

BENDIX/KING® KMD 550/850

Multi-Function Display

**Traffic Avoidance Function
(TCAS/TAS/TIS)**

Pilot's Guide Addendum



For Software Version 01/13 or later

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Manual KMD 550/850 Traffic Avoidance Function (TCAS, TAS, TIS) Pilot's Guide Addendum

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Summary

Changed TIS System Fault "TIS IS NOT ENABLED, TRANSPONDER MUST BE REPORTING ALTITUDE" to "TIS IS NOT ENABLED, TRANSPONDER IS NOT REPORTING ALTITUDE".

Miscellaneous corrections

Revision History

Manual KMD 550/850 Traffic Avoidance Function (TCAS,
TAS, TIS) Pilot's Guide Addendum

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Complete manual revision

Miscellaneous corrections

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Summary

Improved Traffic Icon visibility on the Map Page

Small traffic window will not be displayed on the Map Page when in North-Up orientation.

Miscellaneous corrections

Revision History

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TAS, TIS) Pilot's Guide Addendum

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Summary

This is the original release of this publication.

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INTRODUCTION

The Traffic Function of the Bendix/King KMD 550/850 Multi Function Display allows for the display and control of several models of traffic avoidance systems. Some examples are TCAS I (Traffic Collision Avoidance System), TCAS II, TAS (Traffic Avoidance System) and TIS (Traffic Information Service).

This Pilot's Guide Addendum describes the operation of the KMD 550/850 display for controlling the display of traffic. The detailed description of the general operation of the KMD 550/850 is contained in the other sections of the KMD 550/850 Pilot's Guide. For detailed information on the proper use and interpretation of the displayed traffic data when using TCAS I, TCAS II and TAS systems, please reference the pilot's guide that is provided with the traffic avoidance system.

The traffic avoidance system is used for detecting and tracking aircraft near your own aircraft. Aircraft detected, tracked, and displayed are referred to as Intruders. Intruders are shown as symbols on the traffic display. The system identifies the relative threat of each Intruder by using various symbols and colors. The intruder's altitude, relative to your own aircraft's altitude, is annunciated if the Intruder is reporting altitude. A trend arrow is used to indicate if the Intruder is climbing or descending more than 500 feet per minute.

The Traffic Information Service (TIS) is a data link service that provides information similar to VFR radar traffic advisories normally received over voice radio. The data is received from the terminal Mode S radar system through a TIS capable Mode S transponder to the KMD display once per radar scan (approximately every 5 seconds).

TIS provides the relative position, relative altitude, altitude trend, and estimated ground track angle for as many as 8 intruders that are within 7 NM horizontally and +3,500/-3000 feet vertically of the aircraft receiving TIS. Only aircraft with operating transponders that are within the surveillance volume of a TIS Mode S radar are visible to TIS. Terminal Mode S radars equipped with TIS provide the service to 55 NM (or possibly greater) of the radar location, and as low as the "line of site" limitation inherent to radar surveillance.

ATC procedures and the "see and avoid concept" will continue to be the primary means of ensuring aircraft separation. However, if communication is lost with ATC, TCAS/TAS/TIS adds a significant backup for collision avoidance.

The Bendix/King KMD 550/850 is shown below with the Traffic Page for TCAS/TAS selected.



The Bendix/King KMD 550/850 is shown below with the Traffic Page for TIS selected.



TCAS/TAS

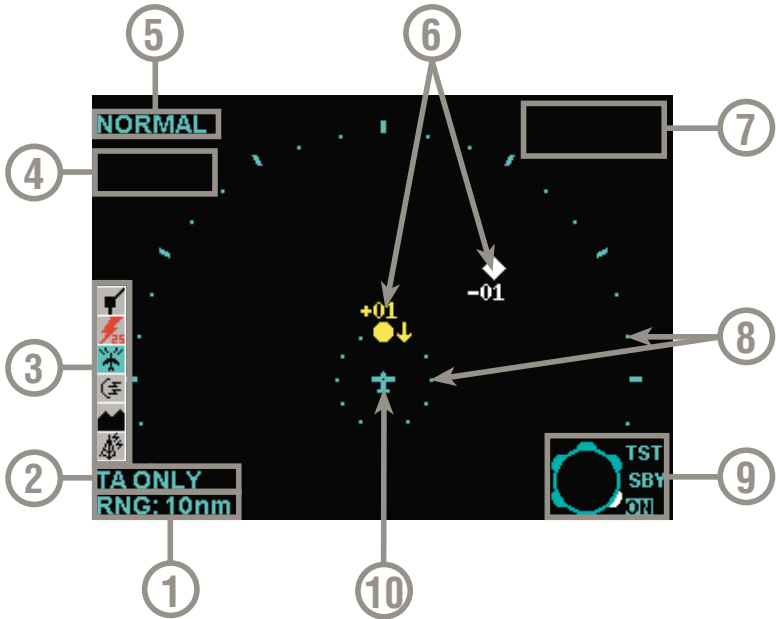
This section applies to TCAS I, TCAS II and TAS systems.

