

\$12.00 U.S.

Pilot's Guide
for the

SKYWATCH[®] HP

Traffic Alert/Advisory System

Model SKY899



BFGoodrich
Aerospace

BFGoodrich Avionics Systems, Inc.

Eyes That Never Blink™

Early Traffic Alert/Advisory Systems

In the early days of flight, pilots were equipped with all they needed for effective collision avoidance—a sharp pair of eyes. But increasing traffic at higher speeds led to the development of TCAS I and II (Traffic Alert and Collision Avoidance Systems) which were too expensive for most regional airlines, business aircraft, and general aviation aircraft.

SKYWATCH®

BFGoodrich Avionics Systems, Inc. recognized the need for an alternative to expensive TCAS systems and developed the SKYWATCH model SKY497 Traffic Advisory System (TAS) and the SKYWATCH HP model SKY899 TAS/TCAS I.

The SKYWATCH HP can be installed as a TAS to provide most of the capabilities of TCAS I, but at a significantly lower cost, making it practical for small aircraft. The SKYWATCH HP can also be installed as a TCAS I.

In addition to its TCAS I capability, SKYWATCH HP improves upon the SKY497 by adding ADS-B surveillance, a larger display range (15 nmi), and a higher maximum closure rate (1200 kn).

Proven Experience

BFGoodrich Avionics Systems, Inc. has been involved in the development of collision warning programs since the early 1980's. In 1985, BFG began development of an enhanced collision warning system for the Navy's T-34C training aircraft.

Based largely on the success of the Navy project, BFG was selected to validate the specifications for TCAS I. As a result, BFG's original TCAS I unit, the TCAS791 was the first TCAS I to be TSO'd, first to receive a full, unrestricted STC, first to fly, and first to be delivered.

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Safety Summary

These warnings and cautions appear later in this guide and are repeated here for emphasis:

CAUTION

page 3-1

To avoid power surges that could damage the SKY899 and the optional WX-1000, start your engines before turning on the SKY899.

WARNING

page 3-5

If the SKY899 is in SKYWATCH mode, the display will not automatically switch into Stormscope mode to display thunderstorms or Stormscope errors. Use the remote SKYWATCH/Stormscope mode switch to periodically check for thunderstorms or Stormscope errors.

WARNING

page 3-6

The SKY899 relies on information obtained from transponders in nearby aircraft. The SKY899 does not detect or track aircraft which are not equipped with an operating Air Traffic Control Radar Beacon System (ATCRBS) transponder.

WARNING

page 3-6

The SKY899 does not track intruder aircraft approaching at a closure rate greater than 1200 knots.

WARNING

page 3-6

Some traffic within the chosen display range may not be displayed due to traffic prioritizing, antenna shielding, or ground intruder filtering.

CAUTION

page 3-6

Optimum SKY899 performance is realized when intruder aircraft are reporting their altitude (via a mode C or other altitude reporting transponder).

WARNING

page 3-6

Do not attempt evasive maneuvers based solely on traffic information on the display. Information on the display is provided to the flight crew as an aid in visually acquiring traffic; it is not a replacement for Air Traffic Control (ATC) and See & Avoid techniques.

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Preliminary

Abbreviations & Acronyms

ABV	Above
Ack	Acknowledge
ADS-B	Automatic Dependent Surveillance-Broadcast
AFM	Aircraft Flight Manual
AFS	Flight Standards Service
AGL	Above Ground Level
AHRS	Attitude and Heading Reference System
Alt	Altitude
ARINC	Aeronautical Radio, Inc.
ATC	Air Traffic Control
ATCRBS	Air Traffic Control Radar Beacon System
ATI	Air Transport Indicator
ATM	Air Traffic Management
BFG	BFGoodrich
BFGAS	BFGoodrich Avionics Systems, Inc.
BLW	Below
Comm	Communication
CPA	Closest Point of Approach
CRT	Cathode Ray Tube
EFIS	Electronic Flight Instrument System
EGPWS	Enhanced Ground Proximity Warning System
FAA	Federal Aviation Administration
fpm	Feet Per Minute
FSAW	Flight Standards Information Bulletin for Airworthiness
GPS	Global Positioning System
GPWS	Ground Proximity Warning System
Grnd	Ground
HP	High Performance
I/O	Input/Output
IVSI	Instantaneous Vertical Speed Indicator
kn	Knots
MFD	Multi-Function Display
Mod	Modification

