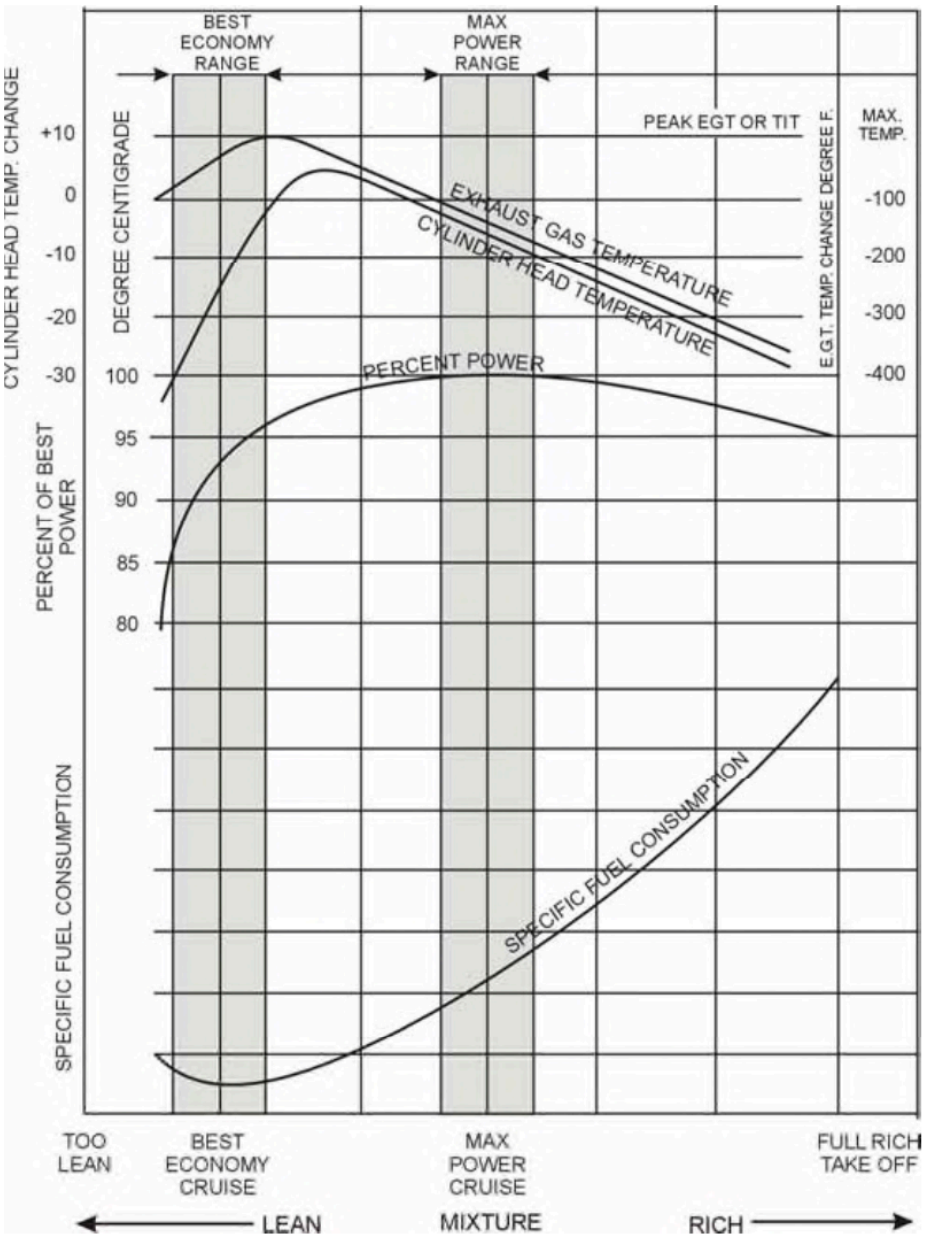
3.1 General



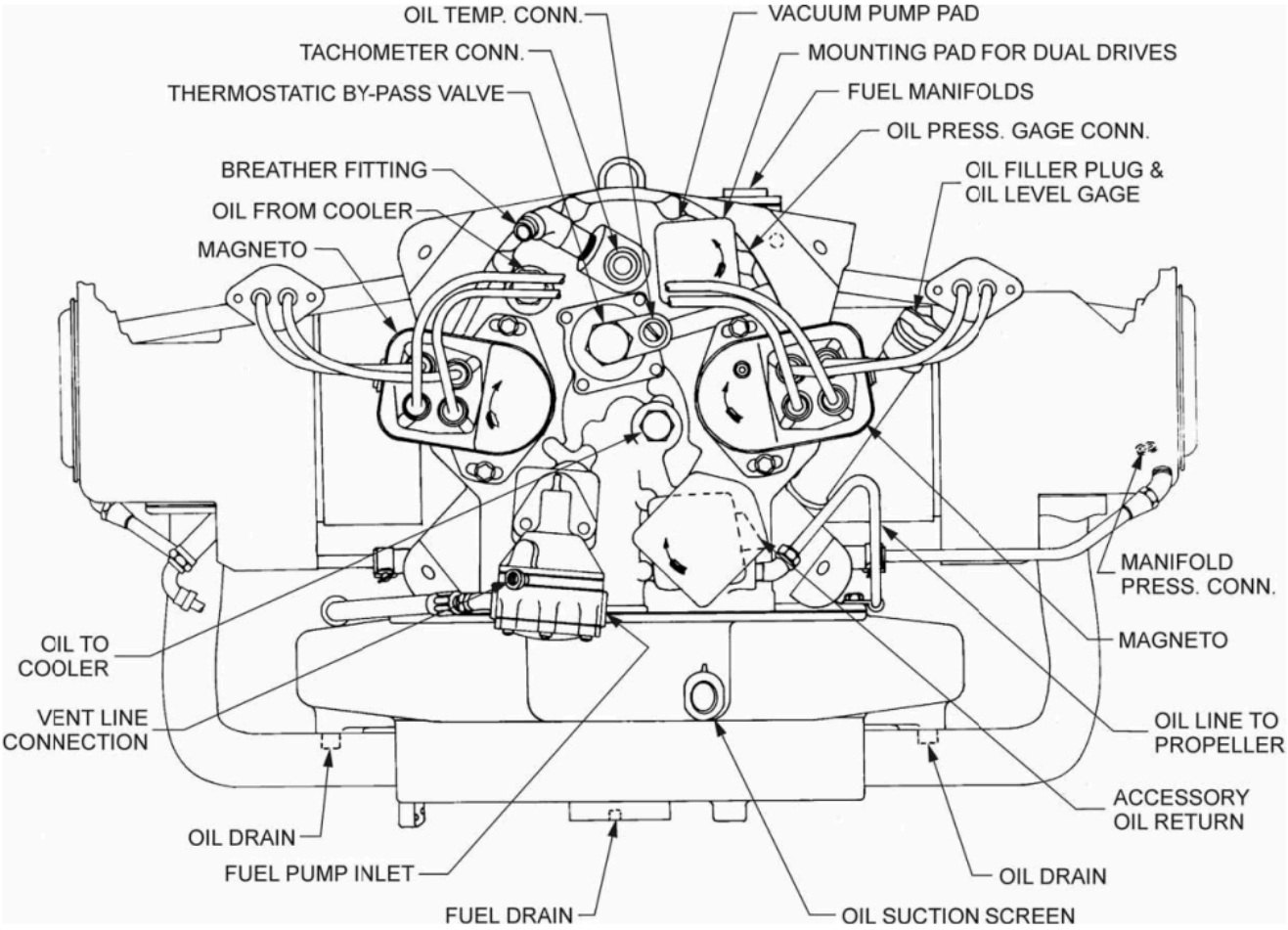
Sea level and altitude performance (IOM-IO-390-C, January 2017, page 57).



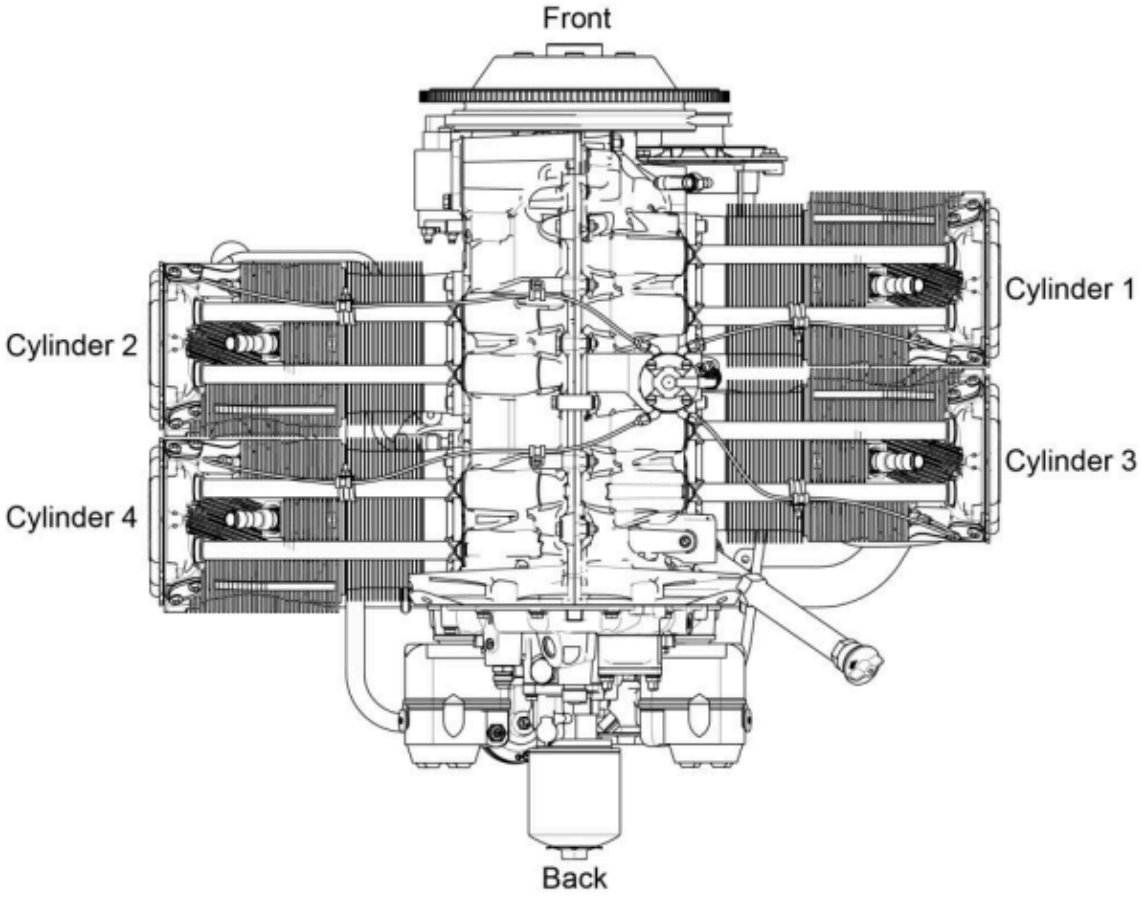
Fuel flow vs. percent rate power (IOM-IO-390-C, January 2017, page 59).



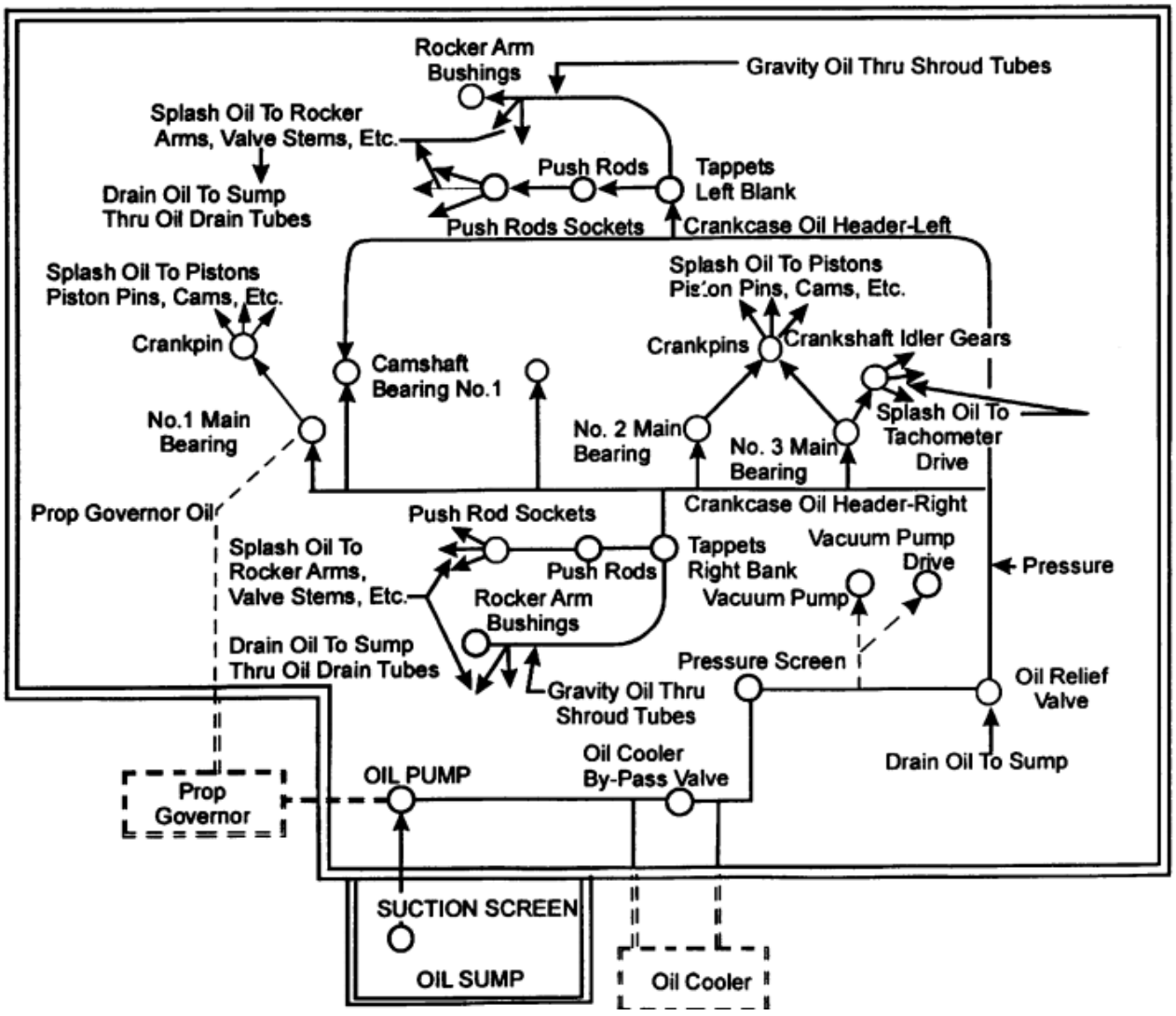
Representative effect of fuel/air ratio on cylinder head temperature, power and specific fuel consumption at constant RPM and manifold pressure in cruise range operation for "IO-390 series" engine (60297-29, page 3-5).



Systems location for "IO-390 series" series engine (60297-29, page 7-4).



Cylinder numbering system, from top of engine (IOM-IO-390-C, January 2017, page 6).



Lubrication system diagram (Textron Lycoming “Troubleshooting high oil temperature”, page 1)

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4 Emergency Procedures

Available in Checklist.

5 Normal Procedures

Available in Checklist.

6 Performance

6.1 Stall and Approach Speeds

		Flap Position			
Speed	**Weight**	**-3°**	**15°**	**25°**	**40°**
Stall	1,700 lbs				47 KIAS
	2,050 lbs	62 KIAS			51 KIAS
Approach 1.3xV_S	1,700 lbs				61 KIAS
	2,050 lbs	81 KIAS			66 KIAS

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7 Weight and Balance

7.1 General

This section describes the procedure for establishing the basic empty weight and moment of the aircraft. Sample forms are provided for reference. Procedures for calculating the weight and moment for various operations are also provided.

7.2 Airplane Weighing Procedure

Weigh the aircraft with three platform type scales which have been certified for accuracy. The airplane should be weighed in the empty condition and in a level attitude. Level attitude is established at the datum line which is the fuselage longeron at the base of the canopy. Scales should be placed simultaneously under both main wheels and the nose wheel, preferably by rolling the aircraft up on the scales via ramps so that the scale readings are not skewed by lateral loading.

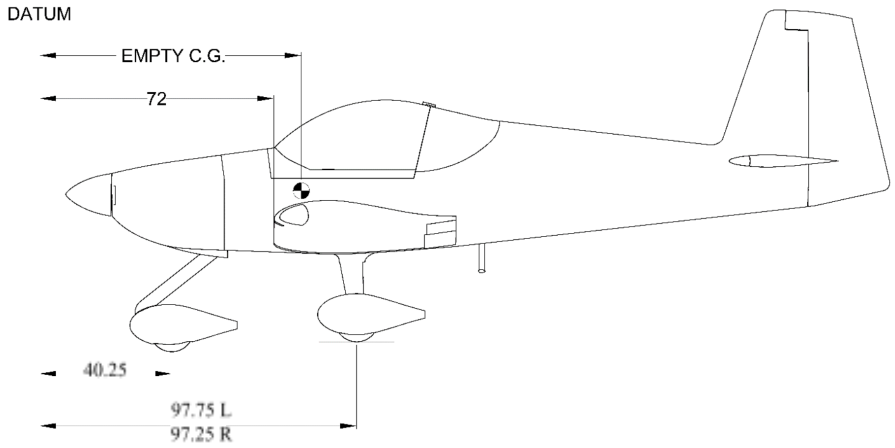
When the aircraft is in its level flight attitude, drop a plumb line from the datum and make a mark on the hangar floor below the tip of the bob. Draw a chalk line through this point parallel to the longitudinal axis of the aircraft. Then draw lateral lines between the actual weighting points for the main wheels, and make a mark along the longitudinal line at the weighing point for the nose wheel or the tail wheel. These lines and marks on the floor allow you to make accurate measurements between the datum and the weighting points to determine their arms.

The forms at the end of this section show a sample calculation of the empty weight center-of-gravity for an RV-14A. To keep all moments positive, a datum has been selected at a point forward of the prop spinner. Only three moments must be calculated and combined to determine the CG position.

7.3 Empty Weight and Balance Data

The datum is located 72” forward of the wing leading edge.

	Weight (lbs)	Arm (inches)	Moment (lb-in)
Left	456	97.25	44,432.64
Right	462	97.75	45,086.58
Nose	362	40.25	14,548.78
Total	1,280		104068
CG		81.3”	

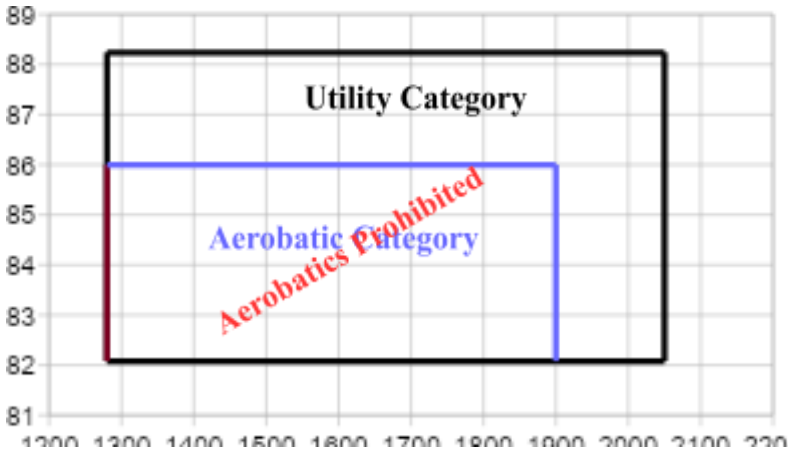


7.4 Weight and Balance for Flight

The table below can be used to determine the total weight and moment for a particular manifest. The moments can be found by multiplying the weight by arm. The final CG is then found by dividing the total moment by the total weight. The CG must be in the ranges specified in §2.7 or illustrated in the operating envelopes figure below, as appropriate for the category of operation.

	Weight (lbs)	Arm (inches)		Moment (lb-in)
Empty	1,280	81.3		104,068.00
Fuel		81.36 gallons•1.22/45	+	
Passenger		99.83		
Pilot		99.83		
Baggage		129.48		
Total				
CG				

The weight/moment operating envelopes are illustrated below.


