CA-320
DIGITAL COMPASS

OPERATOR'S MANUAL

P/N: 150-0102-02
Revision 2 May 2006

Capital Avionics, Inc.
Tallahassee, FL. 32310

WARRANTY

All Capital Avionics, Inc. (CAI) products are warranted against defects in materials and workmanship for a period of one year from date of purchase. During this period CAI products will be repaired or replaced, at our option, without charge for parts or labor, but excluding transportation costs to and from the factory. Unusual wear, abuse, contamination, damage caused by misuse or improper operation are not covered by the warranty. CAI's warranties are specifically set forth above and there are no other express warranties, or warranties of merchantability or fitness for particular purpose. CAI's liabilities and obligations shall be limited to those set forth above and no others.

CAI reserves the right to make design changes, additions to and improvements in its products without any obligation upon itself to install such changes, additions or improvements in products previously manufactured.

CAI certifies that its products are thoroughly tested and calibrated to meet its published specifications, traceable to national standards, when shipped from the factory.

RECORD OF REVISIONS

REVISION NUMBER	DATE OF REVISION	DESCRIPTION OF CHANGES	INSERTED BY	DATE INSERTED
0	February 2005	Original.		
1	April 2005	Added additional alignment procedures.		
2	May 2006	Added equipment upgrade information and operation instructions.		

LIST OF EFFECTIVE PAGES

REVISION NUMBER	(*) INDICATES PAGES CHANGED, ADDED, OR DELETED.
0	1-1 thru 1-3 2-1 thru 2-5 3-1 thru 3-15 4-1 5-1 6-1 7-1
1	1-1 thru 1-3 2-1 thru 2-5 3-1 thru 3-15 4-1 5-1 6-1 7-1
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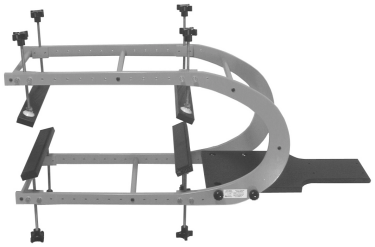


CA-320C Wing Mount

The CA-320A, CA-320B and optional CA-320C comprise the Digital Compass System used to align aircraft magnetic compasses and other magnetic measuring devices. The acceptable methods today are to taxi or tow an aircraft to a compass rose and align it with the cardinal points or to be aligned with a calibrated site compass. Both methods require at least two technicians and skills in orienting the aircraft with a known heading. Alignment accuracy is dependent upon these skills for each heading observed. The method with the CA-320 requires that the technician perform one alignment between the unit and the aircraft, and from then on can easily position the aircraft to any desired heading. The system allows a technician, with no external reference, to perform very precise and accurate (0.5°) compass corrections. With a digital readout, there are also no interpretative skills needed by the technician.

To better understand the operation of the CA-320, a review of magnetic fields is included here. The earth's magnetic field intensity is about 500 to 600 milliGauss or 0.5-0.6 Gauss. This field is generated primarily from iron located at the core of the earth. The magnetic poles are not located at the physical North and South poles of the earth and in fact are constantly moving tens to hundreds of kilometers daily due to normal variations and magnetic storms. Currently they are moving in an approximately northwest direction at 40 KM per year. At the present time (2005), the north magnetic pole is located in the Canadian Arctic at 82.7º North Latitude and 114.4º West Longitude. What is important to remember is that the magnetic lines of flux being measured may vary in any given spot by 0.2º from day to day. While the CA-320A is very sensitive and accurate, the field it is measuring is moving. An analogy is a stream bed that over a year's time does not wander from its banks, yet the swirls of water may be changing direction slightly.

The angle between the true north pole and the magnetic north pole is called the declination angle or variation and can exceed +/- 20°. It is important to remember that we are measuring ***magnetic*** headings and not ***true*** headings. Figures 1 shows the earth's magnetic field with reference to true north and Figure 2 shows the declination angle in the contiguous 48 states.

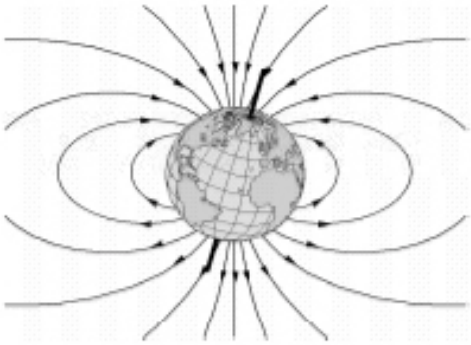


Figure 1-1 Earth's Magnetic Field vs. True North.

