Honeywell
Technical Newsletter

Honeywell
Change 7 Summary
TCAS 2000, TCAS II, and Mode S Systems

Honeywell Pub. No. C23–9000–040

1. Introduction

Change 7 is an upgrade to the TCAS system to incorporate improvements defined by the United States Federal Aviation Administration (FAA) from observations of TCAS systems in operation. This change, while not being mandated by the FAA as of yet, is required to meet upcoming Airborne Collision Avoidance System (ACAS) mandates in Europe (forms for Extension Submittal are available). ACAS is basically the European acronym for TCAS with Change 7 incorporated. TCAS with Change 7 is designed to meet ARINC 735A specifications. The current TCAS units are designed to meet the ARINC 735 specifications.

Change 7 will be available for both the TCAS 2000 computer unit (Part No. 7517900–VAR) and the TCAS II computer unit (currently Part No. 4066010–VAR, except for DC units Part No. 4066010–907 and –954). Incorporation of Change 7 in the TCAS 2000 computer unit requires only a software change. (Although not required for Change 7, this software with hardware MOD C provides extended range capabilities as indicated in the note below.) The TCAS II computer unit will require both software and hardware changes. The changes in the TCAS II computer unit will include expanded program memory and new voice recordings for the aural alerts. Currently, any installation utilizing the –907 or –954 TCAS II computer unit will require replacement in areas requiring Change 7 TCAS operation.

2. Change 7 Implementation

Customers planning Change 7 upgrades should immediately contact their Honeywell representative and provide the quantity and desired schedule for each base part number upgrade.

A. TCAS 2000 Computer Unit (Part No. 7517900–VAR) (Change 7 Part No. 7517900–XX003)

The modification to incorporate Change 7 into the new TCAS 2000 computer unit is a software change only. Change 7 for the TCAS 2000 is scheduled to be available starting November 1999. This software may be installed using one of three methods: an airborne ARINC data loader, an ARINC portable data loader, or by an authorized repair facility.

NOTE: **Although extended range is not required for Change 7 implementation,** the ADSB squitter extended range passive tracking option is included in the software. To implement the extended range feature, a hardware modification (MOD C) is also required and will be incorporated in production TCAS 2000 computer units beginning with October 1999 deliveries. Units delivered prior to the hardware implementation will need to be returned to a Honeywell support center to be upgraded prior to enabling this option. The ADSB Surveillance (RMP–10K) option is required (refer to Paragraph 2.C of this Newsletter).

B. TCAS II Computer Unit (Part No. 4066010–VAR)
(Change 7 Part No. 4066010–910)

The modification to incorporate Change 7 into the TCAS II computer unit consists of both hardware and software changes. Hardware changes include replacing one of the two processor cards and modifying the second card. Change 7 for the TCAS II computer unit is currently anticipated to be available the 2nd quarter of 2000. A modification program is being established to cycle the units through the following Honeywell Support Centers:

- Ohio (Tel: 440–243–8877)
- England (Tel: 44–1256–72–2200)
- New Zealand (Tel: 64–9–256–2078)

C. Aircraft Considerations and Effects With Change 7

Upgrading the TCAS computer units will not require any aircraft changes. It is recommended that operators requiring a revision to their aircraft certification notify the holder well in advance. The upgraded TCAS 2000 computer units will have four additional pin programmable options and one parity option that may be implemented at the customer's discretion with appropriate certification approval.

The additional options for TCAS 2000 computer units are as follows:

- **ADSB Surveillance (RMP–10K):** Allows the tracking of targets at extended range (>100 nmi) if the other aircraft is ADSB equipped. (NOTE: No change will continue active tracking, ADSB passive extended range requires grounding pin for selection.)

- **Display of Flight ID (RMP–11B):** The flight ID of other aircraft may be displayed in the TCAS traffic display if this option is implemented. The TCAS display unit must be capable of displaying the flight ID in order for this function to be operational. (NOTE: No change will continue the traffic display without flight ID.)

- **Male Voice (RMP–11C):** The male voice is an additional voice alert that is pin programmable for those airlines preferring a male cockpit annunciation voice. (NOTE: No change will continue the current female voice.)

- **Extended External Event Recording Capability (RMP–11D):** Enables the long–term recording of event parameters of both aircraft by connecting a Quick Access Recorder (QAR) to the Resolution Advisory (RA) only bus (LS ARINC 429 data link). (NOTE: With no change, the TCAS system automatically records events, up to a maximum of 60.)

- **Parity of Option Selections (RMP–12G):** Set according to the parity of option pins RMP–10G, –10H, –10J, –10K, –11A, –11B, –11C, and –11D. Ground parity if selected options are an odd number. (NOTE: No change required unless adding selections by grounding odd number of option pins.)

