Kraftfahrt-Bundesamt

DE-24932 Flensburg

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MITTEILUNG

ausgestellt von:
Kraftfahrt-Bundesamt

eines Prüfprotokolls gemäß Anhang 18 Punkt 4 der ECE Regelung Nr. 13 für Sicherheitsaspekte komplexer elektronischer Fahrzeugsteuersysteme

COMMUNICATION

issued by:
Kraftfahrt-Bundesamt

of a Test Report regarding Annex 18 item 4 of ECE Regulation No. 13 for safty aspects of complex electronic vehicle Control Systems

R13 180535

Nummer der Bestätigung**: 180535**
Confirmation No.:

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

2. Typ:
Type:
EB+; EB132.11E

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**: 180535**
Confirmation No.:

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

7. Nummer des Prüfprotokolls:
Number of test report:
EB132.11E

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: **15.05.2020**
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: **180535**
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

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Zu: **180535**
To:

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Ausgabedatum: Date of issue:	**15.05.2020**	Letztes Änderungsdatum: Last date of amendment:	**--**

Nebenbestimmungen und Rechtsbehelfsbelehrung
Collateral clauses and instruction on right to appeal

Prüfbericht(e) Nr.: Test report(s) No.: **EB132.11E**	Datum: Date: **23.03.2020**
Beschreibungsbogen Nr.: Information document No.: **GS0440 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**: 180535**
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**

Test Report

No.: EB132.11E

with respect to the special requirements to the

Electronic Function of a Braking System with Electronic Control Transmission

and the

Safety Aspects of Complex Electronic Vehicle Control Systems

according to

UN-Regulation No. 13

as last amended by

supplement 16 to the 11 series of amendments

0. General

This Test Report is issued in addition to the TÜV NORD ABS Approval Report No. EB 128.11E (ABS) to cover the special provisions relating to electronic braking systems (EBS) for trailers with an electric control line and/or an electric control transmission

The Haldex numbers not fully specified in this report indicate that deviations from the listed equipment/components are possible. These, however, have no influence on the function and effect with regard to the inspection performed.

For the sake of simplicity the “Trailer Electronic Braking System **E B +** Information Document” is abbreviated in this report to **“I D _ G S 0 4 4 0”**.

If not other stated, reference to ISO 11992 refer in all cases to edition 2003 and includes Amendment 1 of ISO 11992-2 of 2007.

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

With respect to the previous TÜV NORD Report EB132.10E this report covers the following amendments:

- Inloader cofigurations added (see 2.1.3)
- Optional CAN-Hub (Router/Repeater) added (see 2.6.1)
- Editorial amendments

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

0.1 Statement of equivalence The assessment of the electronic function and safety aspects provided evidence that EB+ Gen 3 can be considered to be equivalent to previous versions of the system.

1. Identification

1.1 Manufacturer: **Haldex Brake Products Ltd**

Redditch, Worcestershire B98 9HA
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

1.3.1 System option with: **EB+Stability** (see paragraph 3.2.4.7 below)

1.3.1.1 Control function: **Roll-over control**

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

2. System and installation

2.1. Scope of application:

One or multi-axle trailers of categories O_3 and O_4 according to the framework Directive 2007/46/EC (70/156/EEC), Annex II or as defined in Annex 7 to the Consolidated Resolution on the Construction of Vehicles (R.E.3) with either drum or disc brakes.

All system configurations as defined in 2.2 above may be used on semi- or centre-axle trailers.

On full trailers only 4S/3M system may be used.

2.2 Types of interface:

The system has been designed to operate with towing vehicles having compressed air braking systems and the following interface connections:

- one pneumatic supply line and one pneumatic control line (see paragraph 5.1.3.1.1 of UN Regulation 13)

or

- one pneumatic supply line, one pneumatic control line and one electric control line (see paragraph 5.1.3.1.2 of UN Regulation 13)

or

one pneumatic supply line and one electric control line (see paragraph 5.1.3.1.3 of UN Regulation 13)

The configurations in the following table fulfil all relevant requirements for the respective interfaces as indicated.

Configuration	**5.1.3.1.1**	**5.1.3.1.2**	**5.1.3.1.3**
2S/1M	✓	✓	✓
2S/2M	✓	✓	✓
2S/2M_SL	✓	✓	✓
2S/2M_DAR	✓	✓	✓
2S/2M_Relay	✓	✓	✓
4S/2M	✓	✓	✓
4S/2M_Relay	✓	✓	✓
4S/3M	✓	✓	✓

Note: The interface connection with one pneumatic supply line and one electric control line (see paragraph 5.1.3.1.3 of UN Regulation 13) is currently prohibited for a towing vehicle or trailer to be approved. However to ensure forward compatibility the system supports this interface connection as well (see also ID_GS0440, paragraph 2.2.1)

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

2.3 System configurations

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

See also paragraph 1.4 and Appendix 1 of ID_GS0440

2.4 "End-of-line" programming:

A list of the parameter blocks is defined in ID_GS0440, paragraph 3.2.3.

2.5 Methods of powering:

All system configurations have the ability to accept a continuous power supply via the prescribed special connector conforming to ISO 7638.
As a backup, an intermittent power supply via the ISO 1185 (24N) or ISO 12098 connector (stop lamp circuit is accepted on all system variants apart from those that employ a slave modulator (see paragraph 1.3 above).

2.5.1 Permanent powering:

The following interfaces provide the primary power source for the systems:

ISO 7638:1985 (24 V)	5 Pin (71/320/EEC)
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

2.5.2 Intermittent powering:

As a safety backup 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.

Under normal permanent power operation the backup power has no effect on the operation of the braking system.

In compliance with paragraph 5.2.2.17.2 of UN-Regulation No. 13:

- It can be confirmed that the EB+ system contains short circuit monitoring in order to protect the backup supply from overload (see also paragraph 3.3.12 below), although the maximum available power from the additional

supply cannot be determined at the time of system approval.

- The system manufacturer does not supply any marking or label to indicate that the trailer is equipped with an additional power supply.

- There is no failure warning device for the purposes of providing a warning in the event of a failure within the trailer braking system when the braking system is powered from the additional supply.
- The operation of the braking system from the backup power source may be verified by two means:
  1) By an additional lamp flash (see Appendix 11 of ID_GS0440) on first application of the backup power supply (after initialisation of the system), as long as the permanent power supply is connected and has no faults and the vehicle has not moved from rest.
  2) With the permanent power supply disconnected, on application of the backup power supply the modulators will cycle once if there are no other faults present.
- Should a failure exist within the electrical supply of energy from the ISO7638 connector the failure warnings as described in paragraph 3.3.9 below are continuously sent.

For more detailed information see ID_GS0440, paragraph 3.4.1.

2.6. Identification of approved components:

For more detailed information see Section 3 and Appendix 7 of ID_GS0440

3. Verification of performance

3.0 General:

The tests defined below were used to establish conformity with the provisions for trailers with an electric control transmission and either a pneumatic control line only or a pneumatic control line and an electric control line or an electric control line only.

The tests were carried out on a 3-axle disc brake semitrailer with and air reservoir capacity of 80 l and on a simulation test rig.

The additional test to cover modifications of variant EB+ Gen 3 were carried out on a simulation test rig.

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

Tests for CAN-Hub (Ann. 16/17/18) were performed on simulation test rigs and 3-axle semi-trailer (response time).

3.1 Compliance with UN-R13 Annex 16:

The requirements of Annex 16 apply only to towing vehicles and trailers equipped with an **electric control line** as defined in paragraph 2.24. of the Regulation.

3.1.1 Prescribed messages transmitted from the towing vehicle to the trailer

Annex 16, paragraph 2.1.1: The following messages are received and processed by EB+:

Function / Parameter	ISO 11992-2	Regulation No. 13
Service/secondary brake demand value	EBS11 Byte 3-4	Annex 10, paragraph 3.1.3.2.
Two electrical circuits brake demand value	EBS12 Byte 3 Bit 1-2	paragraph 5.1.3.2.
Pneumatic control line	EBS12 Byte 3 Bit 5-6	paragraph 5.1.3.2.

3.1.2 Prescribed messages transmitted from the trailer to the towing vehicle

Annex 16, paragraph 2.1.2: The following messages are transmitted by EB+:

Function / Parameter	ISO 11992-2	Regulation No. 13
VDC Active / passive	EBS21 Byte 2 Bit 1-2	Annex 21, paragraph 2.1.6
Vehicle electrical supply sufficient / insufficient	EBS22 Byte 2 Bit 1-2	paragraph 5.2.2.20.
Red warning signal request	EBS22 Byte 2 Bit 3-4	paragraphs 5.2.2.15.2.1., 5.2.2.16. and 5.2.2.20.
Supply line braking request	EBS22 Byte 4 Bit 3-4	paragraph 5.2.2.15.2.
Stop lamps request	EBS22 Byte 4 Bit 5-6	paragraph 5.2.2.22.1.
Vehicle pneumatic supply sufficient / insufficient	EBS23 Byte 1 Bit 7-8	paragraph 5.2.2.16.

3.1.3 Prescribed warnings by the motor vehicle (Annex 16, paragraph 2.2):

The following warnings are transmitted by EB+:

Function / Parameter	ISO 11992-2	Regulation No. 13
VDC Active / passive	EBS21 Byte 2 Bit 1-2	Annex 21, paragraph 2.1.6
Red warning signal request	EBS22 Byte 2 Bit 3-4	paragraph 5.2.1.29.2.1.

3.1.4 Prescribed messages supported by the trailer Annex 16, paragraph 2.3.2:

The following prescribed messages are transmitted by EB+:

Function / Parameter	ISO 11992-2
Vehicle service brake active / passive	EBS22 Byte 1, Bit 5-6
Braking via electric control line supported	EBS22 Byte 4, Bit 7-8
Geometric data index	EBS24 Byte 1
Geometric data index content	EBS24 Byte 2

3.1.5 Towing vehicle messages with respect to certain functions/ parameters (Annex 16, paragraph 2.4.1:

The following tables shows which messages are received from the towing vehicle and processed by EB+:

Function / Parameter	ISO 11992-2	Supported
Vehicle type	EBS11 Byte 2, Bit 3-4	**no**
VDC (Vehicle Dynamic Control) Active / passive	EBS11 Byte 2, Bit 5-6	**no**
Brake demand value for front or left side of vehicle	EBS11 Byte 7	**no**
Brake demand value for rear or right side of vehicle	EBS11 Byte 8	**no**
ROP (Roll Over Protection) system enabled/disabled	EBS12 Byte 1, Bit 3-4	**no**
YC (Yaw Control) system enabled/disabled	EBS12 Byte 1, Bit 5-6	**no**
Enable/disable trailer ROP (Roll Over Protection) system	EBS12 Byte 2, Bit 1-2	**no**
Enable/disable trailer YC (Yaw Control) system	EBS12 Byte 2, Bit 3-4	**no**

Function / Parameter	ISO 11992-2	Supported
Traction help request	RGE11 Byte 1, Bit 7-8	**yes**
Lift axle 1 - position request	RGE11 Byte 2, Bit 1-2	**yes**
Lift axle 2 - position request	RGE11 Byte 2, Bit 3-4	**yes**
Steering axle locking request	RGE11 Byte 2, Bit 5-6	**yes**
Seconds	TD11 Byte 1	**no**
Minutes	TD11 Byte 2	**no**
Hours	TD11 Byte 3	**no**
Months	TD11 Byte 4	**yes**
Day	TD11 Byte 5	**yes**
Year	TD11 Byte 6	**no**
Local minute offset	TD11 Byte 7	**no**
Local hour offset	TD11 Byte 8	**no**

Note: The messages above shall be supported by the trailer as appropriate when it is installed with a function associated with that parameter.

3.1.6 Trailer messages with respect to certain functions/ parameters

Annex 16, paragraph 2.4.2: The following tables shows which are transmitted by EB+:

Function / Parameter	ISO 11992-2	Transmitted
Support of side or axle wise brake force distribution	EBS21 Byte 2, Bit 3-4	**no**
Wheel based vehicle speed	EBS21 Byte 3-4	**yes**
Lateral acceleration	EBS21 Byte 8	**yes**
Vehicle ABS active / passive	EBS22 Byte 1, Bit 1-2	**yes**
Amber warning signal request	EBS22 Byte 2, Bit 5-6	**yes**
Vehicle type	EBS22 Byte 3, Bit 5-6	**yes**
Loading ramp approach assistance	EBS22 Byte 4, Bit 1-2	**yes**
Axle load sum	EBS22 Byte 5-6	**yes**
Tyre pressure sufficient / insufficient	EBS23 Byte 1, Bit 1-2	**yes**

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

Function / Parameter	ISO 11992-2	Transmitted
Brake lining sufficient / insufficient	EBS23 Byte 1, Bit 3-4	**yes**
Brake temperature status	EBS23 Byte 1, Bit 5-6	**no**
Tyre / wheel identification (pressure)	EBS23 Byte 2	**yes**
Tyre / wheel identification (lining)	EBS23 Byte 3	**no**
Tyre / wheel identification (temperature)	EBS23 Byte 4	**no**
Tyre pressure (actual tyre pressure)	EBS23 Byte 5	**yes**
Brake lining	EBS23 Byte 6	**no**
Brake temperature	EBS23 Byte 7	**no**
Brake cylinder pressure first axle left wheel	EBS25 Byte 1	**yes**
Brake cylinder pressure first axle right wheel	EBS25 Byte 2	**yes**
Brake cylinder pressure second axle left wheel	EBS25 Byte 3	**yes**
Brake cylinder pressure second axle right wheel	EBS25 Byte 4	**yes**
Brake cylinder pressure third axle left wheel	EBS25 Byte 5	**yes**
Brake cylinder pressure third axle right wheel	EBS25 Byte 6	**yes**
ROP (Roll Over Protection) system enabled/disabled/	EBS25 Byte 7, Bit 1-2	**yes**
YC (Yaw Control) system enabled/disabled	EBS25 Byte 7, Bit 3-4	**no**
Traction help	RGE21 Byte 1, Bit 5-6	**yes**
Lift axle 1 position	RGE21 Byte 2, Bit 1-2	**yes**
Lift axle 2 position	RGE21 Byte 2, Bit 3-4	**yes**
Steering axle locking	RGE21 Byte 2, Bit 5-6	**yes**
Tyre wheel identification	RGE23 Byte 1	**yes**
Tyre temperature	RGE23 Byte 2-3	**no**

Function / Parameter	ISO 11992-2	Transmitted
Air leakage detection (Tyre)	RGE23 Byte 4-5	**no**
Tyre pressure threshold detection	RGE23 Byte 6, Bit 1-3	**yes**
Tyre module power supply	RGE23 Byte 6, Bit 4-5	**yes**

3.1.7 List of supported messages and parameters:

Appendix 5 of ID_GS0440 shows which of the ISO 11992 messages and parameters are supported.

3.2 Compliance with UN-R13 Annex 17:

Annex 17 provides an example of tests to perform the assessment of functional compatibility of towing and towed vehicles equipped with electric control lines by checking that the relevant provisions of ISO 11992-1 and -2 are fulfilled.

Compliance with the relevant provisions was proved by the test report mentioned under paragraph 3.2.1 below and by demonstration of the bus failure conditions 1 to 8 as defined in paragraph 5.4.3.1 of ISO 11992-1 showing that the specified failure mode requirements had been integrated into the system.

3.2.1 Test Report ISO 11992:

The manufacturers provided six test reports for the controller which demonstrates compliance that the interface, including the physical layer, data link layer and the application layer and the respective position of supported messages and parameters, complies with standard ISO 11992.

EB+ Gen 1:

- C8891: (ISO 11992 Part 1 - 1998)
- C8889: (ISO 11992 Part 2 - 1998)
- C8890: (ISO 11992 Part 3 - 1998)
- C9385: (ISO 11992 - 2003) - This report confirms compliance with the amendments in ISO 11992 - 2003.

EB+ Gen 2

- C9685: (ISO 11992 Part 1 - 2003)
- C9686: (ISO 11992 Part 2 - 2003)

EB+ Gen 3

- C10942: (ISO 11992 Part 1 - 2003)
- C10946: (ISO 11992 Part 2 - 2003, Amd 1 -2007)

CAN-Hub

- C11467 (ISO11992 Part 1 - 2003)
- #19-0005 (ISO11992 Part 2 and 3 – 2014)

3.2.2 Towing vehicle simulator: A towing vehicle simulator was used with an interface according to ISO 7638:1997 (7 pin) which was able to receive all of the messages transmitted by the test trailer and was capable of transmitting all motor vehicle messages defined within ISO 11992-2: 2003.
The simulator was equipped with a failure warning display and an electrical power supply for the trailer.
During verification the parameters and messages were read directly by proprietary CAN analyser (Vector CANalyzer) and displayed on a monitor. This analyser provided a direct readout of messages with the parameters in the data field shown in the correct order in relation to time.
The simulator together with the analyser was capable of measuring the brake system response time in accordance with paragraph 3.5.2. of Annex 6 to UN-Regulation No. 13.

3.2.3 Towed vehicle simulation: For the bench tests the following equipment was also used:

- Wheel speed signal simulator (open loop)
- Pressure sensor simulator (open or closed loop according to test)
- Solenoid breakout and monitor box so that faults could be introduced and observed

3.2.4 Functional checks: With respect to the functional checks according to Annex 17 the modifications of EB+ Gen 3 have no impact on the results of the previous TÜV NORD reports.

3.2.4.1 Service brake system: With the towing vehicle simulator connected to the trailer via the ISO 7638 interface and all towing vehicle messages relevant to the interface being transmitted the following checks were carried out (cp. paragraphs 4.2.2.1.1.1 and 4.2.2.1.1.2 of Annex 17 respectively):

The trailer response to the parameters defined in EBS11 of ISO 11992-2 were in all cases (listed in this paragraph) verified as follows:

- pressure in the supply line at the start of each test was $\geq$ 700 kPa
- laden state of the vehicle simulated

a) Both pneumatic and electric control lines connected:

- both control lines be signalled simultaneously

- the motor vehicle message byte 3, bits 5–6 of EBS12 was set to 01_b and transmitted to the trailer to indicate that a pneumatic control line is connected

EBS11, byte 3–4	pressure at the brake chambers	
prescribed	prescribed	measured*
0	0 kPa	0 kPa
33280d [650 kPa]	650 kPa (brake calculation)	660 kPa

* gauge reading

b) Electric control line only connected:

- the motor vehicle message byte 3, bits 5–6 of **EBS12** was set to 00_b and transmitted to the trailer to indicate that a pneumatic control line is not available
- byte 3, bits 1–2 of **EBS12** set to 01_b to indicate to the trailer that the electric control line signal is generated from two independent electric circuits.

EBS11, byte 3–4	pressure at the brake chambers	
prescribed	prescribed	measured*
0	0 kPa	0 kPa
33280d [650 kPa]	650 kPa (brake calculation)	660 kPa

* gauge reading

Trailer <u>equipped</u> with only an electric control line

The provisions in paragraph 4.2.2.1.2 of Annex 17 are not applicable as the EB+ system is only designed for trailers utilising connections according to paragraph 5.1.3.1.2 of UN-Regulation No. 13 (one pneumatic supply line, one pneumatic control line and one electric control line).

Trailer <u>connected</u> with only an electric control line

In the case that a braking performance of at least 30 per cent of the prescribed performance for the service braking system of the trailer can no longer be ensured, paragraph 5.2.2.15.2 of the UN-Regulation No. 13 and paragraph 4.2.2.1.3 of Annex 17 require that either the "supply line braking request" signal (byte 4, bits 3-4 of EBS22, set to 01_b) via the data communication part of the electric control line is sent or an automatic braking is invoked by the continuous absence of the data communication invoked (see also paragraph 5.2.1.27.10 of UN-Regulation No. 13).
A failure (open circuit brake apply solenoid) was simulated where the prescribed service braking performance could not be met.

General test conditions:
- Pressure in the supply line at the start of each test was ≥ 700 kPa
- The electric control line was connected to the motor vehicle simulator.
- Byte 3, bits 5-6 of EBS12 was set to 00_b to indicate to the trailer that a pneumatic control line is not available.
- Byte 3, bits 1-2 of EBS12 was set to 01_b to indicate to the trailer that the electric control line signal was generated from two independent circuits.
- With no fault present in the trailer braking system the braking system was communicating with the motor vehicle simulator byte 4, bits 3-4 of EBS22 was set to 00_b.

This failure was introduced under two speed conditions
a) vehicle stationary
b) vehicle travelling at a constant speed > 30 km/h

Observation in the case a

Trailer response after introduction of the fault:
- supply line braking request byte 4, bits 3–4 of EBS22, set to 01_b
- Red warning signal request byte 2, bits 3–4 of EBS22 and set to 01_b
- yellow warning signal transmitted via Pin 5 of the ISO 7638 connector
- byte 2, bits 5–6 of EBS22 transmitted by the trailer and set to 01_b (amber warning signal request)

Observation in the case b

Trailer response as case a, however, after a period of about 5 s the ISO 11992 data communication to the motor vehicle simulator was terminated because no deceleration was detected in response to the supply line braking request.

3.2.4.2 Failure Warning: (Annex 17/4.2.2.2)

The following failures as prescribed in UN-Regulation No. 13 were simulated after which the warning messages and signals were detected at the ISO 7638 interface:

a) Permanent failure within the electric control transmission which precludes the service braking performance being met

Both pneumatic and electric control lines connected

A permanent failure (brake apply solenoid permanently shortened to B+) within the electric control transmission

was simulated. After recognizing this fault the ECU electrically isolates all solenoids and the system reverts to entirely pneumatic control.

- Observation 1 with semi-trailer
  - yellow signal transmitted via Pin 5 of the ISO 7638 connector
  - byte 2, bits 5–6 of EBS22 transmitted by the trailer and set to 01_b (amber warning signal request)

- Observation 2 with full trailer
  In addition to observation 1 also the red warning signal request is transmitted by the trailer:
  - byte 2, bits 3–4 of EBS22; set to 01_b

  Note: In the case of semi-trailer the simulated fault does not preclude the service braking system performance from being fulfilled whereas in the case of full trailer the service braking system performance (without locking of the wheels) cannot be guaranteed (due to unknown distribution of braking forces).
  See also Appendix 8 of ID_GS0440

Trailer connected with only an electric control line (according to paragraph 5.1.3.1.3 of UN-Regulation No. 13)

See test conditions and trailer responses as described in paragraph 3.2.4.1 (“Trailer connected with only an electric control line”) above.

b) Low voltage warning

Verification of compliance with the provisions of paragraph **5.2.2.20 of UN-R13; reduction of the voltage** on Pins 1 and 2 of the ISO 7638 connector below 19 V

Trailer response:

- byte 2, bits 1–2 of EBS22 transmitted by the trailer and set to 00_b (vehicle electrical supply insufficient)
- yellow warning signal transmitted via Pin 5 of the ISO 7638 connector
- byte 2, bits 3–4 of EBS22 transmitted by the trailer and set to 01_b (red warning signal request)
- byte 2, bits 5–6 of EBS22 transmitted by the trailer and set to 01_b (amber warning signal request)

c) Low system supply pressure warning

Verification of compliance with the provisions of paragraph **5.2.2.16 of UN-R13**:

The pressure in the trailer air reservoir was reduced below the nominated value of 450 kPa.

Trailer responses when the pressure had reached a value of ≤ 450 kPa in the air reservoir:

- byte 1, bits 7–8 of EBS23 transmitted by the trailer and set to 00_b (vehicle pneumatic supply insufficient)
- byte 2, bits 3–4 of EBS22 transmitted by the trailer and set to 01_b (red warning signal request)
- warning signal transmitted via Pin 5 of the ISO 7638 connector (yellow warning)
- byte 2, bits 5–6 of EBS22 transmitted by the trailer and set to 01_b (amber warning signal request)

d) Verification of the **warning signal indication at system energisation** (compare paragraph 5.2.1.29.5 of UN-Regulation No. 13)

When the electrical part of the braking equipment was first energised byte 2, bits 3-4 of EBS22 was transmitted by the trailer and set to 01_b (red warning signal). After the braking system had checked that no defects that require identification by the red warning signal were present the above message was set to 00_b (no red warning signal).

The yellow warning signal was also transmitted via pin 5 of the ISO7638 connector in accordance with paragraph 3.4.3 and Appendix 11 of ID_GS0440.

In addition, byte 2, bits 5–6 of EBS22 transmitted by the trailer and set to 01_b (amber warning signal request).

3.2.4.3 Response time (Annex 17/4.2.2.3):

The response time was measured in accordance with the requirements of Annex 6 of UN-R13 for both the pneumatic and electric control lines with a normal and a simulated high bus loading of the CAN as follows:

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

2S/2M:

Test conditions [semi-trailer with 80 l air reservoir]	test with electrical control line	test with pneumatic control line. with REV	test with pneumatic control line. without REV
initial reservoir pressure	650 kPa	650 kPa	650 kPa
control line demand signal	33280_d [650kPa]	650 kPa	650 kPa
75 % of the measured asymptotic pressure in the brake chamber	476 kPa	436 kPa	450 kPa
measured response time	0.25 s	0.33 s	0.34 s

4S/3M:

Test conditions [semi-trailer with 120 l air reservoir]	test with electrical control line	test with pneumatic control line. with REV
initial reservoir pressure	650 kPa	650 kPa
control line demand signal	33280_d [650 kPa]	650 kPa
electric control line demand signal (10 %-value)	3328_d [65 kPa]	65 kPa
measured asymptotic pressure in the brake chamber with a digital demand signal in the electric control line of 33280_d bit	600 kPa	590 kPa
75 % of the measured asymptotic pressure in the brake chamber	450 kPa	443 kPa
measured response time (average of 3 measurements)	0.262 s	0.340 s

CAN Repeater: In addition to the above tests, response time tests were carried out with the optional CAN Repeater (see Appendix 2 to this report).

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3.2.4.4 Illumination of stop lamps:

The message requirement "illuminate stop lamps" specified in paragraphs 5.2.2.22.1 and 5.2.2.22.2 of UN-Regulation No. 13 was verified, see paragraph 3.2.4.5 below.

Stop lamps request: EBS22 Byte 4, Bits 5-6, set to set to 01_b

See also ID_GS0440, paragraph 1.5.3.

3.2.4.5 Automatically commanded braking (Annex 17/4.2.2.4):

EB^+ incorporates automatically commanded braking and this was verified in two ways –

(a) The roll-over control function (ID_GS0440, paragraph 1.5.3.7) was activated. An unstable driving condition was simulated. Wheel speed signals were simulated using the end-of-line test program and an external accelerometer was tilted in a vertical plane to simulate a high lateral acceleration which caused the roll-over control function to initiate an automatically commanded braking event, see also paragraph 3.2.4.7 below.

(b) The Soft Docking function (ID_GS0440 paragraph 1.5.3.8) was activated. An obstruction was placed within 1 m of the ultrasonic sensors, which initiated an automatically commanded braking event.

Irrespective of the deceleration, the EB^+ always transmits the "illuminate stop lamps" request in the event of automatically commanded braking (see also paragraph 5.2.2.22.1 of UN-Regulation No. 13).
In the cases above the message EBS22 byte 4, bits 5-6 was monitored using CANalyzer. The data was set to 01_b to request stop lamp illumination during the automatically commanded braking events. When there was no automatically commanded braking the data changed to 00_b.

3.2.4.6 Geometric Data:

In order to verify the geometric data content the CAN data of the message EBS24 was recorded and monitored on the CANalyzer. The following data was received which corresponded to the vehicle setup programmed:

Index (d) EBS24 Byte 1	**Data (d)** EBS24 Byte 2
0	0 (semi-trailer)
1	65 (6.5 m)
2	185 (1.85 m)
3	3 (axles)
4	- (Not draw-bar) [FFh]
5	1 (lift axles)

Index (d) EBS24 Byte 1	**Data (d)** EBS24 Byte 2
6	1 (lift axle position)
7	- (lift axle position) [FFh]
8	- (Not defined) [FFh]
9	- (Not defined) [FFh]
10	- (Not defined) [FFh]
11	14 (1.4 m)
12	14 (1.4 m)
13 – 29	- (Not defined) [FFh]

3.2.4.7 Vehicle stability function:

The EB+ incorporates the roll-over control function "EB+ Stability". During the test described in paragraph 3.2.4.5 a) it was verified that during the intervention of the vehicle stability control function the VDC message EBS21 byte 2 bits 1-2 was set to 01_b (VDC active) and the parameter 01_b changed to 00_b (VDC passive) when the vehicle stability function was inactive.
See also ID_GS0440, paragraph 1.5.3.7.

3.2.4.8 Braking via electric control line:

The EB+ supports the electric control line and the message EBS22 byte 4 bits 7-8 are always set to 01_b. This was verified by observing the data on the CANalyzer.

3.2.5 Additional messages supported by the trailer:

The **supported** messages listed in the table of paragraph 3.1.6 above were verified as follows:

3.2.5.1 Wheel based vehicle speed:

Message EBS21 Byte 3-4:

This message was monitored using CANalyzer while the vehicle was at a simulated speed of 31 km/h; message EBS21 Byte 3-4 corresponded to this speed.

3.2.5.2 Lateral acceleration:

Message EBS21 Byte 8:

This message was monitored using CANalyzer while tilting an external lateral accelerometer. The external accelerometer was tilted at 45 degrees in each direction to simulate left and right lateral acceleration. The corresponding values were shown on the CANalyzer.

3.2.5.3 Vehicle ABS active / passive: EBS22 Byte 1, Bit 1-2:

This message was monitored using CANalyzer while simulating ABS events using the wheel speed simulator. Whilst the ABS was active the data was set to 01_b. Approximately 2.5s after the end of ABS activity the data was reset to 00_b.

3.2.5.4 Amber warning signal request: Message EBS22 Byte 2, Bit 5-6:

This message was monitored using CANalyzer while introducing a fault into the EB+ system. Sensor 1A was disconnected to generate the amber warning signal. The value transmitted while there was no fault was 00_b and after the fault was introduced was 01_b.

3.2.5.5 Vehicle type: Message EBS22 Byte 3, Bit 5-6:

This message was monitored using CANalyzer. The EB+ was programmed using the end-of-line test program as a 3-axle semi-trailer. EBS22 byte 3, bits 5-6 was set to 00_b. The data remains 00_b unless 'dolly' is set as the vehicle type in the end-of-line test program, in which case the data changes to 01_b.

3.2.5.6 Loading ramp approach assistance: Message EBS22 Byte 4, Bit 1-2:

This message was monitored using CANalyzer while simulating reversing up to an obstruction with an EB+ system configured for Soft Docking. The Soft Docking system (see below option a)) was connected and an obstruction placed in front of a sensor to activate the automatically commanded braking. The signal bits 1-2 was active (01_b) during the brake application and passive (00_b) afterwards. In addition the message EBS22 byte 4 bits 5-6 was sent; see paragraph 3.2.4.5 above.
The Soft Docking system uses signals from an external controller, connected using either **a**) Aux 4 or 5 or **b**) diagnostic CAN bus (see ID_GS0440, paragraph 1.5.3.8).
Both options support message EBS22 Byte 4, Bit 1-2.

3.2.5.7 Axle load sum: Message EBS22 Byte 5-6:

This message was monitored using CANalyzer. The suspension pressure was altered between the unladen and laden values by use of a pressure regulator. The system calculated the corresponding load in kg. The transmitted axle load sum was monitored and verified.

3.2.5.8 Tyre pressure sufficient / insufficient:

Message EBS23 Byte 1, Bit 1-2:

This message was monitored using CANalyzer. A tyre pressure monitoring system (TPMS) was placed into a pressure chamber and the signal transmitted to the EB+ system. The pressure was reduced below the warning pressure. The message changed from sufficient (01_b) to insufficient (00_b).

3.2.5.9 Brake lining sufficient / insufficient:

Message EBS23 Byte 1, Bit 3-4:

This message was monitored using CANalyzer with the EB^+ system configured for lining wear indication. The data was initially 01_b to show that the brake lining was sufficient. When the lining wear sensor was open circuited the data changed to 00_b to show that the brake lining was insufficient.

3.2.5.10 Tyre / wheel identification (pressure):

Message EBS23 Byte 2:

This message was monitored using CANalyzer. For the test a trailer was simulated with one axle and one tyre on each side. The corresponding values were shown on the CANalyzer.

3.2.5.11 Tyre pressure (actual tyre pressure):

Message EBS23 Byte 5:

This message was monitored using CANalyzer. A tyre pressure monitoring system (TPMS) was placed into a pressure chamber and the signal transmitted to the EB+ system. The pressure was reduced. The corresponding values were shown on the CANalyzer.

3.2.5.12 Brake cylinder pressure:

Message EBS25 Byte 1: first axle, left wheel
Message EBS25 Byte 2: first axle, right wheel
Message EBS25 Byte 3: second axle, left wheel
Message EBS25 Byte 4: second axle, right wheel
Message EBS25 Byte 5: third axle, left wheel
Message EBS25 Byte 6: third axle, right wheel

This message was monitored using CANalyzer. For the test a 2-axle full-trailer was simulated with the pressure in the brake cylinder set to 90 kPa at axle 1, 60 kPa at axle 2, right side and 100 kPa at axle 2, left side. The corresponding values were shown on the CANalyzer.

3.2.5.13 Traction help:

Message RGE21 Byte 1, Bit 5-6:

The EBS was programmed with the following settings:
- Unladen air bellows pressure = 70 kPa
- Laden air bellows pressure = 500 kPa
- 3-axle semi-trailer with lift-able axle 1 (front)

The air bellows pressure was simulated initially as 480 kPa (95% loaded).

The “Traction help status” in message RGE21 byte 1, bits 5-6 was monitored using CANalyzer.

The value was initially set to 00_b to indicate that traction help was inactive.

When the traction help switch input was activated, the “Traction help status” was changed to 01_b.

The simulated air bellows pressure was then increased slowly. When the pressure reached 640 kPa (> 130% loaded) the “Traction help status” was changed back to 00.

See also ID_GS0440 paragraph 1.5.3.10.

3.2.5.14 **Lift axle 1 position:**

Message RGE21 Byte 2, Bit 1-2:

Lift axle 2 position:

Message RGE21 Byte 2, Bit 3-4:

This message was monitored using CANalyzer with an EB+ system configured for ‘ILAS-E’ front and rear lift axles. The front axle was set to lift below 60% load and the rear axle set to lift below 30% load.

The vehicle load percentage value was simulated using the Haldex end-of-line program. With the percentage load set above 60% both lift axles were down. The transmitted parameter value for both lift axles was 00_b.

The percentage load was reduced to below 60%. The front axle was raised and the transmitted parameter value for lift axle 1 was changed to 01_b.

The percentage load was reduced to below 30%. The rear axle was raised and the transmitted parameter value for lift axle 2 was changed to 01_b.

3.2.5.15 Steering axle locking:

Message RGE21 Byte 2, Bit 5-6:

The EB+ system was configured to lock a steer axle via an auxiliary relay above 25 km/h and unlock below 20 km/h. The vehicle speed was simulated using the end-of-line program, whilst the status message was monitored using CANalyzer. The value was set to 00_b when the speed was initially 10 km/h. The speed was increased to 31 km/h and

the value changed to 01_b. When the speed was reduced to 22 km/h the value remained 01_b, but when reduced to 18 km/h the value changed back to 00_b.

3.2.5.16 Tyre / wheel identification: Message RGE23 Byte 1:
see 3.2.5.10

3.2.5.17 Tyre pressure threshold detection: Message RGE23 Byte 6, Bit 1-3:
This message was monitored using CANalyzer. A tyre pressure monitoring system (TPMS) was placed into a pressure chamber and the signal transmitted to the EB+ system. The pressure was reduced below the threshold for extreme under pressure. The message changed from no warning (010_b) to extreme under pressure (100_b).

3.3 Additional checks: (Annex 17/4.2.3) In addition to the verification procedure according to Annex 17 of UN-R13 (see section 3.2 above) compliance with the following provisions of UN-Regulation No. 13 were demonstrated. The results of these additional checks are unaffected by the modifications of EB+ Gen3:

3.3.1 Failure detection signal: Not applicable (paragraph 5.1.1.5 of UN-Regulation No. 13)

3.3.2 Control line arbitration: In the case of defect in one of the control lines between the towing and towed according to paragraph 5.1.3.1.2 of UN-Regulation No. 13 the trailer used the control line not affected by the failure to ensure, automatically, the braking performance prescribed for the trailer according to paragraph 3.1. of Annex 4 of UN-R13.

With the electric and pneumatic signal present at the coupling head the system uses the electric control signal. In the case of a failure of the electric control line the system switches automatically to the pneumatic control line (paragraph 5.1.3.4.1 of UN-Regulation No. 13). This was verified by the following tests:

- Priority of electrical control line
  The electric control line was set to a constant brake demand of 200 kPa. The pneumatic control line pressure was varied between 300 and 800 kPa. The brake delivery pressure remained constant at 200 kPa.
- Reversion to pneumatic control on failure in electric control line
  The electric control line was set to a constant brake demand of 200 kPa. The pneumatic control line pressure was set to 500 kPa. The brake delivery pressure was

measured as 200 kPa. A failure was introduced in the electric control line which caused a yellow warning signal via pin 5 of the ISO 7638 connector (and simultaneously the amber warning signal request via ISO 11992) and the brake delivery pressure was observed to change to 500 kPa.

3.3.3 Pneumatic line failure:

Paragraph 5.1.3.4.3 of UN Regulation 13 requires that the driver is warned when the pneumatic signal is not present.

If a pneumatic signal is not present and the electric control signal exceeds the equivalent of 100 kPa for more than 1 s, the yellow warning signal is transmitted via pin 5 of the ISO 7638 connector (and simultaneously the amber warning signal request via ISO 11992).

3.3.4 Electric control line:

Paragraph 5.1.3.6 of UN-Regulation No. 13 requires that the electric control line shall transfer information exclusively for braking and running gear functions and that the braking functions have priority and shall be maintained in the normal and failed modes.

The EB+ system software does not process any incoming messages other than EBS11 and EBS12 and running gear messages and the brake messages are given the highest priority according to requirements of standard ISO 11992.

Priority of brake demand: By loading the CAN bus with additional non braking messages (using the Vector CANalyzer) when the brake demand was generated it was demonstrated that the observed delivery pressure did not change.

3.3.5 Distribution of braking:

Paragraph 5.2.2.5 of UN Regulation 13 requires that systems that incorporate functions - such as anti-lock - which may cause deviation from the longitudinal symmetrical distribution of braking must be declared.

3.3.5.1 Declared functions:

The EB+ system includes the following functions which may result in a deviation from the longitudinal braking distribution. In compliance with the requirements above these functions have been taken into consideration during the evaluation of the systems safety concept (see Appendix 1 to this report) and section 5 of ID_GS0440.

- Anti-lock braking:

The manufacturer declared that all variants of the system incorporate an anti-lock braking function that automatically controls wheel slip of the directly controlled wheels to prevent wheel locking. See also ID_GS0440 paragraph 1.5.2.

- Roll-over control:

The manufacturer declared that all 2M and 3M variants of the system may optionally incorporate a stability function that automatically applies the brakes to one or more sides

of the vehicle as part of a detection routine and/or vehicle stabilising function; see also ID_GS0440 paragraph 1.5.3.7 and Manufacturer's Information Document GS 0471 for this function (see TÜV NORD Report EB165.0E).

3.3.5.2 Electronic brake distribution: **n / a** (see Annex 10, paragraph 7.5 of UN Regulation 13)

3.3.5.3 Brake force enhancement: At high control line pressures (emergency braking at $p_m \geq 650$ kPa) the delivery pressure gradient is increased (see also paragraph 1.5.3.1 of ID_GS0440).

3.3.6 Compensation for deterioration or defect within the braking system:

The EB+ system logic does not include brake compensation. Thus, the provisions of paragraph 5.2.2.5.1 of UN-Regulation No. 13 do not apply.

3.3.7 Suppression of automatic braking:

See paragraph 3.6 of ID_GS0440

- Pressure switch or sensor fitted:

This function is not effective when the vehicle is stationary. To verify compliance with paragraph 5.2.2.12.1 of UN-R13 a vehicle speed was simulated at the test trailer during a static test. On supply line failure a red warning signal was transmitted irrespective of reservoir pressure. When the pressure in the air reservoir fell below 450 kPa the trailer brakes were automatically applied.

- Pressure switch or sensor not fitted:

This function is not effective.

3.3.8 Failures in the electric control transmission:

The EB+ system does not distinguish between temporary failures with a duration of ≤ 40 ms and continuous failures.

In the case of a single failure within the electric control transmission caused by an interruption of the electrical power supply (open circuit) a reset occurred and then the red and yellow warning signals (warning signal sequence) were transmitted to the motor vehicle. For the duration of the reset the service brake performance was controlled by the pneumatic control line without pressure reduction (ratio 1:1); see also Appendix 8 of ID_GS0440.

In the case of a failure within the electric control transmission (e.g. breakage, disconnection), the required braking performance of at least 30 per cent of the prescribed performance for the service braking system is ensured by the non-failed part of the pneumatic control transmission.

4S/3M system: A failure (disconnection) in the link cable between master and slave ECU assembly was introduced.

System reactions to this failure:

- illumination of the yellow warning signal
- reversion to pneumatic push-through (see ID_GS0440, paragraph 5.2.1) and loss of load apportioning function on axle controlled by the slave modulator

3.3.9 Failure of energy supply available from ISO 7638:

A failure within the energy supply available from the ISO 7638 connector (see paragraph 5.2.2.15.2.1 of UN-R13) had the following effects:

a) Open circuit failure of Pin 1:

A yellow warning signal via pin 5 of the ISO 7638 connector and a red and an amber warning signal via the data communication part of the electric control line were sent.

b) Open circuit failure of Pin 2 or Pin 3 or Pin 4

A yellow warning signal via pin 5 of the ISO 7638 connector was sent.

Note:

Failure of pin 2 or 4 also results in the loss of the communications part of the electric control transmission.

A failure in the power transmission part of the electric control transmission (pins 1, 2 or 4) causes the system to revert to entirely pneumatic control.

In the case of a failure in pin 3 there is no loss of system function, although an advisory yellow warning signal is sent on pin 5. (See also paragraph 3.3.9 b).

When the optional CAN Repeater is installed, the intermediate power lines 1 to 4 between the Repeater and the EBS have the same failure modes as the pins 1 to 4 on the ISO7638 connection.

3.3.10 Low energy test according to para. 5.2.2.16.1 of UN-R13:

Starting from a pressure of 450 kPa in the air reservoir (80 l) of the test trailer the service brake control was applied 5 times (p_m = 650 kPa). At the fifth full-stroke actuations a pressure of 390 kPa in the air reservoir was obtained. The necessary pressure for the prescribed performance of 22.5 % was for the actual test vehicle 285 kPa (according to the respective brake calculation).

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

3.3.11 Warning signals: See also paragraph 5.2.2.17 of UN-Regulation No. 13

Warning signal indication: Failures or defects of the brake system were signalled to the motor vehicle via the ISO 7638 connector by the red (pins 6/7) and/or yellow (pin 5) warning signal(s).

General Note: The amber warning signal request is always transmitted in parallel with the yellow warning signal via Pin 5 of the ISO 7638 connector when the ISO 11992 data communication is available.

See also paragraph 3.2.4.2 above.

Warning signal sequence: All configurations have the option of two discrete warning signal sequences - see paragraph 3.4.3 and Appendix 11 of ID_GS0440 - both of which fulfil the prescribed requirements of paragraphs 4.1.1 and 4.1.2 (including footnote 3) of Annex X of Directive 71/320/EEC and Annex 13 of UN-Regulation No. 13 respectively.

On the test vehicle the warning signal sequence “option “A” (see paragraph 3.4.3 of ID_GS0440) was realised and positively verified.

Red warning signal The red warning signal request is sent to the motor vehicle in the following cases:

- Low voltage warning (see paragraph 3.2.4.2 b above)
- Low system supply pressure warning (see paragraph 3.2.4.2 c above)
- Activation of the "supply line braking request" signal (byte 4, bits 3 4 of EBS22, set to 01_b), see paragraph 3.2.4.1 b.
- Supply line failure warning (see paragraph 3.3.7 above)

In addition, in the case of full trailers, the red warning signal request is sent when there is a failure which results in the simultaneous loss of both load sensing and anti-lock function (and when the data communication according to ISO 11992 is available).

