RTCA Special Committee 186, Working Group 5

ADS-B UAT MOPS (DO-282), Revision A

Meeting #21

Consolidated Set of Comments to be considered for DO-282A

Maintained by Gary Furr

SUMMARY
This Working Paper contains a number of comments submitted as part of the FRAC process of consideration of changes to the proposed revision to the UAT MOPS, known as RTCA DO-282A. This set of changes, along with any others put before Working Group 5 will be considered and discussed with the objective of coming to a resolution of a final proposed change to be presented to the RTCA SC-186 Plenary on 8-9 April 2004, as the final set of changes required to produce RTCA DO-282A.

Comment #	Author	Section	Page	Comment	Suggested Resolution
	Keith Dutch #1	various		By consensus of representatives from MITRE, FAA en route and terminal automation, Capstone Program Office, Safe Flight 21 Program Office, FAA Flight Standards, and Air Traffic procedures at headquarters and Alaska, attending a meeting March 25, 2004 at FAA Headquarters, I request that RTCA SC-186 WG-5 Working Paper UAT-WP-14-02, "Capstone Specific Addition to the UAT MOPS Requirements; A Proposal to Support the Flight Plan ID" be inserted into the FRAC Draft of the proposed revision to the UAT MOPS, proposed as RTCA DO-282A.	Implement the suggested changes and additions identified in Working Paper UAT-WP-14-02.
	Tom Mosher #1	---	---	Minor: UAT-WP-14-02A was not distributed for comment with the FRAC draft. If UAT-WP-14-02A is to be included in DO-282A, a comment period should be provided.	- Publish UAT-WP-14-02A for formal comments. - WG-5 (telecon) to address any comments that are submitted. - Plenary to delegate to the WG-5 secretary the inclusion of UAT-WP-14-02A (plus any modifications due to comments received) into the body of DO-282A, prior to delivery to PMC.
	Tom Mosher #2	---	---	Editorial: Terms of importance are not defined: shall, should	Provide the following language (modified from DO-289, Sect 2.4) in the Glossary) that defines the terms: Shall: Indicates a minimum requirement. Should: Indicates a characteristic that is highly recommended, but is not required.
	Don Marsh #1	1.3	4	This document implies multiple uses of the uplink segment including FIS-B and TIS-B. How will capacity be allocated for those broadcast or other services anticipated in the uplink segment?	Provide description of apportionment or methodology for future apportionment of uplink capacity.

Comment #	Author	Section	Page	Comment	Suggested Resolution
	Don Marsh #3	1.3	4	Descriptions of FIS-B services lacks detail.	Suggest a section be added (perhaps immediately after sect. 1.3.4) to underscore and illuminate the application of FIS-B to the UAT link with wording such as: "Flight Information Services – Broadcast Broadcast data links are used extensively; the uses are primarily the transmission of information rich, time-dependent and low criticality data such as textual, graphic, and hybrid graphic weather; dynamic map overlays with airport data; TFRs; and NOTAMs. Future applications of UAT may incorporate a variety of broadcast data products."
	Don Marsh #2	1.3.2	5	This section implies a total of 704 MSOs in the ground uplink segment, but the next ADS-B section describes the downlink segment as starting at MSO 752. I presume the "missing" 48 MSOs correspond to the 12 ms gap appearing in Figure 1-1. Is the purpose of the gap addressed in the document?	Add description or background of ground uplink segment "missing" 48 MSOs and 12 ms gap between uplink segment and ADS-B segment in this section.
	Don Marsh #4	Sect 2	13	This section makes frequent reference to ADS-B. Since ADS-B is one service or function such as FIS-B or TIS-B that is supported by the equipment, should the reference be UAT instead of ADS-B?	Change references in this section from ADS-B to UAT as appropriate.
	Don Marsh #5	2.1.11 and Table 2-1	14	There is a market need for receive only airborne applications for broadcast uplink data.	Add a new class of receive-only airborne equipage. This may correspond to a "Class D" type of system in the DO-242A scheme with single antenna and low criticality.

