NAVAL AIR TRAINING COMMAND

ELECTRICAL SYSTEM: A.C. DISTRIBUTION AND AIRCRAFT SERVICE CHANGE 36

NATIP SYSTEM UNIT

UC 09 03 01 03 ER

CNAT P-1153 (Rev. 11-75) PAT

T-28 ENGINEERING
PRIMARY

1976

NAVAL AIR STATION · CORPUS CHRISTI, TEXAS

NAVAL AIR TRAINING COMMAND

PRIMARY PHASE

DISCIPLINE: Engineering

COURSE TITLE: Engineering, T-28 (Primary)

UNIT: Electrical System: A.C. Distribution and Aircraft Service Change 36, NATIP System Unit

PREREQUISITES: Units 1 and 2

FOR INSTRUCTIONAL PURPOSES ONLY

SCOPE: The purpose of this unit is to explain the changes made to the electrical system in the T-28 with the installation of ASC 36 and to familiarize the student with electrical system features and instrumentation requiring and utilizing a.c. power.

SPECIFIC INSTRUCTIONAL OBJECTIVES

Affective Domain

1. To provide the student with the opportunity to interpret and analyze the major changes to the electrical system by ASC 36 (Organization).

2. To provide an opportunity for the student to associate the major components of the system with their functions (Organization).

3. To provide the opportunity for the student to become aware of the effects of power loss/failure (Receiving).

Cognitive Domain

Upon completion of this unit, the student will:

1. List the major components of the a.c. electrical system (Knowledge).

2. Recall the a.c. power flow prior to ASC 36 (Knowledge).

3. Recall the renumbering of the inverters (Knowledge).

4. Recall the effects of generator loss before and after ASC 36 with respect to a.c. power distribution (Knowledge).

5. Recall the changes made by ASC 36 (Knowledge).

Psychomotor Domain

None

INTRODUCTION

Once a thorough knowledge of the d.c. components and distribution is gained, the a.c. distribution becomes less confusing. The real difficulty of the a.c. distribution is that three different configurations exist in the T-28 and the student will be flying all three configurations during his career as a T-28 student.

PROGRAMED TEXT

FRAME 1

To begin the discussion of a.c. power, it is the role of the inverter in the T-28 to convert d.c. power to a.c. power, which is used to power the navigation gear and the pilot's primary flight attitude instruments. The large, or 750-volt amp, inverter is powered by the monitored bus. The small, or 250-volt amp, inverter is powered by the primary bus.

The a.c. power in the T-28 is used to power the navigation gear and the pilot's primary _____ _____ _____.

---

flight attitude instruments

FRAME 2

The aircraft in its original configuration, prior to aircraft service change 36 (ASC 36), will be introduced first.

1 Study figure 1 in detail before proceeding. Note that both cockpits in this version of the aircraft have the same type of a.c. instrument power switch. Refer to unit 1 (Figure 9) and locate this switch on the electrical console.