89
88
87
86
85
84
83
82
81
Utility Category
Aerobatic Category
Aerobatics Prohibited

7.5 Example Weight and Balance Calculations

7.5.1 Utility Category

Utility Category

Most Aft Weight / CG	Wt. (lb.)	Arm (in.)	Moment (in.lb.)
Aircraft Empty =	1280	81.31	104077.00
Left Seat =	170	99.83	16971.10
Right Seat =	170	99.83	16971.10
Baggage =	100	129.48	12948.00
Fuel =	24	82.61	1982.57
Weight =	**1744**		**152949.77**
CG =		**87.70**	

Most Forward Weight / CG	Wt. (lb.)	Arm (in.)	Moment (in.lb.)
Aircraft Empty =	1280	81.31	104077.00
Left Seat =	170	99.83	16971.10
Right Seat =	0	99.83	0.00
Baggage =	0	129.48	0.00
Fuel =	304.8	81.34	24791.92
Weight =	**1754.8**		**145840.02**
CG =		**83.11**	

Gross Weight / CG	Wt. (lb.)	Arm (in.)	Moment (in.lb.)
Aircraft Empty =	1280	81.31	104077.00
Left Seat =	170	99.83	16971.10
Right Seat =	170	99.83	16971.10
Baggage =	98	129.48	12689.04
Fuel =	304.8	81.34	24791.92
Weight =	**2022.8**		**175500.16**
CG =		**86.76**	

Flight Test Weight / CG	Wt. (lb.)	Arm (in.)	Moment (in.lb.)
Aircraft Empty =	1280	81.31	104077.00
Left Seat =	167	99.83	16671.61
Right Seat =	0	99.83	0.00
Baggage =	0	129.48	0.00
Fuel =	304.8	81.34	24791.92
Weight =	**1751.8**		**145540.53**
CG =		**83.08**	

7.5.2 Aerobatic Category

Aerobatic Category

Most Aft Weight / CG	Wt. (lb.)	Arm (in.)	Moment (in.lb.)
Aircraft Empty =	1280	81.31	104077.00
Left Seat =	170	99.83	16971.10
Right Seat =	0	99.83	0.00
Baggage =	0	129.48	0.00
Fuel =	24	82.61	1982.57
Weight =	**1474**		**123030.67**
CG =		**83.47**	

Most Forward Weight / CG	Wt. (lb.)	Arm (in.)	Moment (in.lb.)
Aircraft Empty =	1280	81.31	104077.00
Left Seat =	170	99.83	16971.10
Right Seat =	0	99.83	0.00
Baggage =	0	129.48	0.00
Fuel =	304.8	81.34	24791.92
Weight =	**1754.8**		**145840.02**
CG =		**83.11**	

Gross Weight / CG	Wt. (lb.)	Arm (in.)	Moment (in.lb.)
Aircraft Empty =	1280	81.31	104077.00
Left Seat =	170	99.83	16971.10
Right Seat =	170	99.83	16971.10
Baggage =	0	129.48	0.00
Fuel =	248	81.59	20235.55
Weight =	**1868**		**158254.75**
CG =		**84.72**	

Flight Test Weight / CG	Wt. (lb.)	Arm (in.)	Moment (in.lb.)
Aircraft Empty =	1280	81.31	104077.00
Left Seat =	167	99.83	16671.61
Right Seat =	0	99.83	0.00
Baggage =	0	129.48	0.00
Fuel =	304.8	81.34	24791.92
Weight =	**1751.8**		**145540.53**
CG =		**83.08**	

This specific airframe has not demonstrated aerobatic maneuvers in Phase 1 operations. Until then, the airframe is prohibited from executing aerobatic flight.

8 System Descriptions

8.1 The Airplane

The airplane is a single engine, normally aspirated, low wing configuration with tricycle landing gear. The airframe is aluminum alloy construction except for some steel components comprising: Engine mount, landing gear legs, elevator control horns, control surface bellcranks, control sticks and their bases, steps and other miscellaneous items. The tips of the wings and tail surfaces as well as cowling, landing gear fairings, empennage fairings and canopy fairing are fabricated from fiberglass. The wing airfoil is SSV-2315.

8.2 Engine and Components

The aircraft is powered by a Lycoming IO-390, direct drive, horizontally opposed, fuel injected engine rated at 215 HP. The engine is fitted with a 60 Amp 14 Volt main alternator with internal regulator and external filter (Lonestar LS03-01004). A switchable 40 Amp B&C BC410-H alternator is installed with an LR3D-14 regulator. Ignition is provided by a conventional dual Slick magneto system, model 6350. The engine incorporates a mechanical fuel pump and an alternate air induction system. The starter is a Sky-Tec model 149-12LS which provides ~170 RPM at 11 V and 185-285 A. The exhaust system is all stainless steel with no muffler.

Engine controls consist of throttle, propeller, mixture and alternate air door. The throttle, propeller and mixture controls are located underneath the center of the instrument panel. The alternate air door push-pull control is mounted between the throttle and propeller controls. A “ramp flap” control opens and closes a door aft of the cowl for increased airflow through the engine area/oil cooler.

The engine in this particular airframe was converted from the 210 HP -A model to the 215 HP -C model using Lycoming part number 05K29558-Y.

8.3 Propeller

The engine drives a two-blade constant speed, non-counterweighted propeller. The propeller is capable of blade angles between a low positive pitch and high positive pitch of 13.6” to 35”, respectively. This model is not equipped with an air charge and does not feather. **Hub lubrication requires Aeroshell #6**.

Centrifugal twisting moment acting on the blades moves the blades to a low blade angle to increase RPM. Since the centrifugal twisting moment is only present when the propeller is rotating, a mechanical spring is installed within the propeller to assist movement of the blades to a lower pitch position as RPM decays and to reduce the propeller pitch to the low pitch stop when the propeller is static. With the blades at low pitch, the load on the starter when starting the engine is reduced significantly. Oil pressure opposes the spring and centrifugal twisting moment to move the blades to a high blade angle (high pitch), reducing engine RPM. If oil pressure is lost at any time, the propeller will move to low pitch. This occurs because the spring and blade centrifugal twisting moment are no longer opposed by hydraulic oil pressure. The propeller then reduces blade pitch to the low pitch stop.

8.4 Landing Gear

The landing gear is a tricycle configuration with steel landing gear legs. The nose wheel is free castering. All tire sizes are 5.00-5, 6-ply. Air pressure for main tires is 40 PSI and 35 PSI for nose tire.

8.5 Brake System

The braking system consists of toe brakes attached to both the pilot and copilot side rudder pedals operating two brake master cylinders. The left and right brake master cylinders share a common fluid reservoir installed on the top right forward face of the firewall. Royco 782 brake fluid is used to meet MIL-PRF-83282.

8.6 Flight Control System

Dual controls are fitted. Elevator and ailerons are operated through a system of adjustable push rods. The rudder is operated through a cable system attached to the rudder pedals. Pitch trim is by a single tab on the left elevator actuated by an electric servo controlled by a hat switch on both control stick grips. Roll trim, though provisioned, is not installed. There is no yaw trim. Flaps are operated electrically and are controlled by a momentary switch mounted in the center of the panel, above the throttle control. Both pitch trim and flap position are depicted on indicators located in the PFD screen of the EFIS.

8.7 Fuel System

Fuel is stored in two 25.4 U.S. gallon tanks, each secured to the leading edge of the left and right main wing spars. Fuel drains are fitted to the lowest point of each tank and should be opened prior to the first flight of the day and after each refueling to check for sediment and water.

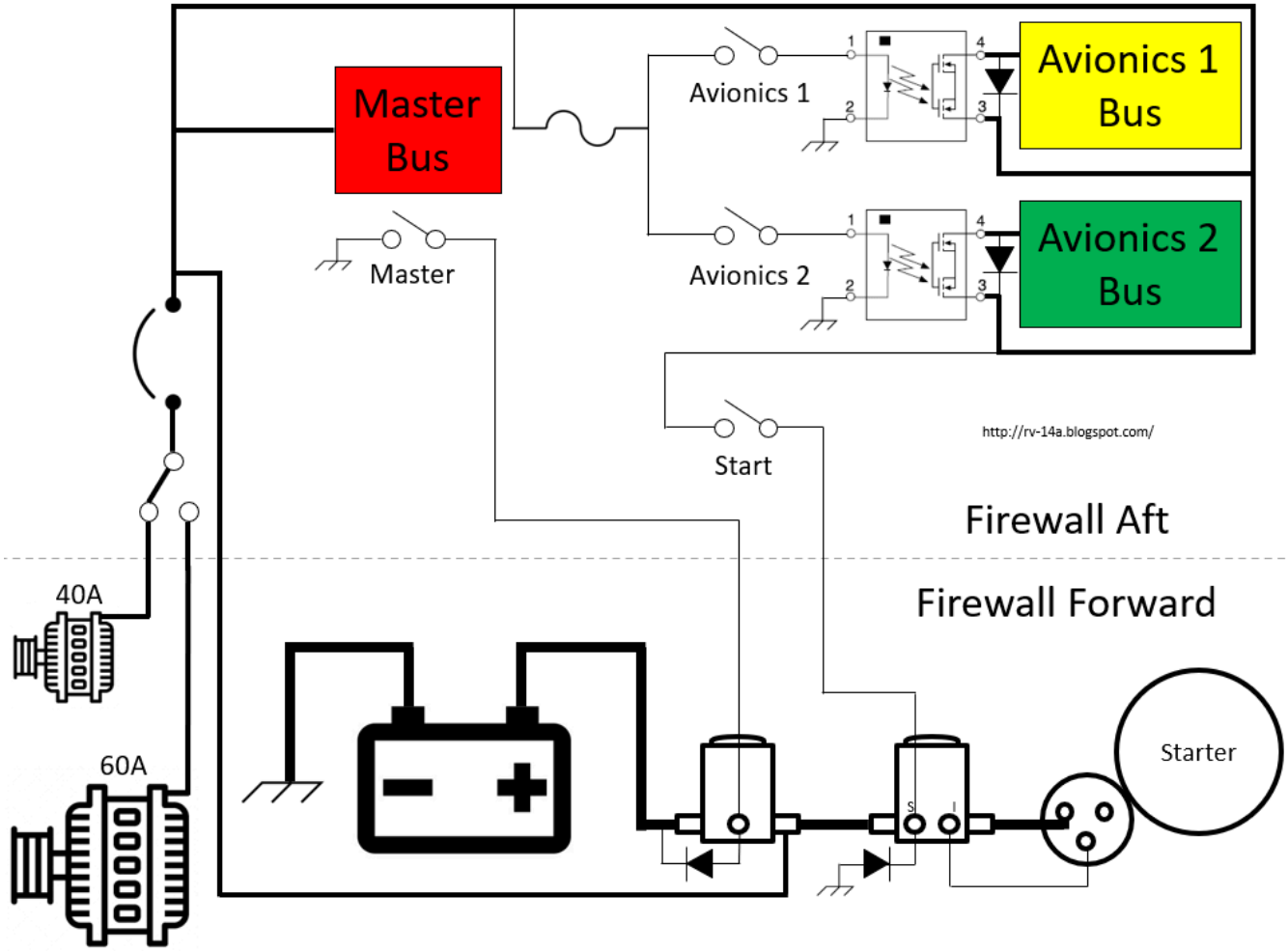
The wing tank fuel is routed to the fuel selector valve which is located on the center tunnel in between the pilot and copilot positions. The handle points to the tank in use or the “OFF” position. A knob on the valve handle must be lifted to change the selection to or from the “OFF” position. Left/Right may be selected without lifting the lever.

Fuel that leaves the selector valve is routed to the fuel filter which is located in the center tunnel. Fuel then flows to an electric boost pump which is fitted in case of failure of the engine-driven fuel pump and is also used during takeoff and landing. The boost pump is controlled by a switch on top left area of the panel. A fuel flow transducer is fitted below the number 4 cylinder of the engine. On the engine side of the firewall, fuel flows to a manifold on the upper left firewall which houses the fuel pressure transducer and also goes to the engine driven fuel pump. The system includes no accommodation for inverted flight.

The fuel flow and pressure transducers are displayed on the EFIS. Fuel quantity gauges are provided on the EFIS system through the use of resistive floats in each tank. Capacitive-based sensors, located in each tank, also provide fuel quantity information through the use of a 2.25” round gauge on the lower right of the panel (Swift DF2-V). The senders (Princeton 5S) are located on the tank attach brackets, behind the lower wing root fairings. Additionally, optically-based (via Honeywell LLE1020000 sensors) low-level announciation for each tank is provided through two lamps on the center-top of the panel with simultaneous aural warning on the intercom's AUX2 input (Aircraft Extras Fuel Guardian). Associated warnings occur when 0.64 gallons remain in the left tank and 0.84 gallons remain in the right tank.

8.8 Electrical System

A diagram of the electrical system follows.



The electrical distribution system consists of an Odyssey ES PC680 battery (specifications below) and Plane Power AL12-EI60 14 Volt, 60 Ampere alternator (with internal crowbar over-voltage protection) and 40 Ampere backup alternator. The battery is connected to the Master bus via the contactor located on the left forward side of the firewall. Both alternator outputs are routed through a 60 A circuit breaker, located above the fuse block underneath the center of the panel, prior to its connection to the Master bus. The battery is charged, and all other aircraft electrical systems are energized, by the alternator so long as the 60 A circuit breaker is not tripped. If the 60 A breaker trips, all aircraft electrical systems are powered by the battery with the latter's remaining available charge.

There are three buses: Master, Avionics 1 and Avionics 2. The Master bus, energized via the Master switch on the bottom left of the panel, powers essential and independently switchable non-essential flight systems. ***The Master bus is the only bus designed to be energized during engine start.***

The Avionics 1 bus can be switched on only when the Master bus is energized. It powers

additional important flight systems. The switch for this bus is located above and to the left of the Master Switch. The left side EFIS is additionally switchable (when Avionics 1 is energized) via a red-capped micro toggle switch on the lower left of the panel.

The Avionics 2 bus, also switchable and available only when the Master bus is energized, powers less critical flight systems. The switch for this bus is above the Master Switch.

Though the switches for Avionics 1 and Avionics 2 buses described above are responsible for turning on the associated buses, these switches independently control solid state relays (SSRs) which subsequently energize the buses. Avionics 1 SSR is located behind the left EFIS. Avionics 2 SSR is located behind the right EFIS. The power to the SSRs is routed through a 1 Amp fuse located forward of the subpanel behind the left EFIS.

Odyssey ES PC680 Battery

Parameter	Value
Voltage	12 V
Pulse Hot Cranking Amps (PHCA)	520 A
Cold Cranking Amps (CCA)	170 A
Hot Cranking Amps (HCA)	350 A
Marine Cranking Amps (MCA)	280 A
Nominal Capacity	16 Ah (20 and 10 hour rates)
Reserve Capacity	24 minutes
Dimensions (LxWxH)	7.27 x 3.11 x 7.55 inches
Weight	15.4 lbs
Terminal	M6 or SAE 3/8-16” receptacle
Torque Specs	50 in-lbs
Internal Resistance	7.5 mΩ
Short Circuit Current	1,000 A

Follows are pictorial representations of the system constituents in each element of the bus topology.

Master Bus

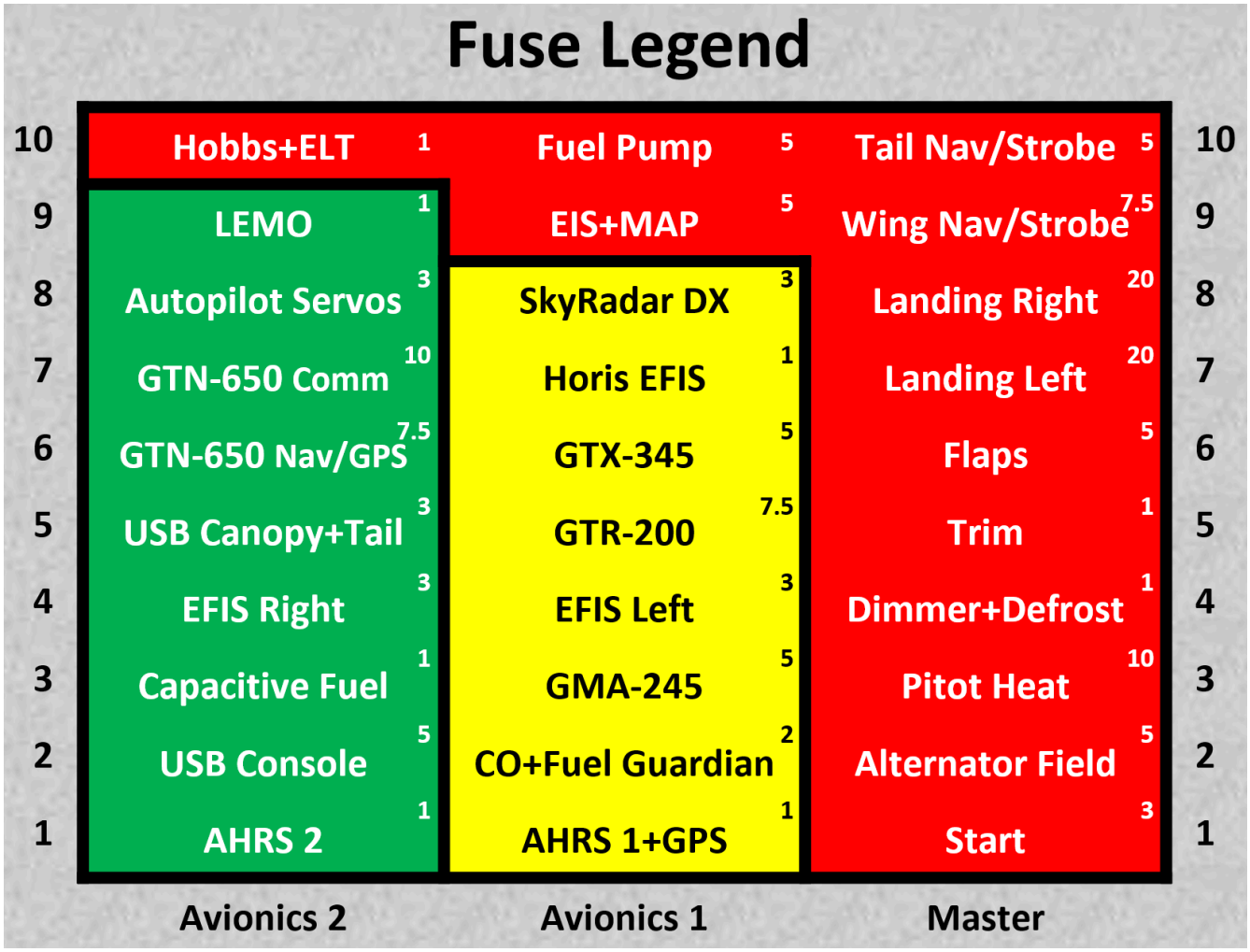
Avionics 1 Bus

Avionics 2 Bus

8.9 Fuse Block

The color-coded Fuse Legend below indicates the different systems included on each bus: Master, Avionics 1 and Avionics 2. Superscript numbers to the right of each fuse position delineates the associated fuse size in Amperes (ATM blade form factor). Blown fuses will announciate via illumination, except those of 1 and 2 A capacities.

