AV-10 PROFESSIONAL RAMP TESTER USERS MANUAL

Software Version 2.06

POWER

The tester is supplied with (4) AA batteries uninstalled.
To install the (4) AA batteries. Remove four rubber
feet using a small phillips screwdriver. Use care to install batteries in correct
orientation (neg battery to springs). When shipping or when storing it is recommended
to remove the batteries.

TESTING PROCEDURE

The transmit power of the AV-10 is very low - at approximately 1/4 of
one thousandth of a watt (0.25 milliwatt) - so you will need to be close (15-40 ft)
to the aircraft for most testing. The power was designed to be very small
so that the likelihood of interference is low and so that the sensitivity
of the aircraft receivers can be checked. However, when using the AV-10,
be sure that you do not interfere with any other aircraft or ATC system.
A good method to limit possible interference is to test inside of a metal hangar.
Note that when testing the ILS marker beacon, the AV-10 antenna will need
to be within a inch or two of the aircraft marker antenna. The aircraft
marker receiver was intentionally designed with 100 times lower sensitivity than your
other receivers so that it only picks up the marker when the plane is close to
the marker transmitter. Make sure the aircraft marker receiver is set to high
sensitivity if available. The ADF receiver may also require the AV-10 to be close
due to the poor antenna match at its low frequencies. For other test modes allow

at least 3 foot spacing between the AV-10 and the aircraft antennas.

When performing transponder testing do a MODE-A test first so that the
AV-10 can adjust its receiver to the current RF conditions. It is
also a good way to find a useable RF location near the aircraft. Sometimes moving
only a foot will change the signal strength quite a bit due to reflections and
shadowing of the signal. When doing ADS-B squitter testing, first find
a good reception location using the mode-s only all-call command.

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    ******* 20 dbm = 0.1 watt is the MAX allowed input *******

To test a transponder using direct connection, it is required to use an attenuator
to reduce the 54dbm, or so, power out to +20dbm or less into the AV-10. An optional
attenuator kit is available. Exceeding the 20dbm input level will cause damage to the
AV-10.

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Note 1; when testing do not overload the AV-10 front end. The AV-10 was designed
    for input signals to the antenna port of **+20db or less**. When testing with
    the AV10, stay 3 foot or more away from the DME and transponder antennas .
    To perform direct connect transponder testing, 40 db or more, of power
    appropriate, attenuation MUST be used. Sun offers an optional 25 watt 40 db
    attenuator.

FRONT PANEL OPERATION

To operate the AV-10, turn on unit and wait for its self test to finish. It will display
the software version then;

    PUSH TO SEL MODE
     <   VOR   >

The AV-10 is controlled using the 3 keys just below the 2 line LCD display. The center
key has two functions based on how long the key is pressed. A short normal press is used
to select the currently displayed menu item. A long (approx 2 seconds) press causes the
unit to stop the current operation and jump back to the < VOR > beginning menu item.
The Left and Right keys just move you through the menu's or adjust selection values.

The blue LED just above the 2 line LCD display will turn on to indicate that the AV-10
is transmitting. Connect the antenna to the BNC connector that is above the display.
For VOR, ILS, NDB functions you may extend the antenna to full length since they run in
the 100-400 MHz range or lower. During DME and TRANSPONDER operation collapse the antenna
to its shortest length.

AV-10 OPERATION:

The AV-10 aircraft avionics ramp tester provides test functions for

the following aircraft avionic equipment:

1. Generates VOR test signal's at each 45 deg radial

or at 0, 45, 90, 135, 180, 225, 270, 315 deg's from the station.
carrier frequencies 108.0, 110.2, 112.4, 113.6 MHz are selectable.
The station ID tone is a 1020 hZ on/off beep.