TCAS/TAS NORMAL OPERATION



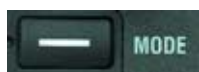
To display the TCAS/TAS traffic page press the TRFC function select key.

The following illustration defines the data that appears on the TCAS/TAS Traffic Display Page:



- 1 Display Range - RNG:##nm
- 2 TAS (TCAS) Operating Mode - TAS (TCAS) TST, TAS (TCAS) SBY, TA Only, TA/RA or TAS (TCAS) Fail
- 3 Available Functions - Displays icons representing data available (black) and displayed (color)
- 4 Current Flight Level - FL:###
- 5 Altitude Volume - NORMAL, ABOVE, BELOW or UNRESTRICTED (not available in all configurations)
- 6 Traffic Intruder Symbols - Indicates type of traffic, altitude of traffic and vertical trend of traffic.
- 7 "No Bearing" Intruder Display Area - AA #.#NM ±XX↓ (Where AA is TA or RA)
- 8 Range Rings - Outer ring radius is selected range, inner ring radius is always two nautical miles
- 9 Outer Knob Icon - Shows current knob selection
- 10 Aircraft Symbol - Stylized airplane indicating aircraft position

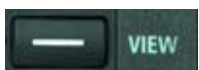
KMD 550/850 TRAFFIC PAGE (TAS/TCAS) OPERATIONAL CONTROLS



MODE - Toggles the altitude tag between relative or absolute altitude as shown in Figures 1 and 2. Operation in the absolute mode is limited to 15 seconds. This key may be enabled or disabled in system configuration. See note below.



RNG▲/RNG▼ - Advances the indicator to the next range. The upper button increases range, the lower button decreases it. The selected range is displayed in the lower left corner of the display with the inner range ring always 2 nm. The **RNG** button labels will not be displayed when their respective range limits are reached.



VIEW - Toggles between altitude volume views of NORMAL, ABOVE, BELOW or UNRESTRICTED. This key may be enabled or disabled in system configuration. See note below.



OVLY - Allows selection of flight plan for overlay on the traffic data. The GPS flight plan data can be overlaid on the traffic display, if the desired data is available.



Outer Knob - Selects between Test (TST), Standby (SBY) and On mode of operation. This control may be enabled or disabled in system configuration. If the KMD 550/850 is used with a TCAS II or L3 Skywatch™ system, this control will

not be available. See note below.

*NOTE: If **MODE** button, **VIEW** button or the **Outer Control Knob** are disabled, these controls will be found on the separate TAS/TCAS controller.*



Figure 1
Relative Altitude Mode



Figure 2
Absolute Altitude Mode

TCAS/TAS SYMBOLOGY

NON-THREAT TRAFFIC



An open white diamond indicates that an intruder is not yet considered a threat. For specifics on relative distance and altitude that defines this symbol, please refer the pilot's guide that is provided with the traffic avoidance system. This one is 200 feet above your own altitude, climbing at 500 feet per minute or greater.

PROXIMITY INTRUDER TRAFFIC



A filled white diamond indicates that the intruding aircraft has reached the next proximity threshold defined by the traffic avoidance system, but is still not considered a threat. For specifics on relative distance and altitude that defines this symbol, please refer the pilot's guide that is provided with the traffic avoidance system. This intruder is now 400 feet below your aircraft and climbing at 500 feet per minute or greater.

TRAFFIC ADVISORY (TA)



A symbol change to a filled yellow circle indicates that the intruding aircraft is considered to be potentially hazardous. Depending on your own altitude the system will display a TA when time to Closest Point of Approach (CPA) is reached as defined by traffic avoidance system. For specifics on CPA as defined by the system, please refer the pilot's guide that is provided with the traffic avoidance system. Here the intruder is 100 feet above your aircraft, descending at 500 feet per minute or greater.

RESOLUTION ADVISORY (RA)



This symbol will only be displayed when the KMD 550/850 is interfaced with a TCAS II system. A solid red square indicates that the intruding aircraft is projected to be a collision threat. TCAS II calculates that the intruder has reached a point where a Resolution Advisory is necessary. The time to CPA with the intruder, depending on your altitude, has been reached as defined by the traffic avoidance system. For specifics on CPA as defined by the system, please refer the pilot's guide that is provided with the traffic avoidance system. The symbol appears together with an appropriate audio warning and a vertical maneuver indication on the RA/VS1. This aircraft is now 100 feet below your altitude and still descending at 500 feet per minute or greater.

NOTE: An intruder must be reporting altitude in order to generate an RA. Therefore, the RA symbol will always have an altitude tag.

“OFF-SCALE” TRAFFIC

TA or RA traffic that is beyond the selected range will be displayed as half the appropriate symbol at the edge of the display matching the bearing of the traffic.