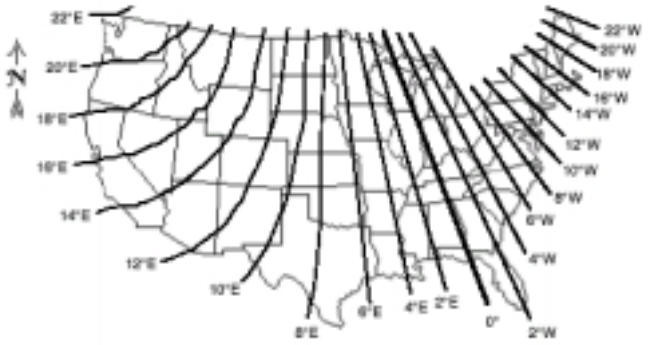


Figure 1-2 Declination Angle to Correct for True North.

Note in Figure 1 that the magnetic field is parallel to the earth's surface at the equator only. At all other latitudes the magnetic field has a vertical component. In the contiguous 48 states, the vertical component of this field, also called the dip or inclination angle, is approximately 70º. Therefore only about 34% of the total magnetic field strength is actually available for our measurements. It is important that this vertical component not be allowed to introduce errors into the heading measurement. See Figure 3.

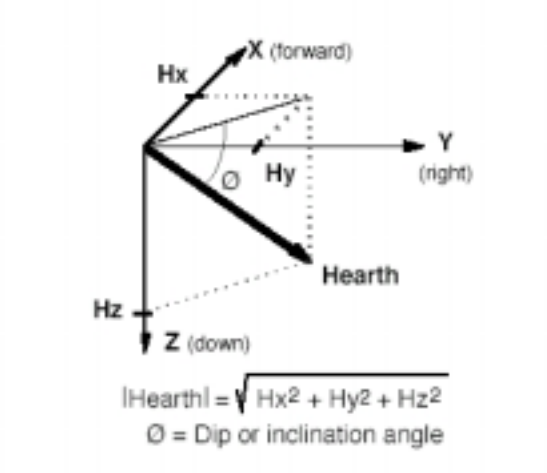


Figure 1-3 Earth's Field in X, Y and Z Coordinates.

The CA-320A has an external gimbal mount that maintains the magneto-resistive sensors in a level position so that the X, Y and Z magnitudes can be accurately determined. There is an additional internal attitude sensor that compensates for any pitch and roll variance from level up to +/- 20°. So as long as the CA-320A is stable the measurements will be accurate; however, acceleration errors will be induced if the CA-320A is swinging when headings are being recorded.

Another important source of errors is proximity to ferrous materials such as iron, nickel, steel and cobalt. The earth's magnetic field travels through the air, which has a low permeability or conductance only until it can find a better medium. Given the opportunity, the field will instead travel through ferrous metals with the effect being to increase the local strength of the field. This is measured by the CA-320 with resultant errors. There are two kinds of errors that can be introduced in such a scenario: hard and soft iron. Hard iron errors are due to *magnetized* ferrous materials and can create large errors at a relatively large distance. Soft iron errors are due to *non-magnetized* ferrous materials and have less effect but are harder to compensate for. Experience has shown that the leading edges and much of the underside of aircraft wings are relatively free of ferrous materials and a good location for the CA-320A sensor. In Section 3, Operations, procedures will be provided to determine the best location.

Section 2

DESCRIPTION

CA-320A Digital Compass Transmitter

The heart of the Digital Compass System, this device contains sensors capable of measuring the magnitude of the earth's magnetic field in three axes and pitch/roll attitude. It also has a "smart" battery charger and a high performance Lithium Ion rechargeable battery. The on board sight laser utilizes a class IIIa device. The unit mounts using a gimbal assembly and precision rotary table. The magnetic heading information is processed and transmitted via wireless link to the CA-320B Digital Compass Receiver. To increase range due to interference, the unit allows the user to select from eight channels.

Things to remember:

- Although rugged in appearance the unit contains delicate sensors and should be handled accordingly. A good guideline to keep is treating it as a laptop computer.

- There are internal devices that sense attitude which may be upset by unusual positions or violent movement. To maintain stated accuracy, allow the unit to remain motionless for at least two minutes after such an event (i.e. turned upside down). The optional Windscreen Accessory (PN 071-0114-00) is recommended for high winds (more than 15 knots), which can create abrupt movements with accompanying acceleration errors.

- The measured heading will be more stable with less vibration. With the engine(s) running, it may benefit to increase the RPM slightly above idle and sync propellers on multi-engine aircraft. For optimal use, tow the aircraft and stop completely between measurements.

- The Sight Laser has a Class IIIa intensity, which requires care in operation. Refer to Appendix A for important safety information.

- Keep away from strong magnetic fields, such as magnetic tipped screwdrivers. It is possible for the electronic circuitry to become magnetized from use. To prevent subsequent hard iron errors, the unit may be degaussed without damage or affecting the calibration. If you have any doubts, degauss the unit.