When the AV-15 is powered on it does its self test and shows its software version.
Then the display shows;
>   **PUSH TO SEL MODE**
>   **<   VOR   >**

To activate the VOR test mode press & release the center key. The display will show;
>   **PUSH TO SEL FREQ**
>   **<   108.0   >**

If you wish to use 108 MHz then select it with the center key, else use right and left
keys to step to another frequency. When the desired frequency is displayed then select
it with the center key. The display shows;
>   **<- VOR RADIAL ->**
>   **0 deg FROM**

The AV-10 is now transmitting the VOR signal with the 9960 FM subcarrier and the 30 Hz
AM signal in phase so that your NAV receiver should display 0 deg from or 180 deg to on
its OBS. The AV-10 modulation is generated digitally and is quite accurate.
The blue led above the display is on to show that the AV-10 is in transmit
mode. Use the right key to select the 45 deg from radial. The display shows;
>   **<- VOR RADIAL ->**
>   **45 deg FROM**

The AV-10 now is transmitting the VOR signal with 45 deg phase shift between the 9960
subcarrier reference and the 30 Hz AM modulation. The NAV OBS should show 45 deg FROM
or 225 TO the station. By using the left or right keys other radials can be selected
at 45 deg intervals. When finished with VOR testing, press and hold the center key
down for about 2 seconds until the blue LED blinks, then release the key to return
to start of main menu.

2. ILS test signals.

a) Localizer
108.1 or 110.3 MHz carrier frequency
center, 1/2 and full deflection right and left
no 150Hz or no 90Hz modulation to check NAV flag.
Also generates 1020 Hz beep station ID.

Example;
Use right or left keys to move to;
>   **PUSH TO SEL MODE**
>   **<   ILS   >**

Select with center key. To do localizer, select it with center key.
Use left right keys to select carrier frequency, then the display shows;
>   **SEL LOC DDM**
>   **DDM=0 or CENTER**

Your NAV indicator should show a centered needle for the ILS localizer. DDM stands
for difference in depth of modulation between the 90 and 150 Hz AM modulation. Press
the right key and the display gives
>   **SEL LOC DDM**
>   **1/2 RIGHT .078**

Your NAV indicator should show half deflection, DDM=.078. Use the left right keys to
select half, full deflection left and right as well as having only 90 or 150 Hz
modulation. When you are finished do a long center key push to return to main menu.
The glide slope works in a similar fashion.

b) GLIDE SLOPE
108.1 - 334.7, or 110.3 - 335.0 MHz carrier frequency.
Center, 1/2 and Full deflection up and down as well as
no 150HZ or no 90Hz modulation to check flag. No ID tone as normal.

c) MARKER BEACON

 A 75MHz AM modulated RF signal. The beep rate is slowest at outer marker.
The AV-10 provides OUTER, MIDDLE, and INNER marker beacon signals.

 As noted above, the marker receiver, in the aircraft, has low sensitivity so you will
need to place the AV-10 antenna within a few inches of the marker antenna.

3. DME test signal.

 VOR paired 108.00 =17X mode or 108.05=17Y mode selectable.
It Generates a fixed 20NM distance signal to the DME.
After selection the DME should lock to the AV-10 signal within a few seconds.

4. ADF signals.

 Provides AM modulated low frequency signals to test that the aircraft
ADF-NDB receiver is picking up the radio signal. As explained in the theory
section, for direction finding the transmitter needs to be a long way from
the aircraft receiver to have E and M waves. But the signal can be used to show
basic ADF operation. The signal is small so the AV10 antenna must be close to
the NDB's antenna.

5. TRANSPONDER A/C/S ADS-B

a) Generates MODE-A test signal and display's squawk code and
 reply percentage. Also allows side lobe suppression check.
 If the transponder IDENT is activated then the AV-10 will
 display IDENT. The AV-10 sends about 235 MODE-A interrogations
 per second. The AV-10 sends 1030MHz P1 and P3 pulses spaced
 8.0uS apart. The P2 side lobe suppression pulse can be selected as
 the same amplitude as P1-P3. The suppression pulse
 is sent 2.0uS after the P1 pulse if enabled. No P4 pulse is sent.
 The top LCD line display's the squawk code then F1=nn.
 The hex number nn is the approx transponders F1 pulse width. The hex
 number times 50nS equates to the measured F1. If the transponder is sending
 ident then the word IDENT replaces the F1 display. Reply percent is
 on the bottom LCD line.