“NO-BEARING” TRAFFIC

If the bearing of TA or RA traffic cannot be determined by the traffic avoidance system, no traffic symbol will be displayed on the TRFC display. The traffic information will instead be displayed in the upper right corner of the display as shown in Figure 3. A maximum of two “no-bearing” TA and/or RA intruders can be displayed. If the intruder is not reporting altitude, the altitude and trend arrow fields will be blank.



Figure 3

TA/RA WHILE IN MAP DISPLAY

If a Traffic Advisory presents itself while in the Map Display a yellow **TRFC** will be displayed as shown in Figure 4. In the case of a Resolution Advisory in a TCAS II system, the **TRFC** will be displayed in red. If AUTO-POP-UP is enabled, a TA or RA will cause the Traffic display to be presented automatically. The default range of the pop-up display will be 7 nm.

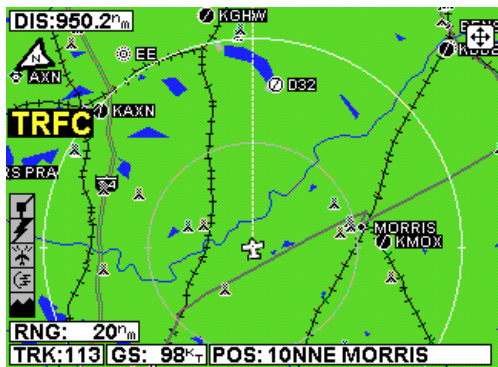


Figure 4

TCAS/TAS TRAFFIC OVERLAY



OVERLAYING TRAFFIC ON MAP DISPLAY

By pressing the **OVLY** Key a display similar to Figure 5 will be displayed. Pressing the **TRFC** soft key will toggle between overlay on or off as shown in Figure 6. A representation of the Traffic Page, with a fixed range of 6 nm, will be displayed in the upper left of the Map display when traffic data is overlaid. Intruders will also be displayed on the map itself up to the range setting selected on MAP Setup Page.

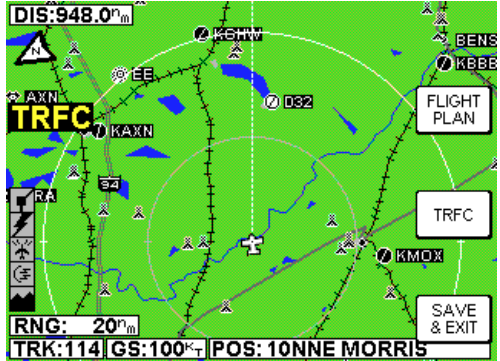


Figure 5

Pressing **SAVE & EXIT** will return to the map display. The overlay status will remain as saved until changed again by pressing the **OVLY** Key.



Figure 6

OVERLAYING TRAFFIC ON TERRAIN DISPLAY

By pressing the **OVLY** Key a display similar to Figure 7 will be displayed.



Figure 7

Pressing the **TRFC** soft key will toggle the overlay on as shown in Figure 8. Pressing the **TRFC** soft key again will toggle the overlay off.

Pressing **SAVE & EXIT** will return to the terrain display. The overlay status will remain as saved until changed again by pressing the **OVLY** Key.



Figure 8

OVERLAYING TRAFFIC ON WEATHER RADAR DISPLAY

By pressing the **OVLY** Key a display similar to Figure 9 will be displayed. Pressing the **TRFC** soft key will toggle between overlay on or off as shown in Figure 10.

Pressing **SAVE & EXIT** will return to the weather radar display. The overlay status will remain as saved until changed again by pressing the **OVLY** Key.

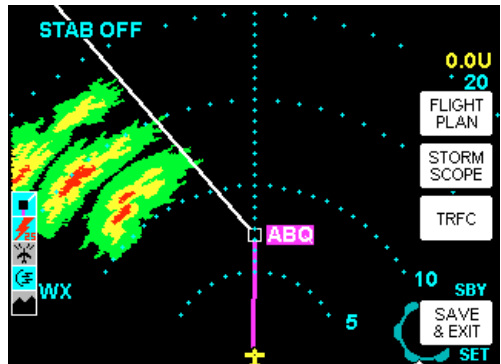


Figure 9

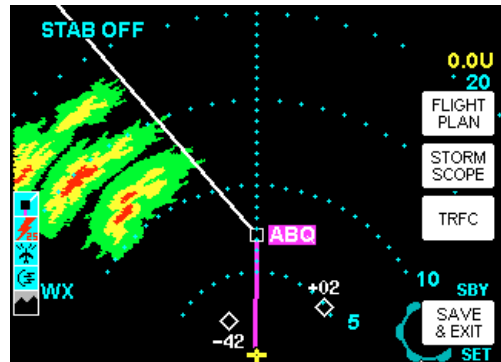


Figure 10

TCAS/TAS TRAFFIC ADVISORIES ON OTHER FUNCTION DISPLAYS

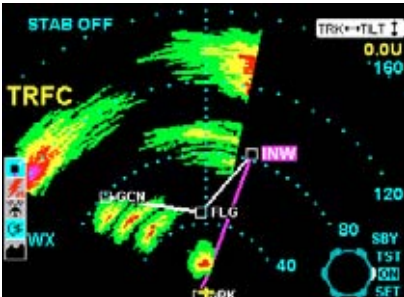
The following figures show traffic advisory annunciations on other function displays. If a TA or RA is presented, the TRFC Function Select Key must be pressed to view traffic on the TRFC Page. The KMD 550/850 may be configured to display the TRFC Page automatically when a TA or RA is received.