Abbreviations & Acronyms (continued)

MSG	Message
Nav	Navigation
nm	Nautical Miles (on the display)
nmi	Nautical Miles (in the text)
NRM	Normal
OPR	Operate
OT	Other Traffic
PA	Proximity Advisory
P/N	Part Number
Rev	Revision
RGC	Radar Graphics Computer
RTCA	Requirements & Technical Concepts for Aviation
SLA	Sensitivity Level A
SLB	Sensitivity Level B
SSR	Secondary Surveillance Radar
STB	Standby
TA	Traffic Advisory
TAS	Traffic Advisory System
TAWS	Terrain Awareness and Warning System
TCAS	Traffic Alert and Collision Avoidance System
TRC	Transmitter Receiver Computer
TSO	Technical Standard Order
UNR	Unrestricted

Chapter 1

System Description

General Description

The SKYWATCH®HP Traffic Alert/Advisory System, model SKY899, from BFGoodrich Avionics Systems, Inc. (BFG) can be installed as a Traffic Alert and Collision Avoidance System I (TCAS I) or as a Traffic Advisory System (TAS). In either configuration, the SKY899 monitors the airspace around your aircraft and advises the flight crew where to look for transponder-equipped aircraft that may pose a collision threat. Traffic information on the display generally includes the range, relative bearing, and relative altitude of intruder aircraft. The SKY899 also makes aural announcements such as traffic advisories on the cockpit audio system. The SKY899 is intended for use by high performance corporate and general aviation aircraft. Figure 1-1 shows the major components of the SKY899.



Figure 1-1. SKY899 Major Components

When installed as a TAS, the SKY899 can share a BFG model WX-1000/SKY497 monochrome display (P/N 78-8060-5900-8 or -9) with a BFG STORMSCOPE® model WX-1000 using a remote SKYWATCH/*Stormscope* mode switch. As a TAS, the SKY899 can also display traffic on a growing number of Multi-Function Displays (MFDs) and Electronic Flight Instrument System (EFIS) displays from companies such as Avidyne, Garmin, and Collins, or on select Instantaneous Vertical Speed Indicators (IVSIs) from Honeywell or Sextant, or on a compatible weather radar indicator via the BFG Radar Graphics Computer, model RGC250. Check with your dealer or with BFG for a current list of approved alternate displays.

When installed as a TCAS I, the SKY899 displays its traffic information on a TCAS I-compatible alternate display as described above, but *not* on the WX-1000/SKY497 display.

Hereafter the word *display* refers to the WX-1000/SKY497 display unless otherwise indicated. For any other display, refer to that display's manual for a description of how it displays SKY899 traffic information.

Transmitter Receiver Computer (TRC)

The TRC is the primary unit of the SKY899. It converts signals from the directional antenna and from other aircraft systems into an on-screen picture of intruder aircraft locations, and if necessary, aural traffic advisories. The TRC can track up to 35 intruder aircraft simultaneously, but to reduce clutter, the SKY899 only displays the 8 most threatening intruders being tracked. The TRC also has built-in test equipment to detect faults and to verify proper operation.

Directional Antenna

The directional antenna transmits omnidirectional mode C interrogations and receives directional replies from other transponder-equipped aircraft in the vicinity. The antenna also receives Automatic Dependent Surveillance-Broadcast (ADS-B) mode S extended squitter broadcasts from intruder aircraft.

Display

The display is a 3-inch Air Transport Indicator (3-ATI) unit with a high resolution, green monochrome Cathode Ray Tube (CRT) display. The bezel contains four momentary contact push-button switches and an on/off/brightness knob. The display provides control and display functions for the SKY899 (installed as a TAS) and for a WX-1000 *Stormscope* (if installed).