- Do not operate in rain. Store unit at room temperature in a dry location.

- Disassembly should never be attempted as the unit contains no user serviceable components or fuses inside.

- The Lithium-Ion battery can be stored with a full charge and its capacity will not be degraded if left for long periods of time in such a condition.

CA-320A Technical Specifications

P/N: 071-0102-20

Triaxial Magneto-Resistive Sensor

Heading accuracy:	0.5^{o}_{RMS}
Resolution:	0.1º (rounded to 0.5º with CA-320B)
Pitch/Roll Limits:	+/- 20º
Maximum Magnetic Field Intensity:	1 Gauss
Repeatability:	0.3º

Laser

Class:	IIIa
Wavelength:	532nm
Power:	Less than 5mW, CW
Beam Divergence:	<1.4mrad

Wireless Link

Frequency:	903.37~921.37 (8 channels)
Power:	0dBM
Digital communication:	9600 Baud
FCC Approval:	Type 15 Class B compliant
FCC ID:	SKKCA320A1
Canadian ID:	IC:6417A-CA320A1

Weight/Dimensions/General

Electronics and Gimbal assembly	3.5lbs.
Dimensions	10.6” x 5” x 3.9”
Inspection Plate adapter/standoffs	1.5”,0.2lbs
Operating Temperature:	-20ºC to +60ºC
Storage Temperature:	-20ºC to +60ºC

CA-320B Digital Compass Receiver

The system uses the same wireless technology that is gaining popularity in computer networks. Developed for applications of penetrating walls and floors, this capability is ideal for use inside the aircraft while taxiing. The CA-320B is microprocessor controlled and the readout is a digital LCD display that indicates heading to 1/2 of a degree and a signal strength meter. To increase range due to interference, the unit allows the user to select from eight channels. To power the unit, an internal high performance Lithium Ion battery is used. To ensure maximum run time, the unit includes an on board smart charger, which fully charges the battery from any state, while protecting it from overcharging. A Battery Status lamp illuminates green during the charge cycle and extinguishes when complete. During operation, the lamp illuminates red if the battery is low. While no damage may occur, the unit is not designed to operate while being charged.

Things to remember:

- It may be necessary to turn the transmitter on first and allow a brief moment before turning on the receiver. If communication with the transmitter cannot be established, repeat increasing the delay, and verify that the transmitter and receiver have the same frequency channel selected.

- Once the units have synchronized, improve reception by keeping the antenna upright and if possible locate near a window on same side of aircraft as the transmitter. Please note that moving the CA-320B Digital Compass Receiver only a few inches can have a significant effect upon the strength of the received signal.

- Do not expose the display to direct sunlight for unnecessary amounts of time.

- While rugged in appearance, the unit contains sensitive electronic components and should be handled with care.

- Disassembly should never be attempted as the unit contains no user serviceable components or fuses inside.

- The Lithium-Ion battery can be stored with a full charge and its capacity will not be degraded if left for long periods of time in such a condition.

CA-320B Technical Specifications

P/N: 071-0104-20

Digital Compass Receiver

Heading accuracy:	Digital readout of CA-320A transmission
Resolution:	0.5º (with CA-320B–001)

Wireless Link

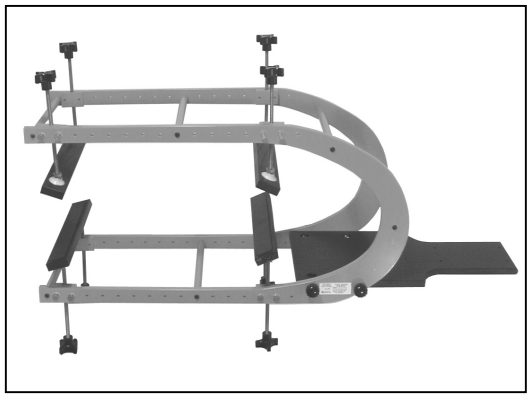
Frequency:	903.37~921.37 (8 channels)
Digital communication	9600 Baud
FCC Approval:	Type 15 Class B compliant
FCC ID:	SKKCA320A1
Canadian ID:	IC:6417A-CA320A1

Weight/Dimensions/General

Portable unit	1.0 lb with antenna
Dimensions	4.2” x 5.0 x 2.2” without antenna
Operating Temperature:	-20ºC to +60ºC
Storage Temperature:	-20ºC to +60ºC

CA-320C Wing Mount Adapter

This device is used to provide an easily accessible location for mounting the CA-320A Digital Compass Transmitter. The clamping pads are low resilient rubber with a high friction coefficient that will not slip with only slight pressure applied. The CA-320C is adjustable to fit the stringer and rib patterns of most wings and the standard model (P/N 071-0105-00) fits wings up to 8.75" thick. Wing mounts to accommodate thicker wings and adapters for helicopters are available upon request.