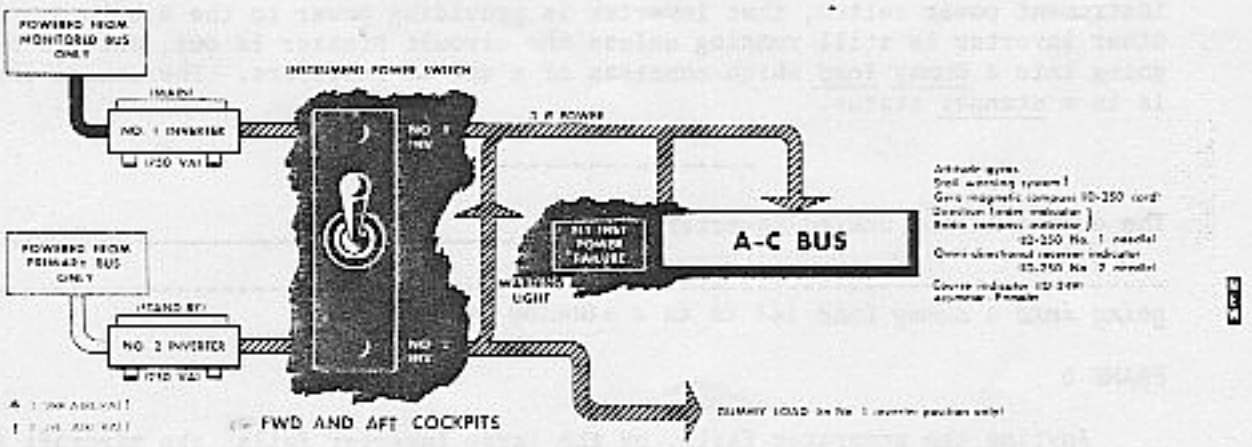

FIGURE 1

What is the No. 2 inverter doing while the No. 1 is powering the a.c. bus? _____

Its output is going into a dummy load.

FRAME 3

The instruments on the a.c. bus that are of greatest concern to the pilot are the attitude gyro, radio magnetic indicator (ID-250), and the course indicator (ID-249). Remembering the power sequence from unit 2, anytime the generator is inoperative, the monitored bus is lost. With the loss of the monitored bus, the a.c. bus and the equipment on this bus are lost until the No. 2 inverter (standby) is selected.

Three a.c. powered instruments lost with a generator failure are the _____ _____, _____ _____ _____, and the _____ _____.

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attitude gyro ... radio magnetic indicator (ID-250) ... course indicator (ID-249)

FRAME 4

An instrument power switch is provided in each cockpit for manual selection of the inverters. The only method of turning the inverters on and off is their respective circuit breakers. If the circuit breaker is in, the inverter is running. This is proven when the inverter circuit breakers are pushed in during the pretaxi checklist. A rise in amperage load, on the loadmeter, will be observed.

No response required.

FRAME 5

Therefore, prior to ASC 36, when a particular inverter is selected on the instrument power switch, that inverter is providing power to the a.c. bus. The other inverter is still running unless the circuit breaker is out, but its output is going into a dummy load which consists of a set of resistors. The unused inverter is in a standby status.

The output of the unused inverter is _____.

---

going into a dummy load (it is in a standby status)

FRAME 6

Anytime the generator fails, or the large inverter fails, the aircraft is without a.c. power to the flight instruments. The small inverter can be selected to take over the job of running the a.c. bus. The pilot making this selection in this version of aircraft must have electrical control.

Prior to ASC 36, the pilot making an inverter shift must have _____ _____.

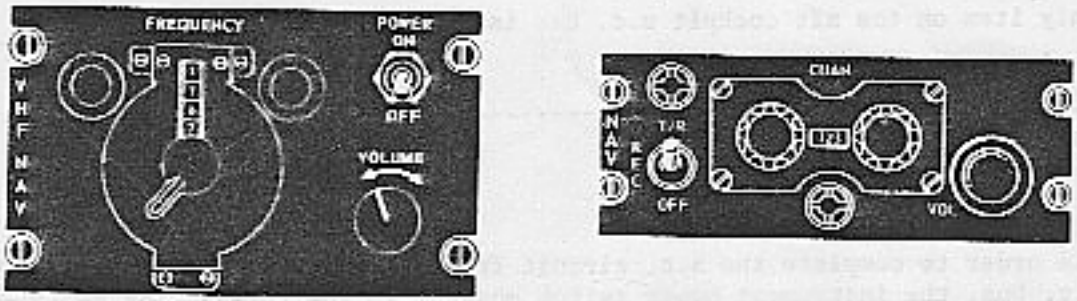
---

electrical control

We will now consider aircraft with ASC 36. ASC 36 was incorporated to facilitate the addition of TACAN.