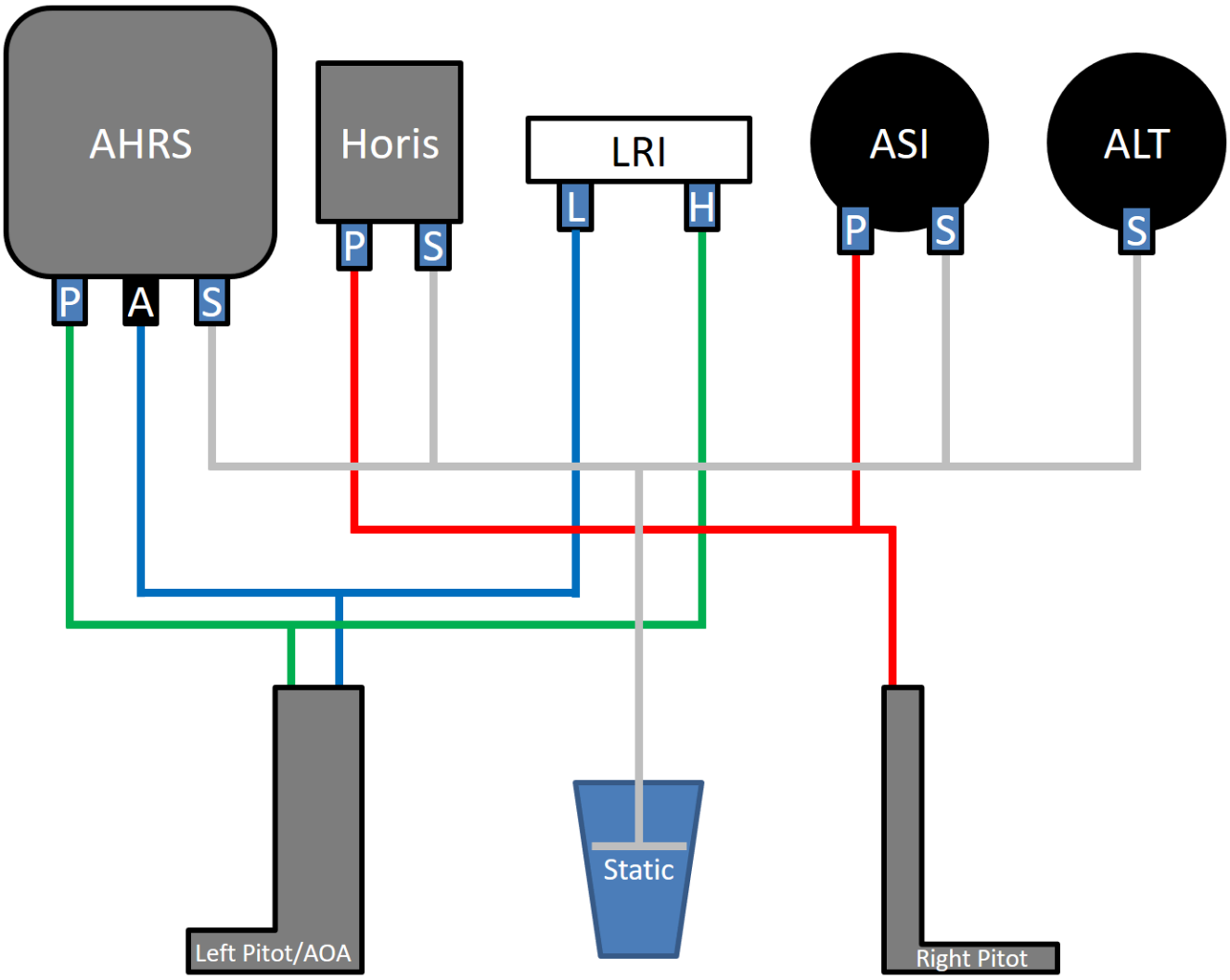
Note that the "Alternator Field" fuse carries current for both the main alternator and backup alternator. If this fuse should open, Turn off both alternators using the switch on the panel, replace the fuse then select the other alternator.



8.10 Pitot-Static System

The static pressure ports, located on the rear sides of the fuselage, provide static pressure to the GRT AHRS behind the subpanel, the airspeed indicator (ASI) and altimeter (ALT). The latter two of which are on the far right side of the panel. There is no alternate static source.

There are two pitot tubes. The pitot tube under the right wing provides pitot pressure to the air speed indicator on the far right of the panel and to the Horis ADAHRS (air data, attitude and heaing reference system). The pitot tube under the left wing is heated (when activated by the switch labeled "Pitot Heat" on the top left of the panel). It feeds pitot pressure to the AHRS and to the Lift Reserve Indicator (LRI) on the right of the panel. This pitot also provides Angle-of-Attack pressure which is fed to both the AHRS and LRI.



8.11 Instrument Panel

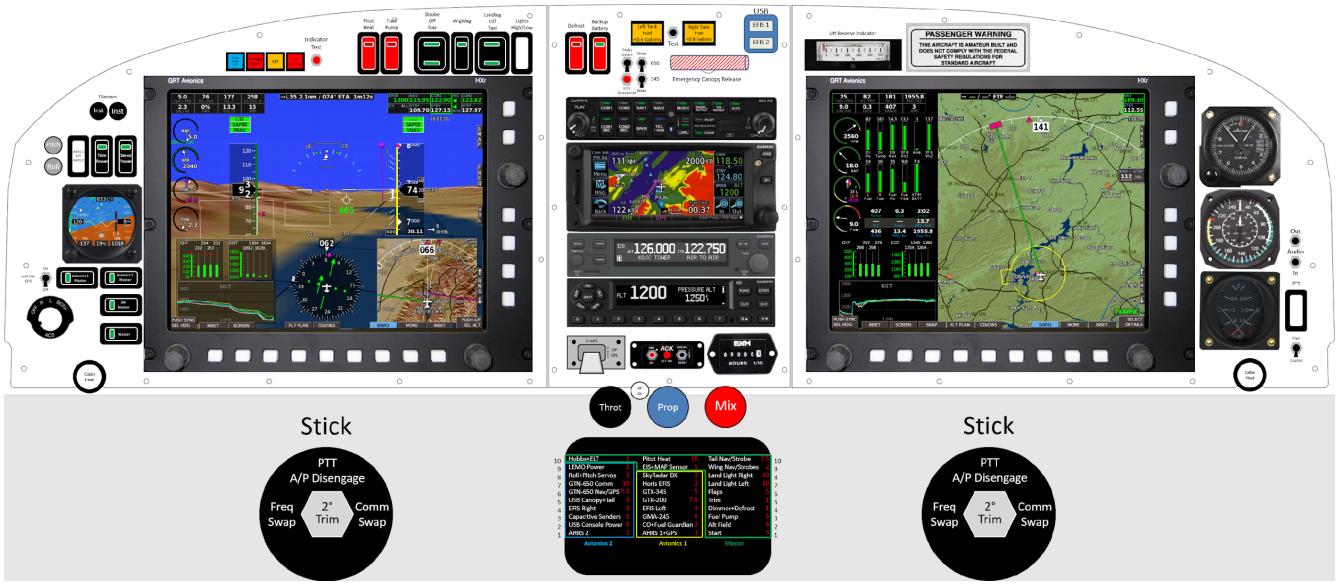
The instrument panel consists of the following avionics:

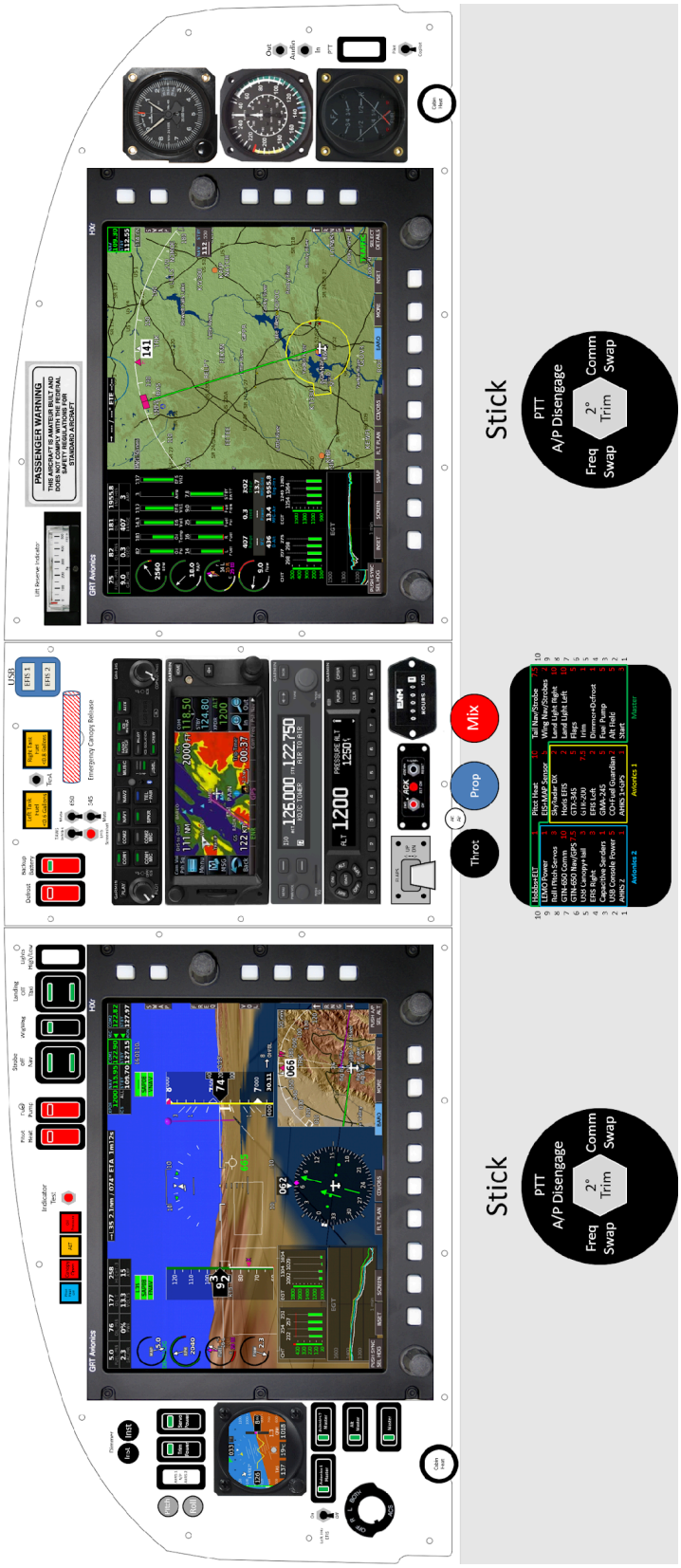
- Two each 12.1” Grand Rapids Technologies EFIS displays.
- Garmin GMA-245 intercom system.
- Garmin GTN-650 GPS/Nav/Com system.
- Garmin GTR-200 transceiver.
- Garmin GTX-345 transponder.
- Kanardia Horis 57 air data, attitude and heading reference system.
    - With UPS-L backup battery for ~180 minutes of power.

Additional items on the panel include:

- ELT remote control switch.
- HOBBS meter.
- Flap switch.
- Emergency canopy jettison pull handle.
- Lift Reserve Indicator.
- Altimeter.
- Airspeed indicator.
- Capacitive-based fuel capacity indicators for both tanks.
- Low level fuel indicators and mute/reset button, optically based.
- USB jacks for both EFIS systems.
- Indicator lamps, with adjacent momentary push-to-test button, for:
    - Pitot heat off.
    - Canopy open.
    - Alternator status.
    - Oil pressure inadequate.
    - CO level unsafe
- Dual color interior lighting PWM dimmers.
- CO Guardian 353P-201 carbon monoxide and cabin pressure monitor behind right EFIS.
- Switches:
    - Landing/Taxi.
        - High/Low.
        - WigWag.
    - Pitot heat switch.

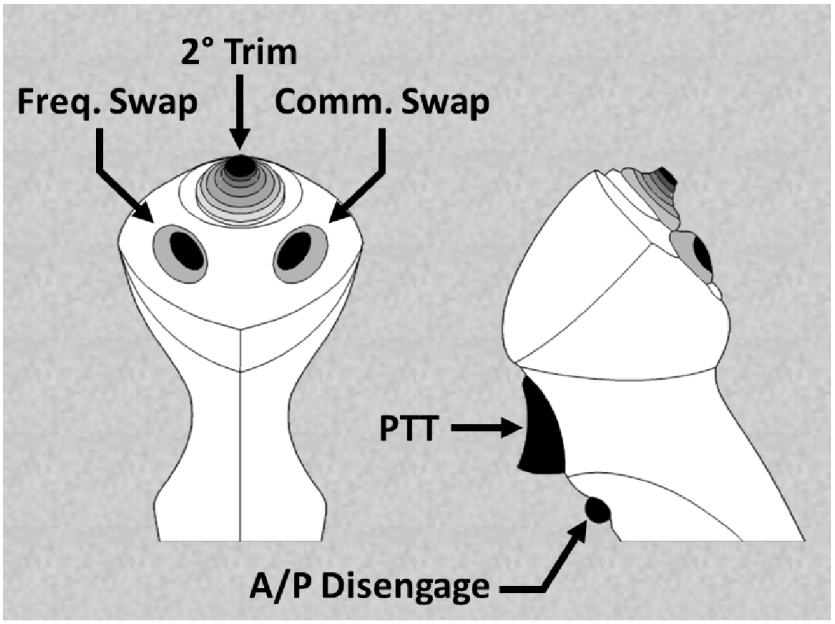
    - Canopy defrost/avionics cooling switch.
    - Fuel pump.
    - Trim power.
    - Autopilot.
        - Autopilot servos power.
        - Autopilot AHRS selection.
        - Independent roll and pitch engage/disengage momentary push-buttons.
    - Alternator field.
    - Bus control.
        - Master.
        - Avionics 1.
            - Independent left EFIS power toggle switch.
        - Avionics 2.
    - UPS for Horis
- Mute controls for GTN-650 and GTX-345.
- EFIS screenshot momentary switch (saves to external USB drives).
- TAWS inhibit switch for GTN-650.
- Keyed ignition switch with Off/Left/Right/Both.
- Heat push/pull knobs.
- Momentary PTT with toggle switch for Pilot or Copilot microphone audio.
- 1/8” stereo jacks for audio input and output.


PASSENGER WARNING
Throt
Prop
Mix
Stick
PTT
A/P Disengage
Freq Swap
2° Trim
Comm Swap
Stick
PTT
A/P Disengage
Freq Swap
2° Trim
Comm Swap


PASSENGER WARNING
Stick
PTT
A/P Disengage
Comm Swap
Freq Swap
2° Trim
Mix
Prop
Throt

8.12 Control Sticks

Below is a legend of the buttons on the control sticks. Both control sticks function identically.



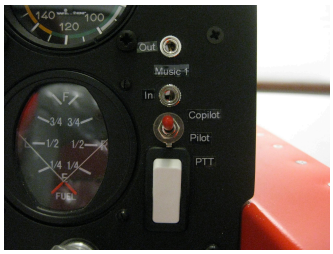
8.13 Heating, Ventilation and Defrosting System

Cabin heat is provided via heat muffs attached to the exhaust system and fed with high pressure air taken from the baffling. The heated air is ducted through the firewall for each seat to the foot well of the pilot and copilot stations. Ventilation air is supplied from two NACA inlets located on the sides of the fuselage forward of the pilot and co-pilot stations. The associated air is fed to eyeball vents under the left and right sides of the instrument panel.

8.14 Cabin Features

Both seats are equipped with Crow 5 point harnesses with a cam-type lock/release mechanism. The seats are removable. The upper portion of the seat is held to the seat back with four snap-buttons each and Velcro. The lower portion of the seat is held in place by Velcro. Once seat cushions are removed, the hinge-attach pins can be removed and the seat backs can be then be removed.

On the right lower side of the panel is a momentary PTT switch. An associated toggle switch immediately above selects pilot or copilot audio for the active transceiver. Above both are the *Music 1* input and output 1/8” stereo jacks. Between the seats is located a dual USB power socket, capable of providing 2.4 A per port. Adjacent to the USB sockets is a 1/8” stereo jack for the *Music 2* input.



A dual color PWM LED strip on the bottom of the aft glareshield is controllable by dimmers on the upper left of the panel. Each color, red and white, is independently adjustable between “OFF” and full brightness.

A CO Guardian 353P-101 carbon monoxide and pressure sensor is affixed to the subpanel behind the right EFIS. Associated alarms are annunciated and reset through the EFIS.

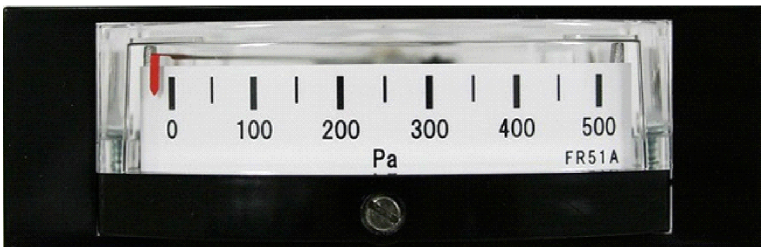
For the purpose of a mounted video camera, in the center of the canopy frame is located a dual USB jack for providing up to 4.2 Amps total current and a 1/8” stereo cable providing intercom audio. The same dual USB jack is provided in the tail and is accessible through the inspection plates under the horizontal stabilizer. This jack is for use with a tail-mounted video camera that is attached to the airframe through the tail tiedown. Images are below.


XPERIMENTAL

8.15 Stall Warning and Angle-of-Attack

The stall warning is triggered by the Angle-of-Attack (AOA) system, comprised by the left wing pitot and EFIS system. The Lift Reserve Indicator (LRI) provides a non-aural, visual representation of the wings' available lift.

Lift Reserve Indicator

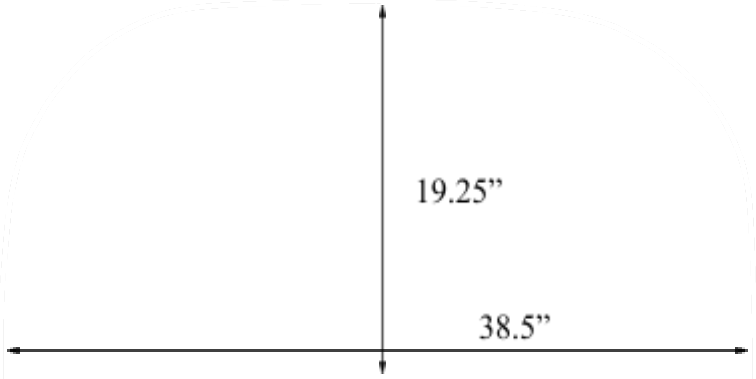


8.16 Baggage Area

The baggage area can support a maximum 100 pounds of baggage. Baggage or loads that might place significant pressure on the floor should be supported with wood boards to help distribute the weight over a larger area.

Entry Width	38.5”
Entry Height	19.25”
Volume	12+ cubic feet

Baggage entry outline.



8.17 Exterior Lighting

AveoMaxx Hercules 30 landing lights are located in the wing cutouts. Aveo ZipTips Premiere 2 wing tips include an additional set of landing and taxi lights. Both the Hercules and ZipTips are connected in parallel and are powered together when selecting “taxi” or “taxi+landing”. An Aveo PosiStrobe JP tail position/strobe light is located on the rudder. The ZipTips include forward nav/strobes and trailing position/strobe lights.

The current draw for the landing lights are listed below in Amperes.

			Wigwag	
	Low	**High**	**Low**	**High**
Taxi	8	12	4	6
Taxi+Landing	21	34	16	26

Hercules 30 Specifications

Number of LED:	30
Input voltage:	from +9 to +36 VDC
Current:	- Taxi -> max. 4.2A (12V) - Landing -> max. 6.3A (12V) - Landing + Taxi -> max. 10.5A (12V)
Output power [Hi/Low]:	- Taxi -> 45/21W - Landing -> 68/33W - Landing + Taxi -> 113W/54W
Voltage protection:	80V, both polarities
Under-voltage lockout:	8.5V , not more
Over-voltage lockout:	37V, not less
Ambient temperature:	from -55°C to +85°C (from -67°F to +185°F)
Function description:	a. Taxi, steady light - 12 LEDs b. Landing, steady light - 18 LEDs c. Taxi+Landing - 30 LEDs d. Synchro Mastrer function, active – low e. Wig-Wag – Taxi LEDs only f. Master/Slave select sequential and simultaneous Wig-Wag mode g. High/Low power select for Landing and Taxi
Beam Pattern:	a. Landing: 12° Vert 12° Horizont b. Taxi: 12° Vert 12° Horizont
Light Intensity (calculated):	a. 104.000 cd - Landing Hi b. 56.000 cd - Landing Lo c. 62.000 cd - Taxi Hi d. 32.000 cd - Taxi Lo e. 166.000 cd - Landing + Taxi Hi f. 88.000 cd - Landing + Taxi Lo
Color and shade:	cool white, 5000K – White
Programmable Soft-Start:	less than 50mS
Overheat protection:	temperature dependent decrement intensity
Weight:	less than 1.08lbs (490 g) with Aveo bracket
Useful life:	not less than 30.000,0 aircraft flight hours
Dimension:	4.33" Round x 1.79" (D = 110mm, H = 45.7mm)
Material:	a. Housing/Heatsink: Aluminum Alloy, natural anodizing b. Lens: Clear PMMA

PosiStrobe JP Specifications

Dimensions (mm):	45.3 mm x 56 mm x 30 mm
Dimensions (inches):	1.785" x 2.206" x 1.18"
Weight:	67 g / 2.363 oz
Operating Voltage Range:	9 – 18 VDC
Input Current – Position:	0.28 A @14V
Input Current – Strobe:	3.5 A @14V (peak)
Average Current Consumption per Frame – Strobe:	0.56 A
Average Current Consumption per Frame – Pos and Strobe:	0.8 A
Input Power – Position	4 W @14V
Input Power – Strobe:	49 W @14V (peak)
Repetition Rate of Strobe:	48 cycles per minute
Fuse (Circuit Breaker) Recommendation:	5A for position 5A for strobe
Operating Temperature:	from -55°C to +85°C from -67°F to +185°F
Overheat Protection:	Yes (+85°C / +185°F)
Recommended Size of Mounting Screw:	M3, #6-32
Reverse Polarity Protection:	Yes
Transient Voltage:	60V at 2sec max, both polarities
Under-Voltage Protection (lockout):	Yes (9V)
Over-Voltage Protection (lockout):	Yes (18V)
Waterproof, Dust-proof, Vibration-proof:	Yes

9 Handling, Servicing and Maintenance

9.1 General

The airplane should be moved using a tow bar which connects to the nose wheel. The airplane may be pushed or pulled from the inboard portions of the prop blades. ***Do not push on the spinner!***

9.2 Ground Handling

The airplane has three tie-down rings. One located on each wing near the outboard bellcrank access panel and another on the tail. The tie-down rings are removable and may be kept inside the baggage compartment area. The airplane can be jacked from the tie down rings or alternatively from the main spar just inboard of the main landing gear. The underside of the fuselage should be protected from the jack and the force distributed over the main spar using padded boards.