Things to remember:

- Always try to stay as far as possible from ferrous metals. A good rule of thumb is a distance more than two diameters from the offending device i.e. 8' for a reciprocating engine.
- Apply only slight pressure to the tightening knobs to prevent damage to the wing skin or structure.
- Adjust the location of the clamping pads to align with structural members or curved areas with greatest strength.

CA-320C Technical Specifications

P/N: 071-0105-00

Dimensions	12.75" x 31.5" x 8.25"
Weight:	12.4 lbs
Maximum Wing Thickness:	8.75"

Section 3

OPERATION

(1)	**Mode Status Lamp**	**(6)**	**Charge/Data Port**
(2)	**Vernier Lock**	**(7)**	**Sight Laser**
(3)	**Rotary Table Lock**	**(8)**	**Mode Select Switch**
(4)	**Vernier Adjustment**	**(9)**	**Antenna**
(5)	**Battery Status Lamp**	**(10)**	**Channel Select Switch**

Figure 3-1. CA-320A Digital Compass Transmitter

1 MODE STATUS LAMP

This lamp indicates the two operating modes of the unit. When this lamp is *GREEN*, the digital compass is operating. When this lamp is *RED*, the sight laser is active. To save battery life, the compass is off during laser operation and vice versa. If this lamp is off, then both the digital compass and the sight laser are off.

2 VERNIER LOCK

Use this knob to lock or hold the Vernier in position once it is properly aligned.

3 ROTARY TABLE LOCK
Use this knob to engage/disengage the vernier. With the vernier disengaged, the rotary table moves freely. Engage and use the vernier to make precise adjustments.

4 VERNIER
The vernier knob is used to make precise adjustments to the rotary table.

5 BATTERY STATUS LAMP
When this lamp is *GREEN*, the unit is charging the battery. When this lamp is *RED*, the battery has a low charge level and should be charged soon. ***Note: This lamp will only indicate low charge while a mode is selected.***

6 CHARGE/DATA PORT
This jack is used primarily to charge the battery. It also functions as a data jack to perform software upgrades to the digital compass and run diagnostic tests. Future options may be incorporated with this interface. ***Note: While no damage may occur, the unit is not designed to operate while being charged.***

7 SIGHT LASER
Use the sight laser to aid in properly aligning the unit. ***CAUTION: Never look directly at the beam. Refer to appendix A for complete safety instructions on operating the sight laser.***

Figure 3-2. CA-320A Laser warning label.

8 MODE SELECT SWITCH
Use this switch to select between operating the sight laser or the digital compass. The unit is intentionally designed to operate in one mode at a time.

9 ANTENNA
The antenna is a modified ¼ λ dipole that determines the range of the transmitter. Always keep it clear of any structure or obstacle that may cause interference. ***Use caution, as the antenna is connected directly to the main board. Should it receive a sharp impact or if the unit is dropped directly on this antenna, damage will most likely occur.***

10 CHANNEL SELECT SWITCH
To increase range due to interference, the unit allows the user to select from eight channels.

(1) Display
(2) Battery Status Lamp
(3) Charge/Data Port
(4) On/Off Switch
(5) Channel Select Switch
(6) Antenna

Figure 3-3. CA-320B Digital Compass Receiver.

1 DISPLAY
The display indicates the compass reading and is backlit for ease of viewing in low light environments. The signal strength meter is used to monitor the level of the received signal. Interference can degrade the range of reception. With the CA-320A Digital Compass transmitter turned off, select a channel than has two or less dots active.

2 BATTERY STATUS LAMP
When this lamp is *GREEN*, the unit is charging the battery. When this lamp is *RED*, the battery has a low charge level and will need to be charged soon. ***Note: This lamp will only indicate low charge while the receiver is turned on.***

3 CHARGE/DATA PORT
This jack is used primarily to charge the battery. It also functions as a data jack to perform software upgrades to the receiver and run diagnostic tests. Future options may be incorporated with this interface. ***Note: While no damage may occur, the unit is not designed to operate while being charged.***

4 ON/OFF SWITCH
This switch is used to turn the receiver on or off. In order for the system to communicate properly, it may be necessary to turn the transmitter on first. After a moment, turn the receiver on. If communication with the transmitter cannot be established, repeat increasing the delay, and verify that the transmitter and receiver have the same frequency channel selected.

5 CHANNEL SELECT SWITCH

This switch is used to select the desired receive channel. The operating frequencies are as follows:

CHANNEL	TX FREQ
0	903.37 Mhz
1	906.37 Mhz
2	907.87 Mhz
3	909.37 Mhz
4	912.37 Mhz
5	915.37 Mhz
6	919.87 Mhz
7	921.37

6 ANTENNA

The antenna is responsible for receiving the heading data from the transmitter. Always keep it clear of any structure or obstacle that may degrade performance.

