

ETSI TS 102 916-2 V1.2.1 (2023-05)



**Intelligent Transport Systems (ITS);
Test specifications for the mitigation techniques to avoid
interference between Cooperative ITS-G5 and TTT DSRC;
Part 2: Test Suite Structure and Test Purposes (TSS & TP)**

[ETSI TS 102 916-2 V1.2.1 \(2023-05\)](https://standards.iteh.ai/catalog/standards/sist/a81ba09b-44fb-4822-8489-02e7ee6a1301/etsi-ts-102-916-2-v1-2-1-2023-05)

<https://standards.iteh.ai/catalog/standards/sist/a81ba09b-44fb-4822-8489-02e7ee6a1301/etsi-ts-102-916-2-v1-2-1-2023-05>

ReferenceRTS/ITS-00439

KeywordsDSRC, ITS, radio, RTTT, TSS&TP

ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - APE 7112B
Association à but non lucratif enregistrée à la
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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Intelligent Transport Systems (ITS).

The present document is part 2 of a multi-part deliverable covering the test specifications for the mitigation techniques to avoid interference between Cooperative ITS-G5 and TTT DSRC, as identified below:

Part 1: "Protocol Implementation Conformance Statement (PICS)";

Part 2: "Test Suite Structure and Test Purposes (TSS & TP)";

Modal verbs terminology

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1 Scope

The present document provides the Test Suite Structure and Test Purposes (TSS&TP) for the test specifications for the methods to ensure coexistence of cooperative ITS-G5 with TTT DSRC as specified in ETSI TS 102 792 [4] and ETSI EN 302 663 [1] in compliance with the relevant requirements and in accordance with the relevant guidance given in ISO/IEC 9646-7 [i.4] and ETSI ETS 300 406 [i.2].

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

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The following referenced documents are necessary for the application of the present document.

- [1] [ETSI EN 302 663](#): "Intelligent Transport Systems (ITS); ITS-G5 Access layer specification for Intelligent Transport Systems operating in the 5 GHz frequency band".
- [2] [ETSI TS 102 916-1](#): "Intelligent Transport Systems (ITS); Test specifications for the methods to ensure coexistence of Cooperative ITS G5 with RTTT DSRC; Part 1: Protocol Implementation Conformance Statement (PICS)".
- [3] [ETSI EN 302 571 \(V2.1.1\)](#): "Intelligent Transport Systems (ITS); Radiocommunications equipment operating in the 5 855 MHz to 5 925 MHz frequency band; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU".
- [4] [ETSI TS 102 792 \(V1.2.1\)](#): "Intelligent Transport Systems (ITS); Mitigation techniques to avoid interference between European CEN Dedicated Short Range Communication (CEN DSRC) equipment and Intelligent Transport Systems (ITS) operating in the 5 GHz frequency range".
- [5] [ETSI EN 302 637-2 \(V1.3.2\)](#): "Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Applications; Part 2: Specification of Cooperative Awareness Basic Service".
- [6] [ETSI TS 102 894-2 \(V1.2.1\)](#): "Intelligent Transport Systems (ITS); Users and applications requirements; Part 2: Applications and facilities layer common data dictionary".

2.2 Informative references

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The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

- [i.1] Void.
- [i.2] ETSI ETS 300 406: "Methods for testing and Specification (MTS); Protocol and profile conformance testing specifications; Standardization methodology".

- [i.3] ISO/IEC 9646-1: "Information technology -- Open Systems Interconnection -- Conformance testing methodology and framework -- Part 1: General concepts".
- [i.4] ISO/IEC 9646-7: "Information technology -- Open Systems Interconnection -- Conformance testing methodology and framework -- Part 7: Implementation Conformance Statements".

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the terms given in ETSI TS 102 792 [4], ETSI EN 302 663 [1] and the following apply:

Abstract Test Method (ATM): Refer to ISO/IEC 9646-1 [i.3].

Abstract Test Suite (ATS): Refer to ISO/IEC 9646-1 [i.3].

Implementation Under Test (IUT): Refer to ISO/IEC 9646-1 [i.3].

Test Purpose (TP): Refer to ISO/IEC 9646-1 [i.3].