Traffic Advisory while viewing an AUX Page.



Resolution Advisory while viewing an AUX Page (TCAS II systems only).



Traffic Advisory while viewing a Weather Radar Page.



Traffic Advisory while viewing a Stormscope™ Page.



Traffic Advisory while viewing a Terrain Page.

NOTE: "Off-Scale" and "No-Bearing" advisories are displayed only on the TRFC Page.

TCAS/TAS SYSTEM FAULTS

NO DATA RECEIVED

If the KMD 550/850 is not receiving any data from the TCAS or TAS sensor then the following screen will be displayed. This could indicate that power is not being provided to the traffic avoidance system (e.g. a pulled breaker), a bad wiring connection between the display and the sensor, or a failed TCAS or TAS unit.



SYSTEM TEST



A system test can be performed to verify the traffic avoidance system is working properly. If the KMD 550/850 is configured to use the Control Knob with the traffic function, turn the outer knob to select **TST**. Figure 11 indicates a properly functioning TCAS I/TAS system. An RA will be displayed for a TCAS II system. If the KMD 550/850 not configured for use of the Control Knob with the traffic function, this test would be performed using the appropriate control unit.

If faults are detected in the KMD 550/850 Traffic Module (KAC 504) or the traffic sensor they will be displayed as shown in Figure 12. This figure shows all faults. Only actual faults will be displayed.



Figure 11



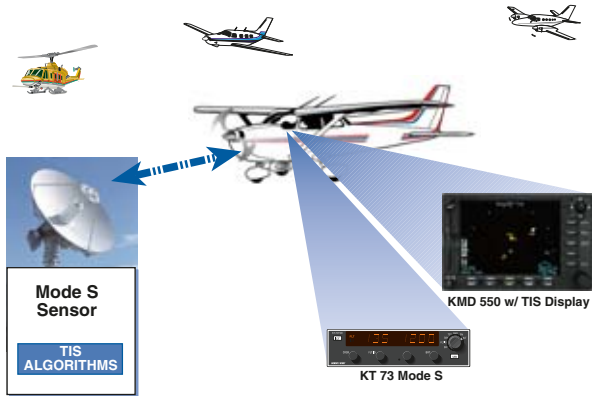
Figure 12

TRAFFIC INFORMATION SERVICE (TIS)

This section applies only to TIS systems.

TIS is an alerting system (covered by US Pat. 6512975) that provides visibility to nearby traffic enhancing “see and avoid” collision avoidance. It’s purpose is to increase situational awareness by supplying information to assist in visually acquiring nearby aircraft. TIS does not relieve the pilot of “see and avoid” responsibility. No avoidance maneuvers are provided or recommended by TIS.

The service is offered through the Federal Aviation Administration’s Mode S terminal sensors and uses the same surveillance information provided to ATC. Estimated bearing, distance, altitude and heading information for aircraft within 7 NM and +3,500/-3,000 feet altitude of your aircraft is sent over the Mode S datalink to the TIS display. The pilot is also alerted to aircraft that are predicted to be within 30 seconds of a potential collision, no matter the distance or altitude.



Target aircraft are displayed only if operating a Mode A, C or S transponder. TIS operation is transparent to ATC and requires no controller intervention.

When the onboard TIS system makes a request for TIS, the request is sent via the Mode S transponder through the datalink. The first available Mode S sensor capable of supporting TIS for your aircraft responds by sending data back through the datalink on every scan of the sensor (approximately every 5 seconds). TIS will be provided by the sensor as long as the aircraft is within coverage range of that sensor. When entering the coverage range of another sensor, TIS will continue provided the next sensor is TIS capable. The transfer of service is automatic. In addition to traffic data, the aircraft receives status messages that advise the pilot when TIS service has been initiated, is continuing, or has been terminated.

While coverage varies with terrain and local site parameters, “line-of-sight” coverage is to be expected within 55 NM of a TIS capable Mode S sensor. Terrain and obstacles can cause areas of no radar coverage.

TIS LIMITATIONS

Traffic may not be displayed for one or more of the following reasons:

1. Radar site is out of service. If a TIS capable Mode S sensor is not in service for any reason, TIS is not available. See Figure 13
2. Your aircraft is beyond maximum range of a TIS capable Mode S site. Maximum range can extend beyond 55 NM up to 100 NM. However, expect TIS service to 55 NM. See Figure 13 and 14.



