

AVIONICS BLUEPRINT READING

Slide 1

•This course will help the technician in reading and understanding Avionics Drawings.

•This course will give several types of general avionics drawing to learn from.

INTRODUCTION



Introduction

•Aircraft are built and wired per drawings and blueprints.

•There are several types of drawings used in the manufacturing and working on a aircraft.

• It is the goal of this lesson to familiarize you, the technician, with these drawings and enable you to utilize the drawings to safely complete tasks without error in the minimum time.





SAFETY

•Working on aircraft is inherently dangerous. It is the your responsibility as the technician to look out for your own safety and of those around you.

•MOVING AIRCRAFT HAVE THE RIGHT OF WAY. Whether they are being towed or are taxiing under their own power.

•BEWARE OF AIRCRAFT WITH OPERATING ENGINES. Noise associated with operating aircraft will damage hearing. Use hearing protection provided when working near running engines.



SAFETY

•STAY CLEAR OF INTAKE AND EXHAUST AREAS. Engines operating at high power levels can pick up objects and ingest them. Ingested objects will be expelled at high velocity and are dangerous.

•FOD Short for Foreign Object Debris. Any object that can be picked up and ingested by a jet engine or does not belong in the aircraft is considered to be FOD. A washer worth a nickel can destroy an engine worth millions of dollars.



ELECTRICAL SAFETY

•DO NOT WEAR RINGS OR LOOSE JEWELRY WHILE WORKING ON ELECTRICAL SYSTEMS. All metals conduct to some degree and precious metals especially well. Remove jewelry before working.

•ALWAYS ASSUME A CIRCUIT IS ENERGIZED UNTIL YOU PERSONALLY VERIFY OTHERWISE. Inform others working on the aircraft what you will be working on & where. Use lockouts where available.

THE PURPOSE OF ELECTRICAL DRAWINGS



RADIO RACK CKT. BKR. PANEL 13003 20 (KLIXON) 7274-11-2 m II- DRAWING NOTES d FLAGNOTES

THE PURPOSE OF ELECTRICAL DRAWINGS

•The purpose of Electrical Drawings is to provide a graphic means by which instructions may be given so items may be consistently installed or repaired.

- •They also aid in troubleshooting are usually Schematics.
- ·location of aircraft electrical systems.
- •Wire size and part number of wire
- •Pin location and part numbers connectors for pinning out.



TYPES OF ELECTRICAL DRAWINGS

How the drawing is formatted and drawn is depending on the company that drafted them. **ATA 100** is the general guidelines for drawings most engineering uses. This course is based on ATA 100

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AVIONICS AND ELECTRICAL DOCUMENTS

The following documents will be found with the aircraft and are specific to that individual aircraft.

Avionics book- Contains the General Notes, Index,

used to document specific operations by departments.

•Inspection log – Show when the "A- B – 4a " ex. were done and any STC's

•The "removal book". This log records every part removed from or installed in the aircraft at a given facility.

•Avionics prints.

MASTER DRAWING LIST

AVION	ACOT ELECTRICAL Master	Drawing	LIST
AIRCRAF	T TYPE G1159A		433
INDEX NO.	. DRAWING NO. & TITLE	LATE	REV
	ELECTRICAL DRAMINCE		
333-0027	WARNING HORN SILANCE HOD	3-10-81	
333-0160	FIRE BELL MOTE SWITCH RELOCATION MOD.	12-0-02	
333-0162	WATER PUMP STITTEN	12-10-82	
333-0163	RLECTRIC TOILET	12-10-02	
333-0164	115V 60 HE RAZOR CUTLET	12-10-82	
333-0166	COCKPIT MAP LIGHTS	3-17-03	
333-0170	VESTIBULE DOME LIGHTS	2-24-83	
333-0177	AFT BAGGAGE LIGHTING	3-17-83	4
333-0179	APT EQUIPMENT AREA LIGHTING	3-2-83	
333-0182	WATER HEATER	3-18-83	
333-0185	OVERBOARD DRAIN HEATERS	3-0-83	
333-0200	GALLEY DOME LIGHTS	4-15-83	

MASTER DRAWING LIST

•Wiring diagrams are found in the Aircraft Log Books.

•These are schematic diagrams which include all the information required to locate, trouble shoot and maintain wiring harnesses.

•This book contains the Index, General Notes, and a complete listing of the diagrams within.