The display does not display traffic and storm information simultaneously. The position of a remote SKYWATCH/*Stormscope* mode switch determines whether the display shows traffic or storm information; however, if you're in *Stormscope* mode and the SKY899 detects traffic that may pose an immediate threat to your aircraft, the display temporarily switches to SKYWATCH mode. Figure 1-2 shows the display with a typical SKYWATCH HP screen. Figure 1-3 shows the display with a typical *Stormscope* screen.



Figure 1-2. Display with Typical SKYWATCH HP Screen



Figure 1-3. Display with Typical *Stormscope* Screen (Optional)

Interaction of Major Components

Figure 1-4 shows how the major components of the SKY899 connect to each other and to other aircraft systems.

Notes on Figure 1-4:

1. The optional radio altitude input affects the SKY899 audio inhibit feature, the ground intruder filtering feature, and the sensitivity levels feature. (See chapter 4 for details.)
2. GPS nav data is only required if you plan on using SKY899's ADS-B feature (for intruder location enhancement).
3. The SKY899 works *without* a heading input, but experiences degraded performance during high-rate-of-turn maneuvers.
4. Having a weight-on-wheels input allows the SKY899 to automatically switch out of standby when you take off, and into standby when you land.
5. The SKY899 may be installed on aircraft with fixed landing gear. The optional landing gear position input affects the sensitivity levels feature. (See chapter 4 for details.)
6. The RGC250/radar indicator or alternate display can be in place of, or in addition to the WX-1000/SKY497 display for TAS installations, but one of the two must be used for TCAS I installations.
7. Only required when using an alternate display that doesn't display vertical display mode indications.

Functional Description

The SKY899 is an active system that operates as an aircraft-to-aircraft interrogation device. The SKY899 interrogates aircraft transponders in the surrounding airspace (within a 35 nmi horizontal radius) similar to the way ground-based radar interrogates aircraft transponders. When the SKY899 receives replies to its interrogations, it computes the responding aircraft's range, relative bearing, relative altitude, and closure rate. The SKY899 also receives any ADS-B broadcasts from the responding aircraft and uses that information along with your own aircraft Global Positioning System (GPS) navigation (nav) data to enhance the computed relative position of the respond-