Figure 13 - TIS Capable Mode S Radar Sensor Sites

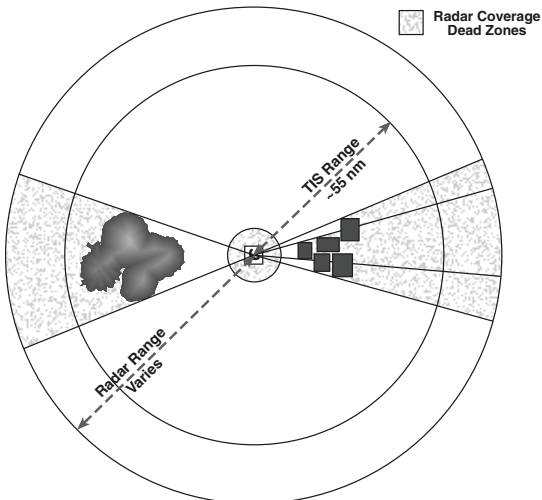


Figure 14 - TIS Functional Range

3. Your aircraft is inside the "Cone of Silence. When near or above (depending on altitude) the TIS radar site, and out of range another TIS radar site, TIS data cannot be received. See [Figure 15](#).

4. The other aircraft is within the “Cone of Silence”. So, remember, there may be aircraft within your alert area, but if they are not seen by the radar site they will not show on your display.

5. Your aircraft is below radar coverage. With no obstructions and flat terrain, the coverage floor is about 2,000-3,000 feet at 60 miles and 4,000-6,000 feet at 100 miles. Terrain and obstacles can substantially decrease coverage range or make coverage asymmetrical about the radar site. See Figure 15.

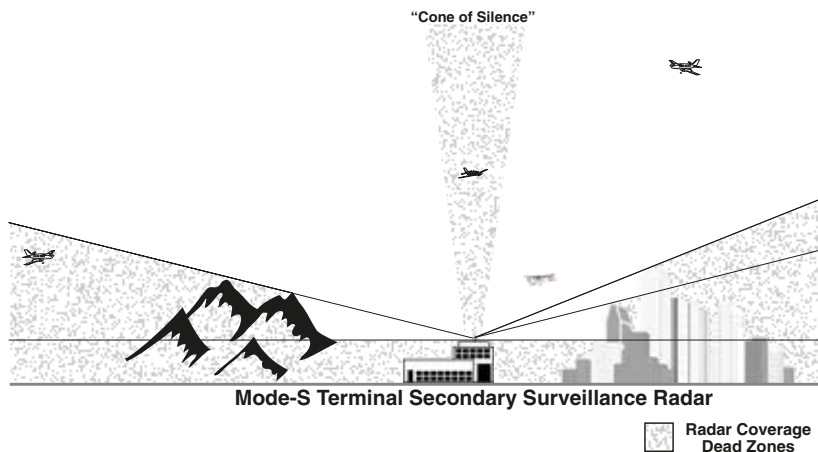


Figure 15 - Obstructions To TIS Coverage

6. The other traffic is below radar coverage. The other aircraft may be in situations mentioned in number 5 and therefore not seen by radar. Again, there may be aircraft within your alert area, but if they are not seen by the radar site they will not show on your display.

7. The other aircraft is without an operating a Mode A, C or S transponder.

8. Bearing error increases as the distance from the radar site increases. However, distance and relative altitude will remain accurate.

9. Due to the way the radar sites check for transponder faults, a reply can be interpreted as two different aircraft. This causes a “self alert”. This is shown as a “pop-up” alert intruder at or near the client’s position and altitude lasting for only one or two radar scans. It most often occurs during maneuvering or upon entry into TIS coverage.

NOTE: It is important to understand that no display or aural warning of traffic information shows the location of all traffic in the vicinity. Whenever in VMC conditions, continue to visually scan for traffic.

NOTE: Pilot’s should report TIS outages to Flight Service which will report them to the Airway Facilities Operations Control Centers for resolution, similar to a report of any other system outage.