• The diagrams in this book are the "Masters".

•These are the drawings that show, in detail, how the various components installed and how they are connected to each other.

• In addition, other vital information can be found on these drawings including:

•Wire size

•Connectors

•Hardware

DOCL	JMENTS
SPI SPI	ECIFICATIONS THE WRIGHT CO.
Type B. Na. 29	Metal Finish Strichert plated More \$6
Wood Finish alessan	4-9 Chains 13-6 Spockets 11-54
Short Chain Guide 6 7 % Short Chain Guide 4' 5 % Radiator S.Cd.	Garone Tank Ald. 12 yet. Upbolary Rail gray 21. 1 gang good skin. Starting Wheele Dodgen, dief unter, nin 2280
Control Fort pedal Seat Doruble	Vanes Shock Absorbers 18 " * 5" / 15"
Clash IW. Suit loth, who Stide III.	Truss wires on main planes and wings ./60 . 090
Horizontal Rudder/5" \$ 36"	Foot set wires .080
2 in Furth of start, I am front of an Wing warping wires .0.90	, 2 in rachaber truss, 13 in work a mart frame tr. Tail bases wires - 8 80
Skid base wires ./ S.0 ./ 00 Tail support wires . 0 % 0	Tail warping wires . 090 Propellor R. P. M. 414 +
Metal fittings, Rivets, and cotter pins Her	Folled in the river
Machine over all 29 X 37	Motee Weight 194
Motor R. P. M. 1280	Total Weight Machine
Balance from Center fore and alt 3/4 - 9	untent lateral 18" & X.
Date Finished July 18, 1911.	Date Shipped
Via On completion of this mathine, the imper general impection of all parts, and sign his name b	Destination tar is charge will examine and check items above mentioned, including a clear only when finished and approved its lis satisfaction.
	Foreman
	Sent
36418	
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A PANER TRACK	and the second sec

DOCUMENTS

•There are several controlling documents that determine what practices and procedures are followed in the construction and completion of aircraft.

•There are several controlling documents that determine what practices and procedures are followed in the repair and completion of aircraft and they are:

•Your Companies Engineering specifications

DOCUMENTS

Service Bulletins and Approved Modifications

• FAA AC 43.13-1B Acceptable Methods, Techniques, and Practices. Aircraft Inspection and Repair

Your Companies Procedures for Wiring guide lines.
FAR 27.1351 as an example for electrical systems.



THE PARTS LIST:

•Contains item designator number: the triangle is a flag note-the number in the triangle is 5 it shows the : part numbers for that item

- •And can give Descriptions
- •And Manufacturer
- •Physical location in the aircraft
- •Drawing number item is related to
- •Any Mil-Spec the wiring must meet ie. Mil-C-22500D

UNDERSTANDING PARTS LIST

ITEM NUMBER	QUANITIY	PART NUMBER	DESCRIPTION	VENDOR
11	1	5-3-4-3	DIODE	REA
10	1	3194	MOUNT	W/DG
9	2	7274-11-1	CKT BREAKER	KLM
8	1	225345-6	COAX PLUG (TNC)	AMP
7	1	100-602061-000	ANTENNA	UNC
6	1	K-12004	PLUG KIT	UNC
5	1	13636-93601-000	MOUNT	UNC
4	1	1070-01	GPS SENSOR	UNC
3	4	AN-3-3	BOLT	VEN
2	4	AN960-10	WASHER	VEN
1	1	NASM / MS20995C20 .020 Dia	SAFETY WIRE	

THE PARTS LIST:

This is another example of a parts list:

- •Contains item 4 designator the number shows the part numbers for that item
- •And can give Descriptions -Antenna
- •And Manufacturer -Uniroyal
- •Physical location in the aircraft

•Drawing number item is related to •Any Mil-Spec the wiring must meet – ie. Mil-C-22500D



WIRING DIAGRAMS

The following sections will help you better understand what lines and symbols that are used on a avionics drawings.

WHAT WILL THE DRAWING SHOW



WHAT WILL THE DRAWING SHOW

- •System
- Component Location
- Component name and or ATA code
- Type of component the drawing applies to.
- Which individual aircraft the drawing applies to.
- Type of wire to be used
- •Hardware
- Wire gauge
- Related drawings
- •Thedrawing will also shows the changes or revisions to the drawing

TYPICAL AIRCRAFT CONFIGURATION

•All wiring diagrams typically represent the aircraft in the following configuration: This might not hold true for your facility.