COMPASS CORRECTION PROCEDURE

(ON FIXED WING AIRCRAFT USING CA-320C WING MOUNT)

1.0 PURPOSE

Use the following procedure to test the magnetic compass and/or compass system(s) in a fixed wing aircraft. It is imperative that the instructions are read and fully understood before proceeding. Appendix A contains important safety information regarding the operation of the Sight Laser; Appendix B contains additional information concerning the operation of the Digital Compass transmitter and receiver with regards to the FCC Part 15 approval.

2.0 REQUIRED/OPTIONAL EQUIPMENT

CA-320A Digital Compass Transmitter	P/N: 071-0102-20
CA-320B Digital Compass Receiver	P/N: 071-0104-20
CA-320C Wing Mount	P/N: 071-0105-00
Digital Compass Stand	P/N: 071-0043-00
Tripod with extension	P/N: 071-0044-00*
optional equipment	
Wind Screen	P/N: 071-0114-00
Safety Goggles	P/N: 081-0027-00

* A wooded stand or aluminum ladder may be substituted.

3.0 SETUP

3.1 Inspect the CA-320 system components for any signs of damage or missing parts. Turn each unit on momentarily to confirm the “Low Battery” status is not shown. If one or both units indicate a low charge, it is recommended that the unit(s) be charged before proceeding.

3.2 In the general vicinity of where the compass alignment will be performed, determine which channel to use by the following steps:

3.2.1 Ensure that the CA-320A and CA-320B are set to the same channel.

3.2.2 With the CA-320A Digital Compass transmitter off, observe the signal strength meter on the CA-320B Digital Compass receiver display. If two dots or less are displayed, there is no significant local interference. Proceed to step 3.2.3. If more than two dots are displayed, select channels 0-7 and leave the unit selected to the channel with the least interference.

3.2.3 Turn the CA-320A Digital Compass transmitter on and select the same channel as the receiver. The channel is selected by inserting a small Phillips or flathead screwdriver into the access hole on the bottom of the unit and gently turning then switch. Detents can be felt as channels are selected. When the units are on the same channel, the signal strength meter will show maximum. ***Note: Use the included screwdriver or one that in non-magnetized.***

3.3 Verify that the units are communicating properly. If the units fail to communicate properly, it may be necessary to turn the transmitter on first. After a moment, turn the receiver on. If the units fail to communicate, turn both off and repeat increasing the delay.

3.4 To save battery life, turn both units off.

3.5 Remove the CA-320C Wing Mount components from their case. See Figure 3-4 below:

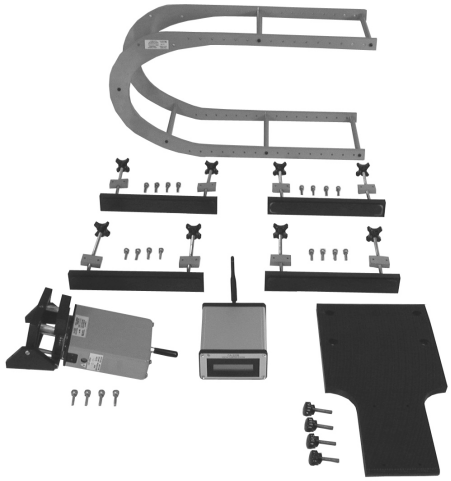


Figure 3-4. CA-320C Wing Mount Components

3.6 Attach the platform to the CA-320C using four (4) ¼" x 20 brass thumbscrews. Do not over tighten.

3.7 Determine a suitable location for the wing mount, preferably near either wing tip and as far away as possible from any sources of magnetic interference. Items that might distort the earth's magnetic field are energized pitot probes, autopilot servos or any electrical motors (whether energized or not), engines, landing gear or steel screws. The horizontal stabilizer can be used if engine operation does not induce unacceptable levels of vibration or if the aircraft is being towed. Remember that some stainless steels are mildly magnetic and should be considered in CA-320C placement. ***Note: A good rule of thumb regarding safe distances from non-magnetized ferrous materials is to stay at least twice the distance from an object based upon its size.***

To determine if the chosen location is free of magnetic interference, perform the following steps: ***Note: It is recommended that the aircraft is under tow to perform these steps.***

3.7.1 Mount the CA-320A in the optional accessory tripod if available, otherwise place the unit in its stand on a non-ferrous table or ladder (aluminum, wooden, etc.) at the same height and 5' forward of the selected spot.