FRAME 7

TACAN requires a significant a.c. capability for operation. This a.c. requirement exceeded the system capacity of the original configuration of the T-28. The small inverter would not carry the TACAN by itself, but it would carry the a.c. bus. The large inverter would not carry both TACAN and the a.c. bus, but would handle the TACAN with ample reserve capacity. If the T-28 has TACAN installed (figure 2) then it has ASC 36.



VHF NAV CONTROL PANEL (TACAN NOT INSTALLED)

TACAN CONTROL PANEL (ASC 36 installed)

FIGURE 2

No response necessary.

FRAME 8

Study figure 3 in detail before proceeding. It begins at the point where the inverters receive their power. At this point, the a.c. distribution is changed significantly. The inverter numbering is now exactly opposite that of the original configuration, but their power sources have not changed. The monitored bus still provides power to the large inverter, and the primary bus still provides power to the small inverter. Compare these number positions with the original configuration, and note that the inverters have changed positions with respect to the instrument power switch.

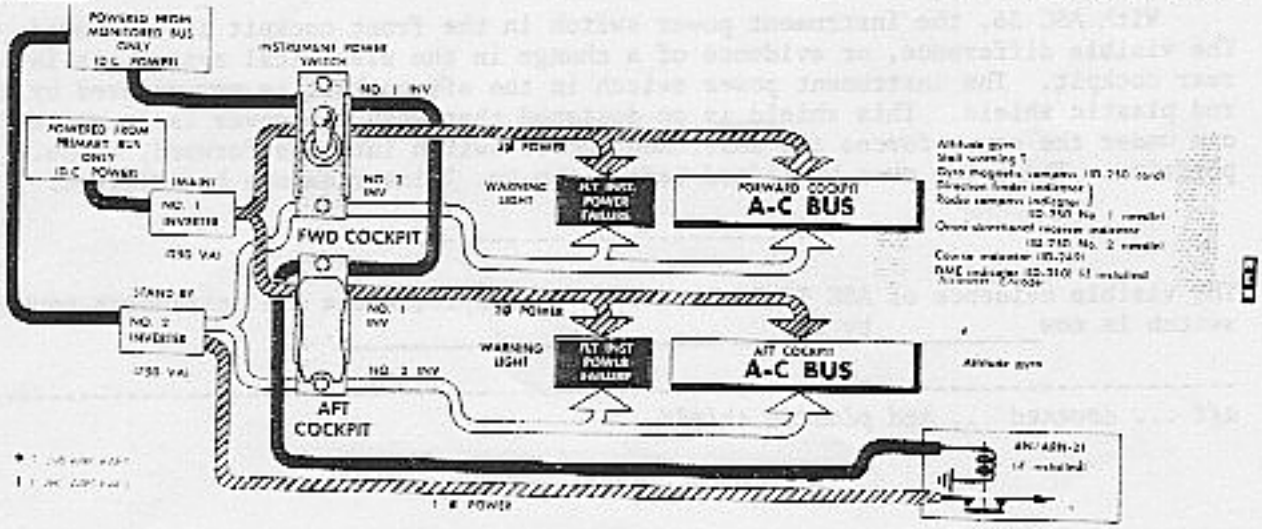


FIGURE 3

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To aid the student in interpreting these diagrams, the solid black lines represent d.c. power routes. The cross-hatched lines represent a.c. power routes. The white, or open, lines represent a.c. power routes when the alternate, or standby, inverter is selected.

Follow the a.c. power route from the No. 1 inverter (now the 250-VA) through the front and aft cockpit switches. Note that the a.c. from the small inverter is now providing power to <u>two</u> a.c. busses, the front and aft cockpit a.c. busses. The change made in the loading at this point is that a second a.c. bus is added as part of ASC 36 to accomodate the aft cockpit attitude gyro.

The only item on the aft cockpit a.c. bus is the_____ _____ _____ _____.