- Aircraft on the ground resting on the landing gear.
- Engines shut down.
- Flaps and slats retracted.
- Doors and access panels open.
- Parking brake handle at intermediate detent.
- Electrical power NOT applied.

- All switches set to NORMAL or OFF.
- All circuit breakers pushed in.

ATA CODES

ATA (Air Transport Association) codes are used to standardize aircraft maintenance, wiring, and operation manuals.

System and sub-system codes are standard regardless of model or manufacturer. Drawing numbers are established in accordance with the ATA codes for the systems and sub-systems they represent.

. In the first blueprint number what does the "23" stand for

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WIRING DIAGRAMS

- •The following sections will help you better understand avionics drawings.
- •The lines and Symbols

PRINT IDENTIFIER

INDE X NO	DRAWING NO & TITLE
	ELECTRICAL DRAWINGS
333-0027	WARNING HORN SILENCE MOD
333-0160	FIRE BELL MOTE SWITCH RELOCATION MOD.
333-0162	WATER PUMP SYSTEM
333-0163	ELECTAIC TOILE?
333-0164	115V 60 HZ RAZOR OUTLET
333-0166	COCKPIT MAP LIGHTS
333-0170	VESTIBULE DOME LIGHTS
333-0177	AFT BAGGAGE LIGHTING
333-0179	RFT EQUIPMENT AREA LIGHTING
333-0182	WATER HEATER
333-0185	OVERBOARD DRAIN HEATING
333~0200	GALLEY DOME LIGHTS
333~0209	CABIN FLOOR HEATERS

PRINT IDENTIFIER

Is typically located on the bottom left side of the drawing above the drawing number. 333-0200 Cabin Floor Heaters is one example

SYSTEM IDENTIFIER

•This is another style of Print identifier is located on the bottom left side of the drawing above the drawing number.

- •The ATA System is 23 sub system 32
- •ATA 23 is Communication

EQUIPMENT IDENTIFICATION

•On some drawings Equipment identification is found just above the component. The number on the left will be found on the component 712RL Public Address Amplifier so any item on the drawings that has 712RL is the Public Address Amplifier.

EQUIPMENT IDENTIFICATION

	CT SWITCH	33.01	
281202	Sale LINTER PEL	1290 T.	
A	- WATER PU	.eo-	
	FIDO-LIPZOIA	18	
	and another prosent	14/535/0	
	A ST AN	-1	
	Allow State		
	-1. 187703 AP2		
	ar 2 ⁸¹⁸		
	5-w	P203.4.8	
	180		
	BA		
-	the sea		
-	5	2 5	TA

EQUIPMENT IDENTIFICATION

•On some drawings Equipment identification is found just above the component. The name is written in as the example above **Galley Switch Panel**.

ITEM DESIGNATOR

The number just above the component is the ID number for that item > 712RL

COMPONENT LOCATION

Component location is found to the right of the component name & designation

SYMBO	LS	
PUSH BUTTON SMPLE WIRE SHART 	-COADUCTOR TWISTED CABLE -COADUCTOR TWISTED CABLE -COADUCTOR TWISTED CABLE -COADUCTOR TWISTED -COADUCTOR -	
Electrical Symbols Used	f in Diagrams	

SYMBOLS

•The following slides will be on symbols that will be found on the wiring diagrams and schematics.

	WIRE NUM	IBER
2	132/20 642 JMC 135/20	712RC SONALERT
RADIC RACK	CKT. BKR. PAU """ """ """ """"""""""""""""""""""""	

WIRE NUMBER

•Identification number on wire & cable is an number that corresponds to the drawing number.

•The first five digits, match the drawing. The last three digits are the number assigned to the wire. The suffix can be wire type or gauge size.

•The Bottom pictures shows the wire number as PL500020 The last 2 digits are the wire size ie. 20 AWG

•Most Wire and coax numbers that are being installed in modern aircrafts are an _8_ digit part number

WIRE SIZE
UNLESS OTHERWISE SPECIFIED : ALL WIRE IS ANG 22

WIRE NUMBER

- •There are several ways in which wire size is indicated on the drawing.
- A note such as the one below can sometimes be found at the bottom center of the wiring diagrams.
- In addition, individual wires on a drawing can be identified to vary from the note.
- •The bottom pictures shows a 22 gauge wire, the top picture shows a 20 gauge wire

BASIC WIRE

This symbol indicates that this wire is a "basic wire" meaning it is basic to the aircraft

•Top Picture -SHIELDED WIRE can be single conductor, twisted pair, or twisted 3 conductor. Solid line with dashes below

•SHIELDED WIRE HIGH TEMPERATURE wire is used in areas where high temperatures are expected to exist, such as engine wiring. Designated on drawings with the suffix HT.