9.3 Engine Air Filter

The engine air filter is reusable. It should be cleaned in solvent and blown dry with air. The filter is then coated in oil and reinstalled. The recommended filter is K&N E-3450.

9.4 Brake Service

Brake linings are Cleveland part number 66-11200. Brake hydraulic fluid is MIL-83282 or equivalent.

9.5 Landing Gear Service

Nose wheel tire pressure: 35 PSI
Main wheels tire pressure: 40 PSI

The nose wheel break out force should be set to 25 lbs. This is measured using a spring scale and adjusted by torquing the bottom nut on the nose wheel.

9.6 Propeller Service

The propeller must be lubricated at intervals not to exceed 100 hours or at 12 calendar months, whichever occurs first. **Use only Aeroshell #6 grease**.

1. If annual operation is significantly less than 100 hours, calendar lubrication intervals should be reduced to six months.
2. If the aircraft is operated or stored under adverse atmospheric conditions, *e.g.*, high humidity or salty air, calendar lubrication intervals should be reduced to six months.

High use of the aircraft may extend the lubrication interval. Lubrication interval may be gradually extended after evaluation of previous propeller overhauls with regard to bearing wear and internal corrosion. Hartzell recommends that new or newly overhauled propellers be lubricated after the first one or two hours of operation because centrifugal loads will pack and redistribute grease,

which may result in a propeller imbalance. Redistribution of grease may also result in voids in the blade bearing area where moisture can collect.

9.7 Oil System Service

The oil system incorporates a filter model CH48110-1, which should be changed along with the oil every 50 hours. The sump incorporates a pressure screen that should be removed, inspected, cleaned and reinstalled at each oil change. The screen's associated crush washer should be discarded and replaced at this time. The part number is AN900-16/MS35769-21.

9.8 Fuel System

Remove the fuel injector screen assembly and check the screen for distortion or openings in the strainer. Clean screen assembly in solvent and dry with compressed air. To install the screen assembly, place the gasket on the screen assembly and install the assembly in the throttle body and tighten 60-70 in-lbs torque. The fuel filter can be cleaned by removing the filter from the fuel system, un-screwing the end cap of the filter assembly with a 1.5" wrench while holding the other side of the housing with a 1.375" wrench or vise. The filter should be inspected after 5-10 hours of operation on new installations and then typically every year at the condition inspection after that. Inspect more frequently if fuel conditions are uncertain. The filter element can be removed from the filter cap and cleaned in mineral spirits then blown dry with compressed air. Inspect the seal O-rings. These may be re-used if in satisfactory condition. Reassemble the filter using some engine oil on the O-rings. Make sure the conical spring is installed correctly and the filter assemble is installed back in the fuel system in the correct flow direction as designated by the arrows on the filter housing.

9.9 Battery Service

The battery is located forward of the firewall on the right side of the airframe. This battery is an Odyssey ES PC680 and is not serviceable.

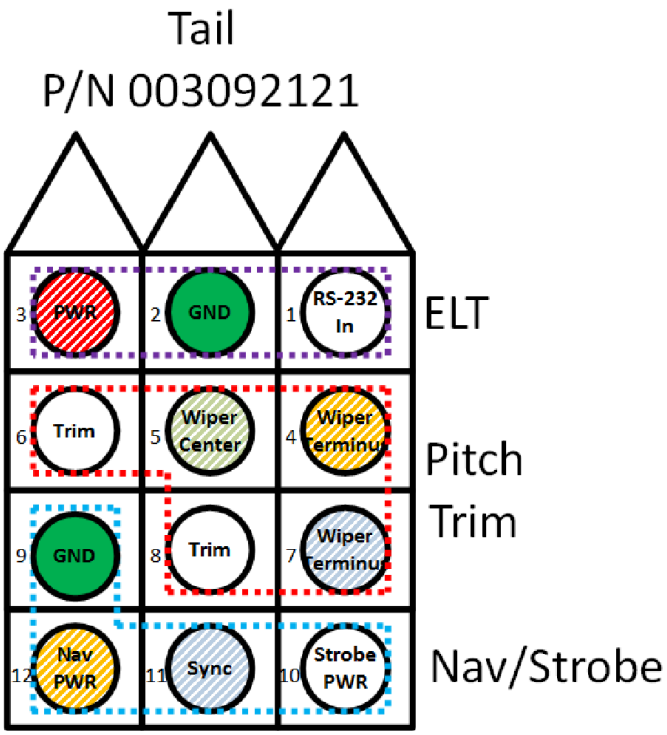
9.10 Lubrication

The landing gear nose wheel and main wheel bearings should be repacked with Aeroshell #5 grease at the annual condition inspection. The nose wheel castering bearing is fitted with a grease fitting and should be serviced with Aeroshell #5 at the annual condition inspection. The control system hinges can be serviced with LPS 2 All Purpose Lubricant or equivalent as needed.

10 Airframe Harness Wiring Maps

10.1 Tail Harness

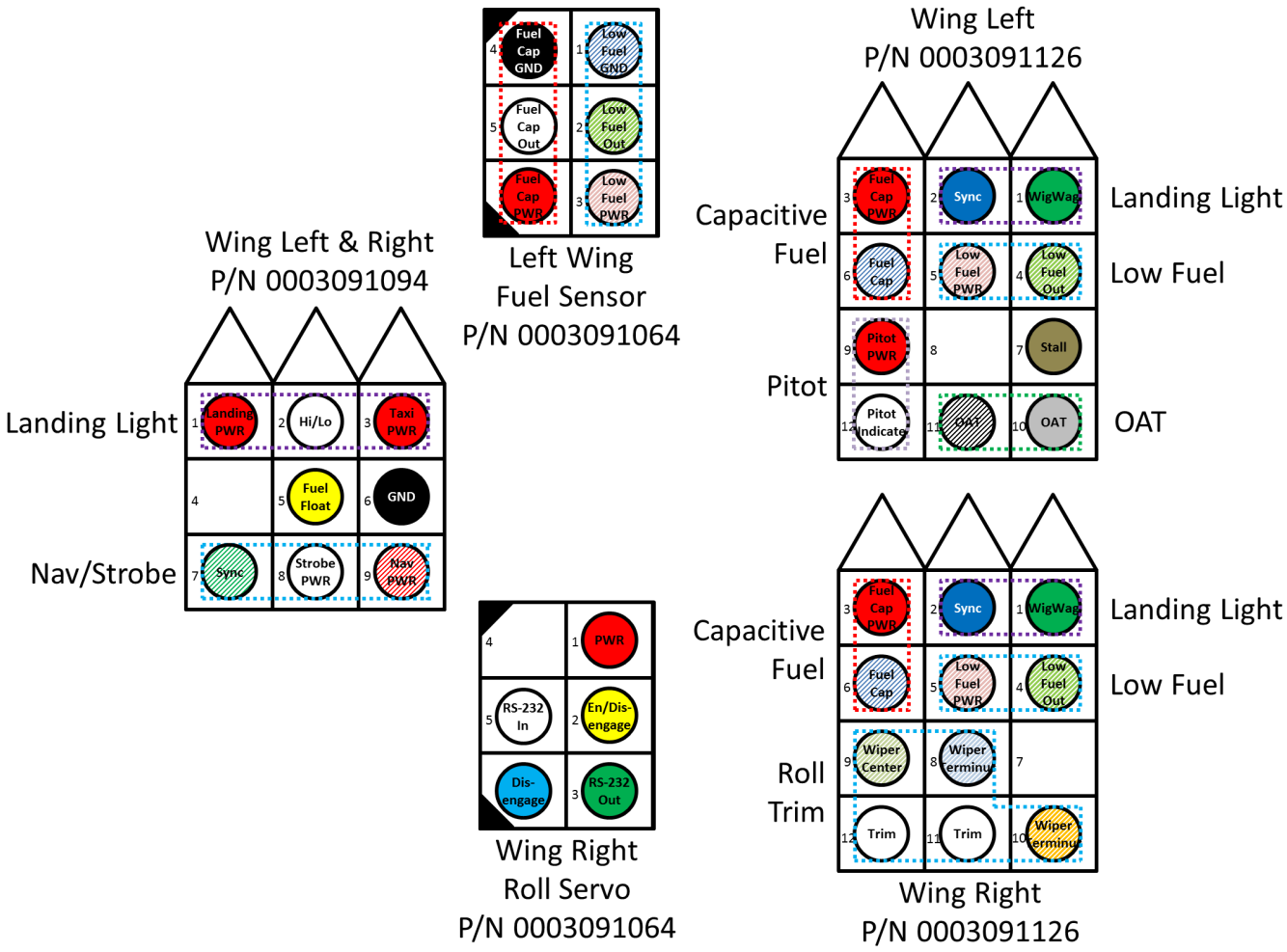
Tail harness located at aft baggage bulkhead. Pitch trim and ELT wires are 22 AWG. Nav/Strobe wires are 18 AWG shielded.



10.2 Wing Harnesses

Wing harnesses located at wing roots.

- Landing and Taxi PWR are 14 AWG. Hi/Lo is 22 AWG. Wig/Wag and Sync are 24 AWG.
  - The Sync wires from both lights are connected aft of the aft bulkhead.
- Nav/Strobe PWR are 18 AWG and Sync is 22 AWG.
  - The Sync wires are connected aft of the subpanel adjacent to the Nav/Strobe switch.
- The left Hercules 30 light “master/slave” line grounded. The right ZipTip “master/slave” is grounded.
- A splitter harness is located on the outboard of both wings that facilitate connecting the two pairs of landing and nav/strobe lights together.
- Low Fuel PWR and Out, Stall, OAT, roll trim, fuel floats are all 22 AWG.
- Roll Servo wires are 18 AWG.
- Left wing fuel sensor wires are a mixture of 22 and 20 AWG.
- Both wing Strobe PWR wires have a 6800 μF, 25 V capacitor (Illinois Capacitor 688CKS025M) acting as a filter located at the respective outboard-most wing ribs accessible by removal of the wing tips.

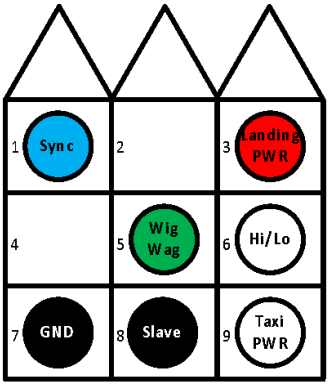

Wing Left & Right
P/N 0003091094
Landing Light
Nav/Strobe
1 Landing PWR
2 Hi/Lo
3 Taxi PWR
4
5 Fuel Float
6 GND
7 Sync
8 Strobe PWR
9 Nav PWR
4 Fuel Cap GND
1 Low Fuel GND
5 Fuel Cap Out
2 Low Fuel Out
6 Fuel Cap PWR
3 Low Fuel PWR
Left Wing
Fuel Sensor
P/N 0003091064
4
1 PWR
5 RS-232 In
2 En/Dis-engage
Dis-engage
3 RS-232 Out
Wing Right
Roll Servo
P/N 0003091064
Wing Left
P/N 0003091126
Capacitive Fuel
Pitot
3 Fuel Cap PWR
2 Sync
1 WigWag
Landing Light
6 Fuel Cap
5 Low Fuel PWR
4 Low Fuel Out
Low Fuel
9 Pitot PWR
8
7 Stall
12 Pitot Indicate
11 OAT
10 OAT
OAT
Capacitive Fuel
Roll Trim
3 Fuel Cap PWR
2 Sync
1 WigWag
Landing Light
6 Fuel Cap
5 Low Fuel PWR
4 Low Fuel Out
Low Fuel
9 Wiper Center
8 Wiper terminus
7
12 Trim
11 Trim
10 Wiper terminus
Wing Right
P/N 0003091126

10.3 Landing/Taxi Light Harnesses

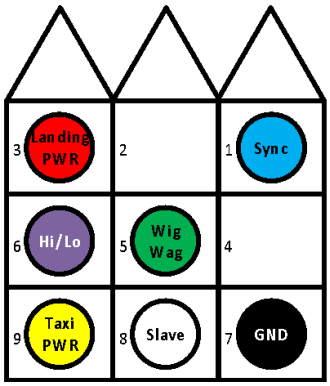
Landing/Taxi light harnesses located at landing/taxi lights.

- Landing and Taxi PWR and Ground are 14 AWG. Hi/Lo is 22 AWG. Wig/Wag and Sync are 24 AWG. Slave is 22 AWG.
- The left Hercules 30 light has its "master/slave" grounded. The right ZipTip has its "master/slave line" grounded.
- Additional splitter cables on the outboard of the wings accommodate connecting both the Hercules 30 and ZipTips.

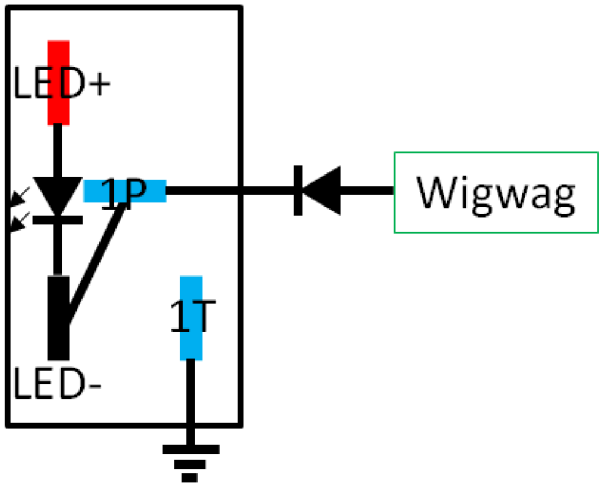
To Hercules 30 Light
P/N 0003091094



From Hercules 30 Light
P/N 0003092091



The switch control for the wigwag function is below. The wigwag line is active low. When the switch is off, the diode prevents the floating wigwag line from illuminating the switch LED. The diode is a Fairchild 1N5817, V_F=450 mV.



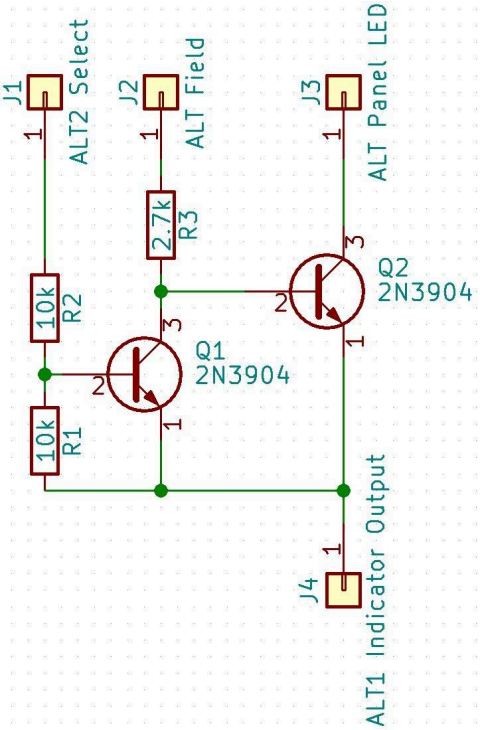
10.4 Alternator LED Indicator

A switch on the lower left of the panel controls which alternator has its field supply energized. The primary alternator has its indicator on when the alternator is either providing low output or no output (*e.g.*, when its field supply is switched off). The secondary alternator only lights the LED when 1) its field supply is on and 2) if it's output is low. So this circuit allows the primary alternator to control the indicator LED only when the secondary alternator is not selected. And the indicator output lines from both alternators are isolated from the other. The circuit is basically a pair of transistors that switch the panel LED as previously described.

With this circuit, when ALT2 (backup alternator on) is selected, Q1 turns on, which turns off Q2. When Q2 is off, the panel LED is disconnected from ALT1's indicator output. When ALT2 is off, Q1 turns off which turns on Q2. When Q2 is on, ALT1's indicator output (which is active low) is connected to the panel LED. Not shown is ALT2's indicator output (also active low) connected to J3 (via in isolating 1N5817 diode). This way, the panel LED indicates ALT1's status only when ALT2 isn't selected. Otherwise, it shows ALT2's status. This means the panel indicator light will turn on when no alternator is selected since ALT1's indicator output is pulled low when ALT1 is off. Arguably, I don't need R1, but I prefer not to have Q1's base float when ALT2 is off.

Wire colors on the circuit board (located behind the indicator LEDs behind the panel):

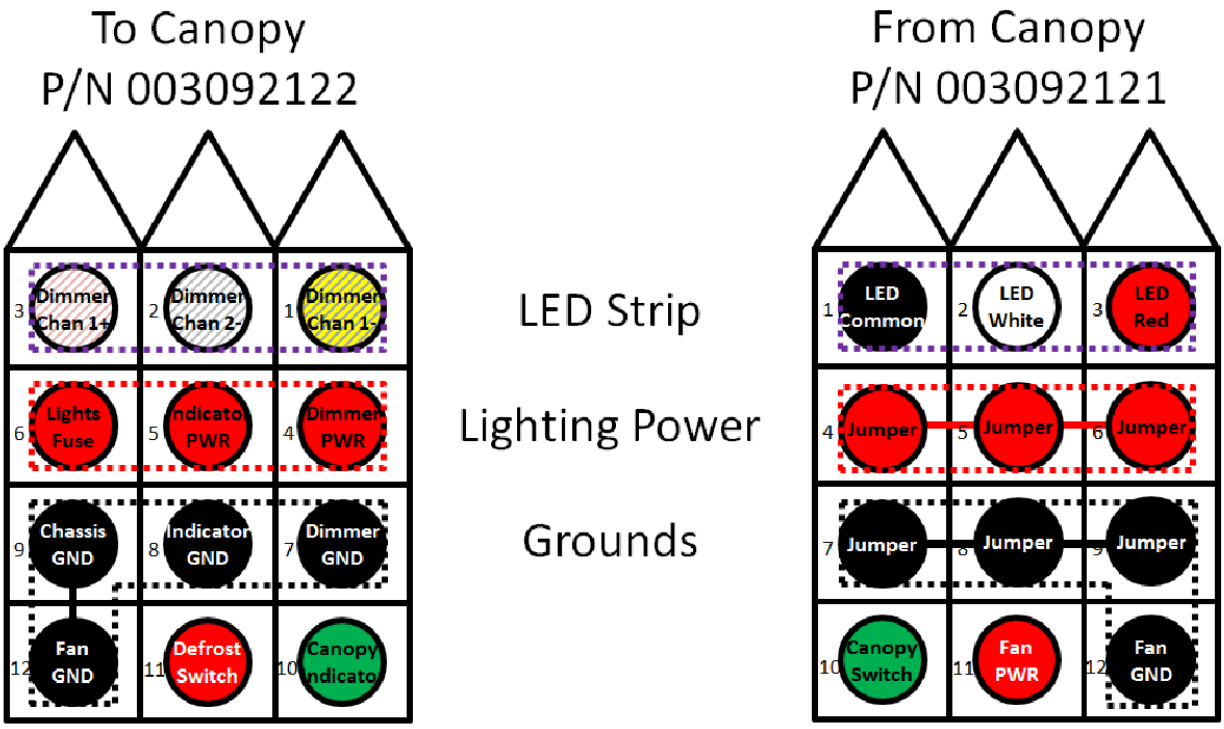
- Red=ALT2 Select
- Red/Green=ALT Field
- White=Panel LED
- Green=ALT1 Indicator Output.



10.5 Canopy Harness

Canopy harness located just below canopy near left instrument panel standoff. Positions marked "*Jumper*" are jumper wires connecting adjacent positions as indicated by the associated solid colored lines.

