Kraftfahrt-Bundesamt

DE-24932 Flensburg

E 1

MITTEILUNG

ausgestellt von:
Kraftfahrt-Bundesamt

eines Prüfprotokolls gemäß Anhang 19 Teil 1 Punkt 5.5. der ECE Regelung Nr. 13 für eine Antiblockiervorrichtung (ABV) für Anhänger

COMMUNICATION

issued by:
Kraftfahrt-Bundesamt

of a Test Report regarding Annex 19 part 1 item 5.5. of ECE Regulation No. 13 for a trailer anti-lock braking system

R13 190533

Nummer der Bestätigung**: 190533**
Confirmation No.:

1. Fabrikmarke (Handelsname des Herstellers):
Make (trade name of manufacturer):
Haldex Brake Products Ltd

2. Typ:
Type:
EB+; EB128.11E

3. Name und Anschrift des Herstellers:
Name and address of manufacturer:
Haldex Brake Products Ltd Warwickshire CV13 6DE
United Kingdom

4. Gegebenenfalls Name und Anschrift des Vertreters des Herstellers:
If any, name and address of manufacturer's representative:
Entfällt
Not applicable

5. Für die Durchführung der Prüfungen zuständiger technischer Dienst:
Technical service responsible for carrying out the tests:
TÜV Nord Mobilität GmbH & Co. KG Institut für Fahrzeugtechnik und Mobilität
DE-45307 Essen

Nummer der Bestätigung**: 190533**
Confirmation No.:

6. Datum des Prüfprotokolls:
Date of test report:
23.03.2020

7. Nummer des Prüfprotokolls:
Number of test report:
EB128.11E

8. Die Bestätigung wird **erteilt**
Confirmation is **granted**

9. Bemerkungen (gegebenenfalls):
Remarks (if any):
***)**

***) Siehe Anlage**
See enclosure

10. Ort: **DE-24932 Flensburg**
Place:

11. Datum: **14.05.2020**
Date:

12. Unterschrift: **Im Auftrag**
Signature:

M. Kasischke

M.Kasischke

KRAFTFAHRT-BUNDESAMT 512

13. Anlagen:
Enclosures:
Gemäß Inhaltsverzeichnis
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Kraftfahrt-Bundesamt

DE-24932 Flensburg

Zu: **190533**
To:

Erklärung über die Einhaltung der Anforderungen hinsichtlich der Übereinstimmung der Produktion gemäß dem Übereinkommen von 1958
Statement of compliance with the conformity of the production requirements of the 1958 Agreement

1. Name des Herstellers:
   Manufacturer's name:
   Haldex Brake Products Ltd Warwickshire CV13 6DE
   United Kingdom

2. Datum der Anfangsbewertung:
   Date of the initial assessment:
   31.01.2013

3. Datum aller durchgeführten Überwachungstätigkeiten:
   Date of any surveillance activities:

Aktenzeichen Register number	Datum der Begehung Date of inspection	Genehmigungsnummer Approval number

   CoP-Q:
   Entfällt
   Not applicable

   CoP-P:
   Entfällt
   Not applicable

Kraftfahrt-Bundesamt

DE-24932 Flensburg

Zu: **190533**
To:

Inhaltsverzeichnis zu den Beschreibungsunterlagen
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Ausgabedatum: Date of issue:	**14.05.2020**	Letztes Änderungsdatum: Last date of amendment:	**--**

Nebenbestimmungen und Rechtsbehelfsbelehrung
Collateral clauses and instruction on right to appeal

Prüfbericht(e) Nr.: Test report(s) No.: **EB128.11E**	Datum: Date: **23.03.2020**
Beschreibungsbogen Nr.: Information document No.: **GS0441 Issue 5**	Datum: Date: **29.01.2020**
Liste der Änderungen: List of modifications: **Entfällt** **Not applicable**	Datum: Date:

Kraftfahrt-Bundesamt

DE-24932 Flensburg

Nummer der Bestätigung**: 190533**
Confirmation No.:

- Anlage -

Rechtsbehelfsbelehrung

Gegen diese Bestätigung kann innerhalb eines Monats nach Bekanntgabe Widerspruch erhoben werden. Der Widerspruch ist beim **Kraftfahrt-Bundesamt, Fördestraße 16, DE-24944 Flensburg,** schriftlich oder zur Niederschrift einzulegen.

- Attachment -

Instruction on right to appeal

This Confirmation can be appealed within one month after notification. The appeal is to be filed in writing or as a transcript at the **Kraftfahrt-Bundesamt, Fördestraße 16, DE-24944 Flensburg.**

EBS-System : **EB+**
Manufacturer : **Haldex**

Approval Report
No.: EB128.11E

with respect to a

Trailer Anti-Lock Braking System

according to

UN-Regulation No. 13 - Annex 19 - Appendix 6

as last amended by

supplement 16 to the 11 series of amendments

0. General

With respect to the previous TÜV NORD Report EB128.10E this report covers the following amendments:

- Inloader cofigurations added (see 2.1.3)
- Optional CAN-Hub (Router/Repeater) added (see 2.6.1)
- Permissible tyre-to-exciter tolerances
- Editorial amendments

For the sake of simplicity the Manufacturer's Trailer ABS Information Document of the Trailer EB+ system is abbreviated in this report to "ID_GS0441".

In this document 'EB+' refers to all variants unless specifically stated otherwise.

0.1 Statement of equivalence

With respect to the assessed anti-lock braking system the comparative tests provided evidence that EB+ Gen 3 can be considered to be equivalent to previous versions of the system (see Appendix 6).

The control logic of the anti-lock control function between EB+ Gen 2 and Gen 3 is unchanged. This was verified by a comparison of the relevant source code with a source version control system. Modifications are limited to editorial amendments according to MISRA guidelines.

EBS-System : **EB+**
Manufacturer : **Haldex**

1. Identification

1.1 Manufacturer: Haldex Brake Products Ltd

MIRA Technology Park
Lindley
Warwickshire CV13 6DE
United Kingdom

1.2 System name/model: **EB+**

1.3 System variants:

EB+ Gen 1: This is a modular EBS package consisting of one or two modulators and a **removable** ECU with the following possibilities:

- 1M system with integrated single modulator (ABS category B system, category O_3 trailers)
- 2M system with integrated twin modulator
- 2M system with integrated single modulator plus slave modulator
- 3M system with integrated twin modulator plus slave modulator

EB+ Gen 2: This is an integrated EBS package consisting of a **non-removable** ECU with the following two possibilities:

- 2M system with integrated twin modulator
- 3M system with integrated twin modulator plus Gen 1 1M slave modulator

EB+ Gen 3: This is an integrated EBS package similar to Gen 2 with an extended power supply range from 8 - 32 V.

- 2M system with integrated twin modulator
- 3M system with integrated twin modulator plus modified Gen 1 1M slave modulator

Except for the configuration "**DAR**" (see paragraph 2.1 below) which is only available for the system variant EB+ Gen 2 and Gen 3, the system software with respect to the anti-lock system performance (ABS control algorithm) is **identical** for all three variants, see also paragraph 2.1 below.

EBS-System : **EB+**
Manufacturer : **Haldex**

2. System and installation

2.1 Configurations and performance:

2S/1M - 2S/2M* - 2S/2M_SL* - 2S/2M DAR - 2S/2M Relay** - 4S/2M* - 4S/2M Relay** - 4S/3M

* These configurations have integrated and non-integrated versions with EB+ Gen 1 variant

** Inloader configurations only, see 2.1.3

See also paragraph 2.1.1.4 and Appendix 1a and 1c of ID_GS0441

2S/2M (independent side by side control) and 2S/1M (select low control) configurations may be utilised to form 4S/3M configuration for trailers with more than 3 axles according to the procedure laid down in UN-R13, Annex 20, paragraph 7.4.

See also paragraph 2.1.1.4 and Appendix 1b of ID_GS0441

	EB+ Gen 1	EB+ Gen 2	EB+ Gen 3
2S/1M	C (B)	--	--
2S/2M	C (B)	D (B)	E
2S/2M_SL	C (B)	D (B)	E
2S/2M_DAR	--	D (B)	E
2S/2M_Relay	--	--	E
4S/2M_S x S	C (B)	D (B)	E
4S/2M_A x A	C (B)	D (B)	E
4S/2M_Relay	--	--	E
4S/3M	C (B)	D (B)	E

The table shows for each variant and configuration the current software version as far as UN-Regulation No. 13 is concerned. The brackets ( ) show the earliest software version still applicable.
The change from software version “B” to “C” did not alter the control logic of the ABS.

The change from the original software version “C” to “D” only adds the configuration “**DAR**” (e.g. sensor code “1D-X” in the case of a 2S/2M system; compare also paragraph 1 of Appendix 4 to this report).

The change from software version "D" to "E" modifies solenoid driving scheme for 8 - 32 V operation (see paragraph 2.1.3.4.1 of ID_GS0441). This change does not alter the control logic of the ABS (see back-to-back test, Appendix 6 of this report).

2.1.1 Category A anti-lock performance:

All anti-lock system configurations “2M” and “3M” contained in Appendix 1a to 1c of the ID_GS0441 comply with the prescribed split friction requirements defined in Annex 13 to UN-Regulation No. 13.

2.1.2 Category B anti-lock performance (O_3 trailers):

The anti-lock system configurations 2S/1M contained in Appendix 1a of the ID_GS0441 do not comply with the prescribed split friction requirements defined in Annex 13 to UN-Regulation No. 13. However, all relevant provisions applicable to this ABS category are fulfilled.

2.1.3 Inloader configurations:

For trailers where it is technically not possible to place the modulator near the brake chambers (e.g. Inloader, special trailers with U-frame for transport of glass panels) comparatively long pipe length are necessary to be used. In order to improve the response behaviour of the anti-lock braking system these configurations include relay valves, see Appendix 1c of ID_GS0441.

2.2 Range of application:

All system configurations as defined in 2.1 above may be used on semi- or centre-axle trailers having up to 3 axles.

For specific applications refer to paragraph 2.1.2 and Appendix 1a of the ID_GS0441.

4S/3M configurations may be used on full trailers with either 2 or 3 axles.
For more detailed system installation examples refer to paragraph 2.1.3.5 and Appendix 12 of the ID_GS0441.

<u>For trailers with more than 3 axles:</u>

Although according to paragraph 5.3.1 of Annex 19 of UN-R13 tests are restricted to representative trailers having up to 3 axles this test report may be utilised for type approval of trailers having more than 3 axles according to paragraph 7.4 of Annex 20.

4S/3M configurations (as a combination of 2S/2M and 2S/1M configurations) may be used on semi-trailers and full trailers with 4 and 5 axles.

This configuration ensures that the minimum number of directly controlled wheels installed on the trailer, irrespective

of type, is four (as prescribed by paragraph 7.4.1, Annex 20, UN-R13).

The axles are grouped in such a way that each modulator controls brakes on not more than three axles and each axle group installations/configurations are covered by the ABS performance tests documented in this test report.

For installation options refer to paragraph 2.1.2 and Appendix 1b of ID_GS0441.

2.3 Methods of powering:

All system configurations have the ability to accept a continuous power supply via the prescribed special connector conforming to ISO 7638. Optionally, as a back up, 1M and 2M integrated systems and 3M systems of Gen 3 can accept an intermittent power supply via the ISO 1185 (24N) or ISO 12098 (15 pin) connector (stop lamp circuit).

Permanent

To comply with the requirements of UN Regulation 13 full functionality of the system can only be obtained when connected to an interface conforming to the following standards:

ISO 7638:2003 Part 1 (24 V) 5 Pin

ISO 7638:2003 Part 1 (24 V) 7 Pin

ISO 7638:2003 Part 2 (12 V) 5 Pin (EB+ Gen 3 only)

ISO 7638:2003 Part 2 (12 V) 7 Pin (EB+ Gen 3 only)

Note: The system is also compatible with connectors produced in accordance with ISO 7638:1997

Intermittent:

As a safety function in the event of a failure of the ISO 7638 electrical power, 1M and 2M integrated systems and 3M systems of Gen 3 are able to receive electrical power from the ISO 1185 (24N) or ISO 12098 (15 pin) connector (stop lamp circuit). In this case the EBS function is disabled but the ABS function and (optionally) a dynamic load sensing function are retained. However, the 2M non integrated and 4S/3M configurations of Gen 1 and Gen 2 do not support this feature.

For more detailed information see ID_GS0441, paragraphs 2.1.1.5 and 2.1.3.4.

EBS-System : **EB+**
Manufacturer : **Haldex**

2.4. Identification of approved components

2.4.1 Wheel speed sensors: see ID_GS0441, paragraph 2.1.3.1

2.4.2 Controller (ECU): see paragraph 2.1.3.2 of the ID_GS0441

2.4.3 Modulators: see paragraph 2.1.3.3.2 and Appendix 13 of the ID_GS0441

2.5. Energy consumption: The values n_e are to be used with the verification procedure defined within Annex 20 of UN-Regulation No. 13.

2.5.1 **Drum brakes :**

2.5.1.1 Equivalent static brake applications:

Semi-trailers: **n_e = 12 applications**
(except Inloader configurations)

Inloader configurations: **n_e = 14 applications**

Full trailers: **n_e = 13 applications**

2.5.1.2 Ratio of actuator stroke against brake lever length: **R** = s_T / l_T = **0.2** (in all cases)

2.5.2 **Disc brakes:**

2.5.2.1 Equivalent static brake applications:

Semi-trailers: **n_e = 13 applications**

Full trailers: **n_e = 14 applications**

2.5.3 Trailers with more than 3 axles: According to UN-R13, Annex 20, paragraph 7.4.3 the same number of equivalent static brake applications may be used in conjunction with the verification procedure of paragraph 7.3 of Annex 20 for trailers with more than 3 axles

EBS-System : **EB+**
Manufacturer : **Haldex**

2.6	**Additional features:**	The following additional features are provided as options by appropriate connection to the 5 auxiliary connectors. **They are not subject to the assessment of this report.**
	Super-Aux Option:	see ID_GS0441, paragraph 2.1.3.2.4.2. EB+ Gen 2 and Gen 3 only
	Reset to Ride Height:	see ID_GS0441, paragraph 2.1.3.2.4.2.
	Speed Lock:	see ID_GS0441, paragraph 2.1.3.2.4.2.
	Lifting axle(s):	see ID_GS0441, paragraphs 2.1.3.2.4.2 and 2.1.2.2
	Traction Assist:	see ID_GS0441, paragraph 2.1.3.2.4.2.
	Retarder Control:	see ID_GS0441, paragraph 2.1.3.2.4.2.
	Trailer mounted warning:	see ID_GS0441, paragraph 2.1.3.2.4.2.
	Tacho:	see ID_GS0441, paragraph 2.1.3.2.4.2.
	Lining wear:	see ID_GS0441, paragraph 2.1.3.2.4.2.
	Auxiliary Power Out:	see ID_GS0441, paragraph 2.1.3.2.4.2.
	Steer lock:	see ID_GS0441, paragraph 2.1.3.2.4.2.
	Trailer Roll Stability:	see ID_GS0441, paragraph 2.1.3.2.4.2. and TÜV NORD Report No. 165.2E
	Soft docking:	see ID_GS0441, paragraph 2.1.3.2.4.2.
	Electric Brake Demand:	see ID_GS0441, paragraph 2.1.3.2.4.2.
	Suspension height control:	see ID_GS0441, paragraph 2.1.3.2.4.2.

2.6.1 CAN Hub:

The CAN Hub is a separate ECU used on long trailers where the 18 m cable length limit of towed vehicles in ISO 11992 would be breached (Repeater) or on towing trailers in order to route ISO 11992 messages / electric control line to two other ECUs (Router); see also ID_GS0441, paragraph 2.1.3.4.1.

2.6.2 Diagnostics:

Diagnostics is in accordance with KWP2000 but using CAN as the physical layer, see ID_GS0441, paragraph 2.1.3.2.5.

EBS-System : **EB+**
Manufacturer : **Haldex**

3. Test data and results

3.0 General: The software versions of the assessed EB+ systems are:

EB+ Gen 1: **C**497: (2M ECU's - covers 1M and integrated 2M systems)

EB+ Gen 1: **C**498: (3M ECU's - covers 3M and non-integrated 2M systems)

EB+ Gen 2: **D**523: (All ECU's - covers 3M and integrated 2M systems)

EB+ Gen 3: **E**642: (All ECU's - covers 3M and integrated 2M systems)

Note: The first character (letter) in the software number of the EB+ system (see above letters "**C**" to "**E**") notes the software version as far as UN-Regulation No. 13 is concerned.

The following number is a sequential identifier and may vary although the function of the EB+ system as far as UN-Regulation No. 13 is concerned is unchanged (compare UN-R13, paragraph 3.3.5.1 of Annex 18).

3.1. Test vehicle data: see Appendix 3 of this approval report.

3.2. Test track data: see Appendix 2 of this approval report.

3.3. Test results: Comparative tests of system variant EB+ Gen 2 versus Gen 3 (see Appendix 6 of this report) showed that the modifications have no impact on ABS system performance with respect to UN-R13. Test results of the previous test reports remain valid unchanged.

3.3.1. Utilisation of adhesion: see Appendix 4-1 of this approval report.

<u>Trailers with more than 3 axles:</u>

The minimum utilisation of adhesion specified within paragraph 6.2 of Annex 13 (75%) is deemed to be achieved as the following conditions are fulfilled (see UN-R13, Annex 20, paragraph 7.4.2)

- The relationship of the number of wheels directly or indirectly controlled by one or more pressure modulators and the location of the directly controlled wheels within the axle group (see also paragraph 2.1 and 2.2 above and Appendix 1b of ID_GS0441) corresponds to those defined within Appendix 1a of ID_GS0441.
- The utilisation of adhesion of the installed configurations is shown in this test report as meeting the requirements of paragraph 6.2 of Annex 13 (see Appendix 4-1 of this report)

EBS-System : **EB+**
Manufacturer : **Haldex**

3.3.2. Energy consumption:

3.3.2.1 Worst case axle load: see paragraph 2.1.2.7.1 and Appendix 6 of the ID_GS0441.

3.3.2.2 Test results: see Appendix 4-2 of this approval report.

Trailers with more than 3 axles:

See paragraph 2.5.3 of this report.

3.3.3. Split-friction test: see Appendix 4-3 of this approval report.

Trailers with more than 3 axles:

The configuration defined in paragraph 2.1 and 2.2 above ensures that the number of wheels which are subject to independent left/right control is equal to or greater than the number of wheels controlled using "select low" axle control

The split friction requirements for Category A performance specified within paragraph 6.3.2. of Annex 13 to UN-R13 are deemed to be fulfilled (UN-R13, Annex 20, paragraph 7.4.6).

3.3.4. Low speed performance: see Appendix 4-4, paragraph 1 of this approval report.

Trailers with more than 3 axles:

Additional verification is not required (UN-R13, Annex 20, paragraph 7.4.4)

3.3.5. High speed performance: see Appendix 4-4, paragraph 2 of this approval report.

Trailers with more than 3 axles:

Additional verification is not required (UN-R13, Annex 20, paragraph 7.4.5)

3.3.6. Additional checks:

3.3.6.1 Additional checks applicable to all system configurations:

Trailers with more than 3 axles:
Additional verification of surface transition performance is not required (UN-R13, Annex 20, paragraph 7.4.7)

3.3.6.1.1 Transition from high to low-adhesion surfaces: see Appendix 4-4, paragraph 3 of this approval report.

3.3.6.1.2 Transition from low to high-adhesion surfaces: see Appendix 4-4, paragraph 4 of this approval report.

EBS-System : **EB+**
Manufacturer : **Haldex**

3.3.6.2 Additional checks applicable to 4S/2M **A x A** system configurations only:

3.3.6.2.1 Transition from split to low-adhesion surfaces: see Appendix 5, paragraph 4 of this approval report.

3.3.6.2.2 Transition from split to high-adhesion surfaces: see Appendix 5, paragraph 4 of this approval report.

3.3.6.2.3 Transition from high to split-adhesion surfaces: see Appendix 5, paragraph 4 of this approval report.

3.3.6.2.4 Transition from low to split-adhesion surfaces: see Appendix 5, paragraph 4 of this approval report.

3.3.7 System safety assessment/ failure mode simulation: The assessment and simulation was carried out following the procedure defined within Annex 18 to UN-Regulation No. 13. The results from this assessment are reported in TÜV NORD "Electronic Function & Safety Assessment Test Report" No. EB 132.11E.

3.3.7.2 Functional checks of optional power connections: A failure of the ISO7638 power supply was simulated by disconnecting the connector. In this case the anti-lock braking function and load dependent pressure control* remains operational when the system is wired to the stop lamp supply of either the ISO 1185 or ISO 12098 connections. This mode of operation is intended to enhance the failure modes of the braking system in the event of a failure of the ISO7638 power supply in service and is not a primary means of powering the braking system (see also paragraph 2.3 of this report).

* The load dependent pressure control under stop light back-up is a customer option.

3.3.7.3 Electro magnetic compatibility: In order to fulfil the legal requirements regarding EMC (e.g. paragraph 5.1.1.4 of UN-Regulation No. 13), the electronics are certified according to UN Regulation No. 10 as last amended by the 03 series of amendments and Directive 72/245/EEC (as last amended by 2006/28/EC and 2009/19/EC respectively). Copies of the approval certificates are included in the ID_GS0441 (see also paragraph 2.1.4 and Appendix 17 that document).

3.3.7.4 ADR regulations: Within this test procedure no assessment was performed against ADR (Regulation governing Road Transport of Hazardous Goods). For information, see Haldex statement in the ID_GS0441, paragraph 2.1.2.1.

EBS-System : **EB+**
Manufacturer : **Haldex**

4. Limitations of installation

4.1. Tyre to exciter relationship: The relationship of tyre circumference to the resolution of the exciter is defined in the ID_GS0441, paragraph 2.1.2.3 and Appendix 16 and is applicable to all system configurations. - see also Appendix 5, paragraph 1 to this approval report

4.2. Tyre size tolerance: The tolerance on tyre circumference between one axle and another fitted with the same exciter is defined in the ID_GS0441, paragraph 2.1.2.4 and is applicable to all system configurations.

4.3. Suspension type: System performance was verified on trailers with balanced pneumatic “trailing arm” and balanced mechanical suspensions (see also in this report Appendix 4, Section 2 “Test schedule”, tables A and B).

For balanced mechanical suspensions see Appendix 4 of the ID_GS0441.

4.4. Differential(s) in brake input torque within a trailer axle group: see paragraph 2.1.2.6 and Appendix 5 of the ID_GS0441 and Appendix 5, paragraph 2 to this approval report

4.5. Wheelbase of full trailer

4.5.1 Two axle full trailers: The wheelbase is defined as the distance between centre line of axle 1 and the centre line of axle 2. The minimum approved wheelbase being 3,21 m.

4.5.2 Three axle full trailers: The wheelbase is defined as the distance between centre line of axle 1 and the centre between the wheels of axles 2 and 3. The minimum approved wheelbase being 3,84 m.

4.6. Brake type: The anti-lock system configurations covered by this approval are deemed to be satisfactory for trailers equipped with either air operated drum or disc brakes.

4.7. Tube sizes and lengths: For conventional trailer see paragraph 2.1.2.2 and Appendix 2 of the ID_GS0441 and Appendix 5, paragraph 3 to this approval report.

Inloader configurations were tested regarding utilisation of adhesion, energy consumption and split friction with the worst case tube size and length permitted according to Appendix 1c of ID_GS0441.

Note: The use of the tube sizes recommended does not guarantee that the prescribed brake system response time can be fulfilled, therefore it shall be

demonstrated that this requirement is fulfilled for each installation.

4.8. Electronic load sensing (ELS): All configurations were evaluated with the ELS operating. Performance of the respective system configurations fulfilled the prescribed requirements; for more detailed information see ID_GS0441 paragraph 2.1.2.8.

4.9. Warning signal sequence: All configurations have the option of two discrete warning signal sequences - see paragraph 2.1.3.4.3 and Appendix 11 of the ID_GS0441 - both of which fulfil the prescribed requirements of paragraph 4.1.1 (including footnote 3) of Annex 13 to UN-Regulation No. 13.

4.10. Other recommendations / limitations

4.10.1 Installation limitations: For approved installation options with respect to sensor / modulator locations and recommendations for the use of lifting and steering axles see paragraph 2.1.2.2. and Appendix 1a to 1c of the ID_GS0441.

Note: This report does not cover an assessment of the reaction of any steering systems to the anti-lock braking control of the E B $^{+}$ system.

5. Date of tests: 2000 - 2002 - 2003 - 2004 - 2006 - 2007 - 2008 - 2009 - 2012 - 2018 - 2019

The tests have been carried out and the results reported in accordance with Annex 19 to UN Regulation No. 13 as last amended by the 11 series of amendments including supplement 16.

Trailer EBS systems covered by this test report fulfil the specific conditions according to the procedure laid down in UN Regulation No. 13, Annex 20, paragraph 7.4 for type approval of trailers with more than 3 axles.

The **technical** content of this report remains valid for future amendments to UN-Regulation No. 13 provided that such future amendments do not change the performance requirements or procedures associated with the systems covered by this report.

EBS-System : **EB+**
Manufacturer : **Haldex**

6 Appendices

R13 190533

PRÜFLABORATORIUM / *TEST LABORATORY*

TÜV NORD Mobilität GmbH & Co. KG
IFM - Institut für Fahrzeugtechnik und Mobilität
Schönscheidtstr. 28, 45307 Essen

DIN EN ISO/IEC 17025, 17020
Benannt als Technischer Dienst / *Designated as Technical service*
vom Kraftfahrt Bundesamt / *by Kraftfahrt-Bundesamt*: KBA – P 00004-96

Branch office Hanover, 23.03.2020

IFM TÜV NORD Mobilität KBA-P00004-96 DIN EN ISO/IEC 17025, 17020

Digital unterschrieben von Thomas Harder
Datum: 2020.03.23 14:04:19 +01'00'

Dipl.-Ing. Harder

Order-No. 8115394647
E-Mail THarder@tuev-nord.de
Phone +49511 998-61936

EBS-System : **EB+**
Manufacturer : **Haldex**

Appendix 1 - Abbreviations & Codes

.11	Distinguishing symbols to denote tests carried out with the test vehicles used for the additional tests carried out for the System Approval Report EB128.11E
.10	Distinguishing symbols to denote tests carried out with the test vehicles used for the additional tests carried out for the System Approval Report EB128.10E
.8	Distinguishing symbols to denote tests carried out with the test vehicles used for the additional tests carried out for this System Approval Report EB128.8E (see also the notes under section “0 General”)
.7	Distinguishing symbols to denote tests carried out with the test vehicles used for the additional tests carried out for the System Approval Report EB128.7E
.6	Distinguishing symbols to denote tests carried out with the test vehicles used for the additional tests carried out for the System Approval Report EB128.6E
.5	Distinguishing symbols to denote tests carried out with the test vehicles used for the additional tests carried out for the System Approval Report EB128.5E.
.4	Distinguishing symbols to denote test vehicles used for RWTÜV system approval reports EB128.0E until EB128.4E
A19	Energy consumption test results according to Annex 19 of UN-Regulation No. 13
A x A	Axle by Axle Configuration
“ABS”	Measurement of “z” with the anti-lock braking system in operation
ASC	Adaptive Surface Control
BC	Brake cylinder
ELS	Electronic Load Sensing
EPRV	Electro Pneumatic Relay Valve
ER	Distance between king-pin and centre of axle or axles of semi-trailer.
ε	The adhesion utilised by the vehicle: quotient of the maximum braking rate with the anti-lock braking system operative (z_{AL}) and the coefficient of adhesion (k)
f	$\mathbf{f} = \mathbf{z}_{RALH} / \mathbf{z}_{RALL}$
$\mathbf{h_D}$	Height of drawbar (hinge point on trailer)
$\mathbf{h_R}$	Height of centre of gravity of the trailer
$\mathbf{h_K}$	Height of fifth wheel coupling (king pin)
k	Coefficient of adhesion between tyre and road
“K”	Measurement of “k” with the anti-lock braking system inoperative between 40 km/h and 20 km/h
$\mathbf{l_T}$	Brake lever length in mm.
$\mathbf{n_e}$	Number of equivalent static brake applications for the purpose of type approval

EBS-System : **EB+**
Manufacturer : **Haldex**

n_{e_int}	Rounded up (**int**eger values) of the equivalent numbers of the static applications n_e
n_{er}	Equivalent number of static applications obtained during testing (according to the procedure defined within Annex 19 of UN-Regulation No. 13)
P or PA	Mass of the trailer
PM	Mass of the motor vehicle (including imposed king pin load if applicable)
PMd	Total normal static reaction of road surface on the unbraked and driven axles of the motor vehicle
PMnd	Total normal static reaction of road surface on the unbraked and non-driven axles of the motor vehicle
p_0	Initial pressure in air reservoir
p_{15s}	Pressure after 15 s
p_5	5th static pressure
Pr	Static reaction of the road of the rear axle of the full trailer
PR	Total normal static reaction of road surface on all wheels (bogie) of the trailer
PRnd-kf	Static reaction of the road surface of the unbraked axles of the full trailer during the determination of k for a front axle
PRnd-kr	Static reaction of the road surface of the unbraked axles of the full trailer during the determination of k for a rear axle
R	Ratio of k_{peak} to k_{lock}.(according to Appendix 4 of Annex 13 to UN-Regulation No. 13)
$R_I \equiv R_1$	$R_1 = \frac{s_T}{l_T}$ ratio of actuator stroke against brake lever length
RV	Relay valve
S x S	Side by Side Configuration
SLV	Select-low valve
t_{zRAL}	40 to 20 km/h ABS deceleration time of the trailer with the anti-lock braking system operative
V_0	Capacity of the braking system air reservoir(s) in litres
s_T	Brake chamber push rod travel in mm
z_R	Braking rate z of the trailer with the anti-lock braking system inoperative
z_{RAL}	Braking rate z of the trailer with the anti-lock braking system operative
z_{RALH}	z_{RAL} on the surface with the high coefficient of adhesion
z_{RALL}	z_{RAL} on the surface with the low coefficient of adhesion
z_{RALS}	z_{RAL} on the split surface

EBS-System : **EB+**
Manufacturer : **Haldex**

Appendix 2 - Test track data

1 Test surface information

1.1 Road surface with good adhesion:

dry asphalt

This surface was used for the purposes of all tests with the exception of split friction and surface transition tests.

wet asphalt

This surface was used for the purposes of split friction and surface transition tests.

1.2 Road surface with low adhesion:

wet basalt

The characteristics of the surface were obtained from Engineering Report 18-0595 as of 22nd August 2018 in accordance with the requirements of footnote 1 of Appendix 4 of Annex 13 to UN Regulation No. 13 respectively as follows:

The full adhesion curve was obtained from a single axle semi-trailer which had the following characteristics:

Test vehicle:	single axle semi-trailer
Axle weight:	4240 kg
Tyre type:	GiTi 385/65 R22.5
k_{peak}	0,1297
k_{lock}	0,1259
Ratio „R“:	1,03

EBS-System : **EB+**
Manufacturer : **Haldex**

Appendix 3 - Test vehicle data

1 Vehicle data

1.1 General

Table "Overview test vehicles ".11" (EB+ Gen 3)

	Manufacturer	Type	Suspension	Brake	Brake-man.
S51.11[*)]	Dennison	one axle semi-trailer (front and rear axle lifted)	air	drum	Haldex
S52.11	Dennison	two axle semi-trailer (front axle lifted)	air	drum	Haldex
S53.11	Dennison	three axle semi-trailer	air	drum	Haldex

[*)] For evaluation of k-value only.

Table "Overview test vehicles ".10" (EB+ Gen 3)

	Manufacturer	Type	Suspension	Brake	Brake-man.
S23.10	Montracon	three axle semi-trailer	air	drum	BPW
S13.10	Fruehauf	three axle semi-trailer	air	disc	Haldex

Table "Overview test vehicles ".8" (EB+ Gen 2)

	Manufacturer	Type	Suspension	Brake	Brake-man.
S23.8	Montracon	three axle semi-trailer	air	drum	BPW
S42.8	M&G	two axle semi-trailer	air	disc	Knorr
C12.8	Dennison	two axle centre-axle trailer	air	drum	ROR

Table "Overview test vehicles ".7" (EB+ Gen 2)

	Manufacturer	Type	Suspension	Brake	Brake-man.
S21.7	Montracon	one axle semi-trailer (front & rear axle lifted)	air	drum	BPW
S22.7	Montracon	two axle semi-trailer (front axle lifted)	air	drum	BPW
S23.7	Montracon	three axle semi-trailer	air	drum	BPW

EBS-System : **EB+**
Manufacturer : **Haldex**

	Manufacturer	Type	Suspension	Brake	Brake-man.
S31.7	General Trailers	single axle semi-trailer (front & rear axle lifted)	air	disc	Haldex
S32.7	General Trailers	two axle semi-trailer (front axle lifted)	air	disc	Haldex
S33.7	General Trailers	three axle semi-trailer	air	disc	Haldex
F42S.7	Abel	two axle full trailer (rear axle removed)	air	disc	Knorr
F42L.7	Abel	two axle full trailer (first rear axle lifted)	air	disc	Knorr
F43.7	Abel	three axle full trailer	air	disc	Knorr
F52S.7	Abel	two axle full trailer (rear axle removed)	air	drum	BPW
F52L.7	Abel	two axle full trailer (first rear axle lifted)	air	drum	BPW
F53.7	Abel	three axle full trailer	air	drum	BPW

Table "Overview test vehicles ".6" (EB+ Gen 2)

	Manufacturer	Type	Suspension	Brake	Brake-man.
S11.6	**AHP**	one axle semi-trailer (wheels of 1st axle removed)	**mech.**	**drum**	**ROR**
S12.6		**two axle semi-trailer**	**mech.**	**drum**	**ROR**
S21.6	**Fruehauf**	one axle semi-trailer (wheels of 1st and 3rd axle removed)	**mech.**	**drum**	**ROR**
S23.6		**three axle semi-trailer**	**mech.**	**drum**	**ROR**
S31.6	**Montracon**	one axle semi-trailer (wheels of 1st and 3rd axle lifted)	**air**	**drum**	**BPW**
S32.6		two axle semi-trailer (wheels of 1st axle lifted)	**air**	**drum**	**BPW**
S33.6		**three axle semi-trailer**	**air**	**drum**	**BPW**

EBS-System : **EB+**
Manufacturer : **Haldex**

Table "Overview test vehicles ".5" (EB+ Gen 2)

	Manufacturer	Type	Suspension	Brake	Brake-man.
S11.5	Fruehauf	one axle semi-trailer (wheels of 1st and 3rd axle lifted)	air	disc	Haldex
S12.5		two axle semi-trailer (wheels of 1stt axle lifted)	air	disc	Haldex
S13.5		three axle semi-trailer	air	disc	Haldex
S21.5	Montracon	one axle semi-trailer (wheels of 1st and 3rd axle lifted)	air	drum	BPW
S22.5		two axle semi-trailer (wheels of 1st axle lifted)	air	drum	BPW
S23.5		three axle semi-trailer	air	drum	BPW

Table "Overview test vehicles ".4" (EB+ Gen 1)

	Manufacturer	Type	Suspension	Brake	Brake-man.
S21	Montracon	one axle semi-trailer (front & rear axle lifted)	air	drum	BPW
S22	Montracon	two axle semi-trailer (front axle lifted)	air	drum	BPW
S23	Montracon	three axle semi-trailer	air	drum	BPW
S31	General Trailers	single axle semi-trailer (front & rear axle lifted)	air	disc	Haldex
S32	General Trailers	two axle semi-trailer (front axle lifted)	air	disc	Haldex
S33	General Trailers	three axle semi-trailer	air	disc	Haldex
SF41*	Abel	two axle full trailer (first rear axle lifted) - first axle unbraked - simulated as an one axle semi-trailer	air	disc	Knorr
F42S	Abel	two axle full trailer (rear axle removed)	air	disc	Knorr
F42L	Abel	two axle full trailer (first rear axle lifted)	air	disc	Knorr
F43	Abel	three axle full trailer	air	disc	Knorr

EBS-System : **EB+**
Manufacturer : **Haldex**

	Manufacturer	Type	Suspension	Brake	Brake-man.
SF51*	Abel	two axle full trailer (first rear axle lifted) - first axle unbraked - simulated as an one axle semi-trailer	air	drum	BPW
F52S	Abel	two axle full trailer (rear axle removed)	air	drum	BPW
F52L	Abel	two axle full trailer (first rear axle lifted)	air	drum	BPW
F53	Abel	three axle full trailer	air	drum	BPW

* A full trailer was used to simulate a one axle semi-trailer for the energy consumption test (see also note to paragraph 1.3 of Appendix 3.

1.2 Weights and dimensions ("K" and "ABS" measurements)

The tables below define the fixed parameters of the trailers used for the purpose of this approval.

Tables "Weights and dimensions of test vehicles ".11" (EB+ Gen 3)

	S51.11	S52.11	S53.11
No. of Axles	**1**	**2**	**3**
axle lifted	**1 & 3**	**1**	**-**
PM [kg]	**9508**	**9888**	**9492**
PMnd [kg]	**5778**	**5840**	**5755**
PMd [kg]	**3730**	**4048**	**3737**
P(Trailer) [kg]	**6300**	**6249**	**6248**
PR [kg]	**4240**	**3809**	**4204**
h_R [mm]	**900**	**900**	**900**
h_K [mm]	**1250**	**1250**	**1250**
ER [mm]	**8040**	**8690**	**8040**

EBS-System : **EB+**
Manufacturer : **Haldex**

Tables "Weights and dimensions of test vehicles ".10" (EB+ Gen 3)

	S23.10	S13.10
No. of Axles	**3**	**3**
axle lifted	**-**	**-**
PM [kg]	**9912**	**9756**
PMnd [kg]	**5948**	**5908**
PMd [kg]	**3964**	**3848**
P(Trailer) [kg]	**7544**	**7676**
PR [kg]	**5714**	**5612**
h_R [mm]	**1250**	**1200**
h_K [mm]	**1300**	**1310**
ER [mm]	**7355**	**7450**

Table "Weights and dimensions of test vehicles ".8" (EB+ Gen 2)

	S23 *	S41	S42	C11	C12
No. of Axles	**3**	**1**	**2**	**1**	**2**
axle lifted / removed	**-**	Wheels of 1st axle removed and 3rd axle lifted of 3-axle semi-trailer	Wheels of 1st axle removed of 3-axle semi-trailer	1st axle and wheels of 3rd axle of 3-axle centre-axle trailer removed	1st axle of 3-axle centre-axle trailer removed
PM [kg]	**9860**	**10530**	**10230**	**9210**	**9670**
PMnd [kg]	**5950**	**5700**	**5690**	**4620**	**4345**
PMd [kg]	**3910**	**4830**	**4540**	**4590**	**5325**
P(Trailer) [kg]	**7650**	**6870**	**6630**	**4290**	**4540**
PR [kg]	**5820**	**4670**	**4730**	**4150**	**3940**
h_R mm]	**1250**	**1100**	**1100**	**900**	**900**
h_K [mm]	**1300**	**1340**	**1340**	**850**	**850**
ER [mm]	**7355**	**8760**	**8100**	**4830**	**5490**

* unladen weights; laden weight see Appendix 5, paragraph 3.1

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EBS-System : **EB+**
Manufacturer : **Haldex**

Tables "Weights and dimensions of test vehicles ".7" (EB+ Gen 2)

	S21	S22	S23	S31	S32	S33
No. of Axles	1	2	3	1	2	3
axle lifted	1st & 3rd	1st	-	1st & 3rd	1st	-
PM [kg]	9860	10350	9860	9910	10380	9990
PMnd [kg]	5970	6040	5950	6050	6150	6070
PMd [kg]	3890	4310	3910	3860	4230	3920
P(Trailer) [kg]	7650	7650	7650	7480	7480	7480
PR [kg]	5820	5330	5820	5600	5130	5520
h_R mm]	1250	1250	1250	1200	1200	1200
h_K [mm]	1300	1300	1300	1300	1300	1300
ER [mm]	7355	8020	7355	7450	8115	7450

	F42S = 4S	F42L = 4L	F43	F52S = 5S	F52L = 5L	F53
No. of Axles	2	2	3	2	2	3
axle lifted / removed	3rd re-moved	2nd lifted wheels re-moved	-	3rd lifted	2nd lifted	-
comment	stripped trailer	stripped trailer	stripped trailer	stripped trailer	stripped trailer	stripped trailer
PM [kg]	9270	9270	9270	9270	9270	9270
PMnd [kg]	5700	5700	5700	5700	5700	5700
PMd [kg]	3570	3570	3570	3570	3570	3570
PR [kg]	5910	5910	5910	5420	5430	5410
Pf [kg]	1720	2970	2470	1580	2790	2280
Pr [kg]	4190	2940	3440	3840	2640	3130
PRnd-kf [kg]	4190	2940	3440	3840	2640	3130
PRnd-kr [kg]	1720	2970	2470	1580	2790	2280
h_R mm]	1150	1150	1150	1000	1000	950
h_D [mm]	750	750	750	770	770	770
E [mm]	3210	4570	3890	3190	4550	3870

EBS-System : **EB+**
Manufacturer : **Haldex**

Tables "Weights and dimensions of test vehicles ".6" (EB+ Gen 2)

	S11.6	S12.6	S21.6	S23.6
No. of Axles	**1**	**2**	**1**	**3**
	wheels of 1st axle removed	-	wheels of 1st and 3rd axle removed	-
PM [kg]	**9055**	**9025**	**9665**	**9370**
PMnd [kg]	**5475**	**5540**	**5580**	**5560**
PMd [kg]	**3580**	**3485**	**4085**	**3810**
P(Trailer) [kg]	**2530**	**2935**	**4890**	**4685**
PR [kg]	**2095**	**2530**	**3850**	**3935**
h_R [mm]	**1050**	**1050**	**1200**	**1200**
h_K [mm]	**1320**	**1320**	**1320**	**1320**
ER [mm]	**6160**	**5480**	**7520**	**7520**

	S31.6	S32.6	S33.6
No. of Axles	**1**	**2**	**3**
	1st & 3rd lifted	**1st lifted**	-
PM [kg]	**9985**	**10405**	**9940**
PMnd [kg]	**5660**	**5665**	**5625**
PMd [kg]	**4325**	**4740**	**4315**
P(Trailer) [kg]	**7425**	**7340**	**7310**
PR [kg]	**6060**	**5555**	**5990**
h_R mm]	**1250**	**1250**	**1250**
h_K [mm]	**1275**	**1275**	**1275**
ER [mm]	**7345**	**8010**	**7345**

EBS-System : **EB+**
Manufacturer : **Haldex**

Table "Weights and dimensions of test vehicles ".5" (EB+ Gen 2)

	S11.5	S12.5	S13.5	S21.5	S22.5	S23.5
No. of Axles	1	2	3	1	2	3
	1st & 3rd lifted	1st lifted	-	1st & 3rd lifted	1st lifted	-
PM [kg]	10020	10480	10015	10050	10710	10080
PMnd [kg]	6040	6140	6055	5650	5880	5650
PMd [kg]	3980	4340	3960	4400	4830	4430
P(Trailer) [kg]	7650	7650	7650	7550	7550	7550
PR [kg]	5650	5200	5580	5950	5450	5920
h_R mm]	1200	1200	1200	1250	1250	1250
h_K [mm]	1310	1310	1310	1275	1275	1275
ER [mm]	7450	8100	7450	7350	8010	7350

Tables "Weights and dimensions of test vehicles ".4" (EB+ Gen 1)

	S21	S22	S23	S31	S32	S33
No. of Axles	1	2	3	1	2	3
axle lifted	1st & 3rd	1st	-	1st & 3rd	1st	-
PM [kg]	11380	11880	11420	10320	10820	10350
PMnd [kg]	5160	5180	5170	6320	6430	6330
PMd [kg]	6220	6700	6250	4000	4390	4020
P(Trailer) [kg]	7860	7860	7860	7910	7910	7910
PR [kg]	6040	5540	6000	5880	5380	5850
h_R mm]	1350	1350	1350	1200	1200	1200
h_K [mm]	1350	1350	1350	1300	1300	1300
ER [mm]	7350	8010	7350	7450	8100	7450

EBS-System : **EB+**
Manufacturer : **Haldex**

	F42S = 4S	F42L = 4L	F43	F52S = 5S	F52L = 5L	F53
No. of Axles	2	2	3	2	2	3
axle lifted / removed	3rd removed	2nd lifted wheels removed	-	3rd lifted	2nd lifted	-
comment	stripped trailer	stripped trailer	stripped trailer	stripped trailer	stripped trailer	stripped trailer
PM [kg]	9070	9070	9070	9560	9560	9560
PMnd [kg]	4670	4670	4670	5160	5160	5160
PMd [kg]	4400	4400	4400	4400	4400	4400
P(Trailer) [kg]	4780	5260	5500	5520	5430	5430
PR [kg]	4780	5260	5500	5520	5430	5430
Pf [kg]	2150	2660	2480	1780	2880	2470
Pr [kg]	2630	2600	3020	3740	2550	2960
PRnd-kf [kg]	2630	2600	3020	3740	2550	2960
PRnd-kr [kg]	2150	2660	2480	1780	2880	2470
h_R mm]	1150	1000	950	1000	1000	950
h_D [mm]	770	770	770	770	770	770
E [mm]	3210	4570	3890	3190	4550	3870

EBS-System : **EB+**
Manufacturer : **Haldex**

1.3 **Weights** (energy consumption tests)

Table "Weights (energy consumption tests) - test vehicles ".11" (EB+ Gen 3)

Energy Consumption Loads			
Trailer	**P** (Trailer) **[kg]**	**PR [kg]**	**Axle load (average) [kg]**
S52.11	7186	4975	2487,5
S53.11	9733	7698	2566

Table "Weights (energy consumption tests) - test vehicles ".10" (EB+ Gen 3)

Energy Consumption Loads			
Trailer	**P** (Trailer) **[kg]**	**PR [kg]**	**Axle load (average) [kg]**
S23.10	9256	7122	2374

Table "Weights (energy consumption tests) - test vehicles ".8" (EB+ Gen 2)

Energy Consumption Loads			
Trailer	**P** (Trailer) **[kg]**	**PR [kg]**	**Axle load (average) [kg]**
S42.8	7410	5250	2625
C12.8	5670	5090	2545

EBS-System : **EB+**
Manufacturer : **Haldex**

Table "Weights (energy consumption tests)- test vehicles ".7" (EB+ Gen 2)

Energy Consumption Loads			
Trailer	**P** (Trailer) **[kg]**	**PR [kg]**	**Axle load (average) [kg]**
S22.7	7430	5210	2605
S23.7	9680	7740	2580
S33.7	9740	7820	3910
F42L.7	5190	5190	2595
F43.7	7650	7650	2550
F52L.7	5140	5140	2570
F53.7	7560	7560	2520

Table "Weights (energy consumption tests)- test vehicles ".6" (EB+ Gen 2)

Energy Consumption Loads			
Trailer	**P** (Trailer) **[kg]**	**PR [kg]**	**Axle load (average) [kg]**
S22.6	5080	4815	2408
S23.6	8815	7175	2392
S32.6	9635*	5305	2653
S33.6	9300	7750	2583

*** Additional ballast weight on the trailer ahead of the king pin**

EBS-System : **EB+**
Manufacturer : **Haldex**

Table "Weights (energy consumption tests)- test vehicles ".5"

UN Annex 19 loading	S12.5	S13.5	S22.5	S23.5
P (Trailer) [kg]	13270*	8650	13450*	12130
PR [kg]	4580	6735	4730	6840
Axle load (average) [kg]	2290	2245	2365	2280

*** Additional ballast weight on the trailer ahead of the king pin**

Tables "Test vehicles ".4" - weights (energy consumption tests - worst case loading/EEC - Directive Annex XIV)" - (EB+ Gen 1)

EEC-worst case loading	S22	S23	S32	S33
P [kg]	11840	9690	7640	9850
PR [kg]	5180	7890	5260	7850
PR_1 [kg]	-	2600	-	2600
PR_2 [kg]	2620	2670	2650	2640
PR_3 [kg]	2560	2620	2610	2610

EEC-worst case loading	SF41L	F42S	F42L	F43	SF51L	F52S	F52L	F53
P [kg]	5390	5190	5260	7870	5340	5190	5220	7920
PR [kg]	5390	5190	5260	7870	5340	5190	5220	7920
PR1 [kg]	(2790)*	2590	2660	2600	(2740)*	2610	2610	2620
PR_2 [kg]	-	2600	-	2650	-	2580	-	2670
PR_3 [kg]	2600	-	2600	2620	2600	-	2610	2630

* First axle used only as an unbraked dolly axle to simulate a one axle semi-trailer

EBS-System : **EB+**
Manufacturer : **Haldex**

Appendix 4 - Test results

1 Locations and identification of sensors on test vehicles

The following table provides **examples** of the locations and identification of sensors on test vehicles.

General notes in respect to the following table

“a”	Modulator 2.1 is logically connected to wheel speed sensor(s) “A” and modulator 2.2 is logically connected to wheel speed sensor(s) “B”
“b”	Modulator 2.1 is logically connected to wheel speed sensor(s) “B” and modulator 2.2 is logically connected to wheel speed sensor(s) “A”
_	an underscore at the beginning of a configuration denotes that this configuration refers to the non-integrated modulator (slave)
Sensors “1”'	fitted on the foremost sensed axle
Sensors “2”'	fitted on the rearmost sensed axle
Sensors “A”'	normally fitted on left side
Sensors “B”	normally fitted on right side
D	means the axle is controlled in a semi-independent manner for a steering dolly application
H	means the axle is controlled by ASC, utilising select high or select low control dependent on the adhesion ratio, see paragraph 2.1.1.5 of the ID_GS0441
L	means select low controlled axle
M	means the axle is controlled by the master valve assembly (master ECU sensors “1A" and "1B” or “2A" and "2B)
R	indirectly controlled axle via a SL-valve (SLV) and conventional relay valve (RV)
S	means the axle is controlled (select low) by the slave valve assembly (master ECU sensors “1A" and "1B” or “2A" and "2B)
T	axle indirectly controlled via a conventional select-low valve (SLV)
„X“	denotes, no sensor fitted on given axle (means an axle indirectly controlled from sensors “1A” and “1B”)
4S/3M	modulator “2” (EPRV) is always in select low control

EBS-System : **EB+**
Manufacturer : **Haldex**

System configuration _S number of sensors (directly controlled wheels) _M number of pressure modulators	**sensing-identifier** sensor reference and position within the bogie	**General notes** **see above**
2 S / 1 M	**1** - one axle trailer - equipped with sensor **1 A** and **1 B** connected to modulator **"2"**	
2 S / 2 M S x S **Side by Side configurations ("integrated")**	**1 a** - one axle trailer - equipped with sensor **1 A** connected to modulator **2.1** - equipped with sensor **1 B** connected to modulator **2.2**	**1 b** - one axle trailer - equipped with sensor **1 B** connected to modulator **2.1** - equipped with sensor **1 A** connected to modulator **2.2**
	X - **1 a** - two axle trailer - axle one without a sensor - equipped with sensor **1 A** connected to modulator **2.1** on second axle - equipped with sensor **1 B** connected to modulator **2.2** on second axle	X - **1 b** - two axle trailer - axle one without a sensor - equipped with sensor **1 B** connected to modulator **2.1** on second axle - equipped with sensor **1 A** connected to modulator **2.2** on second axle
	1 D a - X - two axle trailer - axle two without a sensor - equipped with sensor **1 A** connected to modulator **2.1** on first axle - equipped with sensor **1 B** connected to modulator **2.2** on first axle - DAR control logic	**1 D b - X** - two axle trailer - axle two without a sensor - equipped with sensor **1 B** connected to modulator **2.1** on first axle - equipped with sensor **1 A** connected to modulator **2.2** on first axle - DAR control logic
2 S / 2 M S x S ("non integrated")	**see above "integrated" sensing-identifiers**	**see above "integrated" sensing-identifiers**

EBS-System : **EB+**
Manufacturer : **Haldex**

System configuration _S number of sensors (directly controlled wheels) _M number of pressure modulators	**sensing-identifier** sensor reference and position within the bogie	**General notes** **see above**
2 S / 2 M _ S L	**_1a-T**	the first axle is equipped with sensors „1“, the second axle is not fitted with sensors (indirectly controlled by axle 1 via the SL-valve)
	_1a-R	the first axle is equipped with sensors „1“, the second axle is not fitted with sensors (indirectly controlled by axle 1 via a SL-valve and conventional relay valve
	_X-1a-T	- axle one without a sensor - indirectly controlled by axle 2 - the second axle is equipped with sensors „1“ - the third axle is not fitted with sensors (indirectly controlled by axle 2 via the SL-valve)
	_T-1a-X	- the first axle is not fitted with sensors (indirectly controlled by axle 2 via the SL-valve) - the second axle is equipped with sensors „1“ - third axle without a sensor - indirectly controlled by axle 2
4 S / 2 M S x S **Side by Side configurations**	X **- 1 a - 2 a** - three axle trailer - axle one without a sensor - equipped with sensor **1 A** connected to modulator **2.1** on second axle - equipped with sensor **2 A** connected to modulator **2.1** on third axle	X **- 1 b - 2 b** - three axle trailer - axle one without a sensor - equipped with sensor **1 B** connected to modulator **2.1** on second axle - equipped with sensor **2 B** connected to modulator **2.1** on third axle

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EBS-System : **EB+**
Manufacturer : **Haldex**

System configuration _S number of sensors (directly controlled wheels) _M number of pressure modulators	**sensing-identifier** sensor reference and position within the bogie	**General notes** **see above**
4S/2M A x A **Axle by Axle configurations**	**1 H -** X **- 2 L** - three axle trailer - first axle equipped with sensors **1 A** and **1 B** connected to modulator **2.1** or **2.2** ("ASC-channel") - axle two without a sensor - indirectly controlled by the first (H) axle - third axle equipped with sensors **2 A** and **2 B** connected to modulator **2.1** or **2.2** ("SL-channel")	**1 L - 2 H -** X - three axle trailer - first axle equipped with sensors **1 A** and **1 B** connected to modulator **2.1** or **2.2** ("SL-channel") - second axle equipped with sensors **2 A** and **2 B** connected to modulator **2.1** or **2.2** ("ASC-channel") - axle three without a sensor - indirectly controlled by the second (H) axle
4S/3M **(2-axle semi-trailer)**	**M a - S** - equipped with sensor **S 1 A** controlling modulator **"21"** on first axle - equipped with sensor **S 1 B** controlling modulator **"22"** on first axle - equipped with sensors **S 2 A** and **S 2 B** controlling modulator **"2"** on second axle	**M b - S** - equipped with sensor **S 1 A** controlling modulator **"22"** on first axle - equipped with sensor **S 1 B** controlling modulator **"21"** on first axle - equipped with sensors **S 2 A** and **S 2 B** controlling modulator **"2"** on second axle
4S/3M **(3-axle semi-trailer)**	**M a -** X **- S** - equipped with sensor **S 1 A** controlling modulator **"21"** on first axle - equipped with sensor **S 1 B** controlling modulator **"22"** on first axle - axle two without a sensor - indirectly controlled by axle one side by side - equipped with sensors **S 2 A** and **S 2 B** controlling modulator **"2"** on third axle	**M b -** X **- S** - equipped with sensor **S 1 A** controlling modulator **"22"** on first axle - equipped with sensor **S 1 B** controlling modulator **"21"** on first axle - axle two without a sensor - indirectly controlled by axle one side by side - equipped with sensors **S 2 A** and **S 2 B** controlling modulator **"2"** on third axle
	S - X **- M a** - equipped with sensors **S 1 A** and **S 1 B** controlling modulator **"2"** on first axle - axle two without a sensor - indirectly controlled by axle three side by side - equipped with sensor **S 2 B** controlling modulator **"22"** on third axle - equipped with sensor **S 2 A** controlling modulator **"21"** on third axle	**S b -** X **- M b** - equipped with sensors **S 1 A** and **S 1 B** controlling modulator **"2"** on first axle - axle two without a sensor - indirectly controlled by axle three side by side - equipped with sensor **S 2 B** controlling modulator **"21"** on third axle - equipped with sensor **S 2 A** controlling modulator **"22"** on third axle

EBS-System : **EB+**
Manufacturer : **Haldex**

2 Test schedule

The following tables **A** and **B** define test schedules by system configurations and trailer types that were considered appropriate for the purpose of an “Annex XIV” or “Annex 19” approval.

Table A: Balanced air suspension										
Semi- & centre axle trailer **Sensing identifiers & location of directly controlled wheels**										
no of axles	**1**	**1**	**2**	**2**	**2**	**2**	**3**	**3**	**3**	**3**
2S/1M [1]	**1**		**1-X**	**X-1**	**-**	**-**	**X-1-X**		**-**	**-**
2S/2M - SxS “integrated” [2a]	**1a**	**1b**	**1a-X 1Da-X**	**X-1a X-1Da**	**1b-X 1Db-X**	**X-1b X-1Db**	**X-1a-X**	**X-1b-X**	**-**	**-**
2S/2M - SxS “non integrated” - [2a]	**sensing identifier identical with the above specified integrated system 2S/2M - SxS - see also installation diagrams in Appendix 1a**									
2S/2M_SL [2a]	**-**	**-**	**1a-T**	**1a-R**	**1b-T**	**1b-R**	**T-1a-X R-1a-X**	**T-1b-X R-1b-X**	**X-1a-T X-1a-R**	**X-1b-T X-1b-R**
2S/2M_1R [2a] [5]	**-**	**-**	**1a-X**	**-**	**1b-X**	**-**	**X-1a-X**	**X-1b-X**	**-**	**-**
4S/2M - SxS “integrated” [2a]	**-**	**-**	**1a-2a**	**1b-2b**	**-**	**-**	**X-1a-2a X-1b-2b**	**1a-2a-X 1b-2b-X**	**1a-X-2a 1b-X-2b**	**-**
4S/2M - SxS “non integrated” - [2a]	**sensing identifier identical with the above specified integrated system 4S/2M - SxS - see also installation diagrams in Appendix 1a**									
4S/2M - AxA - ASC front	**-**	**-**	**-**	**1H-2L**	**-**	**-**	**-**	**1H-X-2L**	**-**	**X-1H-2L**
4S/2M - AxA - ASC rear	**-**	**-**	**1L-2H**	**-**	**-**	**-**	**1L-X-2H**	**-**	**1L-2H-X**	**-**
4S/2M_1R [2a]	**-**	**-**	**1a-2**	**1b-2**	**-**	**-**	**-**	**-**	**-**	**-**
4S/3M [2b]	**-**	**-**	**Ma-S**	**Mb-S**	**S-Ma**	**S-Mb**	**S-Ma-X S-Mb-X**	**S-X-Ma S-X-Mb**	**Ma-XS Mb-XS**	**X-Ma-S X-Mb-S**

EBS-System : **EB+**
Manufacturer : **Haldex**

Table A: Balanced air suspension			
Full axle trailer **Sensing identifiers & location of directly controlled wheels**			
no of axles	**2**	**3**	**3**
4S/3M [2b]	**S-Ma / S-Mb**	**S-Ma-X / S-Mb-X**	**S-X-Ma / S-X-Mb**

Table B: Balanced mechanical suspension										
Semi- & centre axle trailer **Sensing identifiers & location of directly controlled wheels**										
no of axles	**1**	**1**	**2**	**2**	**2**	**2**	**3**	**3**	**3**	**3**
2S/2M - SxS "integrated" [2a]	**1a**	**1b**	**1a-X**	**X-1a**	**1b-X**	**X-1b**	**X-1a-X**	**X-1b-X**	**-**	**-**
4S/2M - SxS "integrated" [2a]	**-**	**-**	**1a-2a**	**1b-2b**	**-**	**-**	**X-1a-2a** **X-1b-2b**	**1a-2a-X** **1b-2b-X**	**1a-X-2a** **1b-X-2b**	**-**

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3 Worst case cross referencing

In accordance with the provisions of paragraph 5.4.1 of Annex 19 the following worst case cross references were considered appropriate.

1 2S/1M configurations: The ECU may be mounted facing in different directions as shown in Appendix 1a to 1c of the ID_GS0441

2a The side by side configurations "1a" are identical with the corresponding configurations "1b" in respect of functionality and performance. The same applies for the configurations 1a2a and 1b2b.

2b The 4S/3M configurations "**a** M" are identical with the corresponding configurations "**b** M" in respect of functionality and performance.

EBS-System : **EB+**
Manufacturer : **Haldex**

3 Paragraph 5.3.1.4 of Annex 19 of UN-Regulation requires the utilisation of adhesion to be carried out with the load sensing device set for the laden and unladen conditions. The EB^+ system apportions the brake chamber pressure for the respective vehicle load condition during non-anti-lock operation. When the brake chamber pressure is such that a brake force is produced that exceeds the specified tyre to wheel adhesion limits then the anti-lock system takes control. During anti-lock operation reservoir pressure (≥ **fully laden** worst case demand) is applied on the input to each relay modulator valve. This pressure is modulated by the anti-lock and is **not influenced by suspension behaviour.** Therefore all tests were carried out with the electronic load sensing (ELS) in operation.

4 With respect to the ABS algorithm both variants EB^+ Gen 1 and EB^+ Gen 2 are identical.

EBS-System : **EB+**
Manufacturer : **Haldex**

Appendix 4-1 - Utilisation of adhesion

Note: Tests marked with an * were carried out with a reduction in the brake lever length on axle „1“.

1 Test trailers “.11” (EB+ Gen 3)

Trailer	System config.	Sensor code	No. of axles	k_R	ε
S52.11	2S/2M_1R	**1-X**	2	0,812	**0,79**
S52.11	4S/2M_1R	**1-2**	2	0,812	**0,80**
S53.11	2S/2M_1R	**X-1-X**	3	0,812	**0,79**

2 Test trailers “.8” (EB+ Gen 2)

Trailer	System config.	Sensor code	No. of axles	k_R	ε
S42.8	2S/2M	**1D-X**	2	0,886	**0,84**
S42.8	2S/2M	**X-1D**	2	0,886	**0,82**
C12.8	2S/2M	**1D-X**	2	0,905	**0,83**
C12.8	2S/2M	**X-1D**	2	0,905	**0,85**

3 Test trailers “.7” (EB+ Gen 2)

Trailer	System config.	Sensor code	No. of axles	k_R	ε
S22.7	4S/3M	**MS**	2	0,857	**0,88**
S22.7	4S/3M	**SM**	2	0,857	**0,82**
S32.7	4S/3M	**MS**	2	0,896	**0,88**
S32.7	4S/3M	**MS***	2	0,896	**0,86**
S32.7	4S/3M	**SM**	2	0,896	**0,88**
S23.7	4S/3M	**SMX**	3	0,857	**0,81**
S23.7	4S/3M	**SXM**	3	0,857	**0,79**
S23.7	4S/3M	**MXS**	3	0,857	**0,81**
S23.7	4S/3M	**XMS**	3	0,857	**0,79**
S33.7	4S/3M	**SMX**	3	0,896	**0,88**

EBS-System : **EB+**
Manufacturer : **Haldex**

Trailer	System config.	Sensor code	No. of axles	k_R	ε
S33.7	4S/3M	**SXM**	3	0,896	**0,88**
S33.7	4S/3M	**MXS**	3	0,896	**0,89**
S33.7	4S/3M	**XMS**	3	0,896	**0,86**
S33.7	4S/3M	**XMS***	3	0,896	**0,82**
F42S.7	4S/3M	**SM**	2	0,896	**0,84**
F42L.7	4S/3M	**SM**	2	0,899	**0,84**
F52S.7	4S/3M	**SM**	2	0,861	**0,78**
F52L.7	4S/3M	**SM**	2	0,853	**0,82**
F43.7	4S/3M	**SMX**	3	0,898	**0,85**
F43.7	4S/3M	**SXM**	3	0,898	**0,84**
F53.7	4S/3M	**SMX**	3	0,856	**0,82**
F53.7	4S/3M	**SXM**	3	0,856	**0,83**

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4 Test trailers ".6" (EB+ Gen 2)

Trailer	System config.	Sensor code	No. of axles	k_R	ε
S11.6	2S/2M	1	1	0,896	**0,83**
S12.6	2S/2M	1X	2	0,896	**0,83**
S12.6	2S/2M	X1	2	0,896	**0,88**
S21.6	2S/2M	1	1	0,922	**0,82**
S23.6	2S/2M	X1X	3	0,922	**0,90**
S23.6	2S/2M	X1X *	3	0,922	**0,87**
S12.6	4S/2M	12	2	0,896	**0,85**
S23.6	4S/2M	X12	3	0,922	**0,95**
S23.6	4S/2M	X12 *	3	0,922	**0,88**
S23.6	4S/2M	12X	3	0,922	**0,94**
S31.6	2S/2M	1	1	0,871	**0,88**

EBS-System : **EB+**
Manufacturer : **Haldex**

Trailer	System config.	Sensor code	No. of axles	k_R	ε
S32.6	2S/2M	1X	2	0,871	**0,83**
S32.6	2S/2M	X1	2	0,871	**0,79**
S33.6	2S/2M	X1X	3	0,871	**0,81**
S33.6	2S/2M	X1X *	3	0,871	**0,80**

5 Test trailers ".5" (EB+ Gen 2)

Trailer	System Configuration & sensing identifier	No. of axles	k_R	ε
S11.5	2S/2M_1	1	0,903	**0,77**
S12.5	2S/2M_1X	2	0,903	**0,91**
S12.5	2S/2M_X1	2	0,903	**0,87**
S13.5	2S/2M_X1X	3	0,903	**0,87**
S21.5	2S/2M_1	1	0,874	**0,85**
S12.5	2S/2M_SL_1T	2	0,903	**0,87**
S12.5	2S/2M_SL_1R	2	0,903	**0,83**
S13.5	2S/2M_SL_T1X	3	0,903	**0,80**
S13.5	2S/2M_SL_R1X	3	0,903	**0,80**
S22.5	4S/2M_12	2	0,874	**0,87**
S23.5	4S/2M_1X2	3	0,874	**0,83**
S22.5	4S/2M_ASC front HL	2	0,874	**0,89**
S23.5	4S/2M_ASC front HXL	3	0,874	**0,81**
S12.5	4S/2M_ASC rear LH	2	0,903	**0,85**
S13.5	4S/2M_ASC rear LXH	3	0,903	**0,81**

EBS-System : **EB+**
Manufacturer : **Haldex**

6 Test trailers ".4" (EB+ Gen 1)

Trailer	System Configuration & sensing identifier	No. of axles	k_R	ε
S21	2S/1M_1	1	0,927	**0,77**
S22	2S/1M_1X	2	0,927	**0,92**
S22	2S/1M_X1	2	0,927	**0,87**
S23	2S/1M_X1X	3	0,927	**0,93**
S23	2S/1M_X1X*	3	0,927	**0,94**
S31	2S/1M_1	1	0,880	**0,77**
S32	2S/1M_1X	2	0,880	**0,87**
S32	2S/1M_X1	2	0,880	**0,87**
S33	2S/1M_X1X	3	0,880	**0,87**
S31	2S/2M_1	1	0,880	**0,89**
S32	2S/2M_1X	2	0,880	**0,89**
S32	2S/2M_X1	2	0,880	**0,88**
S33	2S/2M_X1X	3	0,880	**0,84**
S33	2S/2M_X1X*	3	0,880	**0,76**
S22	2S/2M_X1	2	0,927	**0,85**
S22	2S/2M_SL_1T	2	0,927	**0,84**
S22	2S/2M_SL_1R	2	0,927	**0,85**
S23	2S/2M_SL_T1X	3	0,927	**0,88**
S23	2S/2M_SL_R1X	3	0,927	**0,82**
S23	2S/2M_SL_X1T	3	0,927	**0,84**
S23	2S/2M_SL_X1R	3	0,927	**0,83**
S32	2S/2M_SL_1T	2	0,880	**0,85**
S32	2S/2M_SL_1R	2	0,880	**0,82**
S33	2S/2M_SL_T1X	3	0,880	**0,84**
S33	2S/2M_SL_R1X	3	0,880	**0,81**

EBS-System : **EB+**
Manufacturer : **Haldex**

Trailer	System Configuration & sensing identifier	No. of axles	k_R	ε
S33	2S/2M_SL_X1T	3	0,880	**0,86**
S33	2S/2M_SL_X1R	3	0,880	**0,81**
S32	4S/2M_12	2	0,880	**0,90**
S33	4S/2M_X12	3	0,880	**0,86**
S33	4S/2M_12X	3	0,880	**0,81**
S33	4S/2M_1X2	3	0,880	**0,77**
S22	4S/2M_12	2	0,927	**0,87**
S23	4S/2M_X12	3	0,927	**0,90**
S22	4S/2M_ASC front HL	2	0,927	**0,89**
S23	4S/2M_ASC front HXL	3	0,927	**0,79**
S23	4S/2M_ASC front XHL	3	0,927	**0,90**
S32	4S/2M_ASC front HL	2	0,880	**0,86**
S33	4S/2M_ASC front HXL	3	0,880	**0,87**
S33	4S/2M_ASC front XHL	3	0,880	**0,86**
S32	4S/3M_MS	2	0,890	**0,86**
S32	4S/3M_SM	2	0,890	**0,87**
S33	4S/3M_SMX	3	0,890	**0,89**
S33	4S/3M_SXM	3	0,890	**0,88**
S33	4S/3M_MXS	3	0,890	**0,88**
S33	4S/3M_XMS	3	0,890	**0,87**
S22	4S/3M_MS	2	0,927	**0,91**
S22	4S/3M_MS*	2	0,927	**0,92**
S22	4S/3M_SM	2	0,927	**0,91**
S23	4S/3M_SMX	3	0,927	**0,96**
S23	4S/3M_SXM	3	0,927	**0,93**
S23	4S/3M_MXS	3	0,927	**0,92**

EBS-System : **EB+**
Manufacturer : **Haldex**

Trailer	System Configuration & sensing identifier	No. of axles	k_R	ε
S23	4S/3M_XMS	3	0,927	**0,91**
S23	4S/3M_XMS*	3	0,927	**0,91**
F42S	4S/3M_SM	2	0,889	**0,81**
F42L	4S/3M_SM	2	0,888	**0,78**
F43	4S/3M_SMX	3	0,889	**0,84**
F43	4S/3M_SXM	3	0,889	**0,78**
F52S	4S/3M_SM	2	0,878	**0,89**
F52L	4S/3M_SM	2	0,863	**0,86**
F53	4S/3M_SMX	3	0,868	**0,96**
F53	4S/3M_SXM	3	0,869	**0,83**

EBS-System : **EB+**
Manufacturer : **Haldex**

Appendix 4-2 - Energy consumption tests

Note

A19 ⇒ Energy consumption test results according to Annex 19 of UN-Regulation No. 13

1 Test trailers ".11" (EB+ Gen 3)

Trailer	Test	System config.	Sensor identif.	No. of axles	V_0 [l]	p_0 kPa	p_{15s} kPa	p_5 kPa	n_{er_ECE}	n_{e_ECE} = 1,2 * n_{er_ECE}	n_{e_int}	R_l R_1
S52.11	**A19**	2S/2M_1R	**1-X**	2	120	800	642	508	9,16	10,99	**11**	0,2
S52.11	**A19**	4S/2M_1R	**1-2**	2	120	800	605	482	10,39	12,47	**13**	0,2
S53.11	**A19**	2S/2M_1R	**X-1-X**	3	120	800	542	413	11,44	13,73	**14**	0,2

2 Test trailers ".8" (EB+ Gen 2)

Trailer	Test	System config.	Sensor identif.	No. of axles	V_0 [l]	p_0 kPa	p_{15s} kPa	p_5 kPa	n_{er_ECE}	n_{e_ECE} = 1,2 * n_{er_ECE}	n_{e_int}	R_l R_1
S42.8	**A19**	2S/2M	**1D-X**	2	80	800	692	565	8.53	10.24	**11**	disc
S42.8	**A19**	2S/2M	**X-1D**	2	80	800	705	573	8.15	9.78	**10**	disc
C12.8	**A19**	2S/2M	**1D-X**	2	80	800	650	512	8.59	10.3	**11**	0,20
C12.8	**A19**	2S/2M	**X-1D**	2	80	800	661	520	8,26	9.0	**10**	0,20

3 Test trailers ".7" (EB+ Gen 2)

Trailer	Test	System config.	Sensor identif.	No. of axles	V_0 [l]	p_0 kPa	p_{15s} kPa	p_5 kPa	n_{er_ECE}	n_{e_ECE} = 1.2 * n_{er_ECE}	n_{e_int}	R_l R_1
S22.7	**A19**	4S/3M	**M S**	2	80	800	665	543	9.00	10.8	**11**	0.20
S23.7	**A19**	4S/3M	**S X M**	3	100	800	662	523	8.38	10.5	**11**	0.20
S23.7	**A19**	4S/3M	**X M S**	3	100	800	638	506	9.12	10.95	**11**	0.20
S33.7	**A19**	4S/3M	**M X S**	3	100	800	664	538	8.81	10.57	**11**	disc
F42L.7	**A19**	4S/3M	**S M**	2	80	800	611	487	10.05	12.06	**13**	disc
F43.7	**A19**	4S/3M	**S X M**	3	100	800	642	507	9.24	11.08	**12**	disc
F52L.7	**A19**	4S/3M	**S M**	2	80	800	615	431	8.00	9.60	**10**	0.20

EBS-System : **EB+**
Manufacturer : **Haldex**

Trailer	Test	System config.	Sensor identif.	No. of axles	V_0 [l]	p_0 kPa	p_{15s} kPa	p_5 kPa	n_{er_ECE}	n_{e_ECE} = 1.2 * n_{er_ECE}	n_{e_int}	R_l R_1
F53.7	**A19**	4S/3M	**S M X**	3	100	800	668	496	7.57	9.08	**10**	0.20

4 Test trailers ".6" (EB+ Gen 2)

Trailer	Test	System config.	Sensor identif.	No. of axles	V_0 [l]	p_0 kPa	p_{15s} kPa	p_5 kPa	n_{er_ECE}	n_{e_ECE} = 1.2 * n_{er_ECE}	n_{e_int}	R_l R_1
S12.6	**A19**	2S/2M	1 X	2	80	800	681	531	7.60	9.11	**10**	0.20
S12.6	**A19**	2S/2M	X 1	2	80	800	663	521	8.03	9.64	**10**	0.20
S23.6	**A19**	2S/2M	X 1 X	3	100	800	631	497	9.42	11.31	**12**	0.20
S12.6	**A19**	4S/2M	1 2	2	80	800	683	532	7.55	9.06	**10**	0.20
S23.6	**A19**	4S/2M	X 1 2	3	100	800	652	511	8.79	10.55	**11**	0.20
S23.6	**A19**	4S/2M	1 2 X	3	100	800	657	514	8.64	10.36	**11**	0.20
S32.6	**A19**	2S/2M	X 1	2	80	800	654	515	8.83	10.60	**11**	0.20
S33.6	**A19**	2S/2M	X 1 X	3	100	800	670	520	8.14	9.77	**10**	0.20

5 Test trailers ".5" (EB+ Gen 2)

Trailer	Test	System Config.	Sensor identif.	No. of axles	V_0 [l]	p_0 bar	p_{15s} bar	p_5 bar	n_{er_ECE}	n_{e_ECE} = 1.2 * n_{er_ECE}	n_{e_int}	R_l R_1
S12.5	**A19**	2S/2M	1 X	2	80	8.0	7.10	5.76	7.71	9.25	**10**	disc
S12.5	**A19**	2S/2M	X 1	2	80	8.0	6.99	5.69	8.06	9.68	**10**	disc
S13.5	**A19**	2S/2M	X 1 X	3	100	8.0	7.01	5.59	7.63	9.16	**10**	disc
S12.5	**A19**	2S/2M_SL	1 T	2	80	8.0	6.91	5.55	7.61	9.13	**10**	disc
S13.5	**A19**	2S/2M_SL	R 1 X	3	100	8.0	6.79	5.33	7.85	9.42	**10**	disc
S12.5	**A19**	4S/2M_AxA	L H	3	80	8.0	7.05	5.59	7.43	8.92	**9**	disc
S22.5	**A19**	4S/2M	1 2	2	80	8.0	7.00	5.67	7.75	9.30	**10**	0.20
S23.5	**A19**	4S/2M	1 X 2	3	120	8.0	6.93	5.61	7.88	9.46	**10**	0.20
S23.5	**A19**	4S/2M_AxA	H X L	3	120	8.0	6.89	5.63	8.16	9.79	**10**	0.20

EBS-System : **EB+**
Manufacturer : **Haldex**

6 Test trailers ".4" (EB+ Gen 1)

Note: The energy consumption tests of the following table were all carried out with the "EEC worst case loading" (see Table "Test vehicles ".4" - weights (energy consumption tests - worst case loading/EEC - Directive Annex XIV)" in paragraph 1.3 of Appendix 3 of this report). Comparative tests with the prescribed lower UN axle loads were carried out with each type of trailer (covering **all** different types of configurations, brakes and suspensions). All comparative tests (EEC / UN axle loading) have shown that the energy consumption with the UN axle loads were less or equal than the energy consumption with the "EEC worst case loading". The "**worst case**" energy consumption test results of the following table were taken also for the energy consumption test results according to Annex 19 of UN-Regulation No. 13

Trailer	System Configuration	sens.-identif.	No. of axles	V_0 l	p_0 bar	p_{15s} bar	p_5 bar	n_{e_EC} n_{er_ECE}	n_{e_ECE}	p_{5_EC} +20% bar	n_{e_EC} +20%	R_l R_1
S22	2S/1M	1X	2	80	8.1	6.64	5.22	**8.4**	**11**	-	**-**	0.2
S23	2S/1M	X1X	3	100	8.1	6.63	5.10	**8.0**	**10**	-	**-**	0.2
S32	2S/1M	1X	2	80	8.0	7.13	5.7	**7.2**	**9**	5.5	**7.9**	disc
S32	2S/1M	X1	2	80	8.0	7.17	5.7	**7.1**	**9**	5.5	**7.9**	disc
S33	2S/1M	X1X	3	100	8.0	7.01	5.5	**7.3**	**9**	5.3	**8.2**	disc
S32	2S/2M	1X	2	80	8.0	6.72	5.4	**8.7**	**11**	5.2	**9.9**	disc
S32	2S/2M	X1	2	80	8.0	6.93	5.6	**8**	**10**	5.4	**9.0**	disc
S33	2S/2M	X1X	3	100	8.1	6.71	5.3	**8.2**	**10**	5.0	**9.3**	disc
S22	2S/2M	X1	2	80	8.0	6.74	5.4	**8.6**	**11**	-	**-**	0.2
S22	2S/2M_SL	1T	2	80	8.0	7.07	5.6	**7.6**	**10**	-	**-**	0.2
S23	2S/2M_SL	T1X	3	100	8.0	6.60	5.1	**8.0**	**10**	-	**-**	0.2
S23	2S/2M_SL	X1R	3	100	8.0	6.26	4.9	**9.0**	**11**	-	**-**	0.2
S32	2S/2M_SL	1R	3	80	8.1	7.18	5.8	**7.3**	**9**	5.5	**8.2**	disc
S33	2S/2M_SL	R1X	3	100	8.1	6.30	4.8	**10.4**	**13**	4.5	**11.8**	disc
S33	2S/2M_SL	X1T	3	100	8.0	6.42	4.8	**10.1**	**13**	4.6	**11.3**	disc
S32	4S/2M	12	2	80	8.0	7.11	5.7	**7.5**	**9**	5.5	**8.4**	disc
S23	4S/2M	X12	3	100	8.0	6.50	5.0	**8.3**	**10**	-	**-**	0.2
S22	4S/2M _ASC front	HL	2	80	8.0	6.97	5.6	**7.9**	**10**	-	**-**	0.2
S23	4S/2M _ASC front	HXL	3	100	8.0	6.67	5.1	**7.9**	**10**	-	**-**	0.2

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EBS-System : **EB+**
Manufacturer : **Haldex**

Trailer	System Configuration	sens.-identif.	No. of axles	V_0 l	p_0 bar	p_{15s} bar	p_5 bar	n_{e_EC} n_{er_ECE}	n_{e_ECE}	p_{5_EC} +20% bar	n_{e_EC} +20%	R_l R_1
S23	4S/2M _ASC front	XHL	3	100	8.0	6.50	5.0	**8.3**	**10**	-	**-**	0.2
S32	4S/2M _ASC front	HL	2	80	8.1	7.15	5.7	**7.4**	**9**	5.5	**8.2**	disc
S33	4S/2M _ASC front	HXL	3	100	8.1	6.57	5.2	**8.6**	**11**	4.9	**9.8**	disc
S32	4S/3M	MS	2	80	8.0	6.68	5.4	**8.6**	**11**	5.2	**9.6**	disc
S33	4S/3M	SMX	3	100	8.0	6.51	5.1	**8.8**	**11**	4.9	**9.9**	disc
S33	4S/3M	XMS	3	100	8.0	6.80	5.3	**7.8**	**10**	5.1	**8.9**	disc
S22	4S/3M	SM	2	80	8.1	6.84	5.3	**7.8**	**10**	-	**-**	0.2
S23	4S/3M	SMX	3	100	8.1	6.46	5.0	**8.6**	**11**	-	**-**	0.2
S23	4S/3M	MXS	3	100	8.1	6.61	5.1	**8.2**	**10**	-	**-**	0.2
SF41	2S/1M	1	1	40	8.0	6.67	5.2	**8.1**	**10**	5.0	**8.9**	disc
SF41	2S/2M	1	1	40	8.0	6.77	5.4	**8.1**	**10**	5.1	**9.3**	disc
F42S	4S/3M	SM	2	80	8.0	6.79	5.8	**9.9**	**12**	5.6	**11.4**	disc
F42L	4S/3M	SM	2	80	8.04	6.76	5.7	**10.6**	**13**	5.3	**12.0**	disc
F43	4S/3M	SMX	3	120	8.0	6.92	5.7	**10.2**	**13**	5.5	**11.2**	disc
F43	4S/3M	SXM	3	120	8.0	6.91	5.7	**10.3**	**13**	5.5	**11.3**	disc
SF51	2S/1M	1	1	40	8.0	6.80	5.4	**8.0**	**10**	-	**-**	0.2
SF51	2S/2M	1	1	40	8.0	6.86	5.5	**8.4**	**11**	-	**-**	0.2
F52S	4S/3M	SM	2	80	8.1	7.05	6.0	**8.9**	**11**	-	**-**	0.2
F52L	4S/3M	SM	2	80	8.1	7.04	5.9	**8.5**	**11**	-	**-**	0.2
F53	4S/3M	SMX	3	120	8.0	6.64	5.4	**9.3**	**12**	-	**-**	0.2
F53	4S/3M	SXM	3	120	8.0	6.61	5.4	**9.4**	**12**	-	**-**	0.2

EBS-System : **EB+**
Manufacturer : **Haldex**

Appendix 4-3 - Split-friction test

Road surface: **wet blue basalt/ wet asphalt**
Test speeds: **50 km/h**
No inadmissible locking or inadmissible course deviation was observed during any of the following split-friction tests.

1 Test trailers ".11" (EB+ Gen 3)

Trailer	System config.	Sensor code	Axle No.	z_{RALH}	z_{RALL}	f	z_{RALS}	$z_{RALS\_requ.}$
S52.11	2S/2M_1R	**1-X**	2	**0,520**	**0,133**	**3,9**	**0,313**	**0,201**
S52.11	4S/2M_1R	**1-2**	2	**0,354**	**0,080**	**4,4**	**0,207**	**0,127**
S53.11	2S/2M_1R	**X-1-X**	3	**0,428**	**0,082**	**5,2**	**0,269**	**0,143**

2 Test trailers ".8" (EB+ Gen 2)

Trailer	System config.	Sensor code	Axle No.	z_{RALH}	z_{RALL}	f	z_{RALS}	$z_{RALS\_requ.}$
S42.8	2S/2M	**1D-X**	2	**0.581**	**0.079**	**7.4**	**0.282**	**0.159**
S42.8	2S/2M	**X-1D**	2	**0.557**	**0.076**	**7.3**	**0.293**	**0.159**
C12.8	2S/2M	**1D-X**	2	**0.607**	**0.082**	**7.4**	**0.334**	**0.169**
C12.8	2S/2M	**X-1D**	2	**0.608**	**0.095**	**6.4**	**0.330**	**0.174**

3 Test trailers ".7" (EB+ Gen 2)

Trailer	System config.	Sensor code	Axle No.	z_{RALH}	z_{RALL}	f	z_{RALS}	$z_{RALS\_requ.}$
S22.7	4S/3M	**MS**	2	**0.668**	**0.097**	**6.9**	**0.188**	**0.181**
S32.7	4S/3M	**MS**	2	**0.567**	**0.089**	**6.4**	**0.195**	**0.157**
S32.7	4S/3M	**MS***	2	**0.557**	**0.088**	**6.4**	**0.192**	**0.158**
S32.7	4S/3M	**SM**	2	**0.538**	**0.090**	**6.0**	**0.183**	**0.153**
S23.7	4S/3M	**SMX**	3	**0.412**	**0.094**	**4.4**	**0.206**	**0.144**
S33.7	4S/3M	**SXM**	3	**0.567**	**0.099**	**5.7**	**0.244**	**0.163**
S33.7	4S/3M	**MXS**	3	**0.543**	**0.112**	**4.8**	**0.237**	**0.168**

EBS-System : **EB+**
Manufacturer : **Haldex**

Trailer	System config.	Sensor code	Axle No.	z_{RALH}	z_{RALL}	f	z_{RALS}	$z_{RALS\_requ.}$
S33.7	4S/3M	**XMS**	3	**0.567**	**0.093**	**6.1**	**0.235**	**0.163**
S33.7	4S/3M	**XMS***	3	**0.473**	**0.077**	**6.2**	**0.195**	**0.142**
F42L.7	4S/3M	**SM**	2	**0.560**	**0.082**	**6.8**	**0.191**	**0.159**
F52S.7	4S/3M	**SM**	2	**0.458**	**0.098**	**4.7**	**0.223**	**0.164**
F43.7	4S/3M	**SMX**	3	**0.541**	**0.089**	**6.1**	**0.211**	**0.158**
F53.7	4S/3M	**SXM**	3	**0.561**	**0.115**	**4.9**	**0.222**	**0.185**

4 Test trailers ".6" (EB+ Gen 2)

Trailer	System config.	Sensor code	Axle No.	z_{RALH}	z_{RALL}	f	z_{RALS}	$z_{RALS\_requ.}$
S11.6	2S/2M	1	1	**0.539**	**0.096**	**5.6**	**0.309**	**0.167**
S12.6	2S/2M	1X	2	**0.519**	**0.140**	**3.7**	**0.345**	**0.195**
S12.6	2S/2M	X1	2	**0.551**	**0.128**	**4.3**	**0.341**	**0.180**
S23.6	2S/2M	X1X	3	**0.561**	**0.112**	**5.0**	**0.348**	**0.168**
S23.6	2S/2M	X1X *	3	**0.537**	**0.103**	**5.2**	**0.303**	**0.161**
S12.6	4S/2M	12	2	**0.579**	**0.117**	**4.9**	**0.281**	**0.185**
S23.6	4S/2M	X12	3	**0.573**	**0.114**	**5.0**	**0.332**	**0.163**
S23.6	4S/2M	X12 *	3	**0.472**	**0.096**	**4.9**	**0.298**	**0.147**
S23.6	4S/2M	12X	3	**0.553**	**0.111**	**5.0**	**0.306**	**0.160**
S32.6	2S/2M	1X	2	**0.550**	**0.107**	**5.2**	**0.309**	**0.176**
S32.6	2S/2M	X1	2	**0.507**	**0.112**	**4.5**	**0.300**	**0.183**
S33.6	2S/2M	X1X	3	**0.481**	**0.084**	**5.7**	**0.283**	**0.151**
S33.6	2S/2M	X1X *	3	**0.439**	**0.090**	**4.9**	**0.291**	**0.150**

EBS-System : **EB+**
Manufacturer : **Haldex**

5 Test trailers ".5" (EB+ Gen 2)

Trailer	System Configuration & sensing identifier	No. of Axles	z_{RALH}	z_{RALL}	f	z_{RALS}	$z_{RALS\_requ.}$
S11.5	2S/2M_1	1	0.486	0.105	4.6	0.292	0.176
S12.5	2S/2M_1X	2	0.473	0.105	4.5	0.289	0.148
S12.5	2S/2M_X1	2	0.494	0.123	4.0	0.303	0.170
S13.5	2S/2M_X1X	3	0.481	0.119	4.1	0.285	0.165
S21.5	2S/2M_1	1	0.466	0.105	4.4	0.289	0.156
S12.5	2S/2M_SL_1T	2	0.444	0.099	4.5	0.193	0.145
S12.5	2S/2M_SL_1R	2	0.457	0.081	5.7	0.173	0.141
S13.5	2S/2M_SL_T1X	3	0.455	0.103	4.4	0.220	0.163
S13.5	2S/2M_SL_R1X	3	0.428	0.074	5.8	0.205	0.093
S22.5	4S/2M_12	2	0.482	0.106	4.6	0.307	0.156
S23.5	4S/2M_1X2	3	0.414	0.095	4.4	0.282	0.144
S22.5	4S/2M_ASC front HL	2	0.470	0.090	5.2	0.220	0.141
S23.5	4S/2M_ASC front HXL	3	0.431	0.101	4.3	0.242	0.156
S12.5	4S/2M_ASC rear LH	2	0.462	0.088	5.2	0.199	0.144
S13.5	4S/2M_ASC rear LXH	3	0.448	0.098	4.6	0.230	0.156

6 Test trailers ".4" (EB+ Gen 1)

Trailer	System Configuration & sensing identifier	No. of Axles	z_{RALH}	z_{RALL}	f	z_{RALS}	$z_{RALS\_requ.}$
S23	2S/1M_X1X	3	0.467	0.090	5.2	0.115	- **
S23	2S/1M_X1X*	3	0.489	0.099	4.9	0.113	- **
S33	2S/1M_X1X	3	0.464	0.077	6.0	0.081	- **
S31	2S/2M_1	1	0.466	0.076	6.1	0.273	0.130
S32	2S/2M_X1	2	0.513	0.087	5.9	0.311	0.146
S33	2S/2M_X1X	3	0.521	0.080	6.5	0.304	0.149

EBS-System : **EB+**
Manufacturer : **Haldex**

Trailer	System Configuration & sensing identifier	No. of Axles	z_{RALH}	z_{RALL}	f	z_{RALS}	$z_{RALS\_requ.}$
S33	2S/2M_X1X*	3	0.463	0.086	5.4	0.289	0.159
S22	2S/2M_X1	2	0.522	0.095	5.5	0.273	0.159
S22	2S/2M_SL_1R	2	0.475	0.054	8.7	0.149	0.122
S23	2S/2M_SL_R1X	3	0.422	0.075	5.6	0.199	0.132
S32	2S/2M_SL_1T	2	0.500	0.045	11.1	0.170	0.120
S33	2S/2M_SL_X1T	3	0.480	0.064	7.5	0.198	0.128
S32	4S/2M_12	2	0.461	0.079	5.9	0.288	0.130
S33	4S/2M_X12	3	0.432	0.082	5.3	0.286	0.135
S33	4S/2M_12X	3	0.416	0.080	5.2	0.303	0.137
S33	4S/2M_1X2	3	0.433	0.079	5.4	0.295	0.146
S22	4S/2M_12	2	0.543	0.067	8.1	0.253	0.140
S22	4S/2M_ASC front HL	2	0.507	0.082	6.2	0.195	0.141
S23	4S/2M_ASC front HXL	3	0.487	0.089	5.5	0.235	0.160
S32	4S/2M_ASC front HL	2	0.493	0.086	5.7	0.219	0.147
S33	4S/2M_ASC front XHL	3	0.510	0.089	5.8	0.261	0.150
S32	4S/3M_MS	2	0.596	0.099	6.0	0.221	0.173
S33	4S/3M_SXM	3	0.619	0.108	5.7	0.272	0.180
S33	4S/3M_XMS	3	0.630	0.096	6.6	0.249	0.174
S22	4S/3M_MS	2	0.504	0.081	6.2	0.185	0.137
S22	4S/3M_MS*	2	0.540	0.083	6.5	0.175	0.143
S23	4S/3M_SXM	3	0.473	0.099	4.8	0.223	0.140
S23	4S/3M_MXS	3	0.494	0.094	5.3	0.219	0.142
S23	4S/3M_XMS	3	0.477	0.103	4.6	0.195	0.146
S23	4S/3M_XMS*	3	0.483	0.094	5.1	0.215	0.142
F42S	4S/3M_SM	2	0.615	0.108	5.7	0.234	0.194
F43	4S/3M_SXM	3	0.571	0.108	5.3	0.235	0.193

EBS-System : **EB+**
Manufacturer : **Haldex**

Trailer	System Configuration & sensing identifier	No. of Axles	z_{RALH}	z_{RALL}	f	z_{RALS}	$z_{RALS\_requ.}$
F52L	4S/3M_SM	2	0.607	0.112	5.4	0.217	0.184
F53	4S/3M_SMX	3	0.621	0.126	4.9	0.236	0.178

Note: Tests marked with an ***** were carried out with a reduction in the brake lever length on axle „1“.

Tests marked with two ****** were carried out to check the stability behaviour of these vehicles (fitted with a category B anti-lock braking system) when the brakes were suddenly actuated when the right and left wheels of the vehicles were situated on surfaces with differing coefficients of adhesion

EBS-System : **EB+**
Manufacturer : **Haldex**

Appendix 4-4 - Additional checks

1 Low speed performance

The tests described in Section 6.3.1 of Annex 13 to UN-Regulation No. 13 were carried out on the above defined unladen test trailers with each anti-lock configuration.

All tests were carried out on a dry asphalt surface from an initial speed of 40 km/h.

When the brakes were suddenly actuated there was no locking* of any directly controlled wheel at speeds v > 15 km/h or course deviation at any speed.

2 High speed performance

The tests described in Section 6.3.1 of Annex 13 to UN-Regulation No. 13 were carried out on the above defined unladen test trailers with each anti-lock configuration.

All tests were carried out on a dry asphalt surface from an initial speed of 80 km/h.

When the brakes were suddenly actuated there was no locking* of any directly controlled wheel at speeds v > 15 km/h or course deviation at any speed.

3 Transition from high to low adhesion surfaces

Road surface:	dry asphalt / wet blue basalt
Test speeds:	40 km/h and 80 km/h
Observations:	- no locking of any directly controlled wheel at v > 15 km/h - vehicle stable with no deviation from the intended course - in all cases the anti-lock systems reacted rapidly to the change in tyre to road surface adhesion

4 Transition from low to high adhesion surfaces

Road surface:	wet blue basalt/ dry asphalt
Test speeds:	50 km/h
Observations:	- no locking of any directly controlled wheel at v > 15 km/h - vehicle stable with no deviation from the intended course - in all cases the anti-lock system reacted to the change in tyre to road surface adhesion within a time of 0,4 s to 1,6 s.

* In paragraph 6.3.3 of Annex 13, UN-R13, it is stipulated that brief periods of wheel-locking are allowed. For conventional braking system times of 0.1 s (on high adhesion surfaces) and 0.5 s (on low adhesion surfaces) are seen as acceptable brief periods of wheel locking.

However, in the case of Inloader configurations especially at first application of the brakes and at vehicles speeds below 50 km/h wheel locking occurred also for periods up to 0,15 s on high adhesion surface without losing stability, which is seen as acceptable for this kind of special purpose vehicle.

EBS-System : **EB+**
Manufacturer : **Haldex**

Appendix 5 - Further test results

1 Test trailers ".4" (EB+ Gen 1)

The following tests results were obtained with the test vehicles fitted with the previous software version. Comparative testing with vehicles equipped with the new and old software had shown that the old testing results are also applicable for the ABS with the current software version. In particular, the spread of the test results regarding the deviation of the 40 to 20 km/h deceleration times t in % in respect to the various simulated tyre rolling circumference and the various tube lengths were less or equal than of the test results obtained with the previous software.

2 Tyre to exciter relationship

Paragraph 5.4.1.4.2 of Annex 19 to UN-Regulation No. 13 require that the functional checks defined in paragraph 6.3 of Annex 13 to UN-Regulation No. 13 be carried out with the extremes of tolerance of the recommended range of tyre size for a pole wheel with a given number of teeth. To assess the influence on system performance at the extremes defined in the ID_GS0441, assessments of performance were carried out with exciters having 100 (optimum design, equating to 306 revs/km), 75 and 120 teeth which represent a variation on the optimum of - 25 % to + 20 % which is greater than the tolerance defined in the ID_GS0441 (compare paragraph 2.1.2.3).

In Annex 16 of ID_GS0441 the allowed range of tyre rolling circumference for the default programmed values are dark shaded. Tyres with smaller rolling circumference (light shaded) may be utilized as long as the frequency tolerance of -25% to +20% is maintained and the absolute frequency at 150 km/h does not exceed 1800 Hz. Bench tests demonstrated the ABS full functionality up to this limit (Engineering Report 19-0856).

Test results and observations:

The following table contains the respective 40 to 20 km/h deceleration times for the optimum and tolerance extremes.

Simulated tyre rolling circumference	**3268 mm**	**3921 mm**	**2450 mm**
Circumference variation	**0 %**	**+20 %**	**-25 %**
Test order	1st measurement	2nd measurement	3rd measurement
Revolutions/km	306	255	408
Asphalt dry	2,14	2,20	2,14
2S/2M - S33_X1aX	2,20	2,19	2,05
40 to 20 km/h time (t)	2,22	2,23	2,03
average (time t)	**2,19 s**	**2,21 s**	**2,07 s**
deviation of t in %	**0 %**	**+ 0,9 %**	**- 5,5 %**

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EBS-System : **EB+**
Manufacturer : **Haldex**

Simulated tyre rolling circumference	**3268 mm**	**3921 mm**	**2450 mm**
Circumference variation	**0 %**	**+20 %**	**-25 %**
Test order	1st measurement	2nd measurement	3rd measurement
Revolutions/km	306	255	408
Asphalt dry	3.62	3.72	3.71
2S/1M - S11_1	3.82	3.59	3.74
40 to 20 km/h time (t)	3.53	3.54	3.78
average (time t)	**3.66 s**	**3.62 s**	**3.74 s**
deviation of t in %	**0 %**	**- 1.1 %**	**+ 2.4 %**
Asphalt dry	2.42	2.20	2.25
4S/3M - S23_SaMX ("2")	2.36	2.17	2.34
40 to 20 km/h time (t)	2.25	2.21	2.32
average (time t)	**2.34 s**	**2.19 s**	**2.30 s**
deviation of t in %	**0 %**	**- 6.4 %**	**- 1. 7 %**
split	4.12	4.05	3.95
2S/2M - S33_X1aX	3.98	4.07	3.77
40 to 20 km/h time (t)	4.15	4.13	4.01
average (time t)	**4.08 s**	**4.08 s**	**3.91 s**
deviation of t in %	**0 %**	**0 %**	**- 4.2 %**
split	5.91	5.85	5.95
4S/3M - S23_SaMX ("2")	5.66	5.94	5.82
40 to 20 km/h time (t)	5.74	6.01	5.73
average (time t)	**5.77 s**	**5.93 s**	**5.83 s**
deviation of t in %	**0 %**	**+2.8 %**	**+ 1.0 %**

EBS-System : **EB+**
Manufacturer : **Haldex**

3 Differential(s) in brake input torque within a trailer bogie

Within Appendix 4-1 of this report reference is made to tests carried out where the brake input torque was reduced on axle 1 to take account of dynamic load transfer within the bogie during braking.

Differentials in brake input torque within a trailer bogie is not permitted for Inloader configurations.

4 Tube sizes and lengths

To assess the influence of the recommendations contained within the ID_GS0441, response tests were carried out with the delivery tubes specified. Anti-lock performance was then verified at the extremes of tube size recommended.

4.1 Time measurement

4.1.1 Standard configurations

The ID_GS0441 states that the maximum length of tube for a directly and a indirectly controlled wheel shall be limited to 5 m. However in all cases the prescribed system response times must be fulfilled. To verify this statement it was considered appropriate to compare differences in system response and anti-lock performance relative to the tube length from the modulator to brake chamber tube length.

The following response time measurements were obtained from a 3-axle semi-trailer representing the testing conditions of the ABS-performance measurements specified in the table of paragraph 3.1 below. The tube lengths to either a directly controlled axle or indirectly controlled axle were increased according to the maximum tube length of 5,0 m as specified by the manufacturer in paragraph 2.1.2.2 and Appendix 2 of ID_GS0441.

Tube size 12x1.5 mm. $\varnothing_i$ = 9 mm	**Axle 1**	**Axle 2**	**Axle 3**
Delivery tube lengths:	**2.0 m**	**1.0 m**	**1.5 m**
Response time (pneumatic / CAN):	**0.35 / 0.24s**	**0.34 / 0.23s**	**0.35 / 0.23s**
Delivery tube lengths:	**5.0 m**	**5.0 m**	**5.0 m**
Response time (pneumatic / CAN):	**0.40 / 0.29s**	**0.39 / 0.29s**	**0.40 / 0.30s**

EBS-System : **EB+**
Manufacturer : **Haldex**

4.1.2 Inloader configurations

The response time of a trailer with an Inloader configuration was tested at a three-axle semi-trailer in the configuration 2S/2M_1R with the maximum tube length and minimum tube size permitted acc. to Appendix 1c of ID_GS0441.

	Tube Size	Tube Length		
		Axle 1	Axle 2	Axle 3
Reservoir to relay valve	**Ø 15 x 2 mm**	**3 m**	**--**	**3 m**
Modulator to relay valve	**Ø 12 x 1,5 mm**	**7 m**	**--**	**7 m**
Relay valve to brake actuator	**Ø 12 x 1,5 mm**	**4 m**	**--**	**4 m**
Modulator to brake actuator (direct)	**Ø 12 x 1,5 mm**	**--**	**10 m**	**--**
Response time (pneumatic):	**--**	**0,41 s**	**0,39 s**	**0,40 s**
Response time (CAN):	**--**	**0,33 s**	**0,31 s**	**0,32 s**

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4.1.3 CAN Hub (Router/Repeater)

For response time measurements on a trailer equipped with a CAN Hub working as repeater or router see Approval Report EB132.11E, Annex 2.

4.2 Anti-lock performance

4.2.1 Standard configurations

The following test results were obtained from a three axle semi-trailer installed with a **4S/2M_X12** (test trailer S23.8) system where the tube lengths represented a “standard installation” and installation where the delivery tube lengths were increased to the maximum length of **5 m** (motor vehicle unbraked).

S23_unl ⇒ unladen bogie load of the trailer: 5820 kg

S23_lad ⇒ laden bogie load of the trailer: 20100 kg

EBS-System : **EB+**
Manufacturer : **Haldex**

ABS performance				
	t_{zRAL} [s]	axle 1 (indirectly controlled)	axle 2 (directly controlled)	axle 3 (directly controlled)
S23_unl standard tube length	2.22 2.21 2.20	**2.0 m**	**1.0 m**	**1.5 m**
Average	**2.21**			
S23_unl increased tube length	2.27 2.13 2.28	**5.0 m**	**5.0 m**	**5.0 m**
Average	**2.23**			
S23_lad standard tube length	1.78 1.96 1.91	**2.0 m**	**1.0 m**	**1.5 m**
Average	**1.88**			
S23_lad increased tube length	1.75 1.85 1.80	**5.0 m**	**5.0 m**	**5.0 m**
Average	**1.80**			

All comparison tests were carried out on a dry asphalt surface.

Based on the average value of 100% for the 'standard tube length', the above comparison tests show the following percentage values for the time t_{zRAL}:

	unladen	laden
standard tube length	**100 %**	**100 %**
increased tube length	**100.90%**	**95.74%**

On the specific tested trailer S2 the test results in the unladen condition were almost the same. The average deceleration in the laden condition with the 'increased tube length' was approximately 4% higher than that with the 'standard tube length'.

4.2.2 Inloader configurations

See Appendix 4.1 "utilisation of adhesion", table "test trailers .11".

EBS-System : **EB+**
Manufacturer : **Haldex**

5 Specific tests for „Adaptive Surface Control“ configuration

It was considered to be appropriate that for trailers equipped with a **4S/2M axle by axle installation** utilising Adaptive Surface Control on either channel (but only one at any time) should be subject to additional tests although no procedures or requirements exist within the EEC Directive 71/320/EEC or UN Regulation 13. The tests considered appropriate were those that verified that the system was capable of reacting to changes in tyre to road adhesion e.g. „low to split“ etc.

The following tests were carried out.

5.1 Transition assessment tests - test procedure

The trailer only was braked on either a homogeneous surface or split surface and with the anti lock cycling and the appropriate control logic operational a transition to split friction or homogeneous surface was made.

5.2 Observations

5.2.1 Split to **low:**

Following application of the brakes the system recognised the differences in adhesion and changed logic to Select High. On traversing onto the low adhesion surface the controlling high adhesion wheel reacted to the change in surface adhesion which provoked a reaction from the opposite side directly controlled wheel. A comparison of wheel reactions was then made and the system reverted to Select Low as appropriate for the low adhesion homogenous surface.

5.2.2 Split to **high:**

Following application of the brakes the system recognised the differences in adhesion and changed logic to Select High. On traversing onto the high adhesion surface the locked low adhesion wheel reacted to the change in surface adhesion. A comparison of wheel reactions was then made and the system reverted to Select Low as appropriate for the high adhesion homogenous surface.

5.2.3 **High** to split:

Following application of the brakes the system recognised the homogeneous surface and remained in Select Low. On traversing onto the split adhesion surface a difference in wheel reaction was recognised with a change to Select High being made.

5.2.4 **Low** to split:

Following application of the brakes the system recognised the homogeneous surface and remained in Select Low. On traversing onto the split adhesion surface a difference in wheel reaction was recognised with a change to Select High being made.

5.2.5 In all of the above test conditions trailer stability was maintained throughout.

EBS-System : **EB+**
Manufacturer : **Haldex**

Appendix 6 - Back-to-back comparative test Gen 2 vs. Gen3

The upgrade of EB+ Gen 2 to Gen 3 consists of some new features that are mostly related to auxiliary functions (see 2.1.3.2.4.2 and 2.1.3.2.5 of ID_GS0441) and redesign of the ECU housing. The supply voltage range is extended from 19 - 32 V (Gen 2) to 8 - 32 V (Gen 3). The software level changes with Gen 3 from D to E, but the software baseline remains the same and especially the ABS algorithm is unchanged. To provide evidence, that the changes have no impact on system behaviour back-to-back comparative tests have been carried out on 3-axle semi-trailers equipped with a 2S/2M system and a X-1-X sensor configuration, which is a typical trailer/ABS configuration.

The tests were carried out on two different trailers with the same ABS configuration (see Appendix 3, test vehicle data) because of availability of the trailers, but each manoeuvre was done with the same trailer. Both variants (controller/modulator) were installed on each trailer and alternately connected with the braking system for the tests. Software code was D523 for EB+ Gen 2 and E642 for EB+ Gen 3.

With EB+ Gen 2 the trailer was run with a nominal 24 V supply voltage. With EB+ Gen 3 the test were done with both 12 V and 24 V supply voltage due to the extended supply range.

1 ABS Performance test

The following table contains the 40 to 20 km/h deceleration times on three different surfaces, and under split friction conditions all measured with ABS fully cycling. Surfaces were:

- dry asphalt for high adhesion and utilisation of adhesion assessment
  (Since the k-value is the same for all three configurations the time is a direct metric for the utilisation of adhesion.)
- wet asphalt for good adhesion and µ-split assessment
- wet basalt for low adhesion and µ-split assessment

All tests are carried out three times to show deviation within one configuration due to measurement uncertainty based on repeat accuracy.

During the tests no inadmissible locking or in the case of split-friction tests inadmissible course deviation was observed.

		EB+ Gen 2 24 V	**EB+ Gen 3 24 V**	**EB+ Gen 3 12 V**
S23.10 2S/2M_X1X Asphalt dry	**t_{zRAL_1}** [s]	**2,31**	**2,40**	**2,30**
	t_{zRAL_2} [s]	**2,26**	**2,24**	**2,32**
	t_{zRAL_3} [s]	**2,29**	**2,33**	**2,31**
	t_{zRAL} [s] (average)	**2,287**	**2,323**	**2,310**
	deviation between configurations	**0%**	**+1,6%**	**+1,0%**
	deviation between tests for each configuration	**2,2%**	**7,1%**	**0,9%**

EBS-System : **EB+**
Manufacturer : **Haldex**

		EB+ Gen 2 24 V	EB+ Gen 3 24 V	EB+ Gen 3 12 V
S13.10 2S/2M_ X1X Asphalt wet	t_{zRAL_1} [s]	**2,61**	**2,61**	**2,69**
	t_{zRAL_2} [s]	**2,60**	**2,72**	**2,64**
	t_{zRAL_3} [s]	**2,54**	**2,62**	**2,53**
	t_{zRAL} [s] (average)	**2,583**	**2,650**	**2,620**
	deviation between configurations	**0%**	**+2,6%**	**+1,4%**
	deviation between tests for each configuration	**2,8%**	**4,2%**	**6,3%**
S13.10 2S/2M_ X1X Basalt wet	t_{zRAL_1} [s]	**13,40**	**13,79**	**13,19**
	t_{zRAL_2} [s]	**13,34**	**13,92**	**12,96**
	t_{zRAL_3} [s]	**12,89**	**13,89**	**13,14**
	t_{zRAL} [s] (average)	**13,210**	**13,867**	**13,097**
	deviation between configurations	**0%**	**+5,0%**	**-0,9%**
	deviation between tests for each configuration	**4,0%**	**1,0%**	**1,8%**
S13.10 2S/2M_X1X Asphalt/Basalt wet	t_{zRAL_1} [s]	**4,87**	**4,78**	**4,82**
	t_{zRAL_2} [s]	**4,54**	**4,85**	**4,82**
	t_{zRAL_3} [s]	**4,62**	**4,60**	**4,75**
	t_{zRAL} [s] (average)	**4,677**	**4,743**	**4,797**
	deviation between configurations	**0%**	**+1,4%**	**+2,6%**
	deviation between tests for each configuration	**7,3%**	**5,4%**	**1,5%**

The test results of EB+ Gen 2 compared to EB+ Gen 3 with either 24 V or 12 V power supply on all three surfaces show good consistency. The deviation of the average test results between the configurations is less than 5% from Gen 2 to Gen 3 and is within the range given by the repeat accuracy (deviation between tests for each configuration). It is considered as proven that the modifications of Gen 3 and the extension of the range of the supply voltage have no impact on ABS performance of the system on different surfaces and under split friction conditions.

EBS-System : **EB+**
Manufacturer : **Haldex**

2 Energy consumption test

The following table contains the reservoir pressure after energy consumption test according to UN-Regulation No. 13, Annex 13, paragraph 6.1. Initial energy level was 800 kPa. The ratio of brake chamber push rod travel to lever length was set to 0,2 at a brake chamber pressure of 650 kPa. The pressure at the fifth application after the dynamic energy consumption test was calculated from a static depletion curve starting with the average value of the dynamic test.

		EB+ Gen 2 24 V	EB+ Gen 3 24 V	EB+ Gen 3 12 V
S23.10 2S/2M_X1X Energy consumption	p_{15s_1} [kPa]	**650**	**665**	**663**
	p_{15s_2} [kPa]	**657**	**640**	**646**
	p_{15s_3} [kPa]	**652**	**654**	**651**
	p_{15s} [kPa] (average)	**653**	**653**	**653**
	deviation between configurations	**0%**	**0%**	**0%**
	deviation between tests for each configuration	**1,1%**	**3,9%**	**2,6%**
	p_5 [kPa]	**497**	**509**	**513**

The test results of EB+ Gen 2 compared to EB+ Gen 3 with either 24 V or 12 V power supply show good consistency. It is considered as proven that the modifications of Gen 3 have no impact on energy consumption of the system.

Additionally the equivalent number of static brake application according to UN-R13, Annex 19, paragraph 5.4.12. was calculated.

Trailer	System config.	Sensor identif.	No. of axles	V_0 [l]	p_0 kPa	p_{15s} kPa	p_5 kPa	n_{er_ECE}	$n_{e\_ECE} = 1,2 * n_{er\_ECE}$	n_{e_int}	R_l
S23.10 Gen 2 - 24V	**2S/2M**	**X1X**	**3**	**120**	**800**	**653**	**497**	**8,18**	**9,81**	**10**	**0,2**
S23.10 Gen 3 - 24V	**2S/2M**	**X1X**	**3**	**120**	**800**	**653**	**509**	**8,57**	**10,28**	**11**	**0,2**
S23.10 Gen 3 - 12V	**2S/2M**	**X1X**	**3**	**120**	**800**	**653**	**513**	**8,23**	**9.88**	**10**	**0,2**

The results show good consistency and stay within the range of the equivalent static brake applications for semi-trailers with drum brakes as mentioned in paragraph 2.5.1.1 of this approval report.

EBS-System : **EB+**
Manufacturer : **Haldex**

3 Additional checks

3.1 Low speed performance

The tests described in Section 6.3.1 of Annex X to Directive 71/320/EEC and Annex 13 to UN-Regulation No. 13 were carried out on the above described test trailers.

All tests were carried out on a dry asphalt surface from an initial speed of 40 km/h.

When the brakes were suddenly actuated there was no locking of any directly controlled wheel at speeds v > 15 km/h or course deviation at any speed.

3.2 High speed performance

The tests described in Section 6.3.1 of Annex X to Directive 71/320/EEC and Annex 13 to UN-Regulation No. 13 were carried out on all the above described test trailers.

All tests were carried out on a dry asphalt surface from an initial speed of 80 km/h.

When the brakes were suddenly actuated there was no locking of any directly controlled wheel at speeds v > 15 km/h or course deviation at any speed.

3.3 Transition from high to low adhesion surfaces

Road surface: dry asphalt / wet blue basalt
Test speeds: 40 km/h and 80 km/h
Observations:
- no locking of any directly controlled wheel at v > 15 km/h
- vehicle stable with no deviation from the intended course
- in all cases the anti-lock systems reacted rapidly to the change in tyre to road surface adhesion

3.4 Transition from low to high adhesion surfaces

Road surface: wet blue basalt/ dry asphalt
Test speeds: 50 km/h
Observations:
- no locking of any directly controlled wheel at v > 15 km/h
- vehicle stable with no deviation from the intended course
- in all cases the anti-lock system reacted to the change in tyre to road surface adhesion within a time of less than 1,0 s.

EBS-System : **EB+**
Manufacturer : **Haldex**

4 Response time measurement

The following table contains the response time measured with the Wabco CTU tester.

Due to modification of the solenoids control it is expected to have improvements in response time to the pneumatic signal with long pneumatic control line. Although control line length is not a limiting factor in this report because it has to be demonstrated at the time of type approval of the trailer that the response time provisions are fulfilled, for verification the test were conducted with two different lengths of the control line. In the second set of measurements the pneumatic control line was extended by 9,5 m between the coupling head and the filter.

The trailer was equipped with a delivery tube size of 12 x 1,5 mm and length from modulator to brake chamber of 1m (axle 2) and 2 m (axle 1 and 3). The response time was measured at axle 3.

		EB+ Gen 2 24 V	**EB+ Gen 3 24 V**	**EB+ Gen 3 12 V**
S23.10 2S/2M_X1X Response time (CAN) Standard control line	$t_{Response\_1}$ [s]	**0,26**	**0,26**	**0,25**
	$t_{Response\_2}$ [s]	**0,27**	**0,25**	**0,25**
	$t_{Response\_3}$ [s]	**0,27**	**0,26**	**0,26**
	$t_{Response}$ [s] (average)	**0,267**	**0,257**	**0,253**
	deviation between configurations	**0 %**	**-3,7 %**	**-5,2 %**
	deviation between tests for each configuration	**3,8 %**	**4,0 %**	**4,0 %**
S23.10 2S/2M_X1X Response time (CAN) Extended control line	$t_{Response\_1}$ [s]	**0,25**	**0,26**	**0,26**
	$t_{Response\_2}$ [s]	**0,27**	**0,25**	**0,25**
	$t_{Response\_3}$ [s]	**0,26**	**0,27**	**0,25**
	$t_{Response}$ [s] (average)	**0,260**	**0,260**	**0,253**
	deviation between configurations	**0%**	**0 %**	**-2,7 %**
	deviation between tests for each configuration	**8,0 %**	**8,0 %**	**4,0 %**

EBS-System : **EB+**
Manufacturer : **Haldex**

		EB+ Gen 2 24 V	EB+ Gen 3 24 V	EB+ Gen 3 12 V
S23.10 2S/2M_X1X Response time (pneu) Standard control line	$t_{Response\_1}$ [s]	**0,36**	**0,32**	**0,32**
	$t_{Response\_2}$ [s]	**0,36**	**0,33**	**0,32**
	$t_{Response\_3}$ [s]	**0,36**	**0,33**	**0,31**
	$t_{Response}$ [s] (average)	**0,360**	**0,327**	**0,317**
	deviation between configurations	**0%**	**-9,2 %**	**-11,9 %**
	deviation between tests for each configuration	**0 %**	**3,1 %**	**3,2 %**
S23.10 2S/2M_X1X Response time (pneu) Extended control line	$t_{Response\_1}$ [s]	**0,46**	**0,39**	**0,38**
	$t_{Response\_2}$ [s]	**0,45**	**0,40**	**0,40**
	$t_{Response\_3}$ [s]	**0,45**	**0,40**	**0,39**
	$t_{Response}$ [s] (average)	**0,453**	**0,397**	**0,390**
	deviation between configurations	**0%**	**-12,4 %**	**-13,9 %**
	deviation between tests for each configuration	**2,2 %**	**2,6 %**	**5,3 %**

The response time to the electric control signal shows no significant reaction either on the system variant (Gen 2 / Gen 3) or on the supply voltage (24 V / 12 V). The equivalence of both variants with respect to the response time to the electric control signal is sufficiently demonstrated

The response time to the pneumatic control signal shows the expected improvement with EB+ Gen 3 variant. Even with the standard length of the pneumatic control line the response time is reduced at least by 0,3 sec which is more than 9 %. The advantage rises with the extension of the control line length.

It is considered as proven that the modifications of EB+ Gen 3 do not deteriorate the response time of the system.

TRAILER ABS INFORMATION DOCUMENT

ECE Regulation 13, Annex 19

[ECE Regulation 13, Series 11]

System: EB+

Compiled By:			Approving Specialist:	Chief Engineer:
D J Harrison / J S Crawley			D J Harrison	D J Harrison
5	29/01/20	C7149 C7150	Engineering Manager:	Technical Director:
Issue:	Date:	Ref:	W Storrie	C R Mellings

Trailer Braking System Information Document

1 Introduction

1.1 The information contained within this document is to be used in conjunction with a valid approval report at the time of type approval of a trailer falling within the scope of those defined within that approval report.

2 Information Document

2.1 This information document has been compiled in accordance with the requirements prescribed in ECE Regulation 13, Annex 19 (Appendix 5).

2.1.1 General

2.1.1.1 Name of manufacturer: **HALDEX BRAKE PRODUCTS Ltd.**
MIRA Technology Park
Lindley
Warwickshire CV13 6DE
United Kingdom

2.1.1.2 System name: **EB+**

2.1.1.3 System variants: **EB+ Gen 1**

This is a modular EBS package consisting of one or two modulators and a removable ECU, with optional anti-compounding valve. The system operates from 19 – 32V.

EB+ Gen 2

This is an integrated EBS package consisting of a twin modulator, a non-removable ECU, and spring brake distribution with optional anti-compounding and quick release valves. The system operates from 19 – 32V.

EB+ Gen 3

This is an integrated EBS package substantially similar to Gen 2 in construction and features. The system operates from 8 – 32V.

In this document 'EB+' refers to all variants unless specifically stated otherwise.

2.1.1.4 System configurations: 2S/1M, 2S/2M*, 2S/2M SL*, 2S/2M DAR, 4S/2M SxS*, 4S/2M AxA* and 4S/3M

* = Integrated and non-integrated versions available with EB+ Gen 1
_S = Number of sensors (directly controlled wheels).
_M = Number of pressure modulators.
SL = Using select low (inverse) double check valve.
DAR = Dolly Axle Regulation
SxS = Side by side (control configuration)
AxA = Axle by axle (control configuration)

2.1.1.4.1 'Inloader' configurations: 2S/2M Relay and 4S/2M Relay

'Inloader' configurations are special configurations for trailers such as sheet glass carriers, where it is impossible to install the master EBS close to the wheels. The master EBS is instead installed close to the king pin, with long pipes to the wheels on each side of the trailer and relay valves close to the actuators to improve response time.

2.1.1.5 Basic Function of the System

The EB+ system provides electro-pneumatic control of the trailer brakes for full, semi and centre-axle trailers with built in load sensing and anti-lock functions.

The main system package consists of an electronic control unit (ECU) / modulator assembly, containing a brake apply solenoid, twin solenoid operated relay valve(s) and pressure sensors for monitoring the pneumatic control line, brake delivery, reservoir and air suspension pressure. The EB+ system is available with a single modulator valve (1M), a dual modulator valve (2M) or both (3M).

Externally the system comprises two- or four-wheel speed sensors and optionally a pressure switch or sensor sensing the pneumatic control transmission. When used the pressure switch or sensor should be situated before an emergency valve (REV or EV) if fitted.

Trailers fitted with the system may only be towed behind vehicles fitted with an ISO 7638 connector (either 7 pin or 5 pin). When connected with a 7 pin connector the system receives brake demand data via the CAN data line in accordance with ISO 11992. When connected with a 5-pin connector the system determines brake demand by sensing the pneumatic control transmission.

Optionally an ISO 1185 (24N) or ISO 12098 (15 pole) stoplight power back-up connection can be fitted to 1M and 2M integrated systems and Gen 3 3M systems. This provides anti-lock braking control and optionally dynamic load sensing in situations where the ISO 7638 connection is not functioning and is not intended as a normal operating mode.

The apportionment of braking under varying vehicle load conditions is implemented in software. The load sensing parameters, from the brake calculation, are programmed into the ECU using the system diagnostic link.

The control software between Gen 1, 2 and 3 is substantially the same, apart from configuration differences. In addition, it can be expected that the brake response time when powered via 5-pin ISO 7638 is improved with Gen 3, particularly on longer control lines.

Anti-lock Operation

In 1M or 2M systems with two-wheel speed sensors (2S) these are fitted to one axle and are labelled S1A and S1B. In 3M and 2M systems with four-wheel speed sensors (4S) the additional two are fitted to a second axle and are labelled S2A and S2B. The most forward sensed axle always relates to S1 and the left-hand side (viewed as the driver facing forward) is always “A”, such that the front left sensor is always S1A regardless of the modulator orientation or trailer type.

Each wheel speed sensor is assigned to a brake control channel via the diagnostic link. Up to two sensors can be allocated to a channel and the system will then operate using either an independent, select low or adaptive surface control philosophy as programmed.

On 2M systems where two sensors assigned to one valve are fitted to the same axle, an Adaptive Surface Control (ASC) philosophy can be programmed. This is only available for 4S/2M AxA configurations. One of the control channels utilises an “Adaptive Surface Control” philosophy, the function of which is dependent upon the tyre road adhesion on the left and right sides of the trailer. When the left and right adhesion values are similar the ASC channel will utilise a “select low” control mode. However, when a significant differential (adhesion ratio > 2:1) is detected then the control mode changes from “select low” to “select high”, this enables the higher adhesion available to be utilised and produce an increase in vehicle braking rate. The remaining control channel continues to operate in “select low” mode. The combination of the “select low” channel and “adaptive surface” channel produces performance equivalent to that of a conventional 4S/3M configuration and complies with the prescribed “Category A” provisions.

The system configuration ‘2S/2M DAR’ (Dolly Axle Regulation) is designed primarily for use on dollies intended to convert semi-trailers into full trailers, but which may be approved as stand-alone centre-axle trailers. The system limits the relative pressure left/right during anti-lock control, thereby eliminating the risk of inducing a directional instability when used in the dolly application.

2.1.2 Applications

2.1.2.1 The EB+ system has been designed for use on full, semi and centre-axle trailers with air suspension and balanced mechanical steel suspensions. The following tables illustrate the applicable relationship between trailer type, number of axles and anti-lock configuration with the installed suspension type.

Anti-lock Configuration vs. Trailer and Suspension Type

Trailer Type	Number of Axles	Anti-lock System Configuration with Air Suspensions						
		2S / 1M*	2S / 2M	2S / 2M SL	2S / 2M DAR**	4S / 2M SxS	4S / 2M AxA	4S / 3M
Semi-trailer	1	✓	✓					
	2	✓	✓	✓	✓***	✓	✓	✓
	3	✓	✓	✓		✓	✓	✓
	4							✓****
	5							✓****
Centre Axle Trailer	1	✓	✓					
	2	✓	✓	✓	✓	✓	✓	✓
	3	✓	✓	✓		✓	✓	✓
Full Trailer	2							✓
	3							✓
	4							✓****
	5							✓****

Trailer Type	Number of Axles	Anti-lock System Configuration with Steel Suspensions	
		2S / 2M	4S / 2M SxS
Semi-trailer	1	✓	
	2	✓	✓
	3	✓	✓
Centre Axle Trailer	1	✓	
	2	✓	✓
	3	✓	✓

Trailer Type	Number of Axles	Anti-lock System Configuration for 'Inloader' Trailers (with Air Suspension Only)	
		2S / 2M Relay	4S / 2M Relay
Semi-trailer	2	✓	✓
	3	✓	

*only applicable to EB+ Gen 1
**not applicable to EB+ Gen 1
***alternative to 2S/2M SL
****see ECE R13, Annex 20, paragraph 7.4 – a 4S/3M system is used but it is considered to comprise of separate 2S/2M + 2S/1M configurations

All 2M and 3M configurations meet the Category A prescribed split friction performance requirements defined in Annex 13 of ECE Regulation 13.

All 2M and 3M configurations meet the ADR (International Carriage of Hazardous Goods) requirements for ABS systems.

2.1.2.2 Appendix 1 defines the location of sensors and modulators for the various anti-lock configurations with respect to a trailer of a given type and number of axles including steering and lift axles.

Lift Axles

The EB+ system is suitable for use with lift axles with the following constraints.

Any un-sensed axle may be lifted regardless of system configuration and method of lift control. Up to two axles may be lifted independently using the EB+ auxiliary features.

On semi-trailers, using 4S axle-by-axle or 2S configurations, sensed axles may not be lifted. On full trailers, no sensed axles may be lifted. In 4S side-by-side configurations either (but only one at any time) sensed axle may be lifted.

The lifting device (e.g. ILAS-E) must be under the control of the EB+ system if the axle is to be lifted or lowered while the vehicle is in motion. This may either be by the use of a CAN command according to ISO 11992 RGE 11, a manual switch input or according to pre-set suspension pressures. If a sensed axle is lifted and a sensor fault then develops on the axle remaining on the ground, then the lifted axle is lowered to allow the system to re-establish the required sensor inputs. If a request to lift a sensed axle occurs when the axle remaining on the ground has a fault, then this request is over ridden. It is also possible to request a lifting action as may be required for traction support; in this case, an over-load is permitted until a speed threshold is exceeded in accordance with EC 97/27.

If the lifting device is not under control of the EB+ system, then any lifting or lowering of sensed axles must be completed with the vehicle at rest.

Steering Axles

Any axle designated as either forced or self-steering may be directly or indirectly controlled from any configuration of anti-lock system.

In the case of a requirement to provide additional stability to a self-steering axle during anti-lock operation then one of the auxiliary outputs configured for steer lock function can be connected to a solenoid valve which when energised will provide increased pneumatic pressure to the axle stabilising air spring. In this case, the stabilising pressure will only be present for the duration of anti-lock activity after which the self-steering axle would return to normal operation. Alternatively, in 2S/2M configurations a select low (inverse double check) valve may be used (2S/2M SL) or as an alternative on a tandem trailer the 2S/2M DAR system described below.

Dolly Axles

The system configuration ‘2S/2M DAR’ (Dolly Axle Regulation) is designed primarily for use on dollies intended to convert semi-trailers into full trailers, but which may be approved as stand-alone centre-axle trailers. The system limits the relative brake pressure left/right during anti-lock braking, thereby eliminating the

risk of inducing a directional instability in the dolly application, whilst still meeting Category A split adhesion performance. Roll-over control is also possible with this system, which will function independently and does not need or hinder any stability control system on the attached semi-trailer. See also manufacturer's information document GS0471.

The configuration '2S/2M DAR' is only available with Gen 3, or with Gen 2 software versions with a 'D' prefix, and when specifically activated at end-of-line.

Other configurations may be used for dolly axles on consultation with the manufacturer, but '2S/2M DAR' is the only configuration allowed to be used with roll-over control in this application.

Tube Size

The anti-lock's performance including wheel control is dependent upon the installation of the system on the trailer. Therefore, it is necessary to define minimum bore sizes and lengths of the tubes connecting the pressure storage system to pressure modulator and pressure modulator to brake chamber. These recommendations are defined in Appendix 2.

2.1.2.3 Tyre to Exciter Operating Tolerance

To maintain anti-lock performance, the signal frequency produced by the sensor / exciter (tone wheel) must be within acceptable limits. The tyre and exciter sizes may be programmed via the diagnostic link, ensuring optimum setting. However, it is also possible to use any given programmed setting over a range of tyre sizes provided that the signal frequency produced is within - 25% to +20% of that produced by the programmed setting and that all tyres and exciters are the same size. Appendix 16 shows the range of tyre sizes that can be fitted with 60, 80, 90, 100 and 120 tooth exciters with correct programming. It also shows an example of the allowable range when programmed for the default tyre size (385/65R22.5) and exciter (100 teeth).

It is also possible to have different tyre sizes between sensed axles provided that the tyre and exciter sizes for each axle are programmed.

2.1.2.4 Wheel to Wheel Tyre Tolerances

Each sensed axle must be fitted with tyres of the same nominal size and exciters with the same number of teeth. Inter-wheel variations due to wear and manufacturing variations are accommodated by a 6.5% tolerance limit within the ECU. Wheels not installed with sensors and exciters may have any size of tyre as appropriate.

2.1.2.5 Suspensions scope

ECE R-13 Annex 19 – Appendix 5 – Trailer Anti-lock Braking System Information Document paragraph 2.5 was amended by Supplement 2 to the 10 series of amendments. This amended the definition of suspensions as follows: -

2.5 Scope of application with respect to suspension type:

Air suspension: Any type of balanced "trailing arm" air suspension

Other suspensions: to be defined by manufacturer, model and type (balanced/unbalanced)

Haldex authorise any type of balanced 'trailing arm' air suspension to be used with EB+ braking systems with respect to ECE R-13 approvals. Appendix 4 of this document lists other authorised suspensions types. The mechanical suspensions contained in this Appendix 4 are balanced type mechanical suspensions. All listed suspensions are defined according to the manufacturer's model reference.

2.1.2.6. Differential Brake Actuation

To maintain control of indirectly controlled wheels within a bogie, it may, depending upon the anti-lock system configuration and suspension, be necessary to adjust the braking force produced by an axle or axles. When such action is required the brake force is adjusted by a change to the cam lever length or brake chamber size. Without such action, certain indirectly controlled wheels could lock during anti-lock operation, although this is permitted as indirectly controlled wheels may lock for any duration. Appendix 5 defines the ABS configurations and the amount of bias that may be applied to an axle within the bogie.

Differential brake actuation is not allowed in 2S/2M Relay or 4S/2M Relay configurations.

2.1.2.7. Energy Consumption – Worst-Case Loading

The determination of the worst-case axle load is not required by the ECE Annex 19 procedure. Annex 19 of ECE Regulation 13 (paragraph 5.4.1.2.1.) requires trailer(s) to be loaded to an axle load of 2,500kg +/- 200kg or 35 percent of the permissible static axle load whichever is the lower.

2.1.2.8 Additional Information

Electronic Load Sensing (ELS)

The load sensing parameters must be programmed into the ECU via the diagnostic link.

Required parameters: –

- P0 Threshold pressure
- PDx,y In-shot / Pivot point
- P3x,y Laden pressure output
- P3´x,y Unladen pressure output
- Psl Laden air suspension pressure
- Psu Unladen air suspension pressure

Optional parameters –

- P1x,y Laden knee point
- P2x,y Laden knee point

Appendix 3 illustrates the load sensing characteristics and an example “Load Plate”.

The suspension bellows pressure should be connected to the suspension port of the EB+ valve, port 41, this port is also marked with a symbol for the suspension bellows. In the case of full trailer 3M systems, the front bellows pressure should separately be connected to the Slave EB+ valve, port 41 allowing a separate set of parameters to be used.

Suspension systems with a single levelling valve can be connected directly to the suspension port of EB+ valve.

Suspension systems with twin levelling valves (split side by side suspension) should use a double check (select high) valve connected between their outputs and the suspension port of EB+ valve.

If raise lower valves are fitted to the suspension system then a double check (select high) valve is required to be connected between of the suspension bellows and the levelling valve before connecting to the suspension port of EB+ valve. This prevents the apportionment to the unladen condition if the suspension is left in the lowered position in error. If the trailer is fitted with a reset-to-ride system (COLAS) under the control of the EB+ then this double check valve may be omitted. The COLAS system re-sets the suspension to normal ride height automatically when the vehicle speed reaches a pre-set threshold (default 15 km/h) and thus the correct suspension pressure is restored.

2.1.3 Component Description

Component Part Numbers

A list of EB+ part numbers is contained in Appendix 7. Wildcards are denoted by "x". Using "x" wildcards enables versions to be produced that do not affect the function or performance of the product or system as a whole as tested and approved and are used to reduce documentation changes to trailer manufacturers approvals.

Identification of Components

Part number, MO (Manufacturing Order) number and date code along with the Haldex name in a visible position identify each part of the system, which can be replaced separately. The part number will identify the exact part. The MO number will link it to the manufacturing computer system giving details such as date of manufacture and issue level. The date code shows the month (01 to 12) and 2-digit year (e.g. 08 for 2008) of final assembly / test.

By design the software can be upgraded in service. The current level of software can be identified through the diagnostic link. Upgrading of this software is controlled according to KWP2000 security criteria.

2.1.3.1 Wheel Speed Sensors

The wheel speed sensor is a variable reluctance type and is mounted within the brake / hub on a non-rotating element. Each sensor consists of a permanent magnet, magnetic pole piece and electrical coil with conductors for connection to the ECU. The sensor is positioned so that the pole piece is aligned with the teeth in the centre of the exciter ring (tone wheel).

2.1.3.1.1 Sensor Variants

Two variants of sensor are produced:
Straight – Where the cable exits the sensor in line with its centreline.
Right angle – Where the cable exits the sensor at 90º to the centreline.

While the system has been designed to function with Haldex sourced sensors, correct system performance can also be obtained when the installed sensor is obtained from an alternative source. Only the following wheel sensor part numbers are approved for use with the EB+ system. Radun types are functionally identical to Haldex.

Part Number	Supplier	Comments
364 208 xxx 364 094 xxx 364 528 xxx 364 540 xxx 364 541 xxx	Haldex	Straight 90 degree Straight 90 degree Straight
441 032 --- 0	Wabco	90 degree
0 265 050	Bosch	
ES5020 0 486 000 0 486 001	Knorr – Bremse	90 degree 90 degree Straight
GS 024-	Radun	

2.1.3.1.2 Exciter

The exciter or tone wheel is a toothed wheel manufactured from a ferritic material and is mounted on a rotating section of the brake / hub. Exciters should be produced in accordance with Haldex specification GS0006.

All sensor / exciter assemblies are mounted so that the centreline of the teeth of the exciter pass at 90º to the centreline of the sensor with minimum clearance between the two components. This is required to ensure the sensor generates the appropriate voltage. The action of the teeth on the exciter passing the pole piece of the sensor repeatedly modulates the magnetic field around the sensor thereby inducing an AC voltage within the sensor coil, the frequency of which, is directly related to the speed of the wheel. This signal is then transmitted to the electronic controller (ECU) via cables, following which the ECU will utilise these signals in making any anti-lock decision that are considered appropriate relative to the reaction of a wheel or wheels.

2.1.3.2 Electronic Control Unit (ECU)

2.1.3.2.1 Description

The controller for the EB+ system is mounted to the modulator(s), together forming a main assembly.

The controller's primary function is to control braking by adjusting the pneumatic pressure applied to the wheel brake chambers. The controller also measures wheel speed, brake chamber delivery pressures, driver demand pressure, reservoir pressure and load pressures and using this information adjusts the wheel brake chamber pressures via the valve sub-assembly to achieve load apportionment and ABS.

The controller carries out system integrity checks by test pulsing the wheel speed sensors, monitoring solenoid status and if fitted, the trailer pneumatic control transmission pressure switch or pressure sensor operation. If a fault is detected, such as a broken wheel speed sensor cable, it can modify its braking response by using the data from the remaining wheel speed sensors. In a more severe system fault condition, it can turn off all controlled brake functions, with braking then being achieved via a pneumatic push through function.

The controller has a "lamp" output for a cab mounted warning signal indicating operational status.

A CAN ISO 11898 port is provided for diagnostic and data transfer purposes, which is used during factory test or vehicle service to configure the unit, e.g. number of modulators, load plate data, two or four wheel speed sensor operation, auxiliary functions, tyre and exciter sizes and to retrieve system data and fault codes. Associated with this diagnostic port is a power connection sourced from the EB+ system suitable for powering other brakes and running gear functions, e.g. suspension.

The controller is powered from a permanent 24V supply (conforming to ISO 7638) or when there is a malfunction of the permanent supply, it may be powered from an optional 24N or ISO 12098 stoplight supply (only available during braking). During stoplight power operation, the controller performs anti-lock braking function (ABS only) or optionally, also dynamic load sensing. A label is provided for positioning close to the trailer connections warning of the consequence of non-connection of the ISO 7638, see Appendix 15.

The EB+ Gen 1 controller consists of an electronic circuit board encapsulated inside a plastic case. It connects to other units via plugs moulded into the case. The controller is available in 3M, 2M and 1M versions with differing numbers of auxiliary functions. The 2M controller may also be used on 1M systems. The 3M controller can also be used on non-integrated 2M systems. On 2M non-integrated and 3M systems a Slave modulator uses a simple conditioning interface housed in a similar package.

The EB+ Gen 2 and Gen 3 controllers are of similar design, but are integrated with a 2M modulator package and are not removable. A controller variant is also available for 3M systems, which uses an additional non–integrated 1M Slave

modulator with a simple conditioning interface housed in an EB+ Gen 1 enclosure.

The PSW connector (Pressure Switch) is deleted from EB+ Gen 2 and Gen 3 controllers.

2.1.3.2.2 Control Logic

The ECU contains two microcontrollers. The main microcontroller is responsible for all braking control and diagnostic functions. The second microcontroller is fitted so that operational crosschecks can be performed. If either microcontroller detects a failure of the other then an internal shutdown mechanism is activated which prevents electrical actuation of the modulator solenoids.

The ECU operates closed loop brake pressure control for each modulator channel. Braking is initiated when the controller receives a signal from either the CAN ISO 11992 input from the towing vehicle or the on-board control line (demand) pressure transducer or if fitted the trailer control line pressure switch or pressure sensor. Driver demand pressure is then determined from either the ISO 11992 data link or the control line pressure transducer. The demand pressure is then modified into a target pressure for both pressure control channels by a load-sensing algorithm, using data from the air suspension transducer. See Appendix 14.

The integral anti-lock control algorithm may further modify the target pressures. When a wheel speed sensor associated with a modulator channel detects a deceleration of wheel speed towards lock the pressure control is set to dump air from that channel. When the wheel speed is re-accelerating towards synchronous vehicle speed, the algorithm may choose to hold pressure before making a controlled pressure re-application.

On 2M systems where more than one wheel sensor is associated with a channel the algorithm will use either a select low or ASC control strategy according to the system settings. In select low mode the lowest associated wheel speed controls the braking pressure. In ASC mode, all associated wheels control the braking pressure. When a significant differential in adhesion (>2:1) is detected then the control mode changes from “select low” to “select high”.

When the vehicle comes to rest (stationary) and the brakes remain applied, after 5 seconds the system will graduate the target braking pressure from the load modified demand value to the available reservoir pressure and then switches off the solenoids. The system will re-establish load apportionment of braking when the next brake application is applied from zero brake demand.

There is a special mode for roller brake testing enabling the system to be held in either apportioning or non-apportioning (1:1) mode.

If the trailer service brakes are off (including the park brake in the case where the towing vehicle “parks on air”) when the electrical power is applied (turning the ignition key to “run”) it adopts continuous apportioning when the brakes are

subsequently applied. This apportioning is limited to 2 minutes for any single brake application, after which it returns to the push-through condition. This condition is cancelled on vehicle movement above 8 kph returning the system to normal operation.

If the trailer service brakes are on when the electrical power is applied (turning the ignition key to "run") it immediately adopts push-through (non-apportioning). When the brakes are released and re-applied the system remains in push-through unless the brakes are released for longer than 2 minutes, after which it returns to normal operation. This condition is also cancelled on vehicle movement above 8 kph returning the system to normal operation.

2.1.3.2.3 Failure Modes

Electrical failures within the ECU, cabling external to the ECU, pressure modulators and sensors as defined in paragraph 4.1 of Annex X to Directive 71/320/EEC and Annex 13 to Regulation 13 are detected by the ECU and a failure warning signal transmitted by pin 5 of the ISO 7638 connector and on the ISO 11992 data link if applicable and available.

A summary of the system fault handling is provided in Appendix 8.

2.1.3.2.4 Additional / Optional Features

2.1.3.2.4.1 Auxiliary Inputs and Outputs

The EB+ system supports up to 5 auxiliary (aux) channels, the auxiliary channels have different characteristics to provide a wide range of possible applications. Auxiliary functions (e.g. reset-to-ride height) can be assigned to several auxiliary channels with separate parameters to provide multiple channels or thresholds. Each channel uses a 3-pin connector with coloured wires, a summary of the connections is provided below.

Aux 1 – One pin provides a general-purpose digital input or high side drive output. One pin provides a signal dedicated to either a tacho speed signal or a diagnostic tell-tale signal. One pin provides a dedicated B- return.

Aux 2 – One pin provides a general-purpose digital input or high side drive output. One pin provides a general-purpose digital input or low side drive output, which may be used as a switched B- return. One pin provides a general-purpose analogue input [A/D] (or high side drive output*).

Aux 3 – One pin provides a general-purpose digital input or high side drive output. One pin provides a dedicated B- return. One pin provides a general-purpose analogue input [A/D] (or high side drive output*).

Aux 4+5 – One pin provides a dedicated, buffered and tracking 5V power supply that may be used to power external devices [e.g. lining wear monitor]. One pin provides a dedicated B- return. One pin provides a general-purpose analogue input [A/D].

*Marketed as 'Premium Aux' version

Summary of Auxiliary Connections

	Red Wire	Black Wire	Yellow Wire
Aux 1	Digital Input	B- Return	Tacho
	High-side Output		Tell-Tale
Aux 2	Digital Input	Digital Input	A/D Input
		Low side Output	
	High-side Output	Switched Return	High-side Output
Aux 3	Digital Input	B- Return	A/D Input
	High-side Output		High-side Output
Aux 4	5 Volt Supply	B- Return	A/D Input
Aux 5	5 Volt Supply	B- Return	A/D Input

2.1.3.2.4.2 Auxiliary Functions

General Note on Automatically Commanded Braking

At any time during automatically commanded braking a driver demanded braking request will be implemented in parallel, selecting the highest level of overall braking i.e. the automatic function can be overridden by the service braking demand at all times (only in the direction of greater pressure).

EB+ sends the 'Stop Lamps Request' via ISO11992 CAN to the towing vehicle if it uses automatically commanded braking. Note that EB+ does not control the stop lamps directly. Note also that in software versions up to and including C442 the 'Stop Lamps Request' was not implemented as ISO11992 had not been updated to include this message. It is also not guaranteed that a towing vehicle will act on this message.

Super-Aux Option (EB+ Gen 2 and Gen 3 only)

Three digital inputs (A, B, C) and a low-power B+ supply (for a switch), can be provided on the auxiliary Power B connector. This enables lighting or other systems to trigger an output on Aux 1, 2 or 3.

Example: Steer Axle Lock set to lock above 10 km/h on Aux 1. Reversing lamps connected to Input A. Axle will lock if 10 km/h exceeded OR vehicle is reversing.

Power Extension

Gen 3 units have an optional 'power extension' feature. The auxiliary functions can be programmed to continue to operate once the ignition (ISO 7638 pin 2) is switched off. Power is sourced in this case from the permanent power feed (ISO 7638 pin 1). The system will switch itself off after a programmed time period. During the 'power extension' the normal brake control functions are switched off and the system operates in push-through. If the ignition is switched back on during the 'power extension' then the system resets as normal.

Reset-to-Ride Height

This is a timed output that may be used to reset the suspension to the normal ride height when it moves after it has been altered by a raise / lower valve. The default setting is 15 kph for 10 seconds. Up to 3 independent outputs can be provided enabling its use for related functions with different thresholds. This function must be activated and may be re-configured by the End-of-Line-Test.

Speed Lock

Similar to Reset-to-Ride, but provides a continuous output above a speed threshold.

Lift Axle Control

It is possible to connect up to two lift axle control valves. These can control the raise and lower functions either based on axle load settings programmed into the ECU (auto raise / auto lower) or a combination of these settings and a switch input (manual raise / auto lower). This function must be activated and programmed by the End-of-Line-Test.

Traction Assist

Upon request, either via the data communication from the towing vehicle or from a switch, the system can enter a 'Traction Assist' mode. In this mode, any front lift axle is raised and any rear lift axle is lowered. The purpose is to transfer load onto the drive axle of the tractor unit to assist in the case of low friction pull away. Should the load on the remaining axles exceed 130% of the programmed maximum then the front lift axle is lowered again. Once the speed exceeds 30 km/h the lift axles are reinstated to their default states.

Retarder Control

It is possible to provide an output that can be used to interrupt a trailer-mounted retarder. This output is independent from the foundation brake control and is arranged to give preference to using the foundation brakes during an ABS event while still ensuring effective use of the retarder. This function must be activated by the End-of-Line-Test.

Trailer Mounted Warning

It is possible to provide an output that can be used for a trailer mounted warning device. This warning signal is electrically independent but mimics that signalled using pin 5 of the ISO 7638. This function must be configured by the End-of-Line-Test. Note: This trailer mounted warning device may not be permitted in some countries (e.g. Germany) due to national legislation.

Tacho

This is a pulse output equivalent to the “C3” output of a tachograph. It may be used to connect to systems that require the speed as an input, e.g. Electronic Suspension controllers. This function is always present and does not need to be activated by the End-of-Line-Test.

Lining Wear

Lining wear sensors (indicators) may be connected the analogue input on Aux 4.

Power Output

It is possible to provide a continuous output that may be used as a protected power output. This function must be activated by the End-of-Line-Test.

Steer Lock

It is possible to provide an output to lock a self-steering axle. This enables an axle to be locked if there is an ABS event or an optional speed threshold exceeded and remain locked until the ABS event ceases or a lower optional speed threshold passed. Further modification to this operation is also possible according to lift axle status in order to maintain “turning circle” requirements.

Trailer Roll Stability

As an option, it is possible to use either an internal accelerometer or an accelerometer connected to Aux 5 to provide a signal used in the trailer roll stability control algorithm. This system will apply the brakes independent of the driver if an imminent rollover condition is detected. This application of the trailer brakes is autonomous and is of the type defined as “Automatically Commanded Braking” in Para. 2.29 of ECE-Regulation 13.

Soft Docking

The EB+ system also utilises automatic commanded braking as part of the optional ‘Soft Docking’ system. This uses signals from an external controller, connected to Aux 4 or 5 (or in some cases to the diagnostic CAN bus), to determine that the vehicle is reversing and within a pre-defined distance of a loading dock. The service brakes are then applied to bring the vehicle to a halt. This application of the trailer brakes is autonomous and is of the type defined as “Automatically Commanded Braking” in Para. 2.29 of ECE-Regulation 13.

Electric Brake Demand ('EBD')

The EB+ system also has the possibility to generate a user-configurable braking level (up to 4 bar / 400 kPa) up to a user-configurable speed limit (up to 10 km/h), triggered by a switch input on one of the auxiliary inputs. This function is intended for applications such as braking resistance for aggregate tipping trailers in road-laying combinations.

Suspension Height Control

Aux 2 or 3 can be used to drive the raise and lower solenoids of a suspension height control valve, in conjunction with a height sensor on Aux 4 or 5.

2.1.3.2.4.3 Control Line Pressure Switch or Pressure Sensor

The pneumatic control line can optionally be monitored at the front of the trailer (forward of any valves e.g. EV / REV), in addition to the normal monitoring within the EB+ package.

This monitoring can be achieved with either a sensitive (0.2 bar g / 20 kPa g) pressure switch connected to the 'PSW' port of EB+ Gen 1, or by a pressure sensor (8 bar g / 800 kPa g) connected to either of the 'AUX 4' or 'AUX 5' ports, or the CAN Hub if fitted.

2.1.3.2.5 Diagnostics and End of Line Test

The ECU has a CAN diagnostic link enabling connection to a Haldex Info-Centre, a PC equipped with a CAN interface or other approved devices. Diagnostic communication is in accordance with KWP2000.

The diagnostic link is also used for End-of-Line test enabling the programming of system configuration and variable data in addition to a diagnostic "check-out".

The diagnostic power may also be used together with the diagnostic CAN Bus as a power and communications bus connected to other approved devices.

Gen 3 units have two connectors in parallel for multiple devices. In addition, the CAN termination is switchable to allow Gen 3 to be a terminating or intermediate node. Gen 2 units are always terminating nodes.

2.1.3.3 Modulators

2.1.3.3.1 Emergency function

Where an EV (Emergency Valve) or REV (Relay EV) is required, the EB+ system has been designed to function with Haldex sourced valves, including Trailer Control Module see Appendix 7 for applicable part numbers.

2.1.3.3.2 Pressure Modulators

2.1.3.3.2.1 General Description - Main Valve Assembly

The EB+ main valve assembly contains either one or two independently controlled modulator valves designated M1 on a 1M system and M1 and M2 on a 2M system. A 3M system uses a combination of one 1M and one 2M modulator. A 1M modulator has delivery ports designated “2” and can operate between 2 to 6 brake chambers (maximum brake chamber size = Type 30). A 2M modulator is illustrated in Appendices 13.1 to 13.7. Each modulator has delivery ports, which are numbered “21” and “22” respectively. These supply 1 to 3 brake chambers (maximum brake chamber size = Type 30). These valves have been designed to operate within a trailer air braking system utilising the relay principle, with the addition of two solenoids to provide stepping control and a further solenoid to supply control air from the reservoir.

The relay valve has two different sections:

Control: A signal representative of driver demand, to which load sensing and anti-lock control may also be applied via the solenoids.

Delivery: To provide high airflow capability to and from the brake chambers to apply or release the brakes in response to the signal pressure.

Appendix 9 illustrates a schematic cross section through the EB+ Gen 1 and EB+ Gen 2 / 3 integrated 2M valve and its operating components.

2.1.3.3.2.2 General Description - Slave Valve Assembly

The EB+ Slave valve assembly used on 2M non-integrated and 3M systems is based on a standard 1M main valve assembly. For use on semi and centre-axle trailers the suspension (load) pressure transducer may be omitted.

2.1.3.3.2.3 Pneumatic Operation without Electrical Power (Push-Through)

Pneumatic operation without electrical power is shown in Appendices 13.2, 13.3 and 13.4. Signal air enters port 4 into the apply solenoid and then via the hold solenoid into the volume above the relay piston. As pressure increases the piston descends, firstly closing the exhaust seat connecting the brake chamber (port 2) to atmosphere (port 3) and secondly opening the reservoir seat between the pressure storage reservoir (port 1) and the brake chambers deliveries (port 2). Pressure in the brake chamber rises until the pressure acting on the underside of the relay piston balances with the pressure above the relay piston. In the balanced state both the exhaust and reservoir seats, from reservoir to brake chambers and brake chamber to atmosphere, are closed thereby maintaining a steady state condition where brake chamber pressure nominally equates to the signal pressure.

On reduction of the pressure at port 4, pressure from above the relay piston is simultaneously reduced via the solenoids. As there is now a pressure imbalance where the pressure under the relay piston is higher than that above the relay piston will move upward thereby opening the passage between brake chamber and atmosphere via port 3 to correspondingly reduce the pressure at the brake chamber. Brake chamber pressure will continue to decay until either there is a balanced condition or all pressure has been exhausted.

The EB+ modulator assembly can be installed with an optional integrated double-check valve for foundation brake anti-compounding.
The EB+ Gen 2 or Gen 3 modulator assembly can be installed with optional integrated double-check valve for foundation brake anti-compounding, and in this case either four or six spring brake delivery ports can be provided. It is also possible to have an integrated quick release valve for the spring brake circuit. The EB+ Gen 2 or Gen 3 valve additionally has test points for the service deliveries and optionally two extra reservoir ports.

2.1.3.3.2.4 Operation with Electrical Power

Pneumatic operation with electrical power is shown in Appendices 13.5, 13.6 and 13.7. On receiving a signal from either the CAN ISO 11992 input from the towing vehicle or the on-board control line pressure transducer or a control line pressure switch or pressure sensor if fitted, the ECU will energise the apply solenoid allowing air from the trailer reservoir to pass to the hold solenoids. The signal pressure from the driver's demand is measured by the control line pressure transducer and stopped by the apply solenoid from reaching the hold solenoid.

The pressure to the delivery of each valve is then controlled by the ECU by switching the appropriate solenoids as described below.

Anti-Lock Operation:

When the brake chamber pressure is such that a brake force is produced that exceeds the tyre to road adhesion the wheel(s) will begin to decelerate towards lock at which point the ECU will signal the appropriate solenoid to control the pressure at the brake by exhausting, holding and applying the air as described below.

Solenoid Operation (Hold and Dump)

1) (See Appendix 13.7) When both hold and dump solenoids are energised simultaneously the pressure above the relay piston will decay as air is exhausted through the dump solenoid. This reduction will produce a corresponding reduction in pressure at the brake chamber.
2) (See Appendix 13.6) Where it is required to hold pressure, only the hold solenoid is energised. This will produce a nominal balance in pressure above and below the relay piston and result in a pressure hold at the brake chamber.

3) (See Appendix 13.5) An increase in pressure may be obtained by de-energising the hold solenoid. This action will allow pressure to rise towards the target pressure.

4) The rate of pressure increase and decrease can be controlled by combining the above conditions under ECU control to achieve the required brake conditions or ABS operation.

2.1.3.4 Electrical Equipment and Connections

2.1.3.4.1 Power Cabling

The EB+ system uses the ISO 7638 as the power connector using 4.0 mm^2 cable for pins 1 and 4.

The EB+ Gen 1 and 2 units operate using an ISO 7638-1 24V supply. All Gen 3 units can operate from either an ISO 7638-1 24V supply or an ISO 7638-2 12V supply, since they incorporate modified solenoids and a different driving regime.

When using the ISO 7638 7-pin with CAN the total cable length must not exceed 40m with the following maximum distributions:

In towing vehicle	15m
In interconnecting coiled section	7m
In towed vehicle	18m

In the case of centre axle and full trailers the interconnecting coil is part of the trailer.

For correct operation of the CAN communications a length of 18m must not be exceeded. If a cable length in excess of 18m is necessary on the trailer, then two options are possible –

(1) A 5 pin ISO 7638 power cable may be used. NOTE: In this case, the electric control line is not supported and the system works solely using pneumatic signalling.

(2) An additional ECU known as an EB+ CAN Hub may be installed (see Appendix 12a). The CAN Hub receives all 7-cores from the headboard ISO7638 connector, including the ISO11992 data communication part of the electric control line, acts as an intermediate ISO11992 CAN node, and then connects to the main EB+ controller via a 7-core cable of up to 40m length.

A control line pressure sensor (see 2.1.3.2.4.3) can optionally be connected to the port marked ‘AUX’ on the CAN Hub, instead of connecting to AUX 4 or AUX 5 on the master controller. This limits the number of long cable runs. The CAN Hub uses the intermediate ISO11992 CAN Bus to send information from the pressure sensor when there is no electric control line available on the towing vehicle.

The CAN Hub also has a third 7-pin connection for a following trailer / EBS.

As required by paragraph 4.4 of Annex X to Directive 71/320/EEC and paragraph 5.2.2.17 of Regulation 13 all anti-lock trailers must be installed with a connector conforming to ISO 7638. However, the above paragraphs do not specify the exclusive use of the ISO 7638 connector for powering trailer ABS systems, therefore the use of any other power source for the trailer ABS must be considered as an additional, optional provision in the case of a failure of the ISO 7638 supply. EB+ 1M and 2M integrated and Gen 3 3M systems have the capability of accepting electrical power directly from both the ISO 7638 connector and as an optional fall-back, the ISO 1185 (24N) or ISO 12098 (15 pin) connector. See ECU wiring diagram in Appendix 10.

The connection of the stoplight power fall-back can be verified by allowing the normal warning signal check-out sequence, including any auxiliary indication, to complete. When the brake pedal is then operated the warning device will momentarily change state once more, either on or off according to the option specified. This indicates that the stoplight fall-back is connected. Alternately the system can be temporarily disconnected from the ISO 7638 supply, then have the ignition turned to run with the brake pedal already depressed and the presence of a "blowdown" signal from the modulator verified.

2.1.3.4.2 Wiring Diagrams

Appendix 10 shows the wiring diagrams for EB+. The relationship between the wheel speed sensors and modulators is configured in the software allowing the wiring to remain the same in all cases.

System	Wiring diagram
EB+ Gen 3 - Integrated 2M	911 522 001
EB+ Gen 3 - Non-integrated 3M	911 523 001
EB+ Gen 2 - Integrated 2M	911 440 001
EB+ Gen 2 - Non-integrated 3M	911 461 001
EB+ Gen 1 - Integrated 1M / 2M	911 334 001
EB+ Gen 1 - Non-integrated 3M / 2M	911 369 001
EB+ CAN Hub	911 552 001 911 553 001

2.1.3.4.3 Warning Signal Sequence

The EB+ system provides a drive for a warning signal connected to pin 5 of the ISO 7638 connector to control a cab mounted warning device. This is used to indicate both primary EBS / ABS faults and also auxiliary faults; priority is given to the indication of primary faults. There is an option of two simple "check-outs", an on-off-on (option "A") or an on-off (option "B") sequence, as an operator preference. The benefit of the on-off-on sequence is that it provides positive verification of wheel speed sensor operation at move away, however it does require the driver to move away with the warning signal still illuminated. The two warning signal sequences are illustrated in Appendix 11.

Either of the check-out methods can be “corrupted” as a result of modification by the towing vehicle. In order to reduce driver confusion an optional trailer mounted warning device is also provided as an auxiliary function. This signal mimics the signal to the cab warning device. Note: The signal produced may be different to that displayed by the cab device due to possible modification of the latter by the towing vehicle.

2.1.3.4.4 Automatic Braking Suppression with Pressure Switch or Pressure Sensor

Optionally a pressure switch or pressure sensor may be fitted, situated in the pneumatic control transmission ahead of any control valves, i.e. EV / REV or boost relay valve. If fitted the system provides automatic braking suppression according to Para. 5.2.2.12.1 of Regulation 13.

2.1.3.5 Pneumatic Circuits

2.1.3.5.1 Braking System Installation Schematics

Appendix 12 illustrates the installation of the respective ABS configurations within the braking system and Appendices 18, 19, 20, 21, 22 and 23 show functional schematics in detail.

2.1.3.5.2 Tube Size Limitations

The anti-lock system performance including wheel control is dependent upon the installation of the system on the trailer. Therefore, it is necessary to define minimum bore sizes and lengths of the tubes connecting the pressure storage system to pressure modulator and pressure modulator to brake chamber. These recommendations are defined in Appendix 2.

2.1.4 Electro-Magnetic Compatibility (EMC)

2.1.4.1 To fulfil the prescribed legal requirements regarding EMC (paragraph 5.1.1.4 of ECE-Regulation No. 13), the electronics are certified according to ECE Regulation 10. The following approval numbers have been assigned:

Component / System	ECE Approval
EB+ Gen 3	E11 - 10R-057673 Ext. 5
EB+ Gen 2 (2M)	E11 - 10R-033942 Ext. 6
EB+ Gen 2 (3M) **	E11 - 10R-033825 Ext. 4
EB+ Gen 1 (1M/2M)	E11 - 10R-033807 Ext. 4
EB+ Gen 1 (3M) **	E11 - 10R-033825 Ext. 4
EB+ CAN Hub	E11 - 10R-0511053
Pressure sensor	E11 - 10R-034038 Ext. 3
Height Sensor	E1 - 10R-055852 Ext. 1

** These products are covered by the same EMC approval

A copy of the approval certificates together with applicable part numbers is included as Appendix 17.

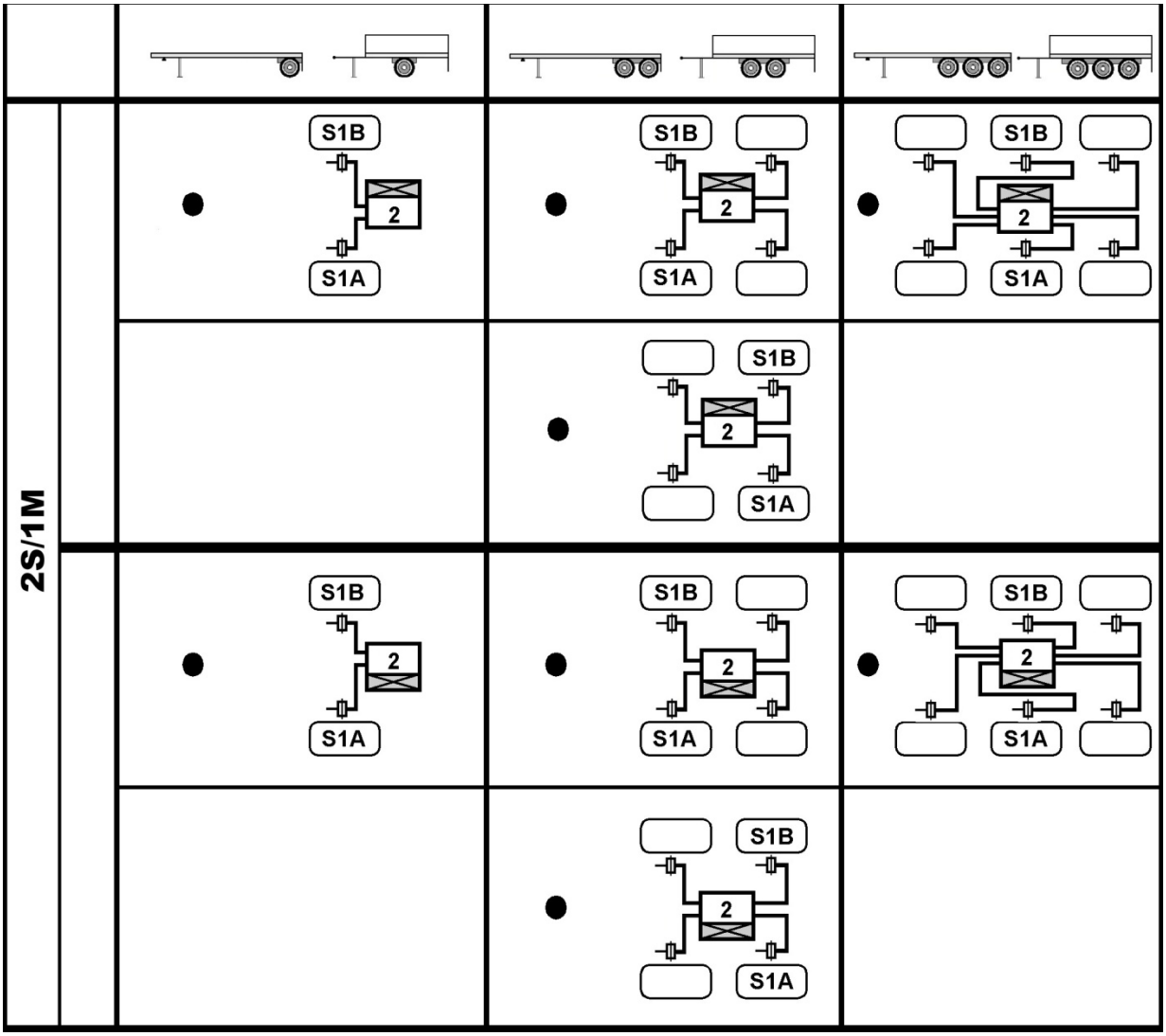
EB+ ABS Information Document - Appendices List

Appendix 1a	Anti-lock installation configurations 1 – 3 axles
Appendix 1b	Anti-lock installation configurations 4 – 5 axles
Appendix 1c	Anti-lock installation configurations – 'Inloader' trailers
Appendix 2	Recommended tube sizes
Appendix 3	Electronic load sensing characteristics and load plate examples
Appendix 4	Approved suspensions
Appendix 5	Differential actuation
Appendix 6	Energy consumption, worst-case axle load
Appendix 7	Part numbers
Appendix 8	Fault handling summaries (1M, 2M, 3M and Stability)
Appendix 9	EB+ valve cross-sections
Appendix 10	Wiring diagrams
Appendix 11	Warning signal sequence
Appendix 12	EB+ Brake system schematics
Appendix 12a	EB+ CAN Hub installation schematic
Appendices 13.1 – 13.7	EB+ Gen 1 with 2M valve operation
Appendices 13.8 – 13.14	EB+ Gen 2 with 2M valve operation
Appendix 14	EB+ Function blocks
Appendix 15	EB+ Headboard information label, ISO 7638 connection
Appendix 16	Tyre size / exciter relationship
Appendix 17	Electro-Magnetic Compatibility (EMC) Approval Certificates
Appendix 18	EB+ Gen 1 in combined service and park brake system schematic with REV 351 009 xxx
Appendix 19	EB+ Gen 1 in combined service and park brake system schematic with REV 351 033 xxx
Appendix 20	EB+ Gen 1 in combined service and park brake system schematic with Trailer Control Module + 352 067 601
Appendix 21	EB+ Gen 2/3 in combined service and park brake system schematic with REV 351 009 xxx
Appendix 22	EB+ Gen 2/3 in combined service and park brake system schematic with REV 351 033 xxx
Appendix 23	EB+ Gen 2/3 in combined service and park brake system schematic with Trailer Control Module + 352 067 601
Appendix 24	EB+ Gen 2/3 in combined service and park brake system schematic with Trailer Emergency Module

Revision History:

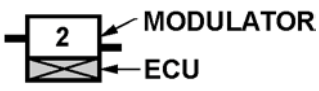
Issue:	Ref:	Date:	Revision
5	C7149 C7150	29/01/20	Addition of CAN Hub Addition of Inloader Changed wheel size programming explanation and Appendix 16.
4	C6237	19/07/12	Introduction of Gen 3
3	C6068	17/05/11	EMC and editorial updates
2	C5757	06/10/09	Mandatory EVSC approval Dolly Axle Regulation
1	PR1985	19/11/08	

EB+ Gen 1 Installation Options - Semi & Centre Axle Trailers



Any axle without directly controlled wheels may be a lift axle
Any axle may be a steered axle

KEY



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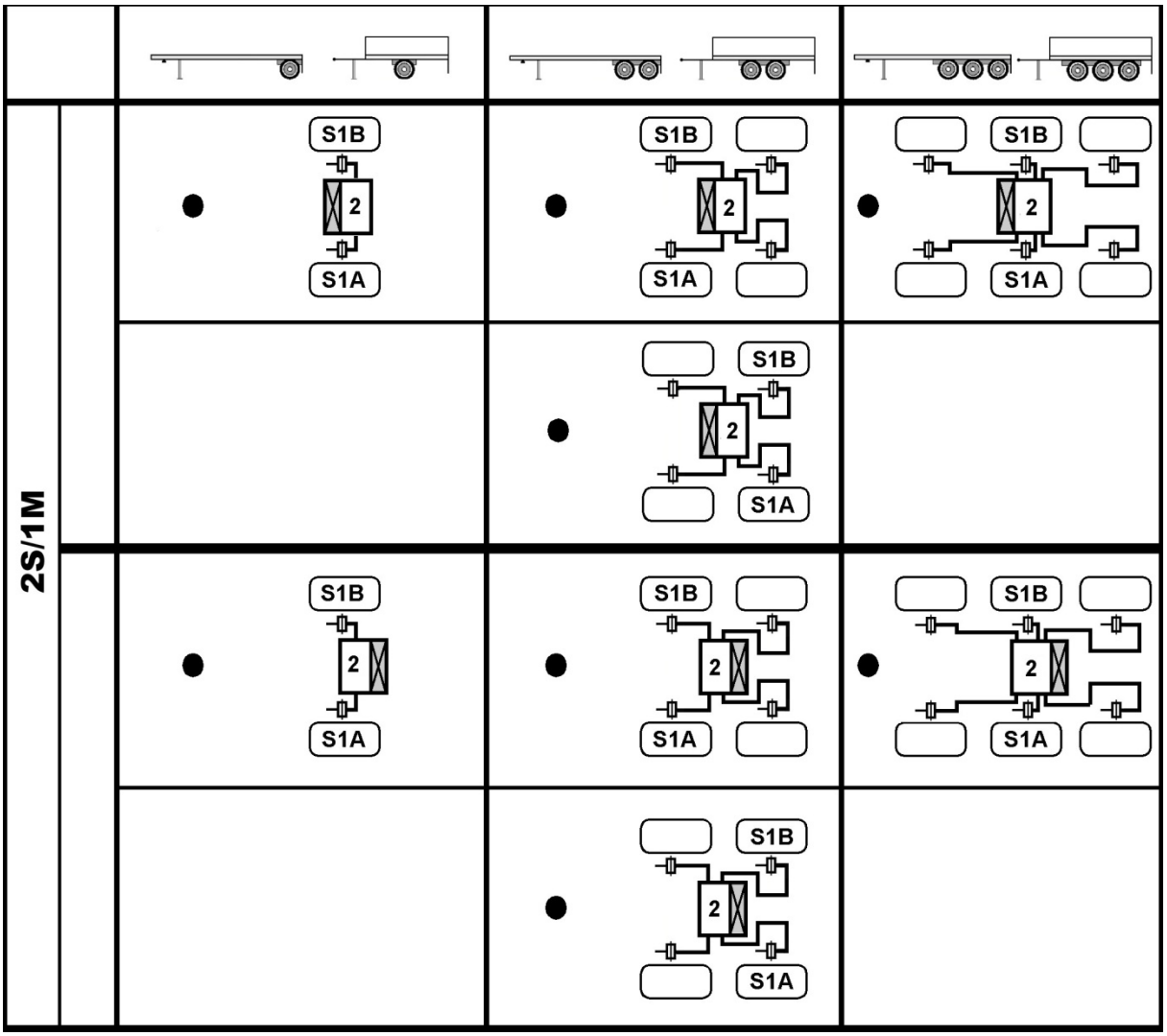
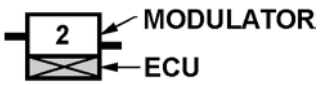
EB+ Gen 1 Installation Options - Semi & Centre Axle Trailers



Any axle without directly controlled wheels may be a lift axle
Any axle may be a steered axle

KEY



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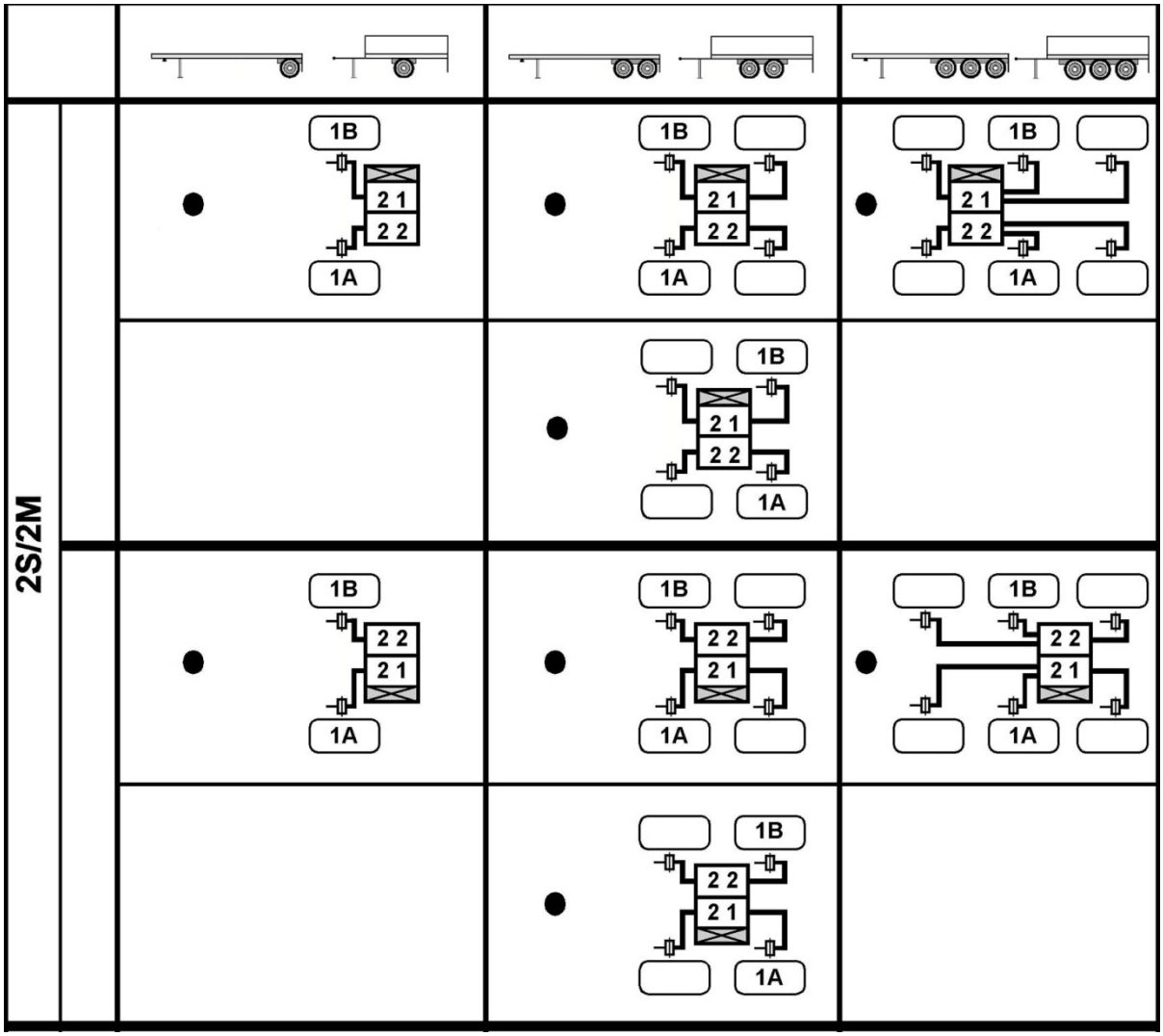
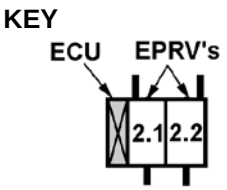
EB+ Gen 1, Gen 2 & Gen 3 Installation Options - Semi & Centre Axle Trailers

Integrated Side By Side (SxS)

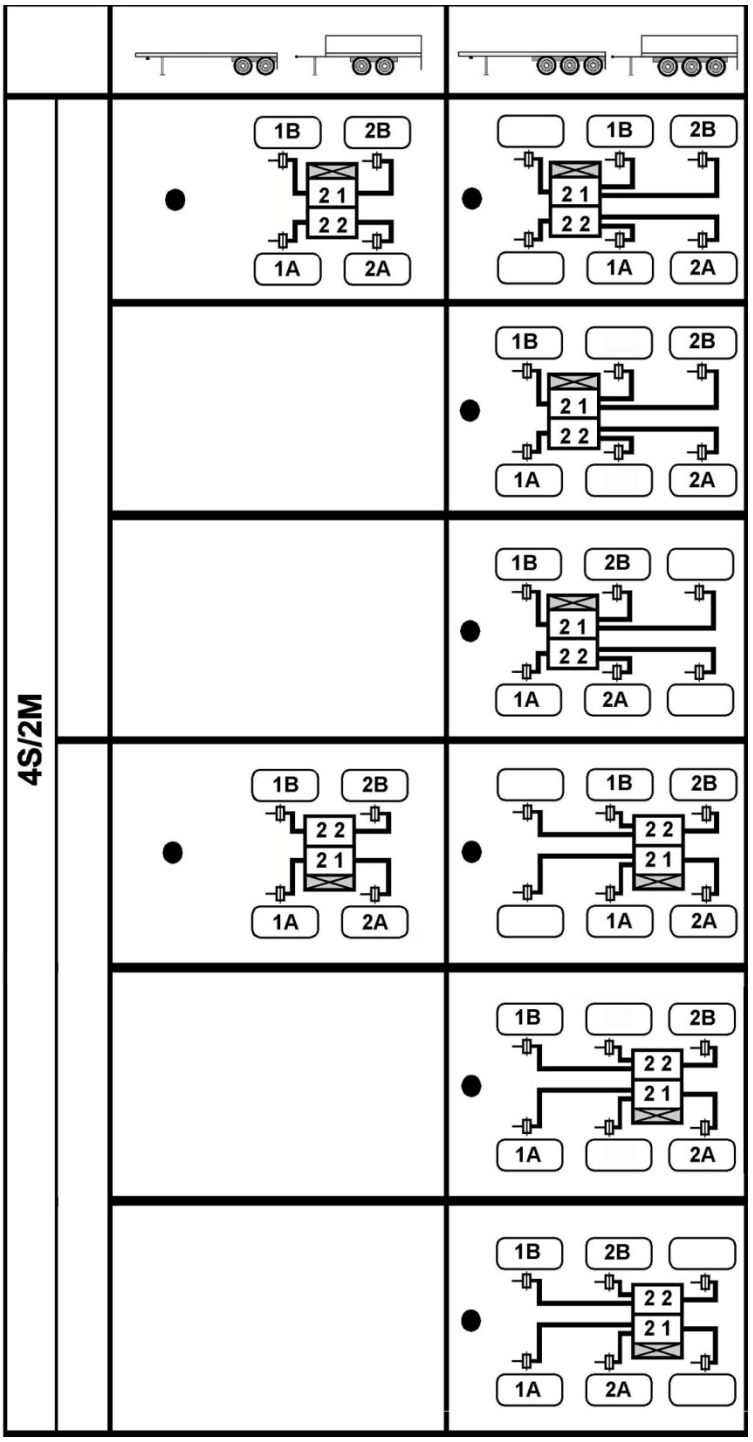


Any axle without directly controlled wheels may be a lifted
Any axle may be a steered axle



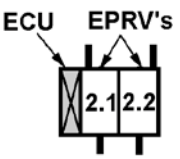
EB+ Gen 1, Gen 2 & Gen 3 Installation Options - Semi & Centre Axle Trailers

Integrated Side By Side (SxS)



Either axle (but only one at a time) directly controlled axle may be a lift axle
Any axle may be a steered axle

KEY



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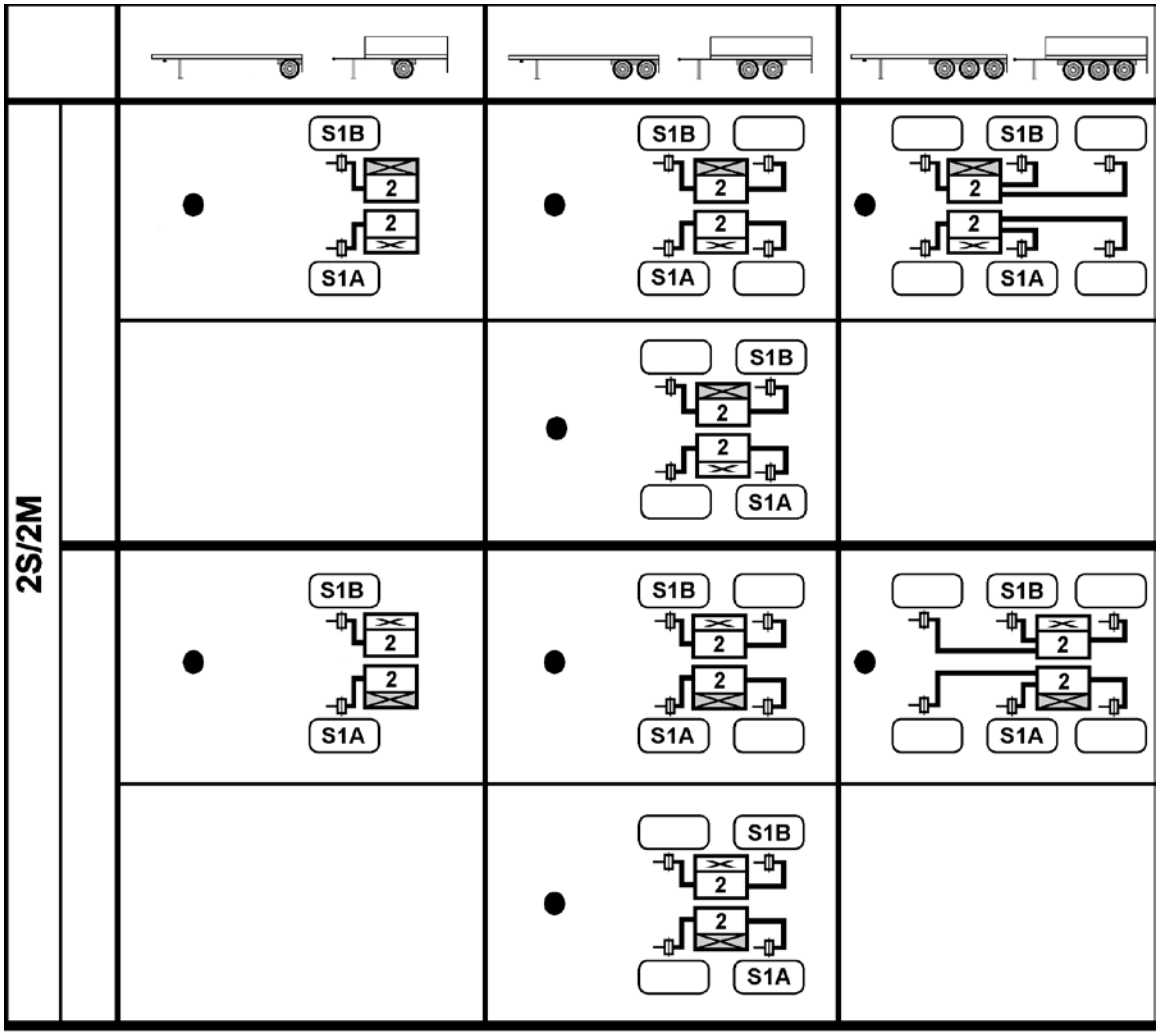
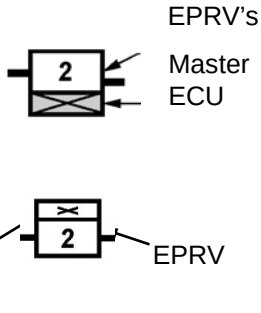
EB+ Gen 1 Installation Options - Semi & Centre Axle Trailers

Non-Integrated Side By Side (SxS)



N1 – All sensors must be connected to Master ECU.

KEY



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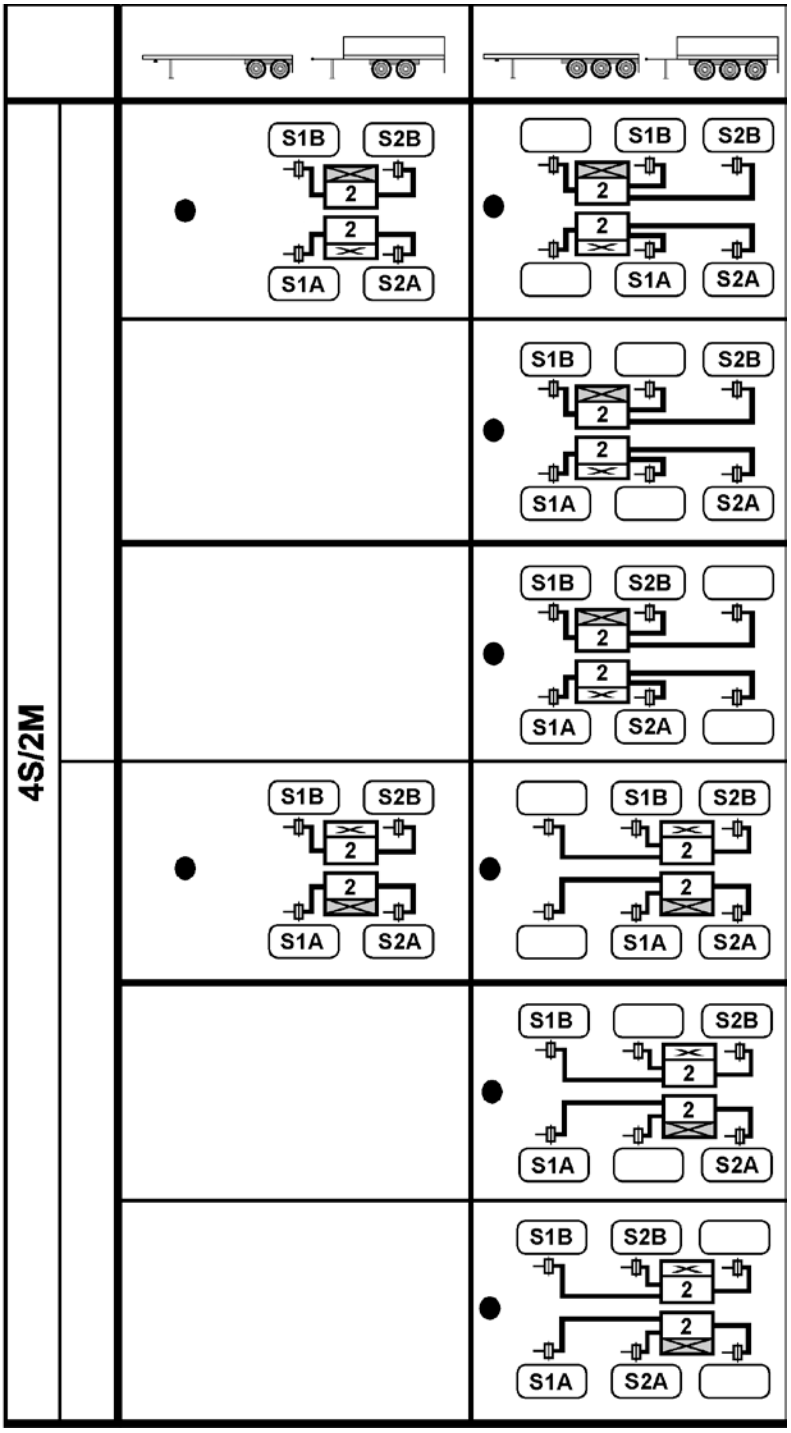
EB+ Gen 1 Installation Options - Semi & Centre Axle Trailers

Non-Integrated Side By Side (SxS)

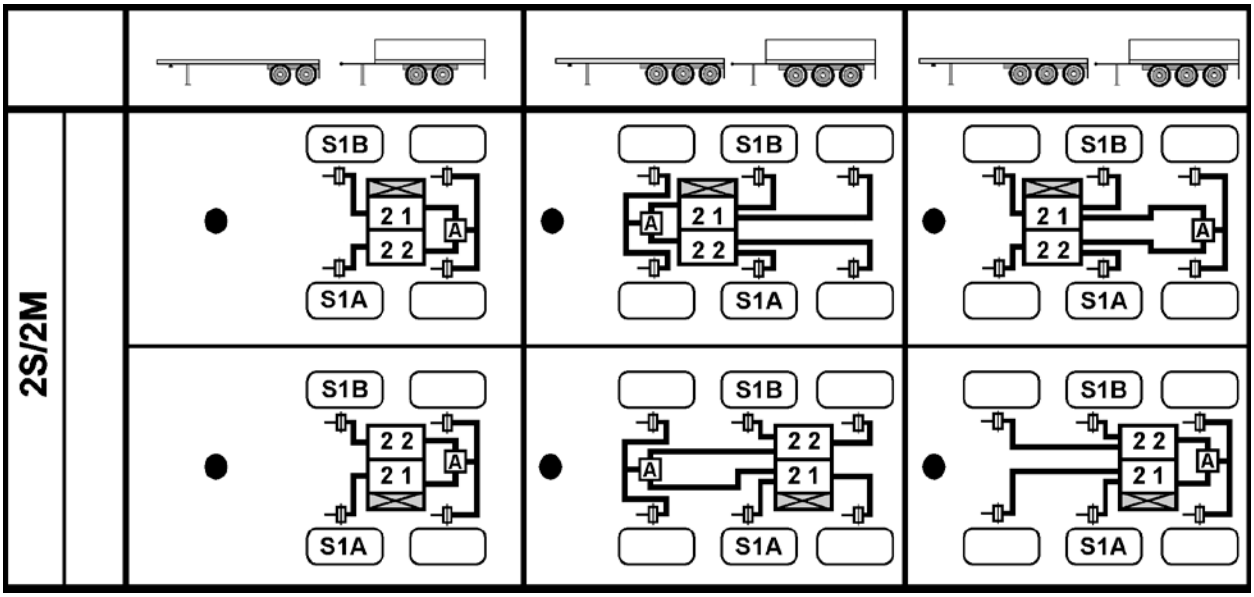


KEY

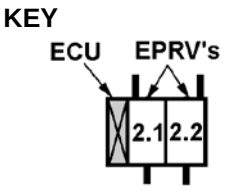
N1 – All sensors must be connected to Master ECU.

EB+ Gen 1, Gen 2 & Gen 3 Installation Options - Semi & Centre Axle Trailers

Side by Side (SxS) 2S/2M + Select low valve



Any axle without directly controlled wheels may be a lift axle



A = Select Low Valve

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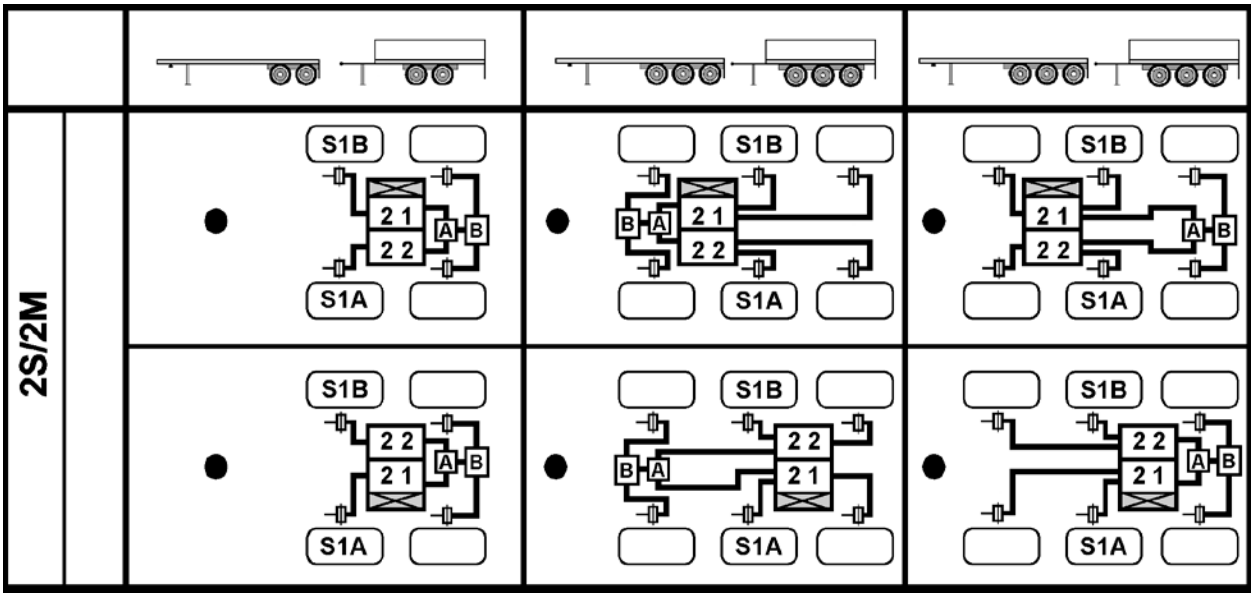
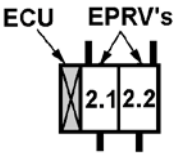
EB+ Gen 1, Gen 2 & Gen 3 Installation Options - Semi & Centre Axle Trailers

Side by Side (SxS) 2S/2M + Select low valve + Relay Valve



Any axle without directly controlled wheels may be a lift axle

KEY

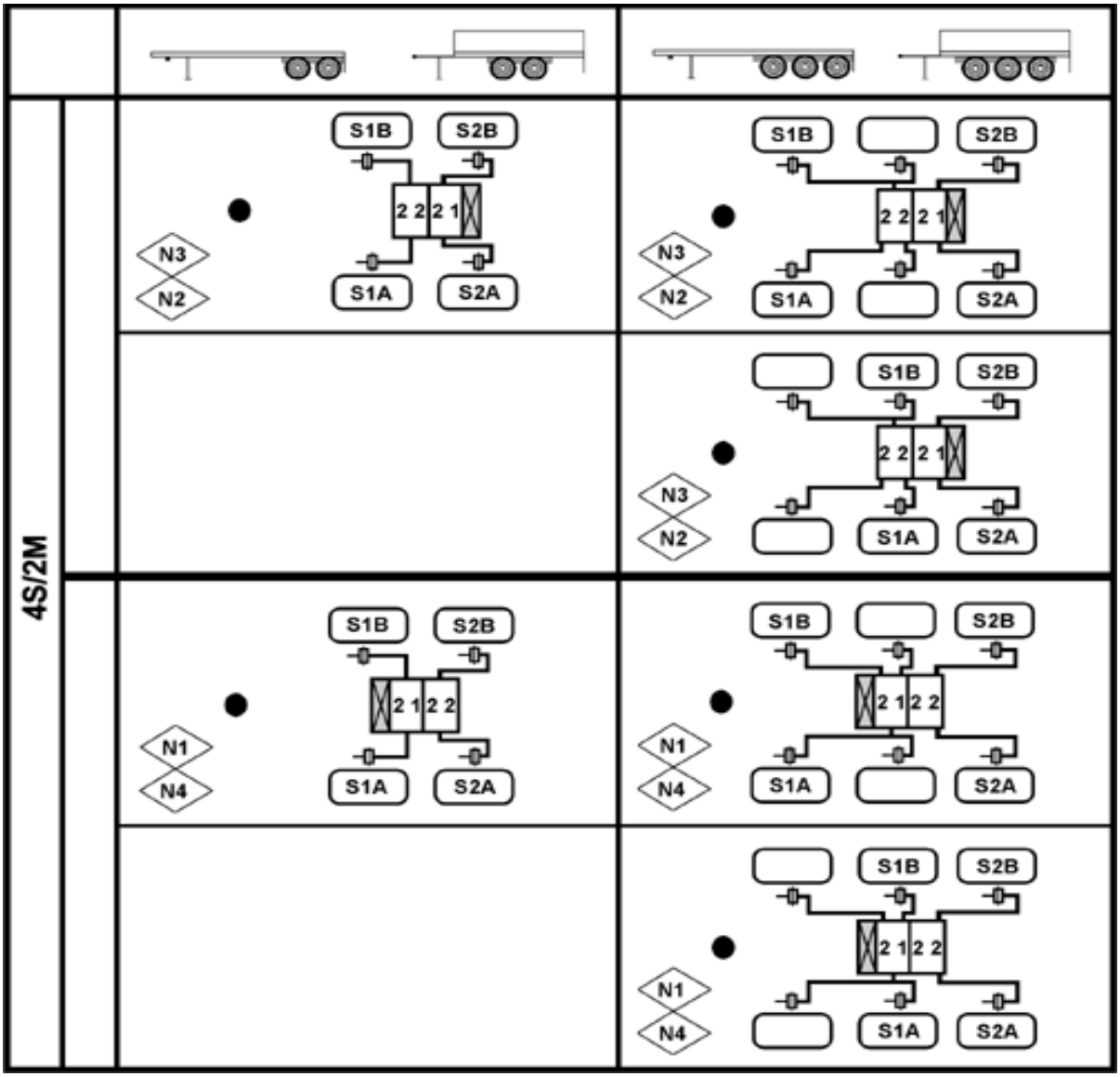


A = Select Low Valve

B = Relay Valve

EB+ Gen 1, Gen 2 & Gen 3 Installation Options - Semi & Centre Axle Trailers

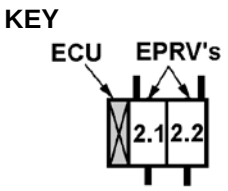
Integrated Axle by Axle **ASC Front, SL Rear**



Sensed axles cannot be lifted
Any axle without directly controlled wheels (un-sensed) may be a lift axle
Any axle may be a steered axle

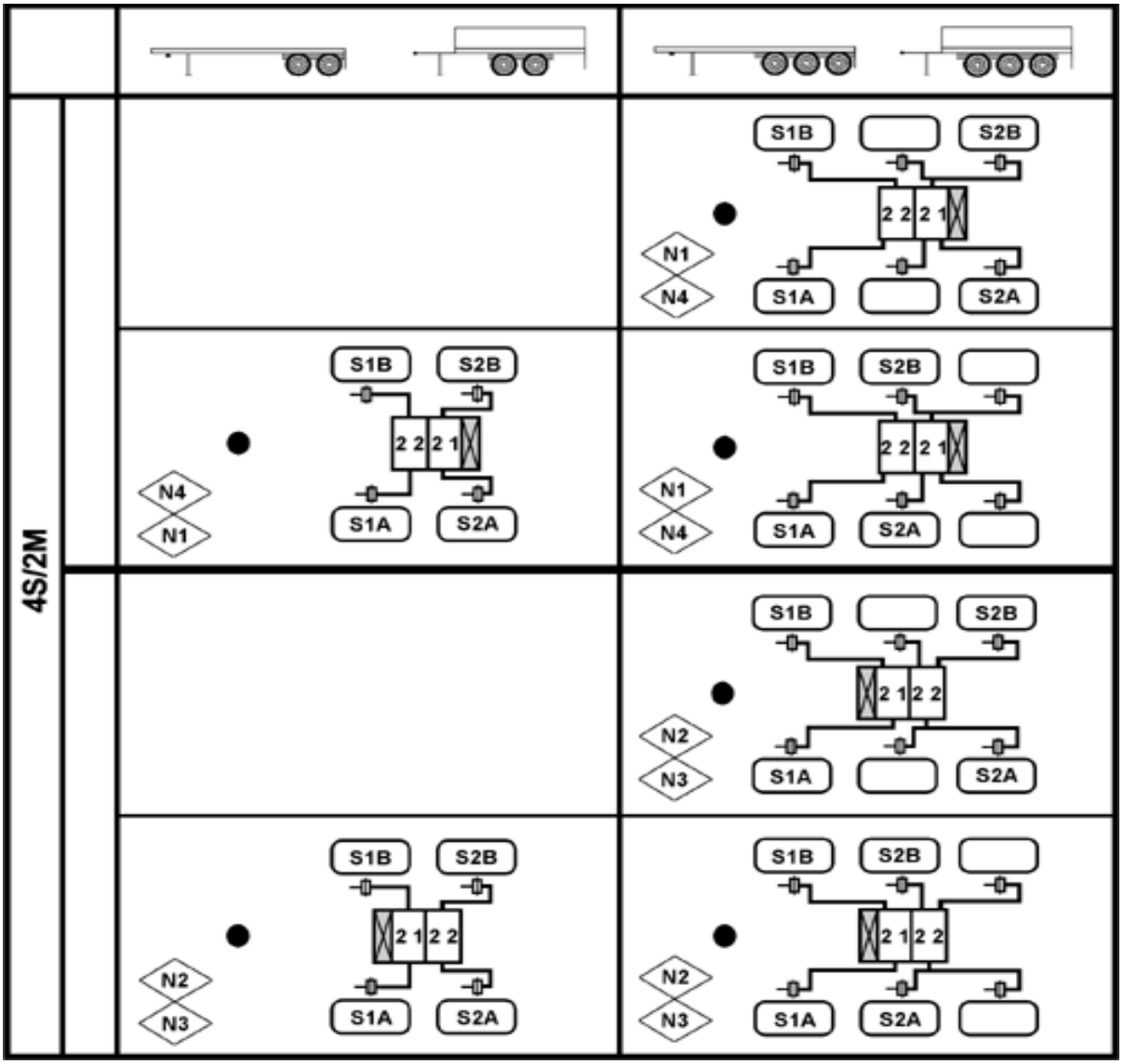
N1-N4 Selectable options set by Haldex or
Vehicle Manufacturer
N1 Adaptive surface control 2.1
N2 Select Low 2.1
N3 Adaptive surface control 2.2

N4 Select Low 2.2



EB+ Gen 1, Gen 2 & Gen 3 Installation Options - Semi & Centre Axle Trailers

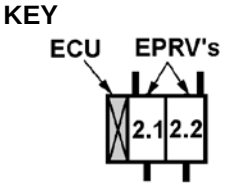
Integrated Axle by Axle **ASC Rear, SL Front**



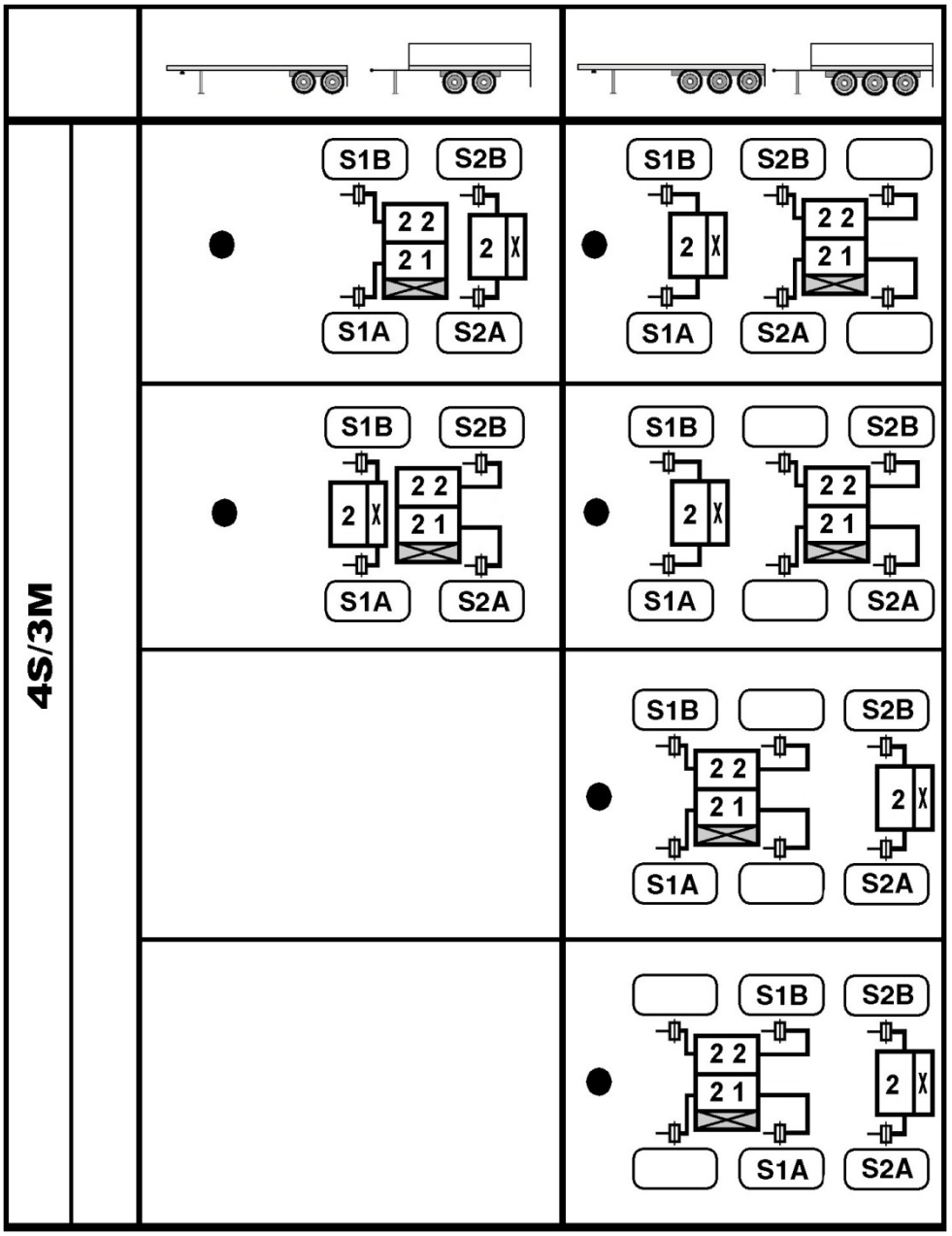
Sensed axles cannot be lifted
Any axle without directly controlled wheels (un-sensed)may be a lift axle
Any axle may be a steered axle

N1-N4 Selectable options set by Haldex or
Vehicle Manufacturer
N1 Adaptive surface control 2.1
N2 Select Low 2.1
N3 Adaptive surface control 2.2

N4 Select Low 2.2



EB+ Gen 1, Gen 2 & Gen 3 Installation Options - Semi & Centre Axle Trailers



N1 – Master ECU is mounted to EPRV's 21/22. All sensors must be connected to this Master ECU.

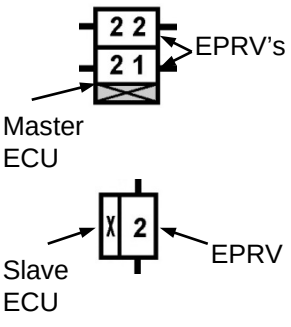
N2 – Directly controlled wheels connected pneumatically to EPRV's 21/22 cannot be lifted.

N3 – Slave ECU is mounted to EPRV 2 and is controlled by Master ECU.
Slave ECU/EPRV 2 is shown facing rear but can also be installed facing forward, left or right, as EPRV 2 is always select low control.

N4 – Sensed wheel connected pneumatically to EPRV 2 can be lifted.

Any axle without directly controlled wheels may be lifted.
Any axle may be a steered axle.

KEY



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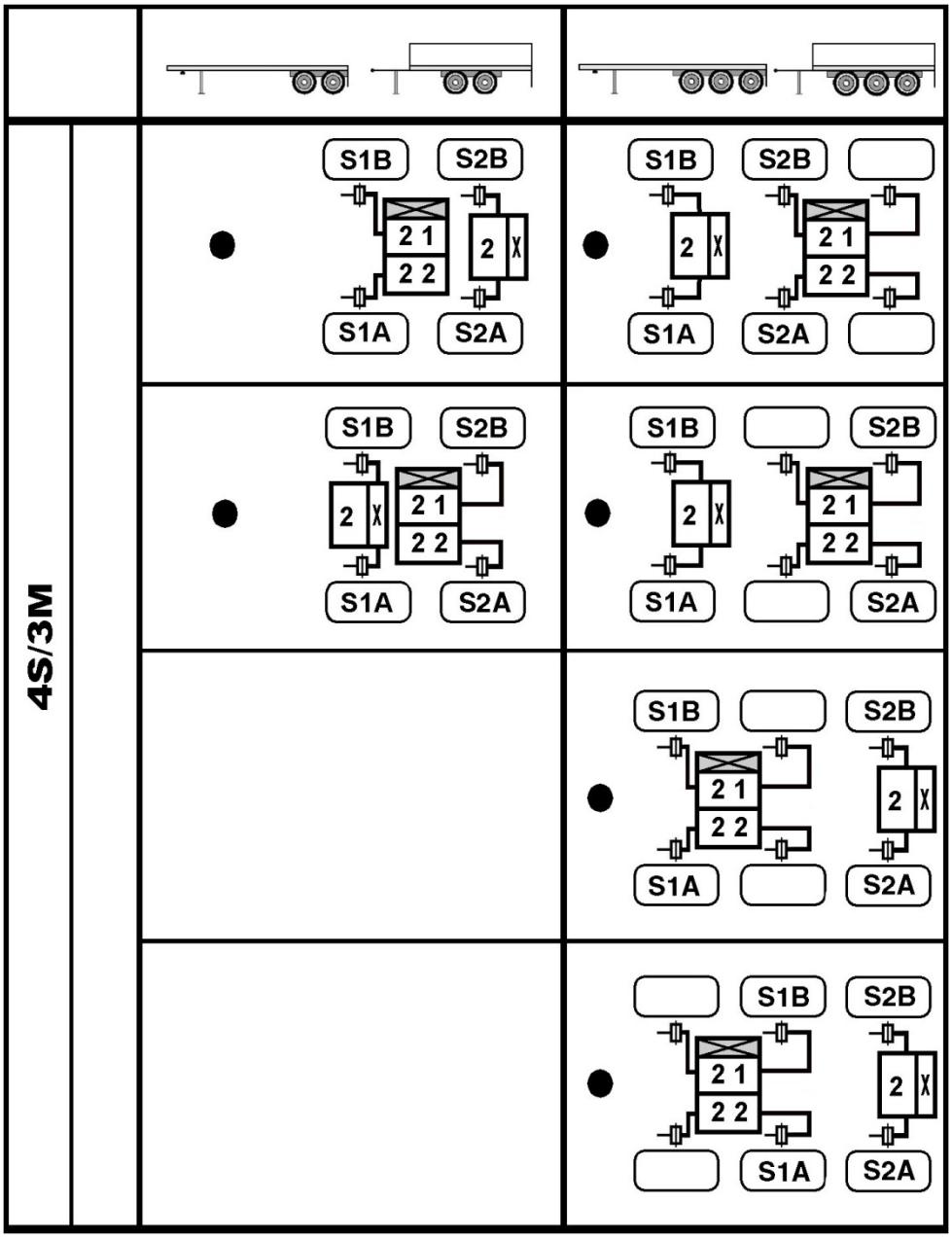
EB+ Gen 1, Gen 2 & Gen 3 Installation Options - Semi & Centre Axle Trailers



N1 – Master ECU is mounted to EPRV's 21/22. All sensors must be connected to this Master ECU.

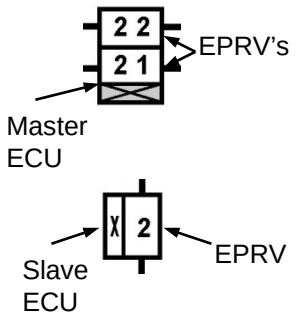
N2 – Directly controlled wheels connected pneumatically to EPRV's 21/22 cannot be lifted.

N3 – Slave ECU is mounted to EPRV 2 and is controlled by Master ECU.
Slave ECU/EPRV 2 is shown facing rear but can also be installed facing forward, left or right, as EPRV 2 is always select low control.

N4 – Sensed wheel connected pneumatically to EPRV 2 can be lifted.

Any axle without directly controlled wheels may be lifted.
Any axle may be a steered axle.

KEY



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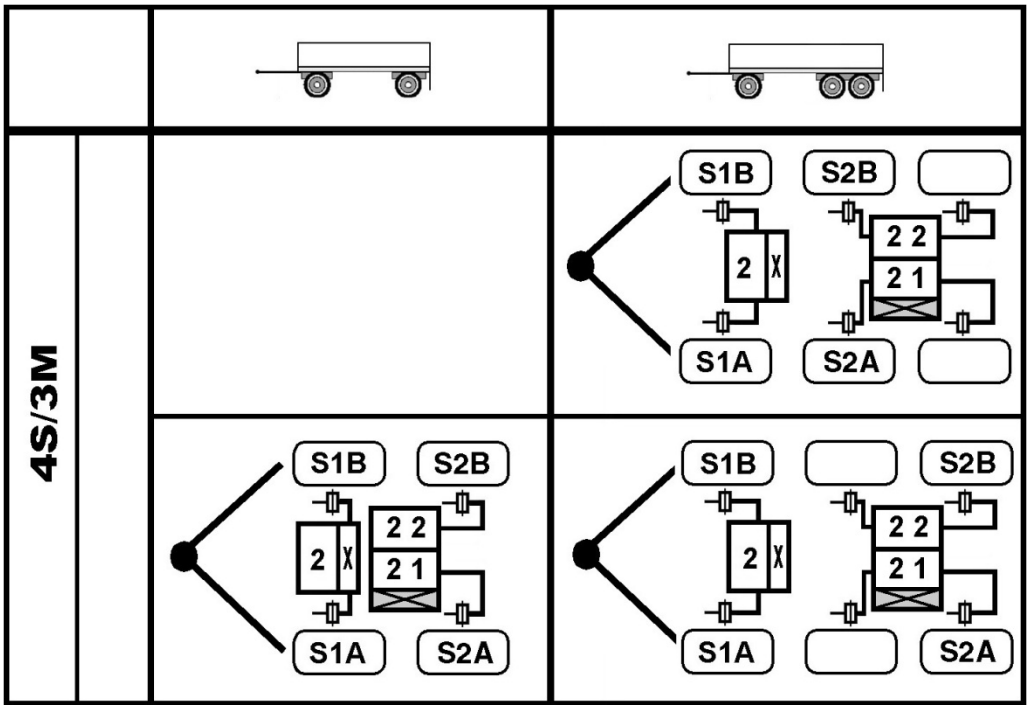
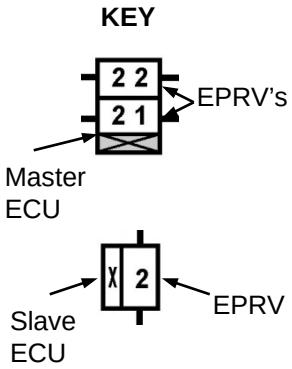
EB+ Gen 1, Gen 2 & Gen 3 Installation Options – Full trailers



N1 – Master ECU is mounted to EPRV's 21/22. All sensors must be connected to this Master ECU.

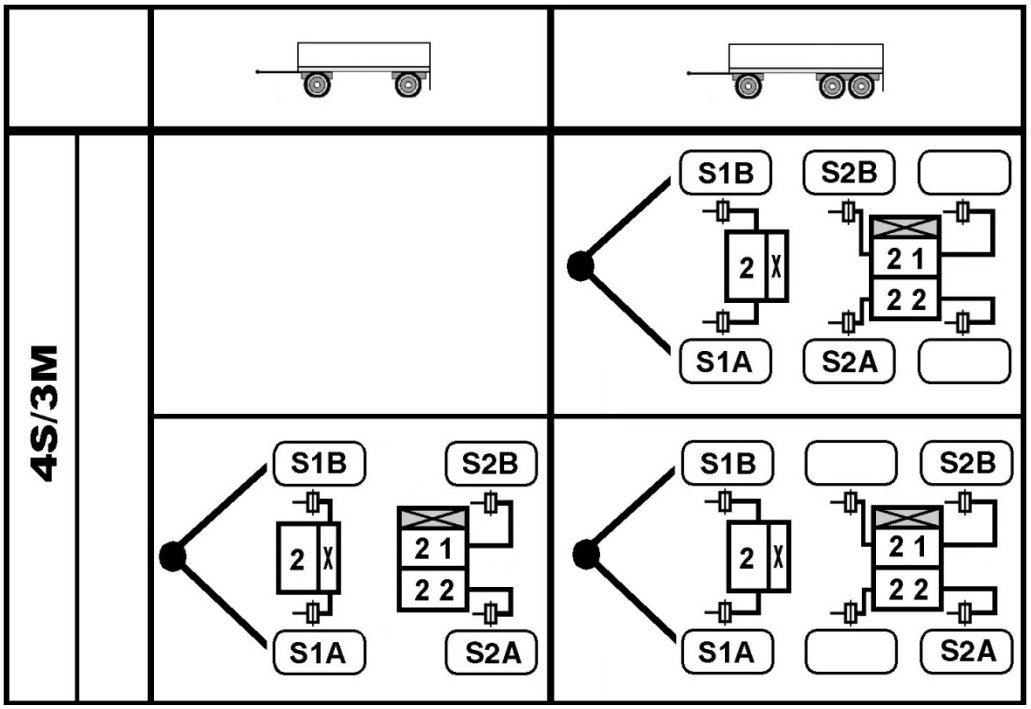
N2 – Slave ECU is mounted to EPRV 2 and is controlled by Master ECU.
Slave ECU/EPRV 2 is shown facing rear but can also be installed facing forward, left or right, as EPRV 2 is always select low control.

Sensed axles cannot be lifted.
Any axle without directly controlled wheels may be lifted.



R13 190533

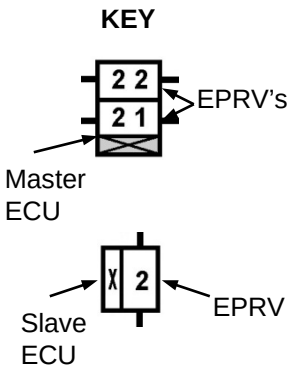
EB+ Gen 1, Gen 2 & Gen 3 Installation Options – Full trailers



N1 – Master ECU is mounted to EPRV's 21/22. All sensors must be connected to this Master ECU.

N2 – Slave ECU is mounted to EPRV 2 and is controlled by Master ECU.
Slave ECU/EPRV 2 is shown facing rear but can also be installed facing forward, left or right, as EPRV 2 is always select low control.

Sensed axles cannot be lifted.
Any axle without directly controlled wheels may be lifted.



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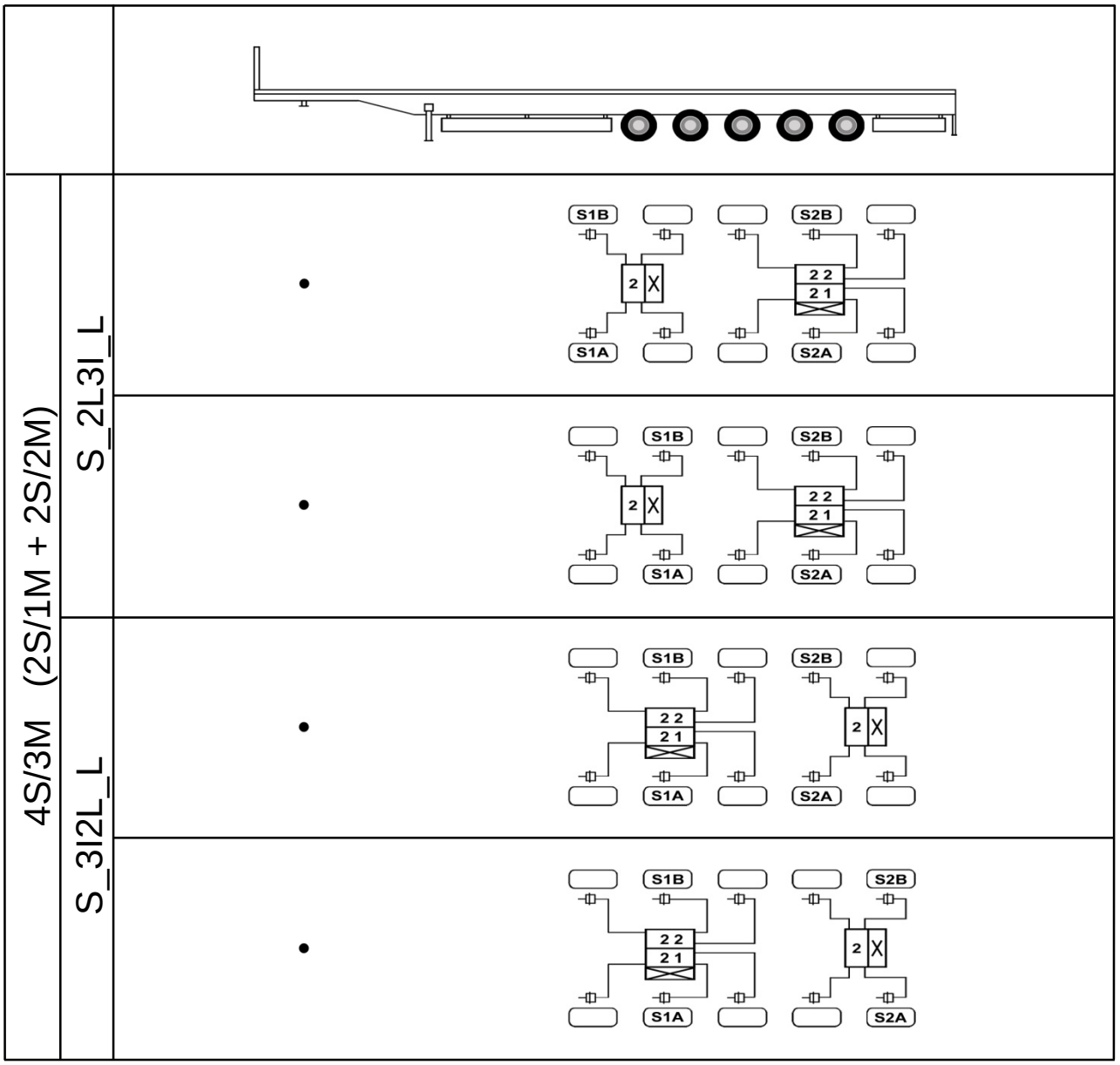
EB+ Gen 1, Gen 2 & Gen 3 Installation Options
Semi trailers



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Applicable notes

N1 – Master ECU is mounted to EPRV's 21/22. All sensors must be connected to this Master ECU.

N2 – Directly controlled wheels connected pneumatically to EPRV's 21/22 cannot be lifted.

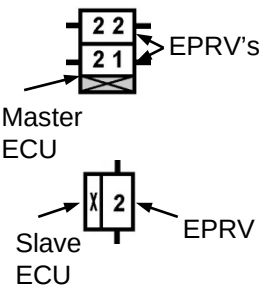
N3 – Slave ECU is mounted to EPRV 2 and is controlled by Master ECU. Slave ECU/EPRV 2 is shown facing rear but can also be installed facing forward, left or right, as EPRV 2 is always select low control.

N4 – Sensed wheels connected pneumatically to EPRV 2 can be lifted but corresponding indirectly controlled wheels must be lifted in parallel.

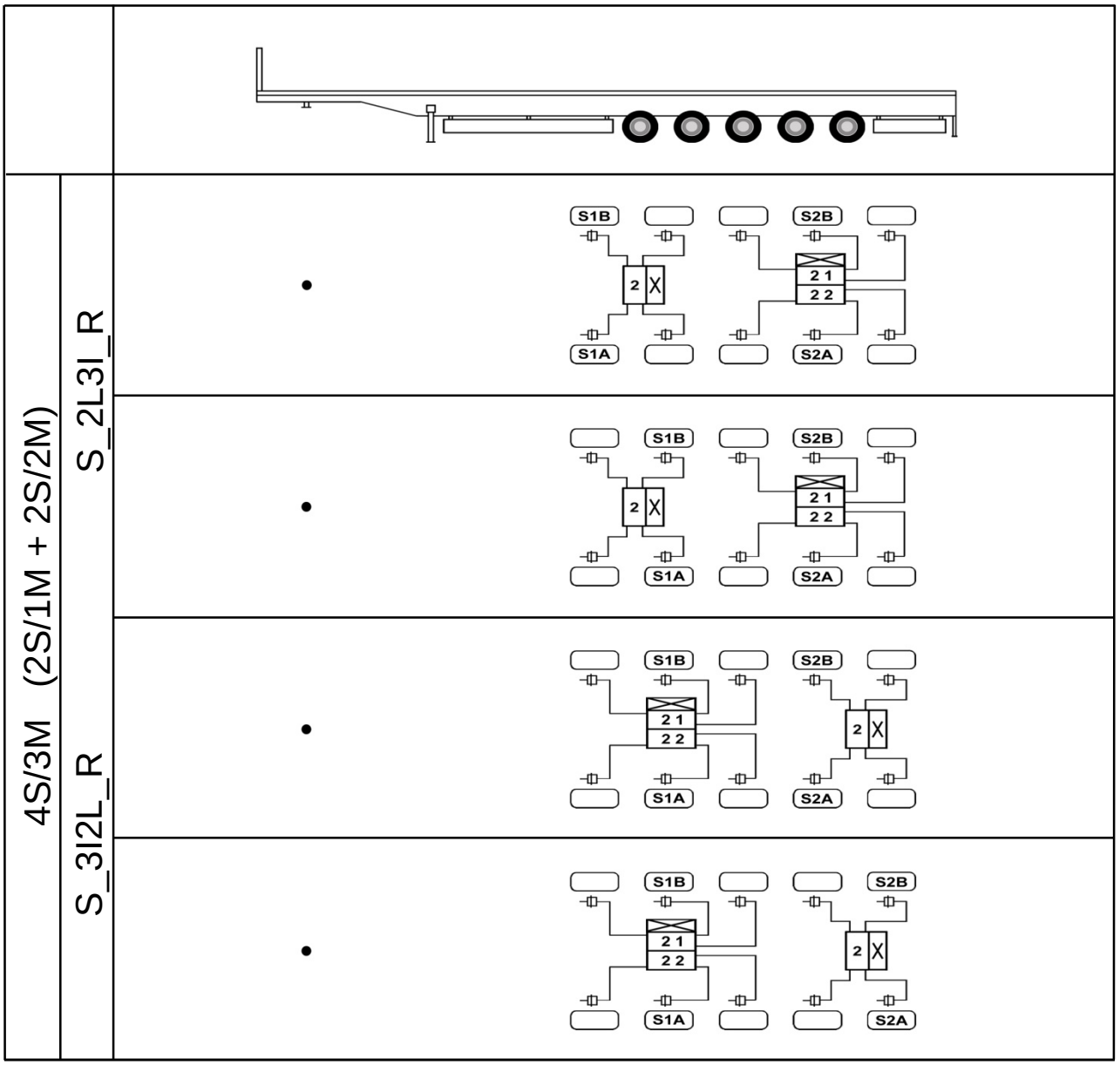
N5 – Any axle without directly controlled wheels may be lifted.

N6 – Any axle may be a steered axle.

KEY



EB+ Gen 1, Gen 2 & Gen 3 Installation Options
Semi trailers



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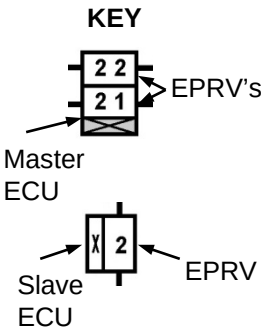
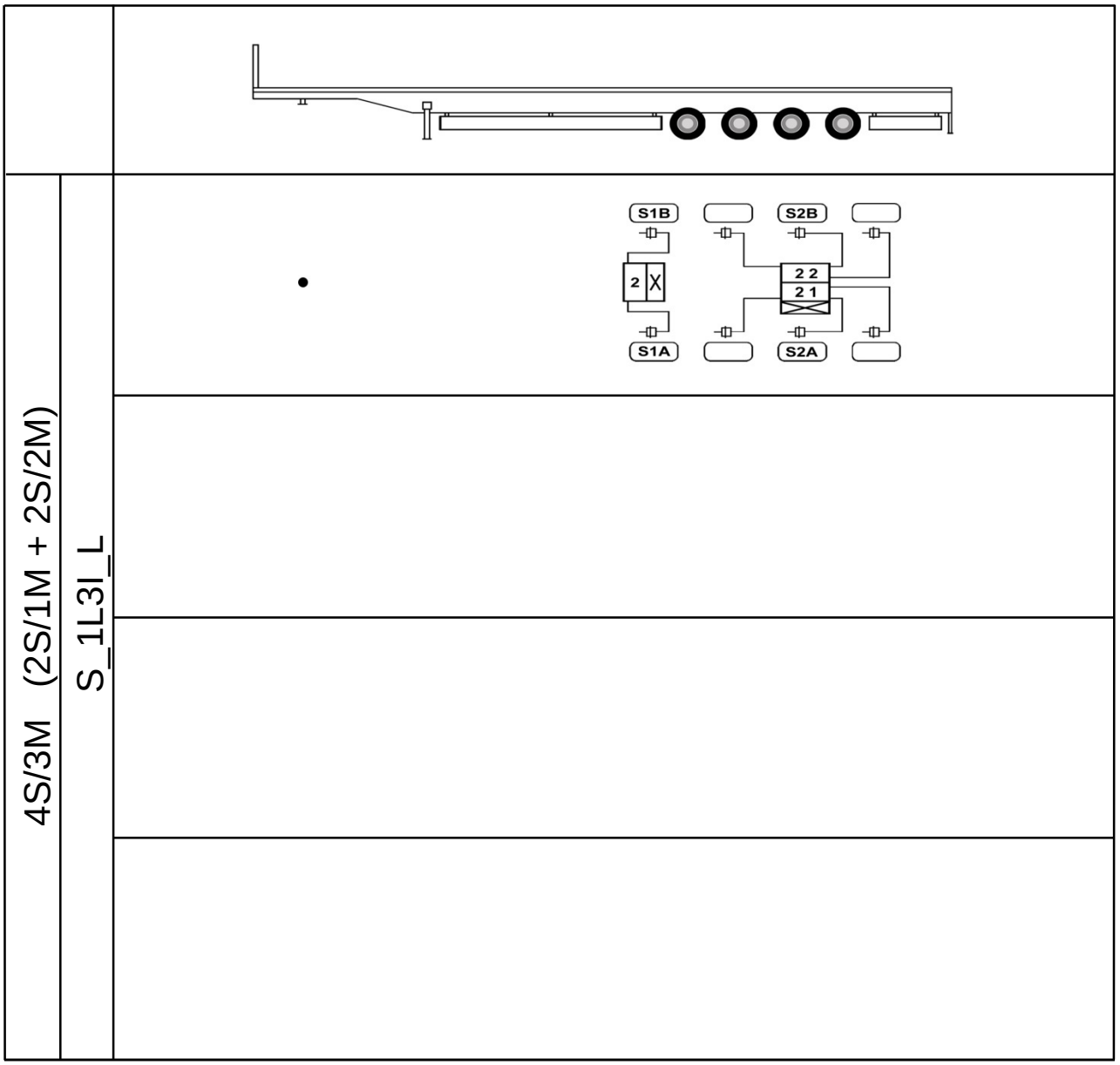


EB+ Gen 1, Gen 2 & Gen 3 Installation Options
Semi trailers



R13 190533

Applicable notes

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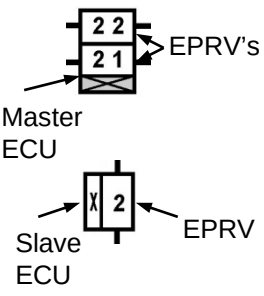
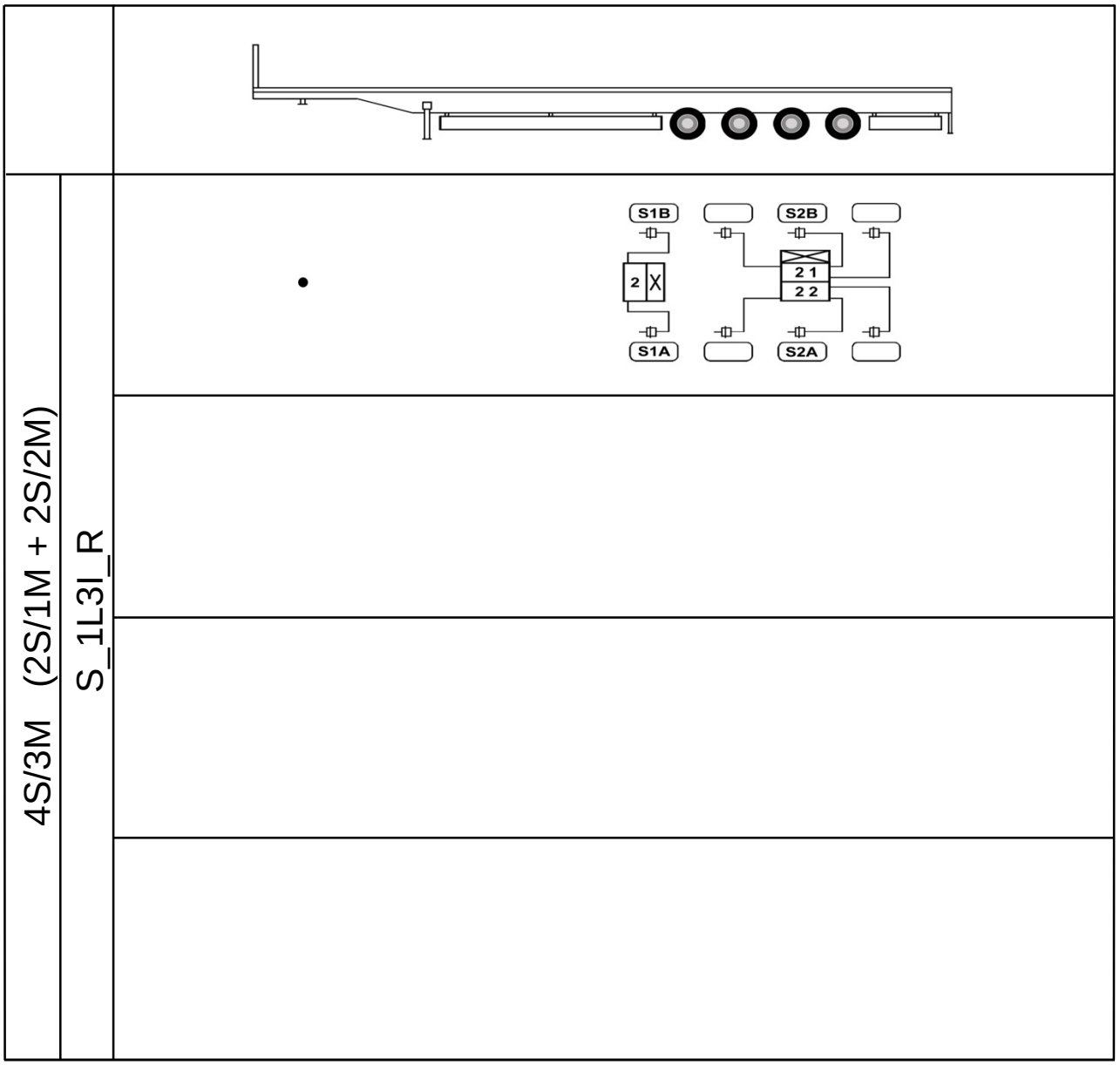


EB+ Gen 1, Gen 2 & Gen 3 Installation Options
Semi trailers



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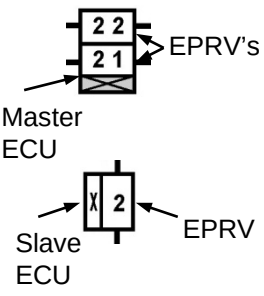
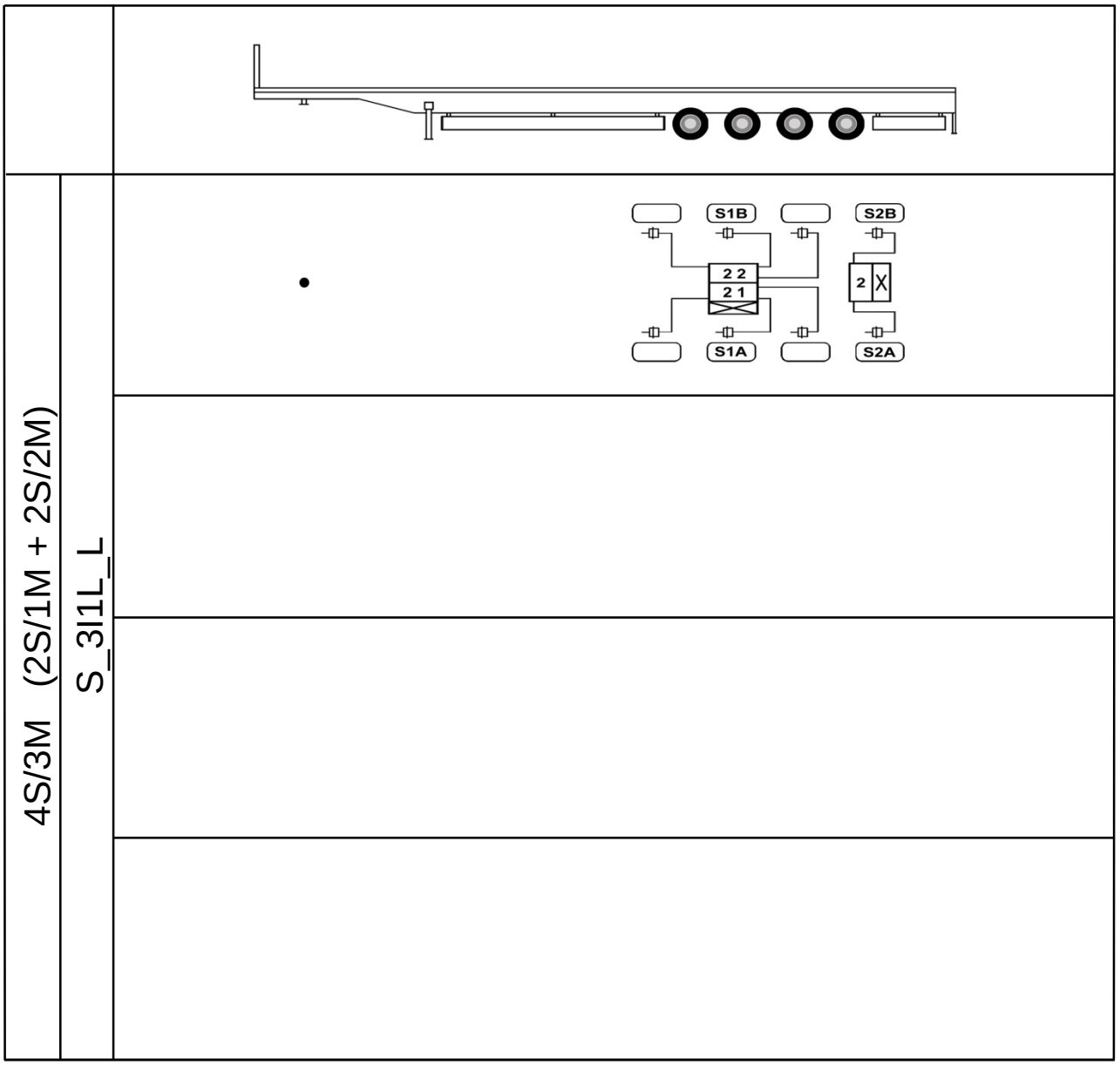


EB+ Gen 1, Gen 2 & Gen 3 Installation Options
Semi trailers



Applicable notes

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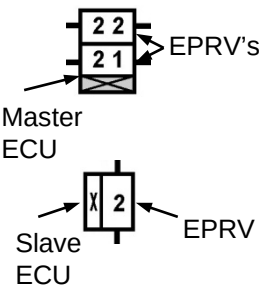
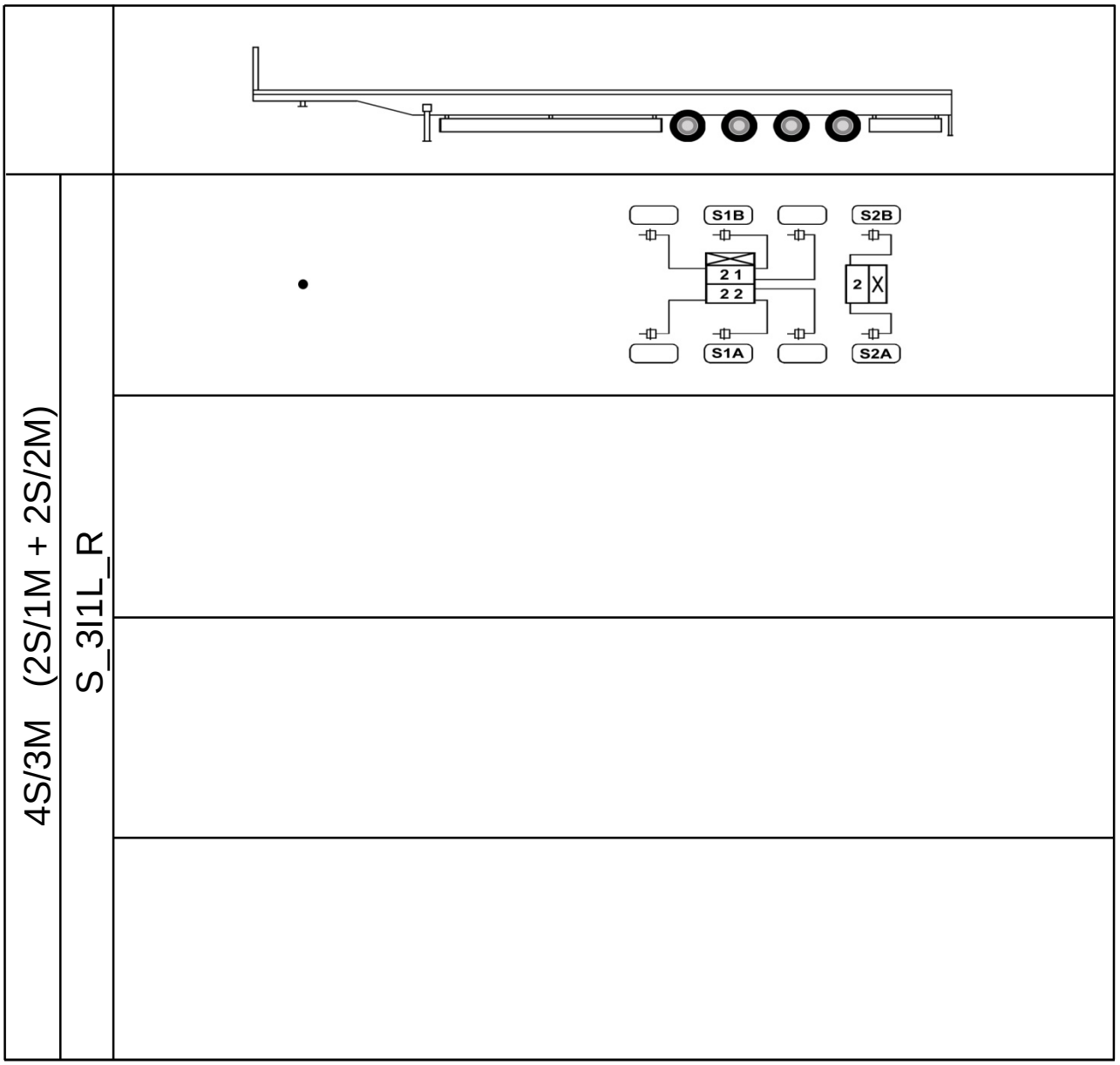


EB+ Gen 1, Gen 2 & Gen 3 Installation Options
Semi trailers



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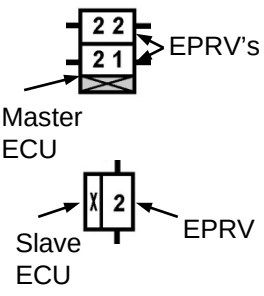
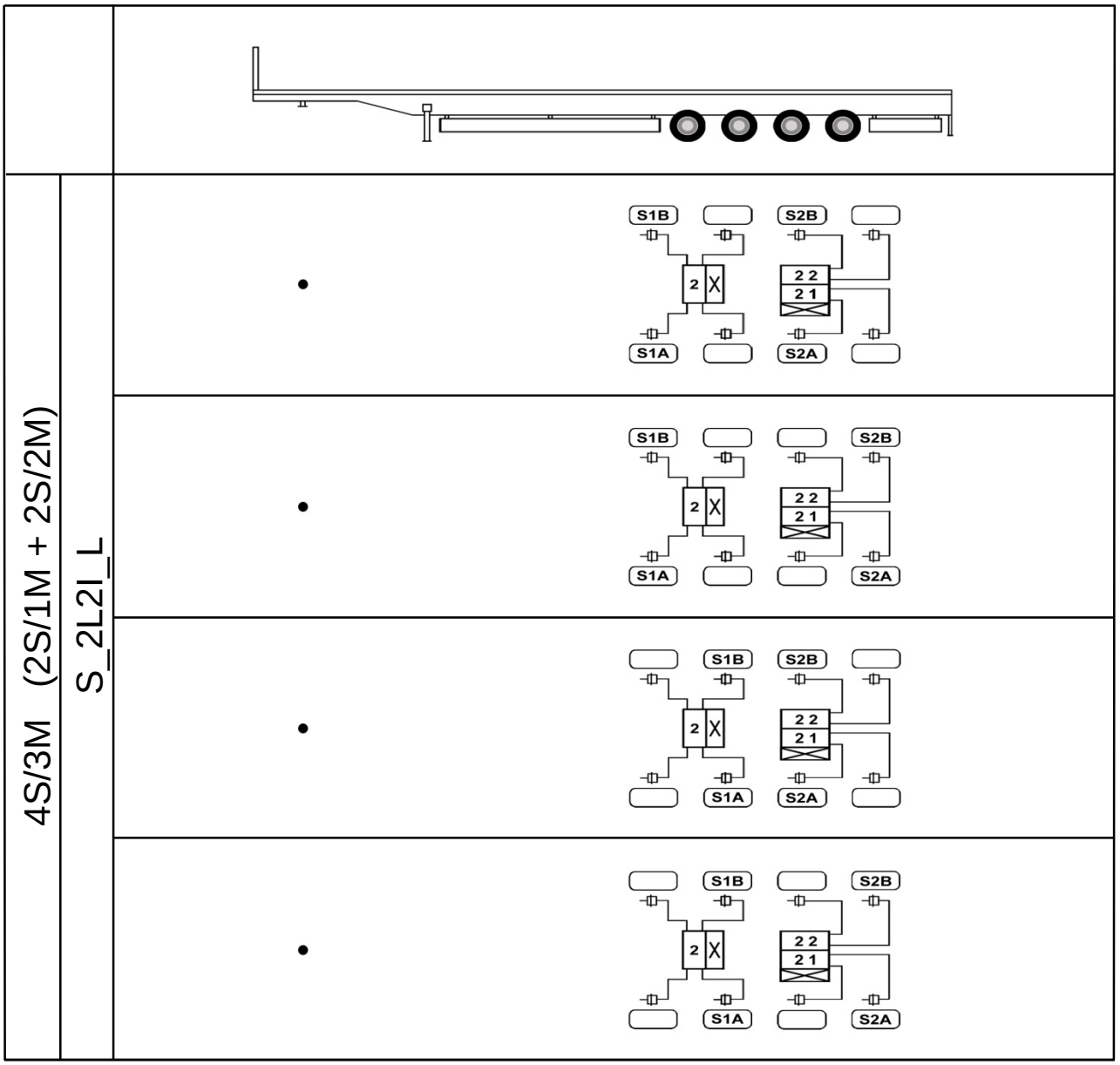


EB+ Gen 1, Gen 2 & Gen 3 Installation Options
Semi trailers



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N5 – Any axle without directly controlled wheels may be lifted.

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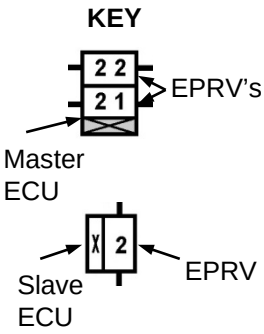
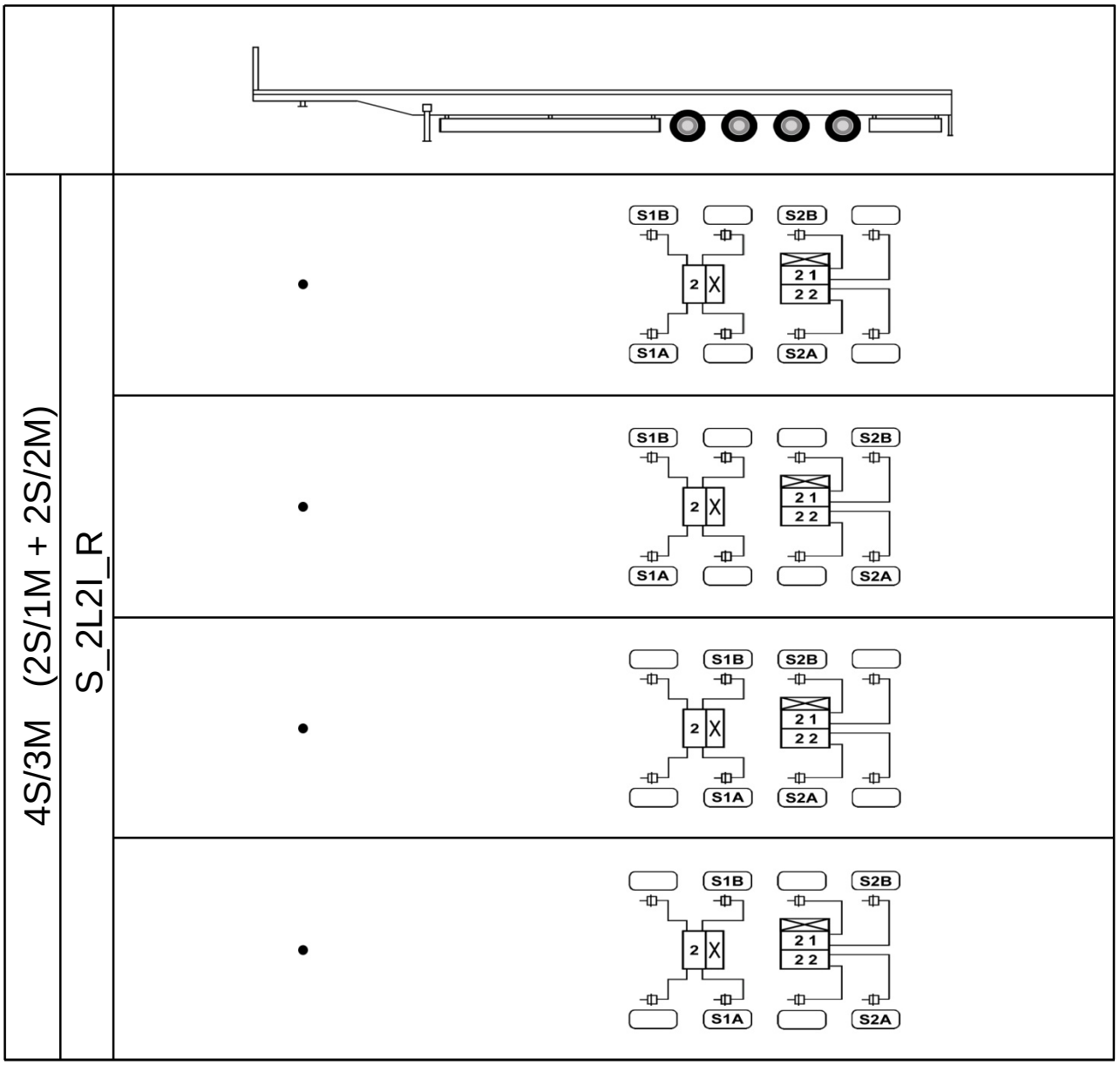


EB+ Gen 1, Gen 2 & Gen 3 Installation Options
Semi trailers



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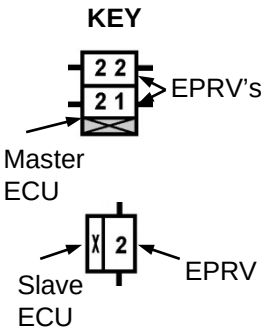
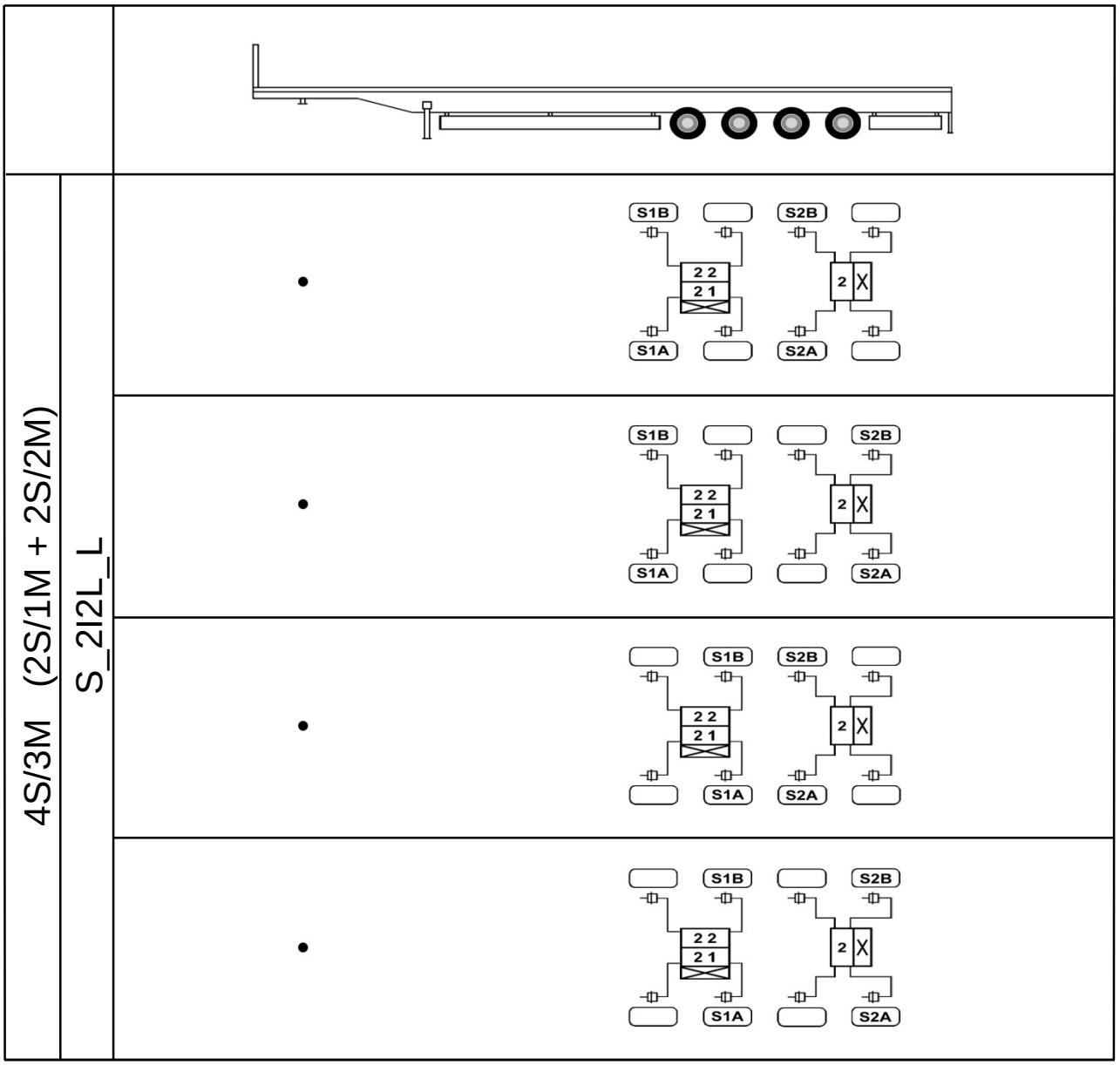


EB+ Gen 1, Gen 2 & Gen 3 Installation Options
Semi trailers



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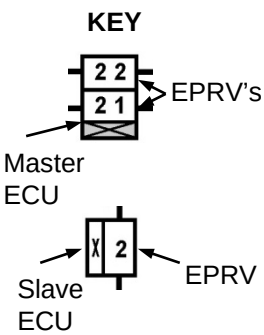
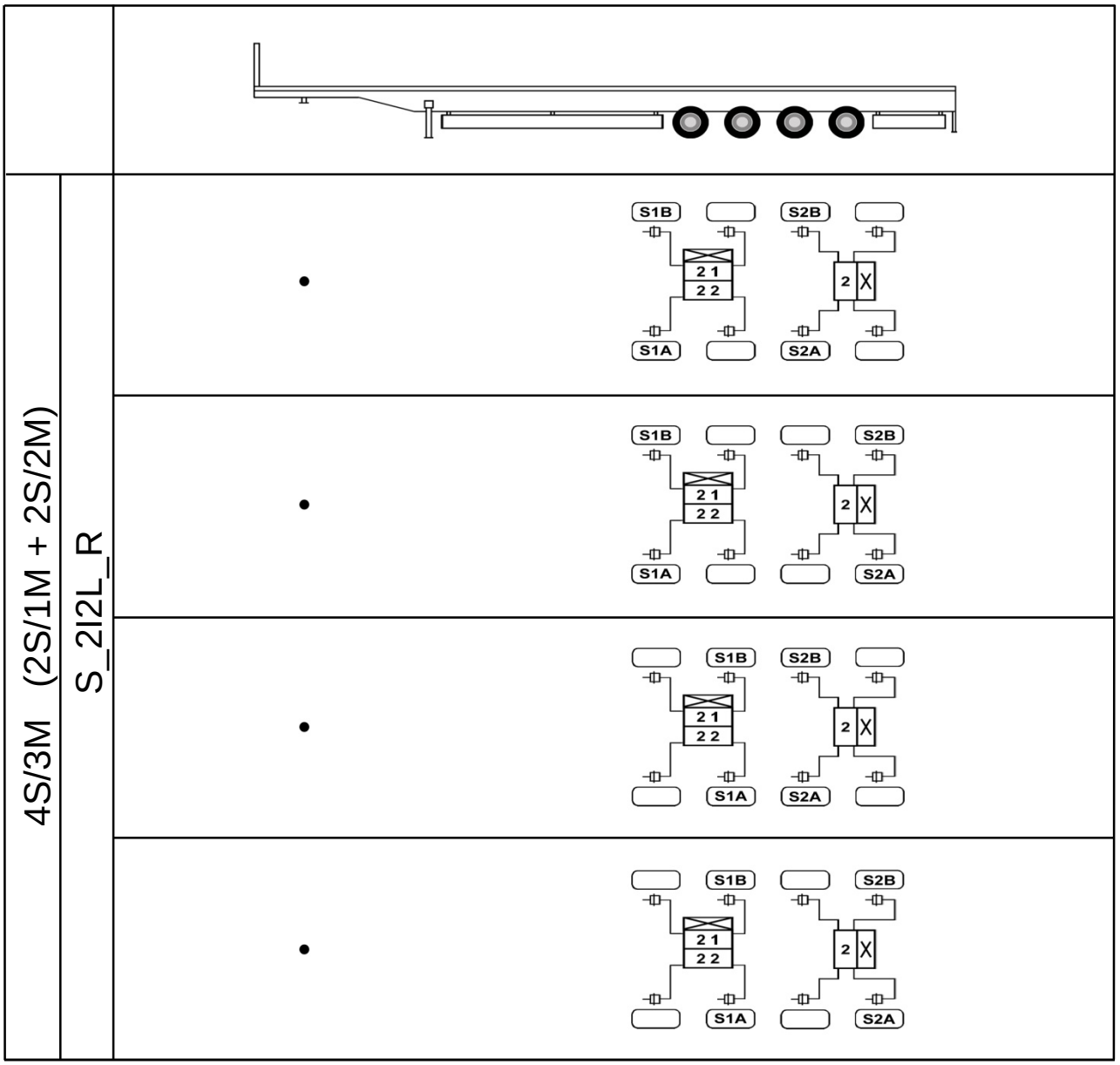


EB+ Gen 1, Gen 2 & Gen 3 Installation Options
Semi trailers



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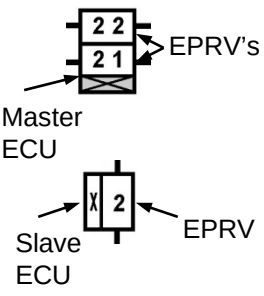
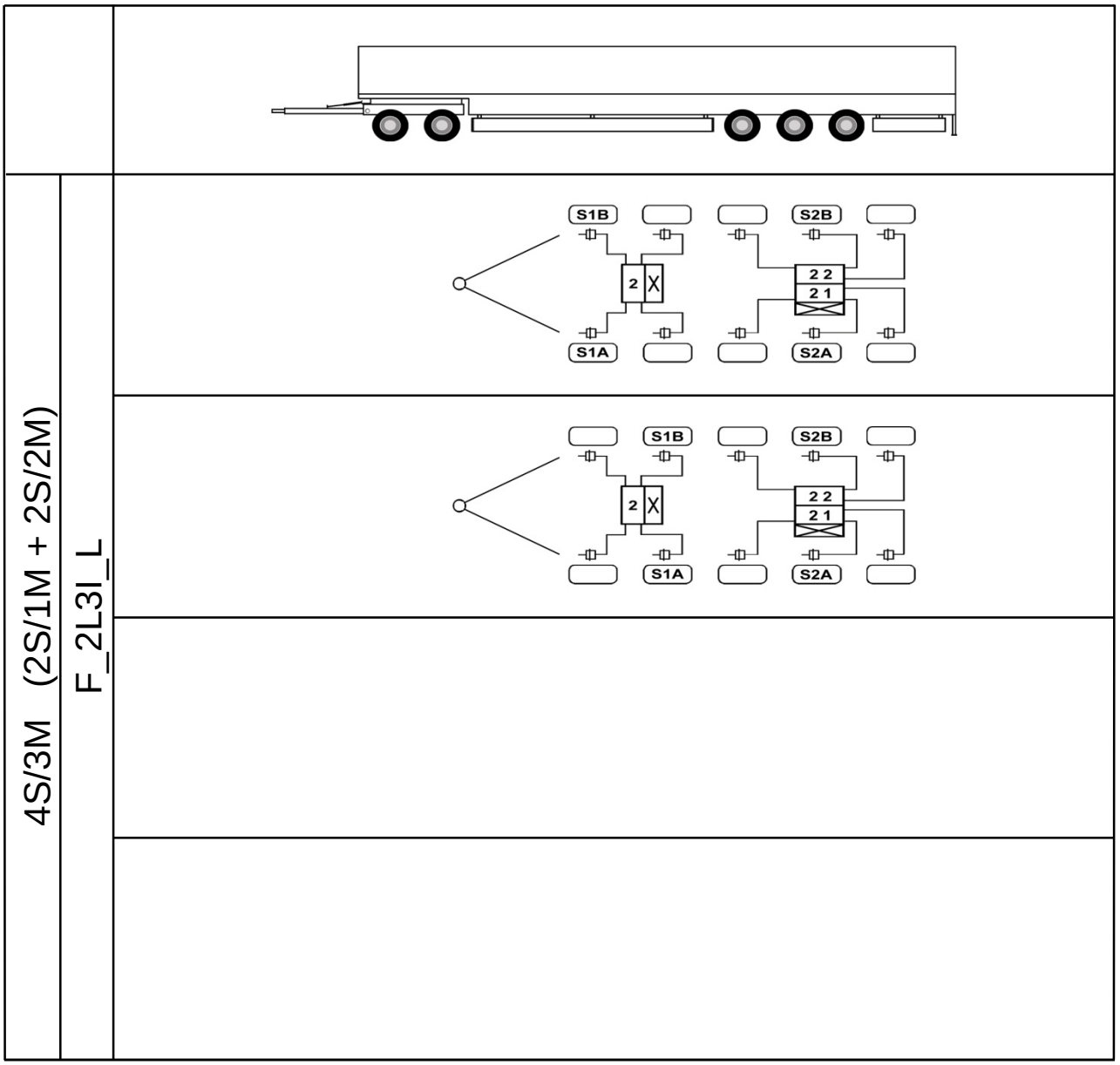


EB+ Gen 1, Gen 2 & Gen 3 Installation Options
Full trailers



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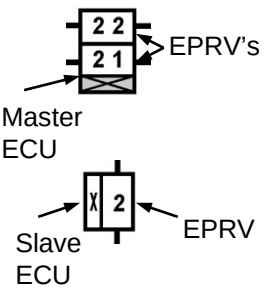
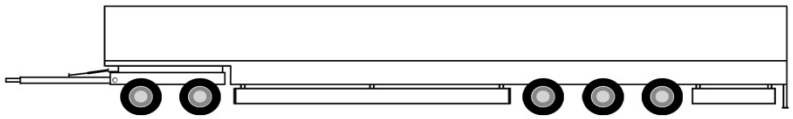
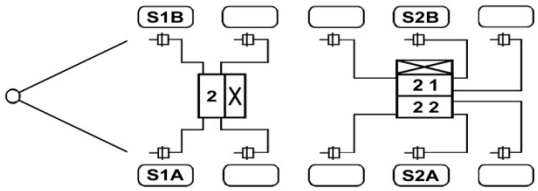


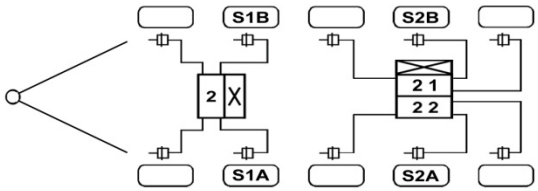
EB+ Gen 1, Gen 2 & Gen 3 Installation Options
Full trailers

4S/3M (2S/1M + 2S/2M)

F_2L3I_R







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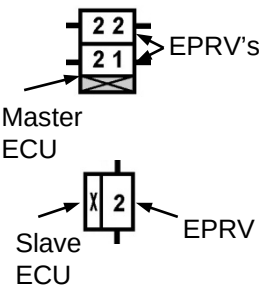
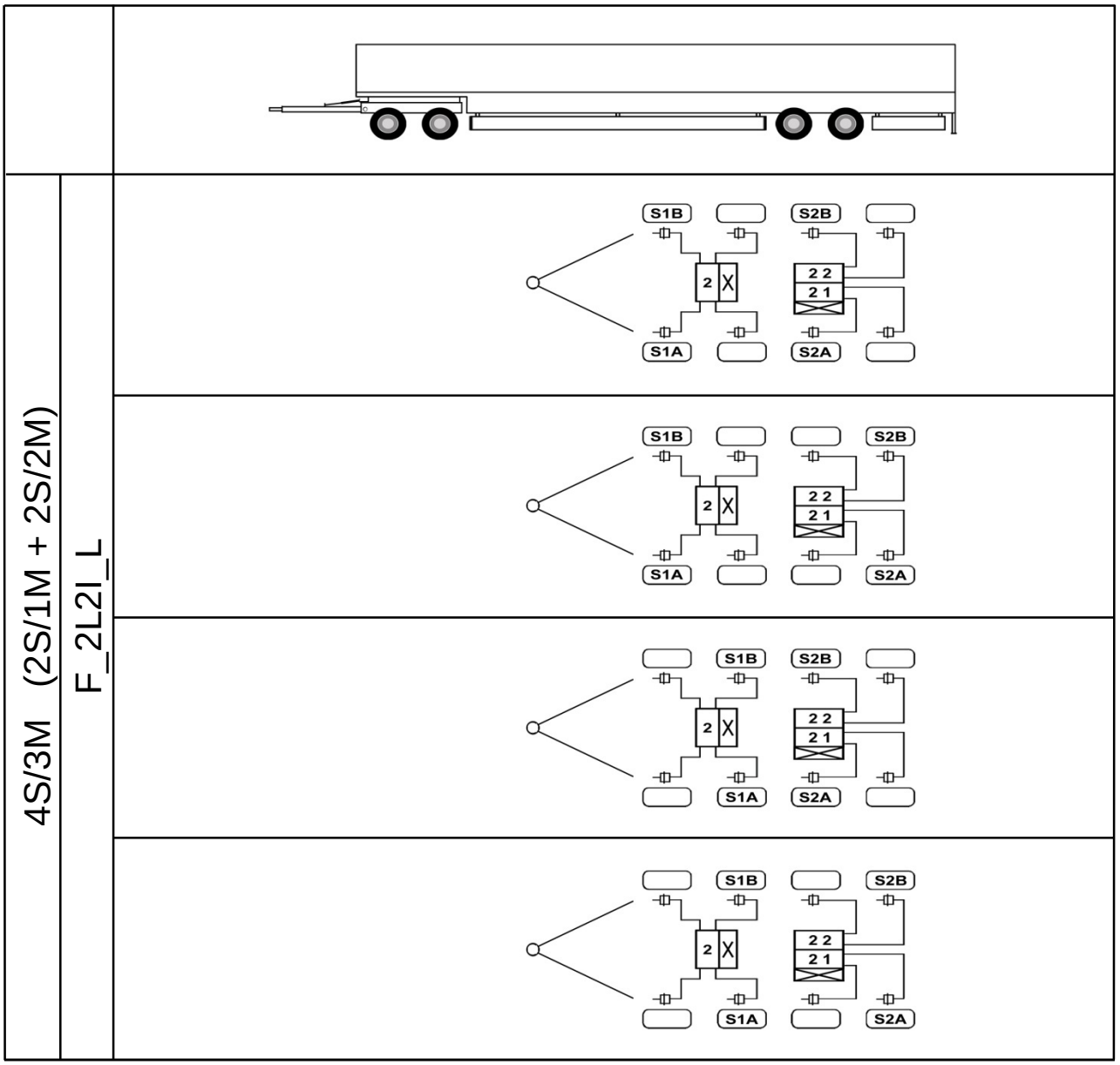


EB+ Gen 1, Gen 2 & Gen 3 Installation Options
Full trailers



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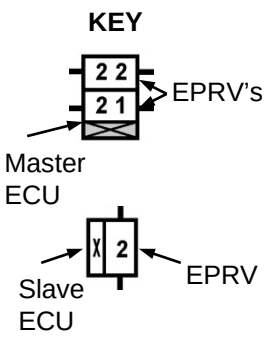
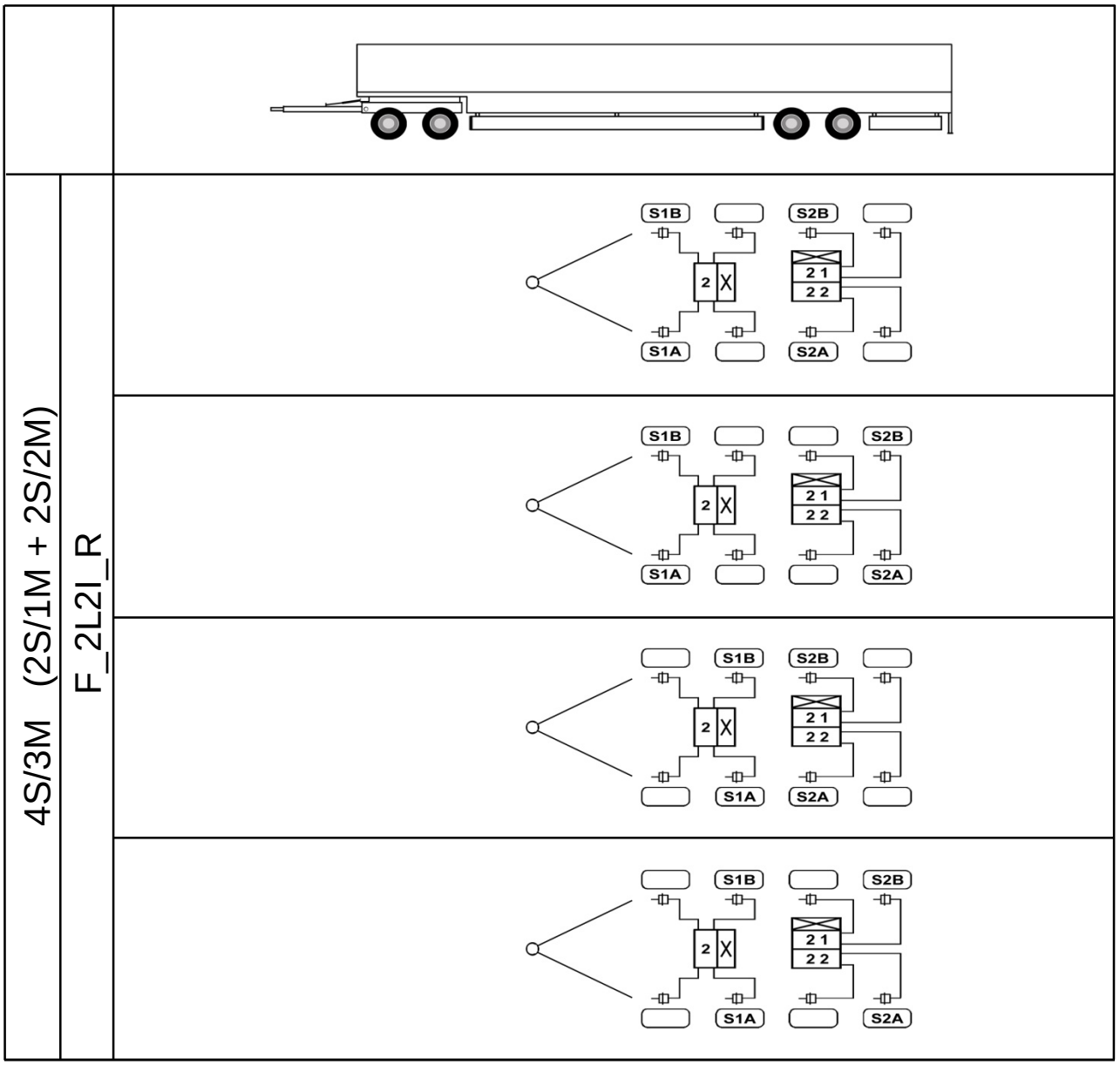


EB+ Gen 1, Gen 2 & Gen 3 Installation Options
Full trailers



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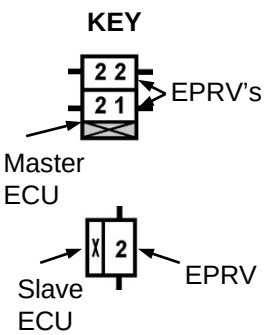
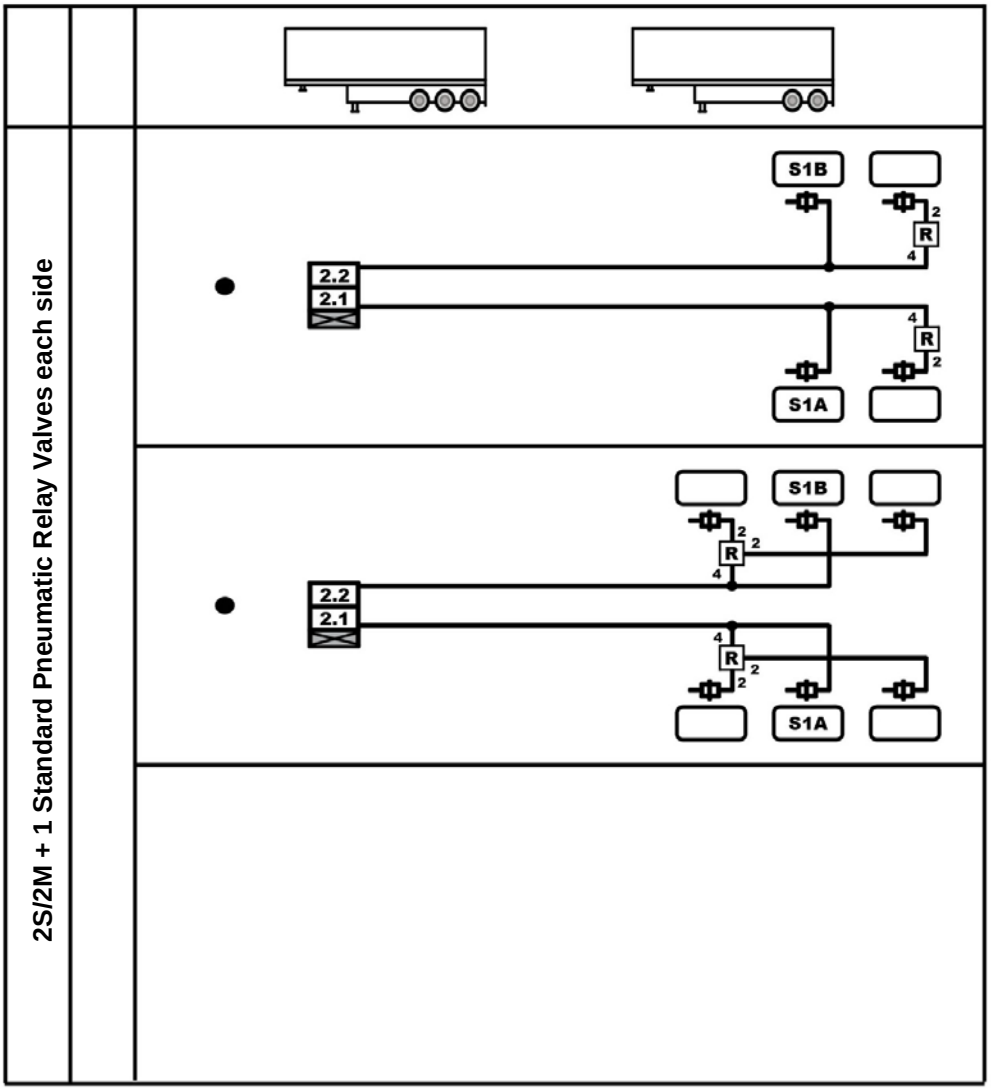


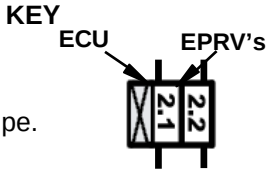
EB+ Gen3 Installation Options – Inloader Semi Trailers

Integrated Side By Side (SxS) with 1 Standard Pneumatic Relay Valve on each side controlled by the EB+ EPRV's



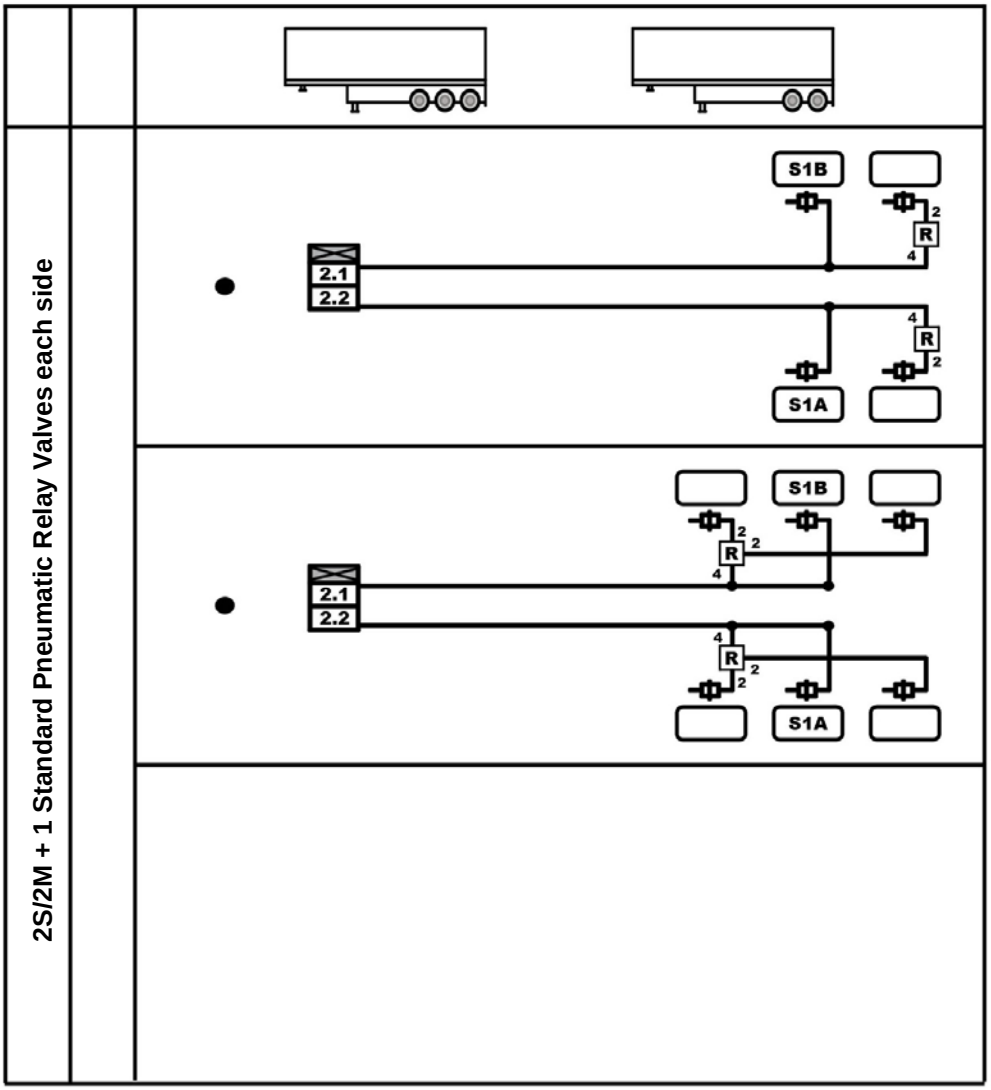
Any axle without directly controlled wheels may be lifted
Any axle may be a command steered axle.

Pipe dimensions:-
EB+ delivery pipe to brake actuators of directly controlled axle maximum length 10m of 12x1.5mm pipe.
EB+ reservoir minimum diameter 15x2mm x 2 pipes maximum length 3m.
Conventional relay delivery port 2 to each axle maximum length 4m of 12x1.5mm pipe.
Conventional relay reservoir pipe minimum diameter 15x2mm and maximum length 4m.



EB+ Gen3 Installation Options – Inloader Semi Trailers

Integrated Side By Side (SxS) with 1 Standard Pneumatic Relay Valve on each side controlled by the EB+ EPRV's



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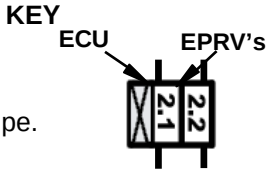
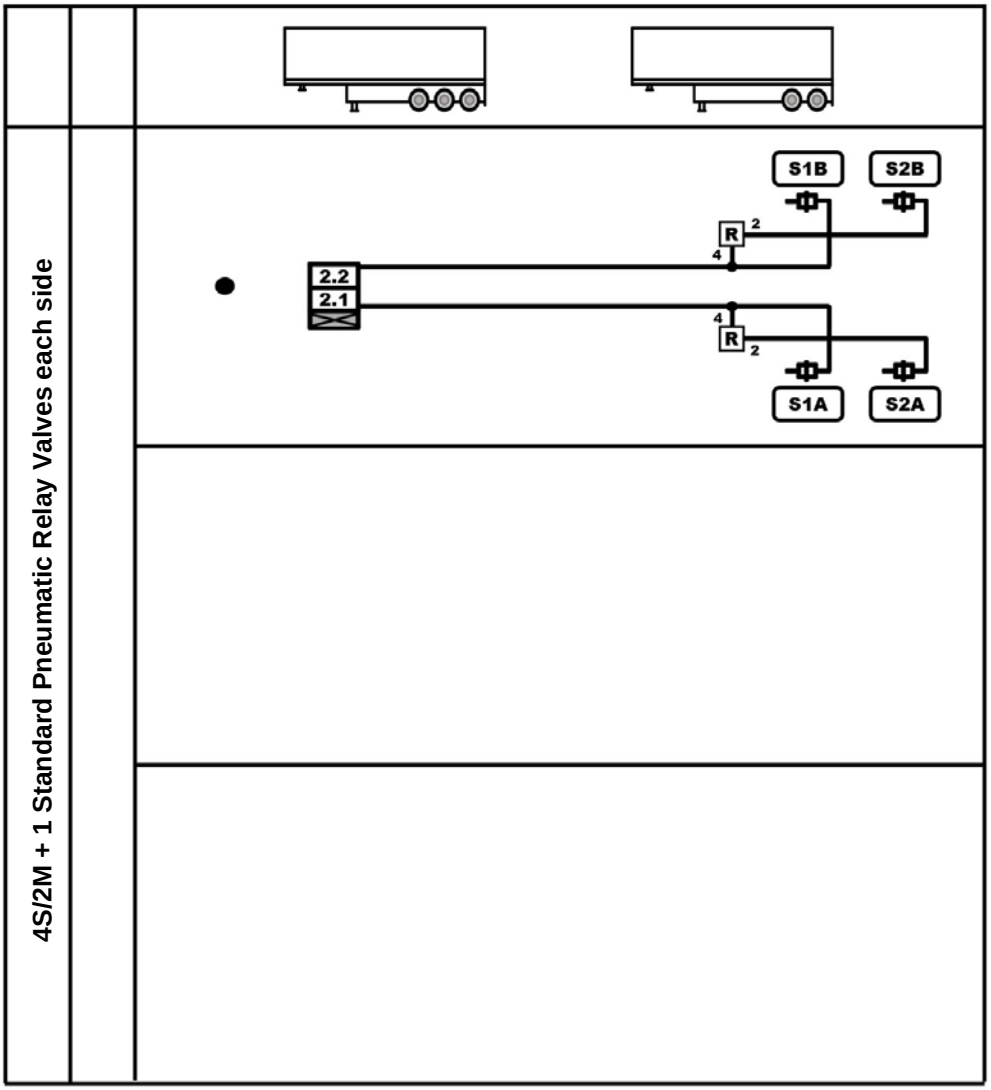


R13 190533

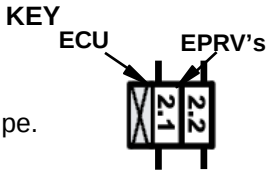
EB+ Gen3 Installation Options – Inloader Semi Trailers

Integrated Side By Side (SxS) with 2 Standard Pneumatic Relay Valves on each side controlled by the EB+ EPRV's



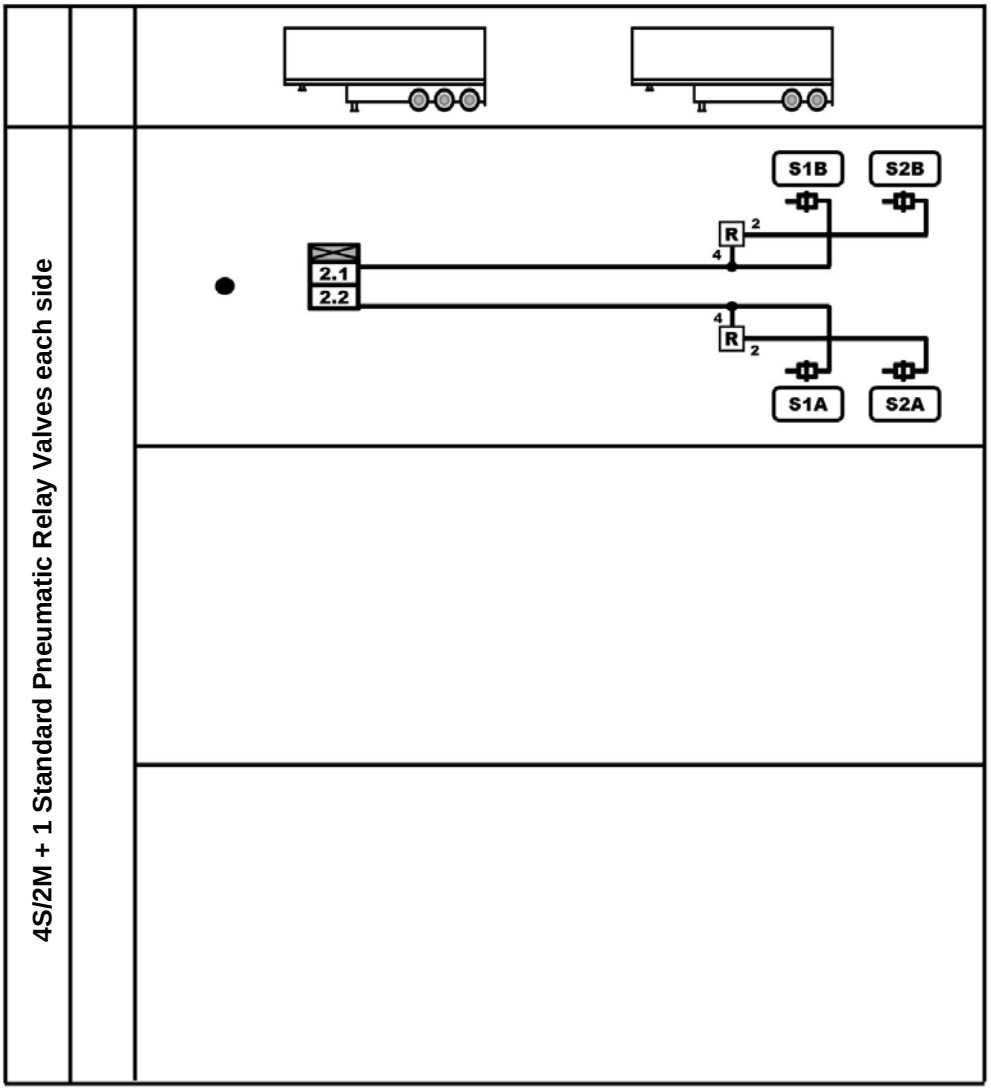
Any axle without directly controlled wheels may be lifted
Any axle may be a command steered axle.

Pipe dimensions:-
EB+ delivery pipe to brake actuators of directly controlled axle maximum length 10m of 12x1.5mm pipe.
EB+ reservoir minimum diameter 15x2mm x 2 pipes maximum length 3m.
Conventional relay delivery port 2 to each axle maximum length 4m of 12x1.5mm pipe.
Conventional relay reservoir pipe minimum diameter 15x2mm and maximum length 4m.



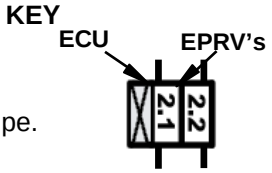
EB+ Gen3 Installation Options – Inloader Semi Trailers

Integrated Side By Side (SxS) with 2 Standard Pneumatic Relay Valves on each side controlled by the EB+ EPRV's



Any axle without directly controlled wheels may be lifted
Any axle may be a command steered axle.

Pipe dimensions:-
EB+ delivery pipe to brake actuators of directly controlled axle maximum length 10m of 12x1.5mm pipe.
EB+ reservoir minimum diameter 15x2mm x 2 pipes maximum length 3m.
Conventional relay delivery port 2 to each axle maximum length 4m of 12x1.5mm pipe.
Conventional relay reservoir pipe minimum diameter 15x2mm and maximum length 4m.



EB+ Trailer Anti-lock - Recommended Tube Sizes

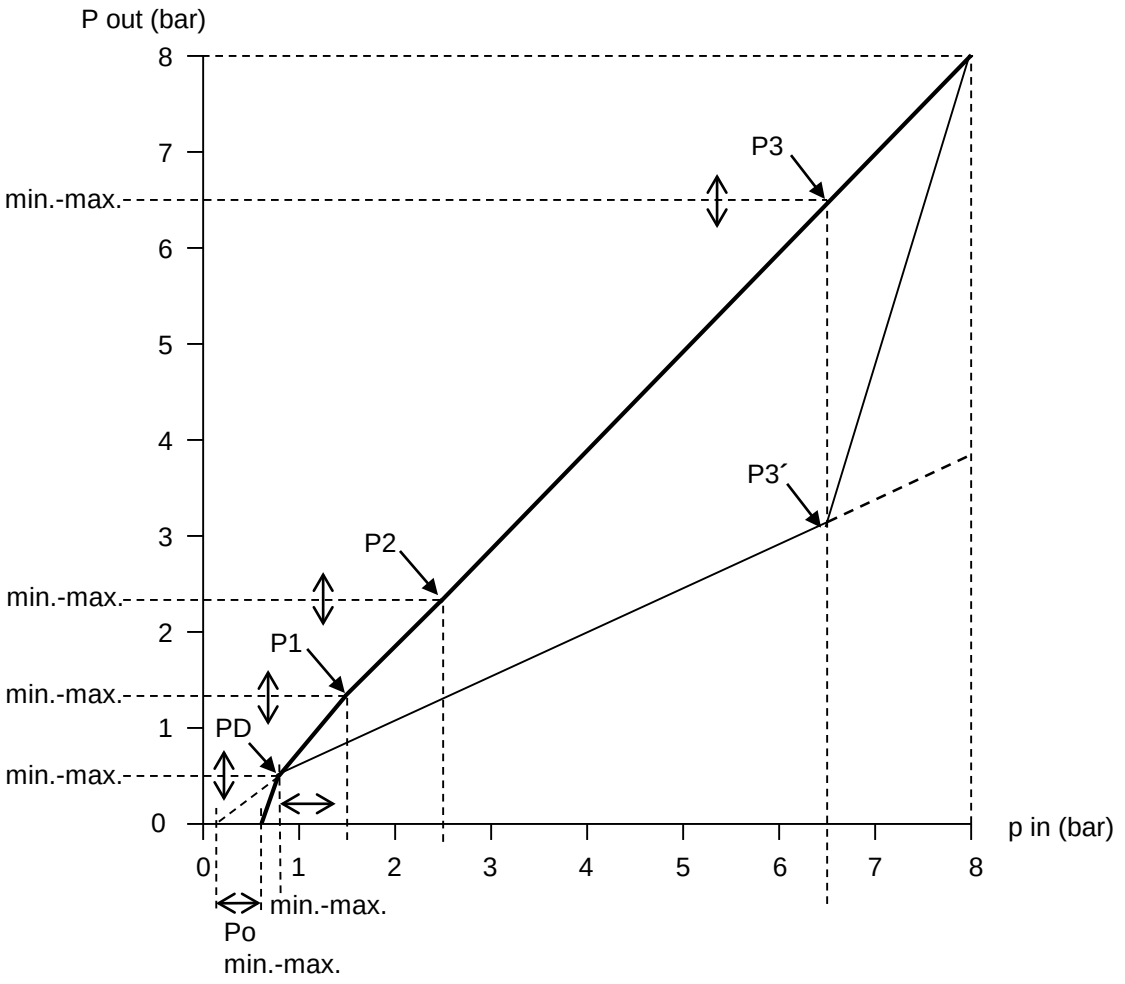
Dimensions of Connecting Tubes Between the Pressure Modulators and the Brake Chambers
Plastic Tube :- Minimum Inside Diameter 9mm Rubber Hose :- Minimum Inside Diameter 11mm The connecting tubes or hoses length shall be less than or equal to 5 metres. In all cases the prescribed brake system response time provisions shall be fulfilled.
Dimensions of Connecting Tubes Between the Air Reservoir and the Pressure Modulators
Integrated and Non-Integrated Systems Plastic Tube :- Minimum Inside Diameter 12mm In all cases the inside diameter and length of the connecting tube(s) shall ensure that the prescribed brake system response time provisions are fulfilled
EB+ Inloader Trailer Anti-lock Configurations - Recommended Tube Sizes
Dimensions of connections for Inloader Configurations see Appendix 1c

Load Plate Data

Example data

LADEN							UNLADEN		
AXLE LOAD (kg)	SUSP. PRESS. (bar)	P0 (bar)	PD (bar)	P1 (bar)	P2 (bar)	P3 (bar)	AXLE LOAD (kg)	SUSP. PRESS. (bar)	P3´ (bar)
			0.8	1.5	2.5	6.5			6.5
9000	5.0	0.2	0.5	1.2	2.2	6.5	3000	0.7	3.0

Electronic Load Apportionment Parameters



Appendix 3

Electronic Load Apportionment Input Parameters

Important Notes (refer to the graph)

Points P3, P3´, P0 and PD are compulsory load plate data inputs.

Points P1 and P2 are optional laden knee points. The corresponding unladen points are automatically calculated in the same proportion as P3 and P3´.

Note applicable only to Software Version B377 onwards

Points P3 and P3´ are both linked by straight lines to a common point at (8.0, 8.0). This means that at control line inputs above P3x, braking force enhancement is in effect in lower load conditions. At a control line input of 8.0 bar, the same brake force is available irrespective of load.

Input Parameter Ranges

Point	Description	Min	Default	Max
P0	Compulsory Threshold pressure	0.0	0.2	PDx
PD	Compulsory Pivot point	(0.0,0.0)	(0.7,0.5)	(P1x,P1y)
P1	Optional laden point	(PDx,PDy)	Not Used	(P2x,P2y)
P2	Optional laden point	(P1x,P1y)	Not Used	(P3x,P3y)
P3	Compulsory laden point	(P2x,P2y)	(6.5,6.5)	(8.0,8.0)
P3´	Compulsory unladen point	(P3x,PDy)	(6.5,3.0)	(P3x,P3y)

Appendix 3

Example Semi Trailer 'Load Plate'

Haldex	EB+ ADR TÜ.EGG.094-04			2S/2M Stability		S1A S1B	520mm 100t	S2A S2B	
TRAILER MANUFACTURER FAHRZEUGHERSTELLER PRODUCTUEUR DE VEHICULE	Haldex			BRAKE CALCULATION NO. BREMSBERECHNUNGSNUMMER CALCUL DE FREINAGE NO.		BC123456/1			
CHASSIS NUMBER FAHRGESTELLNUMMER NUMERO DE CHASSIS	12345678901234567			TYPE TYP TYPE		Semi			
THRESHOLD PRESSURE ANSPRECHDRUCK PRESSION D'APPROCHE [bar]	0.20			PRESSURE LIMIT DRUCKBEGRENZUNG LIMITE DE PRESSION [bar]		-			
E11 13R - 123456	UNLADEN / LEER / A VIDE			LADEN / BELADEN / EN CHARGE					
	INPUT PRESSURE EINGANGSDRUCK PRESSION D'ENTRÉE [bar]		6.50	INPUT PRESSURE EINGANGSDRUCK PRESSION D'ENTRÉE [bar]		0.70	-	-	6.50
	AXLE LOAD ACHSLAST CHARGE ESSIEU [kg]	SUSPENSION PRESSURE BALGDRUCK PRESSION DE SUSPENSION [bar]	OUTPUT PRESSURE AUSGANGSDRUCK PRESSION DE SORTIE [bar]	AXLE LOAD ACHSLAST CHARGE ESSIEU [kg]	SUSPENSION PRESSURE BALGDRUCK PRESSION DE SUSPENSION [bar]	OUTPUT PRESSURE AUSGANGSDRUCK PRESSION DE SORTIE [bar]			
1 AXLE 1 ACHSE 1 ESSIEU	3000	0.70	3.00	9000	5.00	0.50	-	-	6.50
2 AXLE 2 ACHSE 2 ESSIEU	3000	0.70	3.00	9000	5.00	0.50	-	-	6.50
3 AXLE 3 ACHSE 3 ESSIEU	3000	0.70	3.00	9000	5.00	0.50	-	-	6.50

[Generated by Haldex DIAG+ V5.13]

Part No. 028 5301 09

R13 190533

Appendix 3

Haldex Brake Products Ltd
MIRA Technology Park
Lindley
Warwickshire
CV13 6DE
United Kingdom
28/01/2020

Manufacturer	Model	Type	Remarks
ADOC			
	S4107	Mechanical	
ADR			
	KD Series	Mechanical	
	KW Series	Mechanical	
Assali STEFEN			
	SMT	Mechanical	
	SM	Mechanical	
Bartoletti			
	S27 MECC	Mechanical	
Bertoja			
	MSS13	Mechanical	
BPW			
	VA	Mechanical, balanced	Not currently available
	ECO Cargo VB	Mechanical, balanced	
	VB	Mechanical	
	VG	Mechanical	Not currently available
	BW	Mechanical	Not currently available
	GW	Mechanical	Not currently available
	W	Mechanical	
Cardi			
	MR	Mechanical	
Colaert Essieux			
	5205, 5225	Mechanical	
	5265, 5285	Mechanical	
	5206, 5226, 5246	Mechanical	
	5266, 5286, 5306	Mechanical	
	5302, 5323, 5341	Mechanical	
	5362, 5383, 5401	Mechanical	
	5524, 5741	Mechanical	
	5584, 5801	Mechanical	
Cometto			
	MA3	Mechanical	
	G1	Mechanical	
FOURNIER			
	FOM2	Mechanical	
	FOM3S	Mechanical	
	FOM3F	Mechanical	
Gigant			
	LK series	Mechanical	
	GK series	Mechanical	
	F series	Mechanical	
Hendrickson			
	HST	Mechanical	
Industrias Laneko S.A.L. (TRAYL-NOA)			
	TL series	Mechanical	
	Gondola GTL	Mechanical	
Lecinena			
	411	Mechanical	
Lecitrailer			
	SB	Mechanical	
Mecanizacion			
	SN	Mechanical	
Meritor			
	SMT	Mechanical	
Montenegro			
	051 XXXX	Mechanical	
Piazenza			
	B1	Mechanical	
	D2	Mechanical	
	G1	Mechanical	
	G2	Mechanical	
Prim - Ball S.A.			
	SB3	Mechanical	
	SB4	Mechanical	
	SB5	Mechanical	
Schneider Fahrzeug-und Containertechnik Gmbh			
	TD Series	Mechanical	

Haldex Brake Products Ltd
MIRA Technology Park
Lindley
Warwickshire
CV13 6DE
United Kingdom
28/01/2020

Manufacturer	Model	Type	Remarks
	TRD Series	Mechanical	
SAE-SMB			
	SMS80	Mechanical	
	SMS100	Mechanical	
	SM75	Mechanical	
	SM100	Mechanical	
Suspensys			
	LF	Mechanical	Lub-Free - All Variants
	LM	Mechanical	Low Mount - All Variants
	SAB	Mechanical	Spread Axle Bar - All Variants
	SAE	Mechanical	Spread Axle Equalizer - All Variants
	SP	Mechanical	Single-Point - All Variants
York			
	YTE	Mechanical	
Zorzi			
	S6M	Mechanical	
	S10M	Mechanical	
	R10M	Mechanical	

EB+ Trailer EBS - Differential Actuation

Drum brakes					
Suspension Type	ABS Configuration	No. of Axles Within Bogie	Position of Sensors Within Bogie	Axle on Which Differential is Applied	Actuation Differential
Air	2S/1M	3	X 1 X	1	up to -25mm or 1"
Air	2S/2M	3	X 1 X	1	up to -25mm or 1"
Air	4S/2M (SxS)	3	X 1 2	1	up to -25mm or 1"
Air	4S/2M (AxA)	3	X H L	1	up to -25mm or 1"
Air	4S/3M	3	X M S X M S	1 3	up to -25mm or 1"

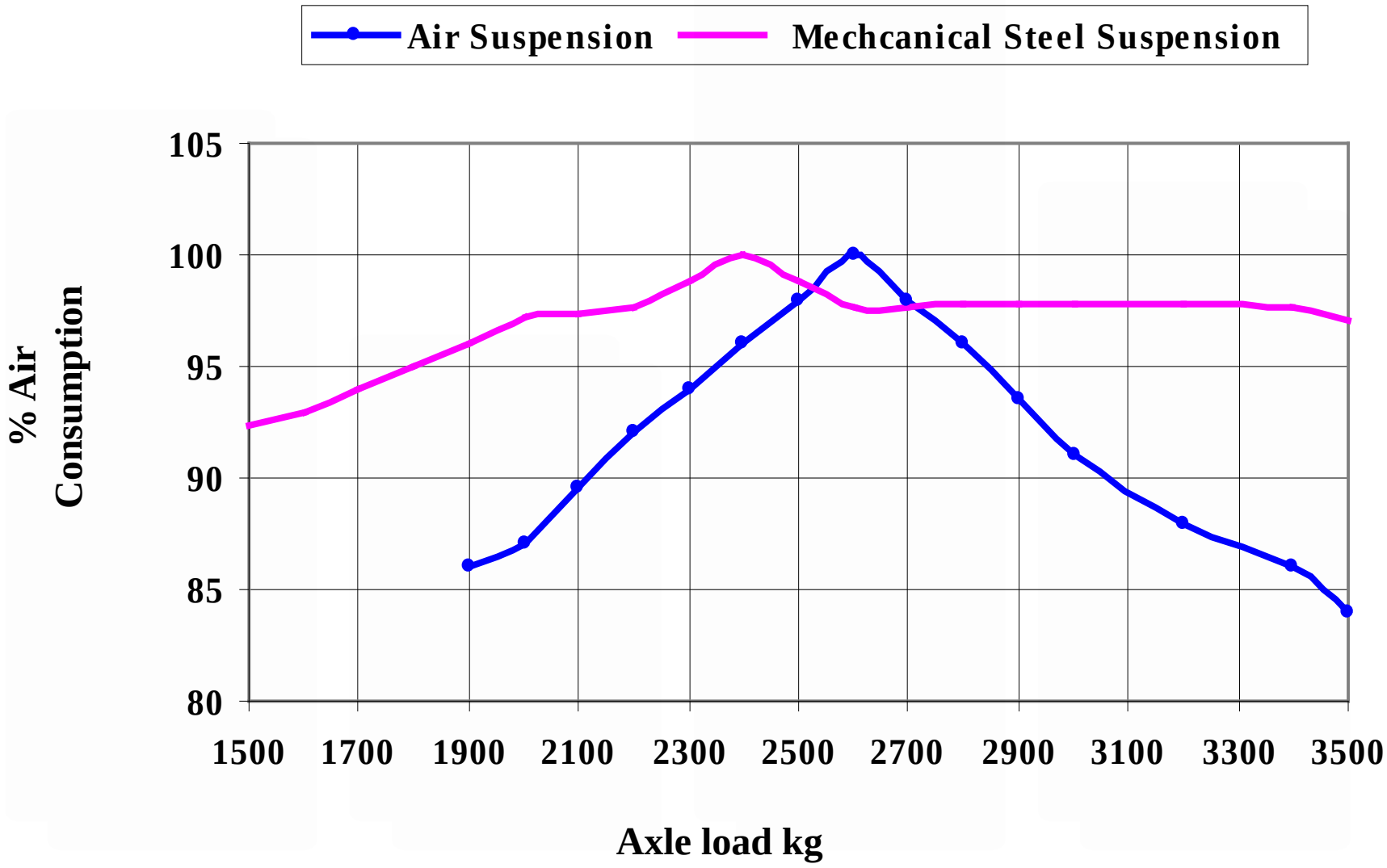
Disc brakes					
Suspension Type	ABS Configuration	No. of Axles Within Bogie	Position of Sensors Within Bogie	Axle on Which Differential is Applied	Actuation Differential Chamber size
Air	2S/1M	3	X 1 X	1	Down from 16 to 14 or Down from 18 to 16
Air	2S/2M	3	X 1 X	1	Down from 16 to 14 or Down from 18 to 16
Air	4S/2M (SxS)	3	X 1 2	1	Down from 16 to 14 or Down from 18 to 16
Air	4S/2M (AxA)	3	X H L	1	Down from 16 to 14 or Down from 18 to 16
Air	4S/3M	3	X M S X M S	1 3	Down from 16 to 14 or Down from 18 to 16

Notes:
1 - Axles within the bogie are number left to right from the front of the trailer e.g. 1 - 2 - 3
2 - X denotes indirectly controlled wheel
3 - X denotes axle on which differential is applied. S denotes axle on which differential is applied
4 - Number denotes ABS Side by Side configuration sensor reference
5 - ABS Axle by Axle configuration channel reference; letter H denotes 'Adaptive Surface Control channel' and L = 'Select Low channel'
6 - 4S/3M configuration channel reference; letter M denotes 'Master ECU' and S = 'Slave ECU'

Drum brakes					
Suspension Type	ABS Configuration	No. of Axles Within Bogie	Position of Sensors Within Bogie	Axle on Which Differential is Applied	Actuation Differential
Steel Balanced Mechanical	2S/2M	3	X 1 X	1	up to -25mm or 1"
Steel Balanced Mechanical	4S/2M	3	X 1 2	1	up to -25mm or 1"

Notes:
1 - Axles within the bogie are number left to right from the front of the trailer e.g. 1 - 2 - 3
2 - X denotes indirectly controlled wheel
3 - X denotes axle on which differential is applied. S denotes axle on which differential is applied
4 - Number denotes ABS Side by Side configuration sensor reference

Determination of Worst case Axle Load for Energy Consumption



Appendix 6

EB+ Part Numbers

EB+ Gen 1 ECU and Valve assemblies

Part Number	Description	Example	Description
810 00x 1xx	Main Assembly – 1M Integrated	810 001 101	Main Assembly – 1M Integrated
		810 001 102	Main Assembly – 1M Integrated - G
810 00x 3xx	Main Assembly – 2M Integrated	810 001 301	Main Assembly – 2M Integrated
		810 001 303	Main Assembly – 2M Integrated - G
810 01x 0xx	Main Assembly – 3M (Non-Integrated)	810 010 002	Main Assembly - 3M Master - G
		810 011 001	Main Assembly - 3M Slave
813 00x 3xx	Valve Assembly 1M and 2M	813 003 301	Valve Assembly 1M No AC
		813 003 302	Valve Assembly 1M No AC - G
		813 002 301	Valve Assembly 2M No AC
		813 002 302	Valve Assembly 2M No AC - G
812 001 101	ECU Assembly – 1M	812 001 101	ECU Assembly – 1M Aux 1
812 001 301	ECU Assembly - 2M	812 001 301	ECU Assembly – 2M Aux 1,2,3,4,5 without LAI
812 013 001		812 013 001	ECU Assembly – 2M Aux 1,2,3,4,5 with LAI
812 001 202	ECU Assembly - 2M	812 001 202	ECU Assembly – 2S/2M Aux 1,2,4 without LAI
812 012 001		812 012 001	ECU Assembly – 2S/2M Aux 1,2,4 with LAI
813 010 xxx	1M Slave Valve Assembly	813 010 001	1M Slave Valve – Int. Susp.
813 011 xxx		813 011 001	1M Slave Valve – No Susp.
812 011 001	ECU Assembly – 3M Slave	812 011 001	ECU Assembly – 3M Slave
812 010 001	ECU Assembly – 3M Master	812 010 001	ECU Assembly – 3M Master without LAI

EB+ Gen 2 Part Numbers

Integrated 2M/3M ECU/Valve assemblies

With internal accelerometer:

820 001 XXX	2S/2M	3 aux	without Super Aux
820 003 XXX	4S/2M (2S/2M)	5 aux	
820 005 XXX	2S/2M	3 aux	
820 007 XXX	4S/2M (2S/2M)	5 aux	
820 009 XXX	2S/2M	3 aux	
820 011 XXX	4S/2M (2S/2M)	5 aux	
820 026 XXX	4S/3M	5 aux	
820 002 XXX	2S/2M	3 aux	with Super Aux
820 004 XXX	4S/2M (2S/2M)	5 aux	
820 006 XXX	2S/2M	3 aux	
820 008 XXX	4S/2M (2S/2M)	5 aux	
820 010 XXX	2S/2M	3 aux	
820 012 XXX	4S/2M (2S/2M)	5 aux	

Without internal accelerometer:

820 013 XXX	2S/2M	3 aux	without Super Aux
820 015 XXX	4S/2M (2S/2M)	5 aux	
820 017 XXX	2S/2M	3 aux	
820 019 XXX	4S/2M (2S/2M)	5 aux	
820 021 XXX	2S/2M	3 aux	
820 023 XXX	4S/2M (2S/2M)	5 aux	
820 014 XXX	2S/2M	3 aux	with Super Aux
820 016 XXX	4S/2M (2S/2M)	5 aux	
820 018 XXX	2S/2M	3 aux	
820 020 XXX	4S/2M (2S/2M)	5 aux	
820 022 XXX	2S/2M	3 aux	
820 024 XXX	4S/2M (2S/2M)	5 aux	

EB+ Gen 3 Valve ECU Assembly

Part Number	Description	Example	Description
823 008 xxx	Standalone 2M ECU/Valve assembly	823 008 001	Standalone 2M ECU/Valve assembly
823 034 xxx	Master 2M ECU/Valve assembly	823 034 001	Master 2M ECU/Valve assembly
810 023 001	Slave 1M ECU/Valve assembly	810 023 001	Slave 1M ECU/Valve assembly

ISO 11992 CAN Router /Repeater ECU

Part Number	Description	Example	Description
815 057 xxx	ECU	815 057 001	ECU with optional pressure sensor input

EB+ Gen 1 Associated Part Numbers

Cables and Auxiliaries

Part Number	Description	Example	Description
041 5023 x9	Pressure switch	041 5023 09	Pressure switch

EB+ Gen 2 Associated Part Numbers

Cables and Auxiliaries

Part Number	Description	Example	Description
814 002 xxx	Super aux	814 002 300	Super aux basic cable Assembly
814 004 xxx	Super aux	814 004 300	Power B to ISO 15170 (4 pole)
814 005 xxx	Super aux	814 005 300	Super aux Y piece assembly
814 00 6 xxx	Super aux	814 006 300	Diag to ISO 15170 (4 pole)
814 007 xxx	Super aux	814 007 300	Power B to ISO 15170 (2 pole 24N)
814 016 xxx	Super aux	814 016 300	Super aux 3 way

EB+ Gen 1 and EB+ Gen 2 Associated Part Numbers

Cables and Auxiliaries

Part Number	Description	Example	Description
814 00x 0xx	3M Link Cable Assembly	814 001 001	3M Link Cable Assembly (12m)
814 00x 3xx	Auxiliary Cable	814 001 301	Auxiliary Cable (7m)
814 00x 2xx	Stoplight Cable	814 002 201	Stoplight Cable (12m)
814 00x 1xx	ISO Socket Assembly	814 003 101	ISO Socket Assembly (12m)
814 00x 4xx	Sensor Cable	814 004 401	Sensor Cable (3m)
814 00x 5xx	REV Pressure Switch Cable	814 001 501	Pressure Switch Cable (10m)
815 012 001	Accelerometer Assembly	815 012 001	Accelerometer (2.5m)
815 022 xxx	Pressure switch	815 022 001	Pressure switch
815 022 xxx	External pressure sensor	815 022 001	External pressure sensor
351 009 xxx 351 033 xxx	REV	351 009 021 351 033 001	REV
352 067 xxx	Trailer Control Module	352 067 011	TrCM
352 067 6xx	Trailer Control Module	352 067 601	TrCM+
352 075 xxx	Trailer Emergency Module	352 075 001	TEM
G 833 999 999	Haldex SLV	G 833 999 999	Haldex SLV
333 009 xxx	Haldex SLV	333 009 001	Haldex SLV
434 500 003 0	Wabco SLV	434 500 003 0	Wabco SLV
815 030 xxx	Height Sensor	815 030 001	Height Sensor
973 011 000 0	Wabco Relay Valve	973 011 000 0	Wabco Relay Valve

Key to table contents

AC = Anti-Compounding
Susp = Suspension Transducer
G = Gauge Demand Pressure Transducer
REV = Relay Emergency Valve
SLV = Select Low Valve
LAI = Lateral Accelerometer Integrated in ECU
Trailer Control Module = Combined Park/Shunt valve with Emergency Function

For part numbers applicable to wheel speed sensors see section 2.1.3.1.1
Using “x” wildcards enables versions to be produced that do not affect the function or performance of the product or system as a whole as tested and approved and are used to reduce documentation changes to trailer manufacturer’s approvals.

EB+ Fault Handling and Action

FAULT	ACTION		RECOVER	WARNING
	MASTER	SLAVE*		
Master valve brake apply solenoid o/c or s/c	Disable EBS Retain ABS	Disable EBS Retain ABS	No	Yellow
Slave valve brake apply solenoid o/c or s/c	Retain EBS Retain ABS	Disable EBS Retain ABS	No	Yellow
Master valve modulator solenoid o/c or s/c	Disable EBS Disable ABS on affected channel	Disable EBS Retain ABS	No	Yellow
Slave valve modulator solenoid o/c or s/c	Retain EBS Retain ABS	Disable EBS Disable ABS	No	Yellow Red(2)
Master valve brake apply or modulator solenoid drive s/c	Disable EBS Disable ABS	Disable EBS Disable ABS	No	Yellow Red(2)
Slave valve brake apply or modulator solenoid drive s/c	Disable EBS Disable ABS	Disable EBS Disable ABS	No	Yellow Red(2)
External pressure switch or sensor (1) electrical fault with ISO11992	None – ISO11992 used in preference	None – ISO11992 used in preference	N/A	Yellow
External pressure switch (1) electrical fault without ISO11992	Disable EBS Retain ABS	Disable EBS Retain ABS	No	Yellow
External pressure sensor (1) electrical fault without ISO11992	Retain EBS but use internal sensor Retain ABS	Retain EBS but use internal sensor Retain ABS	No	Yellow
External pressure switch or sensor (1) / pneumatic demand mismatch, without ISO11992	Disable EBS Retain ABS	Disable EBS Retain ABS	No	Yellow
Demand sensor fault with ISO11992	None – ISO11992 used in preference	None – ISO11992 used in preference	N/A	Yellow
Demand sensor fault without ISO11992	Disable EBS Disable ABS	Disable EBS Disable ABS	No	Yellow Red(2)
Master valve delivery sensor fault	Disable EBS Selectively Disable ABS	Disable EBS Retain ABS	No	Yellow
Slave valve delivery sensor fault	Retain EBS Retain ABS	Disable EBS Disable ABS	No	Yellow Red(2)

EB+ Fault Handling and Action

FAULT	ACTION		RECOVER	WARNING
	MASTER	SLAVE*		
Master valve suspension sensor fault	Disable Load Sensing (go laden) Retain EBS Retain ABS	Disable Load Sensing (go laden) Retain EBS Retain ABS	No	Yellow
Slave valve suspension sensor fault	None – Continue to load apportion	Disable Load Sensing (go laden) Retain EBS Retain ABS	No	Yellow
Reservoir pressure < 4.5 bar	None	None	N/A	Yellow Red
Reservoir pressure > 9.75 bar	Disable EBS Retain ABS	Disable EBS Retain ABS	Yes	Yellow
Reservoir sensor fault	Disable Reservoir Pressure Sensing. Disable Load Sensing (go laden) Retain EBS Retain ABS	Disable Reservoir Pressure Sensing. Disable Load Sensing (go laden) Retain EBS Retain ABS	No	Yellow
Voltage <19V on ISO pin 1 (< 8V on Gen 3)	Disable EBS Disable ABS	Disable EBS Disable ABS	ABS if voltage recovers, EBS on next brake application	Yellow Red
Stop-lamp power only (where this option is available)	Disable EBS Retain ABS	Disable EBS Retain ABS	Yes	No(3)
Wheel speed sensor fault, electrical or dynamic	Retain EBS Selectively Disable ABS	Retain EBS Selectively Disable ABS	No	Yellow
ISO11992 failure	Ignore ISO11992 Retain EBS Retain ABS	Ignore ISO11992 Retain EBS Retain ABS	Yes	Yellow
ISO11992 demand of > 1 bar for 1 sec and expected pneumatic demand is not present	None – Continue to use ISO11992 demand	None – Continue to use ISO11992 demand	N/A	Yellow
Pressure control failure (faulty sensor, modulator or pneumatics)	Selectively Disable EBS Selectively Retain ABS	Selectively Disable EBS Selectively Retain ABS	No	Yellow

EB+ Fault Handling and Action

FAULT	ACTION		RECOVER	WARNING
	MASTER	SLAVE*		
ABS control failure (faulty modulator, pneumatics or brakes)	Retain EBS Selectively Disable ABS	Retain EBS Selectively Disable ABS	No	Yellow
EV / REV Emergency Application, with external pressure switch and: ISO11992 Intact Vehicle Moving Reservoir > 4.5 bar	Override automatic braking and use ISO11992 demand	Override automatic braking and use ISO11992 demand	Yes	Red
EV / REV Emergency Application, all other cases with external pressure switch	Allow automatic braking Disable EBS Retain ABS	Allow automatic braking Disable EBS Retain ABS	Yes	Red
EV / REV Emergency Apply, all other cases without external pressure switch	Allow automatic braking Retain EBS and ABS	Allow automatic braking Retain EBS and ABS	Yes	None
Internal ECU failure	Disable EBS Disable ABS	Disable EBS Disable ABS	No	Yellow(4)

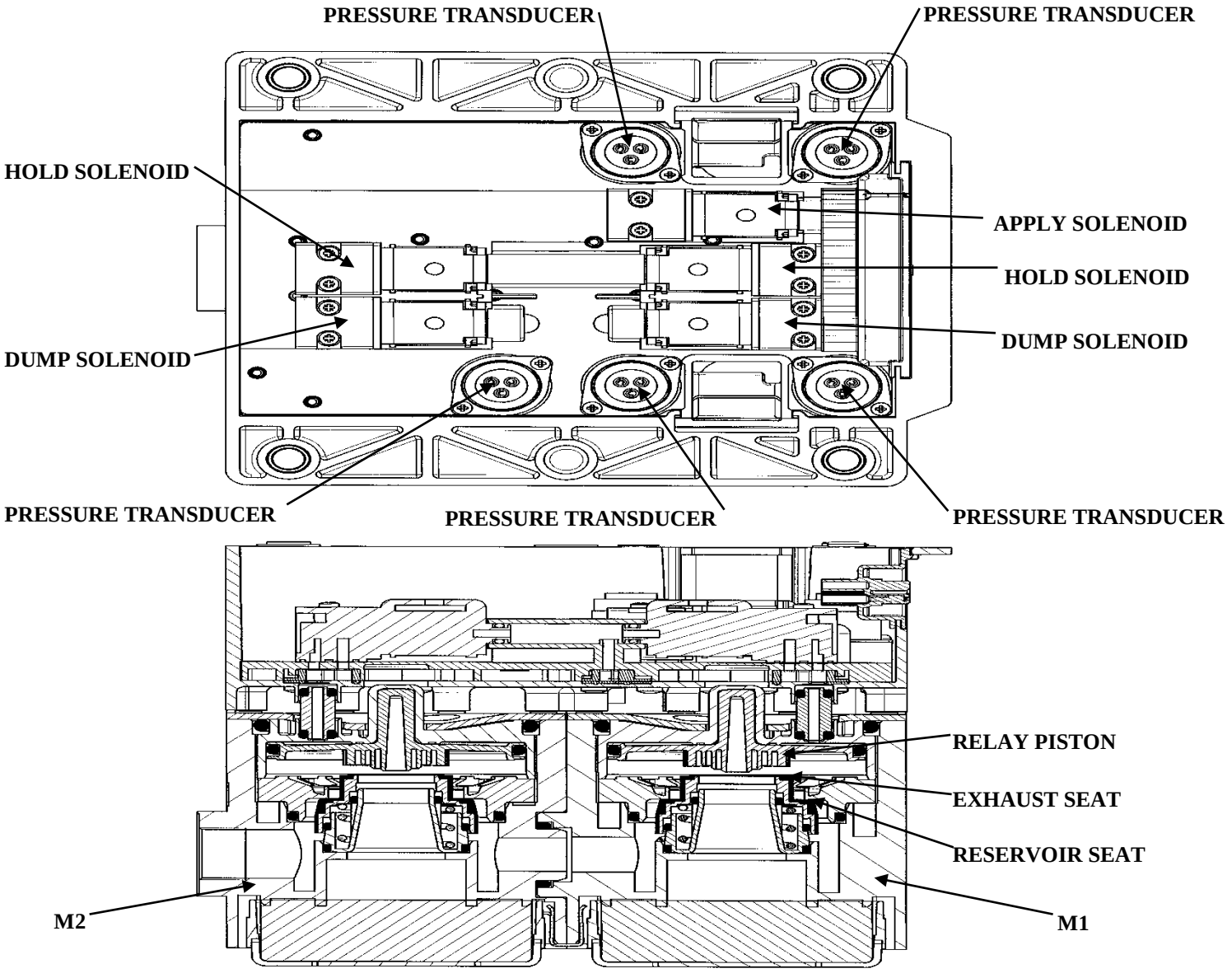
N/A Not Applicable - The system continues to function and no recovery required.
* Where installed.
(1) If fitted.
(2) Full trailer 3M systems only.
(3) Assume cab lamp on ISO7638 pin 5 not connected. If ISO7638 pin 5 still connected then cab lamp will be on. If trailer lamp option fitted then trailer lamp will be on when brakes applied.
(4) In the case of internal ECU failures only the yellow warning signal is given. According to failure circumstances the towing vehicle may provide additionally the red warning signal.

EB+ Stability Fault Handling and Action

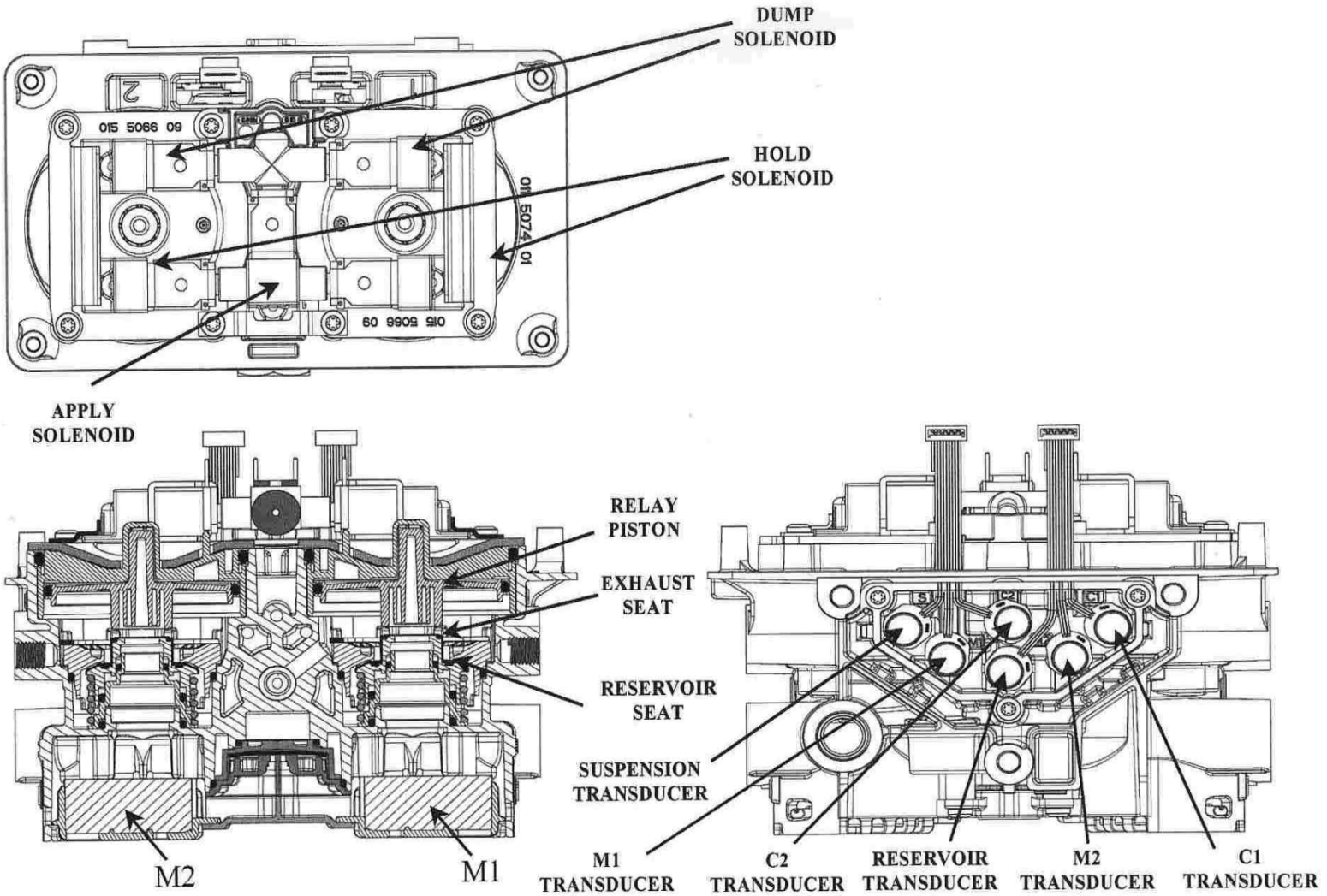
FAULT	ACTION	RECOVERABLE	WARNING
Brake apply or modulator solenoid fault	Disable Stability	No	Yellow
External pressure switch or sensor (1) fault	Retain Stability	N/A	Yellow
Internal demand sensor fault with ISO11992	None – ISO11992 used in preference	N/A	Yellow
Internal demand sensor fault without ISO11992	Disable Stability	No	Yellow
Delivery sensor fault	Disable Stability	No	Yellow
Load sensor fault	Assume laden Retain Stability	No	Yellow
Air Spring failure	Assume laden Retain Stability	Yes	Yellow
Reservoir sensor fault	Retain Stability	N/A	Yellow
Reservoir pressure < 4.5 bar	None	N/A	Yellow and Red
Voltage < 19V on ISO pin 1 (< 8V on Gen 3)	Disable Stability	Yes	Yellow and Red
Stoplight power only	Disable Stability	Yes	No(2)
Wheel speed sensor fault, electrical or dynamic	Disable Stability if not a minimum of one good sensor per side and two per axle group	No	Yellow
ISO11992 failure	Ignore ISO11992 Retain Stability	Yes	Yellow
Pressure control failure (faulty sensor, modulator or pneumatics)	Disable Stability	No	Yellow
Internal ECU failure	Disable Stability	No	Yellow(3)

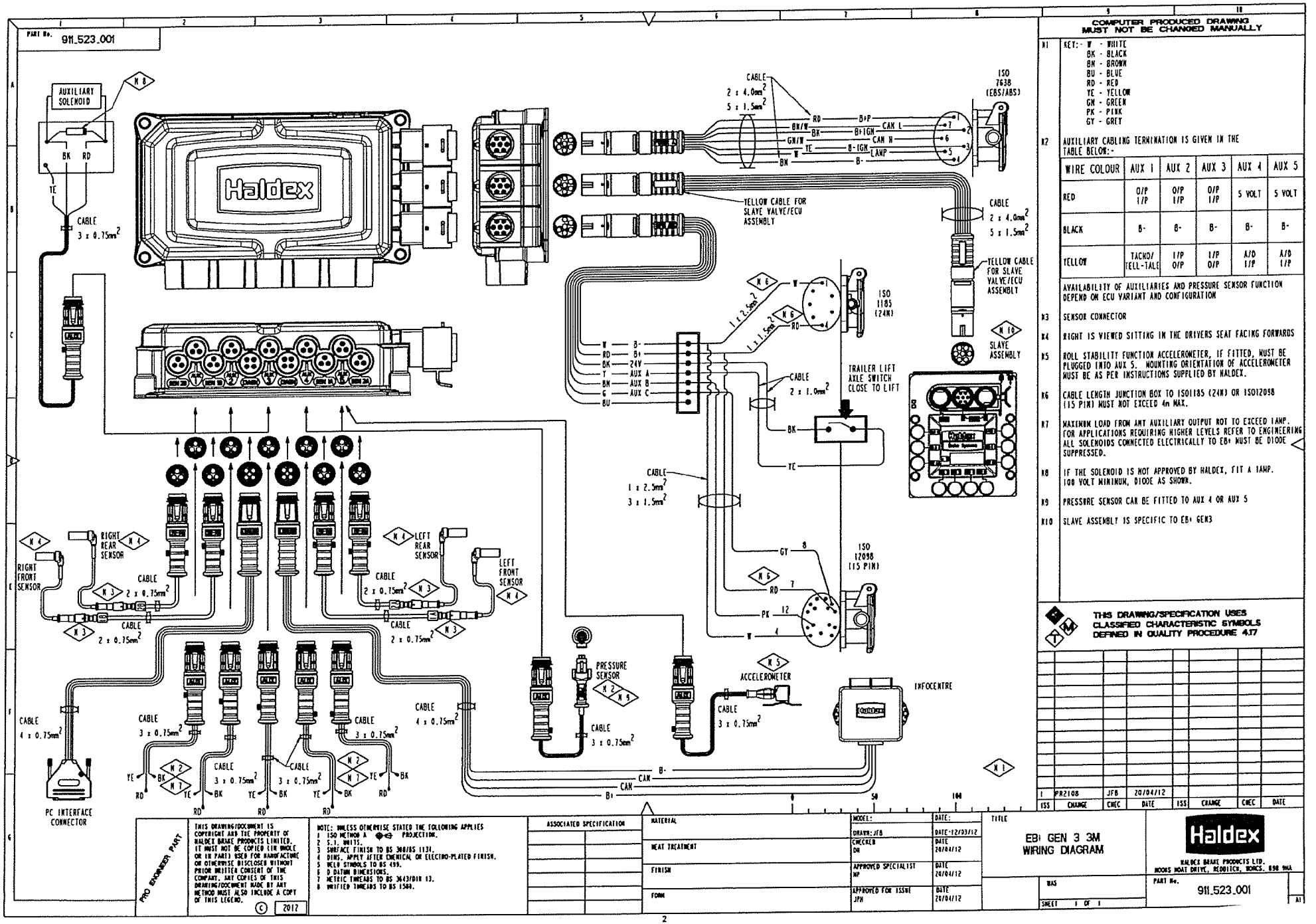
N/A Not applicable – The system continues to function and no recovery required.
(1) If fitted.
(2) Assume cab lamp on ISO7638 pin 5 not connected. If ISO7638 pin 5 still connected then cab lamp will be on. If trailer lamp option fitted then trailer lamp will be on when brakes applied.
(3) In the case of internal ECU failures only the yellow warning signal is given. According to failure circumstances the towing vehicle may provide additionally the red warning signal.

Cross-section EB+ Gen 1 Valve Assembly



Cross–Section EB+ Gen2 and Gen3 Valve Assembly





K1 KEY:- W - WHITE
BK - BLACK
BN - BROWN
BU - BLUE
RD - RED
YE - YELLOW
GN - GREEN
PK - PINK
GY - GREY

K2 AUXILIARY CABLING TERMINATION IS GIVEN IN THE TABLE BELOW:-

WIRE COLOUR	AUX 1	AUX 2	AUX 3	AUX 4	AUX 5
RED	O/P I/P	O/P I/P	O/P I/P	5 VOLT	5 VOLT
BLACK	B-	B-	B-	B-	B-
YELLOW	TACHO/ TELL-TALE	I/P O/P	I/P O/P	A/D I/P	A/D I/P

AVAILABILITY OF AUXILIARIES AND PRESSURE SENSOR FUNCTION DEPEND ON ECU VARIANT AND CONFIGURATION

K3 SENSOR CONNECTOR

K4 RIGHT IS VIEWED SITTING IN THE DRIVERS SEAT FACING FORWARDS

K5 ROLL STABILITY FUNCTION ACCELEROMETER, IF FITTED, MUST BE PLUGGED INTO AUX 5. MOUNTING ORIENTATION OF ACCELEROMETER MUST BE AS PER INSTRUCTIONS SUPPLIED BY HALDEX.

K6 CABLE LENGTH JUNCTION BOX TO ISO1185 (24N) OR ISO12098 (15 PIN) MUST NOT EXCEED 4m MAX.

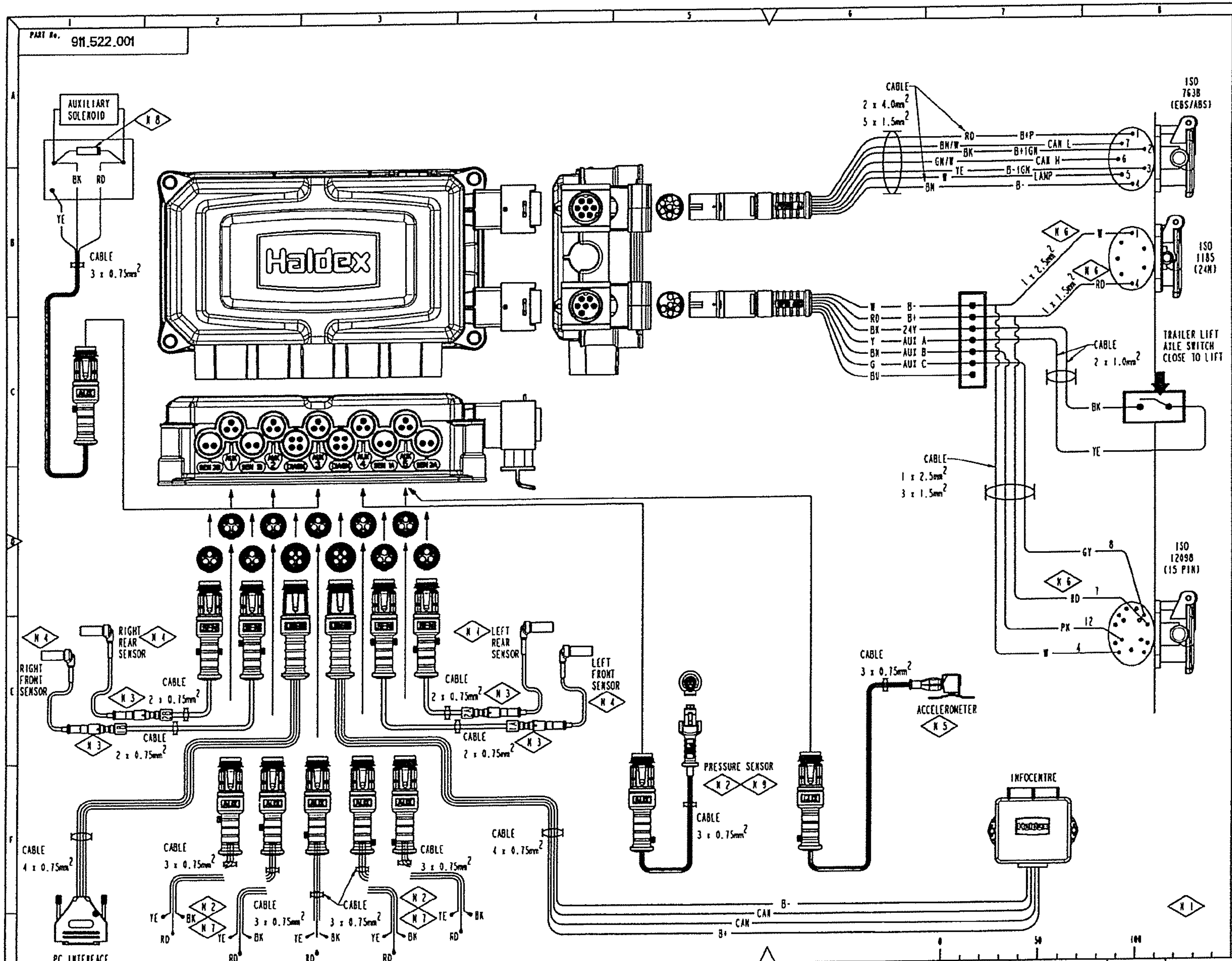
K7 MAXIMUM LOAD FROM ANY AUXILIARY OUTPUT NOT TO EXCEED 1AMP. FOR APPLICATIONS REQUIRING HIGHER LEVELS REFER TO ENGINEERING ALL SOLENOIDS CONNECTED ELECTRICALLY TO EB+ MUST BE DIODE SUPPRESSED.

K8 IF THE SOLENOID IS NOT APPROVED BY HALDEX, FIT A 1AMP. 100 VOLT MINIMUM, DIODE AS SHOWN.

K9 PRESSURE SENSOR CAN BE FITTED TO AUX 4 OR AUX 5

K10 SLAVE ASSEMBLY IS SPECIFIC TO EB+ GEN3

PART No. 911.522.001



COMPUTER PRODUCED DRAWING MUST NOT BE CHANGED MANUALLY

N1 KEY.- W - WHITE
BK - BLACK
BN - BROWN
BU - BLUE
RD - RED
YE - YELLOW
GN - GREEN
PK - PINK
GY - GREY

N2 AUXILIARY CABLING TERMINATION IS GIVEN IN THE TABLE BELOW:-

WIRE COLOUR	AUX 1	AUX 2	AUX 3	AUX 4	AUX 5
RED	O/P I/P	O/P I/P	O/P I/P	5 VOLT	5 VOLT
BLACK	B-	B-	B-	B-	B-
YELLOW	TACHO/ TELL-TALE	I/P O/P	I/P O/P	A/D I/P	A/D I/P

AVAILABILITY OF AUXILIARIES AND PRESSURE SENSOR FUNCTION DEPEND ON ECU VARIANT AND CONFIGURATION

N3 SENSOR CONNECTOR

N4 RIGHT IS VIEWED SITTING IN THE DRIVERS SEAT FACING FORWARDS

N5 ROLL STABILITY FUNCTION ACCELEROMETER, IF FITTED, MUST BE PLUGGED INTO AUX 5. MOUNTING ORIENTATION OF ACCELEROMETER MUST BE AS PER INSTRUCTIONS SUPPLIED BY HALDEX.

N6 CABLE LENGTH JUNCTION BOX TO ISO1185 (24N) OR ISO12098 (15 PIN) MUST NOT EXCEED 4m MAX.

N7 MAXIMUM LOAD FROM ANY AUXILIARY OUTPUT NOT TO EXCEED 1AMP. FOR APPLICATIONS REQUIRING HIGHER LEVELS REFER TO ENGINEERING. ALL SOLENOIDS CONNECTED ELECTRICALLY TO EB+ MUST BE DIODE SUPPRESSED.

N8 IF THE SOLENOID IS NOT APPROVED BY HALDEX, FIT A 1AMP. 100 VOLT MINIMUM, DIODE AS SHOWN.

N9 PRESSURE SENSOR CAN BE FITTED TO AUX 4 OR AUX 5

THIS DRAWING/SPECIFICATION USES CLASSIFIED CHARACTERISTIC SYMBOLS DEFINED IN QUALITY PROCEDURE 4.17

ISS	CHANGE	CHEC	DATE	ISS	CHANGE	CHEC	DATE
1	PR2108	JFB	20/04/12				

PRO ENGINEER PART

NOTE: UNLESS OTHERWISE STATED THE FOLLOWING APPLIES
1 ISO METHOD A PROJECTION.
2 S.I. UNITS.
3 SURFACE FINISH TO BS 308/BS 1134.
4 DIMS. APPLY AFTER CHEMICAL OR ELECTRO-PLATED FINISH.
5 WELD SYMBOLS TO BS 499.
6 D DATUM DIMENSIONS.
7 METRIC THREADS TO BS 3643/DIN 13.
8 UNIFIED THREADS TO BS 1580.

ASSOCIATED SPECIFICATION

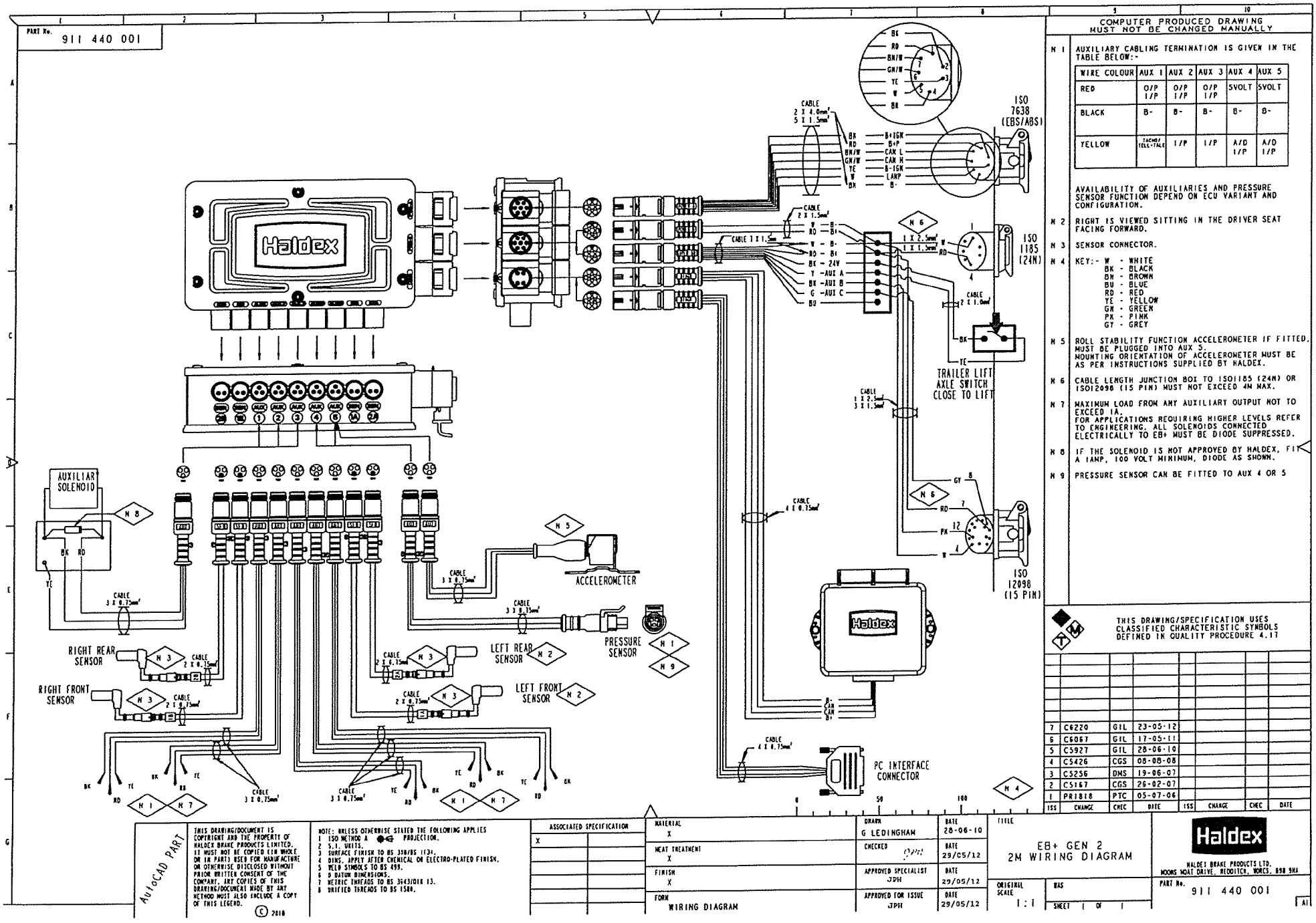
MATERIAL
HEAT TREATMENT
FINISH
FORM

MODEL: | DATE:
DRAWN: JFB | DATE: 12/03/12
CHECKED DH | DATE 20/04/12
APPROVED SPECIALIST NP | DATE 20/04/12
APPROVED FOR ISSUE JPH | DATE 20/04/12

TITLE: EB+ GEN 3 2M WIRING DIAGRAM

Haldex
HALDEX BRAKE PRODUCTS LTD. MOONS MOAT DRIVE, REDDITCH, WORCS. B98 9HA

WAS
SHEET 1 OF 1
PART No. 911.522.001
A1


PART No. 911 440 001
COMPUTER PRODUCED DRAWING
MUST NOT BE CHANGED MANUALLY
N 1 AUXILIARY CABLING TERMINATION IS GIVEN IN THE TABLE BELOW:-
WIRE COLOUR | AUX 1 | AUX 2 | AUX 3 | AUX 4 | AUX 5
RED | O/P I/P | O/P I/P | O/P I/P | 5VOLT | 5VOLT
BLACK | B- | B- | B- | B- | B-
YELLOW | TACHO/ TELL-TALE | I/P | I/P | A/D I/P | A/D I/P
AVAILABILITY OF AUXILIARIES AND PRESSURE SENSOR FUNCTION DEPEND ON ECU VARIANT AND CONFIGURATION.
N 2 RIGHT IS VIEWED SITTING IN THE DRIVER SEAT FACING FORWARD.
N 3 SENSOR CONNECTOR.
N 4 KEY:- W - WHITE BK - BLACK BN - BROWN BU - BLUE RD - RED YE - YELLOW GN - GREEN PK - PINK GY - GREY
N 5 ROLL STABILITY FUNCTION ACCELEROMETER IF FITTED, MUST BE PLUGGED INTO AUX 5. MOUNTING ORIENTATION OF ACCELEROMETER MUST BE AS PER INSTRUCTIONS SUPPLIED BY HALDEX.
N 6 CABLE LENGTH JUNCTION BOX TO ISO1185 (24N) OR ISO12098 (15 PIN) MUST NOT EXCEED 4M MAX.
N 7 MAXIMUM LOAD FROM ANY AUXILIARY OUTPUT NOT TO EXCEED 1A. FOR APPLICATIONS REQUIRING HIGHER LEVELS REFER TO ENGINEERING. ALL SOLENOIDS CONNECTED ELECTRICALLY TO EB+ MUST BE DIODE SUPPRESSED.
N 8 IF THE SOLENOID IS NOT APPROVED BY HALDEX, FIT A 1AMP, 100 VOLT MINIMUM, DIODE AS SHOWN.
N 9 PRESSURE SENSOR CAN BE FITTED TO AUX 4 OR 5
ISO 7638 (EBS/ABS)
ISO 1185 (24N)
ISO 12098 (15 PIN)
TRAILER LIFT AXLE SWITCH CLOSE TO LIFT
AUXILIAR SOLENOID
ACCELEROMETER
PRESSURE SENSOR
RIGHT REAR SENSOR
LEFT REAR SENSOR
RIGHT FRONT SENSOR
LEFT FRONT SENSOR
PC INTERFACE CONNECTOR
THIS DRAWING/SPECIFICATION USES CLASSIFIED CHARACTERISTIC SYMBOLS DEFINED IN QUALITY PROCEDURE 4.17
ISS | CHANGE | CHEC | DATE
7 C6220 GIL 23-05-12
6 C6067 GIL 17-05-11
5 C5927 GIL 28-06-10
4 C5426 CGS 08-08-08
3 C5256 DMS 19-06-07
2 C5167 CGS 26-02-07
1 PR1818 PTC 05-07-06
AutoCAD PART
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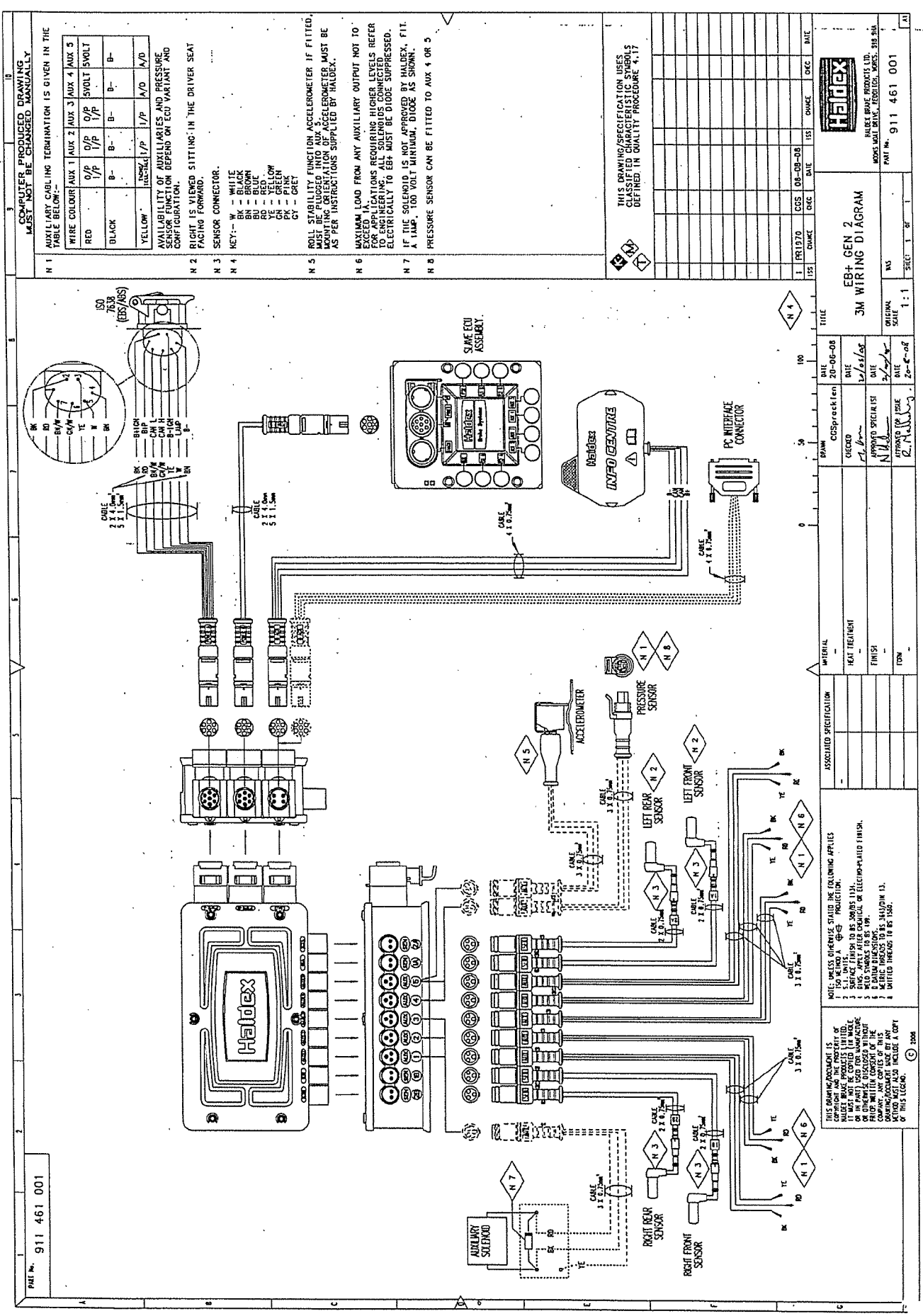
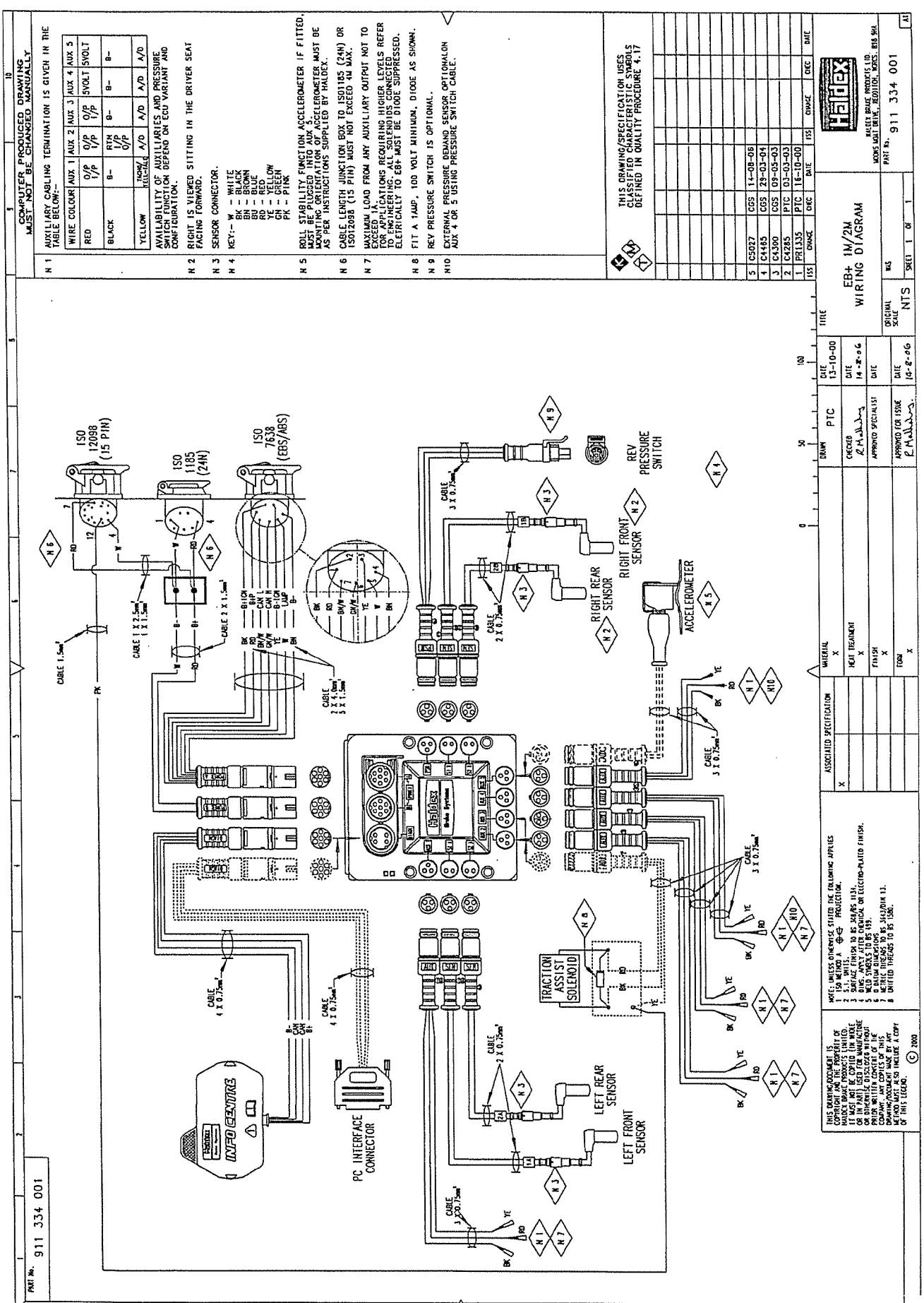
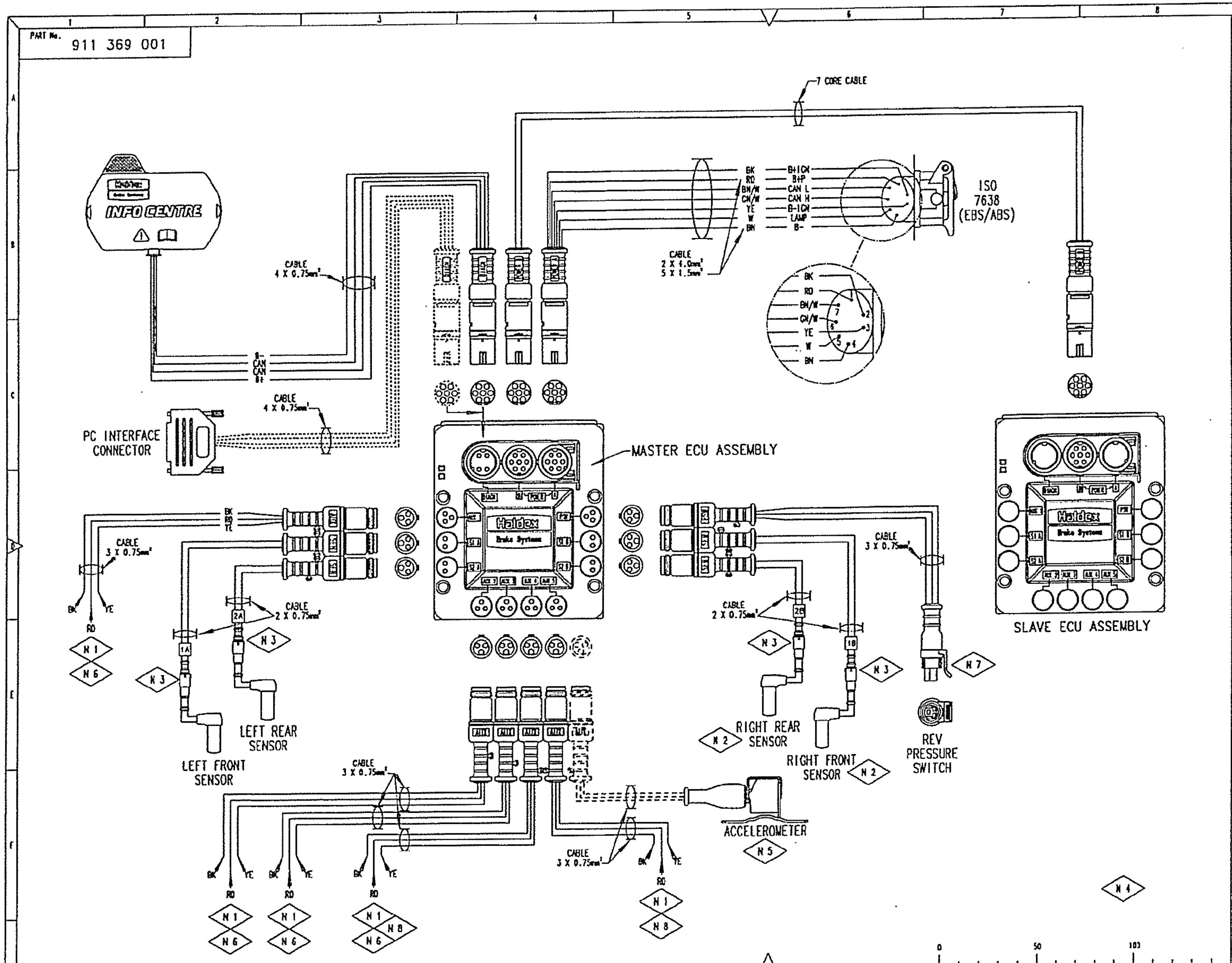
NOTE: UNLESS OTHERWISE STATED THE FOLLOWING APPLIES
1 ISO METHOD A PROJECTION.
2 S.I. UNITS.
3 SURFACE FINISH TO BS 308/BS 1134.
4 DIMS. APPLY AFTER CHEMICAL OR ELECTRO-PLATED FINISH.
5 WELD SYMBOLS TO BS 499.
6 B DATUM DIMENSIONS.
7 METRIC THREADS TO BS 3643/DIN 13.
8 UNIFIED THREADS TO BS 1580.
ASSOCIATED SPECIFICATION
MATERIAL X
HEAT TREATMENT X
FINISH X
FORM WIRING DIAGRAM
DRAWN G LEDINGHAM DATE 28-06-10
CHECKED DATE 29/05/12
APPROVED SPECIALIST JPH DATE 29/05/12
APPROVED FOR ISSUE JPH DATE 29/05/12
TITLE EB+ GEN 2 2M WIRING DIAGRAM
ORIGINAL SCALE 1:1
WAS
SHEET 1 OF 1
Haldex
HALDEX BRAKE PRODUCTS LTD. MOORS MOAT DRIVE, REDDITCH, WORCS. B98 9HA
PART No. 911 440 001
A1


COMPUTER PRODUCED DRAWING
MUST NOT BE CHANGED MANUALLY
AUXILIARY CABLING TERMINATION IS GIVEN IN THE TABLE BELOW:-
WIRE COLOUR | AUX 1 | AUX 2 | AUX 3 | AUX 4 | AUX 5
RED | O/P 1/P | O/P 1/P | O/P 1/P | 5VOLT | 5VOLT
BLACK | B- | B- | B- | B- | B-
YELLOW | TACHO/I/P | I/P | I/P | A/D | A/D
AVAILABILITY OF AUXILIARIES AND PRESSURE SENSOR FUNCTION DEPEND ON ECU VARIANT AND CONFIGURATION.
RIGHT IS VIEWED SITTING IN THE DRIVER SEAT FACING FORWARD.
SENSOR CONNECTOR.
KEY:- W - WHITE
BK - BLACK
BN - BROWN
BU - BLUE
RD - RED
YE - YELLOW
GN - GREEN
PK - PINK
GY - GREY
ROLL STABILITY FUNCTION ACCELEROMETER IF FITTED, MUST BE PLUGGED INTO AUX 5. MOUNTING ORIENTATION OF ACCELEROMETER MUST BE AS PER INSTRUCTIONS SUPPLIED BY HALDEX.
MAXIMUM LOAD FROM ANY AUXILIARY OUTPUT NOT TO EXCEED 1A.
FOR APPLICATIONS REQUIRING HIGHER LEVELS REFER TO APPLICATIONS MANUAL. ALL SOLENOIDS CONNECTED ELECTRICALLY TO 88+ MUST BE DIODE SUPPRESSED.
IF THE SOLENOID IS NOT APPROVED BY HALDEX, FIT A 1.5AMP, 100 VOLT MINIMUM, DIODE AS SHOWN.
PRESSURE SENSOR CAN BE FITTED TO AUX 4 OR 5
THIS DRAWING/SPECIFICATION USES CLASSIFIED CHARACTERISTIC SYMBOLS DEFINED IN QUALITY PROCEDURE 4.17
EB+ GEN 2
3M WIRING DIAGRAM
PART No. 911 461 001
ISO 7638 (EBS/ABS)
SLAVE ECU ASSEMBLY
INFO CENTRE
PC INTERFACE CONNECTOR
ACCELEROMETER
PRESSURE SENSOR
LEFT REAR SENSOR
LEFT FRONT SENSOR
RIGHT REAR SENSOR
RIGHT FRONT SENSOR
AUXILIARY SOLENOID
Haldex
HALDEX BRAKE PRODUCTS LTD.
WORKS MOAT DRIVE, KEIGHLEY, WEST YORKSHIRE, BD21 5HA


COMPUTER PRODUCED DRAWING
MUST NOT BE CHANGED MANUALLY
PART No. 911 334 001
ISO 12098 (15 PIN)
ISO 1185 (24N)
ISO 7638 (EBS/ABS)
INFO CENTRE
PC INTERFACE CONNECTOR
LEFT REAR SENSOR
LEFT FRONT SENSOR
RIGHT REAR SENSOR
RIGHT FRONT SENSOR
REV PRESSURE SWITCH
ACCELEROMETER
TRACTION ASSIST SOLENOID
EB+ 1M/2M
WIRING DIAGRAM
WABCO BRAKE PRODUCTS LTD
PART No. 911 334 001

PART No. 911 369 001



COMPUTER PRODUCED DRAWING MUST NOT BE CHANGED MANUALLY

N 1 AUXILIARY CABLING TERMINATION IS GIVEN IN THE TABLE BELOW:-

WIRE COLOUR	AUX 1	AUX 2	AUX 3	AUX 4	AUX 5
RED	O/P I/P	O/P I/P	O/P I/P	5VOLT	5VOLT
BLACK	B-	RTN I/P O/P	B-	B-	B-
YELLOW	TACHO/ TELL-TALE	A/D	A/D	A/D	A/D

AVAILABILITY OF AUXILIARIES AND PRESSURE SWITCH FUNCTION DEPEND ON ECU VARIANT AND CONFIGURATION.

N 2 RIGHT IS VIEWED SITTING IN THE DRIVER SEAT FACING FORWARD.

N 3 SENSOR CONNECTOR.

N 4 KEY:- W - WHITE
BK - BLACK
BN - BROWN
BU - BLUE
RD - RED
YE - YELLOW
GN - GREEN

N 5 ROLL STABILITY FUNCTION ACCELEROMETER IF FITTED, MUST BE PLUGGED INTO AUX 5. MOUNTING ORIENTATION OF ACCELEROMETER MUST BE AS PER INSTRUCTIONS SUPPLIED BY HALDEX.

N 6 MAXIMUM LOAD FROM ANY AUXILIARY OUTPUT NOT TO EXCEED 1A. FOR APPLICATIONS REQUIRING HIGHER LEVELS REFER TO ENGINEERING. ALL SOLENOIDS CONNECTED ELECTRICALLY TO EB+ MUST BE DIODE SUPPRESSED.

N 7 REV PRESSURE SWITCH IS OPTIONAL.

N 8 EXTERNAL PRESSURE DEMAND SENSOR OPTION ON AUX 4 OR 5 USING PRESSURE SWITCH CABLE.

THIS DRAWING/SPECIFICATION USES CLASSIFIED CHARACTERISTIC SYMBOLS DEFINED IN QUALITY PROCEDURE 4.17

ISS	CHANGE	CHEC	DATE	ISS	CHANGE	CHEC	DATE
4	C5028	CGS	14-08-06				
3	C4465	CGS	29-03-04				
2	C4300	CGS	09-05-03				
1	PR1489	PTC	05-02-03				

NOTE: UNLESS OTHERWISE STATED THE FOLLOWING APPLIES
1 ISO METHOD A PROJECTION.
2 S.I. UNITS.
3 SURFACE FINISH TO BS 308/BS 1134.
4 DIMS. APPLY AFTER CHEMICAL OR ELECTRO-PLATED FINISH.
5 WELD SYMBOLS TO BS 499.
6 D DATUM DIMENSIONS.
7 METRIC THREADS TO BS 3643/DIN 13.
8 UNIFIED THREADS TO BS 1580.

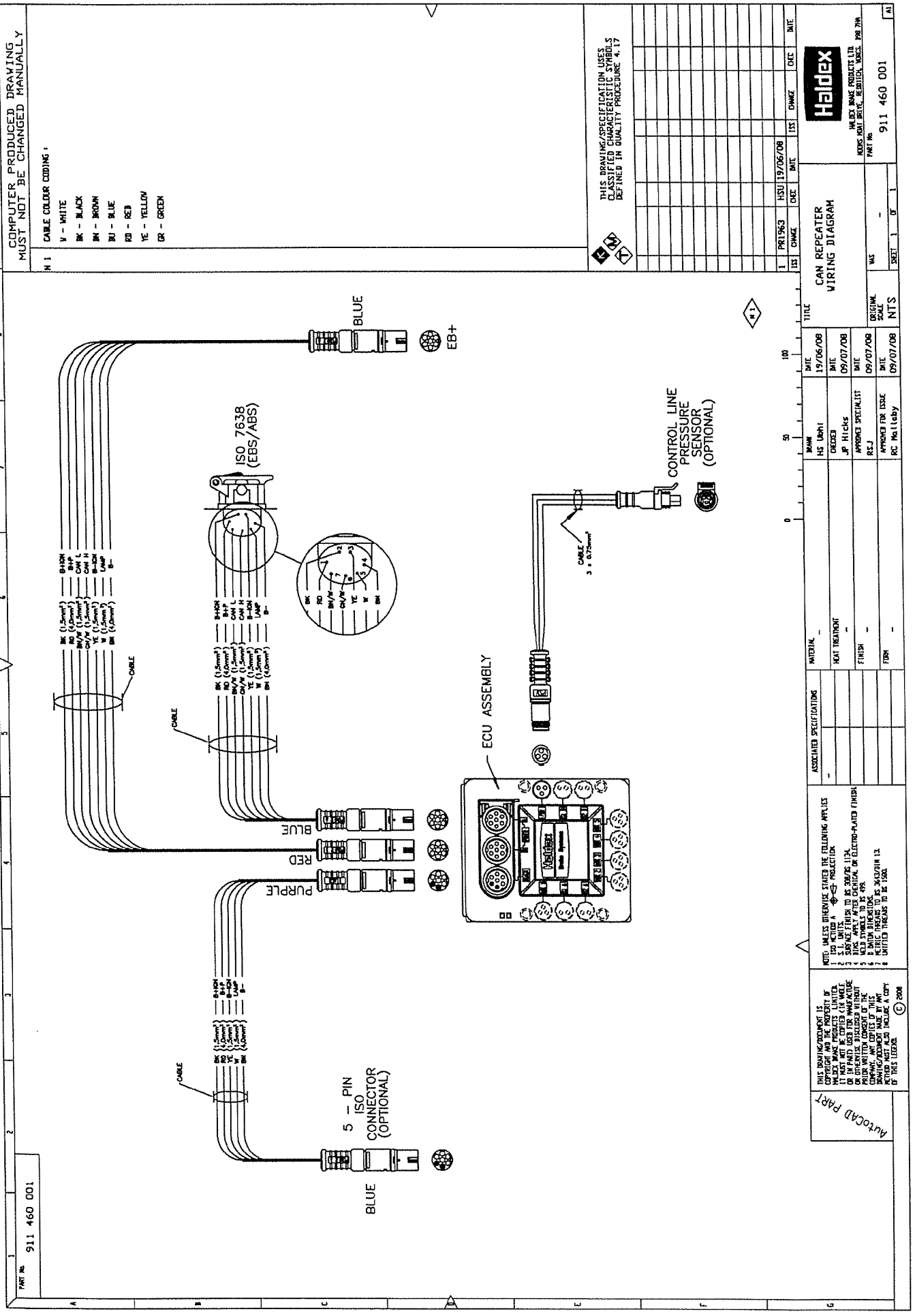
ASSOCIATED SPECIFICATION	MATERIAL	DRAWN	DATE
X	X	PTC	05-02-03
	HEAT TREATMENT X	CHECKED R Mallaby.	14-8-06
	FINISH X	APPROVED SPECIALIST	DATE
	FORM X	APPROVED FOR ISSUE R. Mallaby.	14-8-06

TITLE: EB+ 3M WIRING DIAGRAM

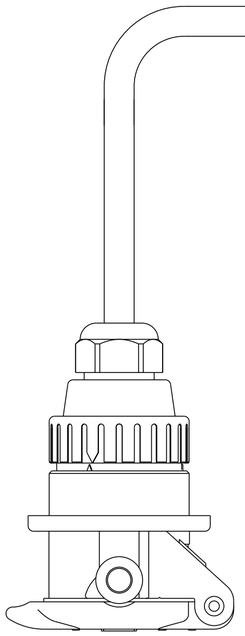
ORIGINAL SCALE 1:1 — WAS — SHEET 1 OF 1

Haldex — HALDEX BRAKE PRODUCTS LTD. MOONS MOAT DRIVE, REDDITCH, WORCS. B98 9HA

PART No. 911 369 001 — A1

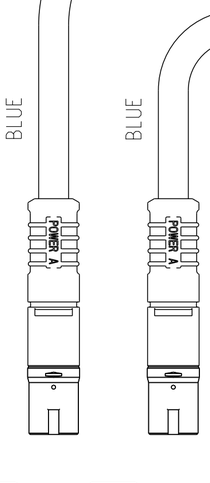

COMPUTER PRODUCED DRAWING
MUST NOT BE CHANGED MANUALLY
CABLE COLOUR CODING :
W - WHITE
BK - BLACK
BN - BROWN
BU - BLUE
RD - RED
YE - YELLOW
GR - GREEN
THIS DRAWING/SPECIFICATION USES CLASSIFIED CHARACTERISTIC SYMBOLS DEFINED IN QUALITY PROCEDURE 4.17
CAN REPEATER WIRING DIAGRAM
Haldex
911 460 001
ISO 7638 (EBS/ABS)
BLUE
EB+
CONTROL LINE PRESSURE SENSOR (OPTIONAL)
ECU ASSEMBLY
RED
PURPLE
5 - PIN ISO CONNECTOR (OPTIONAL)
BLUE
CABLE
ASSOCIATED SPECIFICATIONS
MATERIAL
HEAT TREATMENT
FINISH
DRAWN
HS Ubahi
CHECKED
JP Hicks
APPROVED SPECIALIST
RSJ
APPROVED FOR ISSUE
RC Malleby
DATE
19/06/08
09/07/08
09/07/08
09/07/08
ORIGINAL SCALE
NTS
SHEET 1 OF 1
AutoCAD PART

REV	CHANGE DESCRIPTION AND ORDER NUMBER	DATE	CHANGED	CHECKED	APPROVED
0	PR2209 - INITIAL RELEASE	20180613	FIELD	HOLDE	AK

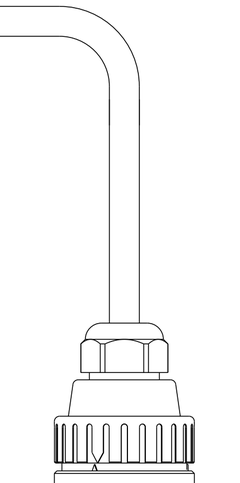


ISO 7638
(TOWED)

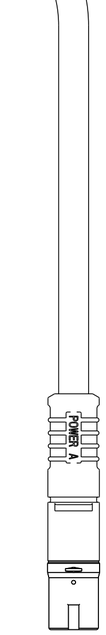
ALL PLUGS CAN BE INSERTED IN TO ANY SOCKET



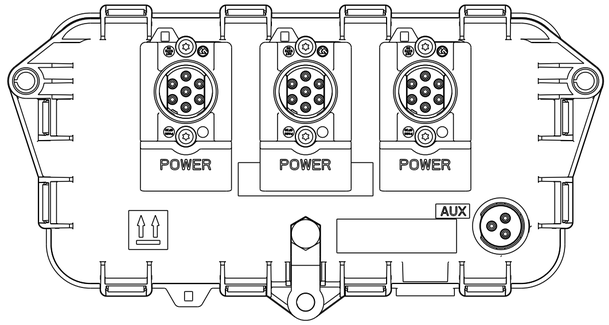
PIN	COLOUR	SIZE	FUNCTION
1	RED	4.0mm^2	B+P
2	BLACK	1.5mm^2	B+IGN
3	YELLOW	1.5mm^2	B-IGN
4	BROWN	4.0mm^2	B-
5	WHITE	1.5mm^2	LAMP
6	GREEN/WHITE	1.5mm^2	CAN H
7	BROWN/WHITE	1.5mm^2	CAN L



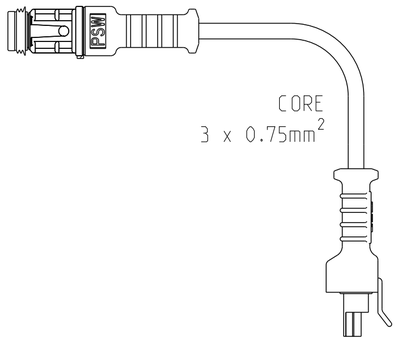
ISO 7638
(TOWING)



LOCAL EB+ ECU

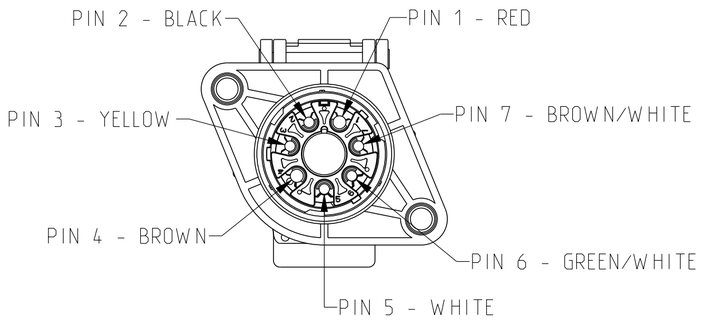


ECU ASSEMBLY



CORE
3 x 0.75mm^2

CONTROL LINE
PRESSURE SENSOR
(OPTIONAL)

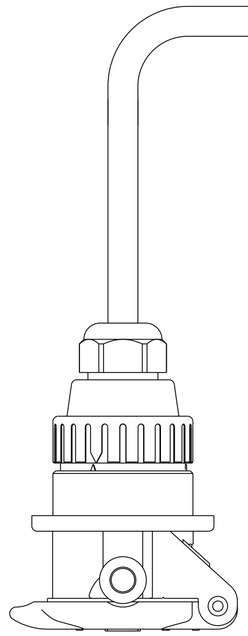


REAR VIEW OF
ISO 7638 SOCKET

TOLERANCES UNLESS OTHERWISE SPECIFIED: N/A	DOC TYPE: ASSEM	SCALE: NTS	MATERIAL: N/A
THIS DOCUMENT USES SPECIAL CHARACTERISTICS AS DEFINED IN PROCEDURE HDX2-3-364	DRAWN: FIELD	DATE: 20180613	WEIGHT [ONLY FOR INFO.]: - / DIMENSION IN: DO NOT SCALE DRAWING
Haldex HALDEX BRAKE PRODUCTS LTD MIRA TECHNOLOGY PARK	CHECKED: HOLDE	DATE: 20180619	TITLE: CAN HUB (ROUTER) WIRING DIAGRAM
	APPROVED: AK	DATE: 18/06/20	ITEM NUMBER: 911_552_001 / PROJECTION / SHEET: 1(1) / FORMAT: A2
			GENERIC MODEL (INFO ONLY): 911_552_001

R13 190533

REV	CHANGE DESCRIPTION AND ORDER NUMBER	DATE	CHANGED	CHECKED	APPROVED
0	PR2209 - INITIAL RELEASE	20180613	FIELD	HOLDE	AK

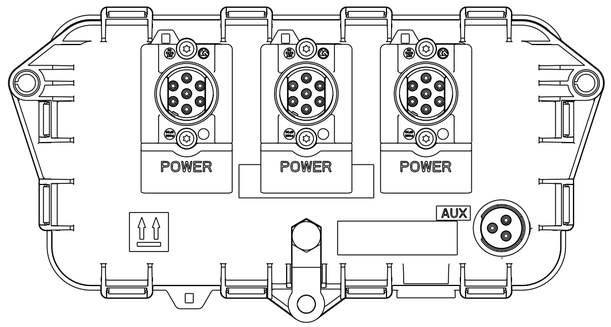


ISO 7638
(TOWED)

BLUE

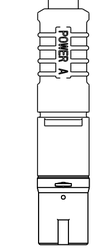
BLUE

ALL PLUGS CAN BE
INSERTED IN TO
ANY SOCKET

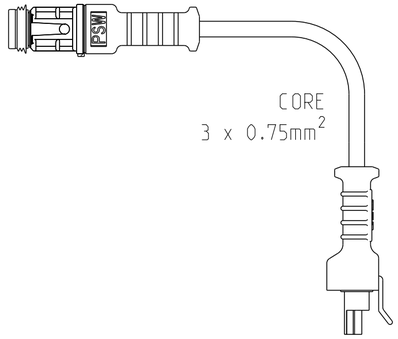


ECU ASSEMBLY

PIN	COLOUR	SIZE	FUNCTION
1	RED	4.0mm^2	B+P
2	BLACK	1.5mm^2	B+IGN
3	YELLOW	1.5mm^2	B-IGN
4	BROWN	4.0mm^2	B-
5	WHITE	1.5mm^2	LAMP
6	GREEN/WHITE	1.5mm^2	CAN H
7	BROWN/WHITE	1.5mm^2	CAN L

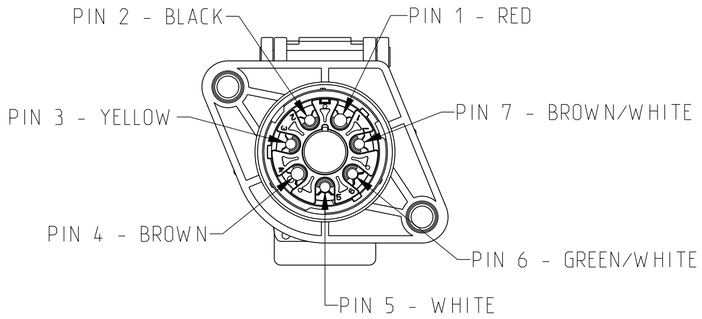


LOCAL EB+ ECU



CORE
3 x 0.75mm^2

CONTROL LINE
PRESSURE SENSOR
(OPTIONAL)



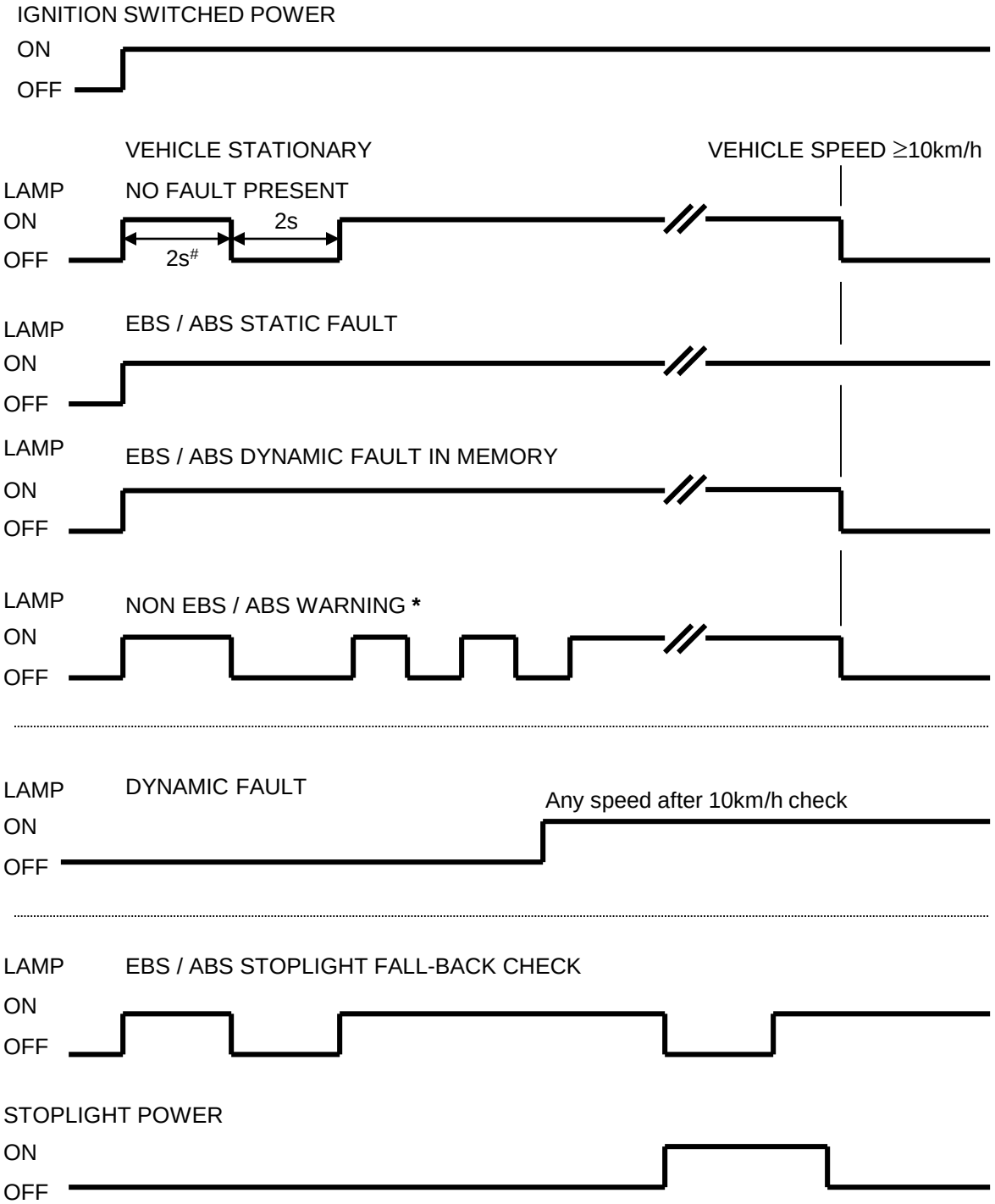
REAR VIEW OF
ISO 7638 SOCKET

TOLERANCES UNLESS OTHERWISE SPECIFIED: N/A	DOC TYPE: ASSEM	SCALE: NTS	MATERIAL: N/A
THIS DOCUMENT USES SPECIAL CHARACTERISTICS AS DEFINED IN PROCEDURE HDX2-3-364	DRAWN: FIELD	DATE: 20180613	WEIGHT [ONLY FOR INFO.]: - / DIMENSION IN: DO NOT SCALE DRAWING
Haldex HALDEX BRAKE PRODUCTS LTD MIRA TECHNOLOGY PARK	CHECKED: HOLDE	DATE: 20180619	TITLE: CAN HUB (REPEATER) WIRING DIAGRAM
	APPROVED: AK	DATE: 18/06/20	ITEM NUMBER: 911_553_001 / PROJECTION / SHEET: 1(1) / FORMAT: A2
			GENERIC MODEL (INFO ONLY): 911_553_001

R13 190533

EB+ Warning Signal - Default Operation

Option 'A'



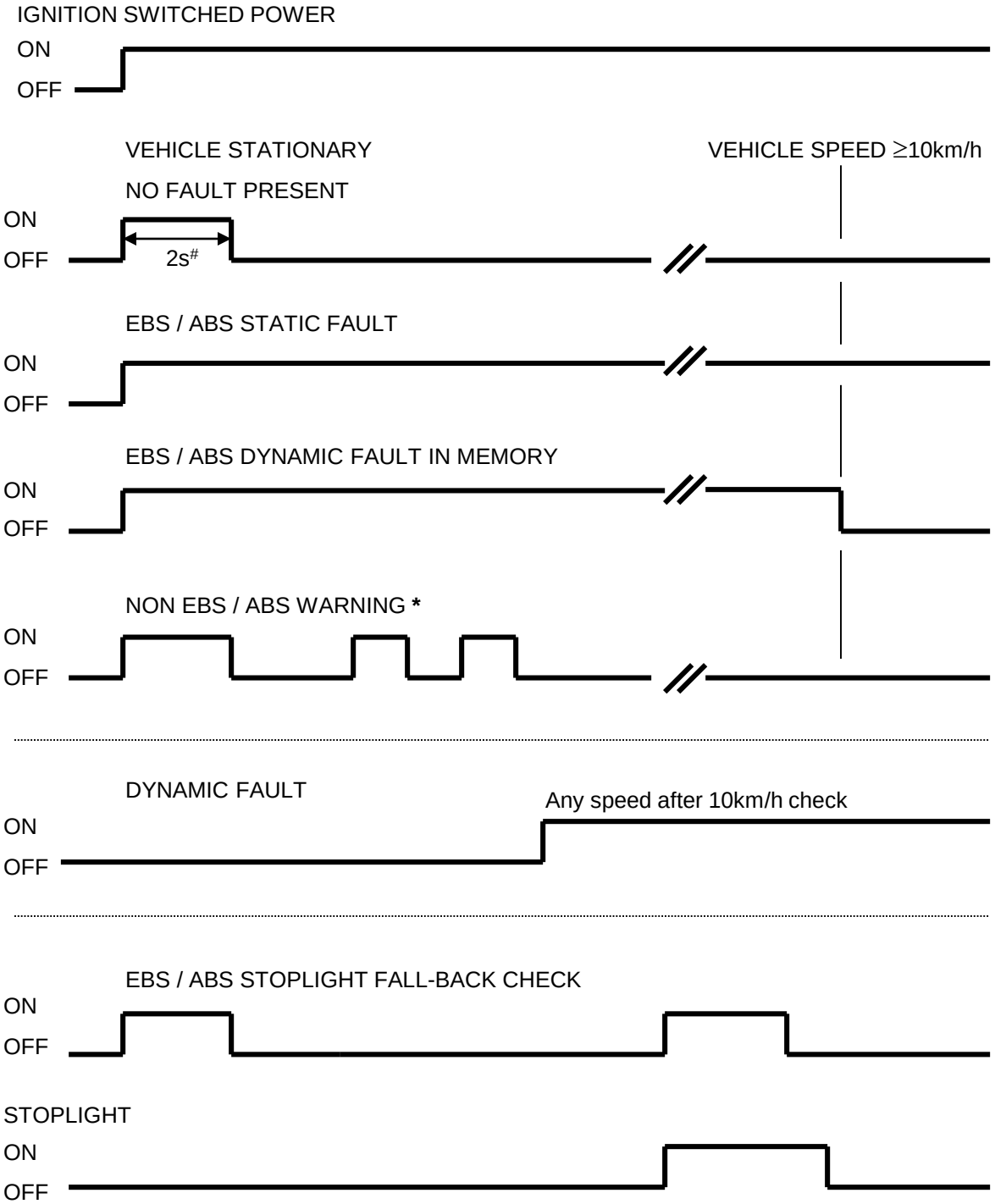
R13 190533

* = E.g. AUX Fault, Service Warning. Flashes may optionally be only 2 or continuous until vehicle reaches 10 kph.

= Default, 2s but may be set up to 5s using diagnostic link.

EB+ Warning Signal - Default Operation

Option 'B'



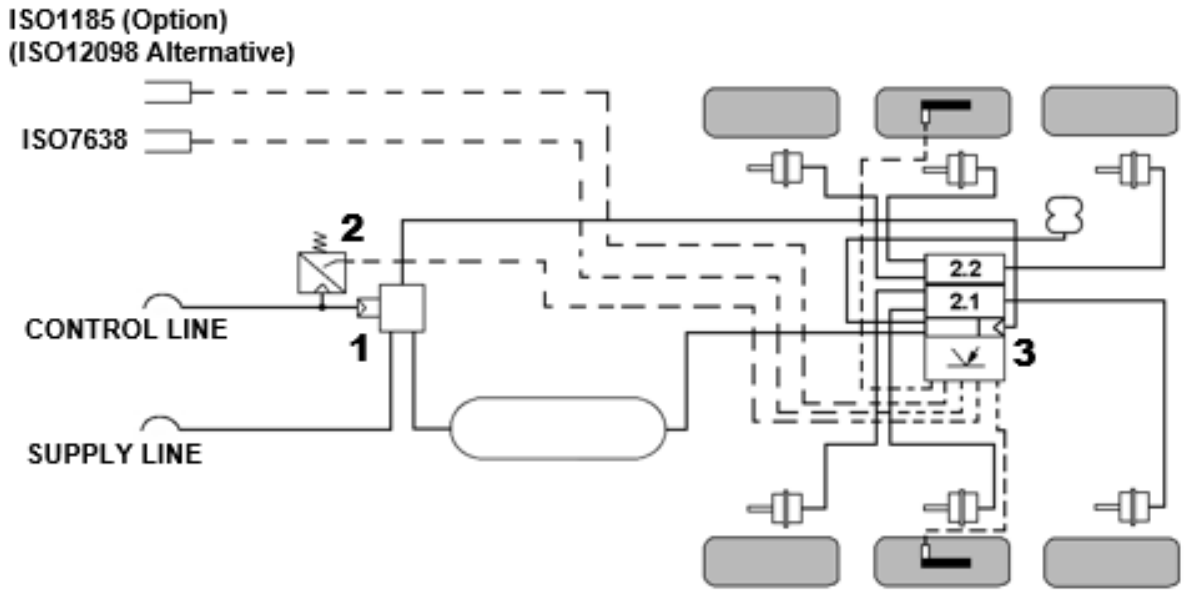
R13 190533

* = E.g. AUX Fault, Service Warning. Flashes may optionally be only 2 or continuous until vehicle reaches 10 kph.

= Default, 2s but may be set up to 5s using diagnostic link.

EB+ Gen 1 & EB+ Gen 2/Gen 3 Brake System Installation Schematics

2S/2M Integrated Semi or Centre Axle Trailer Installation
Side by Side Installation

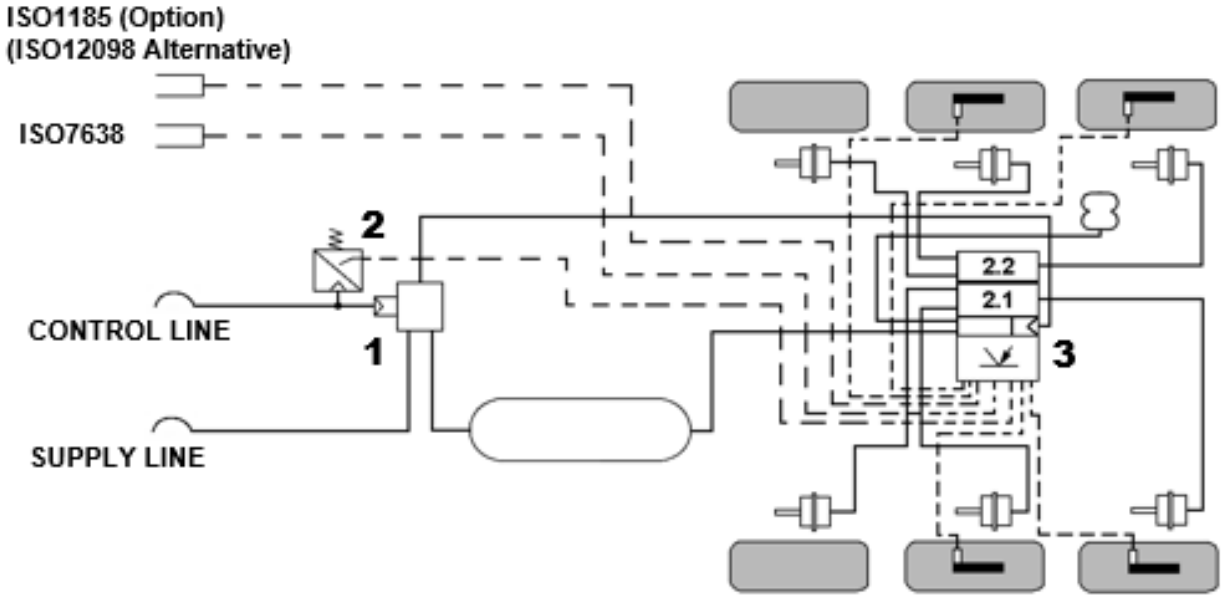


KEY:

1 - Emergency Relay Valve
2 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option)
or in case of EB+ Gen2/Gen3 Pressure Sensor (Option)
3 - EBS Modulators & Electronic Control Unit

EB+ Gen 1 & EB+ Gen 2/Gen 3 Brake System Installation Schematics

4S/2M Integrated Semi or Centre Axle Trailer Installation
Side by Side Installation

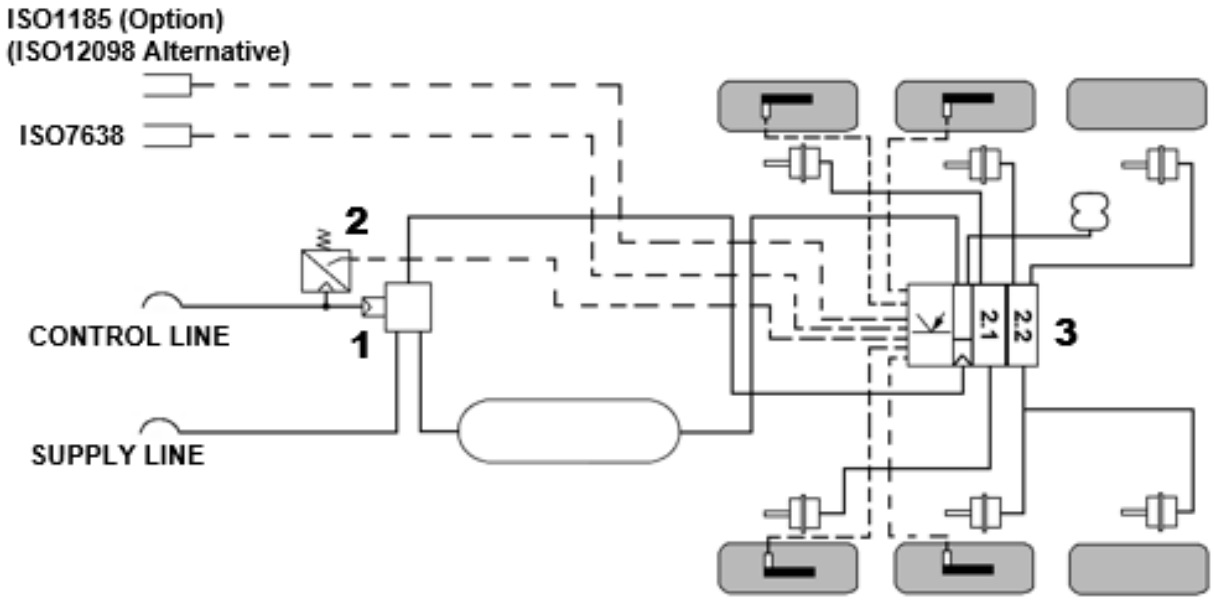


KEY:

1 - Emergency Relay Valve
2 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option)
or in case of EB+ Gen2/Gen3 Pressure Sensor (Option)
3 - EBS Modulators & Electronic Control Unit

EB+ Gen 1 & EB+ Gen 2/Gen 3 Brake System Installation Schematics

4S/2M Integrated Semi or Centre Axle Trailer
Axle by Axle Installation



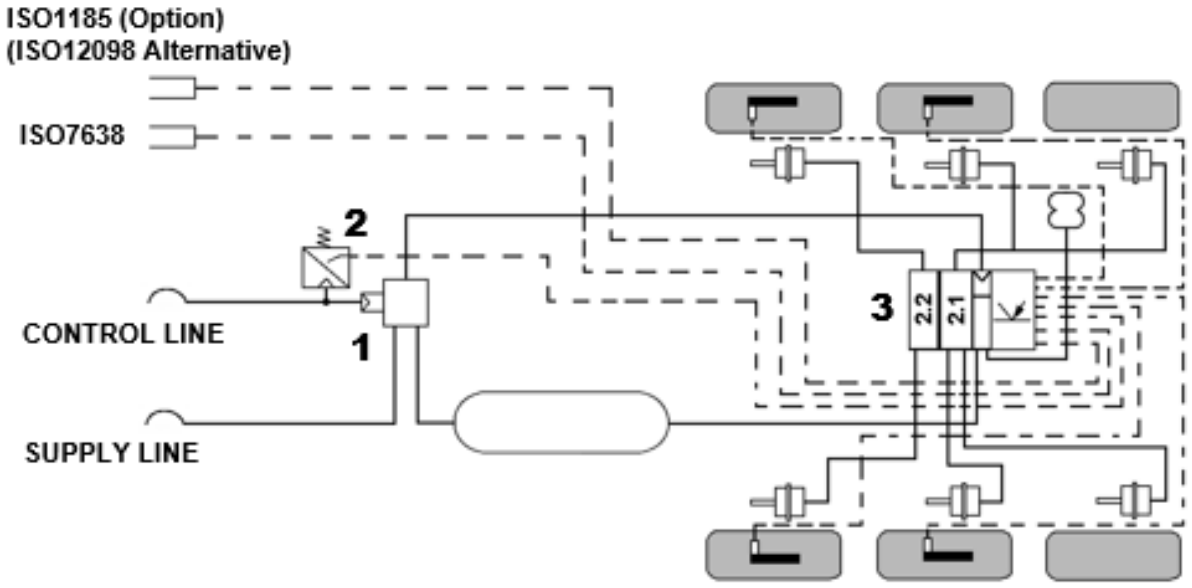
KEY:

1 - Emergency Relay Valve
2 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option)
or in case of EB+ Gen2/Gen3 Pressure Sensor (Option)
3 - EBS Modulators & Electronic Control Unit

EB+ Gen 1 & EB+ Gen 2/Gen 3 Brake System Installation Schematics

4S/2M Integrated Semi or Centre Axle Trailer

Axle by Axle Installation



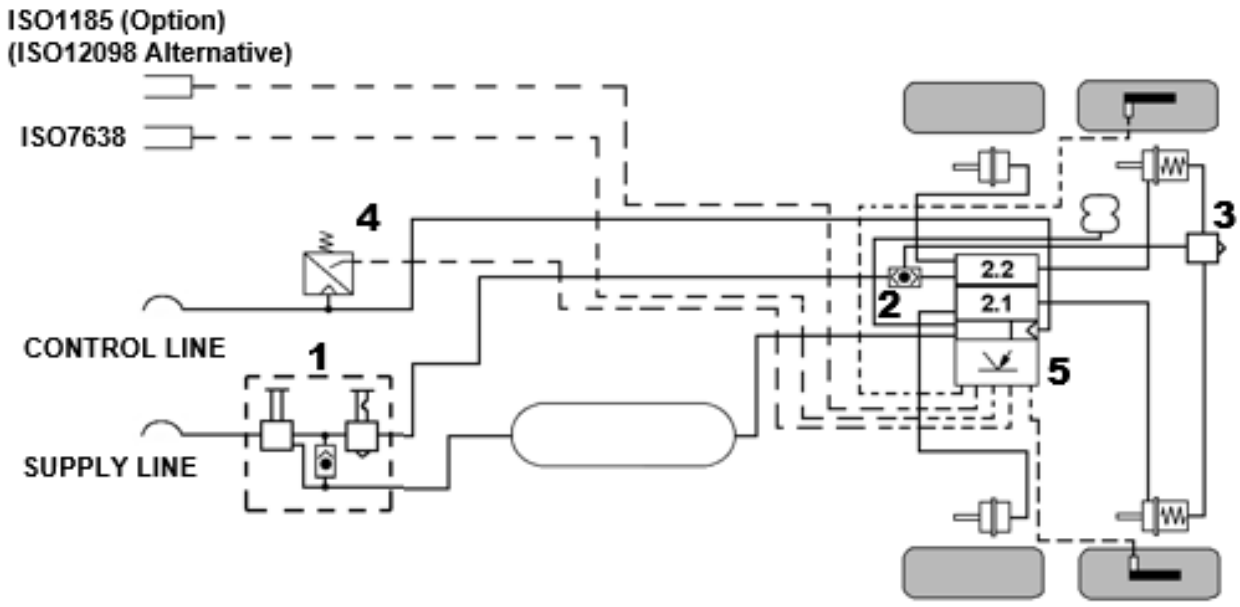
KEY:

1 - Emergency Relay Valve
2 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option)
or in case of EB+ Gen2/Gen3 Pressure Sensor (Option)
3 - EBS Modulators & Electronic Control Unit

EB+ Gen 1 & EB+ Gen 2/Gen 3 Brake System Installation Schematics

2S/2M Integrated Semi or Centre Axle Trailer Installation

Side by Side Installation

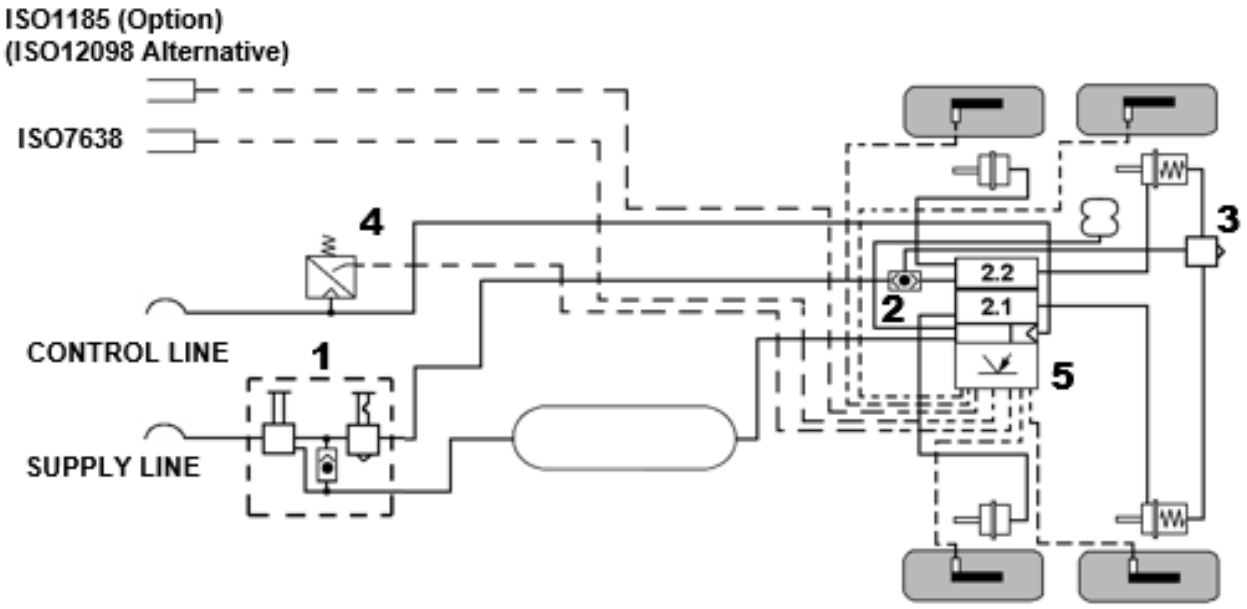


KEY:

1 - Combined Park & Shunt Valve (352 046 …)
2 - Double Check Valve
3 - Quick Release Valve
4 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option)
or in case of EB+ Gen2/Gen3 Pressure Sensor (Option)
5 - EBS Modulators & Electronic Control Unit

EB+ Gen 1 & EB+ Gen 2/Gen 3 Brake System Installation Schematics

4S/2M Integrated Semi or Centre Axle Trailer Installation
Side by Side Installation



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1 - Combined Park & Shunt Valve (352 046 ...)
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3 - Quick Release Valve
4 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option)
or in case of EB+ Gen2/Gen3 Pressure Sensor (Option)
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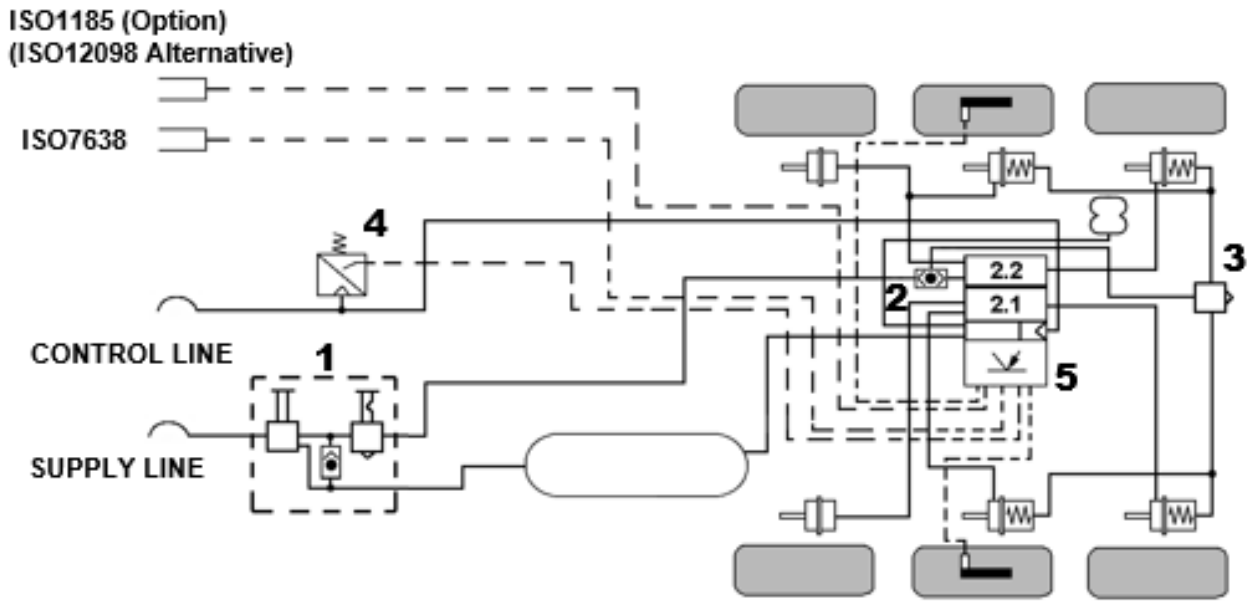
EB+ Gen 1 & EB+ Gen 2/Gen 3 Brake System Installation Schematics

2S/2M Integrated Semi or Centre Axle Trailer Installation
Side by Side Installation



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3 - Quick Release Valve
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or in case of EB+ Gen2/Gen3 Pressure Sensor (Option)
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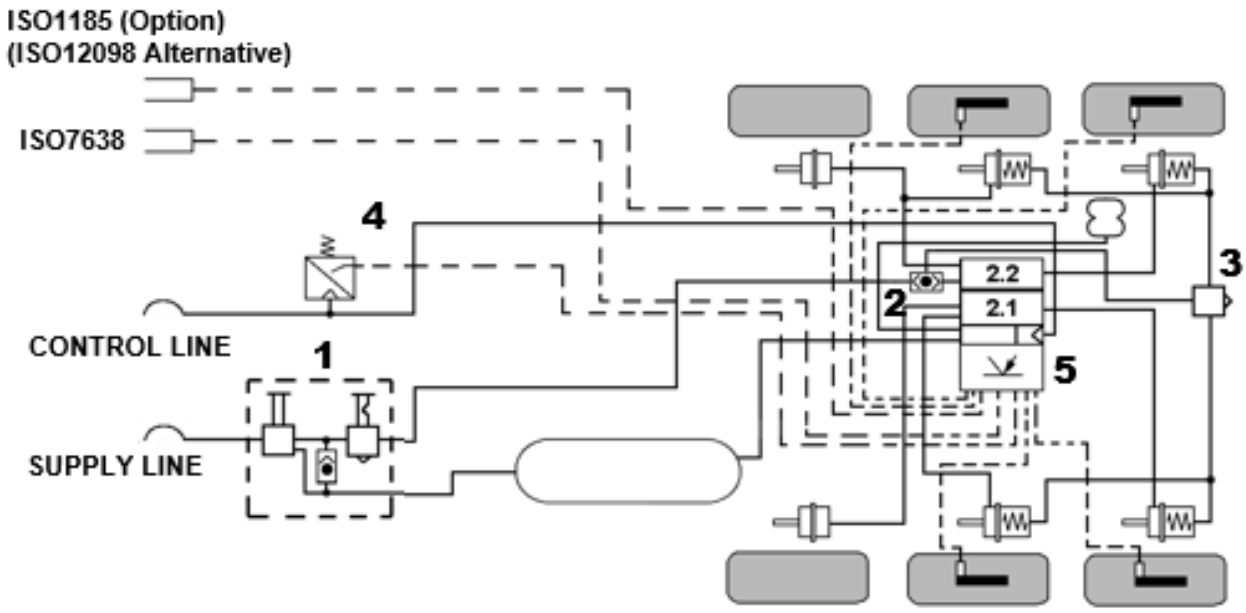
EB+ Gen 1 & EB+ Gen 2/Gen 3 Brake System Installation Schematics

4S/2M Integrated Semi or Centre Axle Trailer Installation
Side by Side Installation



KEY:

1 - Combined Park & Shunt Valve (352 046 ...)
2 - Double Check Valve
3 - Quick Release Valve
4 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option)
or in case of EB+ Gen2/Gen3 Pressure Sensor (Option)
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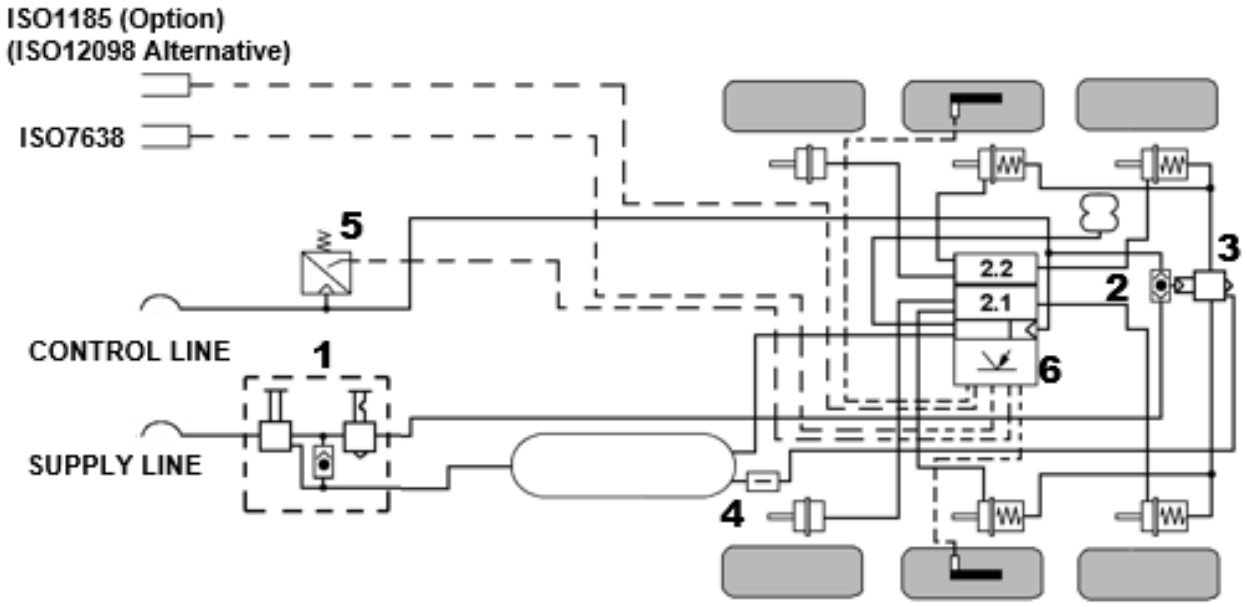
EB+ Gen 1 & EB+ Gen 2/Gen 3 Brake System Installation Schematics

2S/2M Integrated Semi or Centre Axle Trailer Installation

Side by Side Installation

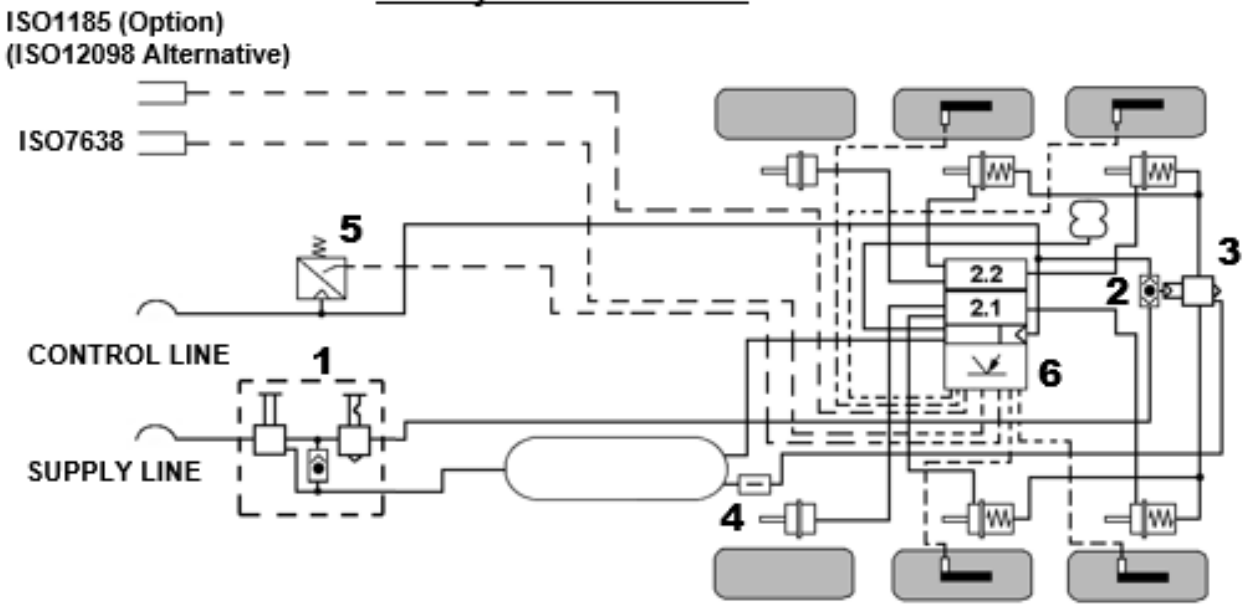


KEY:

1 - Combined Park & Shunt Valve (352 046 ...)
2 - Double Check Valve
3 - Relay Valve
4 - Pressure Protection Valve
5 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option)
or in case of EB+ Gen2/Gen3 Pressure Sensor (Option)
6 - EBS Modulators & Electronic Control Unit

EB+ Gen 1 & EB+ Gen 2/Gen 3 Brake System Installation Schematics

4S/2M Integrated Semi or Centre Axle Trailer Installation Side by Side Installation



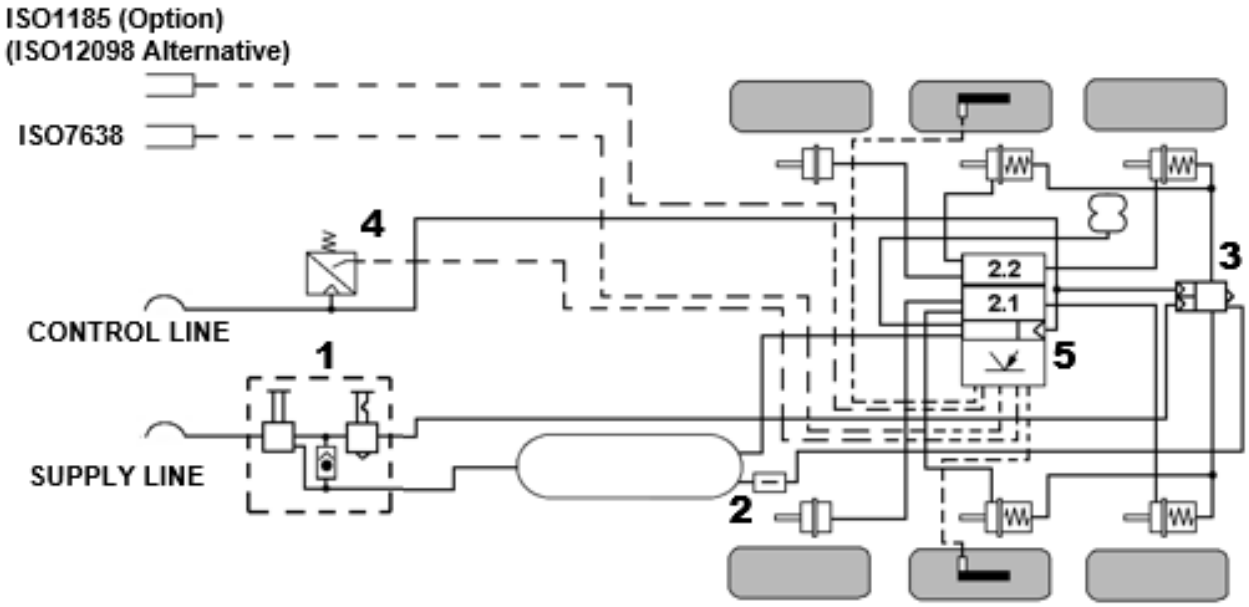
KEY:

1 - Combined Park & Shunt Valve (352 046 ...)
2 - Double Check Valve
3 - Relay Valve
4 - Pressure Protection Valve
5 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option)
or in case of EB+ Gen2/Gen3 Pressure Sensor (Option)
6 - EBS Modulators & Electronic Control Unit

EB+ Gen 1 & EB+ Gen 2/Gen 3 Brake System Installation Schematics

2S/2M Integrated Semi or Centre Axle Trailer Installation

Side by Side Installation

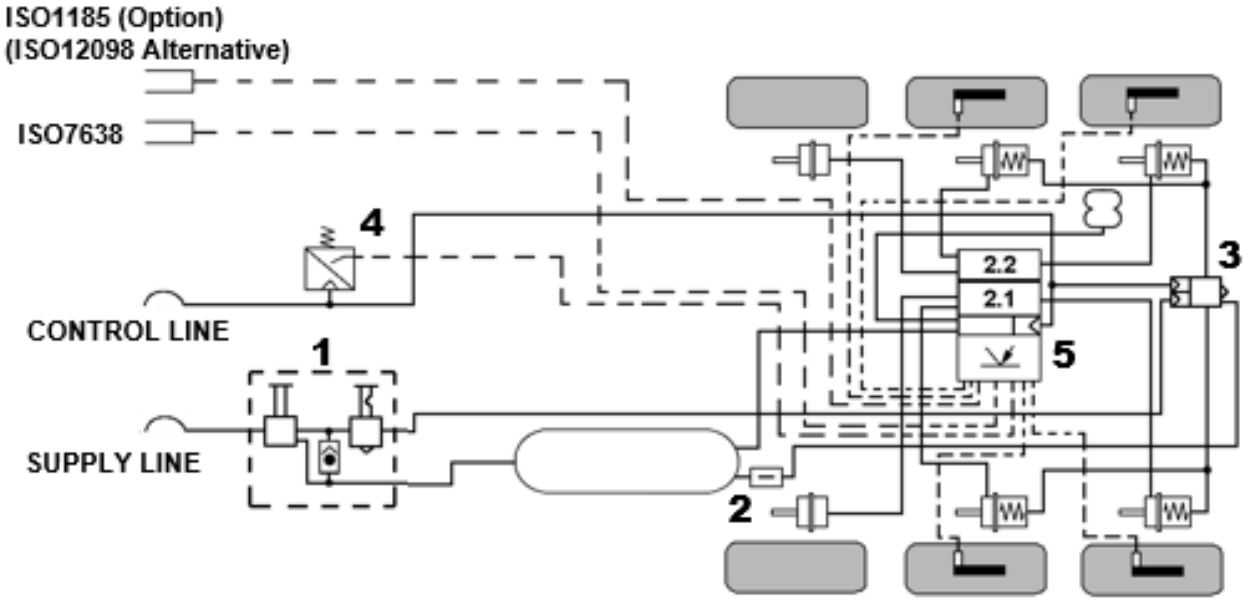


KEY:

1 - Combined Park & Shunt Valve (352 046 ...)
2 - Pressure Protection Valve
3 - Double pilot Relay Valve
4 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option)
or in case of EB+ Gen2/Gen3 Pressure Sensor (Option)
5 - EBS Modulators & Electronic Control Unit

EB+ Gen 1 & EB+ Gen 2/Gen 3 Brake System Installation Schematics

4S/2M Integrated Semi or Centre Axle Trailer Installation
Side by Side Installation

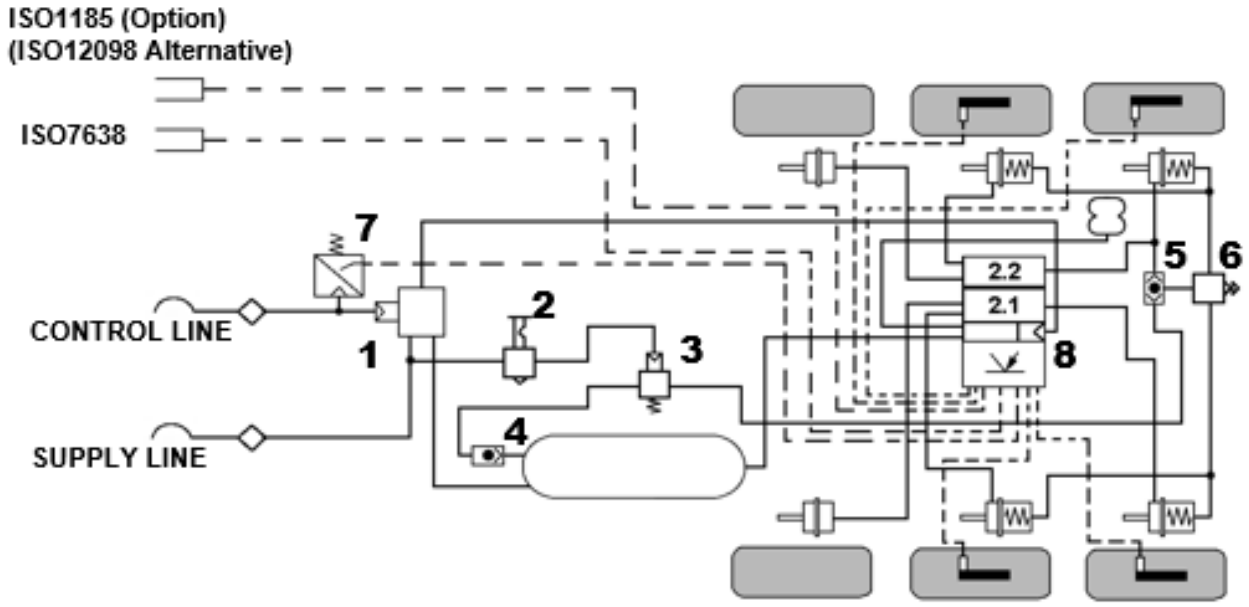


KEY:

1 - Combined Park & Shunt Valve (352 046 ...)
2 - Pressure Protection Valve
3 - Double pilot Relay Valve
4 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option)
or in case of EB+ Gen2/Gen3 Pressure Sensor (Option)
5 - EBS Modulators & Electronic Control Unit

EB+ Gen 1 & EB+ Gen 2/Gen 3 Brake System Installation Schematics

4S/2M Integrated Semi or Centre Axle Trailer Installation
Side by Side Installation



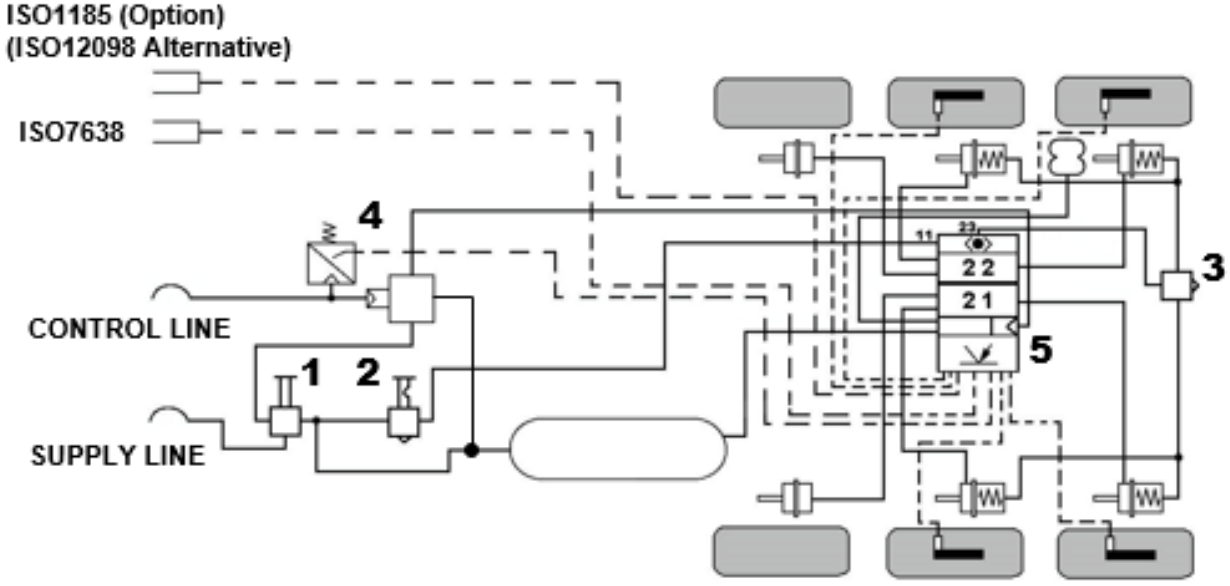
KEY:

1 - Relay Emergency Valve
2 - Park Valve
3 - 3/2 way valve
4 - Single Check Valve
5 - Double Check Valve
6 - Quick release Valve
7 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option)
or in case of EB+ Gen2/Gen3 Pressure Sensor (Option)
8 - EBS Modulators & Electronic Control Unit

EB+ Gen 1 & EB+ Gen 2/Gen 3 Brake System Installation Schematics

4S/2M Integrated Semi or Centre Axle Trailer Installation

EB+ with Integrated double check valve



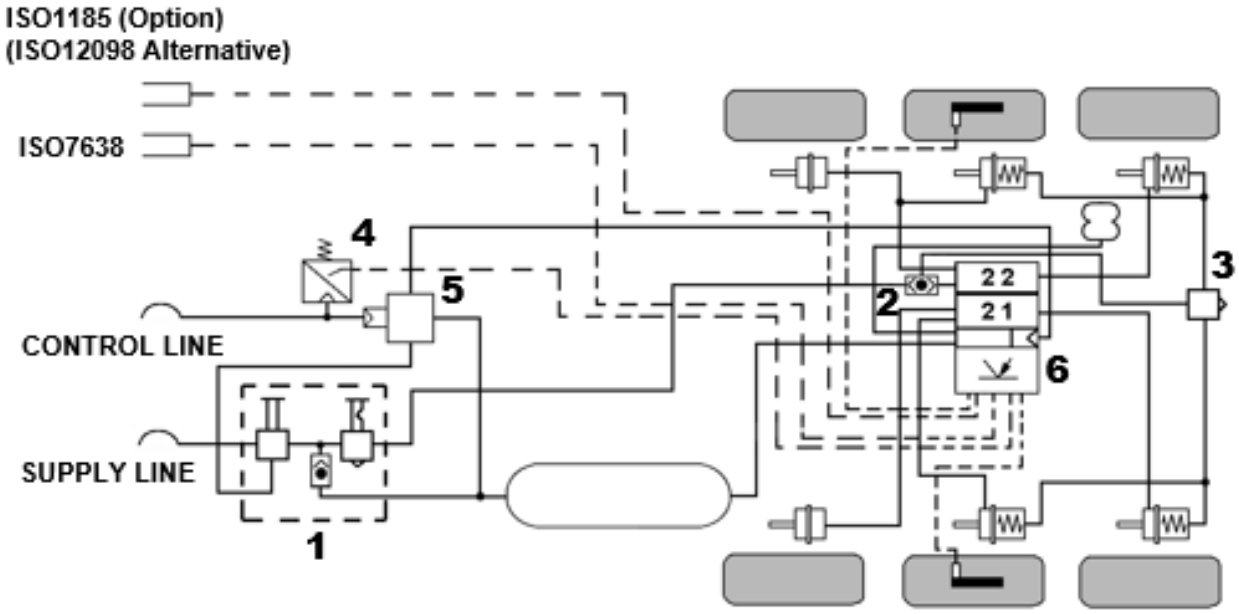
KEY:

1 - Shunt Valve
2 - Park Valve
3 - Quick Release Valve
4 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option)
or in case of EB+ Gen2/Gen3 Pressure Sensor (Option)
5 - EBS Modulators & Electronic Control Unit with Integrated Double Check Valve

EB+ Gen 1 & EB+ Gen 2/Gen 3 Brake System Installation Schematics

2S/2M Integrated Semi or Centre Axle Trailer Installation

Side by Side Installation

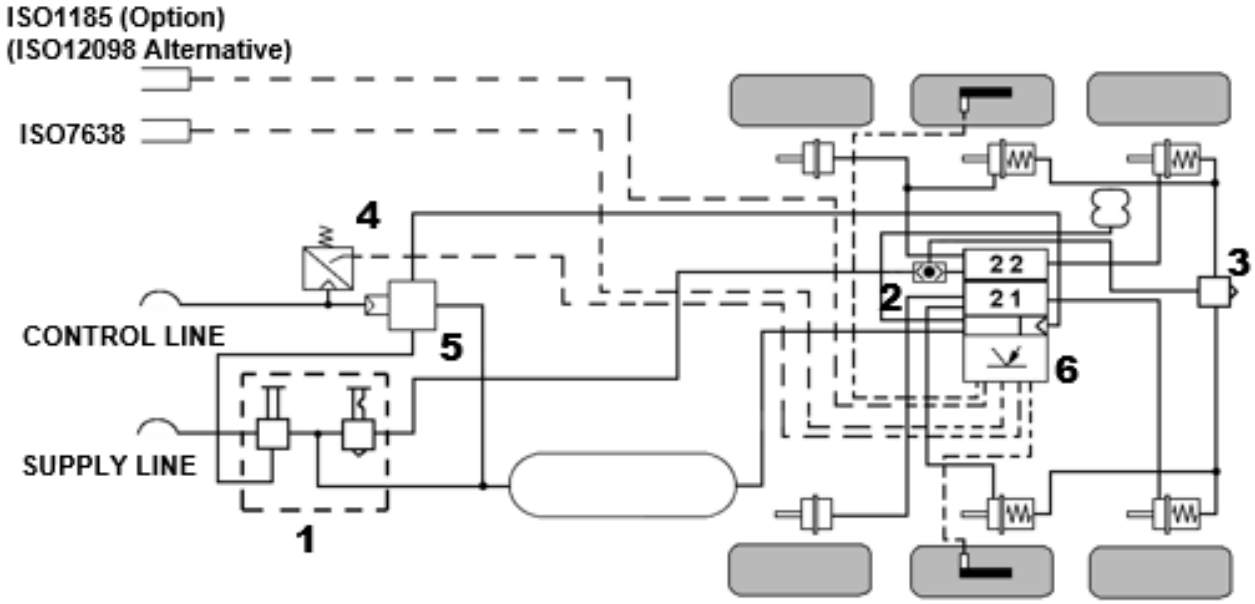


KEY:

1 - Combined Park & Shunt Valve (352 045 ...)
2 - Double Check
3 - Quick Release Valve
4 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option)
or in case of EB+ Gen2/Gen3 Pressure Sensor (Option)
5 - Relay Emergency Valve
6 - EBS Modulators & Electronic Control Unit

EB+ Gen 1 & EB+ Gen 2/Gen 3 Brake System Installation Schematics

2S/2M Integrated Semi or Centre Axle Trailer Installation
Side by Side Installation



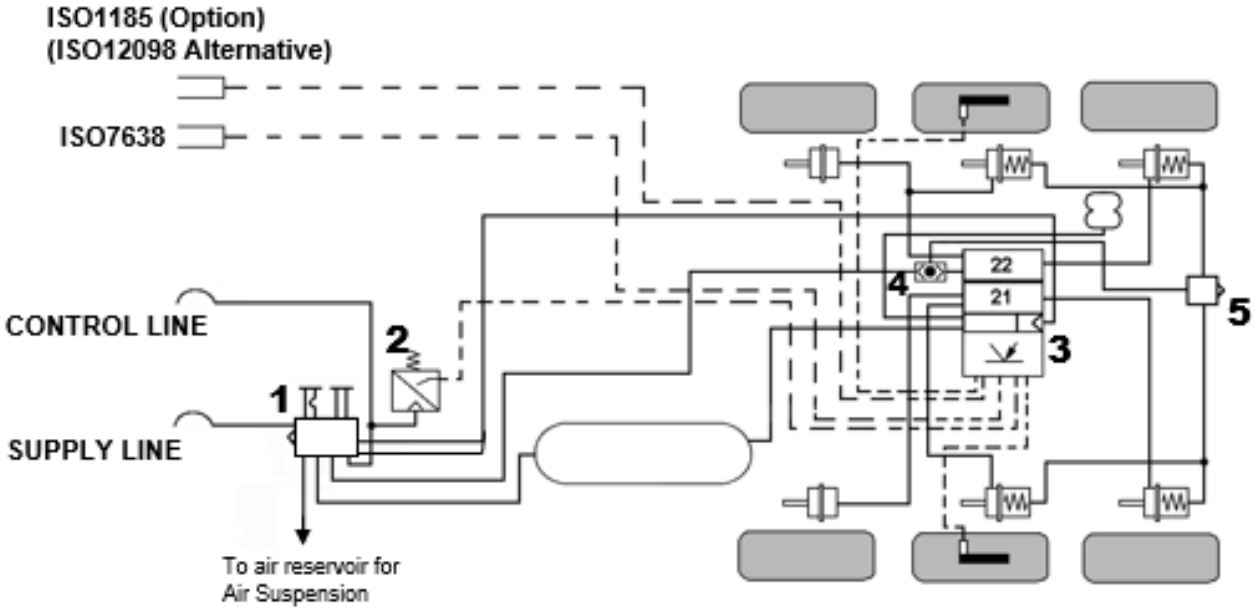
KEY:

1 - Combined Park & Shunt Valve (352 044 ...)
2 - Double Check Valve
3 - Quick Release Valve
4 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option)
or in case of EB+ Gen2/Gen3 Pressure Sensor (Option)
5 - Relay Emergency Valve
6 - EBS Modulators & Electronic Control Unit

EB+ Gen 1 & EB+ Gen 2/Gen 3 Brake System Installation Schematics

2S/2M Semi or Centre Axle Trailer Installation

Side by Side Installation



KEY:

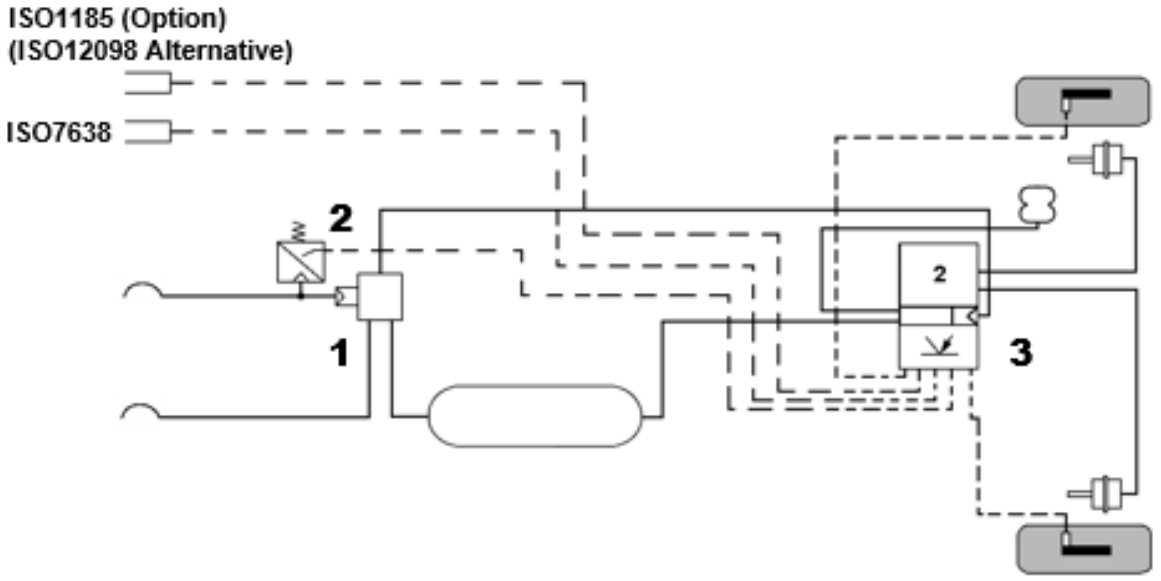
1 - Trailer Control Module +

2 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option)
or in case of EB+ Gen2/Gen3 Pressure Sensor (Option)

3 - EBS Modulators & Electronic Control Unit

EB+ Gen 1 Brake System Installation Schematics

2S/1M Integrated Semi or Centre Axle Trailer Installation

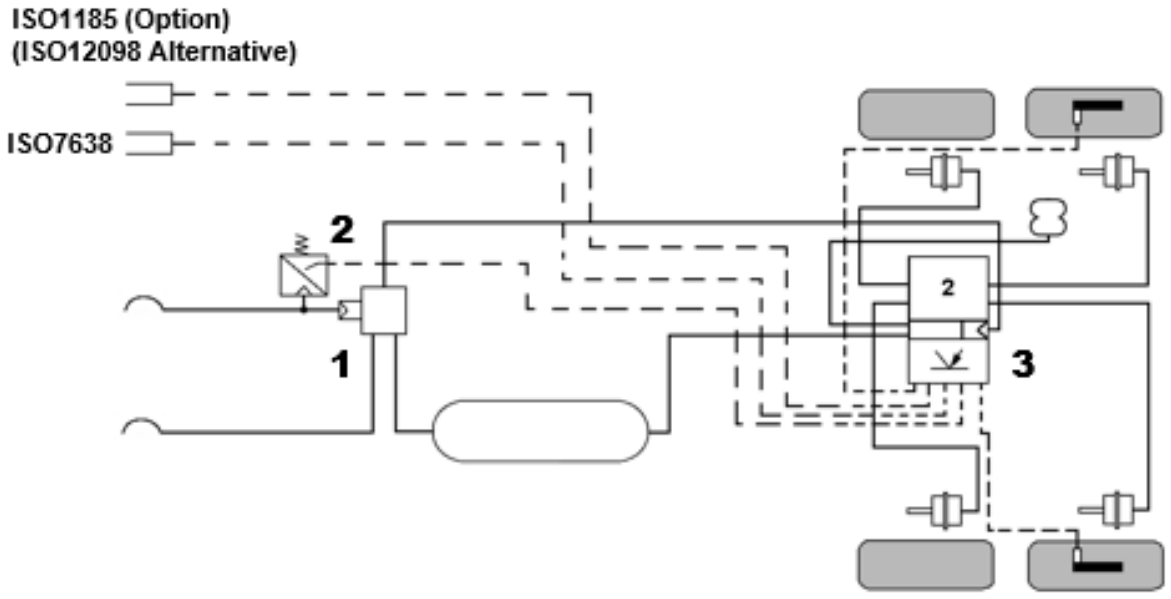


KEY:

1 - Emergency Relay Valve
2 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option)
3 - EBS Modulator & Electronic Control Unit

EB+ Gen 1 Brake System Installation Schematics

2S/1M Integrated Semi or Centre Axle Trailer Installation



KEY:

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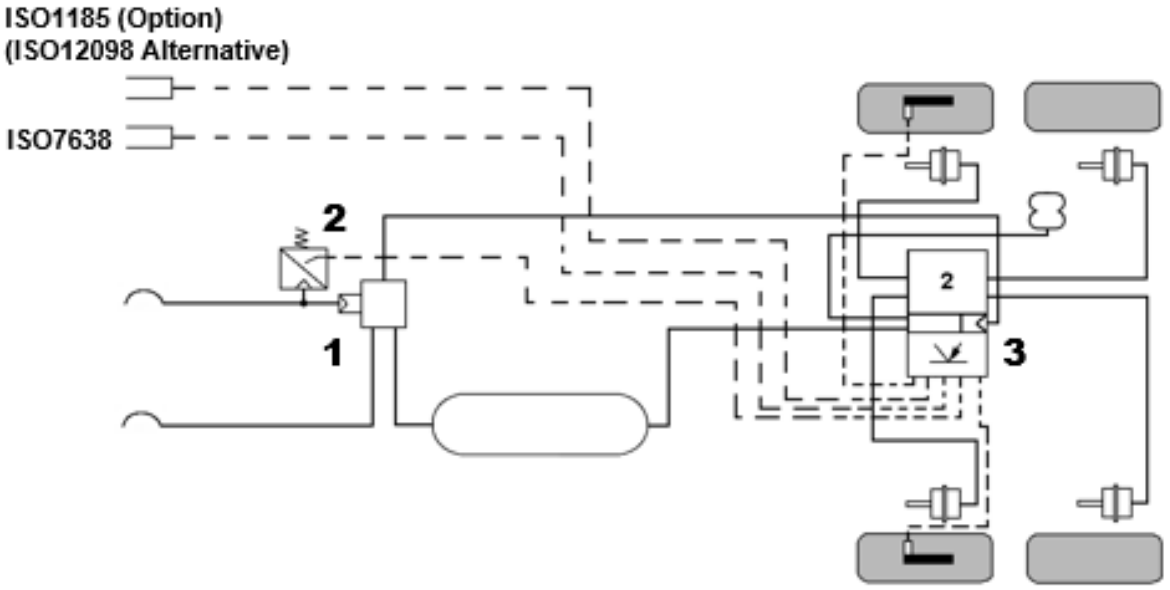
3 - EBS Modulator & Electronic Control Unit

EB+ Gen 1 Brake System Installation Schematics

2S/1M Integrated Semi or Centre Axle Trailer Installation



KEY:

1 - Emergency Relay Valve
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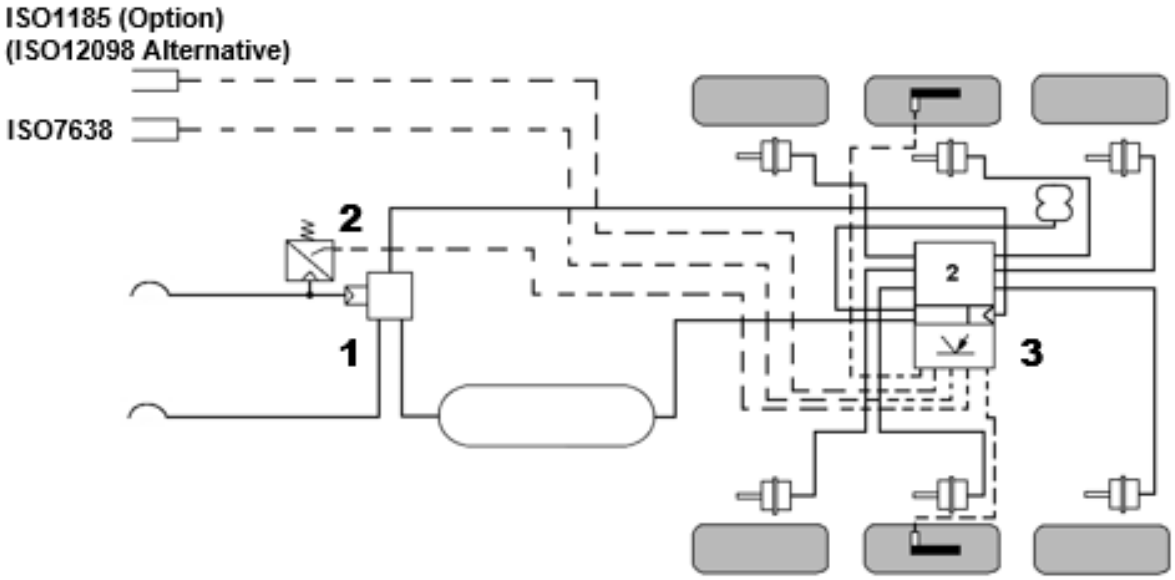
EB+ Gen 1 Brake System Installation Schematics

2S/1M Integrated Semi or Centre Axle Trailer Installation



KEY:

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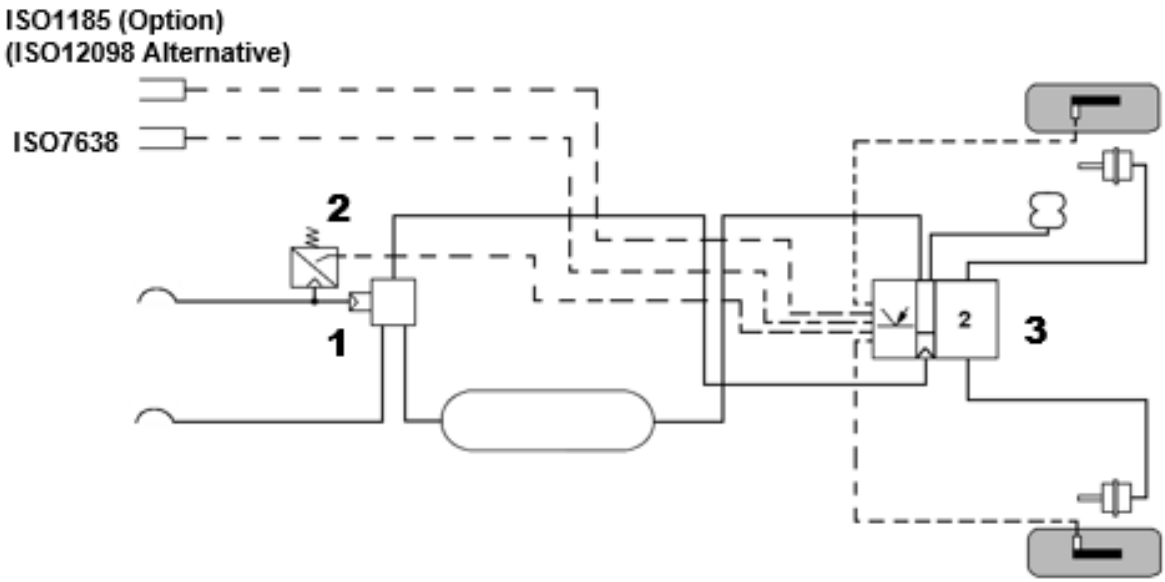
EB+ Gen 1 Brake System Installation Schematics

2S/1M Integrated Semi or Centre Axle Trailer Installation



KEY:

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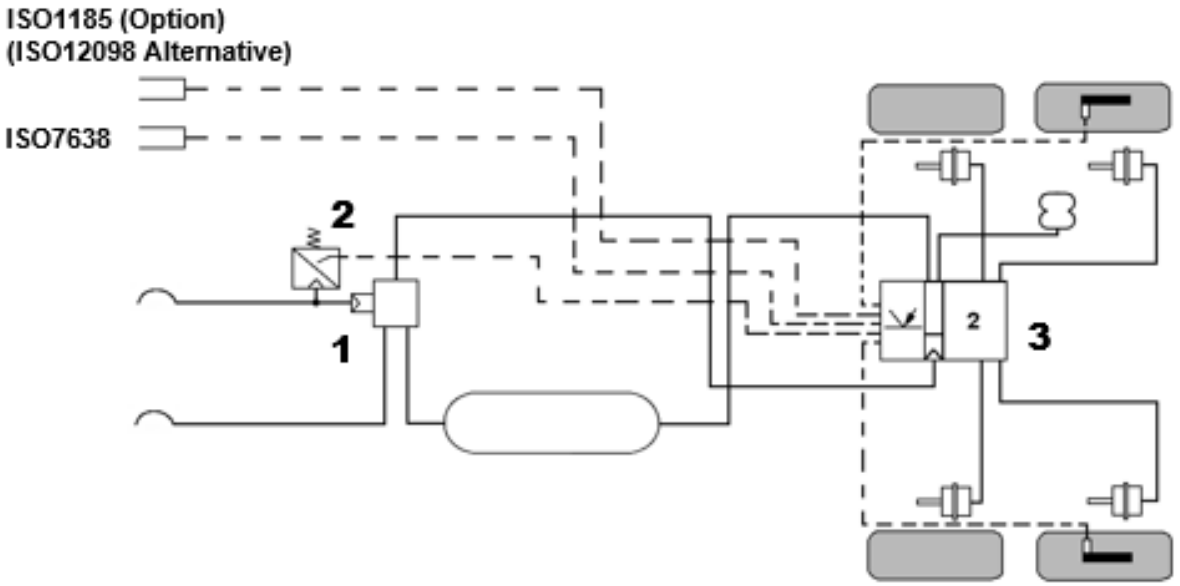
EB+ Gen 1 Brake System Installation Schematics

2S/1M Integrated Semi or Centre Axle Trailer Installation

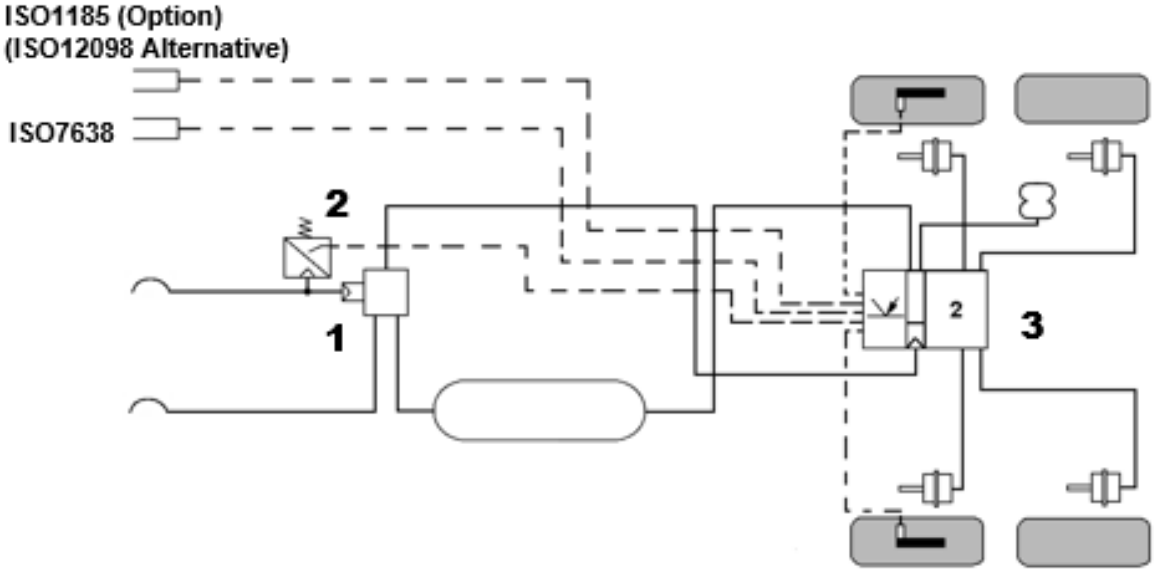


KEY:

1 - Emergency Relay Valve
2 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option)
3 - EBS Modulator & Electronic Control Unit

EB+ Gen 1 Brake System Installation Schematics

2S/1M Integrated Semi or Centre Axle Trailer Installation



KEY:

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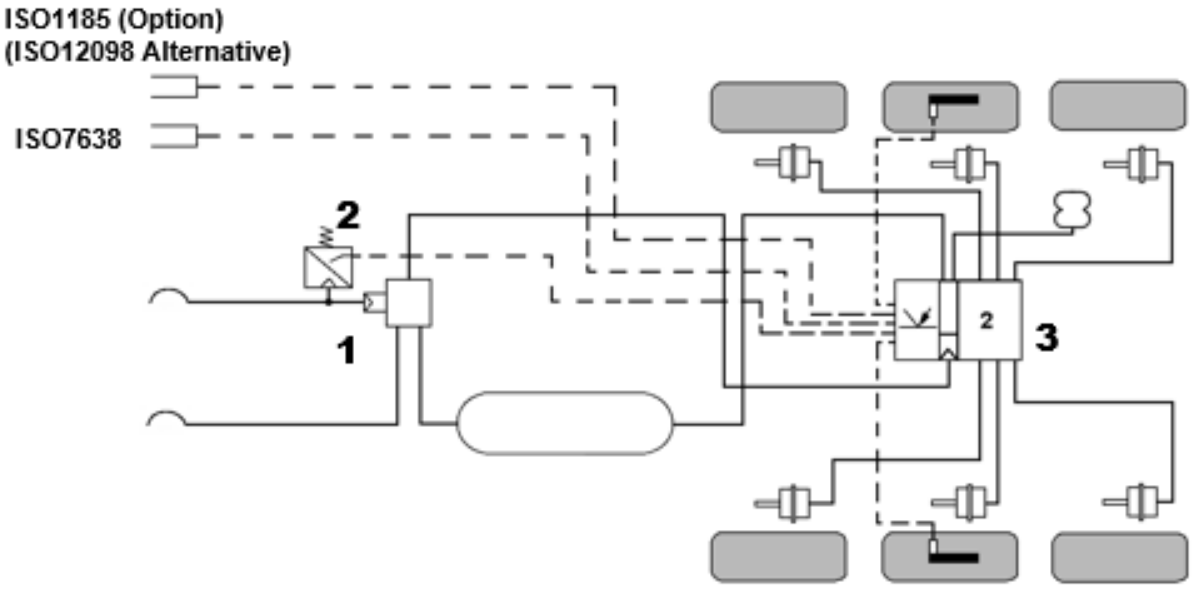
3 - EBS Modulator & Electronic Control Unit

EB+ Gen 1 Brake System Installation Schematics

2S/1M Integrated Semi or Centre Axle Trailer Installation



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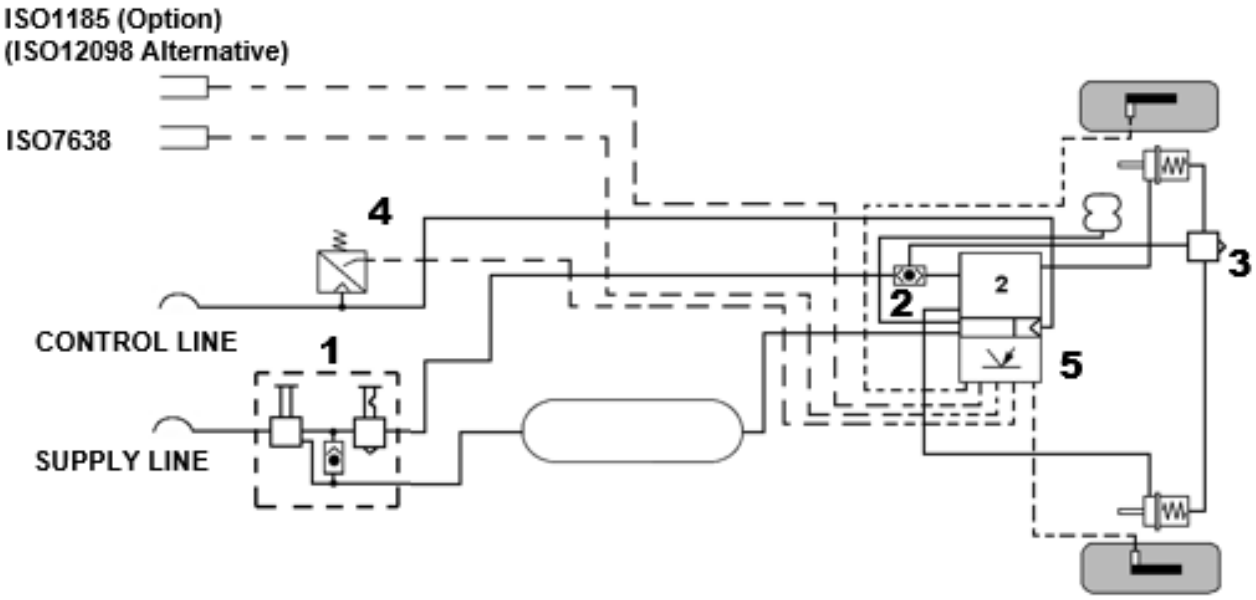
EB+ Gen 1 Brake System Installation Schematics

2S/1M Integrated Semi or Centre Axle Trailer Installation

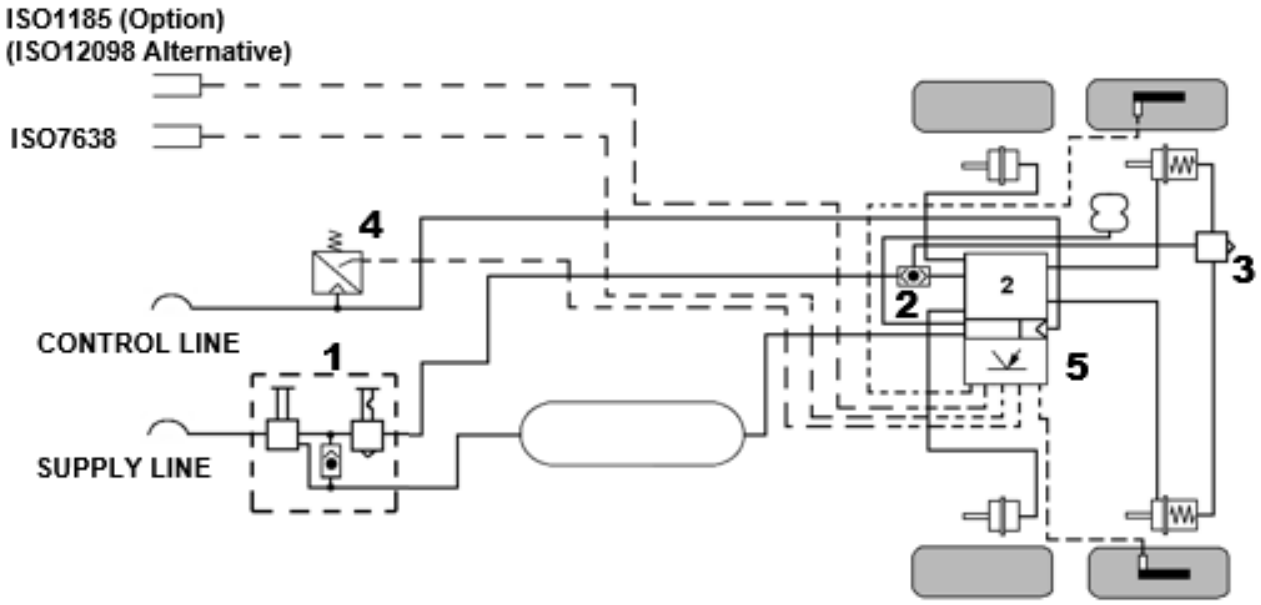


KEY:

1 - Combined Park & Shunt Valve (352 046 ...)
2 - Double Check Valve
3 - Quick Release Valve
4 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option)
5 - EBS Modulator & Electronic Control Unit

EB+ Gen 1 Brake System Installation Schematics

2S/1M Integrated Semi or Centre Axle Trailer Installation



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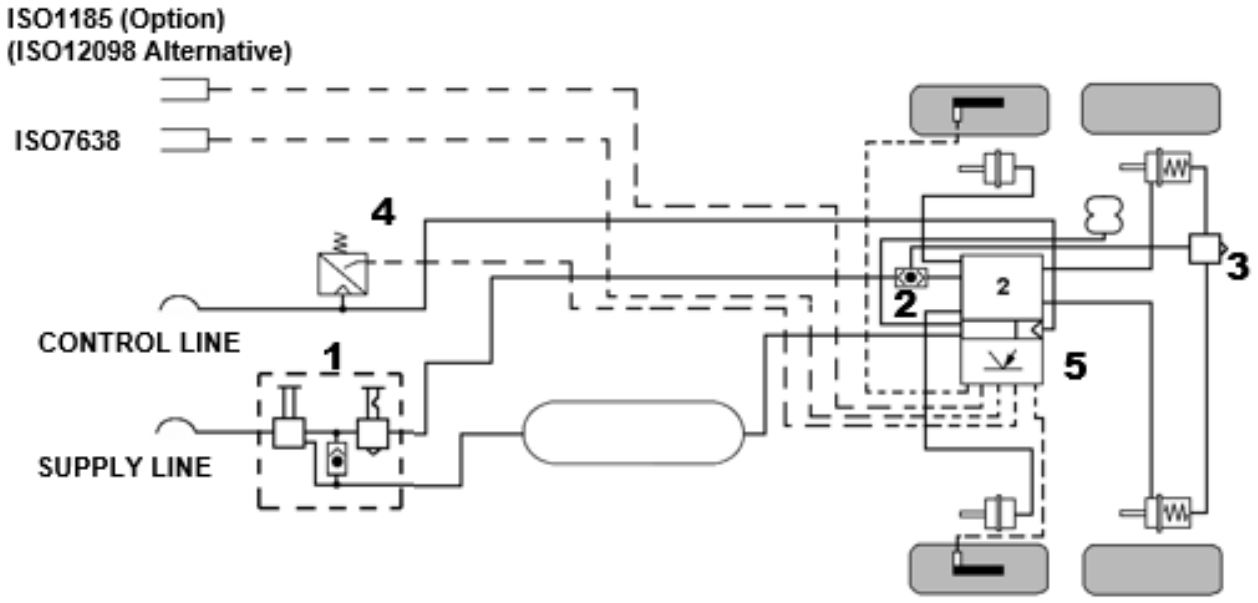
EB+ Gen 1 Brake System Installation Schematics

2S/1M Integrated Semi or Centre Axle Trailer Installation



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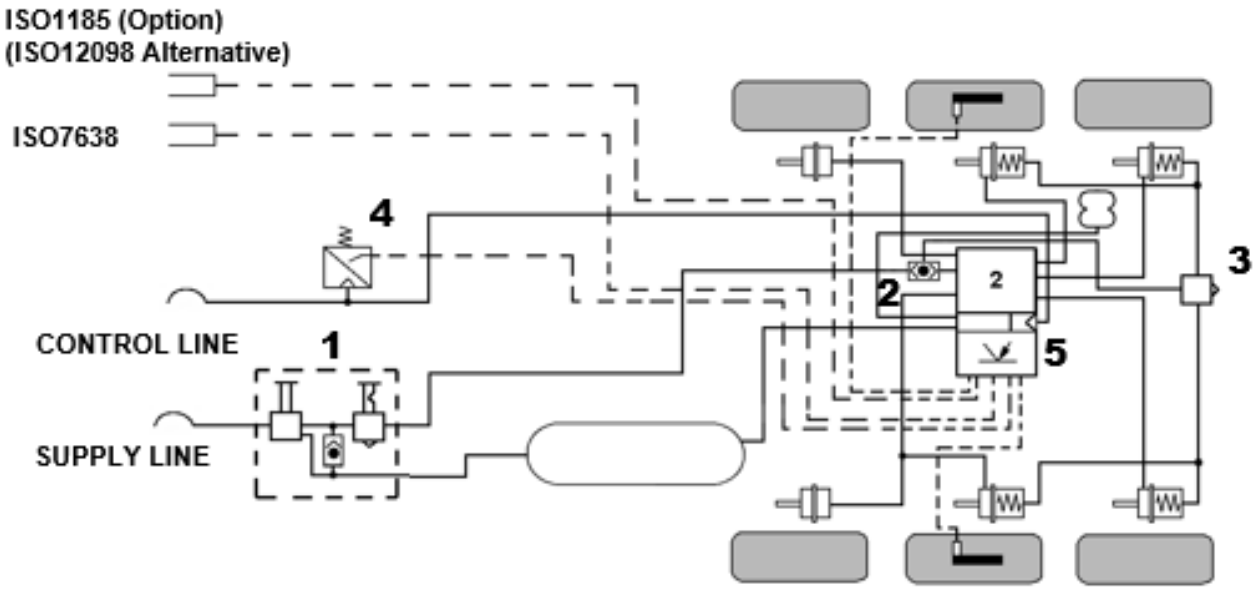
EB+ Gen 1 Brake System Installation Schematics

2S/1M Integrated Semi or Centre Axle Trailer Installation



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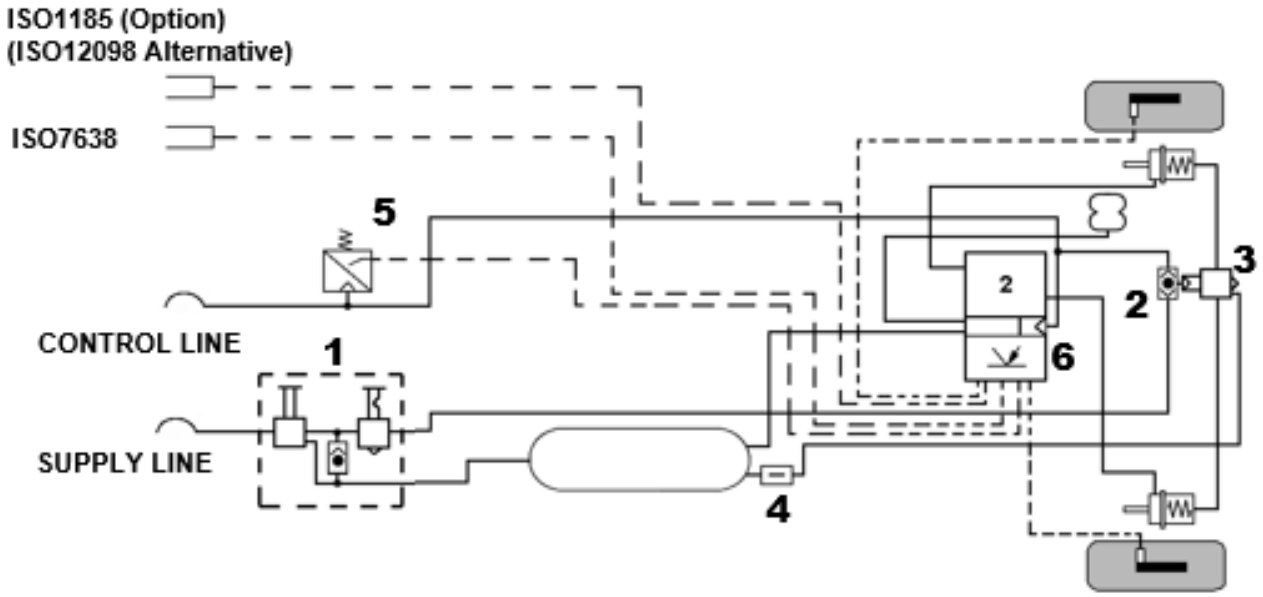
EB+ Gen 1 Brake System Installation Schematics

2S/1M Integrated Semi or Centre Axle Trailer Installation



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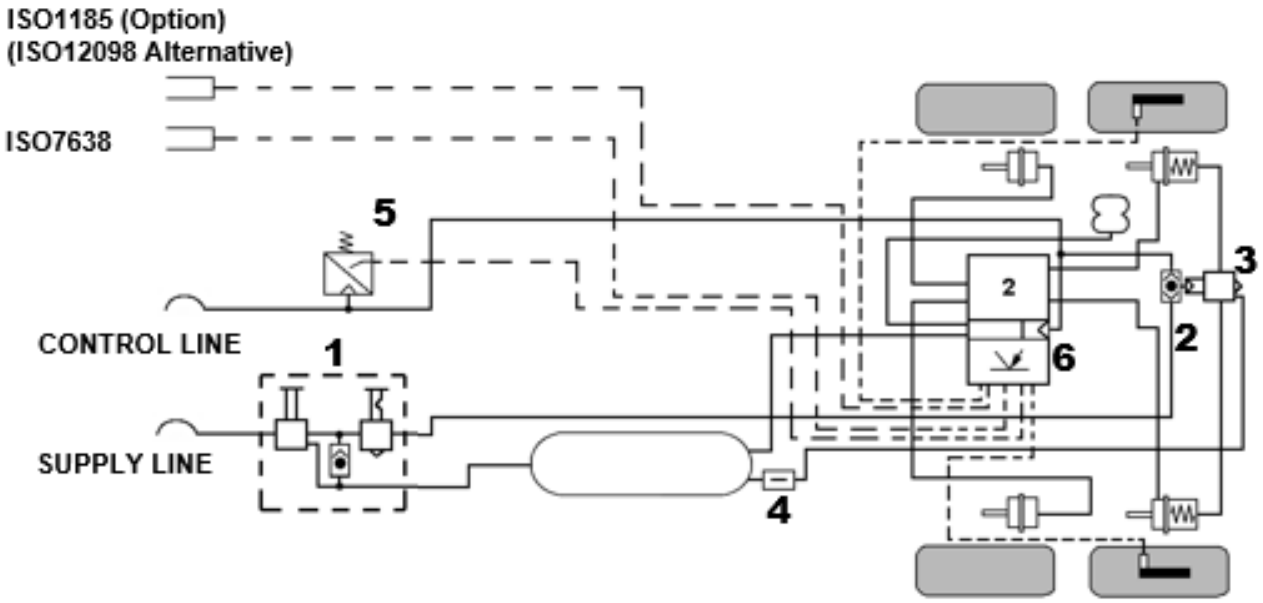

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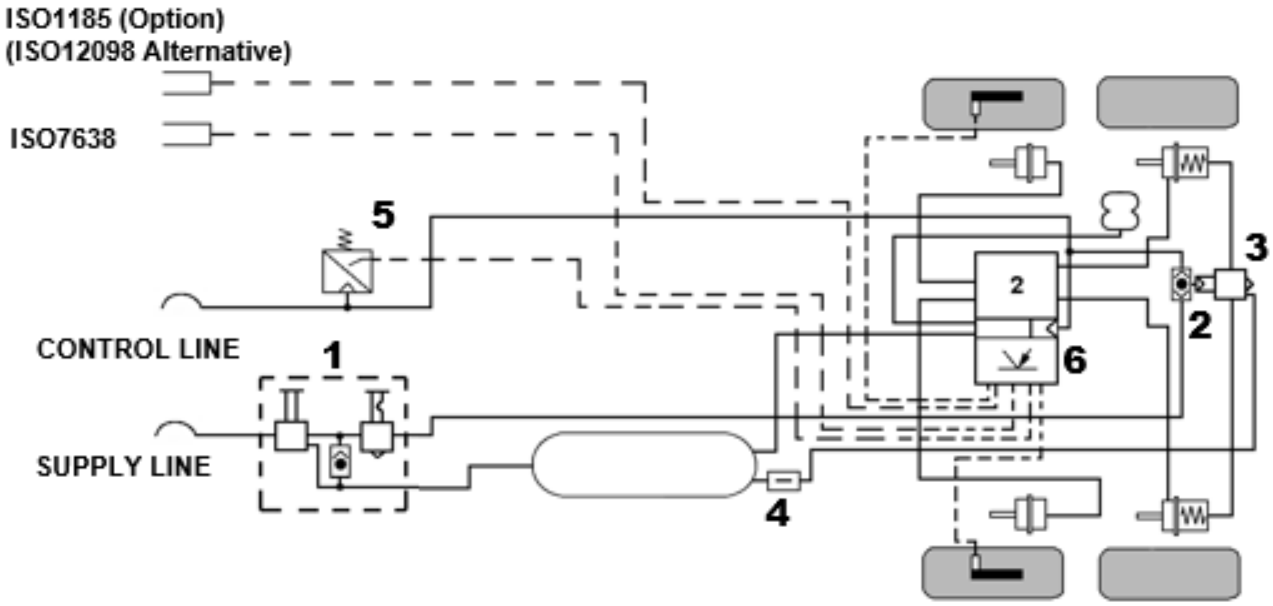

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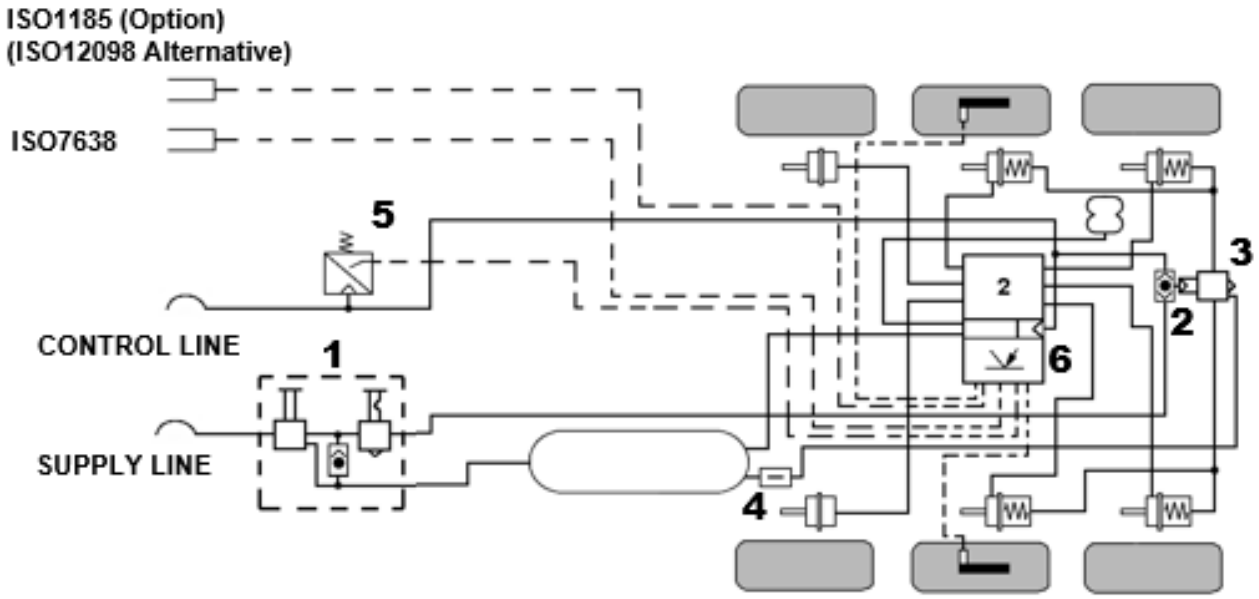
1 - Combined Park & Shunt Valve (352 046 …)
2 - Double Check Valve
3 - Relay Valve
4 - Pressure Protection Valve
5 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option)
6 - EBS Modulator & Electronic Control Unit

EB+ Gen 1 Brake System Installation Schematics

2S/1M Integrated Semi or Centre Axle Trailer Installation

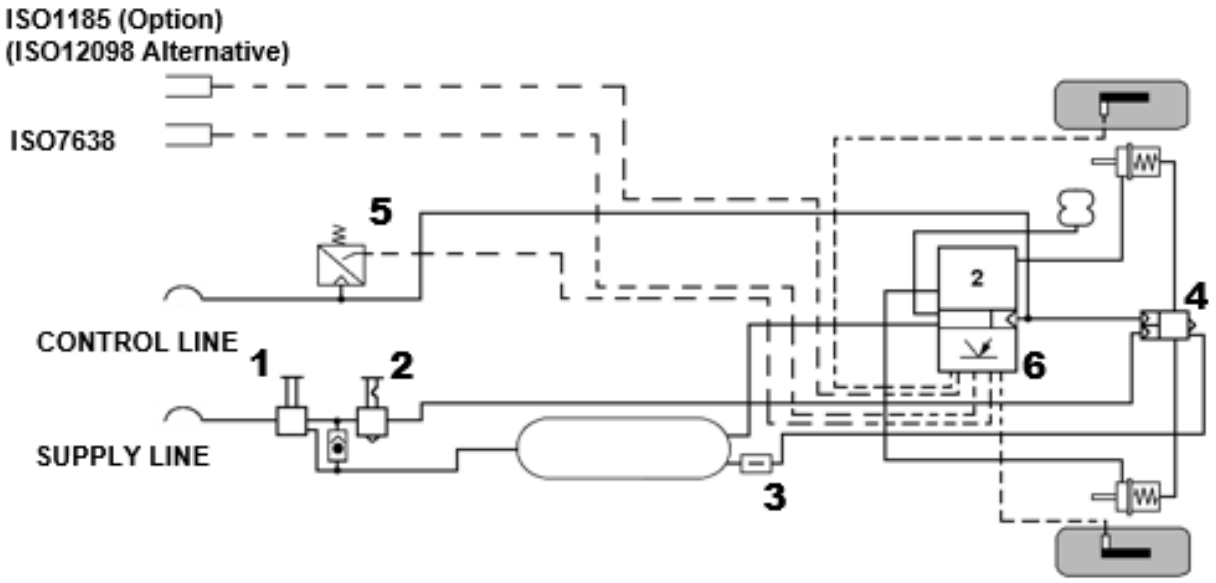


KEY:

1 - Combined Park & Shunt Valve (352 046 ...)
2 - Double Check Valve
3 - Relay Valve
4 - Pressure Protection Valve
5 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option)
6 - EBS Modulator & Electronic Control Unit

EB+ Gen 1 Brake System Installation Schematics

2S/1M Integrated Semi or Centre Axle Trailer Installation

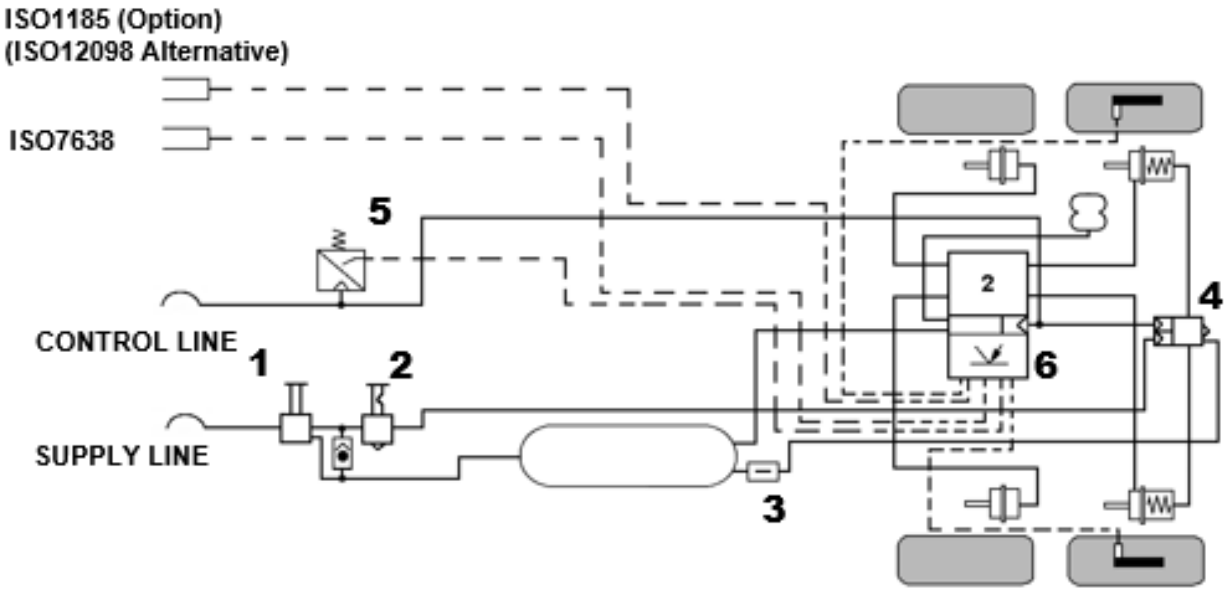


KEY:

1 - Shunt Valve
2 - Park Valve
3 - Pressure Protection Valve
4 - Double Pilot Relay Valve
5 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option)
6 - EBS Modulator & Electronic Control Unit

EB+ Gen 1 Brake System Installation Schematics

2S/1M Integrated Semi or Centre Axle Trailer Installation

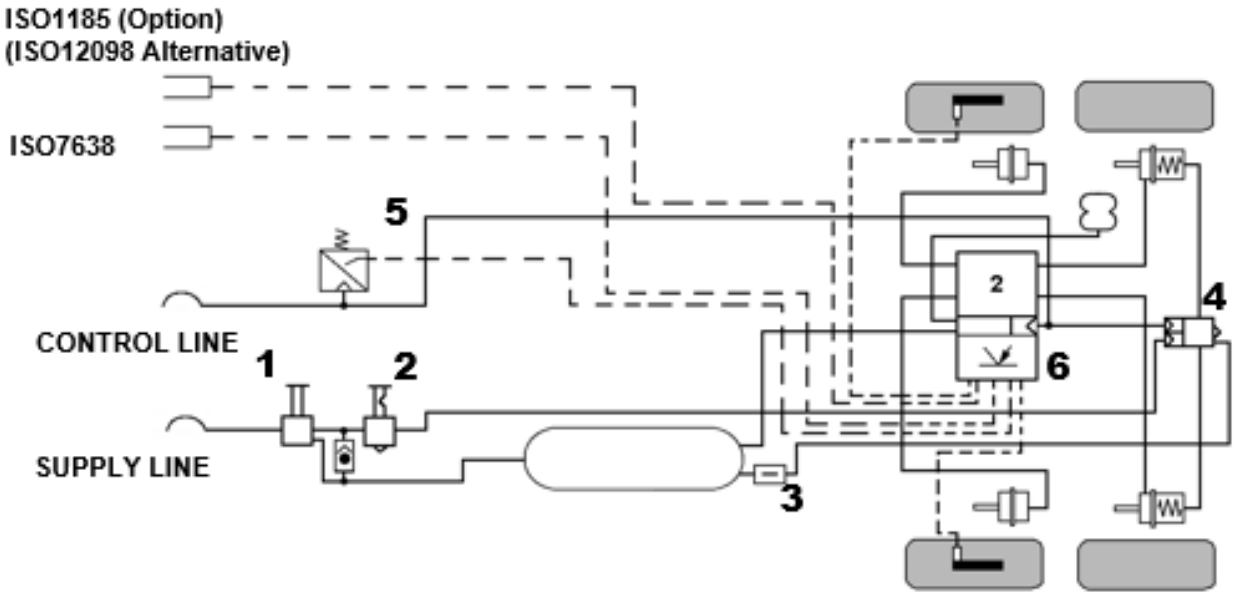


KEY:

1 - Shunt Valve
2 - Park Valve
3 - Pressure Protection Valve
4 - Double Pilot Relay Valve
5 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option)
6 - EBS Modulator & Electronic Control Unit

EB+ Gen 1 Brake System Installation Schematics

2S/1M Integrated Semi or Centre Axle Trailer Installation

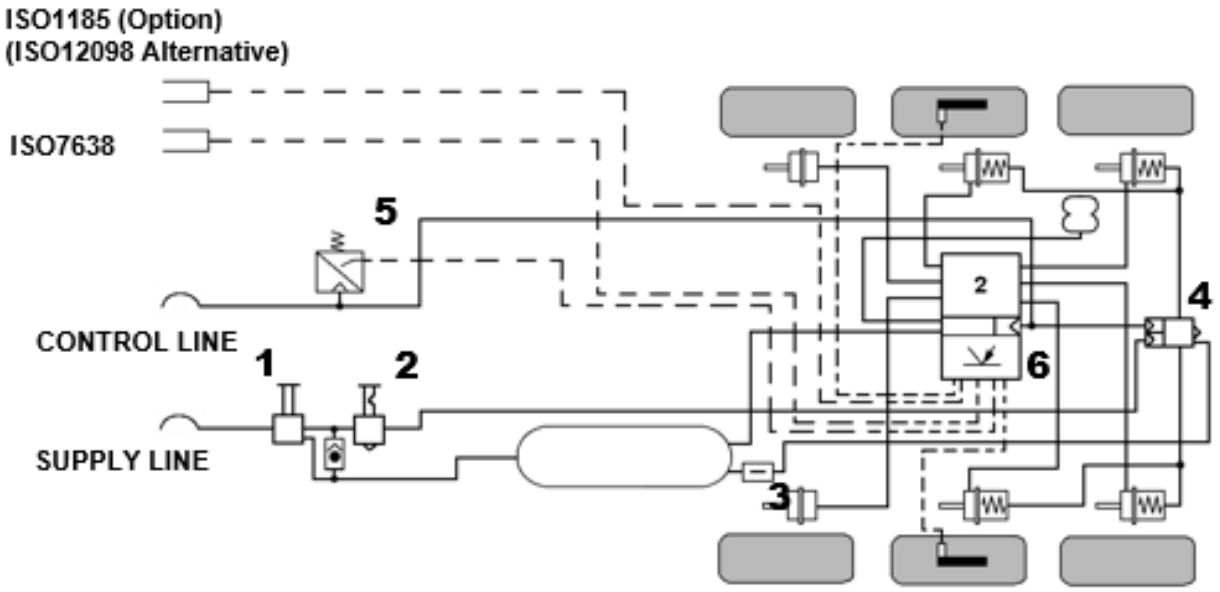


KEY:

1 - Shunt Valve
2 - Park Valve
3 - Pressure Protection Valve
4 - Double Pilot Relay Valve
5 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option)
6 - EBS Modulator & Electronic Control Unit

EB+ Gen 1 Brake System Installation Schematics

2S/1M Integrated Semi or Centre Axle Trailer Installation



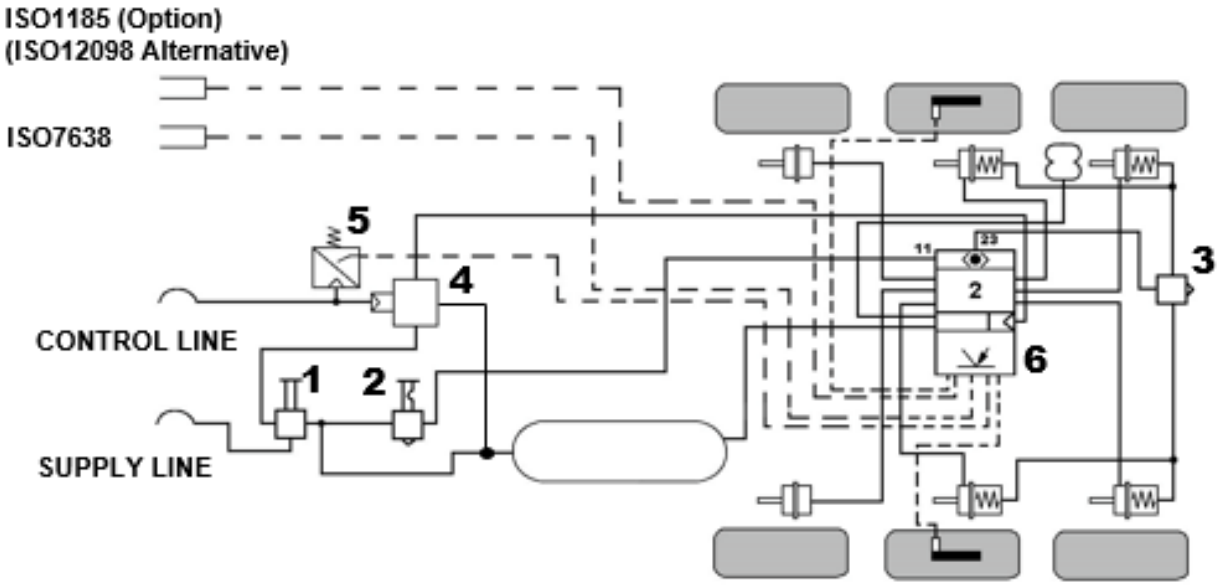
KEY:

1 - Shunt Valve
2 - Park Valve
3 - Pressure Protection Valve
4 - Double Pilot Relay Valve
5 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option)
6 - EBS Modulator & Electronic Control Unit

EB+ Gen 1 Brake System Installation Schematics

2S/1M Integrated Semi or Centre Axle Trailer Installation

EB+ with Integrated double check valve



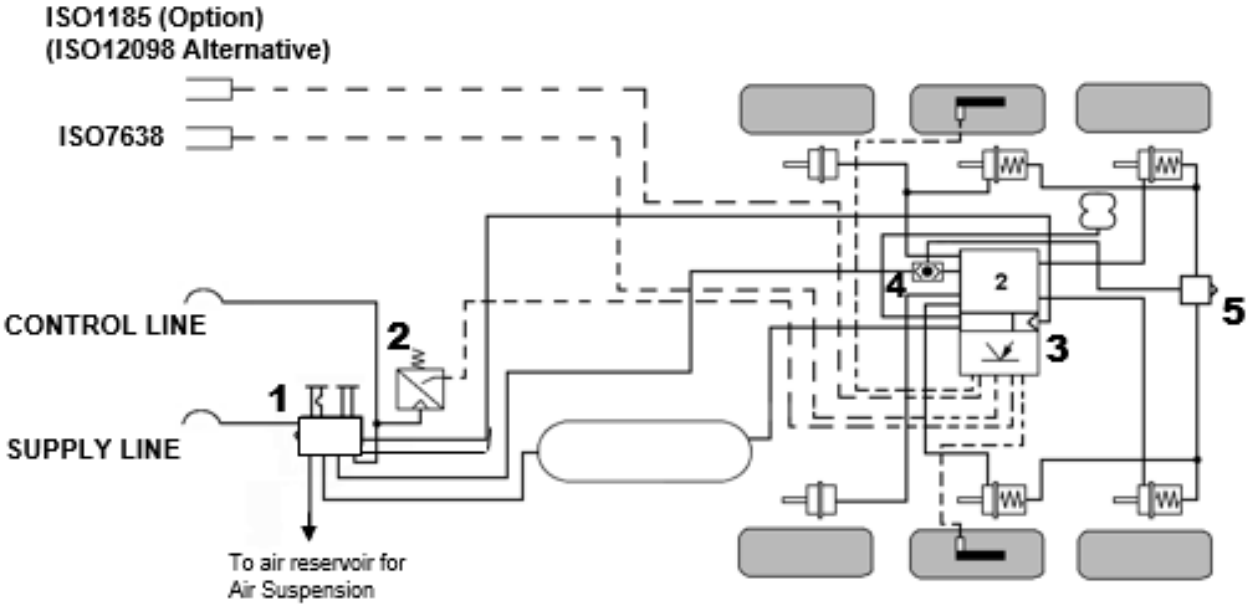
KEY:

1 - Shunt Valve
2 - Park Valve
3 - Quick Release Valve
4 - Emergency Relay Valve
5 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option)
6 - EBS Modulator & Electronic Control Unit with Integrated Double Check Valve

EB+ Gen 1 Brake System Installation Schematics

2S/1M Semi or Centre Axle Trailer Installation

Side by Side Installation

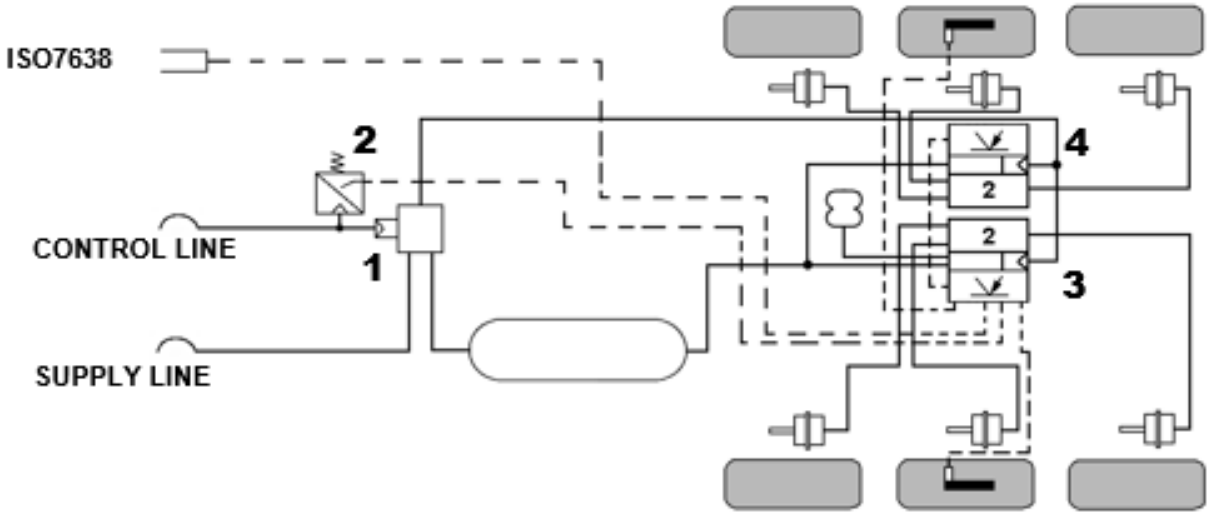


KEY:

1 - Trailer Control Module +
2 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option)
3 - EBS Modulator & Electronic Control Unit
4 - Double Check Valve
5 - Quick release Valve

EB+ Gen 1 Brake System Installation Schematics

2S/2M Non Integrated Semi or Centre Axle Trailer Installation
Side by Side Installation



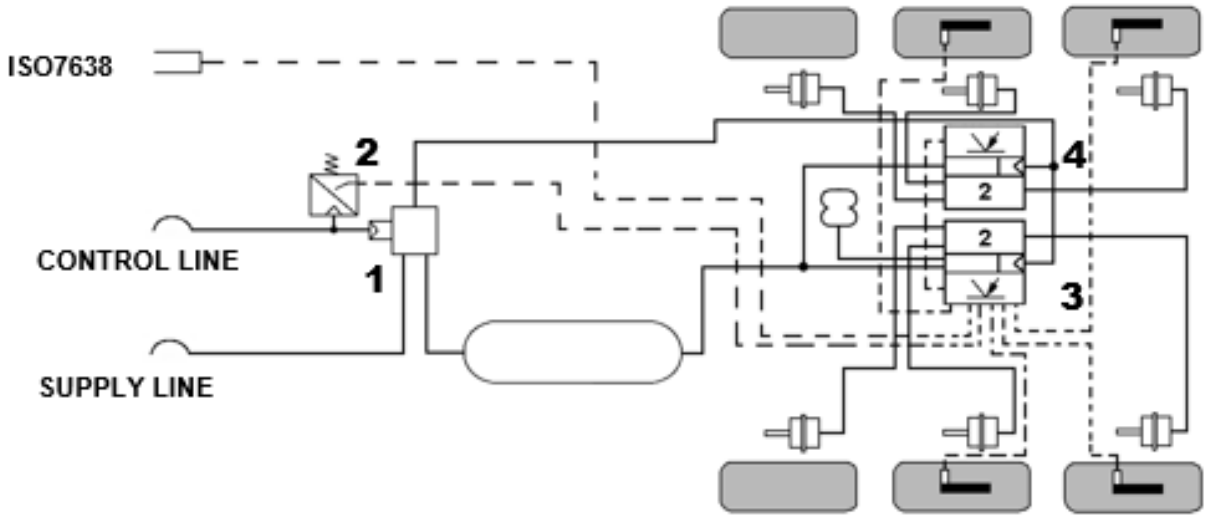
KEY:

1 - Emergency Relay Valve
2 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option)
3 - EBS Modulator & Electronic Control Unit (Master)
4 - EBS Modulator & Electronic Control Unit (Slave)

EB+ Gen 1 Brake System Installation Schematics

4S/2M Non Integrated Semi or Centre Axle Trailer Installation

Side by Side Installation

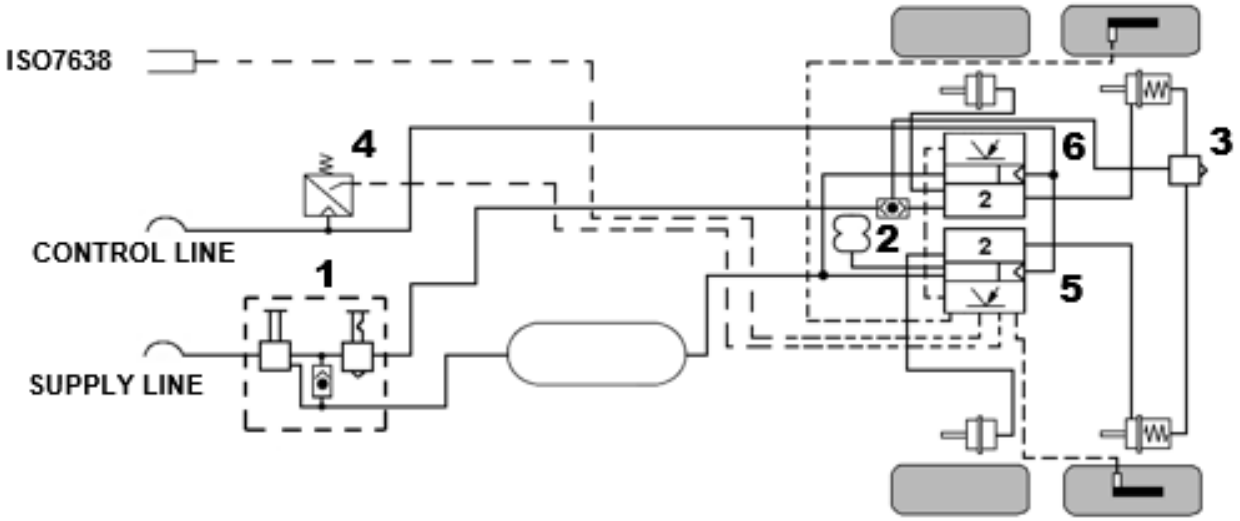


KEY:

1 - Emergency Relay Valve
2 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option)
3 - EBS Modulator & Electronic Control Unit (Master)
4 - EBS Modulator & Electronic Control Unit (Slave)

EB+ Gen 1 Brake System Installation Schematics

2S/2M Non Integrated Semi or Centre Axle Trailer Installation
Side by Side Installation



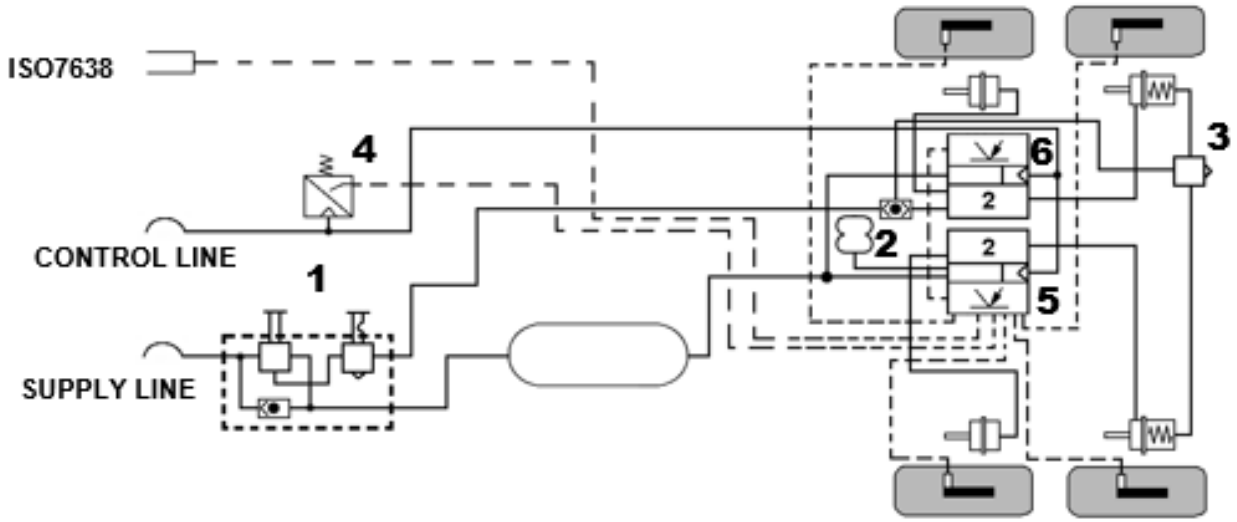
KEY:

1 – Combined Park & Shunt Valve (352 046 …)
2 - Double Check Valve
3 - Quick Release Valve
4 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option)
5 - EBS Modulator & Electronic Control Unit (Master)
6 - EBS Modulator & Electronic Control Unit (Slave)

EB+ Gen 1 Brake System Installation Schematics

4S/2M Non Integrated Semi or Centre Axle Trailer Installation

Side by Side Installation

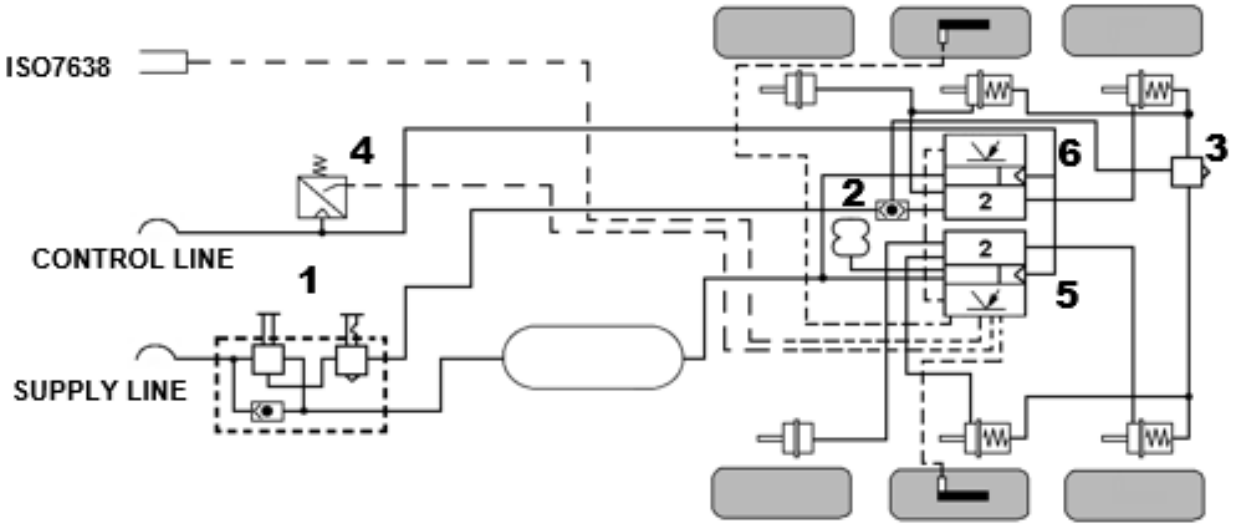


KEY:

1 – Combined Park & Shunt Valve (352 046 …)
2 - Double Check Valve
3 - Quick Release Valve
4 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option)
5 - EBS Modulator & Electronic Control Unit (Master)
6 - EBS Modulator & Electronic Control Unit (Slave)

EB+ Gen 1 Brake System Installation Schematics

2S/2M Non Integrated Semi or Centre Axle Trailer Installation
Side by Side Installation



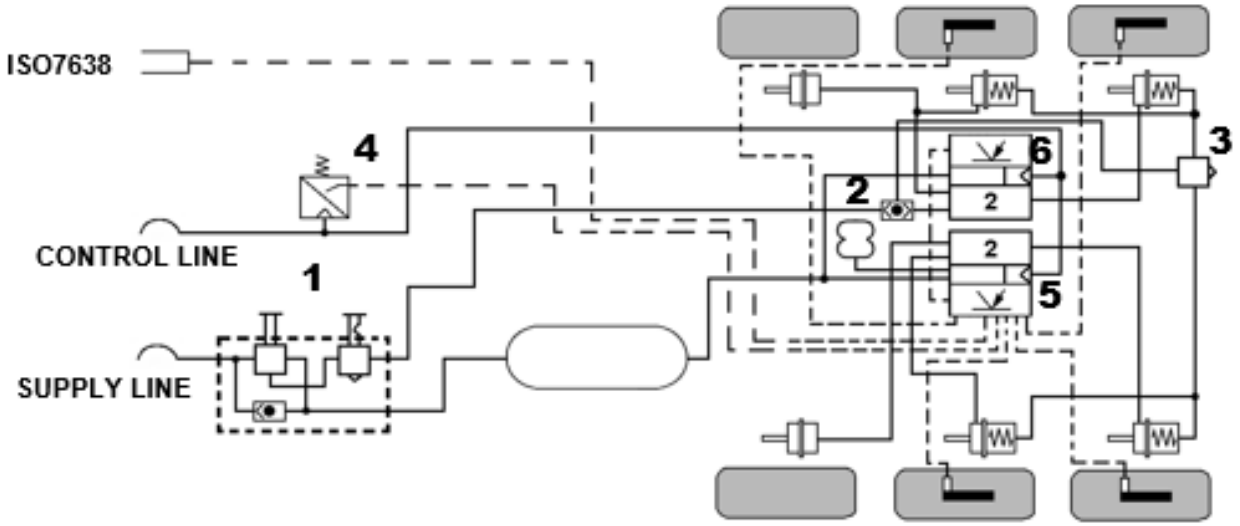
KEY:

1 – Combined Park & Shunt Valve (352 046 …)
2 - Double Check Valve
3 - Quick Release Valve
4 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option)
5 - EBS Modulator & Electronic Control Unit (Master)
6 - EBS Modulator & Electronic Control Unit (Slave)

EB+ Gen 1 Brake System Installation Schematics

4S/2M Non Integrated Semi or Centre Axle Trailer Installation

Side by Side Installation



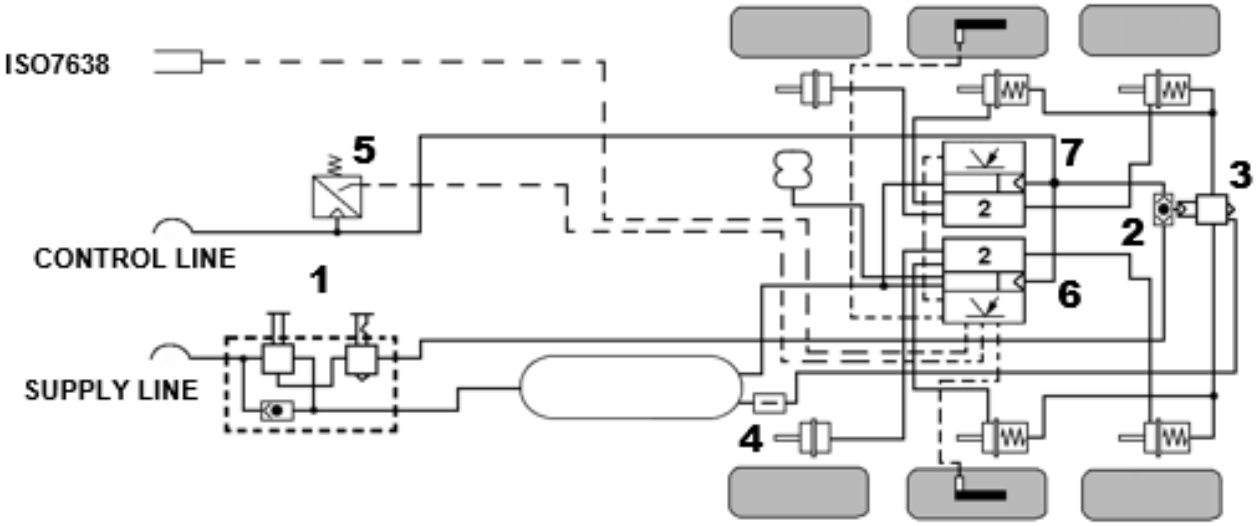
KEY:

1 - Combined Park & Shunt Valve (352 046 …)
2 - Double Check Valve
3 - Quick Release Valve
4 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option)
5 - EBS Modulator & Electronic Control Unit (Master)
6 - EBS Modulator & Electronic Control Unit (Slave)

EB+ Gen 1 Brake System Installation Schematics

2S/2M Non Integrated Semi or Centre Axle Trailer Installation

Side by Side Installation

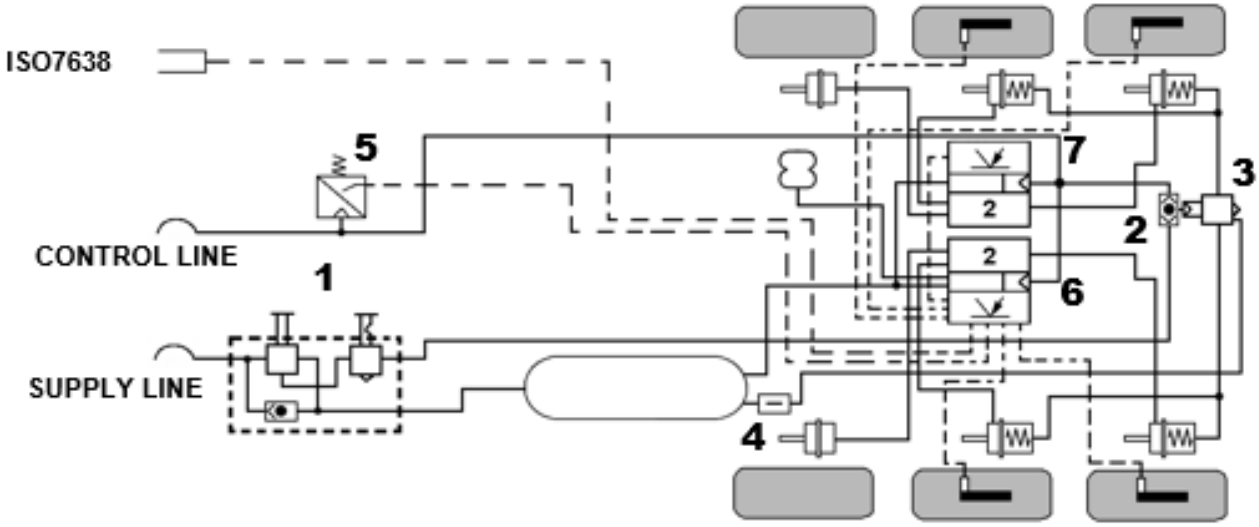


KEY:

1 - Combined Park & Shunt Valve (352 046 …)
2 - Double Check Valve
3 - Relay Valve
4 - Pressure Protection Valve
5 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option)
6 - EBS Modulator & Electronic Control Unit (Master)
7 - EBS Modulator & Electronic Control Unit (Slave)

EB+ Gen 1 Brake System Installation Schematics

4S/2M Non Integrated Semi or Centre Axle Trailer Installation
Side by Side Installation



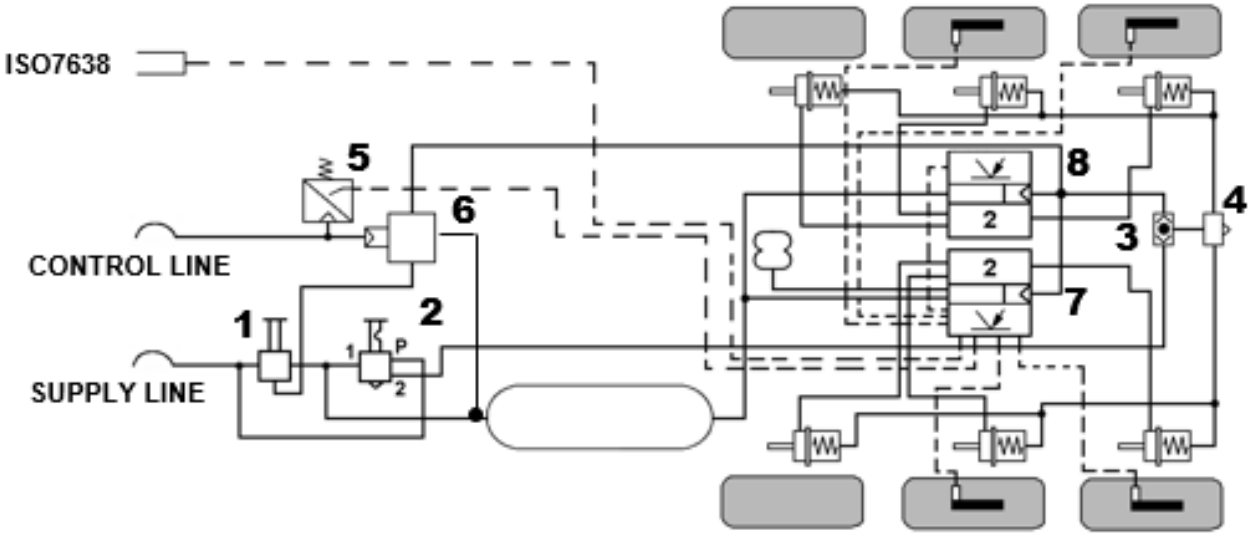
KEY:

1 - Combined Park & Shunt Valve (352 046 …)
2 - Double Check Valve
3 - Relay Valve
4 - Pressure Protection Valve
5 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option)
6 - EBS Modulator & Electronic Control Unit (Master)
7 - EBS Modulator & Electronic Control Unit (Slave)

EB+ Gen 1 Brake System Installation Schematics

4S/2M Non Integrated Semi or Centre Axle Trailer Installation

Side by Side Installation



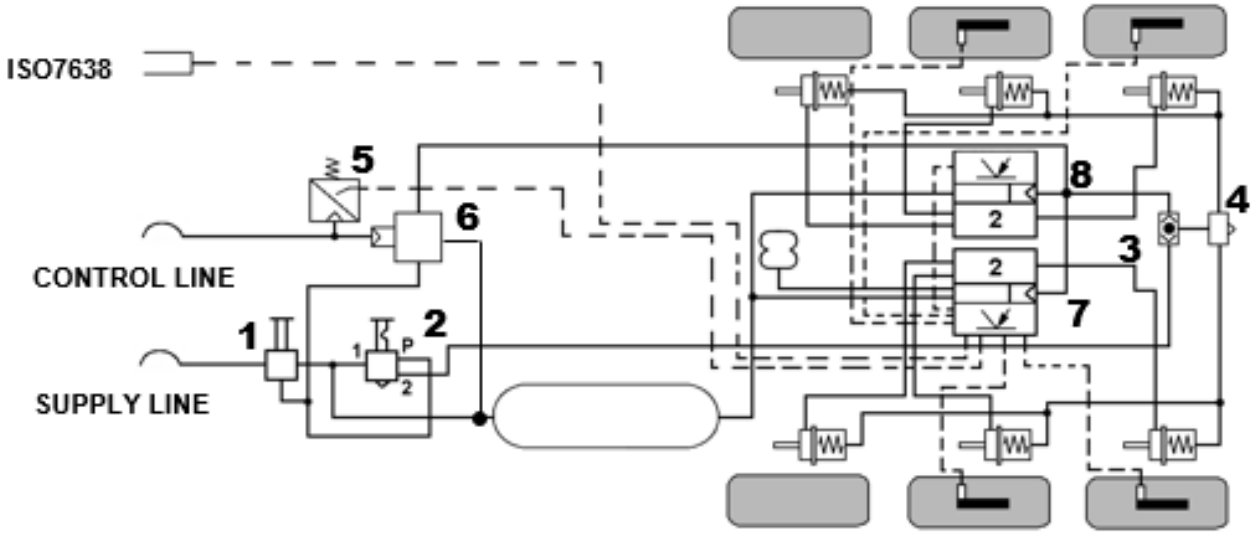
KEY:

1 - Shunt Valve
2 - Auto/ Manual Park Valve
3 - Double Check Valve
4 - Quick Release Valve
5 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option)
6 - Emergency Relay Valve
7 - EBS Modulator & Electronic Control Unit (Master)
8 - EBS Modulator & Electronic Control Unit (Slave)

EB+ Gen 1 Brake System Installation Schematics

4S/2M Non Integrated Semi or Centre Axle Trailer Installation

Side by Side Installation



KEY:

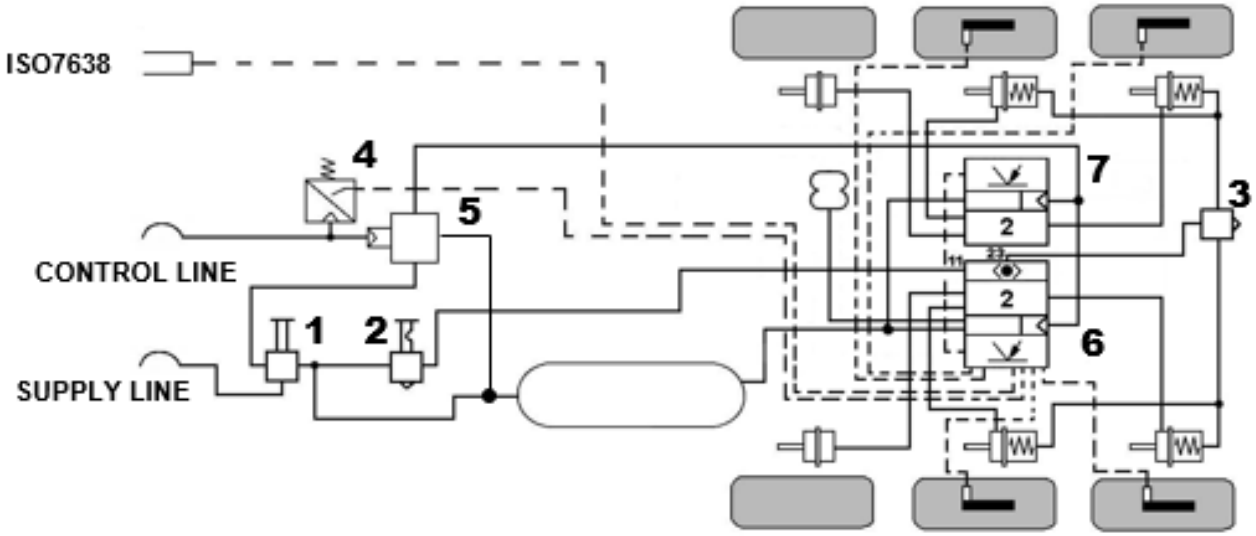
1 - Shunt Valve
2 - Auto/ Manual Park Valve
3 - Double Check Valve
4 - Quick Release Valve
5 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option)
6 - Emergency Relay Valve
7 - EBS Modulator & Electronic Control Unit (Master)
8 - EBS Modulator & Electronic Control Unit (Slave)

EB+ Gen 1 Brake System Installation Schematics

4S/2M Non Integrated Semi or Centre Axle Trailer Installation

EB+ with Integrated Double Check Valve

Side by Side Installation

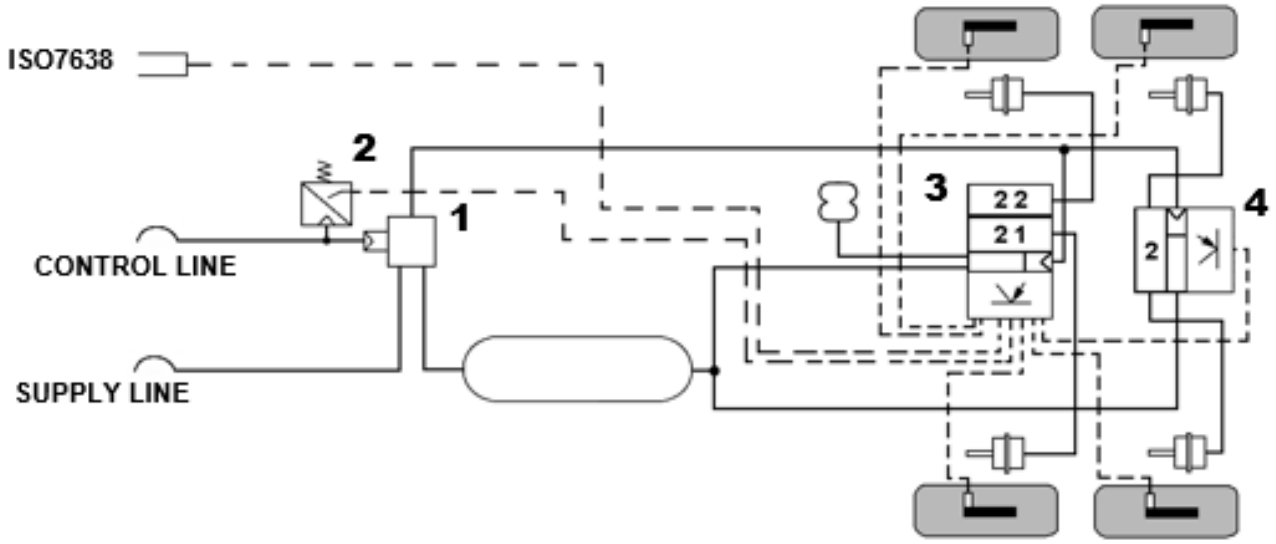


KEY:

1 - Shunt Valve
2 - Park Valve
3 - Quick Release Valve
4 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option)
5 - Emergency Relay Valve
6 - EBS Modulator & Electronic Control Unit (Master)
7 - EBS Modulator & Electronic Control Unit (Slave)

EB+ Gen 1 & EB+ Gen 2/Gen 3 Brake System Installation Schematics

4S/3M Integrated Semi or Centre Axle Trailer Installation
Side by Side Installation



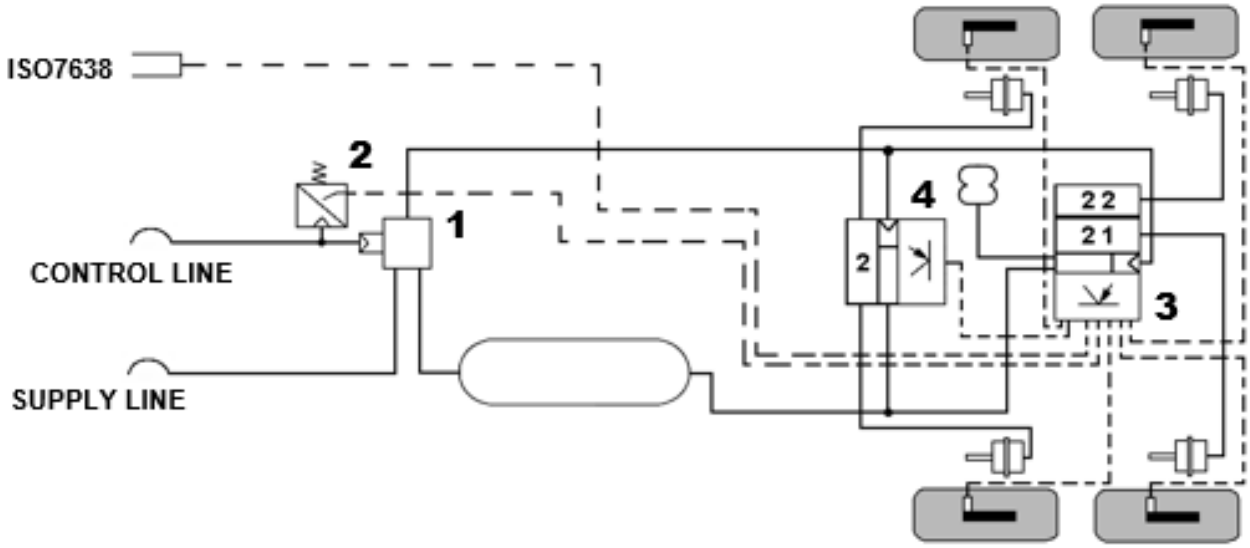
KEY:

1 - Emergency Relay Valve
2 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option). EB+ Gen2/Gen3 Pressure Sensor (Option)
3 - EBS Modulator & Electronic Control Unit (Master)
4 - EBS Modulator & Electronic Control Unit (Slave)

EB+ Gen 1 & EB+ Gen 2/Gen 3 Brake System Installation Schematics

4S/3M Integrated Semi or Centre Axle Trailer Installation

Side by Side Installation



KEY:

1 - Emergency Relay Valve

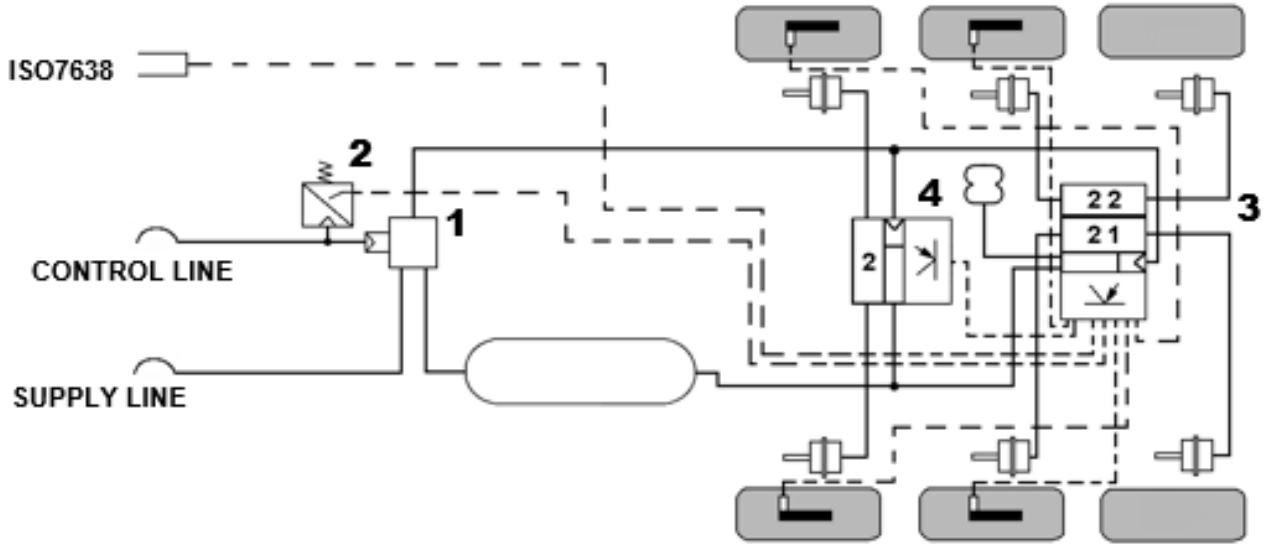
2 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option). EB+ Gen2/Gen3 Pressure Sensor (Option).

3 - EBS Modulator & Electronic Control Unit (Master)

4 - EBS Modulator & Electronic Control Unit (Slave)

EB+ Gen 1 & EB+ Gen 2/Gen 3 Brake System Installation Schematics

4S/3M Integrated Semi or Centre Axle Trailer Installation
Side by Side Installation



KEY:

1 - Emergency Relay Valve

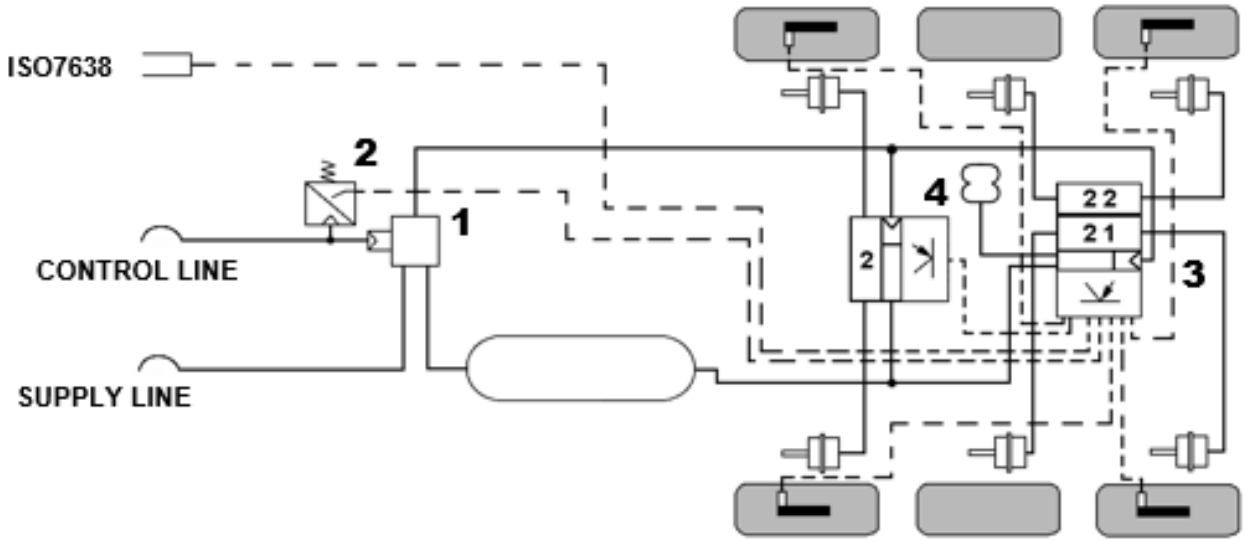
2 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option). EB+ Gen2/Gen3 Pressure Sensor (Option).

3 - EBS Modulator & Electronic Control Unit (Master)

4 - EBS Modulator & Electronic Control Unit (Slave)

EB+ Gen 1 & EB+ Gen 2/Gen 3 Brake System Installation Schematics

4S/3M Integrated Semi or Centre Axle Trailer Installation
Side by Side Installation



KEY:

1 - Emergency Relay Valve

2 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option). EB+ Gen2/Gen3 Pressure Sensor (Option).

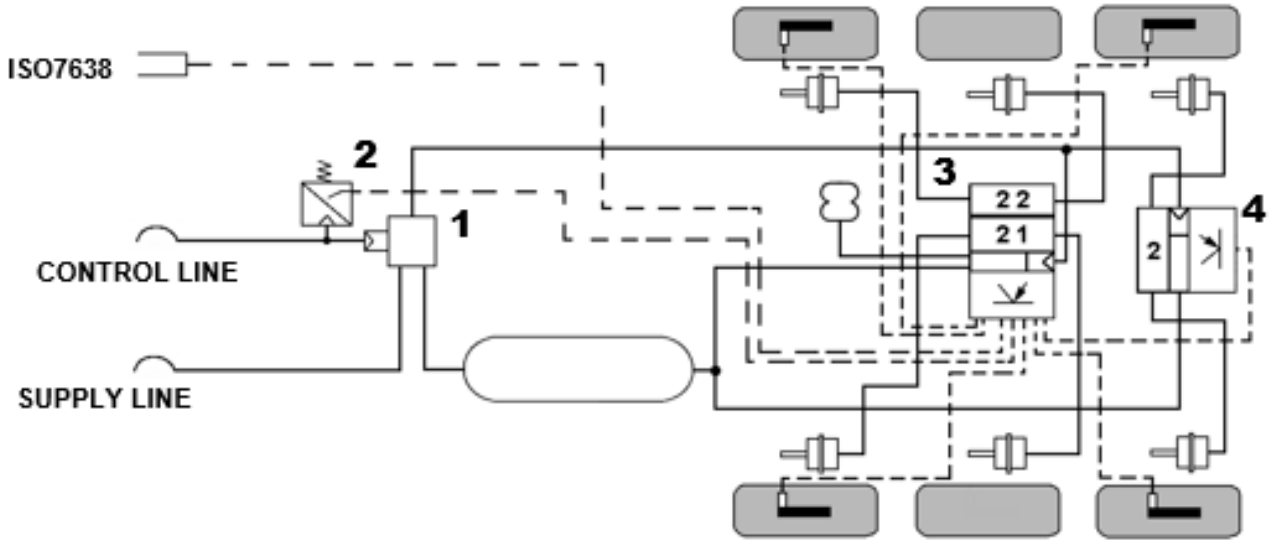
3 - EBS Modulator & Electronic Control Unit (Master)

4 - EBS Modulator & Electronic Control Unit (Slave)

EB+ Gen 1 & EB+ Gen 2/Gen 3 Brake System Installation Schematics

4S/3M Integrated Semi or Centre Axle Trailer Installation

Side by Side Installation



KEY:

1 - Emergency Relay Valve

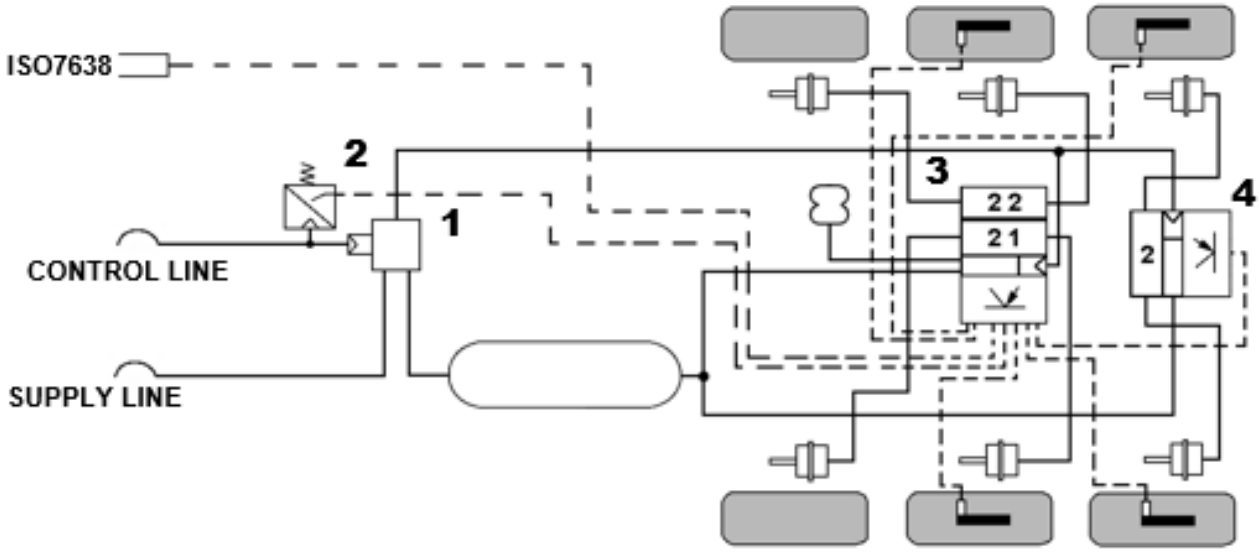
2 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option). EB+ Gen2/Gen3 Pressure Sensor (Option).

3 - EBS Modulator & Electronic Control Unit (Master)

4 - EBS Modulator & Electronic Control Unit (Slave)

EB+ Gen 1 & EB+ Gen 2/Gen 3 Brake System Installation Schematics

4S/3M Integrated Semi or Centre Axle Trailer Installation
Side by Side Installation



KEY:

1 - Emergency Relay Valve

2 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option). EB+ Gen2/Gen3 Pressure Sensor (Option).

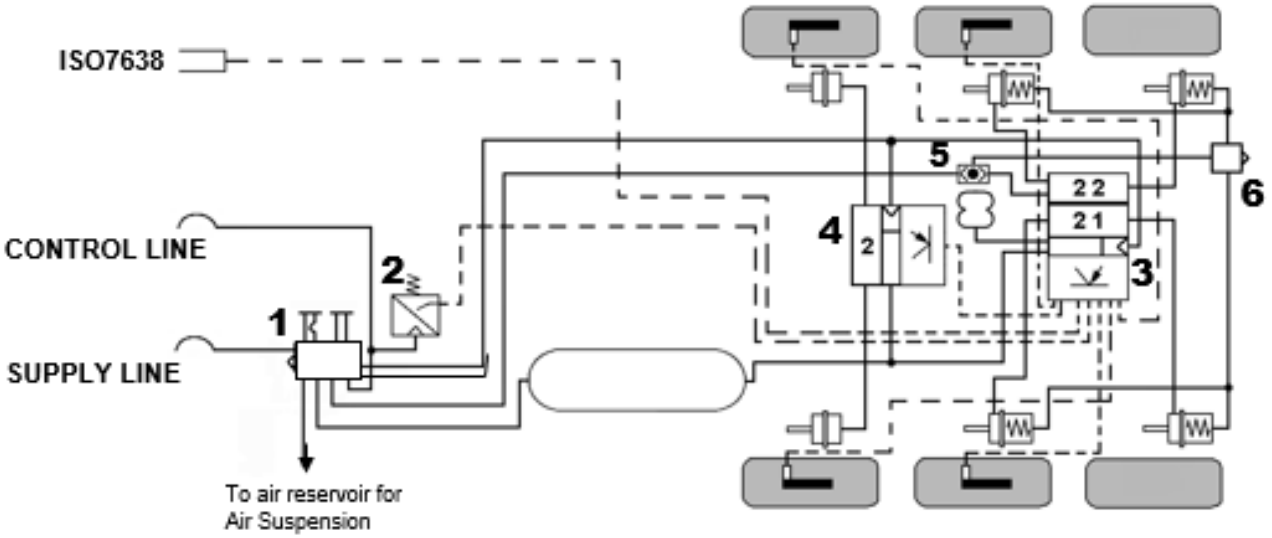
3 - EBS Modulator & Electronic Control Unit (Master)

4 - EBS Modulator & Electronic Control Unit (Slave)

EB+ Gen 1 & EB+ Gen 2/Gen 3 Brake System Installation Schematics

4S/3M Semi or Centre Axle Trailer Installation

Side by Side Installation



KEY:

1 - Trailer Control Module +

2 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option). EB+ Gen2/Gen3 Pressure Sensor (Option).

3 - EBS Modulators & Electronic Control Unit (Master)

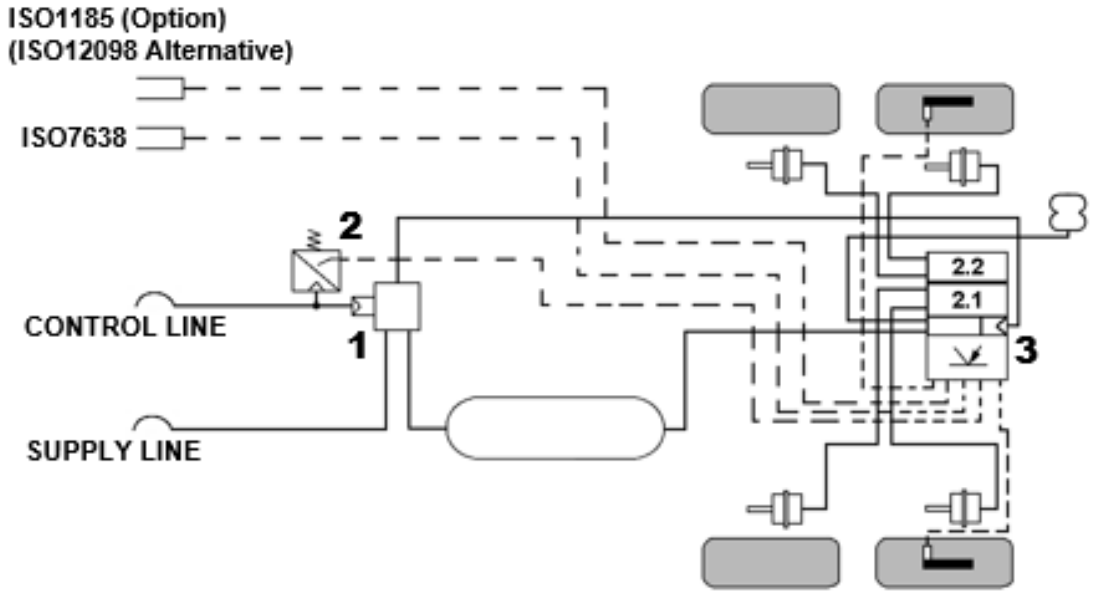
4 - EBS Modulator & Electronic Control Unit (Slave)

5 - Double Check Valve

6 - Quick Release Valve

EB+ Gen 1 & EB+ Gen 2/Gen 3 Brake System Installation Schematics

2S/2M Integrated Semi or Centre Axle Trailer Installation
Side by Side Installation

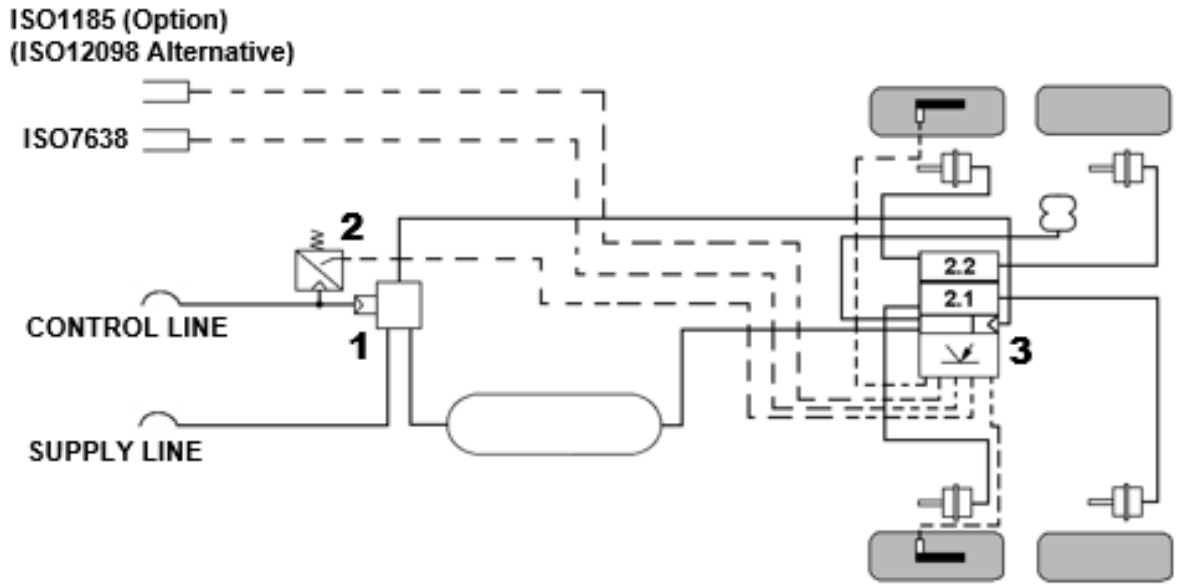


KEY:

1 - Emergency Relay Valve
2 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option)
or in case of EB+ Gen2/Gen3 Pressure Sensor (Option)
3 - EBS Modulators & Electronic Control Unit

EB+ Gen 1 & EB+ Gen 2/Gen 3 Brake System Installation Schematics

2S/2M Integrated Semi or Centre Axle Trailer Installation
Side by Side Installation



KEY:

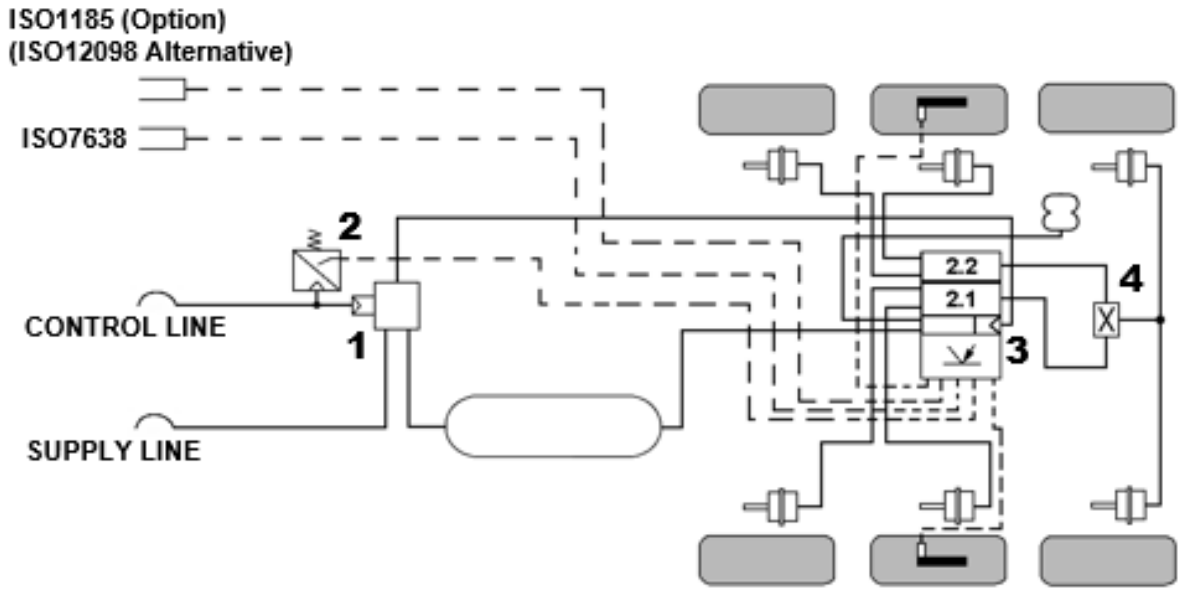
1 - Emergency Relay Valve
2 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option)
or in case of EB+ Gen2/Gen3 Pressure Sensor (Option)
3 - EBS Modulators & Electronic Control Unit

EB+ Gen 1 & EB+ Gen 2/Gen 3 Brake System Installation Schematics

2S/2M Integrated Semi or Centre Axle Trailer Installation

Side by Side Installation

(Select low valve)

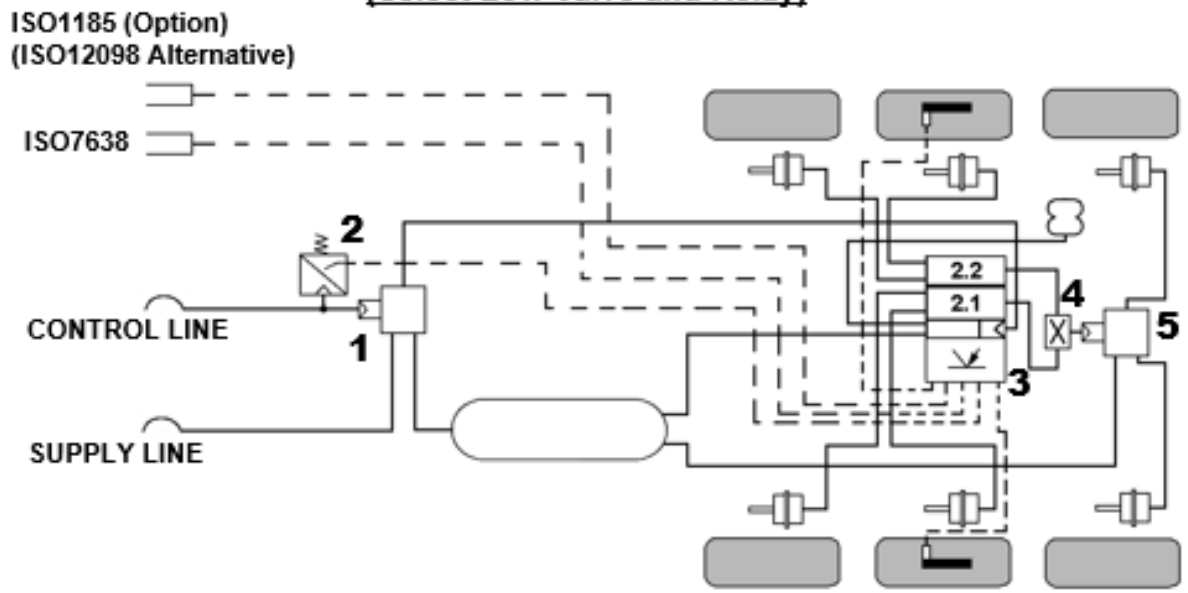


KEY:

1 - Emergency Relay Valve
2 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option)
or in case of EB+ Gen2/Gen3 Pressure Sensor (Option)
3 - EBS Modulators & Electronic Control Unit
4 - Select Low Valve

EB+ Gen 1 & EB+ Gen 2/Gen 3 Brake System Installation Schematics

2S/2M Integrated Semi or Centre Axle Trailer Installation
Side by Side Installation
(Select Low Valve and Relay)

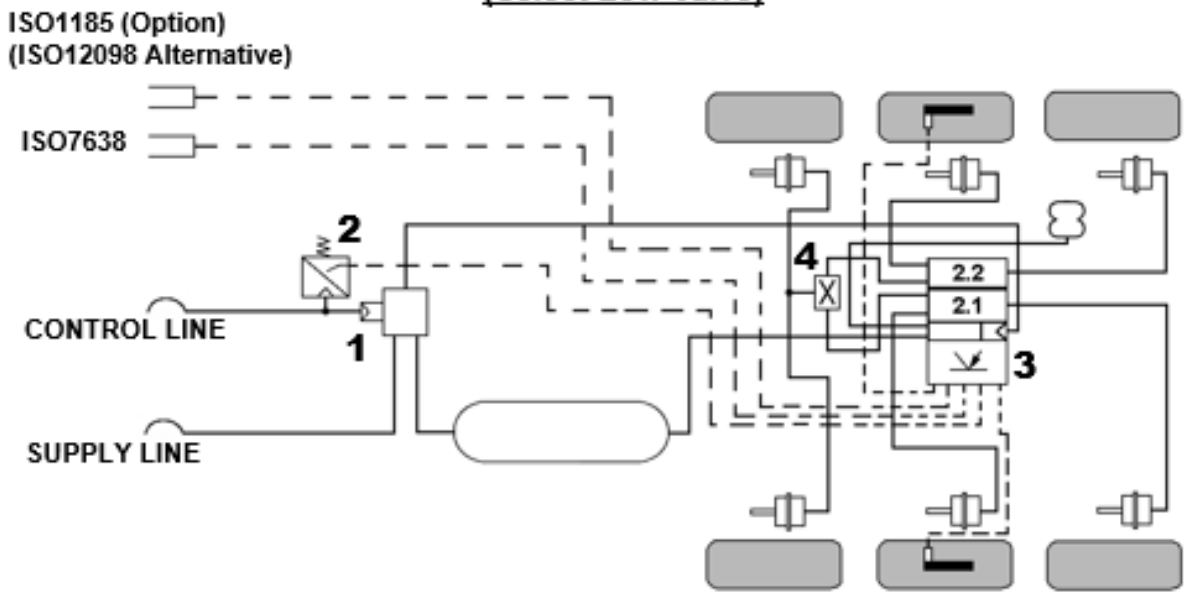


KEY:

1 - Emergency Relay Valve
2 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option)
or in case of EB+ Gen2/Gen3 Pressure Sensor (Option)
3 - EBS Modulators & Electronic Control Unit
4 - Select Low Valve
5 - Relay Valve

EB+ Gen 1 & EB+ Gen 2/Gen 3 Brake System Installation Schematics

2S/2M Integrated Semi or Centre Axle Trailer Installation
Side by Side Installation
(Select Low Valve)

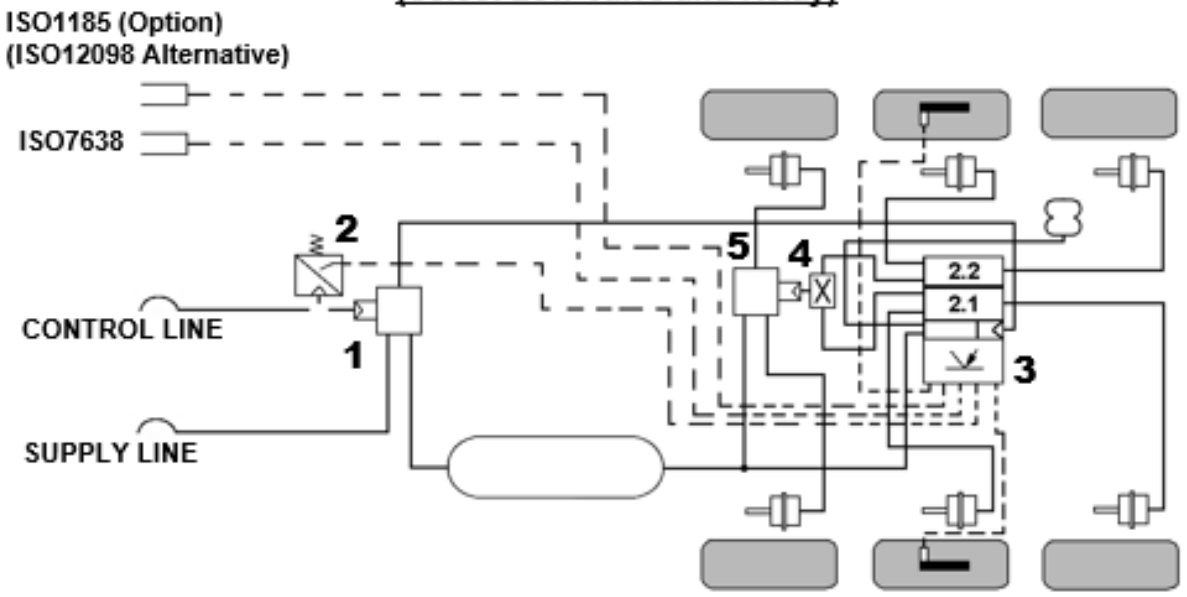


KEY:

1 - Emergency Relay Valve
2 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option)
or in case of EB+ Gen2/Gen3 Pressure Sensor (Option)
3 - EBS Modulators & Electronic Control Unit
4 - Select Low Valve

EB+ Gen 1 & EB+ Gen 2/Gen 3 Brake System Installation Schematics

2S/2M Integrated Semi or Centre Axle Trailer Installation
Side by Side Installation
(Select Low Valve and Relay)

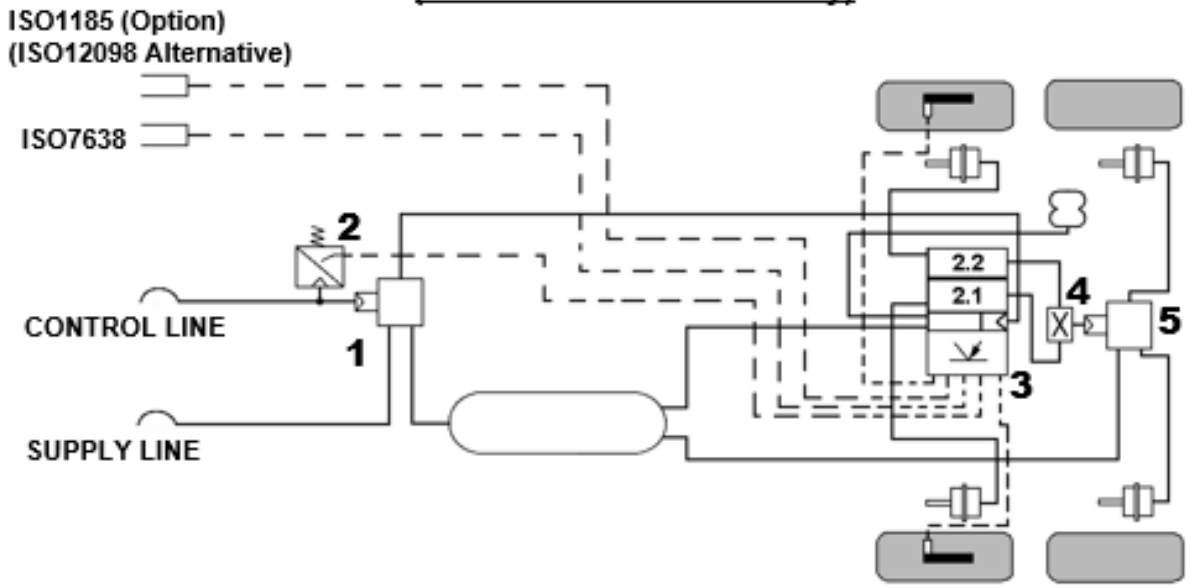


KEY:

1 - Emergency Relay Valve
2 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option)
or in case of EB+ Gen2/Gen3 Pressure Sensor (Option)
3 - EBS Modulators & Electronic Control Unit
4 - Select Low Valve
5 - Relay Valve

EB+ Gen 1 & EB+ Gen 2/Gen 3 Brake System Installation Schematics

2S/2M Integrated Semi or Centre Axle Trailer Installation
Side by Side Installation
(Select Low Valve and Relay)

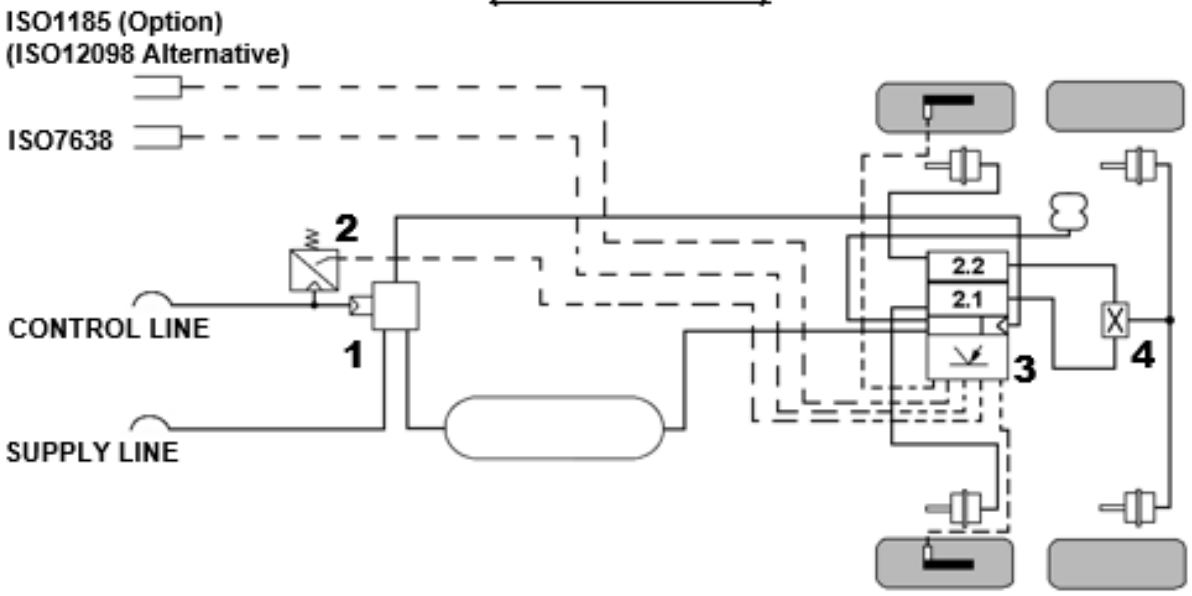


KEY:

1 - Emergency Relay Valve
2 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option)
or in case of EB+ Gen2/Gen3 Pressure Sensor (Option)
3 - EBS Modulators & Electronic Control Unit
4 - Select Low Valve
5 - Relay Valve

EB+ Gen 1 & EB+ Gen 2/Gen 3 Brake System Installation Schematics

2S/2M Integrated Semi or Centre Axle Trailer Installation
Side by Side Installation
(Select Low Valve)



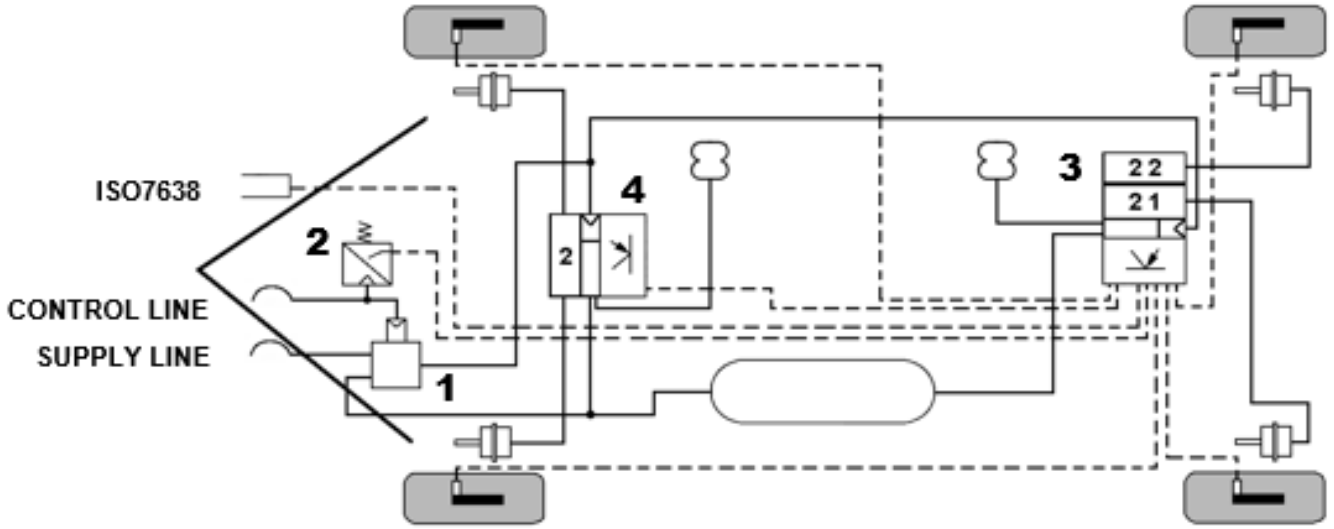
KEY:

1 - Emergency Relay Valve
2 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option)
or in case of EB+ Gen2/Gen3 Pressure Sensor (Option)
3 - EBS Modulators & Electronic Control Unit
4 - Select Low Valve

EB+ Gen 1 & EB+ Gen 2/Gen 3 Brake System Installation Schematics

4S/3M Integrated Full Trailer Installation

Side by Side Installation



KEY:

1 - Emergency Relay Valve

2 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option). EB+ Gen2/Gen3 Pressure Sensor (Option).

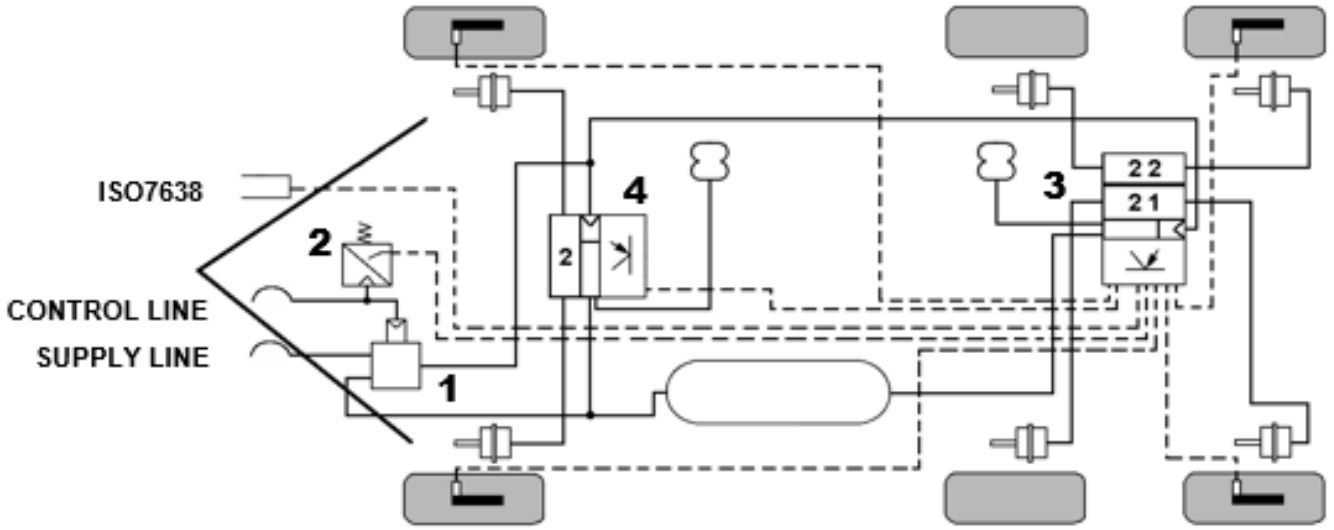
3 - EBS Modulators & Electronic Control Unit (Master)

4 - EBS Modulator & Electronic Control Unit (Slave)

EB+ Gen 1 & EB+ Gen 2/Gen 3 Brake System Installation Schematics

4S/3M Integrated Full Trailer Installation

Side by Side Installation



KEY:

1 - Emergency Relay Valve

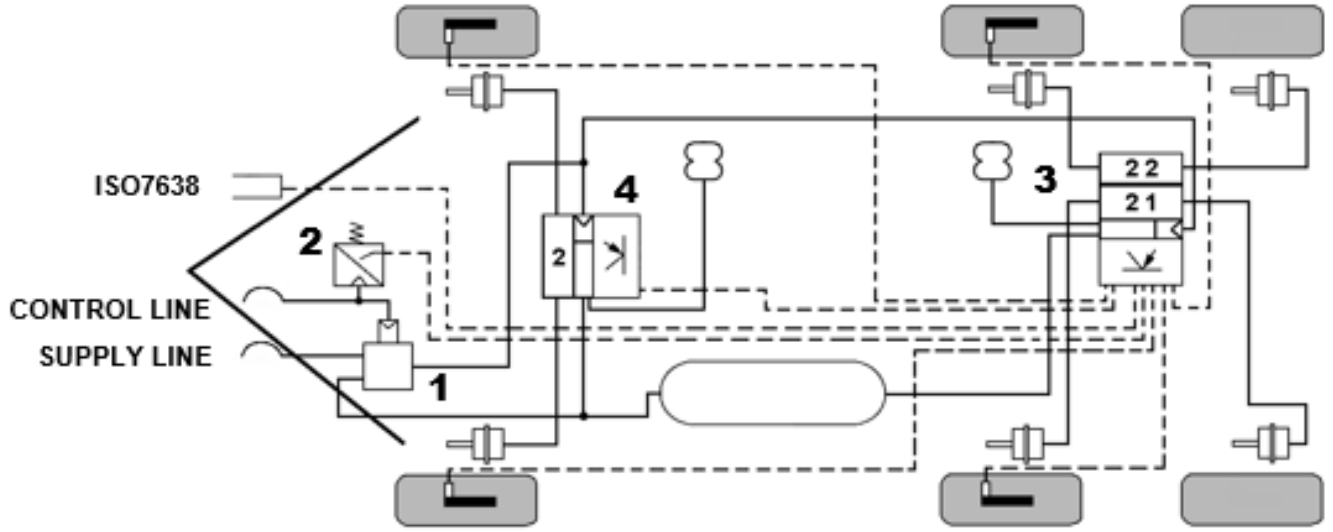
2 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option). EB+ Gen2/Gen3 Pressure Sensor (Option).

3 - EBS Modulators & Electronic Control Unit (Master)

4 - EBS Modulator & Electronic Control Unit (Slave)

EB+ Gen 1 & EB+ Gen 2/Gen 3 Brake System Installation Schematics

4S/3M Integrated Full Trailer Installation
Side by Side Installation



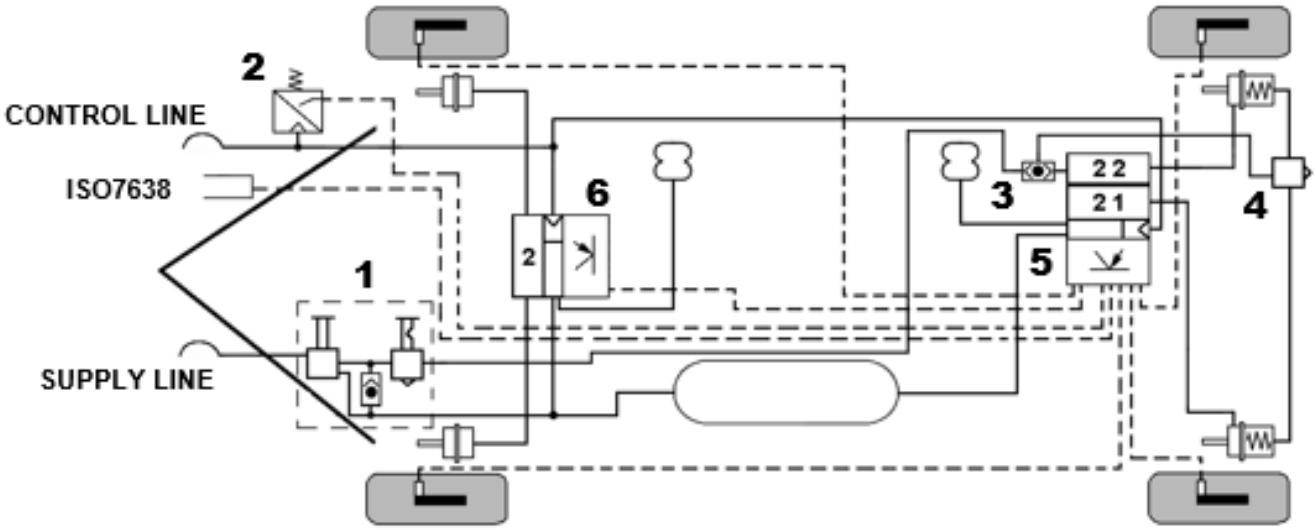
KEY:

1 - Emergency Relay Valve
2 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option). EB+ Gen2/Gen3 Pressure Sensor (Option).
3 - EBS Modulators & Electronic Control Unit (Master)
4 - EBS Modulator & Electronic Control Unit (Slave)

EB+ Gen 1 & EB+ Gen 2/Gen 3 Brake System Installation Schematics

4S/3M Integrated Full Trailer Installation

Side by Side Installation



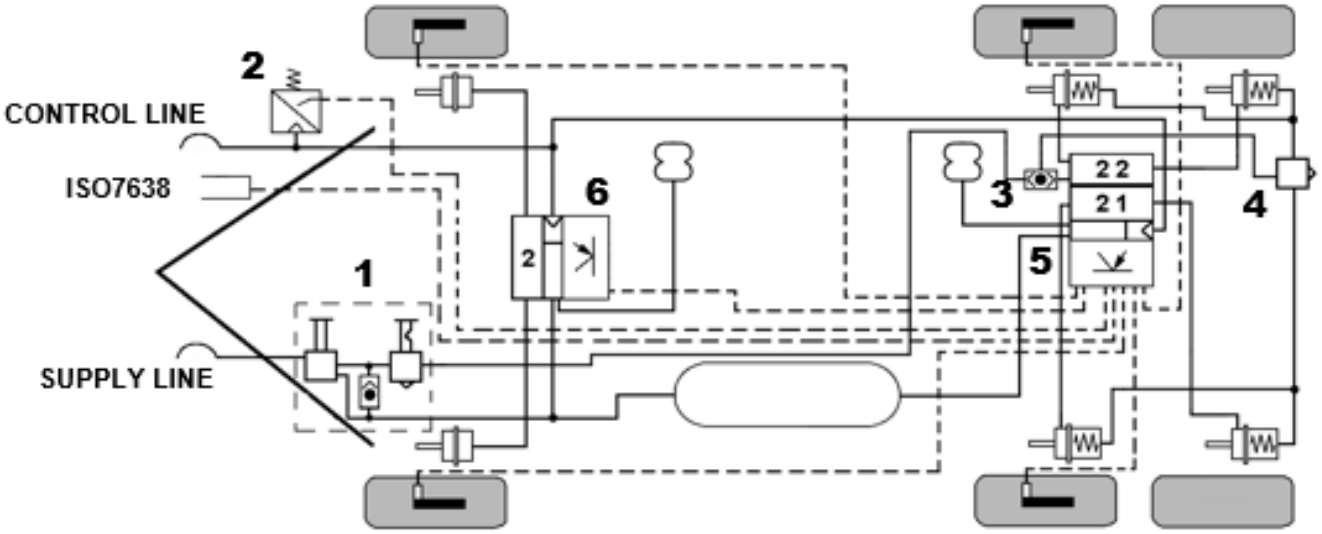
KEY:

1 - Combined Park & Shunt Valve (352 046 …)
2 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option). EB+ Gen2/Gen3 Pressure Sensor (Option).
3 - Double Check Valve
4 - Quick Release Valve
5 - EBS Modulators & Electronic Control Unit (Master)
6 - EBS Modulator & Electronic Control Unit (Slave)

EB+ Gen 1 & EB+ Gen 2/Gen 3 Brake System Installation Schematics

4S/3M Integrated Full Trailer Installation

Side by Side Installation



KEY:

1 - Combined Park & Shunt Valve (352 046 …)

2 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option). EB+ Gen2/Gen3 Pressure Sensor (Option).

3 - Double Check Valve

4 - Quick Release Valve

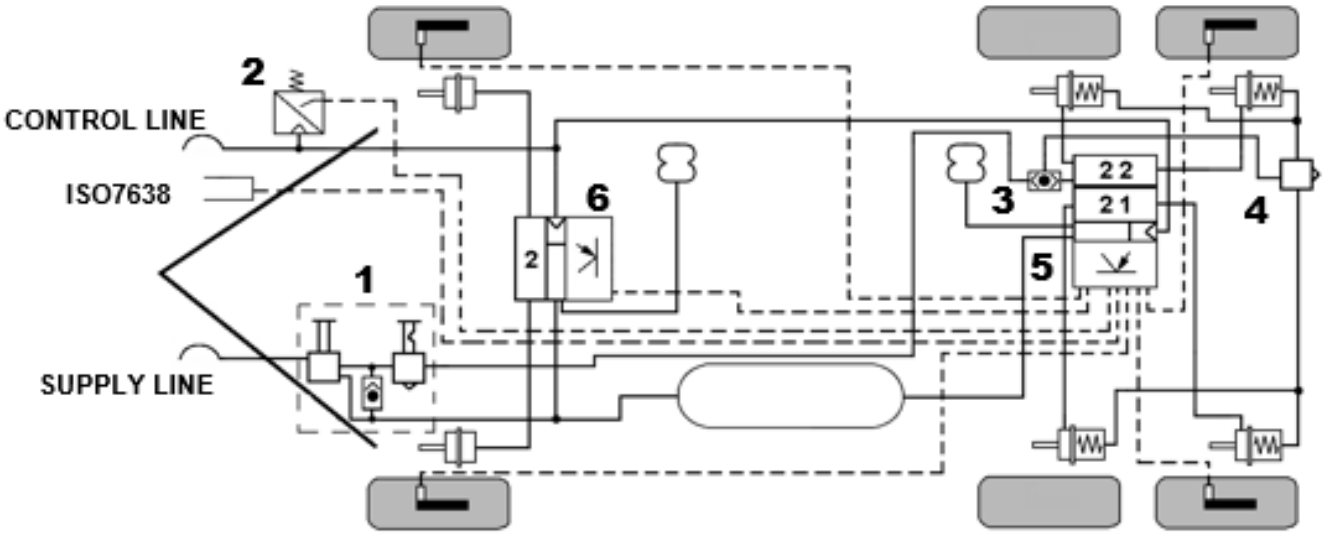
5 - EBS Modulators & Electronic Control Unit (Master)

6 - EBS Modulator & Electronic Control Unit (Slave)

EB+ Gen 1 & EB+ Gen 2/Gen 3 Brake System Installation Schematics

4S/3M Integrated Full Trailer Installation

Side by Side Installation



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KEY:

1 - Combined Park & Shunt Valve (352 046 …)

2 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option). EB+ Gen2/Gen3 Pressure Sensor (Option).

3 - Double Check Valve

4 - Quick Release Valve

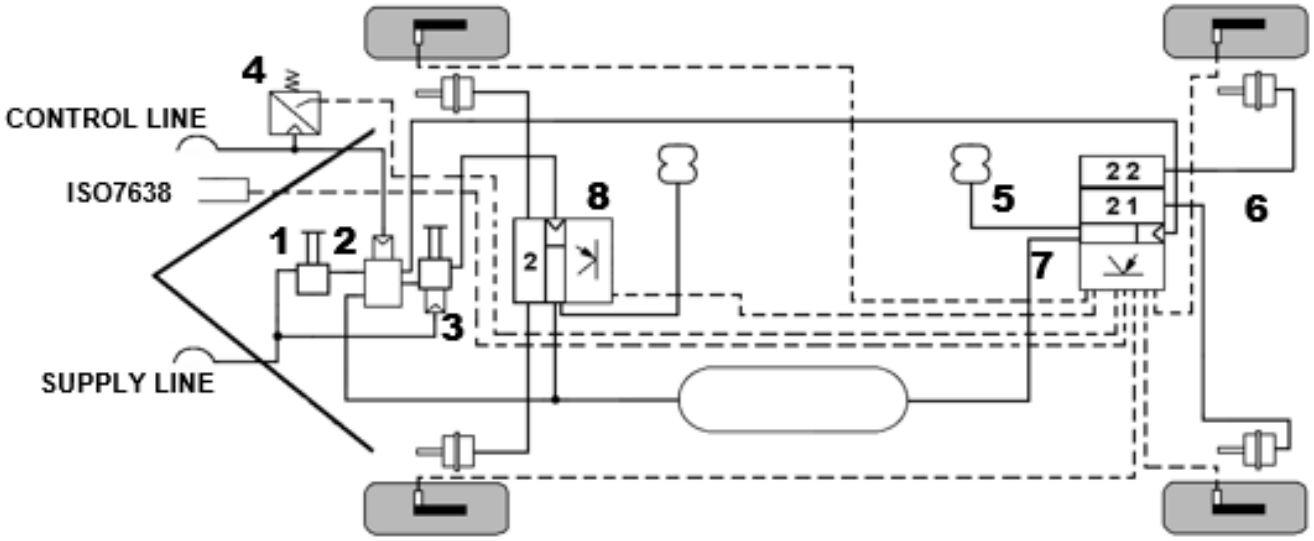
5 - EBS Modulators & Electronic Control Unit (Master)

6 - EBS Modulator & Electronic Control Unit (Slave)

EB+ Gen 1 & EB+ Gen 2/Gen 3 Brake System Installation Schematics

4S/3M Integrated Full Trailer Installation

Side by Side Installation



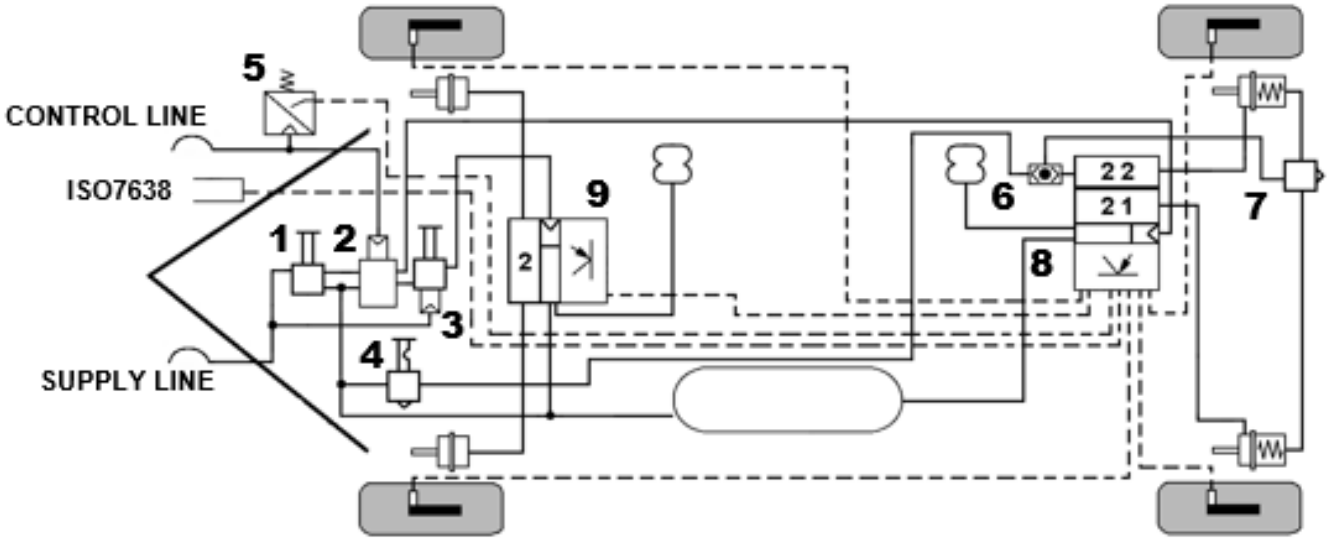
KEY:

1 - Shunt Valve
2 - Relay Emergency Valve
3 - Releases Valve
4 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option). EB+ Gen2/Gen3 Pressure Sensor (Option).
5 - Double Check Valve
6 - Quick Release Valve
7 - EBS Modulators & Electronic Control Unit (Master)
8 - EBS Modulator & Electronic Control Unit (Slave)

EB+ Gen 1 & EB+ Gen 2/Gen 3 Brake System Installation Schematics

4S/3M Integrated Full Trailer Installation

Side by Side Installation

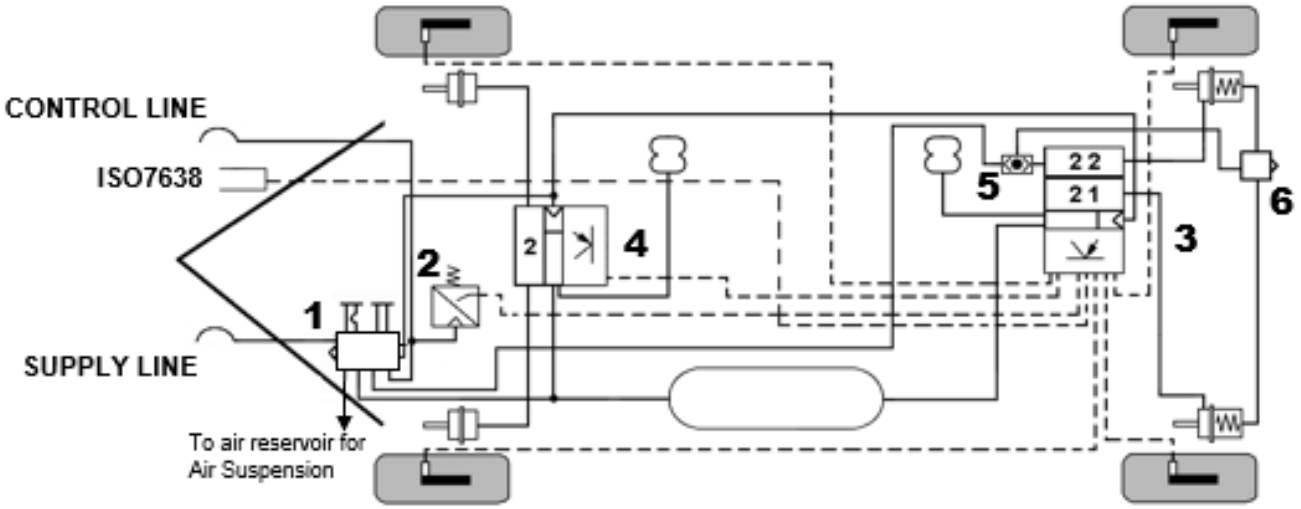


KEY:

1 - Shunt Valve
2 - Relay Emergency Valve
3 - Releases Valve
4 - Park Valve
5 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option). EB+ Gen2/Gen3 Pressure Sensor (Option).
6 - Double Check Valve
7 - Quick Release Valve
8 - EBS Modulators & Electronic Control Unit (Master)
9 - EBS Modulator & Electronic Control Unit (Slave)

EB+ Gen 1 & EB+ Gen 2/Gen 3 Brake System Installation Schematics

4S/3M Full Trailer Installation



KEY:

1 - Trailer Control Module +

2 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option). EB+ Gen2/Gen3 Pressure Sensor (Option).

3 - EBS Modulators & Electronic Control Unit (Master)

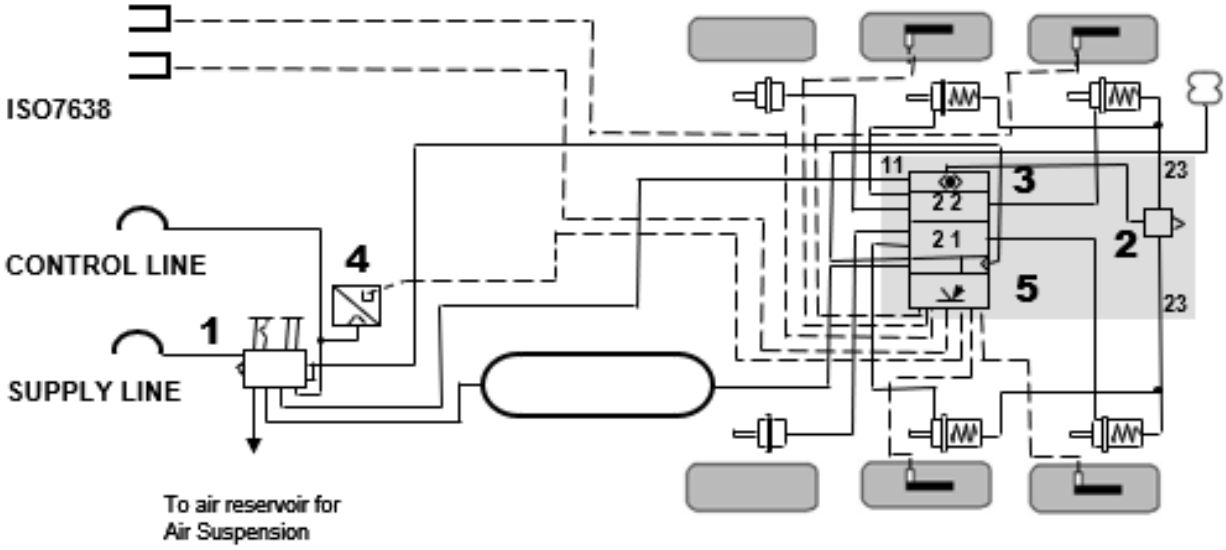
4 - EBS Modulator & Electronic Control Unit (Slave)

5 - Double Check Valve

6 - Quick Release Valve

EB+ Gen 2/Gen 3 Brake System Installation Schematics

4S/2M Semi or Centre Axle Trailer Installation with Integrated Double Check Valve and Quick Release Valve

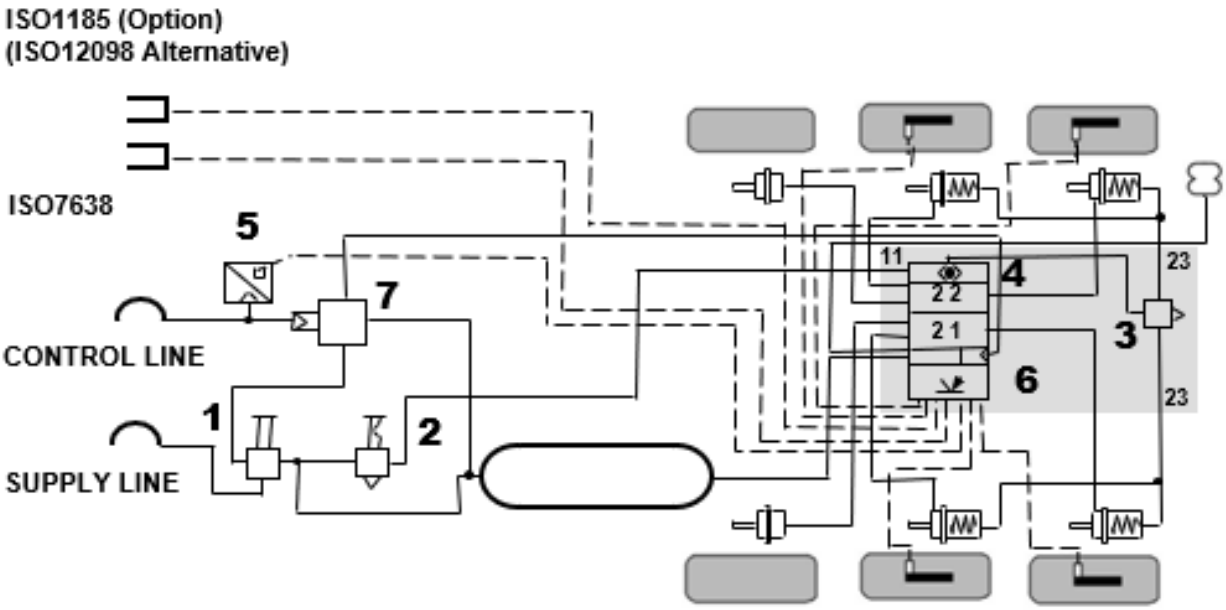


KEY:

1 - Trailer Control Module +
2 - Integrated Quick Release Valve (Option)
3 - Integrated Double Check Valve (Option)
4 - EB+ Gen2/Gen3 Pressure Sensor (Option)
5 - EBS Modulators & Electronic Control Unit

EB+ Gen 2/Gen 3 Brake System Installation Schematics

4S/2M Semi or Centre Axle Trailer Installation with Integrated Double Check Valve and Quick Release Valve

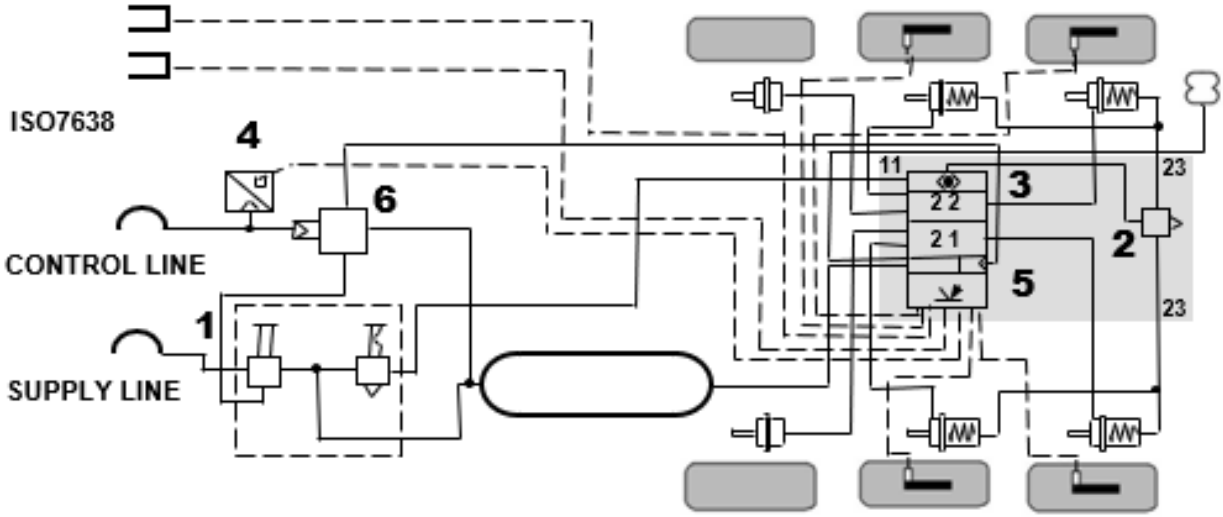


KEY:

1 - Shunt Valve
2 - Park Valve
3 - Integrated Quick Release Valve (Option)
4 - Integrated Double Check Valve (Option)
5 - EB+ Gen2/Gen3 Pressure Sensor (Option)
6 - EBS Modulators & Electronic Control Unit
7 - Relay Emergency Valve

EB+ Gen 2/Gen 3 Brake System Installation Schematics

4S/2M Semi or Centre Axle Trailer Installation with Integrated Double Check Valve and Quick Release Valve



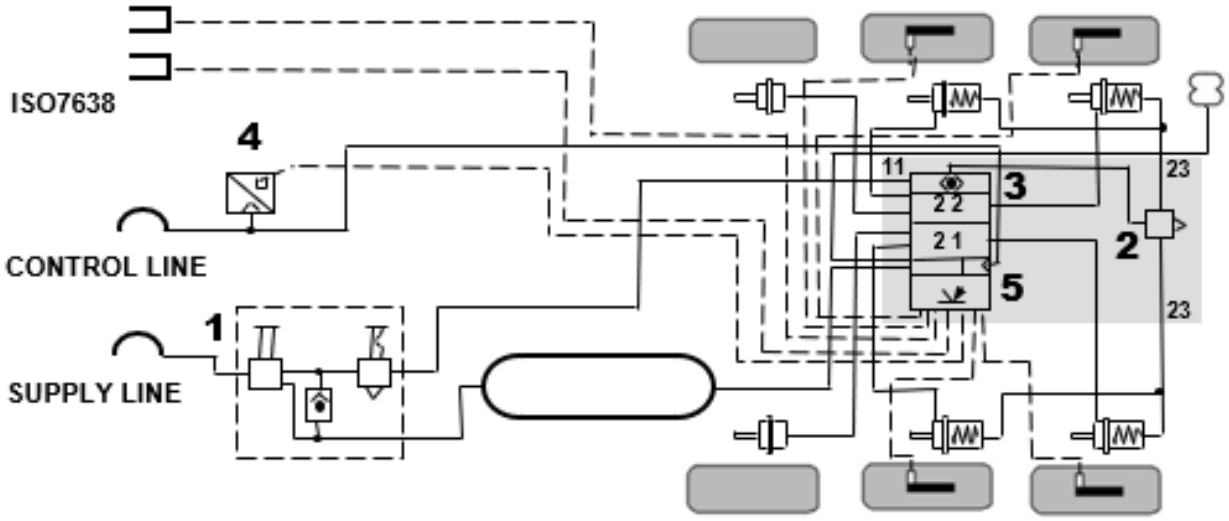
KEY:

1 - Combined Park & Shunt Valve (352 044 ...)
2 - Integrated Quick Release Valve (Option)
3 - Integrated Double Check Valve (Option)
4 - EB+ Gen2/Gen3 Pressure Sensor (Option)
5 - EBS Modulators & Electronic Control Unit
6 - Relay Emergency Valve

EB+ Gen 2/Gen 3 Brake System Installation Schematics

4S/2M Semi or Centre Axle Trailer Installation with Integrated double check valve and Quick Release Valve

ISO1185 (Option)
(ISO12098 Alternative)

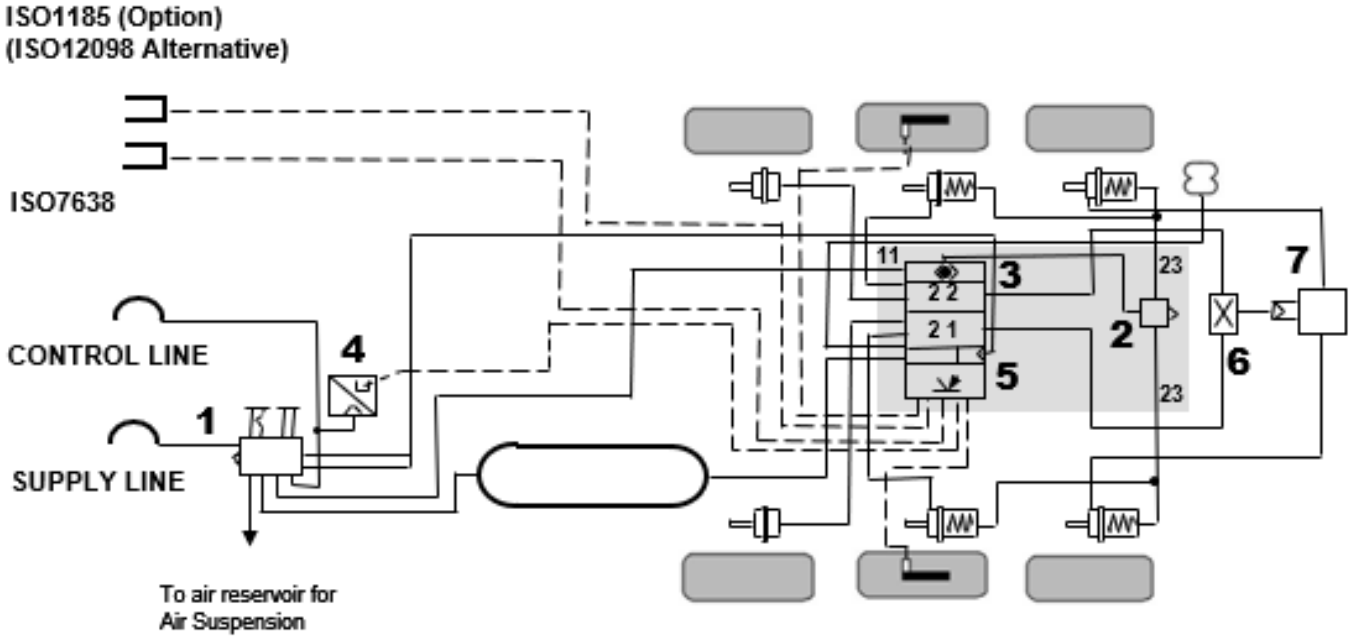


KEY:

1 - Combined Park & Shunt Valve (352 046 ...)
2 - Integrated Quick Release Valve (Option)
3 - Integrated Double Check Valve (Option)
4 - EB+ Gen2/Gen3 Pressure Sensor (Option)
5 - EBS Modulators & Electronic Control Unit

EB+ Gen 2/Gen 3 Brake System Installation Schematics

2S/2M Semi or Centre Axle Trailer Installation with Select Low Valve and Relay Valve

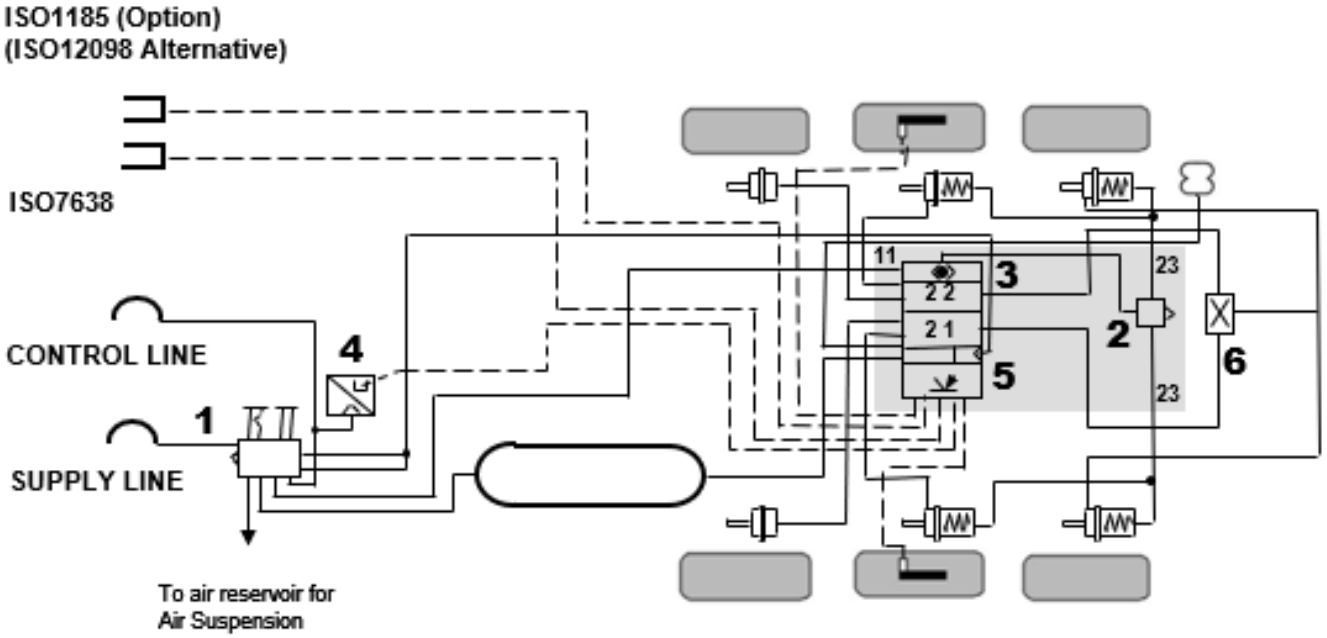


KEY:

1 - Trailer Control Module +
2 - Integrated Quick Release Valve (Option)
3 - Integrated Double Check Valve (Option)
4 - EB+ Gen2/Gen3 Pressure Sensor (Option)
5 - EBS Modulators & Electronic Control Unit
6 - Select Low Valve
7 - Relay Valve

EB+ Gen 2/Gen 3 Brake System Installation Schematics

2S/2M Semi or Centre Axle Trailer Installation with Select Low Valve

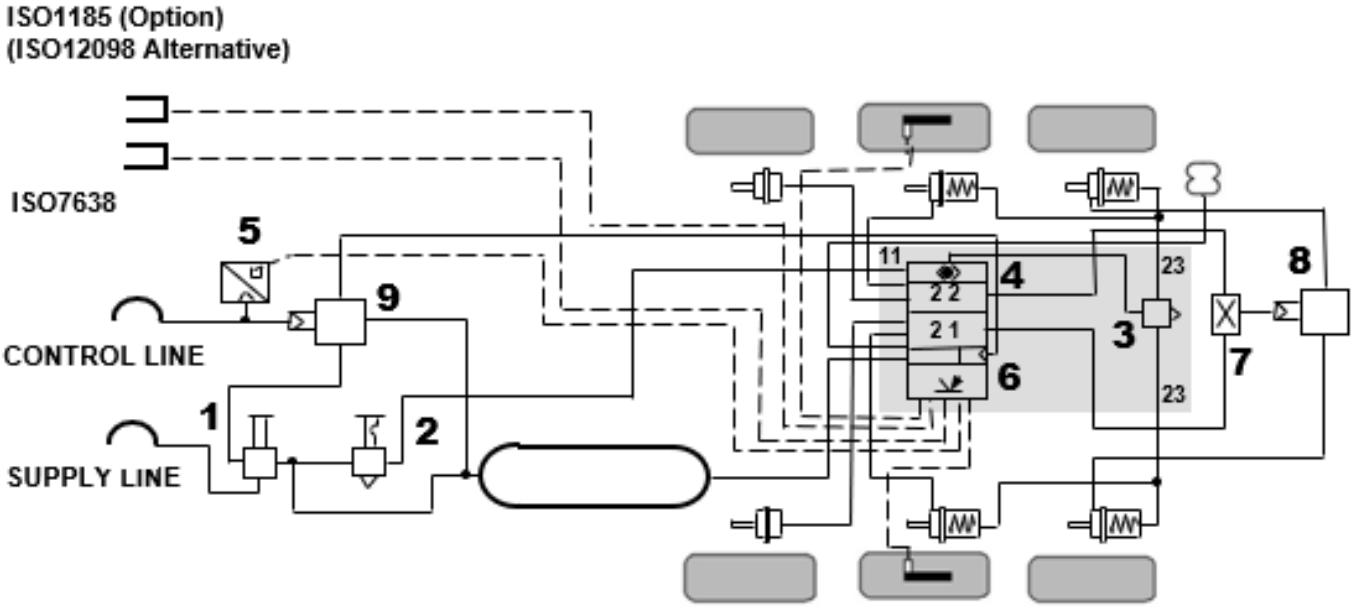


KEY:

1 - Trailer Control Module +
2 - Integrated Quick Release Valve (Option)
3 - Integrated Double Check Valve (Option)
4 - EB+ Gen2/Gen3 Pressure Sensor (Option)
5 - EBS Modulators & Electronic Control Unit
6 - Select Low Valve

EB+ Gen 2/Gen 3 Brake System Installation Schematics

2S/2M Semi or Centre Axle Trailer Installation with Select Low Valve and Relay Valve

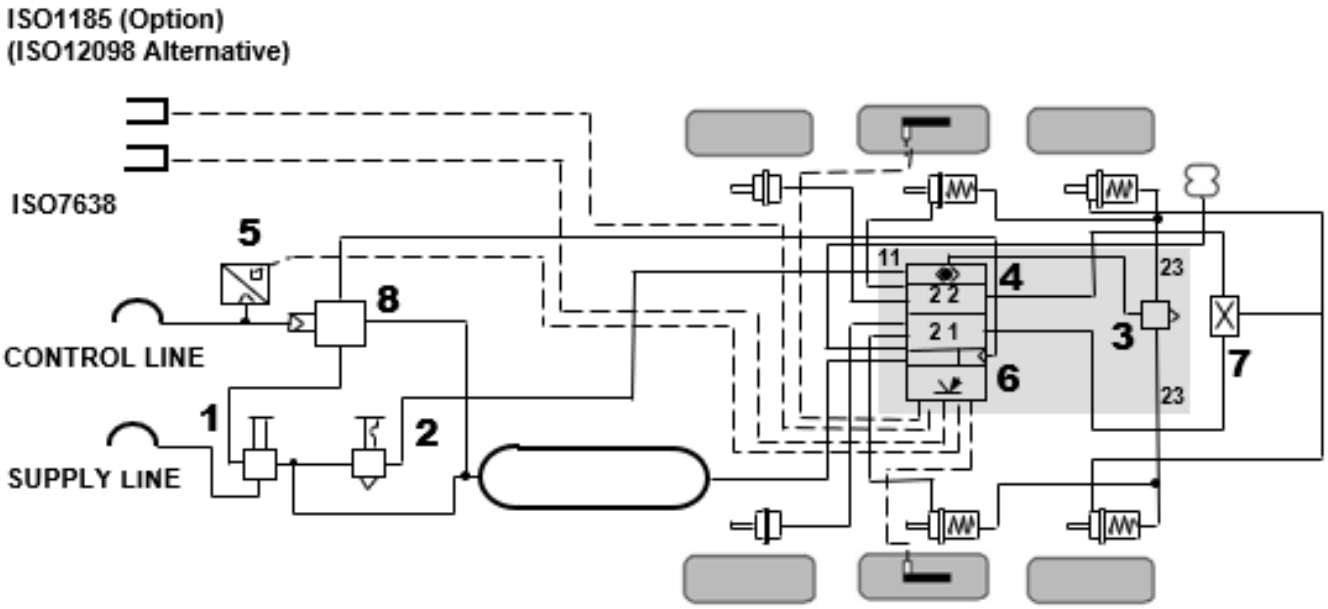


KEY:

1 - Shunt Valve
2 - Park Valve
3 - Integrated Quick Release Valve (Option)
4 - Integrated Double Check Valve (Option)
5 - EB+ Gen2/Gen 3 Pressure Sensor (Option)
6 - EBS Modulators & Electronic Control Unit
7 - Select Low Valve
8 - Relay Valve
9 - Relay Emergency Valve

EB+ Gen 2/Gen 3 Brake System Installation Schematics

2S/2M Semi or Centre Axle Trailer Installation with Select Low Valve



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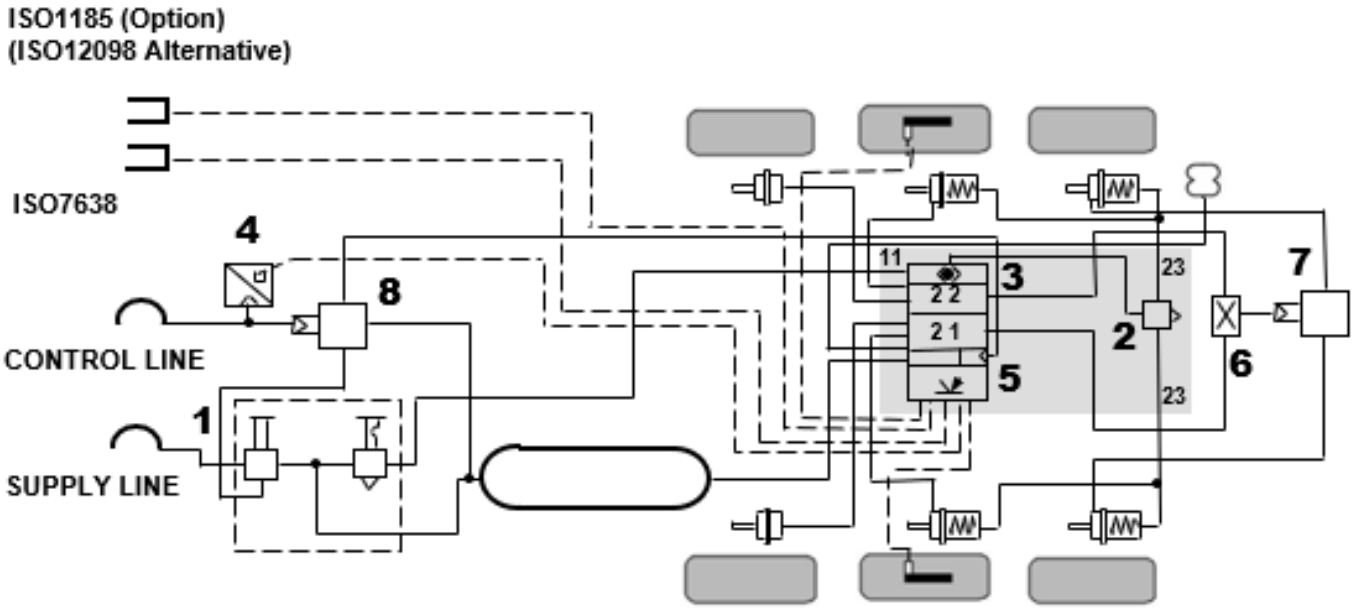
KEY:

1 - Shunt Valve
2 - Park Valve
3 - Integrated Quick Release Valve (Option)
4 - Integrated Double Check Valve (Option)
5 - EB+ Gen2/Gen3 Pressure Sensor (Option)
6 - EBS Modulators & Electronic Control Unit
7 - Select Low Valve
8 - Relay Emergency Valve

EB+ Gen 2/Gen 3 Brake System Installation Schematics

2S/2M Semi or Centre Axle Trailer Installation with Select Low Valve and Relay Valve

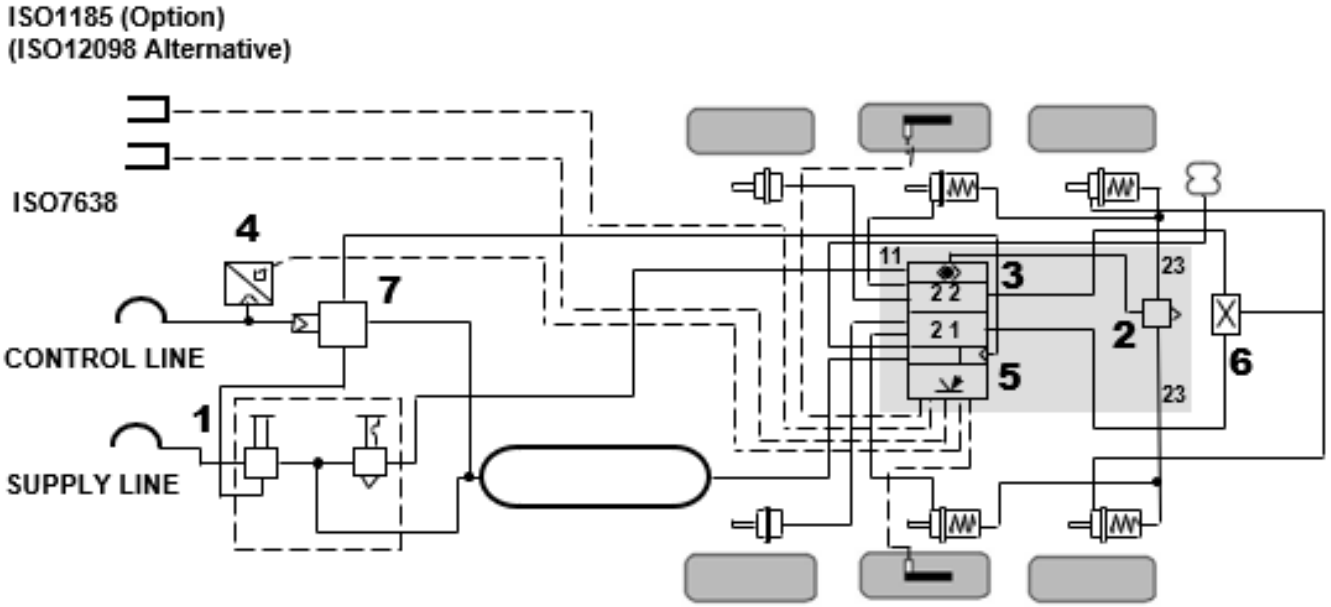


KEY:

1 - Combined Park & Shunt Valve (352 044 ...)
2 - Integrated Quick Release Valve (Option)
3 - Integrated Double Check Valve (Option)
4 - EB+ Gen2/Gen3 Pressure Sensor (Option)
5 - EBS Modulators & Electronic Control Unit
6 - Select Low Valve
7 - Relay Valve
8 - Relay Emergency Valve

EB+ Gen 2/Gen 3 Brake System Installation Schematics

2S/2M Semi or Centre Axle Trailer Installation with Select Low Valve and Relay

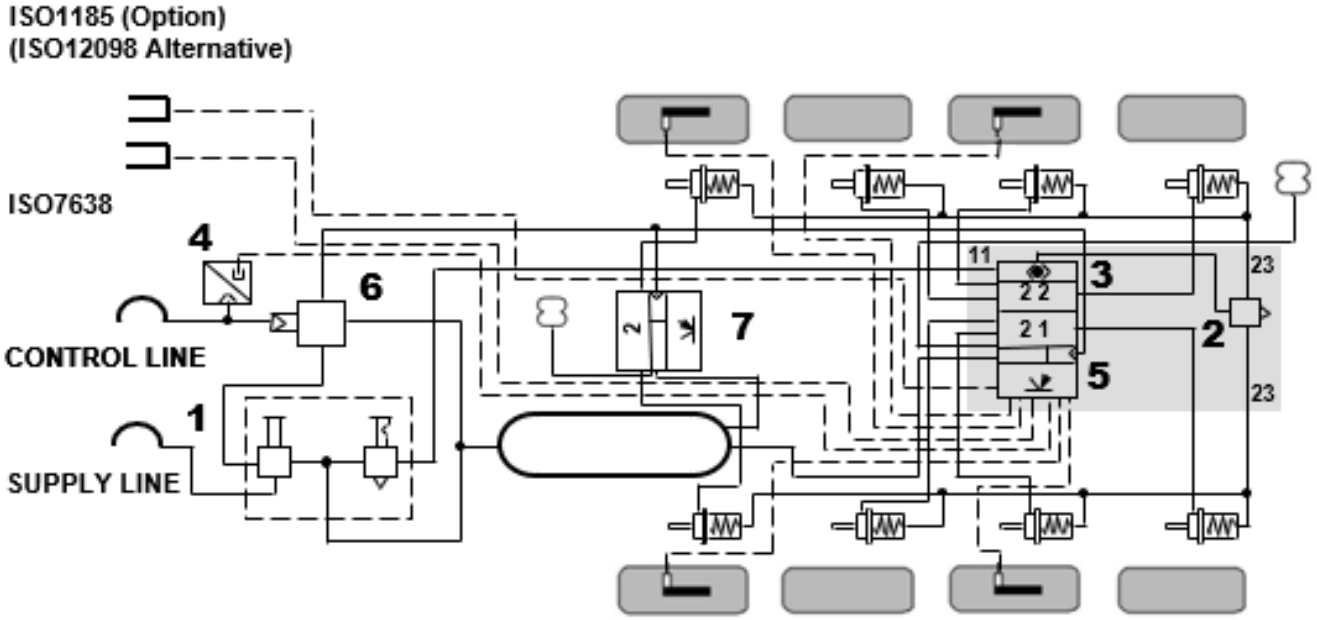


KEY:

1 - Combined Park & Shunt Valve (352 044 ...)
2 - Integrated Quick Release Valve (Option)
3 - Integrated Double Check Valve (Option)
4 - EB+ Gen2/Gen3 Pressure Sensor (Option)
5 - EBS Modulators & Electronic Control Unit
6 - Select Low Valve
7 - Relay Emergency Valve

EB+ Gen 2/Gen 3 Brake System Installation Schematics

4S/3M Semi or Centre Axle Trailer Installation

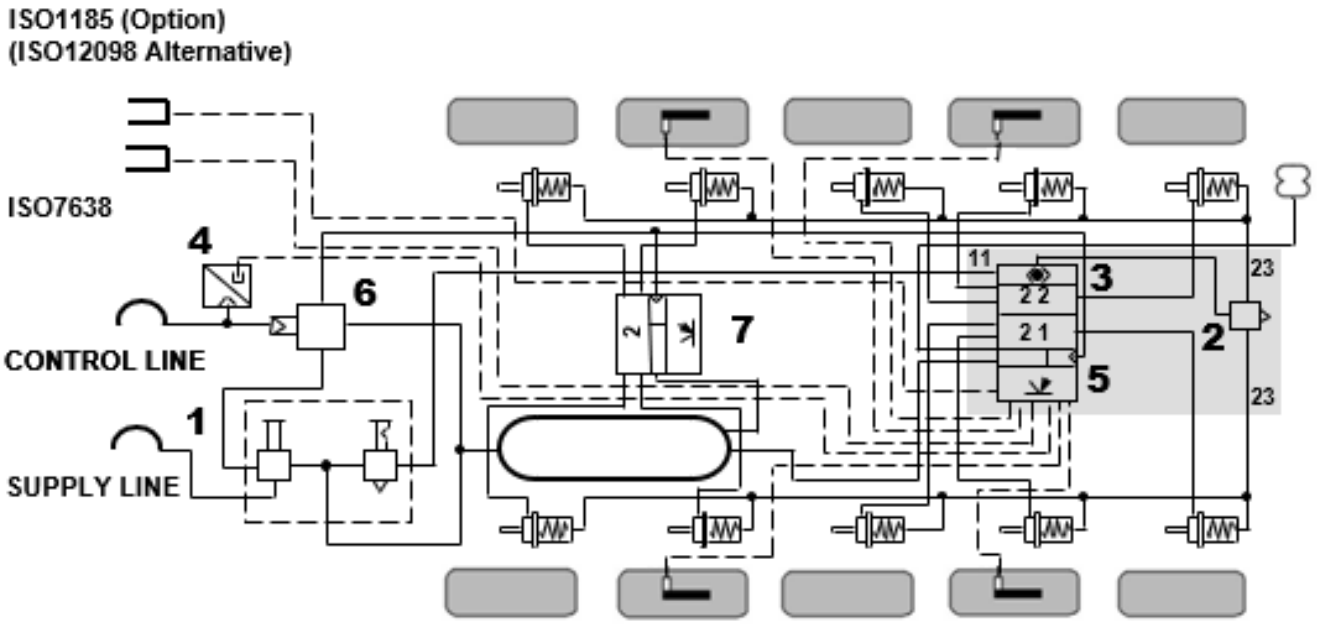


KEY:

1 - Combined Park & Shunt Valve (352 044 ...)
2 - Integrated Quick Release Valve (Option)
3 - Integrated Double Check Valve (Option)
4 - EB+ Gen2/Gen3 Pressure Sensor (Option)
5 - EBS Modulators & Electronic Control Unit (Master)
6 - Relay Emergency Valve
7 - EBS Modulator & Electronic Control Unit (Slave)

EB+ Gen 2/Gen 3 Brake System Installation Schematics

4S/3M Semi or Centre Axle Trailer Installation

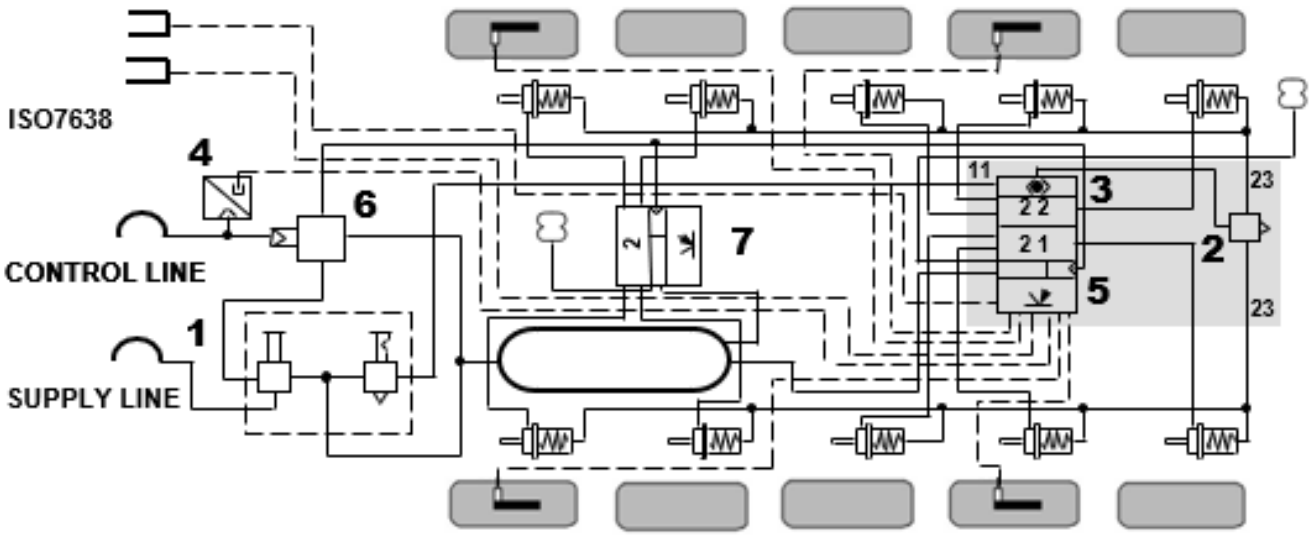


KEY:

1 - Combined Park & Shunt Valve (352 044 ...)
2 - Integrated Quick Release Valve (Option)
3 - Integrated Double Check Valve (Option)
4 - EB+ Gen2/Gen3 Pressure Sensor (Option)
5 - EBS Modulators & Electronic Control Unit (Master)
6 - Relay Emergency Valve
7 - EBS Modulators & Electronic Control Unit (Slave)

EB+ Gen 2/Gen 3 Brake System Installation Schematics

4S/3M Semi or Centre Axle Trailer Installation

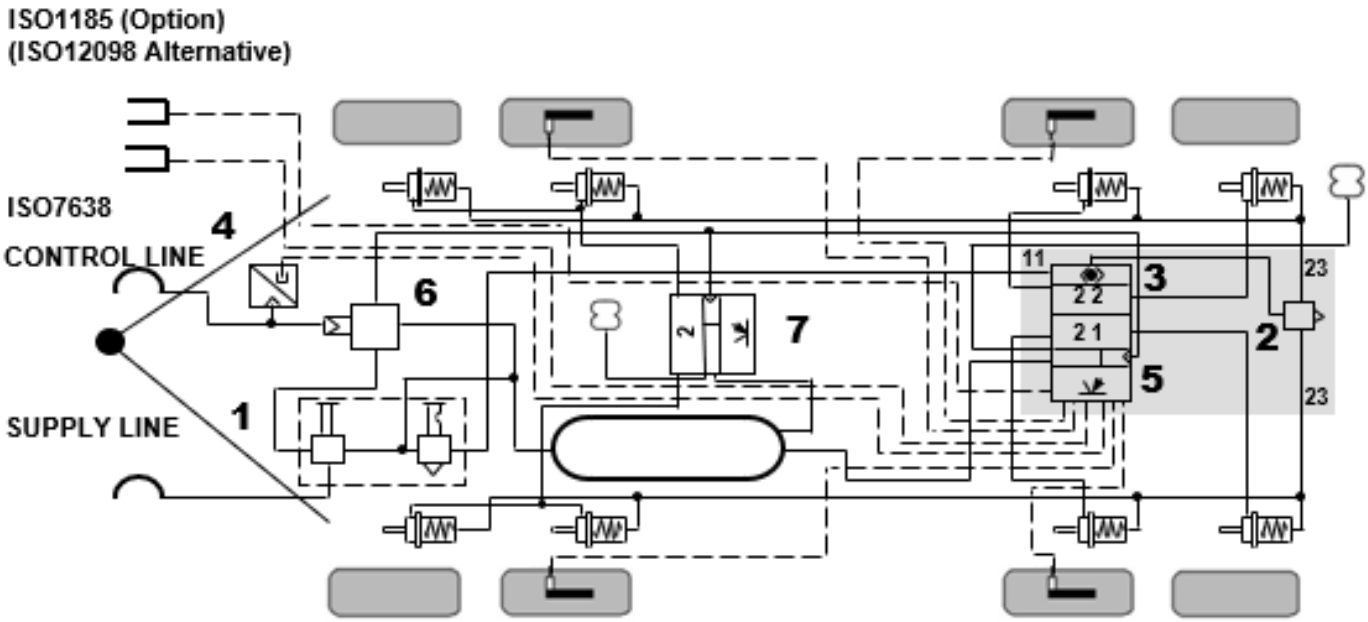


KEY:

1 - Combined Park & Shunt Valve (352 044 ...)
2 - Integrated Quick Release Valve (Option)
3 - Integrated Double Check Valve (Option)
4 - EB+ Gen2/Gen3 Pressure Sensor (Option)
5 - EBS Modulators & Electronic Control Unit (Master)
6 - Relay Emergency Valve
7 - EBS Modulators & Electronic Control Unit (Slave)

EB+ Gen 2/Gen 3 Brake System Installation Schematics

4S/3M Full Trailer Installation



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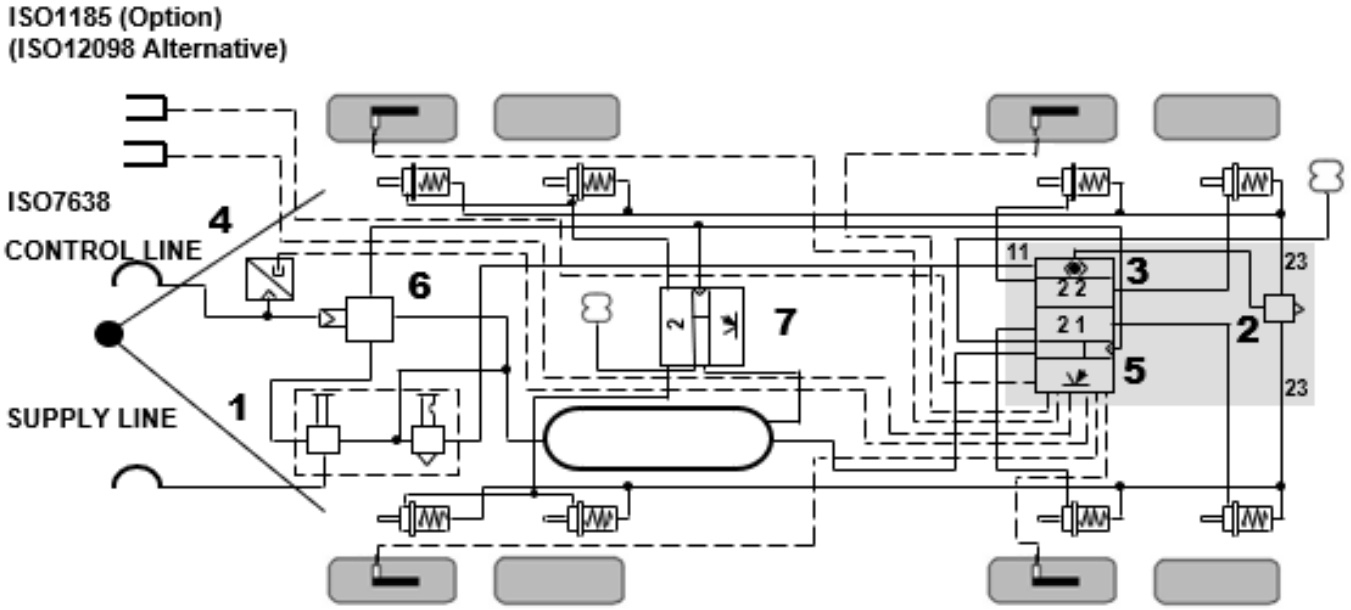
KEY:

1 - Combined Park & Shunt Valve (352 044 ...)
2 - Integrated Quick Release Valve (Option)
3 - Integrated Double Check Valve (Option)
4 - EB+ Gen2/Gen3 Pressure Sensor (Option)
5 - EBS Modulators & Electronic Control Unit (Master)
6 - Relay Emergency Valve
7 - EBS Modulator & Electronic Control Unit (Slave)

EB+ Gen 2/Gen 3 Brake System Installation Schematics

4S/3M Full Trailer Installation

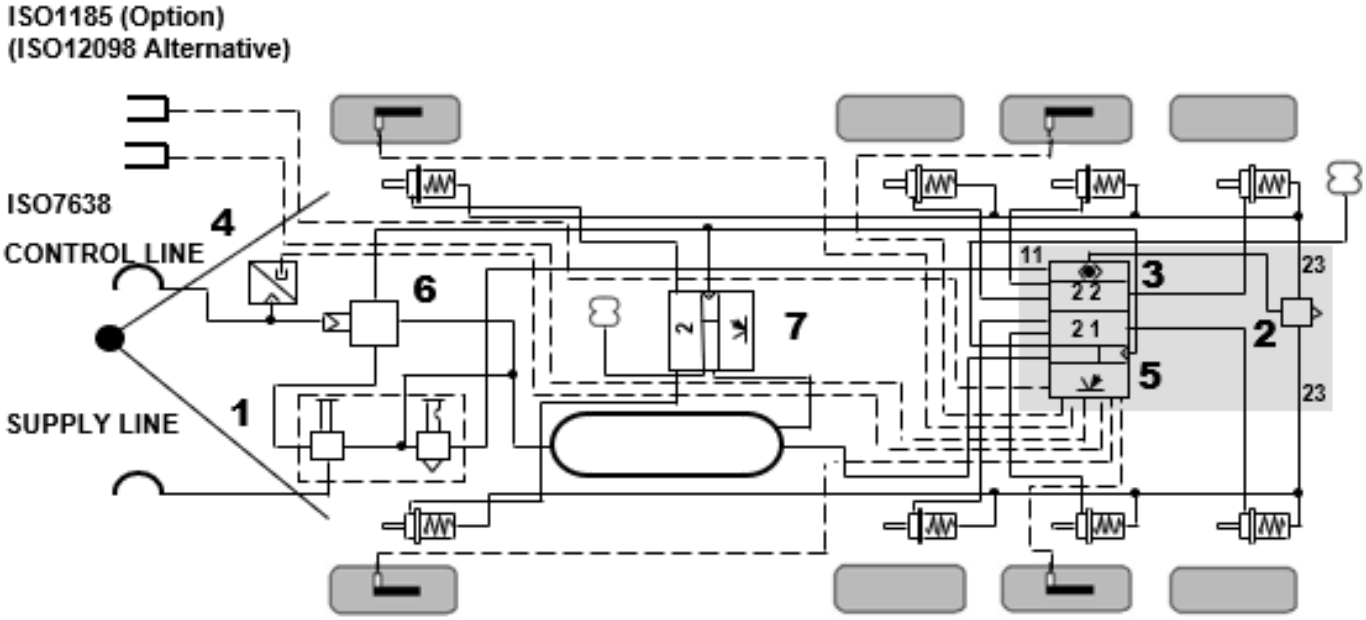


KEY:

1 - Combined Park & Shunt Valve (352 044 ...)
2 - Integrated Quick Release Valve (Option)
3 - Integrated Double Check Valve (Option)
4 - EB+ Gen2/Gen3 Pressure Sensor (Option)
5 - EBS Modulators & Electronic Control Unit (Master)
6 - Relay Emergency Valve
7 - EBS Modulator & Electronic Control Unit (Slave)

EB+ Gen 2/Gen 3 Brake System Installation Schematics

4S/3M Full Trailer Installation

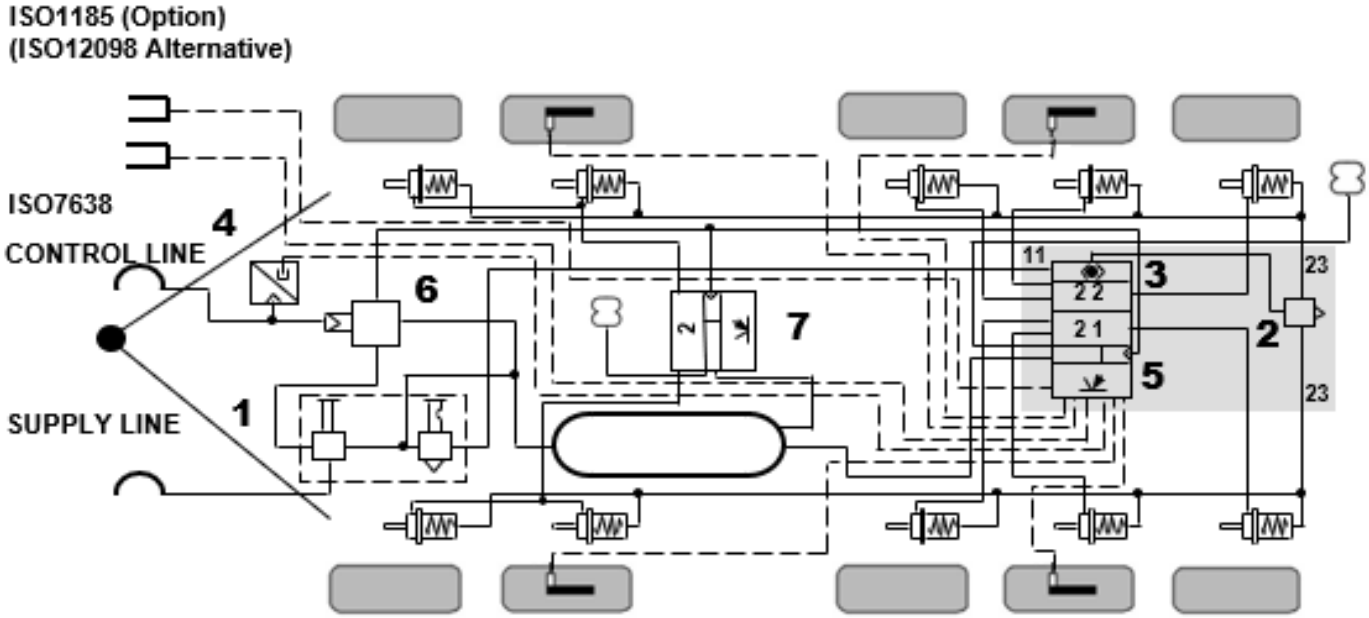


KEY:

1 - Combined Park & Shunt Valve (352 044 ...)
2 - Integrated Quick Release Valve (Option)
3 - Integrated Double Check Valve (Option)
4 - EB+ Gen2/Gen3 Pressure Sensor (Option)
5 - EBS Modulators & Electronic Control Unit (Master)
6 - Relay Emergency Valve
7 - EBS Modulator & Electronic Control Unit (Slave)

EB+ Gen 2/Gen 3 Brake System Installation Schematics

4S/3M Full Trailer Installation

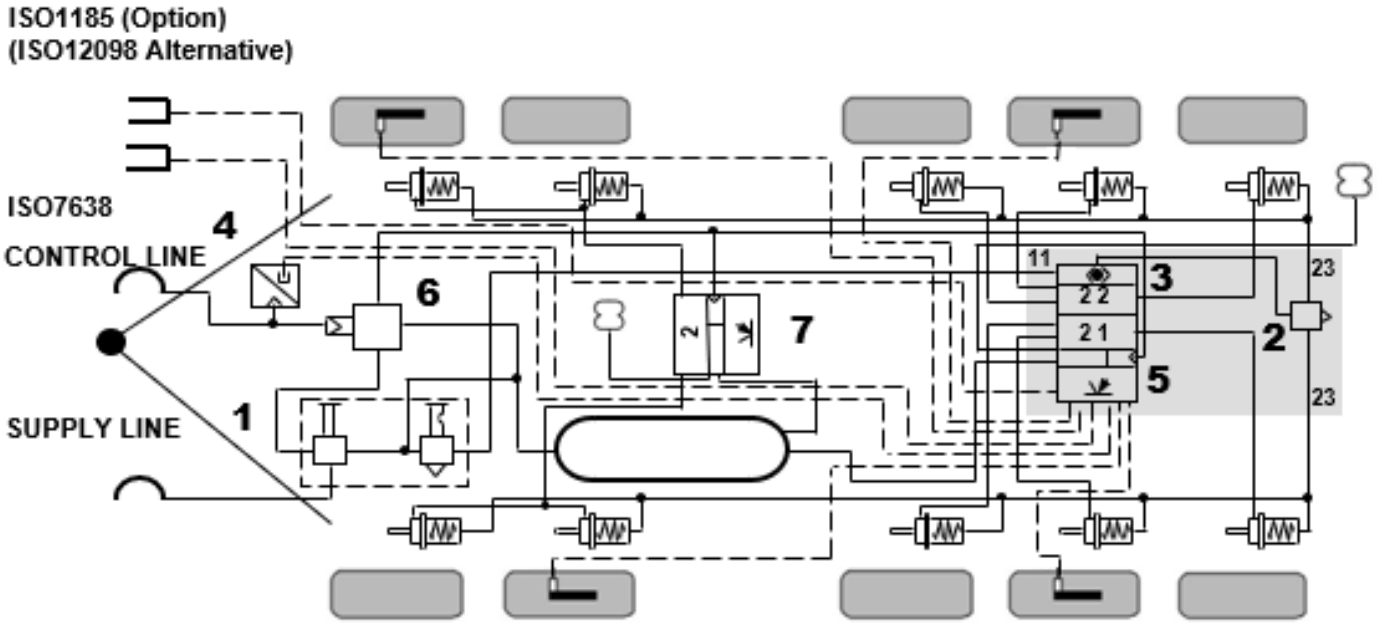


KEY:

1 - Combined Park & Shunt Valve (352 044 ...)
2 - Integrated Quick Release Valve (Option)
3 - Integrated Double Check Valve (Option)
4 - EB+ Gen2/Gen3 Pressure Sensor (Option)
5 - EBS Modulators & Electronic Control Unit (Master)
6 - Relay Emergency Valve
7 - EBS Modulator & Electronic Control Unit (Slave)

EB+ Gen 2/Gen 3 Brake System Installation Schematics

4S/3M Full Trailer Installation

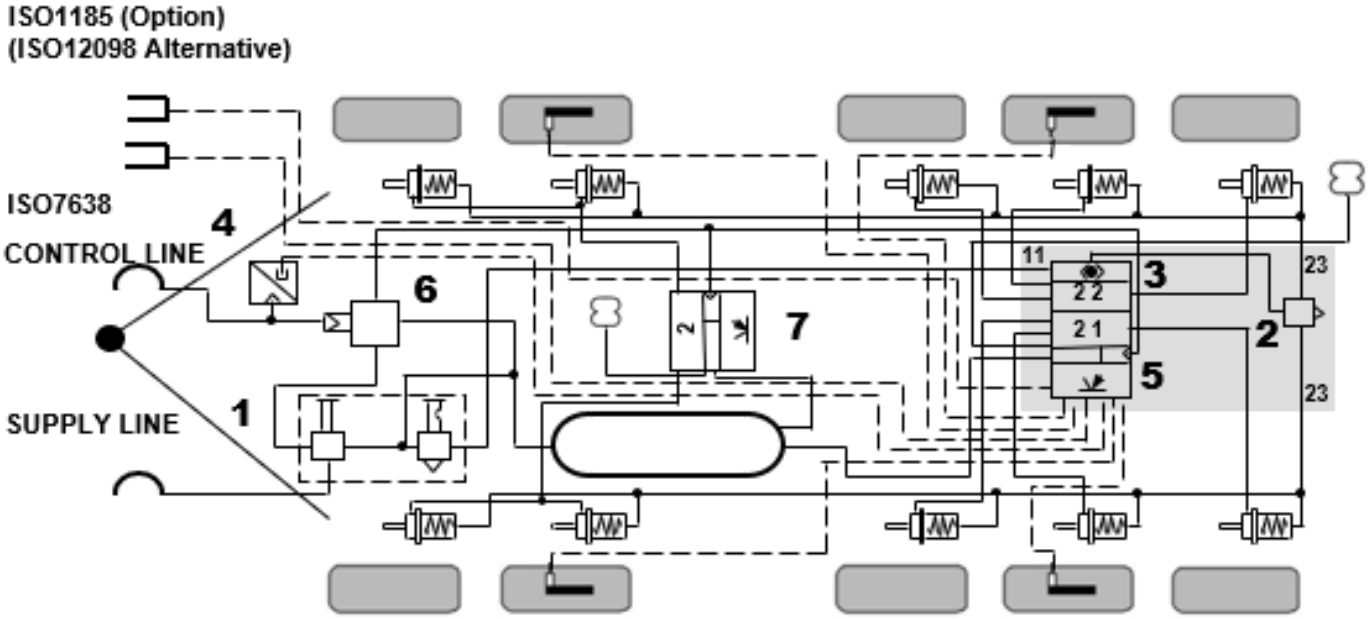


KEY:

1 - Combined Park & Shunt Valve (352 044 ...)
2 - Integrated Quick Release Valve (Option)
3 - Integrated Double Check Valve (Option)
4 - EB+ Gen2/Gen3 Pressure Sensor (Option)
5 - EBS Modulators & Electronic Control Unit (Master)
6 - Relay Emergency Valve
7 - EBS Modulator & Electronic Control Unit (Slave)

EB+ Gen 2/Gen 3 Brake System Installation Schematics

4S/3M Full Trailer Installation

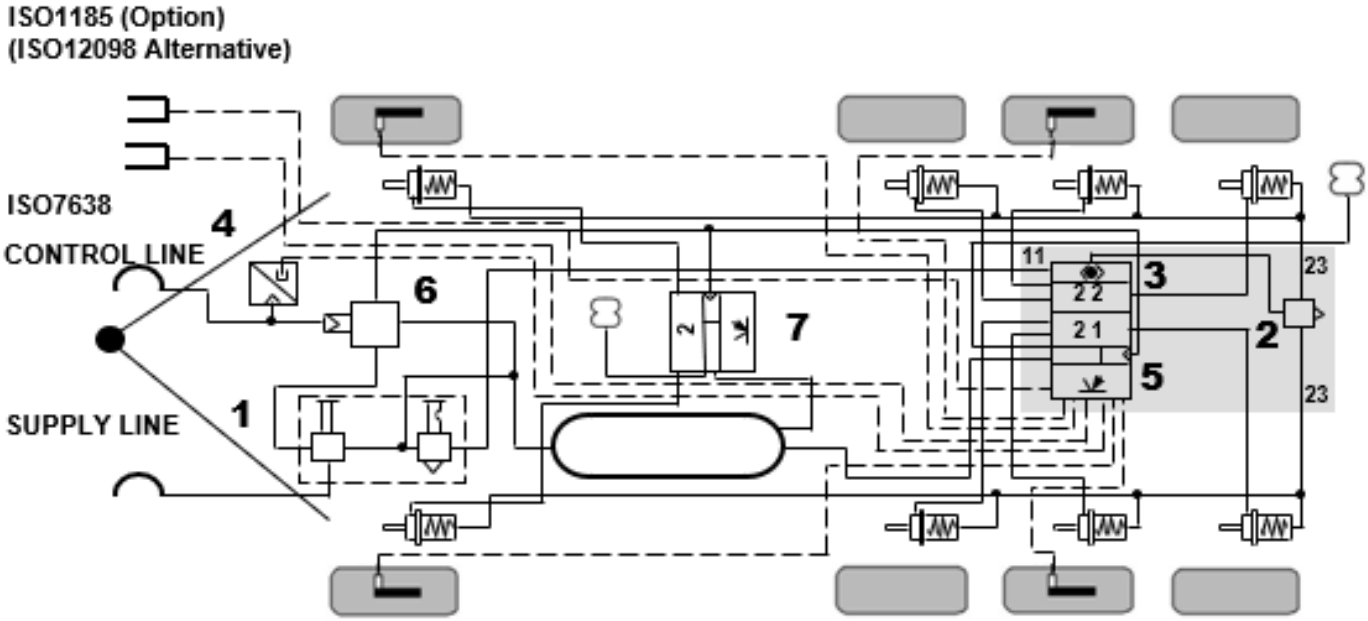


KEY:

1 - Combined Park & Shunt Valve (352 044 ...)
2 - Integrated Quick Release Valve (Option)
3 - Integrated Double Check Valve (Option)
4 - EB+ Gen2/Gen3 Pressure Sensor (Option)
5 - EBS Modulators & Electronic Control Unit (Master)
6 - Relay Emergency Valve
7 - EBS Modulator & Electronic Control Unit (Slave)

EB+ Gen 2/Gen 3 Brake System Installation Schematics

4S/3M Full Trailer Installation



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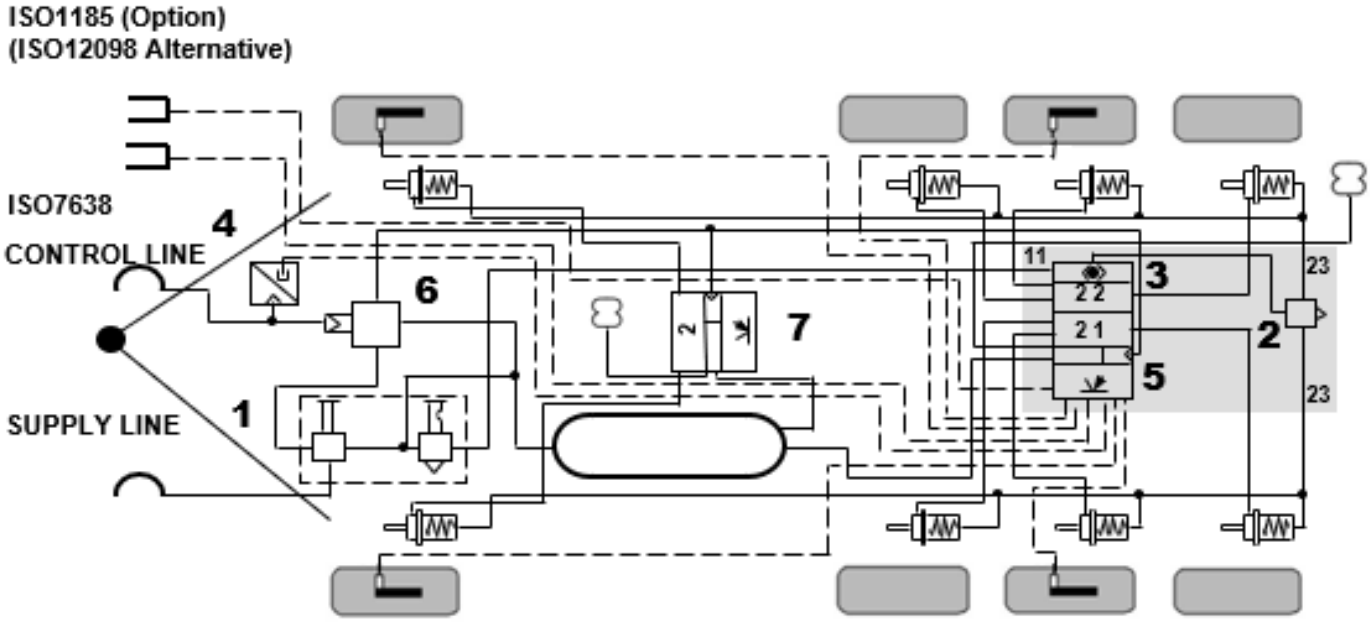
KEY:

1 - Combined Park & Shunt Valve (352 044 ...)
2 - Integrated Quick Release Valve (Option)
3 - Integrated Double Check Valve (Option)
4 - EB+ Gen2/Gen3 Pressure Sensor (Option)
5 - EBS Modulators & Electronic Control Unit (Master)
6 - Relay Emergency Valve
7 - EBS Modulator & Electronic Control Unit (Slave)

EB+ Gen 2/Gen 3 Brake System Installation Schematics

4S/3M Full Trailer Installation

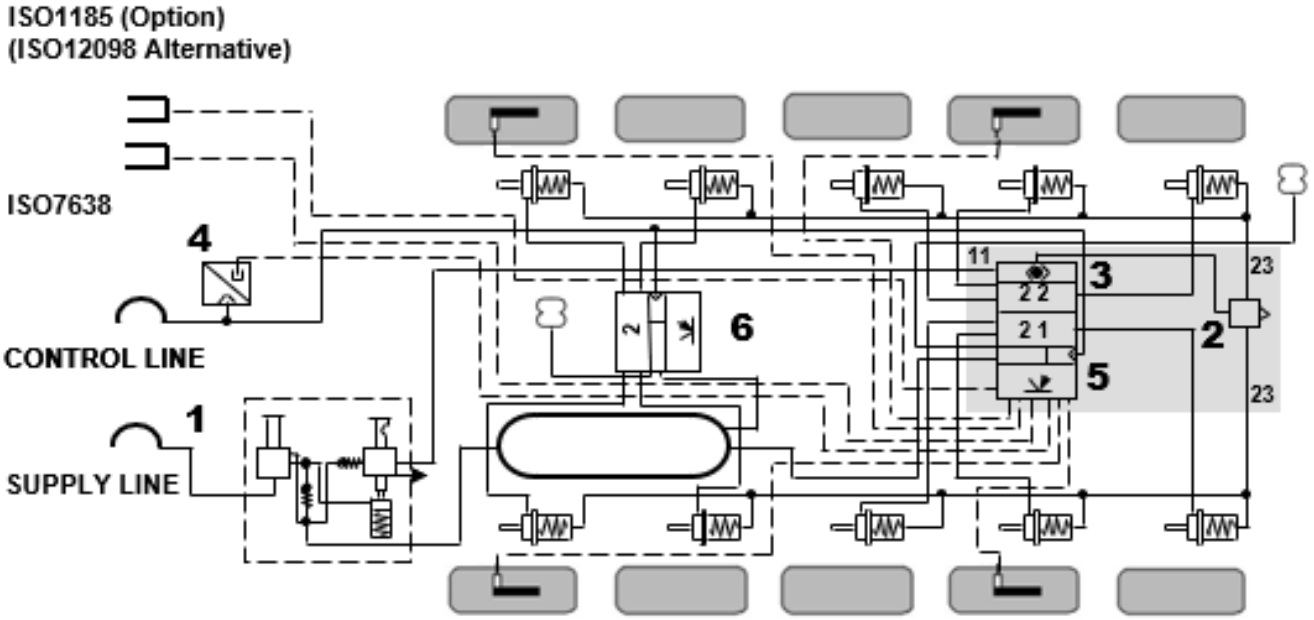


KEY:

1 - Combined Park & Shunt Valve (352 044 ...)
2 - Integrated Quick Release Valve (Option)
3 - Integrated Double Check Valve (Option)
4 - EB+ Gen2/Gen3 Pressure Sensor (Option)
5 - EBS Modulators & Electronic Control Unit (Master)
6 - Relay Emergency Valve
7 - EBS Modulator & Electronic Control Unit (Slave)

EB+ Gen 2 /Gen 3 Brake System Installation Schematics

4S/3M Semi or Centre Axle Trailer Installation

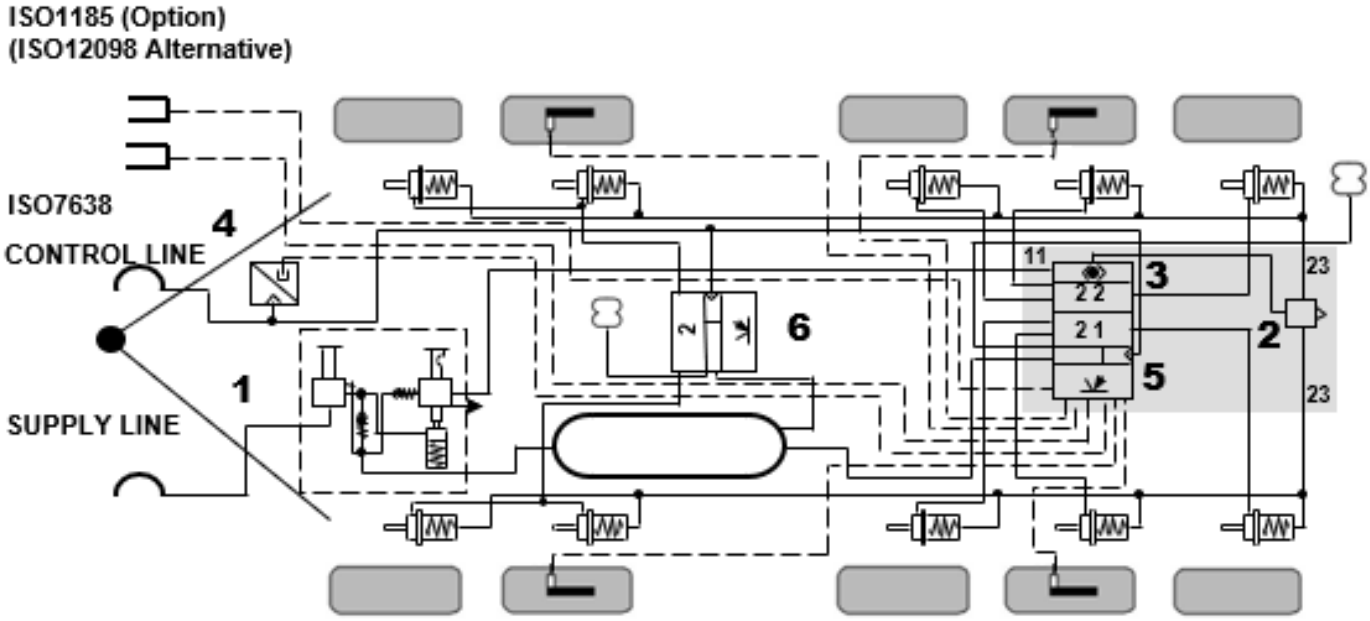


KEY:

1 - Trailer Emergency Module, Park/Shunt (352 075 ...)
2 - Integrated Quick Release Valve (Option)
3 - Integrated Double Check Valve (Option)
4 - EB+ Gen2/Gen3 Pressure Sensor (Option)
5 - EBS Modulators & Electronic Control Unit (Master)
6 - EBS Modulator & Electronic Control Unit (Slave)

EB+ Gen 2/Gen 3 Brake System Installation Schematics

4S/3M Full Trailer Installation



R13 190533

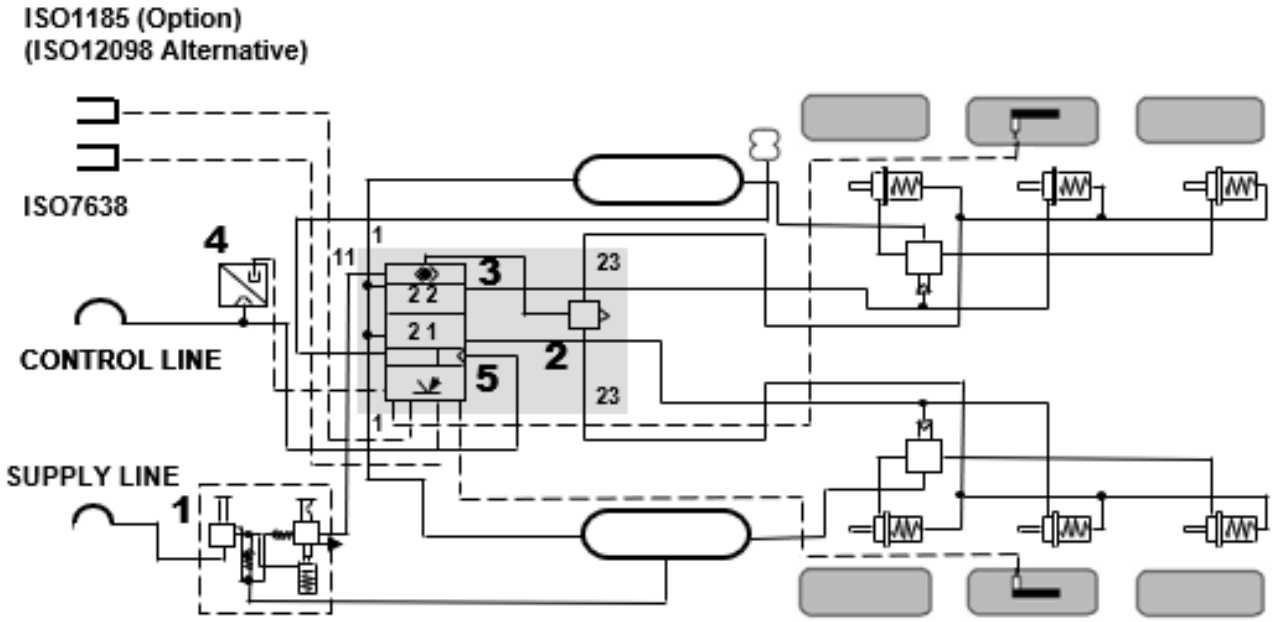
KEY:

1 - Trailer Emergency Module, Park/Shunt (352 075 ...)
2 - Integrated Quick Release Valve (Option)
3 - Integrated Double Check Valve (Option)
4 - EB+ Gen2/Gen3 Pressure Sensor (Option)
5 - EBS Modulators & Electronic Control Unit (Master)
6 - EBS Modulator & Electronic Control Unit (Slave)

EB+ Gen 3 Brake System Installation Schematics Inloader Trailer

2S/2M Semi Trailer Installation

1 Relay Valve each side controlled by EB+



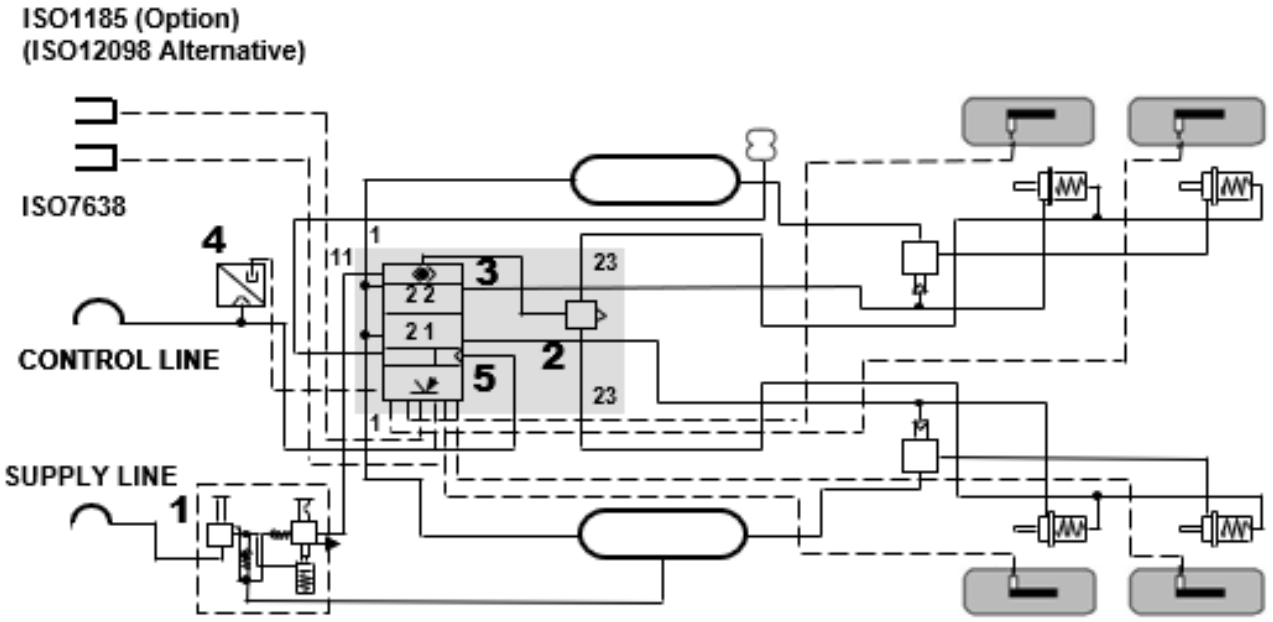
KEY:

1 - Trailer Emergency Module, Park/Shunt (Part No. 352 075 ...)
2 - Integrated Quick Release Valve (Option)
3 - Integrated Double Check Valve (Option)
4 - EB+ Gen2/Gen3 Pressure Sensor (Option)
5 - EBS Modulators & Electronic Control Unit (Master)
6 - EBS Modulator & Electronic Control Unit (Slave)
7 - Wabco Rely valve (Part No 973011000 0)

EB+ Gen 3 Brake System Installation Schematics Inloader Trailer

4S/2M Semi Trailer Installation

1 Relay Valve each side controlled by EB+



R13 190533

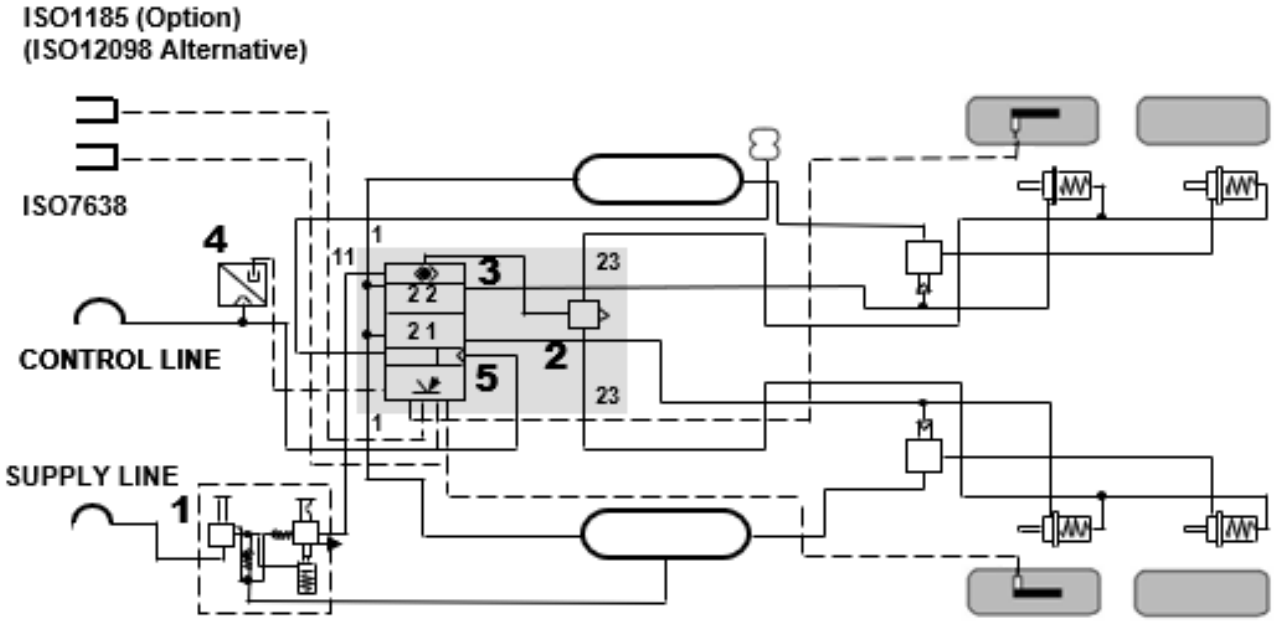
KEY:

1 - Trailer Emergency Module, Park/Shunt (Part No. 352 075 ...)
2 - Integrated Quick Release Valve (Option)
3 - Integrated Double Check Valve (Option)
4 - EB+ Gen2/Gen3 Pressure Sensor (Option)
5 - EBS Modulators & Electronic Control Unit (Master)
6 - EBS Modulator & Electronic Control Unit (Slave)
7 - Wabco Rely valve (Part No 973011000 0)

EB+ Gen 3 Brake System Installation Schematics Inloader Trailer

2S/2M Semi Trailer Installation

1 Relay Valve each side controlled by EB+



KEY:

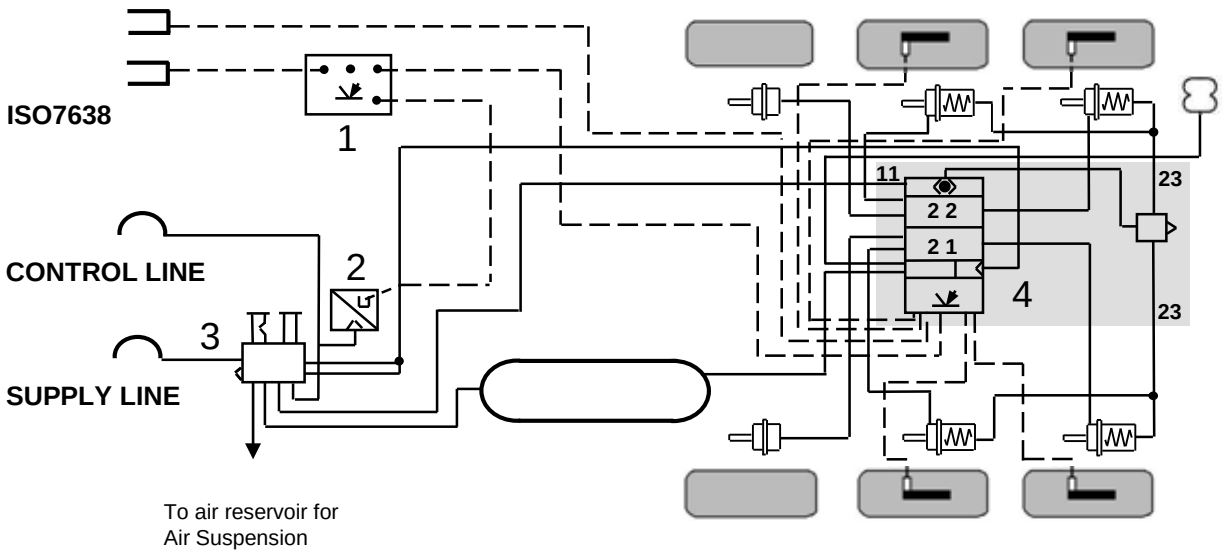
1 - Trailer Emergency Module, Park/Shunt (Part No. 352 075 ...)
2 - Integrated Quick Release Valve (Option)
3 - Integrated Double Check Valve (Option)
4 - EB+ Gen2/Gen3 Pressure Sensor (Option)
5 - EBS Modulators & Electronic Control Unit (Master)
6 - EBS Modulator & Electronic Control Unit (Slave)
7 - Wabco Rely valve (Part No 973011000 0)

EB+ CAN Hub as Repeater Installation Schematic

EXAMPLE

Gen 2/Gen 3 System 4S/2M Semi or Centre Axle Trailer Installation with Trailer Control Module +

ISO1185 (Option)
(ISO12098 Alternative)



R13 190533

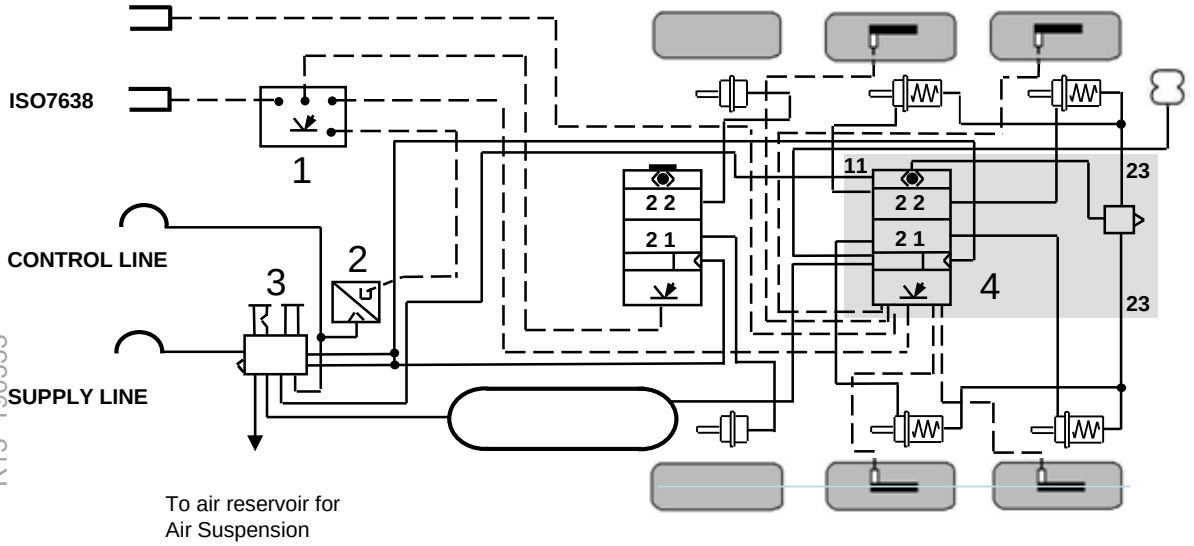
KEY:
1 – EB+ CAN Repeater
2 – EB+ Pressure Sensor (Option)
3 – Trailer Control Module +
4 – EB+ Gen3 Integrated Unit

EB+ CAN Hub Router Installation Schematic

EXAMPLE

Gen 3 System 4S/2M Semi or Centre Axle Trailer Installation with Trailer Control Module +

ISO1185 (Option)
(ISO12098 Alternative)



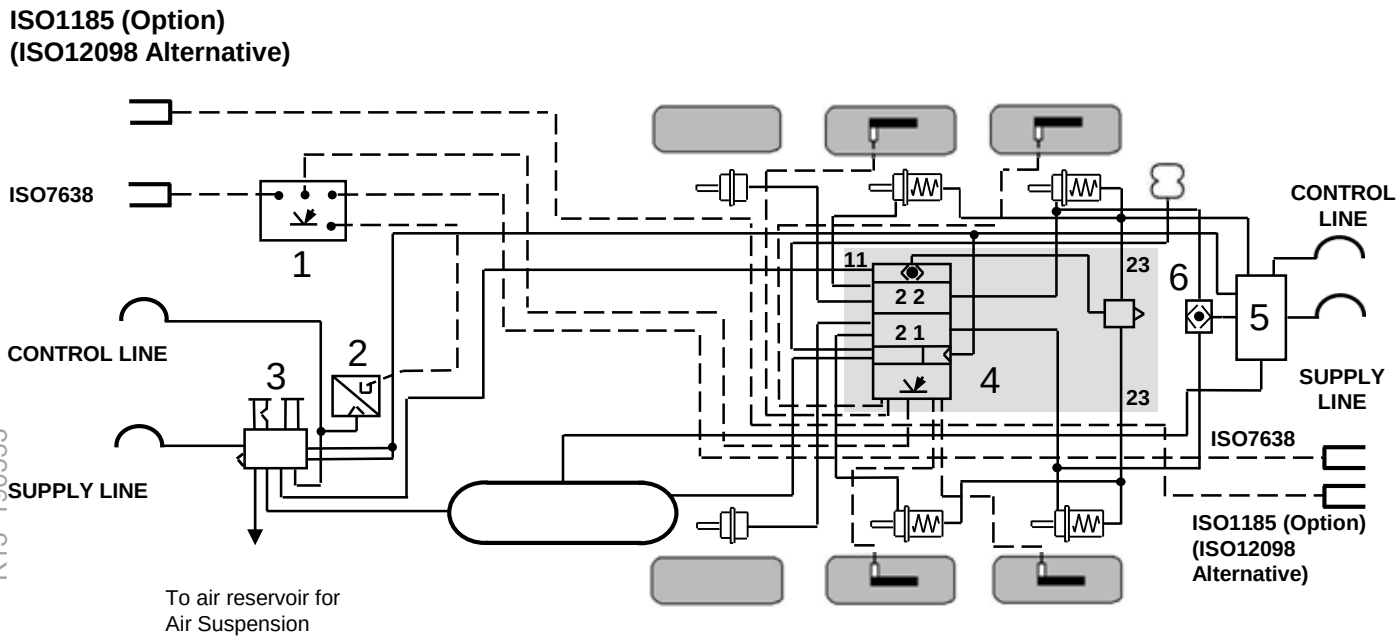
R13 190533

KEY:
1 – EB+ CAN Repeater
2 – EB+ Pressure Sensor (Option)
3 – Trailer Control Module +
4 – EB+ Gen3 Integrated Unit
5 – Trailer Control Valve
6 – Double Check Valve

EB+ CAN Hub Router Installation Schematic

EXAMPLE

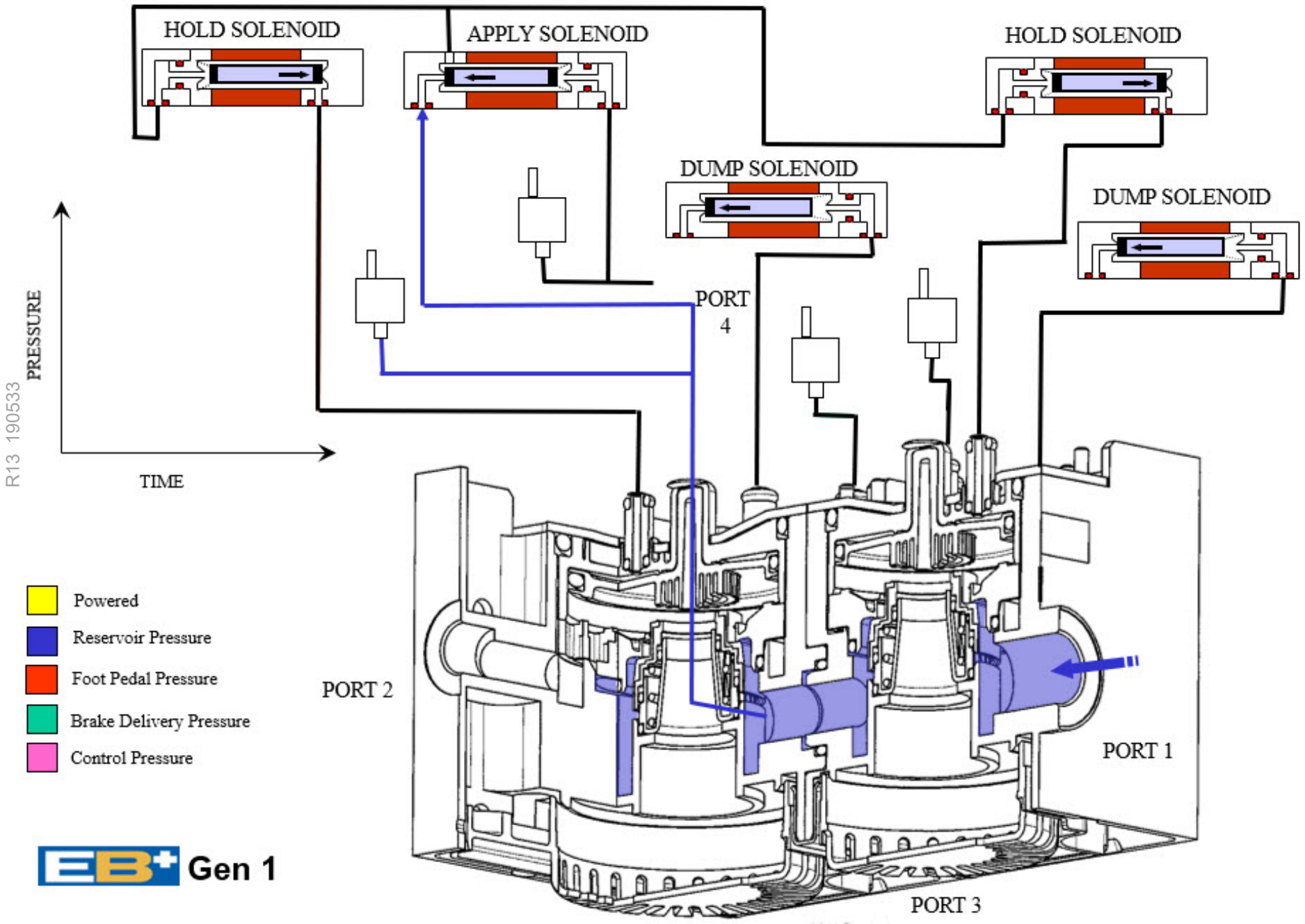
Gen 3 System 4S/2M Semi Trailer Installation with Trailer Control Module +



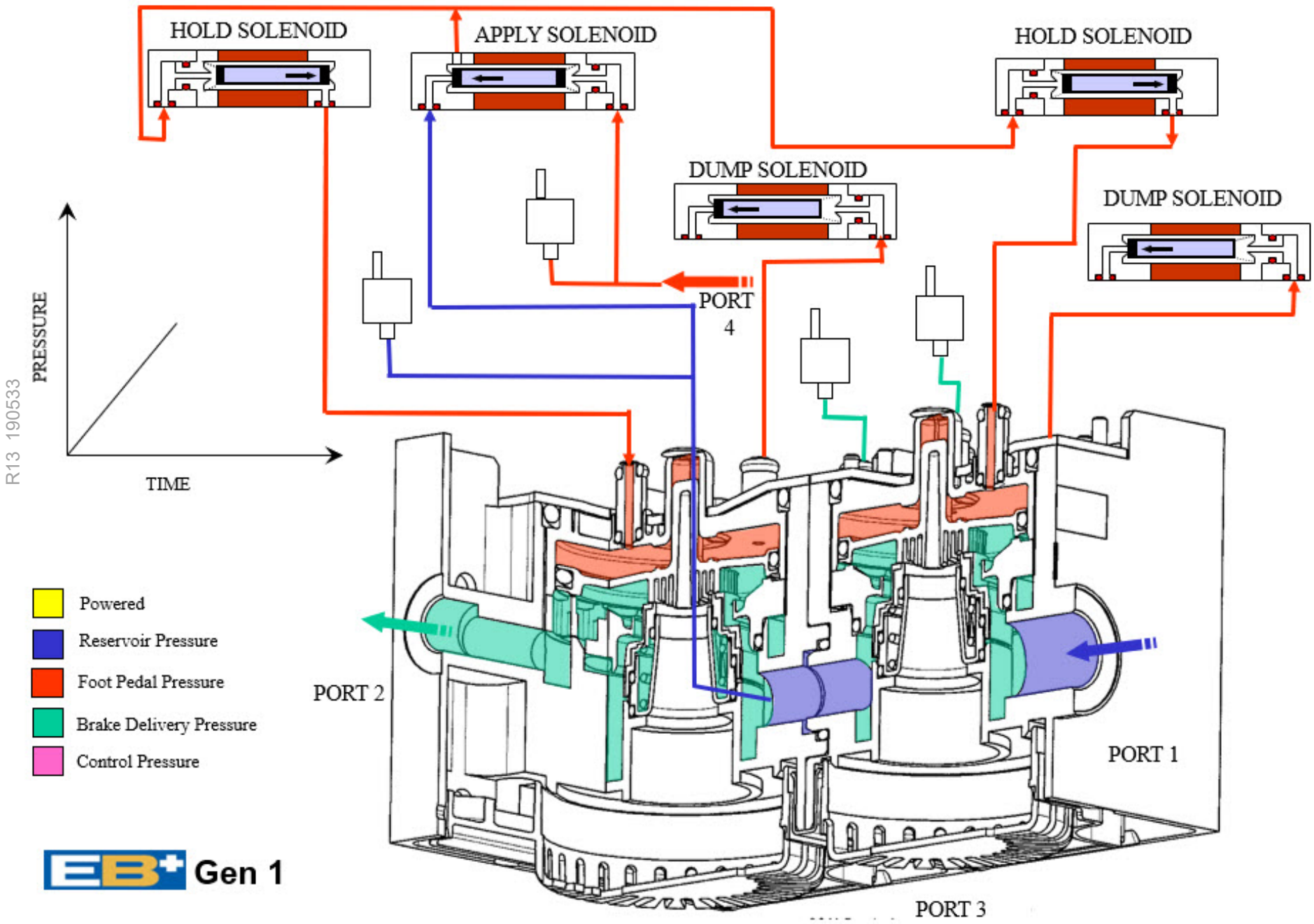
KEY:

1 – EB+ CAN Repeater
2 – EB+ Pressure Sensor (Option)
3 – Trailer Control Module +
4 – EB+ Gen3 Integrated Unit
5 – Trailer Control Valve
6 – Double Check Valve

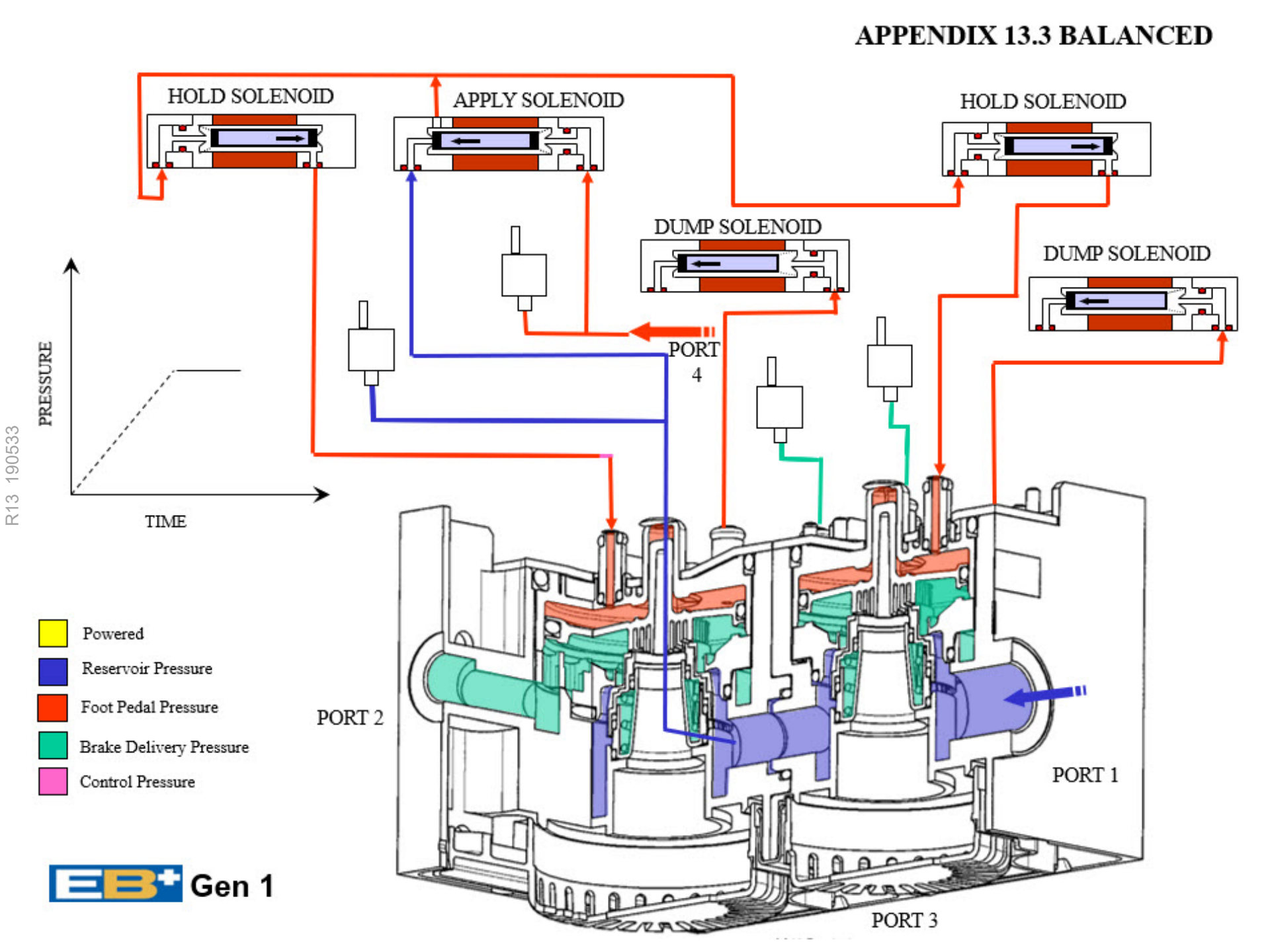
APPENDIX 13.1 RESERVOIR SUPPLY ONLY



APPENDIX 13.2 BRAKE APPLY (PUSH THROUGH)



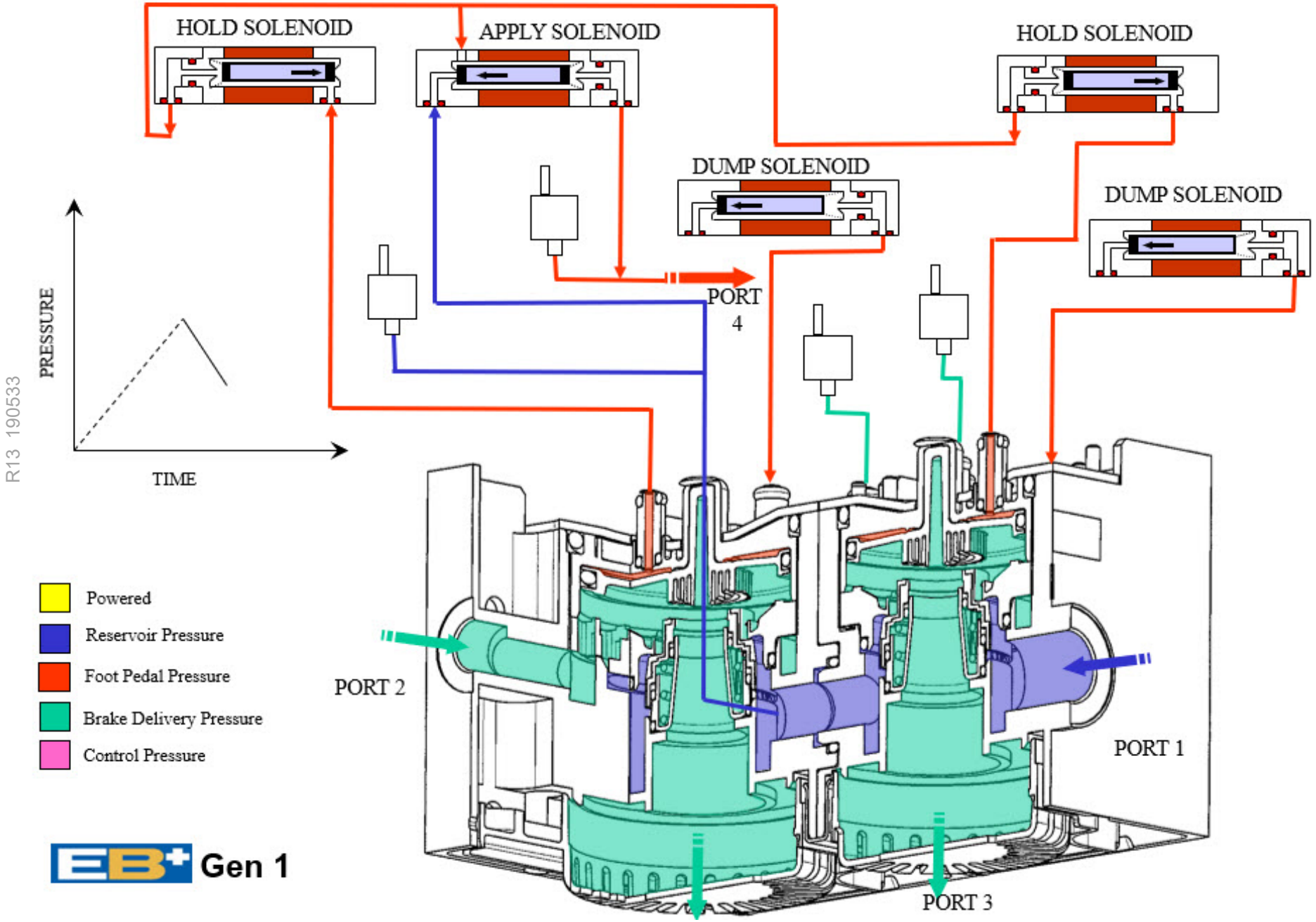
APPENDIX 13.3 BALANCED



R13 190533

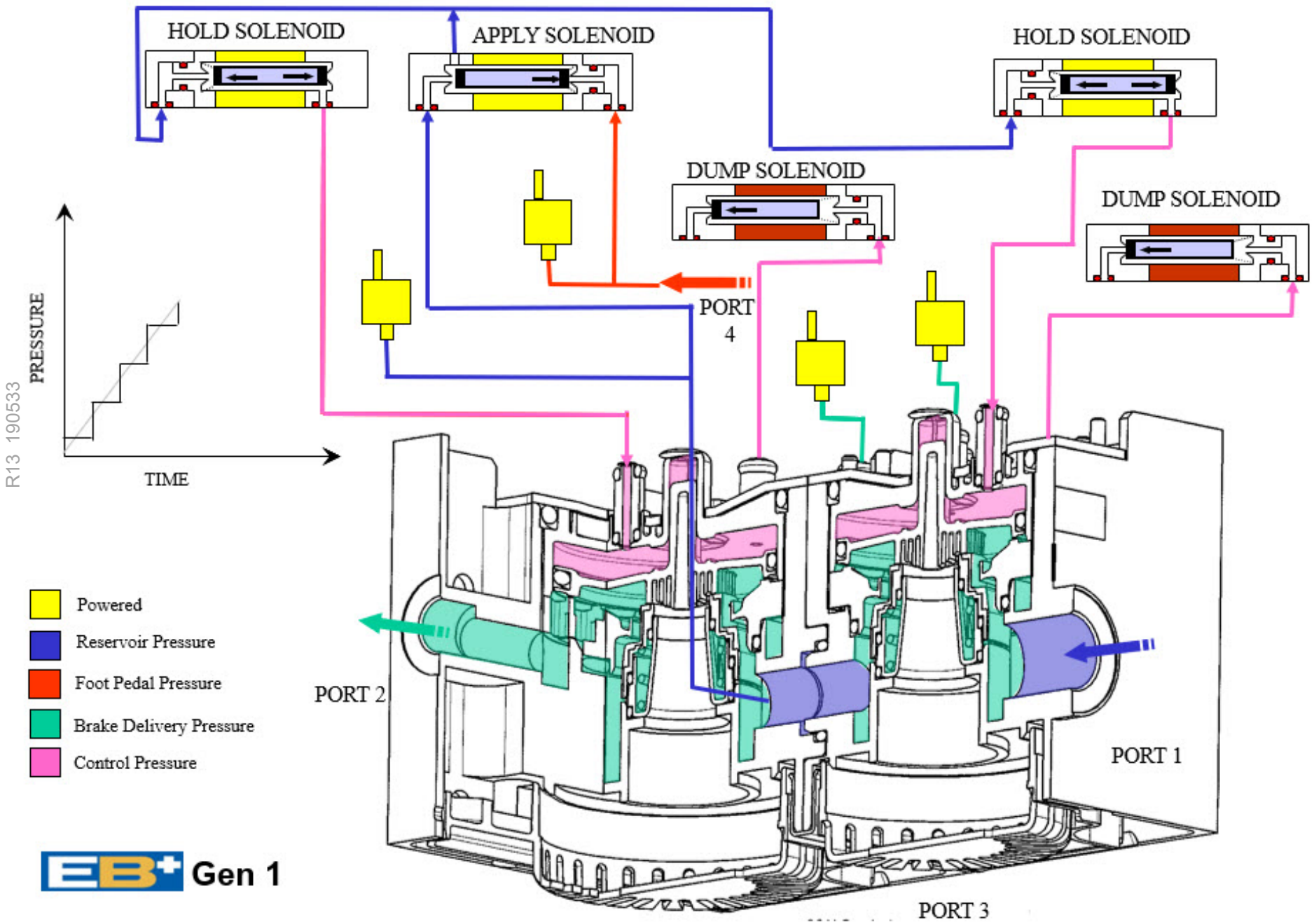
EB+ Gen 1

APPENDIX 13.4 BRAKE RELEASE (PUSH THROUGH)

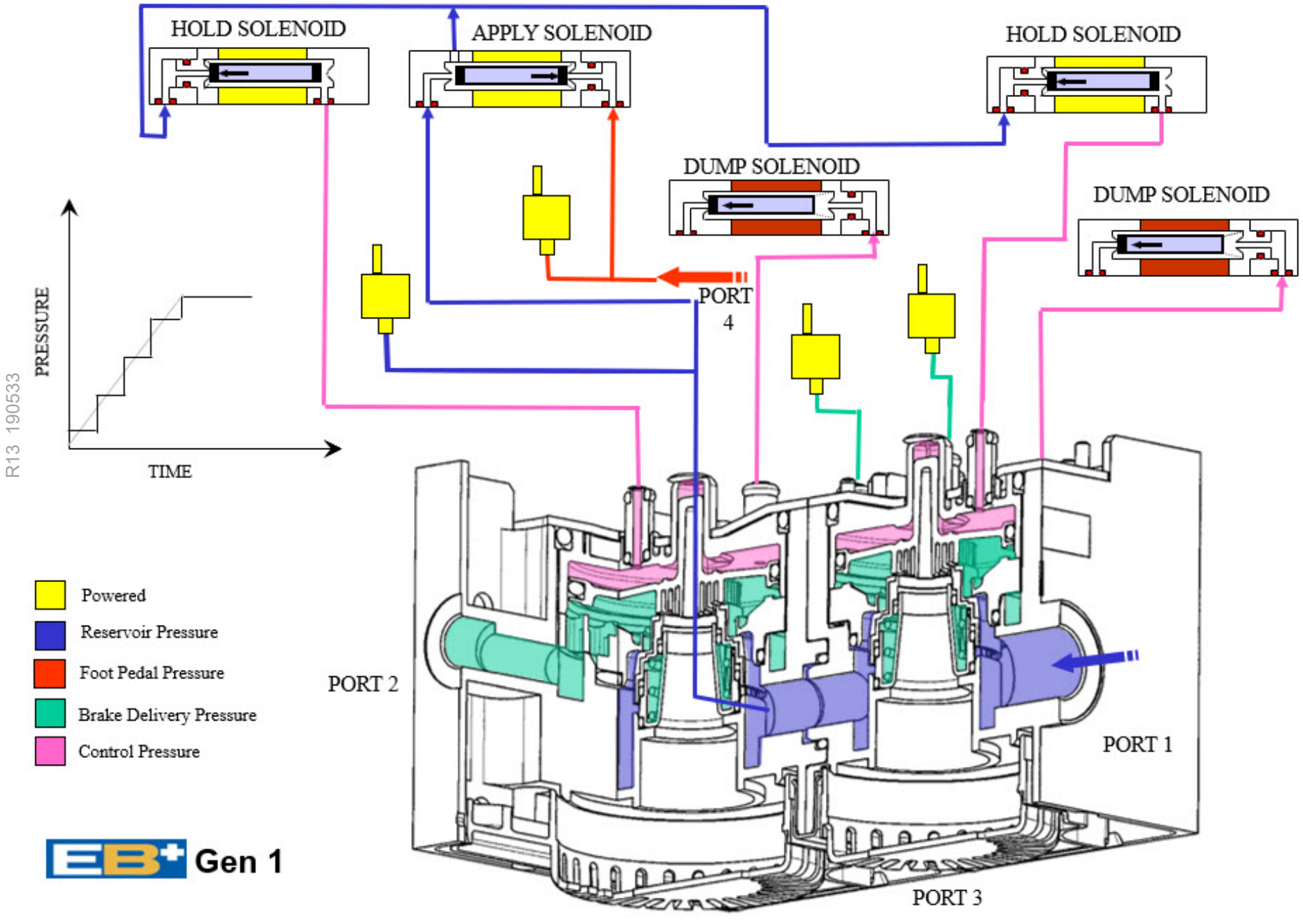


R13 190533

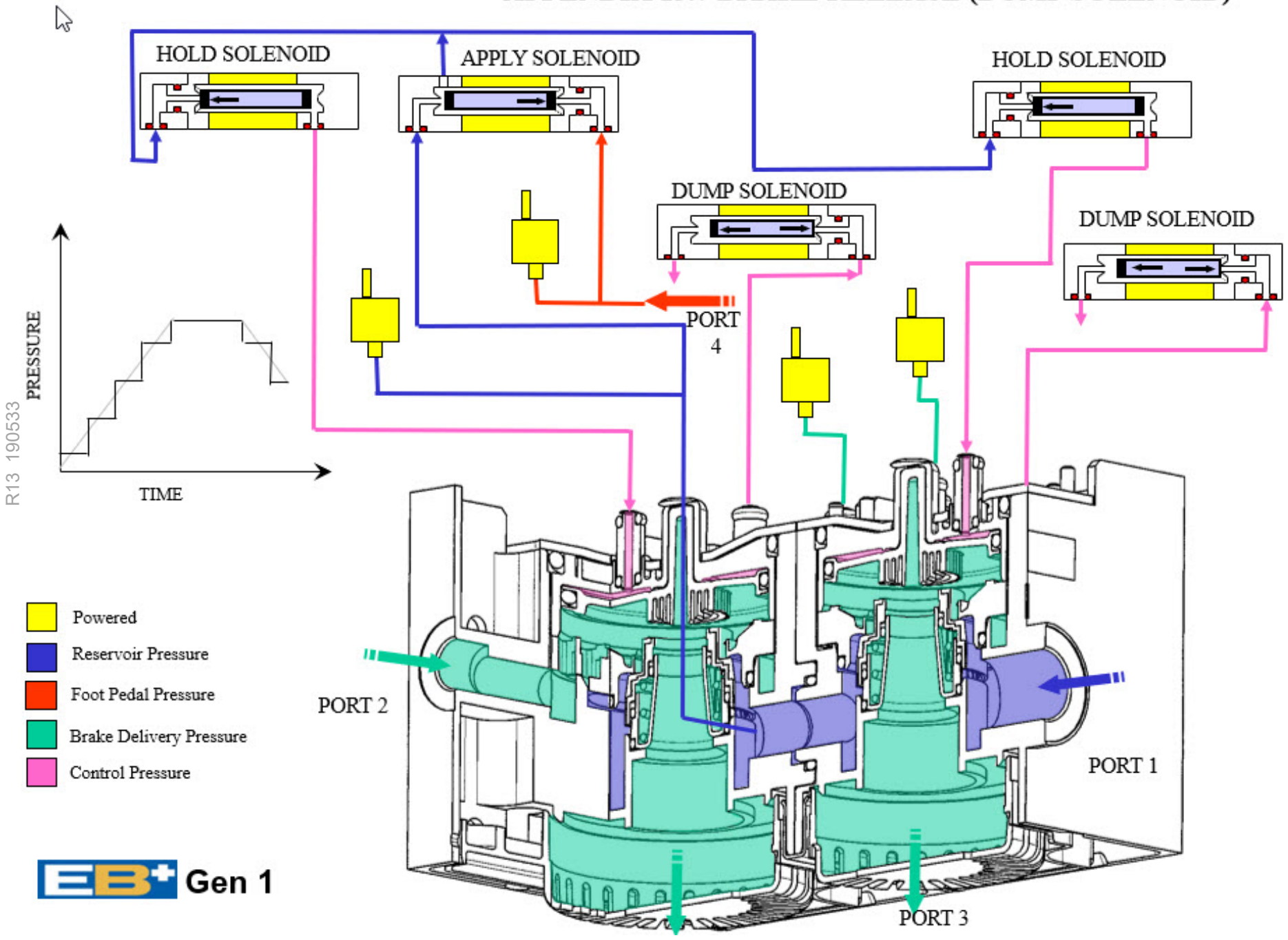
APPENDIX 13.5 BRAKE APPLY (APPLY SOLENOID)

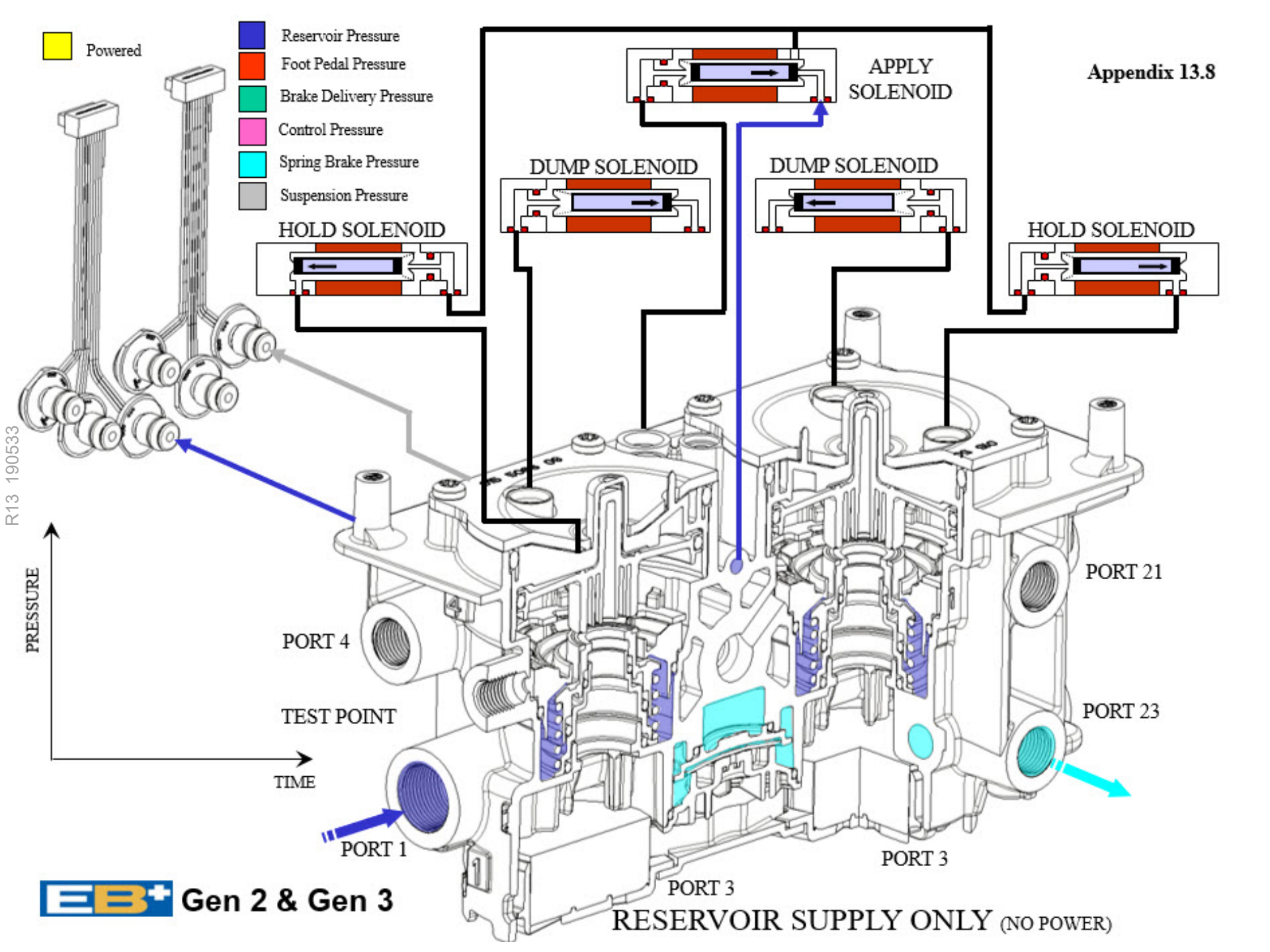


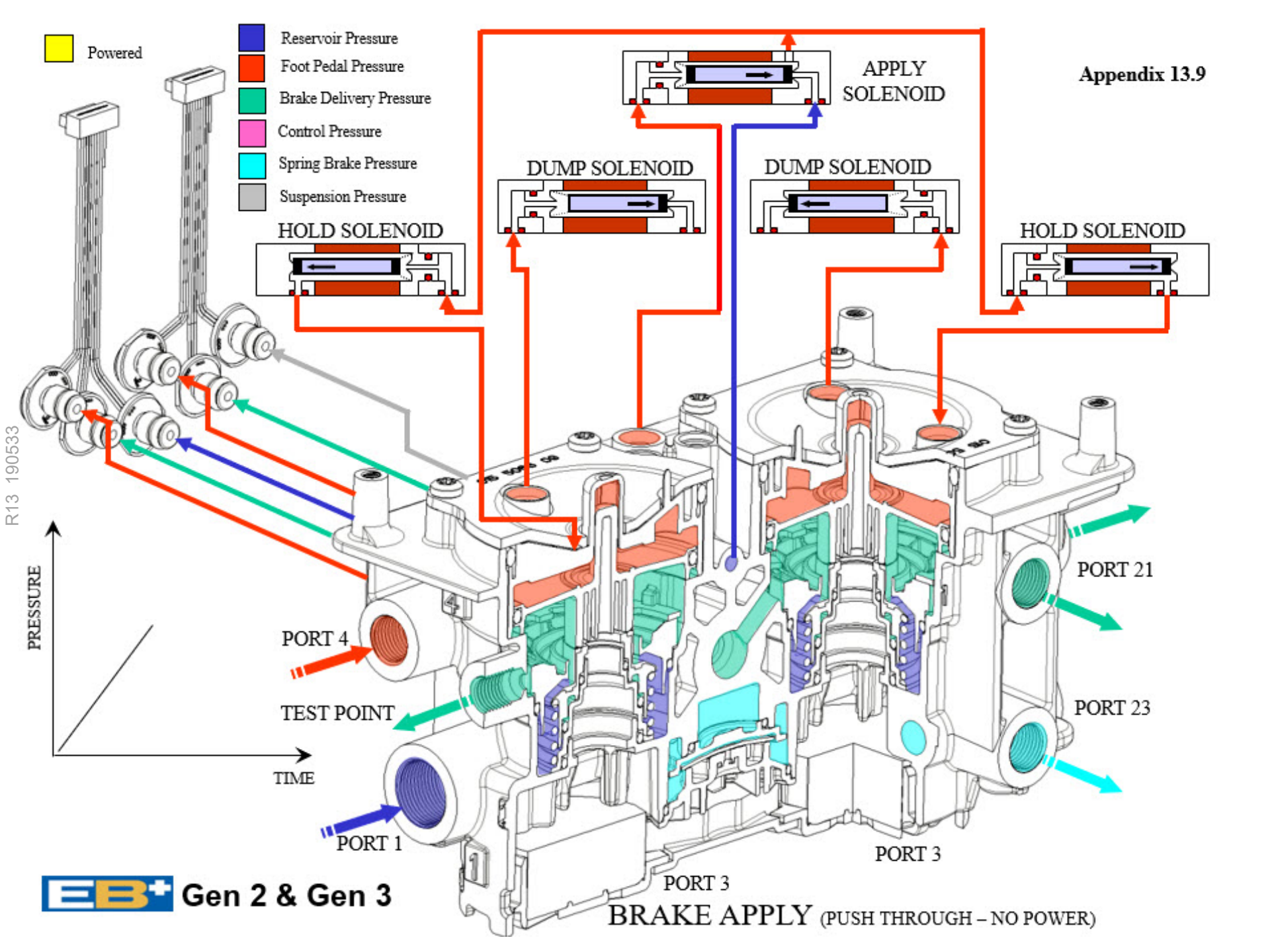
APPENDIX 13.6 HOLD



APPENDIX 13.7 BRAKE RELEASE (DUMP SOLENOID)



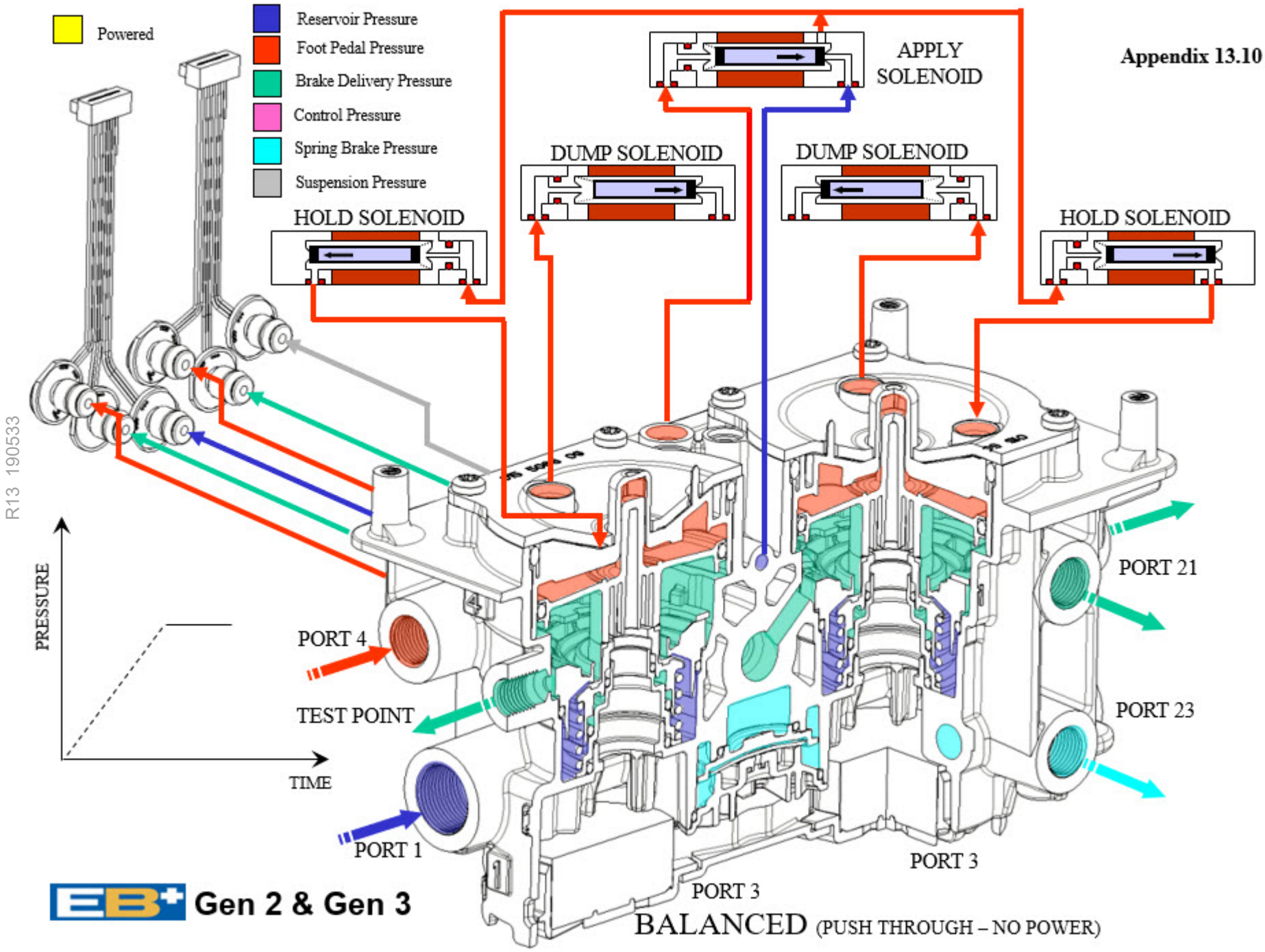

Powered
Reservoir Pressure
Foot Pedal Pressure
Brake Delivery Pressure
Control Pressure
Spring Brake Pressure
Suspension Pressure
APPLY SOLENOID
DUMP SOLENOID
DUMP SOLENOID
HOLD SOLENOID
HOLD SOLENOID
Appendix 13.8
R13 190533
PRESSURE
TIME
PORT 4
TEST POINT
PORT 1
PORT 21
PORT 23
PORT 3
PORT 3
Gen 2 & Gen 3
RESERVOIR SUPPLY ONLY (NO POWER)



R13 190533

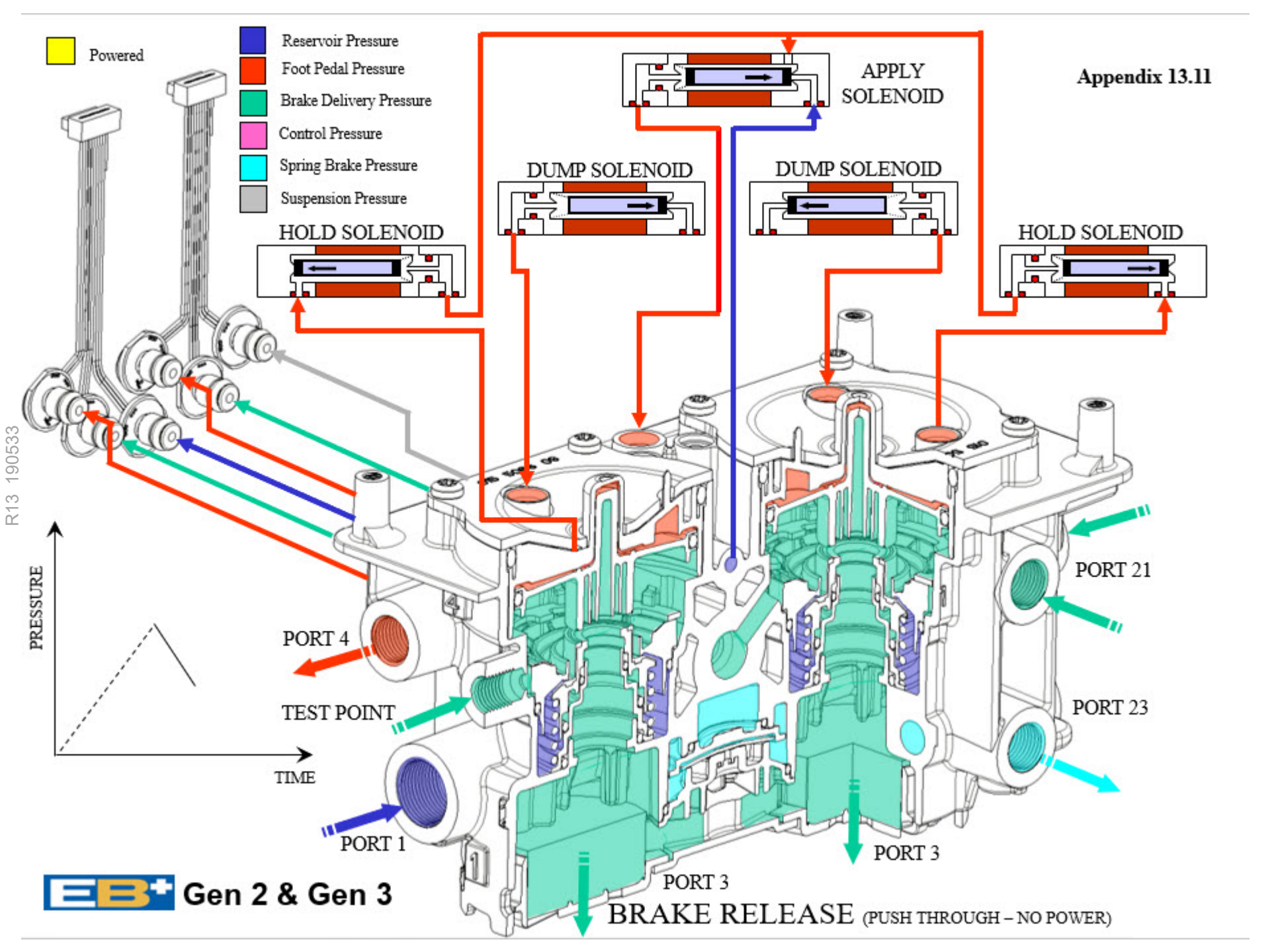
EB+ Gen 2 & Gen 3

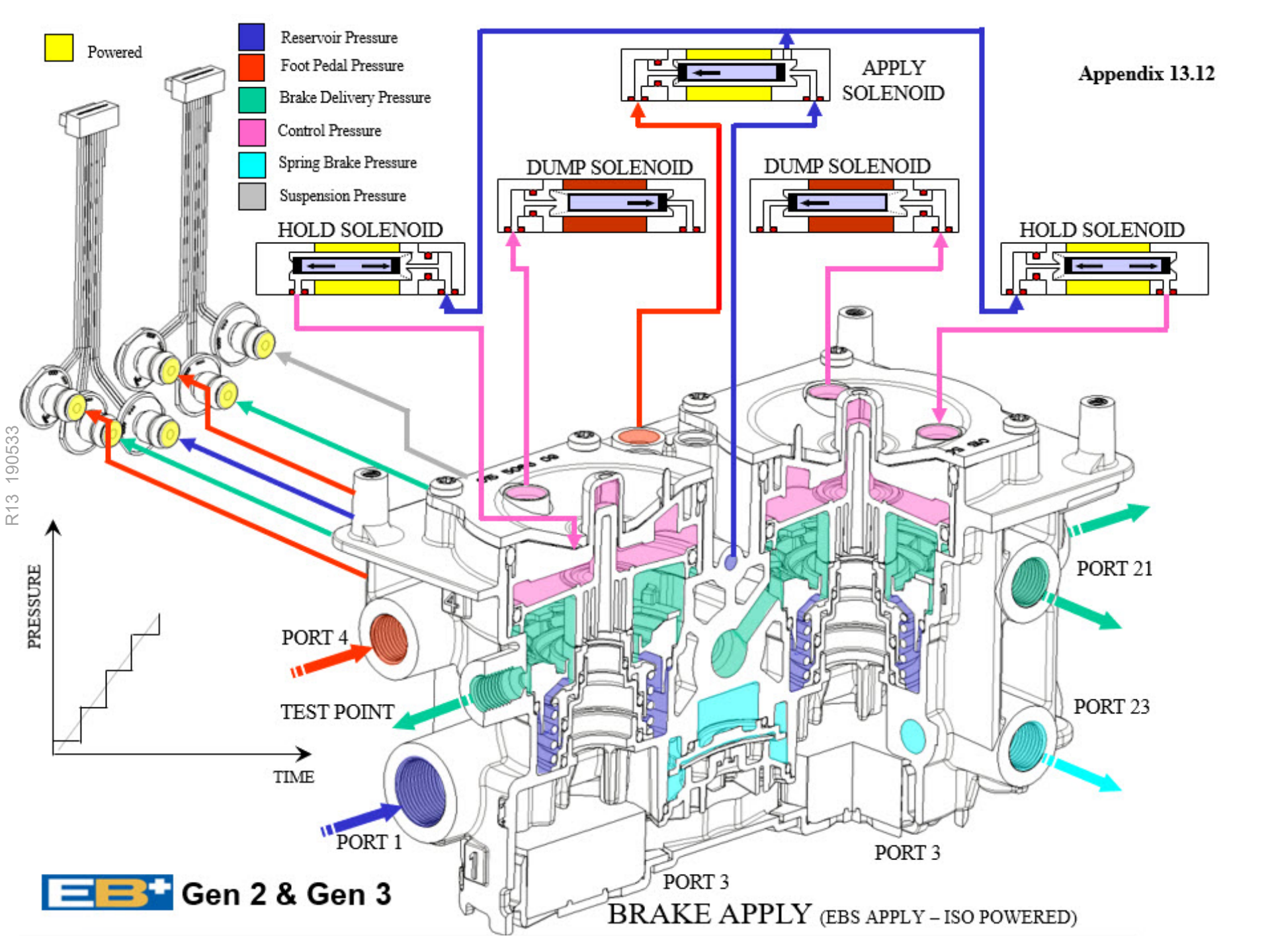
BRAKE APPLY (PUSH THROUGH – NO POWER)



R13 190533

EB+ Gen 2 & Gen 3

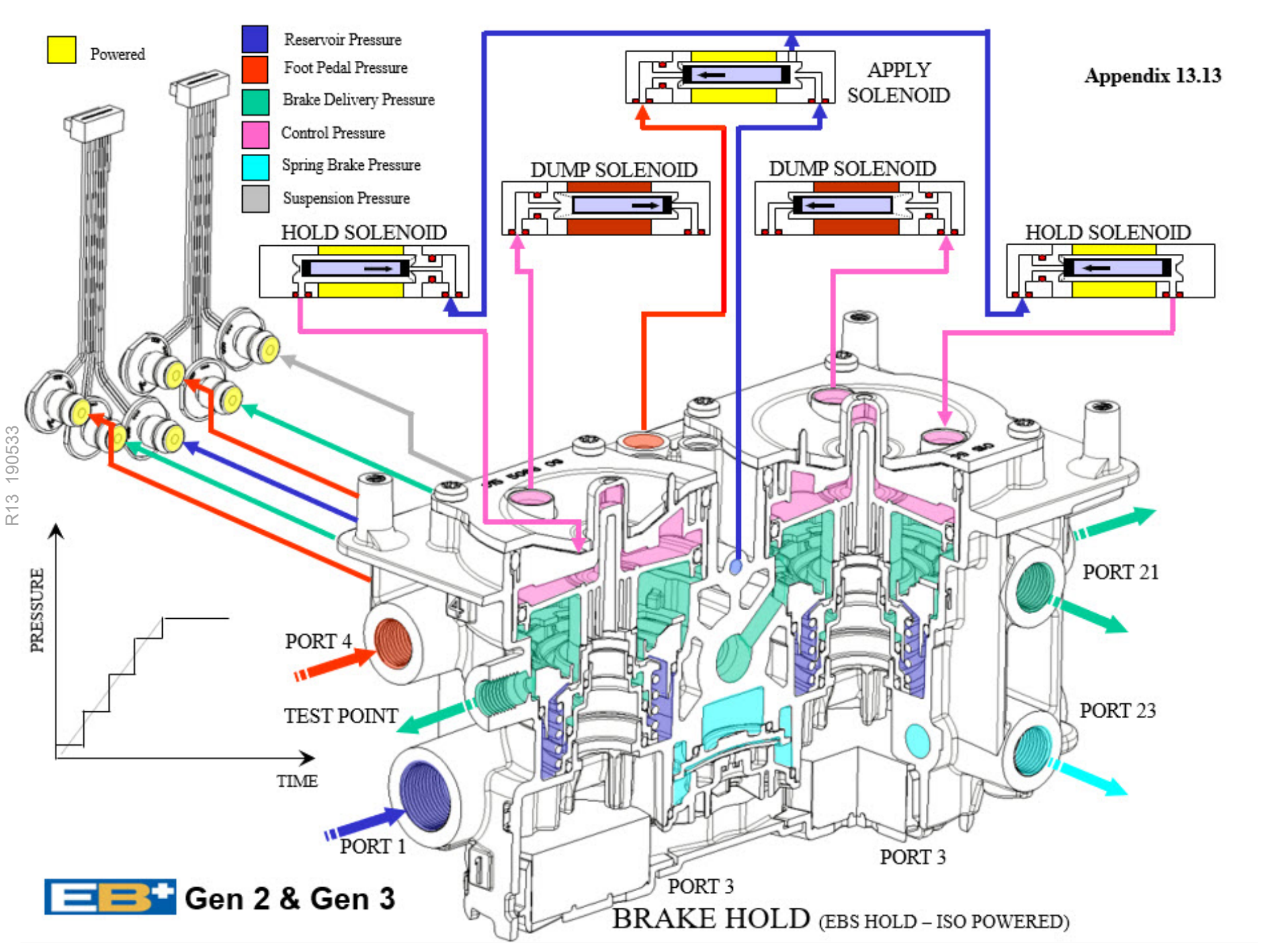

Powered
Reservoir Pressure
Foot Pedal Pressure
Brake Delivery Pressure
Control Pressure
Spring Brake Pressure
Suspension Pressure
APPLY SOLENOID
DUMP SOLENOID
DUMP SOLENOID
HOLD SOLENOID
HOLD SOLENOID
Appendix 13.11
R13 190533
PRESSURE
TIME
PORT 4
TEST POINT
PORT 1
PORT 21
PORT 23
PORT 3
PORT 3
BRAKE RELEASE (PUSH THROUGH – NO POWER)
Gen 2 & Gen 3



R13 190533

Gen 2 & Gen 3

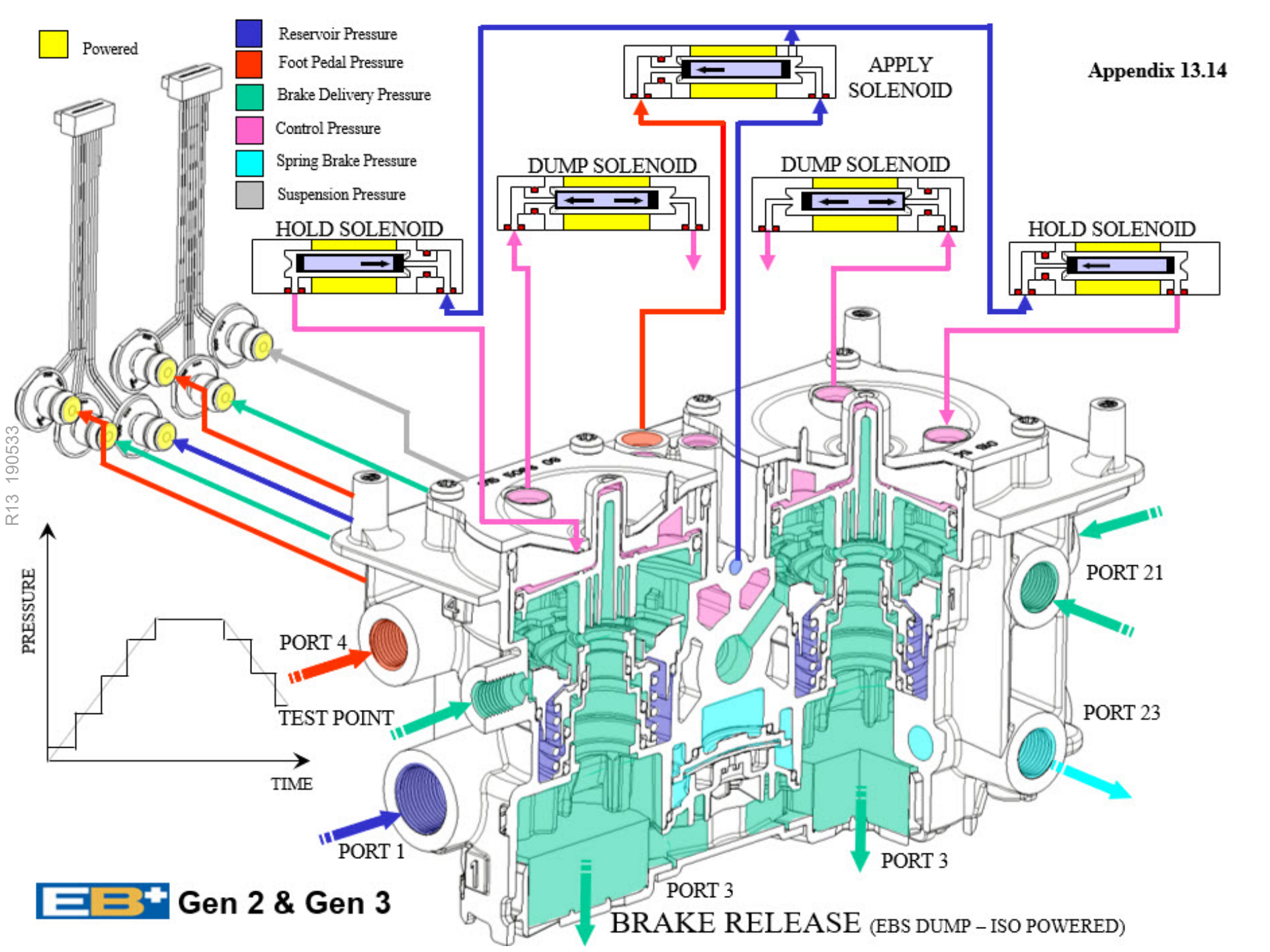
BRAKE APPLY (EBS APPLY – ISO POWERED)



R13 190533

EB+ Gen 2 & Gen 3

BRAKE HOLD (EBS HOLD – ISO POWERED)

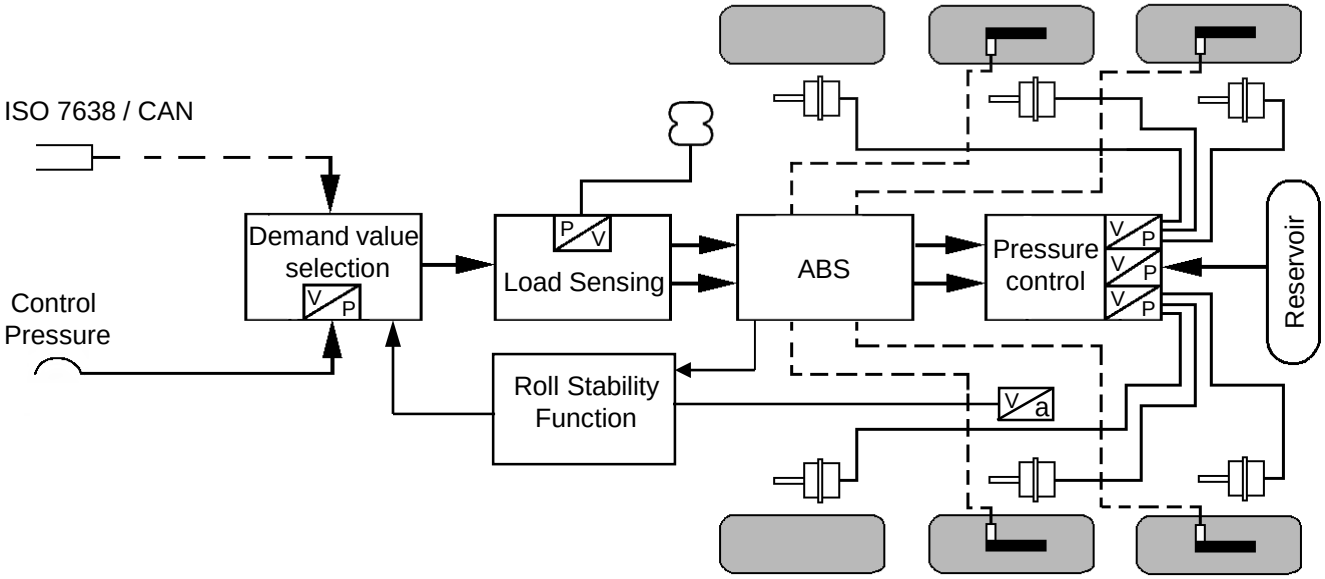


R13 190533

Gen 2 & Gen 3

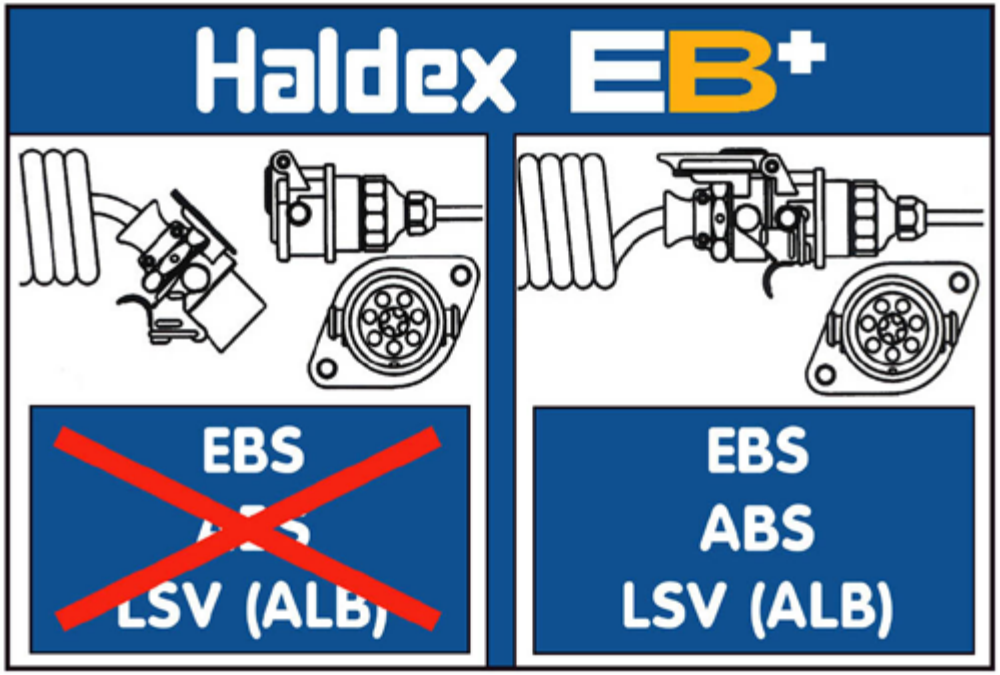
BRAKE RELEASE (EBS DUMP – ISO POWERED)

EB+ Functional Blocks



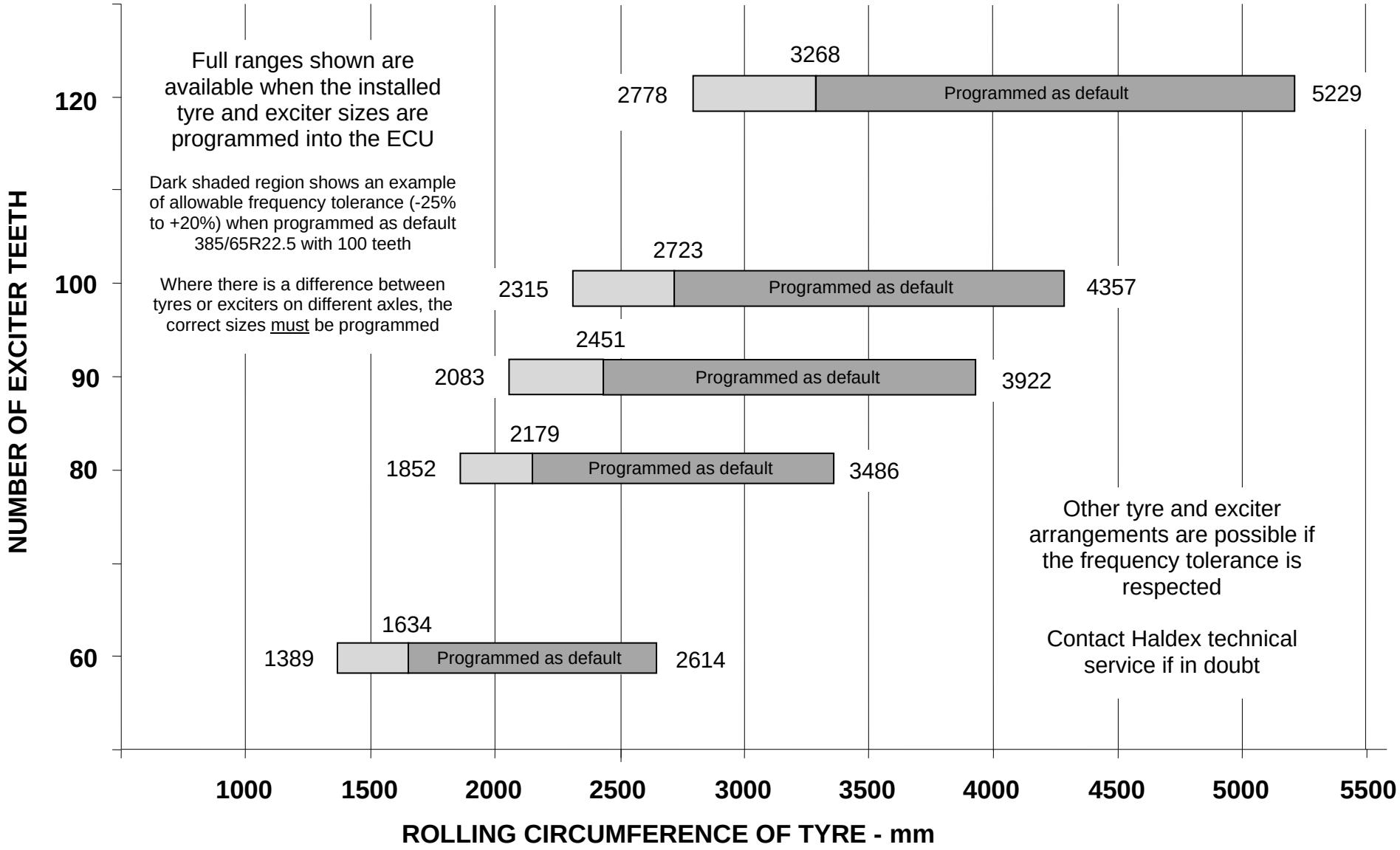
R13 190533

Headboard information ISO 7638 connection



EB+ TRAILER ANTI-LOCK BRAKE SYSTEM

RELATIONSHIP OF TYRE SIZE TO NUMBER OF EXCITER TEETH



Appendix 16

Vehicle Certification Agency

THE UNITED KINGDOM VEHICLE APPROVAL AUTHORITY

COMMUNICATION CONCERNING THE ~~APPROVAL GRANTED~~ [1]/ APPROVAL EXTENDED [1]/ ~~APPROVAL REFUSED~~ [1]/ ~~APPROVAL WITHDRAWN~~ [1]/ ~~PRODUCTION DEFINITIVELY DISCONTINUED~~ [1] OF A TYPE OF ELECTRICAL/ ELECTRONIC SUB-ASSEMBLY [1] WITH REGARD TO REGULATION NO. 10.05

E11 Approval No: 10R-057673

Extension No: 05

1. Make (trade name of manufacturer): Haldex Brake Products Ltd.

2. Type and general commercial description(s):
EB+ GEN 3 Electronically controlled braking system

3. Means of identification of type, if marked on the ~~vehicle~~/component/~~separate technical unit~~: [1]
2 EB+ Gen 3 variants as follows:
823 008 XXX Standalone 2M
823 034 XXX Master Assembly 3M

3.1. Location of that marking: On the ESA

4. Category of vehicle: Not applicable

5. Name and address of manufacturer:

Haldex Brake Products Ltd.
MIRA Technology Park
Lindley
Warwickshire
CV13 6DE
United Kingdom

R13 190533

EAU452919

Vehicle Certification Agency
09-Jul-19

6. In the case of components and separate technical units, location and method of affixing of the approval mark: A label attached to the unit casing

7. Address(es) of assembly plant(s):

In-Tech Electronics Limited
Qihang Industrial Zone No.2,
Hao Ziang Road, Shajing
Bao An, Shenzhen
People's Republic of China

Haldex Brake Products GmbH
Mittelgewannweg
69123 Heidelberg
Germany

8. Additional information (where applicable): See appendix

9. Technical Service responsible for carrying out the tests: HORIBA MIRA Ltd.

10. Date of test report: As before and 19 June 2019

11. No. of test report: As before and 1219535#01

12. Remarks (if any): Approval to supplement 1

See appendix

13. Place: BRISTOL

14. Date: 09 JULY 2019

15. Signature:

D LAWLOR
Chief Technical and Statutory Operations Officer

16. The index to the information package lodged with the Approval Authority, which may be obtained on request, is attached.

17. Reasons for extension: Obsolescence of Solenoid and Auxiliary Driver Circuits

(1) Strike out what does not apply.

R13 190533

EAU452919

Appendix

to type-approval communication form No. E11 10R-057673 Extension 05

concerning the type-approval of an electrical/electronic sub-assembly under Regulation No. 10.05

1. Additional information:

1.1. Electrical system rated voltage: 12V or 24V ~~pos~~/neg ground (1)

1.2. This ESA can be used on any vehicle type with the following restrictions:
Negative ground vehicles only

1.2.1. Installation conditions, if any:
Fitting is to be done in accordance with Haldex installation instructions

1.3. This ESA can be used only on the following vehicle types: Not applicable

1.3.1. Installation conditions, if any: Not applicable

1.4. The specific test method(s) used and the frequency ranges covered to determine immunity were: (Please specify precise method used from Annex 9):
800 mm Stripline Method, 20 MHz to 400 MHz
Free Field Method, 400 MHz to 2000 MHz

1.5. Laboratory accredited to ISO 17025 and recognized by the Approval Authority responsible for carrying out the tests:

HORIBA MIRA Ltd
Watling Street
Nuneaton
Warwickshire
CV10 0TU
United Kingdom

2. Remarks: See Haldex GS0537, Issue 8, Dated 05/12/18

(1) Strike out what does not apply.

Document Control

Note ECU/valve assembly 823 034 001 submitted as representative of the type for EMC considerations contains electronic assembly 003 9604 19 as listed below.

ECUs for control of up to three air brake modulators

Final assembly	823 034 XXX
ECU assembly	003 9604 19 issue 1
ECU schematic	911 512 001 issue 9
PCB assembly	003 9598 19 issue 2

ECUs for control of up to two air brake modulators

Final assembly	823 008 XXX
ECU assembly	003 9602 19 issue 1
ECU schematic	911 519 001 issue 9
PCB assembly	003 9596 19 issue 2

PCB un-populated (all variants)	042 7293 09	issue 4
Wiring diagram	911 523 001	issue 1
Software	042 7291 09	
Accelerometer	042 6782 09	issue 1
Over moulding for accelerometer	815 012 000 1	issue 9

Valve Assembly Electronic Components

Apply solenoid	041 5066 09 issue 1
Hold solenoid	041 5067 09 issue 1
Dump solenoid	041 5068 09 issue 1

Left hand pressure transducer assembly	041 5064 09 issue 2
Right hand pressure transducer assembly	041 5065 09 issue 2

Accelerometer 042 6782 09 issue 1 has approvals as follows:

e11*72/245*2004/104*3819*00

10R-023819

Variants

The electronic hardware variants of the EB+ Gen 3 system are described below.

Control Assembly

The part number of the assembly is uniquely assigned according to the combination of functional mechanical features fitted within the valve body. This part number is of the form 823 YYY XXX. YYY can be any number listed in the table below. Fixed combinations of ECU hardware, mechanical and port combination variants of the pneumatic valve are manufactured that result in the part number table below. XXX can be any number 000 to 999 inclusive reflecting mechanical and port combination differences.

Final Assembly Part Number	Assembly Description
823 008 XXX	Standalone 2M
823 034 XXX	Master Assembly 3M

Slave Assembly

The only ECU variant for a EB+ Gen 3 system has assembly part number: 812 015 001

Accelerometer

This is an optional external auxiliary; part number 042 6782 09 is the variant that has a connector mounted on its body. Variants with permanently attached cables are 815 012 0XX, where XX defines the cable configuration.

CAN Repeater

This is an optional additional ECU fitted to EB+ Gen 3 installations with part number 820 020 XXX fitted to extend the physical ISO 11992 CAN communications link by 40m. The CAN repeater is used to provide EBS on extended or long trailer vehicles.

CAN Hub

This is an optional additional ECU fitted to EB+ Gen 3 installations with part number 815 057 XXX. It has similar but extended functionality compared to the CAN Repeater product in that it provides the repeater functionality for extended or long trailers but also a CAN Hub facility where a separate CAN bus needs to be created for road train situations.

Appendix 3 – List of variants covered by the approval

The following EB+ Gen 3 variants are covered by this approval:

Final Assembly Part Number	Assembly Description
823 008 XXX	Standalone 2M
823 034 XXX	Master Assembly 3M

XXX can be any number 000 to 999 inclusive.

Vehicle Certification Agency

THE UNITED KINGDOM VEHICLE APPROVAL AUTHORITY

COMMUNICATION CONCERNING THE APPROVAL GRANTED [1]/ ~~APPROVAL EXTENDED~~ [1]/ ~~APPROVAL REFUSED~~ [1]/ ~~APPROVAL WITHDRAWN~~ [1]/ ~~PRODUCTION DEFINITIVELY DISCONTINUED~~ [1] OF A TYPE OF ELECTRICAL/ ELECTRONIC SUB-ASSEMBLY [1] WITH REGARD TO REGULATION NO. 10.05

E11 Approval No: E11*10R05/01*11053*00

1. Make (trade name of manufacturer): Haldex Brake Products Ltd.

2. Type and general commercial description(s): CAN Hub

3. Means of identification of type, if marked on the ~~vehicle~~/component/~~separate technical unit~~: [1]
Self-adhesive label

3.1. Location of that marking: On the front face of the product

4. Category of vehicle: Not applicable

5. Name and address of manufacturer:

Haldex Brake Products Ltd.
MIRA Technology Park
Lindley
Nuneaton
Warwickshire
CV13 6DE
United Kingdom

6. In the case of components and separate technical units, location and method of affixing of the approval mark: A label attached to the unit casing

R13 190533

EAU421166

UK Approval Authority Vehicle Certification Agency 16-Jan-20

7. Address(es) of assembly plant(s):

Integrated Micro - Electronics d.o.o. Niš
IMI 1
18205 Niška Banja, Niš,
Serbia

8. Additional information (where applicable): See Appendix

9. Technical Service responsible for carrying out the tests: HORIBA MIRA Ltd.

10. Date of test report: 11 November 2019

11. No. of test report: 1217058#01

12. Remarks (if any):

See Appendix

13. Place: BRISTOL

14. Date: 16 JANUARY 2020

15. Signature:

D LAWLOR
Chief Technical and Statutory Operations Officer

16. The index to the information package lodged with the Approval Authority, which may be obtained on request, is attached.

17. Reasons for extension: Not applicable

(1) Strike out what does not apply.

R13 190533

UK Approval Authority | Vehicle Certification Agency
16-Jan-20

Appendix

to type-approval communication form No. E11*10R05/01*11053*00

concerning the type-approval of an electrical/electronic sub-assembly under Regulation No. 10.05

1. Additional information:

1.1. Electrical system rated voltage: 12V or 24V ~~pos~~/neg ground (1)

1.2. This ESA can be used on any vehicle type with the following restrictions:
12V or 24V negative ground vehicles only

1.2.1. Installation conditions, if any: In accordance with Haldex installation instructions

1.3. This ESA can be used only on the following vehicle types: Not applicable

1.3.1. Installation conditions, if any: Not applicable

1.4. The specific test method(s) used and the frequency ranges covered to determine immunity were: (Please specify precise method used from Annex 9):

800mm Stripline from 20MHz to 400MHz
Absorber Line Chamber from 400 MHz to 2000 MHz

1.5. Laboratory accredited to ISO 17025 and recognized by the Approval Authority responsible for carrying out the tests:

HORIBA MIRA Ltd.
Watling Street
Nuneaton
Warwickshire
CV10 0TU
United Kingdom

2. Remarks: None

(1) Strike out what does not apply.

Vehicle Certification Agency

THE UNITED KINGDOM VEHICLE APPROVAL AUTHORITY

APPROVAL NUMBER: E11*10R05/01*11053*00

INFORMATION PACKAGE CONTENTS

INDEX REVISION NUMBER: Not applicable

Conformity of Production (COP) Declaration	**COP Confirmed**
Assessment Method	**ISO/TS Cert and Control Plans**
Date of Initial Clearance	**November 2019**
Date of Last Clearance	**November 2019**

Total number of sheets: 15 (Fifteen)

Reasons for Revision: Not applicable

R13 190533

Revision Date
&
Office Stamp

UK Approval Authority | Vehicle Certification Agency
16-Jan-20

Document Control

The issue levels of the relevant controlled documents are:

Complete assembly	815 057 001 issue 1
PCB assembly	003 9504 09 issue 1
PCB assembly parts list	003 9503 09 issue 1
Software drawing	042 7768 09 issue 1
Printed circuit board (unpopulated)	042 7688 09 issue 1
Assembly schematic	911 547 001 issue 1
Wiring diagram – CAN Router	911 552 001 issue 1

Notes

1. The EB+ Gen 3 2M ECU part number 823 008 001 used during the EMC assessment of the CAN Hub assembly has approval 10R-057673.
2. The remote-control line pressure transducer 815 022 xxx has approval 10R-034038.

Product Approval History

Date originally tested

Approval number

Date originally approved

First Subsequent Revision

New approval number

Date of new approval

Appendix 2 – Information Required for ECE R10.05 Annex 2B

1 **Make (trade name of manufacturer):** Haldex Brake Products Ltd.

2 **Type:** CAN Hub

3 **Means of identification of type, if marked on the component/separate technical unit:**

Self-adhesive label.

3.1 **Location of that marking:**

Label located on the front face of the product

4 **Name and address of manufacturer:**

Haldex Brake Products Limited
MIRA Technology Park
Lindley
CV13 6DE
United Kingdom

5 **In the case of components and separate technical units, location and method of affixing of the ECE type approval mark:**

A label attached to the unit casing.

6 **Address(es) of the assembly plant(s):**

Integrated Micro-Electronics d.o.o. Nis
IMI 1
18205 Niska Banja, Nis
Srbija

7 **This ESA shall be approved as a component**

8 **Restrictions of use and conditions for fitting:**

12V or 24V negative ground vehicles only.

Fitting is to be in accordance with Haldex installation instructions.

9 **Electrical system rated voltage:**

12 V or 24V, negative ground.

Appendix 3 – List of variants covered by the approval

This approval covers the following CAN Hub variants:

Final Assembly Part Number	Assembly Description
815 057 001	CAN Hub

VCA Headquarters
1 The Eastgate Office Centre
Eastgate Road
Bristol, BS5 6XX
United Kingdom

Switchboard: +44 (0) 117 951 5151
Main Fax: +44 (0) 117 952 4103
Email: enquiries@vca.gov.uk
Web: www.vca.gov.uk

THE UNITED KINGDOM VEHICLE APPROVAL AUTHORITY

E11

COMMUNICATION CONCERNING THE ~~APPROVAL GRANTED~~ [2]/ APPROVAL EXTENDED [2]/ ~~APPROVAL REFUSED~~ [2]/ ~~APPROVAL WITHDRAWN~~ [2]/ ~~PRODUCTION DEFINITELY DISCONTINUED~~ [2] OF A TYPE OF ELECTRICAL/ ELECTRONIC SUB-ASSEMBLY [2] WITH REGARD TO REGULATION NO. 10.03

Approval No: 10R-033942 Extension No: 06

1. Make (trade name of manufacturer): Haldex Brake Products Ltd

2. Type and general commercial description(s): EB+ 2M GEN 2 Electronically Controlled Braking System

3. Means of identification of type, if marked on the ~~vehicle~~/component/~~separate technical unit~~ [2]: See the manufacturer's documentation GS0394 Issue 8 Appendix 3 for the applicable part number

   3.1. Location of that marking: On the ESA

4. Category of vehicle: Not applicable

5. Name and address of manufacturer:
   Haldex Brake Products Ltd
   Moons Moat Drive
   Moons Moat North
   Redditch
   Worcestershire
   B98 9HA
   United Kingdom

6. In the case of components and separate technical units, location and method of affixing of the ECE approval mark: A label attached to the unit casing

7. Address(es) of assembly plant(s):

MSL Circuits
Number 6-3 AV.
Parc D'Activitie Synergie
Val-De-Loire
45130 Meung Sur Loire
France

Haldex Brake Products GmbH
Mittelgewannweg 27
69123 Heidelberg
Germany

8. Additional information (where applicable): See Appendix

9. Technical Service responsible for carrying out the tests: MIRA, Nuneaton

10. Date of test report: As before and 20 April 2011

11. No. of test report: As before and Technical Review EAM235517

12. Remarks (if any): See Appendix

13. Place: Bristol

14. Date: 13 MAY 2011

15. Signature:

A. W. STENNING
Head of Technical and Quality Group

16. The index to the information package lodged with the Approval Authority, which may be obtained on request, is attached.

17. Reasons for extension: To cover
1) Additional ECU assembly part numbers for new product variants
2) Component and PCB layout changes

1/ Distinguishing number of the country which issued/extended/refused/withdrew approval (see Regulation provisions on approval).
2/ Strike out what does not apply.

Appendix to type-approval communication form No. 10R-033942 Extension 06 concerning the type-approval of an electrical/electronic sub-assembly under Regulation No. 10.03

1. Additional information:

1.1. Electrical system rated voltage: 24 V. ~~pos~~/neg ground [2]

1.2. This ESA can be used on any vehicle type with the following restrictions: 24 Negative ground vehicles only

1.2.1. Installation conditions, if any: Fitting is to be in accordance with Haldex installation instructions

1.3. This ESA can be used only on the following vehicle types: Not applicable

1.3.1. Installation conditions, if any: Not applicable

1.4. The specific test method(s) used and the frequency ranges covered to determine immunity were: (Please specify precise method used from Annex 9): 800mm stripline (20 to 1000 MHz) and absorber lined chamber (1000 to 2000 MHz)

1.5. Laboratory accredited to ISO 17025 and recognized by the Approval Authority responsible for carrying out the tests: MIRA Limited, Nuneaton, United Kingdom

2. Remarks: Haldex information document GS0394 Issue 8

2/ Strike out what does not apply.

DOCUMENT CONTROL

Note ECU/valve assembly 820 008 000 2 submitted as representative of the type for EMC considerations contains electronic assembly 003 9468 09 as listed below.

All of the following EB+ GEN2 ECUs use a rotary potting enclosure

ECUs with PremiumAux, internal accelerometer, additional auxiliaries and power output

	Haldex	BPW
ECU assembly	003 9469 09 issue 1	003 9474 09 issue 1
ECU schematic	911 497 001 issue 1	911 497 001 issue 1
PCB assembly	003 9464 09 issue 1	003 9483 09 issue 1
PCB assy parts list	003 9466 09 issue 1	003 9466 09 issue 1

ECUs with internal accelerometer, additional auxiliaries and power output

	5 auxiliaries (Haldex)	5 auxiliaries (BPW)
ECU assembly	003 9468 09 issue 1	003 9473 09 issue 1
ECU schematic	911 478 001 issue 1	911 478 001 issue 1
PCB assembly	003 9463 09 issue 2	003 9481 09 issue 1
PCB assy parts list	003 9465 09 issue 1	003 9465 09 issue 1

	3 auxiliaries (Haldex)
ECU assembly	003 9550 09 issue 1
ECU schematic	911 508 001 issue 1
PCB assembly	003 9551 09 issue 1
PCB assy parts list	003 9552 09 issue 1

ECUs with internal accelerometer but without additional auxiliaries or power output

	5 auxiliaries (Haldex)	5 auxiliaries (BPW)
ECU assembly	003 9470 09 issue 1	003 9472 09 issue 1
ECU schematic	911 498 001 issue 1	911 498 001 issue 1
PCB assembly	003 9478 09 issue 1	003 9480 09 issue 1
PCB assy parts list	003 9485 09 issue 1	003 9485 09 issue 1

	3 auxiliaries (Haldex)
ECU assembly	003 9553 09 issue 1
ECU schematic	911 509 001 issue 1
PCB assembly	003 9554 09 issue 1
PCB assy parts list	003 9555 09 issue 1

ECUs without internal accelerometer but with additional auxiliaries and power output

	5 auxiliaries (Haldex)
ECU assembly	003 9471 09 issue 1
ECU schematic	911 499 001 issue 1
PCB assembly	003 9479 09 issue 1
PCB assy parts list	003 9486 09 issue 1

	3 auxiliaries (Haldex)
ECU assembly	003 9556 09 issue 1
ECU schematic	911 510 001 issue 1
PCB assembly	003 9557 09 issue 1
PCB assy parts list	003 9558 09 issue 1

ECUs without internal accelerometer and without additional auxiliaries or power output

	5 auxiliaries (Haldex)	5 auxiliaries (BPW)
ECU assembly	003 9467 09 issue 1	003 9475 09 issue 1

ECU schematic	911 500 001 issue 1	911 500 001 issue 1
PCB assembly	003 9477 09 issue 1	003 9482 09 issue 1
PCB assy parts list	003 9484 09 issue 1	003 9484 09 issue 1

3 auxiliaries (Haldex)

ECU assembly	003 9559 09 issue 1
ECU schematic	911 501 001 issue 1
PCB assembly	003 9560 09 issue 1
PCB assy parts list	003 9561 09 issue 1

PCB un-populated (all variants)	042 7262 09	issue 1
Wiring diagram (Haldex variants)	911 440 001	issue 5
Wiring diagram (BPW variants)	911 473 001	issue 1
Software (all Haldex variants)	042 7210 09	
Software (all BPW variants)	042 7211 09	

Accelerometer	042 6782 09	issue 1
Accelerometer	042 6782 09	issue 2
Over moulding for accelerometer	815 012 000 1	issue 8

Valve Assembly Electronic Components

Apply solenoid	041 5047 09 issue 3
Hold solenoid	041 5049 09 issue 2
Dump solenoid	041 5048 09 issue 2

Left hand pressure transducer assembly	041 5045 09 issue 3
Right hand pressure transducer assembly	041 5046 09 issue 2

Accelerometer 042 6782 09 issue 1 has approvals as follows:

e11*72/245*2004/104*3819*00

10R-023819

APPENDIX 2 – Information Required for 2004/104/EC Annex IIB

0 **General**

0.1 **Make (trade name of manufacturer):** Haldex Brake Products Ltd.

0.2 **Type and general commercial description(s):** EB+ 2M GEN 2 Electronically Controlled Braking System

0.3 **Means of identification of type, if marked on the component/separate technical unit:**

See the manufacturer's documentation GS0394 appendix 3 for applicable part numbers

0.3.1 **Location of that marking:** On the ESA

0.5 **Name and address of manufacturer:**

Haldex Brake Products Ltd.
Moons Moat Drive,
Moons Moat North,
Redditch,
Worcestershire,
England
B98 9HA

0.7 **In the case of components and separate technical units, location and method of affixing of the EC type approval mark :**

A label attached to the unit casing.

0.8 **Address(es) of the assembly plant(s):**

MSL Circuits
No. 6-3 AV.
Parc D'Activitie Synergie
Val-De-Loire
F-45130 Meung Sur Loire
France

Haldex Brake Products GMBH
Mittelgewannweg 27
69123 Heidelberg
West Germany

1 **This ESA shall be approved as a component.**

2 **Restrictions of use and conditions for fitting:**

24V negative ground vehicles only.

Fitting is to be in accordance with Haldex installation instructions.

3 **Electrical system rated voltage:**

24V, Negative ground.

APPENDIX 3 – List of variants covered by the approval

The following EB+ Gen 2 variants are covered by this approval:

With internal accelerometer:

820 001 XXX	2S/2M	3 aux	Without additional aux
820 002 XXX	2S/2M	3 aux	With additional aux
820 003 XXX	4S/2M (2S/2M)	5 aux	Without additional aux
820 004 XXX	4S/2M (2S/2M)	5 aux	With additional aux
820 005 XXX	2S/2M	3 aux	Without additional aux
820 006 XXX	2S/2M	3 aux	With additional aux
820 007 XXX	4S/2M (2S/2M)	5 aux	Without additional aux
820 008 XXX	4S/2M (2S/2M)	5 aux	With additional aux
820 009 XXX	2S/2M	3 aux	Without additional aux
820 010 XXX	2S/2M	3 aux	With additional aux
820 011 XXX	4S/2M (2S/2M)	5 aux	Without additional aux
820 012 XXX	4S/2M (2S/2M)	5 aux	With additional aux
820 025 1XX	2S/2M (4S/2M) – BPW	5 aux	Without additional aux
820 025 2XX	2S/2M (4S/2M) – BPW	5 aux	With additional aux
820 029 XXX	4S/2M (2S/2M) – BPW	Premium Aux	With additional aux
820 030 XXX	4S/2M (2S/2M)	Premium Aux	With additional aux

Without internal accelerometer:

820 013 XXX	2S/2M	3 aux	Without additional aux
820 014 XXX	2S/2M	3 aux	With additional aux
820 015 XXX	4S/2M (2S/2M)	5 aux	Without additional aux
820 016 XXX	4S/2M (2S/2M)	5 aux	With additional aux
820 017 XXX	2S/2M	3 aux	Without additional aux
820 018 XXX	2S/2M	3 aux	With additional aux
820 019 XXX	4S/2M (2S/2M)	5 aux	Without additional aux
820 020 XXX	4S/2M (2S/2M)	5 aux	With additional aux
820 021 XXX	2S/2M	3 aux	Without additional aux
820 022 XXX	2S/2M	3 aux	With additional aux
820 023 XXX	4S/2M (2S/2M)	5 aux	Without additional aux
820 024 XXX	4S/2M (2S/2M)	5 aux	With additional aux
820 025 0XX	2S/2M - BPW	5 aux	Without additional aux

External accelerometer without cable assembly 042 6782 09, with cable assembly 815 012 0XX

VCA Headquarters
1 The Eastgate Office Centre
Eastgate Road
Bristol, BS5 6XX
United Kingdom

Switchboard: +44 (0) 117 951 5151
Main Fax: +44 (0) 117 952 4103
Email: enquiries@vca.gov.uk
Web: www.vca.gov.uk

THE UNITED KINGDOM VEHICLE APPROVAL AUTHORITY

E11

COMMUNICATION CONCERNING THE ~~APPROVAL GRANTED~~ (2)/ APPROVAL EXTENDED (2)/ ~~APPROVAL REFUSED~~ (2)/ ~~APPROVAL WITHDRAWN~~ (2)/ ~~PRODUCTION DEFINITELY DISCONTINUED~~ (2) OF A TYPE OF ELECTRICAL/ ELECTRONIC SUB-ASSEMBLY (2) WITH REGARD TO REGULATION NO. 10.03

Approval No: 10R-033825 Extension No: 06

1. Make (trade name of manufacturer): Haldex Brake Products Ltd

2. Type and general commercial description(s): EB + 3M Electronically Controlled Braking System

3. Means of identification of type, if marked on the ~~vehicle~~/component/~~separate technical unit~~ (2): See manufacturers documentation GS0328 issue 10 appendix 3 for applicable part numbers

   3.1. Location of that marking: On the ESA

4. Category of vehicle: Not applicable

5. Name and address of manufacturer:
   Haldex Brake Products Ltd
   Moons Moat Drive
   Moons Moat North
   Redditch
   Worcestershire
   B98 9HA
   United Kingdom

6. In the case of components and separate technical units, location and method of affixing of the ECE approval mark: A label attached to the unit casing

R13 190533

25-Jul-12
1
UK Approval Authority

7. Address(es) of assembly plant(s):
Haldex Brake Products GmbH
Mittelgewannweg 27
69123 Heidelberg
Germany

MSL Circuits
No. 6-3 AV.
Parc D'Activitie Synergie
Val-De-Loire
F-45130 Meung Sur Loire
France

8. Additional information (where applicable): See Appendix

9. Technical Service responsible for carrying out the tests: MIRA, UK Limited

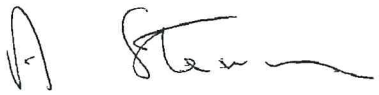
10. Date of test report: As before and 23 July 2012

11. No. of test report: As before and Technical Review EAN257377

12. Remarks (if any): See Appendix

13. Place: BRISTOL

14. Date: 25 JULY 2012

15. Signature: 

A. W. STENNING
Head of Technical and Quality Support Group

16. The index to the information package lodged with the Approval Authority, which may be obtained on request, is attached.

17. Reasons for extension: To cover addition of Slave ECU and Vale assembly

1/ Distinguishing number of the country which issued/extended/refused/withdrew approval (see Regulation provisions on approval).
2/ Strike out what does not apply.

Appendix
to type-approval communication form No. 10R-033825 Extension 06
concerning the type-approval of an electrical/electronic sub-assembly under Regulation No. 10.03

1. Additional information:

1.1. Electrical system rated voltage: 12 V or 24V ~~pos~~/neg ground (2)

1.2. This ESA can be used on any vehicle type with the following restrictions: Negative ground vehicles only

1.2.1. Installation conditions, if any: Generally 24V negative ground vehicles only with the exception of 812 015 001 and 813 012 XXX for 12V or 24V negative ground vehicles. Fitting instructions to be in accordance with Haldex installation instructions

1.3. This ESA can be used only on the following vehicle types: Not applicable

1.3.1. Installation conditions, if any: Not applicable

1.4. The specific test method(s) used and the frequency ranges covered to determine immunity were: (Please specify precise method used from Annex 9): 800 mm stripline (20 to 1000 MHz) and absorber lined chamber (1000 to 2000 MHz)

1.5. Laboratory accredited to ISO 17025 and recognized by the Approval Authority responsible for carrying out the tests: MIRA, UK Limited

2. Remarks: Haldex Information Document GS0328 Issue 10

2/ Strike out what does not apply.

DOCUMENT CONTROL (EB+ 3M Gen 1 Master and Slave ECUs)

The issue levels of the relevant controlled documents are:

System Components.	Master	24V Slave	12/24V Slave
PCB un-populated	042 7009 09 issue 2	042 6772 09 issue 2	042 6772 09 issue 2
ECU assembly	812 010 001 issue 7	812 011 001 issue 5	812 015 001 issue 1
ECU schematic	911 363 001 issue 9	911 364 001 issue 3	911 364 001 issue 3
ECU PCB assembly	003 8939 09 issue 3	003 8935 09 issue 1	003 8935 09 issue 1
PCB assy parts list	003 8940 09 issue 8	003 8943 09 issue 2	003 8943 09 issue 2
Master program code	042 6800 09		042 7291 09 or 042 7311 09
Wiring diagram	911 369 001 issue 4		911 523 001 issue 1

24V Valve Assembly Electrical Components

Apply solenoid	041 5020 09 issue 4	or	041 5031 09 issue 1*
Hold solenoid	041 5021 09 issue 4	or	041 5032 09 issue 1*
Dump solenoid	041 5022 09 issue 4	or	041 5033 09 issue 1*

12/24V Valve Assembly Electrical Components

Apply solenoid	041 5066 09 issue 1
Hold solenoid	041 5067 09 issue 1
Dump solenoid	041 5068 09 issue 1

13.5 bar abs/12.5 bar gauge pressure transducer

041 5025 09 issue 3 or
041 5030 09 issue 3 or
041 5029 09 issue 3*

9 bar abs/8 bar gauge pressure transducer

041 5024 09 issue 5
041 5027 09 issue 4
041 5028 09 issue 3*

Flexible PCB used with * 042 6876 09 issue 1

Accelerometer

042 6782 09 issue 1
042 6782 09 issue 2

Note

042 6782 09 issue 2 has approval e11*72/245*2004/104*3819*00 and 10R-023819
Overmoulding for accelerometer 815 012 000 1 issue 5

DOCUMENT CONTROL (EB+ 3M Gen 2 Master ECU/Valve Assembly)

The 3M Master ECU/valve assembly 820 026 000 2 submitted as representative of the type for EMC considerations has been manufactured using the controlled documents listed below.

ECU assembly	003 9294 09 issue 1
PCB assembly	003 9296 09 issue 1
PCB assy parts list	003 9297 09 issue 1
Software drawing	042 7021 09 issue 7
PCB un-populated	042 7104 09 issue 2
ECU schematic	911 457 001 issue 3

The same electronic assemblies, drawings and software listed above are used for both variants of 3M Master ECU 820 026 xxx and 820 027 xxx.

3M Master ECU variant 820 026 XXX

Wiring diagram	911 461 001	issue 1

3M Master ECU variant 820 027 XXX

Wiring diagram	911 467 001	issue 1

Valve Assembly Electronic Components

Apply solenoid	041 5047 09 issue 3
Hold solenoid	041 5049 09 issue 2
Dump solenoid	041 5048 09 issue 2

Left hand pressure transducer assembly

041 5045 09 issue 3

Right hand pressure transducer assembly

041 5046 09 issue 2

APPENDIX 2 – Information Required for 2009/19/EC Annex IIB

0 **General**

0.1 **Make (trade name of manufacturer):** Haldex Brake Products Ltd.

0.2 **Type and general commercial description(s):** EB+ 3M Electronically Controlled Braking System

0.3 **Means of identification of type, if marked on the component/separate technical unit:**

See the manufacturer's documentation GS0328 appendix 3 for applicable part numbers

0.3.1 **Location of that marking:** On the ESA

0.5 **Name and address of manufacturer:**

Haldex Brake Products Ltd.
Moons Moat Drive,
Moons Moat North,
Redditch,
Worcestershire,
England
B98 9HA

0.7 **In the case of components and separate technical units, location and method of affixing of the EC type approval mark :**

A label attached to the unit casing.

0.8 **Address(es) of the assembly plant(s):**

MSL Circuits
No. 6-3 AV.
Parc D'Activitie Synergie
Val-De-Loire
F-45130 Meung Sur Loire
France

Haldex Brake Products GMBH
Mittelgewannweg 27
69123 Heidelberg
West Germany

1 **This ESA shall be approved as a component.**

2 **Restrictions of use and conditions for fitting:**

Generally 24V negative ground vehicles only with the exception of 812 015 001 & 813 012 XXX for 12V or 24V negative ground vehicles.

Fitting is to be in accordance with Haldex installation instructions.

3 **Electrical system rated voltage:**

Generally 24V, Negative ground with the exception of 812 015 001 & 813 012 XXX for 12V or 24V negative ground vehicles.

APPENDIX 3 – List of Variants Covered by the Approval

The following variants are covered by this approval:

EB+ 3M Gen 1 Master 3M ECU	812 010 001
EB+ 24V Slave 3M ECU	812 011 001
EB+ 12/24V Slave 3M ECU	812 015 001
EB+ 3M Gen 1 Master Valve Assembly	813 00X 3XX
EB+ 24V Slave Valve Assy with suspension pressure transducer	813 010 XXX
EB+ 24V Slave Valve Assy without suspension pressure transducer	813 011 XXX
EB+ 12/24V Slave Valve Assy with suspension pressure transducer	813 012 XXX
EB+ 3M Gen 2 Master 3M ECU/Valve Assembly	820 026 XXX
EB+ 3M BPW ECOtronic	820 027 XXX
Accelerometer without cable assembly	042 6782 09
Accelerometer with cable assembly	815 012 0XX

Notes

1. Optional fitment of remote control line pressure transducer 815 022 XXX has approvals as follows:
   e11*72/245*2009/19*4038 and 10R-034038
2. Optional fitment of external accelerometer 042 6782 09 issue 2 has approval as follows:
   e11*72/245*2004/104*3819*00 and 10R-023819
3. Overmoulding for accelerometer 815 012 000 1 issue 5
   'X' can be any number 0-9, signifying a specific variation in mechanical configuration.

VCA Headquarters
1 The Eastgate Office Centre
Eastgate Road
Bristol, BS5 6XX
United Kingdom

Switchboard: +44 (0) 117 951 5151
Main Fax: +44 (0) 117 952 4103
Email: enquiries@vca.gov.uk
Web: www.vca.gov.uk

THE UNITED KINGDOM VEHICLE APPROVAL AUTHORITY

E11

COMMUNICATION CONCERNING THE ~~APPROVAL GRANTED~~ (2)/ APPROVAL EXTENDED (2)/ ~~APPROVAL REFUSED~~ (2)/ ~~APPROVAL WITHDRAWN~~ (2)/ ~~PRODUCTION DEFINITELY DISCONTINUED~~ (2) OF A TYPE OF ELECTRICAL/ ELECTRONIC SUB-ASSEMBLY (2) WITH REGARD TO REGULATION NO. 10.03

Approval No: 10R-034038 Extension No: 03

1. Make (trade name of manufacturer): Haldex Brake Products Ltd

2. Type and general commercial description(s): Remote Pressure Transducer. See the manufacturer's documentation GS0399 Appendix 3 for applicable part numbers

3. Means of identification of type, if marked on the ~~vehicle/~~component/~~separate technical unit~~ (2): Self adhesive label

   3.1. Location of that marking: On the unit casing

4. Category of vehicle: Not applicable

5. Name and address of manufacturer:
   Haldex Brake Products Ltd
   Moons Moat Drive
   Moons Moat North
   Redditch
   Worcestershire
   B98 9HA
   United Kingdom

6. In the case of components and separate technical units, location and method of affixing of the ECE approval mark: A self-adhesive label attached to the unit casing

7. Address(es) of assembly plant(s): See point 5 above

18-Apr-11
1
UK Approval Authority

8. Additional information (where applicable): See Appendix

9. Technical Service responsible for carrying out the tests: MIRA, Nuneaton

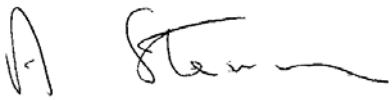
10. Date of test report: As before and 12 April 2011

11. No. of test report: As before and Technical Review EAM235513

12. Remarks (if any): See Appendix

13. Place: Bristol

14. Date: 18 APRIL 2011

15. Signature: 

A. W. STENNING
Head of Technical and Quality Group

16. The index to the information package lodged with the Approval Authority, which may be obtained on request, is attached.

17. Reasons for extension: To cover upgrade to amended level from R10.02 to R10.03

1/ Distinguishing number of the country which issued/extended/refused/withdrew approval (see Regulation provisions on approval).
2/ Strike out what does not apply.

Appendix to type-approval communication form No. 10R-034038 Extension 03 concerning the type-approval of an electrical/electronic sub-assembly under Regulation No. 10.03

1. Additional information:.

1.1. Electrical system rated voltage: 5 V. ~~pos~~/neg ground (2)

1.2. This ESA can be used on any vehicle type with the following restrictions: Negative ground vehicles only

1.2.1. Installation conditions, if any: Fitting is to be in accordance with Haldex installation instructions

1.3. This ESA can be used only on the following vehicle types: Not applicable

1.3.1. Installation conditions, if any: Not applicable

1.4. The specific test method(s) used and the frequency ranges covered to determine immunity were: (Please specify precise method used from Annex 9): 800 mm stripline 20 to 1000 MHz, absorber lined chamber 1000 to 2000 MHz

1.5. Laboratory accredited to ISO 17025 and recognized by the Approval Authority responsible for carrying out the tests: MIRA, Nuneaton, UK

2. Remarks: None

2/ Strike out what does not apply.

Document Control

The issue level for the controlled documents is

Pressure Transducer	815 022 000 2	issue 4

Appendix 2 - Information Required for 2004/104/EC Annex IIB

0 **General**

0.1 **Make (trade name of manufacturer):** Haldex Brake Products Ltd.

0.2 **Type and general commercial description(s):** Remote Pressure Transducer

0.3 **Means of identification of type, if marked on the component/separate technical unit:**

See the manufacturer's documentation GS0399 appendix 3 for part numbers

0.3.1 **Location of that marking:** On the component

0.5 **Name and address of manufacturer:**

Haldex Brake Products Ltd.
Moons Moat Drive,
Moons Moat North,
Redditch,
Worcestershire,
B98 9HA
U.K.

0.7 **In the case of components and separate technical units, location and method of affixing of the EC type approval mark :**

A label attached to the unit casing.

0.8 **Address(es) of the assembly plant(s):**

As 0.5 above

1 **This ESA shall be approved as a component.**

2 **Restrictions of use and conditions for fitting:**

Negative earth vehicles only. Fitting is to be in accordance with Haldex installation instructions.

3 **Electrical system rated voltage:**

5V D.C. regulated from the vehicle supply

Negative ground.

Appendix 3

The following variants are covered by the approval:

Pressure transducers with part numbers 815 022 X0X and 815022 X1X

Note. 'X' can be any number 0-9, signifying a specific variation in mechanical configuration.

Kraftfahrt-Bundesamt

DE-24932 Flensburg

E1

MITTEILUNG

ausgestellt von:
Kraftfahrt-Bundesamt

über die Erweiterung einer Genehmigung
eines Typs einer elektrischen/elektronischen Unterbaugruppe nach der Regelung Nr.10 einschließlich Änderung Nr. 05 Ergänzung 01

COMMUNICATION

issued by:
Kraftfahrt-Bundesamt

concerning the extension of an approval
of a type of electrical/electronic sub-assembly with regard to Regulation No.10 including amendment No 05 supplement 01

Genehmigungsnummer: **E1*10R05/01*5852*01**
Approval number:

1. Fabrikmarke (Handelsname des Herstellers):
Make (trade name of manufacturer):
ASG

2. Typ:
Type:
Drehwinkelsensor

Ausführung(en):
Version(s):
DWS_H

Handelsbezeichnung(en):
General commercial description(s):
Drehwinkelsensor

3. Merkmale zur Typidentifizierung, sofern am Bauteil vorhanden:
Means of identification of type, if marked on the component:
Artikelnummer
Item number

Genehmigungsnummer: **E1*10R05/01*5852*01**
Approval number:

3.1 Anbringungsstelle dieser Merkmale:
Location of that marking:
Auf dem Gehäusedeckel
On the housing cover

4. Klasse der Fahrzeuge:
Category of vehicle:
Entfällt
Not applicable

5. Name und Anschrift des Herstellers:
Name and address of manufacturer:
ASG Luftfahrttechnik und Sensorik GmbH
DE-69469 Weinheim

6. Bei Bauteilen und selbständigen technischen Einheiten, Lage und Anbringungsart des ECE-Genehmigungszeichens:
In the case of components and separate technical units, location and method of affixing of the ECE approval-mark:
Laserbeschriftung auf dem Gehäusedeckel
Laser marking on the housing cover

7. Anschrift(en) der Fertigungsstätte(n):
Address(es) of assembly plant(s):
ASG Luftfahrttechnik und Sensorik GmbH
DE-69469 Weinheim

8. Zusätzliche Angaben (gegebenenfalls):
Additional information (if any):
Siehe Anlage
See appendix

9. Für die Durchführung der Prüfungen zuständiger technischer Dienst:
Technical service responsible for carrying out the tests:
AKKA EMC GmbH
DE-71332 Waiblingen

10. Datum des Prüfprotokolls:
Date of test report:
12.08.2019

11. Nummer des Prüfprotokolls:
Number of test report:
P091403A (Stellungnahme/advisory opinon)

Genehmigungsnummer: **E1*10R05/01*5852*01**
Approval number:

12. Die Genehmigung wird **erweitert**
Approval is **extended**

13. Bemerkungen (gegebenenfalls):
Remarks (if any):
Siehe Anlage
See appendix

14. Ort: **DE-24932 Flensburg**
Place:

15. Datum: **21.08.2019**
Date:

16. Unterschrift: **Im Auftrag**
Signature:

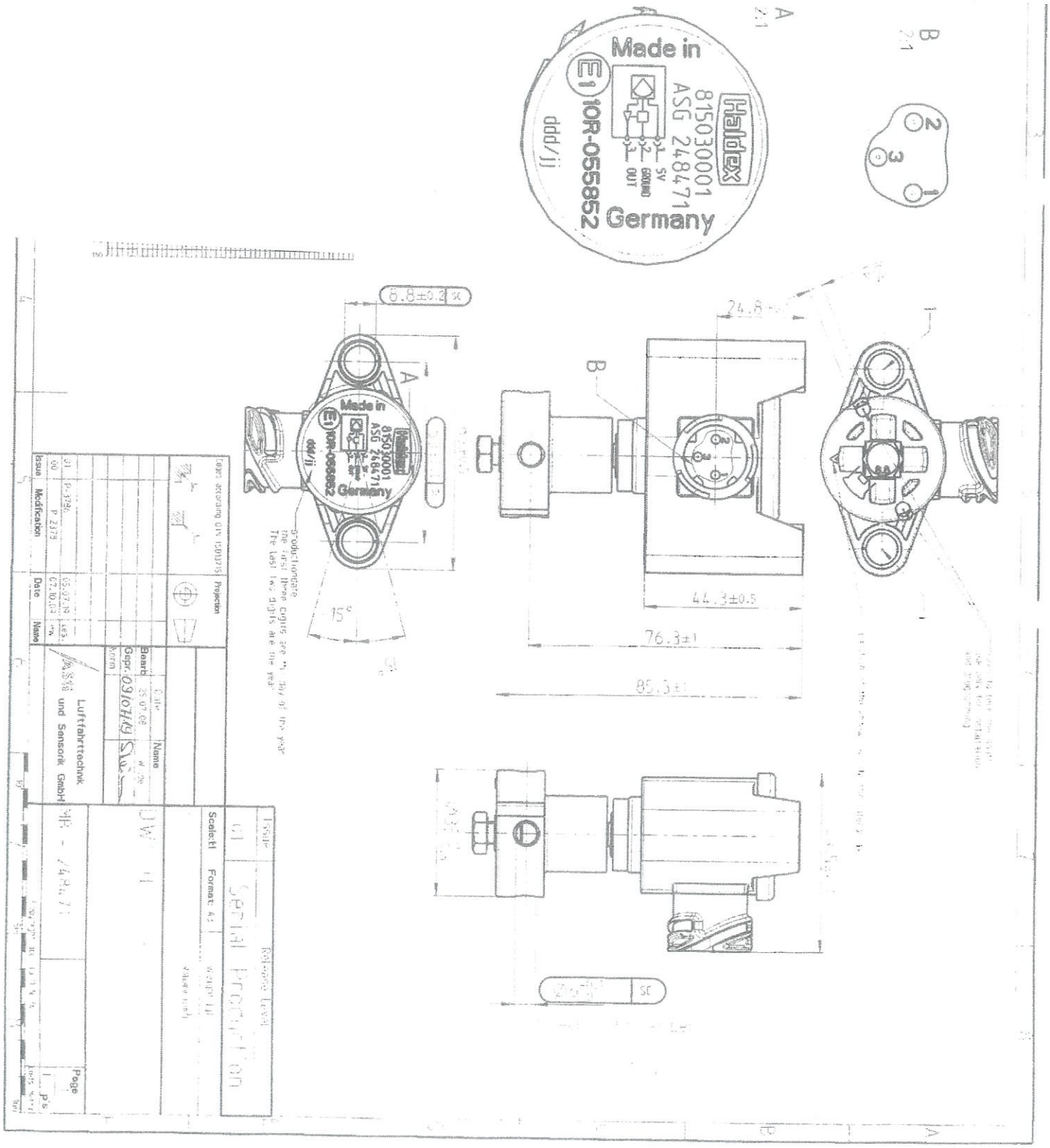
Jörg Burgkhardt

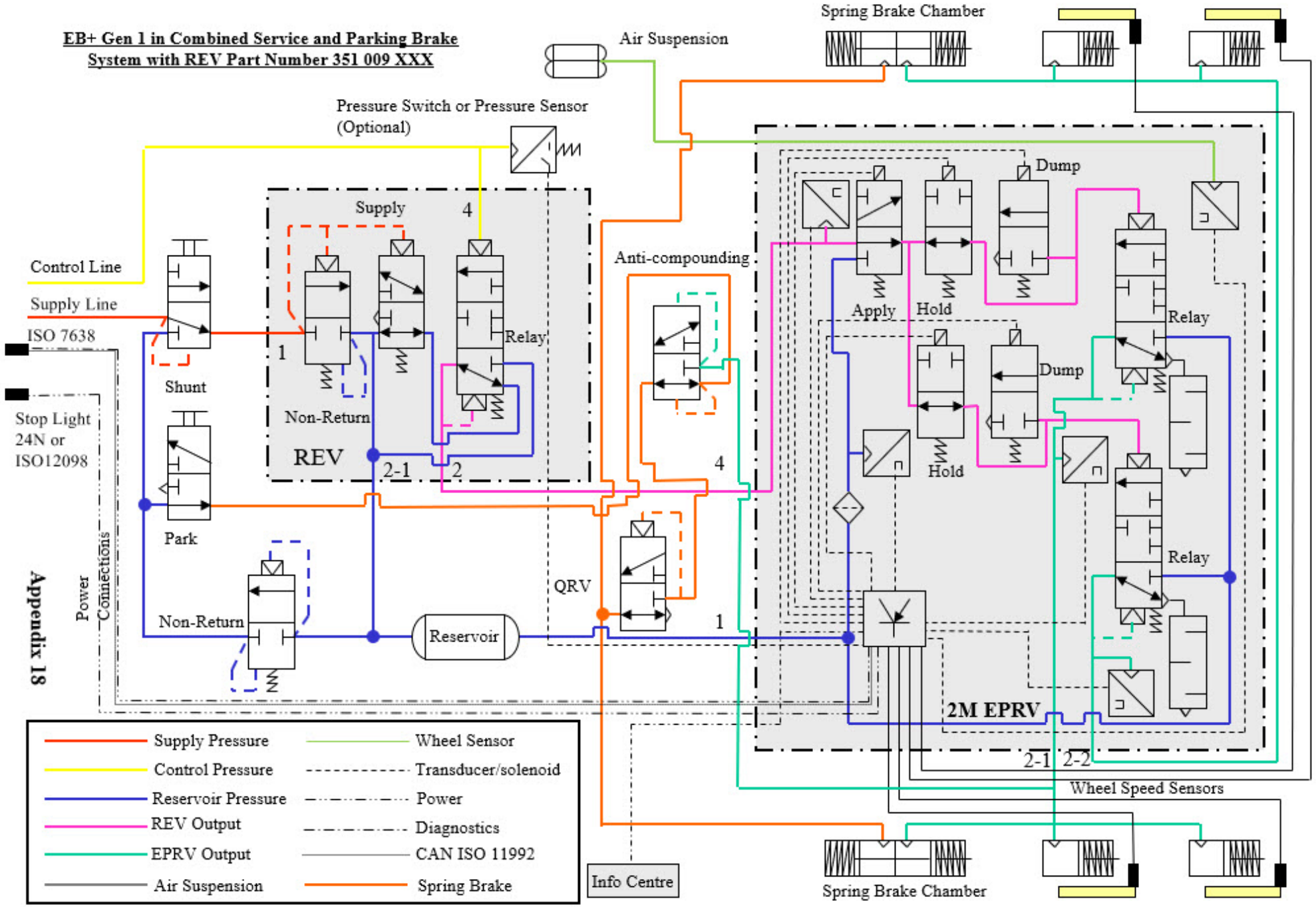
KRAFTFAHRT-BUNDESAMT 527

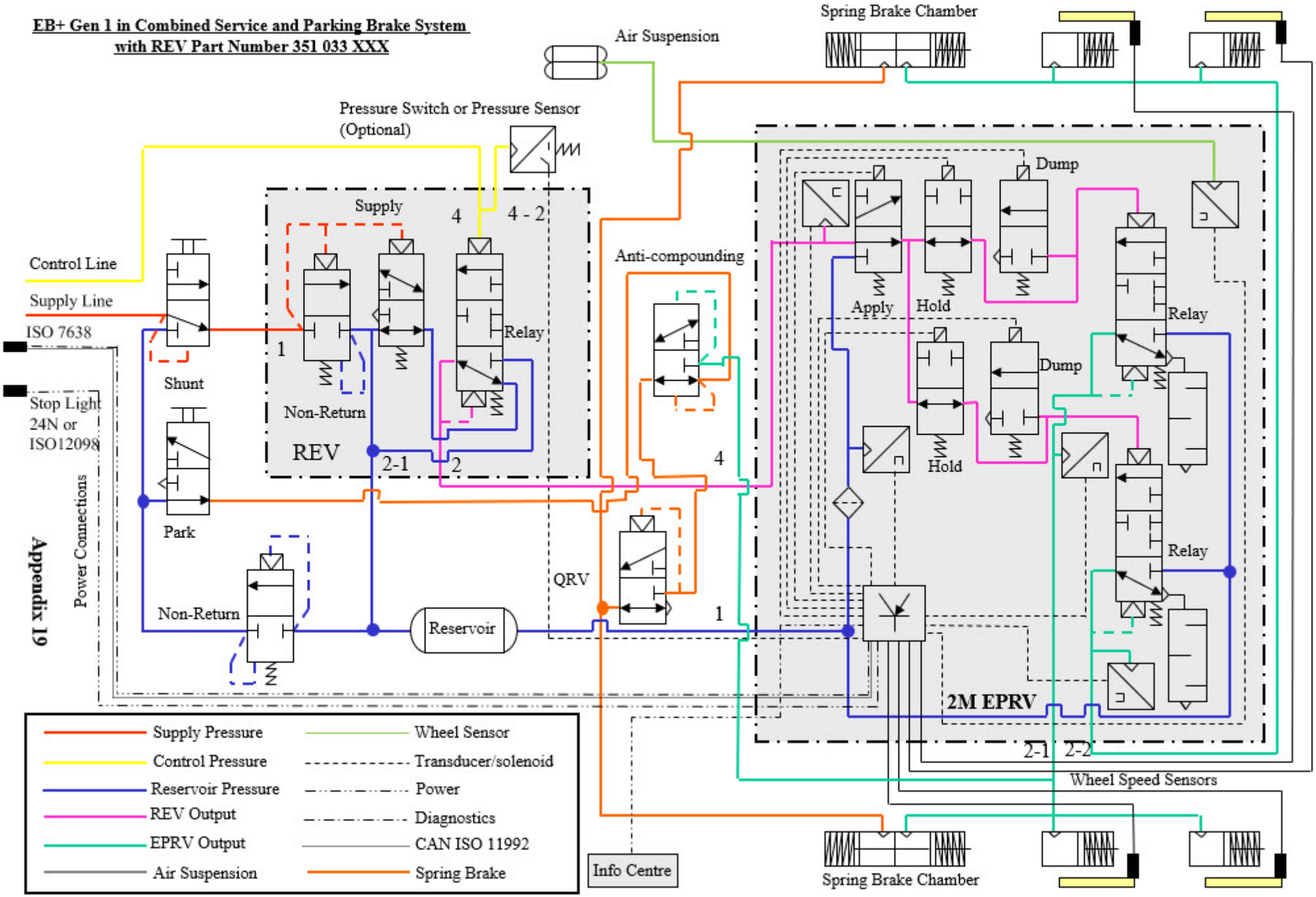
17. Das Inhaltsverzeichnis der bei den zuständigen Behörden hinterlegten Typgenehmigungsunterlagen, die auf Antrag erhältlich sind, liegt bei.
The index to the information package lodged with the approval authority, which may be obtained on request is attached.

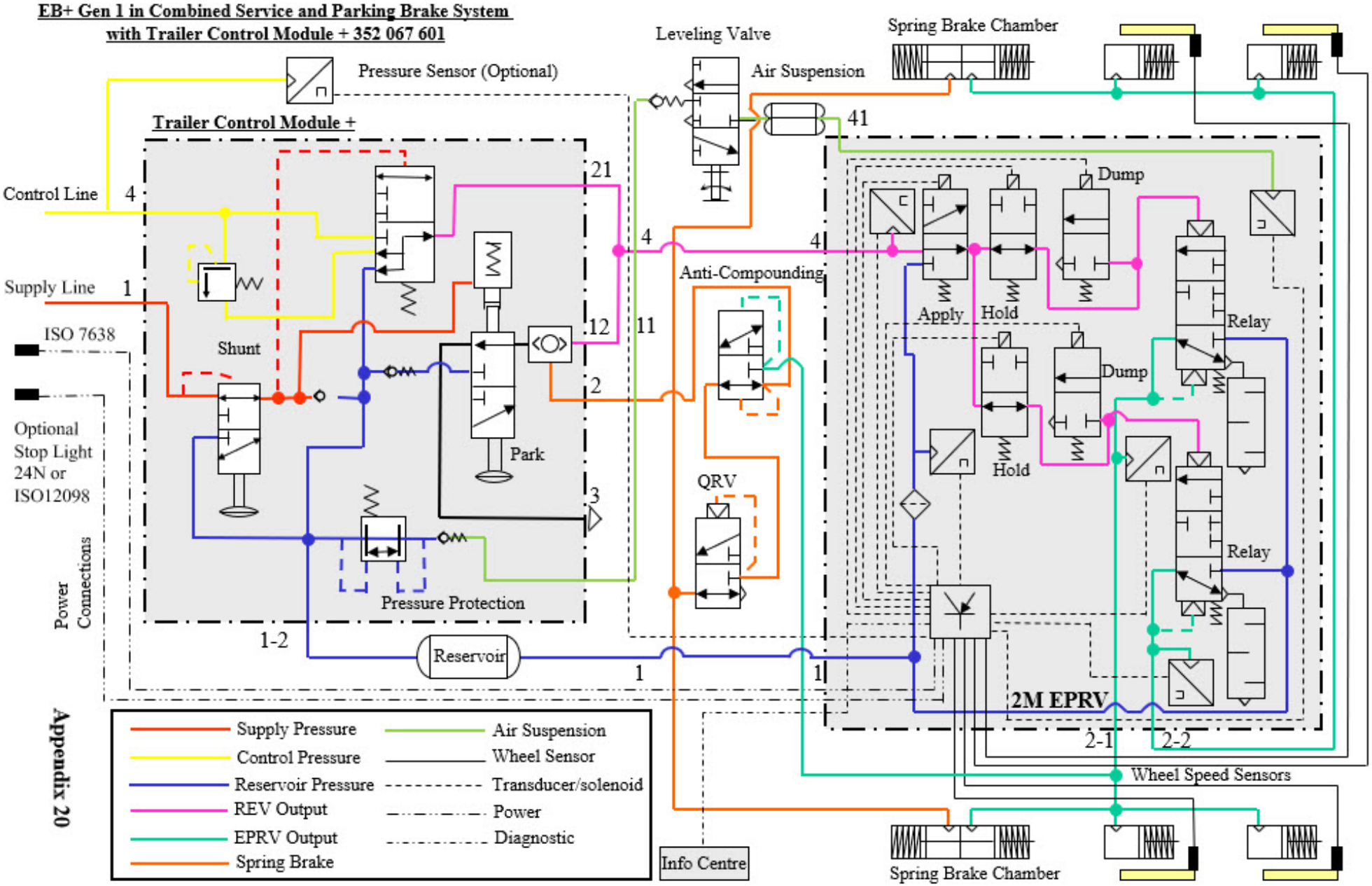
Anlagen:
Enclosures:
Gemäß Inhaltsverzeichnis
According to index

18. Grund oder Gründe für die Erweiterung der Genehmigung:
Reason(s) of extension of approval:
Anpassung an die Änderungsserie 05 der Regelung
Adaption to the 05 series of amendments of the regulation

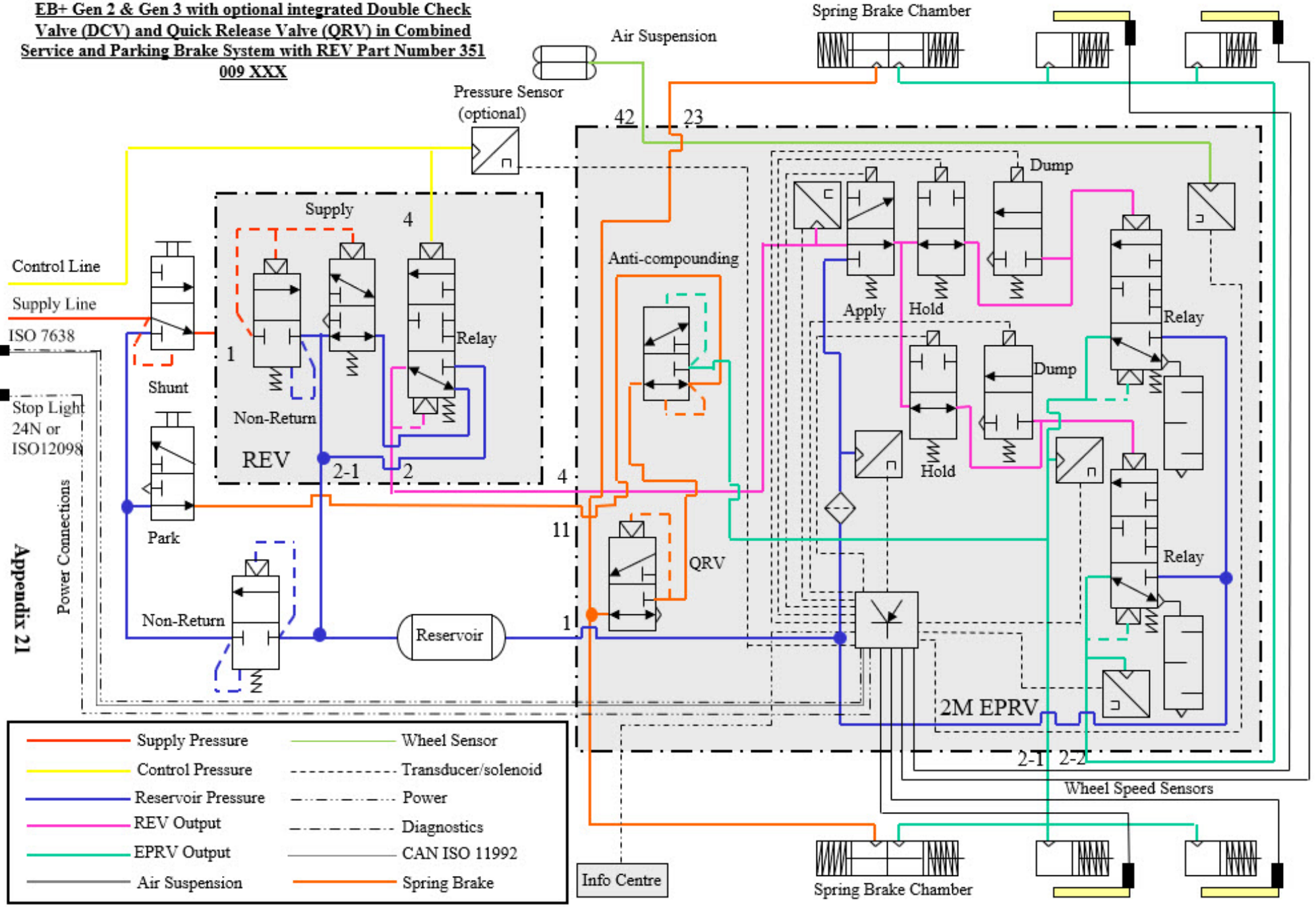

Made in
E1 10R-055852
Haldex
81503001
ASG 248471
Germany
ddd/jj
6.8±0.2
24.8
44.3±0.5
76.3±1
85.3±1
15°
Luftfahrttechnik
und Sensorik GmbH


EB+ Gen 1 in Combined Service and Parking Brake System with REV Part Number 351 009 XXX
Air Suspension
Spring Brake Chamber
Pressure Switch or Pressure Sensor (Optional)
Supply
4
Control Line
Supply Line
ISO 7638
Shunt
1
Relay
Non-Return
REV
2-1
2
Anti-compounding
Dump
Apply
Hold
Relay
Dump
Hold
Relay
Stop Light 24N or ISO12098
Park
4
QRV
1
Non-Return
Reservoir
Power Connections
Appendix 18
2M EPRV
2-1
2-2
Wheel Speed Sensors
Supply Pressure
Control Pressure
Reservoir Pressure
REV Output
EPRV Output
Air Suspension
Wheel Sensor
Transducer/solenoid
Power
Diagnostics
CAN ISO 11992
Spring Brake
Info Centre
Spring Brake Chamber
R13 190533


EB+ Gen 1 in Combined Service and Parking Brake System
with REV Part Number 351 033 XXX
Spring Brake Chamber
Air Suspension
Pressure Switch or Pressure Sensor
(Optional)
Supply
4
4 - 2
Control Line
Supply Line
ISO 7638
Relay
1
Shunt
Non-Return
REV
2-1
2
Anti-compounding
Dump
Apply
Hold
Relay
Dump
Hold
Relay
4
Stop Light
24N or
ISO12098
Park
QRV
1
Non-Return
Reservoir
2M EPRV
2-1
2-2
Wheel Speed Sensors
Info Centre
Spring Brake Chamber
Supply Pressure
Control Pressure
Reservoir Pressure
REV Output
EPRV Output
Air Suspension
Wheel Sensor
Transducer/solenoid
Power
Diagnostics
CAN ISO 11992
Spring Brake
Appendix 19
Power Connections
R13 190533


EB+ Gen 1 in Combined Service and Parking Brake System
with Trailer Control Module + 352 067 601
Pressure Sensor (Optional)
Trailer Control Module +
Leveling Valve
Air Suspension
Spring Brake Chamber
41
Control Line
4
Supply Line
1
ISO 7638
Optional
Stop Light
24N or
ISO12098
Power
Connections
Shunt
21
12
2
3
11
4
Park
Anti-Compounding
QRV
Pressure Protection
1-2
Reservoir
1
Dump
Apply
Hold
Relay
2M EPRV
2-1
2-2
Wheel Speed Sensors
Info Centre
Supply Pressure
Control Pressure
Reservoir Pressure
REV Output
EPRV Output
Spring Brake
Air Suspension
Wheel Sensor
Transducer/solenoid
Power
Diagnostic
Appendix 20
R13 190533

EB+ Gen 2 & Gen 3 with optional integrated Double Check Valve (DCV) and Quick Release Valve (QRV) in Combined Service and Parking Brake System with REV Part Number 351 009 XXX



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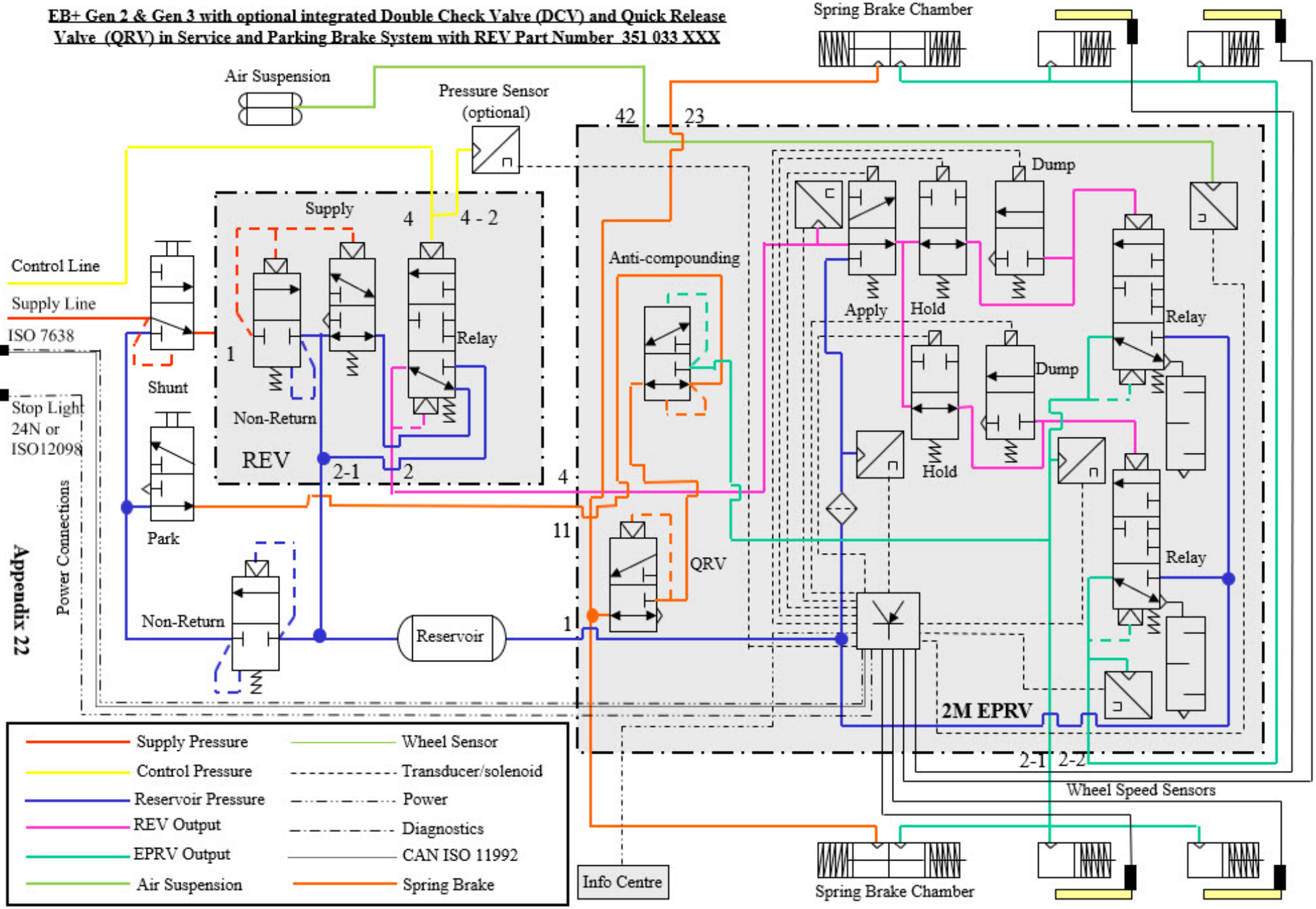
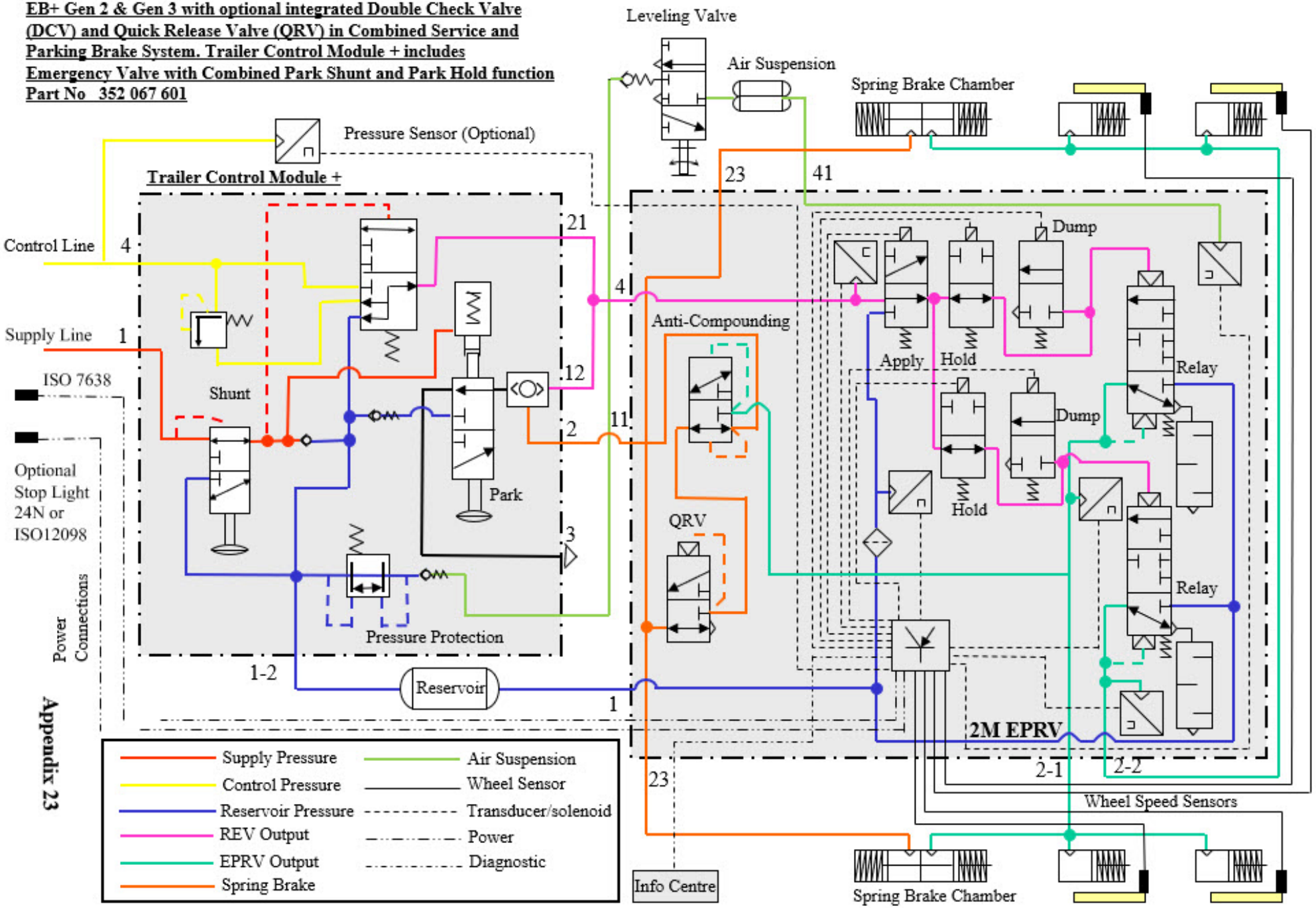
EB+ Gen 2 & Gen 3 with optional integrated Double Check Valve (DCV) and Quick Release Valve (QRV) in Service and Parking Brake System with REV Part Number 351 033 XXX



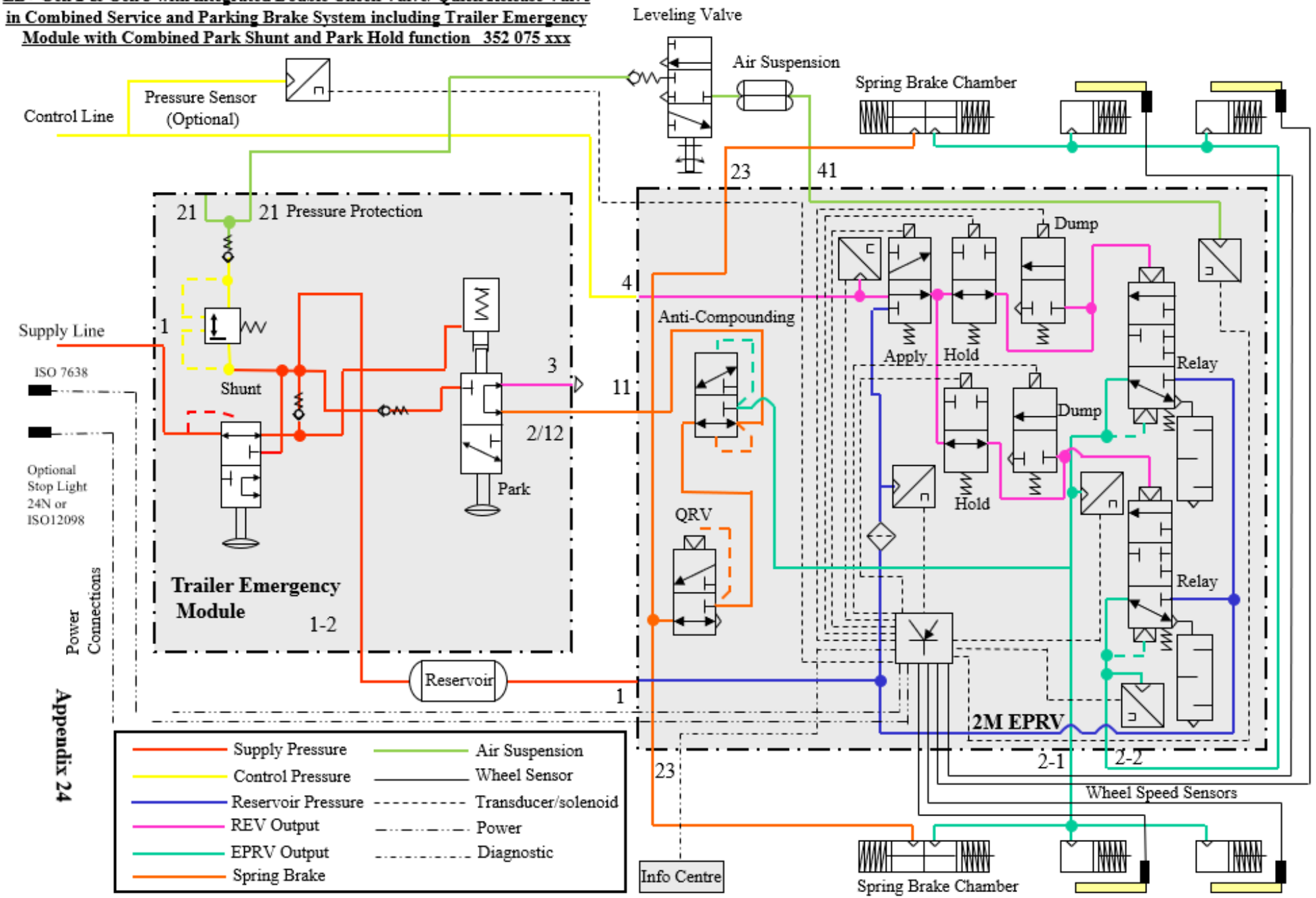
EB+ Gen 2 & Gen 3 with optional integrated Double Check Valve (DCV) and Quick Release Valve (QRV) in Combined Service and Parking Brake System. Trailer Control Module + includes Emergency Valve with Combined Park Shunt and Park Hold function
Part No 352 067 601



R13 190533

Appendix 23

EB+ Gen 2 & Gen 3 with integrated Double Check Valve/ Quick Release Valve in Combined Service and Parking Brake System including Trailer Emergency Module with Combined Park Shunt and Park Hold function 352 075 xxx



R13 190533