     Example; After turning on the AV10 and waiting for the self
    test to run, the display will read

           PUSH TO SEL MODE
            <   VOR   >

    push left push button so that display line 2 reads;

           < TRANSPONDER >

    now push center button to select transponder testing.
    The display will now show

           SEL TXPDR MODE
           MODE A SQUAWK

    If we wanted to do a different transponder test we would
    use the right or left buttons to step through the tests available
    Since we wish to do the Mode-A test we press the center button
    to select it. The display will show

           SIDELOBE SUPPRES
           NO SLS P2 OFF ?

If we wish to do Mode-A with the SLS off then press center
select button. If you wish to send a P2 pulse that is equal
in amplitude to the P1 pulse then use the right or left buttons
Once the center button is pressed the AV-10 will begin
sending Mode-A interrogations and looking for replies. The
AV-10 will display something like;

SQ=1200   F1=09
Reply%=100

Line 1 displays the Squawk code and the F1 shows the pulse
width of the reply F1 pulse where a Hex number between 7 to A is
normal. Line 2 displays the reply percentage. If all interrogations
result in a good reply to the AV-10 then 100% is shown. To
stop Mode-A testing and select a different test, press and hold
the center button down until the blue LED goes off or blinks.
The power switch will also work but any saved mode-S address info
will be lost.

b) Generates MODE-C test signal and displays the altitude and reply percentage.
Also allows sidelobe suppression check.
The AV-10 sends about 235 MODE-C interrogations per second.
The AV-10 sends 1030MHz P1 and P3 pulses spaced 21.0uS apart.
The P2 sidelobe suppression pulse is the same amplitude
as P1-P3 and sent 2.0uS after the P1 pulse, if enabled.
No P4 pulse is sent. The top LCD line displays the raw received code in hex
and the calculated altitude. The bottom line gives reply percentage.

c) checks the Aircraft Transponders Transmit carrier frequency.
The AV-10 sends MODE-A requests and displays a number that is
representative of the magnitude of the received reply. By
moving a filter about the nominal 1090MHz receive frequency
the approximate transponder transmit frequency is determined.
The filter can be moved +/- 15MHz from 1090MHZ in 1MHz steps.
Use the left button to move down and the right key to move the
offset up in frequency. The bottom LCD line shows the offset and the
filter output magnitude. The MAG=(number) will be largest at the transmit
frequency. For example, if you get -2 MHz MAG=(77), -1 MHz MAG=(122),
0 MHz MAG=(85). Then the acft transponder Tx freq is a bit less than 1
MHz lower than the 1090 MHz nominal transmit frequency.

d) All ATCRBS transponders are required to go inactive or suppress
for 35 +/- 10 microseconds (uS) after receiving the P1-P2 side lobe
suppression signal. This ATCRBS suppression feature is now also
used by the mode-s system. The ground stations mode-s interrogation
begins with two pulses spaced 2.0 uS apart just like the SLS pulses.
The mode-s message then continues while the ATCRBS transponders are
in suppression. Therefore it is nice to know if you're A/C transponder
is being suppressed as it should.
The AV-10 provides this "SLS TIME CHECK ?" function to measure
the actual suppression time. The AV-10 sends out a SLS pulse pair
then sends a mode A inquiry after the variable delay time. The time
between the SLS pulse pair and the inquiry is adjustable by you.
So by decreasing the delay time until the reply percentage begins
to fall, the transponder suppression time is determined. The top LCD
line display's the squawk code and reply percentage. The bottom line
display's the delay time in microseconds. Use the left and right keys
to change the delay time.

e) A/C/S ALL-CALL and READs mode-S reply message.
ATCRBS MODE-A/C transponders will send a normal MODE-A reply.
MODE-S transponders will send an S reply. The AV-10 will
display the HEX Aircraft ID and a all 0's CRC error code
for good received S reply's. The AV-10 sends 1030MHz P1 and P3

pulses spaced 8.0uS apart. A 1.6uS wide P4 pulse is sent
2.0uS after P3. The reply from an old ATCRBS transponder is
ignored by the AV-10.