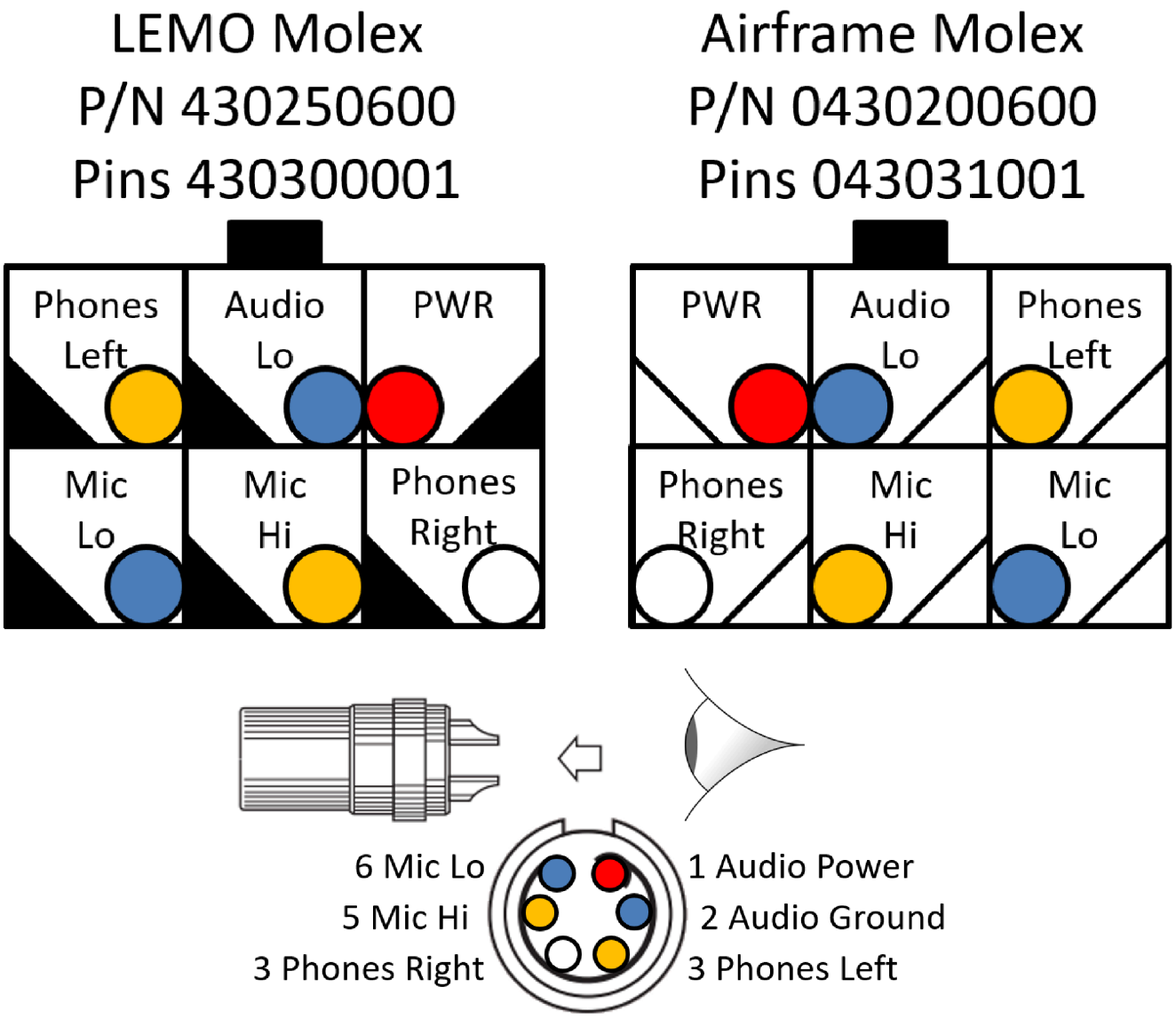
- LED are 22 AWG.
- Fan PWR and GND are 22 AWG.
- Canopy Indicator and Switch are 24 AWG.



10.6 LEMO Connector Harnesses

LEMO connectors are found outboard and aft of each seat. PWR is 22 AWG. Audio and Mic are 24 AWG shielded.

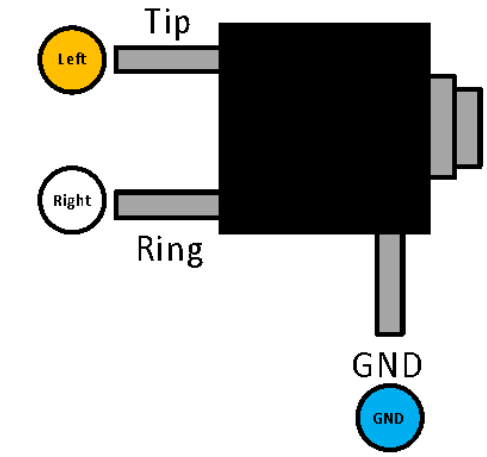
The right LEMO jack has a 100 µF, 50 V capacitor (Panasonic EEU-FC1H1011) on the power line (going to *Audio Lo*) acting as a filter.

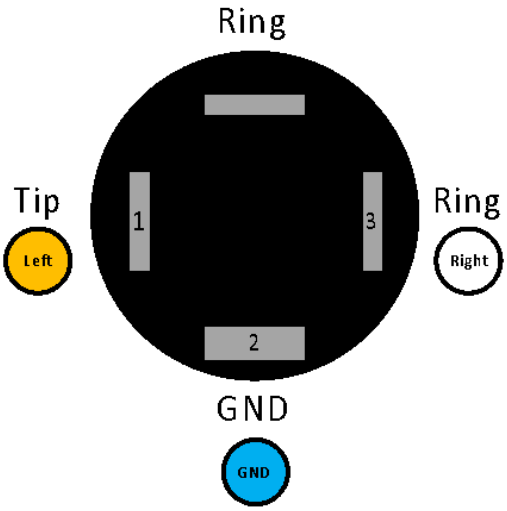


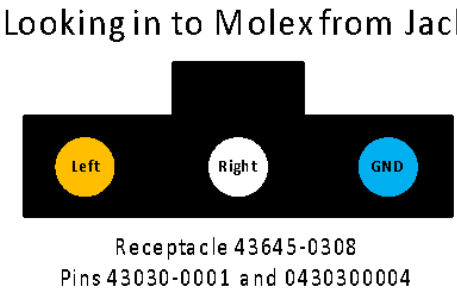
10.7 Audio Jacks Wiring

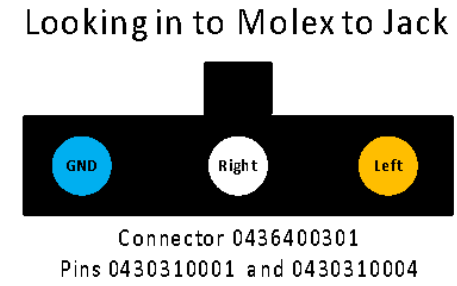
The wiring for the audio jacks ("*Music 1*" in and out). The top diagram illustrates the panel audio jacks. The bottom diagram illustrates the "*Music 2*" input jack located between the seats, adjacent to the USB sockets.

The *Music 2* jack is a Philmore 70-536 3.5mm snap-in panel mount.





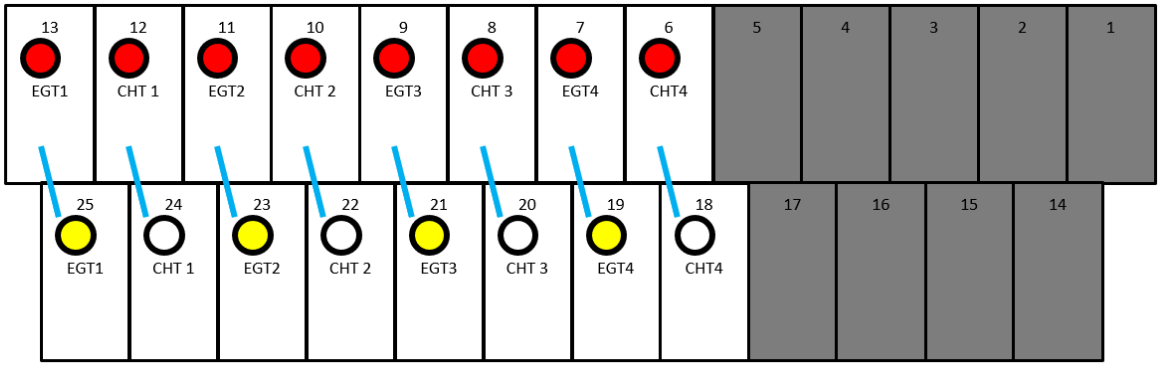




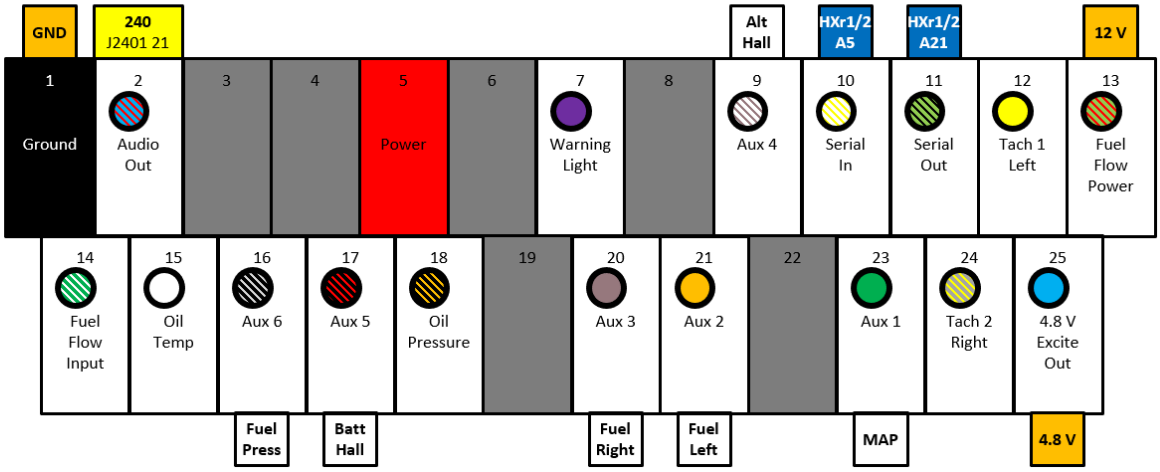
10.8 Engine Information System Wiring

Grand Rapids Technologies EIS model 4000 wiring details. Diagonal blue lines indicate twisted pairs. Serial number 22933. Fuel flow "red cube" serial number 168168.

EIS B



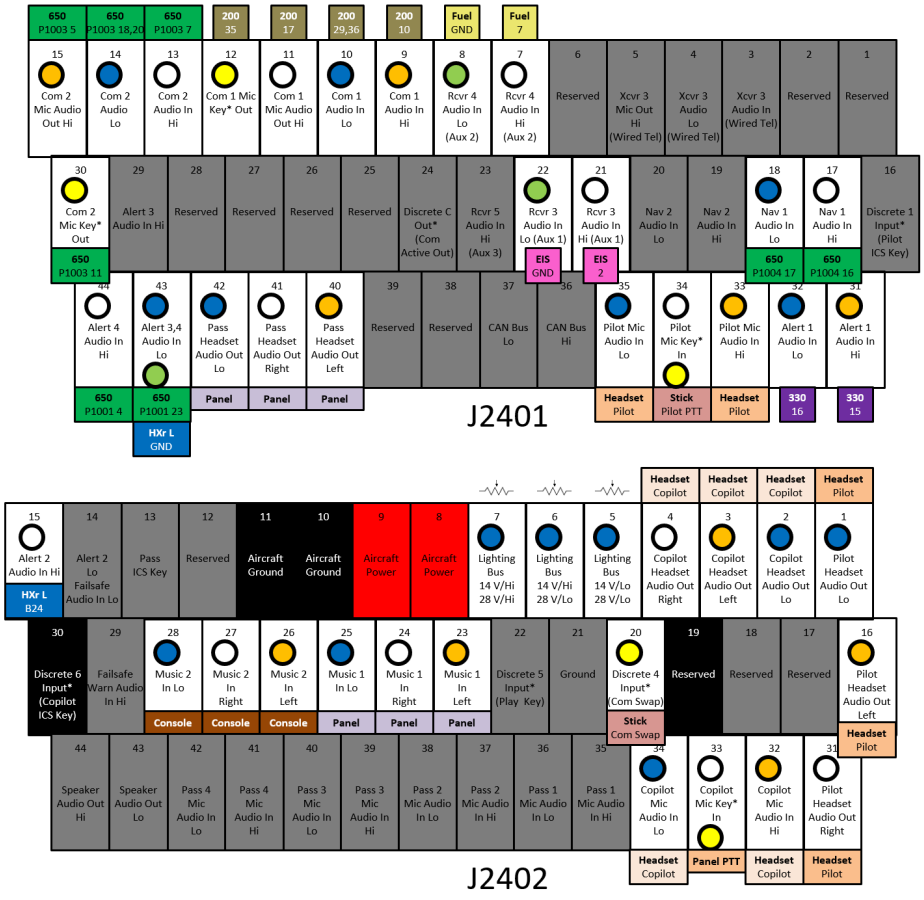
EIS A



Auxiliary Inputs		Dec/Int	Scale Factor	Offset	Fwd/Rev
1	MAP	D	196	66	Fwd
2	Left Float	D	445	1289	Rev
3	Right Float	D	366	1045	Rev
4	Alternator Hall	D	164	305	Fwd
5	Battery Hall	D	114	213	Fwd
6	Fuel Pressure	I	62	47	Fwd
	FloCal		73		

10.9 Intercom Wiring

Garmin GMA-245 intercom wiring details. Serial number 3YL002191.



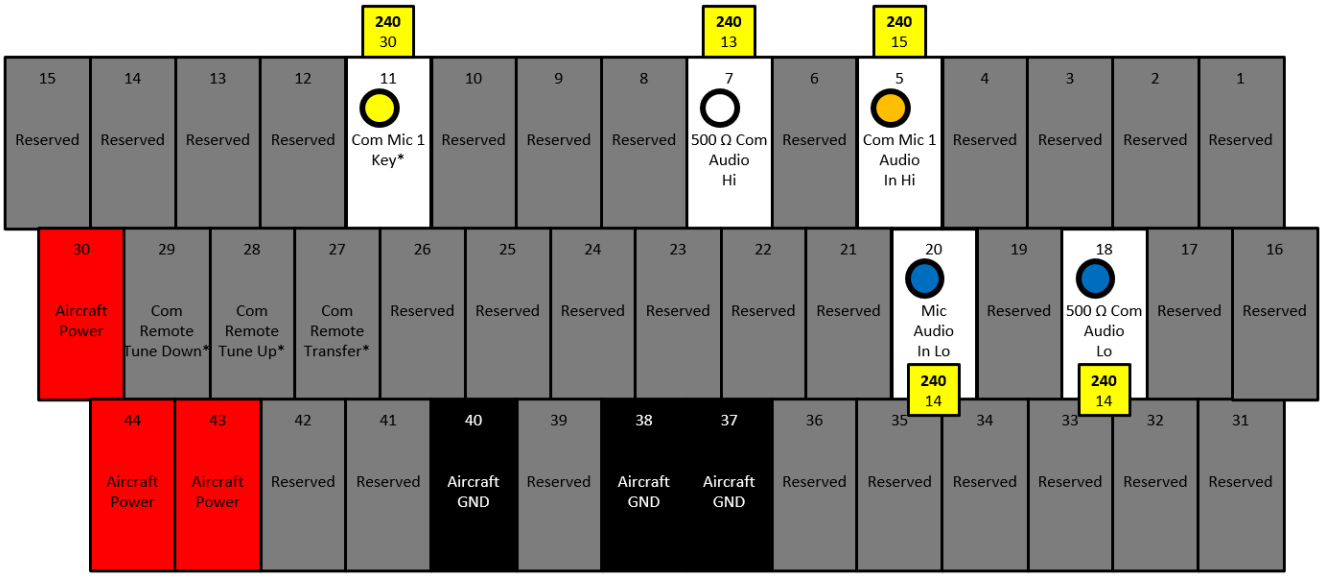
Inputs	
Com 1	GTR 200
Com 2	GTN 650
Nav 1	GTN 650
Nav 2	
Aux 1	EIS
Aux 2	Fuel
Aux 3	
Alert 1	GTX 330
Alert 2	HXr Left
Alert 3	
Alert 4	GTN 650
Music 1	Panel
Music 2	Console
Failsafe	---
Wired Tel	---

GMA 245 Pin Assignments

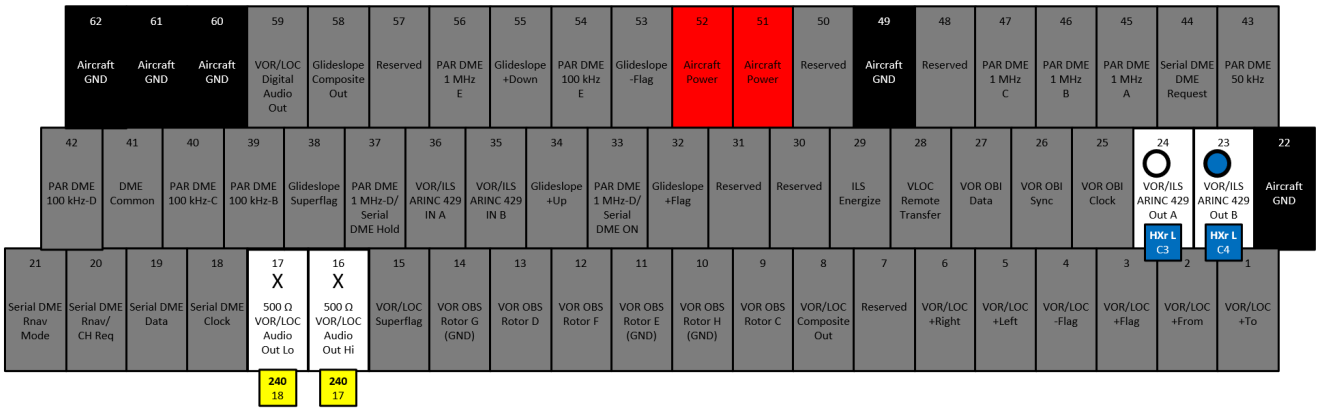
Serial Number 3YL002191

10.10 GPS/Nav/Com System Wiring

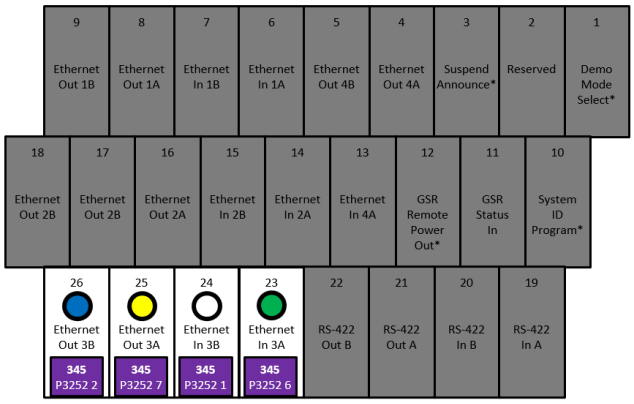
Garmin GTN-650Xi GPS/Nav/Comm system wiring details. Serial number 5FP003564.



GTN-650Xi P1003 Pin Assignments



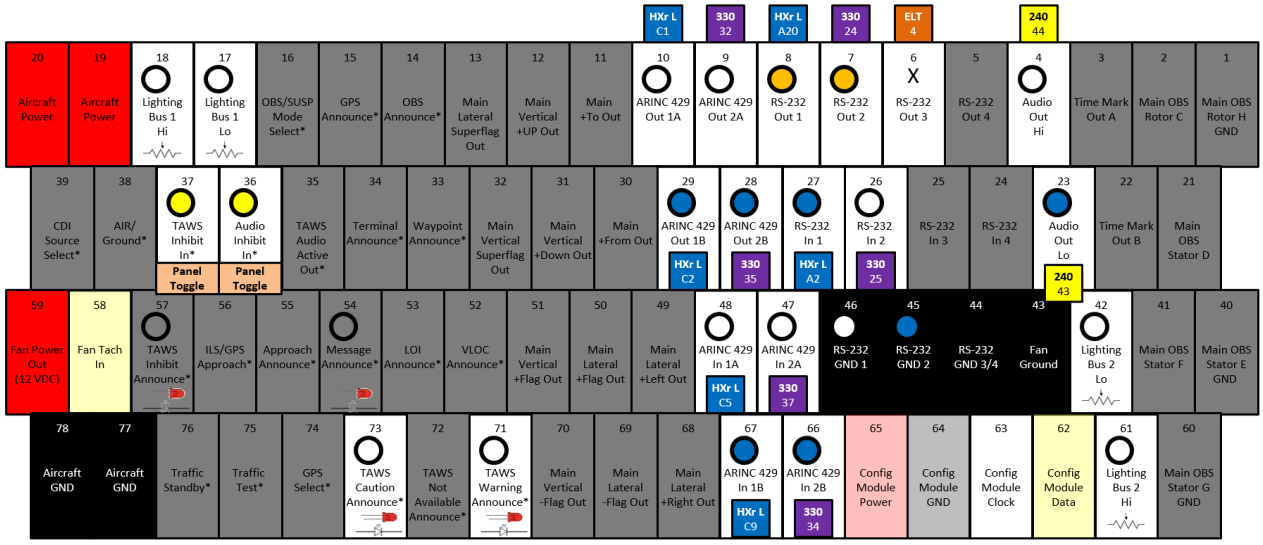
GTN-650Xi P1004 Pin Assignments



Ethernet	
IN 1	---
IN 2	---
IN 3	GTX-345
IN 4	---
OUT 1	---
OUT 2	---
OUT 3	GTX-345
OUT 4	---

RS-422	
IN	---
OUT	---

GTN-650Xi P1002 Pin Assignments



http://rv-14a.blogspot.com/

ARINC	
In 1	HXr L
In 2	GTX-330
VOR/ILS In	---
OUT 1	HXr 1
OUT 2	GTX-330
VOR/ILS Out	HXr L

RS-232	
In 1	HXr L
In 2	GTX-330
In 3	---
In 4	---
Out 1	HXr L
Out 2	GTX-330
Out 3	ELT
Out 4	---

GTN-650Xi P1001 Pin Assignments

The radio is connected to right communications blade antenna.