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aft cockpit attitude gyro

FRAME 9

In order to complete the a.c. circuit from the No. 1 inverter to the aft cockpit a.c. bus, the instrument power switch must be in the forward, or No. 1 position. With ASC 36, the inverter selector switches are no longer on the electrical control shift relay and function independently of one another to power their respective a.c. busses. Since the small inverter is powered from the primary bus, the instruments on the a.c. busses are not lost with a generator failure. With a generator failure, the front and aft cockpit a.c. busses are being energized by the number 1 inverter from the battery. An expedient landing is advisable before the battery is drained excessively.

With a generator failure the_____ _____inverter is still good, and the attitude instruments_____(will/will not) be reliable.

No. 1 [small] ... will

FRAME 10

With ASC 36, the instrument power switch in the front cockpit is unchanged. The visible difference, or evidence of a change in the electrical system, is in the rear cockpit. The instrument power switch in the aft cockpit is now covered by a red plastic shield. This shield is so designed that when the cover is in place, a cam under the cover forces the instrument power switch into the forward, or No. 1, position. The cover must be lifted before the No. 2 inverter can be selected.

The visible evidence of ASC 36 is in the_____cockpit, where the instrument power switch is now_____by a_____ _____ _____.

---

aft ... covered ... red plastic shield

FRAME 11

Another significant visible difference in the aft cockpit is the design and function of the d.c. power switch. Refer to figure 4. The aft cockpit d.c. power switch is now labeled NORMAL ON and EMERG. OFF. This change permits the flight instructor to secure all d.c. power if required.

The two positions on the d.c. power switch in the aft cockpit (an aircraft with ASC 36) are _____ and _____.