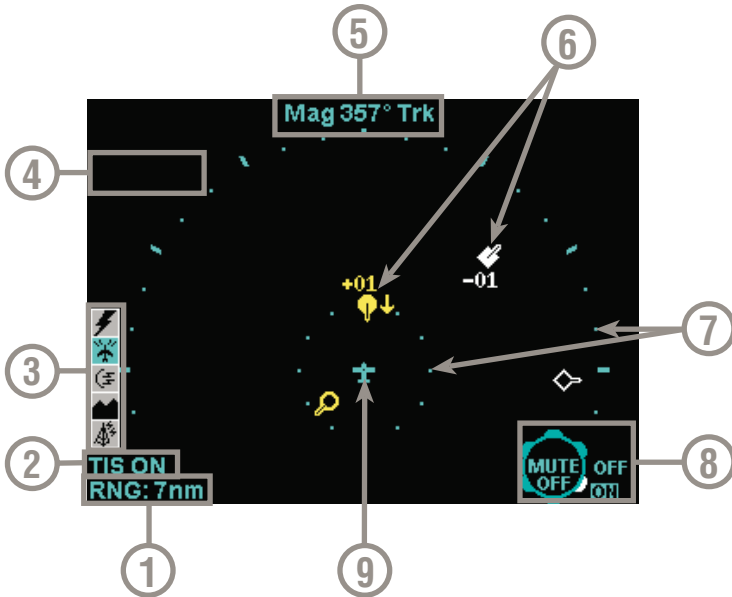
TIS NORMAL OPERATION

NOTE: TIS availability may be intermittent during turns or other maneuvering where the aircraft structure can block the line of sight between the Mode S radar and the Mode S transponder antenna.



To display the TIS traffic page press the TRFC function select key.

The following illustration defines the data that appears on the TIS Traffic Display Page:



- 1 Display Range - RNG:##nm
- 2 TIS Operating Mode - TIS ON, TIS OFF or TIS FAIL
- 3 Available Functions - Displays icons representing data available (black) and displayed (color).
- 4 Current Flight Level - FL:###
- 5 Display Orientation - When in magnetic heading-up orientation, Mag###° Hdg; when in magnetic track-up orientation, Mag###° Trk; when heading or track is not available from the system, No Hdg or Trk. The received traffic bearing and ground track is corrected when the system has heading or track.
- 6 Traffic Intruder Symbols - Indicates type of traffic, altitude of traffic, vertical trend of traffic and ground track of traffic.
- 7 Range Rings - Outer ring radius is selected range, inner ring radius is always two nautical miles.
- 8 Knob Icon - Outer knob selects TIS ON or OFF. Inner knob selects MUTE ON or MUTE OFF for muting of "TIS Unavailable" audio message.
- 9 Aircraft Symbol - Stylized airplane indicating aircraft position.

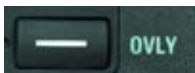
KMD 550/850 TRAFFIC PAGE (TIS) OPERATIONAL CONTROLS



MODE - Toggles the altitude tag between relative or absolute altitude as shown in Figures 16 and 17. Operation in the absolute mode is limited to 15 seconds.



RNG▲/RNG▼ - Advances the indicator to the next range. The upper button increases range, the lower button decreases it. The selected range is displayed in the lower left corner of the display with the inner range ring always 2 nm. The **RNG** button labels will not be displayed when their respective range limits are reached.



OVLY - Allows selection of flight plan for overlay on the traffic data. The GPS flight plan data can be overlaid on the traffic display, if the desired data is available.



Outer Knob - Turns the TIS system **ON** or **OFF**.

Inner Knob - The "TIS Unavailable" audio message may be muted by turning the inner knob. The audible TIS TAs are not affected. The current state is annunciated in the knob icon.



Figure 16
Relative Altitude Mode



Figure 17
Absolute Altitude Mode

TIS SYMBOLOGY

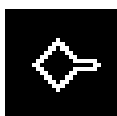
TIS symbols have a track pointer which are not on TCAS/TAS symbols. The track pointer shows the estimated ground track direction the traffic is moving (in 45° increments) relative to your own aircraft.

PROXIMITY INTRUDER TRAFFIC



A filled white diamond indicates that the intruding aircraft has reached the proximity traffic threshold as defined by the TIS system, but is still not considered a threat. This intruder is now 100 feet below your aircraft and flying level. The track pointer on the diamond indicates the direction of the intruder's ground track. Here the intruder is moving approximately 45° to your current track or heading.

PROXIMITY INTRUDER NON-ALTITUDE REPORTING (NAR)TRAFFIC



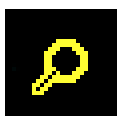
An open white diamond indicates proximity traffic that is non-altitude reporting. The symbol indicates that the intruder's ground track is approximately 90° to your current track or heading.

TRAFFIC ADVISORY (TA)



A symbol change to a filled yellow circle indicates that the intruding aircraft is considered to be potentially hazardous. Depending on your own altitude the system will display a TA when time to Closest Point of Approach (CPA) is reached as defined by the TIS system. Here the intruder is 100 feet above your aircraft. The arrow indicates the intruder is descending at 500 feet per minute or greater. The intruder is moving at approximately 180° to your current track or heading

TRAFFIC ADVISORY NON-ALTITUDE REPORTING (NAR)



An open yellow circle indicates that the intruding aircraft is considered to be potentially hazardous and is not reporting altitude. Here the intruder is moving at approximately 225° to your current track or heading.

“OFF-SCALE” TRAFFIC

TA traffic that is beyond the selected range will be displayed as half the appropriate symbol at the edge of the display matching the bearing of the traffic.