3.2 Symbols

For the purposes of the present document, the following symbols apply:

<i>CenDsrcTollingZone</i>	data field of vehicle CAM containing protected zone information
<i>ProtectedCommunicationZone</i>	data field of roadside unit CAM containing protected zone information
<i>protectedZoneType</i>	distinguishes between temporary and non-temporary protected zone information
T_{off}	time in between two transmissions
T_{on}	duration of a transmitted data packet

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in ETSI TS 102 792 [4], ETSI EN 302 663 [1] and the following apply:

ATS	Abstract Test Suit
CAM	Cooperative Awareness Message
CEN	Comité Européen de Normalisation
DSRC	Dedicated Short Range Communication
GPS	Global Positioning System
ICS	Implementation Conformance Statement
ITS	Intelligent Transport System
ITS-G5	Acronym for the 5,9 GHz vehicular ad-hoc network
ITS-S	ITS Station
IUT	Implementation Under Test
OBU	On Board Unit
PICS	Protocol Implementation Conformance Statement
RF	Radio Frequency
SUT	System under Test
TP	Test Purpose
TSS	Test Suite Structure
TTT	Transport and Traffic Telematics
TX	Transmit

4 Test configurations

4.1 Overview

Test purposes of the present document address the mitigation techniques to avoid interference between European CEN Dedicated Short Range Communication (TTT DSRC) equipment and Intelligent Transport Systems (ITS) operating in the 5 GHz frequency range.

The mitigation techniques are specified in ETSI TS 102 792 [4]. Mobile ITS-S can either trigger the mitigation method when close to a TTT DSRC toll station, or operate always in coexistence mode. Depending on the distance to the next TTT DSRC toll station, fixed ITS-S can either operate always in normal mode, or they shall always operate in coexistence mode.

When operating in coexistence mode, the TX power level and/or the TX timing (duty cycle) of the ITS-S are restricted. The TX power level restriction depends on the distance to the tolling station, and the duty cycle restriction depends on the number ITS-S surrounding the toll station. Both methods can be combined. Four coexistence modes (A, B, C, and D) are specified in ETSI TS 102 792 [4] to simplify the choice of appropriate implementation criteria in terms of complexity and performance. For fixed ITS-S an additional mitigation method is specified in ETSI TS 102 792 [4] that is based on time synchronization with the tolling station nearby.

From this, the following test purposes can be derived:

- Triggering by detection of a TTT DSRC RF signal
- Triggering by a geolocation database
- Triggering by reception of a geolocation
- Mitigation by TX power reduction
- Mitigation by duty cycle restriction
- Mitigation by time synchronization with the tolling station

The following clauses specify the test configurations necessary to assess the abovementioned test purposes.

4.2 TTT DSRC RF detector test configuration

The test configuration and test description for the TTT DSRC RF detector test is specified in clause 5.3.10.3.3 of ETSI EN 302 571 V2.1.1 [3].

4.3 Geolocation simulator test configuration

For the test purposes that assess the correct detection of a tolling station by its geolocation, a GPS simulator is necessary. The GPS simulator is connected to the GPS antenna connector of the SUT and simulates the signals of GPS satellites characteristic for a certain geolocation. Alternatively the geolocation can be transferred to the SUT via a test interface.

4.4 CAM coexistence message test configuration

ETSI EN 302 637-2 [5] and ETSI TS 102 894-2 [6] specify the CAM data fields *CenDsrtcTollingZone* for vehicle ITS-S (ICS 17) and *ProtectedCommunicationZone* for ITS-S of type road side unit (ICS 16), to disseminate the protected zone information. For a roadside unit the data element *protectedZoneType* is used to distinguish between a temporary protected zone position (*protectedZoneType* 1) and a protected zone centre position list (*protectedZoneType* 0).

For the test purposes that assess the correct handling of the CAM data fields *CenDsrtcTollingZone* and *ProtectedCommunicationZone*, a test system that can transmit a CAM containing one of these data fields shall be connected to the ITS-G5 antenna connector of the SUT.