Comment #	Comment Author	Section	Page	Comment	Suggested Resolution
	UAT SG #1	2.1.11 Table 2-1	15	During the review of Table 2-1 and during a discussion of Antenna Diversity by the ICAO ACP WG-C UAT Subgroup, it was agreed that Table 2-1 needed to be clarified with respect to the alternating of antennas.	Proposed Resolutions: (1) Change the heading of the two rightmost columns to: "Intended Antenna Diversity (when Airborne for Classes A & B0-B1) (2) In the column headed "Transmit," replace the word "Alternate" with the phrase "Alternating every 2 seconds." (3) In the column headed "Receive," replace the word "Alternate" with the phrase "Alternating every second."
	Tom Mosher #3	2.2.2.5 Figure 2-1	19 20	Minor: Refer to Fig 2-1. The "20 dB corner" in the upper curve during the ramp-up and ramp-down periods is needlessly restrictive. Background: The exact shape of the upper curve in Fig 2-1 was the committee's best guess at what amplitude envelope would be sufficient to minimize the spectral spreading effects, without having the benefit of a test article for bench measurements to validate the requirement. The spectral purity requirements are in the frequency domain (see 2.2.2.6 and 2.2.2.7). The shape of the upper bound on the power envelope in Fig 2-1 (in the time domain) is not necessarily consistent with the spectral purity requirement in the frequency domain.	Fig 2-1: Remove the 20 dB corner from both the ramp-up and ramp-down periods (between 8 and 4 bit periods). Replace it with a linear transition between the -20 dB and "maximum power" levels. Section 2.2.2.5 text: Replace subparagraphs b and e as follows: b. Between 8 and 4 bit periods prior to the reference time, the RF output power shall remain below a level that increases linearly between 20 dB below the minimum allowed power level at 8 bit times, and the maximum allowed power level at 4 bit times. e. Between 4 and 8 bit periods after the Active state, the RF output power shall remain below a level that decreases linearly between the maximum allowed power level at 4 bit times, and 20 dB below the minimum allowed power level at 8 bit times.

Comment #	Author	Section	Page	Comment	Suggested Resolution
	Don Marsh #6	2.2.3.2.2	24	There is conflict here with DO-267A, ISO 3309, and ISO 4335 in the use of the term "Info", "I"or "Information Frames". The ISO 4435 HDLC specification refers to "I" or "Info" frame definitions that are not consistent with UAT I-frame definitions.	Make consistent with DO-267A and ISO standards with a new term for "I-Frames" and "Information Frames" as appropriate. Perhaps since this section uses this term, "Application Data Frames" would be more appropriate.
	UAT SG #2	2.2.4.5.1.3.2	29	During a review of this section by the ICAO ACP WG-C UAT Subgroup, it was suggested that this requirement be clarified to indicate that the ADDRESS QUALIFIER can only be set to ONE (indicating the use of a self-assigned, temporary address) if the participant is NOT receiving ATC Services.	Proposed Resolution: Revise the entire requirement paragraph to read as follows: "An "ADDRESS QUALIFIER" value of ONE (binary 001) **shall** indicate that the message is an ADS-B Message from an aircraft that is not receiving ATC services, and that the "ADDRESS" field holds the transmitting aircraft's self-assigned ownship temporary address. An "ADDRESS QUALIFIER" value of ONE **shall not** be used when the "Receiving ATC Services Flag" (§2.2.4.5.4.13.3) is set to ONE, indicating that the Participant is receiving ATC services."
	Don Marsh #8	Table 2-40	53	What is meant by "surface vehicle – surface vehicle"? (the table row associated with decimal 38)	Clarify or correct error if one exists. **WG-5 Response:** Table 2-40 is a 'double column' table, which could have caused some confusion. Decimal code 18 references the "Surface Vehicle – service vehicle" Emitter Category, and decimal code 38 is a "reserved" value. The term "Surface Vehicle – service vehicle" is used in all ADS-B documents.