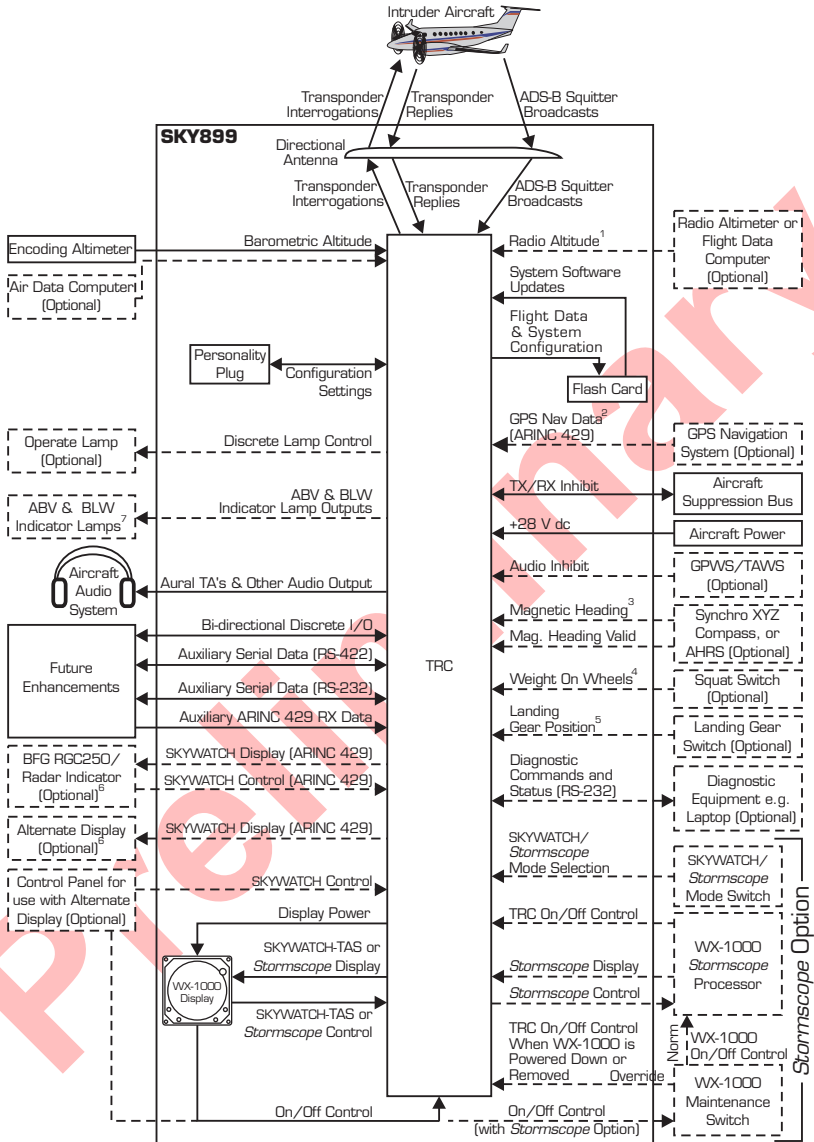


Figure 1-4. System Block Diagram

ing aircraft. The SKY899 then predicts collision threats and plots the eight most threatening aircraft locations on the display.

Figure 1-5 shows the SKY899 vertical display modes (look up, look down, normal, and unrestricted). The figure also shows the traffic zones around your aircraft and the traffic symbols that appear on the display when intruding aircraft enter one of those zones.

A solid circle is the visual part of the Traffic Advisory (TA) that the SKY899 generates when it predicts that an intruder aircraft may pose a collision threat. The aural part of the TA, “traffic, traffic,” is annunciated over a cockpit speaker or headset. An open diamond represents Other Traffic (OT) that does not pose an immediate collision threat. A solid diamond (Proximity Advisory, PA) only appears on TCAS installations.

The SKY899 uses either Sensitivity Level A (SLA) or Sensitivity Level B (SLB) to determine when to display a TA. In general, SLB is used during the in-flight phase and SLA is used during takeoff and landing. Sensitivity levels and other factors affecting the display of traffic symbols are discussed in detail in chapter 4.

Features

- Tracks up to 35 intruder aircraft (displays the 8 most threatening)
- Tracks intruder aircraft approaching at closure rates up to 1200 knots
- Installs as a TAS or as a TCAS I
- Costs only a fraction of the price of a traditional TCAS I or II
- Requires no mode S transponder
- Displays traffic information in three horizontal display ranges: 15, 6, and 2 nmi
- Displays traffic information in four vertical display modes: normal ($\pm 2,700$ ft), look up (+9,000 ft to $-2,700$ ft), look down ($+2,700$ ft to $-9,000$ ft), and unrestricted ($\pm 9,900$ ft)
- Generates visual *and* aural advisories of aircraft that may pose a collision threat