TRAFFIC ADVISORY WHILE IN MAP DISPLAY

If a Traffic Advisory presents itself while in the Map Display a yellow **TRFC** will be displayed as shown in Figure 18. If AUTO-POP-UP is enabled, a TA will cause the Traffic display to be presented automatically. The default range of the pop-up display will be 7 nm.

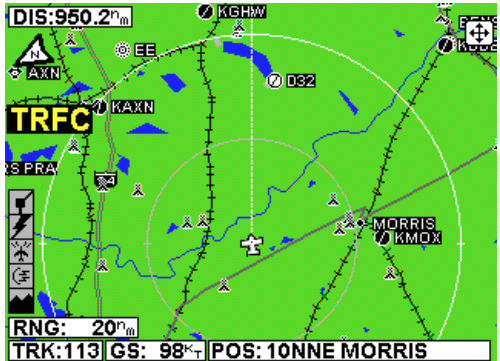


Figure 18

COAST MODE

When intruders are displayed and TIS information is not received from the terminal Mode S radar for one radar scan, the altitude tag of the intruder is replaced with the text "CST" to inform the pilot that the system is in Coast mode. See Figure 19. This means the displayed intruder information is old and could have changed since the last update.

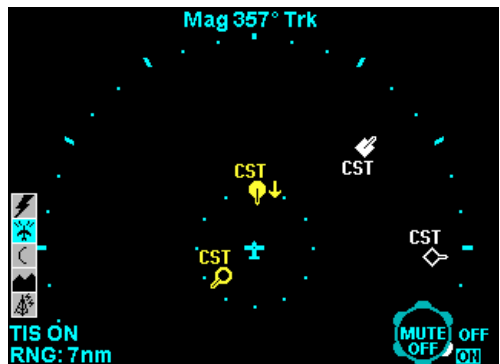


Figure 19

When two radar scans have elapsed without TIS information, the intruders are removed from the display and "TIS UNAVAILABLE" is displayed in the center of the screen as shown in Figure 20. Also, an audible "TIS UNAVAILABLE" message will be heard (if not muted). The display will revert to normal when TIS information is again available.



Figure 20

TIS TRAFFIC OVERLAY



OVERLAYING TRAFFIC ON MAP DISPLAY

By pressing the **OVLY** Key a display similar to Figure 21 will be displayed. Pressing the **TRFC** soft key will toggle between overlay on or off as shown in Figure 22. A representation of the Traffic Page, with a fixed range of 6 nm, will be displayed in the upper left of the Map display when traffic data is overlaid and only if the Map is set to Track-Up. If the Map display is set to North-Up, this small Traffic display will not be shown. Intruders will also be displayed on the map itself up to the range setting selected on MAP Setup Page.



Figure 21

Pressing **SAVE & EXIT** will return to the map display. The overlay status will remain as saved until changed again by pressing the **OVLY** Key.



Figure 22

COAST MODE ON OVERLAY

If the system goes into Coast Mode with traffic overlaid on the Map Display, a display similar to Figure 23 will be displayed.



Figure 23

If TIS information is unavailable while traffic is overlaid on the Map Display, a display similar to Figure 24 will be displayed.

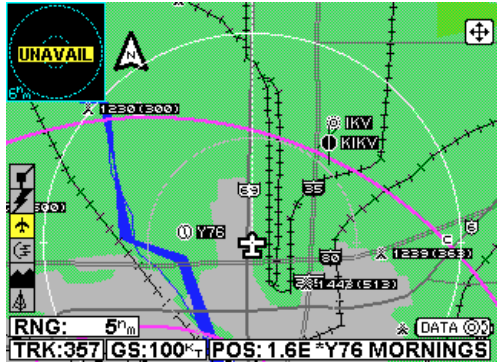


Figure 24

OVERLAYING TRAFFIC ON TERRAIN DISPLAY

By pressing the **OVLY** Key a display similar to Figure 25 will be displayed.

Pressing the **TRFC** soft key will toggle the overlay on as shown in Figure 26. Pressing the **TRFC** soft key again will toggle the overlay off.

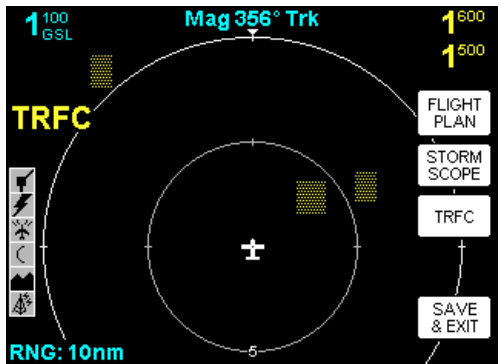


Figure 25

Pressing **SAVE & EXIT** will return to the terrain display. The overlay status will remain as saved until changed again by pressing the **OVLY** Key.