Comment #	Comment Author	Section	Page	Comment	Suggested Resolution
	Tom Mosher #4	2.2.4.5.4	54	Minor: Use of "must" in reference to the Call Sign characters is confusing, since it implies that the UAT equipment performs some action. UAT equipment does not validate the data it is provided, and the Call Sign that is provided to the UAT is only re-formatted into Radix-40 format. Also, "left-most" is non-descriptive without specifying the context.	Re-write the 1st paragraph as follows: The Call Sign field consists of eight characters. Each character shall be represented as Base-40 code values as shown in Table 2-41. The left-most character (as depicted on a cockpit display unit) corresponds to Character #1. Add the following Note: *<u>Note</u>: The formatting of the Call Sign field is outside the scope of this document. It is expected that the 'space' character will only be used as trailing pad characters. Any characters that are not provided to the UAT equipment may be encoded as either the "not available" code, or the "space" character.* Delete the note at the bottom of Page 54, since the information found there would be redundant. The 2nd paragraph remains as-is.
	Tom Mosher #5	2.2.4.5.2	54	Major: The requirement in the 3rd paragraph is out of scope. The UAT equipment transmits the Call Sign it is provided, and cannot guarantee that the call sign is "encoded with an identifier appropriate for the Emitter Category, operating rules, and procedures under which the A/V is operating".	Option 1: Delete this paragraph, and move this requirement to Section 3 or Section 4. Option 2: Change "shall" to "are".

Comment #	Comment Author	Section	Page	Comment	Suggested Resolution
	UAT SG #3	2.2.7.2.3	71	During SC-186 WG-5 Meeting #20, it was agreed by the Working Group that the original text of this section would be modified by deleting subparagraph "b" and the first sentence of the Note following the requirement. During a review of this action by the ICAO ACP WG-C UAT Subgroup, it was agreed that first sentence of the Note should not be deleted, but rather should be changed to be clarified.	Proposed Resolution: Modify the first sentence of the Note to read: "A UAT Transmitting Subsystem that is capable of meeting the timing requirements of §2.2.7.2.2 makes no adjustment to the NIC or NAC that it receives as inputs."
	Don Marsh #7	2.2.7.2.1	78	Are there any requirements for the Non-Precision Condition specified for the ground uplink segment, or does this condition only apply to airborne classes?	Provide requirements if needed.
	Ed Valovage #1	2.2.10.2	90	The receiver throughput is quantified by a message rate in 1 second and a message rate in 10 msec. This was deemed sufficient for random message arrivals, as would be experienced in an ADS-B environment. The FAA is currently developing media access schemes for TIS-B uplinks from ground stations. The current scheme involves 19 msec bursts of 38 messages. Avionics built to the proposed MOPS is not guaranteed to process this burst load.	The current FAA TIS-B scheme is not fully developed but presumably represents the best shot at a workable scheme. The MOPS committee should decide at this time to either: a) Keep the current burst requirement of 20 messages in 10 msec and let this be a limit on TIS-B media access choices, or b) Change the burst rate to 38 messages in 19 msec, to accommodate what the FAA feels is the best TIS-B media access approach.

Comment #	Comment Author	Section	Page	Comment	Suggested Resolution
	Tom Mosher #6	2.2.12	92	Minor: Optimization of the suppression output timing requirements is suggested, per discussion with Tom Pagano and Gary Furr on 31 March 2004.	Replace the entire text of section 2.2.12 as follows: "UAT equipment shall provide an output signal suitable for sending suppression signals. The UAT equipment shall provide a mutual suppression signal whenever the transmitter output power exceeds -20 dBm. In addition, the suppression signal shall not become active prior to 5 microseconds before the start of the ADS-B Message Transmission Interval defined in §2.2.2.5, and the suppression signal shall not remain active later than 5 microseconds after the end of the ADS-B Message Transmission Interval defined in §2.2.2.5. *<u>Note</u>: The tolerance at the beginning and end of the mutual suppression interval insures that the suppression interval is minimized to prevent excessive receiver blanking of onboard L band equipment sharing the mutual suppression bus, but adequately protects the SSR transponder from triggering on UAT transmissions. The UAT equipment must adhere to the electrical characteristics of the on-board mutual suppression bus and is recommended to provide protection circuitry to prevent against UAT equipment failure disabling the mutual suppression.* UAT equipment shall not respond to suppression signals. *<u>Note</u>: UAT equipment is not to inhibit or delay its transmissions based on suppression signals. There is no need to desensitize the UAT Receiver based on suppression signals.*"