3.7.2 Turn on the units and allow the heading reading to stabilize.

3.7.3 Slowly bring the aircraft forward until the leading edge of the wing is adjacent to the CA-320A. The heading read by the CA-320B should have little or no change if there is no interference. If the heading changes more than 0.5°, choose another location and repeat steps 3.7.1 through 3.7.3 until a desirable location is found.

3.8 After finding a location with little or no interference, the CA-320C Wing Mount is assembled to match as closely as possible the ribs and stringers in the wing. Measure the distance from the leading edge of the wing to the first line of rivets or other indication of internal support and the distance from the leading edge to a second line of rivets or indication of internal support. See Figure3-5 below:

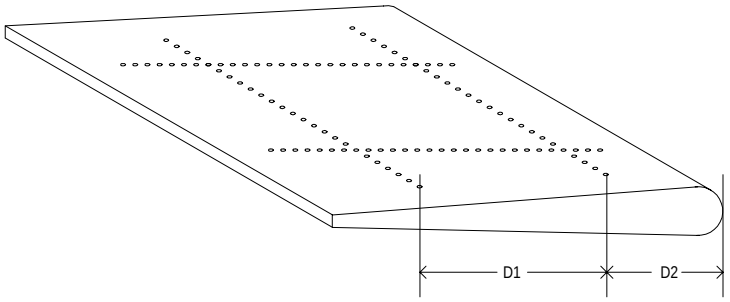


Figure 3-5. Distance between leading edge and rivet lines.

3.9 Assemble the CA-320C with the four clamps matching as closely as possible the distances found to the two rivet lines or strengthened areas of the wing. See figure 3-6 below:

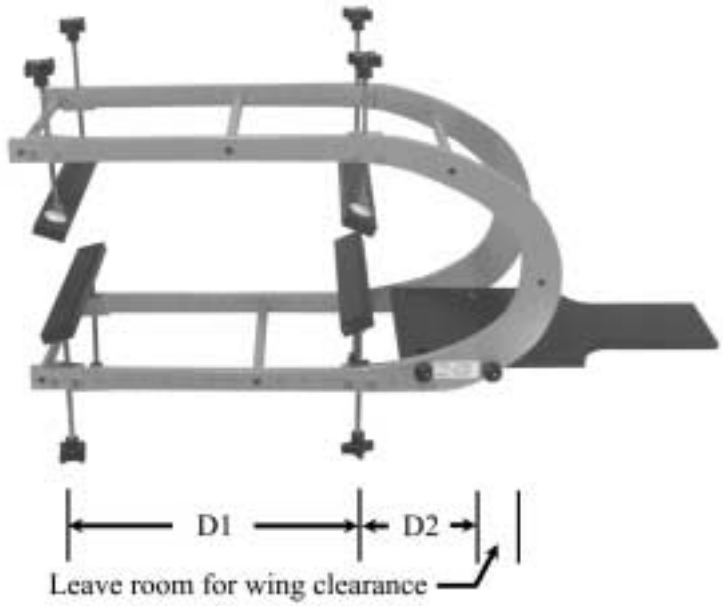


Figure 3-6. Align clamps with distance between leading edge and rivet lines.

3.10 Open the clamps slightly larger than the thickness of the wing, then carefully place the mount on the wing in such a manner that the clamps will contact the rivet lines or structural member. Tighten the bar clamps evenly until slight pressure is felt on the wing. Inspect all contacting surfaces for any sign of excessive pressure indicated by slight depression of the aluminum (or *oil canning*). Tug slightly on the sensor platform to insure it is being held firmly on the wing. ***Caution: It takes very little clamping pressure to achieve rigidity. Excessive pressure may damage the wing and/or the mount.***

3.11 Do **NOT** mount the CA-320A Transmitter to the wing mount at this time.

4.0 ALIGNMENT OF LONGITUDINAL AXIS

*It is important to realize that the actual aircraft heading (in degrees) does **not** need to be known prior to performing this alignment, thus eliminating the need for a compass rose, slight compass, etc.*

*Once the CA-320A Digital Compass transmitter is properly aligned with the aircraft, the technician will **determine** the heading simply by reading the CA-320B Digital Compass display.*

Danger: ***Before performing the alignment, refer to Appendix A and review important safety information regarding the operation of the Sight Laser. The unit utilizes a 532nm Class IIIa CW laser and must never be activated when personnel are forward of the aperture. Care should also be taken to insure that the beam cannot reflect off a shiny surface and one must immediately turn away from any direct or incident light waves. Optional safety goggles (PN: 081-0027-00) are available for service personal who could be exposed to direct or incident laser light waves.***

4.1 Place the CA-320A in front of the aircraft in the optional tripod, otherwise place on a non-magnetic table or ladder. The CA-320A antenna should be directly in front of the center of the radome or nose. Determine the centerline of the aircraft.