Non specified failures:: Non-specified faults (e.g. failure in the control channel of the auxiliary equipment) shall be indicated only by the flashing of the warning signal (see paragraph 5.2.2.17 and 5.2.1.29.6. of UN-Regulation No. 13).
However, the warning signal shall be extinguished when the vehicle speed exceeds 10 km/h (paragraph 5.2.1.29.6.3 of UN-Regulation No. 13).

The following tests were carried out:

a) Introduction of a non-specified fault (suspension relay o/c) at a vehicle speed ≥ 10 km/h with the following reduction of the vehicle speed to 0 km/h

System response: No warning signal was transmitted.

b) With the failure according a) still present the ignition of the system was switched off and on again.

System response: After energising the EB+ system the flashing of the yellow signal started only after the normal warning signal sequence was completed (see also Appendix 11 of ID_GS0440)

c) With the failure according a) still present, in addition a specified failure (sensor 1A o/c) was introduced.

System response: The flashing yellow warning signal was replaced by a non-flashing signal.

Failure mode simulation: Based on the information according to Appendix 8 of ID_GS0440 **external** failures (in addition to the tests mentioned under paragraph 3.2.4.2 above) were simulated on the vehicle and on a test rig both with regard to the sensors and modulators and to the related electrical cables.

The failures were detected and indicated as specified in the above mentioned manufacturer's Information Document.

For the simulation of **internal** ECU-faults see paragraph 3.5 below "Safety assessment" and Appendix 1 to this report respectively.

3.3.12 Protection of braking system: The braking system is protected from an overload external to the braking system according to paragraph 5.2.2.18 of UN-Regulation No. 13.

This function was checked by simulating a short circuit (s/c) of the power supply of the suspension reset to ride height solenoid. After the detection of the s/c the power supply of the solenoid was switched off by the EB+ ECU. There was no influence in the braking pressure.

3.3.13 Dynamic sensor fault: A dynamic sensor fault was introduced at a vehicle speed of greater than 10 km/h. After reducing the speed to zero and switching the ignition on and off the "permanent" yellow failure warning signal was transmitted via pin 5 of the ISO 7638 connector (and simultaneously the amber warning signal request via ISO 11992) (see paragraph 5.1.2.29.5 UN-R13 and paragraph 4.1.2 of Annex 13 to UN-Regulation No. 13).

Where only one wheel is rotating, the time to recognise (and store in memory) the failure of the non-rotating wheel(s) is dependent on the speed of the rotating wheel. This function is implemented into the EB+ system to allow one wheel to be spun (e.g. by hand during maintenance) without inducing a fault.

3.3.14	**Modulator cycling:**	The fulfilment of the requirement of paragraph 4.1.2 of Annex 13 to UN-Regulation No. 13 that the electrically controlled modulator valve(s) shall cycle at least once when the system is energised was verified.
3.4	**Requirements for Periodic Technical Inspection:**	See paragraph 5.1.4.4 of UN-Regulation No. 13
3.4.1	**Static braking forces:**	Paragraph 6.1.2 of ID_GS0440 specifies the conditions under which it is possible to generate maximum braking forces under static conditions on a rolling road or roller brake tester.
3.5	**Safety assessment:**	A safety assessment was carried out. The results are reported in Appendix 1 to this report. The safety provisions applied are considered satisfactory.
3.6.	**Electro magnetic compatibility:**	see paragraph 3.2.3.1 of Appendix 1 to this report
3.7	**Additional Functions:**	These functions are optional and described in paragraphs 1.5.3 of ID_GS0440.
3.7.1.	**Brake Force Enhancement:**	see ID_GS0440, paragraph 1.5.3.1 (see also paragraph 3.3.5.3 above)
3.7.2.	**Lining Wear:**	see ID_GS0440, paragraph 1.5.3.2 (see also paragraph 3.2.5.8 above)
3.7.3.	**Reset-to-Ride Height (COLAS):**	see ID_GS0440, paragraph 1.5.3.3
3.7.4.	**Retarder Control:**	see ID_GS0440, paragraph 1.5.3.4
3.7.5.	**Auxiliary Power Out:**	see ID_GS0440, paragraph 1.5.3.5
3.7.6.	**Steer Axle Lock:**	see ID_GS0440, paragraph 1.5.3.6 (see also paragraph 3.2.5.11 above)
3.7.7.	**Roll Stability:**	see ID_GS0440, paragraph 1.5.3.7 (see also paragraph 3.3.4.7 above)
3.7.8.	**Soft Docking:**	see ID_GS0440, paragraph 1.5.3.8 (see also paragraph 3.2.5.6 above)
3.7.9.	**Electric Brake Demand ('EBD'):**	see also ID_GS0440, paragraph 1.5.3.9 The Electric Brake Demand (EBD) function is regarded as an auxiliary braking function which is only operational at a

speed below 10 km/h. This function is not regarded as a braking function in the meaning of UN R13.

However, a safety assessment of this function was carried out within the Annex 18 procedure.

Safety features incorporated:

- This function can only be activated below 10 km/h
- This function automatically terminates at a user-configurable speed not higher than 10 km/h
- If the switch is closed at a speed higher than 10 km/h, this function will not be activated when the speed drops below the user-configured speed, it is necessary to open and re-close the switch
- As an option it is possible to allow the switch to be closed above 10 km/h, however with this option the function will never be activated until the vehicle is completely stationary
- A malfunction or unintended activation of the switch above 10 km/h has no effect on the braking system

3.7.10. Traction Assist: see ID_GS0440, paragraph 1.5.3.10
(see also paragraph 3.2.5.9 above)

3.7.11. Suspension Height Control: see ID_GS0440, paragraph 1.5.3.11

4 Optional Equipment

4.1 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). The message is transmitted in both directions without alteration, with two exceptions:

a) The EBS1x messages are sent with incremented ‘trailer position’ for towing trailers.

b) In case there is no electric control line available from the predecessor vehicle the EBS11 message is sent on the intermediate CAN with a service brake demand value sourced from an optional control line pressure sensor connected to the CAN-Hub.

See ID_GS0440, paragraph 3.2.6 and Appendix 2 to this report

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

5. Functionality label: A headboard information label (as required by paragraph 5.2.2.17 of UN-R13) is described in Appendix 4 of ID_GS0440.

6. Date of test: 2000 - 2003 – 2004 – 2006 - 2008 - 2009 - 04/2012 – 02/2018

7 Test documents (provided confidentially for inspection)

- **ISO 11992 Conformity Test Reports** (see paragraph 3.2.1 above and see also the cover pages of these reports in appendices 15-1 to 15-10 of GS0440).
- Supporting documentation in respect of the assessment according to Annex 18

8 Annexes

1) **Test Report with respect to the special requirements to "Safety Aspects of Complex Electronic Vehicle Control System"**
2) **CAN-Hub (Router/Repeater)**
3) **Manufacturer's Information Document GS0440 - Issue 5 of 29th January 2020**

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

9 Conclusions

The EB+ system described within this report complies with the special requirements for trailers which are equipped with an electric control line and/or an electric control transmission according to UN Regulation No. 13/11 including Supplement 16*.

The documentation and test reports provided by the manufacturer demonstrates compliance with the provisions of ISO 11992 with respect to the physical layer, data link layer and application layer.

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

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

Appendix 1 to
Test Report
No.: EB132.11E

with respect to the special requirements to

Safety Aspects of Complex Electronic Vehicle Control Systems

according to

UN-Regulation No. 13, Annex 18

as last amended by

supplement 16 to the 11 series of amendments

1. General

This test report has been compiled in accordance with Annex 18 to UN Regulation 13:

"Special Requirements to be applied to the Safety Aspects of Complex Electronic Vehicle Control Systems"

1.1 Note

This report is identical to the previous Annex 18 safety assessment of TÜV NORD Report EB132.10E except for the following additions and amendments:

- Addition of new CAN-Hub (Router/Repeater)

The EMC approvals were also updated accordingly.

2. Identification

2.1 Manufacturer: **Haldex Brake Products Ltd.**
MIRA Technology Park
Lindley
Warwickshire CV13 6DE
United Kingdom

2.2. System name/model: **EB+**

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

2.3 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 substantially similar to Gen 2 in construction and features. The system operates from 8 – 32V.

3. Manufacturer's documentation

3.0 The manufacturer's documentation was made available in two parts as follows.

Part A

Appended Trailer Electronic Braking System Manufacturer's Information Document GS0440 - **Issue 05 of 29th January 2020**

Note: For the sake of simplicity "Trailer Electronic Braking System Information Document" is abbreviated to **" ID_GS0440"**

Part B

Additional material and analysis data of paragraph 3.4.4 of UN R13, Annex 18, which was confidentially made available for assessment, but was retained by the manufacturer.

The documentation of Part A contains the following:

3.1 Periodic technical inspections

How the correct operational status of E B + system can be checked is described in section 6 of ID_GS0440.

3.2 Description of the functions of "The System"

A description of the function of the System is given in sections 1.5.2 and 1.5.3 of ID_GS0440.

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

3.2.1 List of all input variables with their working ranges

A list of all input and sensed variables and the associated working ranges is included in section 1.5.4 of ID_GS0440 (see Appendix 21).

3.2.2 List of all output variables with their working ranges

A list of all output variables controlled by the EB+ system and the associated working ranges is included in section 1.5.5 of ID_GS0440 (see Appendix 22).

3.2.3 Boundaries of functional operation within environmental conditions

The limits defining the boundaries of functional operation are included in section 1.5.6 of ID_GS0440.

The manufacturer demonstrated that, during the system development, adequate provisions had been made to take account of the environmental conditions to which the EB+ system will be subjected (e.g. by Technical Specification GS0136 and appropriate technical test reports).

3.2.3.1 Electromagnetic compatibility (EMC)

Measures have been taken within the design and corresponding tests have been carried out to show the electromagnetic compatibility with respect to conducted and radiated disturbances.

In order to fulfil the legal requirements regarding EMC (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 Directive 2009/19/EC) and have been given the following approval marks:

System variant	UN Approval No.
EB+ Gen 3	E11-10R-057673 Ext. 05
EB+ Gen 2 (2M)	E11-10R-033942 Ext. 06
EB+ Gen 1 / Gen 2 all system configurations with 1M slave modulator	E11-10R-033825 Ext. 06
EB+ Gen 1 (1M / 2M)	E11 – 10R-0323807 – Ext. 4
Remote pressure sensor (transducer)	E11-10R-034038 Ext. 03
Height Sensor (Drehwinkelsensor)	E1*10R05/01*5852*01
CAN-Hub	E11*10R05/01*11053*00

Appendix 17 of ID_GS0440 shows copies of the above mentioned EMC approvals (including the list of variants covered by these approvals).

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

3.3 System layout and schematics

3.3.1 Inventory of components

The inventory of components is included in the component description, see section 3 and Appendix 7 of ID_GS0440.

3.3.2 Functions of the units

The functions of the units are described in section 3 and Appendix 10 of ID_GS0440.

3.3.3 Interconnections

The interconnections are shown in appendices 1 (piping), 10 (trailer wiring) and 12 (motor vehicle wiring) of ID_GS0440.

3.3.4 Signal flow and priorities

The signal flow and priorities are described in section 4.2 of ID_GS0440.

3.3.5 Identification of units

3.3.5.1 Identification of hardware

The hardware units are identified by the corresponding part numbers (see section 3 and Appendix 7 of ID_GS0440) affixed on the component.

In the case of modulators and ECUs, the version of the hardware is further identified by an MO (Manufacturing Order) number.

3.3.5.2 Identification of software

The identification of software version is described in section 5.3.2 of ID_GS0440.

The software version of the **EB+** system is identified by the software release number.

The current software versions of the **EB+** system **at the date of type approval** were:

EB+ Gen 1: **C497**: (2M ECU's - covers 1M and integrated 2M systems)

C498: (3M ECU's - covers 3M and non-integrated 2M systems)

EB+ Gen 2: **D523**: (All ECU's - covers 3M and integrated 2M systems)

EB+ Gen 3: **E642**: (All ECU's - covers 3M and integrated 2M systems)

CAN-Hub: **A739** (compatible with every generation and software version)

Note: The first character (letter) in the software number (see above letter "**C**", "**D**", "**E**" or "**A**") denotes 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 or CAN-Hub as far as UN-Regulation No. 13 is concerned is unchanged (compare UN-R13, paragraph 3.3.5.1 of Annex 18).

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Manufacturer : **Haldex**

New software versions can only be installed by a Haldex controlled program as described in paragraph 5.3.3 of ID_GS0440.

3.4 Safety concept of the manufacturer

During the assessment the design provisions built into the EB+ system regarding the generation of safe operation under fault conditions were explained (see also section 5 of ID_GS0440).

The following design provisions to protect against failures in the EB+ system are implemented as follows:

- Monitoring functions to recognise faults within the electronic control unit (ECU) and external faults (e.g. of sensors, actuators, cables, etc.) associated with the system.
- In the case of a failure, the driver will be warned by the prescribed warning signal.
- Fall-back to partial system operation: the various detected failures and their effects are described in Appendix 8 of ID_GS0440.

3.4.1 Statement of the manufacturer

The required statement of the manufacturer which affirms that the strategy chosen to achieve the “The System” objectives under the conditions defined in paragraph 3.4.1 of Annex 18 of UN-Regulation No. 13 is provided in section 5.1 of ID_GS0440.

3.4.2 Software of EB+ system (outline architecture, software design methods and tools used)

The outline architecture of software (information flow, data flow) and the software design method and tools applied were explained.

The manufacturer gave evidence of the means by which he determined realisation of the system logic during the design and the development process.

Analysis was conducted using a Yourdon CASE (Computer Aided Software Engineering) tool. All software in the main micro-controller is implemented in the MISRA (Motor Industry Software Reliability Association) subset of the “C” language. A software checking tool is used to check for infringement of MISRA rules and a compliance matrix compiled (see also paragraph 5.3 of ID_GS0440).

3.4.3 Design provisions built into “The System” so as to generate safe operation under fault conditions

The trailer braking system is controlled by two independent circuits:

- the pneumatic control line,
- the electric control line.

The effect of a failure of either of these control lines will result in a change to system operation as described in section 5 and Appendix 8 of ID_GS0440.

a) Fall-back operation

The system incorporates a selective fall-back strategy in order to maintain at least a partial operation of the system under fault condition. In the case of any safety critical fault detected,

the system reverts automatically to pneumatic push through (see paragraph 5.2.1 of ID_GS0440).

b) Change over to a separate back-up system

n / a

c) Removal of a high level function

see below paragraph 3.4.3.3

3.4.3.1 Partial performance mode of operation under certain fault conditions

The partial performance provided under fall-back conditions is defined in Appendix 8 of ID_GS0440.

3.4.3.2 Second back-up System

n / a

3.4.3.3 Removal of a high level function

As an option the EB+ system provides a trailer roll stability function.

In the case of a failure in the brake pressure control, wheel speed sensing or lateral accelerometer the trailer roll stability function is suspended.

3.4.4 Safety analysis

The manufacturer carried out a safety analysis which shows, how the EB+ system will behave when any faults occur which may influence the vehicle control performance or safety.

The safety analysis was based on the following documents:

Document	EB+ Gen 1	EB+ Gen 2	EB+ Gen 3	CAN-Hub
System/Design-FMEA	298X5826	820 008 000	823 008 000	DFM360
Failure Mode Specification	GS0326	GS0326 GS0403	GS0326 GS0403 GS0536	N/A
Failure Mode Test Report	A9380	A9380 A9684	A9380 A9684 A10882	N/A

Design-FMEA GS0279 was submitted by the manufacturer for the incorporation of the integrated accelerometer within the EB+ Gen 1 2M ECU assembly.

Based on the evidence supplied in the documentation and the results of subsequent evaluation of possible failures it is evident that the safety concept described is systematic and complete.

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

3.4.4.1 Parameters being monitored (fault monitoring) and warning signal given to the driver and/or service/technical inspection personnel

The parameters being monitored and the fault condition for which a warning signal is given are itemised in appendices 8, 21 and 22 of ID_GS0440.

Appendix 8 of ID_GS0440 covers:

- Failures and their effect on the EB+ system with respect to performance and functionality
- Monitoring of functions to recognise faults within the electronic control unit (ECU) and external faults (e.g. of sensors, actuators, cables, etc.) associated with the system
- Fall-back to partial system operation: the various failures detected and their effects

All failures specified by UN-Regulation No. 13 are indicated to the driver by the prescribed warning signal.

The supported messages from the EB+ system according to ISO 11992 are defined in Appendix 5 of ID_GS0440.

4.0 Verification and Test

4.1 The functional operation of "The System", as laid out in the documents required in paragraph 3 of Annex 18 of UN Regulation 13, was tested as follows:

4.1.1 Verification of the function of "The System"

Track and bench tests were carried out to verify the performance of the vehicle system under non-fault conditions. These demonstrated that the system operated in a manner that ensured that the relevant provisions of EC and UN braking performance requirements would be fulfilled under non-fault conditions.

4.1.1.1 Verification of the roll-over control (RoC) algorithm

Track and bench tests were carried out to verify the performance of the **EB+ Stability** system with respect to the updated software code "C". According to the manufacturer's declaration the modification affected only the algorithm with respect to the RoC. The algorithm with respect to the ABS performance was unchanged. This was verified by comparison bench tests.

The various comparison bench tests showed that the reactions of the ABS to certain inputs (wheel speeds, CAN demand pressure pm_{el}, lateral deceleration) were the same with the old software (code "B") and new software (code "C", see above paragraph 3.3.5.2).

However, the reaction of the modified **EB+ Stability** system to the aforementioned inputs were different. In particular, it was shown that with a simulated "ABS passive state" where the ABS was disabled, the roll-over control function was fully operating.

By the manufacturers declaration the Gen. 3 variant has the same performance as Gen. 2 regarding the UN-R 13 requirements for ABS and RoC. He gave evidence of this by a walkthrough to the relevant source code. Various comparison bench tests (HIL simulations) showed that the reactions of the Gen. 3 are the same regarding RoC as Gen. 2 (software (code "D") and new software (code "E", see above paragraph 3.3.5.2).

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4.1.2 Verification of the safety concept

The introduction of individual internal and external faults to the system enabled the safety concept of the system to be evaluated, by observing the reaction of the individual system elements and their effect on the braking system as a whole.

The fault codes stored were as referenced in the documentation and the system operated as specified.

The protection measures against environmental influences were evaluated (with respect to the protection measures for electromagnetic compatibility see paragraph 3.2.3.1 above).

The safety concept was verified as specified by the system manufacturer.

Failure mode simulation

With regard to fault detection and measures against faults, various failures were simulated on the test vehicles and on the test bench.

Amongst other things the following failures and signals were simulated and analysed:

- Sensor failures
- Faulty sensor signals (e.g. out-of range signals)
- Line interruptions / open circuits
- Short circuits
- Valve failures
- Failure of power supply
- Undervoltage/overvoltage in power supply
- Internal ECU failures

4.1.2.1 Comparison of the verification results with the documented summary of the failure analysis

The reaction by the system to the faults (see paragraph 4.1.2. above) introduced were in correspondence with the documented summary of the failure analysis.

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

5. Summary

Based on the documentation presented and examined in combination with the tests carried out it is anticipated that the measures taken by the manufacturer in respect of failure detection and failure management are appropriate to attain the required level of safety.

6. Place and date of assessment

Redditch / Essen / Hanover / Lindley

11/02 - 05/03 - 04/04 - 10/04 – 08/06 – 10/07 – 09/08 – 10/09 – 04/12 – 02/18

PRÜFLABORATORIUM / *TEST LABORATORY*

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Branch office Hanover, 23.03.2020

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

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

CAN-Hub (Router/Repeater)

Introduction

The CAN-Hub ~~Repeater~~ is an additional ECU used as a Repeater on long trailers where a direct connection of the electric control line to the master controller would not comply with the maximum trailer cable length of 18 m prescribed by ISO11992 (see also ID_GS0440, paragraph 3.2.6). In vehicle combinations with more than one trailer (where it is permitted by national legislation) the CAN-Hub can work as a Router to provide electronic control line to a local brake control module and a towed one.

Assessment

In addition to the Annex 18 safety assessment (see Appendix 1 to this report) response time tests were carried out with a 3-axle semi-trailer to assess the influence on the EB+ system with different configurations; see following **Diagrams A to C, B' and C'** for the tested configuration.

The pressure control of the wheel brakes is generated in the EB+ central module. As the connection of the central module to the wheel brakes does not differ with the installation of a CAN-Hub, a difference in the ABS control and performance is not to be expected.

Diagram A shows the standard configuration of a trailer with an electric control line, a max. cable length of 18 m and a respective length of the pneumatic control line of 12 m.

Diagram B is an example for a long trailer with the CAN-Hub working as a Repeater. 18 m electric control line to the Hub, 40 m intermediate CAN to the EBS central module and 60 m of pneumatic control line.

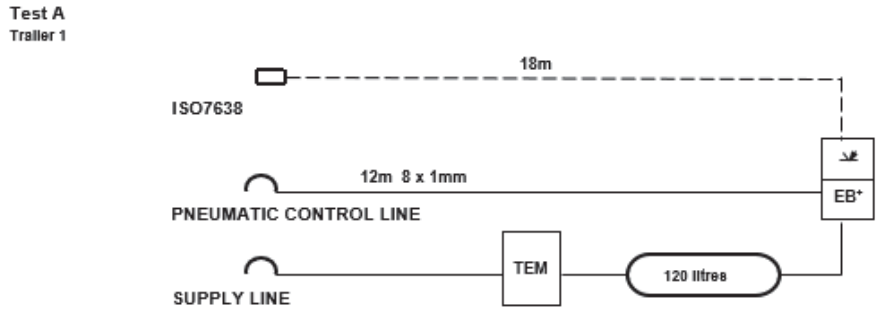
Diagram C shows the same trailer with the optional pressure sensor in the control line (at the headboard of the trailer).

In Diagram B' the CAN-Hub is working as a Router connected with a local ECU (EB+ Trailer 1, simulated) and a successor ECU (EB+ Trailer 2). The CAN-Hub is connected with the 18 m electronic control line at the input, a 23 m intermediate CAN to the towed ECU and a 1 m cable to the simulated Trailer 1. The pneumatic control line connected to the central module is 30 m.
Diagram C' shows the same setup with the optional pressure sensor in the control line (at the headboard of the trailer).

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

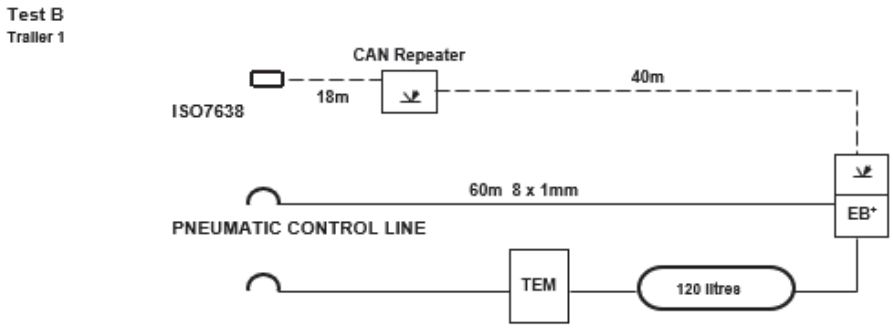
A

EB+ Installation



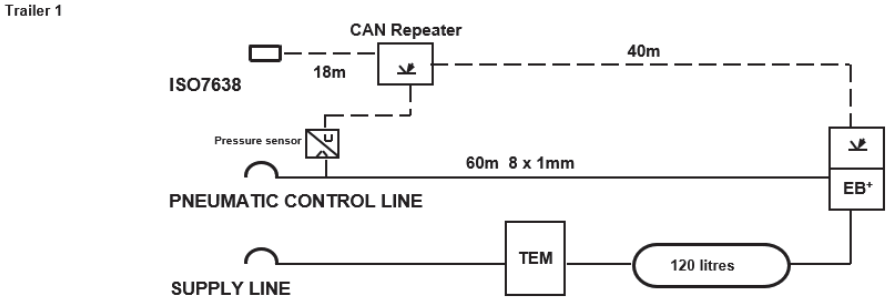
B

EB+ CAN Hub in Repeater Mode



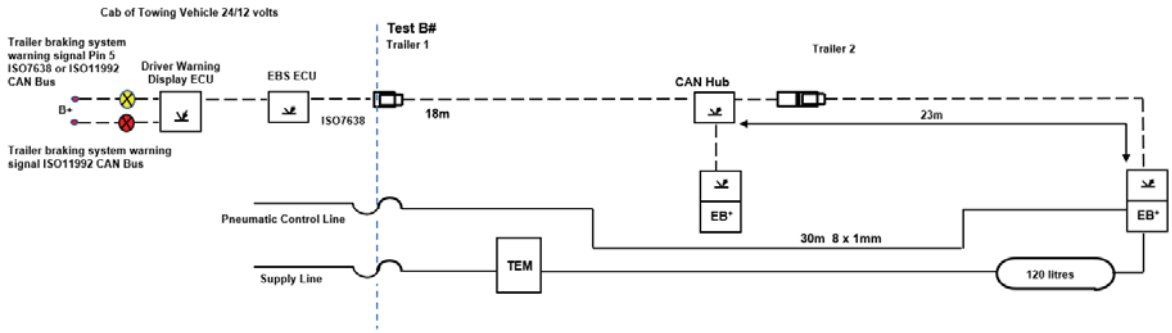
C

EB+ CAN Hub in Repeater Mode

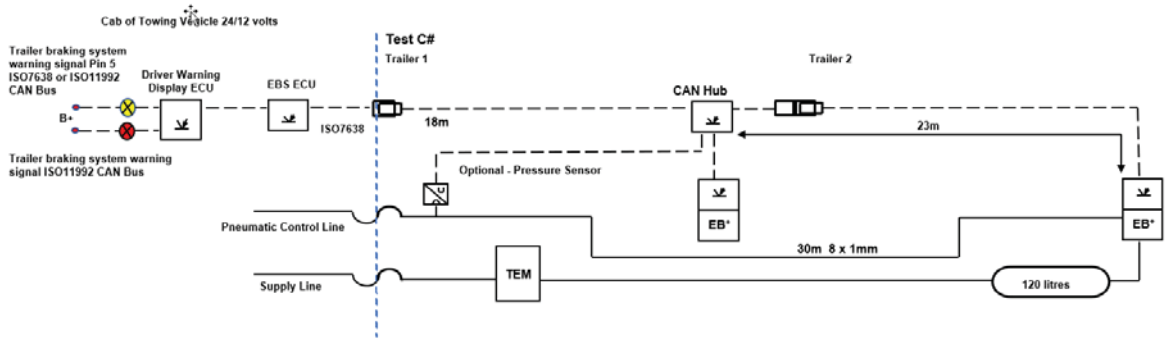


EBS-System : **EB+**
Manufacturer : **Haldex**

B'



C'



TEM = Trailer Emergency Module

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

The response time tests were conducted with a Wabco CTU. It provides two test cases. Test case 1 (TC1) for trailers with a pneumatic control line only, test case 2 (TC2) for trailers equipped with a pneumatic and an electric control line. In TC2 the response test is run twice, first with the brake application controlled by the pneumatic control line, second controlled by the electric control line.

The response time tests for diagram A, B and B' can be conducted with TC2. For very long trailer that will pneumatically not fulfil the response time requirements, the optional pressure sensor may be fitted (Diagram C, C'). It is connected with the CAN-Hub which generates an EBS11 brake demand (byte 7, 8), only if there is no EBS11 message coming from the truck / predecessor.

Because Wabco CTU in TC2 is sending EBS11 permanently for both, the pneumatically and the electronically controlled run of the response time test, the function of the pressure sensor is suppressed. For checking the function of a system with pressure sensor both test cases has to be run, with the results demonstrating:

TC1: pneumatic control with pressure sensor

TC2, pneumatic run: pneumatic control without pressure sensor

TC2, electronic run: electronic control, with or without pressure sensor

SETUP					
Diagram	A	B	C	B'	C'
Pneumatic control line	12 m	60 m	60 m	30 m	30 m
Electric control line	18 m	18 m + 40 m	18 m + 40 m	18 m + 23 m	18 m + 23 m
CAN-Hub	w/o	Repeater	Repeater	Router	Router
Pressure sensor	w/o	w/o	with	w/o	with

RESPONSE TIME					
Diagram	A	B	C	B'	C'
TC1 pneumatic control only	--	--	0,24 s	--	0,25 s
TC2 pneumatic run	0,39 s	1,68 s	--*)	0,71 s	--*)
TC2 electronic run	0,26 s	0,26 s	0,26 s	0,26 s	0,26 s

*) signal of pressure sensor suppressed by CTU sending EBS11

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

The response time results show that

- In a standard system without either CAN-Hub or control line pressure sensor, the electric control line gives faster response than the pneumatic control, as expected;
- In a system with a 58 m electric control line (18 m before + 40 m after Hub), the response time is maintained; independent of the CAN-Hub working as a Router or Repeater
- In a system with a 60 m pneumatic control line without pressure sensor, the response time becomes very long and does not meet the prescribed maximum response time requirements;
- In a system with a 60 m pneumatic control line equipped with a control line pressure sensor located at the headboard and connected to a CAN-Hub, the response time is similar to that of an electric control line.

Trailer Electronic Braking System

Information Document

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: W Storrie	Technical Director: C R Mellings
Issue: / Date: / Ref:		

Trailer Braking System Information Document

1. General

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

1.2 System name: **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 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.

1.4 ABS configurations: 2S/1M, 2S/2M*, 2S/2M SL*, 2S/2M DAR, 4S/2M SxS*, 4S/2M AxA*, 4S/3M, 2S/2M Relay** and 4S/2M Relay**

* = Integrated and non-integrated versions available with EB+ Gen 1
** = 'Inloader' trailer configurations
_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)

1.5 System Overview

1.5.1 Main Features

The EB+ system is a brake control system for semi, centre-axle and full trailers having air brakes. It provides the necessary components to enable compatibility with either an electronically and pneumatically signalled or a pneumatically only signalled towing vehicle.

In addition to normal service brake control, EB+ also optionally contains a roll stability system. This uses a lateral accelerometer, in addition to the existing sensed variables, to determine if the vehicle is close to its roll threshold. Low-level brake test pulses are also used as part of the detection process and automatically commanded braking is used to slow the vehicle below the roll threshold. The accelerometer may be external or internal to the ECU. [See also Haldex Information Document GS0471.]

As well as providing the means for brake control the controller also contains auxiliary channels capable of providing ancillary functions, such as reset-to-ride height and a power / diagnostic link for use by other systems.

Particular features of the system are; a modular pneumatic construction, an encapsulated controller and valve, over-moulded connectors, integrated pressure transducers and a flash upgradeable program memory.

1.5.2 Description of Principle of System Function

The EB+ system provides electro-pneumatic control of the trailer brakes with built in load sensing and anti-lock functions. A functional block diagram is provided in Appendix 14 and a context diagram in Appendix 23. Typical installation schematics are shown in Appendix 1. A powered towing vehicle, wiring schematic example is given in Appendix 12. A trailer wiring schematic is given in Appendix 10.

Onset of braking is denoted by the presence of a demand from the ISO11992 data link, or at the internal control line pressure transducer (in the valve), or at the optional external pressure switch or sensor (in the control line at the front of the trailer). Driver demand is then determined by either the ISO11992 data link or the pneumatic control line pressure. Priority is given to the ISO 11992 data link. The demand pressure is then modified into a target pressure for the pressure control channel(s) by a load-sensing algorithm using data from the air suspension transducer mounted within the valve package or from height sensor on mechanical balanced steel suspensions.

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

On 1M systems the controller uses a ‘select low’ control strategy, controlling all the brakes based on the first wheel to skid.

On 2M systems, where only two wheels are sensed, an independent control strategy is used, controlling each modulator individually. Where more than one wheel sensor is associated with a channel the algorithm will use either a ‘select low’ or Adaptive

Surface Control (ASC) 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 (>2:1) in adhesion is detected then the control mode changes from 'select low' to 'select high'.

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.

On 3M systems, the controller uses independent control on two wheels and 'select low' on the other two.

On 2M systems, both modulators are normally integrated in a single block together with the controller but owing to the modular construction it is possible to use a separate 1M valve and slave controller (as used on the 3M) to form a non-integrated version. This is particularly useful where there is no central point to mount the main assembly.

The controller operates closed loop brake pressure control for each modulator. The inputs for the control loops are the target pressures described above; the feedback is from the appropriate pressure transducer mounted in the brake delivery circuit within the valve package.

Control is exercised by switching the brake apply, dump and hold solenoids that are mounted in the valve package. These solenoids apply, release or hold air pressure in the control volume of the relay modulator(s). The pressure in the brake delivery is set according to the control volume pressure by the pneumatic relay function.

The system uses an adaptive pressure control system. This means that the particular solenoid firings to cancel a pressure error in the control loop are constantly adjusted and refined. One effect of this is that it is possible for brake response time to become shorter as more brake applications are made, and the system 'learns' the characteristics of the installation.

Measurement of the reservoir pressure using an additional transducer within the valve package enables more refined control than could otherwise be achieved and also allows the system to warn of low supply pressure by means of the ISO11992 data link and / or ISO7638 pin 5 warning signal.

No other ECU or data link is involved in either the collection of data from the pressure transducers and speed sensors or the control of the solenoids.

Optional control functions of the system include: automatic suspension reset to ride height (COLAS), lift axle control (ILAS-E), steer axle locking and retarder control during ABS. These functions are on-off controlled using high side switches.

1.5.3 Additional 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.

EB+ sends the 'Stop Lamps Request' in message EBS22 (Byte 4, Bits 5 – 6) to the towing vehicle on ISO11992 if it uses automatically commanded braking (e.g. stability control retardation braking), as defined in ECE-R13 Paragraph 5.2.2.22.1. EB+ does not send the 'Stop Lamps Request' if it uses selective braking or stability control test pulses (see ECE R13 Annex 21 paragraph 2.2.4). Note that EB+ does not control the stop lamps directly.

1.5.3.1 Brake Force Enhancement

EB+ systems with software B377 or later include a brake force enhancement function. This function increases the brake delivery pressure at high demand pressures, by including an additional load sensing point. This is illustrated and described in Appendix 3.

1.5.3.2 Lining Wear

A brake pad lining wear circuit can be connected to Aux 4. This can be used to extend the stationary yellow warning lamp flash sequence, in order to warn the driver that a pad change is necessary (see paragraph 5.2.2.17 and 5.2.1.29.6 of ECE Regulation 13).

1.5.3.3 Reset-to-Ride Height (COLAS)

An auxiliary output can be used to reset the standard suspension ride height on move away from rest. This function requires a solenoid equipped Haldex COLAS raise/lower valve.

1.5.3.4 Retarder Control

An auxiliary output can be used to disable a trailer retarder as part of the anti-lock function.

1.5.3.5 Auxiliary Power Out

An auxiliary output can be used to supply B+ to associated circuits, e.g. switching relays or diagnostics modules. This output is protected from overload, so that the principle braking functions are not affected.

1.5.3.6 Steer Axle Lock

An auxiliary output can be used to lock a steering axle above a set speed or whilst the anti-lock function is operating.

1.5.3.7 Roll Stability

A roll stability algorithm is included in the system software. This can be activated at end-of-line if the system is fitted with an accelerometer, either internal to the controller or plugged into Aux 5.

The EB+ system utilises automatic commanded braking as part of the roll stability algorithm.

Low-level braking test pulses are used on one channel of 2M or 3M systems to determine if there is risk of rollover occurring. If a risk of rollover is detected then

automatically commanded braking is applied to slow the vehicle until the risk has reduced.

1.5.3.8 Soft Docking

A Soft Docking feature is possible. This uses signals from an external controller, connected using either (a) Aux 4 or 5 or (b) diagnostic CAN bus, to determine that the vehicle is reversing and within a pre-defined distance of a loading dock. Automatically commanded braking is then applied to bring the vehicle to a halt.

This function is switched off before the vehicle reaches 15 km/h.

1.5.3.9 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.

1.5.3.10 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.

1.5.3.11 Suspension Height Control

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

1.5.4 Input and Sensed Variables

A list of input and sensed variables together with their working ranges, monitoring and fault warning status is provided in Appendix 21.

1.5.5 Controlled Output Variables

A list of controlled output variables together with their means of control, working ranges, monitoring and fault warning status is provided in Appendix 22.

1.5.6 Limits of Functional Operation

Parameter	Minimum Level	Maximum Level
Supply Pressure (in respect of EB+ system)	4.5 bar / 450kPa	12 bar / 1200kPa (Warning signal @ 9.75bar / 975kPa)
Supply Voltage	19 Volts (Gen 1 / 2) 8 Volts (Gen 3)	32 Volts
Temperature	-40 °C	+70 °C
Vibration		5-37Hz 2.5mm pk-pk 37-600Hz 7g pk
Accelerometer Vibration (Lateral plane)		5 - 600Hz 0.4g pk
Humidity		97% @ 60ºC
Speed	1.8 kph	150 kph
IP rating (Controller and Cables)	IP6K9K	
Salt spray	ASTM B117-94 200 hours	

2 Applications

2.1 System Schematics

Typical schematics representative of EB+ braking system layouts applicable to this approval are defined in Appendix 1.

2.2 System requirements

2.2.1 The EB+ system may be used in conjunction with towing vehicles having interfaces conforming to ECE R13 paragraphs 5.1.3.1.1 (one pneumatic supply line and one pneumatic control line) and 5.1.3.1.2 (one pneumatic supply line, one pneumatic control line and one electric control line).
Towing vehicles conforming to ECE R13 paragraph 5.1.3.1.3 (one pneumatic supply line and one electric control line) are not currently permitted however to ensure forward compatibility the EB+ system also supports this interface. See Appendix 2 for a comparison of failure handling compared to current systems.

2.2.1.1 The electric control line is a point-to-point Controller Area Network (CAN) as defined in ISO11992. This standard stipulates a total length limit of 40m, consisting of 15m on the towing vehicle, 18m on the trailer and 7m for the interconnection. Where the control line length on the trailer would exceed 18m it is possible to install an extra ECU known as EB+ CAN Hub (see Appendix 1a). The EB+ CAN Hub in this situation acts as a repeater. It 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.

2.2.1.2 A trailer equipped to tow another trailer may be equipped with an extra ECU known as EB+ CAN Hub (see Appendix 1a). The EB+ CAN Hub in this situation acts as a router. It receives all 7-cores from the headboard ISO7638 connector, including the ISO11992 data communication part of the electric control line, provides two intermediate ISO11992 CAN nodes, connecting the first to the main EB+ controller via a 7-core cable of up to 40m length and the second to a towing vehicle ISO7638 connector via a further 7-core cable of up to 15m length.

2.2.2 Optionally an additional pressure switch or sensor may be fitted, situated in the pneumatic control transmission ahead of any control valves, i.e. EV / REV or boost relay valve. This sensor enables faster system response in case of no electric control line. When fitted with an electric control line, the sensor enables automatic braking suppression according to Para. 5.2.2.12.1 of Regulation 13.

2.2.2.1 It is possible to connect the control line pressure sensor to the port marked 'PSW' on the CAN Hub, if fitted, instead of the main EB+ controller (Appendix 1a, item 2). This limits the number of long cable runs. The CAN Hub uses the intermediate ISO11992 CAN Bus to send the signal from the pressure sensor when there is no electric control line available on the towing vehicle.

2.2.3 Wheel speed sensors are required for the ABS function, 1M systems use 2 sensors, 2M systems use either 2 or 4 sensors and 3M systems use 4 sensors. The most forward sensed axle always relates to S1 and the left hand (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.

2.2.4 The Electro Pneumatic Relay Valve(s) [EPRV(s)] should be situated as close to the controlled brakes as practicable and preferably symmetrically. At no time should the permissible delivery pipe lengths be exceeded.

2.2.5 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 auxiliary features.

In 3M, 4S axle-by-axle or 2S configurations, sensed axles may not be lifted.

In all other 4S configurations either (but only one at any time) sensed axle may be lifted.

The lifting device for sensed axles (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] 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.

2.2.6 Steering axles (forced or self steer) may be used in any configuration.

2.2.7 The EB+ system (2M and 3M versions only) is suitable for use on hazardous goods vehicles, e.g. ADR / GGVS category vehicles.

3 Component description and operation

3.1 Sensors external to the controller

Part numbers, are shown in [ ] alongside the relevant component.

3.1.1 Pressure Switch [041 5023 x9]
Pressure Sensor [815 022 xxx]

The pneumatic control line can optionally be monitored at the front of the trailer (forward of 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.

Summary of External Control Line Pressure Monitoring Functions

No external control line monitoring	Control line pressure is measured only inside the EB+ unit.
External Pressure Switch (not available on EB+ Gen 2 or 3)	System can be primed before pneumatic control pressure is detected at the EB+ unit which may marginally improve response time. Automatic braking can be detected and suppressed (see Para. 3.6).
External Pressure Sensor	Option available with software version B386 or later. System can operate using the external pneumatic control pressure which may significantly improve response time. Automatic braking can be detected and suppressed (see Para. 3.6).

3.1.2 Wheel Speed Sensors

The wheel speed sensors are magnetic reluctance devices situated in a stationary part of the wheel end assembly. Toothed exciters (tone wheels) are located on a rotating part of the wheel end assembly and arranged to modulate the magnetic field produced by the wheel speed sensor.

The part numbers quoted above are for Haldex supplied sensors, other manufacturers sensors may also be used, see table below. Radun types are functionally identical to Haldex.

EB+ Compatible Wheel Speed Sensors

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	

3.1.3 Pressure Transducers [802460-B] [802460-C] [802461-B] [802461-C]

The pressure transducers used for pneumatic control are external to the controller and are part of the modulator assemblies. They are fully encapsulated and vented to atmosphere through the modulator assembly. Two ranges of transducer are used, 8 bar g / 800 kPa g (9 bar absolute) for brake demand, delivery and suspension and 12 bar g / 1200 kPa g (13 bar absolute) for reservoir.

Each transducer consists of a silicon sensing element and local signal conditioning electronics. Different types of pressure transducer are used, having gauge / absolute characteristics and differing electrical terminations in addition to the range described above.

Connection between the pressure transducers and the controller is by means of a removable multi-way connector on EB+ Gen 1, or fixed connections on EB+ Gen 2 / 3.

3.2 Master Controller

[1M [812 001 101]]

[2M [812 001 301] [812 001 202] [812 013 001] [812 012 001]]

[3M [812 010 001]]

[Gen 2 2M [integrated with 2M modulator 820 001 xxx to 820 024 xxx]]

[Gen 2 3M [integrated with 2M modulator 820 026 xxx]]

[Gen 3 2M [integrated with 2M modulator 823 008 xxx]]

[Gen 3 3M [integrated with 2M modulator 823 034 xxx]]

3.2.1 Description

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

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.

The EB+ Gen 2 and Gen 3 controllers are of similar design, but only available as a 2M unit that is not removable from the modulator package. The PSW connector (Pressure Switch) is also deleted. Internally, there is a difference in the implementation of the ISO11992 interface. For this reason, there are separate ISO11992 compliance reports for EB+ Gen 1 and EB+ Gen 2 (See also Para. 5.7).

The controller's primary function is to control braking by adjusting the pneumatic pressure applied to the wheel brake chambers. Braking is initiated when the controller receives a signal from either the CAN ISO11992 input from the towing vehicle or the control line pressure transducer(s) or the optional trailer control line pressure switch input. The controller measures wheel speeds, brake chamber delivery pressure(s), driver demand pressure, reservoir pressure and load pressure(s) and using this information adjusts the wheel brake chamber pressure(s) via the valve sub-assembly to achieve load proportioning 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 "toggle" 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 ISO11898 port is provided which is used during factory test or vehicle service to configure the unit, e.g. load plate data, number of wheel speed sensors /

modulators, 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. On 1M and 2M integrated systems when there is a malfunction of the permanent supply, it may be powered from an optional 24N stoplight supply (only available during braking). During stoplight power operation, the controller performs an antilock braking function (ABS only) or optionally also dynamic load apportioning.

Some controllers also have an integral lateral accelerometer that is used as part of the optional roll stability system.

3.2.2 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, 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 tachometer speed signal or a diagnostic tell-tale signal. The tell-tale is an electro-mechanical device that shows either a black or orange disc depending on the status of the system, and will maintain that condition on removal of the power. 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 Function	Black Wire Function	Yellow Wire Function
Aux 1	Digital Input	B- Return	Tacho
	High-side Output		Tell-Tale
Aux 2	Digital Input	B- Return	A/D Input
	High-side Output	(optionally switched)	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

3.2.2.1 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.