3. TCAS Upgrade Changes

The upgraded TCAS computer unit software includes the following list of changes identified as Change 7 to the TCAS MOPS, DO–185A. The changes may be categorized as related to the Collision Avoidance System (CAS) algorithms and the Surveillance System (SURV) algorithms.

A. CAS Changes

- Reduction in the number of Resolution Advisories (RAs) issued by the application of a miss distance filter to eliminate those aircraft which are expected to pass with sufficient range separation yet meet the basic RA criteria.
- Aural annunciations will be announced down to 500 +/– 100 feet, down from the current 1000 feet limit.
- Thresholds for issuing RAs for aircraft closing in altitude will be reduced between FL200 and FL420 to reduce the frequency of these types of RAs in this altitude band.
- Altitude separation thresholds for issuing Traffic Advisories (TAs) and RAs between FL300 and FL420 will be reduced for compatibility with RVSM flight operations. (NOTE: TCAS 2000 Part No. 7517900–10001 and –10002 already have this feature.)
- New aural annunciations will be introduced to make the annunciations more consistent with the guidance shown on the display and to “soften” certain pilot responses. Refer to the Attachment at the end of this Newsletter for more details.
- Use of the green arc on the vertical speed command will be increased to provide guidance throughout the time an RA is displayed.
- Fewer multiple TAs will be issued against the same intruder during parallel approach and slow closure situations by adding hysteresis requirements to the qualifying criteria for the TA.
- Modifications will be made to the CAS design to permit reversal of RA directions based on geometry in TCAS/TCAS coordinated maneuvers when one of the aircraft involved maneuvers contrary to the original RA.
- Altitude tracking will be modified to allow the following changes:
  - Tracking of altitude rates up to +/– 10,000 feet per minute.
  - Tracking of either 25 foot or 100 foot intruder altitude quantization system.
  - Capability of auto switching between fine and coarse quantization of own altitude reporting systems.
- Significant enhancement to multi–aircraft advisory resolution.

B. SURV Changes

- Surveillance design will be modified to permit tracking and display of additional traffic when operating in the vicinity of high–density airports by means of an adaptive whisper/shout sequence for ATCRBS equipped aircraft, less frequent interrogations to more distant Mode S equipped aircraft, and more accurate evaluation of the aircraft density pattern.

- Capability is added for receiving long Mode S squitters (a TCAS 2000 feature only).

4. Mode S Requirements

To meet the requirements of an ACAS system, the Mode S transponder also requires certain minimal functionality. The Mode S transponder must be capable of operating as a level 2 datalink unit and meet certain additional datalink requirements for communication protocols with Mode S ground stations. Messaging protocols for RA reporting and Downlink of Aircraft Parameters (DAPs) along with protocol changes for the TCAS to Mode S communication bus must be changed to meet ACAS requirements. A software change only is planned to update the transponder to meet these requirements.

The Mode S change and TCAS Change 7 do not have to be done concurrently on an aircraft. Modified and unmodified TCAS and Mode S transponders can be intermixed. The changes have been designed to allow interoperability of modified and unmodified units. However, both the TCAS and the Mode S transponder must be modified to operate according to the ACAS mandate.

Details for each Mode S transponder are as follows:

A. Mode S Data Link Transponder (ATDL)
(Part No. 7517800–VAR)
(Change 7 Part No. 7517800–XX004)

The Honeywell ATDL transponder is a level 4 transponder and, therefore, exceeds the level 2 datalink requirement. The upgraded ATDL software is anticipated to be available mid–year 2000. Software may be loaded by an approved repair facility or options are being investigated to permit on aircraft loading through the front connector using an ARINC 615 portable data loader or onboard ARINC airborne data loader.

B. Mode S Data Link Transponder (RCZ–852 or Integ. PRIMUS Suite)
(Part No. 7510700–VAR)
(Change 7 Part No. *TBD*)

The Honeywell 7510700 transponder is a level 3 transponder and, therefore, exceeds the level 2 datalink requirement. The upgraded software is anticipated to be available by 4th quarter of 2000 depending upon finalized industry requirements. Software may be loaded by an approved repair facility.

C. Mode S Transponder (Part No. 4061400–VAR) (no Change 7 update planned)

The Honeywell Mode S transponder Part No. 4061400–VAR is not a level 2 datalink unit and would require extensive modification to meet level 2 requirements. It has been decided that this transponder will not be upgraded. The 4061400–VAR transponder will need to be replaced on aircraft flying into airspace that require ACAS systems, such as in European airspace following the ACAS mandate. The new ATDL transponders are form, fit, and functionally equivalent to this transponder and may be easily installed with appropriate certification approval.

5. TCAS II and TCAS 2000 Test Equipment

The TCAS II computer units are currently tested on one of three systems: the first generation MTS (TCAS II MTS), the STS 1000, or the IRIS–2000. Testing of TCAS II computer units not upgraded with Change 7 will continue on these three fixtures.