•Bottom Picture - Normal wire -solid black line

•.

SHIELDED CABLES

The color of the wire covering color will be R = Red and B = Blue and Y = Yellow•Is there any advantage to using twisted pair wires?

There is definitely an advantage.

•Physicists figured out long ago that a wire with a current flowing through it created a magnetic field.

• They also figured out that a magnetic field can induce current to flow in a wire that passes through that magnetic field. By twisting your power and ground leads together, for example, the current flows in opposite directions and the wires cross orthogonally, lessening the effect of the magnetic fields.

•This is why you often see twisted pairs used in RS-232 or RS-422 digital circuits -- they are very sensitive, and need to have the least amount of noise possible.

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COAXIAL CABLE DOUBLE SHIELDED

•Coax is identified by suffix after the wire number.

•Compare the suffix to the General Notes or part number on coax in the Index for the correct part number.


SHIELD JUMPER

Used to jump –(connect) from one wire to the next – part number will vary depending on wire size



SHIELDED SPLICE

Shielded twisted pair spliced to four shielded twisted pairs through a connector. Note shield jumpers.



MODULE CONNECTOR Module connector is in aircraft.

JUNCTION BLOCK



JUNCTION BLOCK Also known as a J block. Split blocks use number designators, whole blocks use lower case letters. Used for Grounding



J-BLOCK This is the symbol for the junction block shown on the previous slide



AUDIO

Top picture – Headphone jack & Left bottom picture - microphone jack and Right Bottom picture - Speaker



Relay Takes power or a ground to operate



JIFFY JUNCTION Type of a connector



JIFFY JUNCTION This is what they look like installed in the aircraft. They serve as a joint/connection for connecting two wires together.



CONNECTORS

- •The Right picture is what they look like in the Aircraft.
- •The left picture is what they look like on the the drawing.
- •They could be circular or box shaped connectors.

•The equipment Emergency Light Power Supply has ABERDCDEHJ EX are the letters located on the front of the connector, the wire is stripped, a Pin is crimped on and inserted into the hole on the back of the connector.

•Connectors serve as a joint/connection for connecting power/control to electrical equipment such as, Power Supplies, Valves, Servos, Electrical Motors, Heads up display, Avionics equipment ex.

•A rear release connector has Blue color band around it.



CONNECTORS

This is what they look like on the drawing.

They could be circular or box shaped connectors. 782 has DEF and ABC are the letters located on the front of the connector if it's a circular connector, the wire is stripped, a Pin is crimped on and inserted into the hole on the back of the connector.

They serve as a joint/connection for connecting power/control to electrical equipment such as. Valves, Servos, Electrical Motors, Heads up display, Avionics equipment ex.



CONNECTORS

This is another example of what they look like on the drawing.

They could be circular or box shaped connectors. This connector has the letters NPALHXYZUVW these letters located on the front of the connector, the wire is stripped, a Pin is crimped on and inserted into the hole on the back of the connector.

•The figure eight symbol shown is a jumper wire

•The wire number at the top going down the pictures is 2RV162E22 the wire size is 22 AWG the last 2 digits.

•The number 3 shown in the triangle is a General note/or Flag note, this will tell you something specific about these 2 wires shown



IN LINE DIODE C is cathode, A is anode. Current flows against the arrow.





INLINE DIODE As installed in the aircraft





GROUND Positive goes to a ground



GROUND

•Inside the green circles are ground symbols

Positive goes to a ground

•This is the main reason Electrical bonding is so critical to be done correctly.



TRANSISTORS TRANSISTORS

•PNP is Power Negative Power it takes a positive charge to open a , they are just tiny switches.

•NPN is Negative Power Negative it takes a negative charge to open.

•These are located in side the components, all you can do is find the bad component and replace the box. FAA does not allow an unauthorized personal to open the equipment up.



SWITCHES

•The wire size is 22 going into the switch.