3.2.2.2 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.

3.2.3 End-of-line Programming

The following parameter blocks are configurable at vehicle build by use of the end-of-line test program.

System configuration: 2S/1M, 2S/2M, 4S/2M Side/Side, 4S/2M Axle/Axle, 4S/3M and ECU orientation.

Wheel scaling: The tyre and exciter sizes are programmable.

Warning signal sequence: Option "A" (on-off-on) or "B" (on-off).

Auxiliaries: The set-up for the auxiliary channels.

Load plate data: It is necessary to program the load sensing settings for the EB+ system. These are similar to those used for pneumatic load sensing valves but are entered directly as numbers. A full list of the possible settings together with an example is given in Appendix 3.

Geometric data: Physical data about the trailer for the load plate and for transmission on the ISO11992 CAN bus.

3.2.4 Diagnostics

The EB+ system has an extensive on-board diagnostic capability. Diagnostic communication uses a CAN data bus according to ISO 11898 but using the Keyword (KWP2000) protocol.

Any suitable device connected to the diagnostic CAN data bus may read diagnostic information. An Info-Centre is provided for EB+ allowing basic fault diagnosis as well as providing other information (e.g. odometer). A Haldex PC based program may be used for more advanced diagnosis. This also allows configuration and system parameters to be entered.
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.

3.2.5 Slave Controller [Gen 1/2 : 812 011 001] [Gen 3 : 812 015 001]

On 3M and 2M non-integrated systems a slave controller is required to control the slave modulator. It is housed in an enclosure similar to the Gen 1 master controller. The slave controller provides the interface for the pressure transducer(s) and solenoid valves but contains no computing function.

3.2.6 CAN Hub [815 057 001 see GS0635 EMC Doc]

The CAN Hub (see Appendix 1a) is an additional ECU used on long trailers where a direct connection of the electric control line to the master controller would breach the 18m length limit imposed by ISO11992, or on towing trailers in order to route ISO11992 to two EBS. It is housed in an enclosure similar to the Haldex U-ABS ECU.

The CAN Hub has three 7-pin connections (coloured blue) for the ISO7638 from the headboard, a 7-pin connection to the master controller and a 7-pin connection to a following trailer / EBS.

The CAN Hub also has an electrical connector for an optional control line pressure sensor (see 3.1.1), so that the pressure sensor cable does not have to reach the master controller (see Appendix 1a, item 2).

3.3 Modulators

The modulators used in the EB+ Gen 1 system are of a modular design enabling the realisation of 1M, 2M and by combination, 3M ABS. It is also possible to have an integrated double-check valve between a park valve and an internal connection to a delivery circuit for spring brake anti-compounding without affecting the delivery circuit.

The modulators in the EB+ Gen 2 and Gen 3 systems are an integrated 2M design. It is also possible to have an integrated double-check valve for spring 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.

3.3.1 1M EB± [813 00x 30x] [813 010 xxx] [813 011 xxx] [813 012 xxx]

The modulator used in the 1M system is designed to handle the airflow for a complete semi or centre-axle trailer and can have up to six delivery ports. The detailed operation is similar to that described below for the 2M modulator in section 3.3.2. The 1M modulator is also used in 2M non-integrated and 3M systems, different versions optimised for these applications then being used.

3.3.2 2M EB± [813 00x 30x]

The 2M modulator has independently controlled electro-pneumatic valves.
Appendix 13 shows the valves with their pressure sensors and solenoids in the various operating modes. Appendix 9 shows the valve internal layout.

Each of the valves has been designed to operate within a trailer air braking system utilising the pneumatic relay principle but with the addition of two solenoids to provide stepping control and a further solenoid to select air from the reservoir or control input.

The valve has two sections, Control and Delivery:

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

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

3.3.2.1 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 control relay piston. As pressure increases the piston descends, firstly closing off the exhaust seat which connected the brake chamber (port 2) to atmosphere (via port 3) and secondly opening the reservoir seat between the pressure storage reservoir (port 1) and brake chambers (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 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. This creates a pressure imbalance where the pressure underneath the relay piston is higher than that above the relay piston, it 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.

3.3.2.2 Operation with Electrical Power

Pneumatic operation with electrical power is shown in Appendices 13.7, 13.6 and 13.5. On receiving a signal from either the CAN link or control line pressure switch the ECU will energise the apply solenoid allowing air from the brake system reservoir to pass to the hold solenoids. When the drivers demand pressure is reached the hold solenoids are energised to stop the pressure rise.

The pressure to the delivery of each valve is then controlled by the ECU which signals 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 or anti-lock control.

3.3.3 2M EB^{+} Gen 2 [820 001 xxx to 820 024 xxx and 820 026 xxx]
2M EB+ Gen 3 [823 008 xxx and 823 034 xxx]

The detailed operation is similar to that described for the 2M modulator in section 3.3.2.

The EB^{+} Gen 2 or Gen 3 valve uses a larger diameter piston in order to reduce hysteresis in pneumatic backup (failed) modes. The control chamber volume is adjusted to give identical EBS pressure control characteristics to the original EB^{+} modulator when operating normally.

The valve additionally has test points for the service deliveries and optionally two extra reservoir ports.

Valve operation is shown in Appendix 13.8 to 13.14.

3.4 Electrical Equipment

Electrical wiring schematics for 1M / 2M and 3M systems are shown in Appendix 10. These show the wiring external to the controller. Connection to the modulator(s) is by means of a reverse mounted multi-way connector on EB+ Gen 1 and by fixed internal connections on EB+ Gen 2 / 3, and is not shown.

3.4.1 The EB+ system is powered by the ISO 7638 connector, either 5 pin or 7 pin. This primary power is connected to the ECU at the port labelled Power A.

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.

Optionally, an ISO1185 (24N) or ISO12098 (15-pole) stoplight power back-up connection can be fitted to all 1M and 2M integrated systems and Gen 3 3M. This provides anti-lock braking control and (optionally) dynamic load sensing in situations where the ISO7638 connection is not functioning and is not intended as a normal operating mode. This auxiliary power is connected to the ECU at the port labelled Power B.

Summary of the Effect of Powering Options on EB+ Function

Power Source	Load Apportioning	ABS	CAN Communication
ISO7638 7pin (Power A)	YES	YES	YES
ISO7638 5pin (Power A)	YES	YES	NO
Stoplight (Power B)	OPTION	YES	NO

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.

3.4.2 A notice highlighting the correct connection of electrical power to the EB+ system is provided for attachment to the trailer headboard or nearby the ISO7638 connector. A copy of this notice is provided in Appendix 4.

3.4.3 Warning Signal Sequence

The EB+ system provides a drive for a warning signal connected to pin 5 of the ISO7638 connector to control a cab mounted warning device. This is used to indicate both the specified EBS / ABS faults and also the non-specified auxiliary faults. Priority is given to the indication of specified faults. There is an option of two simple "check-outs", an on-off-on (option "A") sequence or an on-off (option "B") 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 lamp is also provided as an auxiliary function. This lamp mimics the signal to the cab warning device but will only function if the ISO7638 power is connected. The signal produced may be different to that produced by the cab device due to possible modification of the latter by the towing vehicle. Note: This may not be permitted in some countries (e.g. Germany) due to local restrictions.

3.5 Part Numbers

3.5.1 A list of EB+ part numbers may be found 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.

3.5.2 Identification of Units

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.

3.6 Automatic (Emergency) Braking

The automatic braking function operates in the case of a failure in the pneumatic connecting lines of the vehicle combination. Suitable Haldex EV / REV's for this function are listed in Appendix 7 and Appendices 18, 19 and 20 show functional schematics in detail. However other methods of achieving the requirements may be used, as they do not directly impact the EB+ system.

When the automatic braking function operates, automatic braking occurs on the trailer, this automatic braking will still be subject to load apportioning and ABS similar to a driver braking demand. If the vehicle is moving, has a reservoir pressure above 4.5 bar (450 kPa), an optional control line pressure switch (or sensor) fitted and has a

valid ISO11992 data link this automatic braking will be suppressed, in accordance with para. 5.2.2.12.1 of Regulation 13. This suppression will end if the reservoir pressure falls below 4.5 bar (450 kPa) or the ISO11992 data becomes invalid and will also end once the vehicle has come to rest. The red warning signal will be illuminated throughout, warning the driver, but by suppressing immediate automatic brake application, allows the driver to control the stopping of the vehicle.

4 Interconnections and Signal Flow

4.1 Interconnections

The interconnections are shown in appendices 1 (piping), 10 (trailer wiring) and 12 (motor vehicle wiring).

4.2 Signal flow and priorities

4.2.1 Signal flow

The signal flows are illustrated by the context diagram in Appendix 23.

4.2.2 Priorities

The brake demand value is read from the ISO11992 electric control line using the EBS11 message. This message has the highest priority.

Where a CAN Hub is installed (see 3.2.6), an intermediate ISO11992 CAN connects the CAN Hub to the master controller (see Appendix 1a). The ISO11992 messages are relayed by a polling message strategy in both directions without alteration, with two exceptions.

1) The EBS1x messages are sent with incremented ‘trailer position’ for towing trailer nodes.
2) The EBS11 message is sent on the intermediate CAN with a service brake demand value (bytes 3 – 4) sourced from an optional control line pressure sensor connected to the CAN Hub when there is no electric control line available from the predecessor vehicle. The purpose of this is to improve brake response time in this specific case.

In the case of full trailer systems (3M), the front axle (slave) load and the delivery pressures are multiplexed. The load pressure is sent from slave to master whenever the slave brake apply solenoid signal is inactive, the delivery pressure is sent whenever the signal is active. There is no prioritisation necessary.

There are no other multiplexed data paths within the EB+ system.

5 Safety Concept

5.1 Statement of the Manufacturer

The EB+ system is designed such that operation under non-fault conditions does not prejudice the safe operation of systems which are subject to the prescriptions of ECE R-13.

There are three main design features to ensure that vehicle safety is continuously maintained: pneumatic push-through, use of two microcomputers and resistance to electrical transients. It is arranged that microcomputer or electrical failures revert to the pneumatic push-through condition.

5.2 Safety Design Features

5.2.1 Pneumatic Push-Through

When not braking, the system remains in a passive “pneumatic push-through” mode. In this mode, the pneumatic connection from the “control port” is connected through to the control side of the pneumatic relay valves. The base of the pneumatic relay valve is similar to that of conventional pneumatic relay valves. This means that when the system is not braking should any defect occur the system is ready to operate as a conventional “simple” pneumatic braking system, without any of the higher-level control functions such as Load Apportioning or ABS. The pneumatic push-through condition is maintained by the “Brake Apply Solenoid” which switches between the push-through and reservoir. The “Brake Apply”,” Hold” and “Dump” solenoids are maintained in a “push-through” condition by mechanical springs.

Under normal braking conditions the system determines a brake pressure demand from either the integral pressure transducer or preferably the ISO11992 data bus. This demand signal is processed by the ECU, which then uses the “Brake Apply”, Hold and Dump solenoids to control the brake pressure delivered to the brakes. If there is a deviation of the “actual pressure” delivered to the brake and the “target pressure” the system will indicate a fault.

By the use of the same components for normal braking, and pneumatic push-through, and their monitoring for correct operation by the ECU a non-redundant monitored system is maintained.

5.2.2 Two microcomputers

The ECU has two microcomputers, one that performs the EBS / ABS function and one that provides a monitoring function. Both of these microcomputers control the solenoid “shutdown” element in a logical AND arrangement. By this arrangement, a failure of either microcomputer will be detected by the other and also result in a reversion of the system to the pneumatic push-through condition.

The shutdown element itself is a robust “self protecting” device and is itself tested for correct operation at each power-up.

The CAN Hub also has two microcontrollers in the same manner as described above and a failure in either will cause the device to enter a shutdown mode. In this case, the connected EB+ master controller will operate without an electric control line and fall back to pneumatic operation. In shutdown mode, the CAN Hub sends the yellow warning signal to the towing vehicle via pin 5.

5.2.3 Electrical Transients

Transient suppressors protect the electronic circuit against electrical transients, likely to cause damage. Should an overload condition occur that results in the failure of these devices, non-resettable fuses are also provided in series.

It is not practical to protect the electrical power supply to the controller for significant failures resulting in loss of power (e.g. an open circuit in the wiring) of more than a few milliseconds however the EB+ system is arranged to enter a reset condition upon power failure, reinitialising once satisfactory power is available. During this reset condition, the system reverts to pneumatic push-through (1:1) and no ISO11992 communications are active. The yellow warning signal connected to pin 5 of the ISO7638 connector will be on throughout the power loss and will follow its specified (option A or B) sequence upon reinitialising. The red warning signal will follow its specified operation upon reinitialising.

5.3 Software

5.3.1 Software Design

The software design makes use of two independent microcontrollers.

The main microcontroller is responsible for all braking and diagnostic functions. The second microcontroller is fitted so that operational cross-checks 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.

On exit from reset the main and secondary microcontrollers run their set-up and initialisation software before performing an initial cross-check. Thereafter the main microcontroller enters a cyclic program period of fixed 10 ms duration. Once on every pass of the program period the cross-check is performed, with the secondary also checking that the 10 ms period is within tolerance.

Each high-level software module runs once in order in the 10ms period. In this manner action on events can be guaranteed every 10ms.

The core high-level functions are –

- Wheel speed processing
- Vehicle reference speed calculation
- Power supply monitoring
- ISO11992 CAN
- ABS algorithm
- Roll stability algorithm
- Pressure control algorithm
- Solenoid processing
- Diagnostic

Each high-level function performs self-checking of relevant system components. Where necessary the control function of individual high-level modules may be altered to allow for defective or suspect functions. In addition, the high-level functions will set diagnostic trouble codes for use by the diagnostic module.

A software interface for an EEPROM, non-volatile memory, is included which can be accessed by any module for the storage and retrieval of parameters and diagnostic trouble codes.

Additional, optional high-level functions for auxiliary control, e.g. retarder, lift axle, suspension etc. can be added without interference to the core modules.

The following interrupts run in the main microcontroller –

- 1ms periodic to maintain the program period and to control module run timing within the program period.
- 250µs periodic to perform solenoid switching.
- Wheel speed edge time capture for 4 channels. Interrupt processing overhead at high speed is limited by switching off the interrupts after 16 edges of the same polarity have been detected on each wheel. The interrupts are re-enabled on the next 10 ms pass of the wheel speed module.

The software design for both microcontrollers followed a process of –

- Specification
- Prototyping / Simulation
- Design
- Implementation
- Test

The specific methods and tools varied from module to module as appropriate.

Prototyping was particularly heavily used in the development of the logic for the pressure control loop and the higher-level control of pressure during anti-lock activity.

Mathematical simulation was used in the design of the roll stability algorithm.

Overall software design was conducted using a Yourdon CASE (Computer Aided Software Engineering) tool.

Individual module functions were mostly either analysed using the CASE tool, or modelled using a commercially available systems modelling tool.

All software in the main microcontroller is implemented in the MISRA (Motor Industry Software Reliability Association) subset of the “C” language. The code is compiled using a commercially available “C” compiler (as specified by the microcomputer manufacturer) and then a software checking tool is used to check for infringement of MISRA rules and a compliance matrix compiled.

The main microcontroller software was tested during development using in circuit emulators running the code on the target hardware. All functions that relate to the

performance of the braking system were tested on air brake rigs and / or test vehicles as appropriate.

All software in the secondary microcontroller is implemented in assembly code. The code was assembled using a commercially available assembler and tested using a simulator and a programmed device in circuit in the target hardware. The same secondary microcontroller is also in use on Haldex Modular ABS.

5.3.2 Software Identification

The software contained in the EB+ is identified by an alpha-numeric code. The alphabetical codes A-F cover the approval level applicable and the numeric code is in individual identifier for that software release level. Code G is used for internal purposes and previous release levels. Code X is for internal use only.

Any change that affects the prescribed performance (e.g. ABS) of the system will result in the alphabetical character and the numeric character increasing, but changes that do not affect the prescribed performance (e.g. diagnostics) will only result in only the numeric character increasing.

The current level is “C” for EB+ Gen 1, “D” for EB+ Gen 2 and “E” for Gen 3.

5.3.3 Software Programming

The software within the EB+ system is programmed during manufacture. This software may be updated in service. The update can only be achieved via the diagnostics port, using a PC program provided by Haldex. This program makes use of the highest security level in the Haldex KWP2000 diagnostics protocol.

5.4 Provisions for Failure

The software for the EB+ system allows for the following operating modes –

EBS: Where the system is fully operational and the ISO11992 CAN link is present. Pneumatic signalling may or may not be available according to ECE Regulation 13/09 Supplement 5.

Pneumatic: Where the system is fully operational but there is no ISO11992 CAN link present. Pneumatic signalling must be present.

ABS Backup: When operated from stoplight power only, the system shall revert to an ABS function only. (E.g. ISO7638 fuse blown or cable not connected).

Exceptional: Where the system is operating in a fault-tolerant mode. In this mode, the software is accommodating a component failure by interpolating other data or by disabling some system functions. (E.g. a wheel speed sensor fault would result in that sensor not being included in the ABS wheel state function).

Soft-Fail: Where the system has developed a fault, whose severity makes it no longer possible to continue operation. In this mode, the shutdown

mechanism has been activated so no solenoid activity can take place. Diagnostic activity is still taking place to assist in fault localisation. (E.g. a solenoid output shorted to B+).

Hard-Fail: Where there has been a communication failure with the Watchdog microcontroller. In this mode, the shutdown mechanism has been activated so no solenoid activity can take place. No diagnostic activity is possible in this mode.

Program: Where firmware is being downloaded to the Flash ROM within the processor. Prior to entry into this mode, the vehicle must be in a safe condition, defined as:
The system is 'at rest' with no braking demand. In addition, the system must not have detected any vehicle speed during the current power-up cycle.

5.5 Supporting Failure Analysis

A summary of failure mode and effect is shown in Appendix 8.

5.6 EMC Approval

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 the applicable part numbers is provided in Appendix 17.

5.7 Compliance with ISO 11992

Information necessary to demonstrate compliance with ECE-R 13, Annex 17 is provided as follows –

For ISO11992 supported messages see Appendix 5.

For summary sheets from technical reports (C8889, C8890, C8891 and supplement C9385)) demonstrating compliance of EB+ Gen 1 with ISO11992 interface requirements, see Appendices 15.1, 15.2, 15.3 and 15.4.

For summary sheets from technical reports C9685 and C9686, demonstrating compliance of EB+ Gen 2 with ISO11992 interface requirements, see Appendix 15.5 and 15.6.

For summary sheets from technical reports C10942 and C10946, demonstrating compliance of EB+ Gen 2 with ISO11992 interface requirements, see Appendix 15.7 and 15.8.

For summary sheets from technical reports C11467 and T0#19-0005, demonstrating compliance of CAN Hub with ISO11992 interface requirements, see Appendix 15.9 and 15.10.

6 Periodic Technical Inspection

6.1 Static Test Modes

Apportionment of braking with load ('load sensing') is carried out when the vehicle is moving; the system reverting to push-through (1:1) once the vehicle has come to rest and not reactivating load sensing until the brakes are fully released.

For the purpose of periodic technical inspection it is possible to hold the braking system in either load sensing or push-through mode. This is done by altering the pneumatic brake demand condition at electrical power-up.

6.1.1 Static Test of Load Sensing

If the trailer service brakes are off (note: this may require the release of 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 load sensing when the brakes are subsequently applied. This load sensing 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 km/h returning the system to normal operation.

6.1.2 Static Test of Maximum Braking Force

If the trailer service brakes are on when the electrical power is applied (turning the ignition key to "run") it immediately adopts push-through (1:1). 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 km/h returning the system to normal operation.

Alternatively, 1:1 can be obtained by either removing the ISO 7638 connector or turning the towing vehicle "ignition switch" to "off", the system then adopting 1:1.

6.2 Current Operational Status

This can be verified by turning the system off and then on and checking the correct operation of warning signal(s) as described in section 3.4.3. “Warning Signal Sequence”.

During the verification phase, the electrically controlled modulators will cycle.

6.3 Diagnostics

A diagnostic port is provided, as described in section 3.2.4.

The system can be checked using the Haldex DIAG+ software when a PC interface is connected to this port.

6.4 Verification of ISO11992 Operation

The ISO11992 connection, and absence of simple unauthorised modification, may be confirmed by comparing the ISO11992 and pneumatic brake demands in the main DIAG+ window (see 6.3).

EB+ EBS Information Document - Appendices List

Appendix 1	EB+ braking system schematics
Appendix 1a	EB+ CAN Hub installation schematics
Appendix 2	Electric only failure comparison
Appendix 3	Load plate data and Electronic Load Sensing characteristics
Appendix 4	Headboard information label, EB+ ISO7638 connection
Appendix 5	ISO11992-2 supported messages and parameters
Appendix 6	Not used
Appendix 7	Part numbers
Appendix 8	Fault handling summary
Appendix 9	EB+ valve cross-section - 2M
Appendix 10	Wiring diagram
Appendix 11	Warning signal operation (ISO 7638 Pin 5)
Appendix 12	Towing vehicle ISO 7638 wiring
Appendix 13.1 to 13.7	EB+ Gen 1 modulator valve operation
Appendix 13.8 to 13.14	EB+ Gen 2 modulator valve operation
Appendix 14	Function blocks
Appendix 15.1 to 15.8	ISO 11992 Compatibility test reports
Appendix 16	Not used
Appendix 17	EMC Test certificates
Appendix 18	EB+ Gen 1 combined service and park brake system schematic with REV 351 009 xxx
Appendix 19	EB+ Gen 1 combined service and park brake system schematic with REV 351 033 xxx
Appendix 20	EB+ Gen 1 combined service and park brake system schematic with Trailer Control Module + 352 067 601
Appendix 21	Input and sensed variables
Appendix 22	Controlled output variables
Appendix 23	System context diagram
Appendix 24	EB+ Gen 2/3 combined service and park brake system schematic with REV 351 009 xxx
Appendix 25	EB+ Gen 2/3 combined service and park brake system schematic with REV 351 033 xxx
Appendix 26	EB+ Gen 2/3 combined service and park brake system schematic with Trailer Control Module + 352 067 601
Appendix 27	EB+ Gen 2/3 combined service and park brake system schematic with Trailer Emergency Module 352 075 XXX

Revision History:

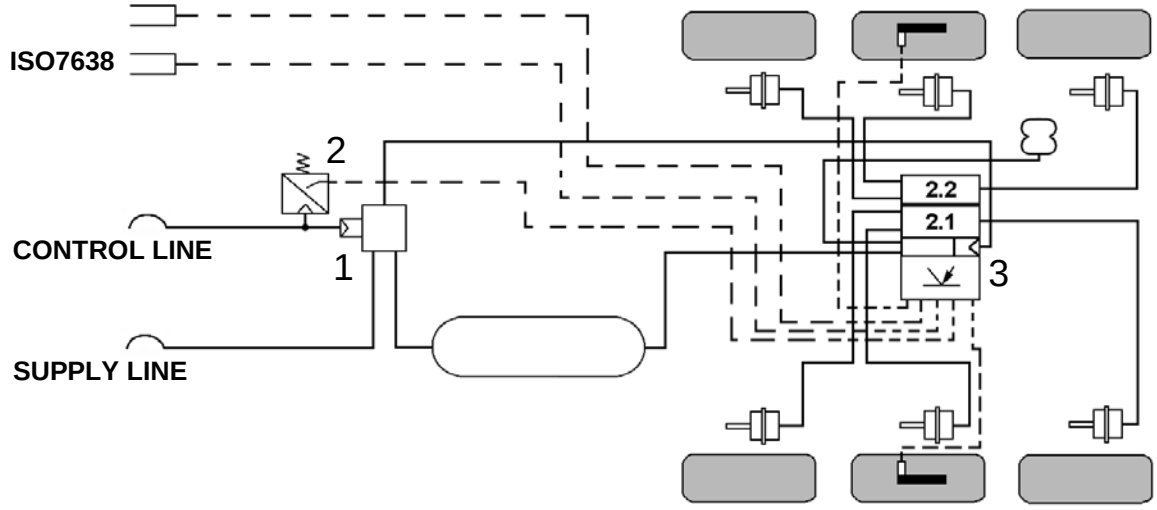
Issue:	Ref:	Date:	Revision
5	C7149 C7150	29/01/20	Addition of CAN Hub Addition of Inloader
4	C6236	19/07/12	Introduction of Gen 3
3	C6068	17/05/11	EMC and editorial updates
2	C5757	06/10/09	Mandatory EVSC approval Dolly Axle Regulation
1	PR1985	19/11/08	

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

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

Side by Side Installation

ISO1185 (Option)
(ISO12098 Alternative)



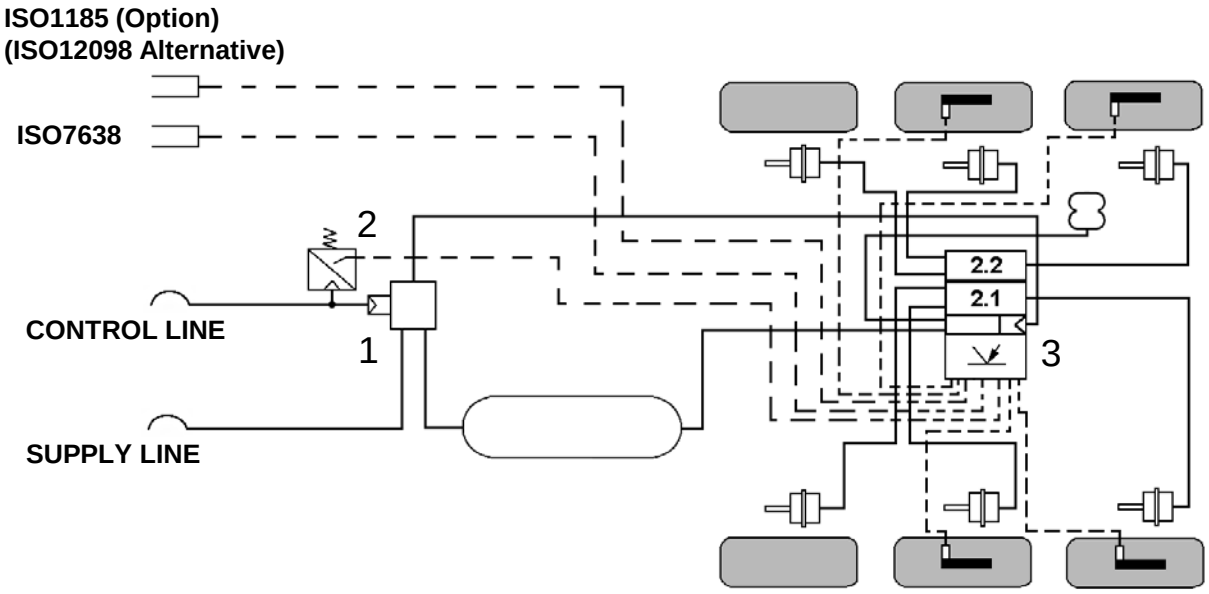
KEY:

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

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

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

Side by Side Installation



KEY:

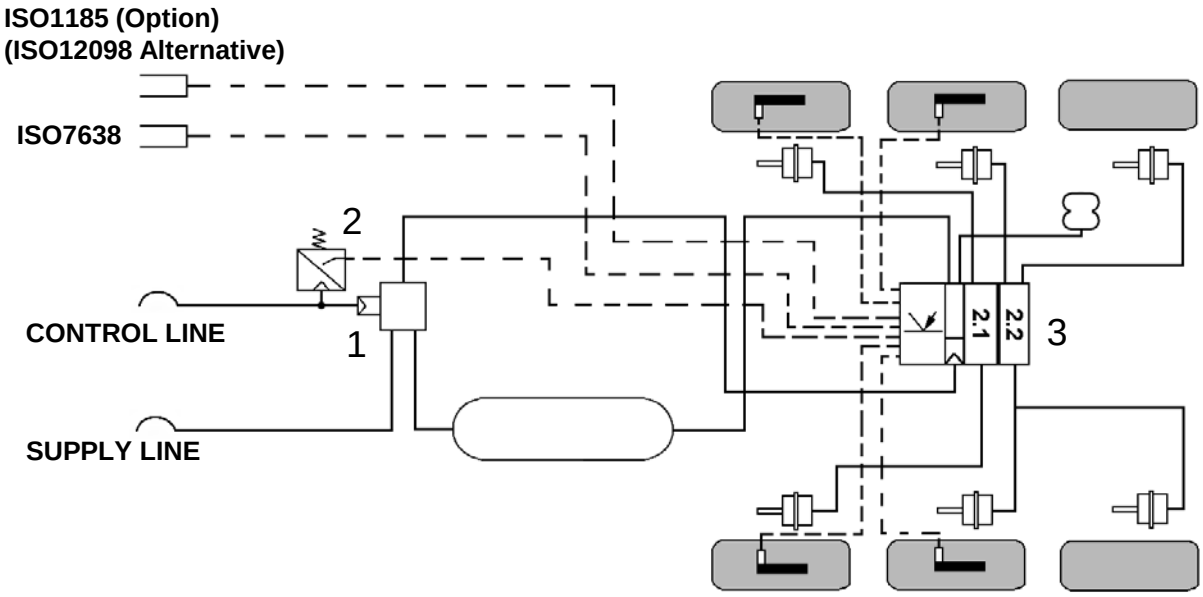
1 - Emergency Relay Valve

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

3 - EBS Modulators & Electronic Control Unit

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

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



KEY:

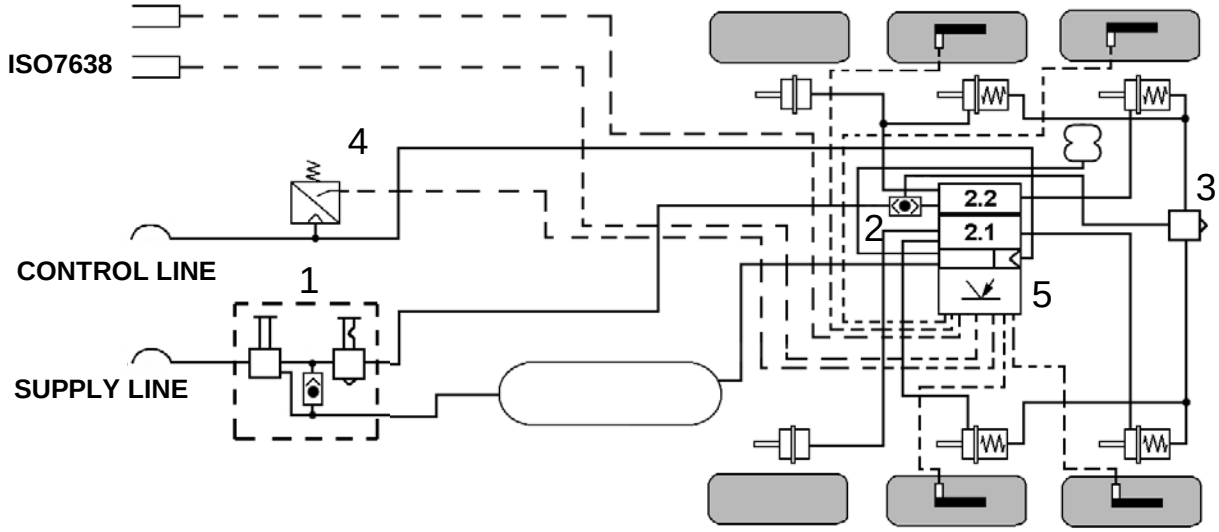
1 - Emergency Relay Valve
2 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option)
or in case of EB+ Gen2 Pressure Sensor (Option)
3 - EBS Modulators & Electronic Control Unit

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

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

Side by Side Installation

ISO1185 (Option)
(ISO12098 Alternative)



KEY:

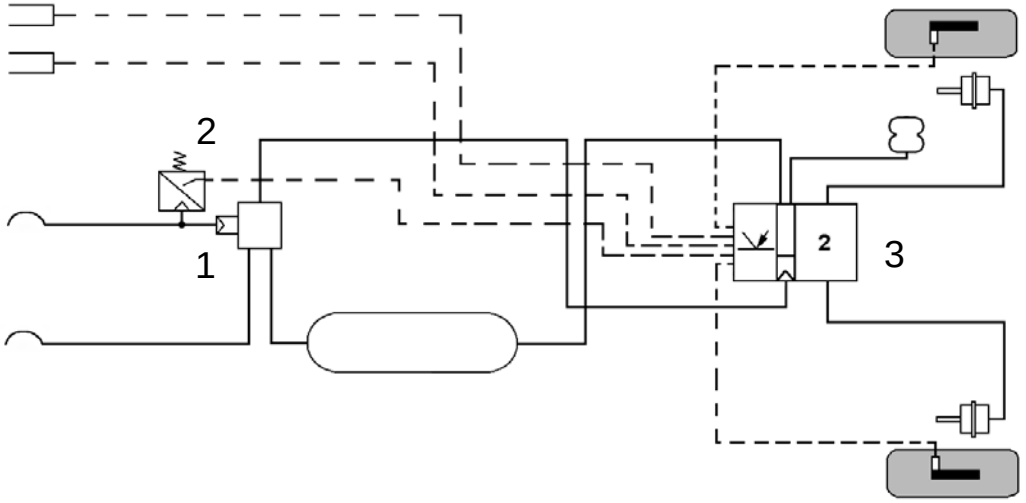
1 - Combined Park & Shunt Valve (352 046 …)
2 - Double Check Valve
3 - Quick Release Valve
4 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option)
or in case of EB+ Gen2 Pressure Sensor (Option)
5 - EBS Modulators & Electronic Control Unit

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

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

ISO1185 (Option)
(ISO12098 Alternative)

ISO7638



KEY:

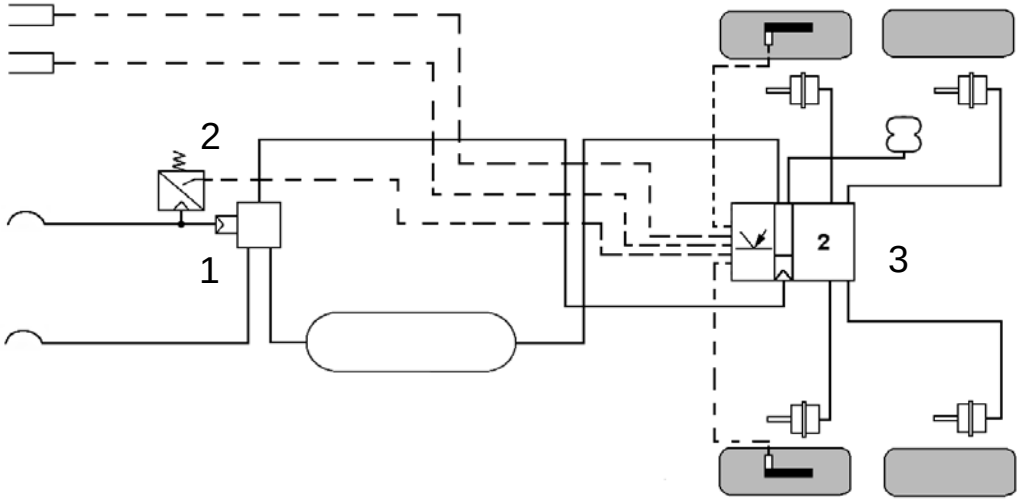
1 - Emergency Relay Valve
2 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option)
3 - EBS Modulator & Electronic Control Unit

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

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

ISO1185 (Option)
(ISO12098 Alternative)

ISO7638

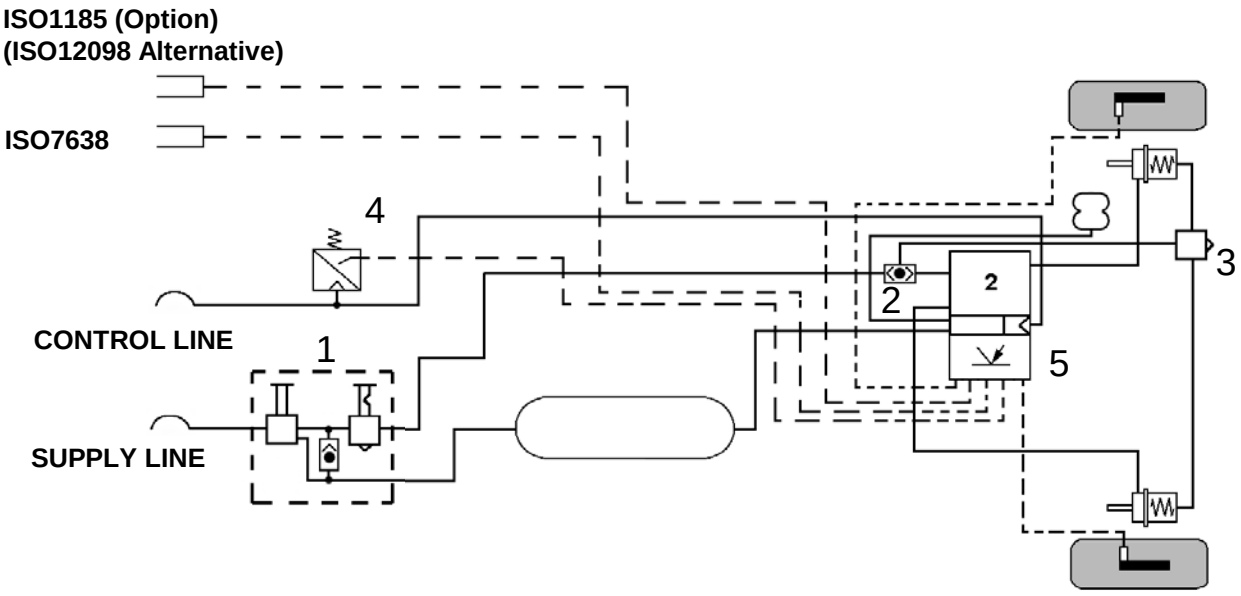


KEY:

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

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

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



KEY:

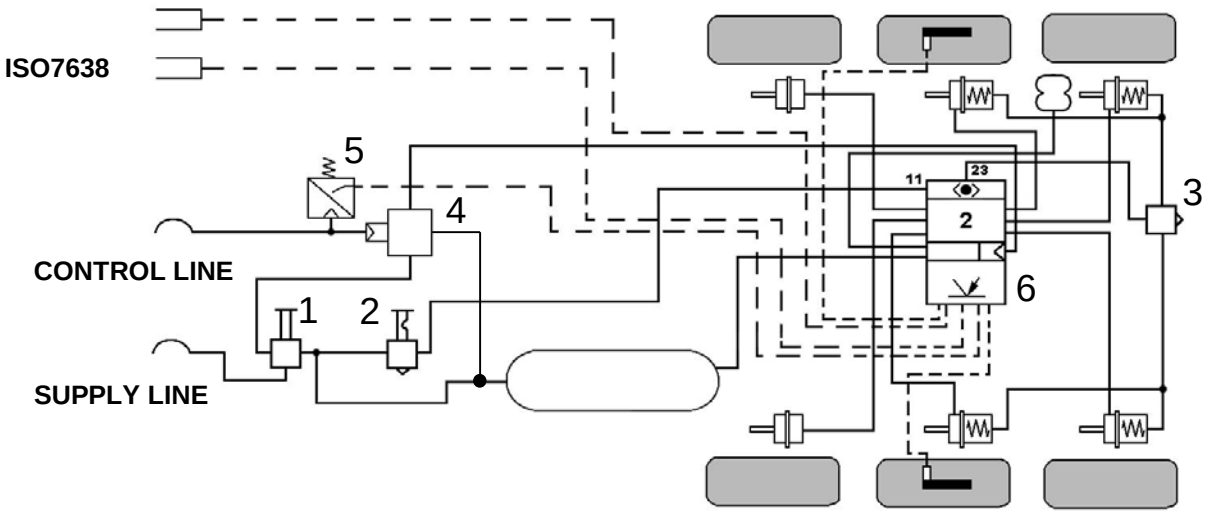
1 - Combined Park & Shunt Valve (352 046 …)
2 - Double Check Valve
3 - Quick Release Valve
4 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option)
5 - EBS Modulator & Electronic Control Unit

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

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

EB+ with Integrated double check valve

ISO1185 (Option)
(ISO12098 Alternative)



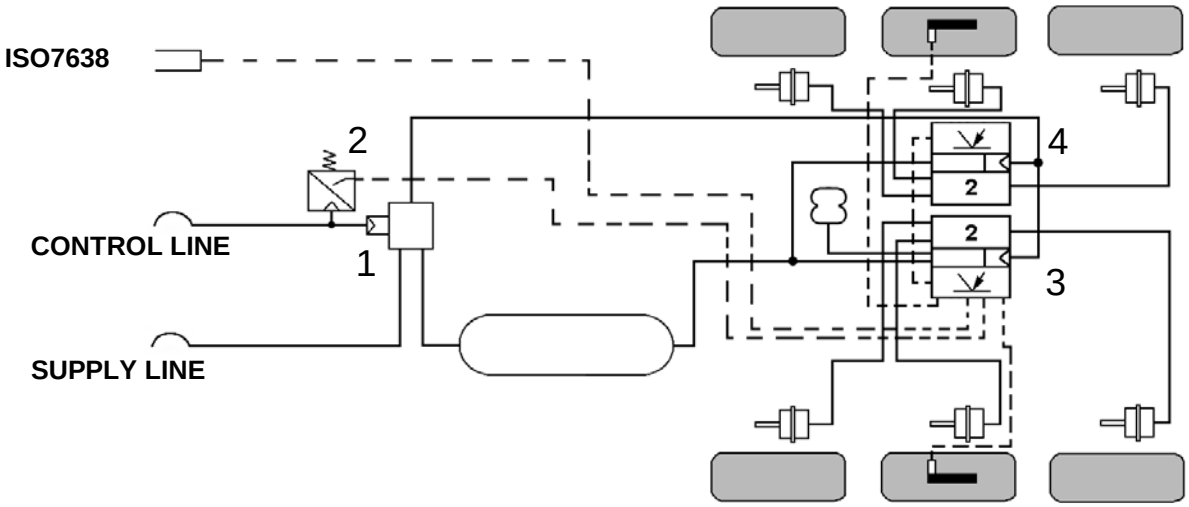
KEY:

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/2M Non Integrated Semi or Centre Axle Trailer Installation

Side by Side Installation



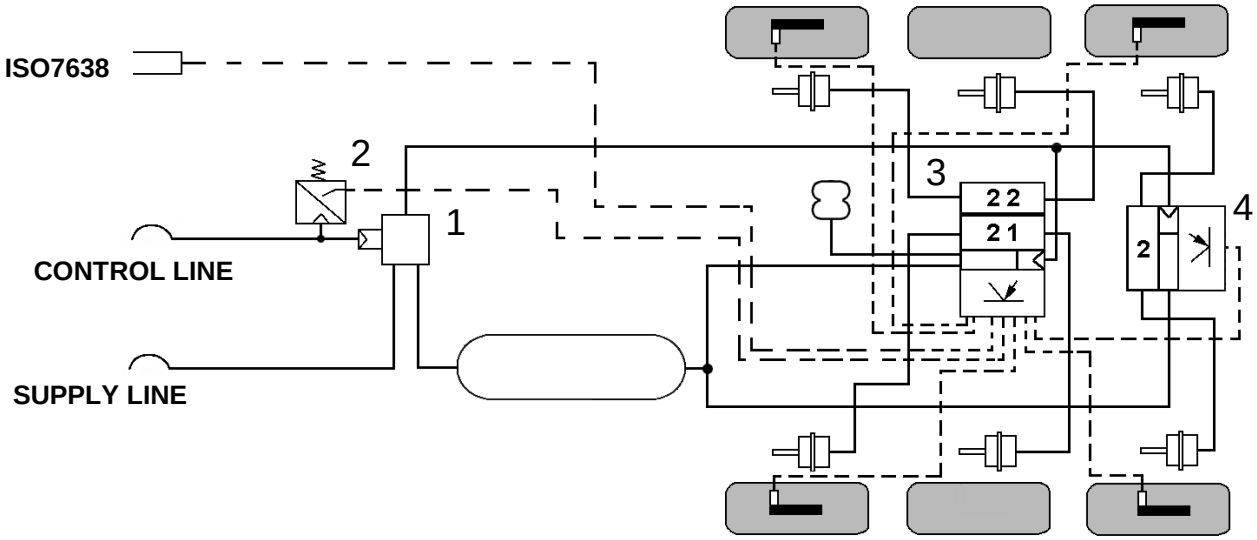
KEY:

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, Gen 2 & Gen 3 Brake System Installation Schematics

4S/3M Integrated Semi or Centre Axle Trailer Installation

Side by Side Installation



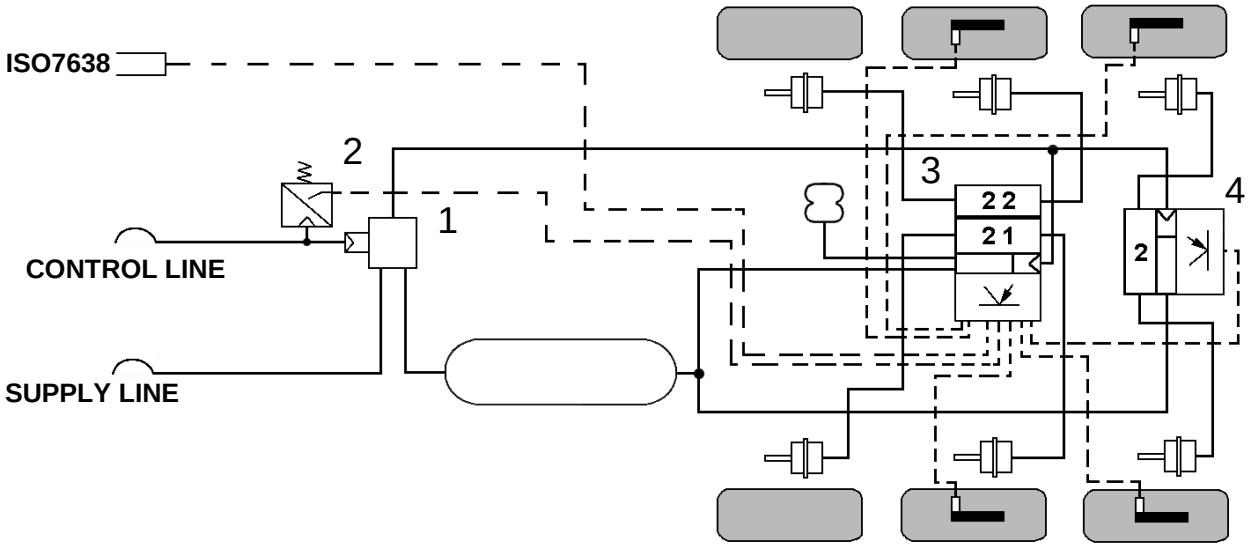
R13 180535

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, Gen 2 & Gen 3 Brake System Installation Schematics

4S/3M Integrated Semi or Centre Axle Trailer Installation
Side by Side Installation



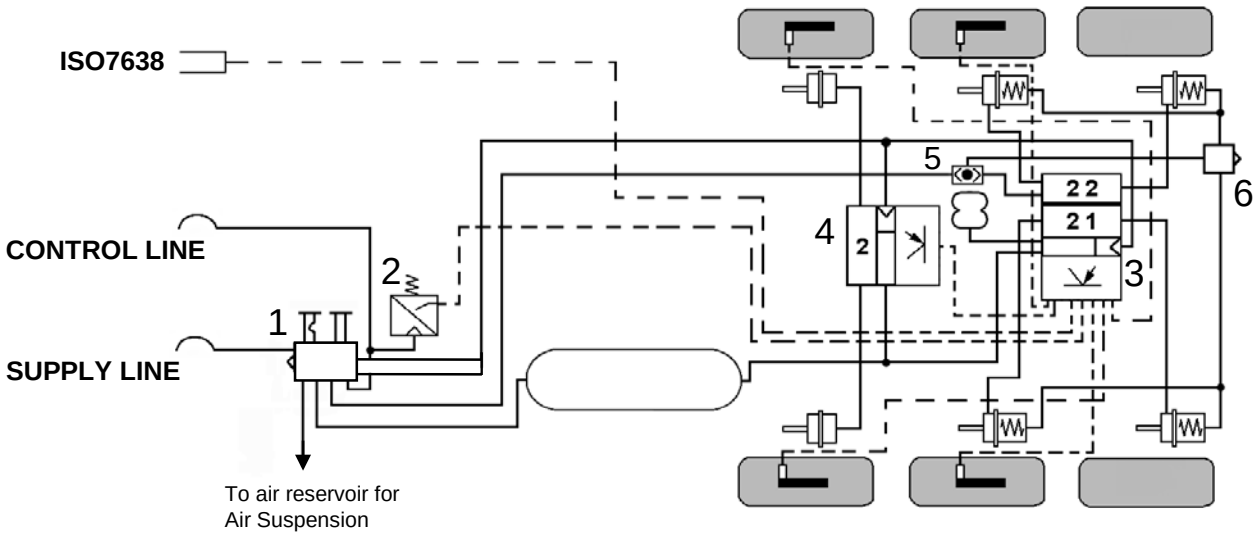
KEY:

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

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

4S/3M Semi or Centre Axle Trailer Installation

Side by Side Installation



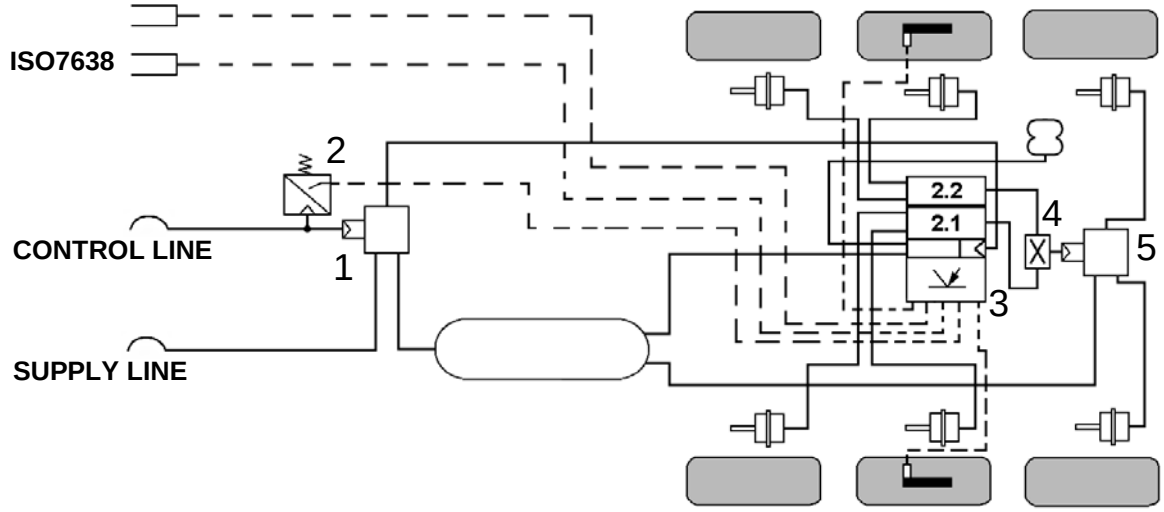
KEY:

1 - Trailer Control Module
2 - EB+ Gen1 Pressure Switch or Pressure Sensor (Option)
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, 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)

ISO1185 (Option)
(ISO12098 Alternative)



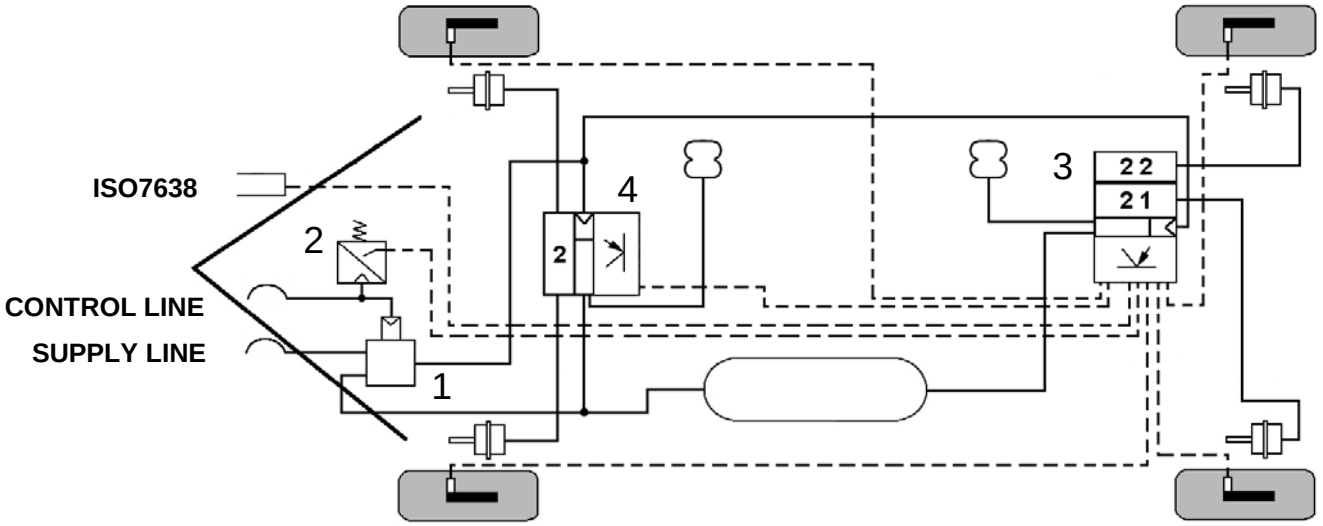
KEY:

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

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

4S/3M Integrated Full Trailer Installation

Side by Side Installation



R13 180535

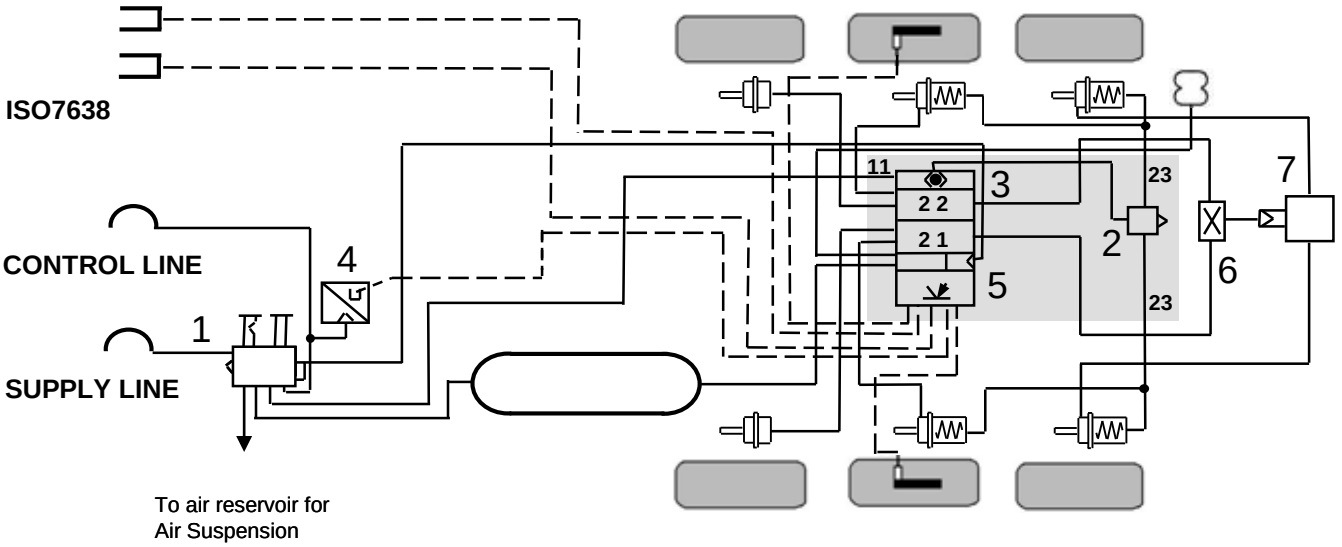
KEY:

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

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

2S/2M Semi or Centre Axle Trailer Installation with Select Low Valve and Relay Valve

ISO1185 (Option)
(ISO12098 Alternative)



R13 180535

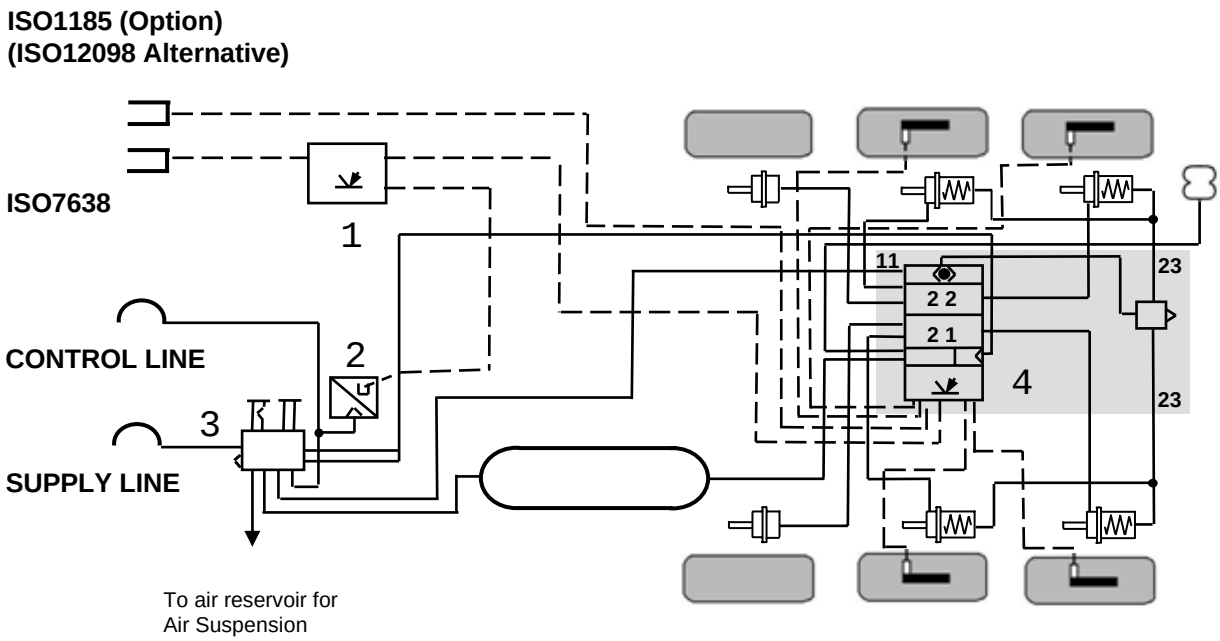
KEY:

1 - Trailer Control Module
2 - Integrated Quick Release Valve (Option)
3 - Integrated Double Check Valve (Option)
4 - EB+ Gen2 Pressure Sensor (Option)
5 - EBS Modulators & Electronic Control Unit
6 - Select Low Valve
7 - Relay Valve

EB+ CAN Repeater Installation Schematic

EXAMPLE ONLY

[Gen 2 4S/2M Semi or Centre Axle Trailer Installation with Trailer Control Module +]



KEY:
1 – EB+ CAN Repeater
2 – EB+ Pressure Sensor (Option)
3 – Trailer Control Module +
4 – Gen 2 Integrated Unit

Electric Only Truck Failure Comparison

Truck Interface	Faulty Electric Control	System Fault (normally leading to "Push-through")	Low Voltage	Low Pressure	Automatic braking
Dual Electric only (No Pneumatic) [Note: Not currently permitted]	Supply line braking request > Termination of ISO11992 Auto Braking using brake apply with ABS. Yellow lamp on Red lamp on if available	Supply line braking request > Termination of ISO11992 Auto Braking using brake apply with ABS. Yellow lamp on Red lamp on if available	Supply line braking request > Termination of ISO11992 (recoverable) Yellow lamp on Red lamp on if available	Braking maintained following driver demand Yellow + Red lamps on	Auto Braking using emergency function Red lamp on
Electric and Pneumatic [Current EBS Truck]	Use Pneumatic signal Yellow lamp on	Go to Push-through Yellow lamp on	Go to Push-through Yellow + Red lamps on	Braking maintained following driver demand Yellow + Red lamps on	Auto Braking using emergency function Red lamp on
Any other combination	Termination of ISO11992 Auto braking using brake apply with ABS if required and available Yellow lamp on				

Appendix 2

Electric Only Truck Failure Comparison

Truck Interface	Faulty Electric Control	System Fault (normally leading to "Push-through")	Low Voltage	Low Pressure	Automatic braking
Dual Electric only (No Pneumatic) [Note: Not currently permitted]	Supply line braking request > Termination of ISO11992 Auto Braking using brake apply with ABS. Yellow lamp on Red lamp on if available	Supply line braking request > Termination of ISO11992 Auto Braking using brake apply with ABS. Yellow lamp on Red lamp on if available	Supply line braking request > Termination of ISO11992 (recoverable) Yellow lamp on Red lamp on if available	Braking maintained following driver demand Yellow + Red lamps on	Auto Braking using emergency function Red lamp on
Electric and Pneumatic [Current EBS Truck]	Use Pneumatic signal Yellow lamp on	Go to Push-through Yellow lamp on	Go to Push-through Yellow + Red lamps on	Braking maintained following driver demand Yellow + Red lamps on	Auto Braking using emergency function Red lamp on
Any other combination	Termination of ISO11992 Auto braking using brake apply with ABS if required and available Yellow lamp on				

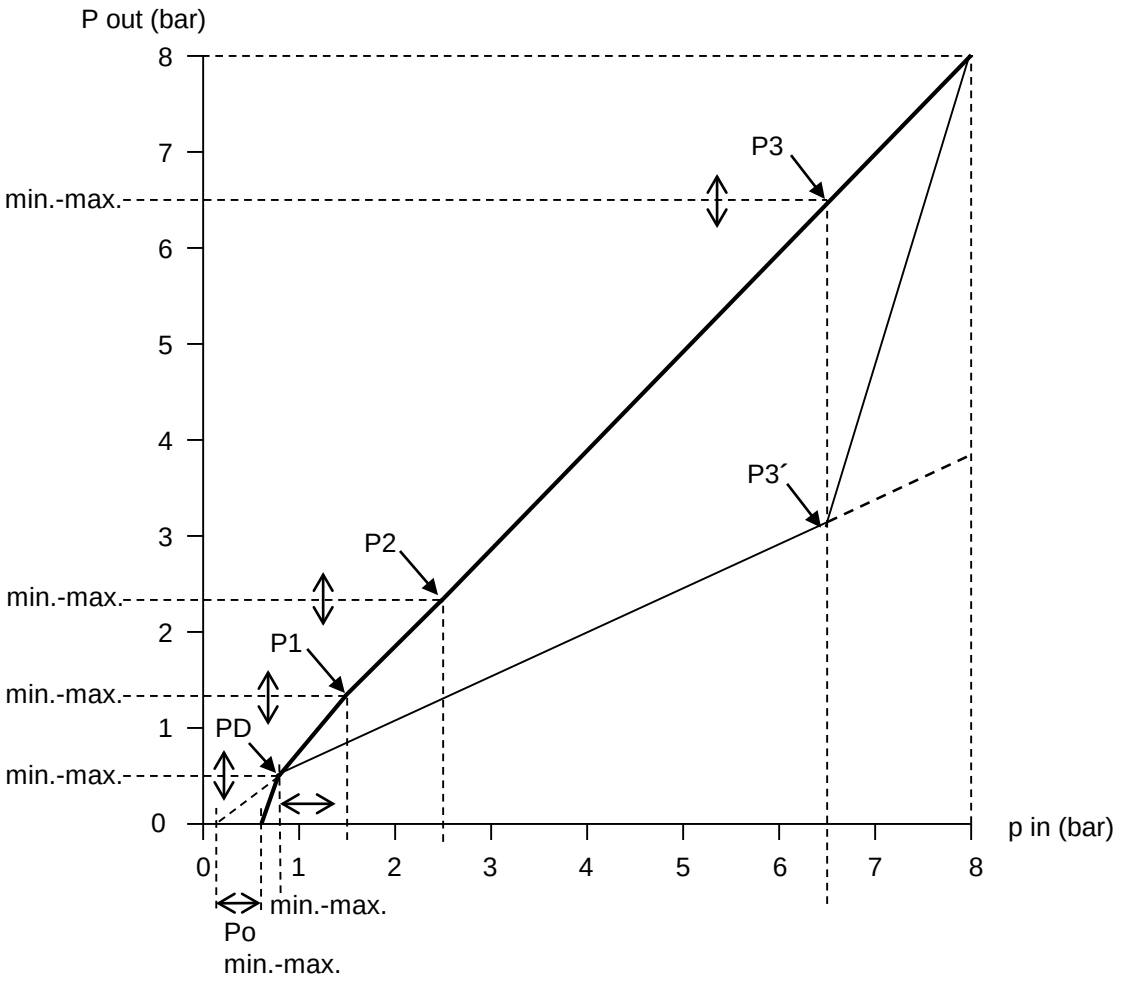
Appendix 2

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



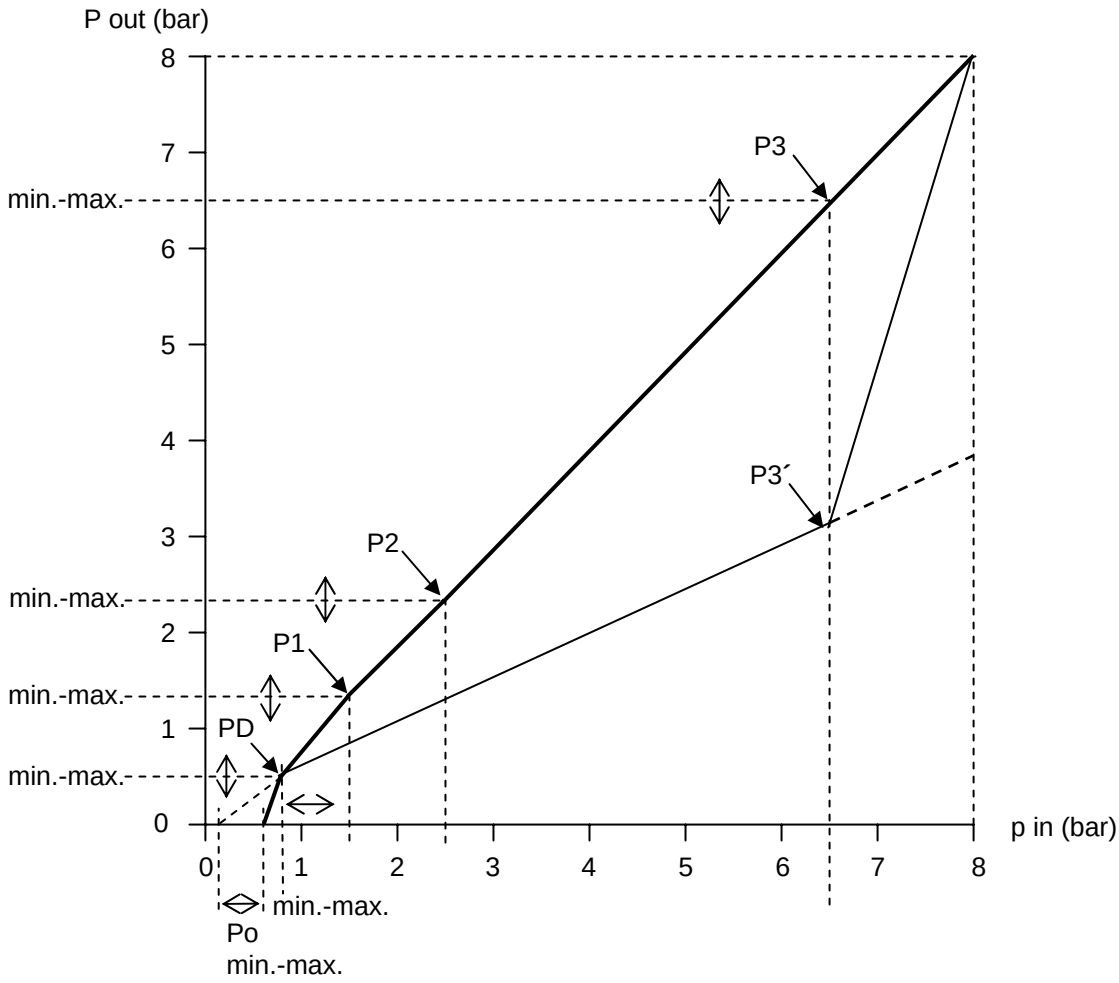
Appendix 3

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)	P'3 (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

Appendix 3

Example Full Trailer Load Plate

Haldex	EB+ ADR TÜ.EGG.094-04				4S/3M		S1A S1B	520mm 100t	S2A S2B	520mm 100t
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		Full			
THRESHOLD PRESSURE ANSPRECHDRUCK PRESSION D'APPROCHE [bar]	1 AXLE 1 ACHSE 1 ESSIEU	0.20	2/3 AXLE 2/3 ACHSE 2/3 ESSIEU	0.20	PRESSURE LIMIT DRUCKBEGRENZUNG LIMITE DE PRESSION [bar]		1 AXLE 1 ACHSE 1 ESSIEU	-	2/3 AXLE 2/3 ACHSE 2/3 ESSIEU	-
E11 13R - 123456	UNLADEN / LEER / A VIDE				LADEN / BELADEN / EN CHARGE					
	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]			
	INPUT PRESSURE EINGANGSDRUCK PRESSION D'ENTRÉE [bar]		6.50		INPUT PRESSURE EINGANGSDRUCK PRESSION D'ENTRÉE [bar]		0.70	-	-	6.50
1 AXLE 1 ACHSE 1 ESSIEU	3000	0.70	3.00		9000	5.00	0.50	-	-	6.50
	INPUT PRESSURE EINGANGSDRUCK PRESSION D'ENTRÉE [bar]		6.50		INPUT PRESSURE EINGANGSDRUCK PRESSION D'ENTRÉE [bar]		0.70	-	-	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]

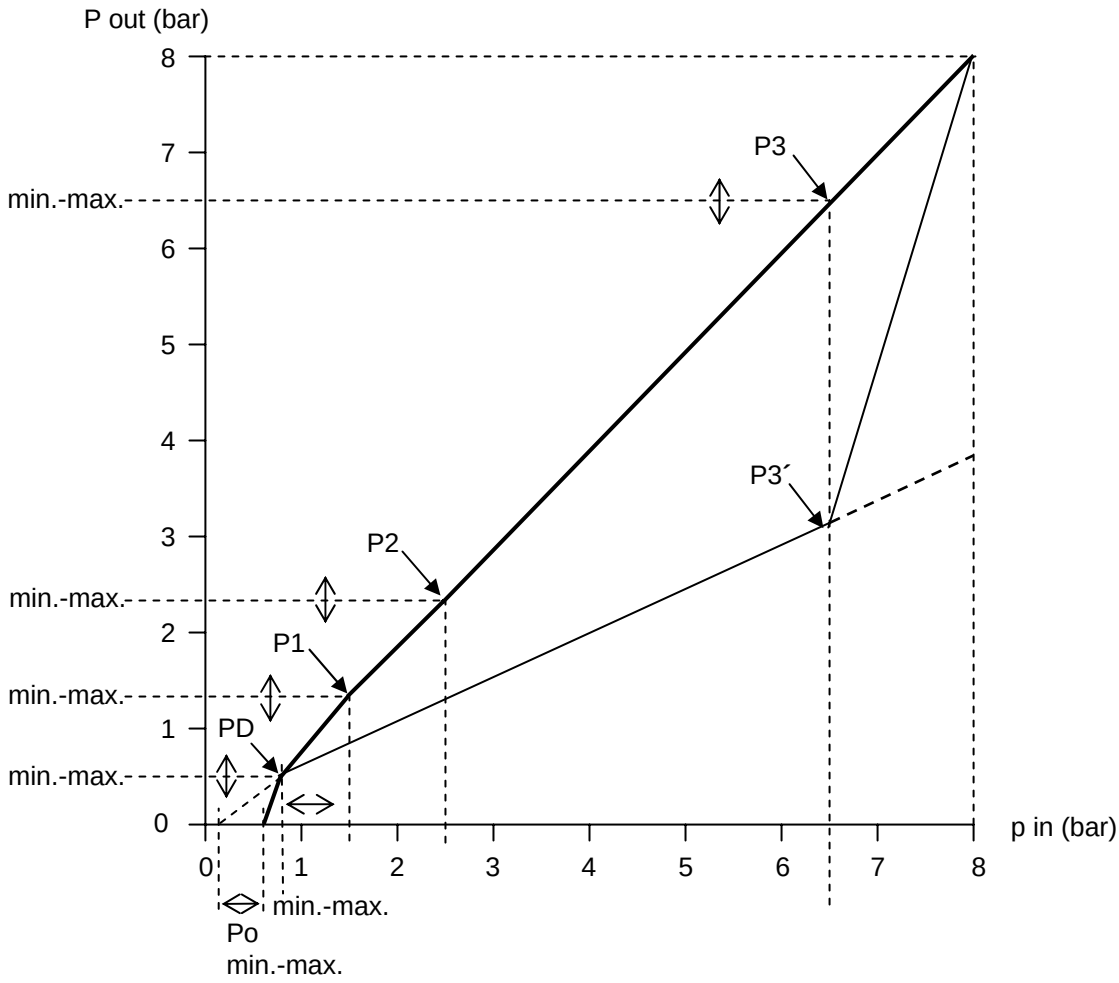
Appendix 3

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)	P'3 (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

Appendix 3

Example Full Trailer Load Plate

Haldex	EB+ ADR TÜ.EGG.094-04				4S/3M		S1A S1B	520mm 100t	S2A S2B	520mm 100t
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		Full			
THRESHOLD PRESSURE ANSPRECHDRUCK PRESSION D'APPROCHE [bar]	1 AXLE 1 ACHSE 1 ESSIEU	0.20	2/3 AXLE 2/3 ACHSE 2/3 ESSIEU	0.20	PRESSURE LIMIT DRUCKBEGRENZUNG LIMITE DE PRESSION [bar]		1 AXLE 1 ACHSE 1 ESSIEU	-	2/3 AXLE 2/3 ACHSE 2/3 ESSIEU	-
E11 13R - 123456	UNLADEN / LEER / A VIDE				LADEN / BELADEN / EN CHARGE					
	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]			
	INPUT PRESSURE EINGANGSDRUCK PRESSION D'ENTRÉE [bar]		6.50		INPUT PRESSURE EINGANGSDRUCK PRESSION D'ENTRÉE [bar]		0.70	-	-	6.50
1 AXLE 1 ACHSE 1 ESSIEU	3000	0.70	3.00		9000	5.00	0.50	-	-	6.50
	INPUT PRESSURE EINGANGSDRUCK PRESSION D'ENTRÉE [bar]		6.50		INPUT PRESSURE EINGANGSDRUCK PRESSION D'ENTRÉE [bar]		0.70	-	-	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]

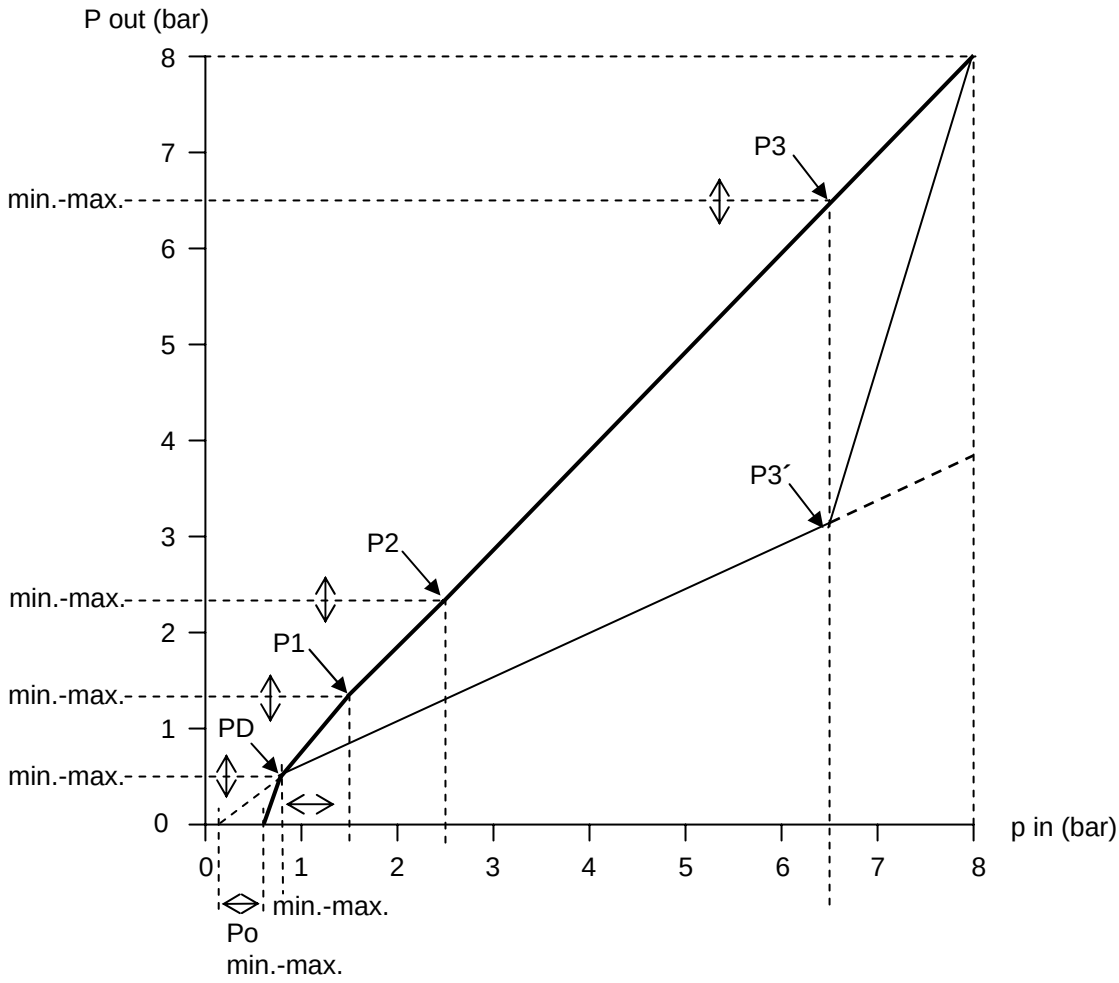
Appendix 3

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)	P'3 (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

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

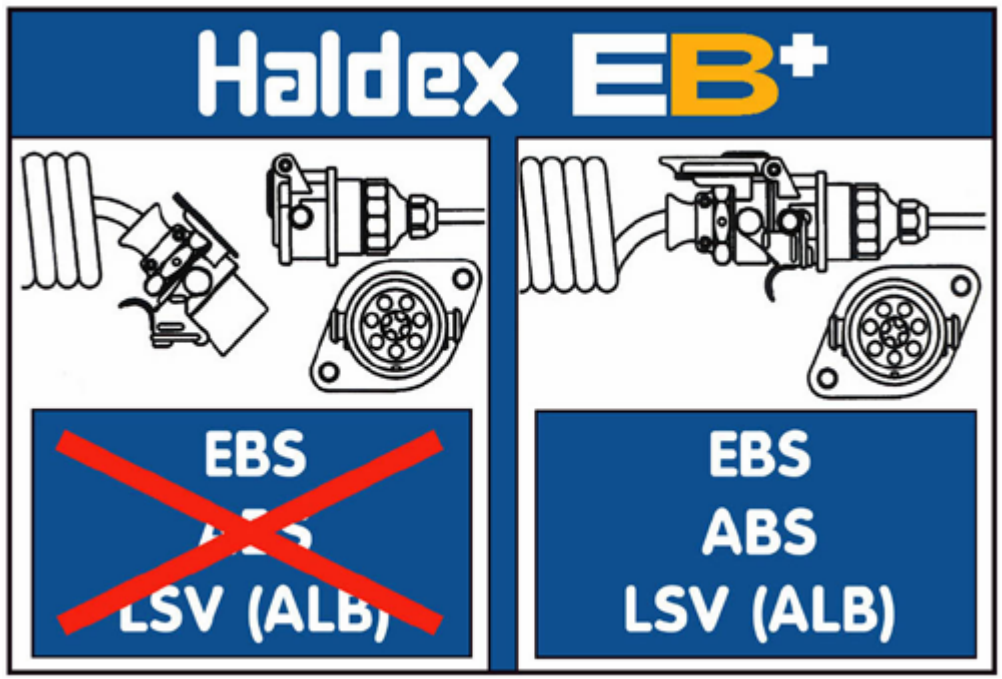
Points P3 and P3´ are both linked by straight lines to a common point at (8.0, 8.0). This means that at control line inputs above P3x, braking force enhancement is in effect in lower load conditions. At a control line input of 8.0 bar, the same brake force is available irrespective of load.

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

Headboard information ISO 7638 connection



Appendix 4

Supported ISO 11992-2 Messages

ISO 11992 – 2					
Messages EBS 11 (towing – towed) 10ms					
MESSAGE	**T/R**	**BYTE**	**BIT**	**DEFINITION**	**EB+**
EBS 11	R	1	1-2	ABS active/passive	
EBS 11	R	1	3-4	Vehicle retarder control active/passive	
EBS 11	R	1	5-6	ASR brake control active/passive	
EBS 11	R	1	7-8	ASR engine control active/passive	
EBS 11	R	2	1-2	Brake light switch	
EBS 11	R	2	3-4	Vehicle type	
EBS 11	R	2	5-6	VDC Active	
EBS 11	R	2	7-8	Not defined	
EBS 11	R	3-4		Service brake demand pressure value	✓
EBS 11	R	5		Park brake demand relative pressure value	
EBS 11	R	6		Retarder demand torque value	
EBS 11	R	7		Relative brake demand for left or front	
EBS 11	R	8		Relative brake demand for right or rear	

ISO 11992 – 2					
Message EBS 12 (towing – towed) 100ms					
MESSAGE	**T/R**	**BYTE**	**BIT**	**DEFINITION**	**EB+**
EBS 12	R	1	1-2	Vehicle retarder control active/passive	
EBS 12	R	1	3-4	ROP system enabled/disabled	
EBS 12	R	1	5-6	YC system enabled/disabled	
EBS 12	R	1	7-8	Not defined	
EBS 12	R	2	1-2	Enable/disable Trailer ROP system	
EBS 12	R	2	3-4	Enable/disable Trailer YC system	
EBS 12	R	2	5-6	Reverse gear status	
EBS 12	R	2	7-8	Emergency braking status	
EBS 12	R	3	1-2	Two electrical circuits brake demand status	✓
EBS 12	R	3	3-4	ABS off road switch on/off	
EBS 12	R	3	5-6	Pneumatic control line status	✓
EBS 12	R	3	7-8	Not defined	
EBS 12	R	4		Towing Vehicle Recognition	
EBS 12	R	5-6		Road curvature	
EBS 12	R	7-8		Wheel-based vehicle speed	

ISO 11992 – 2					
Message RGE 11 (towing – towed) 100ms					
MESSAGE	**T/R**	**BYTE**	**BIT**	**DEFINITION**	**EB+**
RGE 11	R	1	1-2	Ride height request	
RGE 11	R	1	3-4	Level change request, front axle	
RGE 11	R	1	5-6	Level change request, rear axle	
RGE 11	R	1	7-8	Traction help request	✓
RGE 11	R	2	1-2	Lift axle 1 position request	✓
RGE 11	R	2	3-4	Lift axle 2 position request	✓
RGE 11	R	2	5-6	Steering axle locking request	✓
RGE 11	R	2	7-8	Ramp level request	
RGE 11	R	3	1-2	Level control request	
RGE 11	R	3	3-4	Ramp level storage request	
RGE 11	R	3	5-6	Stop level change request	
RGE 11	R	3	7-8	Not defined	
RGE 11	R	4-5		Driven axle load	
RGE 11	R	6		Parking and trailer air pressure	
RGE 11	R	7		Auxiliary equipment supply pressure	
RGE 11	R	8	1-2	Lift axle 3 position request	
RGE 11	R	8	3-4	Lift axle 4 position request	
RGE 11	R	8	5-6	Lift axle 5 position request	
RGE 11	R	8	7-8	Ride height and ramp level request	

ISO 11992 – 2					
Message TD11 (towing – towed) 1000ms					
MESSAGE	**T/R**	**BYTE**	**BIT**	**DEFINITION**	**EB+**
TD 11	R	1		Seconds	
TD 11	R	2		Minutes	
TD 11	R	3		Hours	
TD 11	R	4		Month *	✓
TD 11	R	5		Day *	✓
TD 11	R	6		Year	
TD 11	R	7		Local Minute Offset	
TD 11	R	8		Local Hour Offset	

* As defined in ISO11992-2:2003 amendment 1 2007 [ISO11992-2:2014 is in error]

ISO 11992 – 2					
Message EBS 21 (towed - towing) 10ms					
MESSAGE	**T/R**	**BYTE**	**BIT**	**DEFINITION**	**EB+**
EBS 21	T	1	1-2	Vehicle ABS active/passive	✓
EBS 21	T	1	3-4	Vehicle retarder control active/passive	✓
EBS 21	T	1	5-6	Vehicle service brake active/passive	✓
EBS 21	T	1	7-8	Automatic towed vehicle brake active/passive	✓
EBS 21	T	2	1-2	VDC active	✓
EBS 21	T	2	3-4	Support of side- or axle-wise brake force distribution	
EBS 21	T	2	5-8	Not defined	
EBS 21	T	3-4		Wheel-based vehicle speed	✓
EBS 21	T	5		Actual percentage of the retarder torque	
EBS 21	T	6-7		Wheel speed difference main axle	✓
EBS 21	T	8		Lateral Acceleration	✓

ISO 11992 – 2					
Message EBS 22 (towed - towing) 100ms					
MESSAGE	**T/R**	**BYTE**	**BIT**	**DEFINITION**	**EB+**
EBS 22	T	1	1-2	Vehicle ABS active/passive	✓
EBS 22	T	1	3-4	Vehicle retarder control active/passive	✓
EBS 22	T	1	5-6	Vehicle service brake active/passive	✓
EBS 22	T	1	7-8	Automatic towed vehicle brake	✓
EBS 22	T	2	1-2	Vehicle electrical supply sufficient/insufficient	✓
EBS 22	T	2	3-4	Red warning signal request	✓
EBS 22	T	2	5-6	Amber warning signal request	✓
EBS 22	T	2	7-8	Electrical supply of non-braking system	
EBS 22	T	3	1-2	Spring brake installed	
EBS 22	T	3	3-4	Electric load proportional function	
EBS 22	T	3	5-6	Vehicle type	✓
EBS 22	T	3	7-8	Spring brake engaged	
EBS 22	T	4	1-2	Loading ramp approach assistance	✓
EBS 22	T	4	3-4	Supply line braking request	✓
EBS 22	T	4	5-6	Stop Lamp Request	✓
EBS 22	T	4	7-8	Braking via control line supported	✓
EBS 22	T	5-6		Axle load sum	✓
EBS 22	T	7-8		Reference retarder torque	

ISO 11992 – 2					
Message EBS 23 (towed - towing) 100ms					
MESSAGE	**T/R**	**BYTE**	**BIT**	**DEFINITION**	**EB+**
EBS 23	T	1	1-2	Tyre pressure sufficient/insufficient	✓
EBS 23	T	1	3-4	Brake lining sufficient/insufficient	✓
EBS 23	T	1	5-6	Brake temperature status	
EBS 23	T	1	7-8	Vehicle pneumatic supply sufficient/insufficient	✓
EBS 23	T	2		Tyre / wheel identification (pressure)	✓
EBS 23	T	3		Tyre / wheel identification (lining)	
EBS 23	T	4		Tyre / wheel identification (temperature)	
EBS 23	T	5		Tyre pressure	✓
EBS 23	T	6		Brake lining	
EBS 23	T	7		Brake temperature	
EBS 23	T	8		Pneumatic supply pressure	✓

ISO 11992 – 2					
Message EBS 24 (towed - towing) 1000ms					
MESSAGE	**T/R**	**BYTE**	**BIT**	**DEFINITION**	**EB+**
EBS 24	T	1		Geometric Data Index	✓
EBS 24	T	2		Geometric Data Indexed Content	✓
EBS 24	T	3	1-4	Towed vehicle detection status	
EBS 24	T	3	5-6	Vehicle combination ABS status	
EBS 24	T	3	7-8	Not defined	
EBS 24	T	4-8		Not defined	