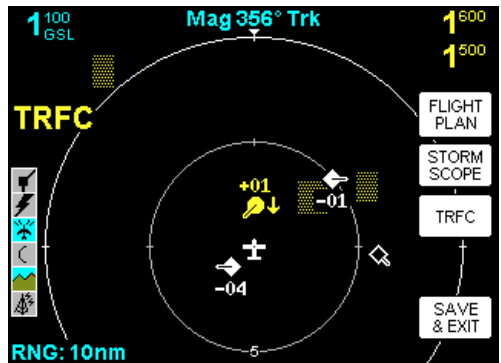


Figure 26

OVERLAYING TRAFFIC ON WEATHER RADAR DISPLAY

By pressing the **OVLY** Key a display similar to Figure 27 will be displayed. Pressing the **TRFC** soft key will toggle between overlay on or off as shown in Figure 28.

Pressing **SAVE & EXIT** will return to the weather radar display. The overlay status will remain as saved until changed again by pressing the **OVLY** Key.

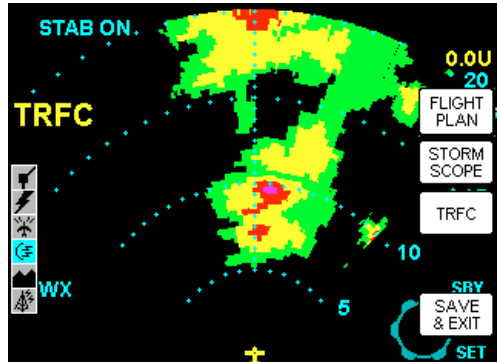


Figure 27

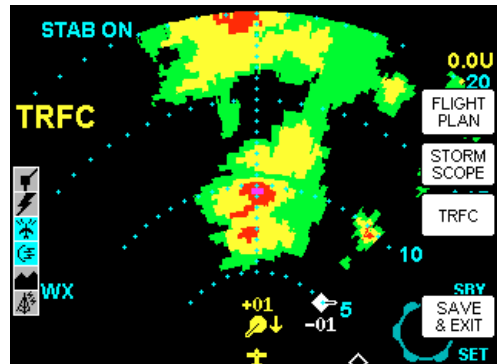


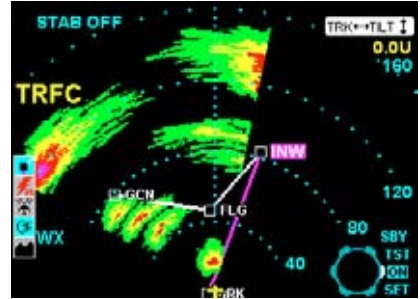
Figure 28

TIS TRAFFIC ADVISORIES ON OTHER FUNCTION DISPLAYS

The following figures show traffic advisory annunciations on other function displays. If a TA is presented, the TRFC Function Select Key must be pressed to view traffic on the TRFC Page. The KMD 550/850 may be configured to display the TRFC Page automatically when a TA is received.



Traffic Advisory while viewing an AUX Page.



Traffic Advisory while viewing a Weather Radar Page.



Traffic Advisory while viewing a Stormscope™ Page.



Traffic Advisory while viewing a Terrain Page.

NOTE: "Off-Scale" advisories are displayed only on the TRFC Page.

TIS SYSTEM FAULTS

SYSTEM OFF

If the TIS system is set to the OFF position, Figure 29 will be displayed.

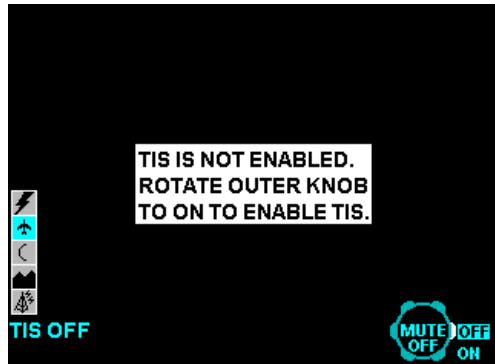


Figure 29

NO DATA RECEIVED

If the KMD 550/850 is not receiving data from the TIS receiver then Figure 30 will be displayed. This could indicate that power is not being provided to the TIS receiver (e.g. a pulled breaker), the TIS receiver is turned off, a bad wiring connection between the display and the receiver, or a failed TIS receiver.



Figure 30

TRANSPONDER IS NOT REPORTING ALTITUDE

If the transponder's altitude source has failed or the transponder is put into a non-altitude reporting mode, Figure 31 will be displayed.



Figure 31

SYSTEM FAILURES

If failures are detected in the TIS system, one of the following will be displayed as shown in Figures 32 and 33.

A display such as that shown in Figure 32 indicates the TIS processor (transponder) is not receiving information from the KMD 550/850.



Figure 32

A display such as that shown in Figure 33 indicates the TIS processor (transponder) is not capable of performing TIS functions. This could be internal failures.



Figure 33

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