10.11 GPS/Nav/Com Settings

- SDI LNAV1

429 Input	Speed	Data	Device
Channel 1	Low	EFIS Format 2	HXr Left
Channel 2			GTX-345

Ethernet	On/Off	Device
Channel 1		
Channel 2		
Channel 3	On	GTX-345
Channel 4		

429 Output	Speed	Data	Device
Channel 1	Low	GAMA Format 1	HXr Left
Channel 2	Low	ARINC 743A	GTX-345

RS-232	Speed	Input	Output	Device
Channel 1	9600	FADC Format 1		HXr L
Channel 2	38400	GTX Mode S+ #1	GTX Mode S+ #1	GTX-345
Channel 3	9600		Aviation Output 1	ELT
Channel 4				

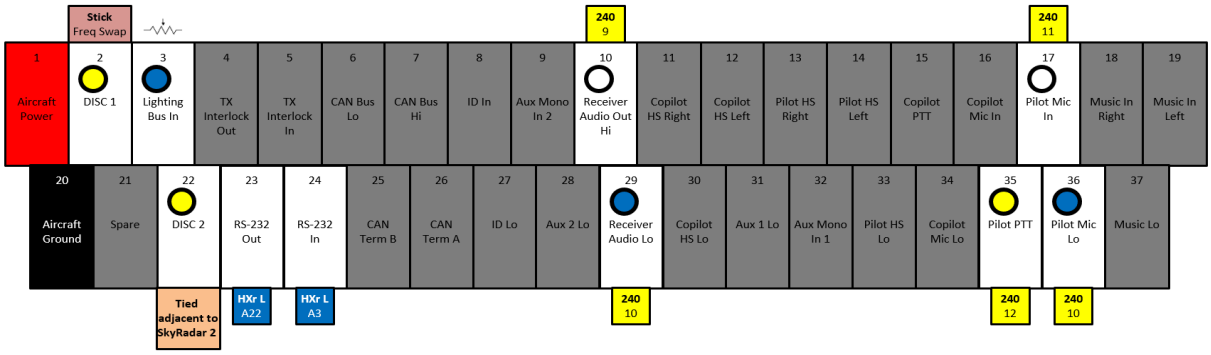
How to setup GTN-650Xi for GTX-345

1. Turn off RS-232 port 2
2. Turn off HSDB port 3
3. Turn off ADS-B and Transponder on Interfaced Equipment
4. Set RS-232 port 2 to GTX-Mode S+ #1
5. Turn on HSDB port 3
6. Turn on ADS-B to “Present” and verify Transponder #1 present on Interfaced Equipment
7. “More RS-232 Setup” to configure the GTN output of pressure altitude to the GTX transponder.
   - If the pressure altitude source is connected to the transponder, set “Forward ALT to GTX” to “Disabled.”

https://www.youtube.com/watch?v=5OlX9XIA83Q

10.12 Garmin GTR-200 VHF Transceiver Wiring

Garmin GTR-200 Transceiver wiring details. Serial number 2QQ006521.



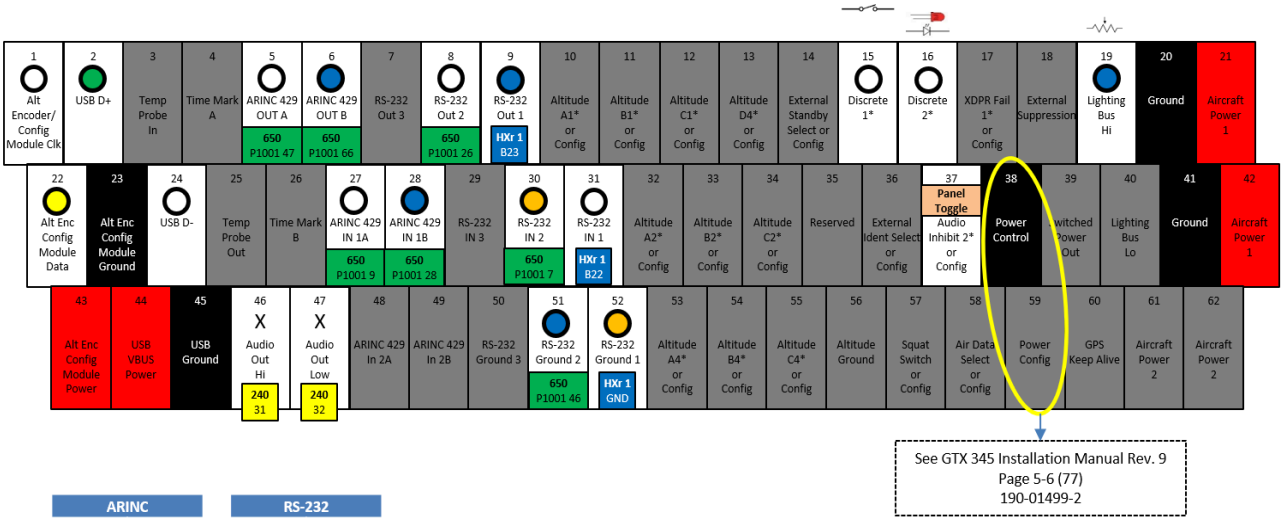
GTR 200 J2001 Pin Assignments

Serial Number 2QQ006521

DISC 2 wire is tied adjacent to the SkyRadar 2.
Connected to left communications blade antenna.

10.13 Transponder Wiring

Garmin GTX-345 Transponder wiring details. Serial number 3EG027490.



ARINC	
IN 1	GTN 650
IN 2	---
IN 3	---
OUT	GTN 650

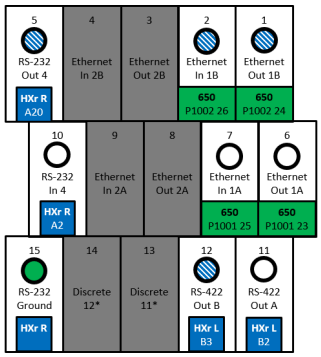
RS-232	
IN 1	HXr L
IN 2	GTN 650
OUT 1	HXr L
OUT 2	GTN 650

http://rv-14a.blogspot.com/

GTX-345 J3251 Pin Assignments

Looking in to cable

Serial Number 3EG027490



Ethernet	
IN 1	GTN 650
IN 2	---
OUT 1	GTN 650
OUT 2	---

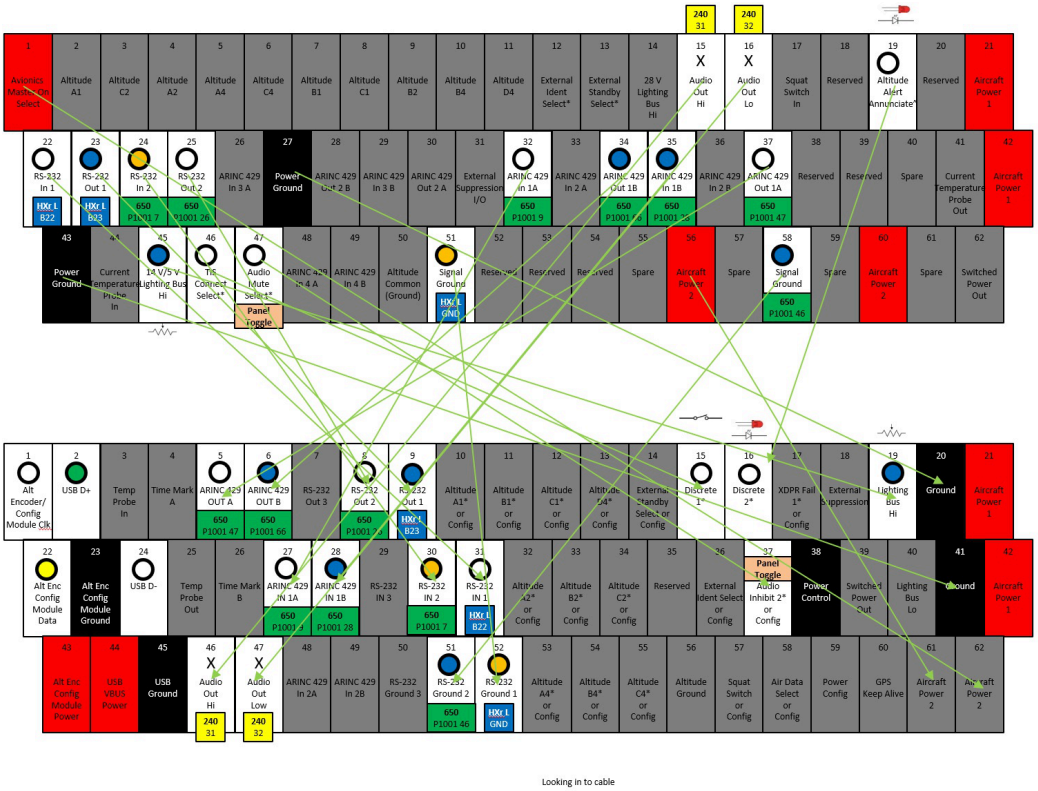
RS-232	
IN 4	HXr R
OUT 4	HXr R

RS-422	
A	HXr L
B	HXr L

GTX-345 J3252 Pin Assignments

Looking in to rear of unit/through connector cable.

The GTX-330ES to GTX-345 dongle wiring map follows.



Mapping		
330ES	345	Function
15	46	Audio Out Hi
16	47	Audio Out Lo
19	16	Discrete 2 (Panel)
21	21	Power
22	31	RS-232 In 1
23	9	RS-232 Out 1
24	30	RS-232 In 2
25	8	RS-232 Out 2
27	20	Ground
32	27	ARINC 429 In 1A
34	6	ARINC 429 Out 1B
35	28	ARINC 429 INB
37	5	ARINC 429 1A
42	42	Power
43	41	Ground
45	19	Lighting Hi
46	15	Discrete 1 (Panel)
47	37	Audio Mute (Panel)
51	52	RS-232 Ground 1
58	51	RS-232 Ground 2
	38→Gnd	Power Control

GTX-330S to GTX-345 Harness Dongle Mapping

GTX-345 settings below.

- Traffic Messages – MSG
- EHS – Enable
- GPS Integrity 1E-7.
- ADS-B TX – Pilot Set

Discrete	Function	Direction	Location
1 (J3251-15)			Panel Toggle (unused)
2 (J3251-16)	ALT ALERT	Out	Indicator Lights (unused)
(J3251-37)	AUD MUTE	In	Panel Toggle

429 Input	Speed	Data	Device
Channel 1		Off	GTN-650
Channel 2			

Ethernet	Interface	Device
Channel 1	GTN	GTN-650
Channel 2		

RS-232	Input	Output	Device
Channel 1	*ADC FMT 1*	*LGCY TRAFFIC*	HXr L
Channel 2	REMOTE FMT 1	REMOTE FMT 1	GTN-650
Channel 3			
Channel 4	ADC FMT 1	*LGCY TRAFFIC*	HXr R

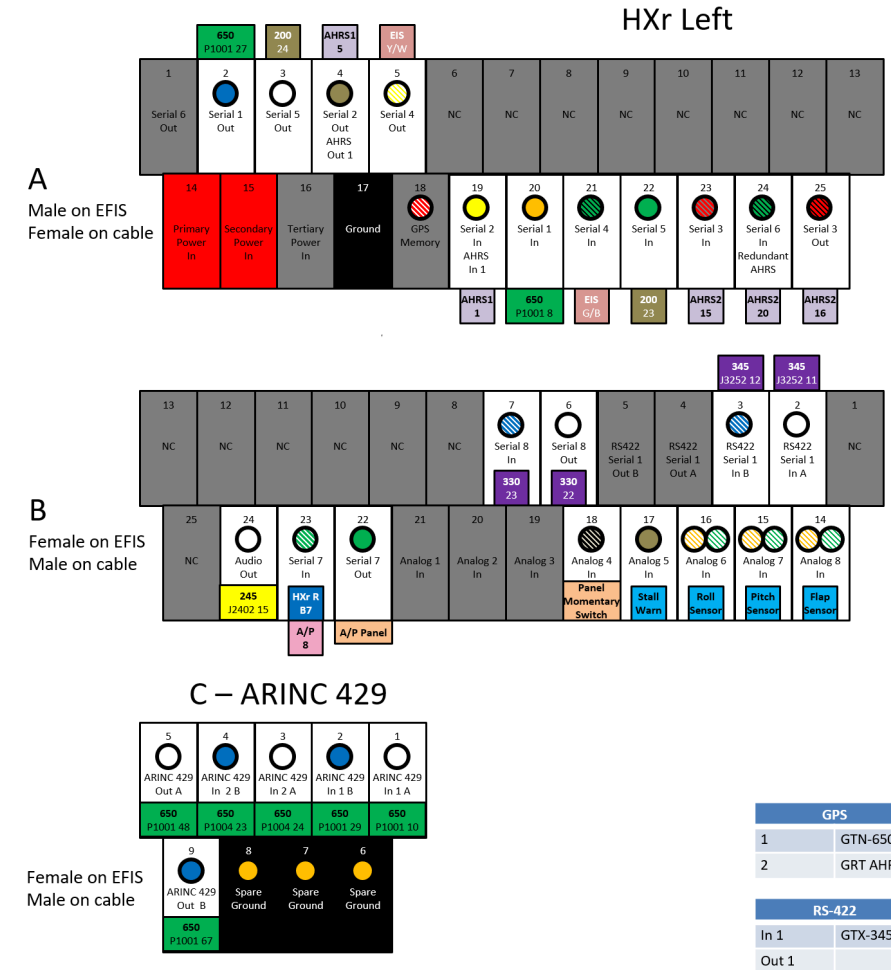
429 Output	Speed	Data	Device
Channel 1		Off	GTN-650
Channel 2			

RS-422	Input	Output	Device
Channel 1		OPT LGCY ADSB	HXr L

RS-232 datum outputs cannot be identical.
Thus, italicized entries indicate available, though unused, settings.

10.14 EFIS Wiring – Left Side

Grand Rapids Technologies HXr EFIS, left side, wiring details. Serial number 266.



Analog	
In 1	
In 2	
In 3	
In 4	Screenshot Pushbutton
In 5	Stall Warner
In 6	Roll Trim Sensor
In 7	Pitch Trim Sensor
In 8	Flap Sensor

ARINC	
In 1	GTN 650
In 2	GTN 650 ILS/VOR
Out	GTN 650

GPS	
1	GTN-650
2	GRT AHRS

RS-422	
In 1	GTX-345
Out 1	

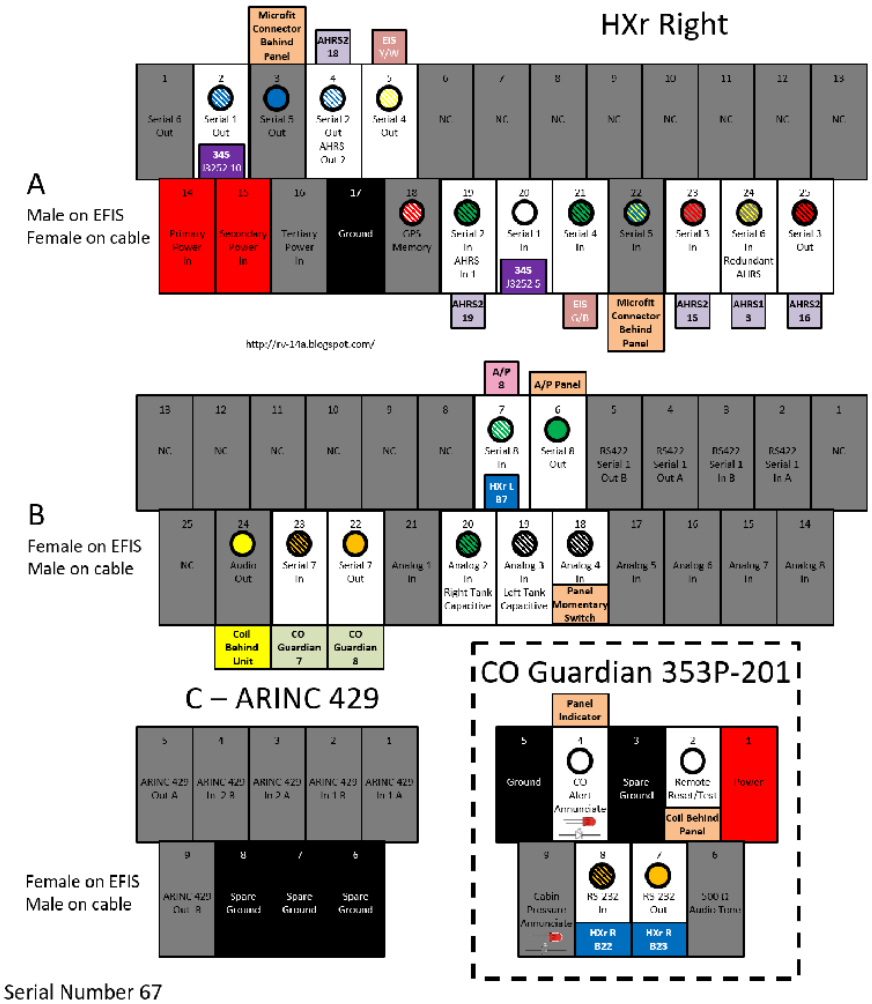
RS-232	
In 1	GTN-650
In 2	AHRS 1
In 3	GPS
In 4	EIS
In 5	GTR-200
In 6	AHRS 2
In 7	A/P Servos
In 8	GTX-330

RS-232	
Out 1	GTN-650
Out 2	AHRS 1
Out 3	GPS
Out 4	EIS
Out 5	GTR-200
Out 6	
Out 7	A/P Panel
Out 8	GTX-330

Serial Number 266

10.15 EFIS Wiring – Right Side

Grand Rapids Technologies HXr EFIS, right side, wiring details. Serial number 67. Includes CO Guardian 353P-201 carbon monoxide detector and pressure sensor (latter feature unused).



Serial Number 67

Analog	
In 1	
In 2	Right Tank Capacitive
In 3	Left Tank Capacitive
In 4	Screenshot Pushbutton
In 5	
In 6	
In 7	
In 8	

ARINC	
In 1	
In 2	
Out	

RS-232		RS-232	
In 1	GTX-345	Out 1	GTX-345
In 2	AHRS 2	Out 2	AHRS 2
In 3	GPS AHRS	Out 3	GPS AHRS
In 4	EIS	Out 4	EIS
In 5		Out 5	
In 6	AHRS 1	Out 6	
In 7	CO Guardian	Out 7	CO Guardian
In 8	A/P Servos	Out 8	A/P Panel

10.16 EFIS Settings

Data input/output settings.

HXr Left

RS-232				
Port	**Input Format**	**Output Format**	**Baud**	**Device**
1	GPS 1 Aviation/Mapcom	Fuel/Air Data (Z Format)	9600	GTN-650
2	AHRS-1/Air Data Computer #1	AHRS-1/Air Data Computer #1	19200	AHRS 1
3	NMEA0183 GPS2 Global Positioning		9600	AHRS GPS
4	EIS-1 Engine Monitor #1		9600	EIS
5	SL40-1	SL40-1	9600	GTR-200
6	AHRS-2/Air Data Computer #2	AHRS-2/Air Data Computer #2	19200	AHRS 2
7	GRT Autopilot Servo	GRT Autopilot Servo	9600	A/P Servos
8		Fuel/Air Data (Z Format)	9600	GTX-330

RS-422				
Port	**Input Format**	**Output Format**	**Baud**	**Device**
8	ADS-B		115200	GTX-345

ARINC 429				
Port	**Input Format**	**Output Format**	**Value**	**Device**
1	VOR/ILS Inputs		Nav 1	GTN-650
2				
Out				

Analog				
Port	**Function**	**Sensing/Active**	**Int/Dec**	**Scale/Offset**
1				
2				
3				
4	Screenshot	Low		
5				
6				
7				
8				

HXr Right

RS-232				
Port	**Input Format**	**Output Format**	**Baud**	**Device**
1		Fuel/Air Data (Z Format)	9600	GTX-345
2	AHRS-2/Air Data Computer #2	AHRS-2/Air Data Computer #2	19200	AHRS 2
3	NMEA0183 GPS2 Global Positioning		9600	AHRS GPS
4	EIS-1 Engine Monitor #1		9600	EIS
5				
6	AHRS-1/Air Data Computer #1	AHRS-1/Air Data Computer #1	19200	AHRS 1
7	CO Guardian	CO Guardian	9600	CO Guardian
8	GRT Autopilot Servo	GRT Autopilot Servo	9600	A/P Servos

RS-422				
Port	**Input Format**	**Output Format**	**Baud**	**Device**
8				

ARINC 429				
Port	**Input Format**	**Output Format**	**Value**	**Device**
1				
2				
Out				

Analog				
Port	**Function**	**Sensing/Active**	**Int/Dec**	**Scale/Offset**
1				
2	Aux (EIS)/Right Fiel	Forward	Decimal	130/0
3	Aux (EIS)/Left Fuel	Forward	Decimal	136/0
4	Screenshot	Low		
5				
6				
7				
8				

10.17 EFIS BIOS Settings

The following steps will address screen formatting issues, especially when the EFIS was previously powered off during its boot cycle.