•The switch is shown in the Gen 1 position, this is multi position switch.Gen1 on Or APU on Or Battery on. •The number on the back of the switch are pin numbers for connecting the wires to the switch.



SWITCHES •The Top switch is on/off.

•The second switch is push on/ push off. •The third switch (bottom of picture) is a multi position - Gen 1 position, this is multi position switch.Gen1 on Or APU on Or Battery on.

ELECTRICAL BUSSES



ELECTRICAL BUSSES •Shown is a typical Battery buss

•Two wire at the top goes out to circuit breakers •The three wires at the bottom of the picture goes out to circuit breakers

•All the wiring will go out to power equipment thru switches, breakers.

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ELECTRICAL BUSSES

•Shown is a simple Battery buss

- •The part number is GD300A wire size is 20 gauge AWG circuit breakers
- •The wires in the picture goes out to circuit breaker marked (3)
- •The circuit breaker part number is 7274 -11 (3) Manufacture is Kliron
- •The wiggly line is a continued on the next page or page 2 ex.

•



FEED THRU Feed thru's are where the wiring passes through the pressure bulkhead. FT = FeedThru



FEED THRU Actual installation on production A/C



CONTINUED ON

This line means part is cut off and continued on another drawing. SD (see drawing) XX-XX-XX (XX represents drawing number.

CONTINUED ON
GALLEY SWITCH PANEL
ANTER PLANTER PLANT QUIT
CAPEDO ADE
ut al

CONTINUED ON

This wavy line means part is cut off and continued on another drawing. If this is on page 1 the part is continued on page 2 or SD (see drawing) XXXXXX (XX represents drawing number.



CONTINUED ON DRAWING 23-15-46 or xxxxxxxx drawing



BROKEN LINE

Indicates print is continued on another drawing. SD = see drawing



STICK DRAWINGS

•Usually hand drawn used for wire harness building only

•Stick drawings are used in the manufacture of the wiring harness.

•They indicate connector type, component location, component ID, distance between breakouts, type of covering (if any), and related prints.



TUNNEL NODE

This takes you to the next drawing to continue XXXXXX represents drawing number Found on stick drawing, this symbol indicates that the bundle branches here and is continued on another drawing.

SPLICE GOING TO ANOTHER DRAWING
SD 25-01-11

SPLICE GOING TO ANOTHER DRAWING





CONNECTOR SYMBOL



RACPRO SPLICE

 $\mbox{-Tells}$ where the splice is to be made. Splice is to be done within six inches of connector

•Big wire to smaller diameter splice will be within 3 inches

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P CONNECTOR



COAXIAL CONNECTOR SYMBOL



COAXIAL TEE CONNECTOR
DIMENSIONING CONVERSION

Conversion of millimeters to feet. 1mm = .03936 INCHES 1 FOOT = 304.8 mm EXAMPLE OF FORMULA 200mm *.03936 = 7.873 INCHES 25.4mm per inch

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Conversion of millimeters to feet. 1mm = .03936 INCHES 1 FOOT = 304.8 mm EXAMPLE OF FORMULA 200mm *.03936 = 7.873 INCHES 25.4mm per inch



DIMENSIONING Cable or wire dimensions shown on drawing is in mill a meter mm Slide 70



RYLON SLEEVING

•Also known as Snake Skin, Rylon is a black net sleeving used to protect wiring where it breaks out from the bundle.

• It is easily damaged when heating shrink tube used to finish the ends.

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ROUNDIT SLEEVE SYMBOL
RYLON SLEEVĘ
600/1-4 Z5 82
ROUNDIT

ROUNDIT SLEEVE SYMBOL

P/N 2000 NX-XX DIA EXAMPLE- XX = 1/2"

ROUNDIT SLEEVE



ROUNDIT SLEEVE

Typical color is green Similar to Rylon sleeve, made of green material. Used to prevent chafing of the wire bundle

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HEAT SHRINK TUBING

Standard type available in sizes from 1/8" to 1-3/4".Also available is ATUM shrink tubing. ATUM only available in one size but has a high shrink ratio. Very rigid after cooling.

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Standard type available in sizes from 1/8" to 1-3/4". Also available is ATUM shrink tubing. ATUM only available in one size but has a high shrink ratio. Very rigid after cooling. Slide 74



WHAT NOT TO DO.

Leaving cut wires tied in the bundle One of these wires controlled power to the thrust reversers.