ISO 11992 – 2					
Message EBS 25 (towed - towing) 50ms					
MESSAGE	**T/R**	**BYTE**	**BIT**	**DEFINITION**	**EB+**
EBS 25	T	1		Brake cylinder pressure first axle left wheel	✓
EBS 25	T	2		Brake cylinder pressure first axle right wheel	✓
EBS 25	T	3		Brake cylinder pressure second axle left wheel	✓
EBS 25	T	4		Brake cylinder pressure second axle right whl	✓
EBS 25	T	5		Brake cylinder pressure third axle left wheel	✓
EBS 25	T	6		Brake cylinder pressure third axle right wheel	✓
EBS 25	T	7	1-2	ROP enabled	✓
EBS 25	T	7	3-4	YAW control enabled	
EBS 25	T	7	5-6	External brake request status	
EBS 25	T	7	7-8	Not Defined	
EBS 25	T	8		Not Defined	

ISO 11992 – 2					
Message EBS 26 (towed - towing) 10ms (NOT TRANSMITTED)					
MESSAGE	**T/R**	**BYTE**	**BIT**	**DEFINITION**	**EB+**
EBS 26	T	1-2		Wheel speed first axle, left wheel	
EBS 26	T	3-4		Wheel speed first axle, right wheel	
EBS 26	T	5-8		Not defined	

ISO 11992 – 2					
Message RGE 21 (towed - towing) 100ms					
MESSAGE	**T/R**	**BYTE**	**BIT**	**DEFINITION**	**EB+**
RGE 21	T	1	1-2	Levelling control system, ride height level	
RGE 21	T	1	3-4	Level control	
RGE 21	T	1	5-6	Traction help	✓
RGE 21	T	1	7-8	Ramp level position	
RGE 21	T	2	1-2	Lift axle 1 position	✓
RGE 21	T	2	3-4	Lift axle 2 position	✓
RGE 21	T	2	5-6	Steering axle locking	✓
RGE 21	T	2	7-8	Not defined	
RGE 21	T	3	1-2	Ride height storage	
RGE 21	T	3	3-4	Ramp level storage	
RGE 21	T	3	5-6	Level change, front axle	
RGE 21	T	3	7-8	Level change, rear axle	
RGE 21	T	4	1-2	Stop level change acknowledge	
RGE 21	T	4	3-4	Normal level	
RGE 21	T	4	5-6	Ramp level	
RGE 21	T	4	7-8	Extended ride height and ramp level storage	
RGE 21	T	5-6		Nominal body level, front axle	
RGE 21	T	7-8		Nominal body level, rear axle	

ISO 11992 – 2					
Message RGE 22 (towed - towing) 100ms (NOT TRANSMITTED)					
MESSAGE	**T/R**	**BYTE**	**BIT**	**DEFINITION**	**EB+**
RGE 22	T	1-2		Relative body level, front axle	
RGE 22	T	3-4		Relative body level, rear axle	
RGE 22	T	5		Tyre/Wheel identification	
RGE 22	T	6-7		Axle Load	
RGE 22	T	8		Not defined	

ISO 11992 – 2					
Message RGE 23 (towed - towing) 1000ms					
MESSAGE	**T/R**	**BYTE**	**BIT**	**DEFINITION**	**EB+**
RGE 23	T	1		Tyre/wheel identification	✓
RGE 23	T	2-3		Tyre temperature	✓
RGE 23	T	4-5		Air leakage detection	
RGE 23	T	6	1-3	Tyre pressure threshold detection	✓
RGE 23	T	6	4-5	Tyre module power supply	✓
RGE 23	T	6	6-8	Not defined	
RGE 23	T	7		VIN data index	✓*
RGE 23	T	8		VIN data content	✓*

***** Added in ISO11992-2:2014

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)

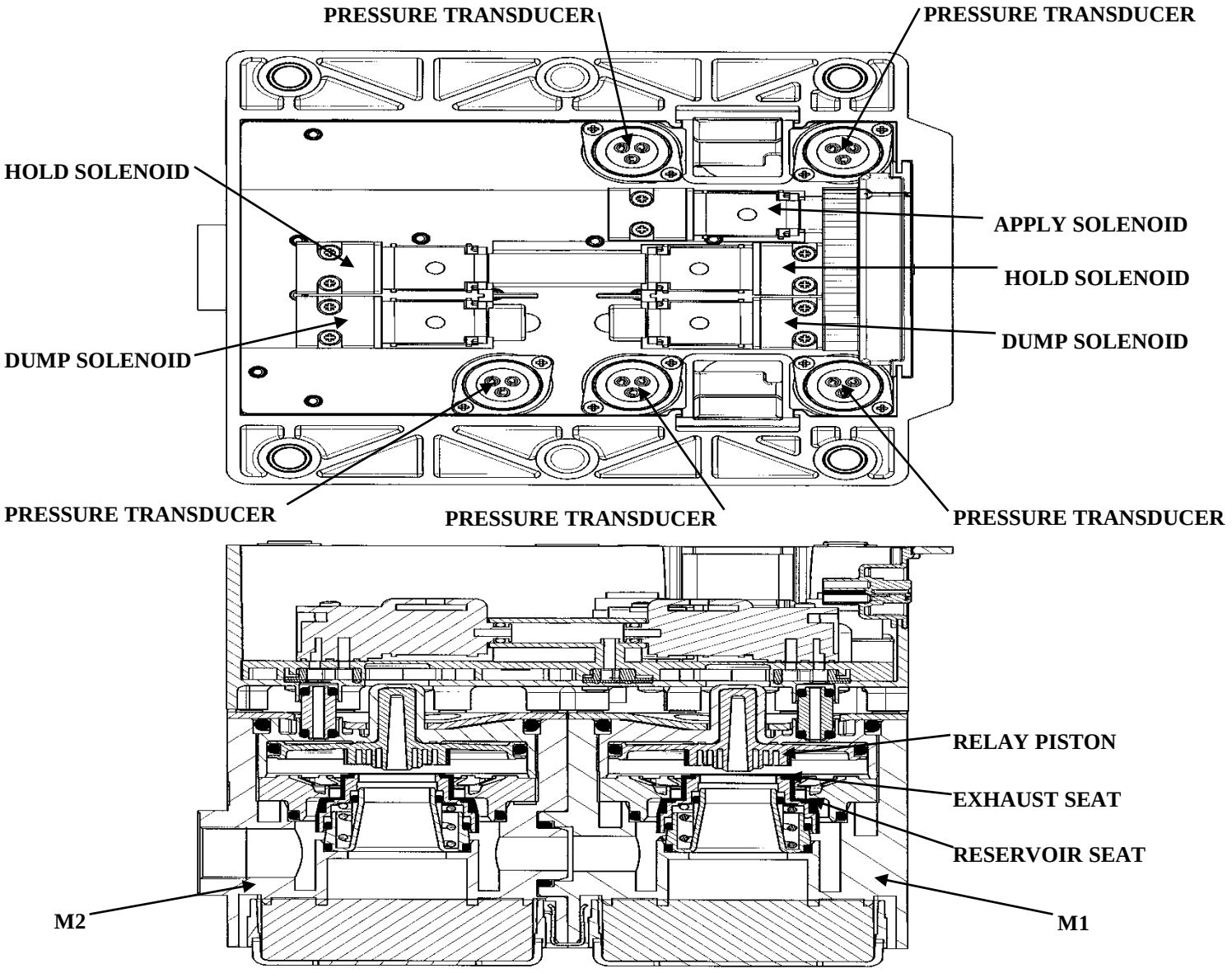
N/A Not Applicable - The system continues to function and no recovery required.
* Where installed.
(1) If fitted.
(2) Full trailer 3M systems only.
(3) Assume cab lamp on ISO7638 pin 5 not connected. If ISO7638 pin 5 still connected then cab lamp will be on. If trailer lamp option fitted then trailer 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)

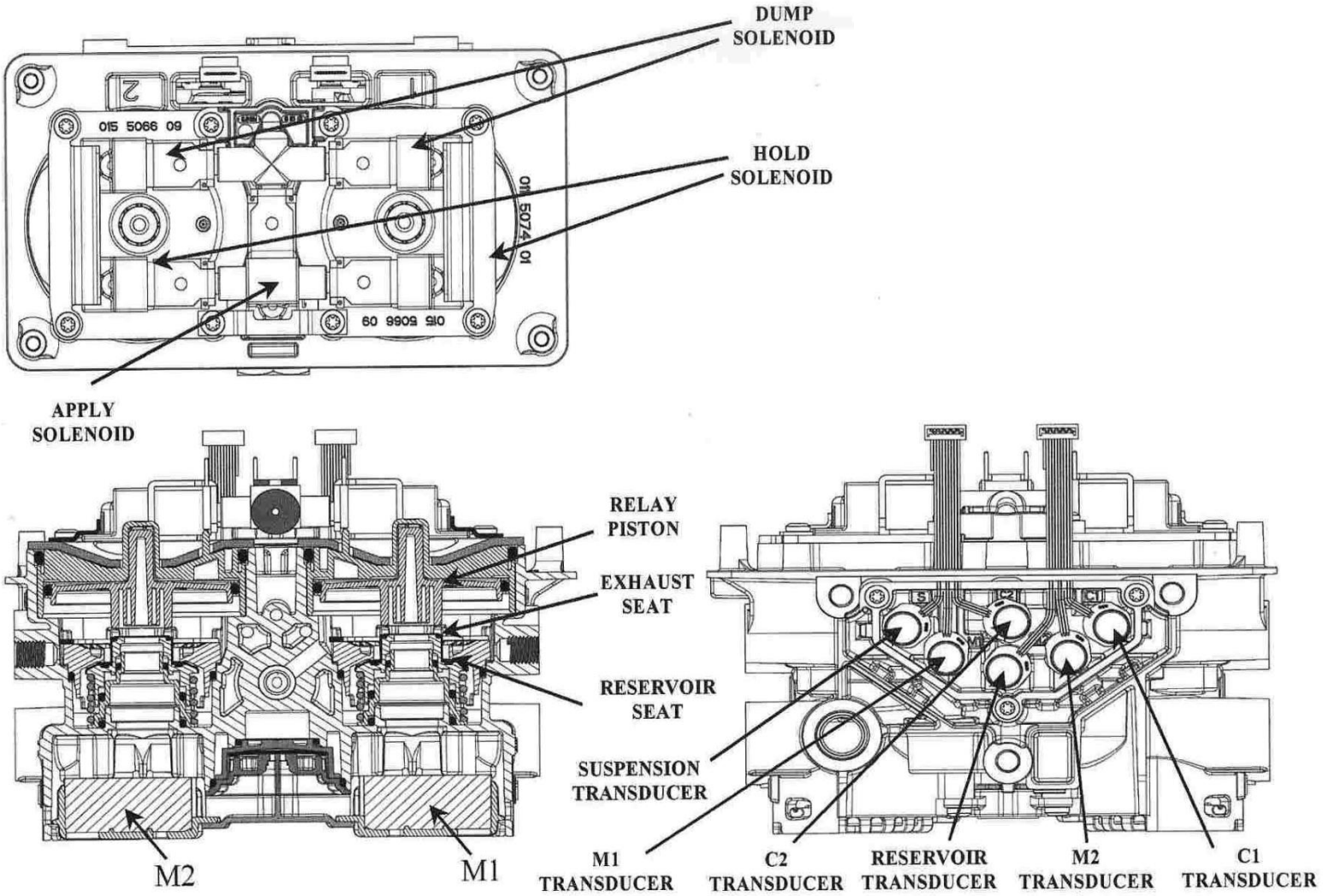
N/A Not applicable – The system continues to function and no recovery required.
(1) If fitted.
(2) Assume cab lamp on ISO7638 pin 5 not connected. If ISO7638 pin 5 still connected then cab lamp will be on. If trailer lamp option fitted then trailer lamp will be on when brakes applied.
(3) In the case 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.

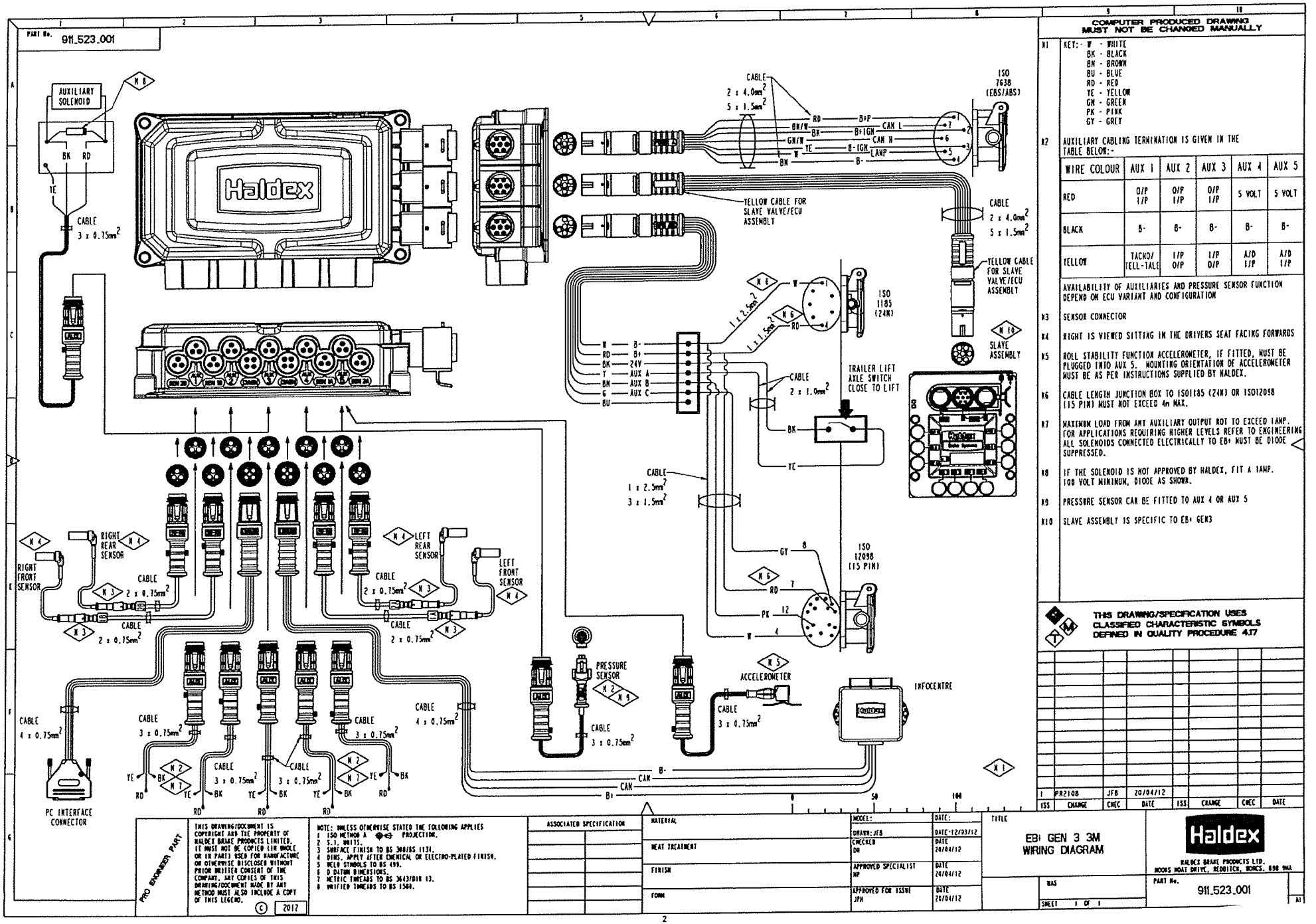
Cross-section EB+ Gen 1 Valve Assembly



R13 180535

Cross–Section EB+ Gen2 and Gen3 Valve Assembly




PART No. 911_523_001
COMPUTER PRODUCED DRAWING MUST NOT BE CHANGED MANUALLY
AUXILIARY SOLENOID
N 8
BK
RD
YE
CABLE 3 x 0.75mm²
Haldex
CABLE 2 x 4.0mm² 5 x 1.5mm²
RD B+P
BK/W CAN L
BK B-IGN
GN/W CAN H
YE B-IGN
W LAMP
BN B-
ISO 7638 (EBS/ABS)
YELLOW CABLE FOR SLAVE VALVE/ECU ASSEMBLY
CABLE 2 x 4.0mm² 5 x 1.5mm²
YELLOW CABLE FOR SLAVE VALVE/ECU ASSEMBLY
N 10
SLAVE ASSEMBLY
N 6
W
RD
1 x 2.5mm²
1 x 1.5mm²
ISO 11185 (24N)
W B-
RD B+
BK 24V
Y AUX A
BN AUX B
G AUX C
BU
TRAILER LIFT AXLE SWITCH CLOSE TO LIFT
CABLE 2 x 1.0mm²
BK
YE
CABLE 1 x 2.5mm² 3 x 1.5mm²
GY 8
RD 7
PK 12
W 4
ISO 12098 (15 PIN)
N 6
RIGHT FRONT SENSOR
N 4
RIGHT REAR SENSOR
N 4
CABLE 2 x 0.75mm²
N 3
LEFT REAR SENSOR
N 4
LEFT FRONT SENSOR
N 4
CABLE 2 x 0.75mm²
N 3
CABLE 2 x 0.75mm²
N 3
CABLE 2 x 0.75mm²
N 3
PRESSURE SENSOR
N 2
N 9
CABLE 3 x 0.75mm²
N 5
ACCELEROMETER
CABLE 3 x 0.75mm²
INFOCENTRE
N 1
CABLE 4 x 0.75mm²
PC INTERFACE CONNECTOR
CABLE 3 x 0.75mm²
CABLE 3 x 0.75mm²
CABLE 3 x 0.75mm²
CABLE 4 x 0.75mm²
N 2
N 1
B-
CAN
CAN
B+
0
50
100
KEY:- W - WHITE
BK - BLACK
BN - BROWN
BU - BLUE
RD - RED
YE - YELLOW
GN - GREEN
PK - PINK
GY - GREY
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 ISO11185 (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
N10 SLAVE ASSEMBLY IS SPECIFIC TO EB+ GEN3
THIS DRAWING/SPECIFICATION USES CLASSIFIED CHARACTERISTIC SYMBOLS DEFINED IN QUALITY PROCEDURE 4.17
ISS CHANGE CHEC DATE
1 PR2108 JFB 20/04/12
PRO ENGINEER PART
THIS DRAWING/DOCUMENT IS COPYRIGHT AND THE PROPERTY OF HALDEX BRAKE PRODUCTS LIMITED. IT MUST NOT BE COPIED (IN WHOLE OR IN PART) USED FOR MANUFACTURE OR OTHERWISE DISCLOSED WITHOUT PRIOR WRITTEN CONSENT OF THE COMPANY. ANY COPIES OF THIS DRAWING/DOCUMENT MADE BY ANY METHOD MUST ALSO INCLUDE A COPY OF THIS LEGEND.
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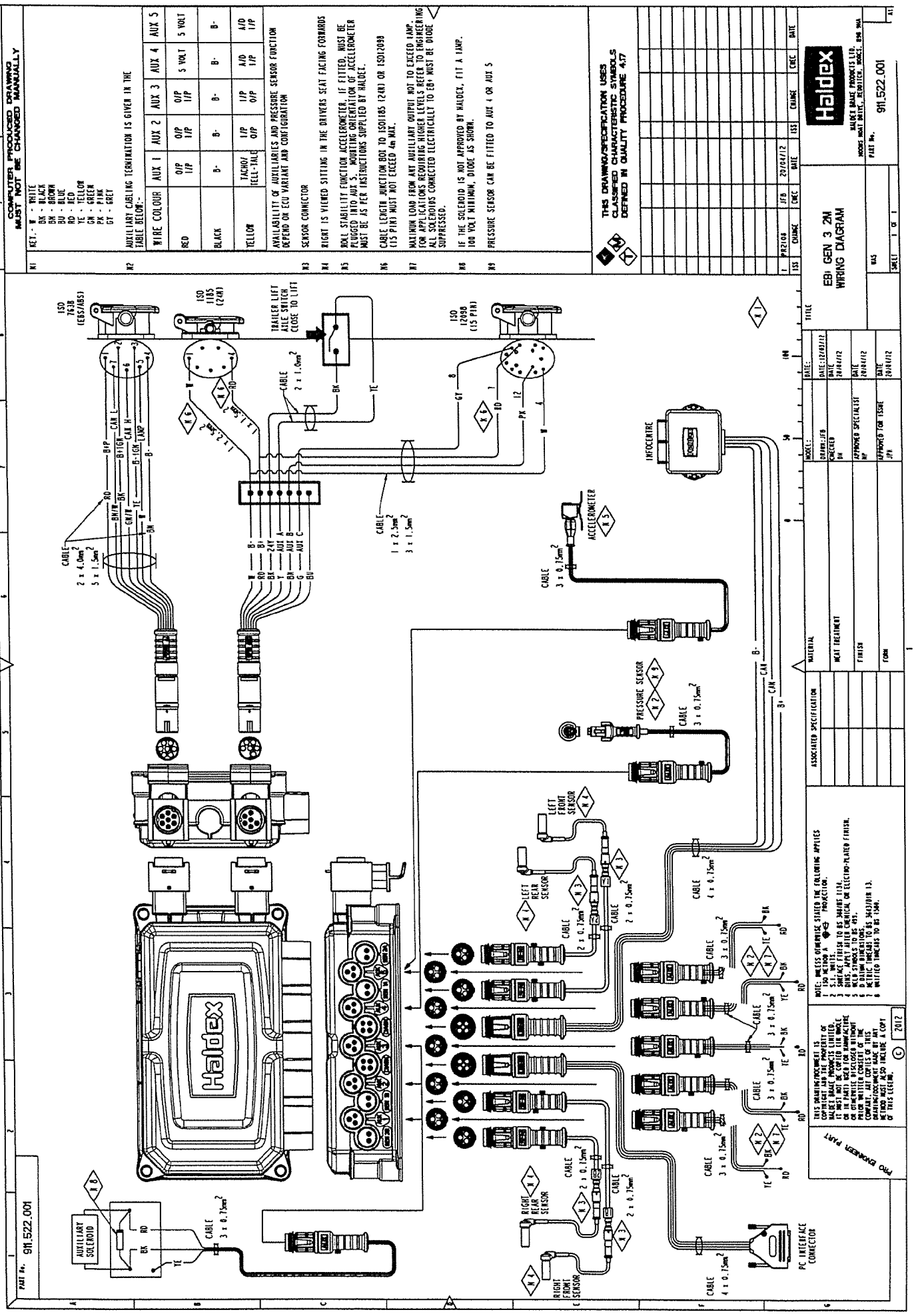
NOTE: UNLESS OTHERWISE STATED THE FOLLOWING APPLIES
1 ISO METHOD A PROJECTION.
2 S.I. UNITS.
3 SURFACE FINISH TO BS 308/BS 1134.
4 DIMS. APPLY AFTER CHEMICAL OR ELECTRO-PLATED FINISH.
5 WELD SYMBOLS TO BS 499.
6 0 DATUM DIMENSIONS.
7 METRIC THREADS TO BS 3643/DIN 13.
8 UNIFIED THREADS TO BS 1580.
ASSOCIATED SPECIFICATION
MATERIAL
HEAT TREATMENT
FINISH
FORM
MODEL:
DRAWN: JFB DATE: 20/03/12
CHECKED DR DATE 20/04/12
APPROVED SPECIALIST MP DATE 20/04/12
APPROVED FOR ISSUE JPH DATE 20/04/12
TITLE
EB+ GEN 3 3M WIRING DIAGRAM
Haldex
HALDEX BRAKE PRODUCTS LTD. HOOKS HOAT DRIVE, REDDITCH, WORCS. B98 9HA
WAS
SHEET 1 OF 1
PART No. 911_523_001
A1


COMPUTER PRODUCED DRAWING
MUST NOT BE CHANGED MANUALLY
KEY:- W - WHITE
BK - BLACK
BR - BROWN
BU - BLUE
RD - RED
YE - YELLOW
GN - GREEN
PK - PINK
GY - GREY
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
SENSOR CONNECTOR
RIGHT IS VIEWED SITTING IN THE DRIVERS SEAT FACING FORWARDS
ROLL STABILITY FUNCTION ACCELEROMETER, IF FITTED, MUST BE PLUGGED INTO AUX 5. MOUNTING ORIENTATION OF ACCELEROMETER MUST BE AS PER INSTRUCTIONS SUPPLIED BY HALDEX.
CABLE LENGTH JUNCTION BOX TO ISO1185 (24N) OR ISO12098 (15 PIN) MUST NOT EXCEED 4m MAX.
MAXIMUM LOAD FROM ANY AUXILIARY OUTPUT NOT TO EXCEED 1AMP. FOR APPLICATIONS REQUIRING HIGHER LEVELS REFER TO ENGINEERING ALL SOLENOIDS CONNECTED ELECTRICALLY TO 'CB+' MUST BE DIODE SUPPRESSED.
IF THE SOLENOID IS NOT APPROVED BY HALDEX, FIT A 1AMP. 100 VOLT MINIMUM, DIODE AS SHOWN.
PRESSURE SENSOR CAN BE FITTED TO AUX 4 OR AUX 5
THIS DRAWING/SPECIFICATION USES CLASSIFIED CHARACTERISTIC SYMBOLS DEFINED IN QUALITY PROCEDURE 4.17
EBS GEN 3 2M
WIRING DIAGRAM
Haldex
PART No. 911.522.001
ISO 7638 (EBS/ABS)
ISO 1185 (24N)
ISO 12098 (15 PIN)
TRAILER LIFT AXLE SWITCH CLOSE TO LIFT
CABLE 2 x 4.0mm² 5 x 1.5mm²
CABLE 1 x 2.5mm² 3 x 1.5mm²
CABLE 2 x 1.0mm²
CABLE 3 x 0.75mm²
CABLE 4 x 0.75mm²
CAN L
CAN H
B-IGN
L-LAMP
INFOCENTRE
ACCELEROMETER
PRESSURE SENSOR
LEFT FRONT SENSOR
LEFT REAR SENSOR
RIGHT REAR SENSOR
RIGHT FRONT SENSOR
AUXILIARY SOLENOID
PC INTERFACE CONNECTOR
ASSOCIATED SPECIFICATION
MATERIAL
HEAT TREATMENT
FINISH
NOTE: UNLESS OTHERWISE STATED THE FOLLOWING APPLIES
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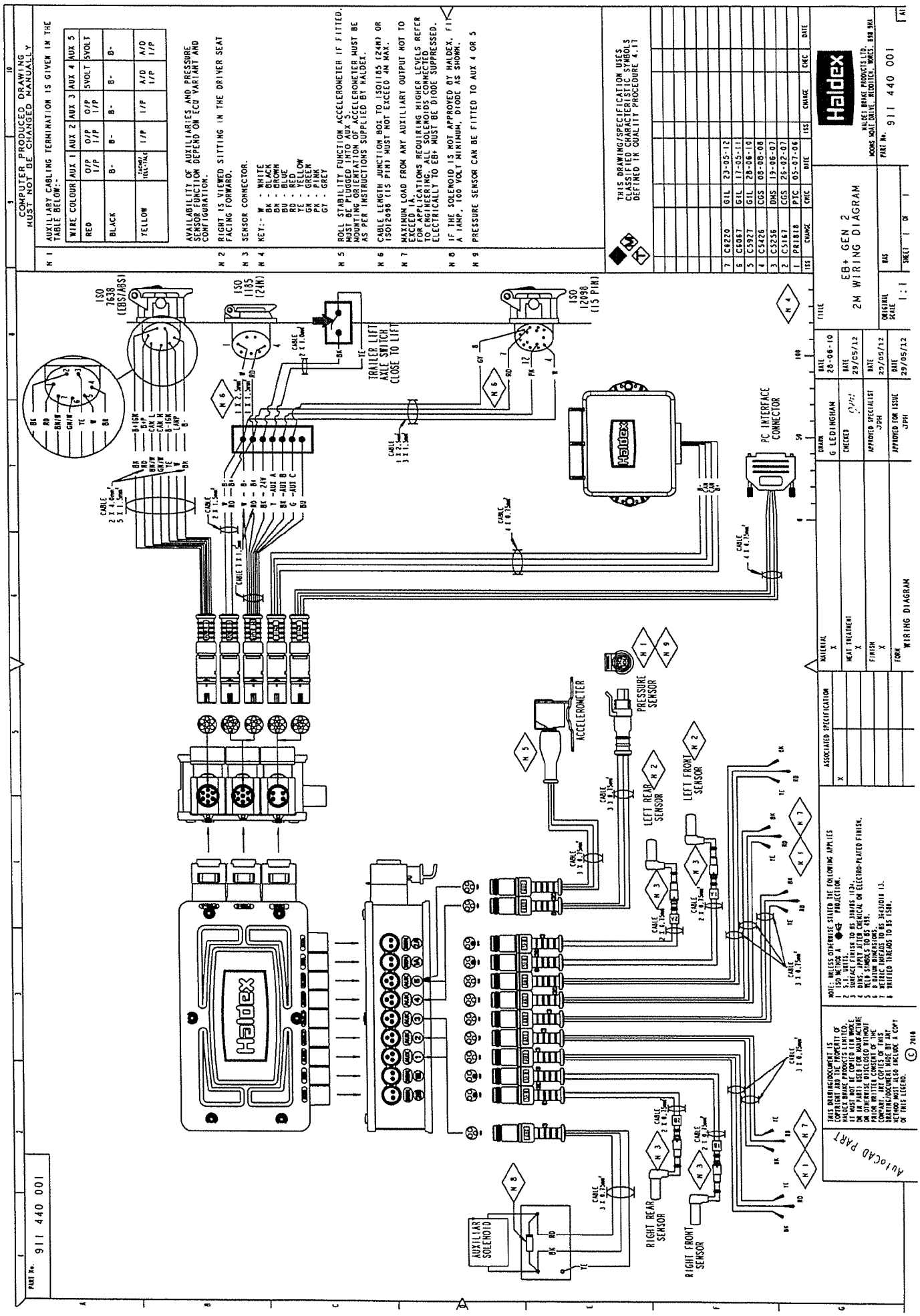
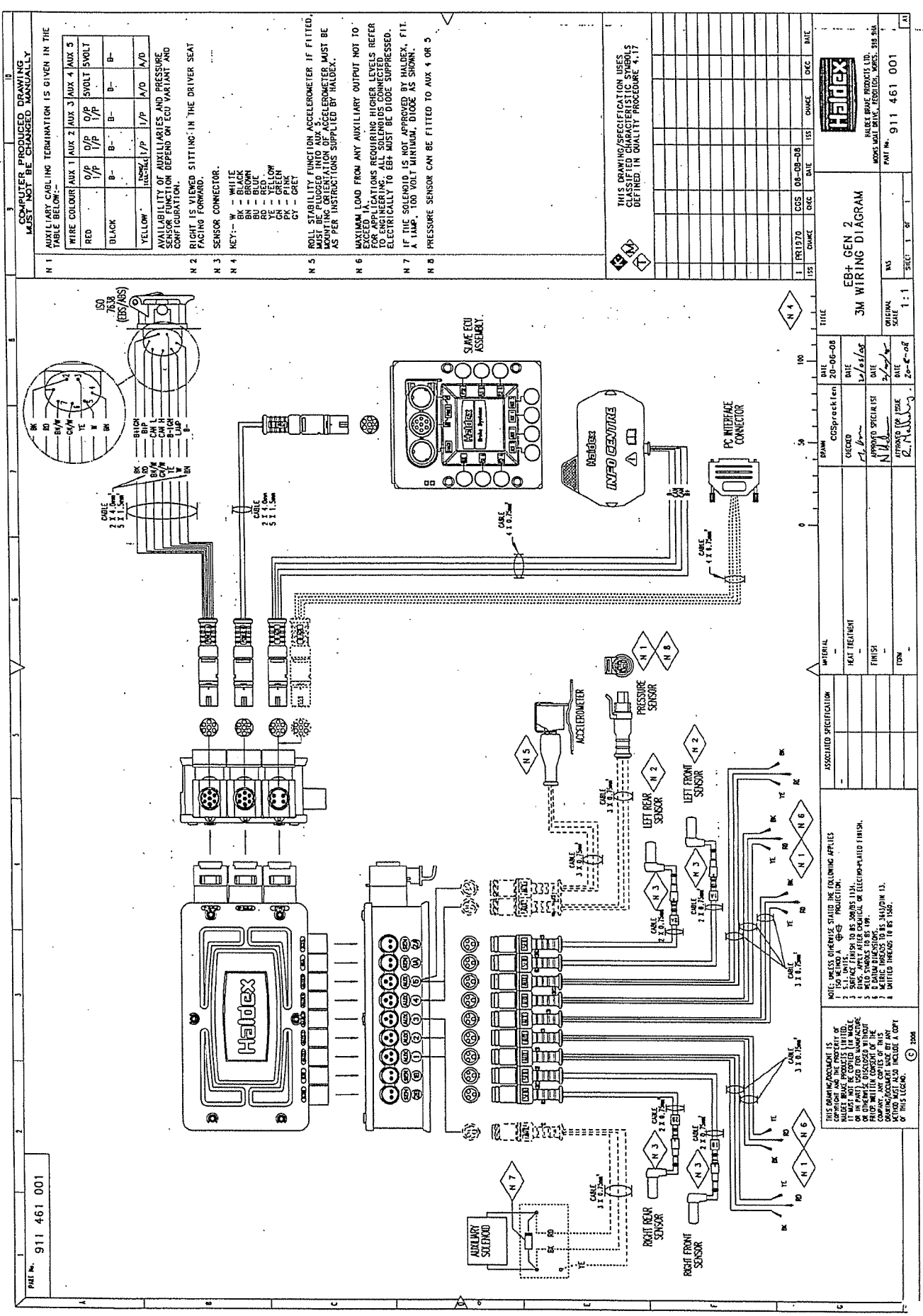
PRO ENGINEER PART
HALDEX BRAKE PRODUCTS LTD. MOORS ROAD DROITWICH, WORCS. WR9 9AA


COMPUTER PRODUCED DRAWING
MUST NOT BE CHANGED MANUALLY
AUXILIARY CABLING TERMINATION IS GIVEN IN THE TABLE BELOW:-
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.
CABLE LENGTH JUNCTION BOX TO ISO11105 (24W) OR ISO12098 (15 PIN) MUST NOT EXCEED 4M MAX.
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.
IF THE SOLENOID IS NOT APPROVED BY HALDEX, FIT A 1AMP, 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
2M WIRING DIAGRAM
PART No. 911 440 001
ISO 7638 (EBS/ABS)
ISO 1185 (24N)
ISO 12098 (15 PIN)
TRAILER LIFT AXLE SWITCH CLOSE TO LIFT
PC INTERFACE CONNECTOR
ACCELEROMETER
PRESSURE SENSOR
LEFT REAR SENSOR
LEFT FRONT SENSOR
RIGHT REAR SENSOR
RIGHT FRONT SENSOR
AUXILIARY SOLENOID
WIRING DIAGRAM
AutoCAD PART


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/O | A/O
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 1AMP, 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
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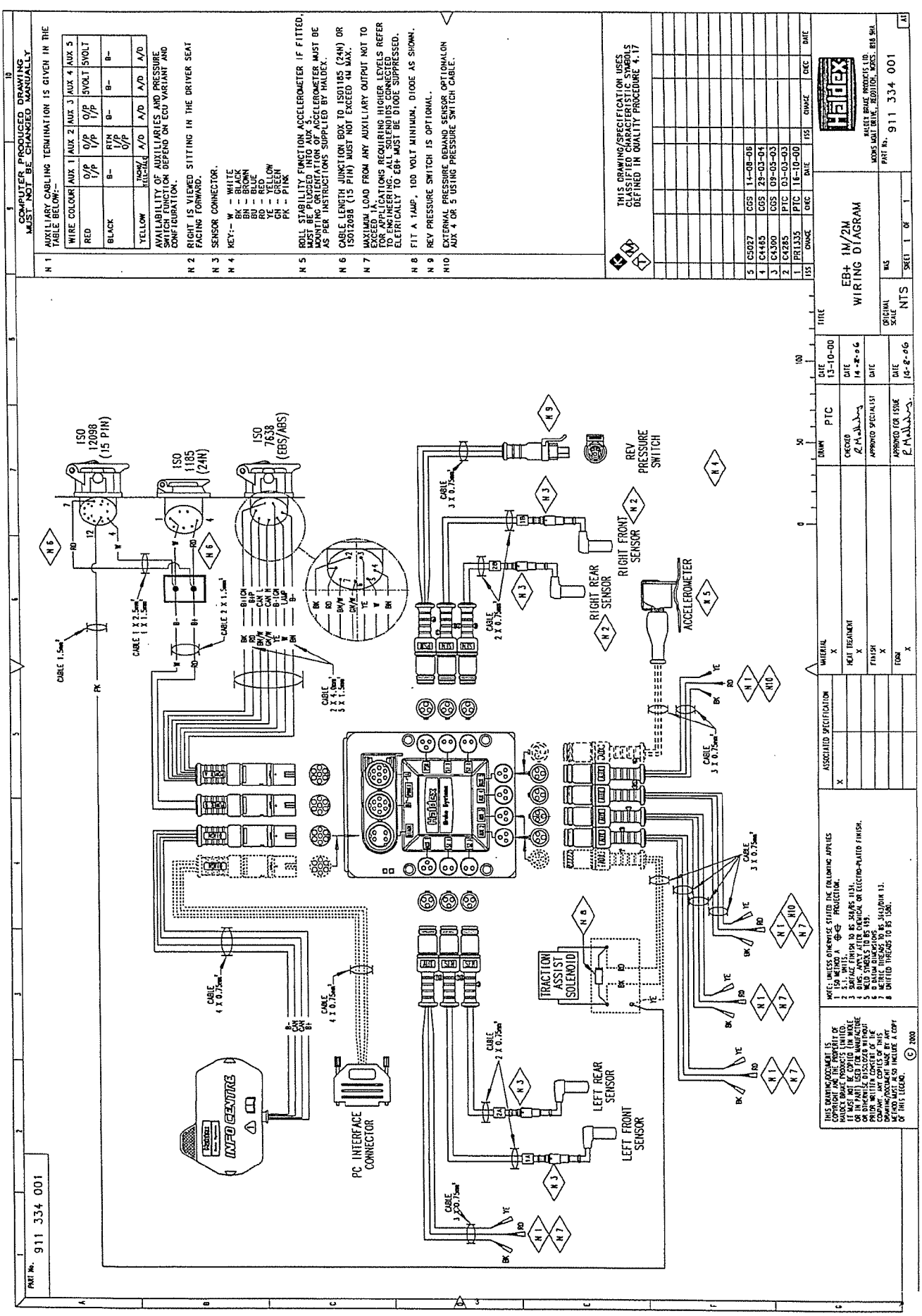
COMPUTER PRODUCED DRAWING
MUST NOT BE CHANGED MANUALLY
N 1 AUXILIARY CABLING TERMINATION IS GIVEN IN THE TABLE BELOW:-
WIRE COLOUR | AUX 1 | AUX 2 | AUX 3 | AUX 4 | AUX 5
RED | O/P I/P | O/P I/P | O/P I/P | 5VOLT | 5VOLT
BLACK | B- | RTN I/P O/P | B- | B- | B-
YELLOW | 74HK/ KELL-MAG | A/D | A/D | A/D | 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
PK - PINK
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 1M MAX.
N 7 MAXIMUM LOAD FROM ANY AUXILIARY OUTPUT NOT TO EXCEED 1A.
FOR APPLICATIONS REQUIRING HIGHER LEVELS REFER TO APPLICATION GUIDE.
ALL COILS MUST BE DIODE SUPPRESSED.
ELECTRICALLY TO EB+ MUST BE DIODE SUPPRESSED.
N 8 FIT A 1AMP, 100 VOLT MINIMUM, DIODE AS SHOWN.
N 9 REV PRESSURE SWITCH IS OPTIONAL.
N10 EXTERNAL PRESSURE DEMAND SENSOR OPTIONALON AUX 4 OR 5 USING PRESSURE SWITCH CABLE.
THIS DRAWING/SPECIFICATION USES CLASSIFIED CHARACTERISTIC SYMBOLS DEFINED IN QUALITE PROCEDURE 4.17
ISO 12098 (15 PIN)
ISO 1185 (24N)
ISO 7638 (EBS/ABS)
REV PRESSURE SWITCH
RIGHT FRONT SENSOR
RIGHT REAR SENSOR
ACCELEROMETER
TRACTION ASSIST SOLENOID
LEFT REAR SENSOR
LEFT FRONT SENSOR
PC INTERFACE CONNECTOR
INFO CENTRE
EB+ 1M/2M WIRING DIAGRAM
PART No. 911 334 001
HALDEX BRAKE PRODUCTS LTD
WORKS ROAD DRIVE, REDDITCH, WORCS. B98 9HA
DRAWN PTC
CHECKED
APPROVED SPECIALIST
APPROVED FOR ISSUE
ORIGINAL SCALE NTS
SHEET 1 OF 1
ASSOCIATED SPECIFICATION
MATERIAL
HEAT TREATMENT
FINISH
TOGGI
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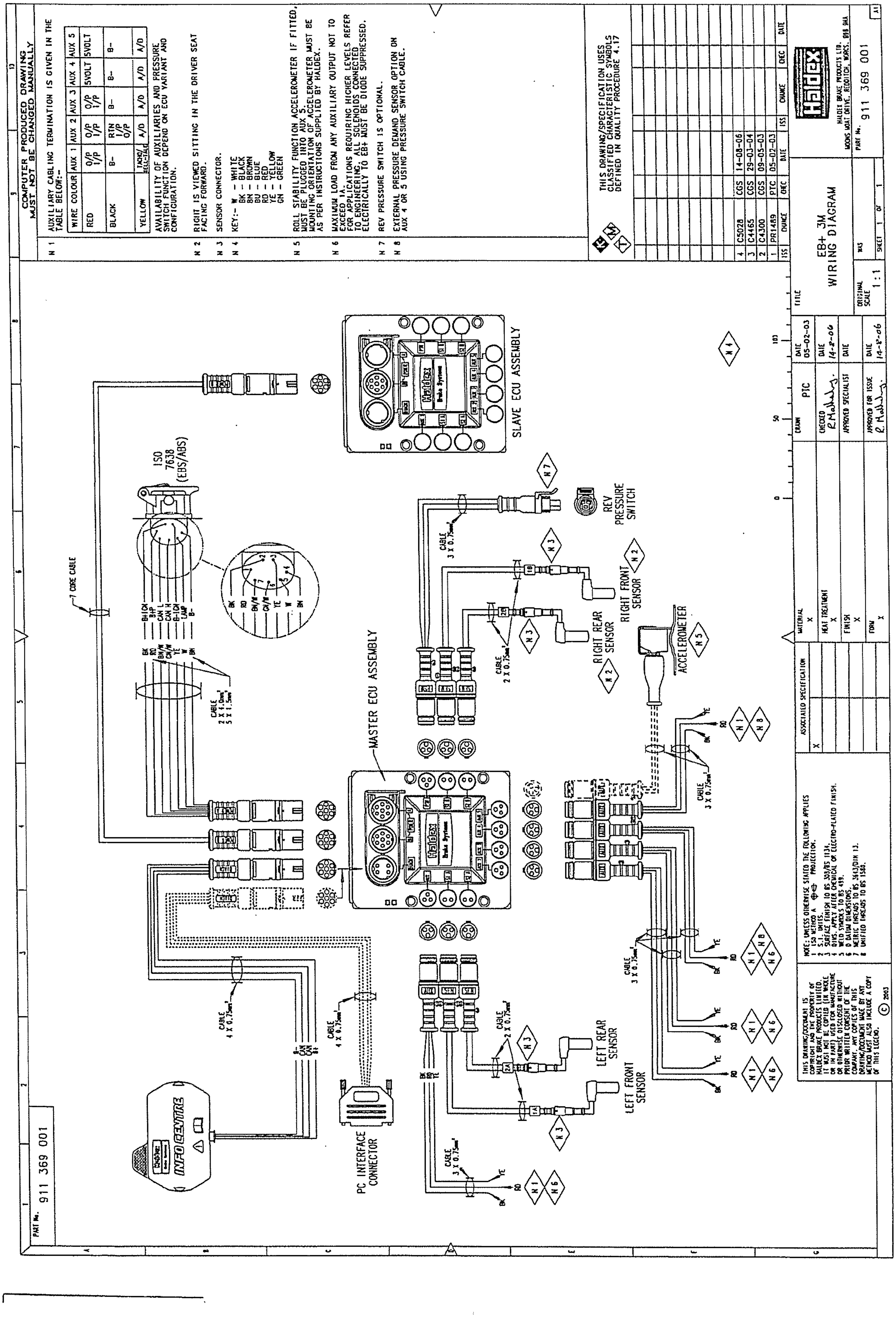
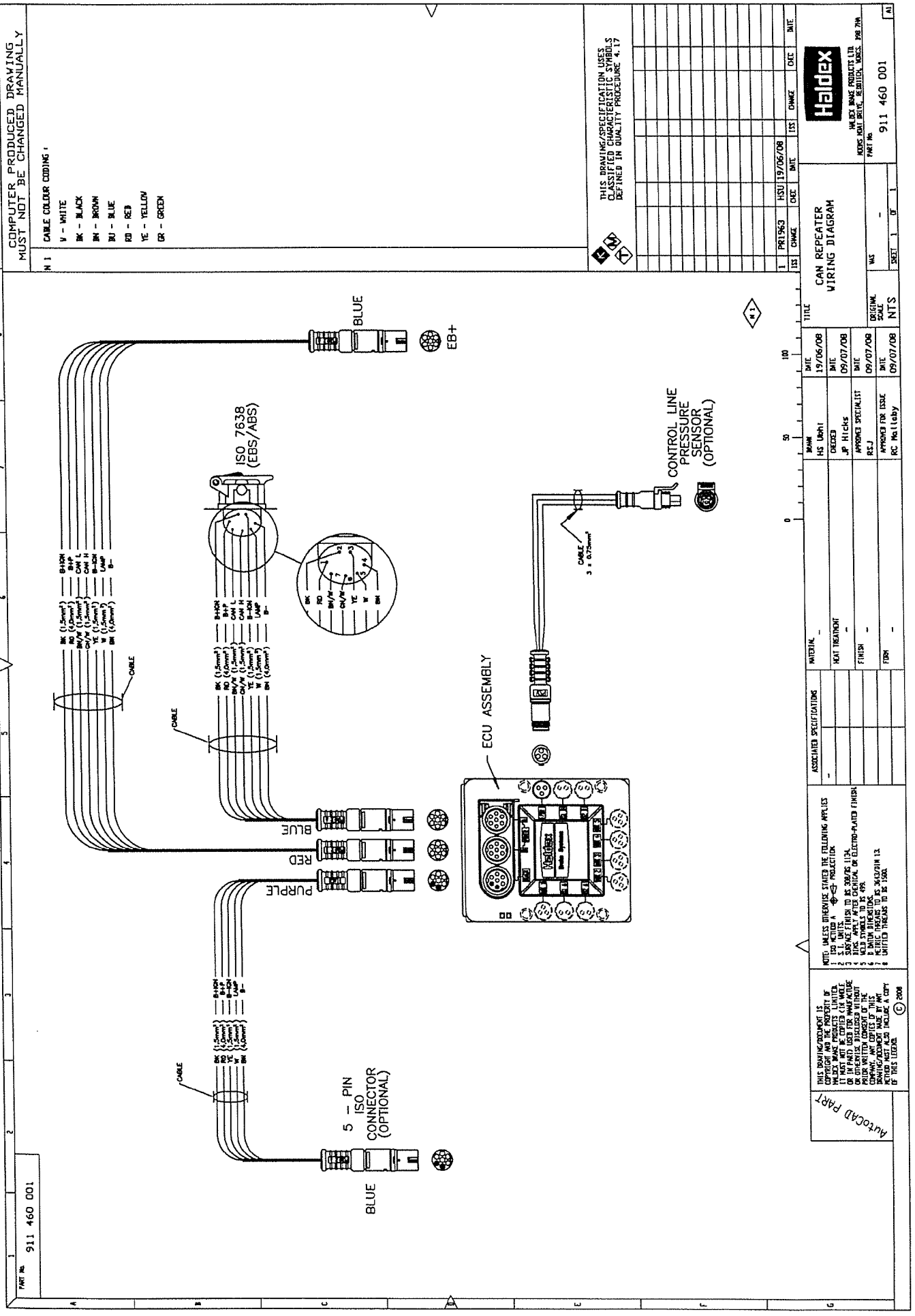
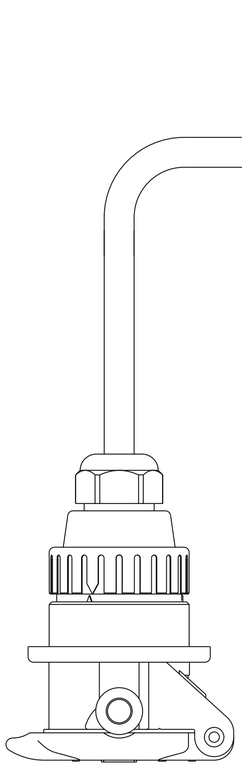

COMPUTER PRODUCED DRAWING MUST NOT BE CHANGED MANUALLY
N 1 AUXILIARY CABLING TERMINATION IS GIVEN IN THE TABLE BELOW:-
WIRE COLOUR | AUX 1 | AUX 2 | AUX 3 | AUX 4 | AUX 5
RED | O/P | O/P I/P | O/P I/P | 5VOLT | 5VOLT
BLACK | B- | RTN I/P O/P | B- | B- | B-
YELLOW | TACHO/ SELL-TALE | A/D | A/D | A/D | 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
ISO 7638 (EBS/ABS)
7 CORE CABLE
SLAVE ECU ASSEMBLY
MASTER ECU ASSEMBLY
REV PRESSURE SWITCH
RIGHT FRONT SENSOR
RIGHT REAR SENSOR
ACCELEROMETER
LEFT REAR SENSOR
LEFT FRONT SENSOR
PC INTERFACE CONNECTOR
INFO CENTRE
TITLE EB+ 3M WIRING DIAGRAM
ORIGINAL SCALE 1:1
SHEET 1 OF 1
PART No. 911 369 001
HALDEX BRAKE PRODUCTS LTD.