- Connect a USB keyboard.
- The screen may be very dark. If it is too dark to see anything, allow the unit to boot then load a navigation database. The reboot after the update will leave the screen bright.
- After turning on the power, or during a reboot, start pressing the [Delete] key to get into the BIOS setup menu.
  - Optional: Load the processor-manufacturer defaults with F9.
- Use the left and right arrow keys to select *Chipset* from the top menu bar.
- Use the up and down arrow keys to select *North Bridge Configuration* from the main area then press [Enter].
- Select *Video Function Configuration* then press [Enter].
- Select *Flat Panel Type* then press [Enter].
- Select *1024x768 (18bit)* from the pop-up list then press [Enter].
- Press [ESC] twice. The full top menu will reappear.
  - On the *Advanced* tab, open *ACPI Configuration* then *Chipset ACPI Configuration*. Set *High Performance Event Timer* to *Enabled*. Press [ESC] twice to return to the main menu.
  - On the *Boot* tab, open *Boot Settings Configuration*.
    - Change *Quiet Boot* to *Enabled*.
    - Change *PS/2 Mouse Support* to *Disabled*.
    - Change *Wait For 'F1' If Error* to *Disabled*.
    - Change *Hit 'DEL' Message Display* to *Disabled*.
  - Press [ESC] to get back to the *Boot* tab, then open *Hard Disk Drives*. Change *1st Drive* to *SATA* or *HDD:3M-SFCF….*
  - Press [ESC] to get back to the *Boot* tab, then open *Boot Device Priority*. Change *1st Boot Device* to *SATA* or *HDD:3M-SFCF….*
  - Press [F10] then [Enter] to save the changes.

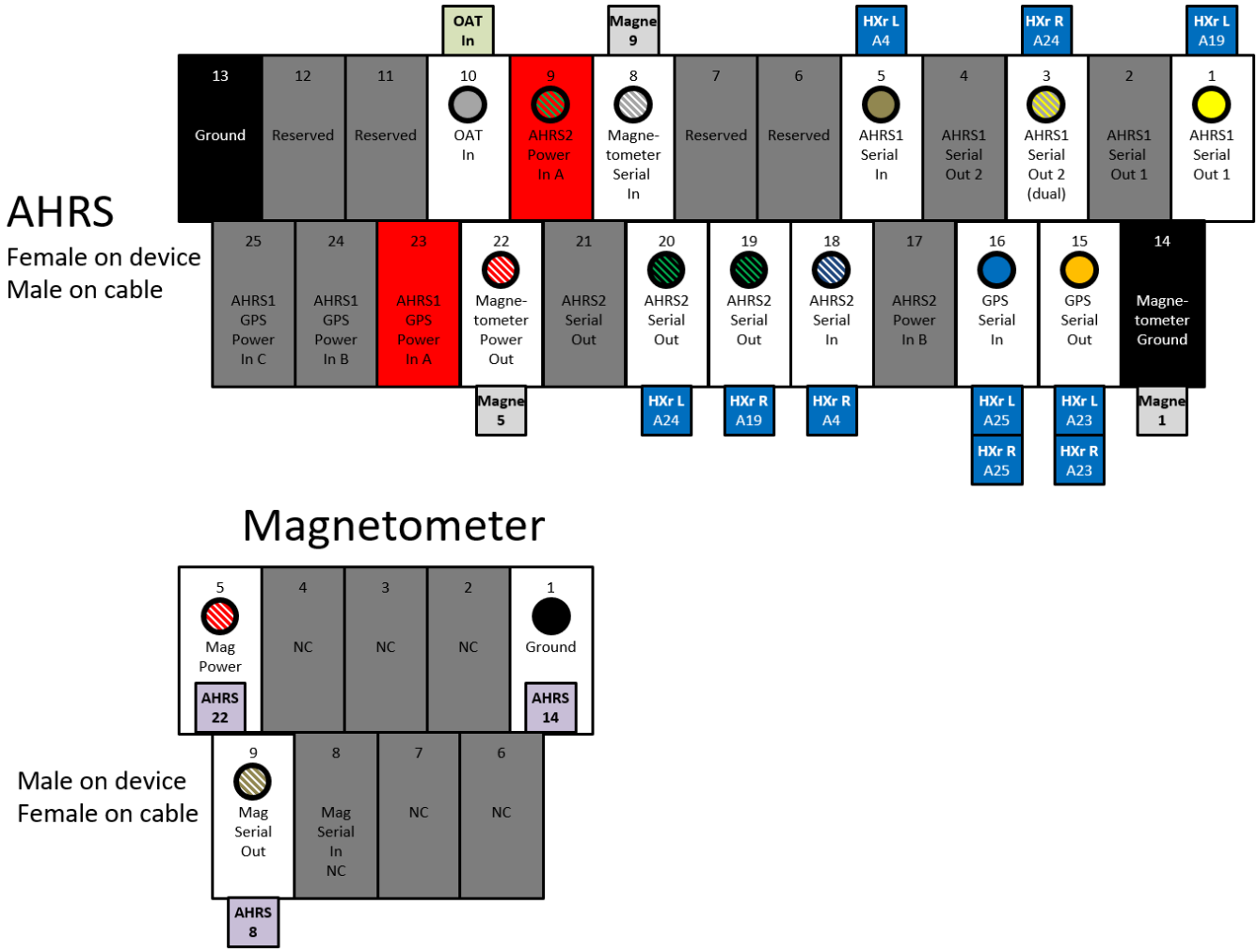

GRT Avionics
OIL PRESSURE TOO LOW
Dual AHRS
CHT

10.18 AHRS and Magnetometer Wiring

Grand Rapids Technologies dual adaptive AHRS, with internal WAAS GPS and AOA, wiring details. Serial number AHRS 1: 10860, AHRS 2: 10869.

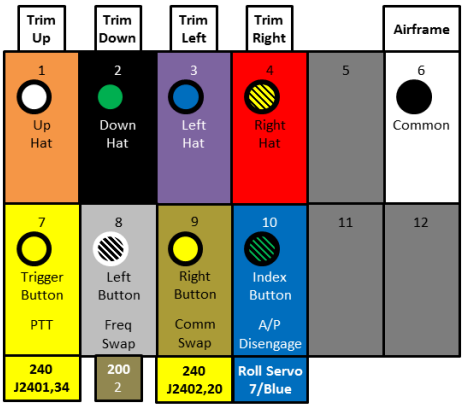
The AHRS is located on the left aft side of the firewall, behind the subpanel. It is fixed to a tray which is aligned with the longitudinal axis of the airframe.

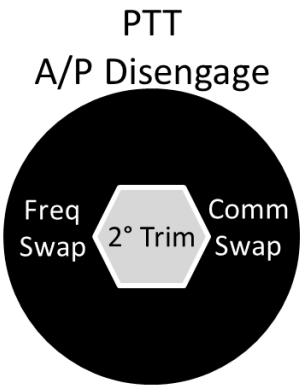
The magnetometer is located in the tail, just forward of the aft turtle deck. It is fixed to a tray which is aligned with the longitudinal axis of the airframe.

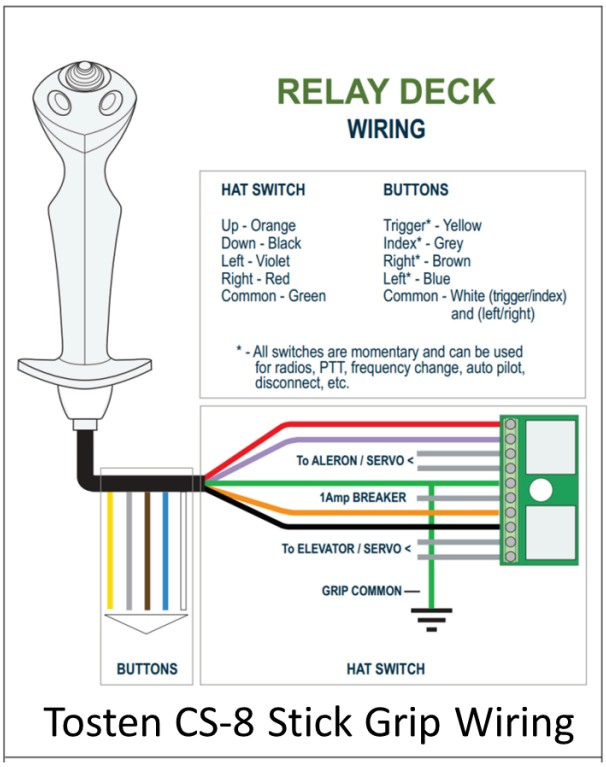


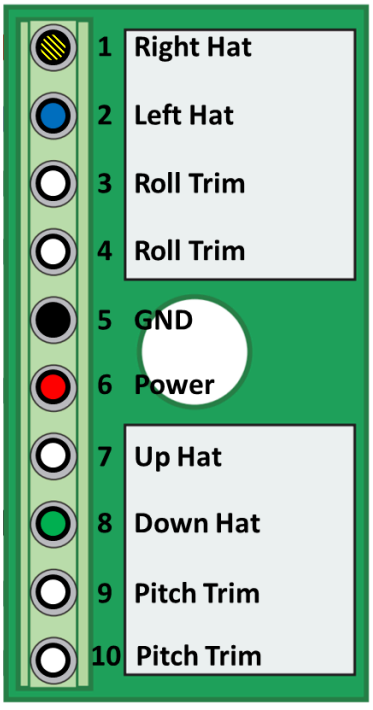
10.19 Stick Grip and Relay Deck Wiring

Stick grip and relay deck wiring details. The relay deck is found on the aft face of the subpanel behind the left EFIS. The connectors for the sticks are found at the base of each stick underneath the associated inspection panels. All wires are 22 AWG.





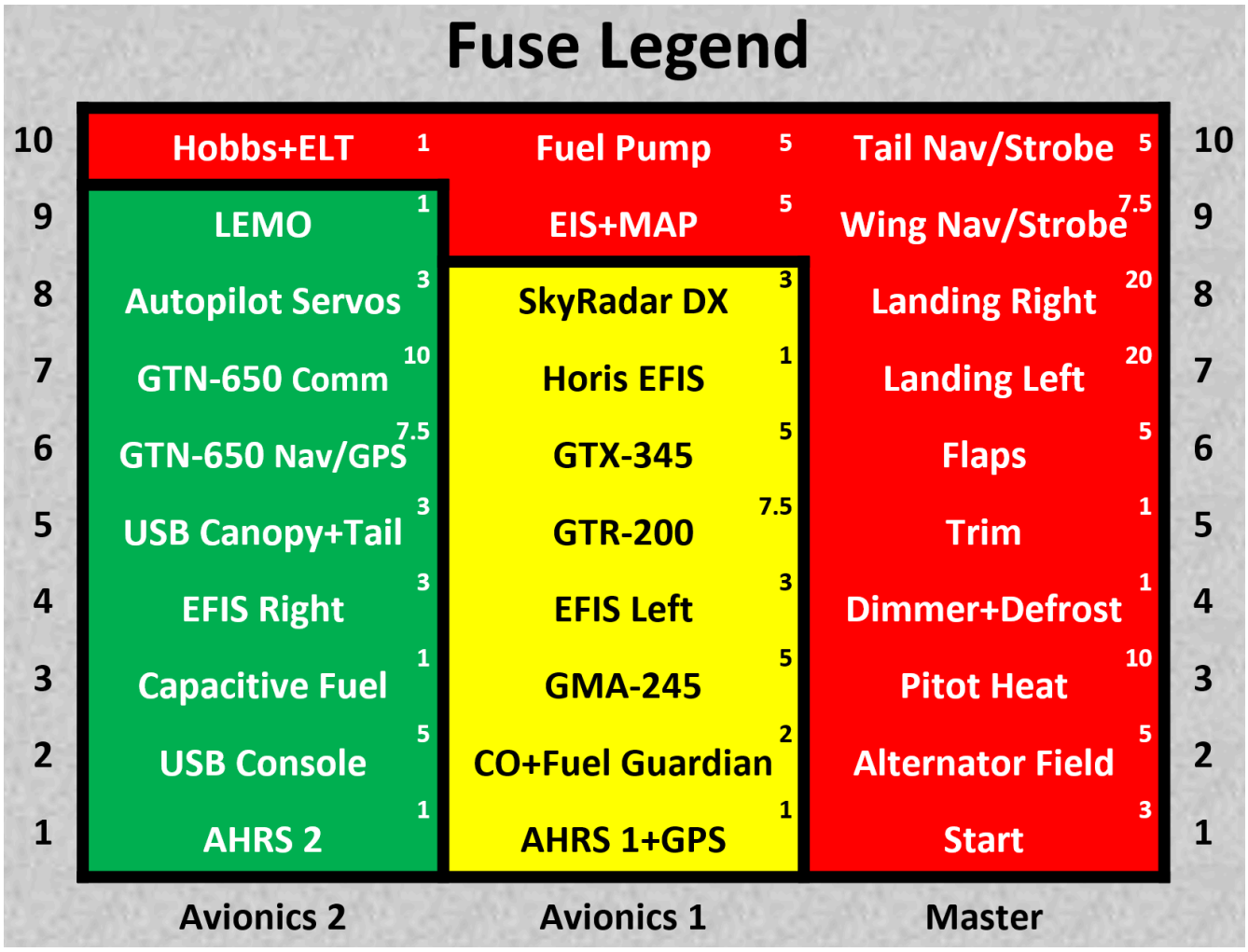




10.20 Fuse Block Legend

Fuse block legend details. ATM size is used for all fuses. Wires associated with 20 Amp fuses are 14 AWG. Wires associated with fuses 5 to 10 Amps are 18 AWG. The three exceptions are the "EIS+MAP", "USB Console" and "Alternator Field", each of which are 22 AWG. The wires associated with fuses 3 Amps or less are 22 AWG. Blown fuses with ratings 3, 5, 7.5, 10 and 20 Amps announciate via illumination.

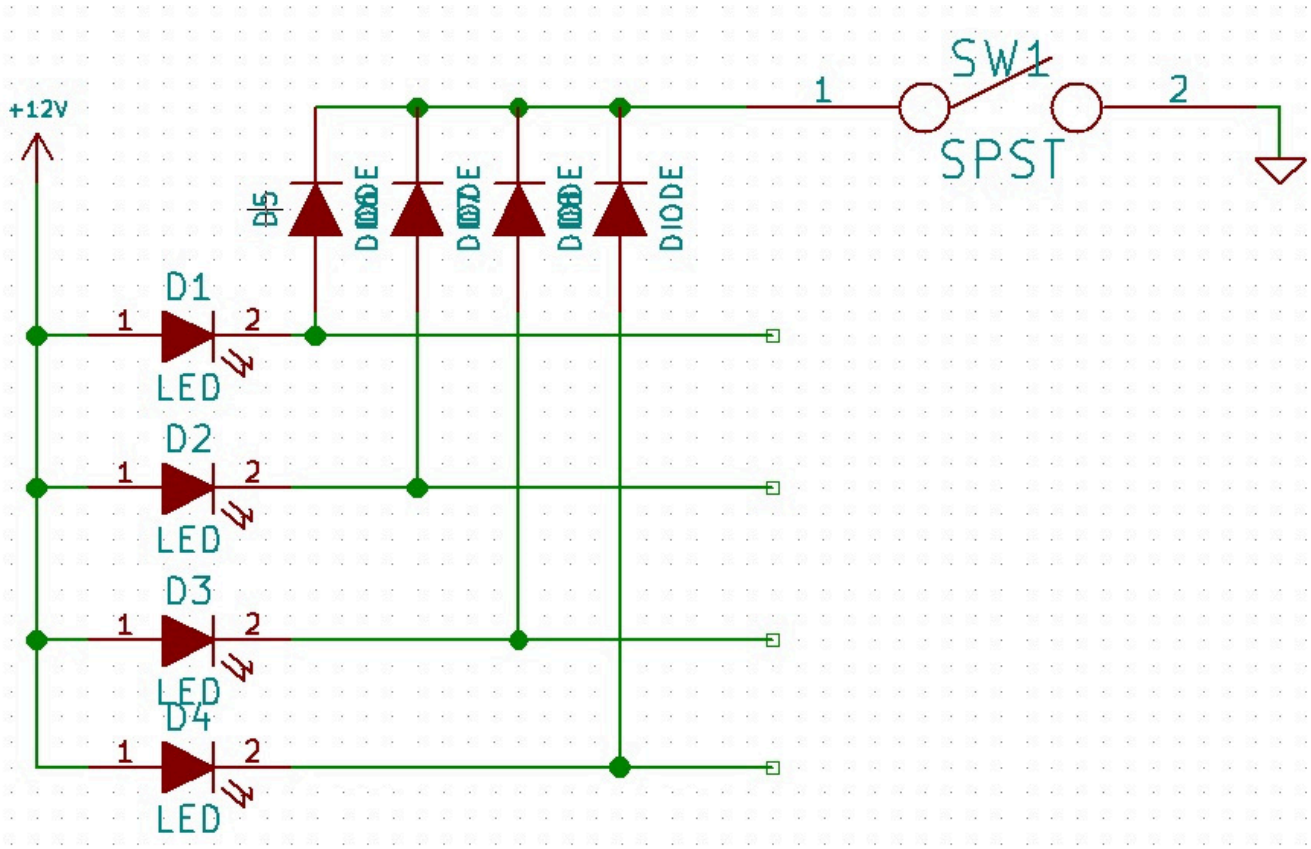
Directly above the fuse block is located a 60 Amp circuit breaker connected to the output of the alternator. If it trips, the alternator is isolated from the entirety of the aircraft electrical system.

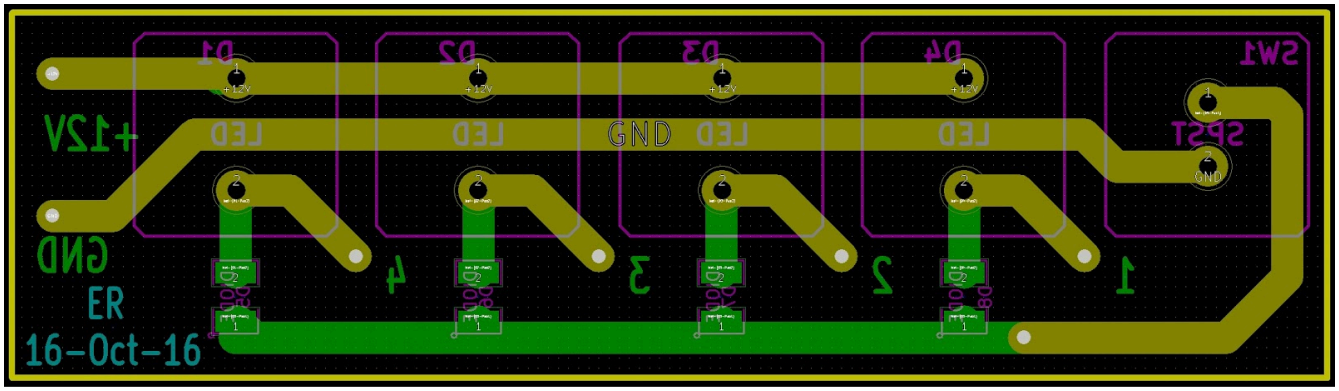


An additional in-line 1 Amp fuse, located on the left side, behind the instrument subpanel, provides protection for the SSRs controlling the Avionics 1 and Avionics 2 buses.