f) ATCRBS only ALL-CALL message.
The AV-10 sends MODE-A 1030MHz P1 and P3 pulses spaced 8.0uS.
The 0.8 uS P4 pulse is sent 2.0uS after P3. The mode-S transponder
should not reply due to the short P4 pulse. The AV-10 looks for
erroneous mode-s reply's. When working with an old ATCRBS transponder
the top LCD line will display the squawk code and F1 pulse width
while line 2 shows "OK; no S reply". When testing a MODE-S unit the
top LCD line should display "SQ=0000 F1=(small)". The second line
should be the same "OK; no S reply". If the AV-10 finds a MODE-S
all-call reply then it will display "MODE-S ERROR" on LCD line 1
and "ALL-CALL REPLY" on line 2.

g) send MODE-S only ALL-CALL.
The AV-10 will send a differential phase-shift keyed (DPSK)
MODE=S ALL-CALL interrogation. ATCRBS MODE-A/C will not
respond since the interrogation starts with two 1030MHz pulses
spaced 2.0uS apart that is seen as a side lobe suppression.
 Since an all 1's ALL-Call address is sent, any MODE-S transponder
will send a MODE-S reply. The AV-10 will display the HEX
aircraft address and all 0's CRC for a good reply. The Hex address is
also saved to RAM for use by following discrete addressed commands.
The top LCD line display's the calculated CRC and L= the capability
number 1 to 7.
0=level 1 unit. 4-7=level 2 transponder unit. This command
runs aprox 50 times per second.

   Info; when the transponder is set to on ground status it may not
         provide all-call reply's. The aircraft hex address must be entered
         into the AV-10 manually or from a ADS-B ID squitter if available.

h) Mode-S DF=4 discrete addressed altitude request.
The saved address from (g) or (l) is used as a starting point of
the adjustable address. The AV-10 sends a UF=4 Altitude request
command with the 24 bit Address as defined by you. So to see if
the Transponder responds with its Altitude, that should match
its mode C altitude reply, just use the saved address. To insure that
it does not reply to other addresses, change the saved address before
sending the command. After the address is selected the AV-10 will
display the hex ID on top LCD line and the calculated altitude on the
bottom line. This command runs at aprox 50 times per second.

   Info: The Aircraft hex address must be manually entered if the
         all-call or ADS-B ID are not functioning. To set the hex address,
         select yes to modify address. Then use the right and left buttons to
         change a digits hex value and the center button to enter each hex character.
         The AV-10 starts with a $000000 hex address after power on and it must
         equal the aircraft hex address, as set in the transponder.

i) Mode-S DF=5 discrete addressed Squawk code request.
The saved address from (g) or (l) is used as a starting point of
the adjustable address. The AV-10 sends a UF=5 ID request
command with the 24 bit Address as defined by you. So to see if
the the Transponder responds with its SQUAWK, that should match
its mode C SQUAWK reply, just use the saved address. To insure that
it does not reply to other addresses, change the hex address before
sending the command. The AV-10 will display the hex ID on the top line
and the squawk code on the bottom line. This command runs at aprox 50 Hz.

j) Mode-s DF=20 discrete addressed Tail number (ID) request.
The saved address from (g) or (l) is used as a starting point of
the adjustable address. The transponder should reply with its flight
number or tail number. The AV10 will display the tail number on line 1.
The hex aircraft code is displayed on line 2.

k) Mode-s DF=21 discrete addressed capability report request.
The saved address from (g) or (l) is used as a starting point of
the adjustable address. The AV10 will display the raw transponder
reply in hex as well as the received aircraft hex address.
All of line 1 gives 16 hex char's or the first 8
bytes and line 2 provides 6 hex char's or 3 bytes giving the first 11
message bytes in hex. Line 2, second half, provides the decoded aircraft
hex address given by 6 hex char's. If the address is correct then the parity
was good and the first 11 bytes are OK. The meaning of each bit can be found
in the standard documents. The first two hex characters of the top line should
be A8 through AF to signify that a DF=21 command was received.

