For Application
Service Providers

On-Board Mass System

Functional and Technical Specification

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Transport Certification Australia Ltd
T: +61 3 8601 4600
E: tca@tca.gov.au
W: www.tca.gov.au
ABN 83 113 379 936

About Us

Transport Certification Australia (TCA) is the Australian entity responsible for providing assurance in the use of telematics and related intelligent technologies.

We manage the National Telematics Framework, which brings producers, providers and consumers together on a common digital business platform.

The National Telematics Framework:

- Provides a national platform for the use of telematics and related intelligent technologies
- Supports different applications across regulatory, contractual and commercial needs
- Supports different levels of assurance
- Is outcome-focussed and encourages innovation.

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1 Introduction

1.1 Purpose of this Specification

1.1.1 This specification serves to describe the functional and technical requirements of an OBM system.

1.1.2 An OBM system is used to determine the mass of axle groups on a vehicle. The determination of axle group mass, and the subsequent gross vehicle mass of a vehicle, addresses numerous public and private policy and operational needs.

1.1.3 An OBM system installed on a vehicle comprises:

- an electronic control unit (ECU) in the cabin; and
- mass sensor units (MSUs) on each axle group.

1.1.4 The ECU and MSU are such that, when type-approved by TCA and connected to each other, they function in accordance with this specification and comprise a single type-approved OBM system.

1.1.5 This specification describes the requirements for OBM system type-approval. These are the requirements that shall be met by an applicant intending to provide an OBM system to TCA for the purposes of obtaining type-approval. TCA is the organisation that grants OBM system type-approval, when appropriate.

1.1.6 This specification has been informed through engagement with stakeholders, including OBM system developers, potential end-users, suppliers and those engaged in the administration and delivery of regulatory and commercial telematics services.

1.1.7 For purposes of clarity, in this specification the term ‘type-approved OBM system’ refers to an OBM system that has been determined by TCA to meet all of the requirements of this specification for its type-approval. An OBM system that has not been type-approved by TCA, whether it has been submitted to TCA for type-approval or not, is referred to as an ‘NTA’ (not type-approved).

1.2 Specification Overview

1.2.1 The philosophy guiding the creation of this specification has been to focus on required outcomes; that is, it is performance-based without being overly prescriptive as to solution. The OBM system operates as part of the National Telematics Framework.

1.2.2 Applicants are encouraged to consider innovative ways of meeting the various requirements of this specification. For example, an applicant may submit for type-approval two versions of its MSU, one version being intended to accommodate a lift axle fitted to the vehicle and, if so, capable of determining whether it is raised or lowered; the other, not catering for a lift axle. This solution might result in each version being separately type-approved in conjunction with the ECU (with one version type-approved for use with a lift axle; the other, not). Alternatively, the applicant may submit for type-approval different types of ECU accommodating different categories of functionality.

1.2.3 This specification commences with this Introduction (Section 1), followed by:

- Background (Section 2); and
- Use of this specification (Section 3).
- Nomenclature (Section 4); and
- References applicable to this specification (Section 5).

1.2.4 Section 6 then sets out the requirements for type-approval of an OBM system. Section 6 includes both:

- the functional and technical requirements for type-approval by TCA of an OBM system; and
- the requirements for a data communications interface between an OBM system and a telematics device.

1.2.5 Acronyms and terms used in this specification are defined in Appendix A.

1.2.6 Requirements for data record exchange between the OBM system and telematics device are presented in Appendix B.

1.2.7 OBM system requirements per category are presented in Appendix C.

1.3 Other Telematics Services

1.3.1 There are various regulatory and commercial telematics services that may utilise a type-approved OBM system in isolation from other telematics functionality.

1.3.2 This specification sets out the requirements for the type-approval of an NTA by TCA in order for it to become a type-approved OBM system. It does not extend to the separate or additional requirements applicable to the use of a type-approved OBM system in conjunction with other telematics services for which certification or type-approval may be provided by TCA – such potential conjunctional use(s) may be the subject of supplementary specifications released by TCA at a future date.

1.4 Document History

Version	Date	Description
0.9	December 2016	Final Draft – released for stakeholder feedback
1.0	April 2017	Final – for publication
1.1	May 2018	Updates to articulate OBM system categories
1.2	November 2021	Updated data record format in Appendix B tables to support ECU ID and MSU ID values of up to 20 alphanumeric characters. Added Table 4 to show data record versions associated with supported specification versions. Changed ‘telematics in-vehicle unit’ to ‘telematics device’ throughout. Updated template.

2 Background

2.1 OBM System

2.1.1 This specification sets out the functional and technical requirements that must be satisfied for type-approval of an NTA by TCA. It does not contain additional telematics service requirements; these are not within scope of this specification and will be set out in supplementary specification(s).

2.1.2 A type-approved OBM system comprises:

- an electronic control unit (ECU);
- mass sensor units (MSUs); and
- all of the related documentation required by this specification.

2.1.3 There are three categories of OBM system operating under the National Telematics Framework. The three categories differ in the functionality offered and their intended use, noting that the ability to accurately measure and report the mass of an axle group and a vehicle is consistent across all categories.

2.1.4 These three categories are:

- Category A – OBM systems in this category electronically display collected data to drivers and/or loaders.
- Category B – OBM systems in this category also collect and transfer the collected data.
- Category C – OBM systems in this category collect data and transfer data records in a standardised way to a telematics device (in accordance with *Interconnectivity of Telematics Device with Other Systems Functional and Technical Specification*).

2.1.5 For a list of requirements that apply to each category, see Appendix C.

2.1.6 The ECU and MSU within a type-approved OBM system function as an OBM system as required by this specification when connected to each other. However, if an ECU that is part of a type-approved OBM system is coupled to an MSU that was not part of the same application for type-approval, then that coupling does not constitute a type-approved OBM system, without first being submitted for type-approval.

2.1.7 The OBM system shall determine the axle group mass of each individual axle group of a vehicle, and also the consequent aggregate or gross vehicle mass.

2.1.8 The OBM system shall meet environmental conditions suitable for its operation in a vehicle.

2.1.9 The OBM system shall collect data identifying malfunctions, tampering and attempts at tampering (subject to OBM system category).

2.1.10 An OBM system includes the documentation associated with its installation, calibration operation and maintenance.

2.1.11 An OBM system may contain other components, functions, sources and sensors to deliver regulatory or commercial telematics service specific requirements, such as an external communications device. Such components must be identified to TCA and documented to TCA's satisfaction to allow determination of their impact on requirements within this specification.

2.2 Vehicle Environment

2.2.1 An operational OBM system may vary in the number of MSUs connected to the ECU, given natural variation that occurs in vehicle types and numbers of axle groups. For the purposes of this specification, the OBM system can exist in three broad operational environments as presented in Figures 1 to 3.

2.2.2 The three broad operational environments are representative of the varying environments in which vehicles operate, and comprise:

- OBM system in a typical rigid vehicle environment (Figure 1);
- OBM system in a typical prime mover environment (Figure 2); and
- OBM system in a typical one or more trailer or dolly axle group connected to a prime mover or rigid vehicle environment (Figure 3).

2.2.3 Prime movers or rigid vehicles with one or more trailers provide certain operational challenges for OBM systems. The immediate challenge is that there will not necessarily be an exclusive and ongoing association between a particular ECU and particular MSUs. Trailers and dollies may be used across numerous prime movers (Figure 3). The OBM system must therefore support the dynamic connection of MSUs to an ECU. Further, a mechanism is required to detect where a trailer or dolly is physically connected to the vehicle but there are no connected MSUs installed on the trailer or dolly. Furthermore, the configuration of an axle group may vary due to the raising or lowering of a lift axle.

Figure 1: OBM System in a Typical Rigid Vehicle Environment

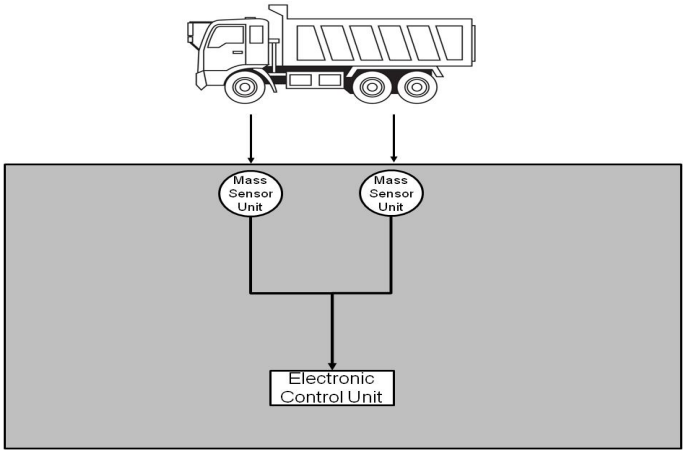


Figure 2: OBM System in a Typical Prime Mover Environment

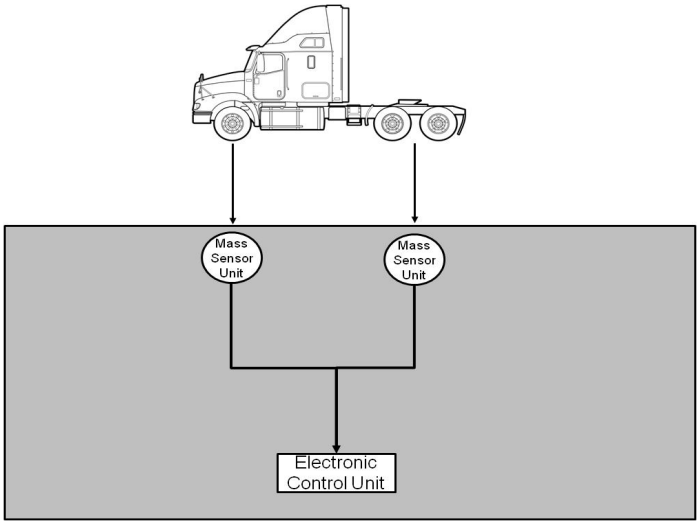
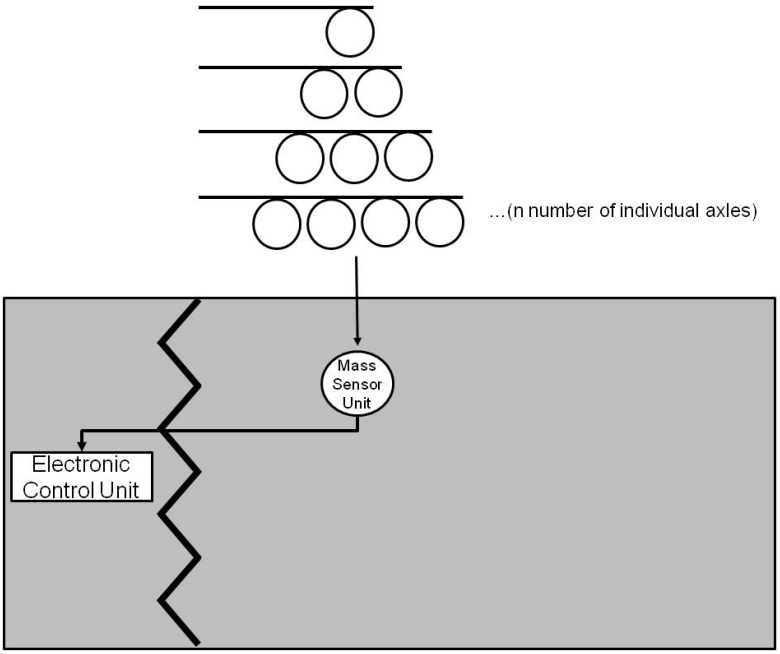


Figure 3: OBM System in a Typical One-or-More Trailer or Dolly Axle-Group Environment Connected to a Rigid Vehicle or Prime Mover



2.2.4 A type-approved OBM system may be used in the context of various regulatory and commercial telematics services and, as such, an OBM system Category C is required to support a communications interface with a telematics device. Typically, this would be a type-approved telematics device capable of functionality including:

- synchronisation of the ECU internal clock to the internal clock of the telematics device (e.g. the GNSS-synchronised internal clock of a telematics device);
- monitoring of the OBM system; and
- transfer of data records generated by the OBM system for processing in the context of other regulatory or commercial telematics services.

2.2.5 The communications interface between the OBM system and telematics device required by this specification is defined within *Interconnectivity of Telematics Device with Other Systems Functional and Technical Specification*.

3 Use of this Specification

3.1 General

3.1.1 This specification contains the functional and technical requirements that shall be met by an applicant intending to submit an NTA to TCA to obtain its type-approval as an OBM system. TCA is the organisation that may grant type-approval of an NTA, when appropriate.

3.1.2 This specification may be used for the following broad purposes:

- by an applicant investigating and/or intending to submit an NTA to TCA to obtain its type-approval; and
- by an intending purchaser/user of a type-approved OBM system or of an NTA, in evaluating and comparing the different type-approved OBM systems and NTAs available in the marketplace against this specification and against each other.

3.2 Use of this Specification

3.2.1 Purchaser/users should note that:

- if TCA has type-approved an NTA, then it has been assessed as meeting all of the functional and technical requirements of this specification applicable to the category that has been type-approved;
- TCA does not accept any responsibility for any consequences arising from any purchaser's/user's use of the information set out in this specification; and
- to the full extent permitted by the laws of negligence and of contract and any provision of any statute of any government within the Commonwealth of Australia which might otherwise impose a liability, TCA hereby excludes all liability to the purchaser/user for any loss or damage suffered by the purchaser/user as a direct or indirect result of the use by the purchaser/user of this specification, including all claims that such loss or damage is a result of negligence and/or breach of contract and/or breach of a statutory provision by TCA in the preparation and/or publication of this specification, and the purchaser/user hereby releases TCA from all such liability and claims.

3.3 Use of this Specification by an Applicant

3.3.1 The requirements set out in this specification shall apply to any NTA presented to TCA for type-approval.

3.3.2 For the purpose of type-approval assessment, an OBM system shall comprise:

- an electronic control unit (ECU);
- mass sensor units (MSUs); and
- all of the related documentation required by this specification.

3.3.3 Applicants are encouraged to consider innovative ways of meeting the various requirements of this specification. This will facilitate the ongoing development and use by applicants of the best available technology, and encourage ongoing development, rather than restricting OBM systems to the technology available at a particular time.

3.3.4 This specification describes the OBM system in a manner that allows a range of physical implementations within the different categories. A non-exhaustive list of performance innovations includes:

- the OBM system may be provided by the original equipment manufacturer, or it may be installed as an after-market product;
- the applicant may propose innovative ways of determining a connection between the ECU and MSUs;
- the OBM system may be able to collect data to identify malfunctions, attempts at tampering and/or tampering that meet the stated requirements by different and innovative means;
- one MSU may share componentry or functionality with another MSU on a vehicle; and
- providing that TCA is satisfied that all of the functionality required to be provided in an OBM system for type-approval is present, the required functionality may be provided by way of disparate componentry – an 'all functionality in one box' solution is not essential.

3.4 Private Use of this Specification

3.4.1 Any use of this specification other than as contemplated by clause 3.3 above shall be classed as 'private use'.

3.4.2 TCA accepts no responsibility for any private use.

3.4.3 Where a party makes private use of this specification, then to the full extent permitted by the laws of negligence and of contract and any provision of any statute of any government within the Commonwealth of Australia which might otherwise impose a liability, TCA hereby excludes all liability to that party for any loss or damage alleged to be suffered by that party as a direct or indirect result of that private use, including all claims that such loss or damage is a result of negligence and/or breach of contract and/or breach of a statutory provision by TCA in the preparation and/or publication of this specification, and that party hereby releases TCA from any and all such liability and claims, and indemnifies TCA in respect of all claims that are contrary to that release, including claims by third parties.

4 Nomenclature

4.1.1 In this specification all references to software include software in any form or medium, including firmware, unless otherwise qualified.

4.1.2 Requirements clauses within this specification that are denoted by:

- "shall" are requirements that must be met;
- "should" are requirements that should desirably be met; and
- "will" are obligations that will be met by other parties.

4.1.3 Notes are included by way of clarification and apply to the immediately preceding requirement(s) or clause.

5 References

5.1.1 Documents referenced in this specification are listed below:

- Degrees of protection provided by enclosures (IP code), AS 60529-2004, Standards Australia.
- Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test, AS/NZS IEC 61000.4.3:2013, Standards Australia.
- Electromagnetic compatibility (EMC) – Testing and measurement techniques – Electrostatic discharge immunity test, AS/NZS IEC 61000.4.2:2013, Standards Australia.
- Information technology – ISO 7-bit coded character set for information interchange, ISO/IEC 646:1991, ISO.
- Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement, AS/NZS CISPR22:2006, Standards Australia.
- Transport Certification Australia (TCA) 2021. *Interconnectivity of Telematics Device with Other Systems Functional and Technical Specification.* Transport Certification Australia. Melbourne.
- Regulation No 10 of the Economic Commission for Europe of the United Nations (UNECE) – Uniform provisions concerning the approval of vehicles with regard to electromagnetic compatibility, Rev.5, 16 October 2014 (UNECE Regulation No10).
- Road Vehicles, Electrical disturbances from conduction and coupling, Part 3: Electrical transient transmission by capacitive and inductive coupling via lines other than supply Lines, ISO 7637-3:2016, ISO 2016.
- Road vehicles – Environmental conditions and testing for electrical and electronic equipment – Part 3: Mechanical loads; ISO 16750-3:2012, ISO 2012.
- Road vehicles – Environmental conditions and testing for electrical and electronic equipment – Part 4: Climatic loads, ISO 16750-4:2010; ISO 2010.
- Vehicle immobilizers, AS/NZS 4601:1999, Standards Australia.

6 Requirements for OBM System Type-Approval

6.1 Overview

6.1.1 This section contains the requirements for the type-approval of an OBM system as set out in the following sections:

- Physical Characteristics
- Environmental Characteristics
- Data Collection
- Record Generation
- Functionality
- Data Storage
- Data Security and Transfer
- Connection to a Telematics Device
- Installation, Calibration, Operation and Maintenance
- Provision of OBM System for Type-Approval.

6.1.2 Approval of an OBM system is on the basis of type. That is, TCA will evaluate against this specification an applicant's sample NTA submitted to it for type-approval as an OBM system. If the sample meets all of the requirements of the specification then it may be type-approved.

PHYSICAL CHARACTERISTICS

A.1 On-Board Mass (OBM) System

A.1.1 A type-approved OBM system shall include:

a. an electronic control unit (ECU);

b. mass sensor units (MSUs); and

c. all of the related documentation required by this specification.

Note: If an ECU that is part of a type-approved OBM system is connected to an MSU that was not part of the same application for type-approval, and vice versa, that new combination does not constitute a type-approved OBM system without first being re-submitted for type-approval. Substantive change to the related documentation required for type-approval also requires the OBM system to be resubmitted for type-approval.

Example: ECUa + MSUa = Type-Approval 1,

ECUb + MSUb = Type-Approval 2,

ECUa + MSUb = New Type-Approval 3 required, or

ECUb + MSUa = New Type-Approval 4 required.

A.2 Electronic Control Unit (ECU)

A.2.1 An ECU shall include:

a. a user interface that permits entry and display of data;

b. a processing unit;

c. an internal memory storage;

d. all cabling, connections and fixings leading up to, but not including:

i. external power supply;

ii. ignition;

iii. any cabling, connections or fixings belonging to an MSU; and

iv. any connected telematics device.

A.2.2 The physical design characteristics of an ECU, and the accompanying documentation, shall be sufficient to ensure that the ECU remains robustly connected to that part of the vehicle in which the vehicle's engine is installed.

A.2.3 The user interface may be external to the ECU.

Note: The user interface may be used to provide for the requirements of this Specification, including the driver presentation functionality.

A.2.4 If the user interface is external to the ECU then the combination of user interface and ECU shall, to the extent appropriate to their particular combined functionality, meet the requirements of this Specification applicable to the ECU itself.

A.3 ECU Identifier

A.3.1 Each ECU shall have a unique identifier (ECU ID) that will be used to identify:

a. the particular ECU; and

b. data from that ECU.

Note: The ECU ID may be the serial number of the specific ECU. In government applications, this may be defined.

A.3.2 Each ECU shall have a known software version and hardware version.

A.3.3 The ECU ID shall be stored in the read-only memory of the ECU.

Note: For instance, stored using EPROM, Flash, battery-backed NV RAM or the like.

A.3.4 The ECU ID, software version and hardware version shall not be able to be set or altered by any person other than the authorised person or otherwise tampered with.

A.3.5 The ECU ID shall be visibly etched or marked on the ECU's exterior casing in a manner such that the ECU ID cannot be modified or removed.

A.4 ECU Security Seals

A.4.1 The ECU shall be protected by a robust security seal(s) with a unique identifier to ensure detection of any unauthorised disconnection, removal or opening.

A.4.2 Disconnection, removal or opening of the ECU shall be possible only by breaking the security seal(s).

A.4.3 The ECU shall be placed in a position that facilitates inspection of the integrity of the security seal(s).

A.4.4 Security seals shall clearly display signs of any unauthorised access, either visually and/or physically and shall be such that if broken they cannot be reinstated.

A.5 Mass Sensor Unit (MSU)

A.5.1 The MSU shall include:

a. one or more mass sensors;

b. a processing unit;

c. an internal memory storage;

d. all cabling, connections and fixings leading up to, but not including:

   i. external power supply (if applicable); and

   ii. the ECU and/or other MSU, terminating at the vehicle the MSU is installed upon.

Note:

i. *The definition of where MSU cabling starts and ends is primarily semantic, as it exists to ensure cabling is recognised as being part of the MSU so that it undergoes appropriate environmental testing. In practice the OBM system functional performance will be assessed with all cabling and connections installed in accordance with the applicant's instructions.*

ii. *If the applicant has multiple mass sensor technologies available, each mass sensor technology constitutes a different MSU which shall be subject to type-approval (i.e. new mass sensor technologies cannot be introduced without resubmitting for type-approval).*

A.5.2 An MSU may share componentry or functionality with another MSU on a vehicle.

Note: For instance, see A.5.1b or c.

A.5.3 An MSU shall be robustly connected to the vehicle for which it, the MSU, is required to measure the mass of an axle group.

A.5.4 An MSU installed on an axle group that has a lift axle shall be able to determine the position of the lift axle (i.e. raised or lowered).

A.6 MSU Identifier

A.6.1 Each MSU shall support a unique identifier (MSU ID) which, once installed, shall be linked with the vehicle identification number (VIN) or, in the absence of a VIN, another unique identifier, for the vehicle or part of the vehicle on which the MSU is installed.

A.6.2 The MSU ID shall be used to identify:

a. the particular MSU; and

b. the data from that MSU.

Note: The MSU ID may be the serial number of the specific MSU. Noting A.5.2, the MSU ID may recognise its shared componentry or functionality with another MSU. In government applications this may be defined.

A.6.3 Each MSU shall have a known software version and hardware version.

A.6.4 The MSU ID shall be stored in the read-only memory of the MSU.

Note: For instance, stored using EPROM, Flash, battery-backed NV RAM or the like

A.6.5 The MSU ID, software version and hardware version shall not be able to be set or altered by any person other than the authorised person or otherwise tampered with.

A.7 MSU Security Seals

A.7.1 The MSU shall be protected by a robust security seal(s) with a unique identifier to ensure detection of any unauthorised removal or opening.

A.7.2 Removal or opening of an MSU shall be possible only by breaking the security seal(s).

A.7.3 Security seals shall clearly display signs of any unauthorised access, either visually and/or physically, and shall be such that if broken they cannot be re-instated.

A.8 ECU Capacity

A.8.1 The ECU shall be able to support at least six MSUs concurrently in operation.

A.8.2 The applicant shall indicate whether its ECU is able to support more than six MSUs concurrently in operation and shall be type-approved accordingly by TCA.

A.8.3 The ECU shall, when connected to an MSU, collect data from that MSU.

A.9 MSU Capacity

A.9.1 The MSU shall, when connected to the ECU, transmit data to the ECU.

A.9.2 The applicant shall indicate whether its MSU is capable of catering for a lift axle and the OBM system shall be type-approved accordingly by TCA.

ENVIRONMENTAL CHARACTERISTICS

A.10 ECU Suitability for Use in Vehicles

A.10.1 The applicant shall provide to TCA evidence of compliance with the following, or equivalent requirements, in relation to the ECU:

a. the vibration requirements specified in AS/NZS 4601:1999 Type 1 paragraph 3.3.4;

b. the impact requirements specified in AS/NZS 4601:1999 paragraph 3.3.5;

c. the temperature and humidity requirements specified in AS/NZS 4601:1999 paragraphs 2.2.5.2 and 3.3.2;

d. ECU components exposed to the elements, dust and water ingress protection requirements of IP66, Table 7, Item 6 and Clause 13.4 and Table 8, Item 6 and Clause 14.2.6 as defined in AS 60529-2004 (IEC 60529 Ed 2.1:2001);

e. ECU components mounted in the cabin, dust and water ingress protection requirements of IP44, Table 7, Item 4 Clause 13.4 and Table 8, Item 4 and Clause 14.2.4 as defined in AS 60529-2004 (IEC 60529 Ed 2.1:2001);

f. ECU radiated immunity, AS/NZS IEC 61000.4.3:2013, paragraph 5, Table 1 where the test field strength is 50 V/m over a frequency range of 80 MHz to 1000 MHz and the test is conducted for set and unset states such that the ECU shall remain in a state where all functions perform as designed during and after exposure;

g. ECU radiated emissions, UNECE Regulation No.10, Rev. 5, sections 6.5 and 6.6;

h. ECU conducted immunity for conducted disturbances along supply lines, UNECE Regulation No.10, Rev. 5, section 6.9 with functional status ‘A’, Table 2;

i. ECU conducted immunity for conducted disturbances on signal lines: ISO 7637-3:2016, the test pulses a through b shall be applied at a severity level III for either Table B.1 12V or Table B.2 24V powered ECUs or both, as appropriate, in both the set and unset states with the test duration 5 min; the ECU shall remain in a state where all functions perform as designed during and after exposure;

j. ECU conducted emissions, UNECE Regulation No.10, Rev. 5, section 6.7, Table 1 using the pulse amplitude level for both 12V and 24V systems, as appropriate; and

k. ECU electrostatic discharge, AS/NZS IEC 61000.4.2:2013, severity level 3 for air discharge, where the test is conducted for set and unset states and the ECU is allowed a functional status of Class C whereby a function of the ECU does not perform as designed during exposure but returns automatically to normal operation after exposure is removed.

A.10.2 Security seals (see A.4) shall remain intact when exposed to the conditions specified in A.10.1.

A.11 MSU Suitability for Use in Vehicles

A.11.1 The applicant shall provide to TCA evidence of compliance with the following, or equivalent requirements, in relation to the MSU:

a. MSUs or their components installed on unsprung masses of the vehicle (i.e. having a direct mechanical connection to the suspension system), the vibration requirements specified in ISO 16750-3:2012 Road vehicles – Environmental conditions and testing for electrical and electronic equipment – Part 3: Mechanical loads, paragraph 4.1.2.9 Test IX-Commercial vehicle, unsprung masses;

b. MSUs or their components installed on sprung masses of the vehicle (i.e. having no direct mechanical connection to the suspension system), the vibration requirements specified in ISO 16750-3:2012 Road vehicles – Environmental conditions and testing for electrical and electronic equipment – Part 3: Mechanical loads, paragraph 4.1.2.7 Test VII-Commercial vehicle, sprung masses;

c. the mechanical shock requirements specified in ISO 16750-3:2012 Road vehicles – Environmental conditions and testing for electrical and electronic equipment – Part 3: Mechanical loads, test requirement specified in paragraph 4.2.2;

d. the temperature and humidity requirements specified in ISO 16750-4:2010 for temperature, Code Z, Operating Temperature Range from -20 °C to +70 °C, tests and requirements 5.1, 5.2, 5.4.2, 5.6.2.3;

e. MSUs and their components exposed to elements, dust and water ingress protection requirements of IP66, Table 7, Item 6 and Clause 13.4 and Table 8, Item 6 and Clause 14.2.6 as defined in AS 60529-2004 (IEC 60529 Ed 2.1:2001);

f. MSU radiated immunity, AS/NZS IEC 61000.4.3:2013, paragraph 5, Table 1 where the test field strength is 50 V/m over a frequency range of 80 MHz to 1000 MHz and the test is conducted for set and unset states such that the MSU shall remain in a state where all functions perform as designed during and after exposure;

g. MSU radiated emissions, UNECE Regulation No.10, Rev. 5, sections 6.5 and 6.6;

h. MSU conducted immunity for conducted disturbances along supply lines, UNECE Regulation No.10, Rev. 5, section 6.9 with functional status ‘A’, Table 2;

i. MSU conducted immunity for conducted disturbances on signal lines: ISO 7637-3:2016, the test pulses a through b shall be applied at a severity level III for either Table B.1 12V or Table B.2 24V powered MSUs or both, as appropriate, in both the set and unset states with the test duration 5 min; the MSU shall remain in a state where all functions perform as designed during and after exposure;

j. MSU conducted emissions, UNECE Regulation No.10, Rev. 5, section 6.7, Table 1 using the pulse amplitude level for both 12V and 24V systems, as appropriate;

k. MSU electrostatic discharge, AS/NZS IEC 61000.4.2:2013, severity level 3 for air discharge, where the test is conducted for set and unset states and the MSU is allowed a functional status of Class C whereby a function of the MSU does not perform as designed during exposure but returns automatically to normal operation after exposure is removed; and

l. the free fall requirements specified in ISO 16750-3:2012 Road vehicles – Environmental conditions and testing for electrical and electronic equipment – Part 3: Mechanical loads, test requirement specified in paragraph 4.3.

A.11.2 Security seals (see A.7) shall remain intact when exposed to the conditions specified in A.11.1.

A.12 Non-Type-Approved Functionality in the OBM System

A.12.1 It shall be permissible for non-type-approved functionality to be accommodated within the OBM system.

A.12.2 The type-approved functionality shall be isolated from any non-type-approved functionality that may be provided by the OBM system such that the performance of the OBM system for type-approved purposes is not hindered or degraded below the requirements in this specification, and such that the type-approved functionality is not compromised.

Note: The OBM system may contain components and functions and may interface with a telematics device and other systems to deliver service-specific requirements.

DATA COLLECTION

A.13 Data Collection

A.13.1 The OBM system shall collect and store the following data:

a. MSU calibration data;

b. axle group mass data;

c. ECU data;

d. date and time data; and

e. alarm status data.

A.14 MSU Calibration Data

A.14.1 The MSU shall support the collection of MSU calibration data.

A.14.2 MSU calibration data shall be collected by the MSU when that MSU undergoes a calibration.

A.14.3 MSU calibration data shall include:

a. the date and time of the most recent MSU calibration; and

b. the MSU calibration values of the most recent calibration.

A.14.4 MSU calibration data shall not be able to be set, altered or otherwise tampered with by any person other than an authorised person.

A.15 Axle Group Mass Data

A.15.1 The MSU shall support the collection of axle group mass data.

A.15.2 The MSU shall be connected to the axle group.

A.15.3 The MSU shall collect the axle group mass of the axle group.

Note: For A.15.2 and A.15.3 in the case of a steer axle(s), alternative approaches to the connection and collection of the axle group mass may be considered subject to TCA approval.

A.15.4 The axle group mass data collected by the MSU shall not deviate from the absolute axle group mass by more than 2% of the maximum permissible mass of the axle group for 98% of observations, when:

a. the vehicle is stationary and on level ground;

b. the MSU is calibrated; and

c. the OBM system is operating in accordance with this specification.

Note:

i. *This requirement applies whether the MSU is measuring the axle group mass of an axle group that is fully laden, partially laden or unladen.*

ii. *The axle group's absolute axle group mass represents a measurement conducted at a licensed weighbridge which is compliant with National Trade Measurement Regulations 2009, and weighed using axle load measurement.*

A.15.5 The MSU shall be capable of measuring at least 150% of the maximum permissible mass of the axle group.

A.15.6 The axle group mass shall have a resolution of 10 kilograms or better.

A.15.7 The MSU shall be capable of collecting axle group mass data at a consistent frequency between 30 and 255 hertz for a minimum duration of 10 seconds and a maximum duration of 20 seconds.

Note: This requirement is used to support the generation of a quality record in accordance with A.22.

A.15.8 The frequency used to collect the axle group mass data in A.15.7 shall be collected.

A.15.9 The number of axle group mass data in A.15.7 shall be collected.

A.15.10 An MSU shall collect the lift axle status of an axle group, indicating:

a. the axle group does not include a lift axle;

b. the axle group includes a lift axle, but the position is unknown;

c. the axle group includes a lift axle, and the lift axle is raised; or

d. the axle group includes a lift axle, and the lift axle is lowered.

Note: A.15.10a. is used for an MSU that is not capable of catering for a lift axle or an MSU that is capable of catering for a lift axle but is not connected to such an axle group. A.15.10b. is used for instances where a malfunction or other issue causes the position of the lift axle to be unknown.

A.16 ECU Data

A.16.1 The ECU shall support the collection of ECU data.

A.16.2 ECU data shall include:

a. MSU count;

b. MSU sequence number;

c. gross vehicle mass; and

d. data from each MSU connected to the ECU.

A.16.3 The MSU count shall comprise the total number of MSUs connected to the ECU.

A.16.4 The MSU sequence number shall be any identifier that has a sequential ordering assigned to each individual MSU connected to the ECU. The assigned identifier shall sequentially increase from the front to the rear of the vehicle.

Note:

i. *The OBM system must support dynamic collection of MSU sequence numbers and associated MSU count.*

ii. *For an OBM system Category C, see Appendix B.*

A.16.5 The gross vehicle mass shall comprise the sum total of the individual axle group masses.

A.16.6 The gross vehicle mass shall have a resolution of 10 kilograms or better.

A.17 Date and Time Data

A.17.1 The ECU shall collect and store date and time data.

A.17.2 The date and time shall be stored with a resolution of 1 second.

A.17.3 The ECU shall have an internal clock that operates independently of the supporting external power supply.

A.17.4 The accuracy of the ECU internal clock, when it has no connection to the supporting external power supply, shall be such that the clock does not deviate by more than 20 seconds per day over any 28-day period.

A.17.5 In the event the external power supply fails or shuts down, the ECU internal clock shall operate for a period of at least 28 days.

A.18 Alarm Status Data

A.18.1 Unauthorised access to the data in the ECU shall be monitored and reported upon in accordance with A.37.4.

A.18.2 Unauthorised access to the software in the ECU shall be monitored and reported upon in accordance with A.37.4.

A.18.3 The connection of the ECU to the MSUs shall be monitored and reported.

Note: Connection or disconnection of MSUs from the ECU are used to detect when there is a change in the configuration of the vehicle.

A.18.4 The communication status of an MSU connected to the ECU shall be monitored and reported.

Note: The communication status includes receiving malformed data including null or zero data where applicable.

A.18.5 The ECU shall be able to monitor and report upon whether all of the vehicle's axle groups have an MSU connected.

Note: Applicants are encouraged to consider innovative ways of meeting this requirement.

A.18.6 The ECU shall monitor and report any adjustment of its internal clock by an amount of 5 seconds or more.

Note: See A.33.

RECORD GENERATION

A.19 Record Generation

A.19.1 The ECU shall process the collected data to generate the following data records:

a. configuration records;

b. mass records;

c. quality records; and

d. alarm records.

A.19.2 The data records prescribed at A.19.1 shall be stored for transmission.

A.20 Configuration Records

A.20.1 The ECU shall generate configuration records.

A.20.2 Configuration records shall consist of the following data:

a. data record version;

b. record number;

c. date;

d. time;

e. ECU ID;

f. MSU count; and

g. For each MSU connected to the ECU:

   i. MSU sequence number; and

   ii. MSU ID.

A.20.3 The ECU shall be capable of generating a configuration record:

a. when the ECU and all the connected MSUs come into operation; and

b. when the ECU is in operation and the MSU count, MSU sequence number and/or MSU ID change.

A.21 Mass Records

A.21.1 The ECU shall generate mass records.

A.21.2 Mass records shall consist of at least the following data:

a. data record version;

b. record number;

c. date;

d. time;

e. ECU ID;

f. MSU count;

g. gross vehicle mass;

h. For each MSU connected to the ECU:

   i. MSU sequence number;

   ii. MSU ID;

   iii. lift axle status; and

   iv. axle group mass.

A.21.3 The ECU shall be capable of generating a mass record:

a. when the ECU is in operation and a mass record is manually requested through the ECU;

b. when the ECU is in operation and at a frequency configured by an authorised person; and

c. when the ECU is in operation and a mass record is requested by a connected telematics device.

A.21.4 The frequency referred to in A.21.3b shall be capable of being:

a. set to once every 5 minutes;

b. set to less frequently than once every 5 minutes; and

c. configured not to occur (i.e. be disabled).

A.22 Quality Records

A.22.1 The ECU shall generate quality records.

A.22.2 A quality record shall consist of at least the following data:

a. data record version;

b. record number;

c. date;

d. time;

e. ECU ID;

f. MSU count;

g. MSU sequence number;

h. MSU ID;

i. lift axle status;

j. for the MSU, axle group mass data readings at a consistent frequency between 30 and 255 hertz for a minimum duration of 10 seconds and a maximum duration of 20 seconds;

k. frequency of axle group mass data; and

l. number of axle group mass data.

Note: A quality record pertains to one MSU. Typically, when required, a quality record is generated for each MSU.

A.22.3 The ECU shall be capable of generating a quality record:

a. when the ECU is in operation and at a frequency configured by an authorised person, and

b. when the ECU is in operation and a quality record is requested by a connected telematics device.

A.22.4 The frequency referred to in A.22.3a shall be capable of being:

a. set to once every 6 hours;

b. set to less frequently than once every 6 hours; and

c. configured not to occur (i.e. disabled).

A.23 Alarm Records

A.23.1 The ECU shall be capable of generating alarm records for each of the following events:

a. an MSU is disconnected from the ECU while the ECU is in operation in accordance with A.18.3;

b. an MSU is reconnected to the ECU while the ECU is in operation in accordance with A.18.3;

c. an MSU is not communicating with the ECU as required by this specification in accordance with A.18.4;

d. after the ECU comes into operation, all of the vehicle's axle groups have an MSU connected to the ECU in accordance with A.18.5;

e. after the ECU comes into operation, one or more of the vehicle's axle groups do not have an MSU connected to the ECU in accordance with A.18.5; and

f. the ECU internal clock is adjusted in accordance with A.18.6.

A.23.2 An alarm record shall consist of at least the following data:

a. data record version;

b. record number;

c. date;

d. time;

e. ECU ID;

f. MSU ID (if applicable); and

g. a unique code identifying the event in A.23.1.

Note: The unique code may be set by the applicant. However, when communicating with a connected telematics device, the alarm codes specified in Appendix B should be used to maintain a common meaning.

A.24 Record Numbering

A.24.1 Data records shall be assigned record numbers from the one record numbering sequence, with consecutive and increasing record numbers assigned to successive data records in order of generation.

A.24.2 The numbering sequence used for rata records shall rotate through a large enough cycle such that the same record number shall not be issued more than once every 30 calendar days.

FUNCTIONALITY

A.25 OBM System Functionality

A.25.1 The ECU shall be considered to be in operation when the ECU's supporting external power supply is connected to the ECU and the ignition status is on.

A.25.2 An MSU shall be considered to be in operation when it is connected to an ECU and, as a minimum, that ECU is in operation.

A.26 ECU Functionality for Driver and/or Loader

A.26.1 The ECU shall provide a visual presentation.

A.26.2 The ECU may provide an audible presentation.

A.26.3 When the ECU is in operation, the ECU shall be capable of presenting, as a minimum:

a. the MSU count and the connected MSU sequence;

b. the axle group mass of each MSU (including lift axle status if applicable) and the gross vehicle mass; and

c. an indication upon changes to the connection or sequencing of MSU(s).

A.26.4 The ECU shall provide a means of presenting when it is functioning in accordance with this specification.

A.26.5 The ECU shall provide a means of presenting when it is not functioning in accordance with this specification.

DATA STORAGE

A.27 Data Storage

A.27.1 The ECU shall be capable of storing sufficient data and/or data records to address the needs of any one specific telematics service, noting that there may be more than one such service associated with an OBM system.

A.27.2 As a minimum, the ECU shall be capable of storing:

a. 200 configuration records and mass records (combined);

b. 200 alarm records; and

c. 20 quality records.

Note: Data records may be deleted by the ECU to provide capacity for further data records, when they have been fully processed in accordance with all of the requirements of this specification.

A.28 OBM System External Power Supply Failure/Shutdown

A.28.1 In the event that the external power supply supporting the OBM system fails or shuts down, the OBM system shall be capable of retaining stored data for at least 28 days.

Note: This requirement refers to both the ECU and the MSU.

DATA SECURITY AND TRANSFER

A.29 Data Security and Confidentiality

A.29.1 It shall not be possible for collected or stored data or software memory within the OBM system to be accessible or capable of being manipulated by any person, device or system, other than an authorised person. Security and confidentiality of data stored in the OBM system shall be maintained at all times.

Note: This requirement refers to both the ECU (OBM system Category B and C) and the MSU.

A.30 Integrity and Origin of Data Transfer from MSU to ECU

A.30.1 The transmission of data from the MSU to the ECU shall support a form of data authentication (i.e. some form of message authentication code only known and accessible to an authorised person), subject to the approval of TCA, that can prove the integrity and origin of the data from an MSU.

CONNECTION TO A TELEMATICS DEVICE

A.31 Applicability

A.31.1 As applicable (subject to the OBM system category), the ECU shall support:

a. the connection and transfer of collected data to a telematics device (i.e. OBM system Category B); or

b. the connection and transfer of data records (i.e. OBM system Category C).

A.31.2 The ECU shall not connect to more than one telematics device at any given time.

A.31.3 The ECU shall support connection with a telematics device in accordance with *Interconnectivity of Telematics Device with Other Systems Functional and Technical Specification*, such that:

a. the telematics device meets the requirements set out for the server device; and

b. the ECU meets the requirements set out for the client device.

Note: The telematics device will typically be a type-approved telematics device, and its connection allows for resynchronisation of the ECU internal clock, monitoring of the ECU, requesting that the ECU collect data and generate data records, and transfer of data records from the ECU. This requirement is only for OBM system Category C.

A.31.4 The ECU shall meet the requirements for the core capability and the OBM system extension profile. as detailed in *Interconnectivity of Telematics Device with Other Systems Functional and Technical Specification*.

A.32 Physical Interface

A.32.1 The ECU shall support the requirements set out for an RS-232 physical interface between the ECU and the telematics device.

Note: The RS 232 standard, defines the minimum signalling levels, data rates, transmission distances and the physical connectors to be used.

A.32.2 While the ECU shall support the specified RS-232 physical interface, the ECU may be connected to the telematics device via an alternate compliant physical interface as approved by TCA.

A.33 Date and Time Synchronisation

A.33.1 The ECU shall synchronise its internal clock to a trusted time source.

Note: A connected telematics device may be used as the trusted time source.

A.33.2 Where the ECU is connected to a trusted time source, the differential between the ECU internal clock and the trusted time source shall be less than 5 seconds, after the ECU comes into operation and the ECU internal clock has been synchronised.

Note: See A.18.6.

A.34 Integrity and Origin of Data Record Transfer from ECU to Telematics Device

A.34.1 All data and/or data records shall be transferred from the ECU to the telematics device.

A.34.2 All data and/or data records transferred from the ECU to the telematics device shall support a form of data authentication (i.e. some form of message authentication code only known and accessible to an authorised person), subject to the approval of TCA, that can prove the integrity and origin of the data from the ECU.

A.34.3 All data and/or data records transferred from the ECU to the telematics device shall be transferred in order of generation.

Note: The requirement is that data records should be transferred in ascending order of record number. However, noting that a reset to a lower record number may occur not more than once every 30 days, no data record may be transferred until the preceding data record has been acknowledged as transferred.

A.34.4 Data records shall not be deleted from the ECU until acknowledgment of data transfer has been received from the telematics device.

A.34.5 Data records transferred from the ECU to the telematics device shall be formatted in accordance with Appendix B, and shall use binary encoding.

A.35 Data Collection and Record Generation

A.35.1 Where the ECU is connected to a telematics device the ECU shall allow the telematics device to request collection of data and/or generation of data records, such that it meets the requirements of this specification.

A.35.2 In meeting requirement A.35.1, the ECU shall only allow the telematics device to request collection of data and/or generation of data records where:

a. the ECU is in operation;

b. no data record is currently being generated;

c. sufficient storage capacity exists to store the generated data record; and

d. the OBM system is otherwise ready and capable of collecting data and generating the required data record.

Note: This requirement pertains to two facets of the connection with the telematics device*. Firstly, the ECU is required to indicate its readiness to collect data and generate data records based upon the conditions set out in this requirement. Secondly, upon receiving a request from the* telematics device *to generate a data record, the ECU shall accept or reject that request based upon the conditions set out in this requirement.*

INSTALLATION, CALIBRATION, OPERATION AND MAINTENANCE

A.36 Installation, Calibration, Operation and Maintenance

A.36.1 The applicant shall provide documentation for the installation, calibration, operation and maintenance of the type-approved OBM system.

A.36.2 The documentation for the installation, calibration, operation and maintenance of the OBM system shall be such that it meets the requirements of this specification.

A.36.3 An OBM system shall have procedures for the installation, calibration, operation and maintenance such that neither the OBM system nor the supporting documentation interfere with the normal, safe operation of the vehicle. The documentation may include a requirement for consultation with the vehicle's manufacturer before activity associated with the installation, calibration, operation and maintenance of the type-approved OBM system and its connection to a telematics device.

A.36.4 The applicant shall provide documentation pertaining to the installation, calibration, operation and maintenance of the type-approved OBM system for use by the authorised person.

A.36.5 Installation, calibration and maintenance functions shall include access controls and shall only be available to an authorised person.

A.36.6 Operation functions may include access controls set by an authorised person.

A.37 Documentation

A.37.1 The applicant shall provide OBM system documentation to support the requirements of this specification.

A.37.2 This documentation shall, to the satisfaction of TCA:

a. document the OBM system and its components, cabling and their interfaces; and

b. describe critical operational, support and rectification processes.

A.37.3 This documentation shall be inclusive of, at a minimum:

a. installation procedures;

b. calibration procedures inclusive of calibration interval (see A.37.5);

c. operation procedures inclusive of a user and driver guideline; and

d. maintenance procedures.

A.37.4 The documentation referred to in A.37.3 shall allow an authorised person to document the installation, calibration and maintenance activities performed on an OBM system as follows:

a. ECU:

i. ECU ID;

ii. VIN or, in the absence of a VIN, another unique identifier for the vehicle in which the ECU is installed;

iii. ECU software version and hardware version;

iv. date and time of the activity;

v. details of the activity performed; and

vi. identification of authorised person.

b. MSU:

i. MSU ID;

ii. VIN or, in the absence of a VIN, another unique identifier;

iii. axle group location;

iv. MSU software version and hardware version;

v. date and time of the activity;

vi. details of the activity performed; and

vii. identification of authorised person.

A.37.5 The applicant shall identify the calibration interval for the MSU based on, but not limited to the following:

a. axle group;

b. use of vehicle;

c. malfunction; and

d. axle group mass accuracy.

PROVISION OF OBM SYSTEM FOR TYPE-APPROVAL

A.38 OBM System Type-Approval

A.38.1 The requirements contained within this section shall apply to an OBM system presented by an applicant for type-approval assessment by TCA.

A.38.2 TCA will, if requested, complete and return to the applicant an executed confidentiality agreement in reasonable terms for the protection of the applicant's intellectual property in the OBM system under assessment.

A.38.3 The applicant shall provide to TCA the ECU, MSU, and all of the related documentation required by this specification from the OBM system under assessment.

A.38.4 TCA will require access to the OBM system under assessment which is installed and fully operational in a vehicle(s) that is approved by TCA for type-approval assessment. For type-approval assessment, the applicant shall provide to TCA:

a. all OBM system data, including data records (as applicable, subject to the OBM system category) during the assessment; and

b. support, procedural guidance, user login account(s) and access to appropriate software tools or utilities to allow the decoding, decryption, decompression, extraction, etc. of data held in any proprietary or custom format, to permit further viewing or analysis of the OBM system data and data records (as applicable) by TCA.

A.38.5 The data and data records referred to in A.38.4 shall be backed up by the applicant for the duration of the type-approval assessment process.

A.38.6 Type-approval of an OBM system shall be valid only for the OBM system as presented to TCA for type-approval by the applicant. An OBM system that has different functional or technical capabilities from those of the OBM system that has been type-approved shall require separate type-approval.

Appendix A Acronyms and Definitions

Acronyms

Acronym	Definition
ECU	electronic control unit
ECU ID	electronic control unit identifier
MSU	mass sensor unit
MSU ID	mass sensor unit identifier
NTA	not type-approved
OBM	on-board mass
UTC	Coordinated Universal Time
VIN	vehicle identification number

Definitions

Term	Definition
applicant	A party which has applied for OBM system type-approval.
authorised person	A person authorised to perform the function of the authorised person in this specification.
axle group	A single axle group, tandem axle group, twin-steer axle group, tri-axle group or quad-axle group.
axle group mass	The mass of an axle group as collected by the connected MSU.
calibration	A function of adjustment of the corresponding indication of the MSU to values provided by a weighbridge with the appropriate licence when such a weighbridge is compliant to National Trade Measurement Regulations 2009.
client device	In the context of this specification the ECU, as it initiates communication by transmitting a message to the server device (namely the telematics device).
data record	A discrete and defined set of data elements, generated by a device.
electronic control unit	A unit installed in a vehicle that collects, amongst other things, data from connected MSUs.
gross vehicle mass	The mass of a vehicle comprising the sum total of the axle group masses.
lift axle status	An indication of whether an axle group is fitted with a lift axle, and if so, whether that lift axle is raised, lowered or in an unknown position.
mass sensor unit	A unit installed on a vehicle that determines, amongst other things, axle group mass.
maximum permissible mass	The legal mass limit for an axle group.
message authentication code	A code only known and accessible to an authorised person that can prove the integrity and origin of data from a source.
MSU count	The total number of MSUs connected to an ECU, when that ECU is in operation.
MSU sequence number	Any identifier assigned to each individual MSU connected to the ECU. The assigned identifier sequentially increases from the front to the rear of the vehicle.
NTA	An on-board mass system that has not been typed-approved by TCA, whether or not it has been submitted to TCA for type-approval.
OBM system	An OBM system which is of a type that has been type-approved by TCA as meeting the requirements of this specification pertaining to the applicable category.

Term	Definition
OBM system category	A category of OBM system that is defined as follows: • Category A – OBM systems in this category electronically display collected data to drivers and/or loaders. • Category B – OBM systems in this category also collect data and transfer the collected data to a telematics device using a mechanism agreed and implemented by the ASP and the supplier of the OBM system. • Category C – OBM systems in this category collect data and transfer data records in a standardised way to a telematics device (in accordance with *Interconnectivity of Telematics Device with Other Systems Functional and Technical Specification*).
operation	ECU An ECU shall be considered to be in operation when the ECU's supporting external power supply is connected to the ECU and the ignition status is on. MSU An MSU shall be considered to be in operation when it is connected to the ECU and that ECU is in operation.
server device	In the context of this specification the telematics device, as it is able to communicate by replying to the client device (namely the ECU) message with its own server device message.
tamper	Conduct towards the OBM system which is intended to prevent the OBM system from functioning correctly.
vehicle	A prime mover, rigid truck or prime mover/rigid truck with trailer(s), dollies or other connections.

Appendix B Requirements for Data Record Exchange

B.1 Applicability

B.1.1 Data records, as generated in accordance with this specification, shall be formatted in accordance with this data record exchange format, if and as required by this or other specifications.

Note: This data format is explicitly used within this specification for the purposes of data record exchange with a type-approved telematics device, but may be used more broadly.

B.2 Data Record Encoding

B.2.1 Each data record shall be encoded using either:

a. the text-based encoding format requirement in B.2.2; or

b. the binary encoding format requirement in B.2.3.

Note: References to this specification will explicitly require that either the text-based or binary encoding format requirement is used in any given context.

B.2.2 Within each data record encoded using the text-based format:

a. each field shall be encoded using ISO/IEC 646:1991 (ASCII) character encoding;

b. each field shall occupy a fixed number of characters;

c. fields that do not consume the specified number of characters shall be padded on the right with spaces;

d. blank / void values shall be indicated by padding the entire field with spaces; and

e. each field shall be encoding using one of the data types set out in Table 1.

Table 1: Data Record Text-based Encoding Data Types

Field Data Type	Format	Description
Integer – unsigned	N(x)	An unsigned integer (whole) number with a maximum width; inclusion of a (plus or minus) sign is not permitted. For example, for the format ‘N(4)’ the values ‘0’, ‘12’, ‘123’ and ‘1234’ are valid, but ‘-123’ is not valid.
Integer – signed	N(+x)	A signed integer (whole) number with a maximum width, including a lead character reserved for a (plus or minus) sign. For example, for the format “N(+4)” the values ‘+1’, ‘-1’, ‘123’ (implied + sign) and ‘+123’ are valid, but ‘+1234’ is not valid.
Alphanumeric (text)	AN(n)	A text value with a maximum width.

B.2.3 Within each data record encoded using the binary format:

a. each field shall occupy a fixed number of bytes;

b. each field shall be encoded using one of the data types set out in Table 2;

c. textual data shall be encoded using ISO/IEC 646:1991 (ASCII) character encoding; and

d. numeric data shall be encoded using one (1), two (2), or four (4) bytes, and with the most-significant byte encoded first (i.e., big-endian encoding).

Table 2: Data Record Binary Encoding Data Types

Field Data Type	Format	Description
Integer – unsigned	UINT(1) UINT(2) UINT(4)	An unsigned integer (whole) number occupying 1, 2 or 4 bytes
Integer – signed	INT(1) INT(2) INT(4)	A signed integer (whole) number occupying 1, 2 or 4 bytes
Text	TXT(n)	A text field with a fixed width; values shorter than this width shall be padded to the right with spaces
Binary	BIN(n)	A binary field with a fixed width

B.3 Data Record Common Elements

B.3.1 Each data record shall have the common header fields as set out in Table 3.