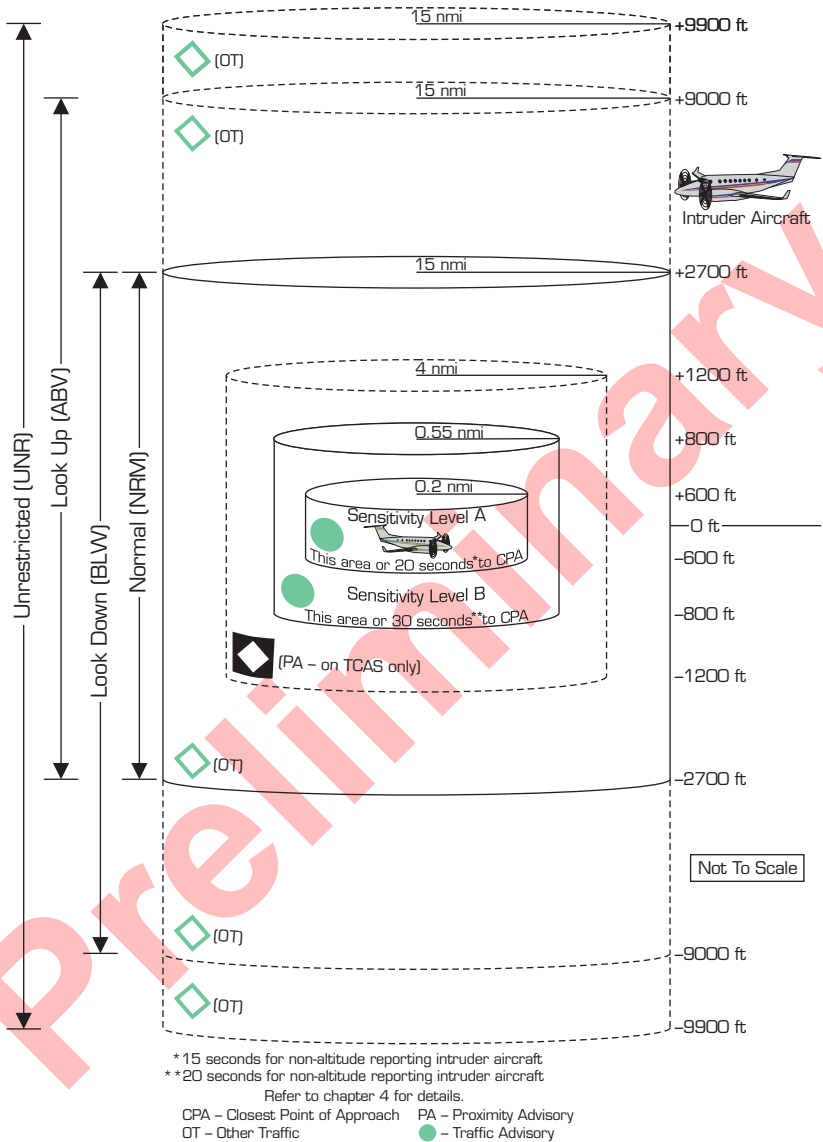


Figure 1-5. Vertical Display Modes and Traffic Zones

Features – Continued

- Performs automatic and operator-initiated self tests
- Offers a high-resolution, green monochrome, CRT display for TAS installations
- Transmits interrogations from the ground (if desired) as well as from the air
- Shares a display with the *Stormscope* WX-1000 (if desired) when the SKY899 is installed as a TAS
- Switches to the SKYWATCH screen from the optional *Stormscope* screen automatically when a TA occurs
- Uses only one antenna
- Eases installation since the standard TAS display fits in a 3-ATI cutout in the cockpit panel
- Displays traffic on a variety of displays
- Uses information from ADS-B broadcasts (if available) along with own aircraft GPS nav data to enhance intruder location computation

Chapter 2

Controls & Indicators

Introduction

This chapter describes the SKY899 controls and indicators including the controls, indicators, and symbols on the display, discrete controls and indicators, and aural announcements.

Controls, Indicators, & Symbols

Figures 2-1 and 2-2 and the following paragraphs describe the SKY899 controls, indicators, and symbols.

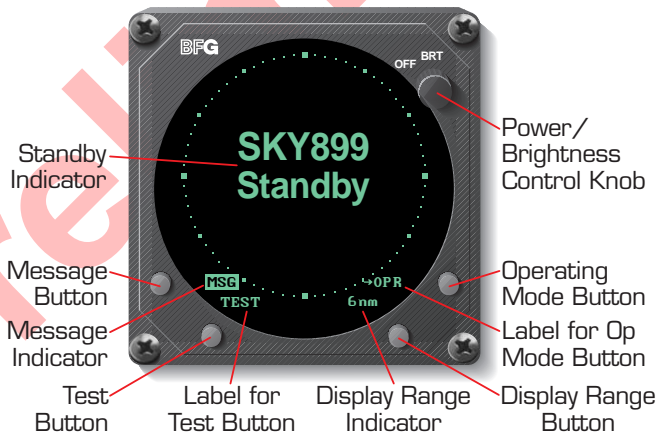


Figure 2-1. Controls & Screen Elements in Standby



Power/Brightness Control Knob (OFF/BRT)

This knob controls power to the SKY899 and WX-1000 (if installed) and adjusts display brightness.