Generally along the fuselage there are features such as rivet patterns, windshield center posts, etc. that give the airframe a left/right symmetry. It is the center of this symmetry that defines the centerline. ***Note: Some top mounted antennas are not always located along the centerline and may be misleading****.*

4.2 Remove the cover and while standing behind the laser aperture, place the CA-320A MODE SWITCH into the LASER position. The MODE STATUS LAMP shall light *RED* in color.

4.3 Refer to Figure 3-7. Align the unit by pivoting the CA-320A in a manner such that the sight laser tracks the centerline, adjusting the position of the unit as required.

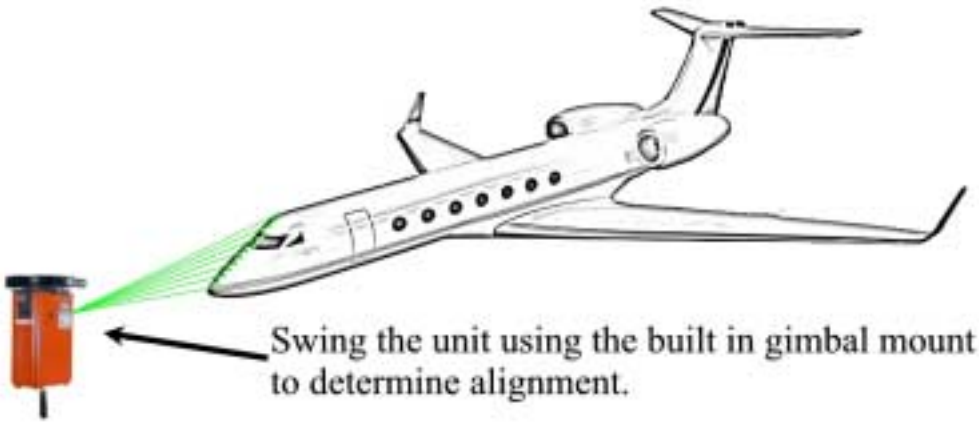


Figure 3-7. Use Sight Laser to align unit with the centerline.

4.4 Place the MODE SWITCH in the COMPASS position and reinstall the laser cover. The MODE STATUS LAMP shall light G*REEN* in color. Record the heading displayed on the CA-320B Digital Compass Receiver. This value is 180° opposite of the actual aircraft heading. Determine the heading by adding or subtracting 180° to the value recorded.

Example #1:
If 4.5° was recorded, then add 180° to determine the actual heading is 184.5°.

Example #2:
If 227.0° was recorded, then subtract 180° determine the actual heading is 47.0°.

4.5 Attach the CA-320A Digital Compass transmitter to the installed wing mount. The unit will be rotated so that the correct heading is displayed on the CA-320B Digital Compass receiver by the following method:

4.5.1 Refer to Figure 3-1. Disengage the ROTARY TABLE LOCK (3) by loosing the knob 1/2 turn. The unit should rotate freely on the rotary table.

4.5.2 While viewing the display, rotate the unit until it is within 1° of the desired heading as determined in step 4.4.

4.5.3 Loosen the VERNIER LOCK (2) by rotating counter clockwise several rotations.

4.5.4 Tighten the ROTARY TABLE LOCK (3), which engages the VERNIER (4). Now use the vernier to dial in the exact heading.

4.5.5 Prevent the table from rotating by tightening the VERNIER LOCK (2). Verify that the desired heading is displayed on the receiver. Repeat steps 4.5.1 through 4.5.5 as necessary to obtain a proper result.

5.0 COMPASS ALIGNMENT PROCEDURE

The technician needs to follow the OEM's instructions for the system being tested and/or aligned. However, most wet compasses and electronic heading systems share a commonality and a brief procedure and troubleshooting analysis is included here.

Make a copy of the Compass Alignment Worksheet provided in Appendix C for each system being checked. It may become overwhelming to adjust more than one system at a time; therefore it is recommended that the systems be checked individually.

5.1 Position the Aircraft Under Test so that the CA-320B is indicating a heading of approximately North (355° to 005°). Record this value under the column titled Aircraft HDG.

5.2 Record the indicated heading of the aircraft's compass system under the column titled Compass HDG.

5.3 Calculate the difference between the two and record under the third column titled Compass Error.

5.4 Re-position the Aircraft Under Test so that the CA-320B is indicating a heading of approximately East (85° to 95°). Record the Aircraft HDG, Compass HDG and Compass Error under the appropriate columns. Repeat these tests for the headings of South (175° to 185°) and West (265° to 275°).

5.5 It is now time to review this data and determine appropriate compensation. There are typically three ways of reducing errors in a properly functioning system. The technician wants to adjust the N/S axis for minimum ***difference*** in error from North and South. In other words, if North is 2.5° low and South is 1.5° low, then the N/S adjustment should be made so that both North and South are 2° low. The technician now performs the same adjustment to the East/West axis after reviewing the data so that the ***difference*** in error is the same.