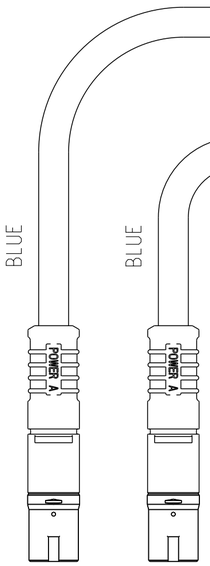

COMPUTER PRODUCED DRAWING
MUST NOT BE CHANGED MANUALLY
CABLE COLOUR CODING :
W - WHITE
BK - BLACK
BN - BROWN
BU - BLUE
RD - RED
YE - YELLOW
GR - GREEN
THIS DRAWING/SPECIFICATION USES CLASSIFIED CHARACTERISTIC SYMBOLS DEFINED IN QUALITY PROCEDURE 4.17
CAN REPEATER WIRING DIAGRAM
Haldex
911 460 001
ISO 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
WAS
SHEET 1 OF 1
AutoCAD PART

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

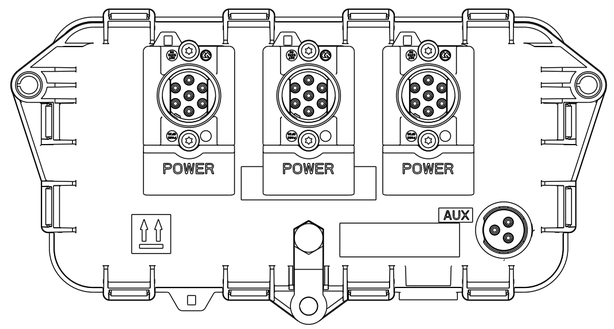


ISO 7638
(TOWED)

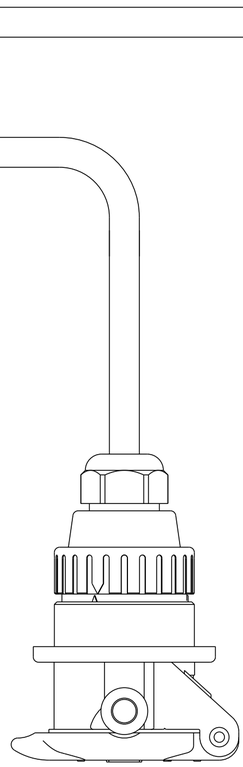
ALL PLUGS CAN BE INSERTED IN TO ANY SOCKET



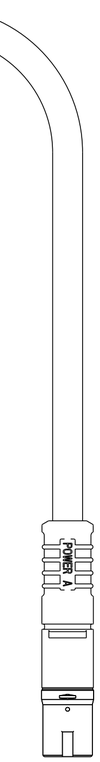
PIN	COLOUR	SIZE	FUNCTION
1	RED	4.0mm^2	B+P
2	BLACK	1.5mm^2	B+IGN
3	YELLOW	1.5mm^2	B-IGN
4	BROWN	4.0mm^2	B-
5	WHITE	1.5mm^2	LAMP
6	GREEN/WHITE	1.5mm^2	CAN H
7	BROWN/WHITE	1.5mm^2	CAN L



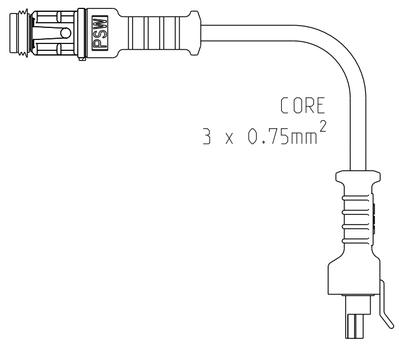
ECU ASSEMBLY



ISO 7638
(TOWING)

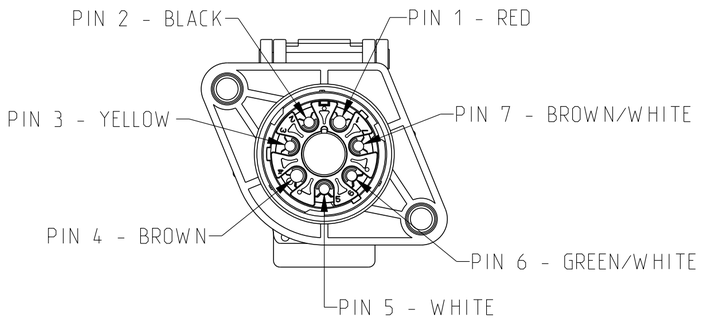


LOCAL EB+ ECU



CORE
3 x 0.75mm^2

CONTROL LINE
PRESSURE SENSOR
(OPTIONAL)

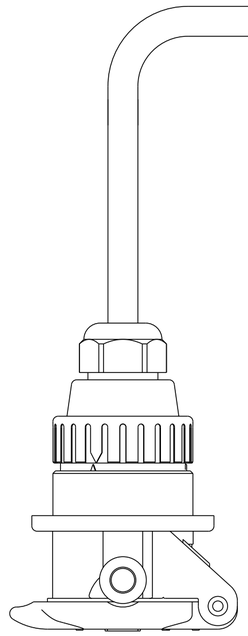


REAR VIEW OF
ISO 7638 SOCKET

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 (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 180535

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

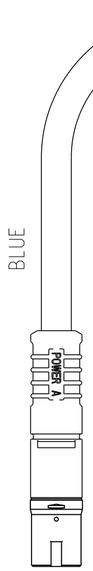


ISO 7638
(TOWED)

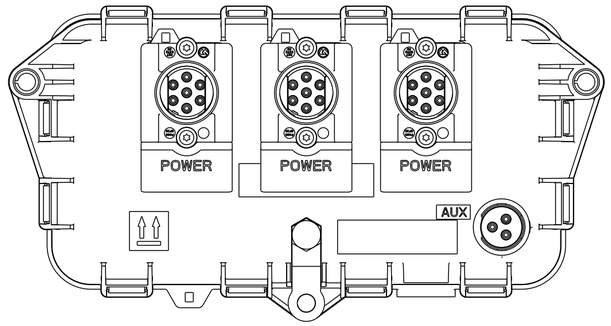
BLUE

BLUE

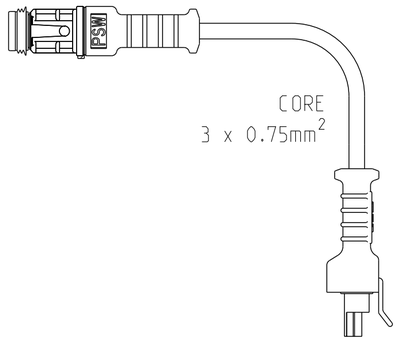
ALL PLUGS CAN BE
INSERTED IN TO
ANY SOCKET



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

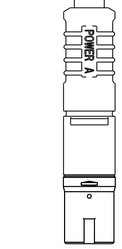


ECU ASSEMBLY

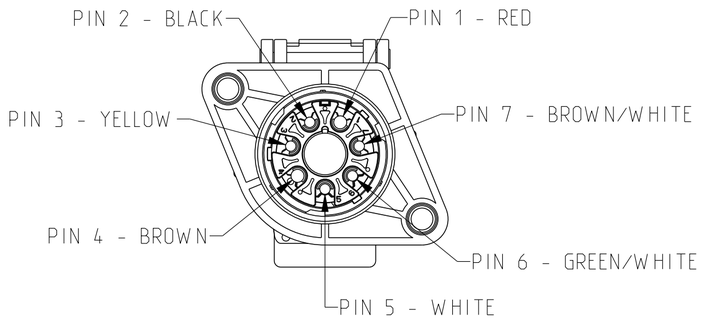


CORE
3 x 0.75mm^2

CONTROL LINE
PRESSURE SENSOR
(OPTIONAL)



LOCAL EB+ ECU



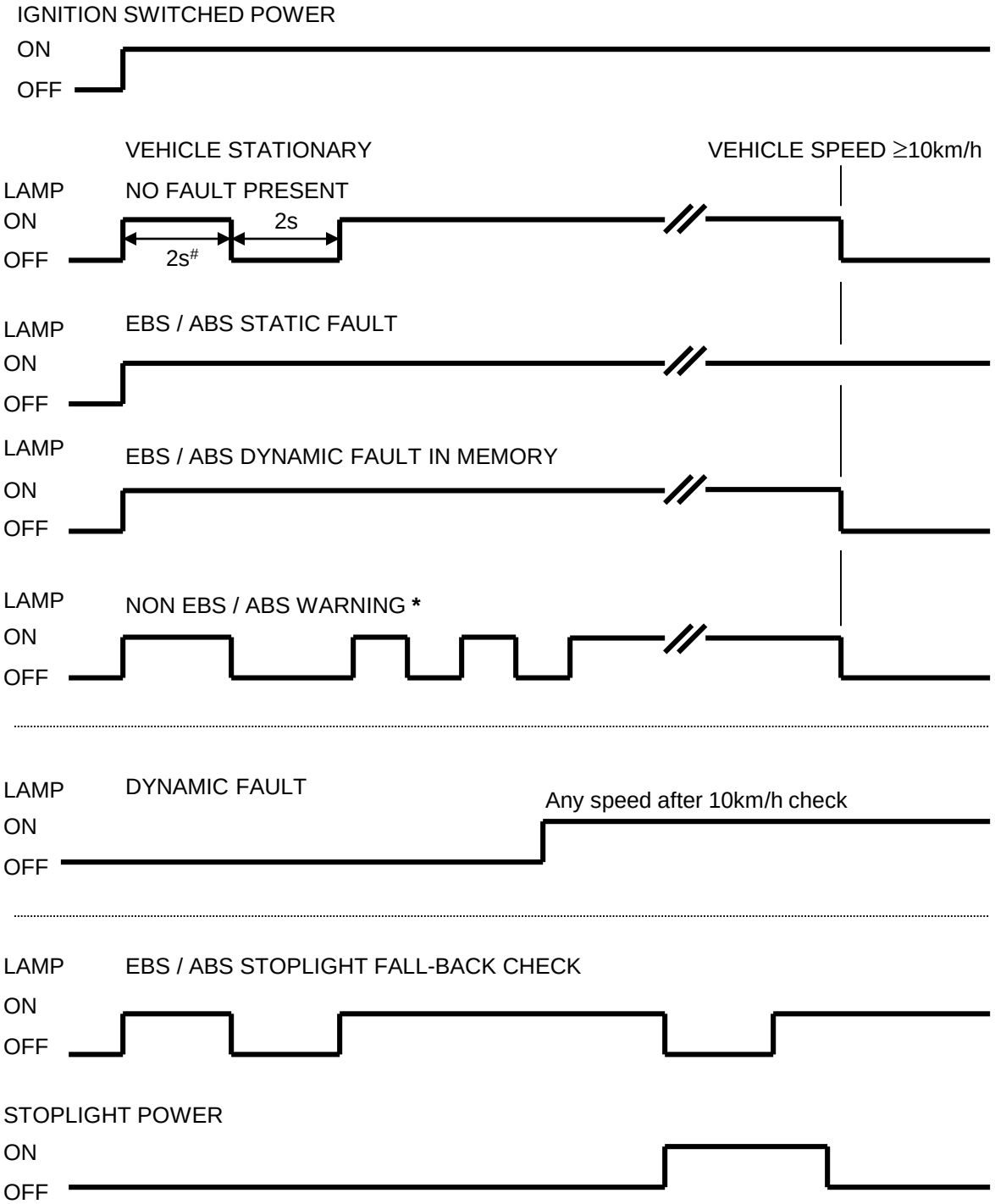
REAR VIEW OF
ISO 7638 SOCKET

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 180535

EB+ Warning Signal - Default Operation

Option 'A'

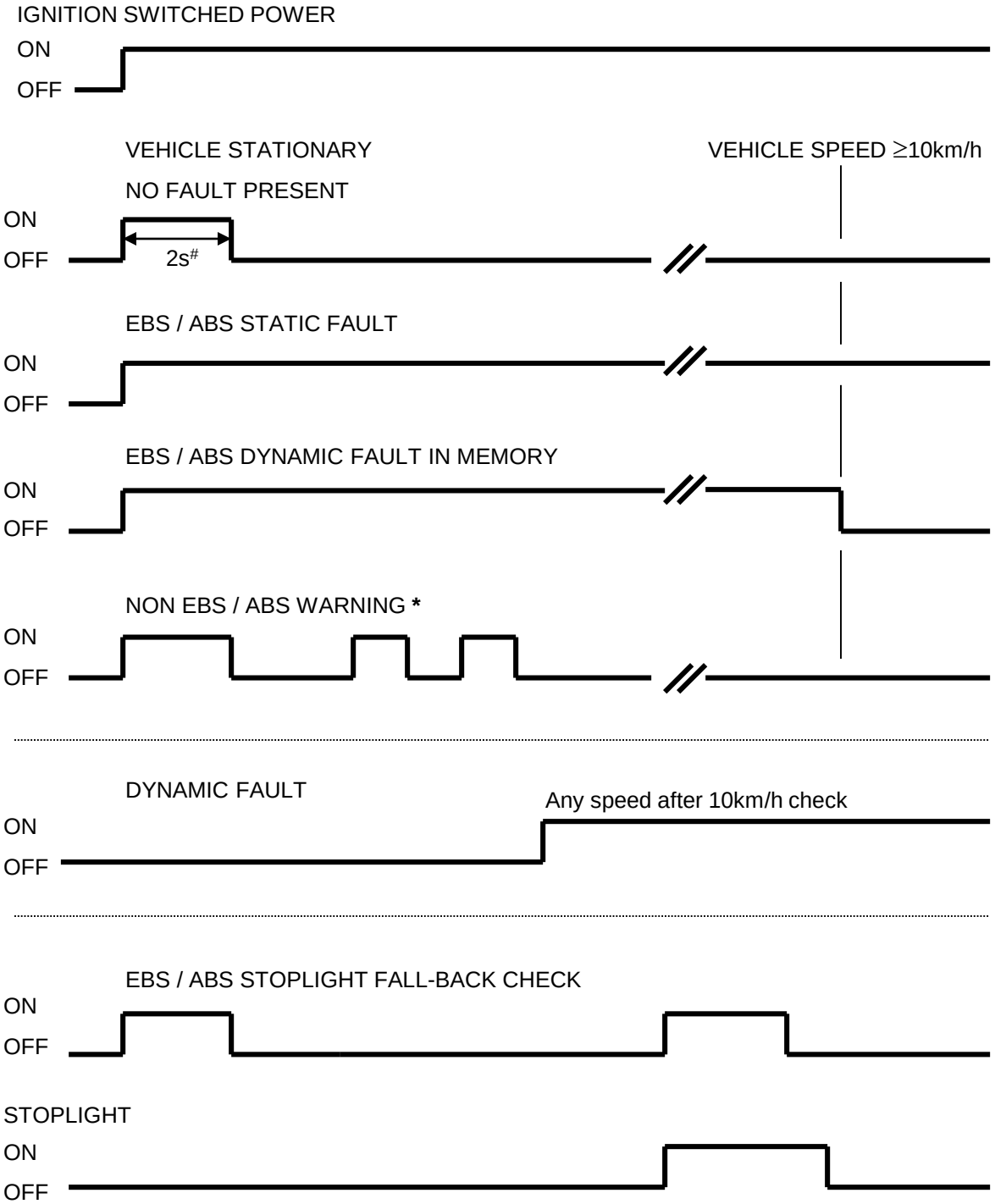


* = E.g. AUX Fault, Service Warning. Flashes may optionally be only 2 or continuous until vehicle reaches 10 kph.

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

EB+ Warning Signal - Default Operation

Option 'B'

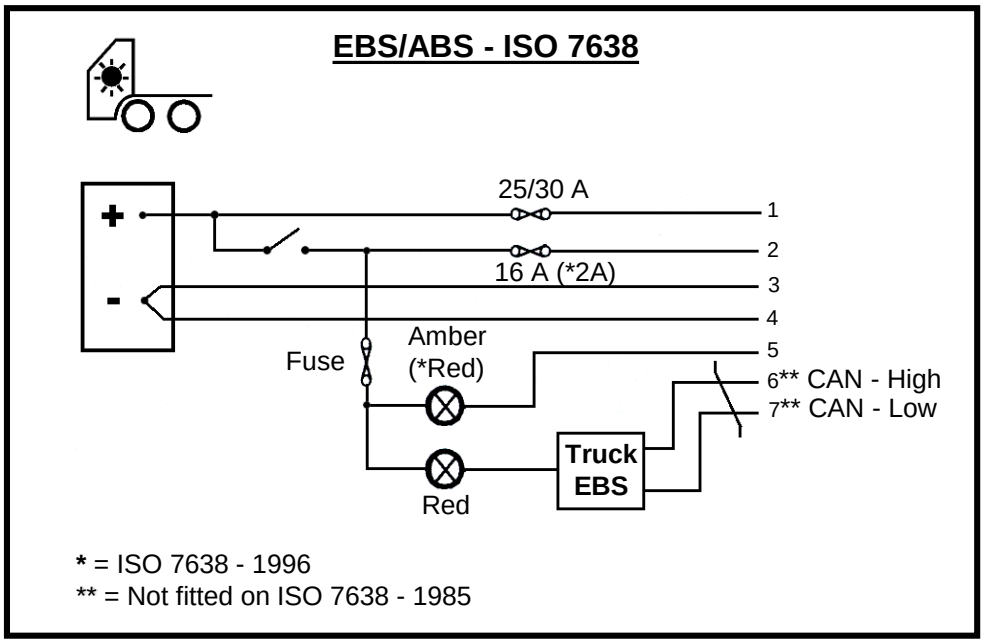


R13 180535

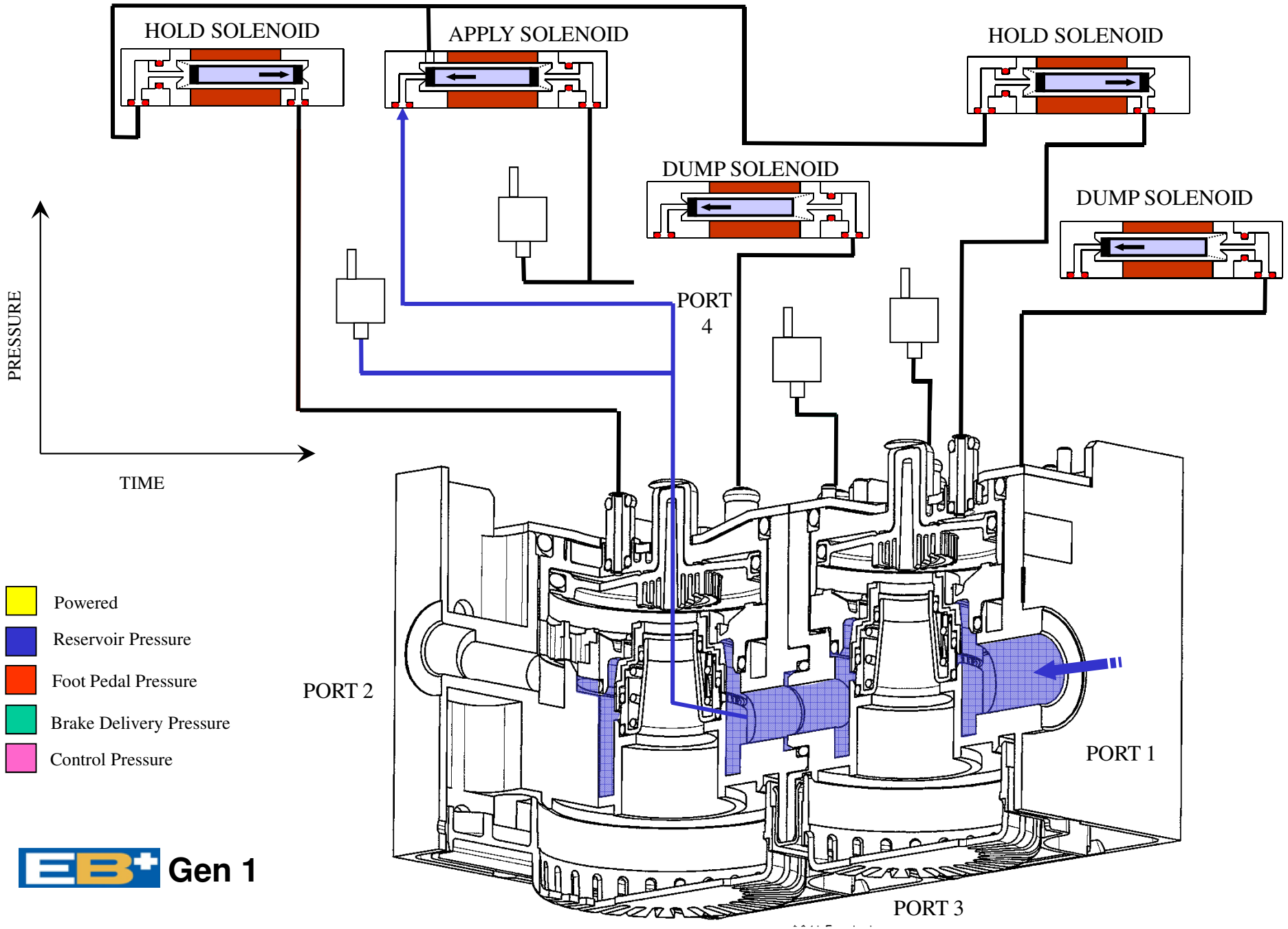
* = E.g. AUX Fault, Service Warning. Flashes may optionally be only 2 or continuous until vehicle reaches 10 kph.

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

Towing Vehicle ISO 7638 Wiring

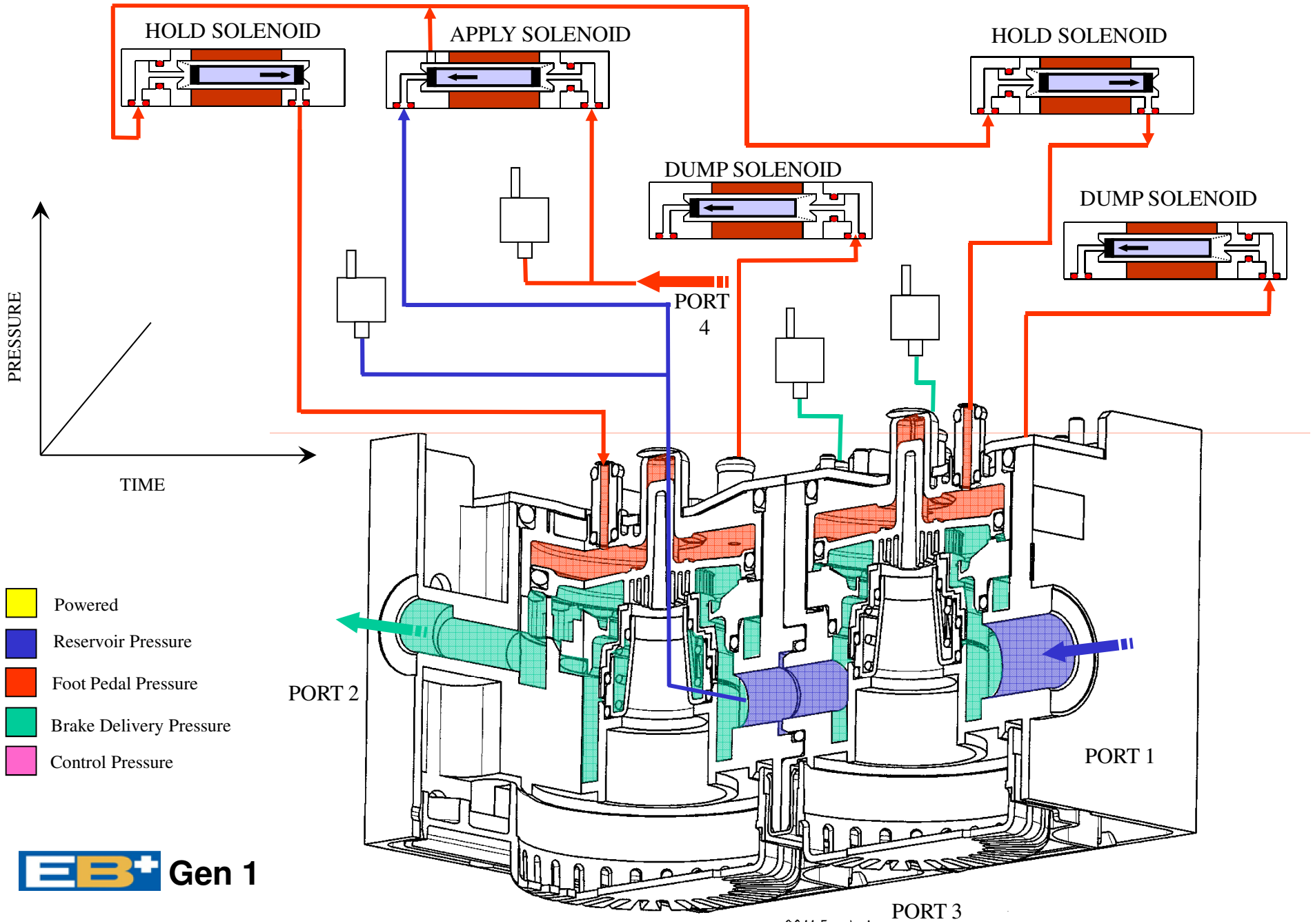


APPENDIX 13.1 RESERVOIR SUPPLY ONLY



EB+ Gen 1

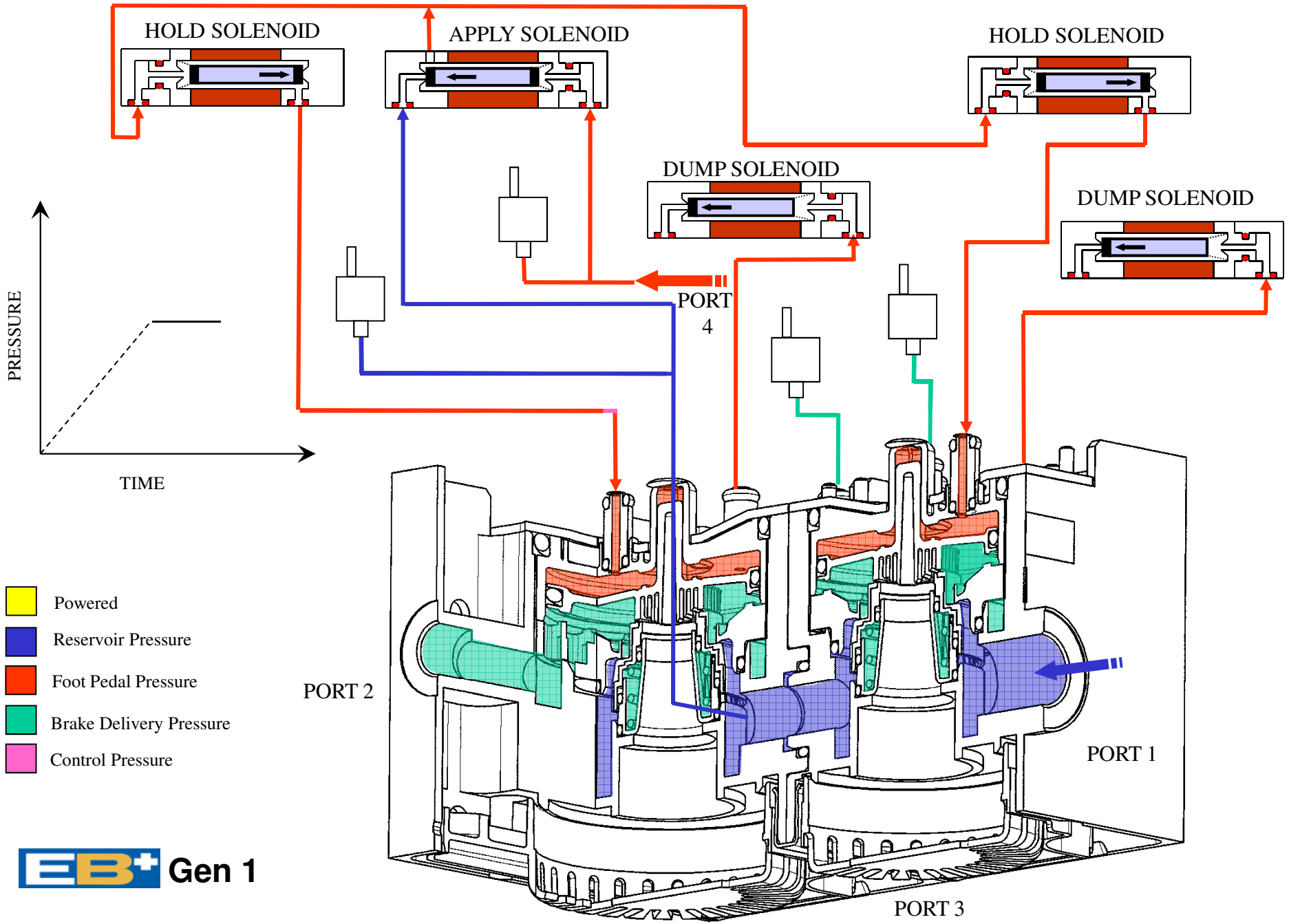
APPENDIX 13.2 BRAKE APPLY (PUSH THROUGH)



EB+ Gen 1

R13 180535

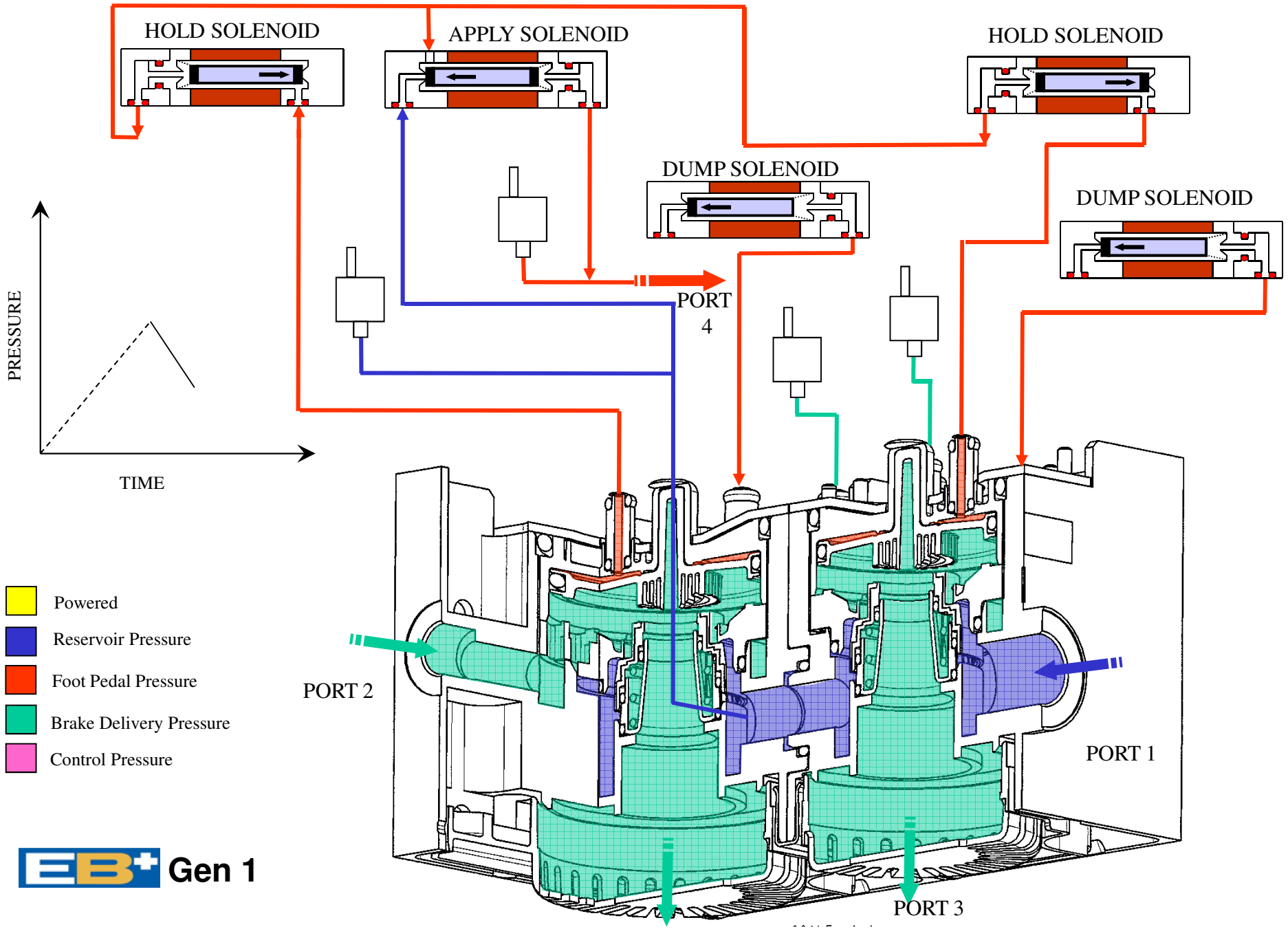
APPENDIX 13.3 BALANCED



EB+ Gen 1

R13 180535

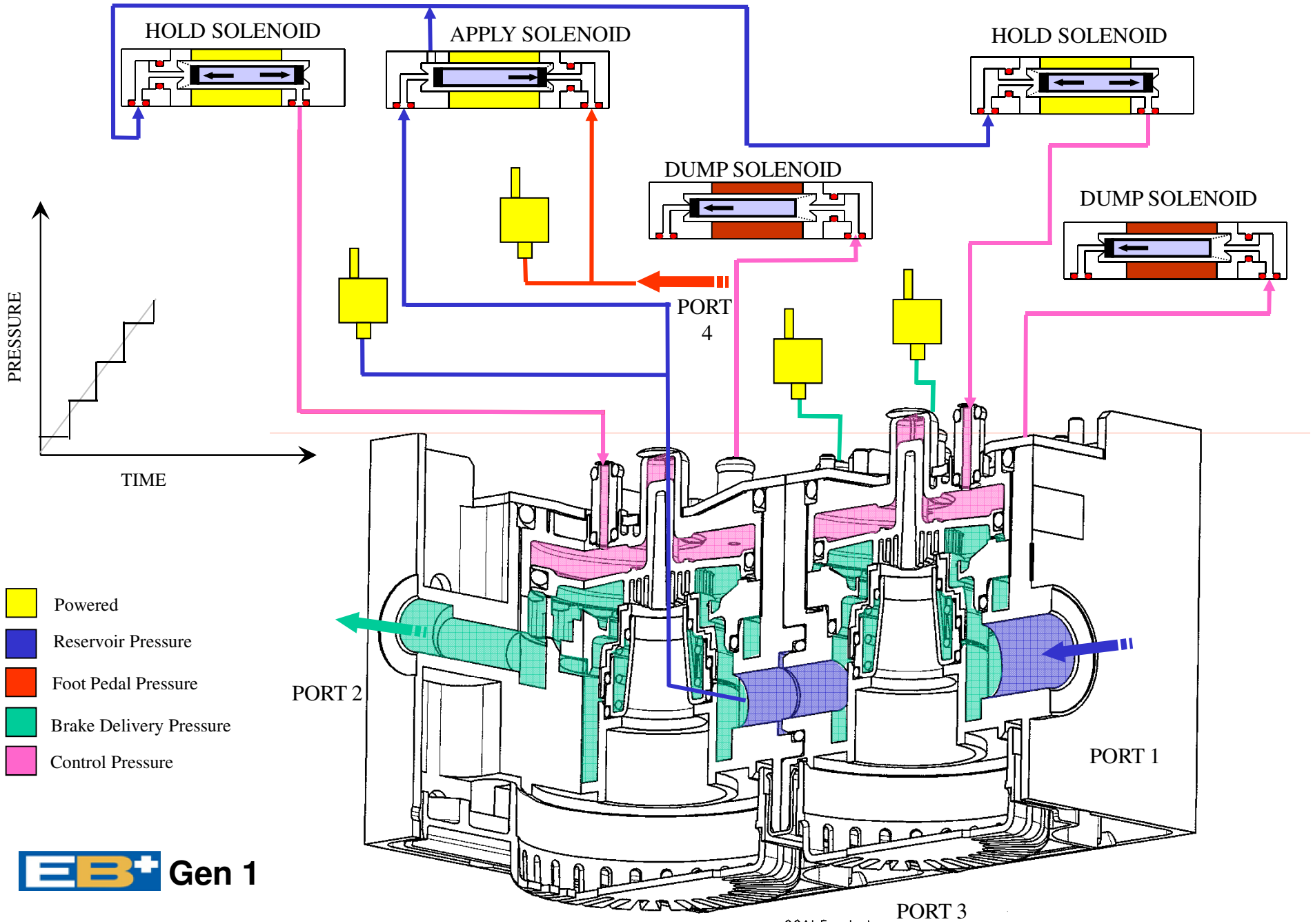
APPENDIX 13.4 BRAKE RELEASE (PUSH THROUGH)



EB+ Gen 1

R13 180535

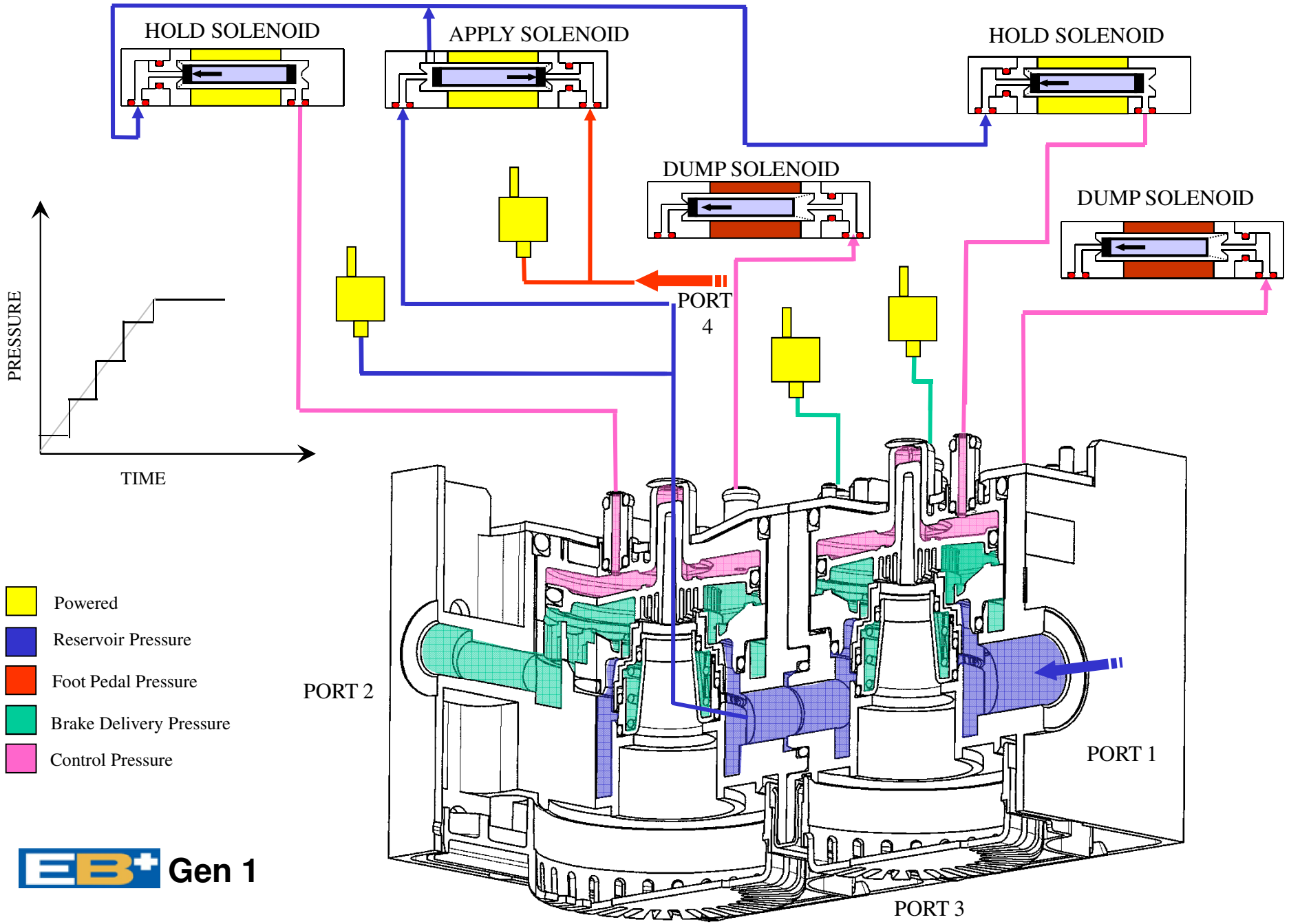
APPENDIX 13.5 BRAKE APPLY (APPLY SOLENOID)



EB+ Gen 1

R13 180535

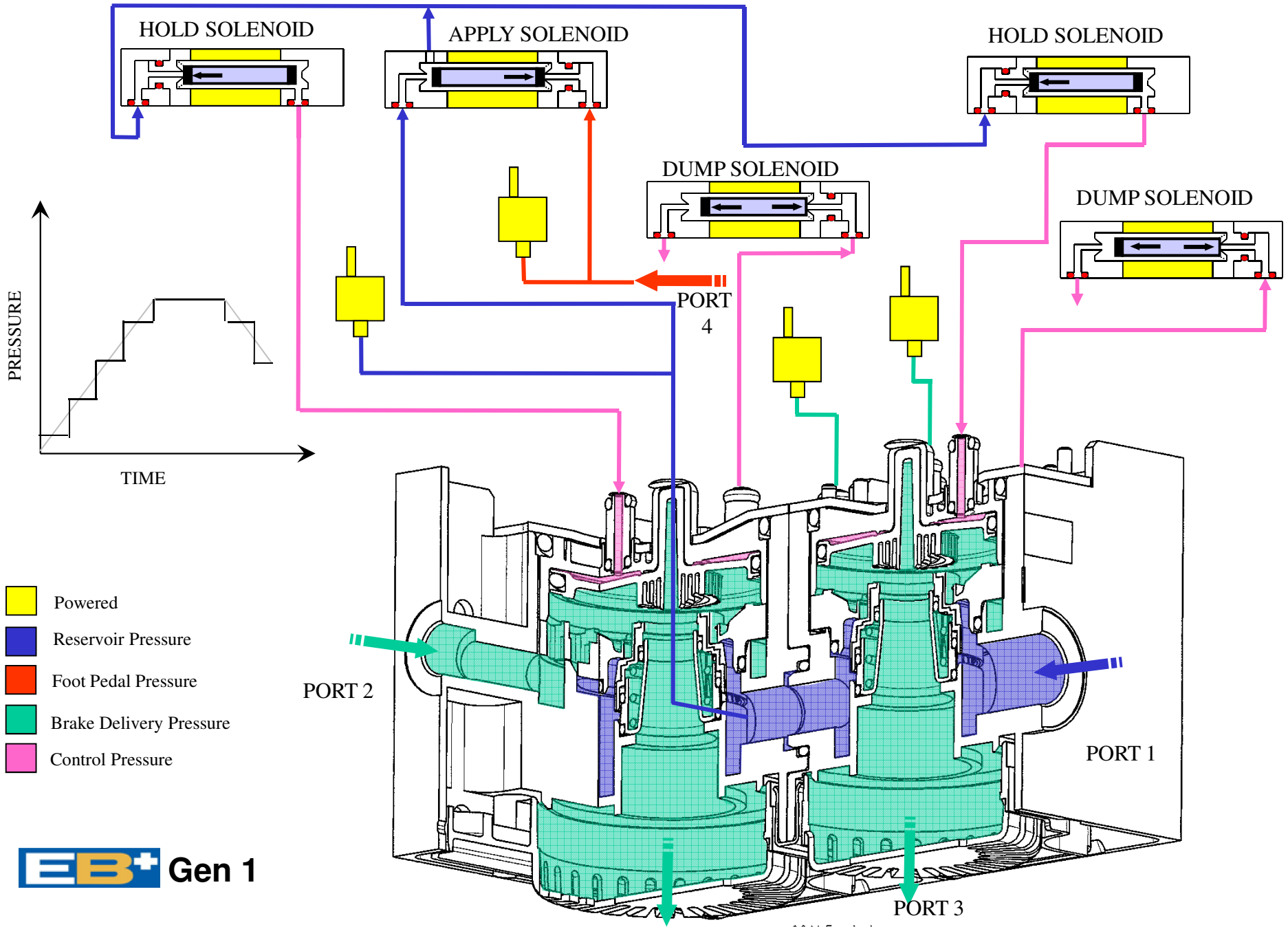
APPENDIX 13.6 HOLD



EB+ Gen 1

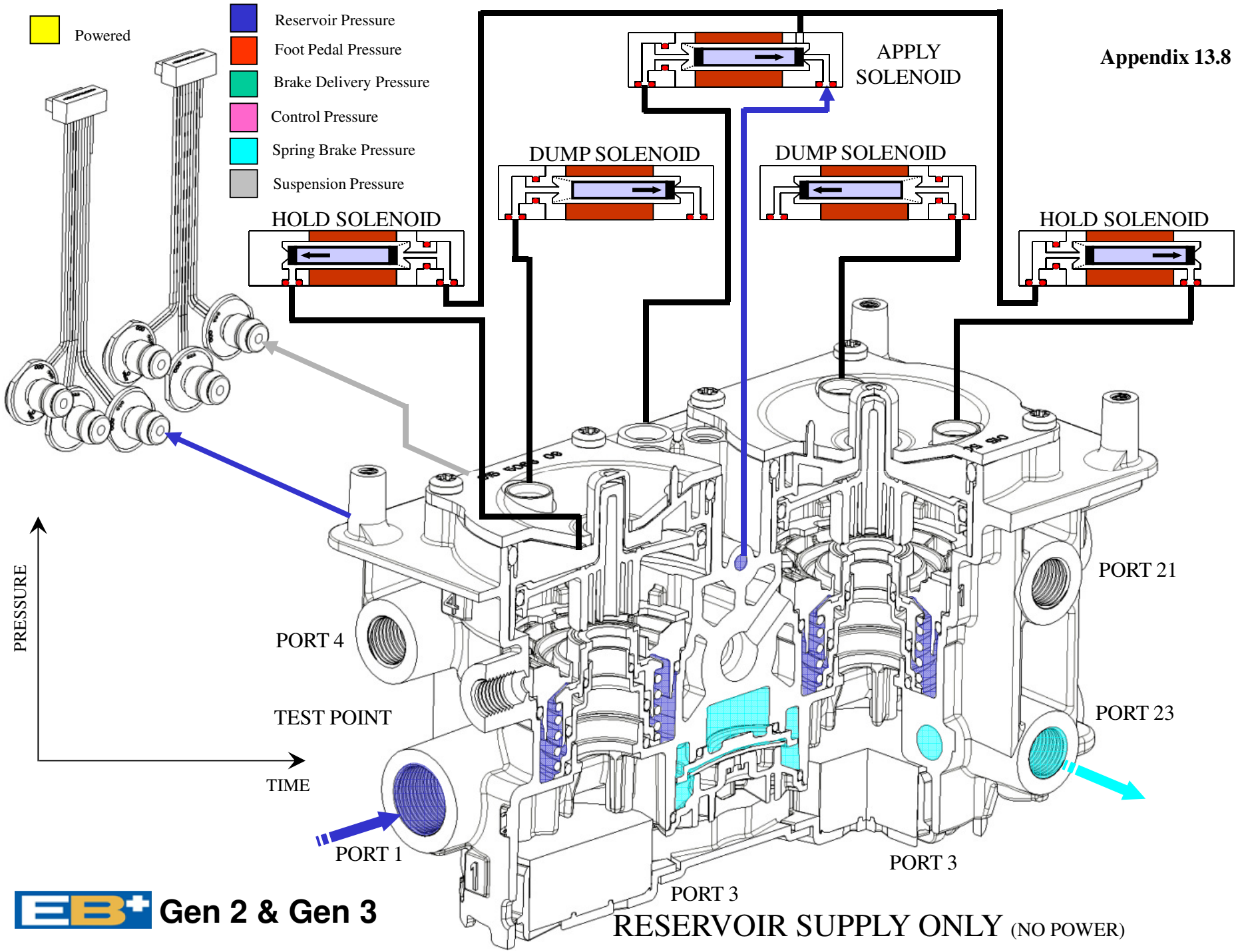
R13 180535

APPENDIX 13.7 BRAKE RELEASE (DUMP SOLENOID)



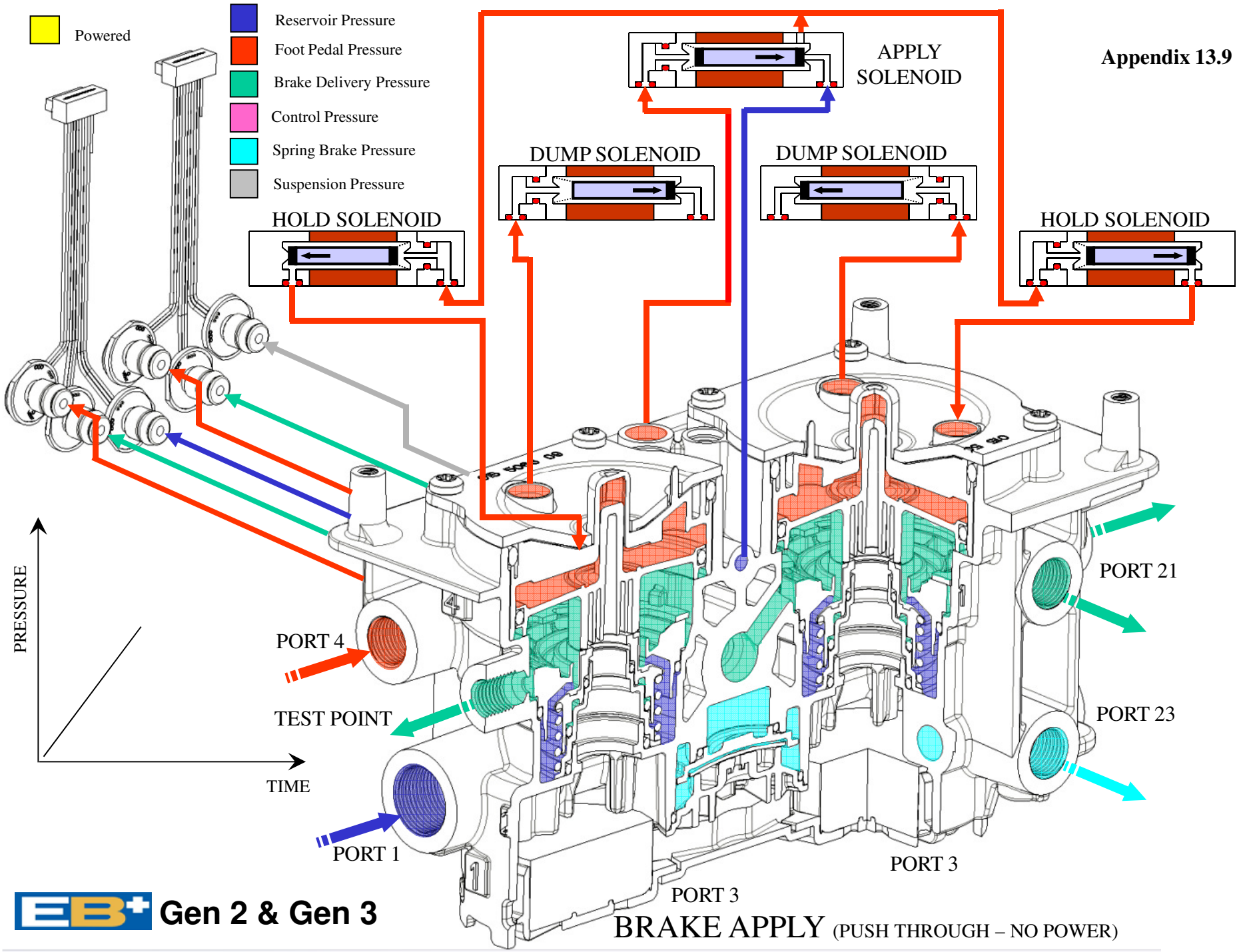
EB+ Gen 1

R13 180535



Gen 2 & Gen 3

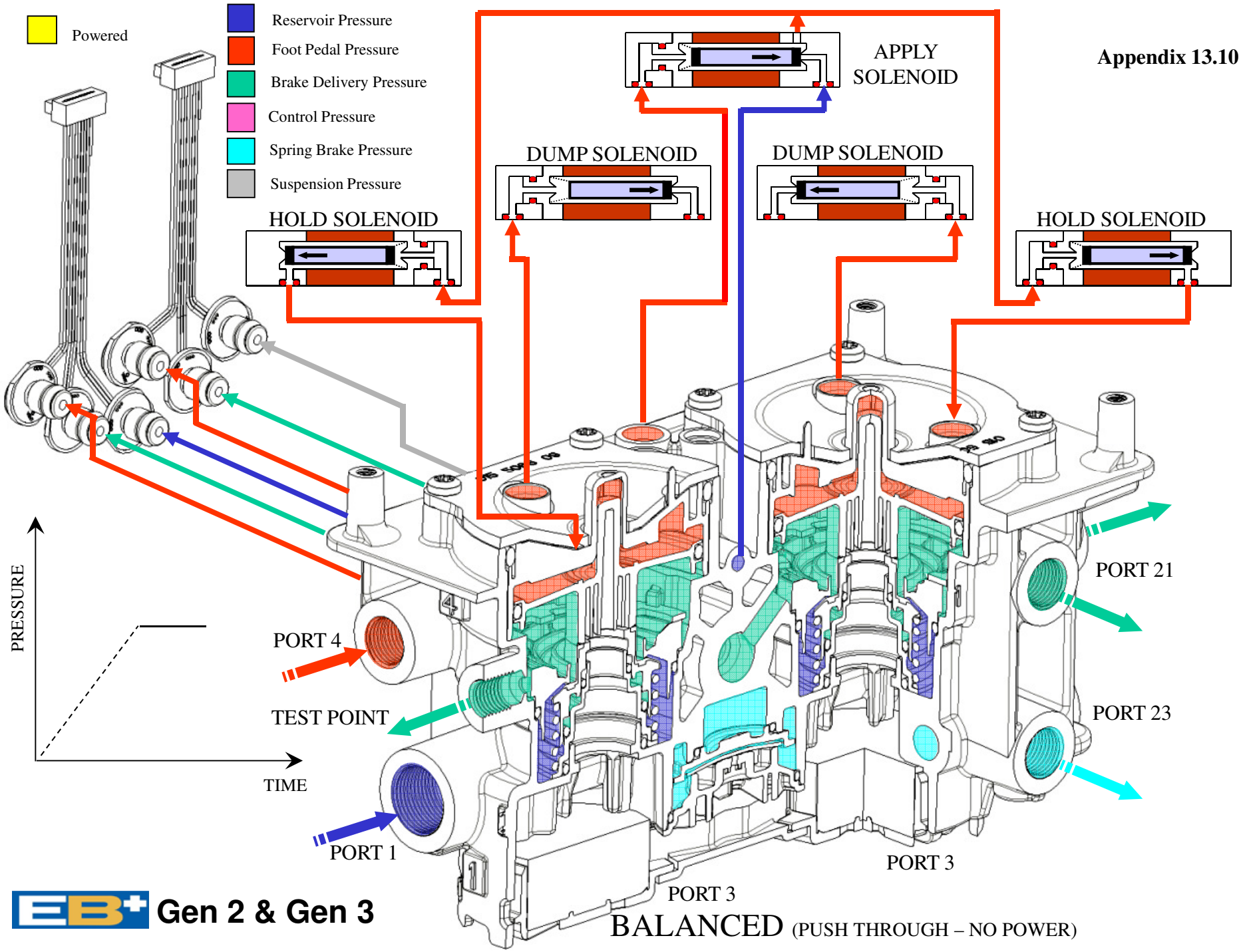
RESERVOIR SUPPLY ONLY (NO POWER)



R13 180535

Gen 2 & Gen 3

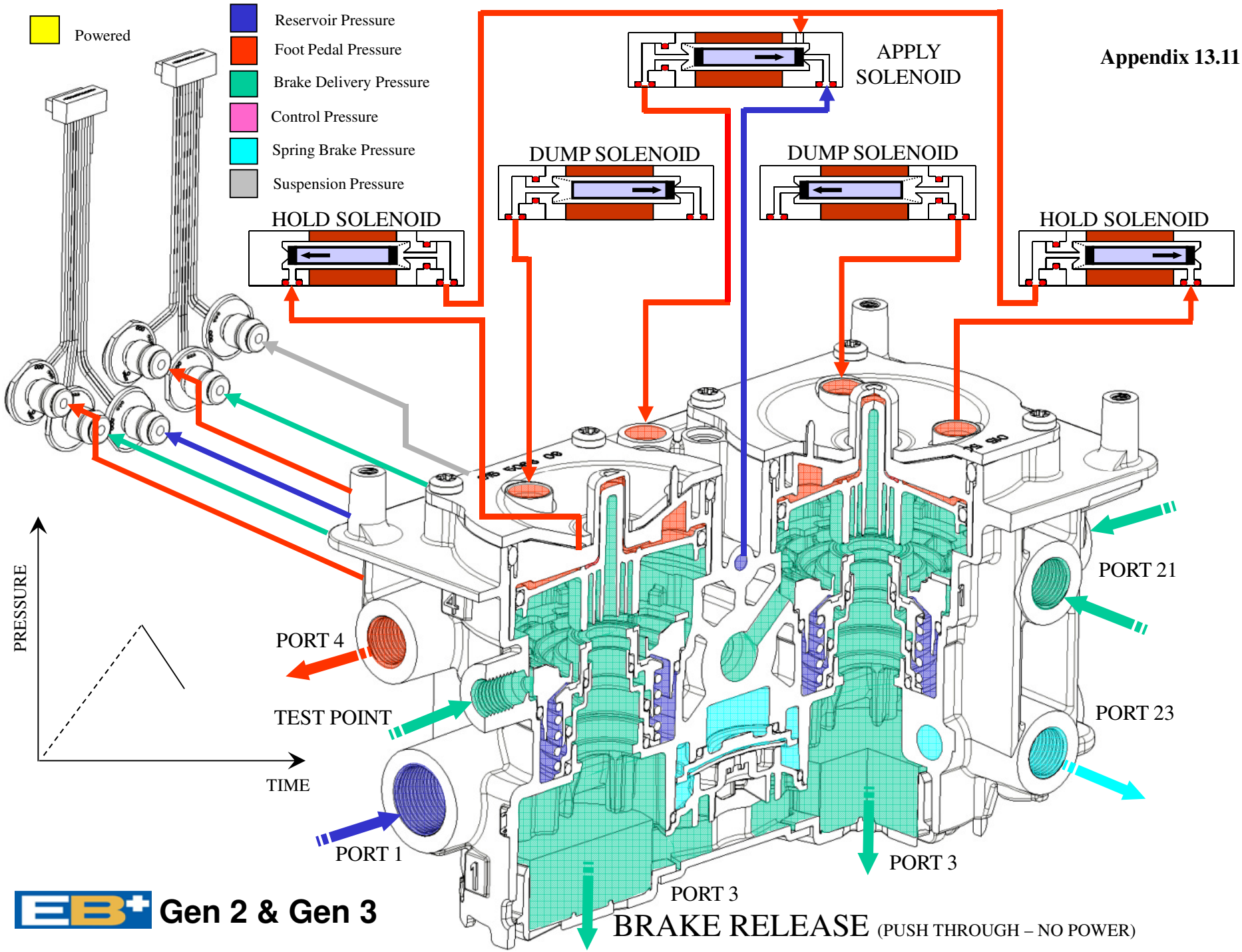
BRAKE APPLY (PUSH THROUGH – NO POWER)



R13 180535

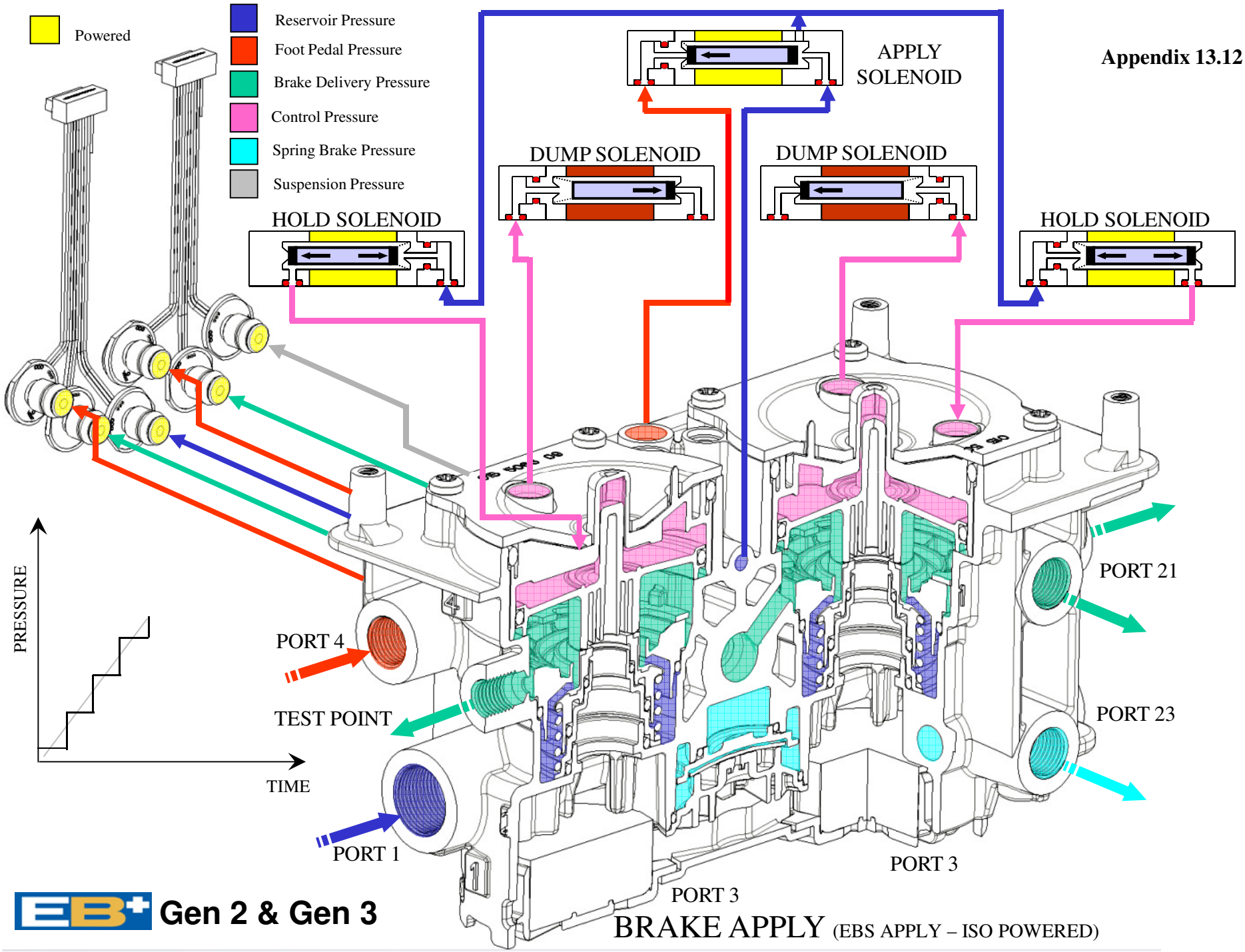
Gen 2 & Gen 3

BALANCED (PUSH THROUGH – NO POWER)



Gen 2 & Gen 3

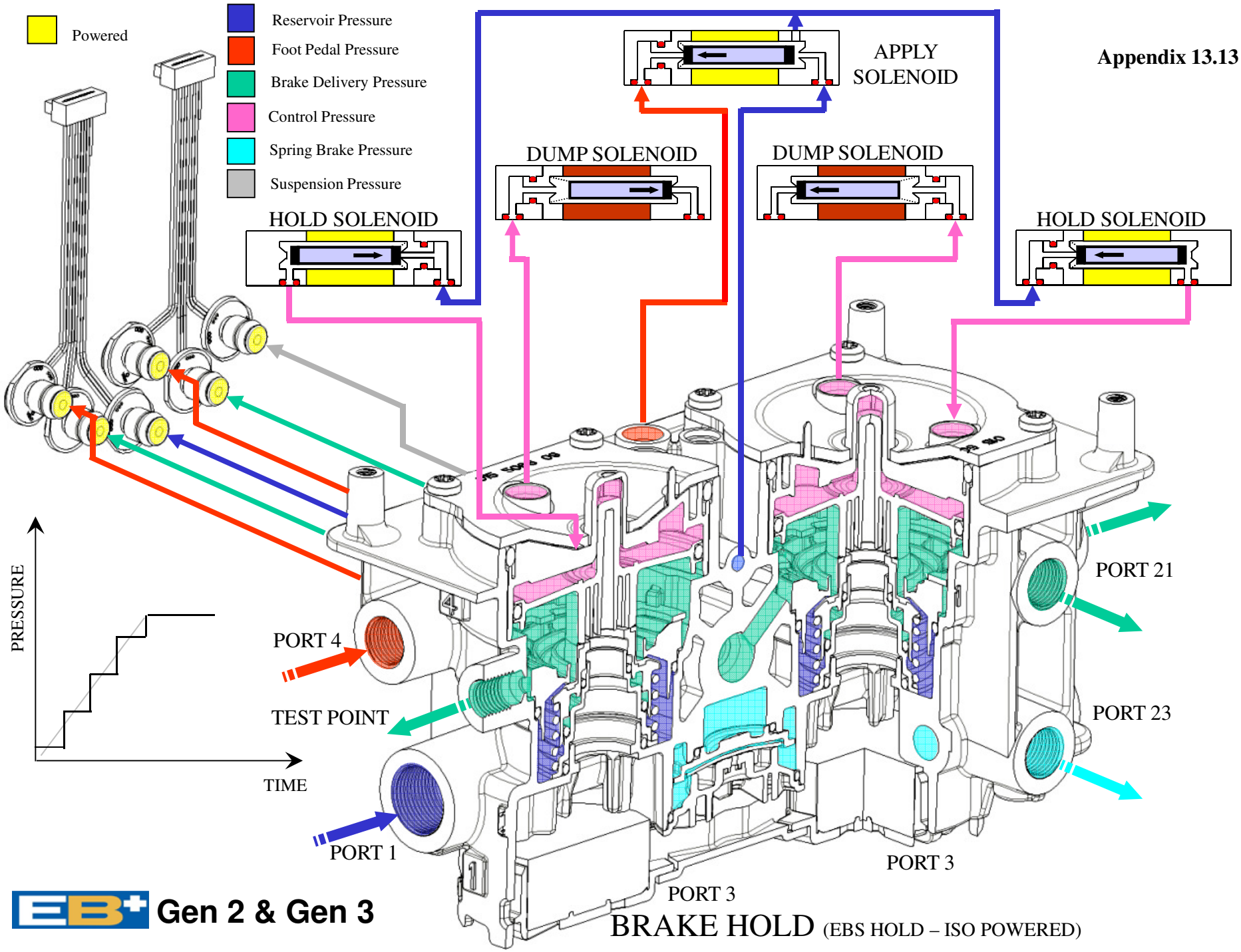
BRAKE RELEASE (PUSH THROUGH – NO POWER)



R13 180535

EB+ Gen 2 & Gen 3

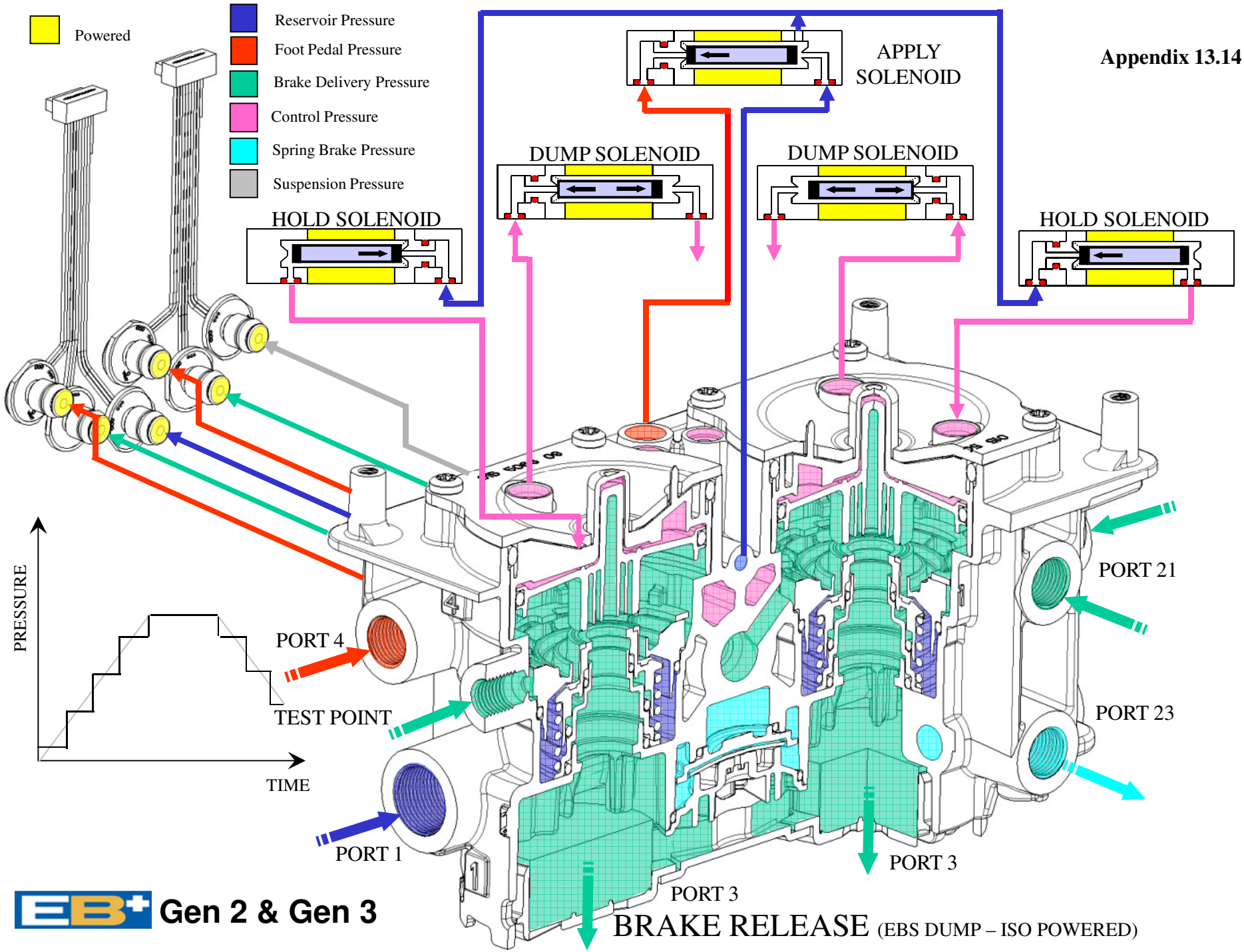
BRAKE APPLY (EBS APPLY – ISO POWERED)



R13 180535

Gen 2 & Gen 3

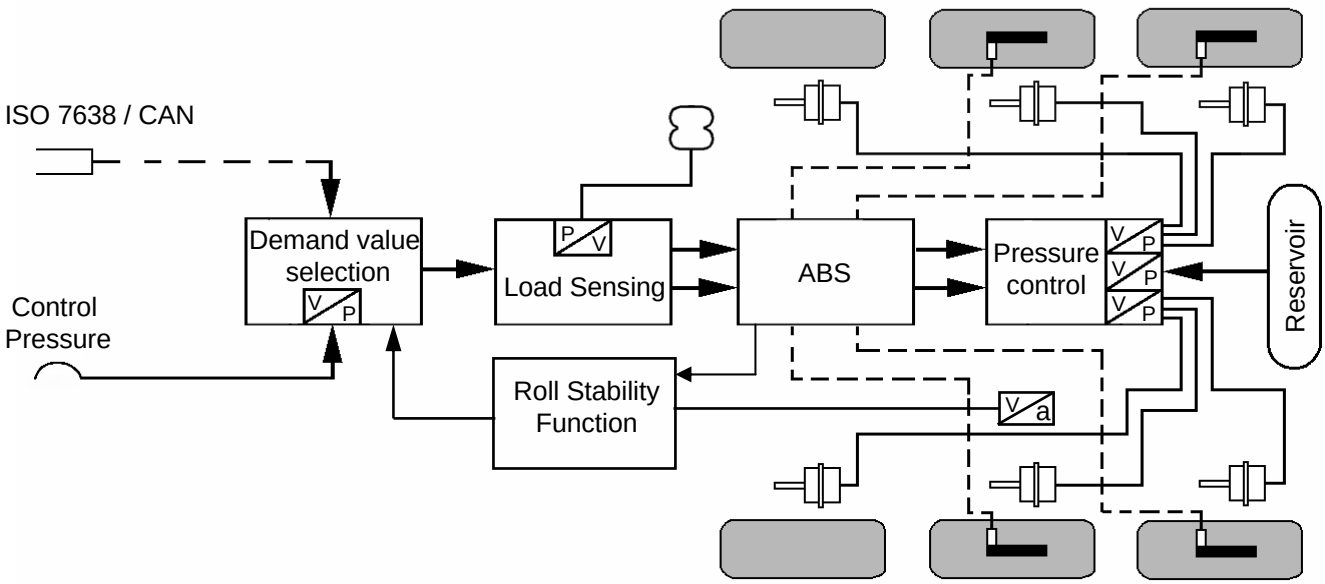
BRAKE HOLD (EBS HOLD – ISO POWERED)



Gen 2 & Gen 3

BRAKE RELEASE (EBS DUMP – ISO POWERED)

EB+ Functional Blocks



Haldex Brake Products Limited
Moons Moat Drive
Moons Moat North
Redditch
Worcestershire
B98 9HA

Haldex
Brake Systems

Report No: C8891
Sheet 1 of 7 sheets
Date: 8 February 2001

ENGINEERING REPORT

Title: CAN conformance testing of EB+ ECU to ISO 11992-1

Circulation	
SUMMARY SHEET	FULL REPORT
P.Bale.	R.D.Prescott. R.S.Porter

PREPARED BY:
P.Reynolds.

APPROVED BY:
8/2/01

AURTHORISED BY:
8/2/01.

An EB+ ECU (part number 812 001 301), was subjected to the CAN conformance tests 6.2 to 6.10 inclusive as listed in ISO 11992-1 : 1998(E) and was found to meet the requirements of the tests.

Haldex Brake Products Limited
Moons Moat Drive
Moons Moat North
Redditch
Worcestershire
B98 9HA

Haldex
Brake Systems

Report No: C8889

Sheet 1 of 3 sheets

Date: 08 Feb 2001

ENGINEERING REPORT

Title: EB+ : ISO 11992 Part 2 Compliance Tests

Circulation	
SUMMARY SHEET	FULL REPORT
P BALE	RD PRESCOTT D HARRISON

PREPARED BY:

W Munslow

APPROVED BY:

RD Prescott

8/2/01

AUTHORISED FOR RELEASE BY:

P Bale

8/2/01.

An EB+ ECU (Part Number: 812301001) was subjected to the conformance tests as defined in Section 6 of ISO 11992 Part 2: 1998 and was found to meet the requirements of the tests.

Haldex Brake Products Limited
Moons Moat Drive
Moons Moat North
Redditch
Worcestershire
B98 9HA

Haldex
Brake Systems

Report No: C8890
Sheet 1 of 3 sheets
Date: 08 Feb 2001

ENGINEERING REPORT

Title: EB+ : ISO 11992 Part 3 Compliance Tests

Circulation	
SUMMARY SHEET	FULL REPORT
P BALE	RD PRESCOTT D HARRISON

PREPARED BY:
W Munslow

APPROVED BY:
R D Prescott
8/2/01

AUTHORISED FOR RELEASE BY:
P Bale
8/2/01

An EB+ ECU (Part Number: 812301001) was subjected to the conformance tests as defined in Section 6 of ISO 11992 Part 3: 1998 and was found to meet the requirements of the tests.

Haldex Brake Products Limited
Moons Moat Drive
Moons Moat North
Redditch
Worcestershire B98 9HA

ENGINEERING REPORT

Title: Supplement to Eng. Reports C8889-91, CAN conformance testing of EB+ ECU to ISO 11992 Parts 1-3

Circulation	
SUMMARY SHEET	FULL REPORT
Paul Bale	Ray Porter Bob Prescott Mike Horne Archive File Project File

PREPARED BY:
Jeff Bagnall
Wayne Munslow

APPROVED BY:
31/3/04
Ray Porter

CONCURRED BY:
31/3/04

Following the re-issue of ISO 11992 the reports listed below have been reviewed:

Report C8891 ISO-11992 Part 1 Conformance Tests.
Report C8889 ISO-11992 Part 2 Conformance Tests.
Report C8890 ISO-11992 Part 3 Conformance Tests.

This supplement confirms that EB+ meets the requirements of ISO 11992: 2003(E).

ISO 11992 - 1 Conformance Tests

Test Numbers

The ECU tested was found to meet the requirements of the conformance tests set out. The re-issue of the ISO document revealed a change in the numbering of the tests. The following table gives the new numbers: -

ISO 11992-1: 1998(E) numbering	ISO 11992-1: 2003(E) numbering
6.2	7.2
6.3	7.3
6.4	7.4
6.5	7.5
6.6	7.6
6.7	7.7
6.8	7.8
6.9	7.9
6.10	7.10

Bus Failure Management

Section 6.9, bus failure management and power on procedure, of the 1998 edition, stated "In case 7, transmission shall work in the CAN_H operation mode", whereas the 2003 version states in the corresponding 7.9 section, "In case 7, transmission shall work in either the CAN_H or in the CAN_L operation mode". Report C8891 stated that the case 7 operation mode was CAN_H, which agrees with the "either or" sense of the 2003(E) edition.

ISO 11992 – 2 Conformance Tests

Test Numbers

The ECU tested was found to meet the requirements of the conformance tests set out. The re-issue of the ISO document revealed a change in the numbering of the tests. The following table gives the new numbers: -

ISO 11992-2: 1998(E) numbering	ISO 11992-2: 2003(E) numbering
6.2.1	7.2.1
6.2.2	7.2.2
6.2.3	7.2.3
6.3.1	7.3.1

Messages

All the running gear messages previously defined in message GFM22 of part 3 are now contained in message RGE21 of part 2. These conform to the requirements of part 2.

ISO 11992 – 3 Conformance Tests

Messages

The conformance tests in report C8890 with respect to GFM22 are applicable to message RGE21, now contained in part 2. No messages other than brakes and running gear are supported, and there is no longer a conformance requirement for part 3.

Haldex Brake Products Limited
Moons Moat Drive
Moons Moat North
Redditch
Worcestershire
B98 9HA

ENGINEERING REPORT

Title: EB+ Gen 2 (820 011 001), CAN bus Conformance Testing – ISO 11992-1:2003(E)

Circulation		PREPARED BY: Jeff Bagnall 22/8/06
SUMMARY SHEET		
Carl Mellings	Ray Porter Archive File Project File No. 66	APPROVED BY: Ray Porter 22/8/06 CONCURRED BY: 22/8

Summary

An EB+ Gen2 (Part No. 820 011 001) was subjected to the CAN conformance tests as listed in ISO 11992-1:2003(E), paragraphs 7.2 to 7.10 inclusive. Due to the tests requiring access to internal signals from the ECU, the tests were performed on the PCB assembly (part No. 003 9206 09) instead of the full ECU and valve assembly. All variants of EB+ GEN2 are identical in respect of the ISO11992-1 interface circuits and controlling software, therefore the assembly 003 9206 09 was chosen as representative of the type. The assembly was found to meet all of the requirements of the tests.

Haldex Brake Products Limited
Moons Moat Drive
Moons Moat North
Redditch
Worcestershire
B98 9HA

Report No: C9686

Sheet 1 of 3 sheets

Date: 24/08/06

ENGINEERING REPORT

Title: EB+ Gen2 ISO11992:2003 Part 2 Compliance Tests

Circulation	
SUMMARY SHEET	FULL REPORT
Carl Mellings	Dudley Harrison Archive File Project File No. 66

PREPARED BY:
Craig Slater

APPROVED BY:
24/08/06.

CONCURRED BY:

An EB+ Gen2 ECU (Part Number: 820 011 001) was subjected to the conformance tests defined in Section 7 of ISO11992:2003 Part 2 and was found to meet the requirements of the tests.

ENGINEERING TEST REPORT

EB+ GEN 3 – ISO11992 Physical Layer Compliance Verification

PROJECT No.	PART NUMBER	ISSUE LEVEL	DATE PRODUCED
127	003 9596 09	C	01/06/12
DESCRIPTION	EB+ GEN 3 – ISO11992 Physical Layer Compliance Verification		
SUPPLIER	Intech/Heidelberg		
REQUESTED BY	**REFERENCE (HIM, WR ETC.)**	**TEST TYPE (DV, PV ETC.)**	**REQUIRED COMPLETION DATE**
M. Poole		DV	13/07/12

TEST OBJECTIVE	To verify that the design of the EB+ Gen 3 tractor-to-trailer communications interface conforms to the physical layer requirements of ISO 11992-1:2003
PASS / FAIL CRITERIA	Pass

TEST RESULTS AND REPORT SUMMARY

The assemblies tractor-to-trailer communications interface was tested for conformity with the physical layer specification described in ISO 11992-1:2003 and was found to fully meet these requirements.

REPORT PRODUCED BY / DATE	Matthew Radford 01/06/12
REPORT APPROVED BY / DATE	14/07/12
TECHNICAL DIRECTOR SIGN-OFF	

CIRCULATION			
C MELLINGS	E CARSWELL	D HARRISON	J CRAWLEY
M POOLE			

Haldex Brake Controls (CVS) Redditch United Kingdom	Haldex	Report No. C10946 Page 1 of 14

ENGINEERING TEST REPORT

EB+ Gen3 ISO11992:2003 & ISO1992-2:2003/Amd.1:2007 Part 2 Conformance

PROJECT No.	PART NUMBER	ISSUE LEVEL	DATE PRODUCED
127	823 008 001	-	07.12
DESCRIPTION	HALDEX EB+ GEN3 UNIT		
SUPPLIER	-		
REQUESTED BY	**REFERENCE (HIM, WR ETC.)**	TEST TYPE (DV, PV ETC.)	REQUIRED COMPLETION DATE
D. HARRISON	-	PV	19.07.12

TEST OBJECTIVE	Test an EB+ Gen3 unit against the requirements of Section 7 of ISO11992:2003 Part 2 specification including ISO1992-2:2003/Amd.1:2007
PASS / FAIL CRITERIA	All requirements of Section 7 of ISO11992:2003 Part 2 specification including ISO1992-2:2003/Amd.1:2007 shall be met

TEST RESULTS AND REPORT SUMMARY

An EB+ Gen3 unit was subjected to the conformance tests defined in Section 7 of ISO11992:2003 Part 2 specification including ISO1992-2:2003/Amd.1:2007 and was found to meet the requirements of the tests.