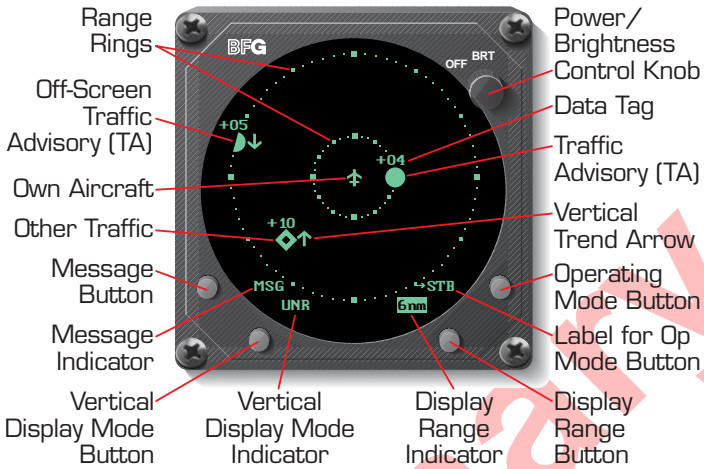


Figure 2-2. Controls & Screen Elements in Operating Mode

+04 Data Tag These two digits indicate, in hundreds of feet, the relative altitude of the intruder aircraft. In this case, +04 means the intruder aircraft is 400 feet above you. A positive data tag is displayed above the traffic symbol to emphasize that the intruder aircraft is above your aircraft. Similarly, a negative data tag is displayed below the traffic symbol. If the intruder is at the same altitude as your aircraft, 00 is displayed above the traffic symbol.

The data tag for a vertically out of range TA stays at the maximum or minimum relative altitude number of the current vertical display mode until the intruder aircraft comes within the relative altitude limits of the vertical display mode. The SKY899 only displays data tags for altitude reporting aircraft. Non-altitude-reporting aircraft are considered to be at the same altitude as your own aircraft.

Traffic Advisory (TA) A TA consists of a symbol on-screen and a “traffic, traffic” message on the cockpit speakers or headset. When an intruder aircraft that meets the TA criteria described in chapter 4 is within the displayed range (inside or outside of the selected vertical display mode), the corresponding symbol is this circle

located at a position on the screen that indicates the relative bearing and range of the intruder aircraft.

In general, the SKY899 issues a TA when it detects an intruder aircraft within 30 seconds of a possible collision, or within a 0.55 nmi horizontal radius and a ± 800 ft relative altitude range of your aircraft. (See chapter 4 for details.)



Vertical Trend Arrow A vertical trend arrow indicates that the intruder aircraft is ascending (up arrow) or descending (down arrow) faster than 500 fpm. No arrow is shown for intruder aircraft in level flight, or for those moving vertically slower than 500 fpm, or for non-altitude-reporting intruder aircraft.



Operating Mode Button Pressing this button when it's labeled \rightarrow STB switches the SKY899 out of normal operating mode and into standby. Pressing the button when it's labeled \rightarrow OPR switches the SKY899 out of standby and into normal operating mode.



Label for Operating Mode Button This on-screen label identifies the function of the adjacent button. The \rightarrow STB label appears on the traffic screen and means *go to standby*. The \rightarrow OPR label appears on the standby screen and means *go to normal operating mode*. If your aircraft has a squat switch, the \rightarrow STB label only appears when your aircraft is on the ground.



Display Range Button Pressing this button when the SKY899 is in standby has no effect. Pressing the button when the SKY899 is in operating mode toggles the SKY899 display range between 15, 6, and 2 nmi as reflected in the on-screen display range indicator.



Display Range Indicator The unhighlighted version of the indicator (present only on the Standby screen) simply reminds you that the adjacent button can be used to select the display range once you switch into operating mode. The highlighted version of the indicator (present only in operating mode) identifies the currently selected display range (15, 6, or 2 nmi).



Vertical Display Mode Indicator This indicator displays the name of the currently selected vertical display mode: ABV (above/look up), BLW (below/look down), NRM (normal), or UNR (unrestricted). The indicator does not appear when the SKY899 is in standby.



Vertical Display Mode Button/Test Button

In operating mode, this button changes the SKY899 vertical display mode between above, normal, below, and unrestricted as reflected in the on-screen vertical display mode indicator. In standby, this button starts a self test.