Look at the actual heading error at all the cardinal points and determine if they are biased in one direction or not. By example, if North, East, South and West are respectively -4°, -1°, -4°, -1°, the average error is the sum (-10°) divided by the number of data points (4) or –2.5°. The technician may adjust the flux valve by +2.5° to compensate for this average error. The resultant heading errors would now be:

North: **-1.5°** (-4° + 2.5°)	East: **+1.5°** (-1° + 2.5°)
South: **-1.5°** (-4° + 2.5°)	West: **+1.5°** (-1° + 2.5°)

For those compass and heading systems that do not align to within manufacturer's specifications, after eliminating the components themselves, one must look for interference problems.

Soft-Iron Distortion of the magnetic field is due to the presence of *non-magnetized* ferrous materials. Remember the rule of thumb of staying at least two diameters from any non-ferrous materials. A soft iron error would be indicated by irregular errors on the North-South axis, the East-West axis, or both.

Hard Iron Distortion is due to the presence of *magnetized* ferrous material. This can be found by analyzing the readings taken during a compass/heading system alignment. Magnetized ferrous materials may cause the North-South and East-West axis to shift from their normal center. By example, if the North reading was -3° and the South reading was +3°, the technician cannot ever make the errors the same. The only solution is to make the magnitude of the errors the same. In this scenario, the magnetized material has shifted the North-South axis 3° and there is no way to adjust it out. Under these situations, where the system does not perform to specifications, the offending material must be found and replaced or demagnetized (if allowed).

Section 4

MAINTENANCE/CALIBRATION

There is no periodic maintenance prescribed for any components of the CA-320 Digital Compass. The gimbal assembly may be cleaned if foreign matter prevents its free movement. A technician may also degauss the unit if it has been exposed to excessive magnetic fields.

There are no field replaceable internal components in the CA-320A and CA-320B.

Annual Calibration is recommended. The CA-320A and CA-320B should be calibrated together, although the CA-320B receivers are interchangeable. Note that the CA-320A transmits digital heading in 0.1° increments and the CA-320B rounds to 0.5°.

Notice:

The CA-320 is an advanced device utilizing proprietary circuitry and practices. Unauthorized use or disclosure of the unit's contents is prohibited.

For maintenance or calibration, please contact:

Capital Avionics, Inc.
3701 Hartsfield Rd
Tallahassee, FL 32303
(850) 575-4028

Section 5

ACCESSORIES

Model: **CA-320A**
Description: Digital Compass Transmitter
Part Number: 071-0102-20

Accessories available:
071-0044-00 Tripod with extension
081-0027-00 Safety goggles
200-0152-01 Antenna

Model: **CA-320B**
Description: Digital Compass Receiver
Part Number: 071-0104-20

Accessories available:
121-0003-00 Antenna

Model: **CA-320C**
Description: Wing Mount
Part Number: 071-0105-00

Accessories available:
071-0114-00 Wind screen
089-0129-00 #8-32 Thumbscrews
089-0130-00 #8 Nylon washers
089-0131-00 ¼" x 20 Thumbscrews
089-0132-00 ¼" Nylon washers

Other Accessories available:
071-0043-00 CA-320A stand
071-0106-00 System charger
081-0022-00 System case
081-0023-00 Accessory case

APPENDIX A

Sight Laser Safety

LASER RADIATION
Avoid Direct Eye Exposure

The CA-320A utilizes a 532nm CW Class IIIa laser operating below 5mW. The internal laser is not adjustable and may be only turned ON/OFF. The emission indicator on the face of the CA-320A indicates RED when the laser is operational and personnel must remain behind the aperture during its operation.

Care should also be taken to insure that the beam cannot reflect off a shiny surface and one must immediately turn away from any direct or incident light waves. Optional safety goggles (PN: 081-0027-00) are available for service personal that could be exposed to direct or incident laser light waves.

The protective laser cover should be installed whenever the laser is not in use.

APPENDIX B

Digital Compass Operation

Instruction To The User

This equipment has been tested and found to comply with the limits for a class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. The equipment generates, uses and can radiate radio frequency energy and if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

* Reorient or relocate the receiving antenna.

* Increase the separation between the equipment and receiver.

* Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

* Consult the dealer or an experienced radio/TV technician for help.

This equipment has been certified to comply with the limits for a Class B computing device, pursuant to FCC Rules. In order to maintain compliance with FCC regulations, shielded cables must be used with this equipment. Operation with non-approved equipment or unshielded cables is likely to result in interference to radio and TV reception. The user is cautioned that changes and modifications made to the equipment without the approval of manufacturer could void the user's authority to operate this equipment.