Note 2; For the following Squitter functions, the squitter messages are
sent by the transponder without being requested by the AV10 and
are sent infrequently. The best way to check squitter is to
first run the mode-s only all-call command and find a good location.
After finding a location where AV10 reception is good, then run
the squitter functions. Sometimes when testing in a hangar with
lots of reflections off walls other equipment and even people, a few
inches of AV10 movement can change the reception dramatically. The
AV10 antenna can also be mounted on our tripod-25 foot cable accessory
which can help in keeping the antenna stationary or while allowing you
to operate the equipment while in the cockpit.

l) ADS-B MODE-S ID SQUITTER
The AV-10 will listen for the ID-SQUITTER AND display the
HEX Address and 0's CRC for good reply. The HEX aircraft
address is also saved in RAM for use by commands h to k above.

m) AIRCRAFT TAIL NUMBER SQUITTER
The AV-10 will listen for the flight number - tail number
squitter and display the Tail number and the HEX ID. Note that
this squitter is only sent a couple times per minute. It is necessary
to be sure you have a good reception location before running this command
see note-2 above.

n) LOCATION SQUITTER
The AV-10 will listen for the GPS derived location squitter
and display the calculated LATitude and LONgitude in decimal
degrees. Due to the way position data is sent, It takes at
least 2 received squitters to calculate the position.

This position command includes 2 additional characters during location
squitter display:
An S or A (Surface or Airborne), followed by a hex value from 0 to B
that represents the NIC (Navigational Integrity Category) Value.
The NIC value represents a radius of containment value defined as follows:

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0 = unknown
1 = < 20 NM
2 = < 8 NM
3 = < 4 NM
4 = < 2 NM
5 = < 1 NM
6 = < .6 NM
7 = < .2 NM
8 = < .1 NM
9 = < 75 meter
A = < 25 meter
B = < 7.5 meter
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o) TEST SQUITTER function.
The AV-10 will display the first squitter transmission it finds
each time you short press the center key. This can be used to manually
decode squitter messages or to check that squitters are being sent.

ABOUT CALIBRATION

The AV-10 has been designed using today's most advanced electronics. Sun Avionic's
custom designed digital circuitry resides in a large gate array. The chip contains
Sun's proprietary micro-computer and what would have been a couple of PC boards full
of parts only a few years ago. The AV-10 design is digital where all timing and
RF frequencies used in the unit are derived from one high precision crystal
oscillator that is compensated to +/- 1.0 parts per million over 0 to 50 deg C.
The AV-10 is calibrated using NIST traceable equipment and supplied with a
statement of calibration document and a calibration sticker that attests that factory
calibration was done and it will meet its published specifications.
There are no user adjustable parts in the unit as all calibration variables reside
in firmware. Of course, anything can and will break. If you suspect a problem, check
another aircraft to see if the problem persists. Make sure batteries are good
(unit may act up as batteries fail). Check that a line of sight RF path exists between
the AV-10 and the aircraft antenna. Try turning the unit off for a few seconds. Read the
operating manual for the aircraft equipment to be sure it's set up correctly.
Contact Sun if needed and we will attempt to help.

The AV10 factory calibration is valid for 1 year and we offer a 1 day turn
Re-cal service at the factory for $100 US plus shipping and any repairs if required.
We also have a calibration procedure on this web site for guidance if you wish
to do recalibration.

BATTERY REPLACEMENT

The AV-10 is powered by (4) AA batteries. Heavy duty alkaline
or equivalent should provide over 2 hours of continuous operation.
To replace the batteries, remove the four rubber feet using a #1 phillips
Screw driver to access the battery holder. Make sure battery negative goes to
spring end of holder positions. Before long term storage it's best to remove the
batteries to prevent battery leakage damage. Also promptly replace expended batteries.

REGULATIONS

Sun Avionics has done its best to provide a useful piece of test
equipment; HOWEVER, understand your requirements when using the AV-10.

Your country's aviation authority has rules that determine who may work
on or repair avionic equipment. Please understand and follow those
requirements. Your aviation authority also has determined what needs to be tested
to return equipment to airworthiness status. Proper use also requires that the operator
understand the operation of the avionics device he is testing.
A great deal of information can be found on our website
(see our Navigation and Transponder Principles <../NavTransPrinciples.html> link)
, the internet or from manufacturers manuals. It is the operators responsibility to
insure safe use of the AV-10. That being said, the AV-10 is a powerful, cost effective,
tool for avionic system testing and trouble shooting.

For updated information, questions, or to send your comments please see our web site:
        www.sunavionics.com <http://www.sunavionics.com>
e-mail us at:
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Thank you for selecting Sun Avionics