The TCAS 2000 computer units are tested on the MTS–T336255. The MTS–T336255 will be capable of testing the TCAS 2000 systems with or without Change 7.

An upgrade to the MTS–T336255 is currently in the development phase to test the TCAS II computer units with Change 7 and the TCAS 2000 computer units with or without Change 7 incorporated. The anticipated completion of the MTS–T336255 update is 1st quarter of 2000.

Test Fixture Capabilities

	TCAS II MTS, STS 1000, IRIS–2000	TCAS 2000 MTS–T336255	MTS–T336255 (upgraded)
TCAS II (without Change 7)	YES	NO	NO
TCAS II (with Change 7)	NO	NO	YES
TCAS 2000 (without Change 7)	NO	YES	YES
TCAS 2000 (with Change 7)	NO	YES	YES

ATTACHMENT

Aural Annunciation Details
(RTCA DO–185A MOPS, Page 163)

TA Annunciation:

1. Traffic, Traffic

RA Annunciations:

1. Climb, Climb
2. Descend, Descend
3. Climb, Crossing Climb — Climb, Crossing Climb
4. Descend, Crossing Descend — Descend, Crossing Descend
5.* Adjust Vertical Speed, Adjust
6.** Adjust Vertical Speed, Adjust
7. Climb, Climb NOW — Climb, Climb NOW
8. Descend, Descend NOW — Descend, Descend NOW
9. Increase Climb, Increase Climb
10. Increase Descent, Increase Descent
11. Monitor Vertical Speed
12. Maintain Vertical Speed, Maintain
13. Maintain Vertical Speed, Crossing Maintain
14. Adjust Vertical Speed, Adjust
15. Clear of Conflict

* Corrective Reduce Climb
** Corrective Reduce Descent

ACAS II TRANSITION PERIOD EXEMPTION APPLICATION FORM

ANNEX D to Specimen AIC

1. Operator and Aircraft information

Aircraft Operator	Contact Person Name: ..... Tel. : e-mail :
Address	

Tel.:	Fax:	e-mail:
Aircraft Type	National Registration	Manufacturer Aircraft Line or Serial No:

2. TCAS and Mode S equipment

Current Fitment TCAS Manufacturer **HONEYWELL INC.**	TCAS - Company Model/No: **4066010-90x**	TCAS - Software Version **PS4071416-908/910/912**
Planned Fitment TCAS Manufacturer **HONEYWELL INC.**	TCAS - Company Model/No: **4066010-910**	TCAS - Software Version **PS4071416-913**
Mode S Manufacturer	Mode S Model & Level	Mode S Address

3. Reason for Exemption request

* Operators should append appropriate supporting documentation

		Tick box
1.	Late parts delivery, for either new TCAS II, Version 7 installation, or upgrade from TCAS II, Version 6.04A to Version 7	
2.	Late approvals of the Service Bulletins for TCAS II, Version 7	**X**
3.	Identification of unexpected technical or airframe installation problems	
4.	Unavoidable delays to the certification process	
5.	Aircraft which will be withdrawn from operation before the end of the transition period	
6.	Other	
Comments: (continue overleaf if required)		

4. Expected ACAS II date in service

TCAS II Version 7 certification date: 18 May 2000	Projected in-service date for the aircraft:

Name:	Signature:	Date:

ACAS II TRANSITION PERIOD EXEMPTION APPLICATION FORM

1. Operator and Aircraft information

Aircraft Operator	Contact Person Name: ..... Tel. : e-mail :
Address	

Tel.:	Fax:	e-mail:
Aircraft Type	National Registration	Manufacturer Aircraft Line or Serial No:

2. TCAS and Mode S equipment

Current Fitment TCAS Manufacturer **HONEYWELL INC.**	TCAS - Company Model/No: **7517900-1000X**	TCAS - Software Version **3410-HNP-02B-01** **3413-HNP-02B-02**
Planned Fitment TCAS Manufacturer **HONEYWELL INC.**	TCAS - Company Model/No: **7517900-10003**	TCAS - Software Version **3412-HNP-02B-03**
Mode S Manufacturer	Mode S Model & Level	Mode S Address

3. Reason for Exemption request

* Operators should append appropriate supporting documentation

		Tick box
1.	Late parts delivery, for either new TCAS II, Version 7 installation, or upgrade from TCAS II, Version 6.04A to Version 7	
2.	Late approvals of the Service Bulletins for TCAS II, Version 7	**X**
3.	Identification of unexpected technical or airframe installation problems	
4.	Unavoidable delays to the certification process	
5.	Aircraft which will be withdrawn from operation before the end of the transition period	
6.	Other	
Comments: (continue overleaf if required)		

4. Expected ACAS II date in service

TCAS II Version 7 certification date: 14 November, 1999	Projected in-service date for the aircraft:

Name:	Signature:	Date: