EUROCAE WG49

EASA - Köln
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Comments and proposed modifications to WG49N5-07 WP

Presented by E. Potier

Updated by R.H. Saffell, RTCA SC-209 on May 30, 2007

SUMMARY
This document presents some comments and proposed modifications to WG49N5-07 WP to be considered by WG-49.

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1 Proposal

The meeting is invited to review the following comments and proposed modifications inserted in the initial text of **WG49N5-07** :

RHS_SC-209_Update_05/30/2007:

Updated all procedures as required so as not to refer to data tables which were also removed. Provided verification requirements in each procedure.

Updated as needed to implement all comments received from E. Potier, Eurocontrol_WG-49.

2.4.2.6. TRANSPONDER RECOVERY AND DESENSITIZATION:

REFERENCE: RTCA/DO-181C Test Requirement Para. 2.4.2.6.
RTCA/DO-181C Unit Requirement Para. 2.2.7.

2.4.2.6.1. TEST SETUP:

REFERENCE: RTCA/DO-181C Figure 2-27.

2.4.2.6.2. TEST PROCEDURE:

STEP 1: ATCRBS SINGLE PULSE DESENSITIZATION AND RECOVERY (2.2.7.1.1. and 2.2.7.2.)

Set the Master Test Set to generate a single pulse not less than 0.7 microseconds wide at the standard ATCRBS interrogation rate and level. Set the Slave Test Set to generate an ATCRBS Mode-A interrogation delayed 3 microseconds from the single pulse. Determine the amplitude of the Slave Test Set required to produce 90% reply efficiency. Repeat the procedure for Master to Slave Test Set delays of 6, 10, and 15 microseconds.

Repeat the procedure given in preceding paragraph with the Master Test Set pulse set at a signal level of ”MTL” + 50 dB.

NOTE: *The receiver shall recover sensitivity within 3 dB of ”MTL”, within 15 microseconds after reception of the trailing edge of a Desensitizing Pulse having a signal strength up to 50 dB above the ”MTL”. Recovery shall be nominally linear at an average rate not exceeding 3.5 dB per microsecond.*

Repeat the procedure given in preceding paragraphs as needed to verify performance of the transponder on both top and bottom channels of diversity transponder.

STEP 2: RECOVERY FROM A MODE-S INTERROGATION REQUIRING NO REPLY (2.2.7.2.1)

Set the Master Test Set to generate a short Mode-S surveillance interrogation with a Broadcast Address. Set the Slave Test Set to generate an ATCRBS Mode-A interrogation. Measure the delay time between the Master and Slave Test sets necessary to elicit a reply efficiency of 90%.

Verify that the delay time is less than or equal to 45 microseconds after the Sync Phase Reversal (SPR) of the Mode-S surveillance interrogation.

Repeat the procedure given in preceding paragraphs as needed to verify performance of the transponder on both top and bottom channels of diversity transponder.

STEP 3: RECOVERY FROM A MODE-S COMM.-C INTERROGATION (2.2.7.2.2.)

Set the Master Test Set to generate the initial segment of a properly addressed Comm.-C interrogation at a signal level of -21 dBm. Set the Slave Test Set to generate an ATCRBS Mode-A interrogation delayed 45 microseconds from the Sync Phase Reversal (SPR) of the Master interrogation. Determine the amplitude of the Slave Test signal required to produce 90% reply efficiency.

Verify that the transponder recovers sensitivity to within 3 dB of the "MTL" no later than 45 microseconds after the receipt of the Sync Phase Reversal (SPR).

Repeat the procedure given in preceding paragraphs as needed to verify performance of the transponder on both top and bottom channels of diversity transponder.

STEP 4: RECOVERY FROM A SUPPRESSION PAIR OR UNACCEPTED ATCRBS/MODE-S OR ATCRBS-ONLY ALL-CALLS (2.2.7.2.3. and 2.2.7.2.5.)

Set the Master Test Set to generate a P1-P2 pulse pair at the ATCRBS standard interrogation rate and level. Set the Slave Test Set to generate a Mode-S Only All-Call interrogation delayed 10 microseconds from the P2 pulse of the Master Test Set interrogation. Measure the reply efficiency.