Comment #	Comment Author	Section	Page	Comment	Suggested Resolution
	Tom Mosher #7	2.2.13.4 2.2.13.5.2	93	Editorial: *I do not propose that the following comments actually be implemented, unless the committee secretary finds himself with lots of time on his hands. This item is a make-good on a pledge to certain software engineers, who burned many hours in sorting-out the many differing UAT failure annunciation requirements.* Section 2.2.13.4 defines the requirements for Receiver Self-Test Capability. It also defines requirements for failure annunciation, which is out of scope. Section 2.2.13.5.2 (Rx Failure Annunciation) defines a redundant set of receiver self-test requirements to those which appear in 2.2.13.4, along with some additional annunciation requirements. However, the test procedure for 2.2.13.5.2 points directly to 2.2.13.4. Note that in the final analysis, it all makes sense once all of the duplicated requirements are accounted for.	At the committee's discretion, do any (or none) of the following modifications: - Remove the failure annunciation requirements from 2.2.13.4. - Remove the self-test capability requirements from 2.2.13.5.2 - Move the test procedure (which uses failure annunciations to show that the self-test capability is working) from 2.4.13.4 to 2.4.13.5.2.

Comment #	Author	Section	Page	Comment	Suggested Resolution
	Tom Mosher #8	2.2.13.4	93	Minor: Self-test: Any lack of ability for the UAT receiving subsystem to "structure appropriate ADS-B reports, and make such reports available to the intended user interface" is inherently undetectable from within the UAT equipment. This would be more appropriate as an installed equipment requirement, rather than as a Self-Test requirement.	Move this requirement to Section 3 or 4.
	Tom Mosher #9	2.2.13.5	93	Minor: There are failure annunciation requirements found throughout the MOPS document. Examples: 2.2.4.5.1.3.1 : ICAO Address 2.2.13.2 Broadcast Monitor 2.2.13.3: Address Verification (again) 2.2.13.4: Self-Test (see above) 4.1.7: Broadcast Monitor (again) 4.1.8: Address Monitor (again) 4.1.9: Failure Annunciation (again) A table someplace (perhaps here?) would be useful to cross-link to all of them.	Provide a single reference point for required failure annunciations.

Comment #	Author	Section	Page	Comment	Suggested Resolution
	UAT SG #4	2.4.4.5.1.3.2	118	Need to conform the test procedure to be consistent with the proposed revision to the original requirement, and to add a step in the test procedure to test that the ADDRESS QUALIFIER can only be set to ONE (indicating the use of a self-assigned, temporary address) if the participant is NOT receiving ATC services.	Proposed Resolutions: (1) Replace the first paragraph of the "Purpose/Introduction with the following: "An "ADDRESS QUALIFIER" value of ONE (binary 001) **shall** indicate that the message is an ADS-B Message from an aircraft that is not receiving ATC services, and that the "ADDRESS" field holds the transmitting aircraft's self-assigned ownship temporary address. An "ADDRESS QUALIFIER" value of ONE **shall not** be used when the "Receiving ATC Services Flag" (§2.2.4.5.4.13.3) is set to ONE, indicating that the Participant is receiving ATC services." (2) Add a new "Step 4" to the test procedure as follows: "Via the appropriate interface, set the "Receiving ATC Services Flag (§2.2.4.5.4.13.3) to ONE (1) and set the Address Selection to Temporary. Verify that the resultant ADDRESS QUALIFIER value is still set to ZERO (binary 000).
	Tom Pagano #1	2.4.4.5.2.4	143	A revision to the test procedure is required because of the addition of text to the requirements statement agreed to by WG-5 during Meeting #20.	Proposed Resolution: Add the following text on to the end of Step 2 in this test procedure: If the ADS-B equipment does not support the timing requirements for the precision condition (§2.2.7.2.2), then verify that the NIC subfield in the transmitted UAT Messages is equal to "8," when the test cases are being run with R_C and VPL data that is provided to the ADS-B Transmitting Subsystem that is consistent with NIC values of "9," "10" or "11."

Comment #	Author	Section	Page	Comment	Suggested Resolution
	Tom Pagano #2	2.4.4.5.4.9	184	A revision to the test procedure is required because of the addition of text to the requirements statement agreed to by WG-5 during Meeting #20.	Proposed Resolution: Add the following text on to the end of Step 2 in this test procedure: If the ADS-B equipment does not support the timing requirements for the precision condition (§2.2.7.2.2), then verify that the NAC_P subfield in the transmitted UAT Messages is equal to "9," when the test cases are being run with NAC_P input data that is provided to the ADS-B Transmitting Subsystem that is consistent with the values of "10" or "11."
	UAT SG #5	2.4.7.2.3	210 211	Need to conform the test procedure to be consistent with the proposed revision to the original requirement, which included deleting subparagraph "b," requiring no extrapolation of position, and modifying the first sentence of the Note following the requirement.	Proposed Resolutions: (1) Modify the first sentence of the Note in the "Purpose/Introduction" to read: "A UAT Transmitting Subsystem that is capable of meeting the timing requirements of §2.2.7.2.2 makes no adjustment to the NIC or NAC that it receives as inputs." (2) Delete Step #2 of the test procedure and renumber Step #3.