NORMAL ON ... EMERG. OFF

T-28C 140584 AND SUBSEQUENT AND AIRCRAFT HAVING ASC'S 20, 36, 63, 93, 109, AND AAC 133 INCORPORATED

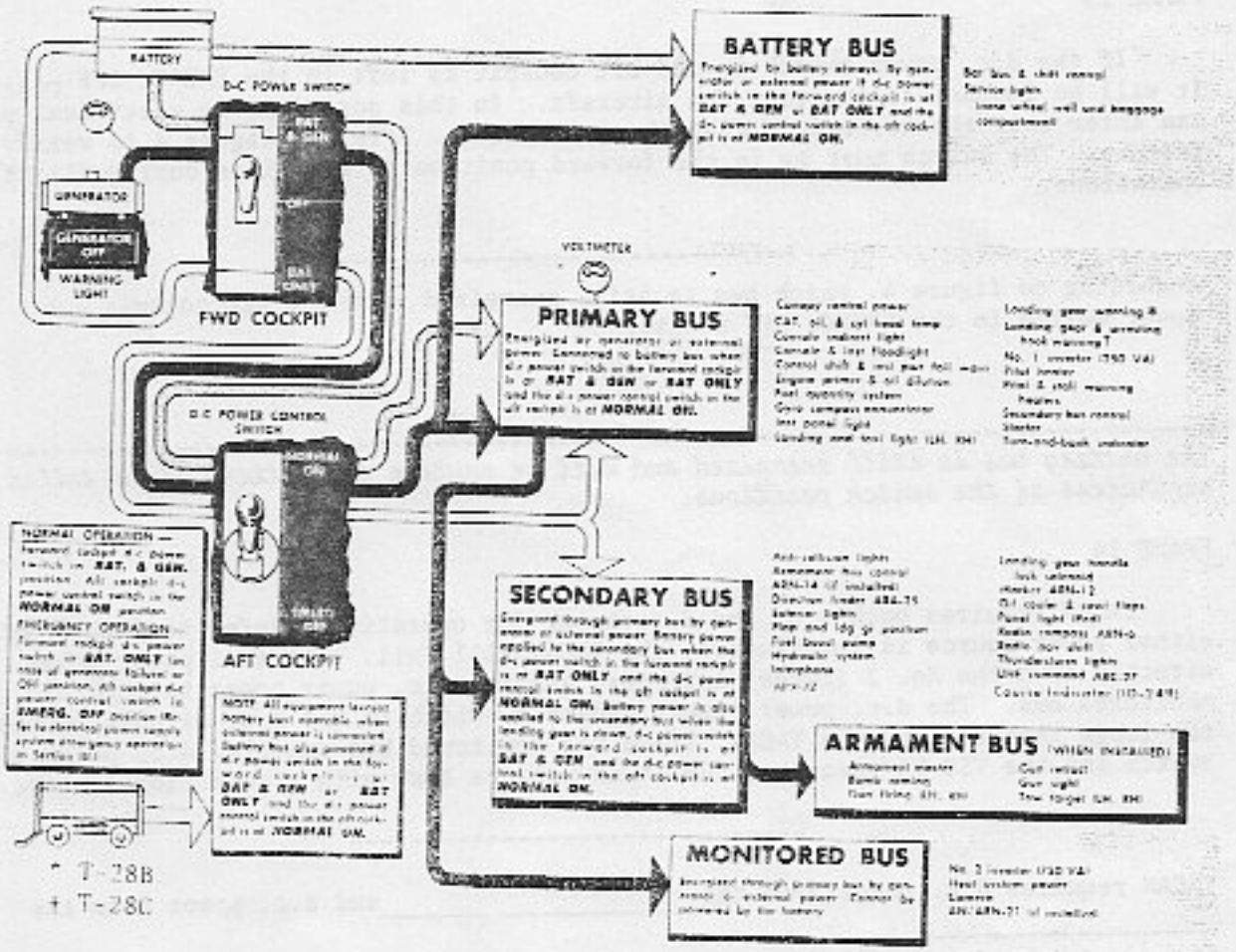

FIGURE 4

FRAME 12

Other changes were made to the electrical system during ASC 36 that are not readily apparent. The d.c. power switch and the instrument power switch were both on the electrical control shift relay circuit before the change. With ASC 36, the d.c. power switches and the instrument power switches were removed from the electrical control shift relay. This means that independent selections of inverters can now be made with or without electrical control.

The_____ _____switches and the _____ _____switches were removed from the electrical control shift relay circuit as a result of ASC 36.

---

d.c. power ... instrument power

FRAME 13

If the d.c. power switch in the aft cockpit is left in the EMERG. OFF position, it will be impossible to start the aircraft. In this position, no electrical power can enter into the aircraft's distribution system. Refer to figure 4 to verify this feature. The switch must be in the forward position at all times during flight operations.

According to figure 4, which bus is still energized with the aft cockpit d.c. power switch in the EMERG. OFF position?

The battery bus is still energized and will be anytime the battery is installed, regardless of the switch positions.

FRAME 14

TACAN requires both a.c. and d.c. power for operation. (Refer to figure 3). If either power source is interrupted, the TACAN will fail. The a.c. power comes directly from the No. 2 (large) inverter, and the d.c. power comes through the monitored bus. The d.c. power simply closes a switch in the a.c. circuit between the large inverter and the TACAN. Since the monitored bus supplies d.c. power to the switch and the 750-VA inverter, the TACAN will be lost with a generator failure.

TACAN requires d.c. power from the_____ _____and a.c. power from the _____ _____.

---

monitored bus ... No. 2 inverter (750-VA)

FRAME 15

With ASC 36 incorporated, the a.c. busses are normally powered by the small inverter, which is in turn powered from the primary bus. Therefore, the a.c. busses and the instruments and equipment on these busses are retained when the aircraft experiences a generator failure. This is of great importance during instrument approaches.

No response required.

FRAME 16

Refer to figure 3. In order to trace the power routes of a.c. and d.c. to the TACAN, begin at the block labeled monitored bus in the upper left corner. The d.c. power (solid black line) for the TACAN is routed through the No. 1 position of the forward cockpit instrument power switch, to the No. 1 position of the aft cockpit switch, and eventually to the TACAN in the lower right corner of the figure. This means that both instrument power switches must be in the forward, or No. 1 position, to complete the circuit. If either instrument power switch leaves the No. 1 position, d.c. power to the TACAN is lost. The TACAN has failed at that point.