***NOTE 1**: Rate of the Master Test Set is set to the Mode-S Standard rate. Triggering of the Slave Test Set is then set to generate the Mode-S Only All-Call at a rate that is less than 200/second.*

Verify that the reply rate is at least 90%.

***NOTE 2**: The receiver shall recover sensitivity within 3 dB of "MTL", within 15 microseconds after reception of the trailing edge of a Desensitizing Pulse having a signal strength up to 50 dB above the "MTL". Recovery shall be nominally linear at an average rate not exceeding 3.5 dB per microsecond.*

Lock-Out the transponder to All-Calls and repeat the procedure using a P4-type All-Call interrogation in place of the Suppression Pair on the Master Test Set.

***NOTE 3**: The Slave Test set should be set to generate a discrete interrogation since the unit will not reply to Mode-S Only All-Call interrogations during a Lockout.*

Repeat the procedure given in preceding paragraphs as needed to verify performance of the transponder on both top and bottom channels of diversity transponder.

STEP 5: NARROW PULSE PERFORMANCE (2.2.7.1.2.)

Set the Master Test Set to generate a single pulse less than 0.7 microseconds wide at the standard ATCRBS interrogation rate and level. Set the Slave Test Set to generate an ATCRBS Mode-A interrogation delayed 3 microseconds from the single pulse. Determine the amplitude of the Slave Test Set required to produce 90% reply efficiency. Repeat the procedure with the Master to Slave Test Set delays set to 6, 10, and 15 microseconds.

Verify that the transponder recovers sensitivity to within 3 dB of the "MTL" no later than 15 microseconds after the receipt of the Sync Phase Reversal (SPR).

NOTE: *The receiver shall recover sensitivity within 3 dB of "MTL", within 15 microseconds after reception of the trailing edge of a Desensitizing Pulse having a signal strength up to 50 dB above the "MTL". Recovery shall be nominally linear at an average rate not exceeding 3.5 dB per microsecond.*

Repeat the procedure given in preceding paragraphs as needed to verify performance of the transponder on both top and bottom channels of diversity transponder.

STEP 6: DEAD TIME (2.2.7.3.)

STEP 6A: DEAD TIME (2.2.7.3.) FOR ATCRBS MODE-A AND MODE-S ONLY ALL-CALL

Set the Master Test Set to generate an ATCRBS Mode-A interrogation at a level of -21 dBm. Set the Slave Test Set to generate a Mode-S Only All-Call interrogation at a level of 3 dB above the "MTL". Determine the Time Delay between the end of the reply to the Master Test Set interrogation and the start of the Slave Test Set interrogation that elicits a 90% reply efficiency from the transponder. Repeat the procedure with the Master Test Set generating a Mode-S Only All-Call interrogation set at -21 dBm and the Slave Test Set generating an ATCRBS Mode-A interrogation set at "MTL" + 3 dB.

Verify that the delay time is less than or equal to 45 microseconds.

NOTE: *Dead time should be minimized to maximize system availability and reliability.*

Repeat the procedure given in preceding paragraphs as needed to verify performance of the transponder on both top and bottom channels of diversity transponder.

STEP 6B: DEAD TIME (2.2.7.3.) FOR ATCRBS MODE-C AND MODE-S ONLY ALL-CALL

Set the Master Test Set to generate an ATCRBS Mode-C interrogation at a level of -21 dBm. Set the Slave Test Set to generate a Mode-S Only All-Call interrogation at a level of 3 dB above the "MTL". Determine the Time Delay between the end of the reply to the Master Test Set interrogation and the start of the Slave Test Set interrogation that elicits a 90% reply efficiency from the transponder.

Verify that the delay time is less than or equal to 45 microseconds.

NOTE: *Dead time should be minimized to maximize system availability and reliability.*

Repeat the procedure with the Master Test Set generating a Mode-S Only All-Call interrogation set at -21 dBm and the Slave Test Set generating an ATCRBS Mode-C interrogation set at "MTL" + 3 dB.

Repeat the procedure given in preceding paragraphs as needed to verify performance of the transponder on both top and bottom channels of diversity transponder.

STEP 7: RECOVERY (2.2.7.2.4.)

STEP 7A: RECOVERY FROM A MODE-S INTERROGATION WHICH HAS NOT BEEN ACCEPTED (2.2.7.2.4.) FOLLOWED BY ATCRBS MODE-A

Set the Master Test Set to generate a standard (i.e., -60 dBm) Mode-S Surveillance interrogation with an incorrect address (i.e., an address different from that of the UUT Mode-S Discrete Address).

Set the Slave Test Set to generate an ATCRBS Mode-A interrogation having a signal level of "MTL" + 3 dB.

Measure the delay of the Slave Test Set signal from the Mode-S Sync Phase Reversal (SPR) required to produce 90% reply efficiency.

Verify that the delay time is less than or equal to 45 microseconds after the Sync Phase Reversal (SPR) of the Mode-S surveillance interrogation.

Decrease the delay of the Slave Test Set signal such that the start of the Slave Interrogation is coincident with the end of the Master Interrogation. Then increase the delay of the Slave Interrogation such that it approaches 45 microseconds.

Verify that the transponder does not generate any undesired replies that can be detected by a properly operating Mode-S 1090 MHz. PAM receiver.

NOTE: *Undesired replies are those containing any wrong or misleading information.*

Repeat the procedure given in preceding paragraphs with the Master Test Set using Mode-S interrogations that are accepted but do NOT require a reply (e.g., All-Call or Broadcast interrogations).

Set the Master Test Set to generate a standard (i.e., -60 dBm) UF4, UF5, Mode A and Mode C interrogations and verify that the ATCRBS Mode A code and Altitude/ Mode C information provided in the transponder replies is correct.

Repeat the procedure given in preceding paragraphs as needed to verify performance of the transponder on both top and bottom channels of diversity transponder.

STEP 7B: RECOVERY FROM A MODE-S INTERROGATION WHICH HAS NOT BEEN ACCEPTED (2.2.7.2.4.) FOLLOWED BY ATCRBS MODE-C

Set the Master Test Set to generate a standard (i.e., -60 dBm) Mode-S Surveillance interrogation with an incorrect address (i.e., an address different from that of the UUT Mode-S Discrete Address). Set the Slave Test Set to generate an ATCRBS Mode-C interrogation having a signal level of ”MTL” + 3 dB.

Verify that the delay of the Slave Test Set signal from the Mode-S Sync Phase Reversal (SPR) required to produce 90% reply efficiency is less than or equal to 45 microseconds.

Decrease the delay of the Slave Test Set signal such that the start of the Slave Interrogation is coincident with the end of the Master Interrogation. Then increase the delay of the Slave Interrogation such that it approaches 45 microseconds.

Verify that the UUT starts to reply to the Slave Interrogations prior to reaching a delay of 45 microseconds. Verify that the UUT does not generate any undesired replies that can be detected by a properly operating Mode-S 1090 MHz. PAM receiver.

Set the Master Test Set to generate a standard (i.e., -60 dBm) UF4, UF5, Mode A and Mode C interrogations and verify that the ATCRBS Mode A code and Altitude/ Mode C information provided in the transponder replies is correct.

Repeat the procedure given in preceding paragraphs as needed to verify performance of the transponder on both top and bottom channels of diversity transponder.

STEP 7C: RECOVERY FROM A MODE-S INTERROGATION WHICH HAS NOT BEEN ACCEPTED (2.2.7.2.4.) FOLLOWED BY MODE S-ONLY ALL-CALL

Set the Master Test Set to generate a standard (i.e., -60 dBm) Mode-S Surveillance interrogation with an incorrect address (i.e., an address different from that of the UUT Mode-S Discrete Address). Set the Slave Test Set to generate a Mode S-Only All-Call interrogation having a signal level of ”MTL” + 3 dB.

Verify that the delay of the Slave Test Set signal from the Mode-S Sync Phase Reversal (SPR) required to produce 90% reply efficiency is less than or equal to 45 microseconds.

Decrease the delay of the Slave Test Set signal such that the start of the Slave Interrogation is coincident with the end of the Master Interrogation. Then increase the delay of the Slave Interrogation such that it approaches 45 microseconds.

Verify that the UUT starts to reply to the Slave Interrogations prior to reaching a delay of 45 microseconds. Verify that the UUT does not generate any undesired replies that can be detected by a properly operating Mode-S 1090 MHz. PAM receiver.

Set the Master Test Set to generate a standard (i.e., -60 dBm) UF4, UF5, Mode A and Mode C interrogations and verify that the ATCRBS Mode A code and Altitude/ Mode C information provided in the transponder replies is correct.

Repeat the procedure given in preceding paragraphs as needed to verify performance of the transponder on both top and bottom channels of diversity transponder.

STEP 7D: RECOVERY FROM A MODE-S INTERROGATION WHICH HAS NOT BEEN ACCEPTED (2.2.7.2.4.) FOLLOWED BY ATCRBS MODE A/MODE S ALL-CALL

Set the Master Test Set to generate a standard (i.e., -60 dBm) Mode-S Surveillance interrogation with an incorrect address (i.e., an address different from that of the UUT Mode-S Discrete Address). Set the Slave Test Set to generate an ATCRBS Mode A/Mode S All-Call interrogation having a signal level of ”MTL” + 3 dB.

Verify that the delay of the Slave Test Set signal from the Mode-S Sync Phase Reversal (SPR) required to produce 90% reply efficiency is less than or equal to 45 microseconds.

Decrease the delay of the Slave Test Set signal such that the start of the Slave Interrogation is coincident with the end of the Master Interrogation. Then increase the delay of the Slave Interrogation such that it approaches 45 microseconds.

Verify that the UUT starts to reply to the Slave Interrogations prior to reaching a delay of 45 microseconds. Verify that the UUT does not generate any undesired replies that can be detected by a properly operating Mode-S 1090 MHz. PAM receiver.

Set the Master Test Set to generate a standard (i.e., -60 dBm) UF4, UF5, Mode A and Mode C interrogations and verify that the ATCRBS Mode A code and Altitude/ Mode C information provided in the transponder replies is correct.

Repeat the procedure given in preceding paragraphs as needed to verify performance of the transponder on both top and bottom channels of diversity transponder.

STEP 7E: RECOVERY FROM A MODE-S INTERROGATION WHICH HAS NOT BEEN ACCEPTED (2.2.7.2.4.) FOLLOWED BY ATCRBS MODE C/MODE S ALL-CALL

Set the Master Test Set to generate a standard (i.e., -60 dBm) Mode-S Surveillance interrogation with an incorrect address (i.e., an address different from that of the UUT Mode-S Discrete Address). Set the Slave Test Set to generate an ATCRBS Mode C/Mode S All-Call interrogation having a signal level of ”MTL” + 3 dB.

Verify that the delay of the Slave Test Set signal from the Mode-S Sync Phase Reversal (SPR) required to produce 90% reply efficiency is less than or equal to 45 microseconds.

Decrease the delay of the Slave Test Set signal such that the start of the Slave Interrogation is coincident with the end of the Master Interrogation. Then increase the delay of the Slave Interrogation such that it approaches 45 microseconds.

Verify that the UUT starts to reply to the Slave Interrogations prior to reaching a delay of 45 microseconds. Verify that the UUT does not generate any undesired replies that can be detected by a properly operating Mode-S 1090 MHz. PAM receiver.

Set the Master Test Set to generate a standard (i.e., -60 dBm) UF4, UF5, Mode A and Mode C interrogations and verify that the ATCRBS Mode A code and Altitude/ Mode C information provided in the transponder replies is correct.

Repeat the procedure given in preceding paragraphs as needed to verify performance of the transponder on both top and bottom channels of diversity transponder.