4.5 TX power level test configuration

The test configuration and test description for the RF output power measurement is specified in clause 5.3.3 of ETSI EN 302 571 V2.1.1 [3].

4.6 Unwanted emission test configuration

The test configuration and test description for the RF unwanted emissions measurement is specified in clause 5.3.4 of ETSI EN 302 571 V2.1.1 [3].

4.7 Duty cycle test configuration

The time T_{on} is defined as the duration of a transmitted data packet. The time T_{off} is the time in between two transmissions. T_{on} can be determined by measuring the time while the transmit power level is above an appropriate threshold, while T_{off} is the time during which the transmit power level is below this threshold.

The maximum time measurement deviation of the test system shall be better than $\pm 100 \mu s$.

4.8 Time synchronization test configuration

The test configuration for the time synchronization test consists of a tolling station that is synchronized with the SUT, so that the SUT is never transmitting when the toll system is transmitting or receiving. The transmission timing of the SUT can be assessed similar to the duty cycle test configuration specified in clause 4.7. The transmission timing of the tolling station can be either assessed by monitoring of the TX power level or by a test interface, since for the reception timing assessment anyhow a test interface is necessary.

5 Test Suite Structure (TSS)

5.1 General

5.1.1 Introduction

Test Purposes have been written for mitigation techniques to avoid interference between European Transport and Traffic Telematics Dedicated Short Range Communication (TTT DSRC) equipment and Intelligent Transport Systems (ITS) operating in the 5 GHz frequency range as defined in ETSI TS 102 792 [4] and ETSI EN 302 663 [1]. All test purposes in the present document assess mandatory functionality unless they have been marked with the keyword "OPTIONAL" at the beginning of the TP summary. The test purposes can only be performed when certain preconditions are met. These preconditions are listed in the TP summary tables.

The test purposes have been divided according to the functionalities into two groups:

- TP_MIT Mitigation methods
- TP_TRIG Trigger methods

5.1.2 TP naming convention

Tps are numbered, starting at 001, within each group. Groups are organized according to the TSS.

Table 1: TP identifier naming convention scheme

Identifier: <TP>_<scope>_<iut>_<nnn>				
<tp>	=	Test Purpose:	fixed to "TP"	
<scop>	=	group	MIT	Test of mitigation method
			TRIG	Test of coexistence mode triggering
<iut>	=	type of IUT:	VEHICLE	ITS-G5 vehicle station
			PERSON	Personal ITS-G5 device
			FIX	ITS-G5 roadside station
			MOBILE	ITS-G5 personal devices and ITS-G5 vehicle stations
			ALL	Any ITS-G5 station
<nn>	=	sequential number	(01 to 99)	

5.1.3 Test strategy

As the base standards ETSI TS 102 792 [4] and ETSI EN 302 663 [1] contain no explicit requirements for testing, the TPs were generated as a result of an analysis of the base standard and the PICS specification ETSI TS 102 916-1 [2].

Radio conformance tests specified in ETSI EN 302 571 [3] are included in the present document by reference.

The test descriptions are split into the assessment of mitigation methods (clause 5.2.1) and the assessment of the correct triggering of the mitigation methods for mobile ITS-S (clause 5.2.2). The triggering tests include the assessment of the detection and determination of the size of a protected zone. The mitigation methods are assessed by characterizing the transmit timing (e.g. duty cycle) and the spectral power density of the transmitted signal.

For mobile ITS-S the mitigation test method is an integral part of the triggering test. Only for fixed ITS-S and mobile ITS-S operating always in coexistence mode the mitigation test method shall be tested separately.

Clause 5.2.1.8 is only applicable to fixed ITS-S and deals with the special case of synchronizing it with a tolling station.

5.2 Test Purposes

5.2.0 Introduction

All PICS items referred to by their Implementation Conformance Statement (ICS) item number in this clause are as specified in ETSI TS 102 916-1 [2] unless indicated otherwise by another numbered reference.

5.2.1 Mitigation methods

5.2.1.1 Mitigation method overview

ETSI TS 102 792 [4] specifies four mitigation methods for mobile ITS-S denominated as coexistence mode A, B, C, and D. The equipment manufacturer shall declare in ETSI TS 102 916-1 [2] the supported coexistence mode(s). Depending on the declared coexistence mode, the following clauses outline different test setups and test sequences that are used by the mitigation triggering tests.