Table 3: Data Record Common Header Fields

Field	Text Format	Binary Format	Value
Data Record Version	N(2)	UINT(1)	Version of the data record (see B.3.2)
Record Type	N(2)	UINT(1)	Record type (see B.3.3)
Record Number	N(5)	UINT(2)	Record number (see A.24)
Record Date and Time	AN(14)	TXT(14)	UTC date and time of record generation in format YYYYMMDDHHMMSS (see A.17)
ECU ID	AN(20)	TXT(20)	See A.3

B.3.2 Within each data record, the Data Record Version field shall be set to the value shown in Table 4 that represents the current value of this specification.

Table 4: Data Record Version Values

Data Record Version	Supported Specification Version(s)
1	1.0, 1.1
2	1.2 (current version)

Note: The Data Record Version field allows the receiver of data records to understand the overall length and internal structure of each record. The structure of the data record associated with earlier Data Record Version values is described in the supported specification versions.

B.3.3 Within each data record, the Record Type field shall have a value as set out in Table 5.

Table 5: Data Record Types

Value	Record Type	Description
1	Configuration Record	See A.20
2	Mass Record	See A.21
3	Quality Record	See A.22
4	Alarm Record	See A.23

B.3.4 Where data records include a lift axle status code, the value shall be as set out in Table 6 (see A.15.8).

Table 6: Lift Axle Status Values

Value	Description
0	The MSU is not capable of catering for a lift axle, or the axle group does not include a lift axle
1	The axle group does include a lift axle, is fitted with a lift status detection capability, but the lift status is not known or not stated
2	The axle group does include a lift axle, and the lift axle is detected as raised
3	The axle group does include a lift axle, and the lift axle is detected as lowered

B.4 Configuration Record

B.4.1 Configuration records generated in accordance with A.20 shall have the format set out in Table 7.

Table 7: Configuration Record Format

Field	Text Format	Binary Format	Value
Common header fields (see B.3.1) Record type = 1 (configuration record)			
MSU Count	N(2)	UINT(1)	Total number of connected MSUs
MSU sub-records	…	…	Details for each MSU (see B.4.2)

B.4.2 Within the configuration record there shall be one MSU sub-record to capture the data required for each MSU connected to the ECU (see A.20.2), and each MSU sub-record shall have the format set out in Table 8.

Table 8: Configuration Record MSU Sub-Record Format

Field	Text Format	Binary Format	Value
MSU Sequence Number	N(2)	UINT(1)	Numbered sequentially and incrementing from the front of the vehicle (starting at 1) to the back of the vehicle
MSU ID	AN(20)	TXT(20)	See A.6

B.5 Mass Record

B.5.1 Mass records generated in accordance with A.21 shall have the format set out in Table 9.

Table 9: Mass Record Format

Field	Text Format	Binary Format	Value
Common header fields (see B.3.1) Record type = 2 (mass record)			
Gross Vehicle Mass	N(6)	UINT(4)	Kilograms
MSU Count	N(2)	UINT(1)	Total number of connected MSUs
MSU sub-records	…	…	Details for each MSU (see B.5.2)

B.5.2 Within the mass record there shall be one MSU sub-record to capture the data required for each MSU connected to the ECU (see A.21.2), and each MSU sub-record shall have the format set out in Table 10.

Table 10: Mass Record MSU Sub-record Format

Field	Text Format	Binary Format	Value
MSU Sequence Number	N(2)	UINT(1)	Numbered sequentially and incrementing from the front of the vehicle (starting at 1) to the back of the vehicle.
MSU ID	AN(20)	TXT(20)	See A.6
Lift Axle Status Code	N(1)	UINT(1)	See B.3.4
Axle Group Mass	N(5)	UINT(2)	Kilograms

B.6 Quality Record

B.6.1 Quality records generated in accordance with A.22 shall have the format set out in Table 11.

Table 11: Quality Record Format

Field	Text Format	Binary Format	Value
Common header fields (see B.3.1) Record type = 3 (quality record)			
MSU Count	N(2)	UINT(1)	Total number of connected MSUs
MSU Sequence Number	N(2)	UINT(1)	Numbered sequentially and incrementing from the front of the vehicle (starting at 1) to the back of the vehicle
MSU ID	AN(20)	TXT(20)	See A.6
Lift Axle Status Code	N(1)	UINT(1)	See B.3.4
Frequency of Axle Group Mass Data	N(3)	UINT(1)	Frequency at which axle group mass data are collected
Number of Axle Group Mass Data	N(4)	UINT(2)	Number of axle group mass data
Axle Group Mass Data	<N(5)>[n]	<UINT(2)>[n]	See A.22.2

B.7 Alarm Record

B.7.1 Alarm records generated in accordance with A.23 shall have the format set out in Table 12.

Table 12: Alarm Record Format

Field	Text Format	Binary Format	Value
Common header fields (see B.3.1) Record type = 4 (alarm record)			
Alarm Code	N(3)	UINT(2)	See B.7.2
MSU ID	AN(20)	TXT(20)	See A.6. Only populated where the alarm record pertains to a specific MSU, otherwise blank.
MSU Sequence Number	N(2)	UINT(1)	Numbered sequentially and incrementing from the front of the vehicle (starting at 1) to the back of the vehicle. Only populated where the alarm record pertains to a specific MSU, otherwise blank.

B.7.2 Within the alarm record, the Alarm Code field shall be set in accordance with the values set out in Table 13.

Table 13: Alarm Code Format

Alarm Code	Alarm Description	Reference
40	An MSU is disconnected from the ECU while ECU in operation	A.23.1a
41	An MSU is reconnected to the ECU while ECU in operation	A.23.1b
42	An MSU is not communicating with the ECU as required by this specification	A.23.1c
43	After the ECU comes into operation, all of the vehicle's axle groups have an MSU connected to the ECU	A.23.1d
44	After the ECU comes into operation, one or more of the vehicle's axle groups do not have an MSU connected to the ECU	A.23.1e
45	The ECU internal clock is adjusted by an amount of 5 seconds or more	A.23.1f

Appendix C OBM System Requirements per Category

C.1.1 All requirements in this specification apply to an OBM system Category C.

C.1.2 For an OBM system Category B, all requirements in this specification apply except for the following:

- A.19.1
- A.19.2
- A.20.1
- A.20.2
- A.20.3
- A.21.1
- A.21.2
- A.21.3
- A.21.4
- A.22.1
- A.22.2
- A.22.3
- A.22.4
- A.23.1
- A.23.2
- A.24.1
- A.24.2
- A.27.2
- A.31.3
- A.31.4
- A.32.1
- A.32.2
- A.34.4
- A.34.5
- A.35.2b, c

C.1.3 For an OBM system Category A, all requirements in this specification apply except for the following:

- A.2.1b, c
- A.3.1
- A.3.2
- A.3.3
- A.3.4
- A.3.5
- A.4.1
- A.4.2
- A.4.3
- A.4.4
- A.5.4
- A.6.2b
- A.6.4
- A.7.1
- A.7.2
- A.7.3
- A.10.2
- A.11.2
- A.13.1d, e
- A.15.7
- A.15.8
- A.15.9
- A.15.10
- A.17.1
- A.17.2
- A.17.3
- A.17.4
- A.17.5
- A.18.1
- A.18.2
- A.18.3
- A.18.4
- A.18.5
- A.18.6
- A.19.1
- A.19.2
- A.20.1
- A.20.2
- A.20.3
- A.21.1
- A.21.2
- A.21.3
- A.21.4
- A.22.1
- A.22.2
- A.22.3
- A.22.4
- A.23.1
- A.23.2
- A.24.1
- A.24.2
- A.27.1
- A.27.2
- A.28.1
- A.31.1
- A.31.2
- A.31.3
- A.31.4
- A.32.1
- A.32.2
- A.33.1
- A.33.2
- A.34.1
- A.34.2
- A.34.3
- A.34.4
- A.34.5
- A.35.1
- A.35.2a, b, c, d

Contact

Transport Certification Australia
Level 6, 333 Queen Street
Melbourne VIC 3000

Phone: + 61 3 8601 4600
Email: tca@tca.gov.au
Website: www.tca.gov.au