STEP 7F: RECOVERY FROM A MODE-S INTERROGATION WHICH HAS NOT BEEN ACCEPTED (2.2.7.2.4.) FOLLOWED BY ATCRBS MODE A-ONLY ALL-CALL

Set the Master Test Set to generate a standard (i.e., -60 dBm) Mode-S Surveillance interrogation with an incorrect address (i.e., an address different from that of the UUT Mode-S Discrete Address). Set the Slave Test Set to generate an ATCRBS Mode A-Only All-Call interrogation having a signal level of ”MTL” + 3 dB.

Decrease the delay of the Slave Test Set signal such that the start of the Slave Interrogation is coincident with the end of the Master Interrogation. Then increase the delay of the Slave Interrogation such that it is greater than 45 microseconds.

Verify that the transponder does NOT reply to the Slave Interrogations.

Verify that the transponder does not generate any undesired replies that can be detected by a properly operating Mode-S 1090 MHz. PAM receiver.

Set the Master Test Set to generate a standard (i.e., -60 dBm) UF4, UF5, Mode A and Mode C interrogations and verify that the ATCRBS Mode A code and Altitude/ Mode C information provided in the transponder replies is correct.

Repeat the procedure given in preceding paragraphs as needed to verify performance of the transponder on both top and bottom channels of diversity transponder.

STEP 7G: RECOVERY FROM A MODE-S INTERROGATION WHICH HAS NOT BEEN ACCEPTED (2.2.7.2.4.) FOLLOWED BY ATCRBS MODE C-ONLY ALL-CALL

Set the Master Test Set to generate a standard (i.e., -60 dBm) Mode-S Surveillance interrogation with an incorrect address (i.e., an address different from that of the UUT Mode-S Discrete Address). Set the Slave Test Set to generate an ATCRBS Mode C-Only All-Call interrogation having a signal level of ”MTL” + 3 dB.

Decrease the delay of the Slave Test Set signal such that the start of the Slave Interrogation is coincident with the end of the Master Interrogation. Then increase the delay of the Slave Interrogation such that it is greater than 45 microseconds.

Verify that the transponder does NOT reply to the Slave Interrogations.

Verify that the transponder does not generate any undesired replies that can be detected by a properly operating Mode-S 1090 MHz. PAM receiver.

Set the Master Test Set to generate a standard (i.e., -60 dBm) UF4, UF5, Mode A and Mode C interrogations and verify that the ATCRBS Mode A code and Altitude/ Mode C information provided in the transponder replies is correct.

Repeat the procedure given in preceding paragraphs as needed to verify performance of the transponder on both top and bottom channels of diversity transponder.

STEP 7H: RECOVERY FROM A MODE-S INTERROGATION WHICH HAS NOT BEEN ACCEPTED (2.2.7.2.4.) FOLLOWED BY DIRECTED MODE-S

Set the Master Test Set to generate a standard (i.e., -60 dBm) Mode-S Surveillance interrogation with an incorrect address (i.e., an address different from that of the UUT Mode-S Discrete Address). Set the Slave Test Set to generate a Directed Mode S (i.e., an address equivalent to the UUT Mode-S Discrete Address) interrogation having a signal level of "MTL" + 3 dB.

Verify that the delay of the Slave Test Set signal from the Mode-S Sync Phase Reversal (SPR) required to produce 90% reply efficiency is less than or equal to 45 microseconds.

Decrease the delay of the Slave Test Set signal such that the start of the Slave Interrogation is coincident with the end of the Master Interrogation. Then increase the delay of the Slave Interrogation such that it approaches 45 microseconds.

Verify that the UUT starts to reply to the Slave Interrogations prior to reaching a delay of 45 microseconds. Verify that the UUT does not generate any undesired replies that can be detected by a properly operating Mode-S 1090 MHz. PAM receiver.

Set the Master Test Set to generate a standard (i.e., -60 dBm) UF4, UF5, Mode A and Mode C interrogations and verify that the ATCRBS Mode A code and Altitude/ Mode C information provided in the transponder replies is correct.

Repeat the procedure given in preceding paragraphs as needed to verify performance of the transponder on both top and bottom channels of diversity transponder.