Comment #	Author	Section	Page	Comment	Suggested Resolution
	Tom Mosher #10	2.4.12	285	Minor: Update the test procedure per the suggested resolution to 2.2.12.	Equipment: - Oscilloscope - An RF detector that provides a trigger output when the input level exceeds -20 dBm - A load for the suppression output signal that is characteristic of the intended application. Measurement Procedure: Step 1: Configure the UAT equipment to transmit Basic ADS-B messages. Connect the suppression output signal to the load. Connect the oscilloscope to the RF detector (trigger input) and the suppression signal (scope channel A) Step 2: Verify that the rising and falling edges of the suppression output signal occur within 5 microseconds of the RF detector trigger points. Step 3: Configure the UAT equipment to transmit Long ADS-B messages. Step 4: Verify that the rising and falling edges of the suppression output signal occur within 5 microseconds of the RF detector trigger points.

Comment #	Author	Section	Page	Comment	Suggested Resolution
	Stuart Searight #1	Appendix B		The ADS-B MASPS compliance matrix in Appendix B does not appear to have been updated with respect to those requirements that have been changed in direct response to the ASA MASPS. (e.g. L&W codes, air/ground determination, etc..) Rationale: These requirements were changed in ASA from those specified in the ADS-B MASPS largely in part to the careful work done during development of the UAT SARPS. So, while some updated DO-282A requirements might no longer comply with the ADS-B MASPS (DO-242A), it is because they now comply to the DO-289 (ASA).	For each new or updated requirement in DO-282A, examine the compliance matrix in Appendix B and note any changes with respect to DO-242A compliance and if non-compliance is because of compliance to the newer, and overriding ASA requirement specified in DO-289.
	Don Marsh #9	Appendix D.2.2	D-8	Shifting of ground uplink slot timing may not be necessary in all broadcast infrastructure cases.	Clarify that shifting of uplink resource slot assignment may be optional, dependent upon required co-ordination with neighboring systems.

Comment #	Comment Author	Section	Page	Comment	Suggested Resolution
	Tom Pagano #3	E.3.1.1	E-9	Since the passive Diplexer integrates UAT equipment with the SSR transponder of the aircraft, it was necessary to coordinate the use of a Diplexer with the Surveillance and Collision Resolution Systems Panel (SCRSP) of the International Civil Aviation Organization (ICAO). SCRSP produces and maintains international standards for the Mode S and SSR systems. The results of the extensive tests that were conducted to verify proper operation of the SSR transponder with a passive Diplexer were made available to SCRSP to evaluate the performance of the SSR transponder through the Diplexer. An additional set of tests were recommended by SCRSP to investigate the performance of a Mode S transponder with the use of a Diplexer and its ability to properly decode Mode S interrogations with numerous Differential Phase Shift Keying (DPSK) phase shifts.	The results of the DPSK tests at the FAA WJH Technical Center should be added into the overall Diplexer test results that are being presented in the revised Appendix E of RTCA DO-282A. We propose adding the text and Figure that is attached to this comment form onto the end of the revised FRAC Draft of section E.3.1.1.

Attachment to Comment "Tom Pagano #3" – Proposed addition to the end of the FRAC Draft of Section E.3.1.1