Label for Test Button This on-screen label only appears when the SKY899 is in standby or in failed mode. It identifies the function of the adjacent button which is to start the operator-initiated self test.



Message Indicator The highlighted version of this indicator appears when there is a new message. The indicator switches to the unhighlighted version when all the messages have been read. In operating and failed modes, the unhighlighted version disappears when the messages disappear, but in standby, the unhighlighted version remains on the screen even if there are no messages.



Message Button When the message indicator is present, pressing this button displays the message screen.



Other Traffic (OT) On the WX-1000/SKY497 display, this symbol represents an intruder aircraft that has been detected within the selected display range and vertical display mode, but which has not generated a TA. On alternate displays, this symbol represents an intruder aircraft that has been detected within the selected display range and vertical display mode, but which does not generate a TA or a PA.



Proximity Advisory (PA) (not shown) This symbol only appears on TCAS installations. A PA

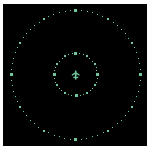
represents an intruder aircraft that does not generate a TA, but which is within a horizontal range of 4 nmi and a relative altitude of ± 1200 ft.



Own Aircraft This symbol represents your aircraft's relative position and heading.



Off-Screen Traffic Advisory (TA) This symbol represents a TA that has been detected beyond the current display range. The symbol is displayed at a position along the outer range ring that indicates the relative bearing of the intruder aircraft.



Range Rings The outer range ring represents a distance of 15, 6, or 2 nmi from your aircraft corresponding to the selected display range as indicated in the display range indicator. The inner range ring on the 15 nmi range represents a distance of 6 nmi. The inner range ring on the 6 nmi range represents a distance of 2 nmi. There is no inner range ring on the 2 nmi range.



Standby Indicator This indicator is displayed as long as the SKY899 is in standby except when the test screen is displayed during an operator-initiated self test. In standby, the SKY899 does not interrogate, process, or display traffic.



Operate Lamp (optional, not supplied) This panel-mounted indicator light is lit whenever the SKY899 is sending out interrogations. The light is not lit in standby or when the unit is in failed mode.

Controls Required for the Stormscope Option

SKYWATCH/*Stormscope* Mode Switch (not supplied)

This panel-mounted toggle switch determines whether traffic information or thunderstorm information is displayed.

The SKY899 and the WX-1000 continue tracking even if the switch is in the other position. If the SKY899 detects a TA or generates an error message when the switch is in the *Stormscope* position, the display switches to the traffic screen to display the TA or the error message.

WX-1000 Maintenance Switch (not supplied) This remote toggle switch (normally installed in the avionics bay near the WX-1000 processor) has a Normal position and an Override (WX-1000 maintenance) position. It should only be moved to the Override position when the WX-1000 processor is removed or powered down at the circuit breaker, and you still want to use the SKY899.

Controls & Indicators for an Alternate Display

Control Panel (not supplied) A discrete control panel provides the functions normally provided by the buttons and knob on the WX-1000/SKY497 display. These functions include controlling power to the SKY899, selecting the display range, selecting the vertical display mode, selecting the operating mode, and starting the self test.

Vertical Display Mode Indicator Lamps (not supplied) Some alternate displays do not display a vertical display mode indicator on-screen. For those displays, two discrete indicator lamps similar to those shown in figure 2-3 indicate the current vertical display mode.



Figure 2-3. Vertical Display Mode Indicator Lamps

Aural Announcements

“Traffic, Traffic” This aural component of a traffic advisory is announced once over the cockpit speakers or headset when a TA is first detected.

“SKYWATCH System Test Passed” This message is announced once over the cockpit speakers or headset after the SKY899 has passed an operator-initiated self test.

“SKYWATCH System Test Failed” This message is announced once over the cockpit speakers or headset after the SKY899 has failed an operator-initiated self test.

Chapter 3

Operating Instructions

Introduction

This chapter lists the SKY899 operating instructions and describes its fault modes.

Turn On the SKY899

CAUTION

To avoid power surges that could damage the SKY899 and the optional WX-1000, start your engines before turning on the SKY899.