When the SUT is always operating in coexistence mode or for fixed ITS-S these test purposes shall be performed when applicable. Otherwise the applicable triggering test cases specified in clause 5.2.2 shall be performed.

5.2.1.2 Mitigation method prerequisites

For the mitigation method test purposes the SUT is assumed to be in a protected zone (see clause 5.1 and clause 5.2 in ETSI TS 102 792 V1.2.1 [4]).

When the SUT is always operating in coexistence mode (ICS 3) the SUT is assumed to be always in the centre of the protected zone.

When the SUT does use the default ITS radio parameters (ICS 13), the protected zone radius is 55 m, or when available the value from a related CAM or a data base entry. Otherwise the protected zone radius shall be determined as specified in clause 5.2.3 of ETSI TS 102 792 V1.2.1 [4].

5.2.1.3 Coexistence mode A

If the equipment manufacturer declared in ETSI TS 102 916-1 [2] the support of coexistence mode A (ICS 8), then the test specification in this clause shall be applied when the preconditions are met.

Coexistence mode A is only applicable when the antenna mounting distance is at least 1,5 m away from the intended TTT DSRC OBU mounting position, or the field strength at this position does not exceed the threshold specified in clause 4.2 of ETSI TS 102 792 V1.2.1 [4] when the ITS station is transmitting with 10 dBm (ICS 20).

Identifier:	TP_MIT_ALL_01		
Summary:	Coexistence mode A		
Configuration:	Specified in clause 5.3.3 and clause 5.3.4 of ETSI EN 302 571 V2.1.1 [3]. Depending on the coexistence mode trigger event, a GPS simulator might be necessary (see clause 4.3).		
SUT	ITS-G5 station		
Specification Reference:	ETSI TS 102 792 V1.2.1 [4] ETSI EN 302 571 V2.1.1 [3]		
Pre-test conditions:	Mandatory when ... <ul style="list-style-type: none"> ... SUT supports coexistence mode A (ICS 8) and ... at least one of the following conditions applies: <ul style="list-style-type: none"> A coexistence mode trigger event as specified in clause 5.2.2 was raised The SUT is a fixed ITS-S (ICS 16) The SUT is always operating in coexistence mode (ICS 3) 		
Test Sequence:	Step	Type	Description
	1	setup	For this test purpose the SUT is assumed to be in a protected zone (see clause 5.2.1.2).
	2	action	Measure the RF output power according to clause 5.3.3 of ETSI EN 302 571 V2.1.1 [3].
	3	action	Measure the unwanted emissions according to clause 5.3.4 of ETSI EN 302 571 V2.1.1 [3].
	4	verify	The measured RF output power level and unwanted emissions shall meet the limits specified for coexistence mode A in table 3.5 of ETSI TS 102 792 V1.2.1 [4].

5.2.1.4 Coexistence mode B

If the equipment manufacturer declared in ETSI TS 102 916-1 [2] the support of coexistence mode B (ICS 9), then the test specification in this clause shall be applied when the preconditions are met.

Identifier:	TP_MIT_ALL_02		
Summary:	Coexistence mode B		
Configuration:	Specified in clause 5.3.3 and clause 5.3.4 of ETSI EN 302 571 V2.1.1 [3] and for the duty cycle test in clause 4.7 of the present document. Depending on the coexistence mode trigger event, a GPS simulator might be necessary (see clause 4.3).		
SUT	ITS-G5 station		
Specification Reference:	ETSI TS 102 792 V1.2.1 [4] ETSI EN 302 571 V2.1.1 [3]		
Pre-test conditions:	Mandatory when ... <ul style="list-style-type: none"> ... SUT supports coexistence mode B (ICS 9) and ... at least one of the following conditions applies: <ul style="list-style-type: none"> A coexistence mode trigger event as specified in clause 5.2.2 was raised The SUT is a fixed ITS-S (ICS 16) The SUT is always operating in coexistence mode (ICS 3) 		