REPORT PRODUCED BY / DATE	CRAIG SLATER / 19.07.12
REPORT APPROVED BY / DATE	19/07/12
TECNICAL DIRECTOR SIGN-OFF	19/7/12.

CIRCULATION

Haldex Brake Products Ltd Lindley United Kingdom	Haldex	Report No. C11467 Page 1 of 23

ENGINEERING TEST REPORT

CAN HUB ISO11992-1 Physical Layer Compliance Verification

PROJECT No.	PART NUMBER	ISSUE LEVEL	DATE PRODUCED
P149	364 656 001	Hw REV4	Dec 2017
DESCRIPTION	CAN HUB ISO11992-1 Physical Layer Compliance Verification		
SUPPLIER	IMI Inc		
REQUESTED BY	REFERENCE	TEST TYPE	REQUIRED COMPLETION DATE
J CRAWLEY	ISO 11992-1		23/02/2018

TEST OBJECTIVE	To verify that the design of the CAN HUB tractor to trailer communications interface conforms to the physical layer requirements of ISO 11992-1:2003
PASS / FAIL CRITERIA	Meets the requirements of the ISO specification.
RESULT (PASS / FAIL / FOR INFORMATION)	PASS
TEST FAILURE CAUSES	NA

TEST RESULTS AND REPORT SUMMARY

The assembly's tractor to trailer communications interface was tested for conformity with the physical layer specification described in ISO 11992-1-2003 and was found to fully meet these requirements

RECOMMENDATIONS

The CAN Hub passed all the requirements so no recommendations are required.

REPORT PRODUCED BY / DATE	Hellend, Gary 12/02/2018
REPORT APPROVED BY / DATE	23/02/2018
VICE PRESIDENT OF R&D	27/02/2018

CIRCULATION			
D HARRISON	M POOLE	C MELLINGS	J CRAWLEY
J NOECKER			

Engineering Test Order Report #19-0005

Confidentiality: This report is confidential and cannot be distributed external of Haldex without approval and signature of Chief Design Engineer or Chief Test Engineer.

Signature _____ Will Storrie, Chief Engineer Date 7th Jan 2020

General Information

Test Order Title	CAN Hub conformance to ISO11992 parts 2 and 3		
Test Location	Mira - Software	**Requester**	Harrison, Dudley
Activity #/ Project #	P149-C150	**Test Engineer/ Technician**	Cooper, Ian Kwiatkowski, Bartek
Test Purpose	Project HPMM-DV	**Test Release Engineer**	Martinengo, Luca

Product Line

Product Line	EBS	**Product Class**	EBS other
Product Unit Name		**Product Description**	CAN Hub for EBS

Samples Being Evaluated

Test Sample Part #	Description	Rev #	Quantity

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Associations

Associated Documents (Change Management #, Warranty #, Deviation #)	
Associated Test Order #	
Evaluated Part #	A742
Evaluated Part Rev	
Evaluated Part Description (Key Words)	Software release A742
Supplier	

Purpose and Specifications

Test Sample Phase:N/A

Purpose (clearly define purpose of this test)

Software conformance to ISO11992

Test Specification(s) & Rev(s)

ISO11992-2:2014 section 7.3 and ISO11992-3:2014 section 7.3

Special Test Procedure Defined

Test Report Results

Test Tech/ Test Engineer	Kwiatkowski, Bartek	December 05, 2019	Pass
Test Release Engineer	Martinengo, Luca	January 06, 2020	Pass

Test Summary:

Preformed test confirmed that the EB+ ISO11992 CAN Hub met requirements of ISO 11992-2:2014 compliance test in full (Ref. ISO 119923,2:2014 7.0).

The device:

- routes required messages from the source addresses to the destination addresses as expected;
- does not route the non – standardized ISO 11992-2:2014 messages within the ISO11992 bus
- generates the EBS11 and EBS12 messages and repeats them in expected time frames if an external pressure sensor is connected;
- routes the messages with time delay lower than the maximum time delay specified by ISO 11992-2:2014 within the road train

Test passed.

Master Samples Retained:

Test Incident #	

Report Distribution

Report Distribution List:

Crawley, Jim

Harrison, Dudley

Test Data

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 180535

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 180535

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 180535

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 180535

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 180535

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

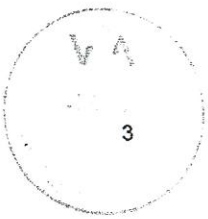
1.3.1. Installation conditions, if any: Not applicable

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 180535

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

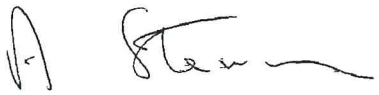
10. Date of test report: As before and 23 July 2012

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
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Switchboard: +44 (0) 117 951 5151
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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

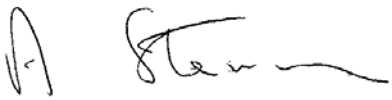
10. Date of test report: As before and 12 April 2011

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:

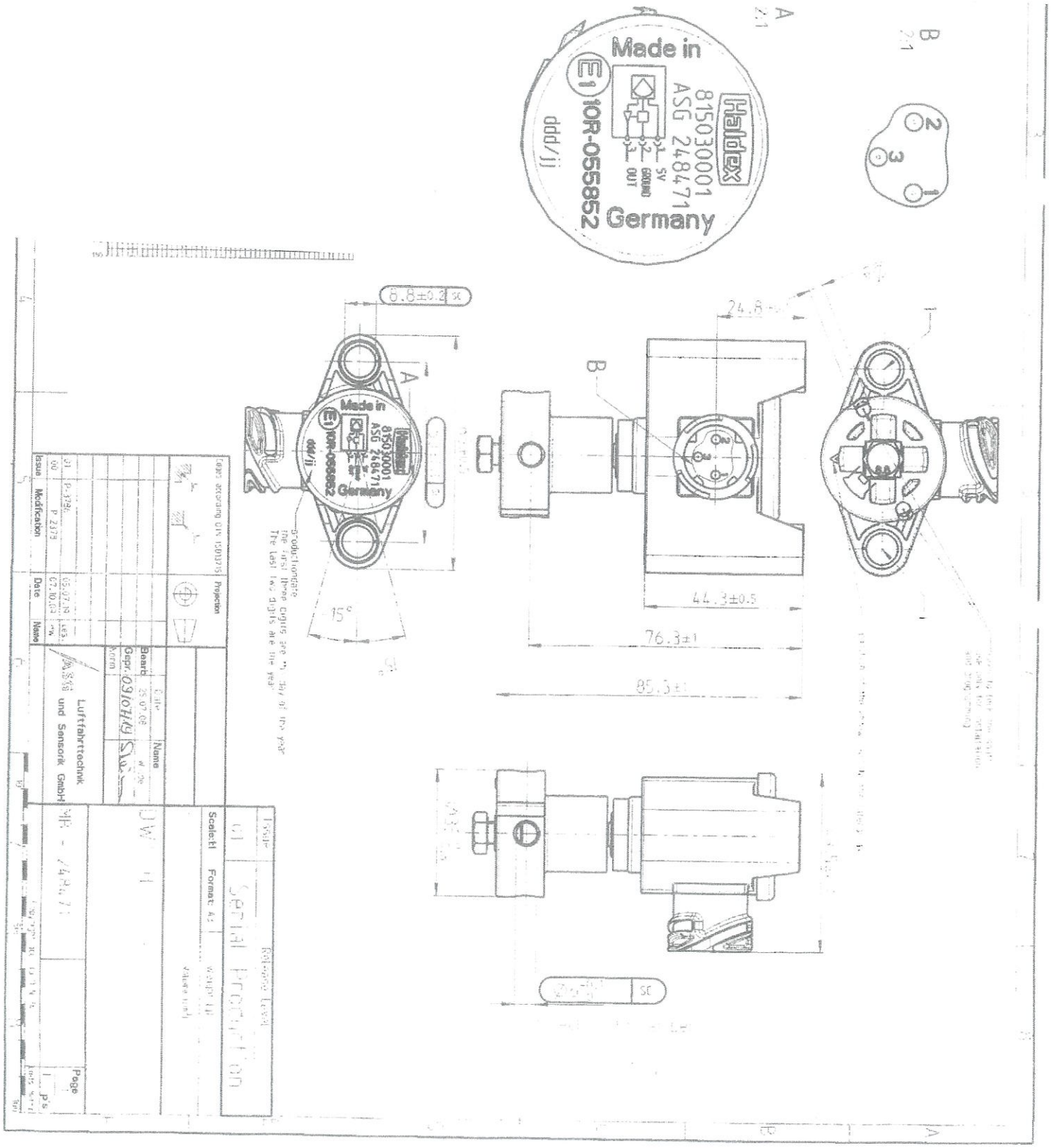
Jörg Burgkhardt

KRAFTFAHRT-BUNDESAMT 527

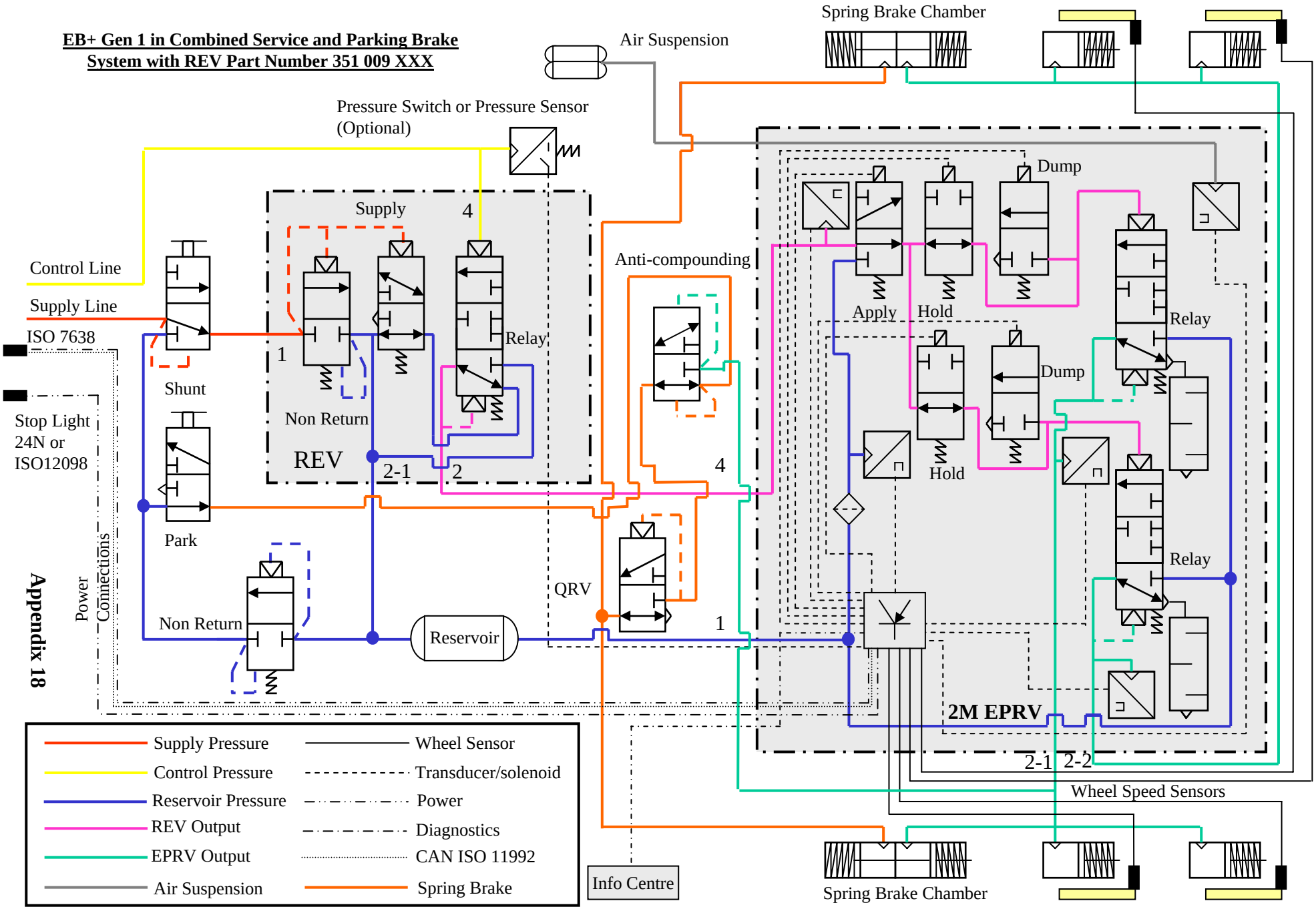
17. Das Inhaltsverzeichnis der bei den zuständigen Behörden hinterlegten Typgenehmigungsunterlagen, die auf Antrag erhältlich sind, liegt bei.
The index to the information package lodged with the approval authority, which may be obtained on request is attached.

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

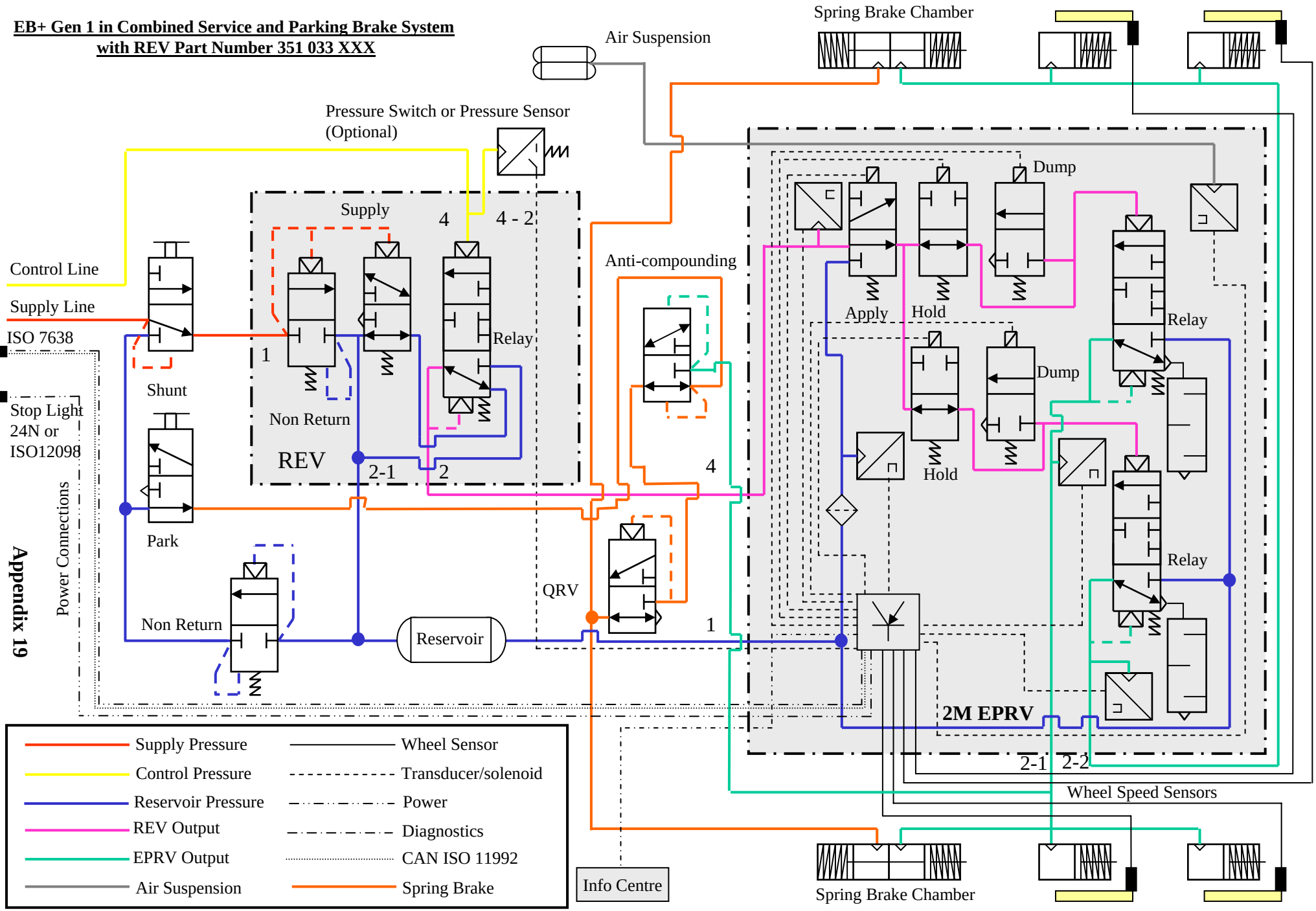

Made in
Germany
81503001
ASG 248471
10R-055852
ddd/jj
6.8±0.2
24.8
44.3±0.5
76.3±1
85.3±1
15°
Luftfahrttechnik
und Sensorik GmbH

EB+ Gen 1 in Combined Service and Parking Brake System with REV Part Number 351 009 XXX

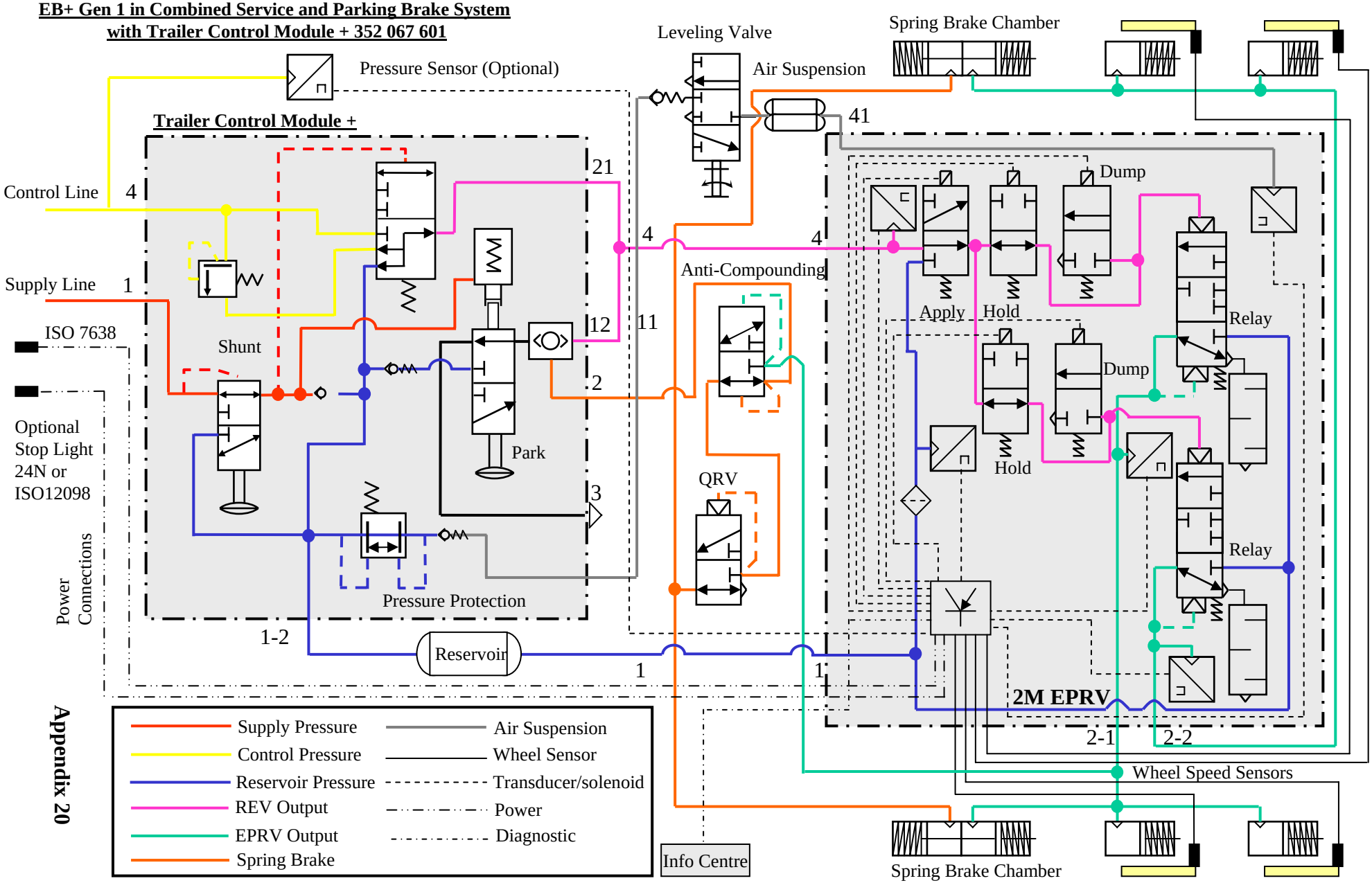


Appendix 18

EB+ Gen 1 in Combined Service and Parking Brake System with REV Part Number 351 033 XXX



EB+ Gen 1 in Combined Service and Parking Brake System with Trailer Control Module + 352 067 601



Appendix 20

Sensed Input Variables

Input Variable	Source	Monitored	Warning	Working Range
Pneumatic Control Line Braking Request [1]	Pressure Switch	Yes	Yellow	On / Off (0.2 bar gauge threshold)
Electric Control Line Pressure	ISO11992 Data Link	Yes	Yellow	0 to 12 bar gauge
Pneumatic Control Line Pressure (Internal)	Transducer	Yes	Yellow	0.7 to 9 bar absolute (-0.3 to 8 bar gauge)
Pneumatic Control Line Pressure (External) [2]	Transducer	Yes	Yellow	
Air Suspension Pressure	Transducer	Yes	Yellow	
Air Suspension Pressure (Slave) [3]	Transducer	Yes	Yellow	
Delivery Pressure 2 [4]	Transducer	Yes	Yellow	
Delivery Pressure 21 [5]	Transducer	Yes	Yellow	
Delivery Pressure 22 [5]	Transducer	Yes	Yellow	
Reservoir Pressure	Transducer	Yes	Yellow	0.7 to 13 bar absolute (-0.3 to 12 bar gauge)
Suspension Height [8]	Rotational Sensor	Yes	Yellow	±15°
Wheel Speed S1A	Speed Sensor	Yes	Yellow	15 Hz to 1500 Hz (< 15 Hz continuity)
Wheel Speed S1B	Speed Sensor	Yes	Yellow	
Wheel Speed S2A [5]	Speed Sensor	Yes	Yellow	
Wheel Speed S2B [5]	Speed Sensor	Yes	Yellow	
Lateral Accelerometer (optional)	Transducer	Yes	Yellow	+/- 1.7g
Lining Wear (optional)	Wire Loop	Yes	Non EBS / ABS	Continuity / Open Circuit
General Purpose Inputs (optional) [6]	Analogue Voltage	Yes	User selectable	0 – 5V
Super Aux Inputs (optional) [6]	Digital Voltage	Yes	None	B- or open circuit / B+
Supply Voltage	B+ Solenoid [7]	Yes	Yellow	7 – 39 Volts

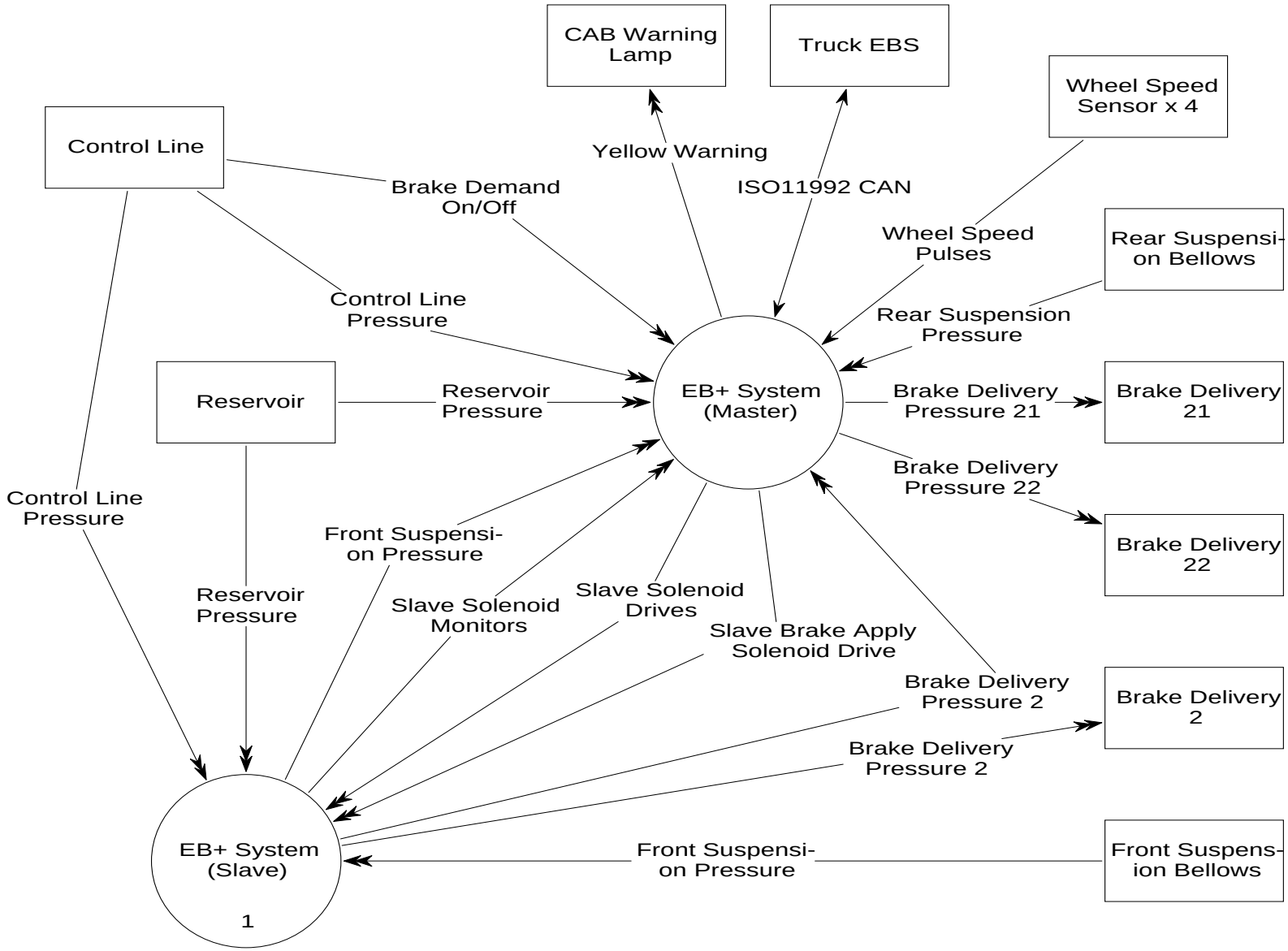
[1] Option on EB+ Gen 1 systems only. [Not Gen 2].
[2] Option.
[3] Applicable to 3M full trailer systems only.
[4] Applicable to 1M and 3M systems only.
[5] Applicable to 2M and 3M systems only.
[6] These can be used to trigger outputs on Aux 1, 2 or 3.
[7] This point is internal to the controller, range is equivalent external voltage on ISO7638 pin 1 or 24N pin 4 inputs to the controller.
[8] Mechanical suspensions only.

Controlled Output Variables

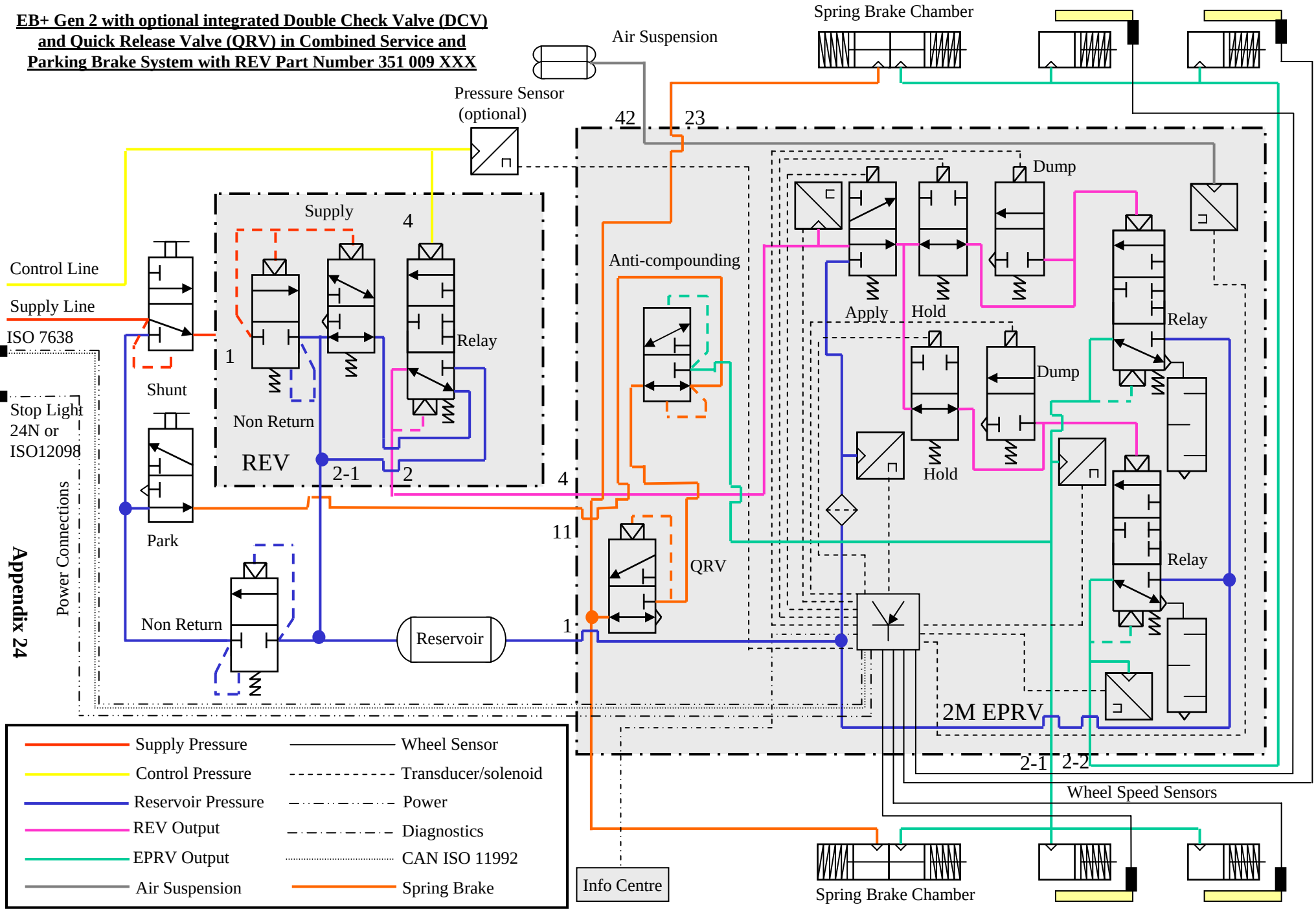
Output Variable	Means of Control	Method	Monitored	Warning	Range of Control
Delivery Pressure 2 [1)]	Solenoid Action	Direct	Yes	Yellow	0.7 to 9 bar absolute (-0.3 to 8 bar gauge)
Delivery Pressure 21 [2)]	Solenoid Action	Direct	Yes	Yellow	
Delivery Pressure 22 [2)]	Solenoid Action	Direct	Yes	Yellow	
Red Warning Signal	ISO 11992 Data Link	Indirect	No	None	On / Off
Yellow Warning Signal – Cab Mounted	Low Side Switch on ISO 7638 (Pin 5)	Direct / Indirect [3)]	Yes	Diagnostic	On / Off
Aux 1 [4)]	High Side Switch	Direct	Yes	Non EBS / ABS	On / Off
Aux 2 [4)]	High Side Switch	Direct	Yes	Non EBS / ABS	On / Off
Aux 3 [4)]	High Side Switch	Direct	Yes	Non EBS / ABS	On / Off
Tacho [5)]	8V PWM signal	Direct	No	None	1.8 kph to 150 kph
Diagnostic Tell-Tale [5)]	8V PWM signal	Direct	No	None	On / Off

[1)] Applicable to 1M and 3M systems only.
[2)] Applicable to 2M and 3M systems only.
[3)] According to towing vehicle circuit.
[4)] Optional. Examples are Suspension Reset-to-Ride (COLAS), Lift Axle (ILAS-E), Steer Axle Lock, Speed Lock.
[5)] Mutually exclusive.

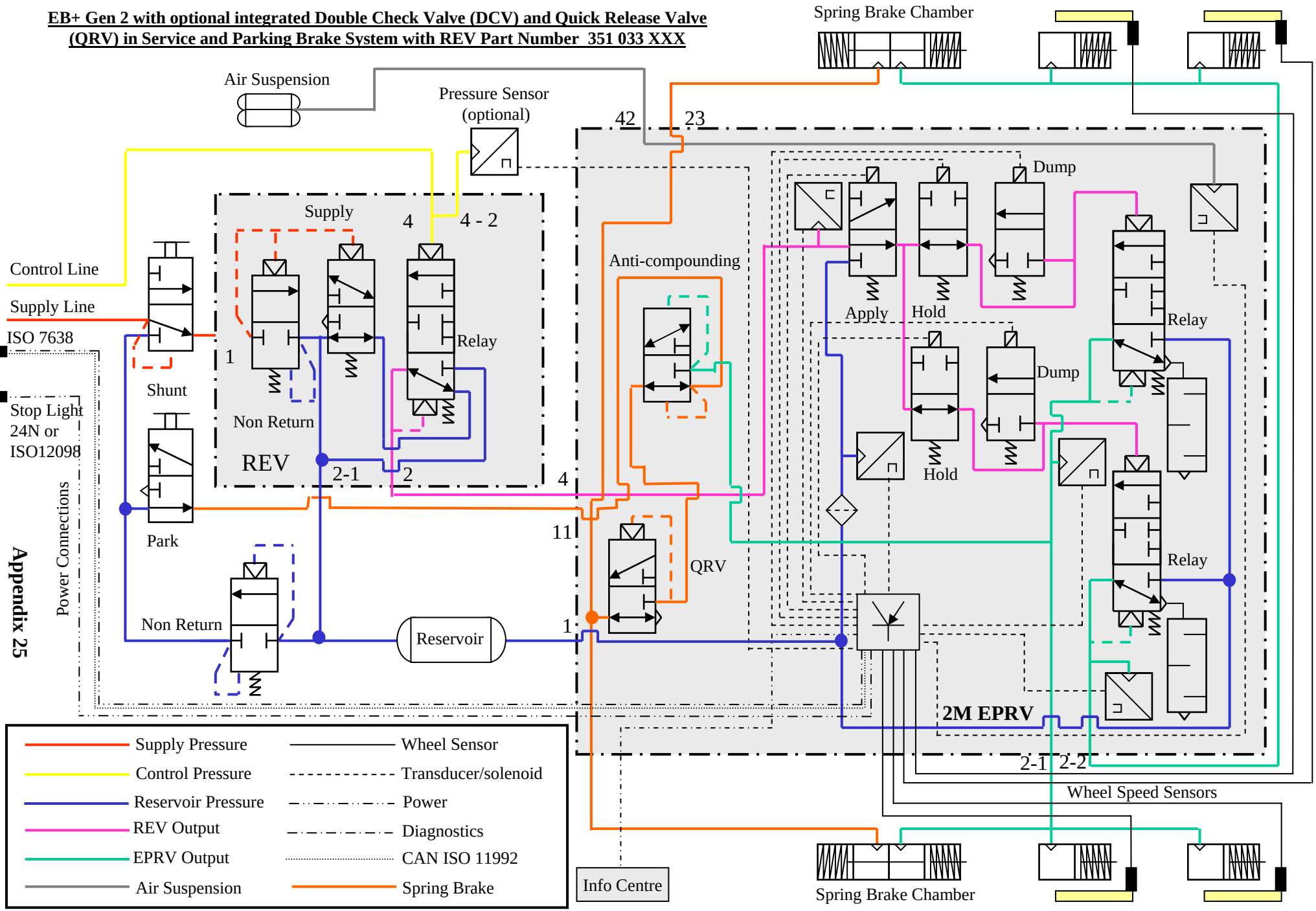
Context Diagram



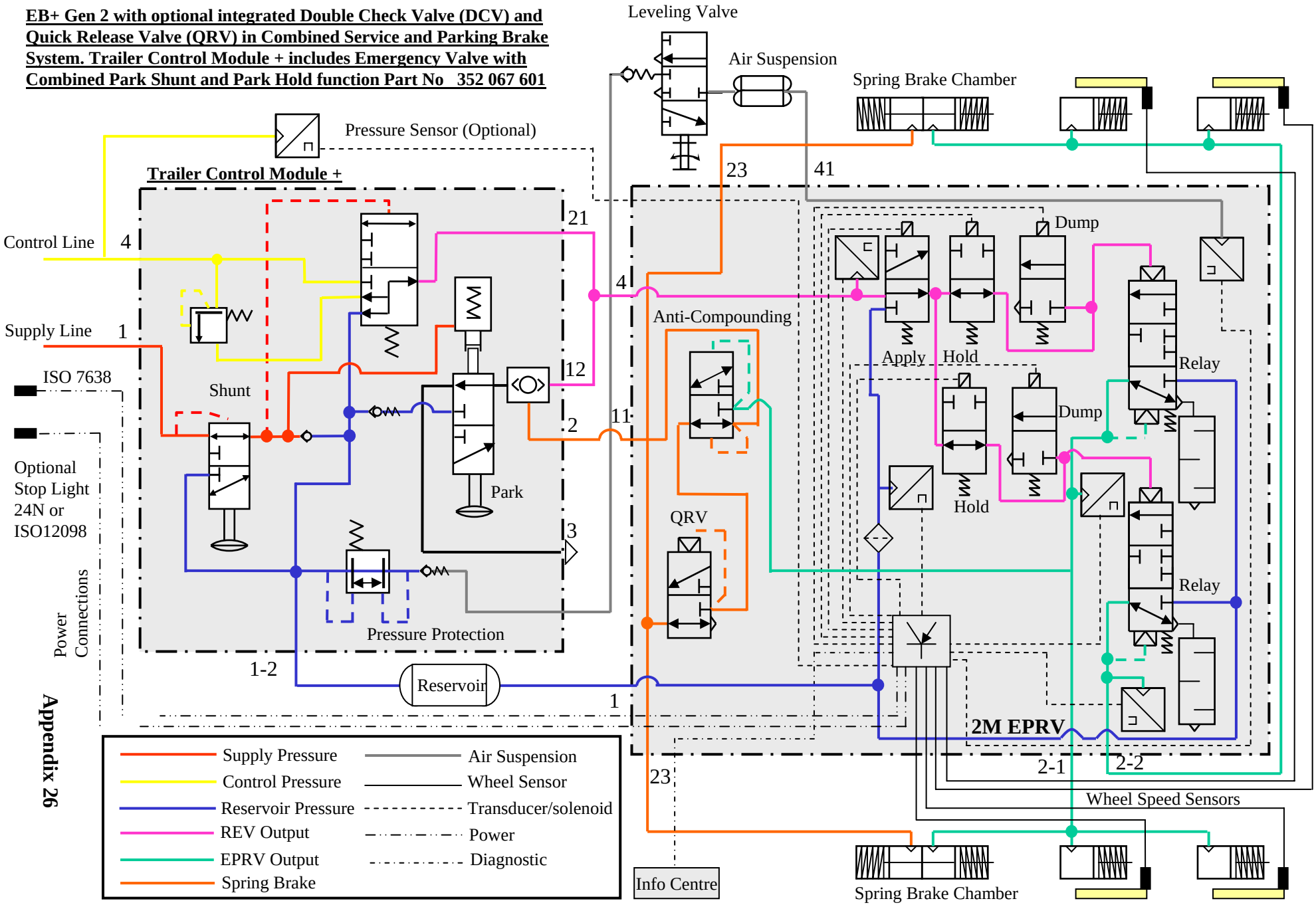
EB+ Gen 2 with optional integrated Double Check Valve (DCV) and Quick Release Valve (QRV) in Combined Service and Parking Brake System with REV Part Number 351 009 XXX



EB+ Gen 2 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

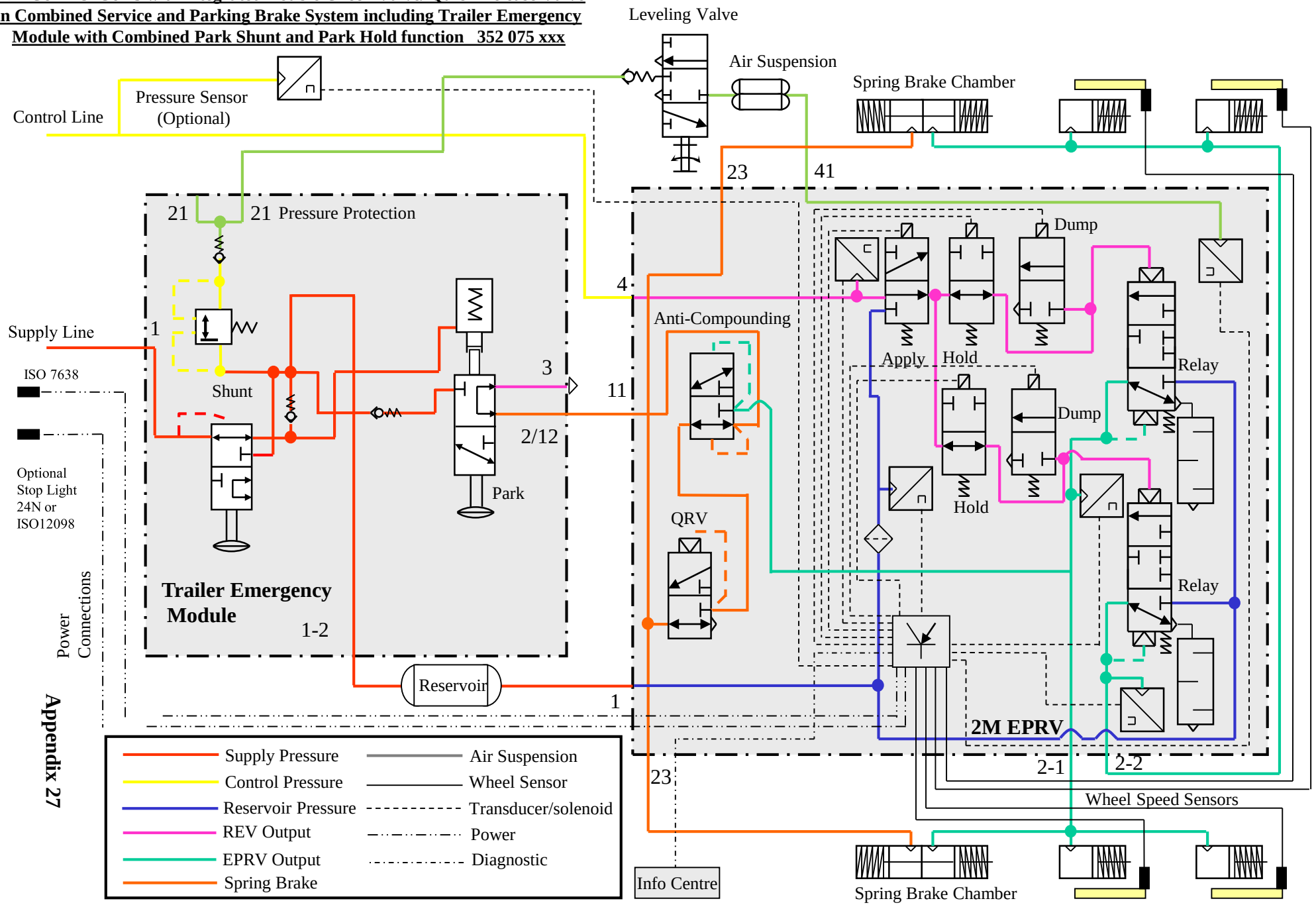


EB+ Gen 2 with optional integrated Double Check Valve (DCV) and Quick Release Valve (QRV) in Combined Service and Parking Brake System. Trailer Control Module + includes Emergency Valve with Combined Park Shunt and Park Hold function Part No 352 067 601



Appendix 26

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



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