1. Turn the OFF/BRT knob clockwise to the desired display brightness.

The BFGoodrich screen (figure 3-1) appears and stays on the display until the power-on self test is complete.

If the SKY899 passes the test, and your aircraft has a squat switch, and your aircraft is on the ground, the standby screen appears (figure 3-2).

If the SKY899 passes the test, and your aircraft has a squat switch, and your aircraft is in the air, the traffic screen appears set on the 6 nmi display range and the *normal* vertical display mode (figure 3-3).



Figure 3-1. BFGoodrich Screen



Figure 3-2. Standby Screen



Figure 3-3. In-Flight Traffic Screen

If the SKY899 passes the test and your aircraft does not have a squat switch, the standby screen (figure 3-2) appears.

In standby, the SKY899 waits 5 minutes for critical sensors such as the barometric altimeter to warm up and come on line before it displays a Failed screen or **MSG** due to the lack of the sensor input; however, if you switch into operating mode, the SKY899 only waits 2 seconds for the sensor inputs before it displays the Failed screen or **MSG**.

If a Failed screen similar to figure 3-4 appears, or if you see **MSG**, refer to the Message Response section on page 3-7. For installations with an ARINC 429 barometric altitude input, turning on the SKY899 during flight causes a temporary Error 20 message while the system is syncing up to the 429 data source.



Figure 3-4. Failed Screen

Run the Operator-Initiated Self Test

It is recommended, but not required that you should run the operator-initiated self test before the first flight of the day (or as specified in your Aircraft Flight Manual [AFM]), and whenever you get a Failed screen.

1. With the SKY899 in standby or failed mode, press the TEST button.

The SKY899 begins its self test and the test screen (figure 3-5) appears. Upon *successful* completion of the self test, you will hear “SKY-WATCH System Test Passed” and the display will revert to the previous standby or traffic screen.



Figure 3-5. Test Screen

2. If you hear “SKY-WATCH System Test Failed” or see a SKY899 Failed screen, push the TEST button again. If it fails again, refer to the Message Response section on page 3-7.
3. If you hear “SKYWATCH System Test Passed” without seeing the test screen, and the OFF/BRT knob is turned to BRT, turn off the SKY899 and contact your authorized BFGoodrich Avionics Systems dealer for troubleshooting help.

Switch Between Standby & Normal Operating Mode

When you’re on the ground, you must manually switch out of standby if you want the SKY899 to display traffic information. The ability to switch out of standby on the ground in conjunction with the *above* display mode is especially useful for scanning the airspace around the airport before takeoff.

1. To manually switch into normal operating mode from the standby screen (figure 3-2), press the button labeled →OPR.

The SKY899 switches out of standby into the *above* display mode and 6 nmi range (figure 3-6).

If your aircraft has a squat switch and you don't *manually* switch out of standby, the SKY899 *automatically* switches out of standby 8 to 10 seconds after takeoff.



Figure 3-6. Traffic Screen on the Ground

- To manually switch into standby from the traffic screen, press the button labeled →STB.

The SKY899 goes into standby and the display switches back to the standby screen. (If your aircraft has a squat switch, the →STB button label is not displayed while airborne, and the SKY899 will not go into standby while airborne.)

If your aircraft has a squat switch, the SKY899 also goes into standby automatically, 24 seconds after landing. This delay allows the SKY899 to remain out of standby during a touch-and-go maneuver.

Change the Display Range

You can change the display range when the SKY899 is in normal operating mode.

- Press the display range button to toggle the display range between 15, 6, and 2 nmi (figure 3-7).

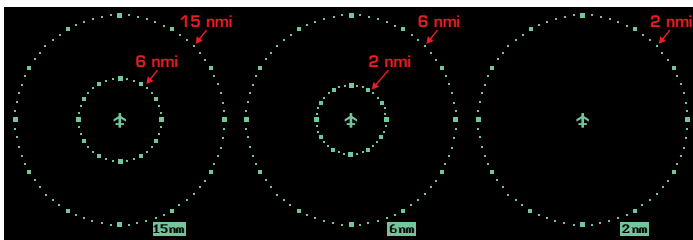


Figure 3-7. Display Ranges