In order to provide d.c. power to the TACAN, both instrument power switches must be in the_____position.

---

forward, or No. 1

FRAME 17

Referring to figure 3, the other d.c. line from the monitored bus is the d.c. power to the No. 2 (large) inverter. From this point, the a.c. (cross-hatched) power line runs to the TACAN. Should the No. 1 inverter fail, the No. 2 inverter can be selected to power the a.c. busses. In this instance, the open white lines would be used from the No. 2 inverter to the respective busses. When this occurs, the TACAN is lost. Remember that these selections can be made with or without electrical control.

No response required

FRAME 18

Refer to figure 3. Assume a No. 1 inverter has failed. Note that when the front cockpit instrument power switch is placed in the No. 2 position, all items on the forward cockpit a.c. bus are powered by the No. 2 inverter. The aft cockpit a.c. bus contains the aft cockpit attitude gyro, and in order to get it reenergized, the aft cockpit instrument power switch must be placed in the No. 2 position.

The only item on the rear cockpit a.c. bus is the_____ _____ _____ _____.

---

aft cockpit attitude gyro

FRAME 19

So far you have studied two configurations of the a.c. electrical system. The third configuration in the a.c. distribution is an aircraft with the ASC 36, but equipped with VOR rather than TACAN. This version has all the characteristics of the TACAN equipped aircraft except the navigation equipment is all on the secondary d.c. bus and the front cockpit a.c. bus, and is still available with a generator failure. This is an outstanding safety-of-flight feature, particularly during instrument flight conditions. Again, battery life is critical and should be conserved.

No response required.

FRAME 20

One final thought will perhaps measure your understanding of this unit. In an aircraft with TACAN, suppose the instructor in the aft cockpit selects the No. 2 inverter for no particular reason. The only indication in the front cockpit of this is the loss of TACAN. The student will not know what caused the failure without trouble-shooting. The TACAN could have failed by itself, with the same indications. The circuit breaker is in for the TACAN and by switching to the No. 2 inverter, you note that the monitored bus is still good. (No a.c. power failure light and no flag in the attitude gyro). The generator is still good. (No light).

With the above information, what steps could be taken to isolate the difficulty?

_____

_____

_____

Ask the instructor the position of his instrument power switch. If the switch is in the No. 1 position, it's a TACAN malfunction. If it's in the No. 2 position, the No. 2 inverter is supplying power to the aft cockpit attitude gyro, and the TACAN is subsequently inoperative.

SUMMARY

1. Prior to ASC 36, electrical control is necessary to switch inverters and control the d.c. powered equipment.

2. An in-flight generator failure will always result in the loss of the 750-VA (large) inverter and the cockpit heater. These items cannot be regained.

3. The 250-VA (small) inverter will always be retained with the loss of the generator, since it is powered through the primary bus.

4. An instrument power failure <u>will always</u> accompany a generator failure in an aircraft <u>without</u> ASC 36 and the No. 2 inverter must be selected to regain those instruments.

5. Aircraft having ASC 36 incorporated will not lose a.c. power to the a.c. instruments with a generator failure. However, the TACAN and the monitored bus will be lost, neither of which can be regained.

6. The large inverter is called the No. 1 inverter in aircraft prior to ASC 36, and the small inverter is called the No. 1 inverter after the change, although they remain on the same d.c. busses.

7. You will recognize the aircraft with ASC 36 by the change in the d.c. and a.c. power switches in the aft cockpit.

8. Prior to ASC 36, when an inverter is not selected to power the a.c. bus, it is in a standby status as long as the circuit breaker is in.

9. The instrument power failure warning light will illuminate anytime power is lost to the a.c. bus.

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