Since the passive Diplexer integrates UAT equipment with the SSR transponder of the aircraft, it was necessary to coordinate the use of a Diplexer with the Surveillance and Collision Resolution Systems Panel (SCRSP) of the International Civil Aviation Organization (ICAO). SCRSP produces and maintains international standards for the Mode S and SSR systems. The results of the extensive tests that were conducted to verify proper operation of the SSR transponder with a passive Diplexer were made available to SCRSP to evaluate the performance of the SSR transponder through the Diplexer. An additional set of tests were recommended by SCRSP to investigate the performance of a Mode S transponder with the use of a Diplexer and its ability to properly decode Mode S interrogations with numerous Differential Phase Shift Keying (DPSK) phase shifts. These tests would verify that the bandwidth of the Diplexer does not cause distortion of the interrogation signal that would degrade the ability of the Mode S transponder receiver to properly decode these interrogations. In order to evaluate the Diplexer impact on DPSK, the transponder receiver sensitivity was tested as interrogation frequency was varied. Three Mode S type transponders were tested both with and without the Diplexer installed in order to make a direct comparison of the Diplexers effect. The transponders tested were from three different manufacturers. The installation of the Diplexer affects the Voltage Standing Wave Ratio (VSWR) of the antenna ports so a slotted line and stub tuner were used to monitor and control VSWR. The stub tuner was used to set the VSWR to the same minimum value obtainable with and without the Diplexer. This was done to minimize the VSWR influence on the sensitivity measurements.

Figure 1 shows a plot of the Sensitivity Variation with Frequency measurements for one of the transponders tested. The interrogation consisted of a legal uplink format defined by the first five bits of the interrogation. All other data bits equal to binary '1' except the Address Parity (AP) field, which was properly coded to elicit a response from the transponder. The all binary 1's format was used to maximize the number of phase shifts in the uplink interrogation. This was the primary interrogation format used to test all three transponders. The data shows a consistent average reduction in sensitivity of about 0.2 dBm, the loss through the Diplexer, which does not vary significantly with frequency. Additional tests were conducted with all variable data bits equal to binary '0' to minimize the number of phase shifts with nearly identical results.

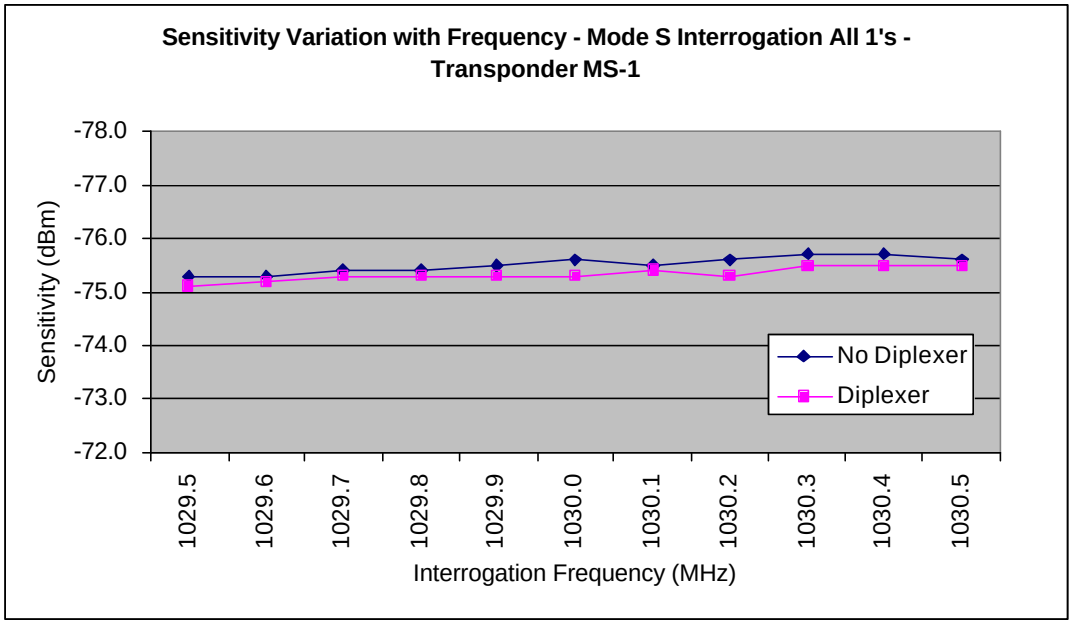

Figure 1 – Sensitivity Variation with Frequency, All 1's Interrogation, Transponder MS-1

All three tested Mode S transponders yielded similar results. The conclusion from running these tests is that other than the expected reduction in the transponder receiver sensitivity from the loss across the Diplexer, the Mode S sensitivity is not affected as a function of frequency within the operating bandwidth of the transponders. The Diplexer bandwidth characteristics for the SSR transponder channel adequately handles 1030 MHz Mode S interrogation signals with excessive DPSK phase variations.