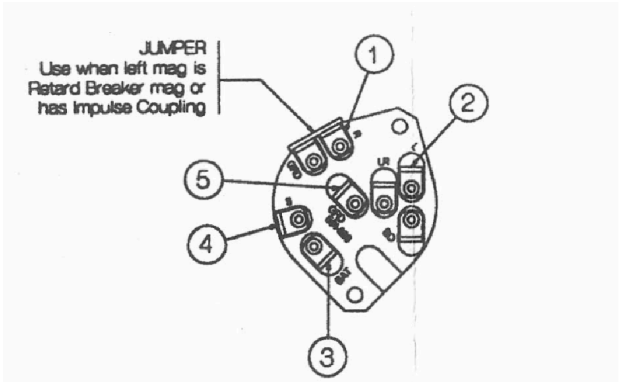
10.21 Indicator Lights Circuit Board

The circuit board for the indicator light test function is shown below. The diodes are Diodes Incorporated part number 1N4148W-7-F.



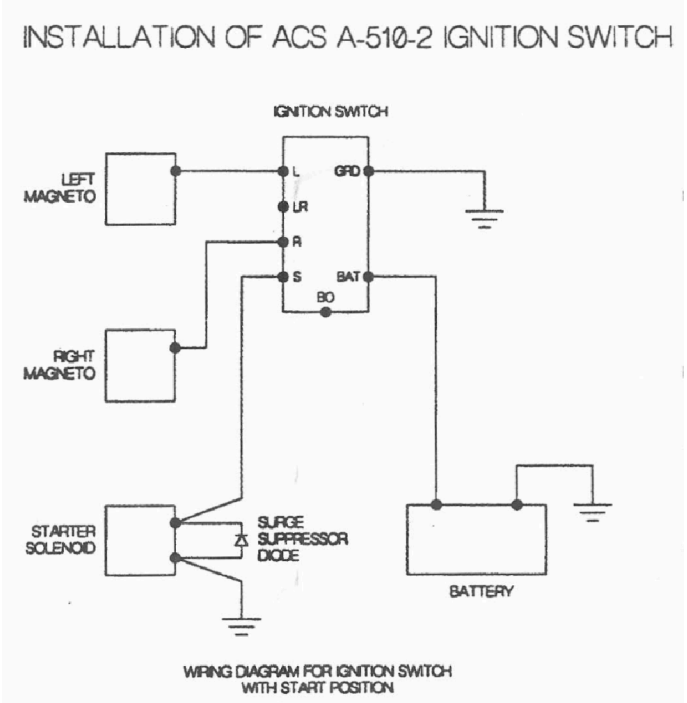


10.22 Ignition Switch Wiring



1. Connect wire from RIGHT MAG to terminal 1.
2. Connect wire from LEFT MAG to terminal 2.
3. Connect wire from POSITIVE terminal of power supply to terminal 3.
4. Connect wire from STARTER SOLENOID to terminal 4.
5. Connect wire from terminal 5 (center GND terminal) to nearest structural member.

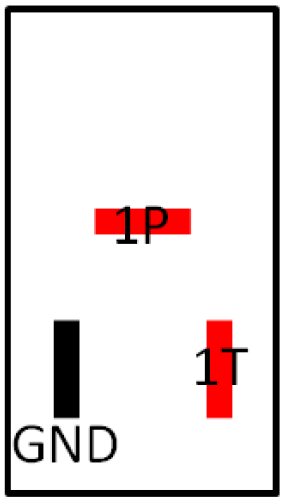
NOTES:
A. Use JUMPER on terminal 1 when LEFT MAG has IMPULSE COUPLING.
B. Use JUMPER on terminal 1 & use the "LR" and "BO" terminals for a 2-terminal starting vibrator when LEFT MAG is RETARD BREAKER MAGNETO.
C. Use SHIELDED wire on all connections and ground shielding to nearest structural member.

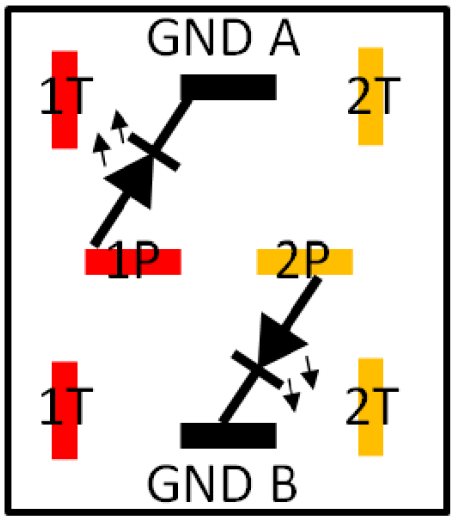


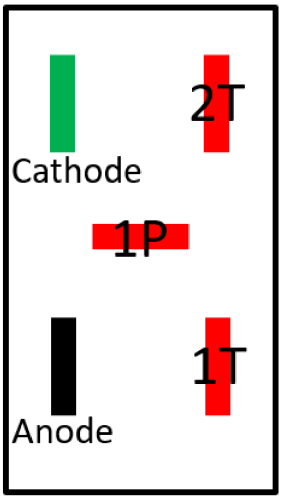
10.23 Otto Rocker Switch Pinouts

Otto K1 (left) and K2 (right) pinout maps. Switch model numbers used are:

- `K1ACCAAAAA`: White SPST, no LED, momentary. Passenger PTT.
- `K1AAANBABA`: Red SPST, red LED. Pitot heat, fuel pump and defrost.
- `K1ACEAAAAA`: White SPST, no LED. Landing light high/low.
- `K1ACBAAAAA`: White SPDT, no LED. AHRS source selection.
- `K2ABNPCCFA`: Black DPDT, green LEDs. Taxi/landing and nav/strobe.
- `K1AABPCADA`: Red SPDT, independent green LED. Kanardia Horis' UPS-L backup battery.
- `K1ABAPCABA`: Black SPST, green LED. Wigwag, trim, A/P servos, main bus, avionics 1 and 2 and alternator.

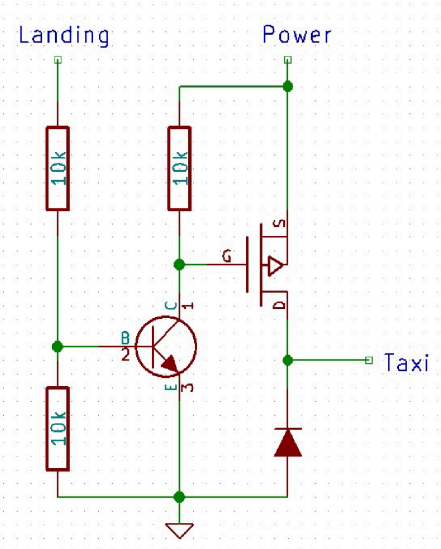






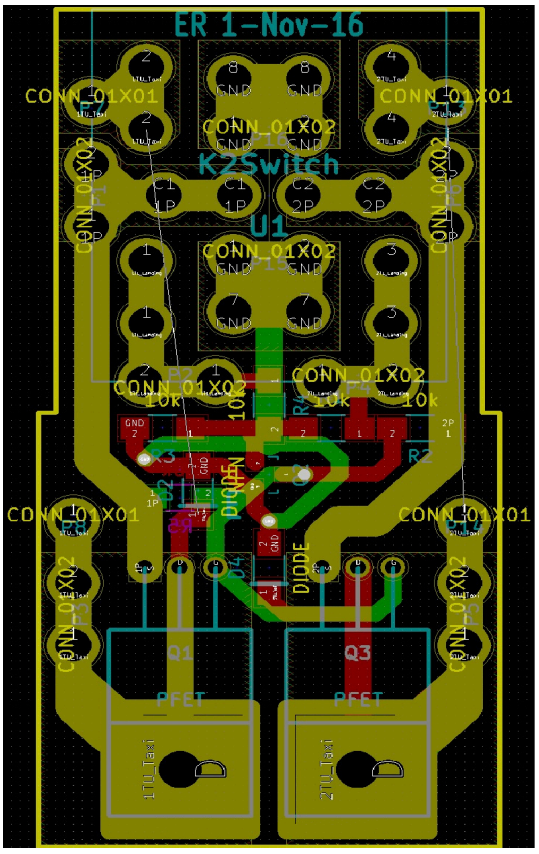
10.24 Taxi/Landing and Nav/Strobe Lights Circuit Board

The schematic for the switch circuit element basis is shown below. For the nav/strobe lights, “strobe” is equivalent to “landing” and “nav” is equivalent to “taxi”.

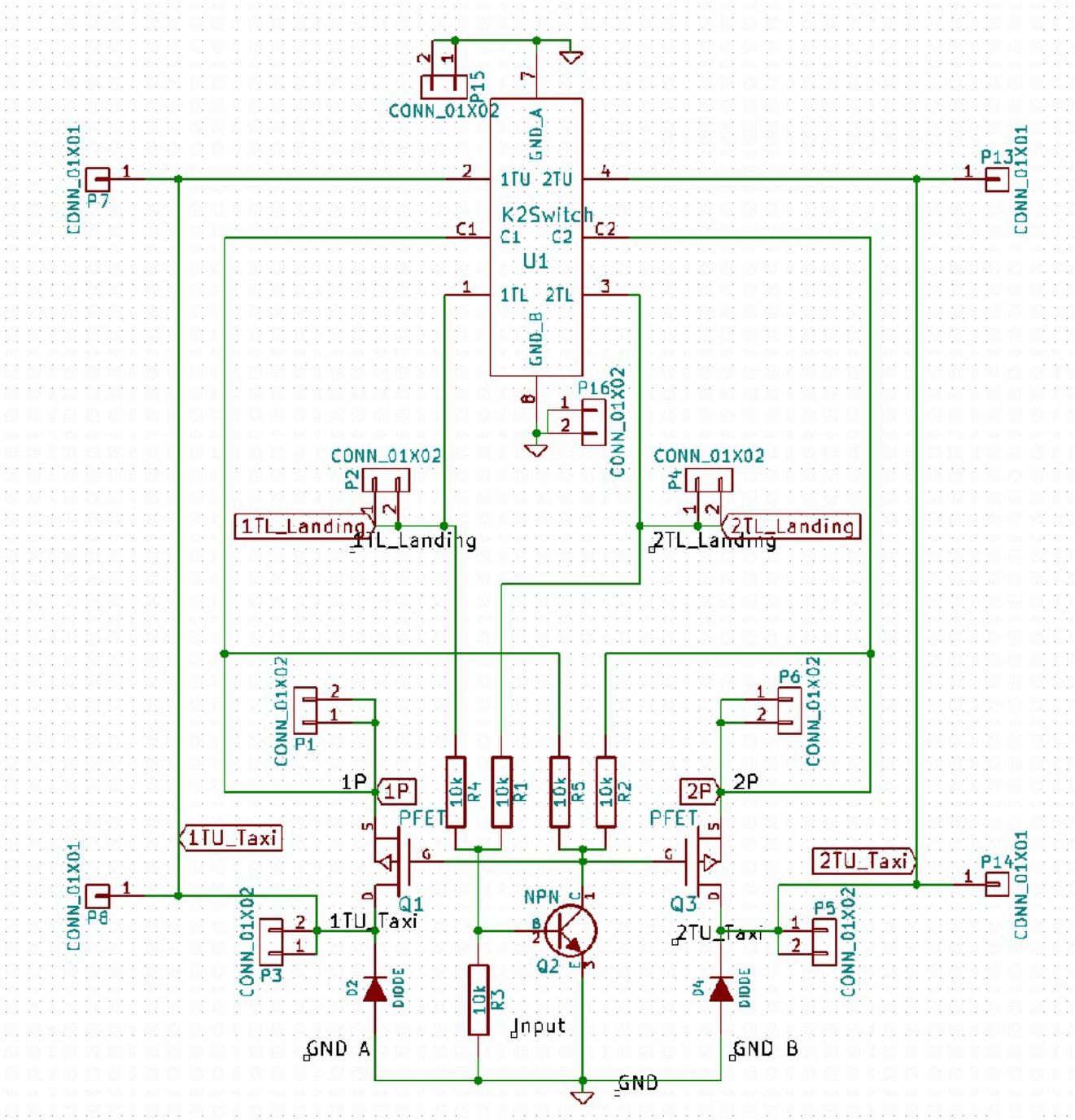


The circuit board layout and parts list for the taxi/landing light control are shown below.

Description	Manufacturer	Part Number
PFETs	Infineon Technologies	IPP80P03P4L-04
Diodes	AVX Corporation	SD1206S040S2R0
NPNs	ON Semiconductor	MMBT2222ALT1G
Resistors	Panasonic	ERJ-8GEYJ103V
Terminals	Keystone Electronics	4902



Complete taxi/landing light board schematic.



11 Garmin GMA-245 Intercom Configuration Information

11.1 System Front Panel Configuration

- Enter configuration mode by holding down the COM1 MIC and SPKR keys while powering up.
- Pressing PLAY key will annunciate the current software/database product version, *e.g.,* "system two dot zero zero".
- Pressing COM1 MIC key selects volume mode. Press the COM1 MIC key until the desired volume is annunciated, *e.g.*, "auxiliary one volume".
- Pressing COM2 MIC key selects Master Avionics Squelch mode.
- Pressing SPKR key annunciates the current option, *e.g.*, "Alerts Mute Music Enabled" or "Cockpit High Noise Disabled".
- Pressing PILOT key increases the selected setting as indicated by the LEDs on the Level Bar.
- Pressing CREW key decreases the selected setting as indicated by the LEDs on the Level Bar.
- When adjusting Options, PILOT and CREW keys are used to indicate the current state and change the state. If the option is enabled, the PILOT key is lit solid and the CREW key flashes (indicating that the CREW key can be pushed to disable the option). Likewise, if the option is disabled, the CREW key is lit solid and the PILOT key flashes (indicating that the PILOT key can be pushed to enable the option. The Level Bar is not used when in the options mode.
- The LEDs in the Level Bar (Figure 2-3) light to indicate an increase/decrease in the selected setting.
- Pressing COM1 and AUX keys simultaneously resets the configuration and operating state back to factory defaults.

11.2 Transceiver Key Functions

Function	Action	Key Annunciations	
COM Selection: Toggle between COM enabled and COM disabled (the audio from the current MIC selected COM is always enabled and cannot be disabled).	Press the corresponding **COM** Key.	 COM Enabled	 COM Disabled
MIC Selection: Selects the COM used to transmit during Push-to-Talk (PTT).	Press the corresponding **MIC** Key. The last MIC pressed remains selected and deselects all others.	 MIC Enabled	 MIC Disabled
Transmit Indication: Audio is sent from the corresponding Crew MIC to the selected COM. *	Push-to-Talk (PTT) keyed.		MIC in-key annunciator flashes.
Split-COM Mode: The pilot transmits on COM1 and the copilot transmits on COM2 independently.	Simultaneously press **COM1 MIC** and **COM2 MIC** keys.		

* The pilot has priority when transmitting in the case that both crew members attempt to transmit on the same COM.

- Press and hold **COM1** or **COM2** to enable/disable monitored COM muting during reception of audio from the COM radio selected for transmission.
- To enable 3D audio, press and hold the **PILOT** key to toggle 3D audio processing on and off

for all headset positions.

11.3 TEL Key Functions

Function	Action	Key Annunciations	
Toggle TEL Audio ON/OFF	Press the **TEL** Key.		**TEL** in-key annunciator toggles between green and OFF.
Receive Bluetooth Phone Call	Incoming call. *		**TEL** flashes blue indicating an incoming Bluetooth phone call.
Answer Bluetooth Phone Call	Press **TEL** during incoming call (TEL flashing).		**TEL** displays solid blue.
Bluetooth Phone Call Disconnected By Source	Lost connection or user action.	 or 	**TEL** returns to previous state (green or OFF).
Disconnect Bluetooth Phone Call Using GMA 245	Press **TEL**.	 or 	**TEL** returns to previous state (green or OFF).
Bluetooth Phone Call Initiated by Source/Phone	Press **TEL**, if TEL is not yet selected.		**TEL** displays solid blue.

* If **TEL** is selected (green), pre-recorded ringer audio is played.

** If **TEL** is selected (green), no action is required. **TEL** automatically turns blue and connects.

11.4 MUSIC and ♫SEL Key Functions

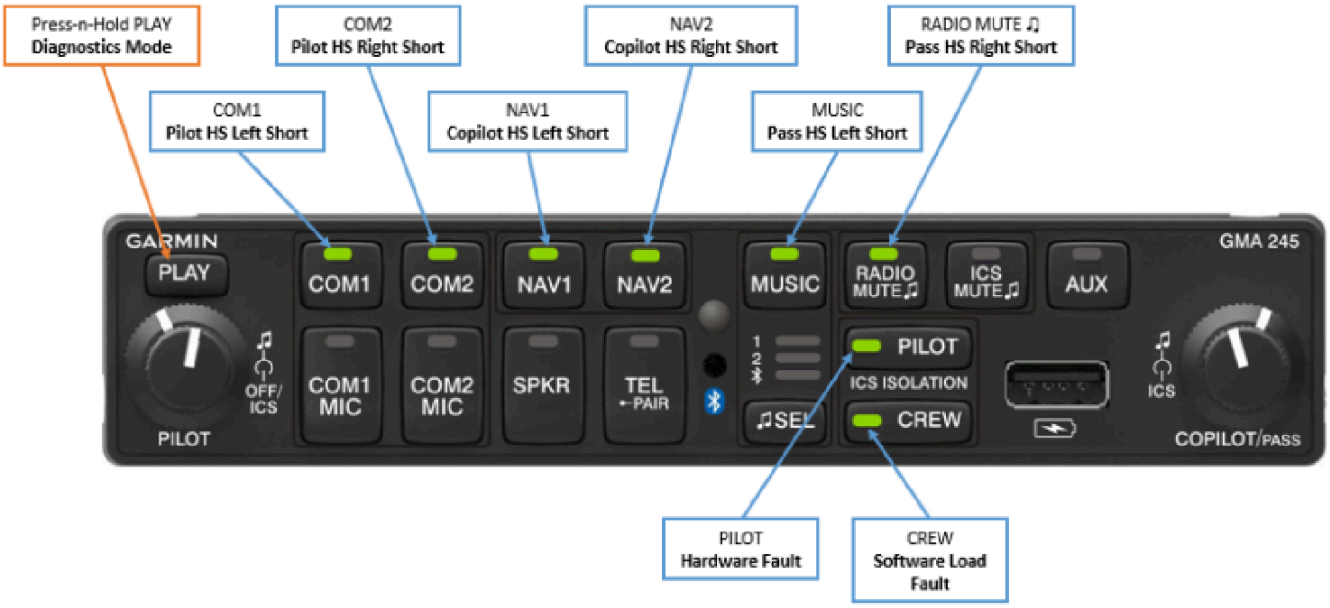
Function	Action	Key Annunciations	Notes
Turn MUSIC ON	Press the **MUSIC** Key (when not selected).		**MUSIC** in-key annunciator turns green.
Turn MUSIC OFF	Press the **MUSIC** Key (when selected).		**MUSIC** in-key annunciator turns OFF (source selection annunciators are unaffected).
Change MUSIC Source	Press the ♫ **SEL** Key.		Music source selection is cyclic, moving from **1** to **2** to **Bluetooth** and then back to **1**.

11.5 Bluetooth Functions

Function	Key(s)	Action
Monitor Mute	COM1 or COM2	Press and hold for 1 second
Radio Mute Intercom	RADIO MUTE	Press and hold for 1 second
3D Audio	PILOT	Press and hold for 1 second
Split COM	COM1 MIC and COM2 MIC	Press keys simultaneously
Music Equalizer	SEL and PILOT	Press keys simultaneously
Music Bass Boost	SEL and CREW	Press keys simultaneously
Bluetooth Media Play/Pause	NAV2 and MUSIC	Press keys simultaneously
Bluetooth Media Skip Previous	NAV2 and RADIO MUTE	Press keys simultaneously
Bluetooth Media Skip Next	NAV2 and ICS MUTE	Press keys simultaneously
Bluetooth Call Volume Increase	PILOT	Press and hold
Bluetooth Call Volume Decrease	CREW	Press and hold
Bluetooth Pairing Mode	TEL PAIR	Press and hold for 1 second
Bluetooth Recording Mode	TEL PAIR and PILOT	Press keys simultaneously

- Press and hold **TEL (PAIR)** key for one second to enter pairing mode. The Bluetooth anunciator will flash for 2 minutes during which time the device is discoverable. The device remembers the last 10 paired devices. The least recently connected device is eliminated from the list when full.
  - To enable Bluetooth recording mode (for a camera), momentarily press the **TEL (PAIR)** and **PILOT** keys simultaneously. The device will annunciate "Bluetooth recording mode enabled."
- To toggle Bluetooth support on or off, press and hold **TEL (PAIR)** for give seconds. The status will be annunciated. A power cycle event will restore Bluetooth functionality.

11.6 Diagnostics Information



To enter diagnostics mode, press the **PLAY** key for five seconds. Whilst still holding the **PLAY** key, all key annunciators will turn off except for those with the associated diagnostic states as illustrated above.